

PSYLLIDAE OF THE INDIAN SUBCONTINENT

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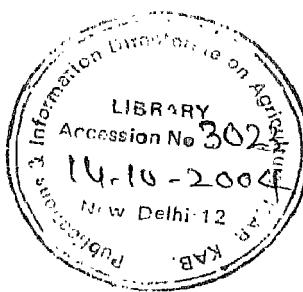
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TO

THE MEMORY OF MY  
MOTHER AND FATHER

## PREFACE

THE need for a comprehensive treatise on the systematics of Indian Psyllidae has been long apparent. These homopterous insects are not seen so frequently because of their secretive habits. Hence this group has been neglected in many parts of the world, especially with reference to India.

My interest in this group arose when under the research programmes in the Forest Entomology, Forest Research Institute, Dehra Dun, an investigation on the gall insects of *Populus euphratica* in the poplar forests of the Muzaffargarh and Multan, Punjab (now in Pakistan) was assigned to me in 1928. Repeated attempts to study the life-cycles of these insects in the forest and in the insectary at Dehra Dun, failed to give any successful results. Attention was, therefore, turned to the local species of Psyllidae occurring on trees, in the expectation that a general study of psyllid ecology would assist the poplar gall investigation as well as the role played by the homopterous insects in the transmission of the spike disease of sandal. This study has revealed the existence of considerable diversity in the habits of psyllids frequenting trees and has cleared up many obscure features in the ecology of the group (Mathur, 1935). The Indian species appear to be very definitely seasonal and, therefore, the collection data are quite important.

Of 101 species which were studied by me, 46 species are new to science. They are distributed in 27 genera. I have also repeated the descriptions and figured those species which have already been described or figured previously by Crawford, Laing, Heslop-Harrison and others, for bringing together all available information on the Psyllidae of India. In some cases, the descriptions have been further augmented with my notes and observations. The descriptions of the immature stages of 45 species have also been included, in order to establish a correlation between the existing adult classification with the facts gained by the knowledge of the nymphal stages. Unless otherwise stated, all the specimens were collected by me, and the names of collectors are given in brackets. The terminology used is that in general use by workers on the Psyllidae.

All of the holotype, allotype and paratype specimens of the new species, together with the nymphal stages if represented, and all slides, are deposited at the Forest Research Institute, Dehra Dun. The paratypes of some species are also donated to the Indian Agricultural Research Institute, New Delhi, as desired by the Indian Council of Agricultural Research, New Delhi. It is strongly emphasised that type material should always be deposited in any of the three National Institutes in India, viz. Forest Research Institute, Dehra Dun, Indian Agricultural Research Institute, New Delhi, and Zoological Survey of India, Calcutta, and nowhere else. In these institutes, proper care and handling of such material is assured. Unfortunately this has been seldom done in the past.

I am highly indebted to the Indian Council of Agricultural Research, New Delhi, without whose financial assistance and encouragement this work would not have been accomplished. This financial grant for study and travel was given to me under the Retired Scientists Scheme of the Council. I also wish to express my gratitude to the President,

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## I. INTRODUCTION

PREVIOUS work on the psyllids of India is limited and very little has been published. As early as 1890, Lethierry first described *Diaphorina guttulata* from Poona. Buckton (1893, 1894) described the mango shoot psylla, *Apsyllo cistellata* damaging mango trees by aborting the young shoots at Dehra Dun, and *Phacopteron lentiginosum* recorded ex leaf galls on *Garuga pinnata* from Poona. Again in 1900, he described *Trioza obsoleta* ex galls *Diospyros melanoxylon*. Kieffer (1905) described seven species from Bengal, viz. *Pauropsylla fusicola* and *P. globuli* in galls of *Ficus* spp., *Cecidopsylla schimae* ex leaf galls on *Schima wallichii*, *Psylla cedrelae* on *Cedrela toona*, *Neotrioza machili* on *Machilus gamblei*, two species of Ozotrioza, *O. styracearum* and *O. laurinearum*; and again in 1909, *Cecidotrioza baccarum* ex galls on *Symplocos* sp., from Kurseong, Bengal. A brief account on Indian Psyllidae, with illustrations of galls on mango, *Alstonia scholaris* and *Ficus glomerata*; and adults and nymphal stages of *A. cistellata* (Buckt.), *P. tuberculata* Crawf., *P. depressa* Crawf., and *T. obsoleta* (Buckt.) is given by Lefroy (1909). In fact, the real systematic papers on several new genera and species appeared in 1912 and 1924, by Crawford, when he studied the collections of the Indian Museum, Calcutta, the Indian Agricultural Research Institute and Ramakrishna Ayyar's material. A list of Psyllidae recorded from India and Ceylon was presented in 1924, by Ramakrishna Ayyar. Brief notes on *A. cistellata* (Buckt.), *P. lentiginosum* Buckt. and *T. obsoleta* (Buckt.) appeared in the *Reports of the Proceedings of the Entomological Meetings, Pusa*. Detailed biological account of *Diaphorina citri* Kuwayama, with description of the adult and nymphal stages and their control, was published by M. Afzal Husain and Dina Nath (1927).

Rahman (1932) was the first to describe the nymphal stages of five species of Psyllidae. The biology of some 24 psyllid species recorded on forest trees was contributed by Mathur (1935). Laing (1930) gave the descriptions of some 5 species of Psyllidae. In his book on *Forest Insects*, Beeson (1941) gave brief biological notes on the psyllid species recorded on forest trees. Again Mathur described the immature stages of 10 species during 1949, 1950, 1952 and 1954. In the following 15 to 20 years, no work was done on this group of insects in India, except the description of galls made by them (Mani, 1935, 1953, 1959, 1964).

## METHODS AND MATERIALS

The psyllid material available for study at the Forest Research Institute, was collected at Dehra Dun or New Forest (Dehra Dun) by myself during 34 years of my service and during tours in the various parts of India, except where otherwise stated. In making the collections, a sweeping net and a sucking tube (aspirator) were used for capturing the adults. Once an infestation of free-living or gall-making species was located, an attempt was made to secure nymphs and to rear some of them to the adult stage, on potted plants. Galls are not easy to rear in "captivity", because the removal of the gall from the infested plant interferes with the nutrition of the insects. Gall insects are also not quick in development. Success was, however, achieved through patient

observations on the times of emergence of adults of such species. For colouration notes, it was necessary to collect live specimens of both adult and nymphal stages. A part of each collection was mounted on card points or pinned with micropins on polyporus pith, and the rest was preserved in alcohol in small vials.

Recording of field data is of vital importance. Each field collection was, therefore, duly labelled with temporary labels, and later each mounted or pinned specimen was labelled with printed data of reference number if any, locality, date of collection, name of collector and host plant. Similarly, the wet collection was labelled. The presence of nymphs gave the positive specific host, and in almost all cases, specimens of the host plants were also simultaneously collected and submitted to the Forest Botanist for identification.

In order to study the finer details of both sexes and nymphal stages of each species, the following method has been found satisfactory. Soak the material in caustic potash for 8 to 10 hours, then boil in water-bath for some time till the specimen becomes clear from internal tissues. After boiling, wash in distilled water, transfer in glacial acetic acid to dissolve organic matter if any. Wash again in distilled water, dehydrate in different grades of alcohol and stain it in eosin soluble in alcohol. Clear and dissect the specimen in clove-oil. The dissected parts were thus mounted in balsam on slides and examined under the compound microscope. The figures were drawn with the desired magnification, with the help of the camera lucida and inked by the professional artist, under my direction. The coloured drawings were also made by the artist.

The author has also examined and studied the psyllid collections present at the Indian Agricultural Research Institute, New Delhi, and at the Zoological Survey of India, Calcutta. A few types present at the latter institution were also studied. Unfortunately, Ramakrishna Ayyar's collection at Coimbatore could not be seen personally there, but through the kindness of the Entomologists at Coimbatore, I was able to study some of the species sent to me, and the result of examination is mentioned under the respective species. The psyllid materials received from the Units of the Commonwealth Biological Control at Kalimpong (Bengal) and Srinagar (Kashmir), and the Agricultural Entomologists, Ludhiana (Punjab), from time to time were very interesting and some of the species, new to science, are described here.

## II. ECOLOGY AND ECONOMIC IMPORTANCE

### HABITS AND DAMAGE

THE collections studied reveal that the Indian fauna is very rich in species of Psyllidae, but because of their small size and active habits they have been overlooked and our knowledge of their distribution is far from sufficient. They are relatively very specific in their selection of host plants, and exhibit considerable diversity in habits, as some are free living while others are gall makers. The insects are phytophagous in both nymphal and adult stages. Sometimes their infestations are localised and it is difficult to say why it is so.

The adults are generally very active and capable of jumping and flying, and some species are sluggish like *Apsylla cistellata* (Buckt.). The free-living species (Plate 2) move about on the host plant and feed on the younger leaves and shoots suitable for inserting their stylets through which the sap is sucked. They breed continuously during the growing season so long as new buds or foliage are available. The nymphal stages are often covered in a small mass of flocculent matter (Plate 2), produced usually from the caudal end of the abdomen. They also secrete an abundance of a sweet, sticky substance known as honey dew which on falling on the lower branches and leaves causes a disagreeable condition, especially when a black, sooty mould develops and thus seriously injuring the tree.

Many species cause plant deformities in the form of regular galls, blisters or pits (Plates 1, 3, 4, 5, 6) on leaves and stems. Gall-makers usually produce the same type of gall on the host plants and such galls are abundant, colourful and often grotesque upon individual trees or plants. The physiology of gall-formation is still obscure (Mani, 1964) and it is generally believed that a secretion from the nymph stimulates gall formation. The galls are usually formed on meristematic tissue and are the result of abnormal cell multiplication. The pit galls generally occur on the under surface of the leaf and appear as roughened elevations on the upper side. The nymphs of some species cause a distortion and folding of the leaves. One or both margins of the leaves are rolled into the mid-rib on the upper surface and the rolled margins gradually become thickened and hard like a gall. The nymphs remain sheltered in these rolled leaves and are often covered with a copious secretion of white wax. Large round drops of liquid excrement with their surface coated with powdered wax and fragments of wax threads, are also present in these rolled leaves. Several kinds of ants, honey bees and wasps frequently visit these leaves and feed on the honey dew for their food. The mature nymphs crawl out of the gall when it dehisces or leave the shelter of the roll, and shed their last skin and this moulting is more commonly performed on the surface of an older leaf. Evidently, there are five molts and the earlier shedding of skins is done inside the gall or roll. Adults are translucent white at emergence and their colouration develops fully after feeding for some time. The renewal of vegetative activity of the host plant determines the emergence of adult psyllids of the gall-forming species.

In the forest, a natural control is brought about by certain biotic agencies, e.g. parasites, mostly by chalcids and few braconids; by predatory insects like Coccinellids, Syrphids, Chrysopids and predatory mites and spiders.

#### ECONOMIC IMPORTANCE

Comparatively little injury is caused to the forest vegetation by these sap-sucking insects. In natural forest the general incidence of psyllids is low, but heavy infestation by free-living and gall-making psyllids is fairly common on individual trees or on small groups that are subnormal in health. In seedbeds and in artificial regeneration areas, on the other hand, the damage done by psyllids can be serious. Their feeding is detrimental to the plant as they drain away the vital food and water or disseminate plant diseases. The leaves become chlorotic and smaller than normal and ultimately fall off. The gall-forming species appear to be more injurious than the free-living types in that the affected buds, shoots and leaves are put out of action and are not replaced by later growth. The free-living species with short life-cycles are more characteristic of trees with a prolonged vegetative period and are capable of infesting the successive flushes of foliage under favourable weather conditions.

Psyllid species are more common in forests and over 100 species have been taken on 95 species of trees and other vegetation growing in the forest. A few species attack fruit trees such as apple, *Citrus* spp., *Cordia* spp., *Grewia asiatica* (*phalsa*), *jaman*, mango, pear and *Zizyphus jujuba* (*ber*). *Arytaina punctipennis* Crawford is destructive to indigo (*Indigofera* spp.) seriously in some seasons. On pumpkin, *Pauropsylla tuberculata* Crawford has been recorded at Pusa, Bihar.

From the available records a host-psyllid list and a psyllid-host list are given below for the sake of ready reference.

TABLE 1. HOST-PSYLLID LIST

List showing the host plants attacked by the species of Psyllidae

Host plants	Species of Psyllidae
<i>Atriplex</i> sp.	... <i>Trioza obliqua</i> Thom.
<i>Albizia chinensis</i> (= <i>A. stipulata</i> )	... <i>Arytaina spinosa</i> , sp. n.
<i>A. odoratissima</i>	... <i>Psylla oblonga</i> , sp. n. ... <i>Acizzia indica</i> Hes. -Harr.
<i>A. procera</i>	... <i>Arytaina spinosa</i> , sp. n. ... <i>Psylla hyalina</i> , sp. n.
<i>Alstonia scholaris</i>	... <i>Pauropsylla tuberculata</i> Crawf.
<i>Anthocephalus indicus</i> (= <i>A. cadamba</i> )	... <i>P. reticulata</i> , sp. n.
<i>Bauhinia variegata</i>	... <i>Psylla simiae</i> Crawf.
<i>Bombax ceiba</i> (= <i>B. malabaricum</i> )	... <i>Tenaphalara acutipennis</i> Kuw.
<i>Buchanania lanzae</i> (= <i>B. latifolia</i> )	... <i>Pauropsylla longispiculata</i> , sp. n.

Host plants			Species of Psyllidae
<i>Bucklandia populnea</i> (= <i>Symingtonia populnea</i> )	...	...	<i>Psylla longigena</i> , sp. n.
<i>Cassia fistula</i>	...	...	...
<i>C. siamea</i>	...	...	...
<i>Cedrela toona</i>	...	...	...
<i>Chenopodium album</i>	...	...	...
<i>Chloroxylon swietenia</i>	...	...	...
<i>Chukrasia velutina</i>	...	...	...
<i>Cinnamomum</i> sp.	...	...	...
<i>Citrus</i> spp.	...	...	...
<i>Cordia grandis</i> (= <i>C. cordata</i> )	...	...	...
<i>C. myxa</i>	...	...	...
<i>C. obliqua</i>	...	...	...
<i>Crataegus</i> sp.	...	...	...
<i>Dalbergia sissoo</i>	...	...	...
<i>Diospyros melanoxylon</i>	...	...	...
<i>D. tomentosa</i>	...	...	...
<i>Duabanga grandiflora</i>	...	...	...
<i>Ehretia acuminata</i>	...	...	...
<i>Eugenia malaccensis</i>	...	...	...
<i>Ficus asperrima</i>	...	...	...
<i>F. hispida</i>	...	...	...
<i>F. hookeri</i>	...	...	...
<i>F. lucescens</i> (= <i>F. infectoria</i> )	...	...	...
<i>F. microcarpa</i> (= <i>F. retusa</i> )	...	...	...
<i>F. nervosa</i>	...	...	...
<i>F. racemosa</i> (= <i>F. glomerata</i> )	...	...	...
<i>F. religiosa</i>	...	...	...
<i>F. roxburghii</i>	...	...	...
<i>F. rumphii</i>	...	...	...
<i>Ficus</i> sp.	...	...	...
<i>F. ulmifolia</i>	...	...	...
<i>Fraxinus ornus</i>	...	...	...
<i>Garuga pinnata</i>	...	...	...
<i>Gmelina arborea</i>	...	...	...
<i>Grewia asiatica</i>	...	...	...
<i>Gymnosporia spinosa</i> (= <i>G. montana</i> )	...	...	...
			<i>Phacopteron lentiginosum</i> Buckt.
			...
			<i>Trioza fletcheri</i> Crawf.
			...
			<i>Paurocephala menoni</i> , sp. n.
			...
			<i>Diaphorina gymnosporiae</i> , sp. n.

Host plants	Species of Psyllidae				
<i>Indigofera anil</i>					
<i>I. erecta</i>	...	...	...	...	... <i>Arytaina punctipennis</i> Crawf.
<i>I. hebepepetala</i>					
<i>I. oligosperma</i>					
<i>I. paucifolia</i>					
<i>I. pulchella</i>					
<i>I. sumatrana</i>					
<i>Juncus</i> spp	...	...	...	...	... <i>Livia juncorum</i> (Latr.) ... <i>L. khaziensis</i> Hes. -Harr. ... <i>Paurocephala</i> near <i>minuta</i> Crawf. ... <i>P. russellae</i> , sp. n.
<i>Kydia calycina</i>	...	...	...	...	... <i>Diaphorina bikanerensis</i> , sp. n. ... <i>Pauropsylla beesoni</i> Laing.
<i>Leptadenia spartium</i>	...	...	...	...	
<i>Litsea monopetala</i> (= <i>L. polyantha</i> )	...	...	...	...	
<i>Mallotus philippensis</i>	...	...	...	...	... <i>Trioza mallotica</i> Crawf. ... <i>T. pitformis</i> , sp. n. ... <i>Aphylla cistellata</i> Buckl. ... <i>Arytaina obscura</i> Crawf. ... <i>Leuronota minuta</i> Crawf. ... <i>Pauropsylla brevicornis</i> Crawf. ... <i>P. maculata</i> , sp. n. ... <i>P. nigra</i> Crawf.
<i>Mangifera indica</i>	...	...	...	...	... <i>Ceropsylla ferruginea</i> , sp. n. ... <i>Diaphorina citri</i> Kuw. ... <i>D. communis</i> , sp. n. ... <i>Psylla murrayi</i> , sp. n. ... <i>Diaphorina citri</i> Kuw. ... <i>D. communis</i> , sp. n.
<i>Miliusa velutina</i>	...	...	...	...	
<i>Murraya koenigii</i>	...	...	...	...	... <i>Euphyllura olivina</i> Costa. ... <i>Aphalara maculipennis</i> Loew ... <i>A. ossianilssonii</i> , sp. n.
<i>M. paniculata</i>	...	...	...	...	... <i>Trioza bifurcata</i> , sp. n. ... <i>T. ceardi</i> Berg. ... <i>T. longiantennata</i> , sp. n.
Olive	...	...	...	...	... <i>Pauropsylla tuberculata</i> Crawf.
<i>Polygonum hydropiper</i>	...	...	...	...	
<i>P. microcephalum</i>	...	...	...	...	
<i>Populus euphratica</i>	...	...	...	...	... <i>Psylla</i> sp. 1
Pumpkin	...	...	...	...	
<i>Pyrus communis</i>	...	...	...	...	... <i>Petalolyma basalis</i> (Wlk.)
<i>P. pashia</i>		...	...	...	... <i>Trioza serrata</i> , sp. n.
<i>P. vistata</i>					... <i>Psylla zaicevi</i> Sulc.
<i>Quercus dilatata</i>	...	...	...	...	... <i>Euphyllura obsoleta</i> , sp. n. ... <i>Diaphorina venata</i> , sp. n.
<i>Sabicea paniculata</i>	...	...	...	...	
<i>Salix</i> sp.	...	...	...	...	
<i>Salvadora oleoides</i>	...	...	...	...	... <i>Macrohomotoma maculata</i> , sp. n. ... <i>Mycopsylla indica</i> , sp. n. ... <i>Psylla santali</i> , sp. n.
<i>Santalum album</i>	...	...	...	...	

Host plants	Species of Psyllidae				
<i>Schima wallichii</i>	...	...	...	...	<i>Cecidopsylla schimae</i> Kieff.
<i>Schleichera trijuga</i>	...	...	...	...	<i>Phacopteron lentiginosum</i> Buckt.
<i>Semecarpus anacardium</i>	...	...	...	...	<i>Pauropsylla verrucosa</i> , sp. n.
<i>Shorea robusta</i>	...	...	...	...	<i>Ceropsylla minuta</i> , sp. n. <i>Leuronota corniculata</i> , sp. n.
<i>Spondias pinnata</i> (= <i>S. mangifera</i> )	...	...	...	...	<i>Pauropsylla spondiasae</i> Crawf.
<i>Sterculia foetida</i>	...	...	...	...	<i>Tenaphalara acutipennis</i> Kuw.
<i>Stranvaesia glaucescens</i>	...	...	...	...	<i>Psylla</i> sp. 1.
<i>Strychnos nux-vomica</i>	...	...	...	...	<i>Diaphorina truncata</i> Crawf. <i>Euphyllura caudata</i> , sp. n. <i>E. concolor</i> , sp. n. <i>Trioza vitiensis</i> Kirk. <i>T. eugeniooides</i> Crawf. <i>T. fuscata</i> , sp. n. <i>T. jambolanae</i> Crawf. <i>T. spinulata</i> , sp. n.
<i>Syzygium cumini</i> (= <i>Eugenia jambolana</i> )	...	...	...	...	<i>Colposcenia constricta</i> , sp. n.
<i>Tamarix</i> sp.	...	...	...	...	
<i>Terminalia alata</i> (= <i>T. tomentosa</i> )	...	...	...	...	<i>Trioza hirsuta</i> Crawf. <i>T. fletcheri minor</i> Crawf.
<i>T. arjuna</i>	...	...	...	...	<i>Paurocephala psylloptera</i> Crawf. <i>Trioza fletcheri</i> Crawf.
<i>T. catappa</i>					
<i>T. paniculata</i>					
<i>Trema orientalis</i>	...	...	...	...	<i>Mesohomotoma lutheri</i> Endl.
<i>Trewia nudiflora</i>	...	...	...	...	<i>Trioza urticae</i> (Linn.)
<i>Urena lobata</i>	...	...	...	...	<i>Psylla viburni</i> Loew
<i>Urtica</i> spp.	...	...	...	...	<i>Arytaina fasciata</i> Laing
<i>Viburnum</i> sp.	...	...	...	...	<i>Paurocephala trimaculata</i> , sp. n.
Walnut	...	...	...	...	
<i>Zizyphus jujuba</i>	...	...	...	...	

## On unknown hosts

1. *Diaphorina enderleini* Klimaszewski, from Poona, in September, 1911
2. *Diceropsylla brunetti* Crawford, from Darjeeling, in May, 1910
3. *Paurocephala phalaki*, sp. n., from Tista, W. Bengal, in October, 1965
4. *Pauropsylla stevensi* Laing, from Darjeeling, Gopaldhara
5. *Psylla quadrimaculata*, sp. n., from Jorhat, in February-March and from Darjeeling, in November, 1965
6. *Rhynopsylla stylata* Crawford, from R. Sutlej, below Simla, May, 1910
7. *Trioza analis* Crawford, from Simla, West Himalayas
8. *T. eugeniooides* Crawford, from Pusa, in January, 1918
9. *T. gigantea* Crawford, from Darjeeling, in March, 1967
10. *T. gigantea curta*, sp. n., from Darjeeling, in March, 1967
11. *T. hyalina* Crawford, from Simla, in May, 1908
12. *T. simplifica*, sp. n., from Deviathan, C. Nepal, in April, 1961

TABLE 2. PSYLLID-HOST LIST

Sub-family	Species		Plant hosts
Liviinae	<i>Livia junctorum</i> (Latr.) ...	...	<i>Juncus</i> sp.
	<i>L. khaziensis</i> Hes. -Harr. ...	...	<i>J.</i> sp.
Aphalarinae	<i>Aphalara maculipennis</i> Loew ...	...	<i>Polygonum hydropiper</i>
	<i>A. ossianilssonii</i> , sp. n. ...	...	<i>P. microcephalum</i>
	<i>Colposcenia constricta</i> , sp. n. ...	...	<i>Tamarix</i> sp.
Pauropsyllinae	<i>Apsylla cistellata</i> (Buckt.) ...	...	<i>Mangifera indica</i>
	<i>Paucepaphala menoni</i> , sp. n. ...	...	<i>Grewia asiatica</i>
	<i>P. near minuta</i> Crawf. ...	...	<i>Kydia calycina</i>
	<i>P. phalaki</i> , sp. n. ...	...	Unknown
	<i>P. psylloptera</i> Crawf. ...	...	<i>Ficus asperima</i> <i>F. hispida</i> <i>F. ulmifolia</i> <i>Ficus</i> sp. <i>Trema orientalis</i>
	<i>P. russellae</i> , sp. n. ...	...	<i>Kydia calycina</i>
	<i>P. trimaculata</i> , sp. n. ...	...	<i>Zizyphus jujuba</i>
	<i>Pauropsylla beesoni</i> Laing ...	...	<i>Litsaea monopetala</i>
	<i>P. brevicornis</i> Crawf. ...	...	<i>Mangifera indica</i>
	<i>P. depressa</i> Crawf. ...	...	<i>Cinnamomum</i> sp. <i>Ficus racemosa</i>
	<i>P. ficicola</i> Kieff. ...	...	<i>F. hookeri</i> <i>F. roxburghii</i>
	<i>P. longispiculata</i> , sp. n. ...	...	<i>Buchanania lanzae</i>
	<i>P. maculata</i> , sp. n. ...	...	<i>Mangifera indica</i>
	<i>P. nigra</i> Crawf. ...	...	<i>M. indica</i>
	<i>P. purpurescens</i> , sp. n. ...	...	<i>Ficus racemosa</i>
	<i>P. reticulata</i> , sp. n. ...	...	<i>Anthocephalus indicus</i>
	<i>P. spodiasae</i> Crawf. ...	...	<i>Spondias pinnata</i>
	<i>P. stevensi</i> Laing ...	...	Unknown
	<i>P. tuberculata</i> Crawf. ...	...	<i>Alstonia scholaris</i> , Pumpkin
	<i>P. verrucosa</i> , sp. n. ...	...	<i>Semecarpus anacardium</i>
	<i>Phacopteron lentiginosum</i> Buckt. ...	...	<i>Garuga pinnata</i> , <i>Schleichera trijuga</i>
Ciriacreminae	<i>Cecidopsylla solimae</i> Kieff. ...	...	<i>Schima wallitchii</i>
	<i>Diceropsylla brunetti</i> Crawf. ...	...	Unknown
	<i>Dynopsis grandis</i> Crawf. ...	...	<i>Ficus nervosa</i>
	<i>Macrohomotoma geniculata</i> , sp. n. ...	...	<i>F. microcarpa</i> <i>Carica papaya</i>
	<i>M. maculata</i> , sp. n. ...	...	<i>Santalum album</i>
	<i>M. striata</i> Crawf. ...	...	<i>Ficus</i> sp.
	<i>Mesohomotoma lutheri</i> Endl. ...	...	<i>Urena lobata</i>
	<i>Mycobpsylla indica</i> , sp. n. ...	...	<i>Santalum album</i>
	<i>Psausia distincta</i> (Crawf.) ...	...	<i>Ficus religiosa</i>
	<i>P. indica</i> , sp. n. ...	...	<i>F. lucescens</i> <i>F. microcarpa</i>

Sub-family	Species	Plant hosts
Psyllinae	<i>Rhinopsylla stylata</i> Crawf. ...	... Unknown
	<i>Tenaphalara acutipennis</i> Kuw. ...	... <i>Bombax ceiba, Sterculia foetida</i>
	<i>Acizzia indica</i> Hes. -Harr. ...	... <i>Albizia procera</i>
	<i>Arytaina fasciata</i> Laing ...	... Walnut
	<i>A. obscura</i> Crawf. ...	... <i>Mangifera indica, Dalbergia sissoo</i>
	<i>A. punctipennis</i> Crawf. ...	... <i>Indigofera anil</i> <i>I. arrecta</i> <i>I. hebeptala</i> <i>I. oligosperma</i> <i>I. paucifolia</i> <i>I. pulchella</i> <i>I. sumatrana</i>
	<i>A. ramakrishni</i> Crawf. ...	... <i>Chloroxylon swietenia</i> <i>Chloroxylon</i> sp.
	<i>A. spinosa</i> , sp. n. ...	... <i>Albizia procera</i> <i>A. chinensis</i>
	<i>Diaphorina bikanerensis</i> , sp. n. ...	... <i>Leptadenia spartium</i>
	<i>D. cardiae</i> Crawf. ...	... <i>Cordia grandis</i> <i>C. myxa</i> <i>C. obliqua</i>
	<i>D. citri</i> Kuw. ...	... <i>Citrus aurantium</i> <i>C. medica limonium</i> <i>C. medica lunetta</i> <i>C. medica acida</i> <i>C. medica medica</i> <i>C. decumana</i> <i>Murraya koenigii</i> <i>M. paniculata</i>
	<i>D. communis</i> , sp. n. ...	... <i>M. koenigii</i> <i>M. paniculata</i> <i>Citrus</i> sp.
	<i>D. dunensis</i> , sp. n. ...	... <i>Ehretia acuminata</i>
	<i>D. enderleini</i> Klimas. ...	... Unknown
	<i>D. gymnosporiae</i> , sp. n. ...	... <i>Gymnosporia spinosa</i>
	<i>D. truncata</i> Crawf. ...	... <i>Strychnos nux-vomica</i>
	<i>D. venata</i> , sp. n. ...	... <i>Santalum album</i>
	<i>Euphalerus vittatus</i> Crawf. ...	... <i>Cassia fistula</i>
	<i>Euphyllura caudata</i> , sp. n. ...	... <i>Syzygium cumini</i>
	<i>E. concolor</i> , sp. n. ...	... <i>S. cumini</i>
	<i>E. obsoleta</i> , sp. n. ...	... <i>Salvadora oleoides</i>
	<i>E. olivina</i> Costa ...	... Olive
	<i>Psylla bengalensis</i> , sp. n. ...	... <i>Cedrela toona</i>
	<i>P. cedrelae</i> Kieff. ...	... <i>C. toona</i> <i>Chukrasia velutina</i>
	<i>P. crataegi</i> Schrank ...	... <i>Crataegus</i> sp.

Sub-family	Species			Plant hosts
	<i>Psylla eastopi</i> , sp. n.	...	...	<i>Cedrela toona</i>
	<i>P. hyalina</i> , sp. n.	...	...	<i>Albizia procera</i>
				<i>Cassia siamea</i>
	<i>P. longigena</i> , sp. n.	...	...	<i>Bucklandia populnea</i>
	<i>P. murayi</i> , sp. n.	...	...	<i>Murraya koenigii</i>
	<i>P. oblonga</i> , sp. n.	...	...	<i>Albizia odoratissima</i>
	<i>P. quadrimaculata</i> , sp. n.	...	...	Unknown
	<i>P. santali</i> , sp. n.	...	...	<i>Santalum album</i>
	<i>P. near simiae</i> Crawf.	...	...	<i>Bauhinia variegata</i>
	<i>Psylla</i> sp. 1.	...	...	<i>Stranvaesia glaucescens</i>
				<i>Pyrus communis</i>
				<i>P. pashia</i>
				<i>P. vistata</i>
	<i>P. viburni</i> Loew	...	...	<i>Viburnum</i> sp.
	<i>P. zaicevi</i> Sulc.	...	...	<i>Salix</i> sp.
	<i>Psyllopsis fraxini</i> (Linn.)	...	...	<i>Fraxinus ornus</i>
Trioziinae	<i>Ceropsylla ferruginea</i> , sp. n.	...	...	<i>Miliusa velutina</i>
	<i>C. fulvida</i> , sp. n.	...	...	<i>Ficus microcarpa</i>
				<i>F. rumphii</i>
	<i>C. minuta</i> , sp. n.	...	...	<i>Shorea robusta</i>
	<i>Leuronota corniculata</i> , sp. n.	...	...	<i>S. robusta</i>
	<i>L. minuta</i> (Crawf.)	...	...	<i>Mangifera indica</i>
	<i>Petalolytta basalis</i> (Walk.)	...	...	<i>Quercus dilatata</i> ; "khandiara"
Phylloplecta-Group	<i>Trioza eugeniooides</i> Crawf.	...	...	Unknown
	<i>T. hirsuta</i> Crawf.	...	...	<i>Terminalia alata</i> var. <i>tomentosa</i>
				<i>T. arjuna</i>
				<i>T. catappa</i>
				<i>T. paniculata</i>
	<i>T. lobata</i> sp. n.	...	...	<i>Dubabanga grandiflora</i>
	<i>T. mallotica</i> Crawf.	...	...	<i>Mallotus philippinensis</i>
	<i>T. piiformis</i> , sp. n.	...	...	<i>M. philippinensis</i>
	<i>T. serrata</i> , sp. n.	...	...	<i>Sabia paniculata</i>
	<i>T. vitiensis</i> Kirk.	...	...	<i>Eugenia (Syzygium) malaccensis</i>
				<i>Syzygium cumini</i>
Trioza-Group	<i>Trioza analis</i> Crawf.	...	...	Unknown
	<i>T. bifurcata</i> , sp. n.	...	...	<i>Populus euphratica</i>
	<i>T. ceardi</i> Berg.	...	...	<i>P. euphratica</i>
	<i>T. fletcheri</i> Crawf.	...	...	<i>Gmelina arborea</i>
				<i>Trewia nudiflora</i>
	<i>T. fletcheri minor</i> Crawf.	...	...	<i>Terminalia alata</i> var. <i>tomentosa</i>
				<i>T. arjuna</i>
				<i>T. catappa</i>
				<i>T. paniculata</i>
	<i>T. fusca</i> , sp. n.	...	...	<i>Syzygium cumini</i>
	<i>T. gigantea</i> Crawf.	...	...	"Uttis" (local name)

Sub-family	Species			Plant hosts
	<i>Trioza gigantea curta</i> , ssp. n.	...	...	Unknown
	<i>T. hyalina</i> Crawf.	...	...	Unknown
	<i>T. jambolanae</i> Crawf.	...	...	<i>Syzygium cumini</i>
	<i>T. longiantennata</i> , sp. n.	...	...	<i>Populus euphratica</i>
	<i>T. obtusa</i> Thomson	...	...	<i>Atriplex</i> sp. <i>Chenopodium album</i>
	<i>T. obsoleta</i> (Buckt.)	...	...	<i>Diospyros melanoxylon</i> <i>D. tomentosa</i>
	<i>T. simplifica</i> , sp. n.	...	...	Wild shrub
	<i>T. spinulata</i> , sp. n.	...	...	<i>Syzygium cumini</i>
	<i>T. urticae</i> (Linn.)	...	...	<i>Urtica</i> spp.

Some of the psyllid species are said to be very destructive pests in other countries, as mentioned below.

1. *Psylla pyricola* Foerster (the pear psylla) :—Pest in Europe. Common in U.S.A., in the pear orchards of the Pacific north-west. It has been identified as the vector of pear decline virus and leaf curl, a related disease of pear trees (Madsen and Morgan, 1970).
2. *P. mali* Schmidberger (the apple sucker) :—Somewhat of limited distribution. Causes appreciable injury.
3. *Paratrioza cockerelli* Sulc.—Native of North America. Major pest of potatoes in western U.S.A.
4. *Trioza alacris* Flor:—Causes curling and thickening of the leaves of laurel trees and thus does some injury.
5. *Pachypsylia celtidis-mamma* Riley forms galls on the underside of leaves of hackberry.
6. *Psylla buxi* L. is responsible for deforming the apical shoots of *Buxus sempervirens* into miniature cabbage-like growths, in Great Britain.
7. *Livia juncorum* Latr. forms tassel-like galls on several species of *Juncus*.
8. *Trioza erythraea* (Del Guercio) is a very serious pest of *Citrus* trees in Africa, and is said to cause the “ Greening Disease ”.
9. *T. perseae* Tuthill attacks avocado
10. *Jensenella psidii* Tuthill attacks guava
11. *Russelliana solanicola* Tuthill attacks potato
12. One species attacks avocado in Mexico.....

Great precautions are necessary to prevent the introduction of these psyllid pests into India.

} in Peru (Tuthill, 1959).

### III. TAXONOMIC TREATMENT

#### EXTERNAL MORPHOLOGY OF ADULTS

THE external morphology of this family has been fully studied in details by Crawford (1914), and his studies because of their completeness and simplicity are useful and generally followed by taxonomists. Some modifications and relationships of the various parts are discussed by Heslop-Harrison (1951), Pesson (1951), Klimaszewski (1964), Dobrea and Manolache (1962) and Loginova (1964) and others. The characters given by Crawford have been used in this contribution. Miss Patch (1909) has discussed the wing venation and its homology with the veins of Aphididae, Coccoidea and Aleyrodidae, and the author has followed the same system of nomenclature. In respect of the genital structures, the features outlined by Ossianilsson, Russell and Weber (1956, in Tuxen) have been adopted here. Emmanuel Witlaczil (1885, Die Anatomie der Psylliden) and Johannes Wilcke (1941) have discussed extensively the internal anatomy and the biology and morphology of *Psylla buxi* L., respectively and these may be consulted.

The various morphological parts of taxonomic value are briefly presented below.

**Head.** The head shows considerable variation in form and shape. It may be spherical or globular (*Paurocephala*, *Pauropsylla*) or greatly elongated horizontally (in *Liviinae*), horizontal, quadrate or flattened (in *Aphalarinae*), deflexed or variously modified by the genae (*Psylla*, *Trioza*). It comprises the vertex, occiput, frons, genae, compound eyes, antennae, clypeus and beak or rostrum. The vertex is divided by a median suture which is absent in some species of *Pauropsylla*, may be flat, or often with irregular depression or foveae, or sometimes rounded forward or downward. Its shape is variable from quadrate to triangular or semi-circular or each lobe may be rhomboidal. Behind the head the occipital regions are normally developed and they cover over the posterior margins of the compound eyes. The frons appears as a small or large sclerite, variously shaped, and bearing the anterior ocellus at its base or the end nearest the vertex.

There are two genae, one on each side of the elongate frons and between the vertex in front and the clypeus behind. They are inferior in position, not well marked, obsolete or weakly swollen beneath, or may form two spherical lobes or two conical processes projecting downward or forward. In some species of *Criocerinae*, part of the vertex is formed by the genae, and the former appears as a pair of narrow oblique lobes with the anterior ocellus far from the front margin while the antennae are attached on the front margin.

The clypeus is very prominent but inferior in position, usually pyriform or cordate in shape. It usually covers the frons and in front view it is obscured by the genal cones. The beak or rostrum is sharply flexed between the fore coxae and passes out between the legs. It is moveable and may be exserted.

The compound eyes are large, usually more or less hemispherical and each eye is

constituted of large facets. There are three ocelli, two located on the postero-lateral corners of the vertex, quite close to the compound eyes, and one on the frons.

The antennae are either attached in front near the junction of the anterior margin of the vertex and genae or near the lateral margin of the genae. They show considerable variation and are normally ten-segmented, and this number is reduced in some species. The two basal segments are always large and stout, while the remaining segments are slender and filiform. They are sparsely pubescent, sometimes profusely hirsute and also bear sensory structures; terminal segment usually bear two unequal apical spines, sometimes these spines are as long as or longer than the antennae (*Pauropsylla* spp.).

**Thorax.** The thorax is large, strongly developed and is quite a complex structure both internally and externally. The prothorax is short, may be arched or roof-shaped, flat or deflexed anteriorly, lateral extremities with prominent foveal impressions and may be uniform or more or less swollen and knob-like. This structure is very useful in classification in respect to the relation borne by the pronotum to the propleurites. In *Aphalara* and *Arytaina*, the pleural suture extends to the middle of the knob-like lateral extremity of the pronotum, while in *Psylla* it is oblique and extends to the posterior edge of the lateral extremity of the pronotum, and the latter is not knob-like. The pleural suture separates the episternum and epimeron vertically, diagonally or horizontally. The episternum may be equal in size to the epimeron, or it may be larger but it is seldom smaller.

The mesothorax is the largest part of the thorax and is divided into a series of prominent, sub-equal and variously flattened or arched plates consisting of prescutum (or dorsulum), scutum and scutellum, with an inferior and smaller post-scutellum (postnotum).

The metathorax is largely concealed by the folded wings, weakly developed and is differentiated into a series of smaller notal plates but its post-scutellum or pseudonotum is quite large and is often produced into a backwardly directed pair of horn-like processes or epiphyses or very prominent ridges. The internal metathoracic skeletal structures are unique to the Psyllidae and undergo greatest modification.

**Legs.** Three pairs of legs are present, the fore and middle pairs are normally developed and more or less uniform throughout. The middle pair is generally smaller. The hind pair of legs undergoes greatest modification. Each leg comprises coxa, trochanter, femur, tibia, two tarsal segments and claws with pulvilli. The coxae are large and sub-globose, ovoid, the metacoxae being much large and more complicated in structure. Externally, these meta-coxae present a simple undivided structure with backwardly directed processes or meracanthalae, and a long curved arm extending laterally round the junction of the base of the thorax and the constricted abdomen. Some of the species of *Trioza* (*Phylloplecta* group) may possess an anteriorly directed process in addition to the posteriorly directed meracanthus.

The trochanter is freely movable. The femur is long and large while the hind femur is thickened and stout. The tibia is as long as or longer than the femur and relatively slender and with a slightly dilated apex. In many genera, there is a spur or a series of irregular notches at the base, and in all the genera there is a variable number of black

movable spines at the apex, arranged in a circle or semicircle or divided into two groups of "inner" and "outer" spines. Some *Ciriacreminae* and *Triozinae* may possess a greatly enlarged spur like a cockspur arising subapically.

The tarsi are two-segmented. The apical segment bears two large sharp claws with a long seta between them. The basal tarsal segment of hind legs in most genera, except *Triozinae* bears a pair of claw-like spines at the apex (in most Psyllinae), one extending out on each side of the distal segment, while some *Ciriacreminae* may possess only one claw-like spine at apex.

Crawford (1914) has described the wings and venation in simple terms, as reproduced below:

*Wings.* "The wings, four in number, are membranous, though sometimes the anterior pair is thickened and leathery. The shape is variable from elongate-ovate to rhomboidal. The venation is simple, and presents relatively few striking differences throughout the family."

"The media and cubitus have fused at the base with the radius, and only one principal basal vein is present ( $R+M+Cu$ ). This divides near the base into either three (*Triozinae*) or two veins. In the latter case the posterior of the two veins ( $M+Cu$ , or the cubital petiole) divides again into the media and cubitus. The upper fork, radius ( $R$ ), gives off the radial sector ( $Rs$ ) about midway in its course to the costa ( $C$ ). The radius may unite with the costa directly or it may turn near the costa and follow parallel with it for a distance before uniting with it. The space between the costa and radius, in the latter case, is called the pterostigma. The radial sector passes to the apical portion of the wing and is branched only in exceptional cases."

"The medial vein is branched once near its apex, forming  $M_{1+2}$  and  $M_{3+4}$  and the cell thus formed is called the second marginal cell. The cubitus, also, forks once into  $Cu_1$  and  $Cu_2$ , forming the first marginal cell. The claval suture dividing the clavus and corium is near the base, extending from the base to near the tip of  $Cu_2$ . Only one anal vein is present, and that is very short and near the base. The veins, and sometimes the membrane, are beset with fine or coarse hairs."

"The venation of the posterior wings is even more simple, the wings themselves being much smaller and more delicate in texture.  $R_1$  is wanting, the first behind the costa being the radial sector. The media is unforked at the end. The cubitus divides, as in the primary wing, into  $Cu_1$  and  $Cu_2$ . A short anal vein is sometimes present." In one of the Indian species, *Trioza obsoleta*, these wings are greatly reduced like small stubs.

*Abdomen.* Heslop-Harrison (1951) writes: "Considerable differences of opinion have been expressed by various authors as to the interpretation of the abdominal segmentation and the associated genital structures." Ten segments are normal and generally accepted in Psyllidae. The first two segments are greatly reduced and suppressed, while the posterior segments are modified and represented by the genital structures. Thus, six segments—third to eighth—are easily visible in the abdomen, each with a spiracle on the lateral side. These segments are more often telescoped, and pubescence is usually prominent on sternites.

*Genitalia.* The male genitalia varies considerably in form and shape in different genera and species, and consists of the anal valve (proctiger), forceps or claspers (parameres), subgenital valve (hypandrium) and the aedeagus. A bobbin-shaped sperm pump is located in the abdomen and is connected with the aedeagus by a fine delicate tube.

Similarly, the female genital structures are also greatly variable, and comprise the dorsal plate bearing the anus, the ventral plate, and in between the ovipositor carrying the gonopophyses (valvulae). The homology of the genital structures are discussed by Heslop-Harrison (1951) and others.

#### IMMATURE STAGES AND THEIR CLASSIFICATION

The nymphs are generally flat creatures, oval in shape, yellowish in early instars and become blackish with reddish marks in later instars, with bright red eyes. They have a long beak enclosing fine stylets, on the ventral surface near the centre. The wing-pads after the first moult appear as small buds on the anterior half of the dorsal side. Their body is often covered or fringed with different types of setae, and in life it is enveloped in masses of flocculent secretion. I have attempted to describe and figure as many as possible the nymphs available in the collections (totalling 45 species) and I have followed the nomenclature of Ferris (1925, 1926, 1928) in nymphal descriptions.

The system of classification based on nymphs only could not be attempted, as the scope of the present work was so limited, and research staff was not provided in the scheme. However, Ferris (1925) recognises two distinct types of nymphs, (1) the triozine type, in which the wing-pads are produced cephalad at the humeral angle and otherwise so arranged that their margin is more or less continuous with the margins of head and abdomen and (2) the psylline type, in which the wing-pads are not produced cephalad at the humeral angle and they project prominently from the contour of the body. Rahman (1932) has added another, pauropsylline type, in which the front wing-pads are not produced cephalad at the humeral angle but show a tendency in that direction, their outer margins are, however, in line with the general contour of the body. The nymphs of the pauropsylline species reported here, do show the tendency as mentioned by Rehman, but the nymphs of *Pauropsylla purpureascens*, sp.n. resemble closely with the triozine forms. Similarly, the nymphs of several species of the sub-family *Criacreminae* resemble the nymphs of the psylline forms (sub-family *Psyllinae*). The nymphs of the genus *Diaphorina* (sub-family *Psyllinae*) resemble the triozine forms. The nymphs of *Leuronota corniculata*, sp.n. (sub-family *Trioziinae*) resemble the pauropsylline form of Rahman. In order to establish a firm taxonomic basis, more knowledge about the immature stages is necessary. The nymphal stages of several species possess the conspicuous bands of pores in addition to the usual circum-anal pore ring. This expanded zone of pores is partially on the dorsum and partially on the venter. This structure may prove of some systematic importance. The homologies of the anal pore ring are discussed by Ferris (1928) and I agree with him that "care must be taken in its use to establish the actual homologies . . . ."

### DISCUSSION

In the course of this work much difficulty was faced due to the non-availability of the types of Indian species described by Lethierry, Kieffer, Crawford, Laing and others. The descriptions and figures given by these authors omit certain details of value and are very flimsy. However, I have been able to identify with reasonable certainty all species, with the exception of a few. These doubtful species were referred to Dr Louise M. Russell, Dr L. D. Tuthill, Dr F. Ossiannilsson, Dr V. F. Eastop and Dr Y. Miyatake and their valuable assistance was secured. The external morphology, wing venation and genital characters are extensively explained and their homologies are discussed by Crawford (1914), Patch (1909), Pruthi (1925) and Ossiannilsson *et al.* (in Tuxen, Copenhagen, 1956). Some changes in the taxonomy of these insects are critically discussed by Heslop-Harrison (1948, 1949, 1951, 1952, 1958, 1959, 1960), but I note that confusion still persists in several genera, because of the inconsistency of certain characters like shape of head, vertex, presence or absence of genae, wing-venation, basal spur and apical spines on hind tibia. It is not my intention to comment at length or with any pretence of authority upon the status of such genera. The characters used in the generic descriptions and keys here are, therefore, merely for convenience in separating the genera found in the Indian subcontinent and are subject to alterations and modifications when further knowledge of other genera and species is available.

The dominant groups present are the genera *Trioza*, *Psylla* and *Diaphorina* showing fairly consistent characters, but another dominant group *Pauropsylla* exhibits inconsistent characters. Male genital structures are useful in specific determination, but not in generic classification. The structural resemblance and relationship of generic and specific characters are discussed by me under the respective genera and species. *Phylloplecta* Ferris is not considered as a valid genus and has been synonymised with the genus *Trioza* Foerster. For convenience, however, I have divided *Trioza* into *Phylloplecta*-group and *Trioza*-group, the former having an anteriorly directed spur of the metacoxae and the latter without it. Another genus *Petalolyma* Scott appears to resemble closely with the typical *Trioza*; however it is considered distinct on the basis of some character combinations. Ramakrishna Ayyar (1924) placed *Allotrioza minuta* Crawford (1912) under the genus *Leuronota* Crawford. In the absence of more material for study, no change is proposed in these two genera at this time.

The sub-family *Ciriocreminae* includes a heterogeneous group of genera showing considerable variation in generic characters. On the basis of such variations, Heslop-Harrison (1958) has regrouped the genera into 7 tribes of this sub-family and has also made *Pauropsyllini* as one of the tribes. To avoid further confusion in the taxonomy of these groups, I have retained *Pauropsyllinae* as a separate sub-family and have included *Phacopteron lentiginosum* Buckton and *Pauropsylla tuberculata* Crawford in this sub-family, as they show closer relationship with *Pauropsylla* than with others.

This study has also brought to light the relationship of the psyllid fauna of the Indian sub-continent to that of other areas. Some of the genera, *Psausia* Endl., *Mesohomotoma* Kuw., *Macrohomotoma* Kuw., *Tenaphalara* Kuw., and *Mycopsylla* Frogg. of the sub-family *Ciriocreminae*, and *Pauropsylla* Rubs. of the sub-family *Pauropsyllinae* of the Old World

Tropics and the Australian region, are fairly represented in India as well. Elements of the palaearctic fauna, e.g. *Psylla zaicevi* Sulc, *Psylla viburni* Loew, *Aphalara maculipennis* Loew, *Trioza ceardi* Berg., and *T. urticae* L., are also met with. Heslop-Harrison (1946) has recorded *Psylla crataegi* Schr., *Psyllopsis fraxini* L., and *Trioza scotti* Loew also palaearctic species from Naini Tal (U.P.).

I feel that the present taxonomic work will not only serve as a means of identifying the species of the Indian sub-continent but will perhaps also stimulate more widespread interest in the psyllid fauna. It is expected that a more thorough taxonomic revision may ultimately be made when more species have been collected, particularly from the Southern Peninsula and the Eastern States of Bengal and Assam.

Heslop-Harrison (1951) in his discussion on the ancestry, family relations, evolution and speciation of the Psyllidae, has correctly said that "it is the balance of all characters on which final judgement must rest in elucidating matters of classification, systematics and phylogeny."

## IV. FAMILY PSYLLIDAE

SOME recent workers in Europe have given the rank of Sub-order under the name *Psylloidea* or *Psyllinea* to this group of insects. The psyllid fauna of the Indian region is generally more restricted to the forest plant species, and, therefore, has great limitations. Further, the collections studied by me were not adequate enough to contain very large series of specimens of many species and considerable variation was thus not noticeable. They are, therefore, confined to the family rank of *Psyllidae*. Heslop-Harrison (1951), in his critical discussion of these homopterous insects, has also maintained the family rank Psyllidae.

- 1798, *Psyllidae* (fam.), Latreille, P. A. *Gen. Crust. Ins.* **3**, p. 168.  
 1876, —— ——. Scott, J. *Trans. ent. Soc. London*, p. 526.  
 1896, —— ——, Edwards, J. *Hem. Hom. Br. Isl.*, p. 233.  
 1900, —— ——, Froggatt, W. W. *Proc. Linn. Soc. N. S. W.* **25**: 250-258.  
 1911, —— ——, Crawford, D. L. *Pomona Coll. J. Ent.* **3**: 480-481.  
 1914, —— ——, Crawford, D. L. *Bull. U. S. Nat. Mus.* **85**: 1-10.  
 1919, —— ——, Crawford, D. L. *Philipp. J. Sci.* **15**: 140.  
 1913, —— ——, Aulmann, G. *Psyllidarum Catalogus*, p. 5.  
 1924, —— ——, Ramakrishna Ayyar, T. V. *Rec. Indian Mus.* **26**: 621-625.  
 1951, —— ——, Heslop-Harrison, G. *Ann. Mag. nat. Hist.* (12) **4**: 1-35.  
 1952, —— ——, Heslop-Harrison, G. *ibid.* (12) **5**: 679-696.  
 1958, —— ——, Heslop-Harrison, G. *ibid.* (13) **1**: 561-579.  
 1959, —— ——, Heslop-Harrison, G. *ibid.* (13) **2**: 157-168.  
 1960, —— ——, Heslop-Harrison, G. *ibid.* (13) **3**: 497-504.  
 1963, —— ——, Klimaszewski, S. M. *Annls. Zool. Warsz.* **20** (20): 363-370.  
 1903, *Psylloidea*, Handlirsch, A. *Sber. Akad. Wiss. Wien*, pp. 716-738.  
 1950, —— ——, Borshenius, N. S. *Akad. Nauk, Opredeliti po faune S.S.R.*, no. 32.  
 1957, —— ——, Vondracek, K. *Fauna, C.S.R. Praha, Ces. akad. Ved. t.* **9**: 1-431.  
 1962, —— ——, Dobrea, E. and Manolache, I. *Fauna Repub. pop. rom. Insecta*, **8**, fasc. 3, Hom. *Psylloidea*, pp. 61-63.  
 1964, —— ——, Loginova, M. M. *Proc. Inst. Zool. Acad. Sci. U.S.S.R.* pp. 52-56.  
 1964, —— ——, Loginova, M. M. *Inst. Biol. Acad. Sci. U.S.S.R.* pp. 437-442.  
 1964, —— ——, Klimaszewski, S. M. *Annls. Zool. Warsz.* **22** (5): 81-138.  
 1861, *Psyllodea* (fam.), Flor, G. *Rhynch. Livl.* **2**: 483.  
 1914, —— ——, Mordvilko, K. A. *Faun. Ross.* **1**: 72-73.  
 1948, —— ——, Tarbinskii, S. P. and Plavilskov, N. N. *Opredeliti nasekomih evropeiskoi ciasti S.S.R.*, Moscow Leningrad, p. 182.  
 1904, *Chermidae* (fam.), Kirkaldy, G. W. *Entomologist*, **38**: 258, 280.  
 1917, —— ——, Van Duzee, E. P. *Cat. Hemip. N. Amer.*, p. 782.  
 1908, *Psyllina* (superfam.), Boerner, C. *Arb. Kais. Biol. Aust. Bd.* **6**: 81-320.  
 1935, —— ——, Haupt, H. *Tierwelt Mittleurop.* **4**, **3**: 221, 222.  
 1954, —— ——, Dlabola, J. *Fauna C.S.R.*, p. 54.  
 1951, *Psyllinea* (subord.), Pesson, P. (in Grasse, P.), T. **10**, fasc. 2, p. 1531.  
 1964, —— ——, Loginova, M. M. *Proc. Inst. Zool. Acad. Sci. U.S.S.R.*, pp. 52-56.  
 1964, —— ——, Loginova, M. M. *Inst. Biol. Acad. Sci. U.S.S.R.*, pp. 437-442.

Loew (1878) classified these insects in four sub-families—*Triozae*, *Psyllinae*, *Aphalarinae*,

and *Liviinae*. Crawford (1914) classified them into six sub-families—*Liviinae*, *Pauropsyllinae*, *Carsidarinae*, *Ciriacreminae*, *Trioziinae*, and *Psyllinae*. Pesson (1951) also recognised these six subfamilies, but in the sub-order Psylloidea. Heslop-Harrison has merged two sub-families *Pauropsyllinae* and *Carsidarinae* in the sub-family *Ciriacreminae* and grouped them into *Liviinae*, *Aphalarinae*, *Trioziinae*, *Ciriacreminae*, *Psyllinae*, and *Spondylaspinae*. These divisions made on the basis of fundamental morphological characters and constituted more for nomenclatorial convenience, are now classed as basic or ancestral, and regarded as of great phylogenetic significance. Dobreanu and Manolache (1962) and Loginova (1964) have differentiated five major families, e.g., *Liviidae*, *Aphalaridae*, *Psyllidae*, *Prionocnemidae* (= *Carsidaridae*) and *Trioziidae* under Psylloidea. For the classification of Indian species, I have followed Crawford's system of tabulation and have retained *Aphalarinae* and *Pauropsyllinae* together with *Liviinae*, *Ciriacreminae*, *Psyllinae* and *Trioziinae* as sub-families. These sub-families are separated by the characters as given in the following key.

## KEY TO THE SUB-FAMILIES OF PSYLLIDAE

1. Frons not covered by genae, usually visible as a small sclerite; front ocellus at extremity of frons; genae seldom produced into conical processes or swellings . . . . . 2
- . Frons covered by genae and not visible except a very narrow border around front ocellus; genae flat, rounded or produced into conical or tubular processes of variable extent and length . . . . . 4
2. Vertex flat and horizontal; wings often more or less thickened . . . . . 3
- . Vertex rounded downward in front, not horizontal; head strongly deflexed; thorax strongly arched; wings usually membranous . . . . . *Pauropsyllinae*
3. Eyes greatly flattened, not hemispherical; vertex longer than broad; antennae with greatly enlarged basal segments; eyes with distinct preocular tubercles; pronotum extending far down laterad toward coxae . . . . . *Liviinae*
- . Eyes more or less spherical; vertex not longer than broad; antennae not as above; eyes without preocular tubercles; pronotum shorter, with a knob-like lateral termination . . . . . *Aphalarinae*
4. Head deeply cleft in front between the antennae; forewing with more than the usual marginal cells; if head is not cleft, forewing elongate and often with pseudo-veins; basal tarsus of hind legs usually with only one claw-like spine at apex . . . . . *Ciriacreminae*
- . Head not as above, the divergent genal cones may give the appearance of a cleft; forewing with only the usual two marginal cells, never with pseudoveins . . . . . 5
5. Forewing rarely angulate at apex, with a cubital stem, i.e., media and cubitus with a common stem; genae developed into conical processes or rounded lobes; basal tarsal segment of hind legs usually with two claw-like spines at apex . . . . . *Psyllinae*
- . Forewing usually angulate at apex, radius, media and cubitus usually diverging at the same point from basal vein or nearly so; genae usually developed into cones, sometimes slightly swollen beneath the antennal bases; claw-like spines of basal tarsal segment absent . . . . . *Trioziinae*

## Sub-family LIVIINAE Loew 1878

1878, *Liviinae*, Loew, F. Verh. zool.-bot. Ges. Wien. **28**: 605-606.

1900, ———, Froggatt, W. W., Proc. Linn. Soc. N.S.W. **25**: 258-59.

1907, ———, Oshanin, B., Verz. Palaearkt. Hem. **2**: 338.

- 1913, ——, Aulmann, G. *Psyllidarum Catalogus*, p. 75.  
 1914, ——, Crawford, D. L. *Bull. U.S. natn. Mus* 35: 19.  
 1949, ——, Schaefer, H. A. *Mitt. schweiz. ent. Ges.* 5: 18.  
 1948, ——, Heslop-Harrison, G. *Ann. Mag. nat. Hist.* (12), 1: 284-93.  
 1949, ——, Heslop-Harrison, G. *Ann. Mag. nat. Hist.* (12), 2: 241-270.  
 1960, ——, Heslop-Harrison, G. *ibid.* (13), 3(32): 503.  
 1963, ——, Klimaszewski, S. M. *Frag. Faun. Warz.* 10(18): 257-258.  
 1963, ——, Klimaszewski, S. M. *Annls. Zool. Warsz.* 20(20): 263-270.  
 1896, *Liviidae*, Edwards, J. *Hem. Hom. Br. Isl.*, p. 227.  
 1935, ——, Haupt, H. *Tierwelt Mitteleur.*, 4, p. X, 224-225.  
 1954, ——, Smreczynski, St. sen. *Psyloidea, Fragmenta Faunistica* 7: 135.  
 1957, ——, Vondracek, K. *Hemiptera III, Hom. Psylleinea, Acta. ent. Mus. Nut. Praga*, t. 28: 113-115.  
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 1962, ——, Dobrea, E. and Manolache, C. *Fauna Repub. pop. rom.*, Insecta, 8, fasc. 3, Homoptera,  
     pp. 62-64.  
 1964, ——, Loginova, M. M. *Inst. Biol. Acad. Sci. U.S.S.R.*, pp. 442-44; *Proc. Inst. Zool. Acad. Sci.* 34,  
     pp. 52-55.  
 1886, *Liviania* (subfam.) Puton, A. *Cat. des. Hem.*, p. 90.  
 1907, ——, (Div.) Oshanin, B. *Verz. palaarkt. Hem.* 2: 338.  
 1882, *Livillinae* (Tribe) (partim), Scott, J. *Trans. ent. Soc. Lond.*, p. 462.

Head not deflexed, as broad as prothorax and closely joined to it. Vertex flat, usually longer than broad, more or less rectangular in outline, apical portion thin, emarginate (sometimes deeply) in front at median line. Genae more or less swollen beneath vertex, never conical. Frons beneath vertex, not covered by genae, visible as a narrow (usually elongate) sclerite from clypeus to front ocellus. Anterior ocellus beneath, not visible from above. Eyes not prominent, greatly flattened (compressed), not hemispherical, with a small preocular tubercle in front of each. Antennae usually short, rather thick, basal segments unusually large and thick. Thorax flat, scarcely arched; sutures not deeply impressed. Pronotum collar-like, extending far down laterad towards coxae. Propleurites very short, subequal. Legs short. Hind tibiae without basal spur. Basal metatarsus without spines. Forewings rather large, more or less thickened, coriaceous, variable in shape and venation; often maculate; basal vein short; cubital petiole ( $M+Cu$ ) shorter, as long as or longer than cubitus; upper fork  $Cu_1$  very long, more than twice as long as lower fork  $Cu_2$ . The preocular tubercles said to be sensory in function and, therefore, of great phylogenetic significance.

The chief features of this sub-family are the flattened head, the inferior position and the shape of frons beneath vertex and not covered by genae, the more or less swollen genae beneath vertex, the short antennae and more or less thickened forewings.

All *Liviinae* are restricted to *Juncus* (*Juncaceae*) and *Carex* (*Cyperaceae*) hosts and their gall-formation is uniform and characteristic.

#### Genus **LIVIA** Latreille 1804

##### *Livia*

- Latreille, P. A. 1804. *Hist. nat. Ins.* 12: 374; 1807. *Genera Crust. et. Ins.* 3: 170.  
 Flor, G. 1861. *Rhynch. Livl.* 2, p. 540; *Bull. Soc. Nat. Moscou*, p. 337.  
 Meyer-Dur, R. 1871. *Mitt. schweiz. ent. Ges.* 3: 380.

- Scott, J. 1876. *Trans. ent. Soc. Lond.* p. 565.  
 Loew, F. 1878. *Verh. zool.-bot. Ges. Wien.* 28: 606.  
 Edwards, J. 1896. *Hem. Hom. Br. Isl.*, p. 227.  
 Oshanin, B. 1907. *Verz. paleearkt. Hem.* 2: 338.  
 Aulmann, G. 1913. *Psyllidarum Catalogus*, p. 76.  
 Crawford, D. L. 1914. *Bull. U.S. Nat. Mus.* 85: 19.  
 Haupt, H. 1935. *Tierwelt Mitt.* 4, p. X, 225.  
 Heslop-Harrison, G. 1949. *Ann. Mag. nat. Hist.* (12) 2: 244, 248-253.  
 Vondracek, K. 1954. *Fauna C.S.R. Prahha, Ces. akad. ved. t.* IX, p. 115.  
 Dobrcanu, E. and Manolache, C. 1962. *Fauna Repub. pop. rom., Insecta*, 8, fasc. 3, pp. 6 f.  
 Loginova, M. M. 1964. *Inst. Biol. Akad. Sci. U.S.S.R.* p. 444.

Type species: *Livia juncorum* (Latreille) (=*Psylla juncorum* Latreille, 1798) (original designation).

The generic characters are already covered by those of the sub-family, since this is the only genus so far known under it.

The genus *Livia* is widely distributed throughout Europe, Britain to the Hibrides, North Africa (Algeria), and also in North America, and Japan. From India, one species *Livia khaziensis* Hes-Harr. has been recorded from Shillong Peak in the Khasi Hills (1,525 m), Assam. This species is described from a single male and its description is reproduced from Heslop-Harrison (1949). Of all the Liviine species, *Livia juncorum* (Latr.) has the widest distribution, and is already reported from the following countries of the Palaearctic area: Norway, Sweden, Lapland, Finland, Russia, Denmark, Holland, Belgium, Germany, Austria, Hungary, Rumania, France, Spain, Portugal, Italy, Turkestan and Algeria; also in Great Britain, Hebrides, Cyprus, Kurdistan and Persia. In Northern India, it was found at Naini Tal (1,830 m) in the Himalayas, U.P., producing characteristic galls on *Juncus* spp. (Heslop-Harrison, 1949). I have not seen both these species, *L. juncorum*(Latr.) and *L. khaziensis* Hes.-Harr.

#### *Livia juncorum* (Latreille) 1798

##### *Psylla juncorum*

Latreille, P. A. 1798. *Bull. Soc. Phylom.* 1 (15): 113.

##### *Livia juncorum*

Latreille, P. A. 1802. *Gen. Insect.* 3: 170, pl. XII, fig. 1.

Foerster, A. 1848. *Verh. naturw. Ver. preuss. Rheinl.* 3: 91.

Flor, G. 1861. *Rhynch. Livl.* 2: 542.

Meyer-Dur, R. 1871. *Mitt. schweiz. ent. Ges.* 3: 404.

Loew, F. 1882. *Verh. zool.-bot. Ges. Wien.* 31: 157-160.

Scott, J. 1876. *Trans. ent. Soc. Lond.* p. 565.

Edwards, J. 1896. *Hem. Hom. Br. Isl.*, p. 227, pl. XXVI, fig. 1.

Oshanin, B. 1907. *Verz. paleearkt. Hem.* 2: 339.

Aulmann, G. 1913. *Pyllidarum Catalogus*, pp. 76-78.

Horvath, G. 1918. *Fauna Regni Hung.* H. 8: 57.

Haupt, H. 1935. *Psylloidea, Tierwelt Mitteleur.* 4 p. X, 225.

Heslop-Harrison, G. 1946. *Entomologists' mon. Mag.* 82: 36.

Heslop-Harrison, G. 1948. *Ann. Mag. nat. Hist.* (12) 1: 284-293, fig. 7.

Heslop-Harrison, G. 1949. *ibid.* (12) 2: 244-245, 248-253,

- Schaefer, H. A. 1949. *Mitt. schweiz. ent. Ges.* **22**: 11.  
 Ossiannilsson, F. 1952. *Opusc. ent. Lund.* **17**: 196.  
 Smreczynski, St. sen. 1954. *Fragmenta Faunistica*, **7**: 135.  
 Vondracek, K. 1957. *Fauna C.S.R. Praha, Ces. akad. ved. t.* **9**: 115-119.  
 Lindberg, H. and Ossiannilsson, F. 1960. *Soc. pro. F. et. Fl. Fennica, Fauna Fenn.* **8**, p. 4.  
 Klimaszewski, S. M. 1963. *Frag. Faun. Warszawa* **10** (18): 258.  
 Loginova, M. M. 1962. *Proc. Inst. Zool. Acad. Sci. U.S.S.R.* **31**: 34.  
 Loginova, M. M. 1964. *Inst. Biol. Acad. Sci. U.S.S.R.* p. 444.  
 Dobrea, E. and Manolache, C. 1962. *Fauna Repub. pop. rom.*, Insecta, **8**, fasc. 3, pp. 64-68, figs. 31, 32.  
 =*Chermes graminis* : Hoy, 1794. *Trans. Linn. Soc. Lond.* **2**: 354.  
 =*Chermes junci* : Schrank, 1810. *Fauna boica* **2**: 142.

Heslop-Harrison (1949) has discussed its distribution, host affinities, details of biology and ecology. Dobrea *et al.* (1962) have redescribed it with excellent figures. This species is not seen by the author, however, its brief features are outlined below.

Colouration brownish or reddish pink; antennae red or reddish pink, 4th to 8th joints white, two apical segments black; forewings thickened, coriaceous, somewhat rhomboidal, pale fuscous-testaceous, very finely wrinkled transversely; legs pale yellow; abdomen fuscous-yellowish or brownish dorsally and yellow ventrally. Head horizontal and closely attached to prothorax. Vertex flat, longer than broad. Frons not visible from above and represent as a long narrow sclerite beneath the vertex. Eyes flattened, with a prominent preocular tubercle. Antennae short, stout, with two basal segments very greatly enlarged. Thorax flattened and pronotum collar-like. Genitalia characteristic.

*Distribution.* This species has a very wide distribution all over Europe and England of the Palaearctic region. Also occurs in Cyprus, Kurdistan, Persia and Northern India (at Naini Tal, 1,830 m). It produces its characteristic gall on several species of *Juncus*.

#### *Livia khaziensis* Heslop-Harrison 1949

Heslop-Harrison, G. 1949. *Ann. Mag. nat. Hist.* (12) **2**, pp. 256-261, fig. 2.

The description is reproduced from Heslop-Harrison (1949).

“*Colour.* Generally, dark brownish-horn colour, with darker longitudinal striae and a median lighter line down the thorax.”

“*Head.* Vertex dirty brown with darkly filled coarse punctures. Preocular tubercles very deeply reddish-brown, lateral ocelli deep reddish-brown, compound eyes almost black. Antennal insertions dark, genae black; frons, clypeus and labrum also black. Antennae dark generally, but the apical segments become pitchy.”

“*Thorax.* Pronotum dirty brown with darkly filled coarse punctures, propleurites concolorous with the latter.”

“Scutum and prescutum darker than the pronotum, with two darker lateral longitudinal striae and a median lighter line. Coarsely punctured, glabrous. Metanotal sclerites lighter in colour. Sternites uniformly very black, legs smoky, meracanthae black.”

"*Abdomen.* Uniformly black, without banding, genitalia of the male also very dark."

"*Wings.* Dark mottled, horn colour, veins yellowish; claval suture pale, almost transparent."

"*Structure.* General body surface coarsely rugose or punctured and wrinkled. Metanotal and metapleural regions folded laterally into deep grooves into which the wing bases fit."

"*Head.* From the side, appearing bluntly wedge-shaped; from above, the lateral margins of the lobes of the vertex, the compound eyes and the lateral margins of the occipital regions are smoothly rounded into two sectors of an almost perfect circle."

"The vertex is strongly notched in front and produced into two bluntly pointed lobes. Median suture weak, disc only slightly excavated. Lateral ocelli not at all prominent, compound eyes almost spherical, but not prominently projecting from the sides of the head, since they merge smoothly with the rounded sides of the vertex, genae and occipital regions. Preocular tubercles obscure, but present. Genae bulging slightly, giving considerable and nearly uniform depth to the head capsule, but hollowed in the middle. Frons obscure, although not covered by the genae. Anterior ocellus obscure. Clypeus poorly defined, with the small black labrum projecting backwards to form a small tubercle lying between the first pair of legs."

"Antennae inserted into the bulging genae, just under the lateral margins of the projecting lobes of the frons. Basal segments large, second segments more than twice their size, each forming a subcylindrical, truncated cone. The surfaces of the basal segments are very heavily wrinkled, almost warty, and together they nearly equal the rest of the antenna in length. The distal segments are rugose, with sensoria on segments 6, 8 and 10, and two long subapical sensory spines or pegs on the darker terminal segment."

"*Thorax.* Pronotum flat and ribbon-like, not quite so long as the head, nor nearly so wide. Strongly rugose, and turned down somewhat abruptly at the sides. Propleurites very small and recessed into square notches cut out of the forward lateral margins."

"The axillary sclerites are large, polygonal plates, with the inner two sides merging in with the prescutum and scutum. The latter are somewhat shining and glabrous, although very strongly rugose or pitted, slightly arched and smoothly rounded down at the sides. Thoracic region generally flat and in a continuous plane with the horizontal vertex."

"The sternites are wrinkled and grooved in such a way that the grooves almost form recesses for the femora of the legs. The legs are stout and somewhat coarsely hairy. Meracanthae straight, bluntly pointed and slightly divergent. Metatibial spines six in number, arranged into one prominent and larger inner spine and five smaller, closely-set outer spines. Claws dark, and not well developed. Basal metafibiae without spurs."

"*Forewing.* Extending beyond the apex of the abdomen, broadest about halfway along its length and rounded at the apex in almost the same way as in *L. juncorum*, but differing from the wing of the latter in being very slightly bean-shaped, i.e., with the apex slightly tilted upwards from the median axis. Venation similar to *L. juncorum*,

but with the junction of the  $R_1$  and the costa very slightly expanded into an incipient pterostigma."

"Veins yellowish, becoming dark and very strong at the base. General wing surface very strongly coriaceous, and mottled with dark fumose-brown pigment. Claval suture clear and, therefore, prominent against the darker back-ground. Micro-sculpturing in the vicinity of the claval suture characteristic and dividing the wing surface up into blotchy, irregular, hexagonal cells."

"Abdomen. The segments are tapering and, together, equal in length to the genital segment of the male."

"Male genitalia. Proctiger stout and cylindrical, finely etched with annular broken striae; coarsely hairy, with the hair thickening and darkening towards the posterior edge of the anal opening."

"Parameres about two-thirds the height of the proctiger, with the forward margin gently bulging out before narrowing down to the bluntly rounded apex. The hind margin is smoothly excavated, making the whole paramere somewhat sickle-shaped."

"From behind, the parameres are seen to curve, bow-like, towards each other. The outer edge of the base is hollowed slightly, and the inner edge is coarsely haired with medium long hair. Tips approximating each other and dark."

"Genital segment (i.e., ninth segment) scoop-shaped, and uniformly, if sparsely, hairy. Dark coloured."

#### DIMENSIONS OF THE MALE

" Length from vertex to the tip of folded wings	2.9 mm
Length of antennae	0.7 mm
Width of head, including the compound eyes	0.42 mm
Length of forewing	1.9 mm
Width of forewing	1.0 mm
Length of abdomen, including the genitalia	0.6 mm "

#### DIMENSIONS OF THE MALE GENITALIA

" Length of proctiger	0.3 mm
Width of proctiger at the base	0.15 mm
Length of parameres	0.2 mm
Width of parameres at the base	0.08 mm
Length of ninth segment	0.3 mm
Depth of ninth segment	0.3 mm
Antennal Ratio	0.6 "

#### NOTES ON THE SPECIES

"Discovering that *Livia juncorum* was apparently a normal element of the psyllid fauna of Northern India, and to be found in the foothills of the Himalayas at altitudes of approximately 1830 m, suggested that it may have an even wider distribution, and a continuous search was initiated for it wherever *Juncus* spp. grew naturally throughout

the Indo-Malayan region. It was whilst searching for this insect in Assam that the present new species was found."

"In March 1946 one, apparently belated male, was swept out of *Juncus* growing in a damp hollow on Shillong Peak in the Khasi Hills at an altitude of approximately 5,000 ft. Further extensive search failed to bring to light others by that method, and it was realized that it was probably about a month too late in the season. At that latitude, even considering the altitude, spring comes very much earlier than in Europe, and most of the spring insects were already beginning to become very scarce or absent."

"As the single insect already collected was at least a new form, if not a new species of *Livia*, it was considered to be highly desirous that other representatives of it should be obtained. Other methods previously known to produce psyllids under similar circumstances were therefore adopted. This resulted in the discovery of one further, somewhat fragmented, male in the debris taken from a spider's web. The web was located in the cleft of a small pine-tree growing within hundred yards of the site of the original discovery. No others were obtained either then or later."

"In general appearance these insects superficially resemble dark forms of *L. juncorum*, but closer examination revealed many points of difference between them and several characters in which they approximate species of the genus *Diraphia*."

"Thus, for example, the slight thickening of the juncture of  $R_1$  and the costa into an incipient pterostigma is decidedly of a Diraphiine character, whilst the basal segments of the antennae are more cylindrical than conical, and not quite so well developed as in *L. juncorum*."

"On the other hand, the general arrangement of the venation is of the genus *Livia*, and the head is strongly cleft and shaped as in the latter."

"The antennal ratio is 0·6. In other species of *Livia* it is from 0·5–0·6±0·025, whilst for species of *Diraphia* it is 1–1·3."

"*L. khaziensis* is not regarded as a transitional species between these two genera, but rather as an archaic type which probably approximates the ancestral form from which both *Livia* and *Diraphia* sprang. As it is obviously to be referred to the genus *Livia*, in it is seen evidence furthering the belief that the present-day species of *Livia* are older and nearer to the ancestral type than are the existing species of *Diraphia*."

"*L. khaziensis*, I believe, should prove to have a wide distribution on high ground throughout the Indo-Malayan Archipelago, and it may be only one of a series of new Liviine forms yet to be discovered in that region."

#### Sub-family APHALARINAE Loew 1878

- 1878, *Aphalarinae*, Loew, F. Verh. zool.-bot. Ges. Wien. 28: 605-606.
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- 1882, ———, Scott, J. Trans. ent. Soc. Lond. p. 450.
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- 1913, ———, Aulmann, G. *Psyllidarum Catalogus*, p. 61.
- 1914, ———, Crawford, D. L. *Pomona Coll. J. Ent.* 3(2): 480.
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- 1935, ——, Haupt, H. *Tierwelt Mitteleur.* **4:** X. 226.  
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 1963, ——, Klimaszewski, S. M. *Frag. Faun.* **10(18):** 257-258.  
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 1964, ——, Loginova, M. M. *Inst. Biol. Acad. Sci. U.S.S.R.* pp. 442-44.  
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Loew in 1878 made the genus *Aphalara* erected by Foerster in 1848, the typical genus of this sub-family.

Body small. Head flat, scarcely deflexed. Vertex rather broader than long, more or less quadrate, slightly excavated on either side of median suture. Front of head either swollen or produced into two rounded lobes, roughly rugged. Genae only slightly swollen, never conical, projecting forward into two rounded lobes under the antennal sockets. Frons elongated, pyriform, with the anterior ocellus located dorsally. Antennae inserted under the vertex, short and stout. Eyes prominent, more or less hemispherical, projecting from the sides of the head. Thorax more or less flattened, or only very slightly arched. Pronotum ribbon-like, extending downwards laterally and terminating in knob-like swellings. Forewings usually obovate, hyaline, often maculated or spotted with dark maculae; cubital petiole ( $M+Cu$ ) as long as or shorter than cubitus; radius as long as or longer than cubital petiole. Male anal valve with a long posterior horizontal lobe, extending back to forceps.

The members of this sub-family are recognised by the flattened, scarcely deflexed head, vertex broader than long or somewhat quadrate, eyes more or less hemispherical, genae only slightly swollen, forewings usually elongate-ovate, hyaline, often maculated, rounded at apex, and male anal valve with a long, posterior horizontal lobe (*Trioza maliotica* Crawf., also possesses such posterior lobes).

In this sub-family, two genera, viz. *Aphalara* Foerster and *Colposcenia* Enderlein, are represented in India. The former is restricted to *Polygonum* (*Polygonaceae*) and the latter on *Tamarix* (*Tamaricinaeae*) hosts. Considerable variation in certain characters, e.g. size and colour of body, shape of forewing, presence, absence or degree of maculation and colouration and size of genital appendages in both sexes is said to be present in the species of *Aphalara* (Crawford, 1914a).

## KEY TO THE GENERA OF APHALARINAE

1. Forewing with a prominent nodus on costal margin; rudiment of subcosta visible  
in anterior basal cell . . . . . *Colposcenia*  
--. Forewing without nodus on costal margin; rudiment of subcosta not visible . . . . . *Aphalara*

Genus **APHALARA** Foerster 1848*Chermes*

Linnaeus, C. 1761. *Fauna Suecica*, 2nd ed., p. 263.

*Aphalara*

Foerster, A. 1848. *Verh. naturw. ver. preuss, Rheinl.* 3: 67.

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Loginova, M. M. 1963. *Entomological Rev. U.S.S.R.* 42: 621-22.

Dobreamu, E. and Manolache, C. 1962. *Fauna Repub. Pop. rom., Insect, Homoptera, Psylloidea*, Vol. 8, Fasc. 3, p. 85.

Ossiannilsson, F. 1963. *Entomologist* 96 (1206): 250-251.

Klimaszewski, S. M. 1963. *Fragmenta Faunistica* 10(18): 261-262.

Type species: *Aphalara calthae* (Linnaeus) == *Chermes calthae* Linn. (original designation).

The distinctive characters outlined by Crawford (1914) and others are expanded with notes as given below.

Body small and slender. Head usually scarcely deflexed; vertex flat, more than half as long as broad, disc somewhat rectangular or quadrate, but rounded in front, making an emargination at point of excision. Frons not covered by genae, but narrow and elongate as in *Iavia*, with front ocellus at its anterior end, anterior ocellus visible from above. Genae not swollen into cones, but often roundly swollen on each side of frons and projecting forwards into two lobes under the antennal insertions. Clypeus pyriform, rather large. Eyes hemispherical. Antennae short, stout, never more than twice as long as, often not longer than, width of head, ten or nine segmented (usually the former), strongly imbricate, with deep transverse irregular serrations. Notum not strongly arched, often almost flat. Pronotum rather long, ribbon-like, with two foveal impressions on each side, and a knob-like lateral termination. Pleurites very short, quadrate, pleural suture straight, extending to middle of lateral termination of pronotum. Prescutum rather short; scutum large. Hind tibiae without spur at base, with six to nine black spines at apex; basal tarsus of hind legs with two black, claw-like spines at end, as in *Psylla* and many other genera. Wings elongate-ovate, never acute at apex, often more

or less thickened and subopaque or hyaline, often maculated or spotted; cubital petiole nearly always as long as radius; pterostigma always wanting. Venation typical Aphaclarine. Male anal valve always with a long, horizontal, posterior lobe, extending back to forceps; forceps club-like, dilated somewhat at tips, each bearing a single well-developed, sub-apical, thumb-like projection on the anterior side, inclined inwards. Absence of the apron-like posterior expansion of the circum-anal pore ring of the dorsal valve of female genitalia is characteristic in the Indian species, unlike those of the North American and European species.

Foerster erected this genus in 1848, and named in it several species but indicated no type species. It was redefined in 1878 by Loew, who then made it the typical genus of his sub-family *Aphalarinae*. This genus is included in the *Liviinae* by Crawford. By some authors it is placed in a separate sub-family *Aphalarinae*.

Two species are represented in this genus from India, and both are recorded on species of *Polygonum*.

#### KEY TO THE SPECIES OF APHALARA

- 1. Forewings elongate-ovate, maculated apically, with darker spots . . . . . 1. *maculipennis*  
Loew
- . Forewings ovate, maculated with bands apically and basally, with darker spots scattered all over the membrane. . . . . 1. *ossianilssonii*,  
sp. n.

#### ***Aphalara maculipennis* Loew 1886**

(Figs. 1,2)

Loew, F. 1886. *Verh. zool-bot. Ges. Wien.* 36:150, pl. IV., Fig. 1.

Aulmann, G. 1913. *Psyllidarum Catalogus*, Berlin, p. 63.

Heslop-Harrison, G. 1946. *Entomologist's mon. Mag.* 82:36.

Heslop-Harrison, G. 1949. *Ann. Mag. nat. Hist.* (12) 2: 798-800.

Length of body, in male, 1.45 mm; in female, 1.7 mm

Length of forewings, in male, 1.95 mm; in female, 2.21 mm

Width of head with eyes, 0.51 mm

Width of vertex between eyes, 0.32 mm

Length of antennae, 0.62 mm

**Colouration.** General colour light brown to chocolate brown with reddish tinge; vertex lighter, greyish on either side of median line and bordered with light orange; post-ocellar region also greyish; antennae yellowish-brown, black at tip; eyes greyish; prothorax with two submedian, greyish pads, lateral margins also greyish, prescutum with a greyish median line, scutum with four dark-brown longitudinal bands, with greyish lines in between, pleural region dark-brown; legs yellowish-brown; abdomen dark-brown dorsad, variegated with greyish tinge ventrad; wings slightly fumate, with light maculation in the apical region, veins dark and prominent.

**Structure.** Body long and slender. Head (Fig. 1a) not quite as broad as thorax, scarcely deflexed, finely and sparsely pubescent, strongly rugulose; vertex large, about

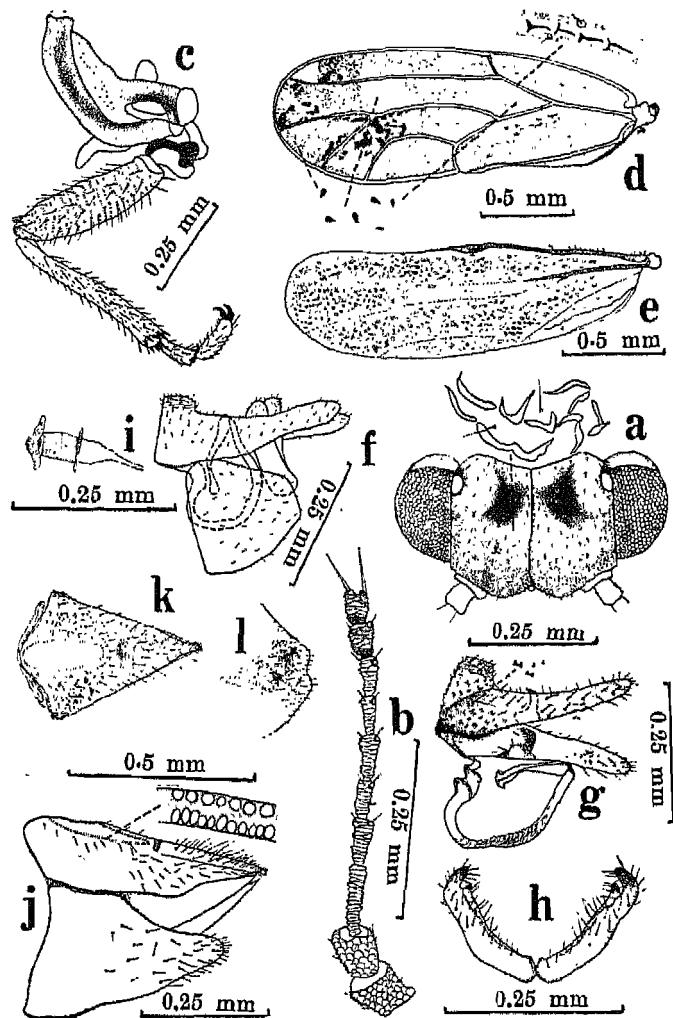


Fig. 1. *Aphałara maculipennis* Loew—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: male genitalia, lateral view; **g**: anal valve and aedeagus; **h**: parameres, caudal view; **i**: sperm pump; **j**: female genitalia; **k**: dorsal plate; **l**: apex of ventral plate.

one and a half times as broad as long, slightly depressed discally on either side of median line, bearing two foveal impressions, posterior to centre, post-ocellar region swollen, posterior margin strongly emarginate, disc rounded and gradually sloping downward in front, rather deeply emarginate in front at median line, anterior ocellus visible from above; frons not covered by genae, bearing front ocellus; genae small, swollen on each side of frons. Clypeus much elongated, somewhat pyriform, rounded at apex. Eyes large and prominent. Antennal sockets lateral.

Antennae (**Fig. 1b**) small, thick, ten-segmented, finely and sparsely pubescent, two basal segments robust, first segment subquadrate, second narrower and as long as first, slightly longer than broad, remaining segments imbricate, third segment longest, fourth and sixth equal and each smaller than third, fifth, seventh to tenth segments equal to one another and smaller than fourth, terminal segment with two long apical spines, six sensoria present on segments 4 to 9.

Thorax long, scarcely arched, finely and sparsely pubescent, rugulose. Prothorax large, somewhat roof-shaped, narrower in middle and broader laterally, with two dark, deep foveal impressions on each side and a knob-like lateral termination, disc swollen in middle, posterior margin strongly arcuate; pleurites very short, somewhat quadrate, pleural suture straight extending to middle of lateral termination of pronotum; prescutum small, about twice as broad as long, broadest beyond middle, gradually narrowed anteriorly, angulate laterally, posterior margin also angulate submedianally; scutum large, about half as long as broad, broadest in middle, disc flat dorso-medianally and gradually sloping laterally; scutellum broadly transverse, slightly broader than long, broad anteriorly and narrow posteriorly, posterior margin slightly invaginated medianally.

Legs (**Fig. 1c**) moderately large, sparsely pubescent and also beset with minute points arranged in rows, femora smaller than tibiae, hind femur armed dorsally with two pairs of thick apical setae, hind tibiae without basal spurs and with 8 to 9 stout, black tooth-like spines at apex, hind basal tarsus with two black, claw-like spines at apex, apical tarsal segments of legs longer than basal segments; meracanthus long and slender.

Forewings (**Fig. 1d**) narrow, elongate-ovate, subopaque, without pterostigma, rounded at apex, slightly less than three times as long as broad, cubital petiole (M-J-Cu) nearly as long as radius (R), basal vein longer than radius, veins more or less running parallel; first marginal cell as long as second, but broader than the latter, maculated apically, leaving clear spaces haphazardly, darker spots present in maculae, membrane beset with thick minute points.

Hind wings (**Fig. 1e**) slightly smaller than forewings, costal margin armed with few simple and hooked setae, membrane beset with minute points.

Abdomen long and slender, finely and sparsely pubescent, and also beset with minute points.

*Genitalia.* Male genital segment (**Fig. 1f**) smaller than abdomen. Anal valve (**Fig. 1g**) small, about 0.13 mm long, sparsely pubescent, also armed with minute points which are thicker in the basal region of valve, with two long, horizontal posterior lobes converging to apex and extending back to forceps, the inferior process of the posterior lobe small, bearing few setae; forceps (**Fig. 1h**) rather short, but longer than anal valve, about 0.19 mm long, bowed when seen caudad, bilobate, slightly enlarged at apex, anterior lobe large and prominent, but smaller than the posterior lobe, both lobes acutely pointed, inner marginal setae long, outer surface bearing small simple setae; basal arm of aedeagus long, with a curved loop, outer arm small, with a small spoon end having hooked point (**Fig. 1g**); hypandrium simple, of usual shape, having sparse pubescence and minute points; sperm pump as figured (**Fig. 1i**).

Female genital segment (**Fig. 1j**) small, sparsely pubescent, with long hairs; dorsal plate (**Fig. 1k**) longer than ventral, roundly pointed at apex; anal-pore ring situated in a clear zone and composed of a double row of pores, patch of pores at the posterior end of the ring absent; ventral plate (**Fig. 1l**) roundly pointed at apex, with a median invagination; setae small and thick at the apices of both plates; ovipositor acutely pointed.

*Host plant.* Several adults and nymphs collected on *Polygonum hydropiper*.

*Distribution.* In India, this species has been recorded from Dehra Dun (610 m), U.P., and consists of a large series of examples present at the Forest Research Institute, Dehra Dun, as follows: 4 examples of 20th, 30 ex. of 24th, 19 ex. of 25th, 6 ex. of 28th, 4 ex. of 30th January 1950, 9 ex. of 1st, 1 ex. of 3rd and 6 ex. of 6th February 1950 (S.E.No. 6865); several adults, nymphs and parasites collected on 28th January 1950, preserved in alcohol; and 3 ex. of 14th, 2 ex. of 16th December, 1933, 23 ex. of 2nd and 10 ex. of 6th January 1934, from Dehra Dun, U.P. (A.K. Sharma) (S.E.No. 1632). Also from Naini Tal (U.P.) (Heslop-Harrison 1946).

Originally recorded from Austria as a variety of *Aphalara calthae* L. (Loew 1886).

*Comparison.* From the material in hand, it is found that this species was incorrectly determined as *Aphalara calthae* by Heslop-Harrison (1946). It differs in several characteristic features from *calthae* and at the suggestion of Dr Russell, two examples were sent to Dr Ossiannilsson, Sweden, who writes (*in litt.*): "These are not *calthae* nor *polygoni*. I think they are *Aphalara maculipennis* (Loew), or something very closely related to that species. The pigmentation of the forewings is much paler in your specimens than in European material but I suppose that this is due to fading. If this is not the case and if the paler pigmentation is constant in your form, perhaps it is a distinct subspecies of *maculipennis*"; Hence, I am retaining this material under *maculipennis*. *A. maculipennis* differs from *ossianilssoni*, sp.n. in the shape and maculation of forewings, shape of head and genitalia.

*Biological notes.* This species is commonly found on *Polygonum hydropiper*, growing abundantly in the hilly river beds. Its nymphs feed gregariously near the apex of plants and are described below.

#### Nymphal stage

*Fifth stage.* (**Fig. 2a**) Length 1.85 mm of typical psylline form; elongate, the wing-pads projecting from the side of the body and slightly produced cephalad; eyes rather prominent and slightly extending beyond the contour of the head. All setae on the dorsal side, in front of head margin, along the margin of wing-pads and abdomen, stout, somewhat lanceolate and of various lengths. Dorsum with the derm for the most part heavily sclerotic, the sclerotic plates arranged as follows: a pair of large head plates, a pair of large plates in each thoracic segment, and four pairs of narrow transverse plates in the first four abdominal segments; these plates are mesally separated; the posterior half of abdomen consisting of a single continuous plate, with some traces of segmentation, the lateral margins of which extend slightly to the ventral side. Wing pads sclerotic throughout. Derm somewhat vermiculate and also bearing numerous sclerotic ridges, sparsely beset with simple setae.

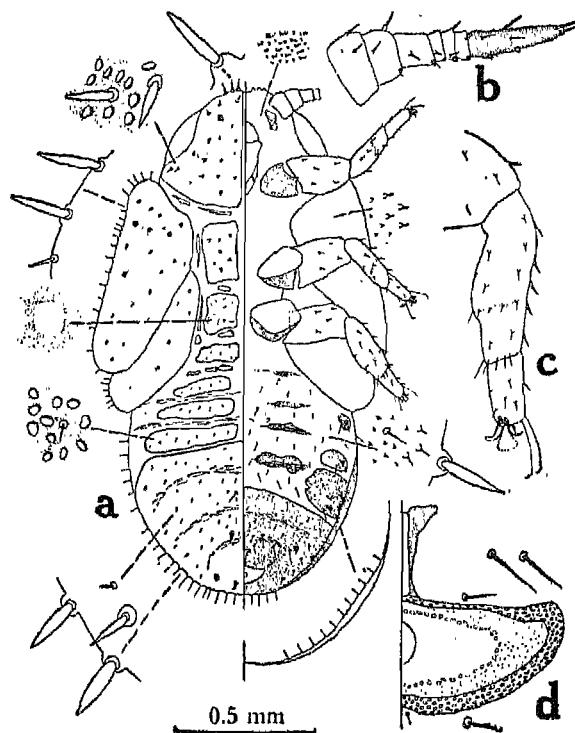


Fig. 2. *Aphalara maculipennis* Loew—**a**: fifth stage nymph; **b**: antenna; **c**: hind leg; **d**: circum-anal pore ring.

Ventral side largely membranous, with a small plate at the base of each antenna, a small plate about each spiracle and two distinct transverse abdominal plates and a large caudal plate. Derm thickly beset with minute points which are heavier in the abdominal region, also with simple and lanceolate scattered setae. Antennae (**Fig. 2b**) situated ventrally, about 0·38 mm in length, seven-segmented, each segment with a few simple and one or more slender lanceolate setae, first two segments stout and transverse, third segment subsquare, slightly longer than broad, 4th, 5th and 6th equal, narrowly transverse, 7th longest, slightly shorter than the first six segments together, bearing two terminal setae, 4 sensoria on 3, 5 and 7 segments. Legs (**Fig. 2c**) small and stout, armed with simple and lanceolate setae, without trochanter, with distinct tibio-tarsal joint; each tarsus with two golf-club setae; pulvillus a small circular pad; claws present. Anal opening ventral, situated slightly away from the caudal margin, the outer ring of circum-anal pores (**Fig. 2d**) consisting of two or three rows of pores, the inner ring of pores irregular and weakly defined, and guarded by three anterior and one posterior pairs of setae.

*Aphalara ossianalissoni*, sp. n.

(Figs. 3, 4)

Length of body, in male, 1.56 mm; in female, 1.88 mm

Length of forewings, in male, 2.00 mm; in female, 2.35 mm

Width of head with eyes, 0.56 mm

Width of vertex between eyes, 0.38 mm

Length of antennae, 0.8 mm

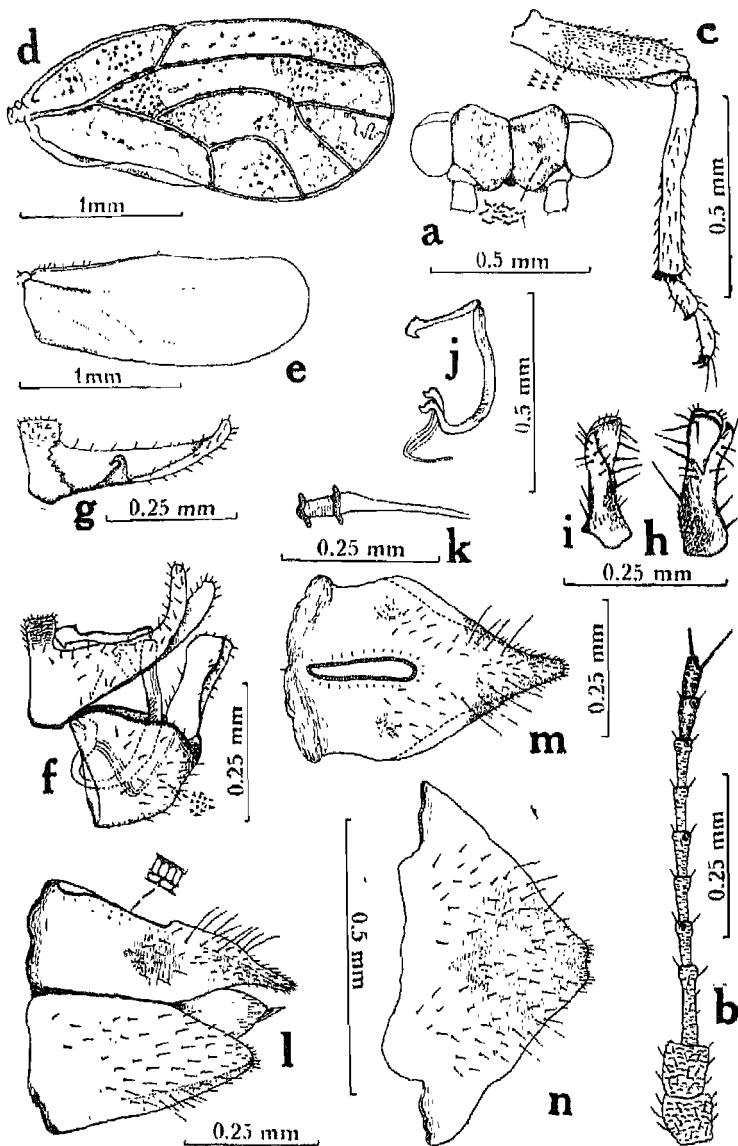
*Colouration.* General colour dark-brown, prothorax fuscous with posterior border paler, legs and antennae pale-brown, except two basal and two apical segments black, abdomen chocolate brown to fuscous, forewings with light brown bands or patches, intermixed with large hyaline areas, basal and subapical bands prominent, small dark-brown spots also present, scattered all over.

*Structure.* Body small and slender. Head (**Fig. 3a**) slightly broader than thorax, scarcely deflexed, finely and sparsely pubescent, finely rugulose. Vertex rather flat, broad, about twice as broad as long, roundly bent downward in front; lobes somewhat trapezoid in shape, with two large, linear foveae, posterior to centre, one on either side of median line; a broad, linear depression from each fovea extending forward and reaching up to antennal socket; posterior margin moderately emarginate, post-ocellar region swollen and ocelli more lateral, anterior margin strongly invaginated; front ocellus visible from above and located at the point of excision; frons not covered by genae but narrow and elongate, with anterior ocellus at top; genae not swollen and visible from the ventral side on each side of frons. Clypeus large, tongue-like. Eyes large, somewhat recessive.

Antennae (**Fig. 3b**) small, slender, ten-segmented, bearing a few setae, imbricate, two basal segments robust, 1st subquadrate, 2nd slightly longer than 1st, rather cylindrical, 3rd segment longest, about one and two-thirds longer than 4th; 4th, 5th, 6th and 8th nearly equal to one another, and each smaller than 3rd, 7th slightly smaller than 4th, 9th and 10th equal and each slightly smaller than 7th, terminal segment having two unequal spines at apex, four sensoria present on segments 4, 6, 8 and 9.

Thorax moderately arched, finely pubescent, prominently rugulose. Prothorax collar-like, convexly rounded, descending, of equal length throughout, with two foveal impressions on each side; prescutum small, broader than long, broadest beyond middle, about two and a half times as broad as long, broadly rounded and narrowed both anteriorly and posteriorly, gradually sloping anteriorly, angulate laterally, posterior margin also angulate; scutum large, broader than long, broadest before middle, about twice as broad as long, longer than prescutum, angulate laterally; scutellum broadly transverse, slightly broad posteriorly, anterior and posterior margins somewhat straight and parallel, about one and a half times as broad as long, with weak antero-lateral angles.

Legs (**Fig. 3c**) small, slender, pubescent and also thickly armed with minute points arranged in lines, these points strong and thick on femora, tibiae longer than femora, each bearing apical comb of setae, hind tibiae without basal spur, with six black, tooth-like spines on one side and four on the other, basal tarsal segments slightly smaller than



**Fig. 3.** *Aphaelara ossianilssonii*, sp. n.—**a:** head, front view; **b:** antenna; **c:** hind leg; **d:** forewing; **e:** hind wing; **f:** male genitalia, lateral view; **g:** anal valve, partly mesal view; **h, i:** forceps, mesal and anterior views; **j:** aedeagus; **k:** sperm pump; **l:** female genitalia, lateral view; **m:** dorsal plate; **n:** ventral plate.

apical, hind proximal tarsus with two black claw-like spines at apex, meracanthus small somewhat tubular, roundly pointed at apex.

Forewings (**Fig. 3d**) small, ovate, rather thickened, subopaque, with scattered hyaline areas, basal area with a broad light pale-brown patch, similar irregular patches also present in the apical area, and an irregular band in the subapical area, membrane beset with minute points and also with scattered dark-brown spots, without pterostigma, apex round, radial sector quite long and slightly flexed apically, radius as long as cubital petiole, cubitus as long as cubital petiole,  $R_1$  smaller than radius, basal vein slightly longer than radius, marginal cells unequal, first slightly longer and broader than second, veins armed with microscopic setae.

Hind wings (**Fig. 3e**) slightly smaller than forewings, membrane uniformly beset with minute points, costal vein armed with few simple and hooked setae.

Abdomen longer than broad, sparsely pubescent and also beset with minute points; pubescence longer on sternites.

*Genitalia.* Male genital segment (**Fig. 3f**) smaller than abdomen; proctiger (anal valve) (**Fig. 3g**) almost as long as parameres, with long, caudal projections from the perpendicular axis, converging to apex and extending back to forceps, apical ends cocked up, anal region small, tubular, with truncate apex, the ventral margin of each posterior lobe produced into a large, upright, hook-like projection mesally (**Fig. 3g**), outer surface armed with strong, thick points and sparsely with large setae; parameres (**Figs. 3h,i**) small, about 0.22 mm long, with sides sub-parallel, broad both basally and apically, both cephalic and caudal margins concave, caudal margin longer than cephalic, anterior mesal process prominently separated from apex of forceps in lateral aspect, apex rather straight, truncate, sinuate mesally, with three strong setae directed downward, caudal margin armed with long setae, basal region beset with strong ridges and scirations; hypandrium simple, of usual shape, dorsal margins thickened, sparsely pubescent, also beset with thick points; outer arm of aedeagus smaller than basal, the latter strongly looped, spoon-end slightly hooked (**Fig. 3j**); sperm pump as figured (**Fig. 3k**).

Female genitalia (**Fig. 3l**) smaller than abdomen; dorsal plate (**Fig. 3m**) longer than ventral, sparsely pubescent, broad basally, gradually narrowed caudally, apex narrowly and roundly pointed, apical region bearing small setae; 4 or 5 pairs of long setae present in middle, circum-anal ring occupying almost the basal half, and composed of a double ring of pores; ventral plate (**Fig. 3n**) broad basally and narrowed apically, sparsely pubescent, apex broadly and roundly pointed, and when viewed ventrally, weakly invaginated at apex, apical end armed with a brush of small setae; ovipositor acutely pointed.

*Host plant.* On *Polygonum microcephalum* Don.

*Type locality.* Kalimpong (1220 m), W. Bengal.

*Types.* Holotype male; Allotype female; Paratypes: 3 males and 3 females, all from the type locality, and collected on August 29th, 1967 (V. R. Phalak). The parcel containing the specimens was found attacked by red ants and the adults and nymphal stages were very badly damaged. The remnants were preserved in alcohol. All types, preserved specimens and some slides were deposited at F.R.I., Dehra Dun,

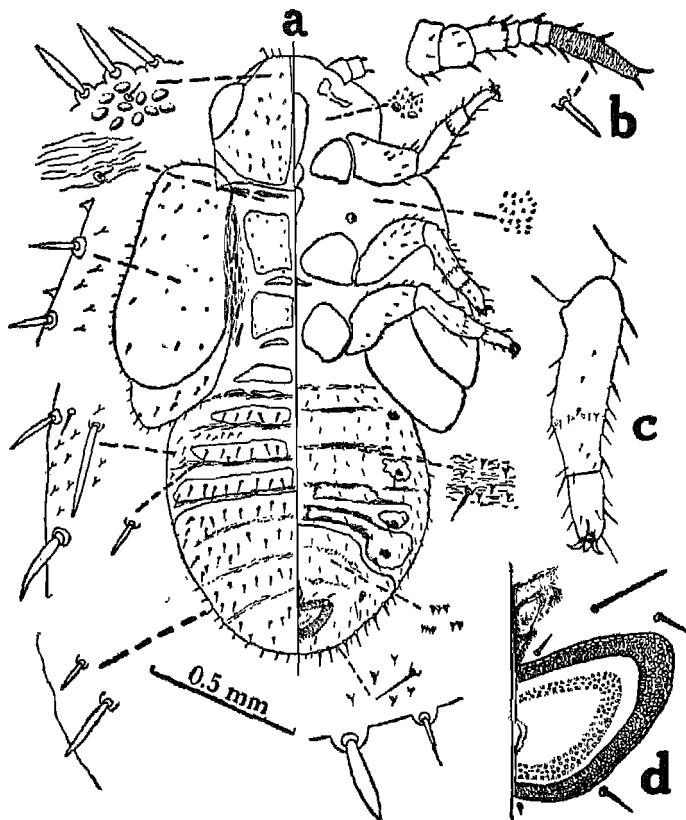


Fig. 4. *Aphalara ossianilssonii*, sp. n.—**a**: fifth stage nymph; **b**: antenna; **c**: hind leg; **d**: circum-anal ring.

*Comparison.* This species differs from *Aphalara maculipennis* Loew in wing pattern, shape of head and wing, genital and some other characters.

*Biological notes.* This species has been recorded on *Polygonum microcephalum*, and nothing is known about its bionomics, etc. Its nymphal stages are described below.

#### Nymphal stages

*Fifth stage.* (Fig. 4) Length 1.76 mm on slide. (Fig. 4a) Psylline form, with elongate body, the wing-pads projecting from the side of the body. Eyes rather prominent and extending beyond the side of the body. Dorsum with the derm for the most part strongly sclerotic. Wing-pads sclerotic throughout. Dorsal plates arranged as follows: head with a pair of large plates, each segment of the thorax with a pair of large and several smaller plates, the plates of both head and thorax separated mesally; the anterior half of the abdomen consisting of four pairs of narrow plates, separated mesally, representing the first four abdominal segments, while the posterior half occupied by a single continuous plate, the lateral margins of which extend to the ventral side, the single caudal

plate apparently consisting of four segments. All plates covered with minute points or small broadly rounded knobs, these fine points becoming stronger along the peripheral regions. Derm vermiculate, sparsely bearing scattered microscopic setae and also with slender lanceolate setae. Margin of wing-pads armed with lanceolate setae. Such setae variable in length.

Antennae (**Fig. 4b**) borne on the margin of the head, about 0·41 mm long, seven-segmented, segments 4, 5 and 6 smallest and together about as long as 3rd segment, 7th segment longest and about as long as the first three segments, each segment beset with one or more slender lanceolate setae; four conspicuous sensoria present on segments 3, 5 and 7.

Ventral side largely membranous, with a small plate at the base of each antenna, abdomen with an irregular plate surrounding the anus, two distinct abdominal plates and a small area around each spiracle, which are weakly sclerotic. Derm entirely beset with fine points, which become small, broadly rounded knobs in the anterior region. Legs (**Fig. 4c**) small, without trochanter, femora not reaching the margin of the body; tibio-tarsal joint distinct; claws present, pulvilli like a small circular pad; setae strong and thick, borne on small tubercles. Anal opening set a short distance away from the apex of the abdomen, surrounded by an outer, greatly enlarged ring composed of a large number of minute pores (**Fig. 4d**). Enclosed within this band is a secondary ring consisting of much more minute and much less defined pores. Both the rings are interrupted medianally and are guarded by three anterior and two posterior pairs of setae.

*Fourth stage.* Length 1·25 mm. What appears to be the fourth stage differs from the fifth chiefly in the smaller size, with antennae apparently five segmented, bearing three sensoria, and without tibio-tarsal articulation.

#### Genus COLPOSCENIA Enderlein 1929

##### *Colposcenia*

- Enderlein, G. 1929. *Wien. ent. Ztg.* 46: 106-109.  
 Loginova, M. M. 1960. *Horae Soc. Ent. Unionis Sovieticae* 47: 63-65.  
 Loginova, M. M. 1966. *Proc. Inst. Zool. Acad. Sci. U.S.S.R.* 37: 18-19.  
 Loginova, M. M. 1967. *Ann. Naturhist. Mus. Wien.* 70: 404.

Type species: *Colposcenia aliena* (Loew) (= *Aphalara aliena* Loew, 1881) (original designation).

Body small and slender. Head slightly broader than thorax, moderately deflexed. Vertex broader than long, somewhat flat, produced anteriorly into two separate, broadly rounded lobes and projecting beyond median suture; genae absent or very small, swollen beneath. Anterior ocellus scarcely visible from above. Frons visible in front as a clear sclerite. Clypeus triangular and visible from beneath. Antennae small and slender. Thorax smaller than width of head, scarcely arched. Pronotum weakly roof-shaped and convexly rounded, posterior margin overlapping the anterior border of prescutum. Pleurites small, pleural suture straight, extending to middle of lateral termination of prothorax; episternum shorter than epimeron. Legs small and slender; hind tibia without basal spur, with 5 or 6 black spines at apex; hind basal tarsal segment with two

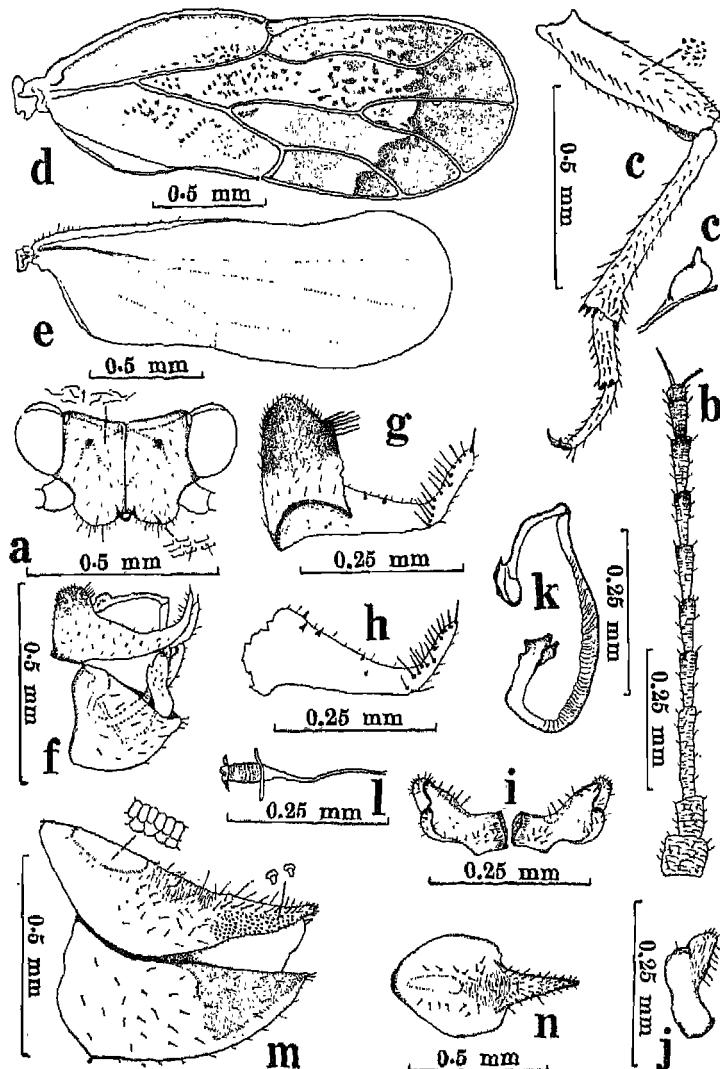


Fig. 5. *Colposcenia constricta*, sp. n.—**a**: head, front view; **b**: antenna; **c**: hind leg and meracanthus (highly magnified); **d**: forewing; **e**: hind wing; **f**: male genitalia; **g, h**: anal valve, lateral and mesal views; **i**: forceps, mesal view; **j**: forcep, lateral view; **k**: aedeagus; **l**: sperm pump; **m**: female genitalia, lateral view; **n**: dorsal plate.

claw-like spines at apex; meracanthus of characteristic shape. Forewings elongate-ovate, with narrowly rounded apex; anterior margin interrupted or notched before pterostigma; pterostigma small, cell-like; rudiment of subcosta visible as a pale line or fold in the anterior basal cell; radius generally longer or as long as basal vein; radial

sector undulating and flexed upward meeting the anterior margin; cubital petiole generally longer than cubitus;  $Cu_2$  recurrent, terminating near nodulus; posterior margin also notched near apex of anal vein, both notches of the anterior and posterior margins in same transverse line. Hind wings with prominent veins. Posterior arms of proctiger of male genitalia horizontal like that of *Aphalara*, setae on these arms variable. Valves of female genitalia gradually narrowed caudally, uniformly beset with small, simple setae.

**Colposcenia constricta, sp. n.**

(Figs. 5, 6)

Length of body, in male, 1.73 mm; in female, 1.92 mm

Length of forewings, in male, 1.85 mm; in female, 2.12 mm

Width of head with eyes, 0.62 mm

Width of vertex between eyes, 0.38 mm

Length of antennae, 0.92 mm

**Colouration.** General colour pea green or chrome lemon with bluish-green tinge and pale-brown longitudinal stripes on mesothorax; antennae pale-yellow with apices of all segments and two terminal segments black, first three segments darker ventrally; legs pale-yellow, darker ventrally; apical tarsal segments darker; anal valve and forceps of male genitalia black apically; caudal region of plates of female genitalia dark-brown; forewings maculated with a light to dark-brown irregular apical band, also dotted with scattered darker spots, a lighter macula also present before middle in the apical half.

**Structure.** Body small and slender. Head (Fig. 5a) slightly broader than thorax, moderately deflexed, finely and sparsely pubescent, finely rugulose; vertex broader than long, about one and a half times as broad as long, disc flat, weakly swollen on either side of median suture, with two foveal impressions, posterior to centre, each in middle of each half, produced anteriorly into two separate, rounded lobes, posterior margin slightly emarginate, posterior ocelli lateral, anterior ocellus scarcely visible from above, located at the excision of median suture; genae small, roundly swollen on each side of frons; sparsely pubescent and beset with a few long setae; frons long and narrow, not covered by genae. Antennal sockets lateral and located below the lower margin of eyes. Eyes large. Clypeus triangular, visible from beneath.

Antennae (Fig. 5b) small, ten-segmented, sparsely pubescent, two basal segments robust, 1st broadly transverse, 2nd cylindrical, almost as long as 1st, remaining segments imbricate, 3rd segment longest, segments 4 to 8 rather equal to one another in length, each slightly more than half as long as 3rd, narrower basally and broader apically, 9th slightly smaller than 8th and as long as 2nd, terminal segment smallest, bearing two unequal apical spines, apparently six sensoria present on segments 4 to 9.

Thorax slightly smaller than width of head, including eyes, finely and sparsely pubescent, finely rugulose, scarcely arched. Prothorax weakly and convexly rounded, flat, longer in middle, thinner laterally, with two foveal impressions on each side and a knob-like lateral termination; prescutum small, much broader than long, about three times

as broad as long, broadest before middle, bluntly angled laterally, anterior margin weakly convex and partly covered by the posterior margin of prothorax; scutum slightly arched, longer than prescutum, about two and a half times as broad as long, broadest before middle, anterior margin moderately concave, angled laterally, posterior margin angulate submedianally; scutellum small, transverse, about two and a half times as broad as long, somewhat seven-sided, posterior margin weakly invaginated; pleurites very short, pleural suture straight, extending to middle of lateral termination of pronotum; episternum shorter than epimeron.

Legs (**Fig. 5c**) small and slender, sparsely pubescent, femora beset with rows of minute points, tibiae longer than femora, each tibia armed with a comb of setae at apex, hind femur also armed with a row of stout setae towards the outside, hind tibiae without basal spur, with five black tooth-like spines (3: 1: 1), middle and hind tibiae also armed with thick setae near apex, apical tarsal segments thinner and longer than basal segments, basal tarsal segment of hind leg with two black claw-like spines at apex, meracanthus small and of characteristic shape, claws quite long.

Forewings (**Fig. 5d**) small, elongate-ovate, about two and a half times as long as broad, apex narrowly rounded, both anterior and posterior margins notched before middle and in same transverse line; pterostigma very small, cell-like; radius longer than basal vein, basal vein almost as long as cubital petiole, rudiment of subcosta visible as a pale line or fold in basal cell, cubitus smaller than cubital petiole, radius and media equal in length,  $R_s$  with loops and flexed upward meeting the anterior margin,  $Cu_2$  recurrent, terminating near nodulus; marginal cells unequal, first cell smaller than second in length; veins armed with microscopic setae.

Hind wings (**Fig. 5e**) slightly smaller than forewings, veins prominent, membrane beset with minute points, costal margin armed with a few simple and hooked setae.

Abdomen longer than broad, finely and sparsely pubescent and beset with minute points, setae longer on sternites.

*Genitalia.* Male genital segment (**Fig. 5f**) smaller than abdomen, sparsely pubescent. Anal valve (**Figs. 5g,h**) small, about 0.15 mm long, with long, horizontal posterior lobes, converging to apex and extending back to forceps, the posterior one-third of each lobe cocked upward, outer surface of each lobe beset sparsely with small simple setae, the inner dorsal surface armed with 2 or 3 thick, stout, black spines near base and similarly 2 spines in middle, the upturned inner margin bearing a row of long setae, anal region small, tubular, beset sparsely with minute setae, the posterior margin beset with a group of black, long spines directed caudally; parameres (**Figs. 5i,j**) very small, about 0.12 mm long, narrow both basally and apically and thick in middle, both forceps curved inside, meeting at apices, each forcep divided into two lobes, the anterior lobe very small, black and rounded at apex, the posterior lobe large, sinuate mesally, broadly rounded and black at apex, outer surface bearing small, simple setae, basal mesal surface beset with small setae, outer marginal setae slightly longer; outer arm of aedeagus small, with a thick spoon end, basal arm long, curved and black (**Fig. 5k**); hypandrium simple, of usual shape, sparsely beset with small setae, basal region black, apex armed with a few thick setae; sperm pump small, as figured (**Fig. 5l**).

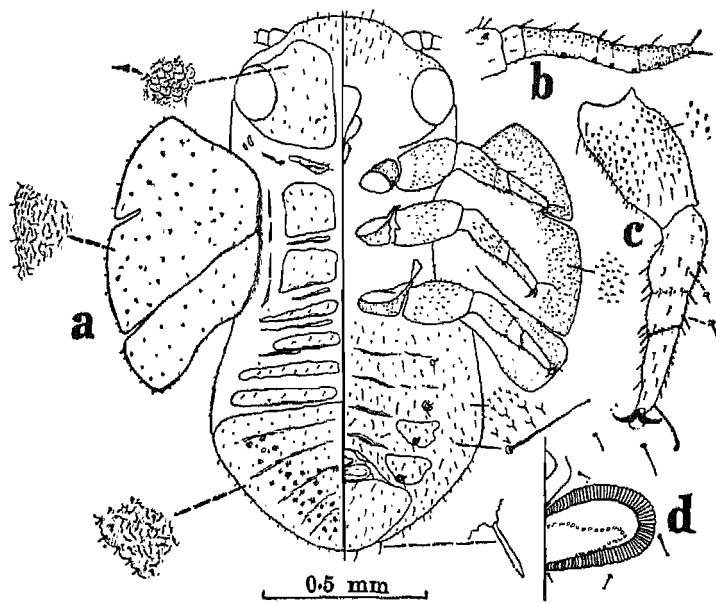


Fig. 6. *Colposcenia constricta*, sp. n.—a: fifth stage nymph; b: antenna; c: hind leg; d: circum-anal pore ring.

Female genital segment longer than abdomen, and flexed downward, sparsely pubescent (**Fig. 5m**). Dorsal plate (**Fig. 5n**) longer than ventral, both plates broad basally and gradually narrowed caudally, apex of dorsal plate rounded and flexed upward, posterior one-third armed with a band of thick and heavy setae, setae in the apical dorsal region longer, circum-anal pore ring somewhat oval, composed of a double ring of pores and guarded by small setae; ventral plate acutely pointed at apex; ovipositor acutely pointed.

*Host plant.* On *Tamarix* sp.

*Type locality.* New Delhi.

*Types.* Described from a small series of specimens. Holotype male; Allotype female, both from the type locality, collected on February 21, 1968 (M.G.R. Menon). Paratypes: 2 males and 2 females, from New Delhi and collected on February 21, 1968 (M.G.R. Menon); and 10 males and 12 females, from New Delhi and collected on September 21, 1968 (S.I. Farooqi). Few adults collected on February 21, 1968 (M.G.R. Menon), and some adults with nymphs (mostly parasitised), collected on September 21, 1968 (S.I. Farooqi) were also preserved in alcohol. All types deposited at F.R.I., Dehra Dun, except 4 males and 8 females paratypes, with a few specimens preserved in alcohol, deposited at I.A.R.I., New Delhi.

*Biological notes.* This species was collected from a solitary plant growing in the campus of the Indian Agricultural Research Institute, New Delhi, on February 21, 1968, and the adults were present in fairly good numbers. Again, a small collection was made

on 12th and 13th March 1968, adults were present, but nymphal stages were not seen. This collection had some gravid females. The adults are quite active and fly about with the slight disturbance. Attempts were made to collect nymphs in September 1968, and some were collected feeding between the axils of buds and young twigs. Mummified and parasitised nymphal stages, with head facing down were present in plenty on twigs, majority of them were with large holes, indicating the emergence of parasites. Its nymphal stage is described below.

### Nymphal stage

*Fifth stage.* (**Fig. 6a**). Length on slide, 1.63 mm. Body broad; head nearly as broad as abdomen; the wing-pads projecting from the side of the body and also produce cephalad almost to the level of the lower margin of eyes. Dorsum with derm for the most part strongly sclerotic and the sclerotic areas represented by a pair of large head plates, each segment of the thorax with a pair of large and several smaller plates; abdomen with a pair of narrow plates on each of the first four segments and somewhat more than the caudal half of the abdomen covered by a single continuous plate, the lateral margins of which partly extend to the ventral side. Derm vermiculate, bearing a number of scattered, minute setae visible under high magnification. All sclerotic plates except the caudal plate, separated mesally. Wing-pads sclerotic throughout, the margin of the anterior pads with a characteristic, large, prominent cleft before middle. Marginal zone strongly rugulose, the marginal setae minute and microscopic.

Ventral side largely membranous, with an irregular caudal area, one pair of distinct submedian abdominal plate, and a small plate about each spiracle, the anterior abdominal segments represented by weak transverse strips. Derm thickly beset with fine points, which become stronger and heavier along the margins, and wing-pads. Few scattered simple setae present on abdominal segments. Caudal plate armed with a pair of lanceolate setae along the margin. Antennae (**Fig. 6b**) borne slightly on the ventral side of the head, apparently three-segmented, the first two basal segments transverse, the third segment longest bearing minute points, having weak segmentation and six sensoria, also armed with slender lanceolate setae and two thick apical setae. Legs (**Fig. 6c**) small, bearing a few setae, without trochanters, femora not reaching the margin of body, thickly armed with strong points, tibio-tarsal articulation distinct, tibiae armed with three or four lanceolate setae, with one golf-club seta at apex, claws present, pulvilli a small, subcircular pad. Anal opening set well away from the apex of the abdomen, surrounded by the outer ring of slit-like pores (**Fig. 6d**), the inner ring irregular and poorly defined, the rings guarded by two anterior and two posterior pairs of long setae.

### Sub-family PAUROPSYLLINAE Crawford 1914

- 1914, Pauropsyllinae, Crawford, D. L. *Bull. U.S. natn. Mus.* **85**: 18, 42.
- 1915, ———, Crawford, D. L. *Philipp. Sci.* **15**: 140-41.
- 1941, ———, Pflugfelder, O. *Psyllina*, Bronn's Klassen und Ordnungen des Tierreichs, vol. 5, Abt. 3 Insecta, Leipzig, p. 75.
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- 1959, ———, Heslop-Harrison, G. *Ann. Mag. nat. Hist.* (13), **2(15)**; 157-162,

- 1962, ——, Dobreanu, E and Manolache, C. *Furna Repub. pop. rom., Insecta*, **8**, fasc. 3, Homoptera, Psylloidea, pp. 70-71.  
 1963, ——, Klimaszewski, S. M. *Ann. Zool.* **20**(20): 363-370.  
 1964, ——, Klimaszewski, S. M. *ibid.* **22**(5): 81-138.  
 1964, ——, Loginova, M. M. *Proc. Inst. Zool. Acad. Sci. U.S.S.R.* **34**: 54.  
 1964, ——, Loginova, M. M. *Inst. Biol. Acad. Sci. U.S.S.R.*, p. 444.

Body robust. Head short, much deflexed, uniformly rounded forward and downward. Median suture present or absent. Frons usually visible, not concealed by the genae; bearing the anterior ocellus at upper end. Genae usually wanting or small, variously swollen. Eyes prominent. Antennae usually short, often with long setae at apex. Thorax strongly arched, broad. Legs slender and usually not large. Forewings large, hyaline sometimes maculated or spotted; ovate, usually broadly rounded at apex; venation various; pterostigma usually large and long, sometimes absent; first marginal cell often enlarged, or long and narrow.

The chief characters of this sub-family are the rounded head, with or without median suture; usually visible frons; genae absent or small and swollen; antennae sometimes with long terminal setae; thorax broad and strongly arched, and forewings large and ovate, usually broadly rounded at apex. Body generally robust.

Heslop-Harrison (1959) included this sub-family as a tribe under the *Ciriacreminae*. He placed *Phacopteron* Buckton, 1894, and *Pseudophacopteron* Enderlein, 1921, under the tribe *Phacopterini* (=*Phacosomini*), though the wing venation shows great similarity with that of *Pauropsylla tuberculata* Crawford (1912). However, he placed *Pauropsylla* along with *Apsylla* and *Microceropsylla* under another tribe, the *Paurosyllini*. Some members of *Pauropsylla* Rubsaamen do possess long terminal setae, quite different from *Liviinae*, which is a significant feature. The author feels it necessary to examine all *Paurosyllini* species of the Old World Tropics on the basis of modern requirements and then reconstitute the taxonomic characters of this sub-family. Till such time the independent rank of this sub-family may be maintained.

Four Indian genera, *Apsylla* Crawford, *Pauropsylla* Rubsaamen, *Paurocephala* Crawford, and *Phacopteron* Buckt. are here included under this sub-family. Many species are gall makers. The nymphal stages of some of the species show characteristic triozine features.

#### KEY TO THE GENERA OF PAUROSYLLINAE

1. Hind legs not larger than middle pair, apparently not saltatory; hind coxae small, and coxal spur nearly wanting; antennae with specialised type of thick joints ... *Apsylla*
- . Hind legs longer than middle pair, apparently saltatory; metacoxae much larger than mesocoxae and metacoxal spur well developed; antennae not as above ... 2
2. First marginal cell of forewing narrow and long, paralleling posterior margin; cubital petiole as long or nearly as long as radius ... *Paurocephala*
- . First marginal cell not narrow and long; cubital petiole usually shorter than radius or wanting ... *Pauropsylla*
- . First marginal cell small, much smaller than second; radial sector and media connected by a cross vein; body of insects large ... *Phacopteron*

Genus **APSYLLA** Crawford 1912*Apsylla*

Crawford, D.L., 1912. *Rec. Indian Mus.*, 7: 421.

Type species: *Apsylla cistellata* (Buckton) (= *Psylla cistellata* Buckton, 1883) (original designation).

The distinctive characters outlined by Crawford (1912) are expanded with the following notes.

Body robust, strongly arched, surface shagreened. Head small, short, much narrower than thorax, more or less retracted; vertex rounded forward, shagreened; posterior margin strongly emarginate; post-ocellar region raised; anterior ocellus large, in front or inferior, barely visible from above. Genal cones entirely wanting. Eyes moderately large, hemispherical. Antennal sockets large. Antennae short, thick, ten-segmented, decreasing in length to tip, with three terminal setae, almost as long as three distal segments; segments beset with peculiar type of biramous setae, visible under high magnification. Thorax broad, strongly arched. Pronotum almost, or quite vertical, convex. Pro-epimeron short. Proepisternum longer. Legs short, all similar and of equal size and length, apparently not saltatory; hind tibiae without basal spur and apical spines; hind coxae unusually small, not larger than mesocoxae and very similar in shape, with coxal spurs lateral, small and almost obsolete. Wings hyaline, both pairs more nearly similar than usual; forewings weakly veined, especially on margin apically, broadest across first marginal cell, narrowly rounded at apex, first furcal very short, radial sector also quite short, flexed upward to costal margin. Male and female genitalia of characteristic shape.

Crawford (1912) writes: "This genus is very distinct from all others in several respects. The principal difference lies in the metacoxae and antennae. It is possible that *Pauro-psylla udei* Rubsaamen, a species which I have not seen, is related to this species."

*Apsylla cistellata* (Buckton) 1893

(Fig. 7) (Plate 1)

Cotes, G. C. 1893. *Indian Mus. Notes*, 3: 13-14 (From blighted shoots of *Mangifera indica*, Dehra Dun).  
 Buckton, C. B. 1893. *Indian Mus. Notes* 3: 91-92 (*Psylla cistellata*), (Damaging mango trees at Dehra Dun).

Vosseler, J. 1906. *Z. wiss. Insekt.* 2: 315.

Lefroy, H. M. 1909. *Indian Insect Life*, p. 743, figs. 514, 515.

Crawford, D. L. 1912. *Rec. Indian Mus.* 7: 421-422, 429 (From galls on mango shoots, Dehra Dun; Bettiah, Champaran, Bihar; on mango trees, Pusa, Bihar).

Crawford, D. L. 1914. *Bull. U.S. natn. Mus. (Smithsonian Institution)* 85: 4.

Fletcher, T. B. 1917. *Rep. Proc. Second. ent. Meet. Pusa* 221.

Fletcher, T. B. 1919. *Rep. Proc. Third. ent. Meet. Pusa* 1: 277.

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 621.

Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 38-39 (Biology).

Beeson, C. F. C. 1941. *Forest Insects*: 776 (Biological notes).

Mani, M. S. 1948. *J. R. Asiat. Soc. Beng.* 14.

Mathur, R. N. 1949. *Indian J. Ent.* 8(2): 224-226, Fig. 1. (Nymphal stages and biological notes).

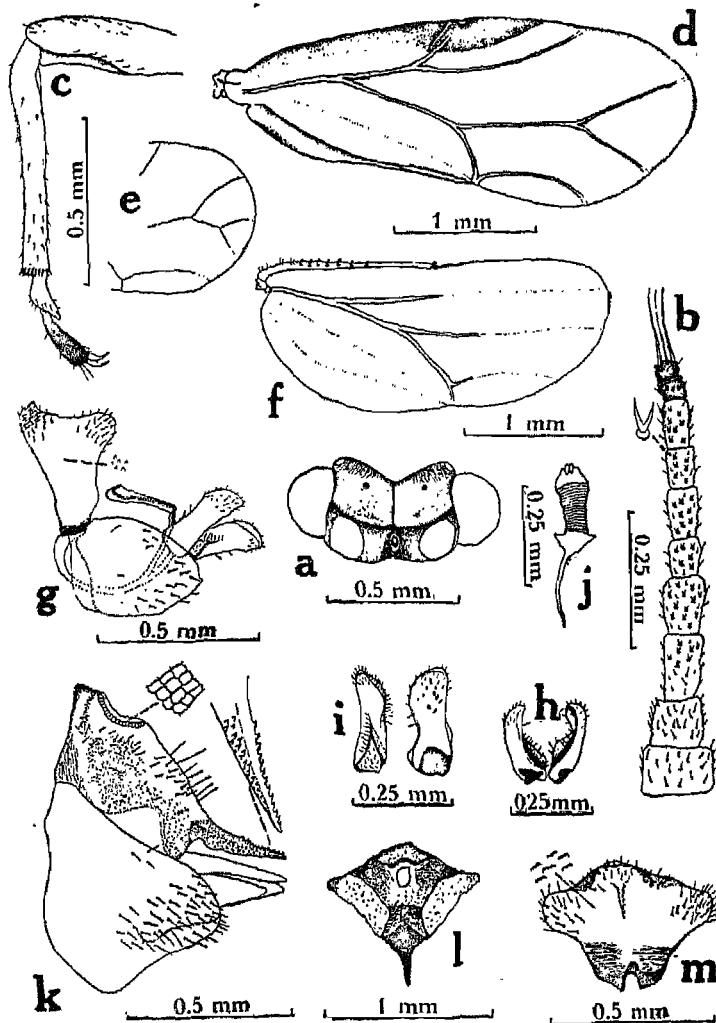


Fig. 7. *Apsylla cistellata* (Buckton) — a: head, front view; b: antenna; c: hind leg; d: forewing; e: apical portion of wing (male); f: hind wing; g: male genitalia, lateral view; h: forceps; i: outer and mesal views of forceps; j: sperm pump; k: female genitalia, lateral view; l: dorsal plate; m: anal valve of male genitalia.

Gupta, R. L. 1953. *Indian J. Ent.* 15(4): 378-379 (Distribution).  
 Chatterjee, P. N. and Sebastian, V. O. 1965. *Indian Forester* 91(4): 228-230. figs. 1, 2.

Length of body, in male, 1.72 mm; in female, 2.50 mm

Length of forewings, in male, 2.25 mm; in female, 3.4 mm

Width of head with eyes, 0.80 mm

Width of vertex between eyes, 0.50 mm

Length of antennae, 0.76 mm

*Colouration.* General colour black, venter of abdomen brownish, antennae light brown with apical segments black, legs light brown, apical tarsal segments black, labrum black apically; male sometimes brown; female genital segment blackish-brown.

*Structure.* Body short, relatively robust, surface shagreened. Head (**Fig. 7a**) small, short, deflexed, much narrower than thorax, beset sparsely with simple setae; vertex about one and one-fourth as broad as long, transversely rather flat, rounded down strongly forward, with a fovea on each side of median suture, posterior to centre, posterior margin deeply arcuate. Anterior ocellus large, in front, barely visible from above. Antennal sockets very large. Eyes large, hemispherical. Labrum small.

Antennae (**Fig. 7b**) small, thick, ten-segmented, bearing sparse simple setae, all segments from third onwards armed with small biramous setae; 1st segment transverse, about twice as broad as long, 2nd sub-quadrata, as long as 1st, 3rd longest, slightly broad apically, 4th slightly shorter than 3rd, 5th and 7th equal and a little shorter than 4th, 6th and 8th equal and slightly longer than 5th, apical two segments smallest, penultimate segment slightly longer than terminal, last segment bearing three unequal apical setae; these setae about as long as three distal segments; sensoria not discernible.

Thorax strongly arched, broad, sparsely beset with small setae, surface shagreened. Pronotum long, somewhat overhanging vertex, convex, deflexed rather vertically, with two foveal impressions on each side; propleurites indistinct; prescutum broader than long, about twice as broad as long, broadest posterior to centre, gradually narrowed anteriorly, posterior margin convex, angulate laterally; scutum very large, about two and a half times as broad as long, almost as long as prescutum, somewhat flat dorsally, angulate laterally; mesopleuron large; scutellum large, transverse, convex dorsally, about twice as broad as long, antero- and postero-lateral angles prominent; post-scutellum of the metathorax narrower and slightly smaller than scutellum, of similar shape; mesosternum large and broad.

Legs (**Fig. 7c**) long somewhat thick, pubescent, femora shorter than tibiae, not enlarged, with a long and deep tibial groove, all tibiae with apical comb of setae, hind tibiae unarmed, without basal spur and apical spines, some of the apical setae black, basal tarsal segment smaller than apical, apical joint with two prominent dorsal setae; meracanthus very small and lateral; meso- and metacoxae somewhat similar in shape, but latter longer than former.

Forewings (**Fig. 7d**) hyaline, transparent, a little more than two and a half times as long as broad, broadest across first marginal cell, weakly veined, narrowly rounded at apex, cubital petiole almost twice as long as radius, basal vein slightly shorter than cubital petiole ( $M+Cu$ ), first furcal very short, almost obsolete, second arched, first marginal cell slightly smaller than second, second marginal cell large and triangular, marginal veins very weak apically, radial cell short, clavus long and large. In one male specimen, fork  $M_3+4$  is again divided into two small forks (**Fig. 7e**).

Hind wings (**Fig. 7f**) small, veins indistinct in the apical half, costal margin with few simple and hooked setae.

Abdomen short, thick, longer than broad, sparsely pubescent, setae longer on sternites, finely shagreened.

*Genitalia.* Male genital segment (**Fig. 7g**) smaller than abdomen. Anal valve about 0.40 mm long (**Fig. 7m**), longer than forceps, erect; in lateral aspect, anterior margin almost straight, with a weak basal concavity, posterior margin a little above middle, projecting into prominent rounded lobes and then converging to apex, apex truncate having distinct anal opening, upper surface of the lateral lobes and apical region armed with long simple setae and with minute points; parameres (**Figs. 7h,i**) enclosed within the lateral lobes of anal valve, small, about 0.25 mm long, forming an ellipse when seen in caudal view, with sub-parallel sides, curved forward and inward, broad and subacute at apex, anterior and apical margins beset with simple setae, mesal surface invaginated at base and then produced into a flange bearing marginal setae, a group of setae present in the basal concavity, apical upper surface beset with small simple setae; hypandrium simple, of usual shape, sparsely beset with setae, caudal margin slightly invaginated at apex; outer arm of aedeagus much smaller than basal; sperm pump as figured (**Fig. 7j**).

Female genital segment (**Fig. 7k**) smaller than abdomen, short, sub-globose at base, dorsal plate (**Fig. 7l**) longer than ventral, gradually sloping caudally and then produced into a long, slender styliform process, with rows of saw-like teeth directed anteriorly, basal region beset with long, simple setae, circum-anal ring clearly demarcated, composed of a band of pores; ventral plate small, sparsely bearing simple setae, weakly invaginated apically; ovipositor bivalved and exserted.

*Host plant.* Bred *ex* bud galls on twigs of *Mangifera indica* Linn.

*Distribution.* Dehra Dun, Hardwar, Gorakhpur, Naini Tal district, and Pilibhit (U.P.); Bettiah, Champaran, Pusa, Chotanagpur division, Ranchi, Hazaribagh, Singhbhum, Bhagalpur, Darbhanga, and Muzzaffarpur (Bihar); occurs throughout the terai area of northern India.

*Material examined.* The collection at the Zoological Survey of India, Calcutta, contains few adults (in poor condition) preserved in alcohol, collected from Dehra Dun, on 24-9-1891 (J.S. Gamble), and few adults on cards (in poor condition), on 20-4-91, from Dehra Dun (J.S. Gamble); 1 male from Bettiah, Champaran, Bihar, 4-3-1908 (others in very poor condition).

The Indian Agricultural Research Institute, New Delhi, contains 2 examples, 27-2-09, from Pusa (C.S.M.), 1 ex. of January, 1912, Pusa, 2 ex. from Champaran (Bihar) (MacKenzie), and 8 ex. from New Forest, Dehra Dun, 14-4-33 (R.N. Mathur). All these specimens are from mango trees.

The collection at the Forest Research Institute, consists of 39 specimens, New Forest collected during 1933, 1934 and 1936 (Exp. No. 439, 495A, 602); 5 ex. of 13-4-60 and 2 females of 31-3-63, from New Forest, Dehra Dun (R.N. Mathur); 5 males and 4 females Dehra Dun, collected on 29-4-33 (G.D. Bhasin), *ex* *Mangifera indica* buds. Some adults and numerous nymphal stages, preserved in alcohol, and collected on 11-4-33, New Forest, Dehra Dun (R.N. Mathur); and of 2-4-51, collected from Jeolikote, Naini Tal, U.P. (Z.A. Siddiqui), *ex* galls on mango.

*Comparison.* This species is characterised by having metacoxae similar to mesocoxae and both nearly of equal size, peculiar type of thick antennae and venation of forewings and some other minor features.

*Biological notes.* Brief notes are given by Mathur (1935, 1945), Beeson (1941) and Chatterjee and Sebastian (1965). Chatterjee *et al.* have overlooked the observations on egg-laying habits made by Mathur (1946). Its nymphal stages are described by Mathur (1946). This species is responsible for heavy destruction of buds (Plate 1) of certain varieties of mango trees, growing in the terai area of north India.

Genus **PAUROCEPHALA** Crawford 1913

*Paurocephala*

- Crawford, D. L. 1913. *Philipp. J. Sci.* 8(4): 293-294.  
 Crawford, D. L. 1914. *Bull. U.S. natn. Mus.* 85: 42.  
 Klyver, F. D. and Ferris, G. F. 1930. *Can. Ent.* 62(8): 174.  
 Vondracek, K. 1957. *Fauna C.S.R. Prague*, pp. 125-126.  
 Dobreamu, E. and Manolache, C. 1962. *Fauna Repub. pop. rom. Insecta.*, Vol. 8, Fasc. 3, p. 72.  
 Klimaszewski, S. M. 1963. *Fragmenta Faunistica* 10(18): 261-264.

*Gamaratoscena*

- Haupt, H. 1935. *Psylloidea, Tierwelt Mittelur.* Vol. 4, p. X, 227.

Type species: *Paurocephala psylloptera* Crawford, 1913 (original designation), from Los Banos, Philippine Islands.

Body small and robust, surface shagreened or reticulately marked; thorax strongly arched. Head strongly deflexed, not quite as broad as thorax. Vertex rounded forward and downward; ocelli large, prominent, posterior pair elevated; frons large, prominent, not covered by genae, visible as a small sclerite; genae not conical, though often swollen beneath antennal bases, or wanting. Eyes large, globose. Clypeus large, rostrum very long, prominent. Antennae longer or shorter than or as long as width of head. Thorax broad and strongly arched; propleurites similar to those of *Pauropsylla*; metascutellum with a prominent, erect, conical epiphysis dorsad. Legs long and slender; metacoxal spur usually long. Wings hyaline or maculated, more or less oval in shape, narrowly or broadly rounded at apex; pterostigma present or absent; radius usually as long as cubital petiole; first marginal cell narrow and long, paralleling posterior margin. Genitalia of male simple, anal valve and forceps without processes. Female genital segment usually deflexed at right angles to abdomen or typically horizontal; apices of plates straight or curved outwards.

Crawford placed this genus in the *Pauropsyllinae*, because of its rounded head and the usually visible frons. The few species studied here apparently closely agree with the significant characters referred to *Pauropsylla*. From India, six species are recorded, out of which four are new to science. They are *P. menoni*, *P. phalaki*, *P. russellae* and *P. trimaculata*. *Paurocephala psylloptera* Crawford is not seen by me. One of the species collected on *Kydia calycina* resembles closely with *minuta* Crawford (1919), except in having dark spots at tips of media and cubitus, in addition to three spots on costal margin (one at base and another at tip of pterostigma, and the third at tip of radial sector). The distinguishing characters are given in the key.

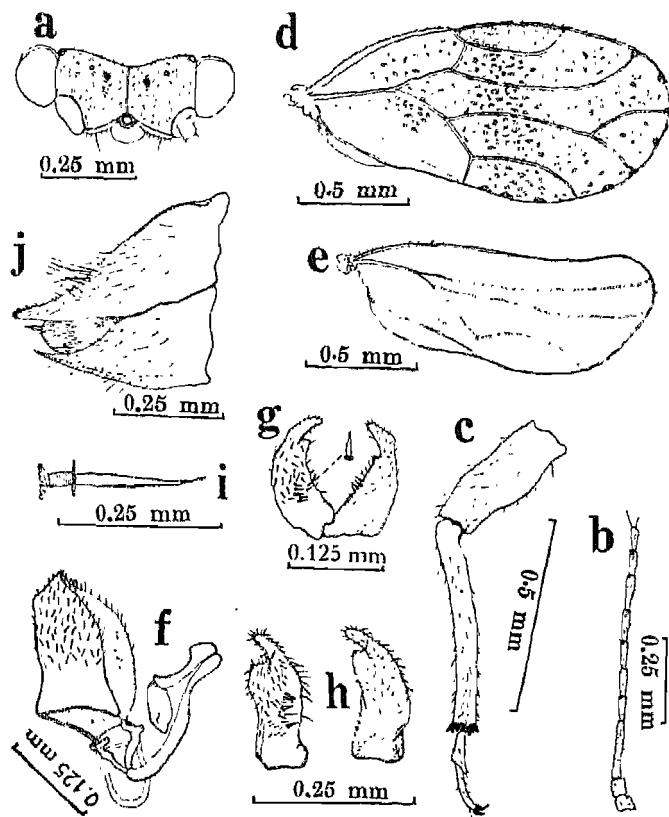


Fig. 8. *Paurocephala menoni*, sp. n.—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: anal valve and aedeagus, lateral view; **g**, **h**: parameres, caudal, dorsal and mesal views; **i**: sperm pump; **j**: female genitalia, lateral view.

#### KEY TO THE SPECIES OF PAUROCEPHALA

1. Forewings hyaline, not maculated	...	...	...	...	...	...	2
—. Forewings maculated	...	...	...	...	...	...	4
2. Antennae about twice as long as width of head; first marginal cell longer than pterostigma	...	...	...	...	...	<i>P. psylloptera</i> Crawford	
—. Antennae short, a little longer or as long as width of head; first marginal cell nearly as long as pterostigma	...	...	...	...	...		3
3. Antennae ten-segmented; pterostigma of forewings long	...	...	...	...	...	<i>P. russellae</i> , sp. n.	
—. Antennae eight-segmented; pterostigma short	...	...	...	...	...	<i>P. minuta</i> Crawford	
4. Forewings speckled with small, scattered spots all over	...	...	...	...	...		5
—. Forewings not speckled with spots, but maculated with transverse bands	...	...	...	...	...	<i>P. phalaki</i> , sp. n.	
5. Forewings speckled with numerous spots; pterostigma small but broad	...	...	...	...	...	<i>P. menoni</i> , sp. n.	
—. Specks not numerous, maculated bands faint; pterostigma long and narrow	...	...	...	...	...	<i>P. trimaculata</i> , sp. n.	

***Paurocephala menoni*, sp. n.**

(Figs. 8, 9)

Length of body, in male, 1.43 mm; in female, 1.72 mm

Length of forewings, in male, 1.30 mm; in female, 1.50 mm

Width of head with eyes, 0.60 mm

Width of vertex between eyes, 0.4 mm

Length of antennae, 0.82 mm

**Colouration.** General colour of live specimens pale-brown, with greenish tinge; antennae (except apical segments) and legs (except femora) pale-yellow; apical antennal segments fuscous; head, genae, thorax, femora of legs, and wings speckled with brownish spots. Colour of preserved specimens (in alcohol) pale yellowish-brown, speckled with brownish spots on head, genae, femora of legs, thorax and wings; femora of legs pale-brown; apical antennal segments fuscous; wings partly opaque due to the presence of light fumate bands in the apical region and in middle; ten or more dark brown spots present along the anterior and posterior margins and at termination of all veins; eyes pinkish red.

**Structure.** Body small but robust. Head (**Fig. 8a**), including eyes, slightly smaller than thorax, moderately deflexed, shagreened, finely and sparsely pubescent; vertex large, about twice as broad as long, rounded downward in front, swollen on either side of median suture, converging anteriorly, with two deep foveal impressions, one on either side of median line and posterior to centre; another small, circular fovea present posteriorly and near to posterior ocelli; posterior margin moderately arcuate; anterior margin strongly invaginated medianally, bordering the frons dorsally; post-ocellar region slightly swollen; frons depressed below the general level of the vertex, and not covered by genae, well defined in front view as a small sclerite, bearing anterior ocellus at apex; anterior ocellus not visible from above; genae small, swollen beneath antennal bases, finely and sparsely pubescent, with a pair of long subapical setae. Clypeus large, pyriform, visible in front; eyes rather large, somewhat recessive. Antennal sockets large, lateral, and margined black.

Antennae (**Fig. 8b**) ten-segmented, slender, longer than the width of head including eyes, imbricate, finely and sparsely pubescent, two basal segments robust, 1st broadly transverse, 2nd cylindrical and slightly longer than 1st, 3rd segment longest, about twice as long as 4th, 5th, 6th and 9th, each equal to one another, 7th and 8th equal and slightly longer than 4th, terminal segment small, with two unequal spines at apex, sensoria present on segments 4, 6, 8 and 9.

Thorax large, arched, shagreened, finely and sparsely pubescent. Prothorax convexly rounded; descending, with a median line, thicker in middle and narrower at sides, with two foveal impressions on each side; propleurites largely covered by eyes; prescutum broader than long, about twice as broad as long, broadest in middle, gradually narrowed anteriorly, bluntly angled at the sides, posterior margin weakly angled submedianally; scutum large, strongly arched, slightly more than two and a half times broader than long, broadest before middle, gradually sloping and angled laterally, slightly longer than prescutum; scutellum transverse, about twice as broad as long, anterior margin weakly

concave, with prominent antero-lateral angles; metascutellum broadly transverse, bearing a small tubercle, roundly pointed dorsad.

Legs (**Fig. 8c**) long and slender, finely and sparsely pubescent, femora shorter than tibiae, all tibiae with apical comb of setae, hind tibiae without basal spur but armed with two groups of nine stout, black tooth-like spines (5 outside and 4 inside) at apex; apical tarsal segment longer than basal segment of all legs; meracanthus very large and sub-conical.

Forewings (**Fig. 8d**) somewhat ovate, about twice as long as broad, round at apex, pterostigma large, broader at apex, radius as long as cubital petiole; radial sector curved and flexed upwards and meeting the anterior margin; basal vein about one and a half times longer than cubital petiole, cubitus slightly shorter than cubital petiole; first marginal cell elongate and longer than second; veins armed biserrately with microscopic setae; membrane speckled with small brownish, lighter and darker spots, with a light fumate band in the apical region and another transverse band in middle, apices of veins and both anterior and posterior margins dotted with dark-brown spots.

Hind wings (**Fig. 8e**) slightly smaller than forewings, membrane thickly beset with minute points, costal margin armed with a few simple and hooked setae in the basal half.

Abdomen large, sparsely pubescent, pubescence longer on sternites.

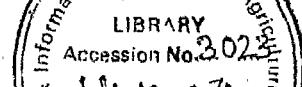
*Genitalia.* Male genital segment smaller than abdomen. Anal valve (**Fig. 8f**) 0.23 mm long, longer than forceps, anterior margin slightly concave basally and almost straight distally, posterior margin convex, tapering gradually to apex (when viewed laterally), oblique and truncate at top, outer surface sparsely covered with simple setae; parameres (forceps) (**Figs. 8g, h**) about 0.18 mm long, broad basally and gradually narrowed apically, bowed inwards, sides subparallel, anterior margin conspicuously constricted distally and ending in a minute point, posterior margin strongly concave, acuminate distally, forming a small, slender process, outer surface beset with small simple setae, mesal surface and inner margin bearing thick setae and also 4 or 5 stout setae in middle; aedeagus (**Fig. 8f**) with the outer arm short and deeply invaginated dorsally, with a thick spoon end; hypandrium simple, of usual shape, bearing sparse pubescence; sperm pump as figured (**Fig. 8i**).

Female genitalia (**Fig. 8j**) smaller than abdomen, pubescent, dorsal plate slightly longer than ventral, roundly pointed at apex and armed with small setae; circum-anal ring composed of a regular double row of simple pores; apex of the ventral plate slightly upturned and acutely pointed; both plates broad basally and gradually narrowed posteriorly and beset with very long hairs in middle; ovipositor acutely pointed.

*Host plant.* On young shoots and buds of *Grewia asiatica* Linn.

*Type locality.* New Delhi.

*Types.* Holotype male, October 6, 1956; Allotype female, May 20, 1963; Paratypes: 2 females, May 20, 1963; all from the type locality (M. G. R. Menon). Additional paratype material includes 4 females and few nymphs, preserved in alcohol, and collected on May 20, 1963; and 7 males and 9 females collected on January 16, 1966, New Delhi (M. G. R. Menon). Few specimens (2 mounted on cards) have also been



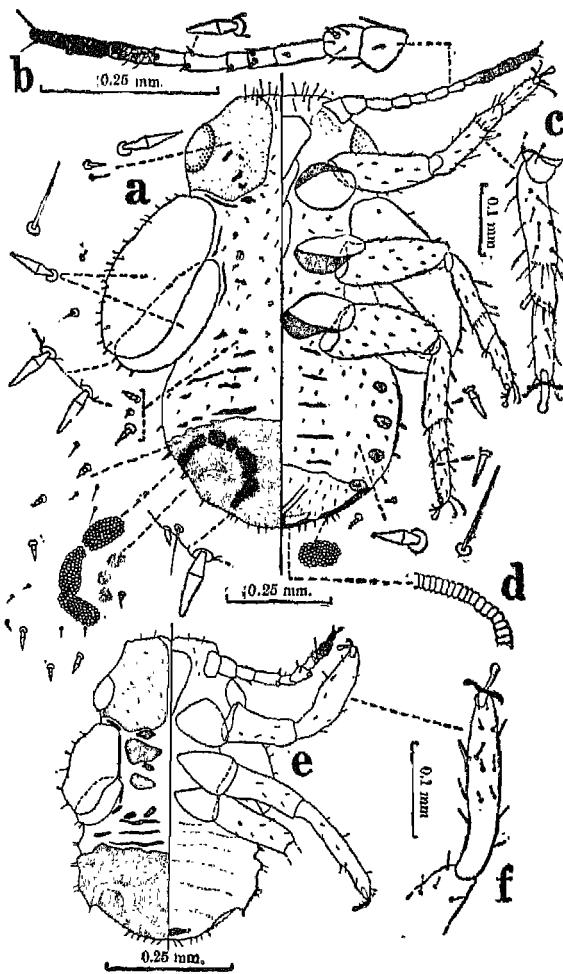


Fig. 9. *Paurocephala menoni*, sp.n.—a: fifth stage nymph; b: antenna; c: foreleg; d: portion of circum-anal ring; e: fourth or third stage nymph; f: foreleg.

received from Ludhiana, Punjab collected on *phalsa*, on November 22, 1966 (O. S. Bindra). All types and preserved material, and slides deposited at F.R.I., Dehra Dun. Five males and 7 females (paratypes) are also deposited at I.A.R.I., New Delhi. Four males and 4 females of 22 November, 1966 (from Ludhiana) are deposited at the Agricultural University, Ludhiana, Punjab.

*Comparison.* *Paurocephala menoni*, sp. n. has been described from a small series of specimens, and I have great pleasure in naming it after its collector. This species is characterised by its shape of head, shape of wings, presence of light fumate bands and speckled with small, brown spots in forewings, venation and other genital characters.

*Biological notes.* This species is reported to infest fresh young buds and shoots, which become bushy, shrivel up and ultimately die due to sucking up of sap. Serious damage is caused in heavy attacks. Mature nymphs are pale yellow with greenish tinge, dorsum with dusky plates, with eyes pinkish red, tip of antennae blackish and abdomen orange. They secrete waxy threads of cottony mass from their body. Nymphal stages are described below.

### Nymphal stages

*Fifth stage.* (**Fig. 9a**). Length 1·35 mm, on slide. Of psylline type, somewhat ovate in form, wing-pads not extending at humeral angle but project prominently beyond the contour of the body; head large, nearly as broad as abdomen. Eyes small. Derm membranous, except the large sclerotic head plates, very small plates in the thorax, wing-pads, and five transverse, thin, strip-like plates and a large plate in the posterior half of abdomen, as illustrated. Derm sparsely beset with simple setae and scattered dagger-shaped setae, each anterior wing-pad bearing a marginal row of short, stout, dagger-like setae; similarly the abdominal margin also armed with the same type of setae. Each hind wing-pad with three dagger-like setae on the distal margin. The pores of the caudal sclerotic area composed of a pair of large patches, being continuous from the dorsal to the ventral side of the abdomen, but mainly dorsal in position. Each patch contains an outer series of conspicuous pore areas consisting of large pores and an inner series of weakly defined pore areas. Posterior margin of abdomen slightly angulated laterally.

Ventral side membranous throughout, except for the weakly sclerotic areas at the base of the antennae, small submedian strip-like areas, small area around each posterior spiracle, and the one-fourth caudal area in the abdomen. Derm sparsely beset with minute simple and small thick setae. Antennae (**Fig. 9b**) situated ventrally, of moderate length, about 0·55 mm long, ten-segmented, imbricate, segments 2 to 8 inclusive bearing short, stout, dagger-shaped setae, 3rd segment longest, 4th and 7th equal and each half as long as 3rd, 5th smallest and half as long as 6th, 8th, 9th and 10th equal and each longer than 6th, sensoria present on segments 4, 6, 8 and 9, terminal segment with two apical setae. Legs (**Fig. 9c**) long, bearing simple setae, without trochanters; the tibiae of middle and hind legs armed with few dagger-like setae; tibio-tarsal articulation distinct; each pretarsus with two lanceolate setae located ventrally at apex, each tarsus with two golf-club setae near apex; claws present, empodium large, tubular-like. Anal opening at the extreme tip of the abdomen, surrounded by a ring of simple pores (**Fig. 9d**).

*Fourth or third stage.* (**Figs. 9e, f**). Length about 0·63 mm (on slide). Resembles the fifth stage, except in size, wing-pads smaller, thoracic plates slightly bigger, antennae apparently seven-segmented, with three sensoria, tibio-tarsal articulation absent, caudal margin of abdomen angulated laterally.

### *Paurocephala* near *minuta* Crawford (Figs. 10, 11)

- Crawford, D. L. 1919. *Philipp. J. Sci.* 15: 150-151, pl. 1, fig. 8.  
Mathur, R. N. 1935. *Indian Forest Rec.* 1 (2): 44-45 (Biology).  
Beeson, C. F. C. 1941. *Forest Insects*, p. 777,

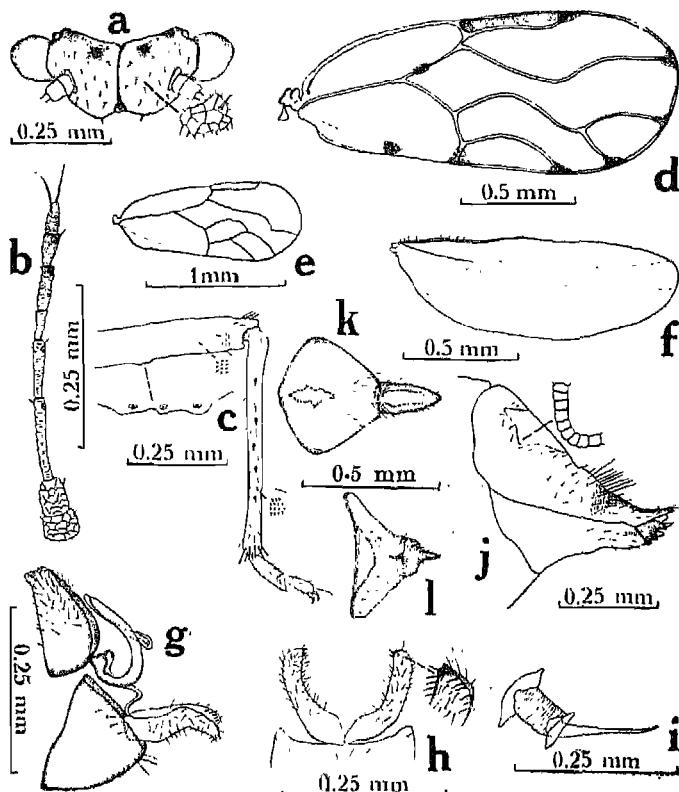


Fig. 10. *Paurocephala minuta* Crawford—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**, **e**: forewings; **f**: hind wing; **g**: male genitalia, lateral view; **h**: parameres; **i**: sperm pump; **j**: female genitalia, lateral view; **k**: dorsal plate; **l**: ventral plate.

Length of body, in male, 1.12 mm; in female, 1.65 mm

Length of forewings, in male, 1.35 mm; in female, 1.60 mm

Width of head with eyes, 0.60 mm

Width of vertex between eyes, 0.39 mm

Length of antennae, 0.48 mm

**Colouration.** General colour brown to dark chocolate brown, with greenish tinge; antennae, legs and venter lighter or pale; colour of the male uniformly darker than that of the female; vertex dark-brown posteriorly and pale clay yellow anteriorly; distal antennal segments black; dark longitudinal bands present on scutum in mature specimens; a pale spot on thorax at base of each forewing; scutellum yellowish antero-laterally, rest chocolate brown; metascutellum with a large, blunt, pale-yellow epiphysis; meso-sternum dark-

brown; eyes violet carmine; third and fourth abdominal sternites dark-brown laterally; forewings hyaline, veins pale-yellow, with dark spots on margin, at tips of veins, at base and tip of pterostigma, on radius and before clavus.

**Structure.** Body small and shining. Head (**Fig. 10a**) strongly deflexed, almost perpendicular, slightly broader than thorax, finely and sparsely pubescent, finely reticulate; vertex slightly more than twice as broad as long, bent roundly forward and downward, with a foveal impression on either side of median line and posterior to centre, strongly emarginate on occipital margin; post-ocellar region swollen; front ocellus large, not visible from above; frons well defined, visible from beneath, bearing anterior ocellus at its upper end; genae weakly swollen beneath, bearing few long setae. Clypeus large and triangular, rostrum projecting forward beneath head. Eyes rather small, roundly cone-shaped.

Antennae (**Fig. 10b**) shorter than width of head including eyes, eight-segmented, finely and sparsely pubescent, two basal segments robust, finely rugulose, 1st broadly transverse, 2nd cylindrical, remaining segments imbricate, 3rd longest, 4th two-thirds longer than 3rd, 5th, 7th and 8th smallest and equal to one another, 6th smaller than 4th and half as long as 3rd, terminal segment with two long, unequal apical spines, four sensoria present on segments 3, 4, 6 and 7.

Thorax broad, strongly arched, finely and sparsely pubescent, finely reticulate. Pronotum somewhat triangular in shape when seen in front, deflexed perpendicularly, longest in centre, with a small, swollen epiphysis and two foveal impressions at each lateral side; prescutum about twice as broad as long, narrowly rounded anteriorly, anterior border partly covered over by pronotum, and steeply inclined anteriorly, broadest in middle, angulate both laterally and posteriorly; scutum slightly longer than prescutum, slightly more than twice as broad as long, broadest in middle and gradually sloping both anteriorly and posteriorly, angulate laterally; scutellum broadly transverse, about twice as broad as long, anterior margin almost straight, with prominent antero-lateral angles; metascutellum with a large, conical, acute epiphysis dorsad; meso-sternum very large, extending far ventrad.

Legs (**Fig. 10c**) moderately large, slender, pubescent and also beset with minute points arranged in lines, femora shorter than tibiae, hind femur with three dorsal setae near apex, slightly swollen ventrally before middle, bearing three sensoria-like structures ventrally, femora of fore and middle legs comparatively much smaller than hind femora; hind tibiae without basal spur, with a longitudinal row of few thick setae, with seven slender sharp spines at apex; basal tarsal segment slightly longer than apical; meracanthus small, bluntly conical.

Forewings (**Fig. 10d**) transparent, ovate, narrowed basally, broadest subapically, slightly more than twice as long as broad, with a prominent pterostigma, rounded at apical margin, radius as long as cubital petiole, radial sector with a prominent bend and flexed upward near apex; first marginal cell elongate, narrow, longer and broader than second, and nearly as long as pterostigma, fork  $M_1+2$  longer than  $M_3+4$ , veins armed with microscopic setae. In one example, radial sector and media are deformed as illustrated (**Fig. 10e**).

Hind wings (**Fig. 10f**) also quite long, membrane beset with minute points, costal margin armed with a number of simple and hooked setae in basal half.

Abdomen short, longer than broad, finely and sparsely pubescent and also beset with minute points arranged in lines.

*Genitalia.* Male genital segment (**Fig. 10g**) smaller than abdomen. Anal valve (proctiger) simple, about 0.15 mm long, in lateral aspect, anterior margin almost straight, posterior margin convex, broad basally and gradually narrowed apically, outer surface beset with simple setae; claspers (parameres) (**Fig. 10h**) almost as long as proctiger, slightly broad basally, sides almost parallel, apex narrow terminating in a thick point, in caudal view, outer margin convex, inner margin concave, bowed inwards, outer surface beset with small, simple setae, mesal surface armed with long setae directed downward; outer arm of aedeagus smaller than basal, scarcely thicker at spoon end (**Fig. 10g**); hypandrium simple, of usual shape, bearing sparse setae; sperm pump as figured (**Fig. 10i**).

Female genital segment (**Fig. 10j**) longer than abdomen, deflexed vertically downward, apices of both plates subacute and flexed outwards; dorsal plate (**Fig. 10k**) longer than ventral, gradually narrowed from base to apex, differentiated into a large anterior region, having an elongate anal ring, and a small, dark posterior region, a tuft of long setae present near their junction, anal-pore ring consisting of a single row of slit-like pores; ventral plate (**Fig. 10l**) bearing short, simple setae in the apical third, apical area pointed like a spike; thick sclerotic scale-like structures of inferior inter-valvulae project out laterally between the two plates; ovipositor sharply pointed.

*Host plant.* Bred *ex* pit-galls on leaves of *Kydia calycina* Roxb.

*Distribution.* Originally recorded from Luzon, Laguna Province, Los Banos, and described from 1 female (Crawford, 1919). Mathur (1935) has recorded this species from New Forest, Dehra Dun, U. P., bred *ex* pit-galls on *Kydia calycina*.

*Material examined.* The collection at the Forest Research institute, contains 1 female, 5.6.33; 1 male, 9.6.33; 1 female, 5.5.34; 2 males and 8 females, 14.4.50; 3 males and 2 females, 3.3.53; 3 females, 15.4.60; and two phials containing some adults and nymphal stages in alcohol, collected on 11.4.50 and March 1951 from New Forest (R. N. Mathur).

One male of 3.3.53 and one female of 15.4.60, collected from Dehra Dun and New Forest respectively (R. N. Mathur), are donated to J.A.R.I., New Delhi.

*Comparison.* *Paurocephala minuta* has been described by Crawford (1919) from a single female and is redescribed from a number of specimens of both sexes bred *ex* pit-galls on leaves of *Kydia calycina*. This species could not be confirmed by Dr. (Miss) Russell, for the following reasons communicated by her: " *Paurocephala* sp. near *minuta* Crawf.—The holotype ♀, the only specimen available, is fragmentary. The antennae, wings, most of legs, epiphysis of the metascutum, and tips of the genital segment are absent. The genital segment in the type appears to have been considerably shorter than in your specimens. In his description Crawford did not mention the black spots at the ends of media and cubitus." However, I have placed these specimens near *minuta*, as the characters resemble closely with this species. Several features, with figures, have been supplemented from my specimens in the description. Its distinguishing characters are given in the key.

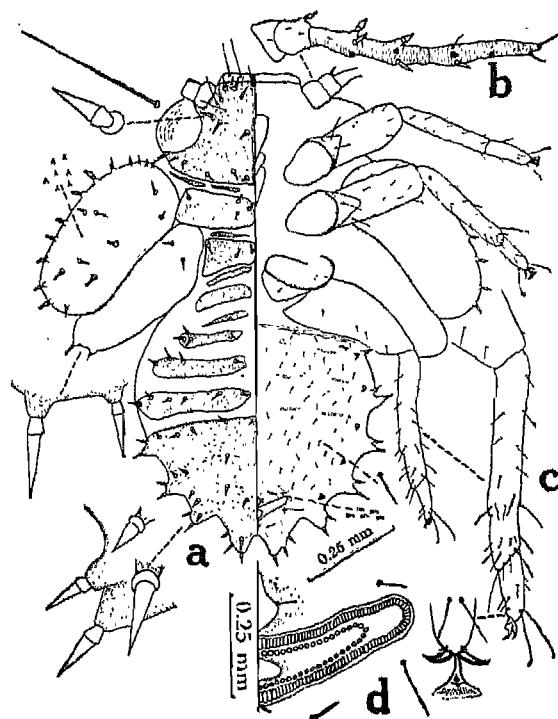


Fig. 11. *Paurocephala minuta* Crawford—**a**: fifth stage nymph; **b**: antenna; **c**: part of hind leg; **d**: circum-anal ring and anus.

This species is easily separated by the shape of head, wings, venation and other characters. The prominently looped radial sector and media and the eight-segmented antennae are characteristic features, by which this species differs from *P. russellae*.

*Biological notes.* This species is commonly found making pit-galls on *Kydia calycina* leaves. Mathur (1935) has given its bionomics, etc. Its nymphal stages are described below. The nymphs are pale yellow, with dorsum of thorax and abdomen darker.

#### Nymphal stages

*Fifth stage.* Length 1.25 mm. Form elongate (Fig. 11a); the wing-pads project from the side of the body and not produced cephalad. Eyes prominent, extending beyond the side of the head. Dorsum with the derm for the most part sclerotic, representing as several plates which are arranged as follows; head with a pair of large mesally separated plates; thorax with two pairs of large and several small plates, and abdomen with three pairs of mesally separated, narrow plates in the basal half and a single caudal plate, showing traces of segmentation. All the plates and wing-pads armed with short, stout lanceolate setae, borne on small papillae. Marginal area of wing-pads beset with minute points and the caudal plate with minute comb-like structures. Derm weakly vermiculate,

Ventral side membranous throughout, except for a small area around each spiracle and an irregular zone below the anal ring. Minute fringe-like processes present both anteriorly and posteriorly of the circum-anal ring. Derm beset with minute points and simple scattered setae, which are arranged segmentally in the abdomen. Antennae (**Fig. 11b**) situated ventrally, about 0·42 mm long, apparently four segmented, two basal segments broad, 3rd long and slender and indistinctly three-segmented, apical segment also long, imbricate, bearing two terminal setae, few lanceolate setae and four sensoria also present on segments. Legs (**Fig. 11c**) long and slender, bearing simple setae; without trochanters; femora reaching the margin of wing-pads; with distinct tibio-tarsal division; each tarsus with two golf-club setae near apex; claws present, the pulvilli petiolate and fish-tail like. Anal opening ventral, set well away from caudal end, surrounded by an outer ring (**Fig. 11d**) of slit-like pores and an inner ring of small, circular pores, both rings interrupted anteriorly and posteriorly, and also guarded by two anterior and two posterior pairs of simple setae and one posterior pair of long, slender bristle-like setae.

*Fourth stage.* Length 0·85 mm. Resembles the fifth stage, except in the absence of several small plates on the thorax, absence of tibio-tarsal articulation, and the presence of three sensoria on antennae.

*Third stage.* Length 0·52 mm. Identical with the fourth stage, but with smaller wing-pads, abdomen with a large caudal plate and narrow plates; antennae with two sensoria.

**Paurocephala phalaki, sp. n.**

(*Figs. 12, 13*)

Length of body, in male, 1·6 mm; in female, 1·82 mm

Length of forewings, in male, 1·82 mm; in female, 2·0 mm

Width of head with eyes, 0·60 mm

Width of vertex between eyes, 0·38 mm

Length of antennae, 0·98 mm

*Colouration.* General colour black dorsally and pale-yellow ventrally; vertex pale-yellow, with blackish foveal impressions; clypeus and tip of labrum black; antennae pale-yellow with apices of segments 4, 6, and 8 and the two terminal segments black; legs pale-yellow with black apical tarsal segments; posterior margin of prothorax greyish; mesothorax with two submedian brownish lines; sides of scutellum greyish white; forewings transparent, and maculated with two brown bands, one in the apical region, E-shaped, enclosing radial sector apically, forks  $M_{1+2}$  and  $M_{3+4}$  and  $Cu_1$  apically, while the other running across the centre transversely.

*Structure.* Body of medium size. Head (**Fig. 12a**) large, broader than thorax, strongly deflexed, sparsely hirsute with white hairs, finely reticulate; vertex broader than long, about one and a half times as broad as long, rounded downward in front, with two foveal impressions, one on either side of median suture and posterior to centre; post-ocellar region strongly elevated; posterior margin moderately emarginate; anterior ocellus large, visible in front; frons visible from in front and below as a distinct small, narrow

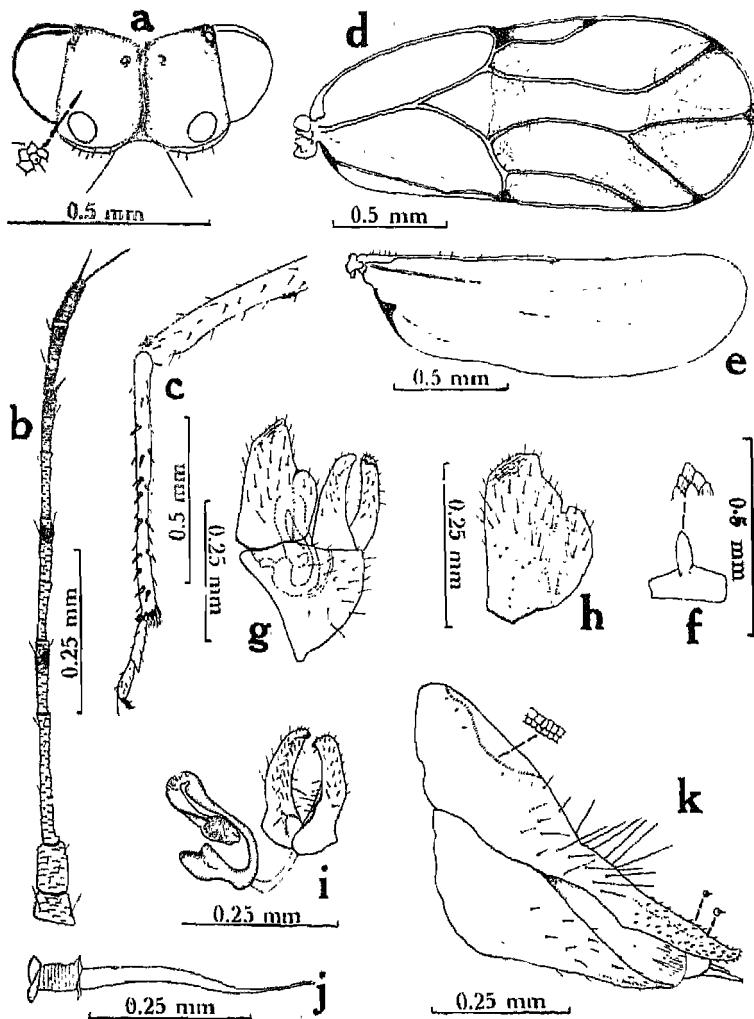


Fig. 12. *Paurocephala phalaki*, sp. n.—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: epiphysis of metascutellum; **g**: male genitalia, lateral view; **h**: anal valve; **i**: parameres and aedeagus; **j**: sperm pump; **k**: female genitalia, lateral view.

sclerite from ocellus to clypeus, and depressed below the general level of the vertex and genae; genae very small and rounded, bearing two rather long subapical setae and scattered small setae. Clypeus very large, globose and visible from beneath. Rostrum projecting forward beneath head.

Antennae (**Fig. 12b**) small, ten-segmented, imbricate and finely and sparsely pubescent, two basal segments robust, 1st subsquare, 2nd elongate, cylindrical, remaining segments slender, 3rd segment longest, one and three-fourths times as long as 4th, 4th slightly longer

than 5th, 6th to 9th segments equal to one another and each slightly longer than 5th and slightly smaller than 4th, terminal segment smallest, about one-third as long as 3rd, bearing two unequal, apical spines, four sensoria present on segments 4, 6, 8 and 9.

Thorax broad, strongly arched, sparsely pubescent with white hairs, surface finely reticulate. Prothorax long, ascending, convex, with two foveal impressions on each lateral side, posterior margin invaginated medially; prescutum small, broader than long, broadest beyond middle, about twice as broad as long, narrowly rounded anteriorly, angulate laterally and also posteriorly; scutum large, broad, broadest before middle, slightly longer than prescutum, about two and one-fourth times broader than long, depressed mid-dorsally and raised subdorsally on either side, angulate both laterally and posteriorly; scutellum broadly transverse, vase-shaped, broad anteriorly and narrow posteriorly, with prominent antero-lateral angles, gradually sloping posteriorly; metascutellum with a prominent, acute, erect, conical process dorsad (**Fig. 12f**); mesosternum very large, extending far ventrad.

Legs (**Fig. 12e**) quite long and slender, pubescent and also beset with linear series of minute points, tibiae longer than femora, bearing apical comb of thick setae, hind femora slightly arched ventrally, with a group of five dorsal setae near apex, with three sensoria-like structures ventrally near base, hind tibiae without basal spur, with two longitudinal rows of thick setae, and 4 or 5 thick spines at apex, tarsal segments of fore and middle legs of equal length, while in hind leg, the basal tarsal segment slightly longer than apical, fore and middle coxae also quite large, meracanthus quite long and tubular.

Forewings (**Fig. 12d**) long, hyaline, transparent, about two and a quarter times as long as broad, oblong, broadly rounded at apex, maculated with a central and apical bands, central macula extending from base of pterostigma to  $Cu_2$ , apical macula like the letter E, enclosing apical part of radial sector, forks  $M_{1+2}$  and  $M_{3+4}$ , while a small macula present enclosing apical part of  $Cu_1$ , 8 black spots present near base of clavus, base and apex of pterostigma and at apices of veins, pterostigma small but broad, radius almost as long as cubital petiole, basal vein longer than radius, marginal cells nearly equal in length, first marginal cell elongate, narrow, longer than pterostigma, membrane beset with minute points and veins armed with microscopic setae.

Hind wings (**Fig. 12e**) also quite long, slightly shorter than forewings, membrane uniformly beset with minute points, costal margin armed with a few simple and hooked setae in the basal half.

Abdomen longer than broad, finely and sparsely pubescent and also beset with minute points arranged in lines.

*Genitalia.* Male genital segment (**Fig. 12g**) smaller than abdomen. Anal valve (**Fig. 12h**) longer than forceps, about 0.25 mm long; in lateral view, anterior margin straight, deflected posteriorly near top, lateral lobes prominently differentiated, broad and strongly convex, apical half and lateral lobes bearing sparse simple setae; forceps (**Fig. 12i**) long and slender, about 0.18 mm long, from behind, bowed strongly laterally and appearing subacute at tip, terminating in a single, small, black point on the inner side, broad at base, sides sub-parallel, outer surface bearing simple setae, minute setae at top like a brush, mesal surface armed with small setae directed downward; hypandrium simple,

of usual shape, having sparse simple setae; aedeagus (**Fig. 12i**) with the outer arm much smaller than basal, ending in a thick spoon-like structure; sperm pump as figured (**Fig. 12j**).

Female genital segment (**Fig. 12k**) slightly smaller and deflexed downward at right angle to abdomen; dorsal plate longer than ventral, tip of both plates flexed outwards, dorsal plate sub-acutely pointed at apex, the apical third bearing a tuft of long setae and numerous peg-like setae; circum-anal ring composed of a double row of pores; ventral plate acutely pointed, bearing sparse simple setae; ovipositor acutely pointed.

*Host plant.* Both adults and nymphs collected on an unknown plant species, local name of which is *khasare*.

*Type locality.* Tista village, Bengal.

*Types.* Holotype male; Allotype female; from the type locality, and collected on October 27, 1965 (V.R. Phalak); Paratypes: 5 males and 5 females, also from the type locality and same date (V.R. Phalak). A few damaged specimens and nymphal stages were mounted on slides. The types, slides and preserved material deposited at F.R.I. Dehra Dun.

*Comparison.* This new species is described from a very small series of specimens and I have great pleasure in naming it after its collector. *P. phalaki* is readily recognised by its banded forewings, shape of head, presence of pterostigma, metascutellum with a conical epiphysis, dorsad and genital characters.

*Biological notes.* *P. phalaki* has been recorded on a plant, locally known as *khasare*, on October 27, 1965, by V.R. Phalak. Nothing is known about its life-history, etc. Its nymphal stages are described below.

### Nymphal stage

*Fifth stage.* (**Figs. 13a,b,c,d**). Length about 1.35 mm (on slide). Pauropsylline type, rather elongate. Head broad but smaller than abdomen, and the wing-pads extending prominently beyond the general margin of the body and backward. Eyes bulging slightly beyond margin of head and thorax. Derm membranous except for the sclerotic head plates, wing-pads, small thoracic plates, and three transverse plates in the anterior half and a single large plate in the posterior half of abdomen. Dorsum with the derm armed with stout, scattered, dagger-shaped setae of varying length, the anterior pair of wing-pads each bearing a marginal row of similar setae, equally spaced, with a larger one usually alternating with a smaller one; the posterior pair having two similar setae on the distal margin. These dagger-shaped setae are borne on small tubercle-like prominences, and are arranged approximately as follows, on each half of body: head, 7; prothorax, 5; meso- and meta-thorax, 4 on each; three anterior, transverse abdominal plates, 5 on each, caudal plate with 1 submedian and 4 lateral setae in each weakly differentiated segment; forewing pads with 9 or 10 dorsal and 8 or 9 around margin; hind-wing pads with 2 dorsal and 2 marginal at apex.

Ventral side membranous throughout and beset with simple setae of different length; spiracles surrounded by minute sclerotic areas. Antennae (**Fig. 13b**) small, 0.75 mm long, apparently five-segmented, bearing few simple setae, two basal segments robust,

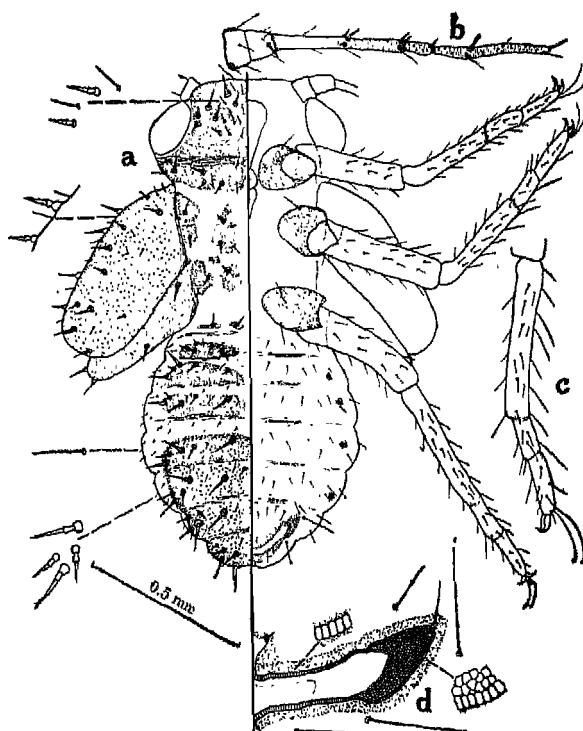


Fig. 13. *Paurocephala phalaki*, sp. n.—**a**: fifth stage nymph; **b**: antenna; **c**: part of leg; **d**: anus and circum-anal pore rings.

1st transverse, 2nd subquadrate, 3rd segment longest, with a weak trace of segmentation and weakly imbricate, 4th small, 5th again long but smaller than 3rd, 4th and 5th imbricate, four sensoria present, two on third and two on fifth, dagger-shaped setae present on each segment except the first. Legs (Fig. 13c) long, bearing simple setae of various sizes; with weak scarcely distinguishable trochanter; tibio-tarsal articulation present, each tarsal joint armed with two golf-club setae; claws present, each tarsus with a relatively large empodium. Anal opening (Fig. 13d) ventral, a short distance away from the apex of abdomen, the circumanal ring consists of a single ring of slit-like pores with an expanded band for pores on each side, while the inner ring with less defined pores, these rings are enclosed in a weak sclerotic area, and are guarded by three anterior, one lateral and three posterior pairs of setae of different lengths.

***Paurocephala psylloptera* Crawford 1913**  
(Fig. 38)

Crawford, D. L. 1913. *Philipp. J. Sci.* **8**: 294, fig. 1.

Crawford, D. L. 1915. *ibid.* **10**: 260-261.

Crawford, D. L. 1917. *ibid.* **12**: 163.

Crawford, D. L. 1919. *ibid.* **15**: 149.

- Crawford, D. L. 1924. *Rec. Indian Mus.* **26**(6): 615.  
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 Mathur, R. N. 1935. *Indian Forest Rec.* **1**(2): 44.  
 Takahashi, R. 1936. *Kontyu*, **10**: 291.  
 Shiraki and Takahashi, R. 1937. *Plant Indust. Publ.* No. **787**, Govt. Formosa, 42, fig. 10.  
 Miyatake, Y. 1964. *Rept. Comm. Foreign Sci. Res. Kyushu Univ.* No. **2**, p. 122.  
 Miyatake, Y. 1971. *Bull. Osaka Mus. nat. Hist.* **25**: 55-56.

The description of this species is reproduced from Crawford (1913-1924).

"Length of body, 1.7 mm; length of forewing, 2.1 mm. Male much darker than female, almost uniformly dark reddish-brown, with anterior femora and a spot above forewings yellowish; abdomen lighter; female orange to light reddish-brown; antennae, tibiae, and eyes brown. Body sparsely and briefly pubescent".

"Head greatly deflexed, almost perpendicular; vertex broader than long, surface irregular, deeply concave on occipital margin, with posterior ocelli greatly elevated, roundly convex in front; anterior ocellus large, between antennal bases; frons swollen beneath antennal insertions; labrum very large, globose from in front. Antennae nearly twice as long as width of head, slender."

"Thorax broad, strongly arched; pronotum long, ascending, longest at centre; dorsulum long. Metascutum with a prominent, acute, erect, conical process dorsad. Mesosternum very large, extending far ventrad, rostrum projecting forward beneath head. Legs slender; hind legs very long; hind tibiae very spinose. Forewings hyaline, narrowed basally, broadest subapically, broadly rounded or slightly angular on apical margin, more than two and a half times as long as broad; cubital petiole and discoidal subcosta equal in length; first marginal cell elongate, narrow, a little longer than pterostigma; second broad and large."

"Abdomen long. Male: fifth tergite produced caudad over genital plate; anal valve simple, longer than claspers which are slender, arched, pubescent within. Female genitalia flexed sharply downward, rather long; both plates acute at tip, dorsal longer than ventral."

"Described from 3 males and 3 females from Los Banos, Philippine Islands (Baker, August, 1912). Collected on *Ficus ulmifolia*" (Crawford, 1913).

"One female from Los Banos, Philippine Islands (Baker), and 23 males and females collected in Peradeniya, Ceylon, May 24, 1914, on young shoots of *Ficus hispida* and *Ficus asperrima* (Rutherford). An accompanying note states that "these insects are attended by ants. The nymphs excrete a long filament of white wax" (Crawford, 1915).

"This appears to be a common species, widely distributed in the South Pacific regions. Since additional material has come to hand it seems necessary to supplement the original description which was drawn up from six specimens. The colour of the male is not uniformly darker than the female; both sexes are usually very dark chocolate brown to dull black; lighter forms seem to be less matured, the colour deepening with

age; vertex and thoracic dorsum sometimes with orange yellow streaks but more commonly uniformly dark, antennae usually as dark as vertex; legs often lighter in colour or even yellowish. Body surface often not hairy; vertex and thoracic dorsum finely, reticulately marked. The beak is moderately long and the mandibular setae sometimes exserted to a length of 1 millimetre or less. The hind tibiae have a row of about seven black spines on outside, several spines at apex and are more or less hirsute. The metacoxal spurs are long and slender. Pterostigma of forewings usually dark coloured, veins black."

"In the Philippine Islands this species has been collected in Luzon, Los Banos (Baker), on *Ficus ulmifolia*; and on Mount Maquiling (Baker). In Ceylon, Peradeniya (Rutherford), *Ficus hispida* and *Ficus asperrima*. Additional specimens are now before me from Tenimber Islands, Larat (Muir), December, 1907, 18 males and 18 females". (Crawford, 1919).

"This species was first described from the Philippines but subsequently has been found to occur in Formosa, Moluccas, Borneo, Ceylon and probably throughout the old world tropics. Enderlein described the same species from Formosa under the name of *Agonoscena* which is a synonym of *Paurocephala*. The Ramakrishna collection has several specimens of this species, taken on *Ficus* shoots at Tenmalai, Travancore, S. India, October 1923" (Crawford, 1924).

*Host plants.* On *Ficus ulmifolia*, *F. hispida*, *F. asperrima*, *Ficus* sp.; Miyatake (1964) has recorded it on *Trema orientalis* Blume.

*Distribution.* Los Banos, Luzon, Palawan Philippine Islands; Mount Maquiling; Larat, Tenimber Islands; Borneo; Formosa; Moluccas; Singapore; Fiji; Peradeniya, Ceylon; Tenmalai, Travancore, S. India. Probably distributed throughout the Old World Tropics.

*Comparison.* This species is not seen by me in the collections of the various institutions studied by me. However, by the characters described by Crawford, it resembles closely with *Paurocephala brevicephala* Crawf., and *P. russellae*, sp. n. in venation. It is readily recognised from other species, by the first marginal cell longer than pterostigma and antennae about twice as long as the width of head.

***Paurocephala russellae*, sp. n.**  
(Figs. 14, 15)

Crawford, D. L. 1917. *Philipp. J. Sci.* 12(3) : 163, pl. 1, fig. 11 (*Pauropsylla brevicephala* Crawf., Mindanao, Davao).

Crawford, D. L. 1919. *Philipp. J. Sci.* 15(2) : 150,

Mathur, R. N. 1935. *Indian Forest Rec.* 1(2) : 44-45,

Beeson, C. F. C. 1941. *Forest Insects*, p. 777.

Length of body, in male, 0.75 mm; in female, 1.38 mm

Length of forewings, in male, 1.24 mm; in female, 1.39 mm

Width of head with eyes, 0.50 mm

Width of vertex between eyes, 0.30 mm

Length of antennae, 0.35 mm

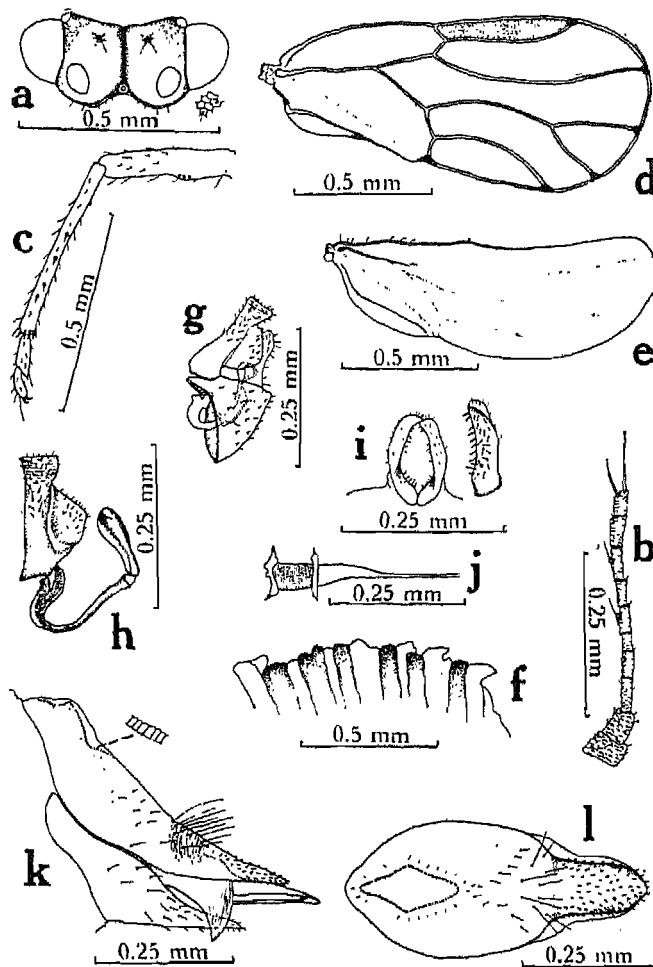


Fig. 14. *Paurocephala russellae*, sp. n.—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: abdominal tergites, lateral view; **g**: male genitalia, lateral view; **h**: anal valve and aedeagus, lateral view; **i**: parameres, caudal and mesal views; **j**: sperm pump; **k**: female genitalia, lateral view; **l**: dorsal plate.

**Colouration.** General colour brown, with orange or yellow markings on dorsum and pleuron of thorax; antennae light brown, with apical segments black; abdominal segments with black spots laterally, forewings hyaline, with five black marginal spots, one at each end of veins and at apex of pterostigma.

**Structure.** Body small and robust. Head (**Fig. 14a**) small, narrower than thorax, strongly declivous, almost perpendicular and concealed beneath the prothorax, finely and sparsely pubescent, finely reticulate; vertex much broader than long, about twice

as broad as long, uniformly rounded forward and downward, with foveal impressions posterior to centre, one on each side of median suture; posterior margin angulately invaginated; post-cellar region prominently elevated, bearing ocelli; front ocellus visible from beneath; frons well-defined, visible in front, bearing anterior ocellus at top; genae scarcely swollen beneath, bearing few long setae. Antennal sockets quite large. Eyes rather large. Labrum small, rostrum projecting forward beneath head.

Antennae (**Fig. 14b**) very short, almost as long as width of vertex between eyes, ten-segmented, bearing few setae, two basal segments robust, 1st broadly transverse, 2nd cylindrical, about twice as long as 1st, other segments slender and imbricate, 3rd longest, 4th and 6th equal and each about one-third smaller than 3rd, 5th smallest and about half as long as 3rd, 7th slightly longer than 5th and slightly smaller than 6th, 8th and 9th equal and each slightly smaller than 3rd and slightly longer than 4th, terminal segment slightly smaller than 4th, bearing two unequal, long spines at apex, four sensoria present on segments 4, 6, 8 and 9.

Thorax strongly arched, broad, finely and sparsely pubescent, finely reticulately marked. Prothorax small, somewhat triangular in shape in front view, almost perpendicular, longest in middle, with small, swollen, submedian epiphysis, with foveal impressions on each lateral side; prescutum broader than long, about two and a half times as broad as long, narrowly rounded and steeply inclined anteriorly, anterior border partly covered over by pronotum, broadest in middle, angulate both laterally and posteriorly; scutum much broader than long, about two and a half times as broad as long, broadest near about middle, slightly longer in length than prescutum, sloping both anteriorly and posteriorly, angulate laterally; scutellum small, narrowly transverse, about twice as broad as long, anterior margin rather straight, with prominent antero-lateral angles, posterior margin somewhat convexly rounded; metascutellum with a prominently thick conical process ending in an acute point dorsad; mcsosternum very large, extending far ventrad.

Legs (**Fig. 14c**) short and slender, but hind leg comparatively longer than others, pubescent and also beset with minute points arranged in lines; both fore and middle coxae quite large; hind femur slightly swollen near middle ventrally, bearing three sensoria-like structures; hind tibiae without basal spur, with seven spines (4 on one side and 3 on the other) at apex, and also armed with a longitudinal row of thick setae, basal tarsal segment slightly longer than apical; meracanthus long and slender, sub-cylindrical and subacute at apex.

Forewings (**Fig. 14d**) hyaline and transparent, a little more than twice as long as broad, broadly rounded at apex, narrow basally, broadest subapically, pterostigma long and broad, slightly longer than first marginal cell, basal vein slightly less than twice as long as radius, cubital petiole a little longer than radius, first marginal cell elongate and narrow, longer and broader than second cell, radial sector weakly curved and flexed upward near apical margin, veins armed with microscopic setae.

Hind wings (**Fig. 14e**) also quite long, costal margin with a few simple and hooked setae in basal half, membrane uniformly beset with minute points.

Abdomen short (**Fig. 14f**), each tergite with a dorsal median hump, which are quite

strong and prominent in female, while in male these humps are absent on the anterior tergites; fifth tergite produced caudad over genital plate; pubescence sparse.

*Genitalia.* Male genital segment (**Fig. 14g**) smaller than abdomen. Anal valve (**Fig. 14h**) about 0.2 mm long, longer than parameres, in profile, anterior margin almost straight, lateral lobes large and clearly demarcated, bearing sparse, simple setae, posterior margin invaginated below apex, apex broad and truncate, apical half of outer surface sparsely beset with small setae; parameres (forceps) (**Fig. 14i**) simple, slender, about 0.15 mm long, bowed strongly inwards, slightly broad basally, sides sub-parallel, terminating apically in a round point, outer surface bearing small, simple setae, mesal surface armed with some thick setae directed downward, marginal setae slightly longer; hypandrium simple, of usual shape, sparsely pubescent with simple setae; outer arm of aedeagus (**Fig. 14h**) smaller than basal, spoon end large and broad; sperm pump as figured (**Fig. 14j**).

Female genital segment smaller than abdomen, deflexed vertically downward, sparsely pubescent; dorsal plate longer than ventral, broader in the basal region, caudal region elongate, narrow, curved outward, roundly pointed apically, and armed with minute peg-like setae (**Fig. 14 l**), central region bearing some long hairs, circum-anal ring composed of a single row of slit-like pores; ventral plate acutely pointed at apex; ovipositor long, exserted and acutely pointed; strongly sclerotic valvulae projecting outward laterally.

*Host plant.* Bred *ex* pit-galls on *Kydia calycina* Roxb.

*Type locality.* New Forest, Dehra Dun (U.P.).

*Types.* Holotype male; Allotype female, June 17, 1932, from the type locality (R.N. Mathur); Paratypes: 1 male of 17.6.32, 1 female of 5.6.33, 1 female of 16.12.33; 1 female of 13.1.34; 1 female of 6.4.34; some males and females of 5.5.34; 3 females of 11.5.50, all from the type locality and *ex* pit-galls on *Kydia calycina* (R.N. Mathur). Some adults and nymphal stages, preserved in alcohol, and collected from New Forest, on 17.6.32 (R.N. Mathur), (Expt. No. 405) are deposited along with all types and slides with mounted parts and nymphs at F.R.I., Dehra Dun.

*Comparison.* *Paurocephala russellae*, sp. n. resembles very closely *P. brevicephala* Crawford (1917), and was provisionally labelled as such. Crawford (1917) has described *brevicephala* from 2 females from Mindanao, Davao. Specimens of this new species were sent to Dr (Miss) Russell for comparison with the types and she has communicated as follows: "Your specimens labelled *P. brevicephala* Crawford are not this species. The most conspicuous differences are the antennae which are shorter than the width between the eyes, the wings which have conspicuous dark spots at tips of radius, media and cubitus and the shape of the female genitalia in *brevicephala*. In the latter species the dorsal valve has a transverse seta bearing ridge near the distal third, the valve is strongly narrowed distad of the ridge, is upturned and the apex is acute."

The collection at the Forest Research Institute is represented by a small series of both sexes, but females predominate. This species differs from another allied species recorded *ex* pit-galls on *Kydia calycina*, in having the radial sector and media almost straight and not looped, and by the shape of second marginal cell, shape of head, ten-segmented

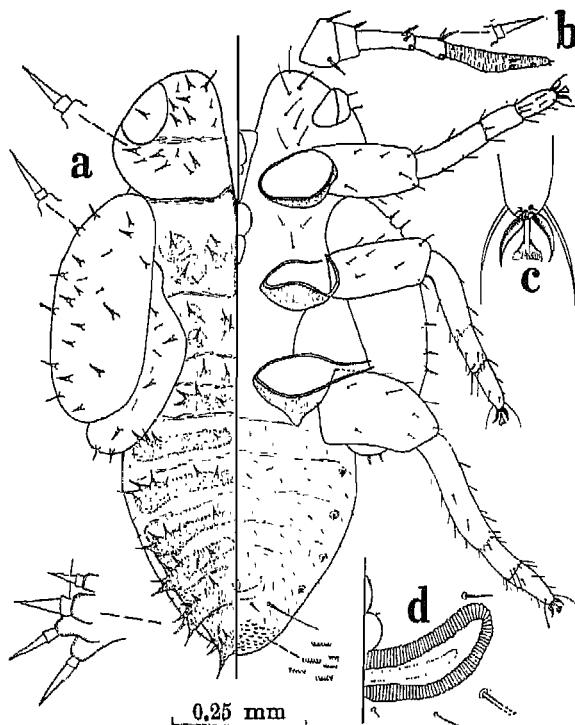


Fig. 15. *Paurocephala russellae*, sp. n. — a: fifth stage nymph; b: antenna; c: claws and pulvillus; d: circum-anal pore ring.

antennae and genital characters. The characters given in the key, separate it from other Indian species.

*Biological notes.* This species is less common on *Kydia calycina*, forming pit-galls on the new leaves.

#### Nymphal stage

*Fifth stage.* (Fig. 15a) Length 1.05 mm (on slide). Form elongate. Wing-pads projecting from the side of the body and not produced cephalad. Head almost as broad as abdomen. Eyes prominent and in contour with the head margin. Dorsum with the derm for the most part sclerotic, having a large mesally separated head plate, large thoracic plates, wing pads, and three transverse anterior plates and a single caudal plate in the abdomen; the caudal plate showing traces of segmentation. Head thoracic plates and wing-pads armed with short, stout lanceolate setae, borne on small tubercles. Derm beset with few scattered minute, simple setae. Each abdominal plate armed with one or two submedian and a group of three to four lanceolate setae laterally.

Ventral side membranous throughout, except for a small area around each spiracle. Derm

beset with small, simple, scattered setae, which are arranged segmentally in the abdomen; caudal region bearing small, comb-like structures. Antennae (Fig. 15b) about 0.35 mm long, located ventrally, apparently five-segmented, two basal segments broad and robust, 3rd long and slender, 4th smaller than 3rd, 5th longest, imbricate, and as long as 2nd, 3rd and 4th combined together, and bearing two sensoria and two small apical spines, 3rd and 4th segments possess one sensorium and two stout lanceolate setae each, while one lanceolate seta present on 2nd and 5th segment. Legs (Fig. 15c) long and slender, bearing few simple scattered setae; without trochanters; femora reaching the margin of wing-pads; tibio-tarsal articulation distinct; each tarsus with two curved long setae near apex; claws present, the pulvilli petiolate and fish-tail like. Anal opening ventral, located far away from the caudal end, surrounded by a double ring of pores (Fig. 15d), the outer ring prominent and consisting of slit-like pores, while the inner-ring is very poorly defined, both rings are interrupted anteriorly and posteriorly and are guarded by one anterior, one lateral and two posterior pairs of simple setae, the outer posterior pair of setae very long.

***Paurocephala trimaculata*, sp. n.**  
(Fig. 16)

- Length of body, in male, 1.22 mm
- Length of forewings, in male, 1.25 mm
- Width of head with eyes, 0.51 mm
- Width of vertex between eyes, 0.32 mm
- Length of antennae, 0.65 mm

*Colouration.* General colour pale clay yellow, with irregular brownish specks on head, thorax, legs and forewings, specks darker on thorax; venter of abdomen darker, with dark-brown specks on lateral sides; antennae pale-yellow, with apical segments and apices of segments 4, 6 and 8 black; legs pale-yellow, with dark-brown specks on femora; forewings transparent, partly maculated with two transverse and one apical, light brown maculae and small fuscous spots scattered on the membrane; male genitalia slightly darker.

*Structure.* Body small. Head (Fig. 16a) strongly deflexed, rather as broad as thorax, finely and sparsely pubescent; vertex broader than long, about twice as broad as long, slightly rounded downward in front, with two deep foveal impressions, posterior to centre, one on each side of median suture, with a sulcus extending from each fovea to base of antennal sockets; posterior margin strongly arcuate; post-ocellar region slightly swollen; anterior ocellus scarcely visible from above; frons visible in front, bearing anterior ocellus at top; genae not conical, weakly swollen beneath antennal sockets, bearing 3 or 4 pairs of long setae. Antennal sockets large, lateral. Eyes large and recessive.

Antennae (Fig. 16b) small, slender, ten-segmented, bearing few setae, two basal segments robust, 1st broadly transverse, 2nd quadrate, almost as long as 1st, remaining segments slender, imbricate, 3rd segment longest, about thrice as long as 2nd, 4th about half as long as 3rd, 5th slightly smaller than 4th, 6th, 7th and 8th almost equal to one another

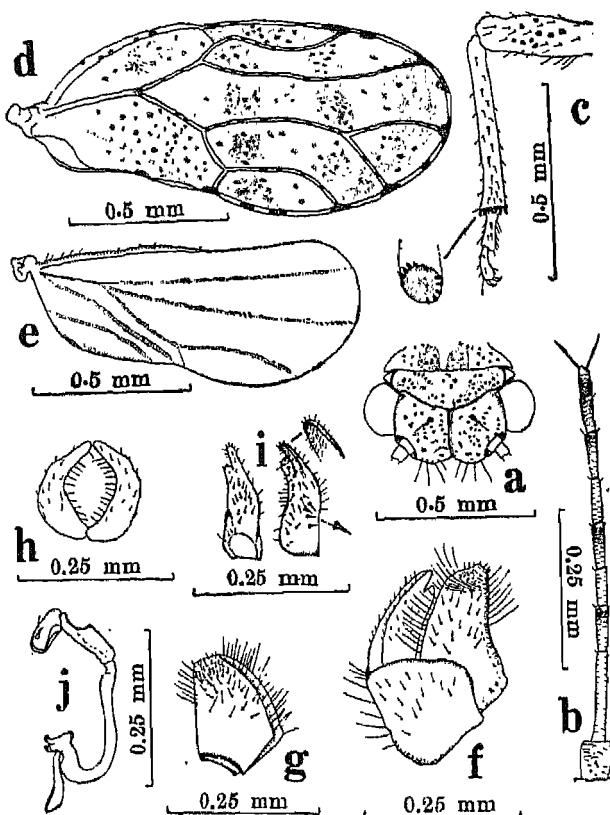


Fig. 16. *Pawocephala trimaculata*, sp. n.—a: head and part of thorax, dorsal view; b: antenna; c: hind leg; d: forewing; e: hind wing; f: male genitalia, lateral view; g: anal valve, lateral view; h, i: parameres, posterior, outer and mesal views; j: aedeagus, lateral view.

and each as long as 4th, 5th and 9th rather equal and each smaller than 8th, terminal segment smallest, with two apical spines, four sensoria present on segments 4,6,8 and 9.

Thorax strongly arched, almost as broad as head including eyes, finely and sparsely pubescent. Prothorax (Fig. 16a) convexly rounded, partly descending, longer in middle and narrower laterally, with two submedian epiphysis and with two foveal impressions on each lateral side; prescutum large, about twice as broad as long, broadest before middle, somewhat anvil-shaped, angulate both laterally and posteriorly; scutum large and broad, about twice as broad as long, almost as long as prescutum, anterior margin strongly concave, angulate and gradually sloping both laterally and posteriorly, disc weakly channelled medio-longitudinally; scutellum broadly transverse, rather rectangular in shape, about twice as broad as long, with prominent antero-lateral angles; post-scutellum of metathorax large and broad, having a strong, median erect epiphysis.

Legs (**Fig. 16c**) small, finely and sparsely pubescent, tibiae longer than femora, all tibiae with apical comb of setae, hind tibiae without basal spur, with 8 or 9 black tooth-like spines at apex and almost arranged in a row, basal tarsal segments slightly smaller than apical segments; meracanthus small, slender and triangular.

Forewings (**Fig. 16d**) large, oval, transparent, maculated with light brownish bands and spotted with scattered dark brown, irregular small specks, a little more than twice as long as broad, narrowly rounded at apex, broadest near about middle, basal vein longer than radius, radius slightly smaller than cubital petiole, cubitus a little more than half as long as cubital petiole, pterostigma present, large and broad, slightly longer than first marginal cell, radial sector quite long and slightly flexed upward to costal margin, marginal cells unequal, first cell longer and broader than second, veins armed with small setae; about a dozen or more black spots present all along the wing margin, and irregularly distributed black spots on the veins.

Hind wings (**Fig. 16a**) also quite large, membrane beset uniformly with minute points, costal margin armed with few simple and hooked setae in the basal half.

Abdomen small, finely and sparsely beset with setae; setae longer on sternites; tergites with humps.

*Genitalia.* Male genital segment (**Fig. 16f**) smaller than abdomen. Anal valve (**Fig. 16g**) large and broad, about 0.20 mm long, slightly longer than parameres; anterior margin straight, broadest in basal half, narrower both basally and apically, posterior margin broadly and convexly rounded, outer surface thickly armed with minute points arranged in linear series and also sparsely beset with long, thick setae in the apical half, marginal setae slightly longer, apex truncate; parameres (**Figs. 16h,i**) small, about 0.18 mm long, strongly bowed inwards, broad basally and gradually narrowed and bilobate apically, the outer lobe longer than the inner, and strongly armed with minute, thick setae, pointing downward, the inner lobe bearing few setae, both lobes sinuate, outer surface sparsely beset with small, simple setae, mesal surface armed with small, 3 or 4 stout and thick setae; hypandrium simple, of usual shape, sparsely pubescent, pubescence longer posteriorly; outer arm of aedeagus (**Fig. 16j**) smaller than basal, deeply notched dorsally in the apical half, spoon end thick.

*Host plant.* On *Zizyphus jujuba* Linn.

*Type locality.* Tambaran, Madras.

*Types.* Described from two male specimens. Type male, February 17, 1968 (B.V. David); Paratype : 1 male (abdomen and male genitalia mounted on slide), from the type locality, 17.2.68 (B.V. David), both collected on *Zizyphus jujuba*. One male paratype of the same data, is deposited at the Agricultural College and Research Institute, Coimbatore (Tamil Nadu).

*Comparison.* This new species is described from two males and resembles closely with *Paurocephala menoni*, but differs from it in shape of head and wings, venation, longer pterostigma, marginal cells and genital characters.

*Biological notes.* Nothing is known about its biology and economic importance, except that it has been recorded on *Zizyphus jujuba* at Tambaran (Tamil Nadu).

Genus **PAUROPSYLLA** Rubsaamen 1899*Pauropsylla*

- Rubaamen, E. H. 1899. *Ent. Nachr. Berlin* 25: 262. figs, 7-13.  
 Kieffer, J. J. 1905. *Ann. Soc. Sci. Bruxelles* 29: 167.  
 Aulmann, G. 1913. *Psyllidarum Catalogus*, Berlin, p. 29.  
 Crawford, D. L. 1915. *Philipp. J. Sci.* 10: 258.  
 Mani, M. S. 1935. *J. Asiatic Soc. Beng.* 1(2): 100.  
 Heslop-Harrison, G. 1951. *Ann. Mag. nat. Hist.* (12) 4: 1-35.  
 Heslop-Harrison, G. 1959. *Ibid.* (13), 2(15): 157-168.  
 Heslop-Harrison, G. 1960. *Ibid.* (13), 3(36): 714.

Type species: *Pauropsylla udei* Rubsaamen, 1899 (original designation).

Body usually short and robust, smooth, strongly arched. Head short, transverse, almost as wide as thorax or slightly smaller, much deflexed, almost vertical, usually without genal cones or genae more or less swollen beneath, sometimes distinct and conical. Vertex usually much broader than long, rounded forward and downward; with or without median suture, with foveal impressions posterior to centre; post-ocellar region generally swollen, post-ocelli often raised; front ocellus scarcely visible from above. Frons usually visible as a small sclerite, bearing the front ocellus at top. Antennal sockets large, lateral. Eyes prominent, large and recessive. Antennae short, often with very long setae at apex, or with smaller terminal setae; shorter or as long as width of vertex between eyes. Prothorax usually descending and partly concealed beneath head. Mesosternum prominent, projecting forward ventrad. Legs usually not large, slender. Forewings hyaline, sometimes maculated, usually large and broadly rounded or subsquarish at the apex; with or without pterostigma; cubital petiole usually smaller than radius, sometimes obsolete and giving the appearance of triozine venation; marginal cells usually unequal, second marginal cell generally near apex.

As some new species have been studied, it seems necessary to supplement the generic characters as described by Rubsaamen in 1899. The already known species are *P. beesoni* Laing, *P. brevicornis* Crawf., *P. depressa* Crawf., *P. ficicola* Kieff., *P. nigra* Crawf., *P. spondiasae* Crawf., *P. stevensi* Laing, and *P. tuberculata* Crawf.; while the new species recorded by me are *P. longispiculata*, *P. maculata*, *P. purpurescens*, *P. reticulata* and *P. verrucosa*. *Pauropsylla stevensi* is not seen by me and its description is reproduced from Laing (1930). All are gall-forming species, except the three species collected on *Mangifera indica*. Their distinguishing characters are tabulated in the key.

## KEY TO THE SPECIES OF PAUROPSYLLA\*

1. Forewings with pterostigma . . . . .	2
—. Forewings without pterostigma . . . . .	8
2. Forewings long and subacute or rounded at apex . . . . .	3
—. Forewings broad and subsquare near apex . . . . .	4
3. Forewings long and subacute at apex . . . . .	<i>P. maculata</i> , sp. n.
—. Forewings narrowly rounded at apex . . . . .	<i>P. stevensi</i> Laing
4. Veins of forewings with small, transverse, scattered black spots; body weakly verrucose . . . . .	<i>P. verrucosa</i> , sp. n.

—. Veins clear, without black spots, body plane . . . . .	5
5. Antennae with two or more very long setae at tip . . . . .	6
—. Antennae with small setae at tip . . . . .	7
6. Antennae with eight long setae, tassel-like . . . . .	<i>P. brevicornis</i> Crawf.
—. Antennae with two long setae, not tassel-like . . . . .	<i>P. nigra</i> Crawf.
7. Head with a median suture . . . . .	<i>P. longispiculata</i> , sp. n.
—. Head without median suture . . . . .	<i>P. spondiasae</i> Crawf.
8. Second marginal cell much longer than first; fork $M_{1+2}$ angulately arched and touching radial sector . . . . .	<i>P. tuberculata</i> Crawf.
—. Second marginal cell not larger than first, usually subequal; fork $M_{1+2}$ not touching radial sector . . . . .	9
9. Head without median suture . . . . .	10
—. Head with median suture . . . . .	11
10. Forewings large and broad, more subsquarish in apical half . . . . .	<i>P. depressa</i> Crawf.
—. Forewings small, gradually and narrowly rounded in apical half . . . . .	<i>P. purpurescens</i> , sp. n.
11. Forewings broad and subsquare near apex . . . . .	<i>P. reticulata</i> , sp. n.
—. Forewings large and narrowly rounded at apex . . . . .	12
12. Cubital petiole present, small; radial sector deflexed towards apex . . . . .	<i>Pauropsylla sicula</i> Kieff.
—. Cubital petiole almost obsolete; radial sector flexed towards costal margin . . . . .	<i>P. beesoni</i> Laing

\* *Pauropsylla globuli* Kieffer not included due to lack of knowledge.

***Pauropsylla beesoni* Laing 1930**  
(Fig. 17) (Plate 3, c)

Laing, F. 1930. *Indian Forest Rec.* 14(8): 36-37, fig. 1.

Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 45-47, pl. 1, fig. 1. (biology).

Beeson, C. F. C. 1941. *Forest Insects*, pp. 777-778, (Biological notes).

Mathur, R. N. 1949. *Indian J. Ent.* 8(2): 226-227, fig. 2, (December, 1946), (Nymphal stages).

Length of body, in male, 2.25 mm; in female, 2.52 mm

Length of forewings, in male, 3.41 mm; in female, 4.16 mm

Width of head with eyes, 0.75 mm

Width of vertex between eyes, 0.42 mm

Length of antennae, 1.52 mm

**Colouration.** General colour pale honey brown to dark-brown, with head dark castaneous brown to black posteriorly and pale-yellow anteriorly; antennae pale-yellowish proximally and dark-brown to black distally, apices of segments 3, 4, 5 and 6 black; eyes black; median area of mesonotum darker; mesoscutellum and pseudonotum yellowish white; legs pale-yellowish with the apices of the tibiae and the tarsal segments partially dark; mesosternum black, pro- and meta-sternum pale-yellow; forewings hyaline with a little pale brown alongside the main vein at the base; nerves pale-brown; abdomen dark-brown with narrow, pale brown intersegmental bands between sternites.

**Structure.** Body very robust and covered sparsely with long hairs. Head (**Fig. 17a**) shorter than thorax, clothed sparsely with long hairs, slightly deflexed; vertex broader than long, about twice as broad as long along the median suture, median line forming a narrow sulcus, with two large foveal impressions, posterior to centre, one on each side

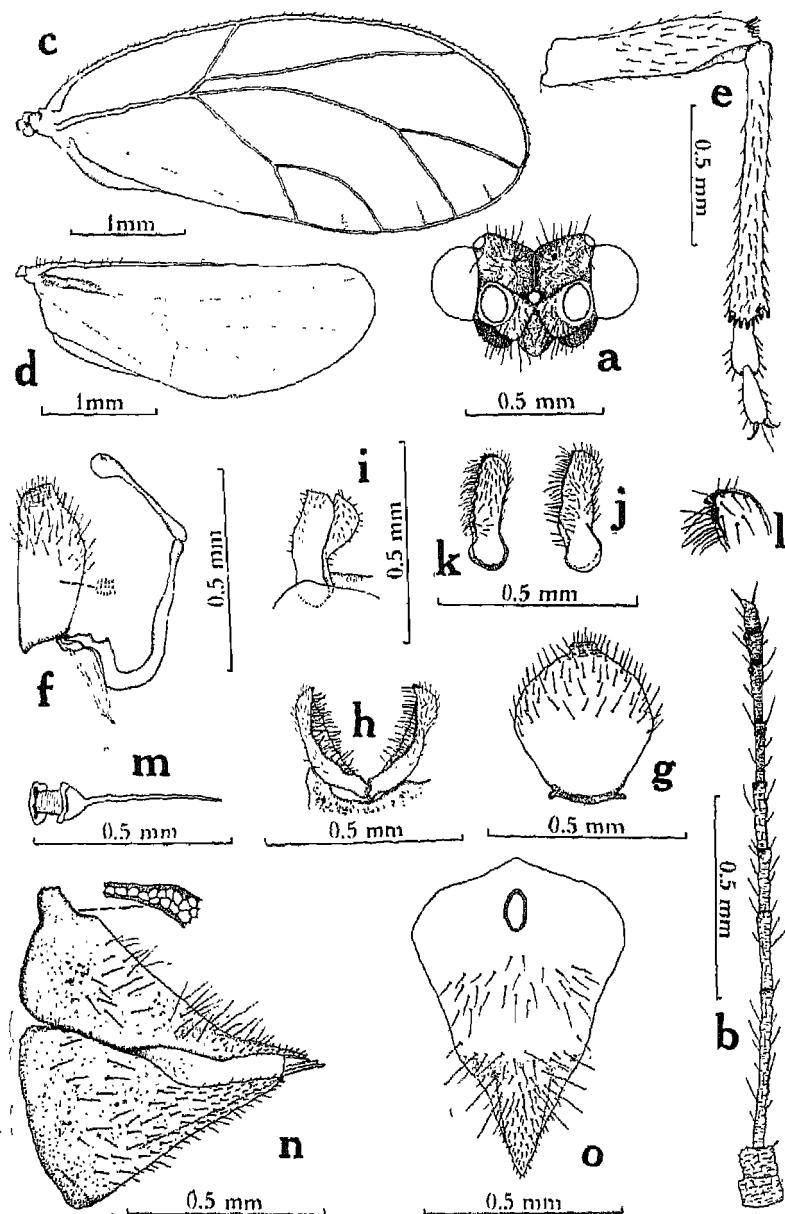


Fig. 17. *Pauropsylla beesoni* Laing.—a: head, front view; b: antenna; c: forewing; d: hind wing; e: hind leg; f: anal valve and aedeagus, lateral view; g: anal valve, upper surface; h: parameres, anterior view; i: same, lateral view; j, k: same, upper and mesal surfaces; l: apical end of forceps, highly magnified; m: sperm pump; n: female genitalia, lateral view; o: dorsal plate.

of median suture, post-ocellar region elevated, posterior margin strongly emarginate, anterior ocellus visible from above and nearly on level with the antennal sockets, anterior margin deeply invaginated in middle; genae small, swollen lobes forming between them a narrow concavity, pubescent with long hairs. Eyes large, somewhat hemispherical when seen in front. Clypeus small, tongue-like, and projecting forward.

Antennae (**Fig. 17b**) long, slender, except two robust basal segments, ten-segmented, bearing few long hairs, imbricate, 1st and 2nd segments broadly transverse, equal in length, 3rd segment longest, about twice as long as 4th, 4th longer than 5th, 5th, 7th and 8th equal to one another and each slightly smaller than 6th, 6th slightly smaller than 4th, 9th half as long as 8th, terminal segment slightly longer than 9th, bearing two unequal spines apically, two apical segments broader, four sensoria present on segments 4, 6, 8 and 9.

Thorax large, robust, strongly arched, sparsely pubescent, finely rugulose; pronotum forming a narrow ring-like segment, convexly and narrowly rounded, descending vertically, with a very small median epiphysis near posterior border, lateral sides project below eyes; prescutum large, slightly broader than long, broadest in middle, narrowly and convexly rounded anteriorly, angulate laterally; scutum large, about two and a half times as broad as long, broadest before middle, slightly shorter in length than prescutum, angulate laterally; scutellum broadly transverse, sub-rectangular, with prominent antero-lateral angles; pseudonotum with the front and hind margins parallel, the front slightly shorter than the rear.

Legs (**Fig. 17e**) moderately long and thick, pubescent and also armed with minute points arranged in linear series, femora shorter than tibiae, all tibiae with apical comb of setae, hind femora with six dorsal spines near apex, hind tibiae without basal spur, with seven thick spines at apex (4 on one side and 3 on the other), apical region slightly swollen and thick; tarsal segments of nearly equal length; meracanthus large, somewhat tubular, roundly pointed apically.

Forewings (**Fig. 17c**) large, hyaline, transparent, about two and one-fourth times as long as broad ( $2\frac{1}{2}$  times, according to Laing, 1930), rounded apically, the radius, media and cubitus arising almost from the same point, radius very small and about  $\frac{1}{4}$ th as long as  $R_1$ ,  $Rs$  quite long, directed straight towards costal margin, cubitus longer than  $R_1$ , basal vein slightly longer than cubitus, first marginal cell scarcely longer than second, but almost equal in width near the margin, veins armed with microscopic setae.

Hind wings (**Fig. 17d**) smaller, costal margin bearing few simple and hooked setae near base, membrane thickly and uniformly beset with minute points.

Abdomen broader than long, armed with fine minute points, sternites bearing small hairs.

*Genitalia.* Male genital segment smaller than abdomen. Anal valve (proctiger) (**Fig. 17f,g**) longer than forceps (parameres), about 0.41 mm long, in profile, anterior margin almost straight, posterior margin broadly convex, broadest above middle, narrower both basally and apically, outer surface armed with minute points arranged in lines, the apical portion beset with long, simple setae, anus small, aperture truncate; parameres (**Figs. 17 h,i,j, k**) about 0.32 mm long, sides sub-parallel, tapering to apex which

is sharply curved mesad and caudad as a black sub-acute, small, bidentate tooth, outer surface beset with strong, thick setae, mesal margins irregular and armed with strong thick setae in the apical region, mesal surface sinuate and also beset with small thick setae directed downward; hypandrium of usual shape, sparsely pubescent and also armed with minute points; outer arm of aedeagus (**Fig. 17f**) smaller than basal, with a spatulate end; sperm pump as figured (**Fig. 17m**).

Female genitalia (**Fig. 17n**) longer than abdomen. Both plates sub-equal, dorsal plate (**Fig. 17 o**) longer than ventral, broad basally, gradually attenuate and roundly pointed at apex, sparsely pubescent, caudal region armed with small, thick setae; circum-anal ring small and composed of a band of pores; ventral plate broad basally, attenuate and acute at apex, pubescent, posterior setae smaller; ovipositor acutely pointed.

*Host plant.* Bred ex galls on leaves of *Litsea monopetala* (Roxb.) Pers. (=*L. polyantha* Juss.).

*Distribution.* Previously recorded from Dehra Dun (U.P.).

*Material examined.* In addition to the para type material and some more specimens of the same, the collection at the Forest Research Institute, Dehra Dun, consists of 1 ex. of 30-5-32; 20 ex. of 8-3-33, 6 ex. of 9-3-33; 1 ex. of 25-3-34; 12 ex. of 12-3-51; and 6 ex. of 28-3-63; all from New Forest, Dehra Dun (U.P.) and from *Litsea monopetala* (R. N. Mathur); and 2 males and 2 females of 4-3-46, from the same host plant and collected from Dehra Dun (U.P.) (R. N. Mathur). The preserved material (in alcohol) includes many adults and nymphal stages, in two phials

There are 8 specimens collected from New Forest, Dehra Dun, ex galls on *Litsea monopetala*, (R. N. Mathur), present at I.A.R.I., New Delhi. Two more specimens of 12-3-1951, collected from New Forest (R. N. Mathur), have been donated to this institute.

*Comparison.* Laing (1930) has described this species and writes, ".....belongs to the same group of the genus *Pauropsylla* as *P. trizoptera* Crawf." It is redescribed with more detailed figures. *P. beesoni* is characterised by the shape of its head, forewings, venation, colouration and other genital characters, and is easily separated by these features from other species.

*Biological notes.* Mathur (1935) has dealt with its biology, etc., and brief notes are also given by Beeson (1941). The nymphal stages are described by Mathur (1949). *P. beesoni* Laing occurs commonly at Dehra Dun, and in heavy infestations, practically all the top leaves are badly galled (Plate 3c) which considerably hamper the growth of trees.

#### *Pauropsylla brevicornis* Crawford 1919

(Fig. 18)

Crawford, D. L. 1919. *Philipp. J. Sci.* 15(2): 142-143, Pl. 1, figs. 1 and 2. (Tenimber Islands, Larat).

Boselli, F. B. 1930. *Boll. Lab. Zool. agr., Portici.*, 24, pl 23. (*Microceropsylla brevicornis*)

Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 47 (Dehra Dun, U.P.).

Heslop-Harrison, G. 1968. *Ann. Mag. nat. Hist.* (12), 1: 291. (*Microceropsylla brevicornis* Crawf.)

Length of body, in male, 1.25 mm; in female, 1.52 mm

Length of forewings, in male, 1.80 mm; in female, 2.0 mm

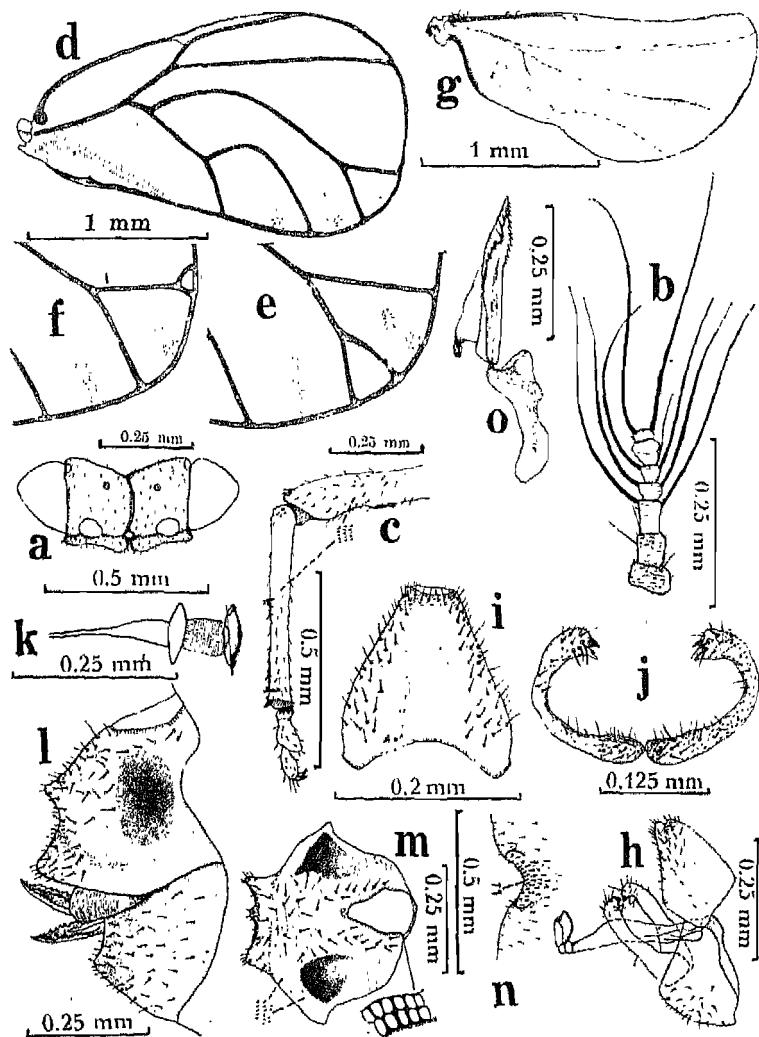


Fig. 18. *Paurophylla brevicornis* Crawford—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**, **f**: apical portion of forewings; **g**: hind wing; **h**: male genitalia, lateral view; **i**: anal valve; upper surface; **j**: forceps; **k**: sperm pump; **l**: female genitalia, lateral view; **m**: dorsal plate; **n**: portion of ventral plate; **o**: ovipositor sheath.

Width of head with eyes, 0.70 mm

Width of vertex between eyes, 0.40 mm

Length of antennae, 0.70 mm

**Colouration.** (Dry specimens) Male: General colour chocolate-brown to black, head black with greyish tinge, thorax black both dorsally and ventrally, metathorax yellow,

legs pale-yellow, metacoxa with a black spot, abdomen yellow with two black lateral bands, genitalia black. Female: General colour of head and thorax pinkish-brown with greyish tinge laterally, scutellum pale-yellow, metathorax yellow, antennae and legs pale-yellow, metacoxa with a broad black spot, abdomen yellow with a broad black transverse band on segment 4, and two broad lateral black bands, genitalia pale-yellow with a fuscous spot on each side of dorsal plate, ovipositor dark-brown.

Wings hyaline with pale-yellow veins, in both sexes.

*Structure.* Body small in male and robust in female, shining. Head (**Fig. 18a**), including eyes, as broad as thorax, strongly declivous, finely and sparsely pubescent; vertex large, roundly convex on both sides of median line in front view, with weak foveal impressions posterior to centre, anterior region beset with minute points, posterior ocelli slightly elevated, anterior ocellus visible in front; frons not visible; genae very small, slightly swollen beneath antennal bases, sparsely hairy and also beset with minute points. Eyes small, subtriangular. Clypeus and beak small.

Antennae (**Fig. 18b**) very short, seven-segmented (Crawford has figured six segments), imbricate, with 8 long, slender setae, tassel-like, first two segments robust, 1st transverse, 2nd subquadrate, segment 3rd thinner, about as long as segments 4 and 5 together, segments 4 and 5 equal, smaller than other segments, 4th slightly broader than 5th, 6th slightly broader than long, apical segment smallest, transverse, with two long setae, these setae are slightly more than one and a half times longer than the antenna itself.

Thorax robust and strongly arched, sparsely hairy, pro- and mesothorax strongly rugulose. Prothorax small, narrow, descending, strongly and narrowly convex, longer in middle, thinner laterally, with two foveal impressions on each side; prescutum large, broader than long, about one and a half times broader than long, broadest before middle, narrower both anteriorly and posteriorly, angulate laterally; scutum large, broader than prescutum, about two and a half times as broad as long, slightly shorter than prescutum in length, broadest in centre, disc weakly depressed forming a longitudinal median channel; scutellum broadly transverse, about one and a half times as broad as long, anterior margin slightly convex, having prominent antero-lateral angles, posterior margin somewhat irregular.

Legs (**Fig. 18c**) short and slender, sparsely pubescent and also armed with minute points, arranged in lines, tibiae longer than femora, hind tibiae without basal spur, with five black tooth-like spines at apex, four approximate and one separate, tarsal segments almost equal in length, meracanthus small, papilla-like.

Forewings (**Fig. 18d**) hyaline, veins prominent, a little more than one and a half times longer than broad, broad and rounded at apex, basal vein slightly longer than radius, radial sector long and straight, pterostigma long and narrow, radius about twice as long as cubital petiole, first marginal cell twice longer than second, broad and subsquarish apically. In some examples of both sexes, either the stem  $M_1+2$  or  $M_3+4$  is branched (**Figs. 18e,f**).

Hind wings (**Fig. 18g**) large, slightly smaller than forewings, membrane thickly beset with minute points, costal margin armed with few simple setae near base and three hooked setae.

Abdomen small in male and moderately large and robust in female, sparsely pubescent and thickly beset with rows of minute points.

**Genitalia.** Male genital segment (**Fig. 18h**) smaller than abdomen, sparsely pubescent; anal valve (**Fig. 18i**) slightly smaller than parameres, about 0.18 mm long, broader at base and gradually narrowed and truncate at apex, anterior margin straight, posterior margin weakly concave, sparsely beset with simple setae and thickly with minute points; parameres (**Fig. 18j**) about 0.21 mm long, sparsely beset with setae strongly curved at apex, broader at base and narrower at top, terminating towards inner side in two acute black points, the apical point stronger and thicker than the lower point, the lower point weakly bipartite, three thick, curved setae present near apical points, basal region bearing a group of small setae, marginal setae slightly longer; outer arm of aedeagus (**Fig. 18h**) small and robust, basal arm swollen in the apical half; hypandrium small, simple, of usual shape, bearing sparse pubescence; sperm pump as figured (**Fig. 18k**).

Female genital segment (**Fig. 18l**) very short, bent downward, sparsely beset with simple setae and rows of minute points, both plates subequal in length and emarginate at apices; dorsal plate (**Fig. 18m**) large and longer than ventral, with two dark, lateral patches, and a large dorsal anal opening, anal-ring composed of a double row of pores and guarded by thick setae; apical region of ventral plate (**Fig. 18n**) armed with small, thick setae; ovipositor sheath (**Fig. 18o**) prominently serrated, ovipositor acutely pointed.

**Host plant.** On young leaves of *Mangifera indica* Linn.

**Distribution.** Previously recorded from Tenimber Islands, Larat (Crawford, 1919); and from Dehra Dun (U.P.) (Mathur, 1935), Ludhiana (Punjab).

**Material examined.** The collection at the Forest Research Institute, New Forest, consists of 1 ex. of March 16, 1932, 1 ex. of April 11, 1933; 1 ex. of June 5, 1933; 1 ex. of March 27 and 3 ex. of April 1, 1936; 1, 8 and 9 examples of April 2, 7 and 8, 1937, respectively; 1, 3, 2, 1, 1 and 2 examples of March 19, 20, 25, 26, 28 and 31, 1963, respectively; and 4 examples of May 15, 1963; all were collected from New Forest, Dehra Dun (U.P.) (R. N. Mathur). Some specimens collected on 15-3-1966 have also been received from Ludhiana, Punjab (O. S. Bindra), on mango. Some adults collected during April and May 1962, from Dehra Dun (R. N. Mathur) were preserved in alcohol. And 4 examples of 8-4-45 from Dehra Dun, and 9 and 4 examples of 12-4-50 and 20-4-50 from New Forest (R. N. Mathur), all collected on mango leaves. Two specimens from New Forest, Dehra Dun, and collected on 25-3-63, on *Mangifera indica* (R. N. Mathur) are donated to the I.A.R.I., New Delhi.

**Comparison.** *Pauropsylla brevicornis* Crawford (1919) was described from 1 male and 2 females. It is redescribed here from a long series of both sexes. Its identification has been confirmed by Dr (Miss) Russell of U. S. National Museum, with these remarks: "Your specimens appear to be similar in structure to the types of *brevicornis* but they differ conspicuously in colour. In the ♀ types the dorsum of the abdomen is black except for the posterior margin of the segment preceding the genitalia. The ventral surface of the abdomen and legs are light. There is a dark spot at the base of the metacoxa as in your specimens. The colour of the ♂ types is the same as that of the ♀ with the genitalia light. The forceps are more slender and in lateral view are more strongly

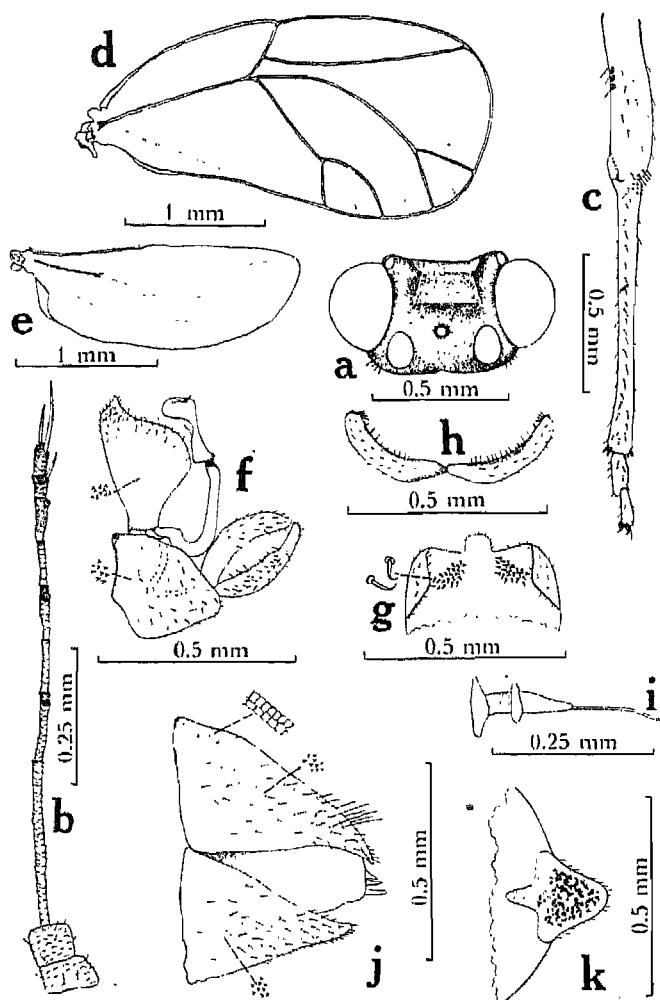


Fig. 19. *Pauropsylla depressa* Crawford—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: male genitalia, lateral view; **g**: anal valve, mesal surface; **h**: parameres, caudal view; **i**: sperm pump; **j**: female genitalia, lateral view; **k**: part of ventral plate, mesal surface.

curved caudad than in your specimens.” However, such differences are likely to occur due to climatic and distributional factors, and therefore, the specimens from India are being retained under *brevicornis* for the present.

*P. brevicornis* Crawf. is easily recognised by its antennae having eight long setae, tassel-like, presence of pterostigma, with distinct median suture and shape of head, venation, genital characters and colouration.

*Biological notes.* Nothing is known regarding its life history, etc., except that this species

appears quite commonly during March to May, at Dehra Dun, when new flush of leaves appear on *Mangifera indica*.

**Pauropsylla depressa** Crawford 1912

(Fig. 19) (Plate 3, a, b)

- Crawford, D. L. 1912. *Rec. Indian Mus.* 7(5): 429-430, pl. XXXIV figs. G, H; pl. XXXV fig. N. (In galls on leaves of *Ficus glomerata*, Pusa, Bihar).
- Crawford, D. L. 1924. *Rec. Indian Mus.* 26: 615 (On *Ficus glomerata*, Coimbatore; on cinnamon shoots, at Mangalore (gall-forming)).
- Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 25: 622 (Noted also in galls of cinnamon leaves, S. Kanara).
- Rahman, Khan, A. 1932. *Indian J. agric. Res.* 2(4): 365-367, pl. xxviii, (Nymphal stages; ex galls on leaves of *Ficus glomerata*, Pusa (Bihar); Lahore (Pakistan)).
- Mani, M. S. 1935. *J. Asiatic Soc. Beng.* 1(2): 101-102, fig. 1.
- Mathur, R. N. 1935. *Indian For. Rec.* 1(2): 48, (Biology), pl. 11, fig. 18.
- Beeson, C.F.C. 1941 *Fore. & Insects*, 7: 8 (Bio'ogical notes).
- Naidu, M. 1945. *Curr. Sci.* 14(2): 42-43 (Braconid parasite, life-history).
- Mani, M. S. 1959. *Agra Univ. J. Res. (Sci.)* 8(2): 252-253 (India).
- Weidner, H. 1961. *Sonderdr. Abh. Verh. der naturw. Vere. Hamburg* 5 (1960): 27, 28, 46.

Length of body, in male, 1·72 mm; in female, 2·1 mm

Length of forewings, in male, 2·80 mm; in female, 3·00 mm

Width of head with eyes, 0·82 mm

Width of vertex between eyes, 0·50 mm

Length of antennae, 1·10 mm

*Colouration.* General colour orange-red or dark-brown with blackish tinge, tip of labium black, legs lighter yellowish, hind femora fuscous, tarsi often more or less black, antennae pale-yellow proximally, apical segments and apices of segments 4 and 6 black or dark-brown; in mature specimens males are darker than females.

*Structure.* Body robust, moderately large. Head (Fig. 19a) short, deflexed, narrower than thorax, somewhat pubescent; vertex much broader than long, shining, no median suture, surface smooth, finely rugulose in the post-ocellar region and ventral to front ocellus, with two foveal impressions posterior to centre, anteriorly roundly bulging, posterior margin arcuate downward between eyes, post-ocelli elevated, anterior ocellus in front visible from above; genal cones entirely wanting. Eyes rather small. Clypeus large, globose in front. Antennal insertions beneath and slightly swollen.

Antennae (Fig. 19b) small, ten-segmented, about one and a third times as long as head, having few setae, two basal segments robust, remaining segments slender, imbricate, 1st segment narrowly transverse, 2nd broadly transverse, slightly longer than 1st, 3rd longest, slightly more than twice as long as 4th, 5th and 6th equal and slightly more than half as long as 4th, 7th and 8th equal and slightly smaller than 5th, 9th half as long as 8th, bearing a long seta, terminal segment slightly longer than penultimate, having two unequal, moderately long apical setae, apical segments slightly compressed; four sensoria present on segments 4, 6, 8 and 9.

Thorax strongly arched, broad, sparsely pubescent, finely rugulose when seen under high magnification. Pronotum short, scarcely visible from above between head and dorsulum, ascending, narrowly convex dorsally, anterior margin invaginated medially, with lateral foveal impressions; prescutum rather large ascending, broader than long, broadest in middle, narrower both anteriorly and posteriorly, angulate both laterally and posteriorly; scutum very large, broad, slightly more than two and a half times as broad as long, slightly smaller in length than prescutum, angulate laterally; scutellum broadly transverse, anterior margin almost straight, with antero-lateral angles, narrowly rounded posteriorly; mesopleurae very large, prominent and produced forward.

Legs (**Fig. 19c**) long, slender, pubescent and also beset with minute points arranged in linear series, femora shorter than tibiae, all tibiae with apical comb of setae, hind femur with three sensoria-like structures ventrally, and with four long, dorsal setae near apex, hind tibiae with a series of minute basal spurs, and three black tooth-like spines at apex (2 on one side and 1 on the other); tarsal joints of equal length; meracanthus small, slender and triangular.

Forewings (**Fig. 19d**) large, hyaline, transparent, broadest subapically, rather square at apex, slightly more than twice as long as broad, basal vein ( $R+M+Cu$ ) very long, cubital petiole ( $M+Cu$ ) very short, marginal cells small, unequal, first longer than but as wide as second, radius ( $R$ ) shorter than  $R_1$ , radial cell broad at base; veins armed with microscopic setae. Hind wings (**Fig. 19e**) small, uniformly beset with minute points, costal vein armed with few simple and hooked setae.

Abdomen in both sexes usually broad and depressed, subcircular in outline from above, beset with minute points, and finely and sparsely pubescent, hairs longer ventrally.

*Genitalia.* Male genital segment (**Fig. 19f**) rather small; anal valve longer than forceps, in lateral view, anterior margin weakly concave basally and then weakly convex or somewhat straight above, posterior margin broadest above base and arcuately produced into broad lateral lobes, simple setae present on the apical and marginal regions of the lateral lobes, outer surface beset with minute points arranged in linear series, mesal surface (**Fig. 19g**) armed with two groups of thick setae; anal opening obtuse; parameres (**Fig. 19h**) curved cephalad and arcuate toward each other, in profile sides somewhat curved parallelly, terminating in a round black point, outer surface bearing small sparse setae, marginal setae slightly longer, four thick setae pointing downwards present just below in the apical concavity; hypandrium simple, of usual shape, sparsely bearing simple setae and also armed with minute points arranged in lines; outer arm of aedeagus (**Fig. 19f**) smaller than basal, thick and curved like a sign of interrogation; sperm pump as figured (**Fig. 19i**).

Female genital segment (**Fig. 19j**) smaller and about half as long as abdomen, and usually bent down, and often (dried specimens) lying along ventral surface of abdomen; dorsal plate slightly longer than ventral, broad basally and gradually sloping caudally, subacute at apex, surface beset with simple setae and also with minute points; anal opening rather oval and surrounded by a ring of double row of pores; ventral plate (**Fig. 19k**) also broad at base and abruptly narrower posteriorly, subacute at apex, surface

armed with simple setae and also with minute points; ovipositor acutely pointed.

*Host plants.* Bred ex galls on leaves of *Ficus racemosa* L. (=*F. glomerata* Roxb.); on *Cinnamomum* shoots.

*Distribution.* Previously recorded from Pusa (Bihar), in galls on leaves of *Ficus racemosa* (=*F. glomerata*); Coimbatore (Tamil Nadu), from the same host plant; Mangalore (Kerala), on *Cinnamomum* shoots, March 1919 (gall forming); New Forest, Dehra Dun, (U.P.); Nagpur (Maharashtra), and Lahore (W. Pakistan). Widely distributed wherever *Ficus racemosa* grows. Mani (1959) has mentioned India, Burma, Ceylon, Java, Hong-kong and Philippines.

*Material examined.* The collection at the Forest Research Institute, Dehra Dun, consists of 3 males, 2 females of 15.3.32; 5 females of 16.3.32; 3 females of 22.3.32, from New Forest, Dehra Dun (R.N. Mathur) (Expt.368); 1 female of 7.2.33; 1 female of 8.2.33; 1 female of 14.2.33; 1 female of 17.2.33; 6 males and 2 females of 23. 2.33; 6 males and 7 females of 8.3.33, all from New Forest, Dehra Dun (R.N. Mathur) (Expt.431); 1 female of 23.3.33, from Asan River, Dehra Dun (M. Bose); 1 male and 2 females of 6.4.34 from New Forest (R.N. Mathur) (Expt.497 A); and 1 male and 2 females of 13.3.35, from New Forest (R.N. Mathur) (Expt. 506 A); some galled leaves of *F. racemosa* were also received from Forest nursery, Mt. Abu, Rajasthan (V.D. Mathur), 16.7.64; from Agra, U.P., 1.7.66, (R.D. Saksena); and from New Delhi, on *Ficus* sp. (B.R. Subba Rao). Some adults and nymphal stages collected from Dehra Dun, during 1952 and 1955 (R.N. Mathur) were preserved in alcohol (2 phials).

At the Indian Agricultural Research Institute, New Delhi; 1 example of 17.10.07, 1 ex. of 17.xii.07, 2 ex. of 26.1.08, 1 ex. of 10.3.09, from Pusa, Bihar (C.S.M); 4 ex of 26.1.16 and 2 ex. of 28.1.16, also from Pusa, Bihar (U. Bahadur). Some of these specimens are in poor condition.

Six specimens are represented at the Zoological Survey of India, Calcutta, having this data: Medical Colony, Ajni, Nagpur (V. Pawar) (Reg.No. 8728, 8733/H7, Lot No. 68, 1964).

One male specimen of 10.4.36, present at the Agricultural Research Institute, Coimbatore (A.G.R.).

*Comparison.* This is the most common gall-forming species on *Ficus racemosa*, and is redescribed from a number of specimens. It is distinguishable by the shape of head, absence of median suture, shape of forewings and venation, antennae and genital characters.

*Biological notes.* Mathur (1935) and Beeson (1941) have given its biology and gall-forming habits. In heavy infestations, the leaves are entirely glomerated with numerous galls (Plate 3, a, b) and become seriously curled or grotesquely shaped. Rahman (1932) has described its nymphal stages. The description of the gall and distribution of the species are given by Mani (1959).

#### ***Pauropsylla ficicola* Kieffer 1905**

(Figs. 20, 21)

Kieffer, J. J. 1905. *Ann. Soc. Sci. Bruxelles* 29: 169-172.

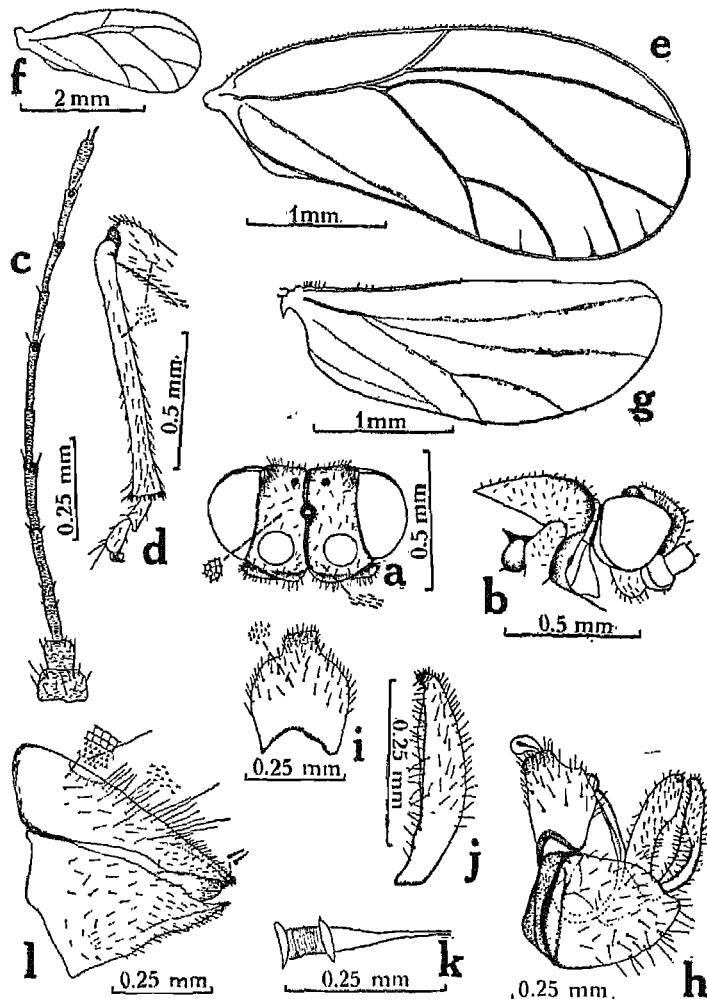


Fig. 20. *Pauropsylla ficicola* Kieff.—a: front view of head; b: lateral view of head and thorax; c: antenna; d: part of hind leg; e: forewing; f: forewing having an extra cell; g: hind wing; h: male genital segment; i: anal valve, anterior aspect; j: forcep, lateral aspect; k: sperm pump; l: female genital segment.

Length of body, in male, 2.23 mm; in female, 2.42 mm

Length of forewings, in male, 2.87 mm; in female, 3.21 mm

Width of head with eyes, 0.72 mm

Width of vertex between eyes, 0.38 mm

Length of antennae, 1.42 mm

*Colouration.* General colour pale-brown to dark-brown, with anterior part of prothorax, anterior broad median band on prescutum, two pairs of longitudinal, submedian, broad bands on scutum, vertex in front of anterior ocellus, distal two-thirds of antennae and tarsal segments dark-brown to fuscous; wings hyaline, transparent, veins dark-brown.

*Structure.* Body robust. Head (**Figs. 20a,b**) slightly smaller than thorax, moderately deflexed, sparsely pubescent with long setae, finely reticulate-rugulose; vertex slightly longer than broad, somewhat horizontal in the posterior region and then roundly bent downward anteriorly, with two foveal impressions near posterior border and on either side of median suture, posterior margin weakly emarginate, post-ocellar region strongly swollen bearing ocelli; frons visible as a small sclerite and situated above the level of antennal sockets, bearing anterior ocellus dorsally; genae small, swollen beneath antennal sockets, finely rugulose and sparsely pubescent with long hairs. Eyes large, somewhat hemispherical.

Antennae (**Fig. 20c**) small, ten-segmented, finely and sparsely hairy, two basal segments robust, 1st transverse, 2nd nearly quadrate, remaining segments slender and imbricate, 3rd longest, 4th and 6th equal but smaller than 3rd, 5th, 7th and 9th equal but smaller than 4th, 8th and 10th equal but smaller than 5th, terminal segment with two small, unequal setae at apex, four sensoria present on segments 4, 6, 8 and 9.

Thorax (**Fig. 20d**) robust, strongly arched, shining, sparsely pubescent with thick setae, finely rugulose. Prothorax much deflexed and thus partly concealed behind head, differentiated into two parts, the convex anterior region and the flat posterior region when viewed dorsally, posterior border deeply grooved, having large foveal impressions on each lateral side; prescutum strongly arched, almost as long as broad, broadest in anterior half, convex and descending vertically anteriorly, much narrower posteriorly, angulate laterally; scutum quite broad, slightly more than twice as broad as long, broadest before middle, grooved longitudinally, forming a shallow median channel, shorter in length than prescutum, anterior margin deeply concave, while the posterior margin broadly convex, angulate both laterally and posteriorly; scutellum broadly transverse about twice as broad as long, gradually narrowed and rounded posteriorly, angulate at antero-lateral angles; mesopleurae large, prominent and produced forward in front.

Legs (**Fig. 20d**) moderately long, pubescent with long setae and also beset with fine points arranged in lines, femora longer than tibiae, all tibiae with a comb of setae near apex, hind femur with four thick, dorsal setae near apex, outer side with a row of thick setae, hind tibiae without basal spur, with seven, thick, black tooth-like spines at apex, basal tarsal segment slightly smaller than apical in all legs, meracanthus large, subtriangular, beset basally with minute points.

Forewings (**Fig. 20e**) large, slightly more than twice as broad as long, broadly rounded at apex, without pterostigma,  $Rs$  quite long and flexed downward, radius about three times as long as cubital petiole, basal vein also long, first marginal cell slightly longer than second,  $R$  and  $R_1$  almost equal in length, veins armed with microscopic setae. In one specimen, a small cross vein present joining media with radial sector, thus forming

a small cell (**Fig. 20f**). Hind wings also quite large, membrane thickly and uniformly beset with minute points, costal margin armed with a few simple and hooked setae in basal half (**Fig. 20g**).

Abdomen robust, longer than broad, pubescent, setae longer on sternites, also thickly beset with minute points.

*Genitalia.* Male genital segment (**Fig. 20h**) smaller than abdomen. Anal valve (**Fig. 20i**) scarcely smaller than forceps, about 0.25 mm long, pyriform, when viewed laterally, anterior margin nearly straight, posterior margin broadly convex, outer surface beset with long and thick setae and also with minute points; parameres (**Fig. 20j**) about 0.28 mm long, subparallel, bent inwards and ending in a strong point at apex, few thick setae directed downward present just below apex, outer surface sparsely armed with simple setae, mesal surface beset with thick setae pointing downward, marginal and basal setae slightly longer than apical; outer arm of aedeagus smaller than basal, ending in a spoon-like apex; hypandrium simple, of usual shape, sparsely pubescent and also beset with minute points.

Female genital segment smaller than abdomen, pubescent with long setae; dorsal plate (**Fig. 20 l**) slightly longer than ventral, broad basally and narrow apically, ending in a rounded apex, surface armed with minute points which are arranged in lines in the basal region, anal ring composed of two rows of pores, guarded by small setae; ventral plate acutely pointed at apex, basal region quite broad; ovipositor acutely pointed.

*Host plant.* Bred *ex* galls on leaves of *Ficus roxburghii* Wall. On *Ficus hookeri* Miq. (Kieffer, 1905).

*Distribution.* Lansdowne (1,677 m), U.P., 2 females and 1 male collected on October 3, 1934 (P.C. Kanjilal); Mussoorie (2,287 m), U.P., 6 males and 6 females bred *ex* galls, on September 10, 1935 (B.M. Bhatia) (R.R.D.924.35.HI), with few adults and nymphs preserved in alcohol. Some adults and nymphal stages collected on December 14, 1949, were also received from Ranikhet, Kumaon (U.P.) (Z.A. Siddiqi), (preserved in alcohol), on local fig leaves (Timla). *Pauropsylla ficicola* Kieffer (1905) has been recorded from Bengal, on *Ficus hookeri* Miq.

*Type.* Neotype male, Mussoorie (1,525 m), 10.9.1935 (B.M. Bhatia), *ex Ficus roxburghii* (leaf galls).

*Comparison.* These psyllids very closely tallied with the description of *P. ficicola* Kieffer. The whereabouts of Kieffers' type is not known. The authorities of the Brussels Museum, from where the original description was published, have reported that it is not in their collection. Further endeavours to trace it also proved futile. Under the circumstance, it was felt desirable to select a neotype. This has been done in accordance with the provisions of Article 75 of the International Code of Zoological Nomenclature. The neotype specimen along with others from the same series is deposited in F.R.I., Dehra Dun. This species has been redescribed from the examples of both sexes, bred *ex* galls of the host plant from the above localities. It differs from other species in the shape and different type of venation of wings, shape of head and genital characters.

*Biological notes.* Brief history of this species is given by Mathur (1935) and Beeson (1941). Its nymphal stages are described below.

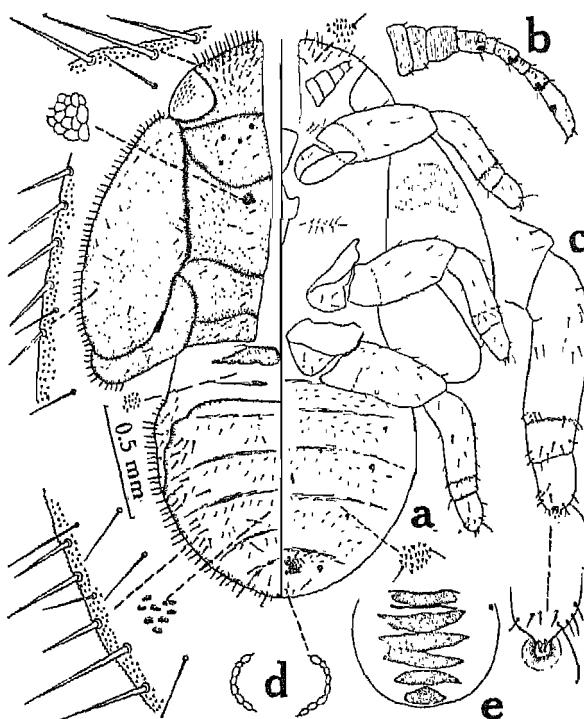


Fig. 21. *Pauropsylla ficicola* Kieff.—a: fifth stage nymph; b: antenna; c: part of leg; d: anal pore ring; e: dorsal aspect of abdomen of fourth stage nymph showing dorsal plates.

### Nymphal stages

**Fifth stage.** Length 2·45 mm. Form pauropsylline (**Fig. 21a**) oval, the continuity of the margin interrupted near the eyes and at the base of abdomen; the wing-pads protecting forward slightly beyond the base of eyes. Derm strongly sclerotic, the abdomen composed for the most part of a single plate, showing traces of segmentation, and the basal region consisting of two transverse, thin, strip-like plates. Entire margin of the body, except for the eyes, beset with a series of simple setae of various length, setae slightly longer in the marginal region of the head and abdomen. Derm weakly vermiculate, and also beset with simple, sparsely scattered setae and thickly with minute points, except for a series of small areas on the abdomen where these appear like minute, fringed processes.

Ventral side membranous throughout except for a weakly sclerotic marginal zone; a small area anterior to anal aperture, a small area about each spiracle, a small plate near the base of each antenna and a large plate near the humeral angle. Derm thickly beset with minute points; simple setae of various length and arranged inter-segmentally present in the abdomen, few simple setae also present near the antennal bases and on the anterior

sternal region. Antennae (**Fig. 21b**) ventral, about 0·52 mm long, nine-segmented, imbricate, bearing few simple setae and also beset with minute points, three basal segments robust, first two segments transverse, 3rd subquadrate and narrow anteriorly, 4th smaller than 3rd and slightly longer than broad, 5th smallest and transverse, 6th and 8th equal and nearly quadrate, longer than 5th but smaller than 4th, 7th smaller than 6th but slightly longer than 5th, 9th longest and as long as the preceding three segments, bearing two apical setae, four sensoria present on segments 4, 6, 8 and 9. Legs (**Fig. 21c**) moderately robust, beset with simple setae and minute points; with trochanter; with tibio-tarsal articulation distinct; each tarsus with a single seta near apex; claws weak, the pulvillus of a peculiar shape, being in the form of a circular pad. Anal opening ventral, situated away from the apex of abdomen and surrounded by a broken ring of single row of pores (**Fig. 21d**).

*Fourth stage.* Length 1·35 mm. Differs from the fifth stage in being smaller in size, with smaller wing-pads and with transverse strip-like plates in the abdomen (**Fig. 21e**); antennae 7-segmented with three sensoria; tibio-tarsal articulation absent.

**Pauropsylla longispiculata, sp. n.**  
(Figs. 22, 23)

Length of body, in male, 1·45 mm; in female, 1·72 mm

Length of forewings, in male, 1·70 mm; in female, 1·82 mm

Width of head with eyes, 0·80 mm

Width of vertex between eyes, 0·40 mm

Length of antennae, 0·45 mm

*Colouration.* General colour pale-yellow, darker in male, genae dark-brown to black, anterior border of prothorax, bands on prescutum and scutum, and mesopleurae dark-brown or chocolate, abdominal sternites dark-brown or chocolate in male, tergites of lighter colour, wings hyaline and transparent.

*Structure.* Body small and robust. Head (**Fig. 22a**) moderately large, strongly declivous, almost deflexed vertical to the axis of body, slightly broader than thorax; vertex slightly more than twice as broad as long, gradually rounded downward in front, sparsely pubescent, finely reticulate, posterior margin deeply emarginate, median suture prominent, foveae present near posterior margin, on either side of median suture, anterior region narrower between antennal sockets; frons small, visible in front, bearing anterior ocellus, posterior ocelli elevated; genae small, transverse, weakly swollen beneath antennal sockets. Eyes large, recessive, subtriangular. Beak long, protruding out between legs.

Antennae (**Fig. 22b**) short, scarcely longer than width of vertex between eyes, ten-segmented, bearing few setae, imbricate, two basal segments robust, 1st transverse, 2nd subquadrate, 3rd longest, 4th, 6th and 8th segments equal, but each smaller than 3rd, narrow basally, broad apically, 5th and 7th smallest and equal, 9th broadly transverse and slightly longer and broader than 10th, bearing one long seta, four sensoria present on segments 4, 6, 8 and 9, each sensorium guarded with two long and thick setae, appearing

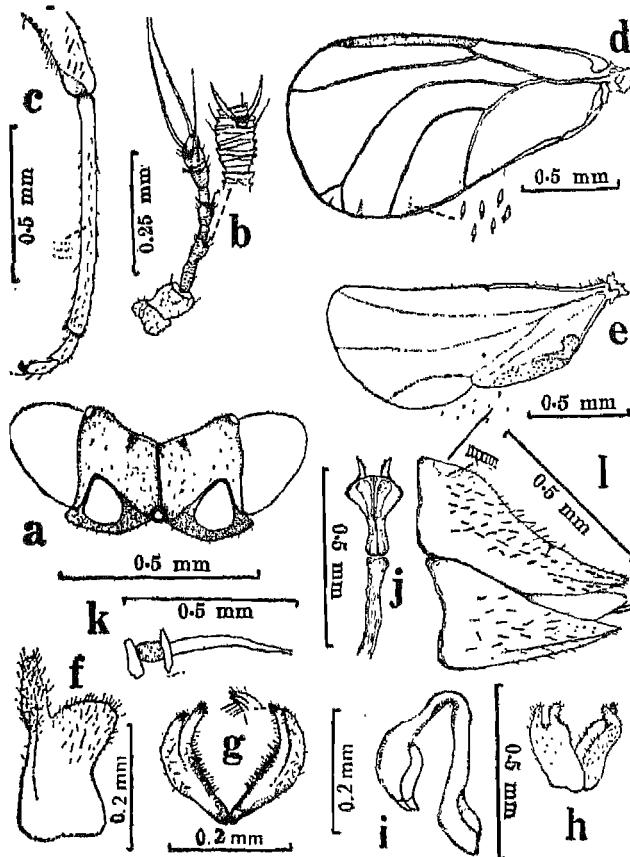


Fig. 22. *Pauropsylla longispiculata*, sp. n.—**a**: front view of head; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: anal valve, lateral aspect; **g**: forceps, lateral aspect; **h**: forceps, upper and mesal aspect; **i**: aedeagus, lateral aspect; **j**: aedeagus, dorsal aspect; **k**: sperm pump, **I**: female genitalia, lateral aspect.

like horns, terminal segment small, transverse, with two, 0.28 mm long apical spines, setae fuscous.

Thorax broad, robust, strongly arched, finely and sparsely pubescent, finely reticulate. Prothorax convexly rounded, descending vertically downward, somewhat triangular in shape when seen in front, having foveal impressions on each side, posterior margin with a small, median and one submedian shallow depressions on either side; prescutum about twice as broad as long, broadest before middle, somewhat pentangular in shape, angulate laterally, posterior margin angulate; scutum large and broad, slightly shorter in length than prescutum, two and two-thirds as broad as long, gradually sloping and angulate laterally, disc with a shallow median channel and gradually sloping posteriorly; scutellum broadly transverse, almost rectangular, twice as broad as long; post-scutellum narrowly

transverse, both anterior and posterior margins weakly invaginated; mesopleurae large and anterior.

Legs (**Fig. 22c**) quite long, pubescent and also thickly beset with minute points, femora shorter than tibiae, all tibiae with a comb of setae at apex, hind femur with three sensoria-like structures on ventral side in the apical half, hind tibiae without basal spur, with seven, black, tooth-like spines at apex (6 closely-set setae on one side and 1 on the other), these spines may vary in number, hind coxae long and thick, meracanthus very small, like a little papilla.

Forewings (**Fig. 22d**) large, hyaline, transparent, about one and three-fourths as long as broad, broadest subapically, somewhat square at apex, pterostigma present, long, first marginal cell very large and long, second cell very small, radius two and a half times as long as cubital petiole, cubitus about one and a half times as long as cubital petiole, basal vein slightly shorter than radius, veins M, Cu<sub>1</sub> and Cu<sub>2</sub> running parallel, radular areas present in both marginal and medial cells, veins armed with microscopic setae.

Hind wings (**Fig. 22e**) also quite large, membrane beset with minute points, costal margin in the basal half armed with few simple and hooked setae.

Abdomen small, longer than broad, finely and sparsely pubescent, finely rugulose, third and fourth tergites rather prominent and ascending, other tergites telescoped.

**Genitalia.** Male genital segment smaller than abdomen. Anal valve (**Fig. 22f**) large, about 0.30 mm long, longer than parameres, lobate, and divided into two areas, the anal tube and the lateral lobes when seen in lateral view, anterior margin of anal tube moderately invaginated subapically, lateral lobes large and bluntly rounded at top, posterior margin invaginated in middle, anal and lateral apical portion of both areas beset with long setae; parameres (**Figs. 22g, h**) about 0.22 mm long, bilobate at apex, both lobes slender, inner lobe slightly longer than outer, only apical portion visible in profile, apices terminating into minute points, inner lobe roundly pointed at apex, outer lobe with two acute points at apex, just below these points, few thick setae present, pointing downward, basal region broad and attenuate, outer surface beset sparsely with simple setae, mesal surface with a group of small setae in middle, when seen from behind, forceps arched strongly laterally; hypandrium quite robust, having few setae in middle and at the lateral angles; aedeagus (**Figs. 22i, j**) small and robust, outer arm small with a thick spoon end, having two lateral projections, each projection acutely pointed and serrated distad; sperm pump as figured (**Fig. 22k**).

Female genital segment (**Fig. 22l**) smaller than abdomen, deflexed, sparsely pubescent, both plates broad at base and gradually narrowed posteriorly, dorsal plate a little longer than ventral and roundly pointed at apex, anal ring composed of a single row of pores; ventral plate acutely pointed at apex; ovipositor long and acutely pointed, and strongly exserted in some examples.

**Host plant.** Bred from galls on leaves of *Buchanania lanzen* Spreng. (= *B. latifolia* Roxb.)

**Type locality.** Chimnapur plantation, East Asir Range, Nimar forest division (M.P.)

**Types.** Described from a small series of specimens bred *ex* galls. Holotype male; Allotype female, from the type locality, collected on March 22, 1959 (R. N. Mathur); Paratypes: 5 males and 5 females, from the same locality and date of collection (R. N.

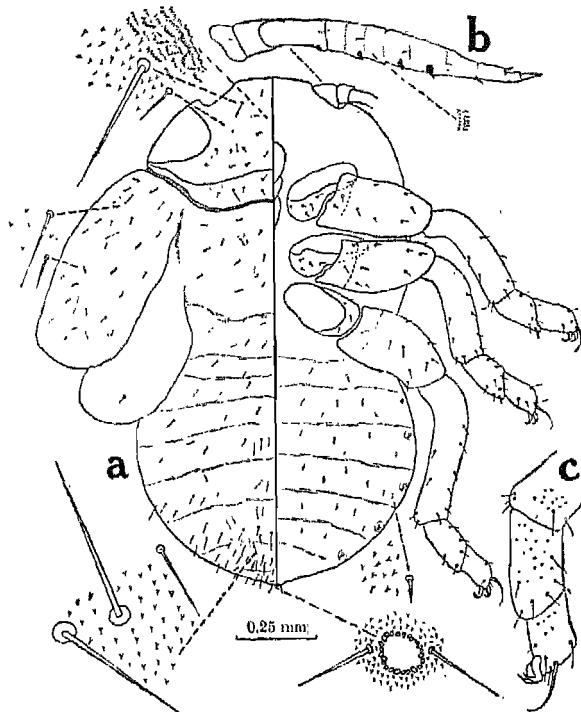


Fig. 23. *Pauropsylla longispiculata*, sp. n.—a: fifth stage nymph; b: antenna; c: part of leg.

Mathur). Some nymphal stages were also extracted from the galls collected on *Buchanania lanzan* and preserved in alcohol, from Chandni forest, East Asir range, Nimar forest division, M. P. on February 5, 1956 (No. 332). Some adults consisting of both sexes and not designated as types, from the type locality, collected on March 22, 1959, were also preserved in alcohol. All this material, together with the types and slides with mounted parts of adults and nymphal stages, deposited at F.R.I., Dehra Dun.

**Comparison.** This species is easily recognised from the other species of *Pauropsylla*, in having characteristic type of antennae, head, shape of wing and venation and genital structures.

#### Nymphal stage

**Fifth stage.** (Fig. 23a) Length 1.44 mm. Of pauropsylline form. Body broadly oval, head nearly as broad as thorax and abdomen; wing-pads extending prominently beyond the general margin of the body and broadly rounded at apex. Derm weakly sclerotic throughout and strongly rugulose having minute points, also beset sparsely with simple setae of various length; wing-pads strongly armed with minute points. Abdomen showing traces of segmentation.

Ventral side weakly sclerotic throughout, thickly and strongly beset with minute points, abdomen having weak traces of segmentation. Derm bearing small, simple, scattered setae. Antennae (**Fig. 23b**) ventral, about 0.55 mm long, apparently three-segmented, having few simple setae, two basal segments small, transverse, 3rd segment long, bearing microscopic points arranged in rows and four sensoria and two thick, separate setae below apex. Legs (**Fig. 23c**) quite robust and short, sparsely beset with small, simple setae and thickly with minute points, femora not attaining the margin of body, smaller than tibiae, each leg with a distinct trochanter, and a prominent tibio-tarsal articulation, each tarsus with a long seta near apex, claws present, pulvillus apparently fish-tail like. Anal opening terminal, like a small round aperture, surrounded by a single row of irregular pores, guarded by two long, lateral setae.

***Pauropsylla maculata*, sp. n.**  
(Fig. 24)

Length of body, in male, 1.0 mm; in female, 1.51 mm

Length of forewings, in male, 1.75 mm; in female, 2.05 mm

Width of head with eyes, 0.55 mm

Width of vertex between eyes, 0.32 mm

Length of antennae, 0.70 mm

*Colouration.* (Live and dry specimens). General colour shining black dorsally and pale-yellow or yellowish orange ventrally, thoracic venter partly black and pale-yellow, prothorax black in male, and pale-brown with blackish tinge in female, genae black in male, pale-yellow dorsally and yellowish-black ventrally in female, antennae yellowish with two light black and very long apical setae, legs pale-yellow, front tibiae and tarsal segments darker, male genitalia black dorsad and pale-yellow ventrad, female genitalia pale-yellow; wings hyaline, with a prominent smoky band along the posterior margin extending from first marginal cell to apex of wing, two black spots near basal border, veins pale-yellow; basal border of hind wings with a smoky patch.

*Structure.* Body small and robust. Head (**Fig. 24a**), including eyes, small, nearly as broad as thorax, strongly declivous, finely and sparsely pubescent, finely rugulose; vertex slightly broader than long, rounded forward and downward, posterior margin slightly emarginate, a pair of prominent, circular foveal impressions present, posterior to centre, one on either side of median line, median suture visible as a thin line, anterior ocellus visible in front, post-ocellar region slightly raised; genal cones present, about 0.12 mm long, about half as long as vertex, approximate, broad at base and narrower at apex, slightly divergent and bluntly rounded at apex, sparsely pubescent, pubescence longer than on the vertex, genae notched latero-basally. Eyes small, somewhat hemispherical.

Antennae (**Fig. 24b**) small, seven-segmented, having few setae, imbricate, basal two segments robust, 1st transverse, 2nd sub-quadrangular, longer than broad, also longer than 1st, 3rd segment thinner, about one and one-third times as long as 2nd, 4th about half as long as 3rd, 5th, 6th and 7th each becoming slightly smaller than other, and also smaller than 4th, two terminal segments transverse, apical joint with two long setae, which are

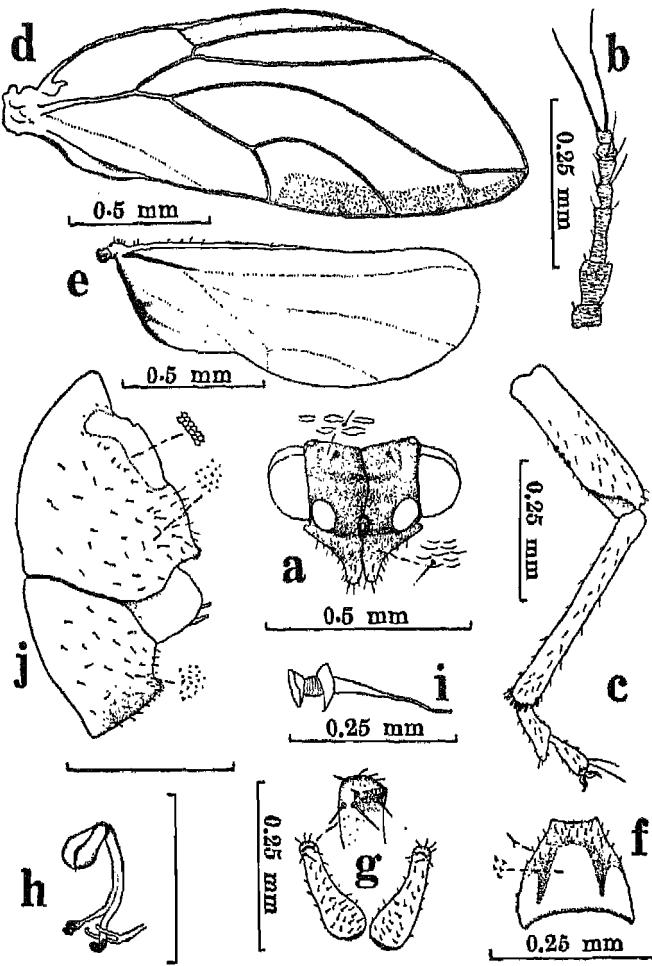


Fig. 24. *Pauropsylla maculata*, sp. n.—a: head, front view; b: antenna; c: hind leg; d: forewing; e: hind wing; f: anal valve of male; g: parameres, mesal surface; h: aedeagus; i: sperm pump; j: female genitalia, lateral view.

almost as long as last five segments combined, 6th segment also bearing a long seta but smaller than the apical setae. Sensoria not clearly discernible.

Thorax moderately large and arched, bearing fine and sparse pubescence, finely rugulose. Prothorax roof-shaped, narrower in middle, broader laterally, narrowly and convexly rounded, descending, with two foveal impressions on each side; prescutum broader than long, about one and a half times as broad as long, broadest beyond middle, somewhat triangular and gradually sloping anteriorly, angulate both laterally and posteriorly; scutum broad, about twice as broad as long, broadest before middle, slightly

smaller than prescutum in length, angulate laterally and posteriorly; scutellum broadly transverse, anterior margin weakly convex, with prominent antero-lateral angles, posterior margin weakly invaginated in middle.

Legs (**Fig. 24c**) short and slender, bearing sparse pubescence and thickly beset with minute points, tibiae longer than femora, each tibia with an apical comb of setae, hind tibiae without basal spur, and with five tooth-like spines at apex (4 approximate and 1 separate), tarsal segments equal in length, meracanthus very small, like a knob, tibial groove of fore and middle legs long.

Forewings (**Fig. 24d**) large, about two and one-third times longer than broad, sub-acute at apex, anterior margin strongly arched, pterostigma long and broad, radius about twice as long as cubital pteriole ( $M+Cu$ ), basal vein slightly longer than radius,  $R_s$  quite long, first marginal cell twice longer than second, fork  $Cu_1$  parallel with the anterior apical margin, fork  $M_{1+2}$  meeting near the apex, veins armed with small setae.

Hind wings (**Fig. 24e**) also quite large, membrane thickly and uniformly beset with minute points, costal margin armed with a few simple and hooked setae.

Abdomen smaller in male, and moderately large and robust in female, finely rugulose, finely and sparsely pubescent, and also beset with minute points, setae longer on sternites.

*Genitalia.* Male genital segment smaller than abdomen, sparsely pubescent. Anal valve (**Fig. 24f**) slightly longer than parameres, about 0.18 mm long, broad basally, gradually narrowed and truncate at apex, outer surface thickly beset with minute points and sparsely with small setae borne on minute papillae, front margin almost straight; parameres (**Fig. 24g**) weakly curved, about 0.16 mm long, inverted club-shaped, broad basally and narrow apically, terminating towards inside into two dark acute points, just below these points two or three stout setae present, pointing downward, outer surface bearing small, simple setae, mesal surface beset with small, thick setae directed inward; outer arm of aedeagus (**Fig. 24h**) very small, with a thick and robust spoon end; hypandrium simple, of usual shape and beset with minute points arranged in small lines; sperm pump small and as figured (**Fig. 24i**).

Female genital segment (**Fig. 24j**) very short, sparsely pubescent, both plates sub-equal in length, and armed with rows of minute points; dorsal plate longer than ventral, broad basally and sub-acute at apex, anal pore-ring large and composed of a double ring of pores, guarded by small, simple setae; ventral plate broad basally and acute at apex, apices of both plates armed with a brush of minute setae; ovipositor partly exserted and acutely pointed.

*Host plant.* Feeding on new flush of leaves of *Mangifera indica* Linn.

*Type locality.* New Forest, Dehra Dun (U.P.).

*Types.* Holotype male; Allotype female, from the type locality, April 8, 1937 (R. N. Mathur); Paratypes: 19 males and 16 females, collected from the type locality on April 8, 1937; 6 males and 10 females, also from the type locality and collected on March 27, 1936 (R. N. Mathur); 2 males and 11 females, collected from the type locality on April 22, 1936 (R. N. Mathur); 1 male from the type locality and collected on March 19, 1932 (R. N. Mathur). Specimens not designated as paratypes are: 1 male and 3 females, collected on March 26, 1 female collected on March 28, and 1 male collected on

April 16, 1963, New forest, Dehra Dun (R. N. Mathur); 7 males and 3 females, March 20, 2 females of April 16 and 1 male and 1 female of May 15, 1963, all collected from Dehra Dun (R. N. Mathur). Additional material consists of 23 examples of 10.4.48 and 2 examples of 9.4.67, from Dehra Dun; 5 examples of 12.4.50, 11 examples of 20.4.50 and 14 examples of 2.4.60, collected from New Forest (R. N. Mathur), all collected on *Mangifera indica*. One male and one female of 28.3.63, collected from New Forest, Dehra Dun, on young leaves of *Mangifera indica* (R. N. Mathur) are donated to the I.A.R.I., New Delhi. Some specimens were preserved in alcohol, and various parts of both sexes were dissected and mounted on slides. All types, preserved material (in 2 phials) and slides, are deposited at F.R.I., Dehra Dun.

*Comparison.* This new species has been described from a long series of both sexes, and is differentiated from the other species by the shape of wings, and a prominent brown maculated band along the posterior border, shape of head and long genal cones, antennae with two long setae, and other genital characters.

*Biological notes.* This species appears commonly on the young flush of leaves of *Mangifera indica*, during March-April, at Dehra Dun (U.P.). Nothing is known about its life-history.

***Pauropsylla nigra* Crawford 1919**  
(Fig. 25)

- Crawford, D. L. 1919. *Philipp. J. Sci.* 15(2): 143.  
Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26(6): 622.  
Laing, F. 1930. *Indian Forest Rec.* 18(8): 170.  
Boselli, F. B. 1930. *Boll. Lab. Zool. agr. Portici* 24: p. 23. [*Microceropsylla nigra* (Crawf.)]  
Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 48.  
Heslop-Harrison, G. 1948. *Ann. Mag. nat. Hist.* (12), 1: 291 (*Microceropsylla nigra*).  
Miyatake, Y. 1971. *Bull. Osaka Mus. Nat. Hist.* 25: 51-52, Fig. 1 (N<sub>1</sub>, N<sub>2</sub>).

Length of body, in male, 1.12 mm; in female, 1.20 mm

Length of forewings, in male, 1.10 mm; in female, 1.30 mm

Width of head with eyes, 0.50 mm

Width of vertex between eyes, 0.25 mm

Length of antennae, 0.18 mm

*Colouration.* Redescribed from both live and dried specimens. General colour shining black, head and thorax black in both sexes, abdomen black dorsad and yellow ventrad in male, abdomen black both dorsally and ventrally, with connective membrane orange-yellow in female, genae yellowish-orange apically and ventrally, thoracic venter partly black and orange, antennae yellowish with two long black setae, legs yellowish except hind femora which are black basally, genitalia black in both sexes, wings hyaline.

*Structure.* Body small in male and robust in female. Head, including eyes (Figs. 25a,b) as broad as thorax, strongly declivous, with a few fine hairs in middle, on either side of median line, about twice as broad as long along the median suture, roundly convex on both sides of median line, leaving a deep sulcus on either side along the eyes (Fig.

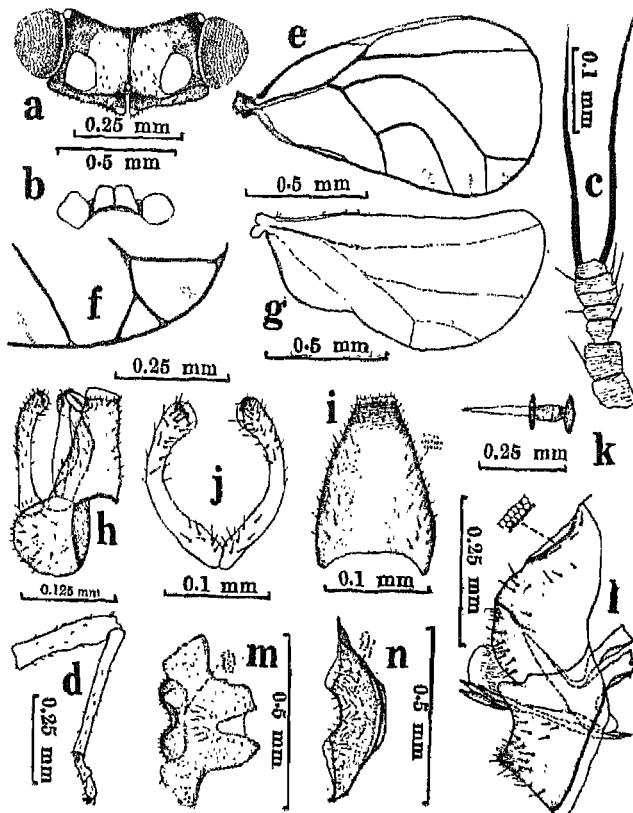


Fig. 25. *Pauropsylla nigra* Crawford—**a**: head, front view; **b**: head, dorsal view; **c**: antenna; **d**: hind leg; **e**: forewing; **f**: apical portion of forewing; **g**: hind wing; **h**: male genitalia; **i**: anal valve, upper surface; **j**: forceps; **k**: sperm pump; **l**: female genitalia, lateral view; **m**: dorsal plate; **n**: ventral plate.

**25b**), posterior margin strongly arcuate, post-ocellar region slightly elevated, anterior ocellus visible from front; genae very small, about 0.10 mm long, below the antennal sockets, bearing few hairs. Eyes small. Antennal sockets large.

Antennae (**Fig. 25c**) small, six-segmented, imbricate, 1st segment subquadrate, 2nd segment robust, slightly longer than wide, longer than 1st, 3rd segment subtriangular, broader at apex, smaller and less broad than second, 4th segment smallest, transverse, twice as broad as long, 5th broad and subquadrate, having an imperfect segmentation in middle, with three small setae, terminal segment smallest, transverse, nearly as large as 4th segment, having two long, slender setae at apex, much longer than the antenna itself.

Thorax short and strongly arched, finely and sparsely pubescent, finely rugulose. Prothorax convexly rounded, descending, narrower in middle, broader laterally, with

two foveal impressions on each side; prescutum small, broader than long, about one and a half times as broad as long, broadest beyond middle, gradually narrowed anteriorly, angulate laterally, posterior margin also angulate; scutum large, about three times broader than long, smaller in length than prescutum, broadest before middle, angulate laterally, posterior margin roundly concave; scutellum very small, transverse, almost rectangular.

Legs (**Fig. 25d**) small and slender, with sparse pubescence and also beset with minute setae, tibiae longer than femora, hind tibiae without basal spur and with five black tooth-like spines at apex, four approximate and one separate, basal tarsal segments slightly longer than apical, meracanthus very small, slender and almost tubular.

Forewings (**Fig. 25e**) hyaline, transparent, veins prominent, slightly more than one and a half times as long as broad, broadly rounded and somewhat squarish at apex, pterostigma long and broad, radius about twice as long as cubital petiole, cubitus longer than radius, basal vein about as long as cubital petiole,  $Rs$  weakly flexed near about middle, first marginal cell about two and a half times longer than second; in one example (**Fig. 25f**), the stem  $M_{3+4}$  is branched. Hind wings (**Fig. 25g**) beset sparsely with minute points, costal margin armed with simple and hooked setae.

Abdomen smaller in male, large and robust in female, sparsely pubescent and thickly beset with minute points.

*Genitalia.* Male genital segment (**Fig. 25h**) smaller than abdomen, sparsely pubescent; anal valve (**Fig. 25i**) about 0.15 mm long and slightly smaller than forceps, broader at base and gradually narrowed and truncate at apex, anterior margin straight to weakly convex in lateral aspect, outer surface sparsely beset with simple setae and thickly with minute points; parameres (**Fig. 25j**) about 0.17 mm long, strongly curved, almost uniformly thick except at base and apex, outer surface beset with few simple setae, apical portion somewhat thick and globular, bearing thick setae and terminating in a small point towards inner side, basal region also thicker; hypandrium simple, of usual shape, sparsely beset with simple setae; outer arm of aedeagus (**Fig. 25h**) small and robust. Sperm pump as figured (**Fig. 25k**).

Female genital segment (**Fig. 25l**) very short, bent downward, sparsely beset with setae and minute points arranged in linear series, both plates (**Figs. 25m,n**) subequal in length and invaginated at apices; dorsal plate (**Fig. 25m**) large and longer than ventral; circum-anal pore ring composed of a double ring of pores and guarded by minute setae; ovipositor sheath weakly serrated and acutely pointed at apex (**Fig. 25 l**).

*Host plant.* On new leaves of *Mangifera indica* Linn.

*Distribution.* Previously recorded from Pusa, Bihar (1 female found in the laboratory) (Crawford, 1919); Malacca, *ex galls on leaves of Mangifera indica* (Laing, 1930); Dehra Dun (U.P.); Philippines (Palawan) (Miyatake, 1971).

*Material examined.* Its new record is from Dehra Dun (U.P.) and is abundantly found at the appearance of new leaves of *Mangifera indica*. A long series (over 100 specimens) of both males and females collected on March 27, 1936, from New Forest, Dehra Dun, U.P. (R.N. Mathur); 2 females collected on April 8, 1937, from the same locality (R.N. Mathur). A good series of males and females collected during 1942, 1962 and 1966 were also preserved in alcohol (in 3 phials). In addition to these, there are 22 examples

of March 19, 18 ex. of March 20, 13 ex. of March 25, 6 ex. of March 26, 12 ex. of March 28, and 6 ex. of March 31, 1960; and 1 ex. of April 16 and 1 ex. of April 26, 1963; all collected from New Forest Dehra Dun (R.N. Mathur).

Four specimens of 27.3.1936 and collected from New Forest, on *Mangifera indica* (R.N. Mathur) (Expt. No. 603) are donated to I.A.R.I., New Delhi.

*Comparison.* This species was described by Crawford (1919) from one female, and it has been redescribed from a very long series of both sexes. It is characterised by its black colour, by the presence of a pterostigma, having two very long setae at tip of antennae, vertex with a distinct median suture, and genital features. Its identification has been confirmed by Dr (Miss) Russell of Washington Museum. She writes: "We have no authentic specimens for comparison".

*Biological notes.* Nothing is known about its life-history, except that the adults appear in great abundance during February and March, when the new flush of leaves of *Mangifera indica* appears at Dehra Dun. The adults are very active and feed on sap from the new young leaves.

***Pauropsylla purpureascens*, sp. n.**

(Figs. 26, 27)

Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 48-50 (Biology).

Beeson, C. F. C. 1941. *Forest Insects*, p. 778 (Biological notes).

Length of body, in male, 1.28 mm; in female, 1.56 mm

Length of forewings, in male, 2.25 mm; in female, 2.50 mm

Width of head with eyes, 0.63 mm

Width of vertex between eyes, 0.30 mm

Length of antennae, 0.85 mm

*Colouration.* General colour in dried specimens shining purplish-brown (with bluish tinge in live specimens), head purplish-brown, antennae two-thirds distally light black, basal one-third pale-yellow, legs pale clay yellow, femora of hind legs partly black, apical tarsal segment of all legs black, mesepisternum and mesosternum purplish-brown in both sexes, abdomen purplish-brown dorsad and pale clay yellow with purplish tinge (bluish green in live specimens) ventrad, except third sternite which is also purplish-brown, basal portion of the anal and subgenital valves fuscous, and the apical portion of the former pale-yellow, wings hyaline, nerves pale-yellow.

General colour in female light brown in dried specimens (with bluish tinge in live specimens), shining, thorax with dark brown longitudinal bands, hind femora pale-yellow, abdomen yellowish-brown with blackish tinge (bluish-green in live specimens), genitalia light brown distally.

*Structure.* Head (**Fig. 26a**) including eyes, slightly broader than thorax, sparsely pubescent, moderately deflexed; vertex slightly broader than long, finely rugulose, flatly depressed in front of posterior margin and then strongly rounded down in front, covering frons, enclosing anterior ocellus, so that the latter appears to be on vertex, a pair of

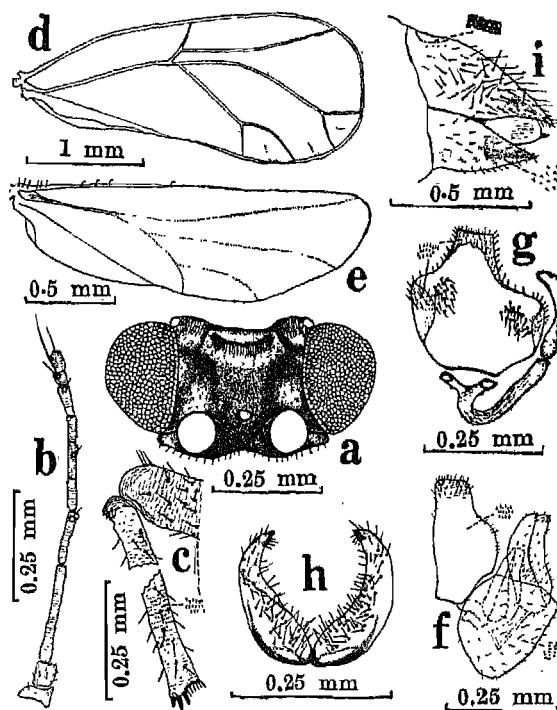


Fig. 26. *Pauropsylla purpureascens*, sp. n.—a: head, front view; b: antenna; c: parts of hind leg; d: forewing; e: hind wing; f: male genitalia, lateral view; g: anal valve and aedeagus, mesal surface; h: parameres, anterior view; i: female genitalia, lateral view.

small foveae present near the posterior border which is margined and moderately emarginate, median suture not present, anterior ocellus large and visible from above, and located above the level of antennal sockets, post-ocellar region swollen bearing large ocelli; frons scarcely visible; genae weakly swollen below antennal sockets and beset with small setae.

Antennae (Fig. 26b) short, ten-segmented, a little shorter than one and a half times the width of head including the eyes, bearing few setae, imbricate, two basal segments robust, 1st narrowly transverse, 2nd subquadrate and slightly longer than 1st, 3rd segment longest, 4th a little longer than half the length of 3rd segment, 5th and 8th segments equal, each one-third as long as 3rd segment, 6th slightly longer than 5th, 7th slightly smaller than 5th, 9th joint small with a small seta at apex, 10th slightly longer than 9th, terminal setae on apical joint unequal and moderately long, sensoria present on 4, 6, 8 and 9 segments.

Thorax moderately arched, finely and sparsely pubescent, finely rugulose. Prothorax much deflexed below prescutum and completely concealed behind head, vertical and convexly rounded, narrower in middle and broader laterally, with foveal impressions on each side; prescutum broader than long, broadest before middle, slightly shorter

than scutum, angulate both laterally and posteriorly; scutum much broader than prescutum, about twice as broad as long, broadest before middle, angulate laterally; scutellum transverse, broader than long, somewhat hexagonal in shape, broad anteriorly, anterior margin straight, with prominent antero-lateral angles.

Legs (**Fig. 26c**) moderately long, sparsely pubescent and also beset with minute points, tibiae longer than femora, hind femur armed with three dorsal, subapical, blunt setae, hind tibiae with weak spurs at base and with three black tooth-like spines at apex, tarsal segments almost of equal length; meracanthus small, slender and triangular.

Forewings (**Fig. 26d**) hyaline, transparent, broadest and subsquare apically, a little more than twice as long as broad, rounded at apex, basal vein quite long and almost as long as  $R_5$ ,  $Rs$  flexed upward, cubital petiole ( $M+Cu$ ) half as long as radius ( $R$ ), first marginal cell longer and broader than second, distance between  $Cu_1$  and  $M_{3+4}$  as long as the distance between  $M_{3+4}$  and  $M_{1+2}$  along the posterior margin, veins armed with microscopic setae.

Hind wings (**Fig. 26e**) slightly smaller than forewings, thickly and uniformly beset with minute points, costal vein armed with a few simple setae near base and four hooked setae.

Abdomen slightly longer than broad, sparsely pubescent and thickly beset with minute points, prominent on sternites.

**Genitalia.** Male genital segment (**Fig. 26f**) smaller than abdomen, pubescent; anal valve (**Fig. 26g**) about 0.30 mm long, longer than parameres, in profile, anterior margin nearly straight, posterior margin with short rounded lobes slightly above base, truncate at apex, mesal surface armed with groups of stout setae located submedianally, and with small, simple setae near the truncated apex, outer surface thickly beset with minute points and with small, simple setae in the apical region and on the lateral rounded lobes; parameres (forceps) (**Fig. 26h**) about 0.25 mm long, slightly bowed, broader at base and narrower at top, terminating in a blunt dark point just below apex, four strong, thick setae present in each clasper, basal mesal surface beset with long setae, and the outer surface sparsely beset with small, simple setae; outer arm of aedeagus (**Fig. 26g**) short and stout; hypandrium simple, of usual shape, sparsely bearing simple setae and also beset with minute points.

Female genitalia (**Fig. 26i**) moderately large but shorter than abdomen, slightly deflexed downward, pubescent, pubescence longer on dorsal plate, both plates broad basally and gradually narrowed posteriorly; anal plate longer than ventral, slightly angulate dorsally, with an anal aperture in a horizontal plane and the distal portion bent downward, terminating in a rounded apex, anal pore-ring composed of a double row of pores and guarded by few minute setae; ventral plate thickly beset with minute points, acutely pointed at apex; ovipositor pointed.

**Host plant.** Bred from pit galls on leaves of *Ficus racemosa* (=*F. glomerata*).

**Type locality.** New Forest, Dehra Dun (U.P.).

**Types.** Described from a long series of specimens. Holotype male, March 4, 1933; Allotype female, March 11, 1933, collected at the type locality, from pit galls on leaves of *Ficus racemosa* (Expt. No. 432) (R.N. Mathur); Paratypes: 19 male, March

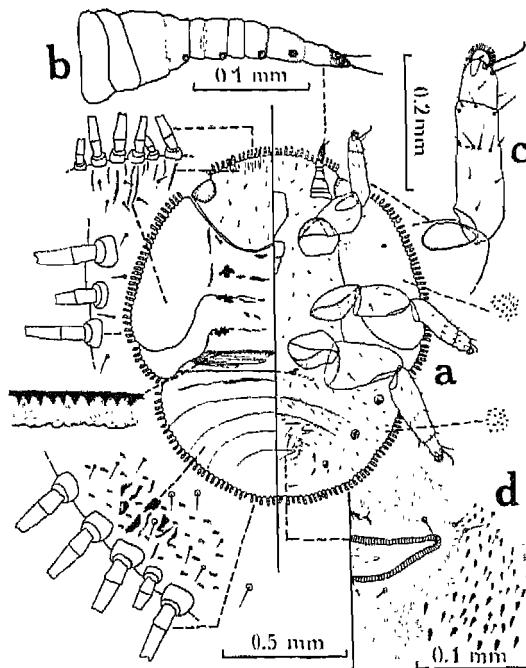


Fig. 27. *Pauropsylla puypurescens*, sp. n.—a: fifth stage nymph; b: antenna; c: leg; d: circum-anal pore ring.

4, 1933; 24 males, March 11, 1933; 5 female, March 4, 1933; 3 females, March 11, 1933; additional male and female paratypes are: 16 examples, March 4, 21 examples March 6, and 3 examples, March 11, 1933. Additional material, not designated as paratypes, as follows: 32 examples, March 4, 14 examples, March 6, 13 examples, March 11, 2 examples, March 18, 1933, and 1 example, August 8, 1933, at the type locality (R.N. Mathur); 5 males and 10 females, February 27, 1950, collected at the type locality (R.N. Mathur). Types, a good number of adults and nymphs collected during 1935, 1950 and 1952 preserved in alcohol (in 3 phials), and some slides having dissected parts of adults and nymphal stages mounted on them, are deposited at F.R.I., Dehra Dun. Three paratypes of 4-3-1933, collected from New Forest (R.N. Mathur) (Expt. No. 432) are donated to I.A.R.I., New Delhi.

*Comparison.* This species is distinguishable from other species in the absence of median suture of head, shape of head, shape of wing and venation and genital characters.

*Biological notes.* Its life-history has been studied by Mathur (1935), and brief notes are also given by Beeson (1941).

#### Nymphal stages

*Fifth stage.* (Fig. 27a) Length 1.5 mm. Form broadly oval but the continuity of margin interrupted near the eyes and at the base of abdomen; humeral angle of the wing-pads

bluntly rounded and reaches up to the posterior end of the small eyes. Dorsum heavily sclerotic throughout except for the small area at the base of the abdomen. Derm vermiculate in appearance in some places and also bears scattered small, simple ring-based setae. Margin of the body with a continuous series of moderately stout sectasetae, interspersed at places with small sectasetae. Two rows of sclerotic points facing each other present at the base of the abdomen, the anterior row is complete and prominent, while the posterior row is weakly marked. Abdomen shows traces of segmentation and is beset with faint minute comb-like structures.

Ventral side membranous throughout except a small sclerotic area near the inner border of the humeral angle of wing-pad, weak sclerotic areas round the circum-anal ring and spiracles. Derm bears simple scattered setae and thickly beset with minute points which are heavier towards the margin. Antennae (Fig. 27b) 0.21 mm in length, borne on the ventral side, seven-segmented with four sensoria, 3rd segment broader at base and narrower at apex, with a faint constriction, 4th also with a faint constriction, 5th segment smallest and transverse, terminal joint quite long, with a weak constriction and two apical spines. Legs (Fig. 27c) short and stout bearing few simple setae, femora not reaching to the margin of the wing-pad, without trochanter, with distinct tibio-tarsal articulation, tarsus having a single golf-club seta and one simple seta at apex, without claws, pulvilli in the form of a circular pad. Just below each hind coxa there is a papilla. Anal opening (Fig. 27d) situated well in front of the apex of the abdomen, surrounded by an outer ring of slit-like pores and the inner ring with minute, indistinct pores. Circum-anal pore-ring is surrounded anteriorly with two pairs of long, curved setae and four pairs of small simple setae and posteriorly with two pairs of small simple setae.

*Fourth stage.* Length 0.91 mm. General form similar to the fifth but with antennae five-segmented having three sensoria and tibio-tarsal division absent.

*Third stage.* Length 0.56 mm. Resembles the fourth stage in shape, but with smaller wing-pads and three-jointed antennae bearing two sensoria.

*Second stage.* Length 0.40 mm. Similar to the third stage but with two-jointed antennae having one sensorium; wing-pads smaller but distinct.

*First stage.* Length 0.22 mm. In this stage, legs are longer, each wing-pad is indicated by the presence of a long sectaseta; marginal sectasetae are very few, long and slender.

***Pauropsylla reticulata*, sp. n.**  
(Fig. 28)

Length of body, in male, 2.03 mm; in female, 2.32 mm

Length of forewings, in male, 2.56 mm; in female, 2.88 mm

Width of head with eyes, 0.80 mm

Width of vertex between eyes, 0.45 mm

Length of antennae, 1.00 mm

*Colouration.* General colour dark-brown to fuscous, vertex dark-brown, distal antennal segments fuscous, basal segments paler, legs yellowish-brown, femora and tarsal segments

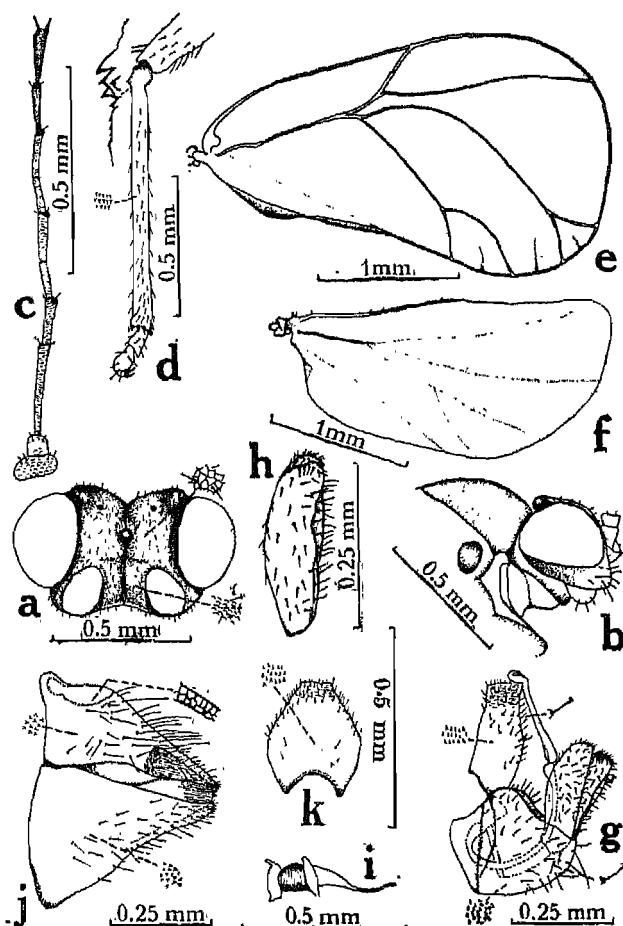


Fig. 28. *Pauropsylla reticulata*, sp. n.—a: front view of head; b: lateral view of head and thorax; c: antenna; d: part of hind leg; e: forewing; f: hind wing; g: male genital segment; h: forceps, mesal view; i: sperm pump; j: female genital segment; k: anal valve of male, upper surface.

darker, mesopleurae yellowish-brown, beak black apically, lateral sides of scutum orange, male genitalia dark-brown, forceps paler.

**Structure.** Body large and robust. Head (**Figs. 28a, b**) slightly broader than thorax, moderately deflexed, finely and sparsely pubescent, finely rugulose-reticulate; vertex broader than long, swollen on either side of median suture, slightly excavated or emarginate anteriorly and around front ocellus, roundly inclined forward vertically, with two circular foveal impressions near the posterior border, posterior margin moderately emarginate, frons visible dorsally and located above the level of antennal sockets, bearing front ocellus, post-ocellar region strongly swollen, having posterior ocelli facing the eyes;

genae small, situated below the antennal sockets, slightly swollen, sparsely pubescent, finely rugulose. Antennal sockets large. Eyes large, somewhat hemispherical. Clypeus large, rather pyriform; beak long, projecting between the legs.

Antennae (**Fig. 28c**) small, ten-segmented, bearing few setae, two basal segments robust, rugulose, 1st segment narrowly transverse, twice as broad as long, 2nd slightly broader than long, as long as 1st, remaining segments slender and imbricate, 3rd longest, 4th, 6th, 8th and 9th equal but each about half as long as 3rd, 5th and 7th equal and slightly smaller than 4th, terminal segment slightly longer than 4th, clavate, bearing two unequal apical spines, four sensoria present on segments 4, 6, 8 and 9.

Thorax (**Fig. 28b**) large and robust, strongly arched, finely and sparsely pubescent, finely rugulose-reticulate. Prothorax small and narrow, completely deflexed and concealed behind the head, convexly rounded, with foveal impressions on each side; prescutum large, moderately deflexed vertically downward anteriorly, broadest in anterior half, narrower both anteriorly and posteriorly, nearly as long as broad; scutum also large but smaller in length than prescutum, about twice as broad as long, broadest before middle, flat dorsally and gradually sloping laterally, angulate both laterally and posteriorly; scutellum small, vase-shaped, broader than long, broad anteriorly and narrowly convex posteriorly, mesopleurae large and prominent, produced forward in front.

Legs (**Fig. 28d**) quite long, beset with strong setae and also with minute points arranged in lines, tibiae longer than femora and bearing a comb of setae at apex, hind femur with three sensoria-like structures on ventral side, with two thick dorsal setae near apex, hind tibiae with a series of small basal spurs and four black tooth-like spines at apex (2 on one side and 2 on the other), tarsal segments rather equal in length, incrancanthus small and conical.

Forewings (**Fig. 28e**) large, hyaline, transparent, one and three-fourths times as long as broad, without pterostigma, broadest subapically, rather square at apex narrow at base, basal vein (R+M+Cu) quite long, cubital petiole (M+Cu) very short, about half as long as radius (R), radius shorter than R<sub>1</sub>, fork M<sub>1+2</sub> as long as M<sub>3+4</sub>, distance between M<sub>1+2</sub> and M<sub>3+4</sub> almost equal to the distance between forks M<sub>3+4</sub> and Cu<sub>1</sub> along the posterior margin, marginal cells small, unequal, first marginal cell longer than second, radial cell broad near base, veins armed with microscopic setae.

Hind wings (**Fig. 28f**) also quite large and broad, about twice as long as broad, membrane thickly beset with minute points, costal margin armed with a few simple and hooked setae in the basal half.

Abdomen slightly longer than broad, finely and sparsely pubescent and also thickly beset with minute points, hairs long and thick on sternites.

*Genitalia.* Male genital segment (**Fig. 28g**) smaller than abdomen. Anal valve (**Fig. 28k**) slightly longer than parameres, about 0.28 mm long, in profile, anterior margin rather straight, posterior margin moderately convex, narrower both basally and apically, truncate at apex, thickly beset with minute points arranged in lines, and also sparsely with simple setae, these becoming stronger along the posterior margin and borne on minute tubercles, two pairs of small, thick setae present in basal half; parameres (**Fig. 28h**) about 0.25 mm long, sides subparallel, broadest slightly above base, curved inward,

gradually narrowed and rounded apically, with a small, black point directed posteriorly, mesal surface sinuate, outer surface armed with small, simple setae, mesal surface bearing sparsely thick scattered setae, marginal setae longer, a row of thick setae pointing downward present just below apex; hypandrium simple, of usual shape, thickly beset with minute and thick points and also with simple setae borne on minute tubercles; outer arm of aedeagus quite long but shorter than basal arm, having a thick spoon end; sperm pump as figured (**Fig. 28i**).

Female genital segment (**Fig. 28h**) smaller than abdomen; dorsal plate smaller than ventral, anal region rather horizontal and then the plate strongly inclined downward caudally, apex roundly pointed, bearing small setae borne on minute tubercles; circum-anal region swollen anteriorly into a round knob, anal ring composed of a double row of pores; ventral plate acutely pointed; both plates broad basally and gradually tapering posteriorly, thickly beset with minute points and also with simple setae, which are longer on dorsal plate; ovipositor small, acutely pointed.

*Host plant.* Recorded *ex* galls on leaves of *Anthocephalus indicus* A. Rich. (= *A. cadamba* Miq.).

*Type locality.* Sylhet, Assam.

*Types.* Holotype male; Allotype female, November 1, 1930, collected from the type locality, *ex* galls on unknown plant (M. Bose); Paratypes: 2 males and 1 female, also from the type locality and same date of collection, *ex* galls on unknown plant (M. Bose); 4 males and 8 females, collected from Bagdogra range, Kurseong, W. Bengal, on July 13, 1935, *ex* galls on leaves of *Anthocephalus indicus* (C.F.G. Beeson). Few examples in poor condition were dissected and their parts were mounted on slides. These slides and the types are deposited at the Forest Research Institute, Dehra Dun.

The records of the Forest Research Institute show that 9 specimens from Sylhet, Assam, were sent to Mr F. Laing of the British Museum, in February 1931, for study purposes.

*Comparison.* *Pauropsylla reticulata*, sp.n. is readily recognised by the shape of head, shape and venation of wings, genital and other characters, as outlined in the key.

#### *Pauropsylla spondiasae* Crawford 1915

(*Figs. 29, 30*)

- Crawford, D. L. 1915. *Philipp. J. Sci.* 10(4): 260, Pl. 1, fig. g. (Peradeniya, Ceylon; *ex* galls on leaves of *Spondias mangiferae*).
- Enderlein, G. 1921. *Zool. Anz.* 52: 115 (*Pelmatobrachia spondiasae*).
- Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 622.
- Mani, M. S. 1935. *J. Asiatic Soc. Beng.* 1(2): 102.
- Mani, M. S. 1959. *Agra. Univ. J. Res. (Science)* 8: 138.
- Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 50.
- Beeson, C. F. G. 1941. *Forest Insects*, p. 778.

Length of body, in male, 1.12 mm; in female, 1.52 mm

Length of forewings, in male, 1.63 mm; in female, 1.90 mm

Width of head with eyes, 0.70 mm

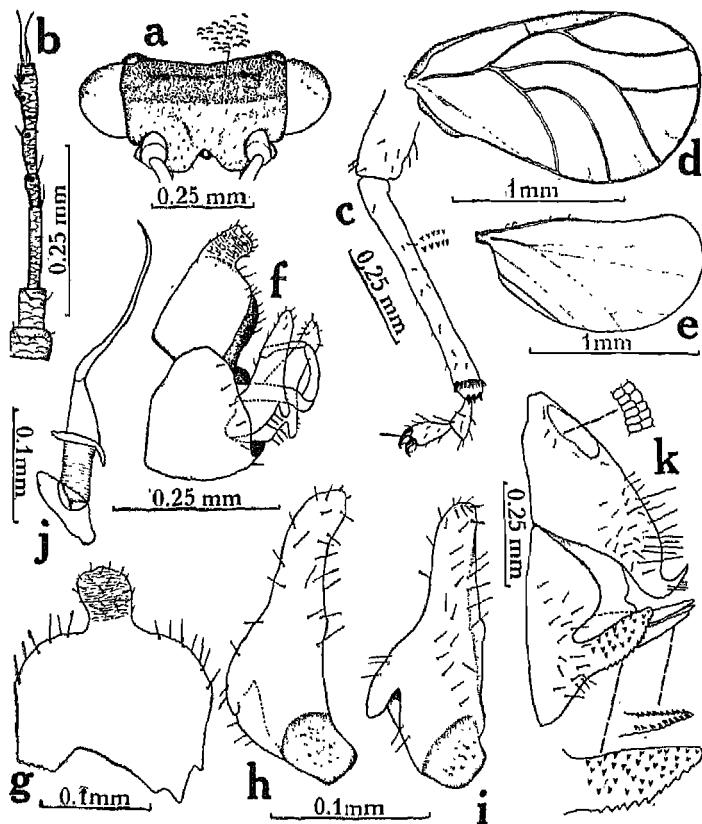


Fig. 29. *Pauropsylla spondiasae* Crawford—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: male genitalia, lateral view; **g**: anal valve, dorsal surface; **h**: forcep, caudal view; **i**: forcep, mesal view; **k**: female genitalia, lateral view.

Width of vertex between eyes, 0.45 mm

Length of antennae, 0.42 mm

**Colouration.** General colour of head and dorsum of thorax dark-brown, with metallic bluish tinge, venter of thorax light brown, vertex dark dorsally and lighter ventrally, antennae except apical segments, legs and abdomen yellow or yellowish-brown with greenish tinge, apical antennal segments light brown; forewings transparent, yellowish; female genitalia dark-brown.

**Structure.** Body small. Head (**Fig. 29a**) very short, nearly as broad as thorax, finely and sparsely pubescent, surface finely rugulose; vertex convex, rounded down in front uniformly, with two large foveal impressions near the posterior border and located by the side of posterior ocelli, posterior margin slightly arcuate, median suture absent, posterior ocelli slightly elevated, anterior margin deeply emarginate in middle; frons visible

in front, not wholly covered by genae, but largely so, with a large anterior ocellus located dorsally; genae slightly swollen beneath antennal bases. Eyes large, somewhat triangular. Clypeus visible in front, rather protruding out, somewhat triangular.

Antennae (**Fig. 29b**) small, nine-segmented, imbricate, sparsely pubescent, two basal segments robust, 1st subsquare, 2nd cylindrical, 3rd longest and slender, 4th a little more than one-third as long as 3rd, 5th and 7th smallest but equal, 6th a little longer than 4th, 8th segment large, club-shaped but smaller than 3rd, 9th smaller and broadly transverse, bearing two long apical spines, which are longer than two terminal segments, segments 4 and 6 broad apically, four sensoria present on segments 4, 6 and 8.

Thorax robust, strongly arched, finely and sparsely pubescent, finely rugulose. Prothorax partly ascending, partly concealed behind head, with two foveal impressions on each lateral side; prescutum large, twice as broad as long, broadest in middle, narrower both anteriorly and posteriorly; scutum slightly smaller in length, but much broader than prescutum, about three and a half times as broad as long, angulate laterally; scutellum broadly transverse, broad anteriorly and narrow posteriorly; mesopleurae large, prominent and anterior.

Legs (**Fig. 29c**) short, pubescent and also beset with minute thick points arranged in lines, femora shorter than tibiae, all tibiae with a comb of setae at apex, hind tibiae without basal spur, with four black, thick spines at apex (three on one side and one on the other), hind femur with two dorsal, thick setae near apex, tarsal segments nearly of equal length and armed with few thick setae; meracanthus small, subacute at apex.

Forewings (**Fig. 29d**) large and broad, broadest near apex, about one and three-fourths times as long as broad, broadly rounded at apex, hyaline but with yellowish tinge, with a long and broad pterostigma, first marginal cell much longer than second, cubital petiole ( $M + Cu$ ) smaller than cubitus, branches  $M_{3+4}$ ,  $Cu_1$  and  $Cu_2$  running somewhat parallel, similarly branch  $M_{1+2}$  running parallel to radial sector ( $Rs$ ), radial sector arising slightly beyond middle of pterostigma, radius smaller than basal vein, veins armed with microscopic setae.

Hind wings (**Fig. 29e**) slightly smaller than forewings, membrane beset with minute points, costal margin armed with a few simple and hooked setae.

Abdomen short and thick, finely and sparsely pubescent and also beset with minute points arranged in lines.

*Genitalia.* Male genital segment (**Fig. 29f**) smaller than abdomen. Anal valve (**Fig. 29g**) scarcely as long as forceps, about 0.68 mm long, erect, demarcated into a broad basal region and a small cylindrical anal region, when seen laterally, anterior margin nearly straight, posterior margin broadly convex, bearing long slender setae, anal lobe beset with minute, simple setae; parameres (forceps) about 0.70 mm long (**Figs. 29h,i**), broad basally, narrow apically, curved forward tapering to a point, lower half of posterior margin with a strong, thick spur directed downward, outer surface with a few scattered setae, mesal surface beset with simple setae, setae in the apical region rather thick and directed forward; aedeagus with both arms nearly equal in length; hypandrium with a few thick setae arranged in a line caudally; sperm pump as figured (**Fig. 29j**).

Female genital segment (**Fig. 29k**) almost as long as abdomen; dorsal plate very large, inclined sub-perpendicularly, with a large anal opening dorsad, somewhat swollen posteriorly and abruptly reduced in thickness near the tip and terminating in a short, curved, acutely pointed spur caudad, the swollen region beset with a tuft of slender hairs of various length, spur armed with two pairs of setae on either side; circum-anal ring composed of a double row of oval and slit-like pores; ventral plate small, slightly retracted into preceding abdominal segment, produced into a short slender acute process caudally, curved upward and ending in a round point, basal region sparsely beset with slender setae, and the process armed with stout saw-like teeth directed downward and backward; ovipositor large, apparently permanently exserted, having minute saw-like teeth, directed upward and cephalad.

*Host plant.* On *Spondias pinnata* (Linn. f.) Kurz (= *S. mangifera* Willd.).

*Distribution.* Previously recorded from Peradeniya, Ceylon (Crawford, 1915). Dehra Dun (U.P.). Mani (1959) has mentioned throughout Ceylon and South India.

*Material examined.* Its new record is from Dehra Dun (U.P.) and both adults and nymphs were collected in September 1952 (R.N. Mathur): 1 male and 1 female of 9.9.52 and 2 males and 2 females of 11.9.52 and a phial containing some adults and nymphal stages, preserved in alcohol and collected on 22.9.52 from Dehra Dun (R.N. Mathur).

*Comparison.* *Pauropsylla spondiasoe* Crawf. is redescribed from the material collected from Dehra Dun, and can be readily separated from other species by the presence of pterostigma, venation and shape of forewings, shape of head, absence of median suture and genital characters.

*Biological notes.* This species is commonly found during August and September forming galls by inrolling the margins of leaves. Its nymphs are pale yellow with light greenish tinge and crawl about actively on the leaves. Its nymphal stage is described below.

#### Nymphal stage

*Fifth stage.* (**Fig. 30a**) Length 1.42 mm. Typical pauropsylline type. Body broader than long. Wing-pads large and broad, the humeral angle projecting forward beyond the contour of the body, and also produced cephalad beyond the eyes, and thus the continuity of margin is interrupted near the eyes and head, and near the base of abdomen. Dorsum strongly sclerotic except for a small area between thorax and abdomen, the derm presenting a slightly vermiculate appearance. Entire margin of the body beset with a continuous series of somewhat broad, lanceolate setae, borne on low prominences; thick points present in between lanceolate setae. Dorsum also covered with small scattered papillae, each papilla bearing a small curved thick seta in centre. Near centre of caudal margin, marginal setae become ice-chisel shaped. Abdomen at the base narrower than the wing-pads. Abdomen composed for the most part of a single plate having faint segmentation lines, with a narrow, medially interrupted plate at the joint between abdomen and thorax. Caudal plate also ornamented with minute structures near the median line.

Ventral side with the derm apparently membranous throughout, except for a faintly chitinized marginal zone, a small area above the circum-anal ring, a small area about

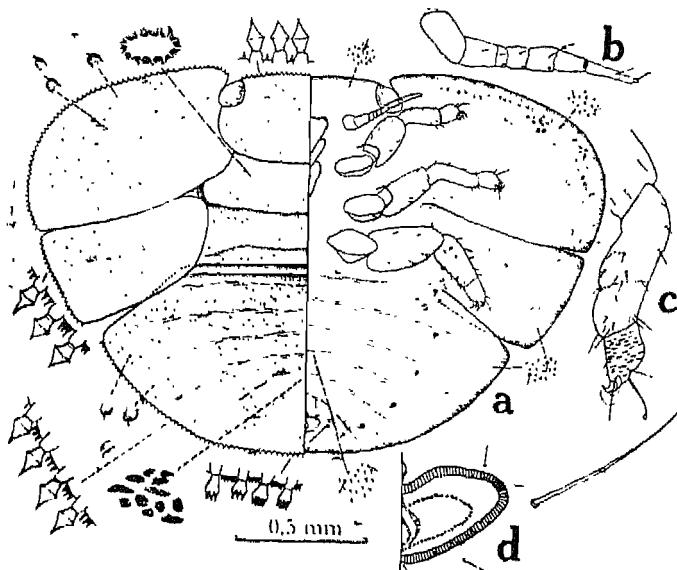


Fig. 30. *Pauropsylla spondiasae* Crawford—**a**: fifth stage nymph; **b**: antenna; **c**: hind leg; **d**: circum-anal ring.

each spiracle and faint sub-median lines in the abdomen; dorsum thickly beset with minute points and also with minute simple scattered setae. Antennae (**Fig. 30b**) about 0.32 mm, apparently six-segmented and armed with a few setae, two basal segments large, 3rd smallest, transverse, 4th subsquare, longer than 3rd, 5th about twice as long as 3rd, 6th longest, broad basally and narrow apically, bearing two unequal setae at apex; four sensoria present on segments 3, 4, 5 and 6, sensorium large on segment 6. Legs (**Fig. 30c**) very short, beset with simple setae, without trochanters, with the division between tibia and tarsus distinct, each tarsal segment with a golf-club seta and a simple seta near apex; claws present, the pulvilli quite large and pad-like. Anal opening (**Fig. 30d**) set well in from the apex of the body, surrounded by an outer ring, consisting of a single row of slit-like pores and an inner ring consisting of an irregular row of small indistinct pores; outer ring interrupted medially both anteriorly and posteriorly, and guarded by three pairs of setae, one anterior, one lateral and one posterior, the lateral pair of setae quite long and thick.

***Pauropsylla stevensi* Laing 1930**  
(*Fig. 31*)

Laing, F. 1930. *Indian Forest Rec.* 14(3): 37-39, fig. 2.

This species is not represented in the collection studied by me and, therefore, the description given by Laing (1930) is reproduced below.

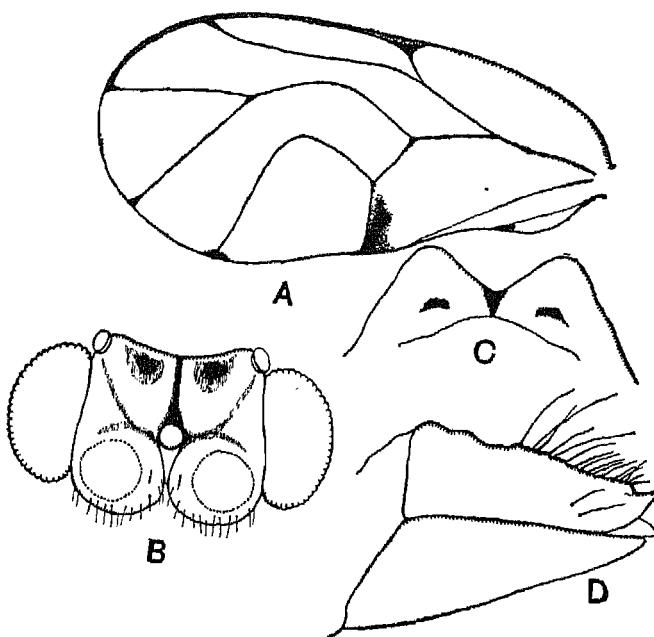


Fig. 31. *Pauropsylla stevensi* Laing.—A: tegmen; B: head, front view; C: saddle-shaped prominence on meta-pseudonotum; D: female genitalia (After Laing).

*Colouration.* “Antennae pale-yellow, the basal two segments pale-brownish, the apices of segments 3-7, 8, except for a narrow basal area, and the whole of 9 and 10 deep black; head and prothorax pale-brown, the former with a median fovea on each half of the vertex, the latter with two spots on each lateral area, dark; dorsum and mesonotum deep castaneous brown, the former with a large, dark, biconvex patch, divided down the middle, on anterior margin; mesonotum with a pale median longitudinal streak; metanotum dark-brown; all the pleurites of thorax yellowish; tegmen hyaline, the veins pale-brown, blackish at the forkings, and where each joins the margin, a rather extensive pale-brownish area alongside Cu<sub>2</sub>; abdomen above very dark-brown with a pale greenish-yellow median longitudinal stripe, below mainly yellowish-green; legs pale yellowish-brown, the second tarsal segment at least blackish.”

*Structure.* “Antennae with a little more than twice the length of head (including eyes); head with posterior margin deeply arcuate; each half of vertex subquadrate, with a deep fovea in the middle and towards posterior margin, whilst the area lying behind a line from the median to the lateral ocellus slightly elevated; thorax slightly arched; dorsal surface of whole thorax finely but irregularly striated; meta-pseudonotum with a saddle-shaped prominence; length of tegmen just over twice the breadth; front tibia with a close fringe of setose hairs forming a half whorl on the inner side; apex of hind tibia with a similar comb, but forming a three-quarter whorl; first tarsal segment of the hind leg

with two apical black spines; ♀ genitalia rather short, the upper valve projecting slightly over the ventral. Length 4 mm; length of tegmen 4 mm."

*Distribution.* "Darjeeling; Gopaldhara, 4,500 feet (H. Stevens)."

**Pauropsylla tuberculata** Crawford 1912

(Fig. 32)

- Lefroy, H. M. 1909. *Indian Insect Life*, p. 742, pl. lxxx.
- Crawford, D. L. 1912. *Rec. Indian Mus.* 7: 430-431, pl. xxxiv. figs. I, J, L; pl. xxxv, fig. E, (Pusa, Bihar; on "pumpkin" and *Alstonia scholaris*).
- Crawford, D. L. 1919. *Philipp. J. Sci.* 15: 146-147.
- Enderlein, G. 1921. *Zool. Anz.* 52: 116 (*Pseudophacopteron tuberculata*).
- Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 622.
- Rahman, Khan A. 1932. *Indian J. agric. Sci.* 2: 361-365, pl. xxxvi. (Nymphal stages).
- Mani, M. S. 1935. *J. Asiatic Soc. Beng.* 1(2): 100-101.
- Mani, M. S. 1959. *Agra. Univ. J. Res. (Science)* 8(2): 208-209 (on leaf and fruit of *Alstonia scholaris*, India; W. Bengal).
- Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 51.
- Beeson, C. F. C. 1941. *Forest Insects*, p. 778.
- Saksena, R. D. 1944. *J. R. Asiatic Soc. Beng.* 10: 123-124 (gall.).
- Heslop-Harrison, G. 1959. *Ann. Mag. nat. Hist.* (13), 2(15): 161.
- Klimaszewski, S. M. 1964. *Annl. Zool.*, 22(5): 111, fig. 38 (Nymph of *Pseudophacopteron tuberculatum*).

Length of body, in male, 1.20 mm; in female, 1.80 mm

Length of forewings, in male, 1.40 mm; in female, 2.10 mm

Width of head with eyes, 0.68 mm

Width of vertex between eyes, 0.38 mm

Length of antennae, 0.60 mm

*Colouration.* General colour in dark forms, red to dark reddish-brown, vertex orange posteriorly and dark reddish-brown anteriorly, dorsum posteriorly orange-yellow, connexivum of abdomen white; while in light forms, shades lighter; antennae black at tip; wings hyaline, transparent, with black basal margin; legs lighter in colour, hind femora brownish dorsally and darker than others, with tarsal segments also slightly darker.

*Structure.* Body small but robust. Head (Fig. 32a) short, as broad as thorax, deflexed, finely and sparsely pubescent, vertex about one and a half times as broad as long, rounded down and forward, surface rather plane, posterior margin angulately emarginate, post-ocellar region not prominently elevated, post ocelli rather remote from eyes, anterior ocellus visible from above, near to clypeus, median suture absent; facial cones entirely wanting. Eyes large, recessive, somewhat triangular in shape. Clypeus large, somewhat oval, visible from front.

Antennae (Fig. 32b) attached somewhat in level with anterior ocellus, nearly as long as width of head, terminal setae very long and about half the length of antennae, ten-segmented, bearing few setae, two basal segments robust, remaining segments slender, imbricate, narrower basally and broader apically, 3rd segment longest, 4th, 6th and 8th equal to one another but each a little shorter than 3rd, 5th slightly smaller than 4th,

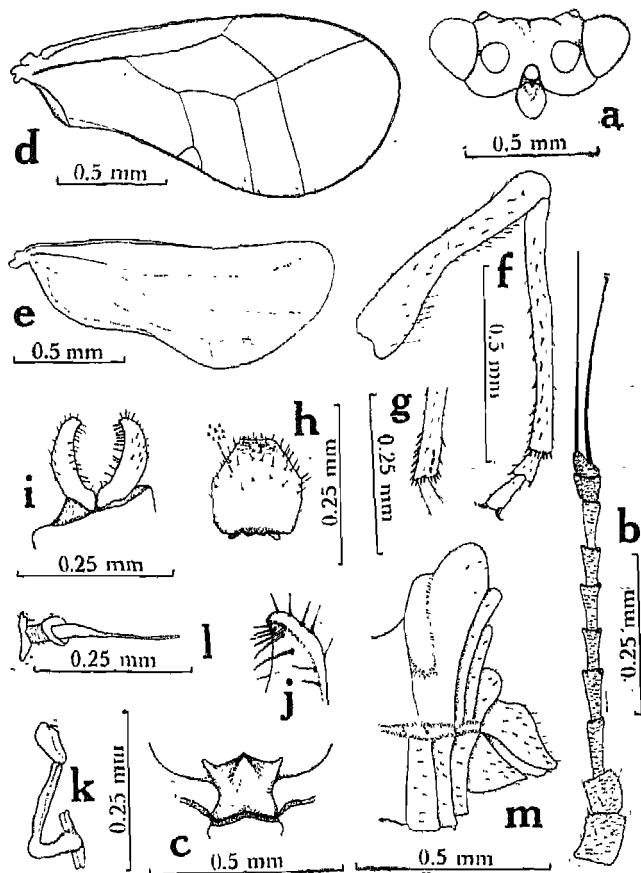


Fig. 32. *Pauropsylla tuberculata* Crawford—**a**: head, front view; **b**: antenna; **c**: scutellum; **d**: forewing; **e**: hind wing; **f**: hind leg; **g**: apical portion of middle tibia; **h**: anal valve of male; **i**, **j**: parameres; **j**: apical portion of forceps, highly magnified; **k**: aedeagus; **l**: sperm pump; **m**: posterior portion of abdomen and genitalia of female, lateral view.

7th slightly smaller than 5th, 9th about half as long as 8th, terminal segment slightly smaller than 9th, bearing two unequal apical setae, the two apical segments compressed.

Thorax robust, strongly arched, finely rugulose, finely and sparsely pubescent. Pronotum short, ascending, narrower in middle, broader laterally, each side with two foveal impressions; propleurites mostly concealed by eyes and occiput; prescutum arched, broadest in middle, about one and a half times as broad as long, narrower both anteriorly and posteriorly, angulate laterally, posterior margin angulate submedianally; scutum broadest in centre and about two and a half times as broad as long, slightly smaller in length than prescutum, angulate laterally; mesopleurae large and anterior; scutellum

(**Fig. 32e**) somewhat pentangular, with a strong dorsal median epiphysis, having a black acute point; post-scutellum of meta-thorax narrowly transverse.

Legs (**Fig. 32f**) typical, pubescent, also armed with thick points arranged in linear series, fore and middle legs comparatively smaller than hind legs, femora shorter than tibiae, hind coxae thick and long, hind femora constricted in middle, all tibiae with apical comb of setae, apical half of fore and middle iactib (**Fig. 32g**) armed with a group of thick setae, hind tibiae beset with two rows of thick setae arranged longitudinally, and a group of about nine apical setae, tarsal segments almost equal in length, meracanthus small and slender.

Forewings (**Fig. 32d**) rather small, broadest and rather square at apex, hyaline and transparent, a little less than twice as long as broad, attenuate at base, radius quite long,  $R_s$  angulate midway and touching arch of  $M_{1+2}$ , cubital petiole shorter than radius, first marginal cell very small, triangular, second cell large and rectangular; veins beset with microscopic setae. Hind wings (**Fig. 32e**) slightly shorter than forewings, costal margin beset with a few simple and hooked setae.

Abdomen robust, sparsely pubescent, third and fourth tergites produced upward into two prominent humps (**Fig. 32m**).

*Genitalia.* Male genital segment small. Anal valve (**Fig. 32h**) about 0.15 mm long, longer than forceps, pear-shaped in anterior view, bearing sparsely thick setae borne on small tubercles, and also armed with thick points, both anterior and posterior margins slightly convex in profile, truncate at tip; parameres (**Figs. 32i, j**) about 0.12 mm long, bowed, broad in middle, gradually narrowed apically and terminating in thick points, outer surface armed with thick setae in the apical region, mesal margins also beset with thick setae, just below the apical point 2 or 3 strong and thick setae present, pointing downward; hypandrium of usual shape, sparsely bearing thick setae borne on minute tubercles, and also armed with thick points; aedeagus (**Fig. 32k**) small, outer arm with a thick oval-shaped spoon end; sperm pump as figured (**Fig. 32 l**).

Female genital segment (**Fig. 32m**) short, stout, pubescent with long hairs, plates unequal, dorsal plate longer than ventral, broad at base, strongly sloping caudad, narrowly rounded at apex; ventral plate broader at base, acute at tip.

*Host plants.* On pumpkin and *Alstonia scholaris* (leaf galls).

*Distribution.* Previously recorded from Pusa, Bihar (Crawford, 1912); Mani (1959) has mentioned W. Bengal, Bombay, Tamil Nadu; probably throughout India; Burma, Siam, Malaya, Java and Philippines.

*Specimens examined.* Bihar: Pusa, 20.3.1919, (Dwarka Parshad) 2 females (one specimen without head and partly in a damaged condition) at the National Collection of the Forest Research Institute, Dehra Dun. A small series is present at the Indian Agricultural Research Institute, New Delhi, as follows: Pusa, Bihar, 1 ex. of 12.12.10 (T.B.F.); 6 ex. of April, 1911 (C.S.M.); on *A. scholaris*, 1 ex. of 12.4.12, (D.R.S.); 3 males of 11.3.16 (T.Ram), on *Alstonia* leaves, 8 ex. of 20.3.19 (Dwarka Parshad). All these specimens are in very poor condition, with parts missing.

In July 1967, some galls on *Alstonia scholaris* were also received from Pusa, Bihar (K. G. Phadke).

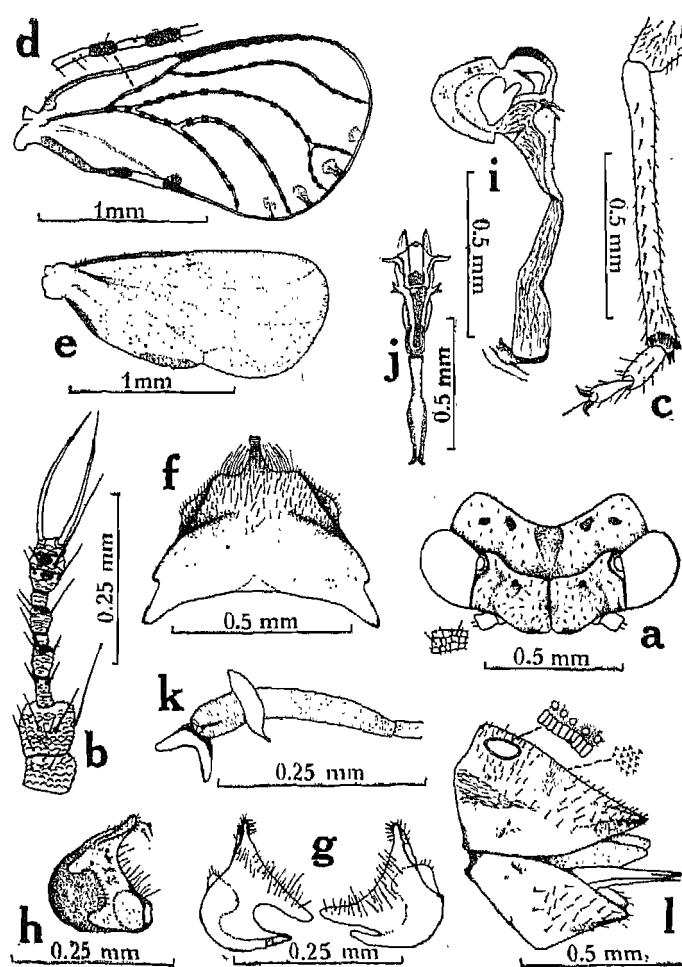


Fig. 33. *Pauropsylla verrucosa*, sp. n.—a: head and prothorax, dorsal view; b: antenna; c: hind leg; d: forewing; e: hind wing; f: anal valve of male, upper surface; g, h: parameres; i, j: aedeagus, lateral and dorsal views; k: sperm pump; l: female genitalia, lateral view.

*Comparison.* This species is redescribed with some more details and figures. It is easily recognised by its very small first marginal cell, fork  $M_{1+2}$  angulately arched and touching radial sector, shape of head, antenna with two long setae, humped abdomen and genital characters. Enderlein (1921) included this species under the genus *Pseudophacopteron*. Heslop-Harrison (1959) writes: "It is undoubtedly closely related, if not cogenetic with *Phacosema zimmermani* Aulm., and both of these forms suggest some affinity for the Brazilian *Epicarsa corniculata* Crawf. ...., and forms of the *tuberculata* and *zimmermani* type (there are several new ones awaiting description), are to be

referred, together with *Phacopteron* Buckton, to the tribe *Phacopteronini*.” However, the characters resemble closely with *Pauropsylla* and, therefore, this species is retained under the genus *Pauropsylla* at present.

*Biological notes.* Brief description of the gall is given by Mathur (1935), and the nymphal stages are described by Rahman (1932). Mani (1935, 1959) has briefly given notes about its gall and distribution; while Saksena (1944) has described the anatomical structures of the gall.

***Pauropsylla verrucosa*, sp. n.**  
(Figs. 33, 34)

Length of body, in male, 2.12 mm; in female, 2.32 mm

Length of forewings, in male 2.0 mm; in female, 1.19 mm

Width of head with eyes, 0.93 mm

Width of vertex between eyes, 0.51 mm

Length of antennae, 0.40 mm

*Colouration.* General colour dark-brown or fuscous, speckled with scattered darker spots on head, dorsum of thorax and abdomen; fore to hind pairs of legs progressively dark-brown with blackish tinge; antennae with two basal segments, 4th, 6th and 8th to 10th segments fuscous, remaining segments paler; clypeus dark-brown, beak of lighter colour; females of lighter colour, with abdomen and genitalia yellowish-brown; wings dull, having dark-brown bands on veins and maculae along the posterior margin.

*Structure.* Body small but robust. Head (**Fig. 33a**) quite large, slightly broader than thorax, moderately declivous; vertex large, two and a half times as broad as long, finely pubescent with white hairs, surface reticulate and weakly verrucose, disc strongly and rather irregularly excavated, with deep circular foveae near posterior margin and on either side of median suture, a broad linear depression extending forward from each fovea but not reaching the anterior margin, lateral margin elevated, posterior margin strongly arcuate, post-ocellar region slightly elevated, median suture invaginated, roundly bent forward and somewhat vertical anteriorly, anterior margin deeply and roundly invaginated near point of excision, anterior ocellus visible in front, not visible from above; frons visible in front as a small sclerite; genae small, weakly swollen beneath antennae. Clypeus large, somewhat circular, bearing long hairs; beak quite long and slender. Eyes large, recessive, sub-triangular.

Antennae (**Fig. 33b**) short, shorter than the width of vertex between eyes, apparently ten-segmented, imbricate, two basal segments robust and thick, 1st transverse, 2nd sub-square, 3rd and 4th nearly equal, 4th broader apically, 5th and 7th smallest but equal, 6th slightly smaller than 4th, 8th, 9th and 10th jointly appearing like a club, apical segment with two very long terminal setae, slightly more than half as long as the antenna itself, two or more long setae present on segments 2, 3, 6, 8 and 9, four sensoria present on segments 4, 6, 8 and 9.

Thorax strongly arched, robust, broad, surface reticulate and prominently verrucose, sparsely pubescent with white hairs. Pronotum (**Fig. 33a**) roof-shaped, quite broad, verti-

cally bent downwards anteriorly with three prominent ridges, one median and two submedian, surface shallowly excavated near posterior border and between submedian ridges, with deep foveal impressions on lateral sides, pleurites concealed by recessive eyes; prescutum large, longitudinally and medianly invaginated or channelled, broadest before middle, slightly more than one and a half times as broad as long, narrowly rounded cephalad, angulate both laterally and posteriorly, with a prominent median tubercle near posterior border; scutum large and broad, nearly as long as prescutum, prominently ridged sub medianally, leaving a broad channel in centre; scutellum about twice as broad as long, somewhat rectangular in shape, with a fuscous median line, angulate at antero-lateral angles; post-scutellum narrowly transverse.

Legs (**Fig. 33e**) quite long, pubescent; femora shorter than tibiae, bearing minute points, all trochanters and femora having long ventral setae, all tibiae with a comb of setae at apex, hind tibiae without basal spur, with a longitudinal row of thick setae and with three black tooth-like spines at apex, hind coxae thick and long; meracanthus comparatively small, subtriangular and beset with minute points.

Forewings (**Fig. 33d**) large, rhomboidal, rather square at apex, a little more than half as broad as long, broadest subapically; pterostigma long and narrow, *Rs* with a loop, *R* about three times as long as cubital petiole (*M+Cu*), *Cu* slightly more than twice as long as cubital petiole, basal vein (*R+M+Cu*) nearly as long as *R*, all veins covered with dark-brown, somewhat rectangular spots, maculae present near apical margin, in radial, first and second marginal, median and near posterior margin of cubital cells, first marginal cell about thrice as long as second, all veins setigerous. Hind wings (**Fig. 33e**) quite large, thickly beset with minute points, costal margin armed with a few simple and hooked setae.

Abdomen short and thick, nearly as long as broad, finely and sparsely pubescent, both tergites and sternites thickly beset with minute points arranged in linear series, first four visible tergites conspicuously humped medianally.

*Genitalia.* Male genital segment smaller than abdomen; anal valve (**Fig. 33f**) large, robust, about 0.48 mm long, much longer than parameres, having a broad basal area and a small, tube-like anal area when seen laterally, the basal arca quite broad at base, convergent distad, with two small, subapical lobes on posterior border, apical half armed with long setae, setae along the posterior border smaller and slender, in lateral aspect, anterior margin of basal area concave in the apical half, anal tube wrinkled, bearing an oblique aperture facing cephalad; parameres (forceps) (**Figs. 33g, h**) very small, about 0.20 mm long, strongly built, bilobate, inner lobe slender and longer than outer, outer lobe shorter and thicker, outer surface of both the lobes beset with small setae, mesal surface gouge-shaped, with the inner lobe bearing thick setae directed slightly downward; aedeagus (**Figs. 33i, j**) robust, peculiarly shaped when seen laterally, the spoon end appearing like a modified halbert (pole-axe) and in dorsal view this end is divided into two broad flaps; hypandrium quite large, pubescent; sperm pump as figured (**Fig. 33k**).

Female genital segment (**Fig. 33l**) smaller than abdomen, finely and sparsely pubescent; dorsal plate slightly longer than ventral, with a moderately steep slope, subacute at apex;

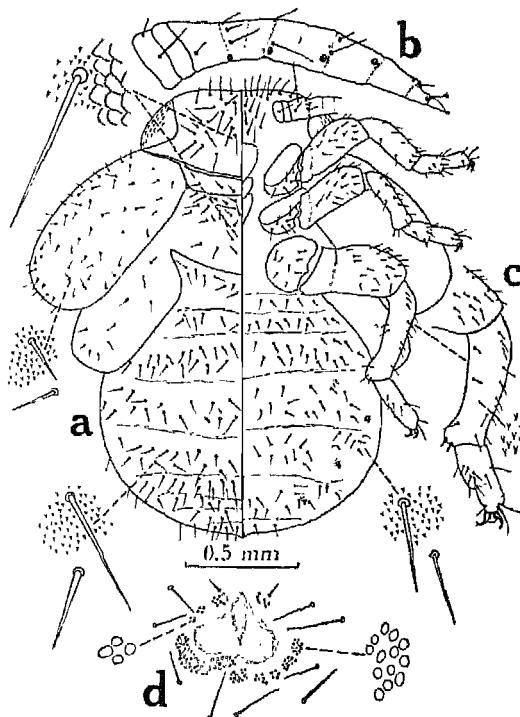


Fig. 34. *Pauropsylla verrucosa*, sp. n.—**a**: fifth stage nymph; **b**: antenna; **c**: hind leg; **d**: circum-anal pore ring.

ventral plate narrowly rounded at apex with a median invagination; ovipositor long and acutely pointed; anal aperture surrounded by a double ring of pores.

*Host plant.* Bred ex galls on leaves of *Semecarpus anacardium* Linn. f.

*Type locality.* Tittimatti, Coorg (Karnataka).

*Types.* Holotype male; Allotype female, from the type locality, January 18, 1942 (R. N. Mathur); Paratypes: 1 male and 1 female, also from the type locality and same date of collection (R. N. Mathur). Numerous nymphal stages and few adults were also preserved in alcohol, January 18, 1942 (R. N. Mathur). All types and the preserved material deposited at F.R.I., Dehra Dun.

*Comparison.* *Pauropsylla verrucosa*, sp. n. is characterised by its verrucose body, shape of wings and bearing dark-brown bands on veins and maculae along the posterior margin, shape of head, antennae, and peculiar genital structures.

*Biological notes.* The galls of this species are pea green in colour, single-celled, flat on the dorsal surface and swollen ventrally, with a conical point and clothed with fine hairs. Each gall may harbour one or more (maximum three) nymphs inside, and dehisces from the ventral side. Mature nymphs crawl out from the gall and shed their last skin. Nymphs are of biscuit colour, with abdomen orange and eyes pinkish red. The adults

on emergence are sluggish, and on maturity they become very active. The structure of the adult nymph is described below.

### Nymphal stage

*Fifth stage.* Length 1.87 mm. Form pauropsylline (**Fig. 34a**), broadly oval; head nearly as broad as thorax and abdomen; wing-pads projecting beyond the contour of the body and broadly rounded at apex. Derm weakly sclerotic throughout, weakly rugulose and thickly beset with minute points arranged in small groups which are clustered together in the middle region. Dorsum bearing simple setae of various length, setae smaller on wing-pads. Prothorax prominently differentiated from head and mesothorax. Abdominal segments demarcated by the presence and arrangement of simple setae.

Ventral surface also weakly sclerotic. Derm beset with simple setae and minute points. Antennae (**Fig. 34b**) ventral, 0.52 mm long, thick, apparently three-segmented, sparsely beset with simple setae, two basal segments small, transverse, 3rd longest, showing traces of segmentation, bearing four sensoria and with two thick setae below apex. Legs (**Fig. 34c**) quite robust, short and thick, beset with simple setae and also with minute points; with a distinct trochanter; femora not reaching the margin of the body, smaller than tibiae, tibio-tarsal articulation distinct; each tarsus with a long seta near apex; claws quite long and strongly curved, pulvillus like a pad. Anal opening terminal, like a minute tube, surrounded by an irregular and broken ring of pores (**Fig. 34d**).

### Genus PHACOPTERON Buckton 1894

#### *Phacopteron*

- Buckton, G. B. 1894. *Indian Mus. Notes* 3(5): 18-19.  
 Crawford, D. L. 1912. *Rec. Indian Mus.* 7(5): 419-420.  
 Aulmann, G. 1913. *Psyllidarum Catalogus*, Berlin, p. 80.  
 Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 622.  
 Heslop-Harrison, G. 1958. *Ann. Mag. nat. Hist.* (13), 1: 561-579.  
 Heslop-Harrison, G. 1959. *ibid.* (13), 2 (15): 157-168.  
 Heslop-Harrison, G. 1960. *ibid.* (13), 3 (32): 497-504.

#### *Phacosema:*

- Kieffer, J. J. 1906. *Z. Wiss. Insekt. Biol.* 2: 387.

Type species *Phacopteron lentiginosum* Buckton, 1894.  
 (original designation).

The distinctive features characterised by Buckton (1894) and Crawford (1912) are expanded with my notes as below.

Insect large, robust. Body strongly arched. Head small, more or less retracted under pronotum, narrower than thorax, but almost as broad as prothorax; vertex transversely rather flat, but rounded down forward, somewhat cleft in front, due to protruding antennal sockets; post-ocellar region strongly elevated and posterior margin deeply emarginate in between; anterior ocellus visible from above. Facial cones rather short, divergent, separate at base, porrect, and subacute at apices. Eyes large, hemispherical. Antennae long and slender, almost as long as head and thorax. Thorax large and broad, strongly

arched. Prothorax long, almost vertical, narrowly convex, with a median epiphysis. Propleurites at base moderately large, suture between them and pronotum not distinct. Mesopleuron large. Legs long, femora large; hind coxae very large, elongate, contiguous along inner margin with spur short. Hind tibiae without basal spur and apical tooth-like spines; hind basal tarsi with two small claw-like spines at apex. Forewings large, more or less hyaline, somewhat rhomboidal in outline; radial sector and fourth furcal connected by a short cross vein or coalesced together, making a third marginal cell, sub-acute at apex, cubital petiole more than half as long as basal vein, second marginal cell quadangular, broadest at margin.

Crawford (1912) writes: "This genus is unmistakably related to *Pachyphyllea* in nearly all its characters except the venation, in which it is similar to *Ciriacremum*. Because of this similarity it has hitherto been grouped with the latter genus, but this relation is only in the wing venation, whereas all the rest of the anatomical characters, even the shape of the wing, point to its affinity with *Pachyphyllea*. By some unaccountable error Enderlein, in his paper on the *Psyllidae of Kilimandjaro*, separated this genus from Kieffer's *Phacosema* by the absence of the cubital petiole. Buckton's original description and accompanying figure clearly show that this is not true. As a matter of fact, these two species, *Phacopteron lentiginosum* Buckt., and *Phacosema gallicola* Kieffer are undoubtedly not only congeneric but also very closely related specifically. Until I have further evidence, however, than Kieffer's description, I will not merge the two genera." Laing (1930) has however definitely mentioned that, "There is no doubt of *Phacosema* Kieff., being a synonym of *Phacopteron* Buckt." Heslop-Harrison (1958, 1959, 1960) has also treated *Phacosema* Kieffer as synonym of *Phacopteron* Buckton.

This genus is represented by a single species, *P. lentiginosum* from India.

**Phacopteron lentiginosum** Buckton 1894

(Fig. 35) (Plate 3, f)

- Buckton, C. B. 1894. *Indian Mus. Notes* 3(5): 18-19.  
 Stebbing, E. P. 1899. *Injurious Insects of Indian Forests*, pp. 25-26.  
 Kieffer, J. J. 1906. *Z. wiss. Insekt. Biol.* 2: 387-390. figs. 1-5.  
 Lefroy, H. M. 1909. *Indian Insect Life*, p. 743.  
 Crawford, D. L. 1912. *Rec. Indian Mus.* 7: 420-421, pl. xxxiii, figs. A, B, F; pl. xxxv, fig. A (Dehra Dun, W. Himalayas; Poona, W. India).  
 Crawford, D. L. 1919. *Philipp. J. Sci.* 15: 154-55 (Coorg).  
 Aulmann, G. 1913. *Psyllidarum Catalogus*, Berlin, p. 80.  
 Ramakrishna Ayyar, T. V. 1919. *Rept. Proc. Third Ent. Meet. Pusa*, p. 1030-1031 (Bred from galls on leaves of *Garuga pinnata*, North Malabar).  
 Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 622.  
 Laing, F. 1930. *Indian Forest Rec.* 16: 39 (Bred from galls on *Garuga pinnata* and *Schleichera trijuga*, Dehra Dun; Tonkin, Hoabinh).  
 Mani, M. S. 1935. *J. Asiatic Soc. Beng.* 1(2): 102 (Biology).  
 Mani, M. S. 1959. *Agra Univ. J. Res. (Science)*, 8(2): 121.  
 Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 51-52 (Biology).  
 Mathur, R. N. 1949. *Indian J. Ent.* 8(2): 227-229, fig. 3 (1946), (Nymphal stages).  
 Beeson, C. F. C. 1941. *Forest Insects*, p. 778-779 (Biological notes).  
 Heslop-Harrison, G. 1959. *Ann. Mag. nat. Hist.* (13) 2(15): 165.

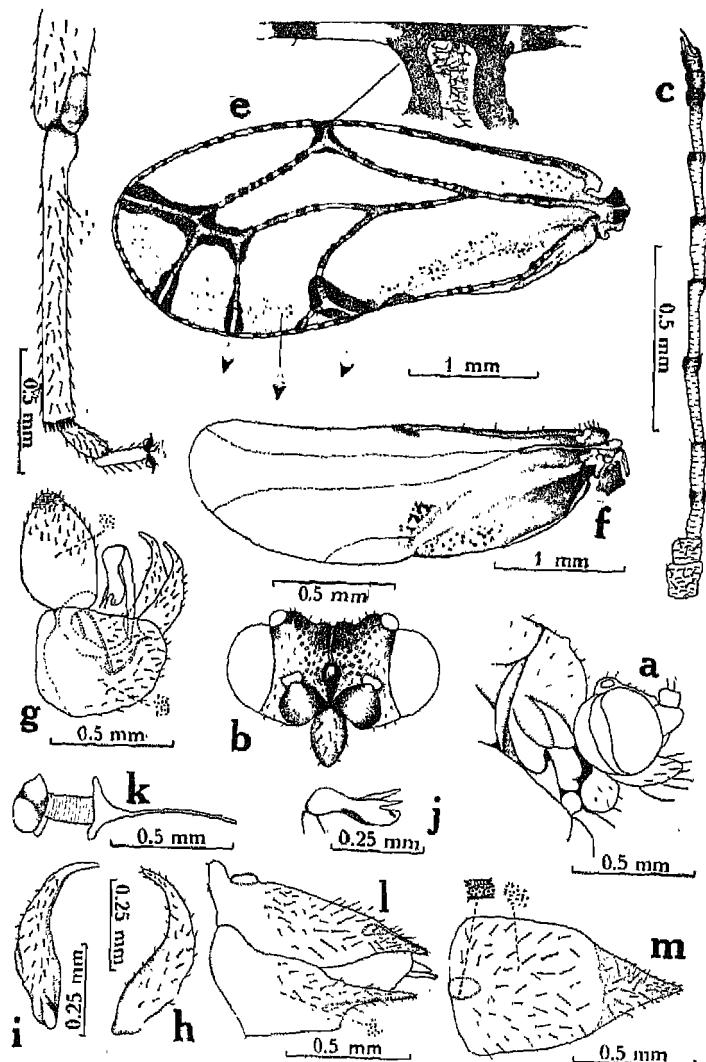


Fig. 35. *Phacopteron lentiginosum* Buckton—**a**: head and part of thorax, lateral view; **b**: head, front view; **c**: antenna; **d**: hind leg; **e**: forewing; **f**: hind wing; **g**: male genitalia, lateral view; **h**, **i**: forceps, outer and mesal views; **j**: outer arm of aedeagus; **k**: sperm pump; **l**: female genitalia, lateral view; **m**: dorsal plate.

Heslop-Harrison, G. 1960. *ibid.* (13) 3 (32): 503-504.

Weidner, H. 1961. *Sonderdr. Abh. Verh. der naturw. Vere Hamburg* 5 (1960): 39-40, 46.

Length of body, in male, 3.45 mm; in female, 4.28 mm

Length of forewings, in male, 3.32 mm; in female, 3.81 mm

Width of head with eyes, 0.88 mm

Width of vertex between eyes, 0.48 mm

Length of antennae, 1.52 mm

*Colouration.* General colour brown, vertex, pronotum and abdomen with light brown blotches, antennae brown, with apices of segments and entire terminal segment black, legs concolourous, forewings maculated apically with dark-brown to black bands, with a macula on  $R_1$ , another at tip of radial sector, around the forks of media and cubitus, veins and margins spotted closely with small black spots, hind wings blackish basally and along costal margin.

*Structure.* Body very large, robust, sparsely and briefly pubescent. Head (**Figs. 35 a, b**) small, strongly deflexed, retracted under pronotum, including eyes, much narrower than thorax, about as broad as prothorax, somewhat cleft in front due to the protruding antennal sockets, finely and sparsely pubescent, finely rugulose; vertex transversely rather flat, but rounded down forward, with a small fovea on each side of median suture posterior to centre, posterior margin deeply emarginate between post-ocellar region, which is strongly elevated, ocelli large, anterior ocellus visible from above, between and a little above facial cones, anterior margin deeply emarginate at point of excision; genal cones short, widely separated at base, divergent, porrect, subacute at tip, pubescence short but longer than that of vertex. Eyes large, hemispherical. Labrum small.

Antennae (**Fig. 35c**) long, slender, almost as long as head and thorax, ten-segmented, bearing a few setae, imbricate, two basal segments robust and subquadrate, 1st larger than 2nd, 3rd segment longest having a dark band and weakly swollen in middle, 4th, smaller than 3rd, 5th slightly smaller than 4th, 6th and 7th equal but smaller than 5th, 8th smaller than 7th, 9th and 10th segments very small, all segments from 3 to 8 thicker at apices, terminal segments slightly clavate, last segment slightly longer than 9th, bearing two apical spines; four sensoria present on segments 4, 6, 8 and 9.

Thorax very large, broad, strongly arched (**Fig. 35a**), pubescent with long hairs, strongly rugulose. Pronotum long, almost over-hanging vertex, narrowly convex, with a small median epiphysis just below posterior margin, with two large foveae on each lateral side; propleurites moderately large, with suture between them and pronotum scarcely visible; prescutum long, ascending, slightly less than one and a half times as broad as long, broadest slightly beyond middle, narrower both anteriorly and posteriorly, angulate laterally; scutum very large, slightly smaller in length than prescutum, about two and a half times as broad as long, angulate laterally; scutellum broadly transverse, broad anteriorly and narrow posteriorly, anterior margin convex, with a small dorso-median epiphysis and prominent antero-lateral angles, posterior margin straight; mesopleurites very large, conspicuous and produced forward.

Legs (**Fig. 35d**) large, long, strongly beset with thick points and coarsely with simple setae, all femora somewhat enlarged, stout, with tibial groove deep and conspicuous, all tibiae armed with apical comb of setae, tibiae longer than femora except hind tibia which is equal in length to hind femur, hind tibiae without basal spur and apical tooth-like spines; tarsi large, basal tarsal joints longer than apical, hind basal tarsi with two small,

claw-like spines; hind coxae very large, elongate, with meracanthus small and blunt.

Forewings (**Fig. 35e**) large, hyaline, maculate, somewhat rhomboidal in shape, a little more than twice as long as broad, broadest just beyond first marginal cell, subacute at apex, radial sector straight, not parallel to margin, connected with arch of  $M_{1+2}$  by a short cross vein in female, then flexed sharply toward margin, terminating slightly before apex of wing, in some specimens, the cross vein is absent and the arch  $M_{1+2}$  coalesces with radial sector, cubital petiole more than half as long as radius, basal vein slightly smaller than radius, cells unequal, first marginal cell very small, second cell quadrangular, broadest at margin, third marginal cell formed near apex of wing; veins armed with setae, minute points also present near apex and along posterior border. Hind wings (**Fig. 35f**) also quite large, thickly beset with minute points, costal margin armed with few simple and hooked setae.

Abdomen large and robust, fusiform and pointed caudally in female, finely and sparsely pubescent, finely rugulose, pubescence longer on sternites.

*Genitalia.* Male genital segment (**Fig. 35g**) smaller than abdomen, rounded. Anal valve large, about 0.50 mm long, broadest in middle, in lateral aspect, anterior margin convex, posterior margin broadly and convexly rounded, upper surface sparsely beset with simple setae and also with thick points; forceps (**Figs. 35 h, i**) slender, simple, rather as long as anal valve, converging uniformly from base to tip, curved forward and roundly acute at apex, forming a tooth-like process, arcuate in caudal view, mesal surface strongly invaginated, forming sharply edged margins, both the outer and mesal surfaces armed with simple setae, setae on the latter directed downward; hypandrium of usual shape, simple, beset with sparse pubescence and also armed with thick points; aedeagus with the outer arm much smaller than basal, spoon-end (**Fig. 35j**) divided into three processes, posterior process rounded, two anterior processes acutely pointed and longer than the posterior; sperm pump as figured (**Fig. 35 k**).

Female genital segment (**Fig. 35 l**) smaller than abdomen, both plates almost equal or subequal in length, and armed with thick points; finely rugulose; dorsal plate (**Fig. 35m**) thick at base, gradually sloping and narrowed caudally, subacute at apex, surface beset with simple setae, with several long hairs in middle; circum-anal pore ring small, raised and composed of a band of pores; ventral plate broad basally, upturned slightly beyond middle and then narrowed caudally, acuminate, acutely pointed apically, pubescence simple, with some long hairs in middle; ovipositor acutely pointed.

*Host plant.* Bred *ex* galls on leaves of *Garuga pinnata* Roxb. and *Schleichera trijuga* Willd.

*Distribution.* Previously recorded from Poona, Bombay; Dehra Dun, Haldwani (U.P.); Coorg (Karnataka); North Malabar (Kerala); Pusa (Bihar); Trichinopoly (Tamil Nadu) Tista Village, Kalimpong, W. Bengal (India); Sikkim, Tonkin, Hoabinh.

*Material examined.* The collection at the Forest Research Institute, Dehra Dun, includes 1 example, 6.12.1922 (without genitalia), 1 female, 4.1.1923, 1 female, 4.3.1923, all from Thano, Dehra Dun, U.P. (R.R.D., 62.208. G. jar B), bred *ex* galls of *Garuga pinnata* (N. C. Chatterjee); + males and 3 females, 4.5.1930, from Chakata, Haldwani, U. P.

(B. M. Bhatia); 4 examples from Bombay, I. xii. 1901 (E.P.S.); 6 examples of November 10 and 7 examples of November 29, 1922, from Golatappar, Dehra Dun (Students coll.); 7 examples of November 14/15, 1922 from Golatappar (N. C. Chatterjee); 5 examples of November 15, 1922, from Golatappar (C. F. C. Beeson); 11 examples of 1933, from Thano, Delira Dun (N.C.C.); 17 examples of 16.8.1935 from Dehra Dun (Sher Bahadur); 23 examples from New Forest, 24.1.1936 (R. N. Mathur); and 39 examples from Shahapur, Thana, Bombay, 6.2.50 (R.R.D. 862) (R.F.O.); 6 examples from New Forest, Dehra Dun of September, 1933 and 6 examples of 16.2.1950, *ex* galls on *Garuga pinnata* (R. N. Mathur); and 13 examples from Mercara (Res. Range Officer) of 30.11.1950, *ex* galls, *Garuga pinnata*.

The collection at the Zoological Survey of India comprises 10 specimens from Dehra Dun, U. P. *ex* galls on *Garuga pinnata* (Director of Forest School), and 1 male and 3 females, from the same locality, and a small jar containing galls preserved in alcohol.

Five specimens from Polibetta, Coorg, 27.5.1917 (Y. R. Rao) are present at I.A.R.I., New Delhi.

Few specimens (in poor condition) of this species are also present at the Agricultural College and Research Institute, Coimbatore. The specimens examined by me are: 1 example from North Malabar, Taliparamba, June, 18 (P. S. Nathan), and 1 female from Arukutty, Travancore, 25.4.1918 (Isaac), all from galls of *Garuga pinnata*.

*Comparison.* This species is redescribed from a good series of both sexes, bred *ex* galls of *Garuga pinnata* at Dehra Dun. It is easily recognised by its colouration, shape of head and venation. The characters of *Phacosema gallicola* given by Kieffer (1906) show close similarity with those of *Phacopteron lentiginosum* described by Buckton (1894) and Crawford (1912). Both these species are recorded from India, and the former may be only a synonym of the latter.

*Biological notes.* Brief notes are given by Cotes (1894), Kieffer (1906), Lefroy (1909), Ramakrishna Ayyar (1919), Mathur (1935) and Beeson (1941). This species is commonly found with its host plants. The terminal young leaves are deformed and crumpled into the most grotesque shapes and the leaves of some plants are entirely absorbed by these nut-like galls and resemble a large conglomeration of fruits (Plate 3f). The nymphal stages are described by Crawford (1919) and Mathur (1949).

#### Subfamily CIRIACREMINAE Enderlein 1910

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- 1911, ———, Crawford, D. L. *Pomona Coll. J. Ent.* 3(2): 481.
- 1914, ———, Crawford, D. L. *Bull. U.S. natn. Mus.* 85: 62-63.
- 1913, ———, Aulmann, G. *Psyllidarum Catalogus*, p. 79.
- 1958, ———, Heslop-Harrison, G. *Ann. Mag. nat. Hist.* (13), 1: 561-579.
- 1959, ———, Heslop-Harrison, G. *ibid.* (13), 2: 157-168, 237-247.
- 1960, ———, Heslop-Harrison, G. *ibid.* (13), 3: 503, 551-559.
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- 1963, ———, Klimaszewski, S. M. *Annls Zool. Warsz.* 20(20): 363-370.
- 1882, *Prionocnemidae* (Subf.), Scott, J. *Trans. ent. Soc. Lond.* p. 466.
- 1886, ———, Loew, F. *Verh. zool.-bot. Ges. Wien.* 36: 160.
- 1901, ———, Froggatt, W. W. *Proc. Linn. Soc. N. S. W.* 26: 286.

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 1951, ——, Heslop-Harrison, G. *ibid.*, (12), 4: 11, 19, 21, 26.  
 1962, ——, Dobreanu, E., and Manolache, C. *Fauna Repub. pop. rom. Insecta*, 8, fasc. 3, Hom. Psylloidea, p. 62, 363.  
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 1914, ——, Crawford, D. L. *Bull. U.S. natn. Mus.* 85: 53-54.  
 1919, ——, Crawford, D. L. *Philipp. J. Sci.* 15: 155-156.  
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 1964, *Carsidaridae* (Subf.), Klimaszewski, S. M. *Ann. Zool.* 22(5): 81-138.  
 1964, ——, Loginova, M. M. *Inst. Biol. Acad. Sci. U.S.S.R.* pp. 442-472.  
 1964, ——, Loginova, M. M. *Proc. Inst. Zool. Acad. Sci. U.S.S.R.*, p. 54.

Tuthill (1905) writes: "The name *Prionocneminae* which has clear priority may not be used for this group as there is no genus *Prionocnemus* in the family Psyllidae." The subfamily *Ciriacreminae* was created by Enderlein in 1910. The status of this subfamily has been critically discussed by Heslop-Harrison (1959, 1960) and its retention has been assessed.

Body typically elongate, often slender. Head small, deeply cleft in front at median suture, strongly birostrate in appearance which is increased by the large basal segments of antennae (except in *Tenaphalara* and *Cecidopsylla*). Vertex more or less concave on front margin. Genae usually wanting or sometimes the anterior portion swollen into small or large conical processes beneath antennal bases. Frons usually covered by genae, somewhat as in *Psyllinae*, or sometimes not covered and easily visible between genae, as in *Pauropsyllinae*. Anterior ocellus more or less visible from above, usually on dorsal surface. Antennae usually long, slender, sometimes much thickened and attached to apex of rostrate lobes, and sometimes very hairy; two basal joints very large and long. Eyes large, hemispherical, usually not at all recessive. Labrum small, posterior. Rostrum usually very long and slender. Thorax often quite narrow, not strongly arched; pronotum narrow, broadest in middle. Propleurites very long. Epimeron largely visible. Hind tibiae often with a stout angular spur at base, spur sometimes reduced; apex dilated, bearing spines. Basal tarsus of hind legs usually with one claw-like spine (two in *Psausia-Homotoma*). Forewings always membranous and hyaline, sometimes maculated, shining, variously shaped, elongate, more or less acute at apex; branching of veins usually not so typically dichotomous as in *Psyllinae* (branching lateral instead of terminal); cubital petiole short; with additional cells, formed by the cross or pseudovcins between radial sector and media.

The genera of this sub-family show great variation in characters. However, the most characteristic features are the deeply cleft head, often absence of genal cones, the peculiar type of wing venation, presence of one or more additional cells formed by the forking of media or by pseudo-veins, and the short cubital petiole. This sub-family is represented by a large number of species in tropical countries.

This sub-family is represented by nine genera in the Indian region, as follows: *Cecidopsylla* Kieffer, 1905; *Diceraopsylla* Crawford, 1912; *Dynopsylla* Crawford, 1913; *Macrohomotoma*

Kuwayama, 1907; *Mesohomotoma* Kuwayama, 1907; *Mycopsylla* Froggatt, 1901; *Psausia* Enderlein, 1914; *Rhinopsylla* Riley, 1883; and *Tenaphalara* Kuwayama, 1909.

These genera are grouped together in different tribes of the sub-family *Ciriacreminae*, by Heslop-Harrison (1958), as below:

<i>Rhinopsylla</i> Riley		Tribe <i>Bactericerini</i> Heslop-Harrison
<i>Tenaphalara</i> Kuwayama		Tribe <i>Tenaphalarini</i> Hes.-Harr.
<i>Macrahomotoma</i> Kuwayama		Tribe <i>Phacopteronini</i> Hes.-Harr. (= <i>Phacosemini</i> Enderlein, 1910).
<i>Psausia</i> Enderlein		
<i>Mycopsylla</i> Froggatt	}	Tribe <i>Homotomini</i> Hes. -Harr.
<i>Dynopsylla</i> Crawford		
<i>Mesohomotoma</i> Kuwayama	}	Tribe <i>Carsidarini</i> Hes. -Harr.
<i>Diceraopsylla</i> Crawford		

The genus *Cecidopsylla* Kieffer has been listed in the sub-family *Carsidarinae*, whilst the genus *Diceraopsylla* Crawford in the subfamily *Pauropsyllinae* by Ramakrishna Ayyar (1924). The former shows affinity with *Psyllinae*, in having quite long genal cones, but in wing venation it is closer to *Ciriacreminae*.

#### KEY TO THE GENERA OF CIRIACREMINAE

1. Branching of veins trichotomous as in *Triozinae*; fork  $M_{1+2}$  terminating at or near apex of wing; post tibial spur small ... ... ... *Rhinopsylla*
- . Cubital petiole distinctly present, variable in length ... ... ... 2
2. Forewings rounded at apex, not angulate ... ... ...
- . Forewings somewhat sub-angulate at apex ... ... ... 3
3. Fork  $M_{1+2}$  terminating above apex of wing; apex within second marginal cell ... ... ... ... ... 4
- . Fork  $M_{1+2}$  terminating below apex of wing ... ... ... ... ... 6
4. Radius and media quite or nearly contiguous for a greater or less length ... ... ... ... ... ... 5
- . Radius and media separate and not contiguous, independent ... ... ...
5. Head produced into a long upturned horn over each antennal socket; antennae very long and slender beyond third segment, segment 1 very large and thick, segment 2 produced into a long acuminate point; first marginal cell very large ... ... ... *Dynopsylla*
- . Head not produced as above; antennae thick throughout and thickly hirsute and often carinate; first marginal cell much smaller than second or wanting ... ... ... *Psausia*
6. Radial sector large and much deflexed, terminating below apex of wing; genal cones very large and vertical ... ... ... *Cecidopsylla*
- . Radial sector small and terminating up to costa ... ... ... 7
7. Forewings with a transverse callus connecting radius and media ... ... ... ... ... 8
- . Transverse callus in forewing wanting ... ... ...
8. Forewings without pterostigma; head birostrate in appearance ... *Mesohomotoma* (= *Tyora* Walker)
- . Forewings with pterostigma; head not birostrate, vertex more or less quadrate ... ... ... ... ... *Tenaphalara*

Genus **CECIDOPSYLLA** Kieffer 1905*Cecidopsylla*

Kieffer, J. J. 1905. *Ann. Soc. Sci. Bruxelles*, pp. 160-161, figs. 5, 6, 7.

Aulmann, G. 1913. *Psyllidarum Catalogus*, Berlin, p. 30.

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26(6): 623.

Type species: *Cecidopsylla schimae* Kieffer 1905 (original designation).

The distinctive characters outlined by Kieffer (1905) are expanded with further notes, as below.

Body long and slender, finely rugulose. Head almost as broad as thorax, deflexed. Vertex inclined vertically downward in front; posterior margin arcuate; post-ocellar region strongly elevated; front ocellus not visible from above. Frons visible as a small sclerite. Genal cones long, slender, vertical, separate but contiguous, apices projecting forward as small lingua. Antennae long and slender. Thorax strongly arched; prothorax quite long, convex and vertically deflexed. Post-scutellum of metathorax with two prominent epiphysis. Legs long and slender; hind tibiae with a prominent basal spur, and with two tooth-like spines at apex; hind basal tarsal segment with one claw-like spine at apex. Forewings long, narrowly rounded at apex; pterostigma long but very narrow; radius and  $R_1$  of equal length, cubital petiole about one-third as long as radius; radial sector quite long and meeting posterior margin below apex; radial sector and fork  $M_{1+2}$  almost running parallel to the costal margin in the apical region; first marginal cell extremely small, second quite large bordering the posterior margin.

This genus was erected by Kieffer in 1905, for a single species, *C. schimae* from India.

***Cecidopsylla schimae* Kieffer 1905**

(Figs. 36, 37) (Plates 5e, 6a)

Kieffer, J. J. 1905. *Ann. Soc. Sci. Bruxelles*, pp. 165-167, figs. 5, 6, 7; Pl. II, fig. 12.

Aulmann, G. 1913. *Psyllidarum Catalogus*, Berlin, p. 30,

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26(6): 623.

Length of body, in male, 2.19 mm; in female, 2.52 mm

Length of forewings, in male, 2.65 mm; in female, 3.24 mm

Width of head with eyes, 0.58 mm

Width of vertex between eyes, 0.32 mm

Length of antennae, 1.82 mm

*Colouration.* General colour yellowish-brown with reddish tinge, dorsum with two pairs of dark-brown, anterior, longitudinal bands on prescutum and two pairs on scutum; vertex of head pale-brown anteriorly and dark-brown posteriorly; post-ocellar region with orange tinge; genal cones fuscous, paler apically; antennae fuscous in distal half; tip of labium black; legs paler, with tibiae and tarsi progressively darker from hind to forelegs; venter of abdomen paler; wings hyaline, transparent, with a very narrow light brownish band running along the posterior margin from the apex of the wing to the first marginal cell, veins brownish.

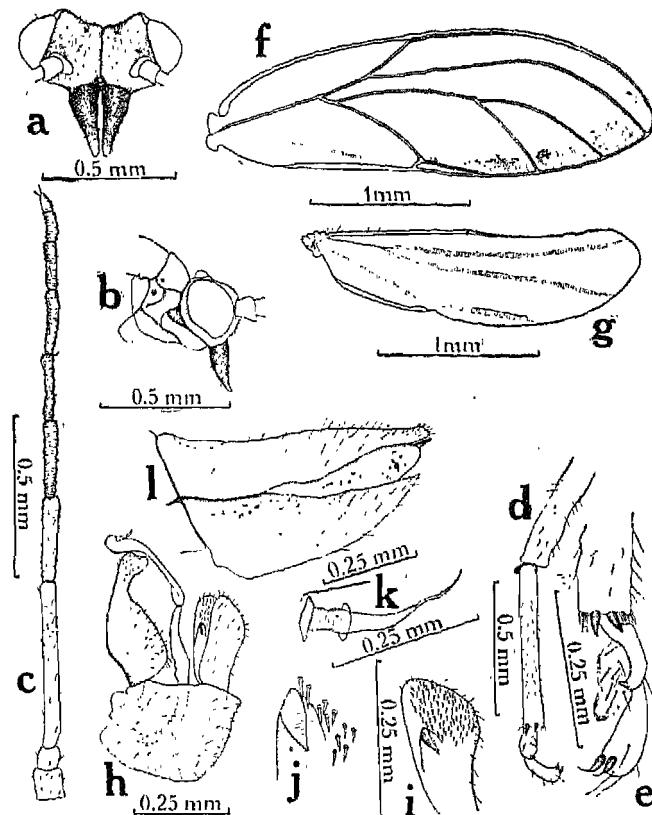


Fig. 36. *Cecidophylla schimae* Kieffer—**a**: head, front aspect; **b**: head and part of thorax, lateral aspect; **c**: antenna; **d**: hind leg; **e**: hind tibia and tarsal segments; **f**: forewing; **g**: hind wing; **h**: male genitalia, lateral aspect; **i**: forceps, mesal aspect; **j**: stout hook of forceps, highly magnified; **k**: sperm pump; **l**: female genitalia, lateral aspect.

**Structure.** Body long and slender. Head (**Figs. 36a,b**) nearly as broad as thorax, moderately deflexed; vertex somewhat horizontal posteriorly and then inclined vertically downward in front, about twice as broad as long, finely and sparsely pubescent, finely rugulose, with two foveal impressions near posterior margin and on either side of median suture, posterior margin strongly arcuate, anterior margin deeply emarginate in centre, post-ocellar region strongly elevated bearing orange-coloured ocelli; front ocellus not visible from above; frons visible as a small sclerite, having anterior ocellus dorsally, anterior ocellus visible in front; genal cones about 0.25 mm long and slender, vertical, slightly longer than vertex, broad basally and narrow apically, ending in a small lingua projecting forward, separate but contiguous, sparsely beset with long setae and also with minute points arranged in lines. Eyes large, somewhat hemispherical. Beak long, protruding between legs.

Antennae (**Fig. 36c**) long and thick, ten-segmented, finely and sparsely pubescent, imbricate, two basal segments robust, quadrate, 2nd smaller than 1st, 3rd longest, 4th smaller and half as long as 3rd, 5th slightly smaller than 4th, 6th and 7th equal but smaller than 5th, 8th smaller than 6th, 9th much smaller and half as long as 8th, 10th segment smallest, bearing two apical spines.

Thorax (**Fig. 36b**) strongly arched, finely and sparsely pubescent, finely rugulose. Prothorax quite long, convex, somewhat vertically deflexed, with two pairs of foveal impressions on each lateral side; prescutum about twice as broad as long, broadest in middle, narrow both anteriorly and posteriorly, angulate both posteriorly and laterally; scutum slightly longer than prescutum, about twice as broad as long, angulate laterally; scutellum subquadrate, slightly broader than long, broad anteriorly; post-scutellum of metathorax with two prominent epiphysis.

Legs (**Figs. 36d,e**) long and slender, pubescent and also beset with minute points; tibiae longer than femora and bearing comb of setae near apex; hind tibiae with a prominent basal spur and two tooth-like spines at apex; basal tarsal segments smaller than apical, and posterior basal segment having one claw-like spine at apex; mcracanthus long, slender and triangular.

Forewings (**Fig. 36f**) long, hyaline, with a very narrow brown band running along the posterior margin from apex to base of first marginal cell, and scattered spinules present all along this band, about three times as long as broad, narrowly rounded at apex, pterostigma long and very narrow, basal vein twice as long as radius (R), radius and  $R_1$  of equal length, radius about two and a half times as long as cubital petiole (M+Cu), first marginal cell very small, radial sector terminating below apex of wing, veins  $R_s$  and  $M_{1+2}$  running parallel to costal margin in apical region. Hind wings (**Fig. 36g**) also quite long and thickly beset with minute points, costal margin armed with a few simple and hooked setae.

Abdomen long and slender, finely and sparsely pubescent, and also beset with minute points arranged in series.

*Genitalia.* Male genital segment (**Fig. 36h**) smaller than abdomen. Anal valve (prociger) about 0.38 mm long, longer than forceps; in lateral aspect, anterior margin nearly straight, posterior margin convex basally and concave apically, the lateral flaps bent inwards and armed with a cluster of setae, apical anal region broad and truncate at apex, and beset with small simple setae; parameres (**Figs. 36i,j**) about 0.30 mm long, narrow at base, gradually widening to become roundly spatulate in the distal half, the outer surface bearing a number of fine sparsely scattered setae, the inner surface of the apical region armed with numerous, very closely set, short and stout, downwardly pointing setae, marginal setae slightly longer, the anterior margin in the apical region thickened into a strong sclerotic ridge and ending in a stout hook-like structure, bearing strong ridges; outer arm of aedeagus smaller than basal and the spoon end with a hook; hypandrium simple, strengthened with sclerotic lines and beset with simple scattered setae; sperm pump as figured (**Fig. 36k**).

Female genital segment (**Fig. 36l**) slightly smaller than abdomen. Dorsal plate slightly longer than ventral, roundly pointed at apex, beset with sparsely scattered setae,

setae smaller and in a cluster near apex, anal aperture elongate oval; ventral plate bearing sparse setae and acutely pointed at apex; ovipositor acutely pointed.

*Host plant.* Bred ex leaf-curls of *Schima wallichii* Chois (Chilauni).

*Distribution.* Bengal (Kieffer, 1905).

Fresh records are from Samsing, Kalimpong (Bengal), November 18, 1934 (A. M. Posford); Kalimpong (Bengal), September 2, 1965 (V. R. Phalak).

*Material examined.* 2 males and 2 females, with some nymphs collected on November 18, 1934, from Sampsing (Bengal) (A. M. Posford); and 1 male and 1 female from Kalimpong (Bengal), September 2, 1965 (V. R. Phalak), and few nymphs preserved in alcohol.

*Comparison.* *Cecidopsylla schimae* Kieffer is the only species representing this genus from India and has been redescribed from a small collection collected from Bengal. These specimens exhibit characteristic features of the genus as outlined by Kieffer (1905). The whereabouts of the type material is not known, perhaps it is lost or destroyed in the great wars. Dr H. Synave, Section d'Entomologie, Institut Royal des Sciences Naturelles de Belgique, Bruxelles, in his letter of October 4, 1965, has informed me that the types of Kieffer are not present in any scientific institutions there. The specimens now recorded and deposited at the Forest Research Institute, Dehra Dun, are therefore, designated as neotypes.

*Biological notes.* This species makes stiff rolled galls along the margins of leaves, and nymphs feed inside them. The nymphs produce large amount of waxy matter and exude honey dew copiously inside the rolled galls. Its nymphal stages are described below.

### Nymphal stages

*Fifth stage.* Length 2.43 mm. Of psylline form (**Fig. 37a**). Head noticeably narrower than the abdomen. Wing-pads large and prominent, extending beyond the general margin of the body. Dorsum with the derm largely sclerotic, the wing-pads, a pair of large plates occupying most of the head, the thoracic region, and a large posterior plate and four pairs of narrow strip-like plates in the abdomen strongly sclerotic; posterior abdominal plate showing traces of segmentation. Derm thickly beset with minute points and with small, slender, scattered setae borne on small prominences, these setae becoming longer near the margins of head and abdomen; wing-pads with a series of simple setae borne on small prominences along the margin. Large plates of the head, thoracic and the basal region of wing-pads ornamented with numerous small, strongly sclerotic areas, and the central region of the posterior abdominal plate bearing minute comb-like structures.

Antennae (**Fig. 37b**) small, about 0.52 mm long, thick, apparently seven-segmented, segments progressively becoming narrower from base to apex, each segment with a number of long setae in a whorl near apex, basal segment small and transverse, 2nd robust, longer than broad, showing traces of segmentation, segments 3rd to 6th broadly transverse, 7th slightly longer than two preceding segments, bearing two setae near apex; four sensoria present on segments 2, 4, 6 and 7; apical segment weakly imbricate.

Ventral side membranous throughout, except for small areas about each spiracle and slender strips in the abdomen. Derm faintly beset with minute points and with small

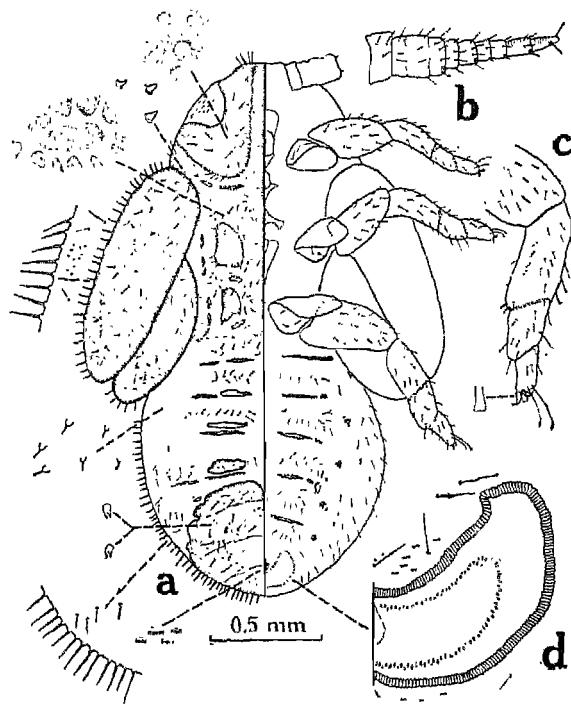


Fig. 37. *Cecidopsylla schimae* Kieffer—**a**: fifth stage nymph; **b**: antenna; **c**: leg; **d**: circum-anal ring.

simple setae arranged segmentally in the abdomen. Legs (**Fig. 37c**) small, beset with few thick setae, the femora scarcely reaching the margin of the body; without trochanter; tibio-tarsal articulation distinct; each tarsal segment with two curved setae near apex; claws present, the pulvillus large and tubular. Anal area (**Fig. 37d**) ventral, set well away from the apex of the abdomen; the circum-anal ring consisting of a double ring of slit-like pores, the inner ring of pores less well-defined.

*Fourth stage.* Length 1.54 mm. Resembling the last stage nymph but smaller in size, having small wing-pads, with thick antennae, apparently four-segmented, with three sensoria and without tibio-tarsal articulation.

#### Genus **DICERAOPSYLLA** Crawford 1912

Crawford, D. L. 1912. *Rec. Indian Mus.* 7: 425.

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26(6): 622.

Heslop-Harrison, G. 1958. *Ann. Mag. nat. Hist.* (13), 1: 578.

The description of this genus is reproduced from Crawford (1912).

"Body robust; thorax strongly arched; body surface conspicuously shagreened; head

with eyes not as broad as thorax; vertex more or less plane, concave transversely, slightly cleft in front; facial cones entirely wanting, with two rounded ridges on face extending from antennal bases to labrum; eyes not large; antennae slender, at least moderately long. Pronotum ascending; proepisternum large, protruding above, hindmost tergite of metanotum (post-scutellum) bifid; appearing as two blunt horns extending back; legs normal; wings membranous, hyaline, rounded at apex, with a pterostigma."

" Type of genus: *Diceraopsylla brunetti* Crawf. "

" This genus is somewhat similar to *Heteropsylla* Crawf. (MS.) in the absence of facial cones, but differs not only from this but from all other genera in the bifid post-scutellum, for which the genus is named. "

**Diceraopsylla brunetti** Crawford 1912

(Fig. 38)

Crawford, D. L. 1912. *Rec. Indian Mus.* 7: 425-426, pl. xxxiii, figs. Q, R, U: pl. xxxv, fig. G.

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 622. (Darjeeling, Eastern Himalayas).

The description of this species is reproduced from Crawford (1912).

" Length of body 2.5 mm; length of forewing 3.8 mm; greatest width 1.7 mm; width of vertex between eyes 0.35 mm; with eyes 0.68 mm. General colour black; face, legs, tip of abdomen brown; antennae brown, with segment tips and terminal segment black; wings somewhat maculate. Body rather small, very robust, surface conspicuously sha-greened, including antennae and femora. "

" Head small, short, with eyes distinctly narrower than thorax; vertex with post-ocellar regions and ocular margins elevated, with a small fovea on each side of median line posteriorly; front margin rounded down, with anterior ocellus in front visible from above, somewhat cleft in front, as in *Rhinopsylla*. Antennae ten-segmented, slender, longer than head and thorax; I moderately large; III longest; IX and X short, thickened; labrum small. "

" Pronotum ascending, arched; episternum large, prominent; epimeron small, mostly concealed; dorsulum large; scutum long; post-scutellar processes fully as long as thick, rounded at tip. Legs normal; hind tibiae unarmed. Forewings rather large, with a macula over first furcal and several small black spots on the veins especially at the furcations, broadly rounded at the apex, about two and a half times as long as broad; first marginal cell usually large; second marginal cell smaller than first; radius short, terminating far from apex of wing; pterostigma short, broad; cubital petiole almost as long as discoidal subcosta. Hind wings hyaline, scarcely veined.

" Male—Abdomen slender; genital segment relatively large; scarcely rounded; claspers slender, arched, quite acute at tips; anal valve slender, rather long. "

" Described from two males from Darjeeling, East Himalayas, altitude 7,000 ft (E. Brunetti), May 29, 1910. "

" Type No. 9733/18. "

Unfortunately, there is no type specimen left except pin and labels, at Z.S.I., Calcutta.

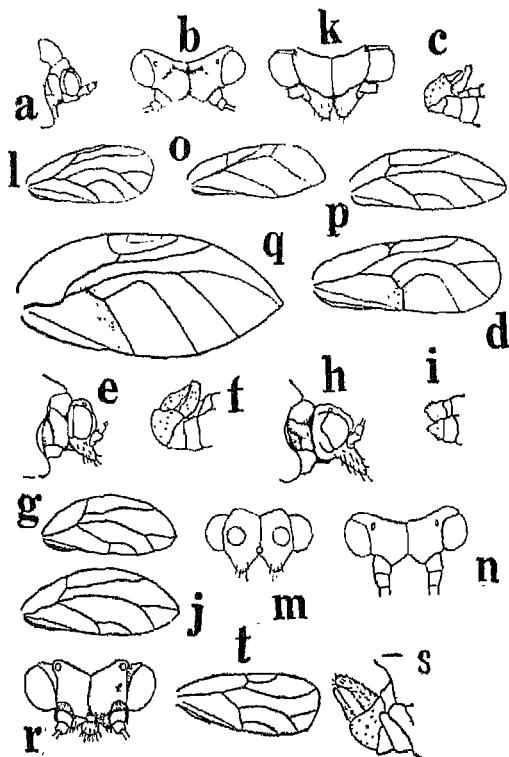


Fig. 38. *Dicernopsylla brunetti* Crawf.—a: b: head, lateral and front views; c: male genitalia, lateral view; d: forewing (After Crawford). *Trioza hyalina* Crawf.—e: head, lateral view; f: male genitalia, lateral view; g: forewing (After Crawford). *Trioza analis* Crawf.—h: head, lateral view; i: female genitalia; j: forewing (After Crawford). *Arytaina obscura* Crawf.—k: head, front view; l: forewing (After Crawford). *Psausia distincta* Crawf.—m: n: head; o: forewing; *Trioza jambolanae* Crawf.—p: forewing. *Macrohomotoma striata* Crawf.—q: forewing. *Paurocephala psyllobtera* Crawf.—r: head, front view; s: male genitalia; t: forewing (After Crawford).

#### Genus DYNOPSYLLA Crawford 1913

- Crawford, D. L. 1913. *Philipp. J. Sci.* 7: 295.  
 Crawford, D. L. 1915. *ibid.* 10: 257, 263.  
 Crawford, D. L. 1919. *ibid.* 15: 156, 158 (*Thysanogyna minor* Crawf.).  
 Crawford, D. L. 1924. *Rec. Indian Mus.* 26: 618-619.  
 Enderlein, G. 1914. *Ent. Mitt.* 3: 231 (under *Sphingocladia*).  
 Enderlein, G. 1918. *Zool. Jb.* 41: 482 (illustration of wings).  
 Enderlein, 1926. *Ent. Mitt.* 15: 398-399 (under *Crawfordella*).  
 Heslop-Harrison, G. 1958. *Ann. Mag. nat. Hist.* (13) 1: 578.

Its generic description is reproduced from Crawford (1913).

"Body large, robust, pubescent. Head very deeply cleft in front between antennae;

vertex very deeply depressed between posterior ocelli, with a horn-like process in front of each posterior ocellus directed forward and upward; genal cones wanting; frons small, elliptical. Eyes and ocelli large. Antennae very long, longer than body or at least as long, slender; basal segment very elongate and large, much longer than second. Thorax broad; pronotum short, much depressed below dorsulum. Legs stout and large; hind tibiae unarmed at base, but with several very large spines at apex. Forewings membranous, very large, powerful, angulate at apex, veins heavy; venation atypical; hind wings much smaller, frenulum conspicuous."

"Type of genus: *Dynopsylla cornuta* sp.nov."

"This genus belongs to the sub-family *Carsidurinae*, being related rather closely to several genera therein, including *Carsidara*. The absence of the basal spur on the hind tibiae, I believe, is of minor importance."

Further notes published by Crawford (1924) are reproduced as below.

"The genus *Dynopsylla* was erected in 1913 for a remarkable species collected by C.F. Baker on *Ficus nervosa* in the Philippine Islands. A year later Enderlein placed a very closely similar species in the new genus *Sphingocladia* which he erected probably without knowledge of my *Dynopsylla*."

"In a collection of psyllids from Brazil (South America) sent to me for identification this same genus is represented by a species which is remarkably similar to the Philippine species, but unfortunately no data accompanied the specimens to show the food plant. By an interesting coincidence, the Ramakrishna collection from India contains this same species with the information that it forms galls on leaves of *Ficus nervosa*, which is the host plant of the Philippine species."

"*Dynopsylla minor* was doubtfully referred to this genus in 1915 and later placed in a new genus, *Thysanogyna*, because it was considered on further study to be not congeneric with the type species of *Dynopsylla*. Later, it was found to be identical with Walker's old species *Carsidara marginalis*, with which it now merged in synonymy, my names *Dynopsylla minor* and *Thysanogyna* being now synonyms of Walker's species."

"There are, therefore, three species known in the genus *Dynopsylla*, a key to which is given below. The distinctive features of this genus are (1) the peculiar venation of the forewing and (2) the shape of the head; the head is deeply cleft in front and genal cones are wholly lacking and the unusually large basal segments of the antennae are very conspicuous, the vertex is in some species produced into a pair of horn-like processes in front."

"The three species are distributed as follows:

1. *D. cornuta* Crawford—Philippine Islands, on *Ficus nervosa* (gall-forming).
2. *D. pinnativena* Enderlein—Formosa.
3. *D. grandis*, n. sp.—Taliparamba, North Malabar, S. India, on *Ficus nervosa* (galls), and in Brazil, South America."

#### KEY TO THE SPECIES

"A. 1. Veins of forewing with a double row of long hairs; media sinuous, closely contiguous with radius and cubitus, but not confluent; segment II of antennae not produced into a sharp point.

- B. 1. Cubital veins with a basal stem; media distinctly contiguous with radius and with Cu<sub>1</sub>, antennae not hairy beyond segment II, segments III to VIII not black at tip; vertex with a pair of conspicuous horn-like processes in front . . . . *D. cornuta* Crawf.  
 B. 2. Cubital veins without basal stem, branching at same point as the media; media close to but not touching radius and cubitus; antennae hairy, segments III to VIII black at tip, head covered with thick pubescence, vertex without horns, but somewhat bulging in the corresponding place . . . . . *D. pinnativena* Enderl.  
 A. 2. Veins of forewing without hairs; media not sinuous, but confluent with radius; segment II of antennae produced into a sharp point, head and dorsum sparsely pubescent . . . . . *D. grandis*, n. sp."

***Dynopsylla grandis***

(Fig. 39)

"Length of body 4 mm, forewing 6 mm, length of body to tip of folded wings about 7 to 8 mm. General colour light brown; vertex yellowish-brown, darker between posterior ocelli; prothorax brown, mesonotum brown with yellowish stripes and bands, legs and antennae light brown."

"Head about as broad as prothorax, rather large; vertex broader than long, concave between posterior ocelli, produced into a long, upturned horn in front of each eye, clothed with long pubescence; front ocellus visible from above. Genae protruding forward around insertion of antennae making the head cleft in front between antennae. Rostrum short. Eyes very large, constituting fully half the width of the head. Antennae long, nearly as long as body (not including wings); segment I very large, thick, more than twice as long as thickness, hirsute; segment II not quite so thick as I, much shorter, produced in a long, acuminate point, hirsute; segments III-X slender, filiform, not hirsute."

"Thorax very large, broad, roundly arched, dorsum pubescent. Legs stout, relatively short, pubescent; hind tibiae short, without basal spur, with four large finger-like spines at apex; basal tarsus of hind legs with one black claw. Forewings large, broad, hyaline, acutely pointed, veined....., veins black, prominent. Hind wings about half as long as forewings."

"Male forceps short, broad, truncate at apex, emarginate on posterior margin; anal valve about twice as long as forceps, the terminal portion cylindrical, black, nearly as long as basal part. Female genital segment very short, acutely pointed."

"Locality. Described from three females collected at Taliparamba (S. India) in September, 1918, by T.V. Ramakrishna; these were found in galls on *Ficus nervosa*. Also 4 specimens (males and females) in a collection from South America (Brazil) sent by Professor J.S. Tavares. These four specimens were not labelled and no information was given as to where they were taken and what host plant, but it is assumed that they were collected in Brazil. These are almost exactly identical with the Indian specimens even in minor details, suggesting that the species has probably been introduced in rather recent times into one or the other of these two widely separated countries."

*Material examined.* By the courtesy of Prof. T.S. Santhanaraman of the Agricultural College and Research Institute, Coimbatore, I was able to recover few parts, two wings (fore and hind), head with basal antennal segments, and femur and tibia of a hind leg

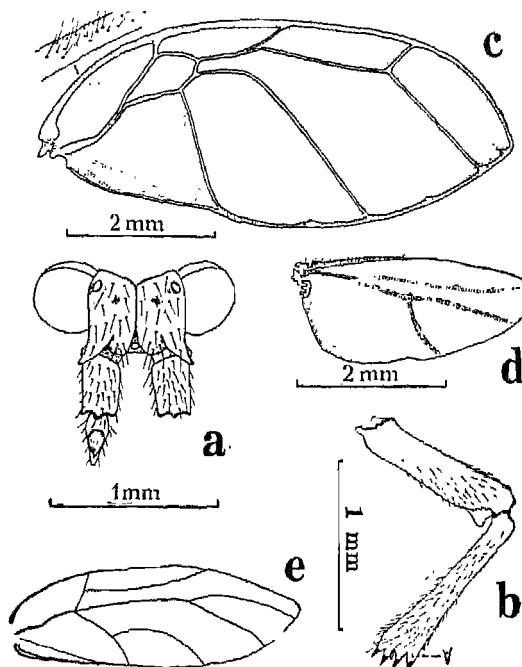


Fig. 39. *Dynopsylla grandis* Crawford--a: head, with two basal segments of antennae, front view; b: femur and tibia of hind leg; c: forewing; d: hind wing; e: forewing of *Phylloplecta (Megatrioza) vitiensis* Kirk. (After Crawford).

of *D. grandis* from the material (one example) sent by him in March 1968. Unfortunately, this material was very badly damaged in transit. The figures have been drawn from these parts, which were retained by me. No useful purpose would have been served in returning these broken parts to Coimbatore. I have not seen a perfect specimen, and therefore, the description of this has been reproduced from Crawford.

#### Genus MACROHOMOTOMA Kuwayama 1907

##### *Macrohomotoma*

- Kuwayama, S. 1907. *Trans. Sapporo nat. Hist. Soc.* 2: 179.  
 Aulmann, G. 1913. *Psyllidarum Catalogus, Berlin*, 36.  
 Crawford, D. L. 1919. *Philipp. J. Sci.* 15: 157.  
 Heslop-Harrison, G. 1958. *Ann. Mag. nat. Hist.* (13), 1: 578.

*Type species.* *Macrohomotoma gladiatum* Kuwayama, 1907 (original designation).

Body generally large and stout, surface usually reticulately marked. Head broader or narrower than thorax, deflexed, posterior margin moderately emarginate; post-ocellar region weakly swollen. Frons visible, bearing front ocellus at top. Genae not produced into cones, swollen beneath antennal sockets. Clypeus large, visible below frons. Eyes large, recessive over pleurites. Antennae usually smaller than width of head including

eyes, sometimes longer than head. Thorax large and robust, reticulately marked, strongly arched. Prothorax usually concealed, descending beneath head. Post-scutellum of metathorax broadly transverse, with two large, erect, horn-like epiphysis. Legs moderately large. Hind tibiae without basal spur, with black tooth-like spines at apex. Proximal tarsal segment of hind leg with two claw-like spines at apex. Forewings usually large, somewhat leaf-shaped, hyaline or maculated, pointed at apex; pterostigma present, usually small but broad, elliptical or oval in shape; cubitus as long as or a little longer than cubital petiole, stem of cubital vein just one-third or about half as long as Cu<sub>2</sub>; marginal cells usually very large; fork M<sub>1+2</sub> meeting below apex of wing; basal vein smaller than radius; radial sector small, meeting costal margin beyond middle. Posterior lobes of anal valve (proctiger) of male genitalia having small, prominent apical processes towards mesal surface.

In wing venation and cephalic characters, the Indian species indicate close relationship to *Macrohomotoma gladiatum* Kuwayama, a Formosan species, but they differ in several distinctive features. However, since the limitations of this genus having been not well elucidated, all these species are tentatively placed under one and the same genus. This genus appears certainly to be related to the *Pauropsyllinae* instead of the *Carsidarinae* to which it had been assigned by Crawford since 1911. Heslop-Harrison (1958) has treated this genus under tribe *Phacopteronini* of the sub-family *Ciriacreminae*. I can add no information as to its relationships. Three species are recorded from India, two of which are new to science.

#### KEY TO THE SPECIES OF MACROHOMOTOMA

- |  |                               |
|--|-------------------------------|
| 1. Forewings hyaline and transparent . . . . .   | <i>M. geniculata</i> , sp. n. |
| —. Forewings maculated . . . . .   | 2                             |
| 2. Forewings with black or brown stripe extending along cubitus from<br>medial vein to posterior margin . . . . .  | <i>M. striata</i> Crawf.      |
| —. Forewings with light brown band along posterior margin, broad<br>band in basal region and small stripes along forks M <sub>3+4</sub> and<br>Cu <sub>1</sub> . . . . . | <i>M. maculata</i> , sp. n.   |

#### *Macrohomotoma geniculata*, sp. n. (Figs. 40, 41)

Length of body, in male, 2.15 mm; in female, 2.75 mm

Length of forewings, in male, 3.10 mm; in female, 3.50 mm

Width of head with eyes, 1.08 mm

Width of vertex between eyes, 0.53 mm

Length of antennae, 0.94 mm

**Colouration.** General colour light to dark-brown, males darker than females, thorax with or without dirty brown blotches, scutum fuscous posteriorly, scutellum with or without two submedian dirty white anterior spots, eyes light crimson, antennae with the basal border of first segment, apices of segments 3 to 8 and two terminal segments blackish, femora of legs smoky black dorsally and dirty white ventrally, apical tarsal joint of legs

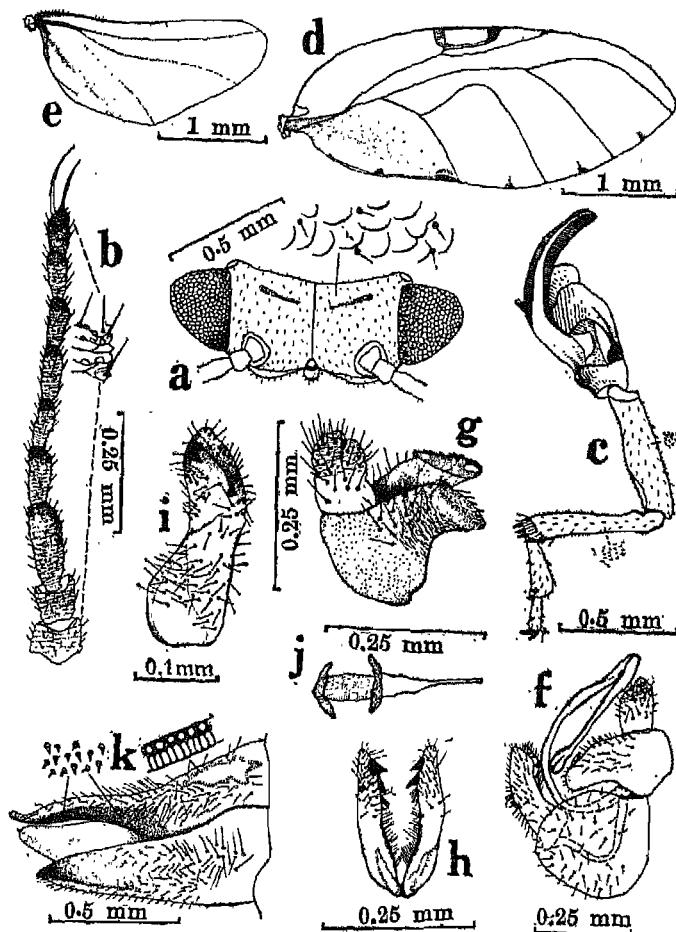


Fig. 40. *Macrohomotoma geniculata*, sp. n.—a: front view of head; b: antenna; c: hind leg; d: forewing; e: hind wing; f: male genitalia; g: anal valve; h: parameres, posterior view; i: mesal view of forceps; j: sperm pump; k: female genitalia.

partly black, metacoxa brown with a small anterior spot, abdominal sternites light black laterally, forceps of male black apically, hypandrium light black laterally, ventral plate of female light black posteriorly, area around anus light orange, wings hyaline, transparent, forewings with four light black spots on posterior margin and one at apical end of pterostigma.

**Structure.** Body large and stout, with reticulately marked surface. Head (Fig. 40a), including eyes, almost as broad as thorax, strongly declivous, finely and sparsely pubescent, finely rugulose; vertex broad, about twice as broad as long along median suture, almost perpendicular to axis of body, with two transverse foveal impressions, posterior to

centre, posterior margin arcuate, frons visible between genae, with a large anterior ocellus at apex; genae small, swollen beneath antennal sockets, finely and sparsely pubescent, post-ocellar region slightly elevated, having large ocelli. Clypeus large, visible below frons. Eyes large, recessive over propleurites.

Antennae (**Fig. 40b**) ten-segmented, moderately thick, slightly smaller than the width of head with eyes, two basal joints robust, sparsely pubescent, imbricate, 3rd segment longest, 4th and 6th equal and each about two-thirds as long as 3rd, 5th and 7th equal and slightly smaller than 4th, 8th slightly smaller than 7th, 9th about one-third as long as 3rd, terminal segment smallest, bearing two, unequal, long, apical setae.

Thorax large and robust, strongly arched, finely and sparsely pubescent, finely and reticulately marked. Prothorax partly concealed by head, descending, longer in middle and narrower laterally, with foveal impressions on each side; prescutum large, broader than long, about twice as broad as long, broadest before middle, angulate laterally, posterior margin angulate submedianally, strongly sloping anteriorly; scutum large, about two and a half times as broad as long, slightly longer than prescutum, strongly sloping and angulate laterally, posterior margin also angulate; scutellum small, somewhat vase-shaped or hexagonal, broad anteriorly, anterior margin almost straight, strongly convex posteriorly; post-scutellum of metathorax broadly transverse, with a median line and two large, horn-like, upright processes; mesepisternum large and produced forward.

Legs short and thick, having fine, coarse pubescence and microscopic points, tibiae longer than femora of anterior and middle pairs, hind leg (**Fig. 40c**) with tibia and femur nearly of equal length, hind tibiae without basal spur and with four, thick, black spines at apex, basal tarsal segment longer than apical of hind leg, bearing two thick, black spines at apex, tarsal segments of fore and middle legs equal in length, meracanthus small, somewhat tubular, tibial groove of first two pairs of legs quite long.

Forewings (**Fig. 40d**) very large and broad, about two and one-third times as long as broad, hyaline, clear, acutely pointed, veins thinner bearing microscopic setae, pterostigma elliptical, about twice as long as broad, marginal cells very large and nearly equal in length, cubital petiole ( $M+Cu$ ) and cubital vein equal in male, equal or shorter in female,  $R_1$  very short, radius quite large, stem of cubital veins about half as long as basal cubital branch ( $Cu_2$ ), distance between  $Cu_1$  and  $M_{3+4}$  equal to the distance between  $M_{3+4}$  and  $M_{1+2}$  along posterior margin. Hind wings (**Fig. 40e**) small, costal vein armed with a few simple and hooked setae, membrane uniformly beset with minute points.

Abdomen short and thick, finely and sparsely beset with hairs and also with minute points.

*Genitalia.* Male genital segment (**Fig. 40f**) short, pubescent; anal valve (**Fig. 40g**) about 0.30 mm long, slender, prominently demarcated into a broad basal portion and one-third apical tubular region, the latter inclined posteriorly, the basal portion produced caudad on each side into a lobe and again elbowed mesally into a slender arm bent anteriorly, lobes beset with long, simple setae while the arms bear marginal setae; parameres (forceps) (**Figs. 40h, i**) about 0.25 mm long, slightly smaller than proctiger, in profile, broad basally and narrow apically, apical margin truncate, the anterior apical angle terminating in a thick black tooth and also produced as a thick ridge on mesal surface ending in a thick

black tooth posteriorly, a bunch of strong setae present just below this tooth, posterior apical angle narrowly rounded, basal mesal surface armed with a group of long setae; hypandrium (**Fig. 40f**) simple, of usual shape, sparsely beset with small setae; outer arm of aedeagus (**Fig. 40f**) smaller than basal, with a thick spoon end, basal arm quite long and strongly curved.

Female genital segment (**Fig. 40k**) longer than abdomen, coarsely pubescent, setae longer in middle; dorsal plate longer than ventral, broad basally and much narrower and acuminate in the posterior half, roundly pointed at apex, with an upturned tip, dorsal surface slightly depressed in middle, apical region thickly beset with minute peg-like setae, circum-anal ring consisting of a double row of pores; ventral plate broad basally and gradually narrowed posteriorly, with an acute apex, surface beset with minute points; ovipositor scarcely exposed.

*Host plant.* Bred from nymphs feeding near the axil of fruits of *Ficus microcarpa* L.f (= *F. retusa*).

*Type locality.* New Delhi.

*Types.* Described from a long series of both sexes. Holotype male; Allotype female, December 22, 23, 1942 (R.N. Mathur); Paratypes: 9 males, December 22, 1942; 11 males, April 3, 1963; 13 females, December 22, 1942; 10 females, April 3, 1943 (R.N. Mathur); December 1942 collection is from the type locality and April 1963 collection is from New Forest, Dehra Dun (U.P.). Additional collection: adults and nymphal stages collected on March 15, 1952, from New Forest, Dehra Dun; April 12, 1952, from Dehra Dun (U.P.), all preserved in alcohol (R.N. Mathur); some adults and nymphal stages collected on December 22, 1942, from the type locality, and on April 3, 1943, from New Forest, Dehra Dun, also preserved in alcohol (R.N. Mathur). All types deposited at F.R.I., Dehra Dun. Two specimens donated to I.A.R.I., New Delhi. In addition, there are 3 examples from Mercara, Coorg, collected on 30.11.50 (Research Range Officer), on *F. retusa*; 2 examples from Dehra Dun, of 17.12.40 (Balwant Singh), found on *Carica papaya* (rotten).

*Comparison.* Two specimens (male and female) were sent to Dr Russell for comparison with the type of *Pauropsylla apsylloides* Crawford (1919), and she has supplied the following information: "Your two specimens labelled *Macrohomotoma apsylloides* on *Ficus retusa*, New Forest, 3.4.1963, are about one-half the size of the type female from Larat and the other type female from Macao....I think the three type specimens of *apsylloides* represent two and perhaps three distinct species. We have no males of *apsylloides* so I cannot compare actual specimens of this sex....In the characteristics of the female, your specimens appear to be more like *gladiatum* Kuwayama than like *apsylloides*, but that species is as large as *apsylloides* and the male genitalia appear to be different...." (*in litt.*). On receipt of this valuable information, two specimens (male and female) were sent to Professor S. Kuwayama, Japan, for comparison with *gladiatum*, and he concludes "...that the Indian specimens taken on *Ficus retusa* were not *M. gladiatum*. The principal differences are: size, much smaller; forewing, less acutely pointed, brownish marking at the end of clavus small; both dorsal and ventral valves of genital segment rather short" (*in litt.*). On the basis of these, the present material is considered under a distinct species.

From India, only one species *M. striata* has been described by Crawford (1925), taken on *Ficus* sp. at Kcolegal (S. India). This new species differs from *striata*, in being much smaller in size, forewings also smaller and absence of the brownish stripe along the cubitus.

*Biological notes.* Both adults and nymphs are commonly found during March and April on *Ficus microcarpa*. The nymphs live within fluffy cottony mass feeding near the axils of fruits. Mature nymphs are yellowish-orange, with wing-pads, head, thoracic plates, abdominal strips, tarsal joints and terminal segments of antennae smoky black.

### Nymphal stages

*Fifth stage.* (**Fig. 41a**). Length 1.62 mm. Broadly oval; the wing-pads large and projecting beyond the contour of the body, not produced anteriorly, bluntly rounded. Posterior margin pointed bluntly medianally, armed with a bunch of minute setae. Head well-marked and separated from the thorax. Eyes large. Dorsum with a pair of large sclerotic areas, occupying most of the head, with large plates on thorax, with 4 pairs of transverse plates in the anterior half and a single large plate in the posterior half of abdomen, as illustrated. Faint segmentations present in the large posterior plate. Derm slightly vermiculate and sparsely beset with simple ring-based setae of various length. Entire margin of wing pads and the posterior half of abdomen with a continuous intermixed series of simple setae of various length. Simple setae borne on small papillae. Minute fringed processes also present on the large abdominal plate.

Ventral side membranous, except for small areas near the spiracles, small abdominal strips and an anal plate. These sclerotic areas are thickly beset with minute as well as thick points. Derm in the abdomen sparsely beset with simple ring-based setae of various length. Antennae (**Fig. 41b**) located ventrally, short and thick, about 0.60 mm long, eight-segmented, two basal segments broad and transverse, 3rd slightly longer than 4th, smaller and subquadrate, 5th and 6th joints longest, with imperfect segmentations, with four sensoria and two terminal spines. Legs (**Fig. 41c**) moderately large and stout, with few setae, without trochanters, the femora not reaching the margin of body, tibio-tarsal articulation well-defined, tarsus with two golf-club setae, claws present, pulvillus small, pad-like. Anal opening (**Fig. 41d**) set well away from the apex of abdomen, surrounded by a broad double band of pores, the anterior border of the outer band is armed with a series of simple setae, the anterior portion of the inner band of pores faintly visible.

*Fourth stage.* Length 1.20 mm. Similar to fifth stage, except for the large sclerotic plates on head, thorax and abdomen, antenna seven-segmented, tibio-tarsal articulation absent, and the tip of abdomen with a shallow median cleft, bearing two setae on either side.

### *Macrohomotoma maculata*, sp. n.

(**Fig. 42**)

Length of body, in male, 2.14 mm; in female, 2.57 mm

Length of forewings, in male, 3.0 mm; in female, 3.5 mm

Width of head with eyes, 0.9 mm

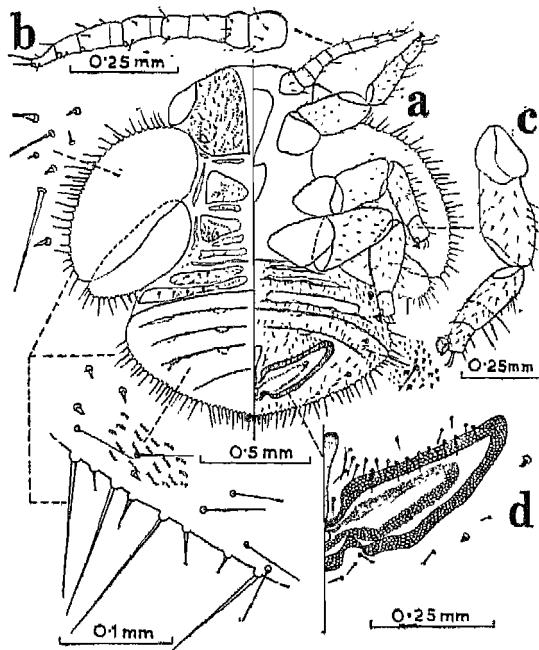


Fig. 41. *Macrohomotoma geniculata*, sp. n.—a: fifth stage nymph; b: antenna; c: leg; d: circum-anal pore ring.

Width of vertex between eyes, 0.57 mm

Length of antennae, 1.53 mm

**Colouration.** (Dry specimens). General colour pale clay yellow, forewings transparent with a broad light brown band at base, with a band along the posterior margin, extending from apex to part of first marginal cell and a small band on each of forks  $M_{3+4}$  and  $Cu_1$ , and six darker spots on the margins. One male specimen from Fraserpét (9.11.30) is without maculated bands (perhaps teneral example).

**Structure.** Body large. Head (Fig. 42a) narrower than thorax, sparsely pubescent, finely reticulate, moderately deflexed, vertex broader than long, about twice as broad as long down median suture, rather flat, with two foveal impressions posterior to centre, one on each side of median line, with a deep sulcus extending from each fovea, posterior margin moderately emarginate, post-ocelli lateral, weakly raised, anterior ocellus not visible from above, frons visible as a small sclerite, bearing front ocellus at top; genae small, swollen beneath antennal bases. Antennal sockets small. Clypeus large, visible below frons. Eyes large, recessive over propleurites.

**Antennae** (Fig. 42b) broken in both the specimens, except one antenna in a male example; small, longer than the head, including eyes, ten-segmented, two basal segments robust and subquadrate, remaining segments slender and imbricate, 3rd segment longest,

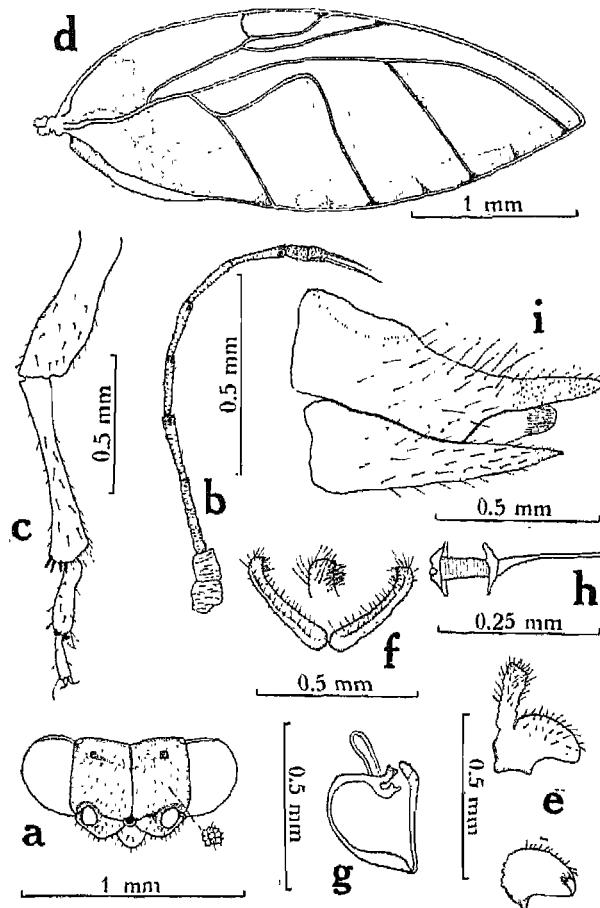


Fig. 42. *Macrohomotoma maculata*, sp. n.—a: head, front view; b: antenna; c: hind leg; d: forewing; e: anal valve, lateral and mesal aspects; f: forceps; g: aedeagus; h: sperm pump; i: female genitalia, lateral aspect.

4th slightly smaller than 3rd, 5th and 6th equal and each smaller than 4th, 7th slightly smaller than 6th, 8th a little smaller than 7th, 9th about half as long as 8th, terminal segment smallest, bearing two long, unequal, apical spines, sensoria present.

Thorax large and broad, strongly arched, sparsely pubescent, finely reticulate. Prothorax partly concealed, descending beneath head, convexly rounded, with two foveal impressions on each side; prescutum almost as long as broad, gradually narrowed both anteriorly and posteriorly, broadest somewhat in middle, angulate laterally, posterior margin also angulate; scutum large and broad, about twice as broad as long, slightly shorter in length than prescutum, bluntly angulate laterally, surface flat dorsally and gradually sloping laterally; scutellum broadly transverse, somewhat vase-shaped, broad

anteriorly and gradually narrowed posteriorly, anterior margin rather straight; post-scutellum of metathorax with two prominent, erect, strong epiphysis.

Legs (**Fig. 42c**) quite long, sparsely pubescent and also beset with minute points, tibiae longer than femora, each tibia with an apical comb of setae, hind tibiae without basal spur, with four black tooth-like spines at apex, basal tarsal segments thicker and longer than apical, proximal tarsal segment of hind leg with two black claw-like spines at apex; meracanthus large and triangular.

Forewings (**Fig. 42d**) very large and long, about two and a half times as long as broad, leaf-like, with a pointed apex, with a small but broad, oval pterostigma, basal vein slightly smaller than radius, radial sector almost straight to costa, slightly longer than radius, cubital petiole small and nearly as long as cubitus, marginal cells very large, first cell somewhat trapezoid in shape, slightly smaller in length than second, but as broad as second along the posterior margin, distance between  $Cu_1$  and  $M_{3+4}$  equal to the distance between  $Cu_1$  and  $Cu_2$  along the margin, fork  $M_{1+2}$  meeting posterior margin slightly below apex, veins armed with microscopic setae. Hind wings quite small, veins obscure, membrane uniformly beset with minute points.

Abdomen small, dorsum with weak humps, sparsely pubescent.

*Genitalia.* Female genital segment (**Fig. 42i**) longer than abdomen, sparsely pubescent, both dorsal and ventral plates broad basally and narrow posteriorly, dorsal plate longer than ventral, posterior region acuminate, with a roundly pointed apex, central region beset with long setae, acuminate region armed with minute peg-like setae; ventral plate acutely pointed at apex.

Male genital segment smaller than abdomen, sparsely pubescent (Parts dissected and mounted on slides). Proctiger (anal valve) (**Fig. 42e**) about 0.33 mm long, differentiated into two regions, the anal region like a cylindrical tube, sparsely beset with setae, the posterior region constituting two arc-shaped lobes, each lobe having a small, erect process mesally at apex, outer surface of each lobe bearing sparse setae and the process armed with a bunch of small setae at apex; parameres (**Fig. 42f**) small, slender, about 0.33 mm long, each forcep curved towards inside, meeting each other at top, sides sub-parallel, apex round, terminating into two black acute points towards inside, outer surface beset with small setae, mesal marginal setae slightly longer, a brush of setae present just below the acute points; aedeagus (**Fig. 42g**) slender, outer arm smaller than basal, basal arm thicker distally; hypandrium simple, of usual shape, sparsely beset with setae; sperm pump as figured (**Fig. 42h**).

*Host plant.* On *Santalum album* Linn.

*Type locality.* Jawalagiri, North Salem (Madras). F.R.I. Sandal Insect Survey.

*Types.* Holotype female, from the type locality, March 25, 1930; Allotype male, from the type locality, March 21, 1930 (mounted on slide). Paratype male, from Fraserpet, Coorg, 9.2.30.

*Comparison.* Described from two specimens, male and female in a partly damaged condition. Male parts were dissected and mounted on slides. This species differs from the other two species recorded from India, in having a broad basal band and a long band along the posterior margin of the forewings and the shape of the wings is exactly like a

leaf; while in *striata* Crawford the black or brown stripe extends along the cubitus from medial vein to posterior margin, and in *geniculata*, sp. n. the wings are hyaline.

**Macrohomotoma striata** Crawford 1925

(Fig. 38)

Crawford, D. L. 1925. *Proc. Hawaii ent. Soc.* 6(1): 38, Fig. 2.

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 622.

Length of body, in female, 4.2 mm

Length of forewing, in female, 5 mm

The description given by Crawford (1925) is presented below:

"Colouration. General colour-brown, with indistinct splotches of slightly darker-brown on thoracic dorsum."

"Structure. Vertex broad, smooth, strongly deflexed downward, with a slight foveal depression on each side of the median line. Frontal sclerite about half covered by the anterior ocellus and about half visible below the ocellus. Antennae a little longer than width of head between the inner margins of the eyes, but not as long as width of head, including eyes; moderately slender beyond the second segment."

"Thorax large and stout, smooth, without pubescence. Metanotum with a pair of small horn-like process. Forewings hyaline, with a conspicuous black or brown stripe extending along cubitus from medial vein to posterior margin; stem of cubital veins just one-third as long as Cu<sub>2</sub>."

"Abdomen large, with genital segment of female moderately long, but only about half as long as greatest width of forewing."

"Host plant. Described from one female taken on *Ficus* sp at Keollegal (India), May, 1916, by T. V. Ramakrishna."

Genus **MESOHOMOTOMA** Kuwayama 1907

*Mesohomotoma*

Kuwayama, S. 1907. *Trans. Sapporo nat. Hist. Soc.* 2: 180.

Aulmann, G. 1913. *Pyllidarum Catalogus, Berlin*, p. 36.

Crawford, D. L. 1925. *Proc. Hawaii ent. Soc.* 6: 32-35.

Tuthill, L. D. and Taylor, K. L. 1955. *Aust. J. Zool.* 3(2): 249-250.

Heslop-Harrison, G. 1959. *Ann. Mag. nat. Hist.* (13), 2(15): 163.

Heslop-Harrison, G. 1960. *Ann. Mag. nat. Hist.* (13), 3(32): 503.

*Udamostigma*

Enderlein, G., 1910. *Wissenschaftl. Ergeb. der Schewed. Zool. Wiss. Ergebn. schwed. Zool. Exped. Kalimandjaro, Exped. nach Dem Kalimandjaro, Deutsch-Ostafrikas, 1905-1906, Hemiptera*, p. 138.

*Type species. Mesohomotoma camphorae* Kuwayama, 1907 (original designation).

The distinctive characters defined by Crawford (1925) and Tuthill and Taylor (1955) are expanded below with my notes.

Body large and slender. Head large, deeply cleft anteriorly, antennae attached to the apices on each side of the cleft and enhancing the birostrate appearance of the head,

scarcely narrower than mesonotum. Vertex horizontal, somewhat raised above eyes laterally, with deep oblique sulcus from near base to anterior margin of each side of medial suture, produced as small overhanging teeth at antero-lateral angle. Genal cones generally wanting or small, contiguous, completely covering frons except for small portion around median sulcus, with small blunt lobes at postero-ventral margin next clypeus. Median ocellus on dorsal side of head. Eyes small, rounded. Postocular portion of occiput well developed. Antennae long and slender, over twice as long as width of head, usually about half as long as forewing or in some species longer. Thorax slender, quite flat dorsally, slightly arched. Pronotum very long, broad, flat, with a pair of small angular processes (epiphysis) on anterior margin, extending below margin laterally. Metanotum with a pair of small sharp dorsal processes or carinae. Forewing large, long, membranous, usually more or less pointed at apex, basal vein very short; media and cubitus with common petiole; no pterostigma present,  $R_1$  straight to costa;  $Rs$  very short, curved to costa; medial cell very large, not including apex of wing, cubital cell very broad, much smaller than medial; distinct cross vein or pseudovein present between furcation of media and radial sector. Legs stout, rather long. Metacoxa long, with well-developed meracanthus. Meta-tibia with strong basal spur and several (usually five) large black apical spines. Proximal segment of metatarsus with one black claw. Both male and female genitalia of characteristic shape.

Crawford (1925) wrote: "The genus *Mesohomotoma* was erected in 1907 by Kuwayama for the species *M. camphorae*, prevalent in Formosa on the foliage of camphor trees. To this genus there should be referred, also, several other species previously or subsequently described in other genera.....*Tyora indica* Crawford (1919) also belongs to *Mesohomotoma*."

"*Tyora* was erected by Walker (1870) for the South Pacific species *T. congrua*, which is quite distinct from the other species referred to this genus. *Tyora congrua*, the type species, has a distinct pterostigma in the forewing, while *Mesohomotoma* species have none; *Tyora* has two pseudo-cross veins (callus), while *Mesohomotoma* has but one. In other respects, also, *Tyora* is very distinct, as in the less deeply cleft vertex.

"*Udamostigma* was erected by Enderlein in 1910 with Froggatt's *Tyora hibisci* as type species...."Crawford (1925) has stated: "This species described by Enderlein in 1918 from specimens collected in Ceylon seems without doubt to be the same as *Tyora indica* Crawford, and as Enderlein's name has priority, the latter is sunk in synonymy."

".....*Udamostigma* having nothing to separate it generically from *Mesohomotoma*."

Tuthill and Taylor (1955) has mentioned that, "Crawford (1920, p. 356; 1925, p. 32) placed *Udamostigma* in synonymy with the earlier *Mesohomotoma* Kuwayama. We can add no information as to its relationships. It occurs through much of the Pacific on *Hibiscus tiliaceus* Linn." Heslop-Harrison (1960) in his discussion on psyllid taxonomy, has stated: "The scope of *Tyora* Walker is quite unknown since its definition was inadequate and the genus is represented by a single headless type. Under the circumstances *Mesohomotoma* Kuwayama cannot be considered to be an invalid synonym of it. *Tyora* should, however, be compared and related to *Tenaphalara* Kuwayama, rather than *Mesohomotoma*." The present author agrees with Heslop-Harrison that these genera (e.g.

*Carsidara* Walker, *Tyora* Walker, *Nesiopoe* Kirkaldy, *Mesohomotoma* Kuwayama, *Tenaphalara* Kuwayama and *Udamostigma* Enderlein) require careful study and their relationships should be clearly defined. However, *Tyora indica* Crawford is treated here under the genus *Mesohomotoma*.

***Mesohomotoma lutheri* (Enderlein) 1918**  
(Figs. 43, 44)

- Enderlein, G. 1918. *Zool. Jb.* 41: 484-485 (*Udamostigma lutheri*).  
Crawford, D. L. 1919. *Philipp. J. Sci.* 15(2): 159-160, pl. 2, fig. 1 (*Tyora indica*).  
Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26(6): 623 (*Tyora indica* Crawf.).  
Crawford, D. L. 1925. *Proc. Hawaii. ent. Soc.* 6(1): 32-34 (*Mesohomotoma lutheri*).  
Crawford, D. L. 1935. *Insects of Samoa*, 1927-35; 30-31 (*Tyora indica* = *Mesohomotoma lutheri* (Endl.)).

Length of body, in male, 2.72 mm; in female, 3.35 mm  
Length of forewings, in male, 3.70 mm; in female, 4.42 mm  
Width of head with eyes, 0.65 mm  
Width of vertex between eyes, 0.40 mm  
Length of antennae, 2.12 mm

**Colouration.** (Specimens preserved in alcohol, some mounted on cards). General colour dark-brown with orange tinge or yellowish-green, head, tibiae of legs and genitalia lighter, tarsi dark-brown, lateral ridges of vertex and ridge on each side of median suture whitish in male, antennae pale-brown with tip of each segment and two apical segments fuscous, dorsum of thorax sometimes with paler streaks or often white stripes in male, wings transparent but with flavus tinge, with several brown spots along margins, veins brownish, abdomen of male darker than that of female, female genitalia dark-brown posteriorly.

**Structure.** Body long and slender, and often covered with flocculent material. Head (Fig. 43a) small, scarcely smaller than thorax, finely and sparsely pubescent, finely rugulose, somewhat horizontal, not declivous, deeply cleft in front; vertex broader than long, emarginate at posterior margin, with lateral borders and area along the median line elevated into a narrow rim, with two foveae near the posterior margin and one on either side of median suture, a linear depression extending from each fovea and becoming slightly divergent towards anterior margin, anterior margin over each antennal base forming two small horn-like epiphysis, the antero-lateral angles acute and slightly covering the eyes, anterior margin deeply emarginate at the end of median suture, front ocellus at apex of excision of the median suture, visible from above; frons very narrow, scarcely visible between genae; genae not swollen into cones beneath, but projecting forward at the antennal bases, forming the frontal cleft; posterior ocelli slightly elevated. Beak moderately long.

Antennae missing in most specimens. One complete antenna mounted on a slide. Antenna (Fig. 43b) ten-segmented, two basal segments robust, bearing few setae, 1st segment broadly transverse, 2nd narrower and longer than broad, remaining segments slender, imbricate, 3rd segment longest, 4th smaller than 3rd but longer than other

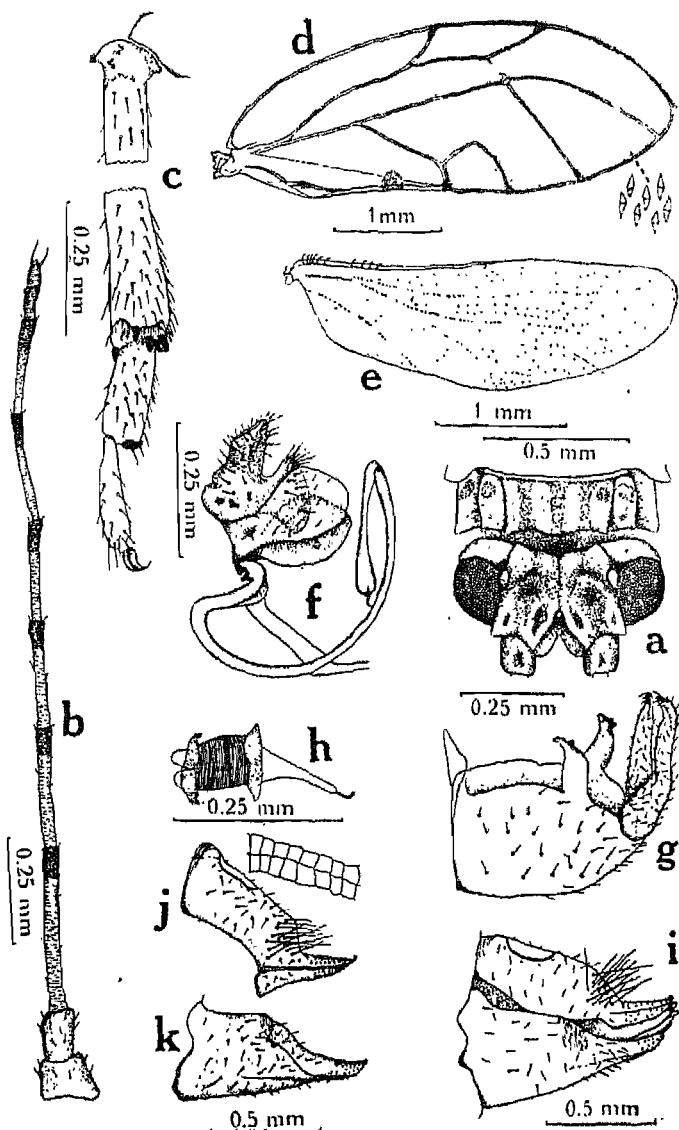


Fig. 43. *Mesohomotoma lutheri* Endl.—a: head and prothorax, dorsal view; b: antenna; c: hind leg; d: forewing; e: hind wing; f: proctiger and aedeagus; g: hypandrium and parameres, lateral view; h: sperm pump; i: female genitalia, lateral view; j: dorsal plate; k: ventral plate, lateral view.

segments, 5th and 7th equal and smaller than 4th, 6th slightly smaller than 5th, 8th slightly smaller than 6th, two apical segments smallest, 9th slightly bigger than 10th, apical segment with two unequal spines at apex, four sensoria present on segments 4, 5, 6 and 8.

Thorax not broad, very slightly arched, rugulose, finely and sparsely pubescent. Prothorax (**Fig. 43a**) weakly arched, descending anteriorly, broadly transverse, with two submedian whitish epiphysis on anterior margin, and with broad, deep foveal impressions on each lateral side; prescutum large, arched, about one and three-fourths times as broad as long, broadest before middle, bluntly angulate laterally, posterior margin broadly and convexly rounded; scutum large and broad, broadest before middle, gradually sloping posteriorly, angulate both laterally and posteriorly, a little longer than prescutum; scutellum narrowly transverse, cup-shaped, anterior margin concave; post-scutellum of metathorax with a pair of sub-median, strong and raised ridges or carinae.

Legs (**Fig. 43c**) quite long, beset with fine pubescence and minute points, femora shorter than tibiae, all tibiae with apical comb of setae, hind tibiae with an extremely large basal spur and five black spines at apex, basal tarsal joint smaller than apical joint of all legs, basal tarsus of hind legs with one black spine at apex, all trochanters and pro- and meso-coxae sparsely hirsute, meracanthus long and conical.

Forewings (**Fig. 43d**) long and large, about two and three-fourths times as long as broad, rather acute at apex, first marginal cell much smaller than second, second cell very large, without pterostigma, radius extending straight to margin and slightly more than twice as long as cubital petiole (M+Cu), furcal vein  $M_{1+2}$  meeting below apex of wing and rather paralleling the anterior apical margin, with a callus or a pseudo-vein arising from base of second marginal cell and extending to radial sector, basal vein shorter than cubital petiole. Hind wings (**Fig. 43e**) also long, costal margin armed with a few simple and hooked setae, membrane beset with uniformly distributed minute points.

Abdomen moderately long, longer than broad, finely and sparsely pubescent and also beset with minute points.

*Genitalia.* Male genital segment smaller than abdomen, sparsely pubescent. Anal valve (**Fig. 43f**) slightly smaller than forceps, divided into two areas, the basal portion broad and produced caudad into two long clubbed lobes, the apical portion bilobate, the caudal lobe extending between the clubbed lobes, the anal lobe hirsute, anal aperture facing anterad; parameres (**Fig. 43g**) about 0.35 mm long, slender, slightly broad at base, rest cylindrical except at apex, bent inward near top, ending in a strong acute point, slightly notched below apex, outer and mesal surfaces sparsely beset with small setae, marginal setae slightly longer, two setae (one curved and the other straight) present just below acute point; hypandrium (**Fig. 43f**) sparsely pubescent, bearing dorsally on each side a sharp, recurved spur, each spur with a small inner epiphysis; aedeagus (**Fig. 43f**) slender, basal arm long and curved, outer arm small, the spoon end with a minute tongue-like process; sperni pump thick and robust (**Fig. 43h**).

Female genital segment (**Fig. 43i**) scarcely smaller than abdomen, sparsely pubescent, dorsal plate (**Fig. 43j**) almost as long as ventral, bulging upward and then abruptly sloping backward, abruptly constricted in the apical third, acutely pointed, terminating in a recurved point, sloping area bearing long hairs, apical portion armed with numerous thick and heavy setae, circum-alar ring composed of a double row of pores; ventral plate (**Fig. 43k**) broad basally, similarly constricted slightly beyond apical half, bearing thick and heavy setae near apex; ovipositor acutely pointed.

*Host plant.* Recorded on *Urena lobata* Linn.

*Distribution.* Previously recorded from Moluccas, Amboina (Muir), January, 1908, 5 males and 6 females, India, Mercara, Coorg (Y.R. Rao), May 24, 1917, 3 females (Crawford, 1919), Ceylon (Enderlein, 1918).

*Material examined.* New records are: Tittimatti, Coorg, 8 males and 1 female, mounted on cards, November 15, 1941, few adults and nymphs preserved in alcohol, collected on *Urena lobata* (R.N. Mathur); Nagerhole, Coorg, 2 males and 2 females mounted on cards, and some adults and nymphs preserved in alcohol, December 18, 1941, and collected on *Urena lobata* (R.N. Mathur); Tista Valley, Darjeeling, W. Bengal, 5 males and 7 females, mounted on cards, September 1, 1934 (N.C. Chatterjee); Tista village, W. Bengal, few adults preserved in alcohol (3 specimens mounted on cards) October 1965, and collected on *Urena lobata* (V.R. Phalak). One male collected on 15.11.41, from Tittimatti, S. Coorg (R.N. Mathur), donated to I.A.R.I., New Delhi.

*Comparison.* Crawford (1919) wrote: "This species is very close to *Tyora hibisci* Froggatt, differing in some colour characters and in the genitalia of both sexes. *Mesohomotoma camphorae* Kuwayama is very similar to this species and apparently is not generically distinct". In 1935, the same author has repeated: "Tyora appears to be a South Pacific genus, somewhat related to *Carsidara* and *Tenaphalara*. . . . . Other species have been erroneously referred to this genus: *T. hibisci* Froggatt should be known as *Mesohomotoma hibisci* (Froggatt); *T. indica* Crawford should be known as *Mesohomotoma lutheri* (Enderlein); *T. sterculiæ* Froggatt does not belong to the present genus but should be referred to another, perhaps *Neocarsidara*." Provisionally, this species was placed under *Carsidara*, and specimens were sent to Dr Russell, for comparison with the type *Tyora indica* Crawford. She writes (*in litt.*). "Your specimens labelled *Carsidara indica*, on *Urena lobata*, Nagerhole, 18.12.1941 apparently are the species Crawford reported from Coorg as *Tyora indica*. Whether this species is actually the same as *Mesohomotoma lutheri* (Enderlein), I cannot say." However, for the present, it is advisable to retain this species under *Mesohomotoma*, till such time when the relationships of the other genera, e.g., *Carsidara* and *Mcsohomotoma* are carefully studied, and accept the specific synonymy established by Crawford himself.

*Biological notes.* This species has been recorded from Coorg during November and December 1941 and during September 1934 and October 1965 from Darjeeling (W. Bengal). The nymphs feed gregariously and are often covered with white flocculent material. The nymphal characters are described below.

#### Nymphal stages

*Fifth stage.* (**Fig. 44a**) Length 2.65 mm. Of the psylline type. Form broadly oval, the wing-pads projecting from the side of the body. Derm membranous throughout, except the head plate, the weakly sclerotic wing-pads and about one-third caudal area of the abdomen. Derm beset sparsely with small, simple setae of various length. Eyes small.

Ventral side membranous throughout, except the apical caudal area which is weakly sclerotic. Derm bearing a few small, simple setae. Antennae (**Fig. 44b**) situated ventrally,

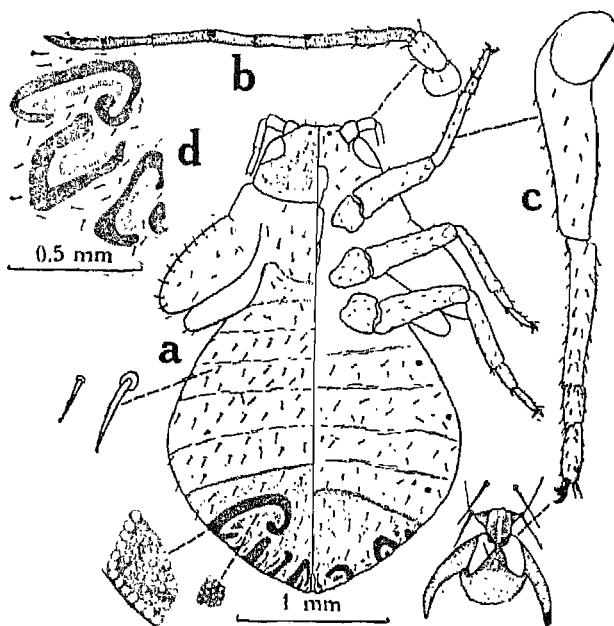


Fig. 44. *Mesohomotoma lutheri* Endl.—a: fifth stage nymph; b: antenna; c: foreleg; d: pore area, dorsal and ventral views.

about 1.40 mm long, ten-segmented, slender, imbricate, having a few simple setae, 3rd and 7th segments longest and equal, 4th and 8th equal and smaller than 3rd, 5th and 6th equal and smaller than 4th, the last two terminal segments smallest, bearing two unequal setae at apex, four sensoria present on segments 4, 6, 8 and 9. Legs (Fig. 44c) long and slender, having a few setae, without trochanter, tibio-tarsal articulation distinct, tarsi with a weak empodium. Anus at the extreme tip of the abdomen, surrounded by a thick band of pores. The pore areas (Fig. 44d) on the caudal sclerotic area consist of four separate, curved double bands which are composed of many small pores, the smallest caudal band surrounding the anal aperture. These bands are situated partly on both dorsal and ventral sides of the abdomen. The inner bands contain faint pores.

*Fourth stage.* Length 1.87 mm. Identical with the fifth stage, except being smaller in size, antennae eight-segmented with three sensoria, tibio-tarsal articulation absent, wing-pads small.

*Third stage.* Length 1.12 mm. Resembling the fourth stage, but with antennae of six segments and smaller wing-pads.

#### Genus MYCOPSYLLA Froggatt 1901

##### *Mycopsylla*

Froggatt, W. W. 1901. *Proc. Linn. Soc. N. S. W.* 26: 258-259, Pl. XV, fig. 7; Pl. XVI, figs. 8, 17.

Tuthill, L. D. and Taylor, K. L. 1955. *Aust. J. Zool.* 3(2): 248-249, fig. 17.  
 Aulmann, G. 1913. *Psyllidarum Catalogus*, W. Junk, Berlin, pp. 30-31.

*Type species.* *Mycopsylla fici* (Tryon) (= *Psylla fici* Tryon 1894) (original designation, Froggatt 1901).

Head scarcely broader than thorax. Vertex deeply excavate medially; post-ocellar region strongly swollen, with lateral ocelli above eyes; disc depressed between eyes; median suture present; genae not produced but swollen beneath; frons covered except for a narrow sclerite below front ocellus. Eyes very large and rounded. Antennae large, very long, slender, much longer than width of head with eyes. Thorax arched. Pronotum large but almost concealed and deflexed vertically below head, laterally fused with propleura forming large lobe which extends back nearly to mesonotum. Postscutellum of metathorax produced as two truncate dorsal epiphyses. Legs large, long. Hind tibia with a strong basal spur and with corona of thick black spines apically. Metacoxa smoothly curved, with a large meracanthus. Proximal segment of hind leg with two black claw-like spines at apex, large plantar vesicle. Forewing large, membranous, angulate apically, costa narrow, basal vein short, sinuate, cubital petiole ( $M+Cu$ ) very short, pterostigma present, large, closed, opaque,  $R_s$  short, curved to costa, medial cell narrow, paralleling costa, including apex of wing, cubital cell very large,  $Cu_1$  approaching base  $M$ , fork  $M_{1+2}$  turning upward above tip of wing, fork  $M_{3+4}$  turning down below tip of wing, about thrice the length of upper fork. Proctiger with two characteristic finger-like processes directed caudally. Forceps T-shaped apically, with acutely pointed anterior arm. Dorsal plate of female genitalia convexly rounded caudally.

This genus seems to belong to the Pauropsyllinae on the basis of head and wing venation, and is perhaps most closely related to *Macrohomotoma* Kuwayama, as stated by Tuthill and Taylor (1955). *Mycopsylla* has so far been known only from Australia; this is the first record from India.

***Mycopsylla indica*, sp. n.**

(Fig. 45)

Length of body, in male, 2.55 mm; in female, 3.52 mm

Length of forewings, in male, 4.21 mm; in female, 5.06 mm

Width of head with eyes, 0.95 mm

Width of vertex between eyes, 0.55 mm

Length of antennae, 2.85 mm

*Colouration.* (Dried specimens) General colour brown ochre, with vertex, scutum and abdomen chestnut brown, basal antennal segments pale-brown, distal segments brown, femora of legs pale-brown, tibiae and tarsal joints brown, ventral valve of male genitalia black, dorsal plate of female genitalia black.

*Structure.* Body large and robust. Head (Fig. 45a) scarcely broader than thorax, deflexed, shining, finely and sparsely pubescent, finely rugulose; vertex broader than long, about one and one-third as broad as long, in dorsal view depressed between the eyes,

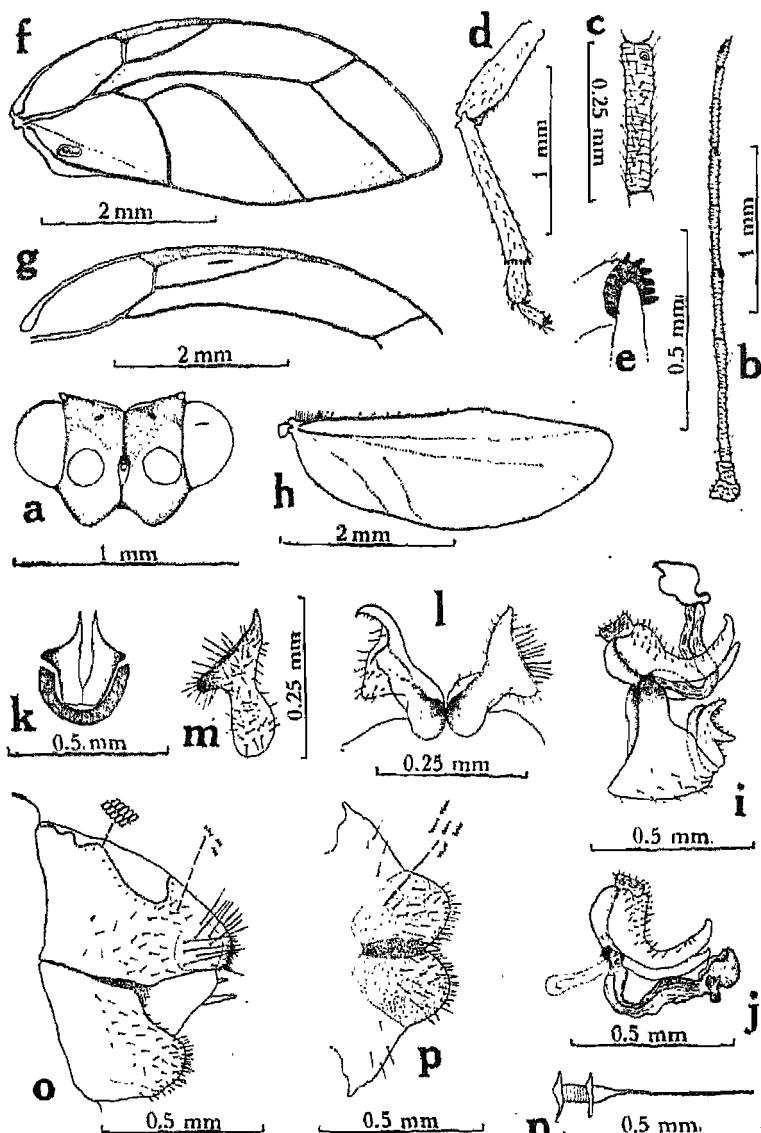
and then weakly rounded or somewhat bent vertically downward in front, with two foveal impressions near the posterior margin and one on each side of median suture, posterior margin emarginately angled in middle, post-ocellar region swollen, lateral ocelli above eyes, anterior ocellus visible from above, deeply excavate medially in front; genae small, and weakly swollen beneath, frons covered except for a very narrow sclerite below front ocellus. Eyes large, somewhat hemispherical. Clypeus visible in front between fore coxae.

Antennae (**Figs. 45b, c**) large, very long and slender, except two basal segments which are robust, much longer than width of head with eyes, ten-segmented, strongly pubescent, 1st segment broadly transverse, 2nd subquadrate, as long as 1st, remaining segments imbricate and filiform, 3rd segment longest, 4th smaller than 3rd, slightly longer than half of 3rd segment, 5th slightly longer than 6th but slightly smaller than 4th, 7th slightly smaller than 6th, 8th slightly more than half as long as 7th, 9th segment smaller than 8th, terminal segment very small, bearing two unequal apical setae, four sensoria present on segments 4, 6, 8 and 9.

Thorax large and long, moderately arched, finely and sparsely pubescent, finely rugulose. Prothorax almost concealed and deflexed perpendicularly behind head, convexly rounded, narrower in middle, broader laterally, with two foveal impressions on each side, laterally fused with propleura forming large lobe which extends back nearly to mesonotum; prescutum slightly broader than long, broadest posteriorly beyond middle, gradually narrowed anteriorly, angulate laterally, posterior margin also angulate submedianally; scutum large and broad, about twice as broad as long, broadest near about middle, slightly smaller in length than prescutum, angulate laterally; scutellum broadly transverse, about twice as broad as long, convex in dorsal view, broad anteriorly and narrow posteriorly, anterior margin almost straight, with prominent antero-lateral angles; post-scutellum of metathorax quite large and broad, bearing two strong and thick epiphyses, each having a strong, black acute point.

Legs (**Fig. 45d**) quite large and long, coarsely pubescent and also beset with minute points arranged in linear series, tibiae longer than femora, bearing apical comb of setae, tibial grooves of fore and middle legs large, hind tibia with a strong and blunt basal spur and with corona of heavy, tooth-like, black spines apically (**Fig. 45e**), tarsal segments of fore and middle legs equal, but in hind leg, basal segment is longer than apical and bears two black claw-like spines at apex, large plantar vesicle; metacoxa smoothly curved, with meracanthus large and somewhat tubular.

Forewings (**Fig. 45f**) very large and broad, hyaline, clear, slightly less than two and a half times as long as broad, membranous, angulate apically, costa narrow, basal vein short, strongly sinuate, pterostigma present, small, narrow, closed and opaque, slightly longer in female (**Fig. 45g**), cubitus smaller than radius, but slightly longer than cubital petiole,  $R_1$  slightly smaller than radius,  $Rs$  short, curved to costa and slightly longer than basal vein, marginal cells very large, first marginal cell longer and broader than second, the latter almost rectangular in shape, with fork  $M_{1+2}$  turning upward above tip of wing, and fork  $M_{3+4}$  turning down below tip of wing, about two and a half times the length of upper fork, cubital petiole slightly shorter than radius, medial cell narrow,



**Fig. 43.** *Mycopsylla indica*, sp. n.—**a:** front view of head; **b:** antenna; **c:** segment of antenna; **d:** hind leg; **e:** apical spines of hind tibia; **f:** forewing of male; **g:** portion of forewing of female; **h:** hind wing; **i:** male genitalia; **j:** proctiger and aedeagus, lateral aspect; **k, l, m:** forceps, caudal and mesal aspects; **n:** sperm pump; **o:** female genitalia, lateral view; **p:** ventral plate, ventral view.

paralleling costa, including apex of wing, cubital cell very large,  $Cu_1$  approaching base of M, membrane beset with minute points.

Hind wings (**Fig. 45h**) also quite large and broad, membrane beset with minute points, costal margin armed with several simple and a few hooked setae.

Abdomen longer than broad, finely and sparsely pubescent, and also beset with minute points, pubescence prominent on sternites.

*Genitalia.* Male genital segment (**Fig. 45i**) smaller than abdomen. Anal valve (**Fig. 45j**) short, somewhat globose basally, posterior margins produced caudad into two long finger-like processes (when seen in lateral view), arus situated on a slightly elevated ring above caudal prolongations, anal ring armed with long setae, upper surface of the caudal processes also beset with long setae; parameres (**Figs. 45k, l, m**) relatively short, narrow at base, very broad at apex, somewhat T-shaped in caudal view, outer surface convexly rounded apically, with the anterior process of apex longer, slender and acutely pointed, projecting upward and bent posteriorly to meet the process of the other side, posterior process small, strong and thick and directed downward and sub-acutely pointed, mesal surface armed with long and simple setae; hypandrium (**Fig. 45i**) simple, of usual shape, with basal lateral margins produced quite upwards, surface bearing sparse simple setae; aedeagus (**Fig. 45j**) of peculiar shape, basal arm long having a loop, outer arm small, thick and shaped like a hood, with a strong posterior condyle, anterior portion armed with minute points; sperm pump as figured (**Fig. 45n**).

Female genitalia (**Fig. 45 o**) smaller than abdomen. Dorsal plate longer than ventral, broad at base and narrow caudally, convexly rounded apically, bearing a brush of setae near the posterior end, surface beset with simple setae and also with minute points, setae longer in the caudal region, anal opening quite large and surrounded by a double ring of slit-like pores, the circum-anal ring guarded by minute setae; ventral plate (**Fig. 45p**) small, broad at base, narrow and subacute apically, deeply invaginated medianally near apex, sparsely pubescent with long and simple setae, caudal region armed with minute rows of points; ovipositor acutely pointed.

*Host plant.* On *Santalum album* Linn.

*Type locality.* Kottur, 1,129 m, Vellore district (Tamil Nadu), (F.R.I. Sandal Insect Survey).

*Types.* Holotype male, July 16, 1931 (plot 22); Allotype female, August 22, 1931 (plot 24); Paratypes are: 2 males, July 2, 1931 (plot 22), 1 male, July 16, 1931 (plot 22), 1 male, July 31, 1931 (plot 23), 3 males, October 25, 1931 (plot 24), 1 male, October 28, 1931, (plot 27), 1 female, May 8, 1931 (plot 25), 1 female, June 20, 1931 (plot 23), 1 female, June 21, 1931 (plot 25), 1 female, June 25, 1931 (plot 22), 1 female, June 27, 1931 (plot 27), 1 female, June 28, 1931 (plot 25), 1 female, October 24, 1931 (plot 23), and 1 female, December 7, 1931; all from the type locality (F.R.I. Sandal Insect Survey). All type material and some slides with mounted parts, deposited at F.R.I., Dehra Dun.

*Comparison.* *Mycopsylla indica*, sp.n. is the only species of this genus recorded from India. It differs markedly from *M. fici* Tryon and *M. proxima* Frogg., in details of wing venation, but resembles to some extent in genitalia with the latter species.

Genus **PSAUSIA** Enderlein 1914*Psausia*

Enderlein, G. 1914. "Psyllidologia II". *Ent. Mitt.*, 3, Nr. 7.  
Heslop-Harrison, G. 1949. *Ann. Mag. nat. Hist.* (12) 2: 375-384.

The position of the genus *Psausia* Enderlein has been discussed in detail by Heslop-Harrison (1949), who wrote: "On the basis of wing venation alone, Enderlein (1914) has separated the genus *Psausia*, naming the type to be *P. radiata* (Kuw.), a species first described in 1907". Enderlein's diagnosis of *Psausia* reads as follows:

"Radius und *rr* eine lange Strecke dicht neben der Media hinlaufend und ziemlich nahe der Basis von *Cu-M* getrennt. *M<sub>1</sub>* weit vor der Flugel spitze, *M<sub>2</sub>* hinter der Flugel spitze mundend. Cubitus ungegabelt. Adern mit länger Behaarung. Fühler dicht behaart."

Heslop-Harrison has shown that species placed by Crawford under *Homotoma* fall under this genus and further mentioned that, "In practice, when using Crawford's 1919 key to the genus *Homotoma*, we find the whole is split into three well-defined groups of species on characters which seem to deserve higher rank than the merely specific."

"Group One, including *H. radiatum* Kuw. and *H. distincta* Craw., whilst possessing the reduced venation of a type parallel with the next group, has the "medial vein contiguous with the radius for about one half of the length of the latter, leaving an open cell between them on the costal margin."

"Group Two includes *H. bakeri* Craw. and *H. biliniata* Craw. and is also characterised by reduced venation but possesses the "medial vein contiguous with the radius for nearly or quite the entire length of the latter, leaving no cell, or only a very small one between them—the first marginal cell present but small."

"Group Three, containing only one species, *H. pacifica* Craw., possesses more or less normal venation and a pterostigma."

"This key had obviously been drawn up without reference to the type species of *Homotoma*, *H. ficus*. The normal psylline venation of the latter prevents its inclusion into the first and second groups, while the fact that it has no pterostigma prevents its entry into the last."

"Enderlein's genus *Psausia* constitutes Group One, his *Metapsausia* Group Two, and *Labobrachia* Group Three. It now seems fairly clear where he obtained the main ideas for the separation of the latter two genera; it is most unlikely that he saw many of the species involved."

"In *Psausia*, the medial vein approximates the path of the radius to a remarkable degree without actually fusing with it. There is, however, a well-marked cell left open on the costal margin, but the cubital cell, formed normally by *Cu<sub>1a</sub>* and *Cu<sub>1b</sub>* (*Cu<sub>1</sub>* and *Cu<sub>2</sub>* of many authors) and the wing margin, is absent as the result of the fusion of these latter two secondary veins."

The species present in my collection shows striking reduction in the wing venation and agrees with the characters defined in the first and second groups and it is, therefore, considered advisable to combine both these groups and retain them under the genus

*Psausia*, containing *radiatum*, *distincta*, *bakeri*, *biliniata* and the new species described by me. The characters of *Psausia* expanded by Heslop-Harrison are redefined as below.

Head very strongly cleft in front; slightly broader or narrower than the thorax; genae small, slightly swollen, divergent, and unmistakable from the side elevation; antennae not noticeably tapering, with nine distinct segments, terminal tenth segment small and reduced; pronotum depressed below prescutum, partly concealed behind head, visible only at the lateral margins; post-scutellum large, with two large, thick, erect spinous processes; hind tibia without basal spur; basal tarsal segment of hind leg with two prominent or weakly developed claw-like spines at apex; venation much reduced, medial vein contiguous with the radius for about one half of the length or nearly or quite the entire length of the latter, leaving an open cell or no cell, or only a very small cell between them on the costal margin; the first marginal cell present but small, or absent.

From India, only two species are recorded: *P. distincta* (Crawf.) and *P. indica*, sp. n.

#### KEY TO THE SPECIES OF PSAUSIA

1. Medial vein contiguous with the radius for about one half the length of the latter, leaving an open cell between them on the costal margin; first marginal cell absent.....*P. distincta* Crawf.
- . Medial vein contiguous with the radius for nearly or quite the entire length of the latter, leaving an open cell between them on the costal margin; first marginal cell present but small.....*P. indica*, sp. n.

#### *Psausia distincta* (Crawford) 1912 (Fig. 38)

Crawford, D. L. 1912. *Rec. Indian Mus.* 7(5): 433, pl. xxxiv, figs. T, U; pl. xxxv, fig. P. (*Homotoma distincta*).

Heslop-Harrison, G. 1949. *Ann. Mag. nat. Hist.* (12), 2: 375-384, figs. 1-5.

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 622 (*Homotoma distincta*).

Length of body, in male, 2.4 mm; in female, 1.7 mm

Length of forewings, in male, 2.7 mm; in female, 2.8 mm

Greatest width of forewings, 1.0 to 1.1 mm

Width of head with eyes, 0.59 to 0.6 mm

Width of vertex between eyes, 0.36 to 0.37 mm

Length of antennae, 0.8 mm

This species is not represented in my collection and salient features are reproduced as defined by Crawford (1912) and Heslop-Harrison (1949).

*Colouration.* General colour light yellow, glossy; antennae brown to black.

*Structure.* Body rather small. Head (Figs. 38m, n) short, somewhat deflexed, with eyes not quite as broad as thorax, deeply cleft in front between antennae; vertex glossy, sparsely pubescent, descending from each side to median line; anterior ocellus not visible from above; lateral ocelli situated on prominent tubercles on top of head, bright orange in colour easily distinguishable with the naked eye; facial cones inferior, not visible from above, short, widely divergent, slightly pubescent. Antennae thick, more

than twice as long as width of head, strongly hirsute, and in proportion to the rest of the insect, extremely stout, with nine complete segments, tenth atrophied, as an incompletely differentiated sensory region, segments becoming progressively darker towards apex, 1st segment stout, 3rd as long as 4th to 6th combined, terminal setae short. Eyes large, appear slightly more prominent due to the strongly cleft head, yellow orange in live specimens but becoming bone-white on death. Labrum small.

Thorax somewhat arched in continuity with the slightly deflexed head and the down-curved abdomen, notal region dull yellow becoming shiny on death, with slight indications of darker longitudinal striae; pronotum short, narrow and obscured behind the head underneath the prescutum; propleurites oblique, extending downwards to terminate approximately at the cox 1, very indistinct in outline.

Legs rather stout, short, slightly pubescent, darker in colour towards their inner surfaces; hind tibiae without basal spurs; posterior basal tarsi with weakly developed apical spines; meracanthus strikingly white, prominently situated and characteristically curved in a downward direction.

Forewings (**Fig. 38 o**) hyaline, transparent, membrane becoming tinged with yellow on death of insect, pointed, leaf-like, strongly pointed at apex, about two and a half times as long as broad, broadest two-thirds along its length, costal margin straight up to the junction of  $M_{1+2}$ , then turning in an oblique curve to the pointed apex, and abruptly round again at the other side of the wing before reaching the junction of  $M_{3+4}$ , second marginal cell very large, including apex of wing, first marginal cell wanting, cubital petiole and base of second cubital very close to discoidal subcosta and base of radius but not joined thereto, radius short, black, anal margin continued in a gentle curve, alar radulae absent, complete absence of trichia. Hind wings reduced, venation absent or obscure.

Abdomen slender and attenuated.

*Genitalia.* Male genital segment and 8th sternite appearing to be fused into a shallow elongated boat-shape, equal in length to the rest of the abdomen. Anal valve small, about 0.14 mm long, lobed and somewhat sinuate in contour, inconspicuous when it lies pressed back on the abdomen; aedeagus large, stout and easily discernible in life; parameres about 0.12 mm long, curved backwards away from the anal valve, width at base about 0.33 mm, each with a thumb-like tooth on the inner side and a diagonal, more heavily chitinized stria across the top, rather hirsute, with distinctly glandular regions on the apices of inferior faces.

Female genital segment about as long as rest of abdomen, stout, dorsal plate a little longer than ventral, both rather acute.

*Host plant.* On *Ficus religiosa*.

*Distribution.* Recorded from Pusa (Bihar); Kanpur (U.P.).

*Comparison.* This species was described by Crawford from a single female, while Heslop-Harrison has given the characters of the males, under *Homotoma distincta* and *Psausia distincta*, respectively, and the species is rightly placed in the genus *Psausia*. This species differs from *indica*, sp. n. in the absence of first marginal cell, shape of wing, shape of head, length of 3rd antennal segment, and some other characters. This is very close to *Homotoma radiatum* Kuwayama (Japan), which also goes in *Psausia*, but seems to be

quite distinct in several respects. The records of the Indian Agricultural Research Institute, New Delhi, show that the female specimen collected on 26.4.10, on wing (C.S.M.) is with D. L. Crawford.

*Biological notes.* According to Heslop-Harrison (1949), this species is an extremely active insect and its powers of flight are great. At rest the wings are held at an angle to the plane of the body in a triozine posture, while the stout, long, hirsute antennae are held straight out in front of the head—almost touching each other. Both adults and nymphs inhabit the leaves of *Ficus religiosa*, occurring wildly at Kanpur.

### Nymphal stages

Heslop-Harrison writes: “The nymphs appear to be free-living on the leaves of *Ficus religiosa*, and are capable of sluggish, but unrestricted movement. The seta-setae secrete a silvery, halo-like fringe of wax plates that become easily detached. Honey-dew secretion seems limited and the droplets are thrown clear on secretion by an upward flicking of the abdomen.” He has described and figured the last nymphal stage.

#### *Psausia indica*, sp. n.

(Figs. 46, 47)

Length of body, in male, 2.35 mm; in female, 2.50 mm

Length of forewings, in male, 2.80 mm; in female, 3.30 mm

Width of head with eyes, 0.63 mm

Width of vertex between eyes, 0.40 mm

Length of antennae, 1.70 mm

*Colouration.* (Dried specimens). General colour brownish-yellow with greenish tinge, head pale clay yellow, slightly darker in male, genae pale-yellow, antennae fuscous dorsally and lighter ventrally and in proximal half, ocelli pink red, thorax with grayish tinge, two thick spinous processes of metathorax smoky black, legs pale-yellow, apical tarsal segments of hind to forelegs light to dark-brown, spines on hind tibiae black, abdomen brownish-yellow, darker laterally, pale-yellow ventrally, genitalia brownish-yellow, forewings hyaline, transparent, veins light brown, with a fuscous stripe running along the radial sector to costal margin.

*Structure.* Head (Figs. 46a, b) slightly smaller than thorax, not declivous, deeply cleft in front between antennae, vertex gradually sloping forward, descending from each side to median suture, about twice as broad as long, sparsely hairy with long hairs, with prominent foveal impressions on each side, near posterior margin, posterior ocelli large and somewhat elevated, anterior ocellus not visible from above; genae not visible from above, inferior, short, slightly swollen and not covering frons, divergent, sparsely hairy with long hairs. Eyes large, somewhat hemispherical. Clypeus large, visible from below.

Antennae (Fig. 46c) long and thick, ten-segmented, much smaller than body without wings, conspicuously hairy, hairs borne on minute tubercles, segments from 4 to 9 progressively decreasing in length, segments with fine serrated carinae, two basal segments large and robust, 3rd segment longest, slightly more than twice as long as 4th, and almost

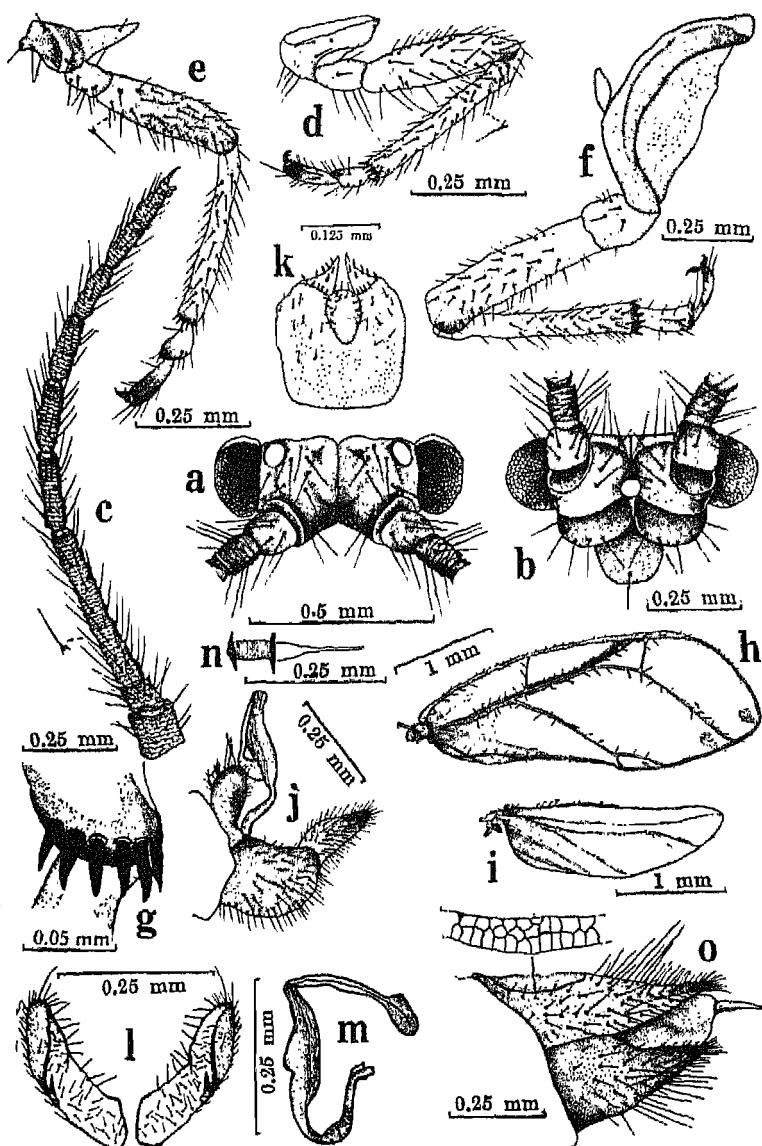


Fig. 46. *Psusia indica*, sp. n.—a: head, dorsal view; b: head, front view; c: antenna; d: foreleg; e: middle leg; f: hind leg; g: apical spines of hind leg; h: forewing; i: hind wing; j: male genitalia; k: anal valve, anterior view; l: parameres, mesal view; m: aedeagus; n: sperm pump; o: female genitalia.

as long as 7th to 10th combined, terminal segment smallest with two spines at apex, four sensoria present on segments 4, 6, 8, 9.

Thorax moderately arched, robust, sparsely beset with hairs, very finely reticulated. Prothorax short, depressed below prescutum, partly concealed behind head, convexly rounded, descending, with two strong, submedian epiphyses, one on either side, and continued laterally as a ridge, ending in a blunt angle, with two foveal impressions on each side, lateral sides bent forward below eyes; prescutum broader than long, about one and three-fourths times broader than long, broadest in middle, gradually narrowed and convexly rounded anteriorly, bluntly angled at the sides, posterior margin also angled; scutum large, about twice as broad as long, broadest before middle, flat dorso-medianally and gradually sloping and bluntly angled at the sides, slightly longer than prescutum; scutellum small and transverse, about twice as broad as long, anterior margin almost straight, with prominent antero-lateral angles, broadly rounded posteriorly; post-scutellum (pseudonotum) large, with a median line and two large, thick, horn-like, spinous processes, directed upward.

Legs (**Figs. 46d, e, f, g**) moderately long, stout, coarsely hairy, hairs borne on minute tubercles, tibiae longer than femora, hind tibiae without basal spur, with 5 or 6 short, stout black spines on the margin at apex (**Fig. 46g**), basal tarsal segment as long as apical of hind leg, having two black claw-like spines at apex, basal tarsal segments shorter than apical of fore and middle legs, meta-coxal spur (meracanthus) of medium size, bluntly conical.

Forewings (**Fig. 64h**) hyaline, transparent, somewhat rhomboidal in shape, subacute at apex, about two and a half times as long as broad, veins conspicuously hairy, first marginal cell very small, second marginal cell very large, including apex of wing, media and radius quite contiguous for more than one half the length of latter, leaving an open cell between them on costal margin, pterostigma wanting, cubital petiole and base of cubitus very close to basal vein and base of radius, radius short, with a fuscous stripe running along the radial sector, cubitus without black band. Hind wings (**Fig. 46i**) small, membrane thickly beset with minute points and with few thick and hooked setae on costal margin.

Abdomen short and thick, sparsely hairy ventrally, with long hairs.

*Genitalia.* Male genital segment (**Fig. 46j**) small, pubescent. Anal valve (**Fig. 46k**) small, about 0.20 mm long, slightly smaller than forceps (parameres), demarcated into two regions, the basal balloon-shaped region and the apical anal region, anal region small, cylindrical, beset with stout setae, with an opening at top, the basal region invaginated posteriorly and mesally, forming round lobes, each lobe is produced into a slender, conical process mesally, armed with stout setae, posterior margin of lobes also beset with thick setae; parameres (**Fig. 46 l**) small, about 0.28 mm long, in lateral aspect, broad basally and gradually narrowed and roundly pointed at apex, each forcep with a black sclerotic, mesal ridge, running from apex to near about its middle, and a thick peg-like tooth set in a socket, below the ridge, outer surface beset with small simple setae, mesal surface below the ridge armed with simple setae, marginal setae longer and slightly curved; hypandrium simple, of usual shape, sparsely beset with simple setae; aedeagus quite

long, with a thick spoon end, outer arm smaller than basal, basal arm thicker in middle.

Female genital segment (**Fig. 46 o**) smaller than abdomen, pubescent, hairs borne on minute tubercles, slightly deflexed downward; dorsal plate longer than ventral, broad basally and gradually narrowed posteriorly, apex roundly pointed, bearing a brush of short setae, anal opening longer than wide, oval, with a ring of double row of minute pores, long hairs arising from minute papillae present in the central and posterior regions of valve; ventral plate gradually narrowed from centre and acute at apex, with a brush of short setae, hairs longer in middle; ovipositor long, exerted and acutely pointed.

*Habit plants.* On young shoots of *Ficus macrocarpa* (=*F. retusa*) and *F. luceiensis* (=*F. infectoria*).

*Type locality.* New Forest, Dehra Dun (U. P.).

*Type.* Described from a long series of males and females. Holotype male; Allotype female, from the type locality, March 15, 1960; Paratypes 1 male and 7 females, March 15, 1960, 11 males and 13 females, March 16, 1960, 7 males and 7 females, March 23, 1960 (R. N. Mathur), on *Ficus infectoria*. Additional material, not designated as paratypes: 4 males and 3 females, April 23, 1963, 2 males and 1 female, April 24, 1963, 1 male and 5 females, April 30, 1963, all collected on *Ficus infectoria* (R. N. Mathur). All types deposited at F.R.I., Dehra Dun. Some slides, and both adults and nymphs, preserved in alcohol, also incorporated in the National Collection at this Institute. Two paratypes (1♂, 1♀) also deposited at I.A.R.I., New Delhi.

*Comparison.* This species resembles closely with *Homotoma distincta* Crawford (1912) and *H. radiatum* Kuwayama (1908) which also come under *Psausia* but is distinguishable from them by the venation, shape of wing, presence of first marginal cell and a black stripe running along the radial sector and some other characters.

*Biological notes.* Both adults and nymphs are commonly found on the young shoots of *Ficus macrocarpa* at New Forest, Dehra Dun (Plate 2b). Its mature nymphal stage is described below.

### Nymphal stages

*Fifth stage.* (**Fig. 47a**). Pale-yellow with abdomen brownish, eyes pinkish-red, margin of abdomen and wing pads with long white waxy threads. Length 1.72 mm. Body broadly oval; the wing-pads large and projecting beyond the contour of the body, not produced anteriorly. Dorsum with a pair of large sclerotic areas which occupy most of the head, with large plates on the thorax; with 5 pairs of large transverse plates in the anterior half and a single large plate in the posterior half of abdomen as indicated in the figure. Entire margin of wing pads and the posterior half of abdomen with a continuous intermixed series of both lanceolate and spear-shaped setae, borne on minute papillae. Derm beset with minute points and also with thick setae borne on minute tubercles.

Ventral side membranous, except for the posterior one-third, a small area around two spiracles and three pairs of small submedian areas. Derm thickly beset with minute points and also with small simple setae.

Antennae (**Fig. 47b**) borne ventrally, quite large, about 0.52 mm long, sparsely armed

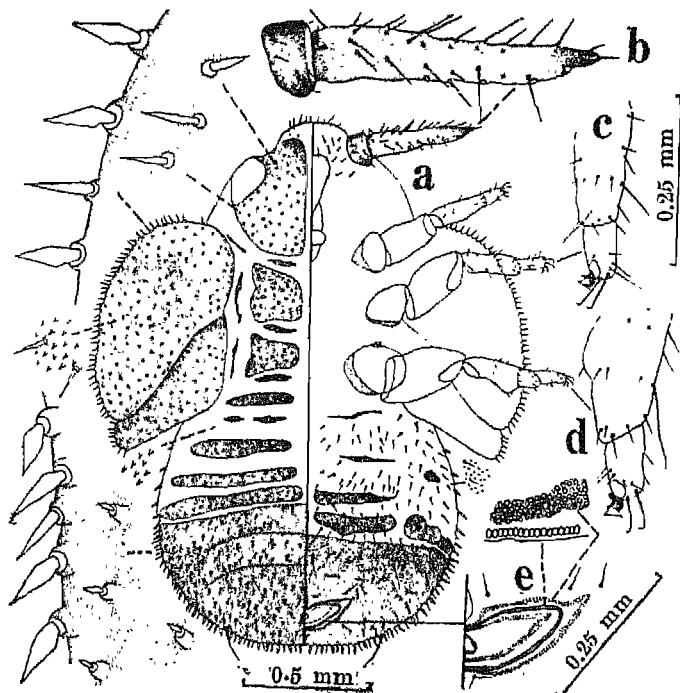


Fig. 47. *Pslausia indica*, sp. n.—**a**: fifth stage nymph; **b**: antenna; **c**: part of middle leg; **d**: part of hind leg; **e**: circum-anal pore ring.

with long simple setae, two-segmented, basal segment large and transverse; 2nd segment longest, having four sensoria, weakly constricted near apex, and with two unequal apical spines. Legs (Figs. 47c, d) well-developed, without trochanters, the femora far from attaining the margin of the body, tibio-tarsal articulation distinct, tibia of hind leg with a prominent ventral bulge, each tarsus with two golf-club setae; claws present, pulvilli small, fish-tail like. Anal opening set well away from the apex of the abdomen. The pore area on the caudal sclerotic area appears as a large band separated from the circum-anal pore ring of pores. This band is composed of a continuous clusters of many small round pores. The circum-anal pore ring consists of a single row of slit-like pores and an inner ring of less defined pores (Fig. 47e).

#### Genus RHINOPSYLLA Riley 1883

##### *Rhinopsylla* :

- Riley, C. V. 1883. *Proc. biol. Soc. Wash.* 2: 77.
- Crawford, D. L. 1911. *Pomona Coll. J. Ent.* 3(1): 440-441.
- Crawford, D. L. 1911. *ibid.* 3(2): 433.
- Aulmann, G. 1913. *Psyllidarum Catalogus, Berlin*, p. 60.
- Crawford, D. L. 1914. *Bull. U.S. natn. Mus.* 85: 59.
- Tuthill, L. D. 1942. *J. Kan. ent. Soc.* 15(2): 45.

*Type species.* *Rhinopsylla schwarzi* Riley 1883 (original designation).

This genus was erected for the single species, *schwarzi*, in 1883, by Riley. The characters outlined by Crawford (1911, 1914) and Tuthill (1942) are expanded with my notes, as below.

Body moderately slender, slightly arched dorsally, surface punctate or conspicuously reticulated or shagreened. Head often deeply cleft anteriorly at median suture, narrower, as broad or broader than thorax. Anterior ocellus in front, visible from above. Post ocellar region elevated. Frons covered by genae. Facial cones wanting, sometimes swollen under insertion of antennae. Antennal sockets large, lateral and located below the level of lower margin of eyes. Antennae long and slender, two basal segments large and robust, third segment longest. Thorax only slightly arched. Prothoracic episterna strongly produced anteriorly. Legs long and slender, femora of foreleg not enlarged; hind tibiae with a small spur or a series of small spurs at base or often none, apex large and expanded bearing one outer and three inner apical spines. Forewings large, venation typical triozine, costal margin strongly curved, rather rounded at apex, radial sector quite long, fork  $M_1+2$  meeting near apex, marginal cells unequal.

Crawford (1914) wrote: "This is a very interesting genus, in that it grades into *Kuwayama* of the *Triozinae* on the one hand, and other species grade into the preceding genera of *Carsidinae* on the other hand. There are unmistakable relationships to both families, but the most fundamental characters seem to indicate a closer relationship with the *Carsidinae*." In 1942, Dr Tuthill has correctly remarked that: "The genus *Rhinopsylla* is poorly represented in most collections of Psyllidae. Due principally to this paucity of material, numerous errors have been made by all those who have worked with the group." In the collections in India, there is only one species, *R. stylata*, which has been described by Crawford in 1912. This type female specimen present at the Zoological Survey of India, is also in poor condition (one antenna, one forewing, both hind wings and legs partly missing).

***Rhinopsylla stylata* Crawford 1912**  
(Fig. 48)

Crawford, D. L. 1912. *Rec. Indian Mus.* 7 (5): 426-427, Pl. xxxiii, fig. W; Pl. xxxiv, fig. F; pl. xxxv, fig. H.

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 623.

Length of body, in female, 2·5 mm

Length of forewing, in female, 2·83 mm

Width of head with eyes, 0·60 mm

Width of vertex between eyes, 0·35 mm

Length of antenna, 1·14 mm

*Colouration.* General colour deep black dorsally, lighter ventrally, antenna pale-brown, darker distally, legs pale-brown, femora darker, forewing flavus, veins darker.

*Structure.* Body moderately large, shining, surface conspicuously reticulated or shagreened. Head (Figs. 48a, b) a little narrower than thorax, slightly deflexed, deeply

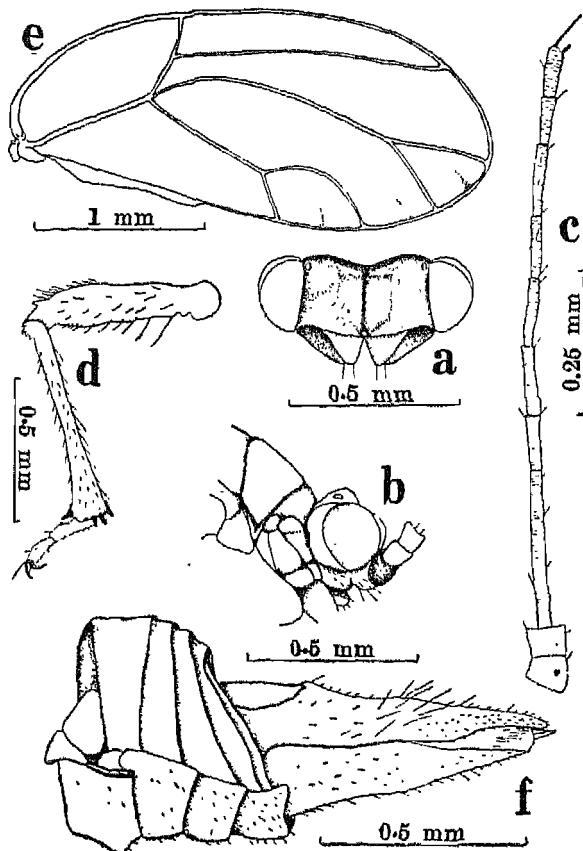


Fig. 48. *Rhinopsylla stylata* Crawford—**a**: head, front view; **b**: head and thorax, lateral view; **c**: antenna; **d**: hind leg; **e**: forewing; **f**: abdomen and female genitalia, lateral view.

cleft anteriorly; vertex broader than long, slightly more than twice as broad as long, excavated in centre between median suture, foveal impressions not discernible, post-ocellar region elevated, posterior margin moderately emarginate, anterior margin deeply emarginate, with front ocellus at apex of emargination, front ocellus visible from above; facial coroes wanting, slightly swollen under insertion of antennae, sparsely pubescent with long hairs. Labrum visible from front. Rostrum long, projecting downward between legs. Eyes large, protruding, anterior. Antennal sockets large and located below the level of lower margin of eyes.

Antenna (**Fig. 48c**) long, slender, ten-segmented, bearing few setae, two basal segments robust, broadly transverse, equal in length, remaining segments slender, imbricate, 3rd longest, about two and a half times as long as 4th, 4th a little smaller than 5th, 5th, 6th, 7th and 8th, each almost equal in length and slightly longer than 4th, 9th and 10th also equal and each smaller than 4th, terminal segment bearing two unequal apical spines.

Thorax (**Fig. 48b**) slightly arched, deeply reticulated. Prothorax moderately long, convexly rounded, descending, having two foveal impressions on each side; pleurites large, prominent, strongly produced anteriorly; prescutum scarcely longer than broad, broadest beyond middle, gradually narrowed and sloping anteriorly, angulate laterally; scutum and scutellum obscured by the pin.

Legs (**Fig. 48d**) long and slender, sparsely pubescent, femora shorter than tibiae, not enlarged, tibiae bearing apical comb of setae, hind tibiae with a series of small basal spurs, apex large and expanded into a strong spur bearing one black spine on one side and three black spines on the other, basal tarsal segments longer than apical, hind coxae very large, with long spur, meracanthus rather long, slender and triangular.

Forewing (**Fig. 48e**) large, hyaline, transparent, a little more than twice as long as broad, greatest width about 1.2 mm, rather rounded at apex, without pterostigma, venation typical triozine, i.e., R, M, and Cu arising from the same point, basal vein almost as long as cubitus, radius slightly longer than R<sub>1</sub>, radial sector quite long, cubitus a little more than two and a half times as long as radius, fork M<sub>1</sub>+M<sub>2</sub> meeting at apex of wing, marginal cells subequal, first cell slightly longer and broader than second.

Hind wings broken in the specimen.

Abdomen small, but broad, suddenly narrowed before genital segment, sparsely pubescent (**Fig. 48f**).

*Genitalia.* Female genital segment (**Fig. 48f**) much longer than abdomen, sparsely pubescent, slender, acuminate, plates subequal, dorsal plate longer than ventral, roundly pointed at tip, hairs longer in middle, apical region armed with minute peg-like setae; ventral plate acutely pointed at apex; ovipositor acutely pointed.

*Distribution.* One female collected from valley of the River Sutlej, below Simla (W. Himalayas, now Himachal Pradesh) (N. Annandale), on May 6, 1910.

*Comparison.* Redescribed from the female type specimen (No. 9708/18), incorporating the characters outlined by Crawford (1912). This specimen present at the Zoological Survey of India, Calcutta is in poor condition, as indicated above. Only a single species is represented from India, under the genus *Rhinopsylla* Riley. It is easily recognisable by the triozine venation and deeply cleft head anteriorly.

#### Genus **TENAPHALAR** Kuwayama 1907

##### *Tenaphalaria*

- Kuwayama, S. 1907. *Trans. Sapporo nat. Hist. Soc.* 2: 155.  
 Aulmann, G. 1913. *Psyllidae Catalogus, Berlin*, p. 75.  
 Crawford, D. L. 1919. *Philipp. J. Sci.* 15: 163.  
 Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 623.  
 Heslop-Harrison, G. 1959. *Ann. Mag. nat. Hist.* (13), 2(15): 163.  
 Heslop-Harrison, G. 1960. *ibid.* (13), 3 (32): 503.

##### *Strongylocephala*

- Crawford, D. L. 1917. *Philipp. J. Sci.* 12: 166.

*Type species.* *Tenaphalaria acutipennis* Kuwayama 1908 (original designation).

The distinctive characters are expanded as below:

Body elongate, slender. Head short, not much deflexed, nearly or quite as broad as thorax; vertex quadrate or scarcely longer than broad, more or less uniformly rounded forward and downward, with anterior ocellus at front end of head and antennae inserted at end of each side of front ocellus. Post ocelli not elevated. Posterior margin of head almost straight. Genae not produced into cones, slightly swollen beneath antennal sockets, usually not wholly covering frons. Frons visible between genae. Antennae long and slender, longer than width of head. Eyes hemispherical, not recessive. Thorax long and slender, not arched. Legs slender, often rather long; hind tibiae with basal spur and short black spines at apex; proximal tarsal joint of hind leg without claw-like spines at apex. Forewings long and narrow, more or less acutely pointed at apex; venation of *Carsidarinae* type, with two pseudo-veins or calluses; pterostigma present. Abdomen long and slender.

Kuwayama placed this genus at the end of his sub-family *Aphalarinae*, but Crawford placed *Tenaphalara* without the cleft head and with the Aphalarine venation, within the *Carsidarinae*, as majority of the characters point rather to an affinity with the latter sub-family which he considered distinct. The genus *Strongylocephala* Crawford is treated as synonymous with *Tenaphalara* by Crawford (1917). This genus includes one species *acutipennis* Kuwayama from India, and also recorded from Formosa and Philippines.

***Tenaphalara acutipennis* Kuwayama 1908**  
(Fig. 49)

- Kuwayama, S. 1908. *Trans. Sapporo nat. Hist. Soc.* 2: 155.  
 Crawford, D. L. 1912. *Rec. Indian Mus.* 7: 432-33, Pl. xxxiv, figs. M, N, P, Q; Pl. xxv, fig. O, (*T. elongata*).  
 Fletcher, T. B. 1917. *Rep. Proc. Second ent. Meet. Pusa*, p. 131.  
 Crawford, D. L. 1919. *Philipp. J. Sci.* 15: 164-65.  
 Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 623.  
 Rahman, Khan, A. 1932. *Indian J. agric. Sci.* 2(4): 367-370 (Nymphal stages of *T. elongata*).  
 Bhatia, H. L. and Shafi, M., 1932. *Indian J. agric. Sci.* 2(6): 543-570 (*Ctenaphalara elongata*).  
 Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 63 (Biological notes).  
 Beeson, C. F. G. 1941. *Forest Insects*, p. 781.  
 Klimaszewski, S. M. 1964. *Annls Zool. Wars.* 22 (5): 81-138, figs. 8, 9, 34, 42, Warszawa.

Length of body, in male, 2·6 mm; in female, 2·8 mm

Length of forewings, in male, 2·85 mm; in female, 3·35 mm

Width of head with eyes, 0·58 mm

Width of vertex between eyes, 0·28 mm

Length of antennae, 1·45 mm

*Colouration.* General colour greenish-yellow throughout, dorsum sometimes with whitish longitudinal streaks, antennal segments 4 to 9 black at apices, and terminal segment also black, eyes brown, veins and apical portion of forewings yellowish.

*Structure.* Body very long and slender. Head (Fig. 49a) nearly as wide as thorax, not deflexed, moderately long, finely and sparsely pubescent; vertex rather broad, rounded down and forward uniformly, rather plane, long behind eyes, with a fovea on each side

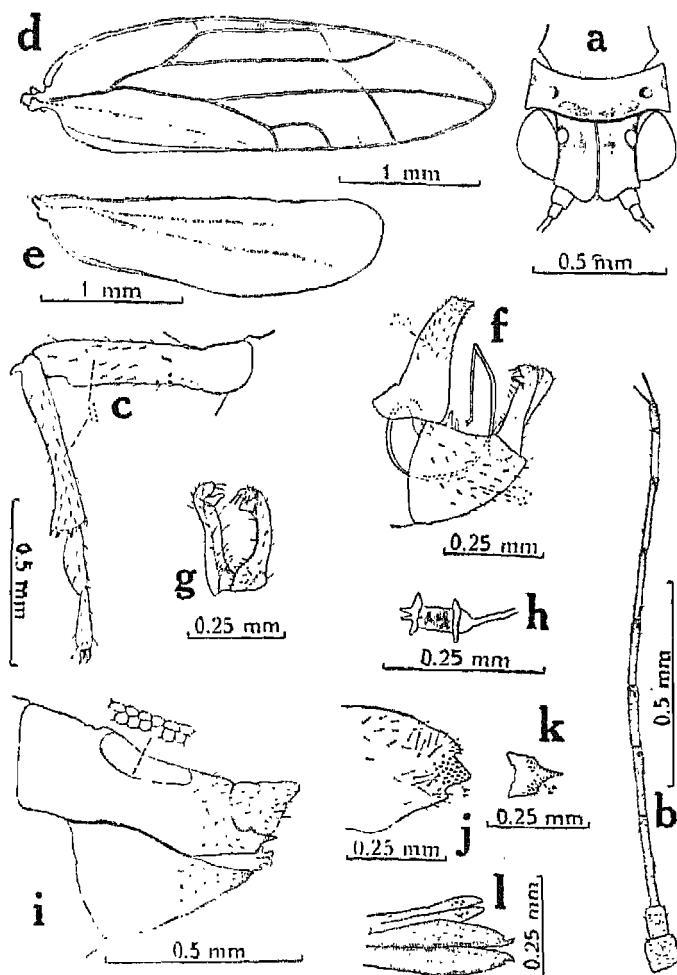


Fig. 49. *Tenaphalara acutipennis* Kuwayama—**a**: head and part of thorax, dorsal view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: male genitalia, lateral view; **g**: forceps, caudal and mesal views; **h**: sperm pump; **i**: female genitalia, lateral view; **j**: apical region of ventral plate; **k**: styliform lobe of dorsal plate; **l**: ovipositor.

of median suture, posterior to centre, posterior margin almost straight, post-ocelli not elevated, anterior ocellus visible from above, at front end of head, at end of frons; frons visible between genae; facial cones entirely wanting. Eyes small. Clypeus small, protruding forward, subacute apically.

Antennae (Fig. 49b) long and slender, about two and half times as long as width of head, ten-segmented, imbricate and bearing few setae, two basal segments robust, 1st subquadrate, 2nd cylindrical slightly longer than 1st, 3rd longest, 4th about three-fourths as long as 3rd, 5th about two-thirds as long as 3rd, 6th as long as 5th, 7th and

8th equal and as long as 1th, 9th smaller than 5th, terminal segment smallest, half as long as 5th, bearing two short apical spines, five sensoria present on segments 4, 5, 6, 8 and 9.

Thorax long and slender, narrow, not arched, somewhat cylindrical, finely and sparsely pubescent, finely rugulose; pronotum (**Fig. 49a**) rather long, arched, anterior and posterior margins somewhat parallel, two weakly swollen submedian areas present near anterior border, with two lateral foveal impressions on each side; propleurites large, sutures often indistinct; prescutum small, finely reticulate anteriorly and rugulose posteriorly, broader than long, broadest in middle, narrower both anteriorly and posteriorly, posterior margin angulate; scutum much broader than long, slightly longer than prescutum, flat dorsally, gradually sloping laterally, posterior margin angulate; scutellum small, broad anteriorly, narrow posteriorly, anterior margin invaginated, with prominent antero-lateral (**Fig. 49b**) angles.

Legs (**Fig. 49c**) rather short, pubescent and also beset with minute points arranged in linear series, all tibiae with apical comb of setae, fore and middle tibiae longer than femora, hind tibia short and almost as long as femur, having three ventral sensoria-like structures near base, hind tibiae with a conspicuous strong spur at base and five tooth-like spines at apex, borne on small papillae, basal tarsal joint smaller than apical; meracanthus small, triangular.

Forewings (**Fig. 49d**) long, slender, three and a half times as long as broad, hyaline, transparent, acute at tip, pterostigma open, cubital petiole longer than radius and basal vein, radius nearly as long as basal vein, with a pseudo-vein (callus) extending from tip of pterostigma to radius and from radius to base of second marginal cell, second marginal cell longer and larger than first, fork  $M_{1+2}$  near apex of wing, veins armed with microscopic setae.

Hind wings (**Fig. 49e**) also quite long, membrane thickly beset with minute points, costal margin with a few simple and hooked setae.

Abdomen elongate and slender, tapering to narrow apex, finely and sparsely pubescent, and also armed with fine points.

*Genitalia.* Male genitalia (**Fig. 49f**) smaller than abdomen. Anal valve about 0.35 mm long, constricted at base, sides subparallel in profile, armed with minute points, pubescent mainly in the upper region, posterior margin slightly convex basally, invaginated near apex, anterior margin almost straight, deflexed caudally near apex; forceps (**Fig. 49g**) about 0.28 mm long, slender, bent inwards, broad basally, gradually narrowed apically, ending in a conspicuously rounded hood, with a prominent jaw-like process just below apex, the apical region appearing like an open mouth of a snake in a striking posture, outer surface bearing few small and stiff setae pointing forward near top, a few thick setae directed downward also present mesally below the jaw-like process, inner margins beset with long setae; hypandrium of usual shape, beset with sparsely simple setae and also with minute points, two slender finger-like processes present, one on each side; aedeagus long and slender, outer arm much smaller than basal, spoon end small and slender; sperm pump as figured (**Fig. 49h**).

Female genital segment smaller than abdomen. Dorsal plate longer than ventral,

irregular in outline, constricted near apex, caudal region divided into two lobes, dorsal lobe narrowly rounded, beset with minute but strong points and also with simple setae, setae in middle longer, ventral lobe (**Fig. 49k**) styliform and armed with minute peg-like setae, circum-anal pore ring long and composed of a double row of pores; ventral plate broad basally, narrow apically, bearing simple setae of varying length, caudal margin divided into three lobes (**Fig. 49j**), central lobe acute at apex and armed with rows of strong peg-like setae; ovipositor (**Fig. 49 l**) acutely pointed.

*Host plants.* On leaves and young shoots of *Bombax ceiba* Linn. (=*Bombax malabaricum*). Also collected on *Sterculia foetida* (Crawford, 1919).

*Distribution.* Previously recorded from Formosa, Luzon, Laguna Province, Los Banos, both sexes taken on *Sterculia foetida* (Crawford, 1919); Pusa (Bihar) on "silk cotton" (Crawford, 1912; Rahman, 1932).

Fresh records are from Dehra Dun (U.P.) and Calcutta (Bengal).

*Material examined.* The collection at the Indian Agricultural Research Institute, New Delhi, contains 3 examples of November 29, 1908 (D.P.S.), 8 examples of December 1, 1908 (C.S.M.), 6 examples of January 4, 1909 (D.P.S.), 1 example of December 12, 1915 (C.S.M.), 1 example of January 25, 1916 (C.S.M.) and 4 examples of December 9, 1931 (H.L. Bhatia). All these specimens were recorded from Pusa (Bihar) and collected on *Bombax ceiba* Linn. (=*B. malabaricum* DC.), commonly known as "silk cotton".

The material at the Forest Research Institute, Dehra Dun, includes: 1 example from Pusa (Bihar) December 13, 1908 (C.S.M.); 4 males and 4 females from Dehra Dun, collected on January 2, 1931 (B.M. Bhatia); 12 examples of January 4, 1934, from New forest (R.N. Mathur); 4 males and 3 females of December 12, and 4 males and 2 females of December 13, 1949, from New Forest, Dehra Dun (R.N. Mathur). All these specimens were recorded on *Bombax ceiba* leaves. Some adults and nymphs collected on October 1, 1965 from New Forest (R.N. Mathur) were preserved in alcohol from the same host plant.

Few adults and nymphal stages collected on 12.10.66, from Shibpur, Botanical garden, Calcutta (B. Datta) are present at Z. S. I.

*Comparison.* This species is readily recognised by the shape of head which is broadly rounded both horizontally and dorsoventrally, by the long and slender forewings, having a pseudovein between radius and radial sector and another between radial sector and media, and some other characters.

*Biological notes.* The infestation by this species begins in winter and the rapid increase in insect population causes the leaflets to wilt and turn yellow. The nymphs remain covered with white flocculent mass of waxy matter and exude copious amount of honey dew. Its nymphal stages are described by Rahman (1932).

#### Sub-family PSYLLINAE

- 1878, Psyllinae, Loew, F. Verh. zool.-bot. Ges. Wien, **28**: 607.  
 1901, ———, Froggatt, W. W. Proc. Linn. Soc. N.S.W. **26**: 242-243.  
 1913, ———, Aulmann, G. *Psyllidarum Catalogus*, p. 5.

- 1914, ———, Crawford, D. L. *Bull. U.S. natn. Mus.* 85: 167-169.  
 1919, ———, Crawford, D. L. *Philipp. J. Sci.* 15: 105-106.  
 1935, ———, Haupt, H. *Tiere Welt Mitteleur.* 4: 231.  
 1943, ———, Tuthill, L. D. *Iowa St. Coll. J. Sci.* 17(4): 443-660.  
 1951, ———, Heslop-Harrison, G. *Ann. Mag. nat. Hist.* (12), 4: 1-35, 417-454.  
 1960, ———, Heslop-Harrison, G. *ibid.* (13) 3: 417-439.  
 1963, ———, Miyatake, Y. *J. Fac. Agr. Kyushu Univ.* 12(4): 325.  
 1875, Psyllaria, Puton, A. *Cat. des Hem. d'Europe et Med.* p. 91.  
 1907, ———, Oshanin, B. *Ver. polaarktischen Hem.* 2: 349.  
 1896, Psyllidae, Edwards, J. *Hem. Hom. Br. Isl.*, p. 233.  
 1957, ———, Vondracek, K. *Faune C.S.R. Praha, Ceskoslovenska akad.. Ved t.* ix, pp. 171-72.  
 1962, ———, Dobrenau, E. and Manolache, C. *Fauna Rep. pop. rom. Insecta*, 8, fasc. 3, Hom. Psylloidea, pp. 124-125.  
 1963, ———, Klimaszewski, S. M. *Annls. Zool.* 20 (20): 1-93.  
 1964, ———, Klimaszewski, S. M. *ibid.* 22(5): 81-138.  
 1964, ———, Loginova, M. M. *Proc. Inst. Zool. Acad. Sci. U.S.S.R.* 34: 52-56.  
 1964, ———, Loginova, M. M. *Inst. Biol. Acad. Sci. U.S.S.R.*, pp. 437-413, 457-472.

Body small to large, slender. Head more or less deflexed, sometimes vertical. Vertex large, flat and often quadrate, semicircular, or subtriangular. Genae always produced into variously shaped, either conical or flat, spatulate processes beyond end of vertex, contiguous or divergent. Frons covered by genae, visible only as a small sclerite bearing front ocellus. Antennae always slender, typically ten-segmented, length variable, two basal segments robust, and broader than others, with two apical setae. Thorax broad, usually well arched; sclerites of thorax variable; mesonotum large. Legs slender or robust; hind tibiae with or without basal spur, with variable number of black spines apically; proximal segment of posterior tarsi usually with a pair of claw-like spines at apex; meracanthi present, variable in shape and length. Forewings large and broad, variable from thick to hyaline, rhomboidal to elongate-ovate, or opaque, sometimes maculated, usually rounded at apex; pterostigma present; media and cubitus always with a petiole. Hind wings normally developed, usually as long as forewings. Male proctiger simple, sometimes produced caudad or with a secondary lobe as in *Acizzia*.

The chief distinctive characters of this sub-family are the concealed frons, the presence of genal cones or lobate processes, the presence of the apical claw-like spines on the proximal segment of posterior tarsi, and the presence of a cubital petiole (M+Cu.).

Several genera are grouped in this sub-family and we readily see the inter-relationships and similarities of the various genera. In India, there are seven genera represented, viz., *Acizzia* Heslop-Harrison, *Arytaina* Foerster, *Diaphorina* Loew, *Euphalerus* Schwarz, *Euphyllura* Foerster, *Psylla* Geoffroy, and *Psyllopsis* Loew. No representative of *Psyllopsis* has been seen by me, though one species *P. fraxini* L. has been recorded from Naini Tal, U.P. (Heslop-Harrison, 1946). I have not, therefore, included it in the key below.

Psyllid species recorded in this contribution on *Pyrus* spp. and *Spiraea glaucescens* (Rosaceae) appear to be an assemblage of variable species and closely resembling *Psylla mali* Schmid., and *P. pyricola* Forst., from which it is difficult to separate with our limited ecological knowledge, hence it is recorded as only *Psylla* sp.

## KEY TO THE GENERA OF PSYLLINAE

1. Forewings strongly rhomboidal, usually thickened and opaque; vertex flat; genae produced into two transverse, contiguous lobes, on the same plane with vertex . . . . . *Euphyllura*
- . Forewings elongate-ovate, sometimes with a rhomboidal tendency, usually hyaline or subhyaline, rarely opaque; genal cones not as above . . . . . 2
2. Pleural suture of prothorax extending to middle of lateral extremity of pronotum, which is more or less swollen and knob-like; propleurites subequal in length; antennae seldom long, usually very short . . . . . 3
- . Pleural suture of prothorax extending obliquely to posterior part of lateral extremity of pronotum, not attaining to it at all; episternum longer than epimeron; genal cones various, usually conical; antennae at least longer than width of head . . . . . *Psylla*
3. Vertex large, flat, with eyes strongly recessive; genal processes in same plane with vertex, flat; wings rhomboidal, often subopaque, with closed pterostigma . . . . . 4
- . Vertex smaller, less flat, with eyes less recessive; genal cones not as above; wings usually subopaque to hyaline . . . . . 5
4. Genal cones large, broad, usually quadrate; forewings rounded or somewhat angulate at apex . . . . . *Euphalerus*
- . Genal cones large, thick, as long as or longer than broad, porrect, apices narrowly rounded or truncate; forewings broad subapically, rounded at apex, narrow in basal half . . . . . *Diaphorina*
5. Genal cones rounded at apex; male proctiger simple . . . . . *Arytaina*
- . Genal cones roundly swollen, widely separated; male proctiger with a secondary process . . . . . *Acizzia*

This sub-family contains a number of small free-living species, exhibiting a number and sequence of generations in a year. The generations vary within wide limits, and as many as 11 generations have been recorded for *Psylla simiae* Crawf. (Mathur, 1935). They feed on young leaves and are able to breed continuously during the active season so long as new buds or foliage are available. Their numbers and intensity of attack decrease by the heavy rainfall during the monsoon season. Some of the species are perfectly naked, but others are enveloped or sheltered under a flocculent or woolly exudation or surrounded with waxy filaments produced from glands along the outer margin of the body. The eggs are generally laid all over the tips of the young foliage and fresh buds. In severe infestations, all stages of the species are met with. The nymphs excrete honey dew excessively, resulting in the whole foliage and branches of the tree being heavily smothered with the exudation. This sugary coating is attacked with a fungus which covers it with a smutty black coat seriously injuring the tree.

## Genus ACIZZIA Heslop-Harrison 1960

*Acizzia*

Heslop-Harrison, G. 1951. *Ann. Mag. nat. Hist.* (12), 4(41): 417.

Heslop-Harrison, G. 1960. *ibid.* (13), 3(31): 417-418.

Loginova, M. M. 1967. *Ann. Natur. Mus. Wien.*, Bd. 70: 404-405.

*Neopsylla*

Heslop-Harrison, G. 1949. *Entomologist's mon. Mag.* 85: 161-162.

*Psylla*

Maskell, W. M. 1894. *Entomologist's mon. Mag.* 30: 171.

*Type species.* *Acizzia acaciae* (Maskell) (= *Psylla acaciae* Maskell 1894) (original designation Heslop-Harrison, 1960).

Body small but robust. Head large, wider than thorax, not deflexed; vertex somewhat horizontal, extending forward into two rounded lobes. Anterior ocellus not visible from above. Frons scarcely visible. Genae small, and roundly swollen, not produced into conical processes, widely separated. Eyes prominent, somewhat spherical. Antennae long and slender. Thorax small, moderately arched. Pronotum flat, descending. Propleural suture extending to middle of more or less swollen end of pronotum, as in *Arytaina*. Hind tibiae with or without basal spurs, with four or five black apical spines. Basal tarsus of hind legs with one or two black claw-like spines at apex. Forewings membranous, speckled with small, irregular brownish spots or bands, rounded at apex; pterostigma prominent, closed, and opaquely white. Anal valve of male genitalia always expanded into two prominent, lateral lobes, which may or may not possess a secondary marginal filiform process. Female genitalia somewhat angulate in profile, normally deflexed ventrally, plates widely divergent posteriorly.

According to Heslop-Harrison (1960), "it has been only recently distinguished as an independent taxonomical unit, earlier its members were referred to genera *Psylla* Geoffroy and *Arytaina* Frst. The contents of the genus is not established yet, but even now comprises 15 species, the majority of which live on *Acacia*, also on *Albizia*, *Hakea*, *Dodonaea* and on other genera of *Leguminosae*."

Loginova (1967) writes: "It is an abundant genus, widely distributed in Africa, India, Indo-Malaya, New Zealand and Australia." From the Indian region, only one species *Acizzia indica* Heslop-Harrison is represented.

***Acizzia indica* Heslop-Harrison 1949**

(Fig. 50)

- Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 36, 39 (Under *Arytaina*, biology).  
 Mathur, R. N. 1952. *Indian J. Ent.* 14(2): 159-160, figs. 1-3 (Nymphal stages).  
 Beeson, G. F. C. 1941. *Forest Insects*, p. 776 (Notes).  
 Heslop-Harrison, G. 1951. *Imm. Mag. nat. Hist.* (12), 4: 417.  
 Heslop-Harrison, G. 1960. *ibid.* (13), 3(31): 417-418.

This species was originally described by Heslop-Harrison (1949) and is redescribed here with some more notes and figures.

Length of body, in male, 1.12 mm; in female, 1.40 mm

Length of forewings, in male, 1.50 mm; in female, 1.75 mm

Width of head with eyes, 0.62 mm

Width of vertex between eyes, 0.38 mm

Length of antennae, 0.85 mm

*Colouration.* In live specimens, general colour apple green to yellowish or brownish-green, with dull white longitudinal lines on head and thorax; antennae yellow, with apices of segments 3 to 8 and last two segments black or dusky; eyes bone white; legs

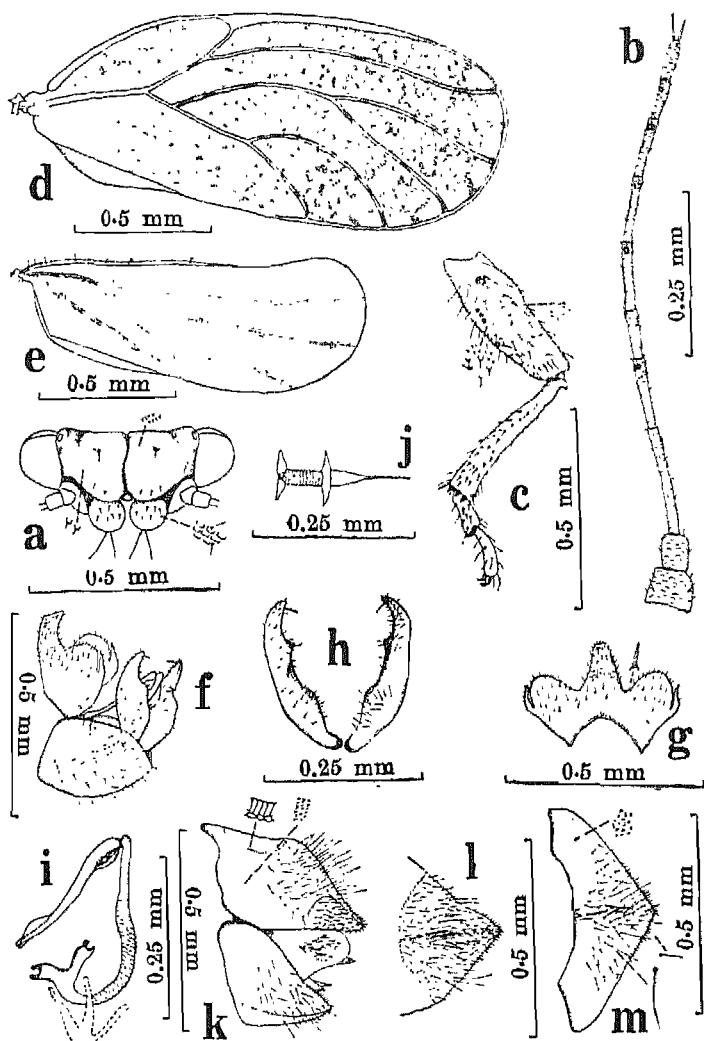


Fig. 50. *Acizzia indica* Heslop-Harrison—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: male genitalia, lateral view; **g**: anal valve, upper surface; **h**: forceps, caudal and mesal views; **i**: aedeagus; **j**: sperm pump; **k**: female genitalia, lateral view; **l**: apical portion of dorsal plate; **m**: ventral plate.

yellow-green; meracanthus white or semi-translucent; forewings maculated with small irregular brownish spots which become confluent into regular bands towards the apical margins, intermixed with clear and glassy areas in between, pterostigma always opaque white, veins yellow-green or straw-coloured.

*Structure.* Body of medium size. Head (**Fig. 50a**) broader than thorax, finely and

sparsely pubescent, finely rugulose, moderately deflexed and in a continuous plane with the gently descending thorax, about twice as broad as long, gently rounded down in front, swollen on either side of median suture, with two prominent foveal impressions, posterior to centre and one on either side of median line, post-ocellar region swollen, post-ocelli lateral, posterior margin moderately emarginate; anterior ocellus scarcely visible from above; and located below the point of excision at the end of median suture; frons small and completely covered by genae and anterior ocellus; genae small rounded swellings, about half as long as vertex along median line, widely separated, divergent, finely and sparsely pubescent and finely rugulose, also bearing two approximating very long and downwardly directed setae. Antennal sockets lateral and touching the eyes laterally.

Antennae (**Fig. 50b**) long, ten-segmented, bearing few setae, two basal segments robust, 1st broadly transverse, 2nd cylindrical, as long as 1st, remaining segments slender, imbricate, 3rd longest, 4th, 6th and 7th equal and each slightly longer than half of 3rd, 5th slightly smaller than 4th, 8th slightly longer than 5th, 9th smallest, terminal segment a little longer than penultimate segment, bearing two unequal spines at apex, four sensoria present on segments 4, 6, 8 and 9.

Thorax small, arched, narrower than width of head including eyes, finely and sparsely pubescent, finely rugulose; prothorax descending, flat, longer in middle and thinner laterally, with two foveal impressions on each side; prescutum small, twice as broad as long, broadest in middle, gradually narrowed both anteriorly and posteriorly, angulate laterally and posteriorly; scutum large, about two and a half times as broad as long, broadest before middle, slightly longer than prescutum, anterior margin concave, angulate laterally; scutellum broadly transverse, swollen, cup-shaped, broadly rounded posteriorly, antero-lateral angles prominent; metascutellum broadly transverse, with a prominent median ridge.

Legs (**Fig. 50c**) short, somewhat stout, sparsely pubescent and also armed with minute points which have become strong and heavier in all femora, tibiae of fore and middle legs longer than femora, while hind tibia is almost as long as hind femur; hind femur with 4 or 6 lateral setae near apex and three sensoria-like structures before middle; all tibiae with apical comb of setae; hind tibia with a small but strong basal spur, and with five black apical spines (4 on the inner side and 1 on the outer side), basal tarsal segment of all legs smaller than the apical; basal meta-tarsal segment with a single black spine at apex; meracanthus well-developed and prominent.

Forewings (**Fig. 50d**) small, somewhat oval, about two and one-fourth times as long as broad, broadly rounded at apex; pterostigma prominent, closed, white, broad and long; basal vein almost as long as cubitus, radius about twice as long as cubital petiole;  $R_1$  almost as long as cubital petiole; radial sector long, curved and flexed upward near apex; second marginal cell a little longer than first, first cell slightly broader than second along the posterior margin; maculations fine towards the base, becoming small, irregular brownish bands towards the apex; membrane punctured throughout with fine disc-like sculpturings.

Hind wings (**Fig. 50e**) small, colourless, veins obscure, membrane uniformly beset with minute points, costal margin armed with a series of simple and hooked setae in basal half.

Abdomen small, finely beset with minute points arranged in small series, and also sparsely pubescent, pubescence longer on sternites.

*Genitalia.* Male genital segment (**Fig. 50f**) smaller than abdomen. Anal valve (**Fig. 50g**) large, about 0.30 mm long, slightly longer than parameres, in profile, conspicuously differentiated into two parts, the anterior anal part cylindrical and the large posterior rounded lobes, outer surface of both the parts sparsely beset apically with small setae borne on minute tubercles and finely rugulose in the basal region, each posterior lobe having a darker, secondary, finger-like process on the outer margin, which is also armed with few simple small setae; parameres (**Fig. 50h**) about 0.24 mm long, bowed, broad basally and gradually narrowed apically, terminating in an acute dark point, outer margin gently curved, inner margins sinuate, outer surface bearing small, simple setae, inner margins having an acute point in the apical third and another bluntly rounded process in the basal third, a strong, thick seta directed downward and a series of small setae present just below apex, basal marginal setae slightly longer; hypandrium simple, of usual shape, bearing sparse setae; aedeagus (**Fig. 50i**) moderately long, stout and elbowed, outer arm broad basally, spoon end slender; sperm pump as figured (**Fig. 50j**).

Female genital segment (**Fig. 50k**) smaller, about one-third the length of abdomen and normally curved downward ventrally, both plates widely separated. Dorsal plate (**Fig. 50l**) longer than ventral, strongly angulate, broad basally and gradually narrowed distally, the basal half somewhat horizontal and continuous with the contour of the abdomen, bearing the circum-anal pore ring, while the distal half bent obtusely downwards, ending in a blunt point, basal region armed with minute points, the middle zone hirsute with long hairs and the apical area beset with thick setae directed cephalad, circumanal pore ring consisting of a double ring of pores; ventral plate (**Fig. 50m**) broad basally, bluntly rounded apically, beset with simple setae, setae longer in middle, while the dorsal margin near apex armed with a regular row of thick setae; ovipositor exserted and acutely pointed.

*Host plant.* On *Albizzia procera* Benth.

*Distribution.* Quite common and widely distributed throughout India (Heslop-Harrison, 1949). Previously recorded from Dehra Dun, 701 m, Naini Tal, 1,830-2,440 m, Kanpur (U.P.), Delhi, Deolali (Bombay), Chowringi near Calcutta (Bengal), Pandu, Khasi Hills (Assam), and Karachi (Pakistan).

*Material examined.* A good series of both sexes bred on *Albizzia procera*, from New Forest, Dehra Dun (U.P.), during April-June, 1932 (R.N. Mathur); 6 examples of 4.5.33 and numerous specimens bred during May, August and September 1934 (Expt. No. 497/2; 499A) and 1 example of 6.6.50; and many adults and nymphal stages, preserved in alcohol (in phials) (R.N. Mathur) are present in the National Collection of F.R.I., Dehra Dun. Three specimens of 31.5.33, from New Forest, Dehra Dun, on *Albizzia procera* (R.N. Mathur) are donated to the Indian Agricultural Research Institute, New Delhi.

In the collection of I.A.R.I., New Delhi, are included few examples from New Forest, which were donated by the Forest Research Institute. Recently some specimens collected from New Delhi, on *Albizzia procera* (M.G.R. Menon), were also determined by me.

*Comparison.* This species was originally described by Heslop-Harrison under a new genus *Neopylla*, and in 1951 he renamed it *Acyzzia*, as *Neopylla* was preoccupied by a recognised genus of fleas (Wagner, 1903). His description is supplemented with some more features and drawings. *Acyzzia indica* is easily recognised by the shape of wings and maculations, shape of head, genal cones, genitalia and other characters.

*Biological notes.* Its brief biological history is given by Mathur (1935) and Beeson (1941), under *Arytaina* sp.n. This psyllid is found in abundance on *Albizia procera*, at New Forest, Dehra Dun, during April-August. The ravages of the pest are restricted to fresh shoots and buds. Both adults and nymphs are very active. The nymphal stages are described by Mathur (1952).

#### Genus ARYTAINA Foerster 1848

##### *Arytaina*

- Foerster, A. 1848. *Verh. natur. Ver. preuss. Rheinl.* 5: 67.  
 Crawford, D. L. 1914. *Bull. U.S. natn. Mus.* 85: 122-123.  
 Crawford, D. L. 1919. *Philipp. J. Sci.* 15: 172-173.  
 Tuthill, L. D. 1943. *Iowa State Coll. J. Sci.* 17(4): 503-504.  
 Heslop-Harrison, G. 1951. *Ann. Mag. nat. Hist.* (12), 4: 425-428.  
 Vondracek, K. 1957. *Fauna C.S.R. Praha*, p. 182.  
 Dobreanu, E. and Manolache, C. 1962. *Fauna Repub. pop. rom.*; Insecta, Homoptera, Psylloidea; Vol. 6, Fasc. 8, pp. 131-132.

##### *Arytarna*

- Scott, J. 1876. *Trans. ent. Soc. Lond.*, p. 528.  
 Loew, F. 1878. *Verh. zool.-bot. Ges. Wien.* 27: 596, 609.  
 Edward, J. 1896. *Item. Itom. Br. Isl.*, p. 250.  
 Kieffer, J. J. 1905. *Ann. Soc. Sci. Bruxelles* 29: 165.  
 Aulmann, G. 1913. *Psyllidarum Catalogus*, Berlin, p. 32.  
 Haupt, H. 1935. *Psylloidea, Tierwelt Mittelr.*, Vol. 4, p. X, 221-X, 252.

##### *Psylla*

- Latreille, P. A. 1804. *Hist. nat. Inv.* 12: 377-382.

##### *Ataenia*

- Thomson, G. G. 1877. *Opusc. ent.* 8: 828.

##### *Psyllopa*

- Crawford, D. L. 1911. *Pomona Coll. J. Ent.* 3: 628.

##### *Peripsyllopsis*

- Enderlein, G. 1926. *Ent. Mitt.* 15: 399.

*Type species.* *Arytaina genistae* (Latreille) (= *Psylla genistae* Latr. 1804) (original designation Foerster, 1848).

Body usually small, but robust. Head nearly or quite as broad as or broader than thorax, moderately declivous. Vertex usually nearly or quite flat, disc sometimes impressed on each side of median line; anterior ocellus visible from above. Genal cones usually short and very broadly rounded, seldom long or produced into conical or subquadrate processes extending forward nearly in same plane with vertex but separated from vertex by impressed line, not widely divergent. Eyes large, more or less recessive over pleurites. Antennae moderately long, slender. Thorax usually strongly arched and broad. Pronotum large, flat, collar-shaped, ending in a knob-like swelling laterally.

Pterurites long, large, subequal in length; propleural suture extending to middle of more or less swollen end of pronotum. Hind tibiae with or without basal spine; basal tarsus of hind legs with two claw-like spines at apex. Forewings usually more narrowly or broadly rounded at apex, hyaline or semi-hyaline, or coloured or rarely subcoriaceous, often more or less maculated, spotted or marked; pterostigma present, large; radius almost as long as or longer than cubital petiole. Hind wings small, hyaline and clear.

This genus was erected by Foerster (1848) and was spelt as *Arytaena* by several authors, *Pylla* Latreille (1804), *Atacnia* Thomson (1877), and *Pyllota* Crawford (1911), all refer to this genus. It is closely related to the genus *Pylla* Geoffroy (1762), but differs from it in having the pleural suture of prothorax extending to middle of lateral exuvium of the more or less swollen end of pronotum, the propterus subequal in length, the large flattened pronotum, the shape and position of the genal cones, and the often more or less coriaceous forewings.

*Arytina* includes five species from India and Pakistan, of which one is a new species.

#### KEY TO THE SPECIES OF ARYTINA

- |   |                               |
|---|-------------------------------|
| 1. Forewings maculated or speckled with brown or black dots or bands  | 2                             |
| —. Forewings hyaline and transparent  | 3                             |
| 2. Forewings with two transverse brown bands and another brown subapical area occupying from costa to radial cell | <i>A. fasciata</i> Laing.     |
| —. Forewings speckled with numerous brown or black dots or bands  | <i>A. punctipennis</i> Crawf. |
| 3. Radius almost as long as cubital petiole   | <i>A. ranakrishni</i> Crawf.  |
| —. Radius longer than cubital petiole   | 4                             |
| 4. Apex of forewing uniformly rounded; pterostigma almost as long as media up to furcation point                  | <i>A. spinosa</i> , sp. n.    |
| —. Apex of forewing not uniformly rounded; pterostigma shorter than media up to furcation point                   | <i>A. obscura</i> Crawf.      |

#### *Arytina fasciata* Laing 1930 (Fig. 51)

Laing, F. 1930. *Indian Forest Rec.* 4(7): 43-44.

This species is not examined by me and, therefore, its description from Laing (1930) is reproduced below.

"♂. Antennae pale yellowish-brown, segment 1 slightly shaded, the apices of 3-6 black, 7-10 wholly black except the extreme base of 7 which is slightly paler. Head pale yellowish-grey, the margin of the genal cones and a spot lying above and to the side of the median ocellus, black; the median area on each half of vertex with a darker shaded fovea; eyes and ocelli pinkish-red. Pronotum concolourous with head, two rather faint sub-median spots and a well-defined black lateral one; ground colour of dorsulum and mesonotum the same as the head, this being in the former, covered for a narrow margin around the lateral and posterior borders, by a dark brown area partially divided down the middle, and in the latter overlaid by the same shade of dark brown except for two well-defined sub-median and a more ill-defined sub-lateral stripe; scutellum pale yellowish-brown; tegmen semi-hyaline with two well-defined transverse brown bands, a sub-basal

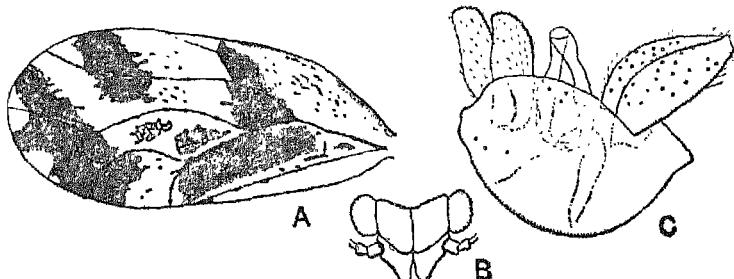


Fig. 51. *Aleytina fasciata* Laing.—A: tegmen; B: head from front; C: male genitalia (after Laing).

which expands and fills most of the anal cell, and an apical which stretches from near the apex of  $Rs$  to the middle of the first marginal cell, with two circular clear areas on the margin of the second marginal cell; another brown sub-apical area stretching from the costa into the radial cell; brown spotting in all the cells; veins more or less spotted with black; wing hyaline; legs pale brown, the femora shaded with darker brown, both tarsal segments with a certain amount of black; abdomen wholly dark brown."

"Antennae slender, the length approximately twice the width of the head, including the eyes; genal cones sub-conical, two-thirds the length of the vertex; vertex rhomboidal in shape, a sulcus stretching diagonally from the anterior lateral angle to the median line posteriorly, the posterior ocelli elevated; thorax very slightly arched, the pronotum about six times as broad as long, the dorsulum considerably smaller than the mesonotum, with a gently arched anterior margin and the median part of the posterior straight; tegmen almost twice as long as broad, the veins elevated slightly above the membrane. Length 1.75 mm; length of tegmen 2 mm."

"Sind Valley, 2,287 m on walnut."

"In its colouring this species approaches that found generally among members of *Diaphorina*, but the shape of the genal cones and the much longer and more slender antennae at once cuts it off from that genus. The heavily fasciated tegmen and the darkest body colouring distinguish it from *A. punctipennis* Crawf."

*Host plant.* On walnut.

*Distribution.* Sind Valley, 2287 m.

***Arytaina obscura* Crawford**  
(Fig. 38)

Crawford, D. L. 1912. *Rec. Indian Mus.* 7: 432, Pl. xxxiv, fig. S; Pl. xxxv, fig. M (*Psyllopa obscura*)  
(From Pusa, Bihar, taken on mango leaves).

Crawford, D. L. 1919. *Philipp. J. Sci.* 15: 172, 177.

Crawford, D. L. 1924. *Rec. Indian Mus.* 26: 617-618.

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 624. (Noted also on *Dalbergia* leaves, Coimbatore (Ramakrishna Coll.), (*Arytaina obscura*)).

This species was not examined by me, as no representative was available. One or two examples were sent to me by the Entomologist and Associate Professor of Entomology,

Coimbatore, but unfortunately, the specimens arrived completely damaged to pieces, in transit, and hence could not be studied. Its description is reproduced from Crawford (1912), as below.

" Length of body 2.1 mm; length of forewing 3.6 mm; greatest width 1.5 mm; width of vertex between eyes 0.44 mm; with eyes 0.68 mm. General colour orange yellow throughout; antennae black on apical half. Body rather large, robust."

" Head about as broad as thorax, deflexed; vertex moderately large, typical; facial cones a little more than half as long as vertex, thick at base, roundly acute at apex, much deflexed from plane of vertex; eyes large; antennae fully twice as long as width of head; slender."

" Thorax broad, arched; pronotum rather long; legs moderately long. Forewings hyaline, two and a third times as long as broad, rounded at apex; pterostigma moderately large; cubital petiole shorter than discoidal subcosta."

" Female genital segment thick at base, as long as abdomen, subacute at apex; dorsal valve a little longer than ventral."

" Described from one female from Pusa, Bengal, taken on mango leaves."

*Host plants.* On mango leaves (Crawford, 1912); noted also on *Dalbergia* leaves (Ramakrishna Ayyar, 1924).

*Distribution.* Pusa, Bihar; Coimbatore, Tamil Nadu.

In the collection of the Indian Agricultural Research Institute, New Delhi, I noticed a label bearing the data: *Psyllopa obscura*, Pusa, Bengal, 17.2.09, on mango flowers (specimen with D. L. Crawford). In the list provided to me by Dr V. F. Eastop, it is mentioned that the type is in the British Museum, London.

*Comparison.* Crawford (1924) wrote: "Under the name *Psyllopa obscura* this species was described in my earlier paper on Indian Psyllidae, only one specimen was available, which now is in the British Museum as the type of the species. In the Ramakrishna collection there are a number of specimens which seem to belong to this species, though a comparison with the type should be made before a positive assertion is made. These specimens were collected on shoots of *Dalbergia* at Coimbatore, October, 1923."

**Arytaina punctipennis** Crawford  
(Fig. 52)

Cotes, E. C. 1891-93. *Indian Mus. Notes* 2(7): 18, 167.

Crawford, D. L. 1912. *Rec. Indian Mus.* 7: 431-32, pl. xxxiv, figs. K, O; pl. xxxv, fig. U (*Psyllopa punctipennis* Crawf.)

Aulmann, G. 1913. *Psyllidarium Catalogus*, Berlin, p. 17 (*Psylla isitis* Buckt.).

Crawford, D. L. 1919. *Philipp. J. Sci.* 15: 177.

Grove, A. J. and Ghosh, C. G. 1914. *Mem. Dep. Agric. India* 4(6): 329-57, pls. xv-xx (*Psylla isitis* Buckton).

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 624.

Rahman, K. A. 1932. *Indian J. agric. Sci.* 2(4): 358-77, pls. xxxviii; xl, fig. 4 (Nymphal stages.)

Length of body, in male, 1.25 mm; in female, 1.72 mm

Length of forewings, in male, 1.78 mm; in female, 2.12 mm

Width of head with eyes, 0.53 mm

Width of vertex between eyes, 0.32 mm

Length of antennae, 0.95 mm

*Colouration.* General colour light brown with greenish tinge, with dark brown longitudinal bands on mesothorax, antennae black at tip of segments 3 to 8, terminal segments also black, vertex with two orange stripes, tip of beak black, anal valve in male dark-brown cephalad, forewings speckled with numerous brown or black dots or bands, both on veins and membrane.

*Structure.* Body small, moderately robust. Head (**Fig. 52a**) nearly as broad as thorax, moderately deflexed, finely and sparsely pubescent, finely rugulose; vertex slightly longer than half its width, with a round fovea on either side of median suture, a stellate-like impression extending from each fovea, front ocellus visible from above, posterior margin moderately arcuate, anterior margin deeply emarginate at point of excision, post-ocellar region slightly swollen; genal cones prominent, approximate basally and divergent distally, about two-thirds as long as vertex, narrowly rounded at tip, hairs longer than that of vertex, surface finely rugulose and also beset with minute points, with two long ventral setae. Eyes large.

Antennae (**Fig. 52b**) slender, ten-segmented, imbricate, bearing few fine setae, two basal segments robust, 1st broadly transverse, 2nd rectangular, slightly longer than broad, 3rd longest, twice as long as 5th, 4th, 6th and 7th equal and slightly longer than 5th, 5th and 8th equal and half as long as 3rd, 9th smallest, terminal segment slightly longer than 9th, bearing two unequal apical setae; four sensoria present on segments 4, 6, 8 and 9.

Thorax moderately arched, finely and sparsely pubescent, finely rugulose. Prothorax broadly transverse, anterior margin slightly convex, with two dark brown foveal impressions on each lateral side; prescutum about twice as broad as long, lateral angles truncate, posterior margin angulate; scutum slightly longer than prescutum, about twice as broad as long, angulate laterally; scutellum broadly transverse, broad anteriorly and narrow posteriorly; pleurites broad.

Legs (**Fig. 52c**) moderately long, bearing simple setae, femora shorter than tibiae and beset with minute points, all tibiae with a comb of setae at apex, hind tibia without basal spur, with four black tooth-like spines at apex, basal tarsal segment much smaller than apical, bearing two claw-like apical spines; meracanthus small and triangular.

Forewings (**Fig. 52d**) rather small, hyaline, speckled with numerous brown or black dots or bands, about two and a half times as long as broad, rounded at apex, pterostigma small and narrow, R scarcely longer than M+Cu, basal vein slightly longer than R, radial sector flexed upward near apex, first marginal cell slightly longer than second, veins armed with microscopic setae, membrane beset with minute points. Hind wings (**Fig. 52e**) thickly beset with minute points, basal half of costal margin bearing a few simple and hooked setae.

Abdomen longer than broad, finely and sparsely pubescent, setae longer on sternites.

*Genitalia.* Male genital segment (**Fig. 52f**) quite large but smaller than abdomen. Anal valve about 0.25 mm long, in lateral aspect, with anterior margin nearly straight,

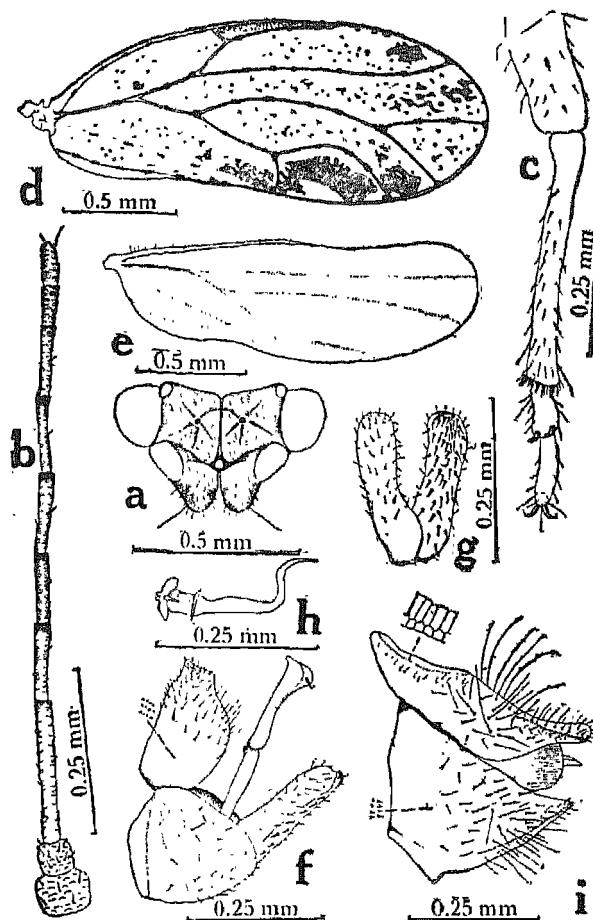


Fig. 52. *Arytaina punctipennis* Crawford—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: male genitalia, lateral view; **g**: parameres, outer and mesal views; **h**: sperm pump; **i**: female genitalia, lateral view.

posterior margin broadly convex, gradually narrowed both apically and basally, truncate at apex, upper surface thickly beset with minute points arranged in lines and with sparsely scattered simple setae, setae slightly longer along the posterior margin; parameres (Fig. 52g) nearly as long as proctiger, sides sub-parallel, bent inwards apically and ending in a sharp black spine, outer surface bearing simple setae, mesal surface with a bunch of thick setae just below apex and pointing downwards, setae in the lower part scattered and less in numbers; hypandrium of usual shape, bearing few setae; aedeagus quite long, outer arm shorter than basal, with a thick spoon end; sperm pump as figured (Fig. 52h).

Female genital segment (Fig. 52i) thick, smaller than abdomen, plates sub-equal,

sparingly pubescent, dorsal plate slightly longer than ventral, roundly pointed at tip; ventral plate acutely pointed at tip; setae longer in the central areas of both plates; circum-anal pore-ring composed of a double row of pores; ovipositor acutely pointed.

*Host plants.* On *Indigofera hebeptala* Benth. and *I. pulchella* Roxb., causing twisting and curling of young leaves. Previously recorded on *Indigofera anil*, *I. arrecta*, *I. oligosperma*, *I. panicifolia* and *I. sumatrana* (Grove and Ghosh, 1914).

*Distribution.* Originally recorded from Pusa (Bihar); Calcutta (Bengal); Ceylon, Peradeniya.

*Material examined.* In the main collection of the Forest Research Institute, Dehra Dun, are present 3 examples, 2.12.08, 4 ex. 30.6.13 (D.P.S.), and 2 ex. 1.12.13 (R. S.), all from Pusa, Bihar. In addition to these, there are several specimens of this species collected during March 16-20, 1959 and March 4-7, 1960, on *Indigofera hebeptala*, New Forest, Dehra Dun (R. N. Mathur). Some adults and nymphal stages from the above collection were also preserved in alcohol. One male specimen of 16.2.59, from New Forest, Dehra Dun, U.P. (R. N. Mathur) is donated to I.A.R.I., New Delhi.

There are some examples of this species, present at I.A.R.I., New Delhi, collected from Pusa (Bihar) on indigo, as listed: 1 ex. 4.12.08 (D.P.S.), 2 ex. 10.4.09 (C.S.M.), 1 ex. 23.1.09, 14 ex. 30.6.13 (D.P.S.), and 6 ex. 9.12.13 (R.S.). Nine specimens collected from Peradeniya, Ceylon, on indigo, of April 14-17, 1914 (T.B.F.) are also present.

The collection of Z.S.I., Calcutta, contains 3 tubes (No. 4483/10, 4484/10, and 4485/10) having few nymphs and adults, preserved in alcohol, with this data: Pusa, Bihar, 16.12.13, 18.12.13, and 19.12.13.

*Biological notes.* It is a serious pest of indigo in Bihar and in 1890, this species was reported as excessively destructive to indigo in Bengal (Cotes, 1891-93). The nymphal stages are described by Rahman (1932).

*Comparison.* Cotes (1891-93) described this species as *Psylla isitis*. Crawford (1912) wrote: "This is probably the adult of Buckton's *Psylla isitis*, which he described from the nymph only. In order to avoid confusion, however, in case they should not be identical, I have given it another name. The forewing of this species bears a close resemblance to *Aphalaro multipunctata* Kuwayama (Japanese);" and he named it *Psyllopa punctipennis*. *Psyllopa* Crawford has been placed under *Arytaina* Förster, and therefore this species is now considered as *A. punctipennis* (Ramakrishna Ayyar, 1924). This species is easily separated from the other species of *Arytaina* by the speckled forewings.

#### *Arytaina ramakrishni* Crawford 1924

(Fig. 53)

Crawford, D. L. 1924. *Rec. Indian Mus.* 26: 618, fig. 2 (wing) (In leaves of *Chloroxylon swietenia*, Coimbatore, India).

Ramakrishna Ayyar, T. V. 1924. *ibid.* 26: 624 (On galls in leaves of *Chloroxylon swietenia*, Coimbatore).

Enderlein, G. 1926. *Ent. Mitt.* 15: 399-400 (*Peripsyllopsis ramakrishni*; S. India).

Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 39.

Mani, M. S. 1959. *Agra. Univ. J. Res. (Science)* 8(2): 118 (On leaf, *Chloroxylon swietenia*; Coimbatore).

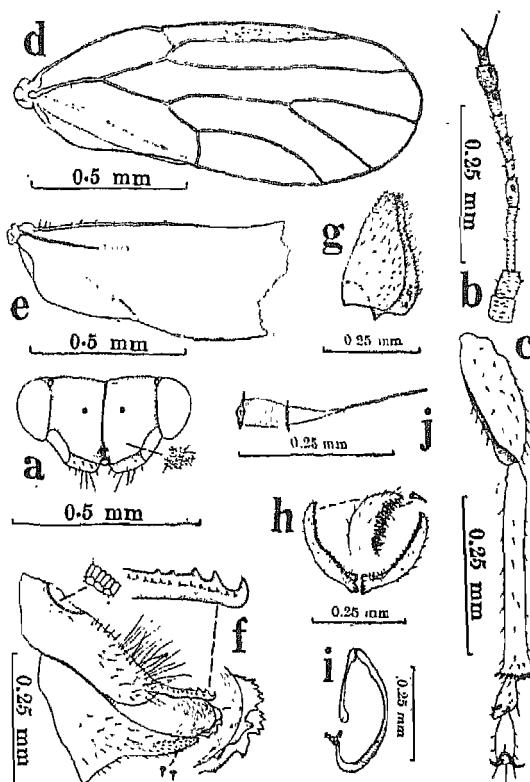


Fig. 53. *Arytaina ramakrishni* Crawford—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing (partly damaged); **f**: female genitalia, lateral view; **g**: anal valve of male, lateral view; **h**: parameres, caudal view, with apical end, highly magnified; **i**: aedeagus; **j**: sperm pump.

Length of body, in male, 1.0 mm; in female, 1.20 mm

Length of forewings, in male, 1.3 mm; in female, 1.22 mm

Width of head with eyes, 0.48 mm

Width of vertex between eyes, 0.32 mm

Length of antennae, 0.45 mm

*Colouration.* General colour creamy or yellowish-white; forewings hyaline, transparent with a whitish colour; antennae black at tip.

*Structure.* A small whitish insect. Head (Fig. 53a) moderately deflexed, slightly broader than thorax, finely rugulose and finely and sparsely pubescent, and also armed with minute points; vertex broader than long, about twice as broad as long, gradually rounded downward in front, broad posteriorly and narrow anteriorly, with a deep and round foveal depression on each side of median suture, posterior margin slightly emarginate, anterior ocellus visible from above; genal cones small, much shorter than vertex, deflexed from plane of vertex, bluntly rounded in front, finely rugulose, sparsely pubescent,

setae longer than that of vertex, and also bearing 2 or 3 pairs of long and strong ventral setae. Eyes small. Clypeus small and round, and visible from ventral aspect.

Antennae (**Fig. 53b**) small, about as long as width of head, ten-segmented, two basal segments robust, 1st subquadrate, slightly broader than 2nd, 2nd cylindrical, nearly as long as 1st, remaining segments moderately slender, imbricate, bearing sparse setae, 3rd segment longest about twice as long as 4th, 4th and 9th equal and each about half as long as 3rd, 4th segment slightly thicker, 5th and 10th smallest, each half as long as 4th, 6th, 7th and 8th equal but each slightly longer than 5th, 9th segment thick and club-shaped, terminal segment bearing two long apical setae, four senseria present on segments 1, 6, 8 and 9.

Thorax small, moderately arched, finely and sparsely pubescent, finely rugulose and also armed with minute points. Prothorax small, narrowly transverse, with two foveal impressions on each lateral side; prescutum small, broader than long, broadest beyond middle, gradually and narrowly rounded anteriorly, posterior margin angulate; scutum large, broader than long, about twice as broad as long, broadest in middle, slightly smaller in length than prescutum, gradually sloping and angulate laterally; scutellum small, narrowly transverse, broad cephalad and narrow caudad.

Legs (**Fig. 53c**) small, slender, pubescent and also armed with minute points, arranged in linear series, femora shorter than tibiae, all tibiae bearing apical comb of thick setae, hind tibiae without basal spur and armed with four black spines on one side and two on the other at apex, tibial groove quite long, basal tarsal joint much smaller than apical, bearing two claw-like spines at apex; meracanthus small, somewhat tubular.

Forewings (**Fig. 53d**) small, hyaline, transparent, rather elongate-oval, about two and a half times as long as broad, broadly rounded at apex, with a long elongate pterostigma, vein fine, somewhat parallel in middle, radius as long as cubital petiole, basal vein slightly longer than radius, marginal cells unequal, first slightly longer and much broader than second cell, *Rs* quite long and weakly flexed in middle.

Hind wings (**Fig. 53e**) smaller than forewings, membrane uniformly beset with minute points, costal vein armed with a few simple and hooked setae, in basal half.

Abdomen small, longer than broad, finely and sparsely pubescent, and also armed with rows of minute points; all tergites with weak lumps.

*Genitalia.* Female genital segment (**Fig. 53f**) not quite as long as rest of abdomen, large at base, apical half abruptly narrowed into a slender and acutely pointed process, dorsal plate a little longer than ventral, steeply inclined caudad, sparsely pubescent and also armed with minute points, with a tuft of long hairs midway on dorsal surface, apex with an up-turned hook, apical region armed with few saw-like teeth facing upward; ventral plate broad at base, flexed ventrally, acutely pointed at apex, apical region beset with minute peg-like setae; circum-anal pore ring small and composed of a double row of pores.

Male genitalia is described from the material received from Nagpur.

Male genital segment smaller than abdomen. Anal valve (**Fig. 53g**) about 0.30 mm long, slightly longer than parameres, pyriform in anterior view, broad basally and gradually narrowed apically, anterior margin almost straight in profile, posterior margin broadly

convex basally, apex truncate, outer surface sparsely beset with thick setae, apical region also armed with minute points, marginal setae long and thick, a group of 5 to 7 thick setae present in the basal mesal surface near posterior margin; parameres (Fig. 53h) about 0.20 mm long, gradually curved inward, broad basally and gradually narrowed apically, terminating in an acute point, outer surface bearing few small setae, inner marginal setae short and stout and arranged in small groups, setae numerous in the apical region, few longer setae also present in the basal region; hypandrium simple, of usual shape, having small setae; outer arm of aedeagus (Fig. 35i) much smaller than basal, terminating in a spoon-shaped end, basal arm long and bowed; sperm pump as figured (Fig. 35 j).

*Host plant.* On leaves of *Chloroxylon swietenia* DC.

*Distribution.* Originally recorded from Coimbatore, India.

*Material examined.* By the courtesy of Dr M. Bashir, Entomologist and Associate Professor of Entomology, Agricultural College, Coimbatore, I have been able to study this species, from a female specimen received in February 1965. Unfortunately, the specimen was badly damaged in transit, and its parts were collected together from the consignment, under the binocular, and were mounted on slides. This specimen has the following data: Coimbatore, S. India, 19.6.36, on *Chloroxylon* leaves (A.G.R.), and is labelled as *A. ramakrishni* Crawf.

In November 1969, a few specimens of this species from Nagpur, Maharashtra, and bred from *Chloroxylon* sp., were given to me by Shri P.S. Thakare, Research Student, Department of Zoology, Nagpur.

*Comparison.* This species is redescribed from fresh material in hand. The shape of the first marginal cell in forewing is slightly different from the figure given by Crawford (1924, Fig. 2). It is distinguished by the small antennae, shape of head, hyaline wings, radius almost as long as cubital petiole and in genital characters.

Enderlein (1926) treated this species under a new genus *Peripsyllopsis*, since it depicts close relationship with *Arytaina*, this cannot be fully justified.

*Biological notes.* This species has been recorded on leaves of *Chloroxylon swietenia*, from Coimbatore, Madras, and was collected in October 1923 (Crawford, 1924) and June 1936. Nothing is known about its life-history and economic importance.

#### *Arytaina spinosa*, sp. n.

(Figs. 54, 55)

Length of body, in male, 1.43 mm; in female, 1.82 mm

Length of forewings, in male, 1.95 mm, in female 2.31 mm

Width of head, with eyes, 0.68 mm

Width of vertex between eyes, 0.45 mm

Length of antennae, 1.42 mm

*Colouration.* General colour pale clay yellow, with greenish tinge, antennae pale-yellow with apices of segments and apical joints black; legs pale-yellow; wings hyaline, veins pale-yellow.

*Structure.* Body small. Head (**Fig. 54a**) including eyes, broader than thorax, moderately declivous, finely and sparsely pubescent, finely rugulose; vertex broader than long, about twice as broad as long, swollen anteriorly and also on either side of median suture, gradually rounded in front, disc depressed on either side of swollen median region, bearing two foveal impressions, post-ocellar region swollen, posterior margin strongly arcuate; anterior ocellus visible in front; genal cones small, swollen, below the level of vertex, directed vertically downward, finely rugulose, apices bluntly rounded, setae slightly longer than that of vertex, two long ventral setae also present on each gena. Eyes bulging.

Antennae (**Fig. 54b**) ten-segmented, imbricate, long and slender except two basal segments, 1st segment subsquare, 2nd somewhat cylindrical, as long as 1st, 3rd segment longest, one and a half times as long as 4th, 4th and 7th nearly equal, 5th, 6th and 8th equal but smaller than 4th, 9th half as long as 5th, terminal segment smallest, bearing two unequal setae at apex.

Thorax large, moderately arched, finely and sparsely pubescent, finely rugulose. Prothorax large, convex, gradually sloping, bearing two foveal impressions on each lateral side; prescutum partly concealed antero-medianally by prothorax, twice as broad as long, broadest posteriorly beyond centre, gradually narrowed anteriorly, angulate both laterally and posteriorly; scutum slightly longer than prescutum, about one and a half times as broad as long, angulate both laterally and posteriorly; scutellum transverse, posterior margin concave, antero-lateral angles prominent; post-scutellum of metathorax large, with one median and two lateral ridges, having prominent foveal depressions in between these ridges.

Legs (**Fig. 54c**) moderately long, sparsely pubescent, femora shorter than tibiae, all tibiae bearing an apical comb of strong setae, hind femur with a group of five or six dorsal setae just before apex, hind tibiae with a small basal spur and five tooth-like setae at apex, hind basal tarsal joint with two claw-like black spines at apex, apical tarsal joint longer than basal; meracanthus small, triangular.

Forewings (**Fig. 54d**) large, hyaline, a little less than two and a half times as long as broad, with apex rounded, with a long pterostigma, radius about twice as long as cubital petiole, basal vein slightly longer than radius, cubital vein slightly longer than cubital petiole, marginal cells unequal, second longer than first. Hind wings (**Fig. 54e**) also large, beset with minute points, costal margin in basal half bearing a few simple and hooked setae.

Abdomen longer than broad, finely pubescent and also beset with fine points arranged in lines.

*Genitalia.* Male genital segment (**Fig. 54f**) smaller than abdomen. Anal valve (proctiger) nearly as long as parameres, obtiangular when viewed laterally, anterior margin nearly straight, each side produced posteriorly into a lobe, very broad at base and sub-triangular in shape, outer surface beset with simple setae and also with minute points arranged in linear series; parameres (**Figs. 54g, h**) simple, elongate, sides sub-parallel, broad basally and gradually narrowed apically and bent inwards, terminating in a bidentate black end, inner margin of basal half with a strong epiphysis directed

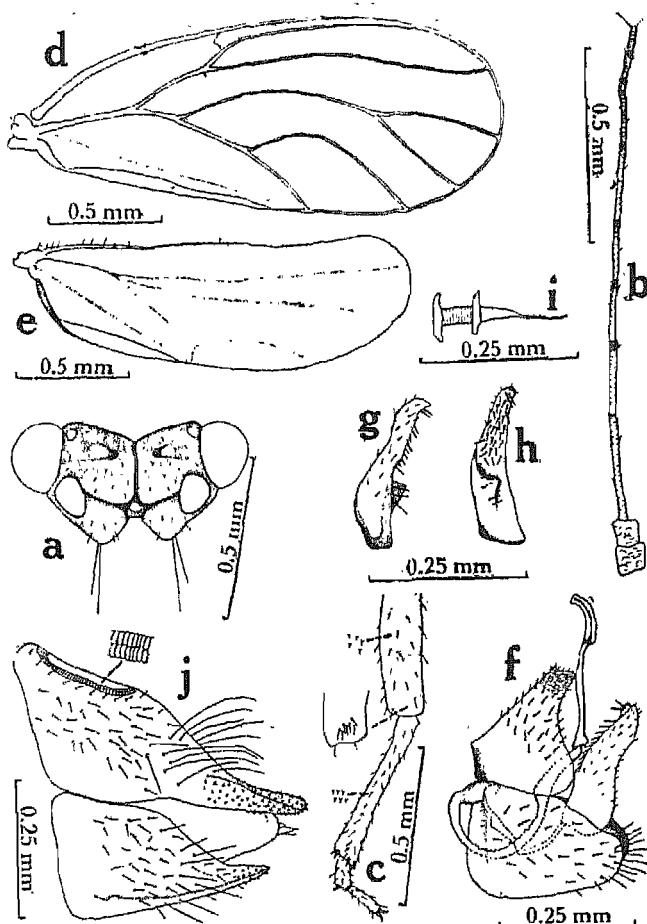


Fig. 54. *Arytaina spinosa*, sp. n.—a: head, front view; b: antenna; c: hind leg; d: forewing; e: hind wing; f: male genitalia, lateral view; g, h: forceps, outer and mesal view; i: sperm pump; j: female genitalia, lateral view.

cephalad, outer surface beset with small simple setae, mesal surface armed with strong setae pointing downwards, two strong setae also present just below apical end; hypandrium simple and of usual shape, bearing sparse simple setae; outer arm of aedeagus smaller than basal; sperm pump as figured (Fig. 54i).

Female genital segment (Fig. 54j) smaller than abdomen, plates sub-equal in length, dorsal plate longer than ventral, acuminate in apical portion, rounded at apex; ventral plate acute at tip; both plates beset with simple setae, setae longer in the central regions, apical portions armed with minute peg-like setae; ovipositor acutely pointed; circum-anal ring composed of double row of pores.

*Host plants.* On young, fresh leaves and twigs of *Albizia procera* Benth. and *A. chinensis* (Osbeck) Merr. (= *A. stipulata* Boiv.).

*Type locality.* New Forest, Dehra Dun (U.P.).

*Types.* *Arytaina spinosa*, sp.n. is described from a small series of both sexes. Holotype, male; Allotype female, both from the type locality and collected on May 9, 1950, on *Albizia procera* (R.N. Mathur); Paratypes: 5 males and 2 females, data same but collected on June 11, 1950; 5 males and 3 females, data same but collected on March 31, 1959, on *Albizia chinensis* (Osbeck) Merr. (= *A. stipulata* Boiv.) (R.N. Mathur). Few adults and nymphal stages, of March 31, 1959, were also preserved in alcohol (in a phial). All types, preserved material and some slides with parts of adults and nymphal stages mounted on them, are deposited at F.R.I., Dehra Dun.

*Comparison.* *Arytaina spinosa*, sp.n. is recognised by its hyaline wings, with apex gradually rounded, pterostigma almost as long as media up to furcation point, divergent genal cones and genital characters.

#### Nymphal stage

*Fifth stage:* (**Figs. 55a, b, c, d**). Length 1.34 mm. Typical psylline form. Elongate; head scarcely as broad as the abdomen. Wing-pads large and projecting well beyond the contour of the body, not produced anteriorly. Eyes large and prominent. The derm for the greater part sclerotic, the head and wing pads bearing large sclerotic areas, the thorax and the anterior half of the abdomen having a few sclerotic areas, while the posterior half of the abdomen being occupied by a single large plate as shown in the figure. Derm is beset sparsely with small, slender setae. The anterior pair of wing-pads having large black setae, each seta being flattened or spatulate at the tip; each of the posterior wing-pads having two large similar setae at their distal end and three setae along the posterior margin. The posterior half of the abdomen having five large conspicuous spatulate setae varying in size and marginal in position. General surface of the derm in abdomen bearing small, simple, scattered setae.

Ventral side for the most part membranous, with small areas on the anterior half of the abdomen and the posterior half of the abdomen almost completely sclerotic; the abdominal surface beset with small, simple, scattered setae.

Antennae (**Fig. 55b**) about 0.75 mm long, nine-segmented, beset with few simple setae, two basal segments robust, 1st broadly transverse, 2nd longer than broad, subcylindrical, remaining segments slender, apical three segments imbricate, 3rd segment longest, about two and one quarter times as long as 4th, with a weak constriction in centre, 4th slightly smaller than 5th, 5th, 6th and 7th nearly equal to one another, 8th slightly smaller than 4th, slightly longer than 5th, bearing two apical spines, four sensoria present on segments 3, 5, 7 and 8.

Legs (**Fig. 55c**) quite long and extend beyond the contour of the body, sparsely beset with simple setae; without trochanters; femora and tibiae bearing few black spatulate setae of various length; tibio-tarsal articulation distinct; all tarsi with one golf-club seta; claws present, pulvilli petiolate, fish-tail like.

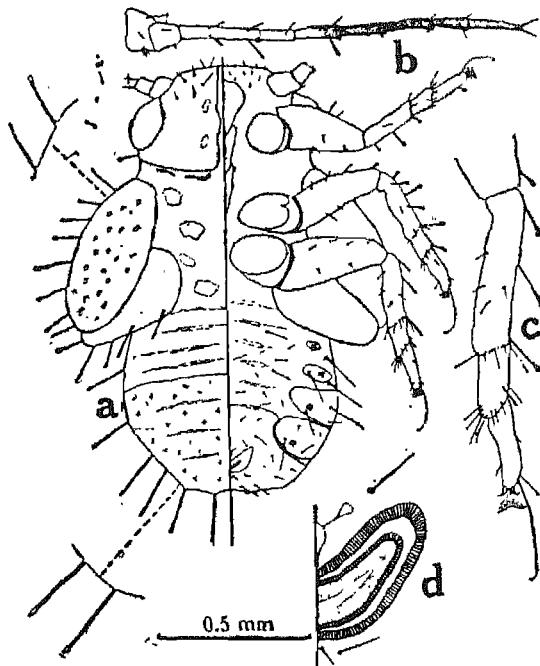


Fig. 55. *Arytaina spinosa*, sp. n.—**a**: fifth stage nymph; **b**: antenna; **c**: hind leg; **d**: circum-anal pore ring.

Circum-anal pore ring (**Fig. 55d**) situated well beyond the apex of abdomen, somewhat V-shaped and composed of two rings of slit-like pores, and guarded by one anterior and two posterior pairs of setae.

#### Genus DIAPHORINA Loew 1879

##### *Diaphora*

Loew, F. 1878. *Verh. zool.-bot. Ges. Wien.* **28**: 603.

Kieffer, J. J., 1905. *Ann. Soc. Sci. Bruxelles* **29**: 162.

##### *Diaphorina*

Loew, F. 1879. *Verh. zool.-bot. Ges. Wien.* **29**: 567.

Aulmann, G. 1913. *Psyllidarum Catalogus*, Berlin, p. 7.

Vondracek, K. 1957. *Fauna C.S.R., Praha, Ceskoslovenske Akademi ved.*, t. **IX**, p. 194.

Dobreanu, E. and Manolache, G. 1962. *Fauna Repub. pop. rom. Insecta, Homoptera, Psylloidea*, Vol. **8**, fasc. 3, p. 148.

##### *Gonanoplicus*

Enderlein, G. 1910. *Psyllidae*, in *Sjostedt Zool. Kiliman. Exped.* **2**: 143, fig. 3, 5-8.

Aulmann, G. 1913. *Psyllidarum Catalogus*, Berlin, p. 33.

Klimaszewski, S. M. 1964. *Annls. Zool.* **22**(3): 59.

Franz loew (1878) erected the genus as *Diaphora*, but, as the name was preoccupied in Lepidoptera, he changed it to *Diaphorina* in 1879.

*Type species.* *Diaphorina putonii* Loew (= *Diaphornia putonii* Loew 1878) (original designation); recorded from Italy and Greece.

The distinctive characters outlined by Loew (1878), Crawford (1924) and others are expanded with the notes given below.

Body generally long and slender, and covered over with mealy waxy secretion. Head narrower than thorax, usually punctate, scarcely deflexed; vertex flat, and generally broader than long. Frons concealed by genal cones dorsally but visible ventrally as a large plate. Genal cones large, thick, as long as or longer than broad, porrect, extending forward in the same plane with vertex or nearly so, apices narrowly rounded or truncate. Eyes large, recessive. Antennal sockets scarcely visible. Antennae very short, moderately thick, usually ten-segmented, about as long as width of head or less. Thorax moderately narrow and slender, moderately arched, punctate, dorsal surface more or less granulate ('gekörnelt'). Legs of medium size, pubescent with strong setae, hind tibiae with black, tooth-like spines at apex, varying in number in different species; proximal tarsal segment of hind leg with two stout, claw-like spines at apex. Forewings long and large, membrane sub-hyaline and thickened, usually maculated extensively with brown, broad sub-apically, rounded at apex, narrow in basal half, pterostigma long and very narrow or wanting, radial sector quite long and flexed near apex, radius as long as or longer than basal vein, cubitus longer than radius, second marginal cell larger than first.

There are 9 species including 5 new to science, representing this genus in India. Their distinguishing characters are presented in the key.

#### KEY TO THE SPECIES OF DIAPHORINA

1. A cross vein present, connecting the radial sector, and the first medial branch . . . . . *D. venata*, sp. n. . . . .
- . No such cross vein . . . . . 2
2. Colour smoky black or fuscous; wings entirely maculated with black, scattered maculae, intermixed with small hyaline areas . . . . . 3
- . Colour yellowish-brown, brown or orange, with greenish tinge; wings partly maculated . . . . . 7
3. Genal cones narrowly rounded at apex . . . . . 4
- . Genal cones truncate at apex . . . . . *D. truncata* Crawf.
4. Genal cones smaller or as long as vertex along median suture. . . . . 5
- . Genal cones longer than vertex . . . . . *D. dunensis*, sp. n.
5. Maculae dense and composed of small scattered spots, inter-mixed with hyaline areas . . . . . *D. communis*, sp. n.
- . Maculae less dense . . . . . 6
6. Second marginal cell longer than first . . . . . *D. enderleini* Klimasz.
- . Second marginal cell as long as first . . . . . *D. cardiae* Crawf.
7. Apical band in forewing continuous from apex of radial sector to marginal cells . . . . . 8
- . Apical band interrupted in medial cell . . . . . *D. gymnosporiae*, sp. n.
8. Media and cubitus banded with maculae . . . . . *D. bikanerensis*, sp. n.
- . Media and cubitus without bands . . . . . *D. citri* Kuw.

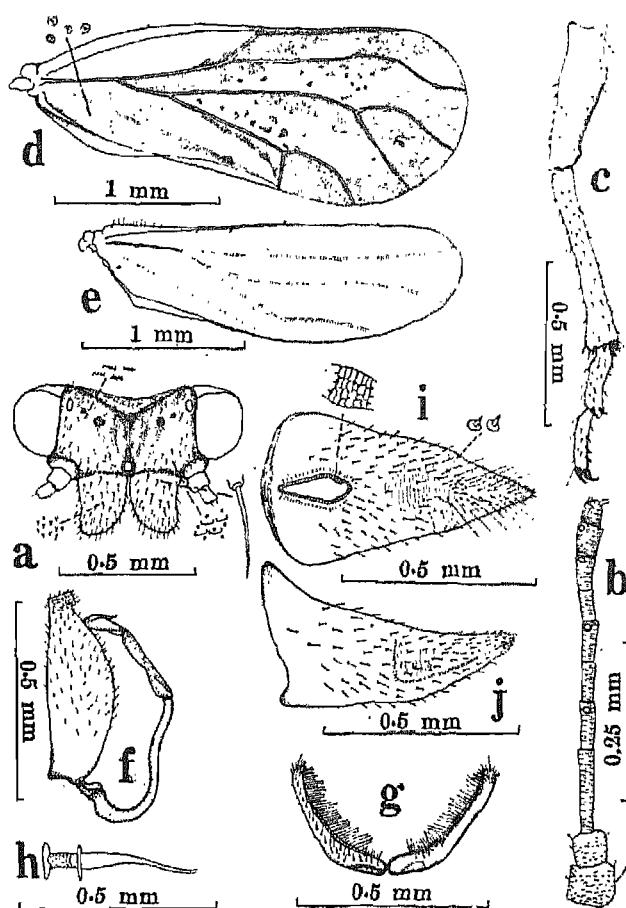


Fig. 56. *Diaphorina bikanerensis*, sp. n.—a: head, front view; b: antenna; c: hind leg; d: forewing; e: hind wing; f: anal valve and aedeagus of male, lateral view; g: forceps, caudal view; h: sperm pump; i: dorsal plate of female; j: ventral plate, lateral view.

***Diaphorina bikanerensis*, sp. n.**  
(Fig. 56)

Length of body, in male, 1.82 mm; in female, 2.2 mm;

Length of forewings, in male, 2.6 mm; in female, 2.6 mm

Width of head with eyes, 0.83 mm

Width of vertex between eyes, 0.48 mm

Length of antennae, 0.60 mm

**Colouration.** General colour yellowish-brown, dorsum and lateral sides of thorax and lateral sides of abdomen greyish; head yellowish-brown with posterior border margined

black; prothorax in middle, anterior area of prescutum and two pairs of longitudinal stripes on scutum dark brown; genae greyish; antennae yellowish-brown with two apical segments black; hind to forelegs progressively light to dark brown or blackish; metacoxal spur dark brown; meracanthus lighter; female genitalia yellowish-brown and blackish posteriorly.

**Structure.** Body long and slender. Head (Fig. 56a), including eyes, almost as broad as thorax, moderately deflexed; vertex sparsely pubescent, finely rugulose, finely punctate, about twice as broad as long, with two pairs of foveal impressions on each side of median suture, posterior to centre, from each anterior fovea a shallow depression extending anteriorly towards the median suture, but not attaining the anterior margin, posterior foveae minute and circular, disc slightly swollen on either side of median line; post-ocellar region swollen, post-ocelli large and lateral; posterior border margined and strongly emarginate; anterior ocellus visible from above; frons visible, surrounding the front ocellus; genal cones large, about 0.18 mm long and as long as vertex, directed forward, on the same level as the vertex but distinctly separated by the deep impressed line, separate but approximate, apices divergent and roundly pointed, pubescent and finely rugulose and also armed with minute points. Eyes large and recessive. Antennal sockets large and located just below the lower margin of eyes.

Antennae (Fig. 56b) small, thick, bearing few setae, two basal segments robust, 1st broadly transverse, 2nd almost quadrate and as long as 1st, 3rd segment longest, about twice as long as 5th, 4th slightly more than half as long as 3rd and a little longer than 5th, 5th and 6th equal, 7th, 8th and 9th equal to one another and each slightly smaller than 6th, terminal segment smaller than 9th, bearing two apical spines, 9th segment thicker than others, four sensoria present on segments 4, 6, 8 and 9.

Thorax strongly arched, finely and sparsely pubescent, finely punctate, and finely beset with minute points. Pronotum flat, as wide in the middle as at the sides, with two subequal, lateral foveal impressions, disc convexly rounded, descending, in the same plane as prescutum; prescutum gradually sloping anteriorly, broader than long, a little more than one and a half times as broad as long, broadest in middle, narrower both anteriorly and posteriorly, angulate laterally and posteriorly; scutum large and broad, a little longer than prescutum, about two and a half times as broad as long, anterior margin concave, disc swollen submedianally, forming a shallow longitudinal median channel, sloping and angulate laterally, posterior margin angulate submedianally; scutellum narrowly transverse, saucer-shaped, with prominent antero-lateral angles, about twice as broad as long.

Legs (Fig. 56c) long and robust, coarsely pubescent, tibiae longer than femora and each having an apical comb of setae, without basal spur, with six black, tooth-like spines at apex; basal tarsal segments smaller than apical; meta-basal tarsal joint with two black claw-like spines at apex; tibial grooves quite long; meracanthus large and subtriangular.

Forewings (Fig. 56d) long, narrow at base, rounded at apex, broadest subapically, about two and a half times as long as broad, maculated in all cells except C+Sc, the maculae forming large bands, leaving clear areas in between and small clear spots along the apical margin, costal margin angulate apically, pterostigma long, narrow and pubescent, radius

longer than basal vein, cubital petiole about half as long as radius, cubitus slightly longer than radius, radial sector almost running parallel to costal margin and then abruptly flexed downwards near apex, marginal cells unequal, first cell smaller than second, veins with two rows of microscopic setae; fork  $M_{1+2}$  with a weak loop.

Hind wings (**Fig. 56e**) slightly smaller than forewings, membrane uniformly beset with minute points, costal margin armed with a few simple and hooked setae in the basal half.

Abdomen long and narrow, finely and sparsely pubescent, and also armed with minute points, pubescence longer on sternites.

*Genitalia.* Male genitalia smaller than abdomen. Anal valve (**Fig. 56f**) about 0.5 mm long, longer than parameres, in profile, anterior margin almost straight or weakly convex, posterior margin broadly convex and slightly invaginated near apex, valve narrower both apically and basally, truncate at apex, somewhat pear-shaped when viewed anteriorly, outer surface sparsely beset with small, thick setae; parameres (**Fig. 56g**) about 0.35 mm long, slender, bowed, narrower apically and wider near base, sides subparallel, terminating in an acute, thick black point, outer surface sparsely beset with minute setae, mesal margins bearing long, numerous setae, apices armed with a group of small setae, directed downwards; hypandrium simple, of usual shape, having sparse setae; aedeagus (**Fig. 56f**) elbowed, outer arm smaller than basal, spoon end simple; sperm pump as figured (**Fig. 56h**).

Female genitalia smaller than abdomen; plates sub-equal, broad basally and gradually narrowed caudally; dorsal plate (**Fig. 56i**) a little longer than ventral, roundly pointed apically, pubescent, with six pairs of long setae in the posterior third and also thickly armed with minute peg-like setae on lateral sides, setae in middle smaller; circum-anal pore ring composed of a narrow band of pores and guarded by minute setae; ventral plate (**Fig. 56j**) acutely pointed apically, coarsely pubescent in the posterior two-thirds, with a bunch of minute setae near apex; ovipositor acutely pointed.

*Host plant.* Collected on *Leptadenia spartium* White.

*Type locality.* Bikaner (Rajasthan).

*Types.* Described from a small series of dry specimens, which were represented mostly with females, antennae missing in all specimens and legs in few, one dislodged antenna mounted on slide. Holotype female, of 8.11.68 from the type locality (Sawai Singh); Paratypes: 4 females of 8.11.68, from the type locality (Sawai Singh). All types deposited at F.R.I., Dehra Dun. One male specimen from the same lot, was dissected and its parts were mounted on slide. Two paratypes are deposited at the Department of Zoology-Entomology, Punjab Agricultural University, Ludhiana.

*Comparison.* This species is separated from other species of *Diaphorina* by the different pattern of maculations in the forewings, shape of head and genal cones and second marginal cell of forewing; genae separate but approximate, with apices divergent and rounded. In wing maculations, this species somewhat resembles *D. gymnosporiae*, but the pattern is different.

*Biological notes.* Nothing is known about its biology and economic importance, except

that the species has been collected on *Leptadenia spartium*, from Bikaner (Rajasthan) on 8th November 1968 (Sawai Singh).

**Diaphorina cardiae** Crawford 1924

(Figs. 57, 58)

Crawford, D. L. 1924. *Rec. Indian Mus.* 26(6): 617.

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26(6): 624.

Husain, M. A. and Dina Nath, 1927. *Mem. Dep. Agric. India Ent. Ser.* 10(2): 9.

Length of body, in male, 2.15 mm; in female, 2.35 mm

Length of forewings, in male, 2.05 mm; in female, 2.10 mm

Width of head with eyes, 0.62 mm

Width of vertex between eyes, 0.35 mm

Length of antennae, 0.47 mm

**Colouration.** This species shows considerable variation in wing pattern and colouration and the following description has been made from the North Indian specimens. General colour pale-orange, head orange, genae pale-yellow dorsally, slightly darker apically and ventrally, antennae pale-yellow, two basal joints dark-brown, apex of joint 8 and two terminal segments black, prothorax black anteriorly; prescutum with a broad, anterior band and scutum with two pairs of bands of dark-brown colour, legs pale-yellow except femora, femora of fore and middle legs dark brown, and of hind leg lighter, basal portion of tibiae and apical tarsal joints dark-brown, spines black, claws black, abdominal tergites dark-brown, sternites pale-yellow, with two distinct dark-brown longitudinal stripes, genitalia dark-brown, anal ring orange, forewings with maculae numerous and scattered, but concentrated mostly in the outer half of the wing.

**Structure.** Body long and slender. Head (**Fig. 57a**) scarcely declivous, finely punctate, including eyes, slightly smaller than thorax; vertex flat, slightly more than two and a half times as broad as long, sparsely pubescent, deeply emarginate at the posterior margin, weakly swollen on either side of median suture, with an oval fovea on each side of median line, near the posterior margin, without shallow linear depression, anterior ocellus visible from above and located at the point of excision; genal cones on the same level as the vertex, separate, about 0.15 mm long and as long as wide and nearly as long as vertex, diverging slightly outward, rounded at tip, more pubescent than vertex. Eyes large and recessive. Antennal sockets lateral and situated on level with the lower margin of eyes.

Antennae (**Fig. 57b**) small and thick, ten-segmented, bearing a few setae, first two joints robust, 1st slightly broader than long, 2nd quadrate, slightly smaller than 1st, remaining segments imbricate and progressively becoming thicker from third to apex, 3rd segment longest, 4th, 5th and 6th equal to one another, 7th and 8th equal but smaller than 6th, penultimate joint slightly wider than the terminal, terminal segment with two unequal, apical spines, four sensoria present on segments 4, 6, 8 and 9.

Thorax somewhat arched, robust, finely punctate, sparsely pubescent. Prothorax flat, viewed dorsally, longer in middle and narrower laterally, with two subequal foveal impressions on each side; prescutum viewed dorsally, about twice as broad as long, broadest in middle, gradually sloping anteriorly, bluntly angled laterally, and also distinctly

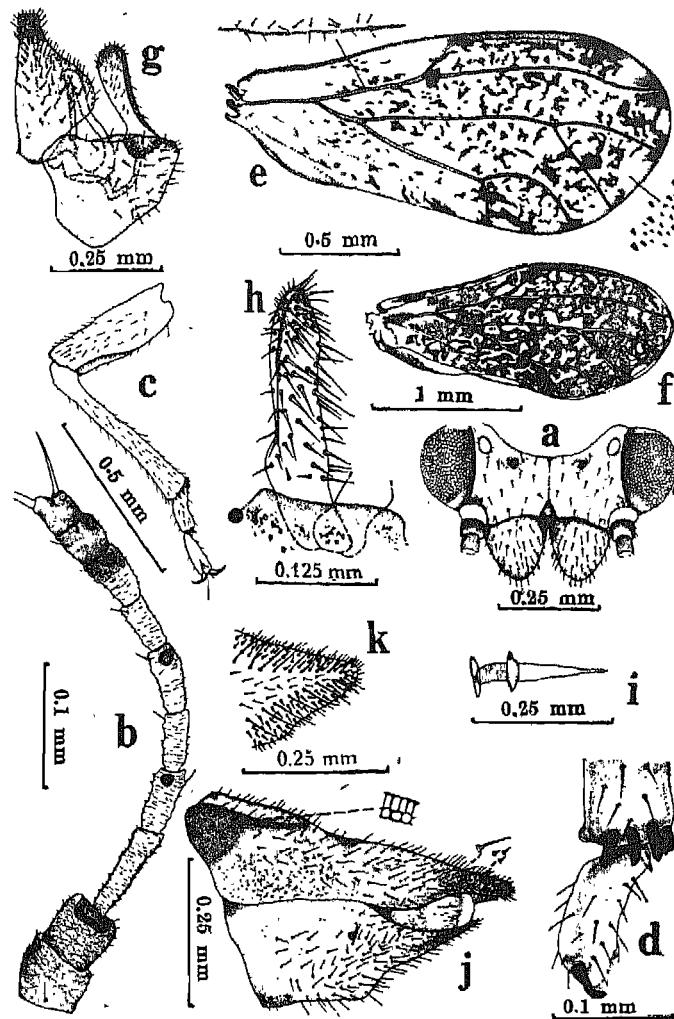


Fig. 57. *Diaphorina cardiae* Crawf.—a: front view of head; b: antenna; c: hind leg; d: part of hind leg, showing number and arrangement of apical spines on tibia; e: forewing; f: forewing (from S. Indian specimen); g: lateral view of male genitalia; h: forceps, mesal view; i: sperm pump; j: lateral view of female genitalia; k: caudal end of dorsal plate, dorsal view.

angled submedianally on the posterior margin; scutum large, broad, and convex, about twice as broad as long, broadest before middle, slightly longer than prescutum, angled both laterally and posteriorly; scutellum small and transverse, vase-shaped, about twice as broad as long, broad anteriorly, with prominent antero-lateral angles; mesepisternum large and directed forward.

**Legs (Fig. 57c)** of medium size, coarsely pubescent, femora shorter than tibiae, all

tibiae with apical comb of stout setae, hind tibiae without basal spur and with about seven short, stout, black spines on the margin at apex, similarly basal tarsal segment with two black claw-like spines at apex, metacoxal spur (meracanthus) of medium size, acutely conical, tibial groove quite long.

Forewings (**Figs. 57d,f**) large, a little more than twice as long as wide, widest subapically, rounded at apex, stem R about one-third longer than basal vein ( $R+M+Cu$ ), cubital petiole about half as long as radius,  $Rs$  slightly flexed near apex, pterostigma long and narrow and pubescent, first marginal cell as long as second and slightly wider than second, veins with a double row of minute setae. Hind wings also quite large. Both fore and hind wings beset with microscopic setae (minute points). The wing of S. Indian specimens (**Fig. 57f**) are more densely maculated with small, irregular specks than the wings of North Indian specimens (**Fig. 57e**).

Abdomen longer than broad, sparsely beset with simple setae and thickly with minute points ventrally, setae longer on sternites.

*Genitalia.* Male genital segment (**Fig. 57g**) smaller than abdomen, pubescent, anal valve about 0.32 mm long, longer than parameres, in profile, anterior margin weakly convex, lateral lobes large, broadly rounded in middle, and gradually narrowed both basally and apically, attenuate at apex; parameres about 0.28 mm long, broadly rounded at apex in profile, each forcep with a small, strong, black tooth at its extremity and surrounded by a cluster of thick setae, setae on the mesal surface and on margins longer and directed downward (**Fig. 57h**), outer surface beset with small simple setae; hypandrium simple, of usual shape, sparsely beset with simple setae; outer arm of aedeagus small, with a thick spoon end; sperm pump as figured (**Fig. 57i**).

Female genital segment (**Fig. 57j**) smaller than abdomen, coarsely pubescent. Dorsal plate longer than ventral, narrowly rounded at apex, anal opening surrounded by an oval ring of double row of pores and guarded by small setae, posterior region (**Fig. 57k**) armed with thick peg-like setae, setae in centre longer and arranged in two rows, ventral plate acuminate in the posterior region and acutely pointed at apex, both plates broad basally; ovipositor acutely pointed.

*Host plants.* Collected on *Cordia grandis* Roxb. (= *Cordia cordata* Steud.), *C. myxa* Linn., and *C. obliqua* Willd.

*Distribution.* Aligarh (U.P.), Ludhiana (Punjab), Coimbatore (Tamil Nadu), Nagpur (Maharashtra).

*Material examined.* Numerous adults and nymphal stages collected on February 2, 1937, from Aligarh, U.P., on *Cordia myxa* (R.N. Mathur); some adults with nymphal stages, received on June 15-16, 1960, from the Professor of Zoology and Entomology (S. Singh), Punjab Agricultural University, Ludhiana, and from this collection, 4 males and 7 females (R.R.D. 2504), and 6 males and 5 females were later mounted on cards; in February 1965, few examples, in poor condition, were received from the Entomologist and Associate Professor of Entomology, Agricultural College and Research Institute, Coimbatore (Tamil Nadu). These specimens were collected on *Cordia obliqua* Willd. and *C. myxa* Linn., during 1915, 1917, 1923 and 1936, from Coimbatore. They are provisionally identified as *Diaphorina cardiae* Crawf. The writer had also examined the material

present at the Indian Agricultural Research Institute, New Delhi, having this data: 4 examples, Coimbatore, S. India, July 22, 1912 (T.V.R.), on *Cordia*, and 8 examples from the same locality, collected on August 25, 1915 (Fletcher). They are also *D. cardiae* Crawf.

*Comparison.* Crawford (1924) described this species from specimens collected from Coimbatore (S. India) and his description is very meagre. It was noted that the examples represented in S. India possess darker wings and are densely covered with brown maculae than those collected from N. India. *D. cardiae* Crawf. differs from other species in wing pattern, shape of genal cones and genital structures. Two pairs of *D. cardiae* collected from N. India were sent to Dr Russell for comparison with the Crawford's type material present at the U.S. National Museum. She writes (*in litt.*), "Diaphorina sp., not *cardiae* Crawf.—In *cardiae* the ♀ ventral valve of the ovipositor is turned upward at a right angle; the ♂ forceps are parallel sided in lateral view, and the distal portion of the proctiger appears to be longer in relation to the basal portion than in your specimens. The cubital and medial cells are slightly different in shape and radius is more strongly curved than in your specimens". Personally, I am inclined to think from the materials (north and south India) examined by me that the differences are very minor and that the two collections should be referred to the same species. Besides, the host plants of both the collections, are species of *Cordia*. The major difference is in colouration and relative distribution of brown maculae in forewings.

*Biological notes.* This is a free living species, infesting young leaves and twigs; the adults are quite active and fly about with a slight disturbance. The nymphs are chrome orange or pale cadmium yellow, with smoky wing-pads, and their characters are described below.

#### Nymphal stages

*Fifth stage.* (**Fig. 58a**). Length 1·65 mm. Body oval; the wing-pads moderately large, projecting from the side of the body, the humeral angle produced cephalad, reaching the level of the lower margin of eyes, each wing-pad with clavate setae arranged along the margin and also with a single lanceolate seta near the posterior angle; eyes prominent. Dorsum strongly sclerotic throughout, having some thoracic and abdominal plates as illustrated, these plates are separated mesally by a narrow strip, except the large posterior abdominal plate, indicating traces of segmentation. Entire margin of abdomen armed with a continuous series of lanceolate setae. Derm thickly beset with minute points and sparsely with clavate setae.

Ventral side membranous throughout, except the anal plate, with one lateral area, a small area about each spiracle and four pairs of small submedian areas. Derm thickly beset with minute points. Simple ring-based setae present intersegmentally in the abdomen. Antennae (**Fig. 58b**) borne at the margin of the head, about 0·35 mm long and armed with a few simple setae, three-segmented, the first two basal segments distinct, quite short, 3rd segment longest, not differentiated into segments, bearing three lanceolate setae, four sensoria and two unequal, thick terminal spines. Legs (**Fig. 58c**) long and well developed, bearing a few simple setae, without trochanter, with tibio-tarsal articulation

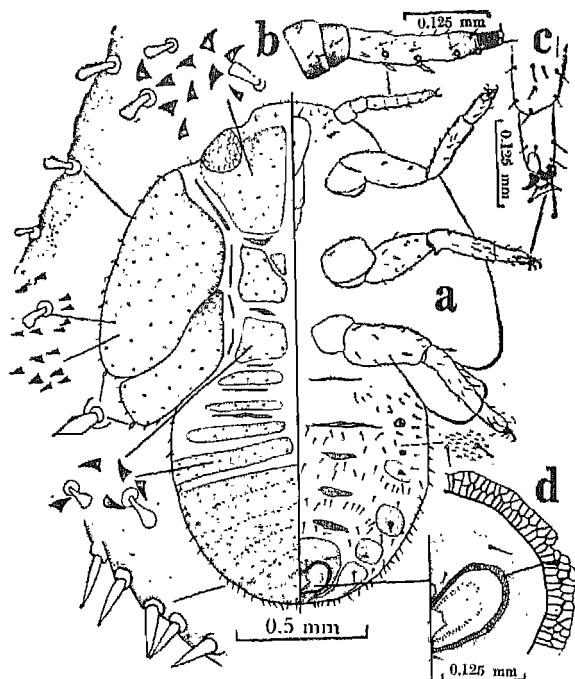


Fig. 58. *Diaphorina cardiae* Crawf.—**a**: fifth stage nymph; **b**: antenna; **c**: part of leg; **d**: part of circum-anal ring.

well-defined, tarsus with a single golf-club seta, claws present, pulvillus like a fish-tail. Anal opening (**Fig. 58d**) set well away from the apex of the abdomen, the outer circum-anal pore ring consisting of two to three rows of pores, the inner ring with faint, minute pores.

Other younger stages similar in general characters except for smaller size, and relatively fewer marginal setae and fewer clavate setae on the dorsum, reduced size of the wing-pads, and absence of the tibio-tarsal articulation.

**Diaphorina citri** Kuwayama 1907  
(Fig. 59)

- Kuwayama, S. 1907. *Trans. Sapporo nat. Hist. Soc.* 2: 160, pl. III, fig. 16.  
Crawford, D. L. 1912. *Rec. Indian Mus.* 7: 424-425, pl. xxiii, figs. N, O, P; pl. xxv, fig. D (*Euphalerus citri* Kuw.).  
Crawford, D. L. 1917. *Philipp. J. Sci.* 12: 168. (*Euphalerus citri*).  
Fletcher, T. B. 1917. *Proc. Second ent. Meet.*, pp. 215-216.  
Fletcher, T. B. 1919. *Proc. Third ent. Meet.*, p. 276.  
Hussain, A. M. 1923. *Rep. Proc. Fifth ent. Meet.*, pp. 122-128.  
Ramakrishna Ayyar, T. V. 1923. *Rep. Proc. Fifth ent. Meet.*, p. 267.  
Crawford, D. L. 1924. *Rec. Indian Mus.* 26: 616.  
Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 623.

- Hussain, A. M. and Dina Nath, 1927. *Mem. Dep. Agric. India Ent. Ser.* 10(2) : 5-27, pls. 1-4, figs. 1-3.  
 Kuwayama, S. 1931. *Insecta mits* 5 : 125.  
 Kuwayama, S. 1932. *Icon. Ins. Japan*, 1814, fig. 3584.  
 Shiraki and Takahashi, R. 1933. *Pl. Ind. Publ.* no. 636, Govt. Formosa, 67.  
 Kuwayama, S. 1943. *Trans. nat. Hist. Soc. Formosa* 33 : 506.  
 Miyatake, Y. 1964. *Contr. Sci. Exped. Kyushu Univ.* 26 : 124.

Length of body, in male, 1.7 mm; in female, 2.4 mm  
 Length of forewings, in male, 2.1 mm; in female, 2.4 mm  
 Width of head with eyes, 0.55 mm  
 Width of vertex between eyes, 0.35 mm  
 Length of antennae, 0.58 mm

*Colouration.* General colour brown, vertex slightly lighter; antennae black at tip; eyes darker, with black stripe from eye to tip of cone on side (not distinctly visible in living specimen but quite clear in alcoholic material), this stripe varies in colour, usually it is greyish, black only in very dark specimens; the colour of abdomen also varies, it is usually greyish-brown, but in some specimens it is distinctly bluish, while in gravid females, it is distinctly orange; forewings with a spotted macula of brown on the upper margin from a little below tip of clavus to tip of radius, and another on lower margin not quite merged into first, maculae not continuous but composed of smaller scattered spots.

*Structure.* Body long and slender. Head (**Fig. 59a**) narrower than thorax, descending, very finely pubescent, finely punctate; vertex flat, broader than long, about two and a half times as broad as long, with a large fovea on each side, posterior to centre, posterior margin strongly arcuate, post-ocelli large and lateral, anterior margin almost straight; frons concealed by the genal cones dorsally, but visible ventrally as a large plate; genal cones about 0.12 mm long and slightly smaller than vertex, broad at base, in same plane with vertex, convergent toward and rounded at apex, almost contiguous, finely pubescent and also beset with minute points. Eyes large and recessive. Antennal bases scarcely visible, as in other species. Clypeus large and visible ventrally.

Antennae (**Fig. 59b**) short, not longer than head and pronotum combined, slender, ten-segmented, bearing few setae, imbricate, two basal segments robust and almost subquadrate, 3rd joint longest, 4th, 6th and 8th equal to one another, but each slightly smaller than 3rd, 5th, 7th and 9th equal, but each slightly smaller than 4th, 8th and 9th segments clavate, terminal joint smallest and armed with two unequal, hollow apical spines, four sensoria present on segments 4, 6, 8 and 9.

Thorax very finely pubescent, prominently punctate, scarcely arched. Pronotum rather long, convexly rounded, sides parallel, narrower in middle, broader laterally, with foveal impressions on each side; pleurites typical of genus; prescutum longer than broad, broadest beyond middle, gradually narrowed anteriorly, angulate both laterally and posteriorly; scutum large, broad, broadest beyond middle, about two and one-fourth times as broad as long, almost as long as prescutum, angulate laterally; scutellum narrowly transverse, with prominent antero-lateral angles, posterior margin weakly invaginated medianally.

Legs (**Fig. 59c**) long and slender, coarsely pubescent and also beset with strong points, tibiae longer than femora, each tibia with an apical comb of setae, hind tibiae without basal spur, with 6 to 8 strong, black spines at apex, tarsal joints of each leg of equal length, proximal tarsal joint of hind leg with two black claw-like spines at apex, in between with a pad-like structure, meracanthus large, finger-like.

Forewings (**Fig. 59d**) large and long, subhyaline, rather thickened as in other species, maculate with brown maculae on the upper margin from a little below tip of clavus to tip of radius, and another on lower margin not quite merged into first, maculae not continuous but composed of small scattered spots, attenuate at base, broadest sub-apically, rounded at apex, about two and a third times as long as broad, basal vein shorter than radius, first cubital long, second marginal cell larger than first, radius long, about twice as long as cubital petiole, pterostigma very narrow, quite long.

Hind wings (**Fig. 59e**) slightly smaller than forewings, membrane uniformly beset with minute points, costal margin armed with a few simple and hooked setae.

Abdomen longer than broad, sparsely pubescent and also beset with points which are thicker and stronger on sternites.

*Genitalia.* Male genital segment (**Fig. 59f**) smaller than abdomen, rather conspicuous, sparsely pubescent. Anal valve elongate-pyriform or flask-shaped, about 0.38 mm long, attenuate above, anterior margin almost straight, posterior margin broadly rounded, broadest in basal half; parameres (**Fig. 59g**) long, about 0.30 mm long, slender, simple, slightly smaller than anal valve, subacute at tip, ending in a strong tooth at its extremity, mesal and marginal setae longer, a group of simple setae also present in the apical region; hypandrium simple, of usual shape, bearing small scattered setae in the apical region; aedeagus small, outer arm much smaller than basal, basal arm looped and striated, spoon end slightly flattened; sperm pump as figured (**Fig. 59h**).

Female genital segment (**Fig. 59i**) short, small, pubescent; dorsal plate about 0.7 mm long, slightly longer than ventral, wedge-shaped, broad basally and gradually narrowed caudally, with a clear area near base and having an elliptic circum-anal ring, composed of a double row of pores, posterior region armed with minute peg-like setae and also with rows of short strong bristles; ventral plate slightly shorter than dorsal valve, boat-shaped, acutely pointed at apex, with a prominent ventral bulge in middle; ovipositor acutely pointed.

*Host plants.* Several species of *Citrus*, e.g., *Citrus aurantium* (orange), *C. medica limonium* (lemon), *C. media lunetta* (sweet lime), *C. medica acida* (sour lime), *C. medica* (citron), *C. decumana* (pomelo). This species has been found throughout India, on all the cultivated varieties of *Citrus*. Also recorded on *Murraya koenigii* at Coimbatore (Tamil Nadu), and Pusa (Bihar), and it may be considered as an alternative food plant (Afzal Husain and Dina Nath, 1927). This species has been recorded on *Murraya paniculata* Jack in Japan (Miyatake, 1964).

*Distribution.* *D. citri* Kuw. is widely distributed throughout the orient (Crawford, 1917). It is known from Formosa, Japan, the Philippine Islands, Moluccas (Amboina), Southern China (Macao), and occurs all over India (Crawford, 1912; Afzal Husain and Dina Nath, 1927). Actual authenticated records are from Pusa (Bihar); Adra

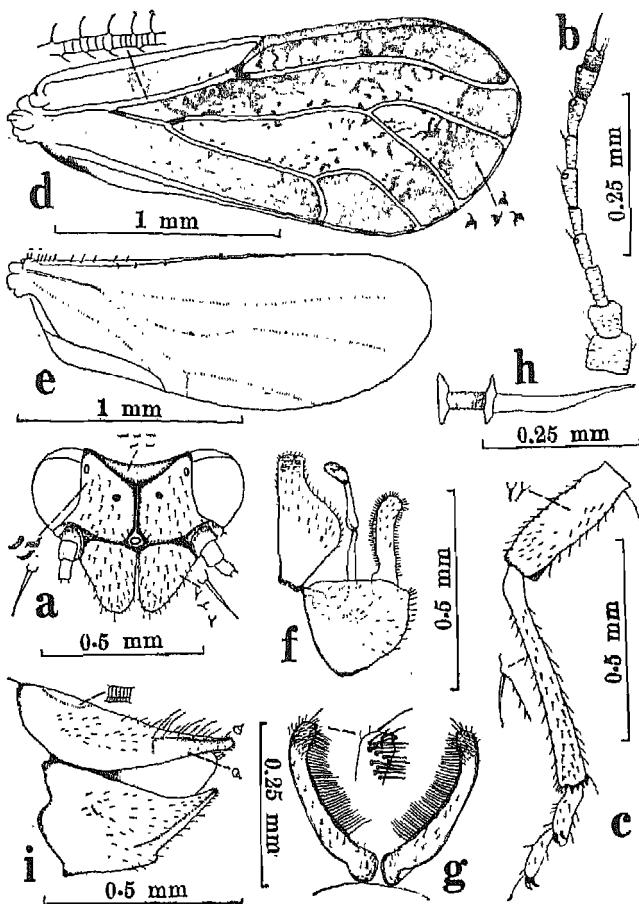


Fig. 59. *Diaphorina citri* Kuwayama—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: male genitalia, lateral view; **g**: parameres, caudal view; **h**: sperm pump; **i**: female genitalia, lateral view.

(Bengal); E. Punjab; Coimbatore (Tamil Nadu); Delhi; Dehra Dun (U.P.); and Pakistan.

*Material examined.* The collection at I.A.R.I., New Delhi, contains 2 examples of 10.12.08, on orange (C.S.M.), 5 examples of 12.12.08 on orange (D.P.S.), 5 ex. of v. 09. on orange (C.S.M.), 7 ex. of 12.1.09 on orange (D.P.S.), 8 ex. of 17.2.09 on orange (C.S.M.), 1 ex. of 27.6.11 (A.H.), 1 ex of 11.8.18 on lemon (C.S.M.), 7 ex. of 29.7.15 on *Citrus* (U. Bahadur), 7 ex. of 3.9.15 on lemon leaves (U. Bahadur), and 20 examples, no data. All these specimens are from Pusa, Bihar.

The Zoological Survey of India, Calcutta, collection consists of: Adra, Singbhum Dist., 12.X.09. (No.9731/18) (specimen missing), a tube containing few males and

females, from Bankura (Bengal) collected on 7.iii.53, on *Citrus* (No. 6484/H7), in alcohol, and in another tube, 2 specimens without any data (No. 8822/H7), preserved in alcohol.

The collection at F.R.I., Dehra Dun, includes 4 males and 7 females, of 16.3.59, from New Forest, Dehra Dun (U.P.) (R.N. Mathur), 3 males and 5 females of 17.3.60, also from New Forest (R.N. Mathur) and collected on *Citrus medica*; 3 examples of 9.4.67, 5 examples of 20.10.67 and 2 examples of 20.7.68, from Dehra Dun, on *Citrus* (R.N. Mathur); and 18 examples of 9.7.35, collected from New Forest, Dehra Dun (R.N. Mathur), on *Citrus*. Two phials containing adults and nymphal stages, from New Forest, on *Citrus medica*, of 16.3.59 and 17.3.60.

*Comparison.* This species can easily be recognised by the characters given in the key. Further its head with somewhat parallel sides and longer genal cones are distinctive features. The wing maculations are also characteristic.

*Biological notes.* *Diaphorina citri* Kuw. is commonly known as the 'Citrus Psylla', and is of the greatest importance all over the country. The ravages of this insect cause very serious losses to *Citrus* cultivation. A detailed account on its systematic position, distribution, description of various stages, bionomics, economic importance, parasites and predators and control measures, is given by Afzal Husain and Dina Nath (1927). This species is also suspected to cause a serious virus disease known as the 'Greening' disease, in *Citrus* orchards. In South Africa, *Trioza erytreae* (Del Guer.), belonging to the sub-family *Trioziniae*, is incriminated as a vector of the 'Greening' virus of *Citrus*, and this species has not been recorded in India. *Diaphorina citri* Kuw. belongs to the sub-family *Psyllinae*. It is said that the 'Greening' virus disease of *Citrus* is quite prevalent in India and some research work is in progress to assess its virulence.

**Diaphorina communis, sp. n.**

(Figs. 60, 61)

Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 40-42.

Beeson, C. F. C. 1941. *Forest Insects*, p. 777.

Length of body, in male, 2.1 mm; in female, 2.4 mm

Length of forewing, in male, 2.5 mm; in female, 2.6 mm

Width of head with eyes, 0.6 mm

Width of vertex between eyes, 0.35 mm

Length of antennae, 0.52 mm

*Colouration.* (Live and dried specimens). General colour black with greyish-brown tinge and covered with a white mealy-like secretion; head black; genae brownish-black, antennae pale-yellow, basal two joints brownish-black, apical two segments black, tips of joints 4th and 6th black; prescutum with a thin greyish dorsal median line and scutum with a broad dorsal median greyish band; femora black, tibiae and tarsal segments light brown except anterior tibiae having blackish tinge, spines black; abdomen black dorsad and brownish-black ventrad; genitalia brownish black; forewings sub-opaque, densely maculated with smoky black maculae and irregular clear spaces.

*Structure.* (Fig. 60a). Head somewhat but not greatly declivous, finely punctate;

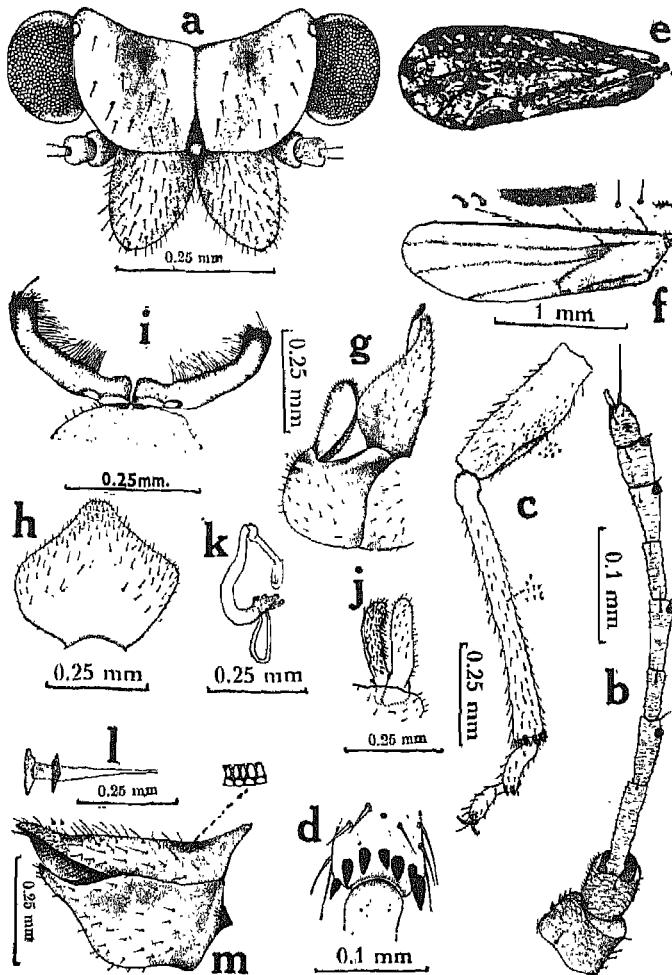


Fig. 60. *Diaphorina communis*, sp. n.—a: dorsal view of head; b: antenna; c: hind leg; d: tibial apical spines on hind leg; e: forewing; (Photo by late Shri K. N. Tandon) f: hind wing; g: lateral view of male genitalia; h: upper surface of anal valve; i: forceps, caudal view; j: forceps, outer and mesal views; k: aedeagus; l: sperm pump; m: female genitalia, lateral view.

including eyes, slightly smaller than thorax. Vertex flat, about twice as broad as long, sparsely pubescent, rather deeply emarginate at the posterior margin, with a large circular fovea on each side near the posterior margin and located slightly inwards from the middle of each half, a shallow depression extending from the fovea towards the anterior. Genae on the same level as the vertex, contiguous near the base, a little longer than wide, about 0.15 mm long and as long as vertex, diverging slightly outwards, bluntly rounded at tip a little more coarsely pubescent than the vertex. Eyes large and recessive,

Antennae (**Fig. 60b**) small, slightly smaller than head including eyes, ten-segmented, bearing a few setae, imbricate, two basal joints robust, 1st broadly transverse, 2nd slightly smaller than 1st, longer than broad, remaining segments slender, 3rd joint longer than others, 4th slightly smaller than 6th, 5th one-third smaller than 6th, 7th and 8th equal but each slightly smaller than 4th, 4th, 6th and 8th clavate, the two terminal joints almost equal in length but wider than the preceding, apical joint having two unequal spines at apex, a small seta present near each sensorium on segments 4, 6, 8 and 9.

Thorax somewhat arched, robust, finely punctate, sparsely pubescent, strongly rugulose. Pronotum flat, viewed dorsally, longer in middle and narrower laterally, convexly rounded, sloping anteriorly, with two subequal, circular foveae, the inner ones smaller than the outer; prescutum viewed dorsally, broader than long, broadest in middle, gradually narrowed both anteriorly and posteriorly, bluntly angled at the sides, distinctly angled submedially on the posterior margin; scutum large, broader than long, broadest before middle, slightly more than twice as broad as long, almost as long as prescutum, flat dorsally and sloping laterally, slightly depressed medially, forming a shallow longitudinal channel; scutellum small, narrowly transverse, somewhat vase-shaped, broad anteriorly with prominent antero-lateral angles.

Legs (**Fig. 60c**) of moderate size, coarsely pubescent and thickly beset with minute points, tibiae longer than femora, tibial groove quite long, middle and hind tibiae with three and two stout, subapical setae respectively, hind tibiae without basal spur, with seven stout black tooth-like spines at apex (**Fig. 60d**), tarsal segments of equal length, basal tarsal segment of the hind leg with two short black claw-like spines at apex; mera-canthus large, somewhat subtubular.

Forewings (**Fig. 60e**) large, two and a half times as long as wide, widest subapically, narrowly rounded at apex, narrow at base, first marginal cell almost as long as wide but shorter and wider than second, stem R slightly more than twice as long as cubital petiole ( $M+Cu$ ), pterostigma long and narrow; seven clear spaces present at the margin of the wing: 4 spots, one in each of the four cells, 2 spots between  $Cu_1$  and  $Cu_2$ , and 1 spot near clavus; all veins armed with a double row of minute setae. Hind wings (**Fig. 60f**) with the costal margin armed with 7 or 8 simple and 4 to 6 hooked setae. Both wings thickly beset with minute points.

Abdomen longer than broad, sparsely pubescent dorsad and coarse ventrad, sternites also armed with minute points.

*Genitalia.* Male genitalia (**Fig. 60g**) slightly smaller than abdomen, pubescent; anal valve (**Fig. 60h**) about 0.38 mm long, longer than forceps, rather pyriform in shape when viewed anteriorly, anterior margin almost straight in profile, lateral lobes small, broadly rounded in the basal half; parameres (**Figs. 60i, j**) about 0.25 mm long, in profile, broadly rounded at apex and gradually narrowed down basally, each forcep with a small, strong, black point at apex, just below this point, a cluster of stout setae present, pointing outward, setae on the mesal surface longer and thicker than others and directed downwards, basal region with a strong small projection pointing anteriorly; hypandrium of usual shape, sparsely pubescent; outer arm of aedeagus (**Fig. 60k**) smaller than basal, having a thick spoon end. Sperm pump as figured (**Fig. 60l**).

Female genitalia (**Fig. 60m**) smaller than abdomen, pubescent, both plates broad basally and narrow caudally; anal plate longer than ventral, roundly pointed at apex, apical one-third armed with short, stout peg-like setae, anal opening surrounded by an oval ring of double row of pores and guarded by minute setae; ventral plate with the posterior half bent upward and acutely pointed at apex; ovipositor acutely pointed.

*Host plants.* Commonly found on *Murraya koenigii* Spreng. and *M. paniculata* (L.) Jack. Rarely on *Citrus* sp.

*Type locality.* New Forest, Dehra Dun (U.P.).

*Types.* Described from a long series of specimens. Holotype male; Allotype, female, from the type locality and collected on April 24, 1950 (R.N. Mathur); Paratypes: 20 specimens of September 29, 15 specimens of September 30, 1932, and 15 specimens of May 12, 1933; and 4 males and 7 females of April 24, 1950, all from the type locality (R. N. Mathur); 2 males and 4 females, collected on February 16, 1953, from Dehra Dun (U.P.). Additional material not designated as paratypes are: 6 examples of April 5, 6, 1932; 12 examples of May 12, 1933; 3 males and 4 females from New Forest, Dehra Dun, and collected on April 8, 20 males and 9 females, from the same locality and collected on May 7, 1960, 14 examples collected between January and March 1963 from New Forest and 10 examples from Dehra Dun (R. N. Mathur). The host of all these specimens is *Murraya koenigii*. Three males and 4 females, from New Forest, Dehra Dun and collected on April 8, 1960, and 20 males and 9 females, collected on May 7, 1960, recorded from *Murraya paniculata* (L.) Jack. A good collection of adults of April 5, 1964, collected on *Murraya koenigii*, Hardwar-Rishikesh Road (M.G. Ramdas Menon), was examined by the author at the Indian Agricultural Research Institute, New Delhi. Some adults and nymphal stages collected on April 10, April 15, 1948 from Dehra Dun (U.P.) and April 8 and May 5, 1960 from New Forest, Dehra Dun, on *Murraya koenigii*, (R. N. Mathur), were preserved in alcohol. Some adults collected on *M. paniculata*, on May 5, 1960, from New Forest, Dehra Dun (R. N. Mathur), and preserved in alcohol. All the type material and preserved specimens, together with the slides, deposited at F.R.I., Dehra Dun.

*Comparison.* *Diaphorina communis*, sp. n. is clearly differentiated from other species of *Diaphorina* by its black colouration, densely maculated wings, shape of head and genal cones, and genital characters. It matches closely with *D. dunensis*, sp. n. and *D. truncata* Crawf. in colouration, but differs greatly from them in shape of head, genae and genital armature.

*Biological notes.* This species is quite common on *Murraya koenigii*, wherever it grows. Its bionomics and economic importance are given in detail by Mathur (1935), and the nymphal stages are described below.

### Nymphal stages

*Fifth stage.* (**Fig. 61a**). Length 1.59 mm. Broadly oval; the wing pads large and well developed, projecting from the side of the body, the humeral angle produced cephalad, reaching slightly below the anterior margin of the eyes; eyes prominent. Dorsum strongly sclerotic throughout, having numerous plates as illustrated: head with a pair

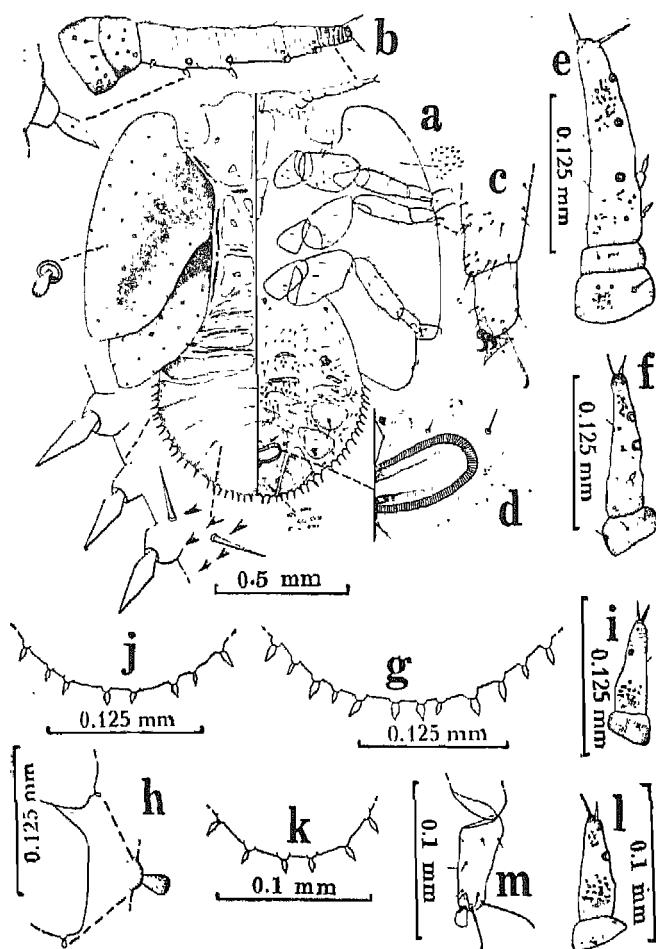


Fig. 61. *Diaphorina communis*, sp. n.—a: fifth stage nymph; b: antenna; c: part of leg; d: circum-anal ring; e: antenna, fourth stage nymph; f, g, h: antenna, abdominal margin, wing-pads of third stage nymph; i, j: antenna and abdominal margin of second stage nymph, k, l, m: abdominal margin, antenna and leg of first stage nymph.

of large plates separated from the thorax by two pairs of narrow sclerites, each thoracic segment with a pair of large and several small plates, the large plates of both head and thorax separated mesally by a narrow strip. Abdomen with four pairs of mesally separated narrow plates and a large posterior plate indicating traces of segmentation, thin sclerites also present intersegmentally between some of the anterior tergal plates. Entire margin of abdomen armed with a continuous series of 45 to 50 lanceolate setae. Derm thickly beset with minute points and sparsely with clavate setae on head and thorax and simple setae on abdomen.

Ventral side membranous throughout except for a small plate at the base of each antenna, one near the eye, the anal area with two lateral areas, a small area about each spiracle and four pairs of small submedian areas. All these sclerotic areas are beset with minute points and the posterior portion of anal area with fringed processes. Derm of wing-pads with minute points and of abdomen with simple ring-based setae of various length. Antennae (**Fig. 61b**) borne at the margin of the head, quite large, about 0·34 mm long and armed with a few simple setae, three-segmented; the first two basal segments distinct, quite short; third segment longest, not differentiated into segments, bearing three lanceolate setae, the proximal seta smaller than the other two, with four sensoria and two unequal, thick terminal spines. Legs (**Fig. 61c**) well developed, with a few simple setae, without trochanter, with tibio-tarsal articulation well defined, tarsus with a single golf-club seta, claws present, pulvilli large, fish tail-like.

Anal opening (**Fig. 61d**) situated well inside from the apex of the body, the outer circumanal pore ring consisting of a single row of slit-like pores, the inner ring with an irregular row of small faint pores, and guarded by one anterior, one lateral and one posterior pairs of setae.

*Fourth stage.* Length 0·98 mm. Resembles the fifth stage, except in having smaller wing pads, less number of thoracic plates, antennae (**Fig. 61e**) with three sensoria and two lanceolate setae, tibio-tarsal articulation absent, slight reduction in the number of lanceolate setae situated along the margin of apical plate of the abdomen, with one large and one small seta alternating.

*Third stage.* (**Figs. 61f, g, h**). Length 0·62 mm. Like the fourth stage but with two-segmented antennae having only two sensoria and one lanceolate seta on the second segment, marginal lanceolate setae on abdomen fewer; each wing pad with a single clavate seta.

*Second stage.* (**Figs. 61i, j**). Length 0·45 mm. With two-segmented antennae and having one sensorium, without lanceolate seta; marginal setae on abdomen still fewer; wing-pads with a single lanceolate seta on each.

*First stage.* (**Figs. 61k, l, m**). Length 0·33 mm. Antennae two-segmented, with one sensorium; dorsal plates markedly defined; each wing-pad represented by a lanceolate seta; with two golf-club setae on each of the middle and hind legs and a single seta on each of the forelegs; pulvilli like flat rounded lobes; anus nearer the apex.

**Diaphorina dunensis, sp. n.**

(**Fig. 62**).

Length of body, in male, 2·16 mm; in female, 2·35 mm

Length of forewings, in male, 2·7 mm; in female, 2·7 mm

Width of head with eyes, 0·62 mm

Width of vertex between eyes, 0·35 mm

Length of antennae, 0·52 mm

*Colouration.* General colour fuscous; head dark-brown; genae light brown; antennae pale brown, two basal segments brown and two apical segments black; prescutum anteriorly, two broad, longitudinal bands on scutum, scutellum and parapteron black;

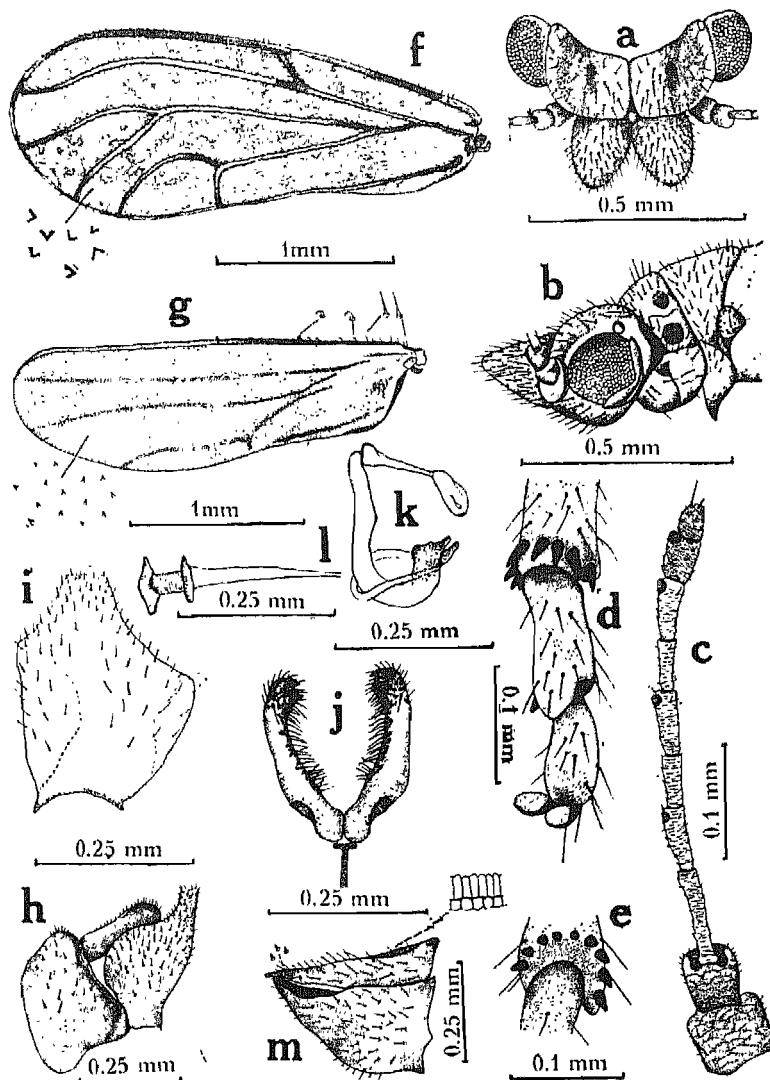


Fig. 62. *Diaphorina dunensis*, sp. n.—**a**: front view of head; **b**: lateral view of head and part of thorax; **c**: antenna; **d, e**: part of hind leg, showing arrangement and number of apical spines on tibia; **f**: forewing; **g**: hind wing; **h**: lateral view of male genitalia; **i**: outer surface of anal valve; **j**: caudal view of forceps; **k**: lateral view of aedeagus; **l**: sperm pump; **m**: lateral view of female genitalia.

femora fuscous, tibiae and tarsal joints pale brown, spines black; abdomen fuscous dorsad and bluish-green or greyish-brown ventrad; genitalia fuscous; forewings subopaque, maculated entirely with fuscous patches intermixed with small irregular clear spaces, seven clear spots present along the margin.

**Structure.** Body long. Head (**Figs. 62a, b**) somewhat but not greatly deflexed, sparsely pubescent, finely punctate; including eyes, slightly narrower than thorax, vertex flat, about thrice as broad as the length of the median suture, deeply emarginate at the posterior margin, with a distinct circular fovea on each side of the median suture, near the posterior margin and near the middle of each half, with a shallow linear depression extending anteriorly from each; genal cones on same level as the vertex, contiguous near the base, slightly longer than wide, about 0·18 mm long and slightly longer than vertex, slightly divergent outward, rounded at tip, a little more coarsely pubescent than the vertex. Eyes of medium size, slightly recessive.

Antennae (**Fig. 62c**) ten-segmented, smaller than the head including eyes, imbricate, bearing a few setae, two basal joints robust, 1st broadly transverse, 2nd subquadrate, remaining segments thicker, 3rd segment longer than others, segments 4, 6 and 8 equal and each one-third smaller than 3rd, segments 5 and 7 equal and each smaller than 4th, two apical segments slightly wider than the preceding, with two unequal spines at apex, four sensoria present on segments 4, 6, 8 and 9.

Thorax (**Fig. 62b**) somewhat arched, robust, finely punctate, coarsely pubescent. Pronotum flat, viewed dorsally, longer in middle and narrower laterally, with two subequal foveae on each lateral side, the inner ones smaller than the outer; prescutum viewed dorsally, broader than long, about twice as broad as long, broadest before middle, bluntly angled at the sides and distinctly angled submedianally on the posterior margin; scutum broad and convex, gradually sloping laterally and posteriorly, about twice as broad as long, broadest in middle, with a shallow longitudinal channel, angled at the sides and on the posterior margin; scutellum small and transverse, about twice as broad as long.

Legs (**Figs. 62d, e**) of medium size, coarsely pubescent; tibiae longer than femora, tibial groove quite long; hind tibiae without basal spur and with 7 to 9 short, stout, black spines on the apical margin, basal segment of hind tarsi with two claw-like spines at apex, tarsal segments of equal length; meracanthus large, triangular.

Forewings (**Fig. 62f**) large, about two and a half times as long as wide, widest subapically, rounded at apex, narrow at base, pterostigma long and narrow, stem R about twice as long as basal vein (R+M+Cu) and thrice as long as cubital petiole (M+Cu), cubital petiole about one-third smaller than basal vein, first marginal cell almost as long as wide, but shorter and wider than the second, veins armed with a double row of minute setae. Hind wings (**Fig. 62g**) with the costal margin armed with 7 to 8 simple and 4 to 6 hooked setae. Both wings thickly beset with minute points.

Abdomen longer than broad, sparsely pubescent, setae longer on sternites.

**Genitalia.** Male genital segment (**Fig. 62h**) slightly smaller than abdomen, sparsely pubescent, anal valve (**Fig. 62i**) pyriform, longer than parameres, about 0·38 mm long, anterior margin almost straight in profile, lateral lobes large and broadly rounded;

parameres (Fig. 62j) about 0.26 mm long, swollen and slightly broader at apex and then narrowed down in the basal region when viewed laterally, each paramere with a small, strong, acute black tooth at apex, surrounded by a cluster of long and stout setae, marginal setae slightly longer and directed downward; hypandrium of usual shape and simple; outer arm of aedeagus (Fig. 62k) smaller than basal with a thick spoon end. Sperm pupin as figured (Fig. 62l).

Female genital segment (Fig. 62m) smaller than abdomen, sparsely pubescent. Dorsal plate longer than ventral, narrowly rounded at apex, apical region closely beset with minute peg-like setae, anal opening surrounded by an oval ring of double row of pores and guarded by small setae; ventral plate strongly cocked up from posterior half and acutely pointed at apex.

*Host plant.* Commonly found on *Ehretia acuminata* R. Br.

*Type locality.* New Forest, Dehra Dun (U.P.).

*Types.* Holotype, male; Allotype, female; collected on August 5, 1957, from the type locality (R. N. Mathur); Paratypes: 12 males and 11 females, also from the type locality and the same date of collection (R. N. Mathur). Additional paratypes specimens collected from the type locality, on August 5, 1957, are: 19 males and 10 females; also 6 males and 4 females collected on July 16, 1960, and 2 males and 2 females collected on July 18, 1960, from New Forest, Dehra Dun (U.P.) (R. N. Mathur). To study the characters in detail few adults from the type locality were dissected and their parts were mounted on slides. Adults of both sexes were also preserved in alcohol, collected on July 26, 1966, from New Forest, Dehra Dun. All this material, together with the types, are deposited at F.R.I., Dehra Dun.

*Comparison.* This new species is described from a long series of both sexes, and is easily distinguishable by its colouration, wing pattern, shape of genal cones and genital armature. In colouration, it resembles *D. communis* present on *Murraya koenigii*, but differs greatly from it, in shape of genal cones, number of black apical spines in hind tibiae, and genital structures.

**Diaphorina enderleini Klimaszewski 1890**  
(Fig. 63)

- Lethierry, M. 1890. *Proc. Asiat. Soc. Beng.*, p. 165 (*D. guttula'a*).
- Enderlein, G. 1910. *Hemiptera*, 8, *Psyllidae*, in Sjostedt Y. *Zoologische Kilimandjaro-Meru Expedition*. 2, Stockholm, pp. 137-144. (*Gonanoplicus guttulatus*).
- Aulmann, G. 1913. *Psyllidarum catalogus*, Berlin, p. 23.
- Crawford, D. L. 1917. *Philipp. J. Sci.* 12: 168.
- Crawford, 1924. *Rec. Indian Mus.* 26: 616-617.
- Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 623.
- Klimaszewski, S. M. 1964. *Ann. Zool. Warsz.* 22(3): 59. (*D. enderleini*, nom. nov.)

Length of body, in female, 1.88 mm

Length of forewings, in female, 2.00 mm

Width of head with eyes, 0.55 mm

Width of vertex between eyes, 0.35 mm

Length of antenna, 0.51 mm

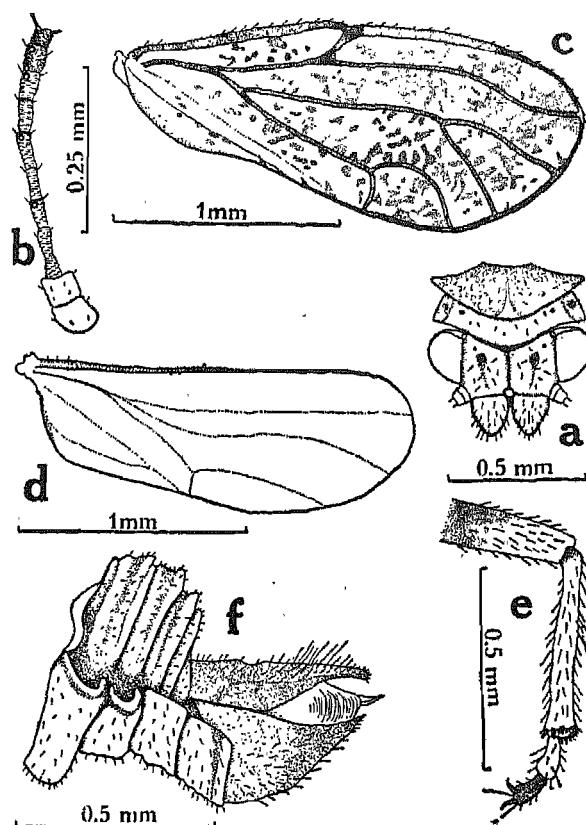


Fig. 63. *Diaphorina enderleini* Klimaszewski—**a**: dorsal view of head and part of thorax; **b**: antenna; **c**: forewing; **d**: hind wing; **e**: hind leg; **f**: lateral view of female genitalia and abdomen.

**Colouration.** General colour dark-brown to fuscous, prothorax and head and tibiae of lighter colour, genae black along the margin and ventrally, apical tarsi dark-brown, venter of abdomen light brown, apical segments and apices of segments 4, 6 and 7 of antennae black, apical half of forewings with more or less uniformly distributed maculae, while the basal half more nearly clear and hyaline, with less number of brown spots.

**Structure.** Body small and slender. Head (Fig. 63a) almost as broad as thorax, moderately deflexed, sparsely pubescent, punctate, vertex a little more than twice as broad as the length of median suture, disc nearly flat, with a small, circular fovea in each half near the middle and posterior to centre, and also with a distinct, minute puncture posterior to each fovea, shallow depression extending forward from each fovea towards the anterior margin but not attaining it, posterior margin moderately emarginate, anterior ocellus visible from above; genal cones on the same level as the vertex, somewhat porrect, contiguous at or near the base, about as wide as long, almost as long as vertex, diverging outward, subconical at tips, conspicuously pubescent, with hairs slightly longer than that

of vertex. Eyes slightly recessive, of medium size. Antennal sockets lateral, and located somewhat below the lower margin of eyes.

Antennae (**Fig. 63b**) small, ten-segmented, bearing few setae, two basal segments robust, subquadrate, 1st slightly longer than 2nd, remaining segments imbricate, 3rd segment longest, 4th, 5th, 7th and 8th equal to one another and each slightly smaller than 6th, 6th smaller than 3rd, 9th slightly smaller than 8th and slightly longer than apical segment, terminal segment smallest, bearing two unequal apical spines, two apical segments rather broad and thick, four sensoria present on segments 4, 6, 8 and 9.

Thorax (**Fig. 63a**) somewhat arched, pubescent with small hairs, finely punctate. Prothorax flat, longer in middle than at the sides, with two foveal impressions on each side, the innermost smaller than the outermost; prescutum broader than long, about one and a half times as broad as long, broadest beyond middle, acutely angled at the sides, posterior margin also angled submedianally (Specimen pinned through the scutum).

Legs (**Fig. 63e**) of medium size, coarsely pubescent, femora shorter than tibiae, all tibiae with apical comb of setae, hind tibiae without basal spur, with about five black spines on the margin at apex, three visible on one side and two on the other, basal tarsal segments smaller than apical segments, hind basal tarsal segment with two black claw-like spines at apex, coxae robust, meracanthus strong, of medium size and acutely conical.

Forewings (**Fig. 63c**) large, having numerous and scattered maculations in the apical half, slightly more than twice as long as broad, broadest subapically, narrowly rounded at apex, pterostigma long, narrow, pubescent, radius about one and a half times as long as basal vein ( $R+M+C$ ), cubital petiole ( $M+Cu$ ) about half as long as basal vein,  $R_1$  nearly as long as cubital petiole,  $Rs$  strongly flexed near apex, marginal cells unequal, first cell much shorter but slightly broader than second. Hind wings (**Fig. 63d**) large and slightly smaller than forewings, membrane uniformly beset with minute points, costal vein armed with few simple and hooked setae, veins quite prominent.

Abdomen (**Fig. 63f**) longer than broad, sparsely pubescent with prominent hairs.

*Genitalia.* Female genital segment (**Fig. 63f**) slightly smaller than abdomen, sparsely pubescent, both plates broad basally and gradually narrowed posteriorly, dorsal plate longer than ventral, attenuate and roundly pointed apically, weakly flexed ventrally near apex, setae longer in middle, caudal region with smaller setae; circum-anal region large, somewhat oval in shape; ventral plate with apex acutely pointed, but broad and bluntly rounded when seen from the ventral side; the apical part of the dorsal valvula projecting laterally as broad membranous plate and rounded posteriorly; ovipositor slightly exserted and acutely pointed.

*Distribution.* Poona, Bombay, September 8, 1911 (T.B. Fletcher).

*Material examined.* In the collection of the Zoological Survey of India, Calcutta, the writer examined 4 specimens, all females, collected from Poona, December 1889 (R. Wroughton) (Reg.No.1563/12), and determined by Lethierry. At the Indian Agricultural Research Institute, New Delhi, the author has also examined three specimens in poor condition, determined by Rahman in 1926. These specimens are also labelled

by D.L. Crawford as *Diaphorina citri* Kuw. Due to their poor condition, it has not been possible to determine them correctly. They bear the data: Poona, Bombay, September 8, 1911 (T.B.F.). However, from the date of collection, i.e., September 8, 1911, all these specimens obviously belong to *D. enderleini* Klimaszewski.

*Comparison.* Lethierry (1890) described this species from the specimens collected in December, 1889, from Poona, Bombay (R.C. Wroughton). His description is very brief, pertaining mostly to colouration of both sexes. It appears that the four females present at the Zoological Survey of India, Calcutta, belong to this original lot. Crawford (1924) observed some variation in the colour pattern of the forewing in the specimens collected on September 8, 1911, from Poona (T.B. Fletcher). These specimens show considerable variation in the amount of maculation and the wings are more extensively whitish and hyaline with numerous brown spots, whereas the Wroughton's specimens are mostly dark and opaque with numerous white spots. The description given above is based on a single female specimen received on loan from the Smithsonian Institution, United States National Museum, Washington, through the courtesy of Dr (Miss) Russell. This specimen is labelled as Poona, Bombay, September 8, 1911, (T.B.F.), (Pusa coll.) (1943 coll. D. L. Crawford), and determined as *Diaphorina guttulata* Leth. There are two specimens in the Smithsonian Institution. Since the author has seen both the lots, he agrees with Crawford's views and the species is redescribed. Klimaszewski (1964) has proposed a new name, *D. enderleini*, for *guttulata* Leth.

*D. enderleini* Klimaszewski, resembles closely with *D. communis*, *D. dunensis*, and *D. truncata* Crawf., in colouration, but differs from them in shape of wing, shape of vertex and genal cones, and female genitalia. No male specimen is present in the collections in India.

***Diaphorina gymnosporiae*, sp. n.**

(Figs. 64, 65)

Length of body, in male, 1.86 mm; in female, 1.97 mm

Length of forewings, in male, 1.92 mm; in female, 2.00 mm

Width of head with eyes, 0.52 mm

Width of vertex between eyes, 0.32 mm

Length of antennae, 0.45 mm

*Colouration.* (Specimens preserved in alcohol). General colour chrome-orange; head orange, ocelli reddish, eyes pinkish-red, antennae pale-yellow, except two basal, two apical segments and apex of eighth segment which are black; genae smoky ventrally; anterior border and lateral sides of prothorax, a pair of broad, anterior bands on prescutum, two pairs of longitudinal, submedian bands on scutum, scutellum posteriorly, metanotum posteriorly and lateral sclerites smoky black; anterior and middle legs, posterior legs with femur, about one-fourth of tibia basally, and apical tarsal segment fuscous, while the three-fourths of tibia and basal tarsal segment of hind leg pale-yellow. Forewings semi-hyaline and partly maculated, the maculae forming rather large areas all along the veins, with hyaline areas extending in all cells (Fig. 64f), junction of veins  $R_1$ ,  $R_2$  and  $Rs$ , base of cubital petiole and base of media dark-black. Abdominal tergites

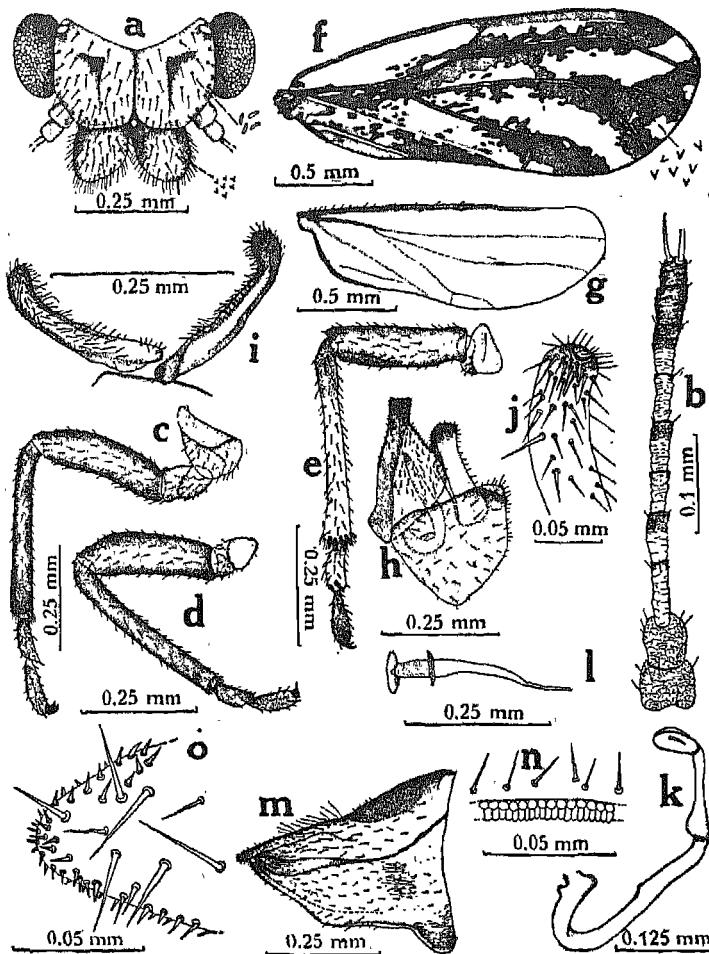


Fig. 64. *Diaphorina gymnosporiae*, sp. n.—a: head, dorsal view; b: antenna; c, d, e: fore, middle and hind legs; f: forewing; g: hind wing; h: male genital segment, lateral view; i: forceps, lateral and mesal views; j: apical portion of forceps, mesal view; k: aedeagus; l: sperm pump; m: female genital segment, lateral view; n: portion of anal ring; o: caudal end of dorsal plate, dorsal view.

smoky brown. Female genital segment smoky brown; anal valve of male genitalia smoky brown.

In dried specimens, general colour light orange with smoky brown tinge, eyes grey. The specimens collected from New Delhi are slightly darker, with darker maculations.

**Structure.** Body long and narrow. Head (Fig. 64a) scarcely deflexed, including the eyes, narrower than thorax, pubescent and also beset with minute points (seen under high magnification); vertex about twice as wide as the length of the median line; rather

deeply emarginate at the posterior margin, with two foveal impressions on each side, posterior to centre and in the middle of each half, anterior foveae larger than the posterior foveae, a shallow linear depression extending forward from the anterior fovea and nearly reaching to the anterior border of vertex; genal cones on the same level as vertex, directed forward, separate, subconical, longer than broad, about 0.12 mm long and slightly smaller than the vertex, divergent and curving outwards, a little more coarsely pubescent than the vertex and also armed with minute points. Eyes large, recessive and somewhat reniform. Antennal sockets lateral.

Antennae (**Fig. 64b**) thick, ten-segmented, bearing few setae, two basal segments robust, 1st broadly transverse, 2nd longer than broad, remaining segments imbricate, 3rd segment narrower and slightly longer than others, segments 4, 6 and 8 slightly thicker and each almost equal in length, 5th segment small, 7th slightly longer than 5th but smaller than 4th 8th slightly thicker apically, segment 9 broad and about as long as 5th, apical segment slightly smaller than the penultimate segment and provided with two long spines at apex, four sensoria present on segments 4, 6, 8 and 9.

Thorax moderately arched, robust, punctate, sparsely pubescent, the setae almost as long as those on the head, thickly beset with minute points arranged somewhat in rows. Pronotum flat, weakly arched, viewed dorsally, slightly longer in middle than at the sides, with two large foveal impressions of equal size on each side; prescutum partly concealed anteriorly under pronotum, broader than long, broadest beyond middle, about one and a half times as broad as long, gradually narrowed anteriorly, acutely angled laterally, weakly angular on each side of the posterior margin; scutum very broad and arched, about twice as broad as long, broadest in middle, slightly longer than prescutum, angled laterally; scutellum small and narrowly transverse, somewhat rectangular, antero-lateral angles prominent.

Legs (**Figs. 64c, d, e**) of medium size, pubescent with strong setae, fore and middle femora slightly arched, tibiae longer than femora and each bearing apical comb of setae, hind tibiae with five long and slender black spines on the apical margin, basal tarsal segment of all legs smaller than apical, basal tarsal segment of hind leg with two stout, black spines at apex, meracanthus of medium size, acutely conical.

Forewings (**Fig. 64f**) large, broad subapically, about two and a half times as long as wide at the widest part, rounded at apex, narrow at base, stem R about one and one-fourth times as long as basal vein (R+M+C), cubital petiole (M+Cu) about one-third shorter than basal vein, pterostigma long and narrow, R<sub>5</sub> quite long and flexed downward near apex, first marginal cell as long as wide and distinctly shorter in length and wider than second, membrane thickly beset with minute points, veins armed with two rows of setae (seen under high magnification). Hind wings (**Fig. 64g**) also quite large and thickly beset with minute points, costal margin armed with a few simple and hooked setae, veins quite distinct.

Abdomen long and slender, finely and sparsely pubescent.

**Genitalia.** Male genital segment (**Fig. 64h**) smaller than abdomen, sparsely pubescent; anal valve (proctiger) longer than forceps, about 0.28 mm long, in profile, anterior margin weakly convex in middle, invaginated both basally and apically, apical region attenuated,

posterior margin broadly convex in middle, converging both basally and apically; forceps (parameres) (Fig. 64*i*) about 0.22 mm long, with subparallel sides, viewed from behind, each forcep bowed towards each other, bluntly pointed at tip and thickly beset with setae (Fig. 64*j*) apically, mesal surface armed with thick setae pointing downward, marginal setae slightly longer; hypandrium simple, of usual shape, and sparsely beset with small setae; aedeagus (Fig. 64*k*) moderately long, elbowed, outer arm smaller than basal, with thick spoon end; sperm pump as figured (Fig. 64*l*).

Female genital segment (Fig. 64*m*) smaller than abdomen, ventral plate a little shorter than dorsal, dorsal plate sparsely pubescent with small, simple setae, narrowly and roundly pointed caudally, caudal region armed with small, peg-like setae (Fig. 64*o*), anal aperture large, somewhat elliptical, and surrounded by a double row of pores (Fig. 64*n*), hairs longer in middle, ventral plate beset with small setae and acutely pointed apically; ovipositor acutely pointed.

*Host plant.* Collected on *Gymnosporia spinosa* (Forsk.) Fiori (= *Gymnosporia montana* Benth.).

*Type locality.* Mandwa plantation, E. Asir range, Nimar Forest division (M.P.).

*Types.* Described from a small series of specimens of adults, collected with nymphal stages, on *Gymnosporia spinosa*. Holotype male; Allotype female, both from the type locality and collected on March 16, 1959 (R.N. Mathur); Paratypes: 1 male and 2 females, from the same locality and date, 8 males and 2 females from Charkhera, Singhaji range, M.P., collected on January 12, 1956 (F.R.I. Project). Additional specimens examined are from New Delhi, 7 males and 13 females, collected (date not recorded) by M.G. Ramdas Menon. Host also unknown. All types, some nymphal stages and few adults preserved in alcohol, and some slides deposited at F.R.I., Dehra Dun. The New Delhi specimens are deposited at I.A.R.I., New Delhi.

*Comparison.* *Diaphorina gymnosporiae*, sp.n. is distinguishable by its characteristic maculated bands in the forewings, shape of vertex, separate and divergent genal cones, antennae and genital characters. From *D. bikanerensis*, sp.n., it is separated by the different pattern of bands in forewings and shape of genal cones.

*Biological notes.* The adults and nymphs are commonly found infesting young buds and fresh leaves of *Gymnosporia spinosa* in Madhya Pradesh. The nymphs remain in congregation on young buds and exude small globules of honey dew profusely, which are covered with waxy powder. Mature nymphs crawl on the under surface of leaves and shed their last skin there. The description of the nymphal stages is given below.

#### Nymphal stages

Colour pale chrome orange with smoky plates as indicated (Fig. 65). Eyes pinkish-red, antennae smoky black at apex.

*Fifth stage.* (Fig. 65*a*). Length 1.35 mm; of psylline form, broadly oval. Head slightly narrower than the abdomen. Wing-pads projecting beyond the general margin of the body and produced cephalad at the humeral angle and bluntly rounded. Head well marked and separated from the thorax. Eyes small. Derm membranous, except for the sclerotic areas of the head, wing pads, the posterior two-thirds of the abdomen,

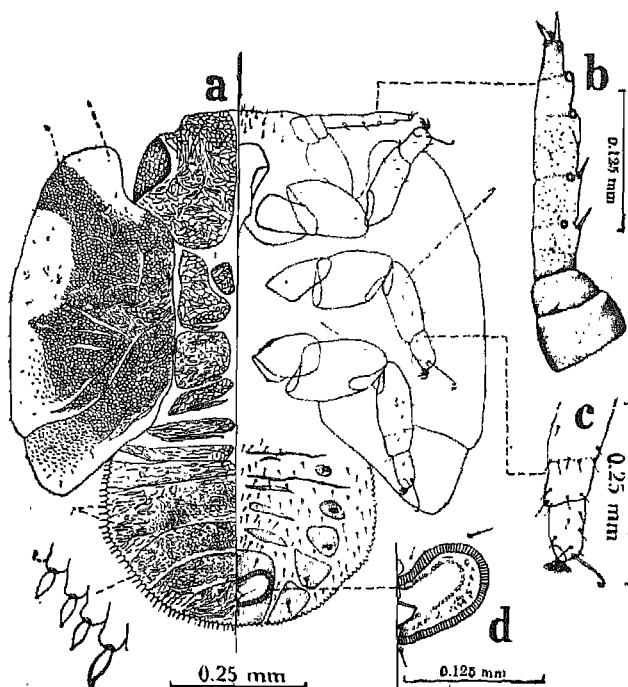


Fig. 65. *Diaphorina gymnosporiae*, sp. n.—a: fifth stage nymph; b: antenna; c: part of leg; d: circum-anal ring.

and the smaller areas of thorax and abdomen as shown in the figure. Entire margin of the caudal plate beset with a continuous series of slender, spear-shaped setae borne upon distinct prominences. Dorsum with the derm vermiculate and with punctate appearance and beset with minute, scattered setae.

Ventral side membranous, except for small areas near the spiracles, small abdominal strips and an anal plate. These sclerotic areas are thickly beset with minute points. Derm sparsely beset with simple ring-based setae intersegmentally in the abdomen. Antennae (Fig. 65b) located ventrally, short, about 0.25 mm long, three-segmented, two basal segments broad and transverse; third segment long with imperfect segmentations, with four sensoria and two terminal spines. Legs (Fig. 65c) relatively short, with few setae, without trochanters, with the tibio-tarsal articulation well-defined, tarsus with a single golf-club seta; claws present; pulvilli small, fish-tail like. Anal opening (Fig. 65d) set well in from the apex of the abdomen, surrounded by the outer circum-anal pore ring consisting of a single row of slit-like pores and the inner ring of indistinguishable pores.

*Fourth stage.* Length 0.90 mm. Resembles the fifth stage, except in having smaller wing pads, antennae three-segmented, 0.15 mm long and with three sensoria, and tibio-tarsal articulation absent.

*Second stage.* Length 0.42 mm. Body oval, with longer legs and broader abdominal plates; antennae 0.07 mm long, two segmentcd with one sensorium; with few marginal setae on abdomen.

**Diaphorina truncata** Crawford 1924  
(Figs. 66, 67)

Crawford, D. L. 1924. *Rec. Indian Mus.* 26(6) : 617, figs. 1, 1a (India; Southern China).

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 624 (Walayar forests, Malabar).

Mathur, R. N. 1935. *Indian Forest Rec.* 1(2) : 42.

Beeson, G. F. G. 1941. *Forest Insects*, p. 777.

Length of body, in male, 2.25 mm; in female, 2.67 mm

Length of forewings, in male, 2.15 mm; in female, 2.70 mm

Width of head with eyes, 0.64 mm

Width of vertex between eyes, 0.42 mm

Length of antennae, 0.47 mm

*Colouration.* General colour chocolate brown to black or fuscous; head dark-brown with black foveae; genae dark-brown dorsally, black ventrally; pronotum dark-brown with a pale median line and with two lateral black foveae on each side; prescutum and scutum dark-brown, scutum with two submedian, longitudinal black stripes on each side of the middle; femora of all legs fuscous, tibiae and tarsi pale brown; abdomen black, venter with greenish or yellowish tinge; forewings dark-brown to black, mottled with numerous maculae distributed all over the surface, with a large hyaline area near the apex of anterior basal cell, a round area near apex of cell  $R_s$  and another large area at the apex of cell Cu.

*Structure.* Body not large, slender. Head (Fig. 66a) not deflexed, somewhat horizontal, including eyes slightly shorter than widest part of thorax; vertex about two times wider than the length in the middle, surface rough, slightly swollen in middle, posterior margin deeply emarginate, with a small circular fovea in each half near the middle, posterior to the centre, sparsely pubescent, antero-lateral margins produced forward as small angles; anterior ocellus visible from above; genae about 0.12 mm long and smaller than and on same level as vertex, directed forward, closely approximate for about half their length, slightly wider than long, divergent apically, truncate at tip, coarsely and conspicuously pubescent, with setae a little longer than on the vertex. Eyes of medium size, slightly recessive. Antennal sockets lateral.

Antennae (Fig. 66b) small, ten-segmented, bearing few setae, two basal segments robust, 1st and 2nd subquadrate, 2nd smaller than 1st, remaining segments slender, imbricate, 3rd and 4th longest but equal, 5th and 7th small but equal, 6th slightly smaller than 4th, 8th slightly smaller than 6th, 9th segment thick and slightly longer than 7th, terminal segment smallest, bearing two unequal spines at apex, four sensoria present on segments 4, 6, 8 and 9.

Thorax somewhat arched, finely and sparsely pubescent, thickly covered with minute points, finely punctate. Prothorax slightly narrower in middle, anterior margin roundly notched medially, with a ridge-like border on either side of the notch, two lateral

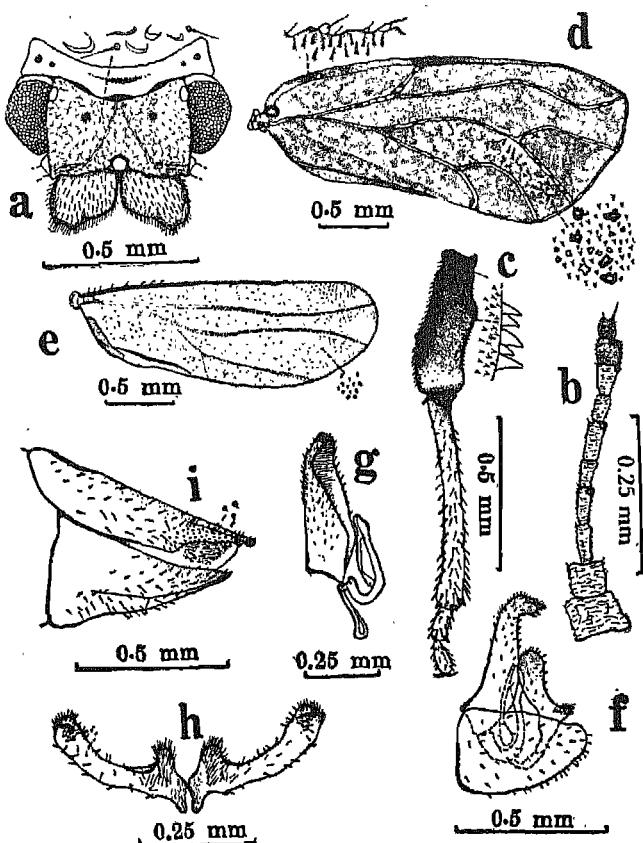


Fig. 66. *Diaphorina truncata* Crawf.—a: dorsal view of head and prothorax; b: antenna; c: hind leg; d: forewing; e: hind wing; f: lateral view of male genitalia; g: anal valve and aedeagus; h: caudal view of forceps; i: lateral view of female genitalia.

circular foveae present on each side, the inner ones smaller than the outer; prescutum twice as broad as long, widest in middle, conspicuously angled submedianally on the posterior margin; scutum large and longer than prescutum, about twice as broad as long, broadest before middle, with a shallow longitudinal channel medianally, disc swollen in small, longitudinal patches having impressed areas in between; scutellum small, transverse, bowl-shaped, about twice as broad as long, with prominent antero-lateral angles; mesepisternum large and produced forward.

Legs (Fig. 66c) of medium size, coarsely pubescent and also armed with minute points, which are thicker on femora, femora shorter than tibiae, all tibiae with apical comb of setae, fore and middle tibiae with a weak basal spur, but hind tibiae possess a prominent, acutely pointed, black basal spur, and armed with six stout, black spines on the margin at apex (2 on the outer, 2 on the inner and 2 on the lateral sides), tarsi of all legs of

equal length, basal tarsal segment of hind leg with two black spines at apex, tibial groove quite long, meracanthus small and conical.

Forewings (**Fig. 66d**) opaque, membrane covered with minute points and thick, irregular specks, slightly more than twice as long as wide at the widest part, with an angular apex, narrow at base, pterostigma short and narrow, stem R slightly longer than cubital petiole, basal vein shorter than cubital petiole, vein *Rs* flexed before reaching apex, first marginal cell nearly as long as second and also as wide as second, veins armed with two rows of setae, visible under high magnification. Hind wings (**Fig. 66e**) transparent, venation as figured, membrane thickly covered with minute points, costal margin beset with a few simple setae and hooked setae.

Abdomen finely and sparsely pubescent, setae longer on sternites.

*Genitalia.* Male genital segment (**Fig. 66f**) smaller than abdomen, anal valve about 0.45 mm long, broad basally and gradually converging towards tip, in profile, anterior margin almost straight in middle (**Fig. 66g**), slightly invaginated basally and convexly rounded apically, apical region bent caudally, posterior margin convexly rounded and then deeply invaginated near top, ending in a truncate apex, outer surface beset sparsely with small setae, setae numerous in the apical region; parameres (**Fig. 66h**) smaller than anal valve, about 0.25 mm long, sides sub-parallel in lateral view, slightly broad apically and beset with a cluster of small setae, basal portion produced posteriorly into a small thick lobe, bearing a brush of setae, apical end black, roundly pointed and margined at top, outer surface beset sparsely with small setae, mesal surface armed with a bunch of small setae just below apex; hypandrium simple, of usual shape; outer arm of aedeagus small and slender (**Fig. 66g**).

Female genitalia (**Fig. 66i**) smaller than abdomen, both plates broad basally and narrow caudally; dorsal plate slightly longer than ventral, roundly pointed at tip, armed with short setae which become more numerous and heavier posteriorly and arranged in a band; ventral plate sparsely beset with simple setae, slightly invaginated ventrally near base and acutely pointed apically.

*Host plant.* On young twigs and fresh leaves of *Strychnos nux-vomica* Linn.

*Distribution.* Crawford (1924) has mentioned India (Walayar Forests), Malabar May 1921 (Ramakrishna coll.); Southern China (Macao) (F. Muir).

*Material examined.* Few specimens of both sexes, in poor condition, from Thogarapalli near Krishnagiri, Salem District, April 18, 1963 (B.V. David); a large collection of adults and nymphs, received preserved in alcohol, collected from Medical College campus, Calicut, Kerala, between February 29 and March 3, 1968 (K.J. Joseph); from this collection, 9 males and 11 females were mounted on cards. All this material has been deposited at F.R.I., Dehra Dun..

*Comparison.* *D. truncata* Crawf. resembles closely *D. communis*, *D. dunensis* and *D. enderleini* Klimasz. in colouration, but is easily recognised by the angular apical margin of forewing and the conspicuously truncate genal cones. Crawford (1924) has mentioned that this is a very distinct species and apparently more closely related to a South African species.

*Biological notes.* It is reported that this species is commonly found in S. India, wherever

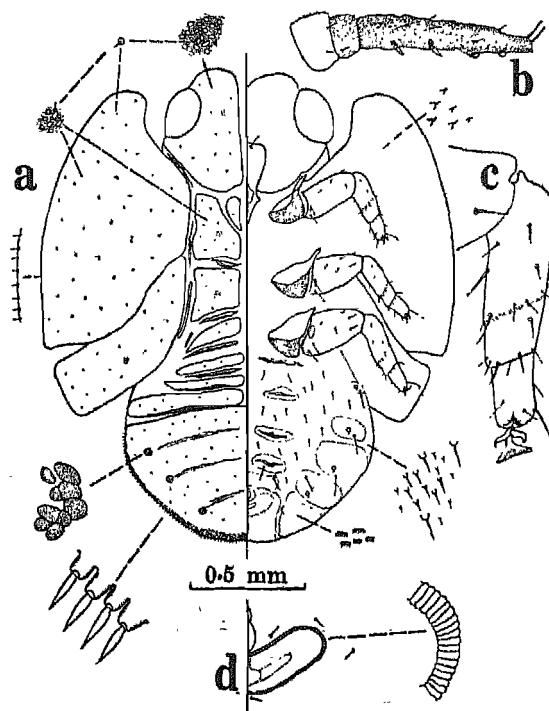


Fig. 67. *Diaphorina truncata* Crawf.—a: fifth stage nymph; b: antenna; c: part of leg; d: circum-anal pore ring.

*Strychnos nux-vomica* grows. Mature nymphs are pale yellow with light smoky tinge, antennae black and eyes pinkish red in colour, and are described below.

#### Nymphal stages

**Fifth stage.** (Fig. 67a). Length 2.05 mm. Body quite large, broadly oval, the continuity is broken near the head and the base of abdomen; wing-pads large, the humeral angle extending forward up to the anterior margin of eyes, head smaller than the width of abdomen; dorsum with the derm mostly sclerotic, consisting of large head plates, a number of small thoracic plates, wing-pads, four pairs of small, transverse, strip-like anterior abdominal plates and a large single posterior plate in the abdomen. Derm vermiculate, punctate, punctures strong and thick near the borders, thickly beset with minute points and sparsely with minute, scattered, simple setae. Head and wing-pads armed with small, simple setae along the margin, posterior abdominal plate black near the border and armed with a marginal row of lanceolate setae.

Ventral side for the most part membranous, except for a small plate beneath each antenna, four pairs of submedian, transverse, strip-like plates, six pairs of lateral plates enclosing the spiracles, and an irregular caudal plate bearing the anus and the

circum-anal ring of pores in the abdomen. Derm thickly beset with minute points which becoming stronger and thicker near the borders, and sparsely beset with simple setae of various length, these setae are also present intersegmentally in the abdomen, minute comb-like structures also present in the caudal plate. Rostrum armed with two pairs of simple setae near base.

Antennae (**Fig. 67b**) small, black, about 0.36 mm long, apparently three-segmented, basal two segments small and transverse, third segment longest, having traces of segmentation, bearing a few simple setae and four sensoria, two basal sensoria guarded by two thick lanceolate setae, apex with two small, unequal spines. Legs (**Fig. 67c**) small and thick, having a few scattered setae, femora not reaching the margin of the body, without trochanters, tibio-tarsal articulation distinct, each tarsus with a prominent golf-club seta, claws present, empodium with a large fish-tail like pulvillus. Anal opening (**Fig. 67d**) well in front of the apex of abdomen and surrounded by a double ring of pores, the outer ring consisting of slit-like pores and the inner ring with minute, faint oval pores, both rings are medianally interrupted and guarded by two anterior pairs of setae.

*Fourth stage.* Length 1.2 mm. Resembles the fifth stage, except in being smaller in size, with smaller wing-pads, less number of thoracic plates, antennae apparently three-segmented, with three sensoria and absence of tibio-tarsal articulation.

**Diaphorina venata, sp. n.**

(**Fig. 68**)

Length of body, in female, 2.35 mm

Length of forewings, in female, 2.58 mm

Width of head with eyes, 0.81 mm

Width of vertex between eyes, 0.48 mm

Length of antennae, (missing in specimens).

*Colouration.* General colour dark-brown with blackish tinge, head and genae dark-brown, prothorax with a light black median patch, prescutum with two light black, longitudinal bands anteriorly, scutum with two pairs of submedian, longitudinal bands, legs dark-brown, hind tibiae of lighter colour, forewings with numerous and scattered dark-brown or blackish maculae intermixed with hyaline areas, maculae less in the basal area, venter of abdomen pale brown.

*Structure.* Body small but robust. Head (**Fig. 68a**) somewhat deflexed, almost as broad as thorax, sparsely pubescent; vertex about thrice as broad as the length of median suture, deeply emarginate at the posterior margin, with a distinct circular fovea on each side, posterior to centre and near the middle of each half, disc swollen on either side of median line; front ocellus visible from above; genae on the same level as the vertex, broader than long, about 0.12 mm long, shorter than vertex, contiguous at or near the base, slightly divergent at apex, apices bluntly rounded, a little more pubescent than the vertex; frons covered by the genae and visible ventrally as a large plate. Eyes large and recessive. Clypeus large, thick and tubular. Antennae missing.

Thorax (**Fig. 68a**) robust, arched, sparsely pubescent, finely punctate. Pronotum

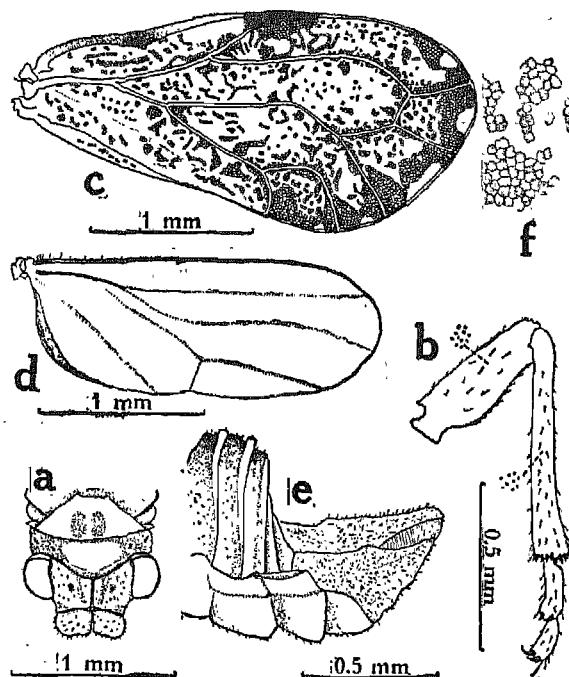


Fig. 68. *Diaphorina venata*, sp. n.—a: head and part of thorax; b: hind leg; c: forewing; d: hind wing; e: female genitalia and part of hind abdominal segments, lateral aspect; f: sculpture pattern of forewing, highly magnified.

arched, viewed dorsally, longer in middle and narrower laterally, anterior margin convexly rounded, with two foveal impressions on each lateral side; prescutum viewed dorsally, about twice as broad as long, broadest slightly before middle, distinctly angled submedianally at the posterior margin; scutum large, longer than prescutum, broader than long, about twice as broad as long, broadest before middle, anterior margin concavely rounded, disc shallowly depressed in middle when viewed dorsally, gradually sloping laterally, acutely angled at the sides; scutellum small, narrowly transverse, about twice as broad as long; anterior margin with prominent antero-lateral angles.

Legs (Fig. 68b) of medium size, thick, pubescent and also beset with thick minute points, femora shorter than tibiae, all tibiae with apical comb of setae, hind tibiae without basal spur, with about nine short, stout black spines on the margin at apex, tarsal segments of nearly equal length, hind basal tarsus with two black claw-like spines at apex, tibial groove long; meracanthus strong, thick and conical.

Forewings (Fig. 68c) small, almost twice as long as broad, widest in apical half and roundly angulate at apex, narrow at base, radius slightly longer than basal vein, cubital petiole shorter than basal vein; pterostigma small, narrow, pubescent;  $Rs$  flexed near apex, a prominent cross vein present joining the flexed portion of  $Rs$  with fork  $M_{1+2}$ .

first marginal cell smaller in length and width than the second, second marginal cell somewhat trapezoid in shape; maculae (Fig. 68f) numerous and scattered inter-mixed with hyaline areas, basal area with less maculae, five hyaline spots present along the apical margin. Hind wings (Fig. 68d) slightly smaller than forewings, costal vein armed with some simple and hooked setae, venation as figured.

Abdomen small, sparsely pubescent.

*Genitalia.* Female genitalia (Fig. 68e) large, longer than the rest of the abdomen, sparsely pubescent; dorsal plate slightly longer than ventral, broader at base and gradually narrowed posteriorly, roundly pointed at apex, circum-anal region large, occupying nearly the basal half, anal ring somewhat oval in shape; ventral plate acutely pointed at apex.

*Host plant.* On *Santalum album* (*sandal*).

*Type locality.* Aiyur, North Salem, Tamil Nadu.

*Types.* Two female specimens from Aiyur, North Salem, 25.iv.31 (F.R.I. Sandal Insect Survey), one specimen in very poor condition. No males available for description. Holotype female; Paratype: female, in poor condition; data same, from the type locality.

*Comparison.* *Diaphorina venata*, sp.n. is easily recognised from the other Indian species, in possessing an extra cross vein, joining the radial sector with  $M_{1+2}$ . This cross vein is present on both the forewings and in both specimens, and is, therefore, not an aberration. It also differs in the shape of genal cones. These differences prompted the author to consider it under a distinct genus for which he proposed the name *Neodiaphorina*, however, the consensus of opinion in consultation with Dr Tuthill, Dr Russell and others, has been that it would be better to retain it tentatively under *Diaphorina*.

#### Genus EUPHALERUS Schwarz 1904

##### *Euphalerus*

- Schwarz, E. A. 1904. *Proc. ent. Soc. Wash.* **6**: 234-245.
- Aulmann, G. 1913. *Psyllidarum Catalogus*, Berlin, p. 74.
- Crawford, D. L. 1914. *Bull. U.S. natn. Mus.* No. 85: 118-119.
- Crawford, D. L. 1919. *Philipp. J. Sci.* **15**(2): 169.
- Van Duzee, E. P. 1917. *Cat. Hemip. N. Amer.* p. 802.
- Ferris, G. F. 1928. *Can. Ent.* **60**(5): 113.
- Tuthill, L. D. 1937. *J. Kans. ent. Soc.* **10**: 69-70.
- Tuthill, L. D. 1943. *Iowa State Coll. J. Sci.* **17**(4): 519.

*Type species.* *Euphalerus nidifex* Schwarz, 1904 (original designation) from Key West, Florida.

The distinctive characters outlined by Schwarz (1904) and Crawford (1914) are expanded with my notes, as below.

Body robust, surface rugulose or punctate. Head nearly or quite as broad as thorax, vertical to subvertical; vertex flat, often rugulose, broader than long, sides straight between eyes, then converging to front, truncate at front margin; antero lateral angles prominent, posterior ocelli scarcely elevated and anterior ocellus visible from above. Genal cones large, broad, flat, usually quadrate, rounded at apex, more or less divergent, not depressed below level of vertex, separated therefrom by a slightly impressed line. Eyes large,

somewhat recessive over pleurites. Antennae variable in length, short, slender. Thorax strongly arched and broad; pronotum not extending far down laterally, terminating in a knob-like swelling; mesonotum large. Propleurites long and narrow; propleural suture extending to middle of pronotum. Legs robust, hind tibiae usually with or without basal spur, hind proximal tarsal segment with two small claw-like spines at apex. Forewings large broad, oblong-oval or somewhat rhomboidal, membranous, more or less hyaline, sometimes subopaque, maculated or unicolourous, rounded or somewhat angulate at apex, pterostigma present.

Only one species, *Euphalerus vittatus* Crawford (1912), is represented from India.

**Euphalerus vittatus** Crawford 1912  
(Fig. 69)

- Crawford, D. L. 1912. *Rec. Indian Mus.* 7: 423-424. pl. xxxiii, figs, I, J, L, M; pl. xxxv, fig. C.  
Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26(6): 623.  
Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 43-44 (Biology).  
Mathur, R. N. 1949. *Indian J. Ent.* 8(2): 230-231. fig. 4 (1946), (Nymphal stages).  
Beeson, C. F. C. 1941. *Forest Insects*, p. 777.

Length of body, in male, 1.75 mm; in female, 2.17 mm

Length of forewings, in male, 1.82 mm; in female, 2.61 mm

Width of head with eyes, 0.77 mm

Width of vertex between eyes, 0.48 mm

Length of antennae, 0.85 mm

*Colouration.* General colour whitish and fuscous, vertex and dorsum yellowish-brown or whitish with greenish tinge, a dark-brown vitta extending from each eye over upper portion of pleuron and thence along upper half, or slightly less, of forewing to apex of latter, lower portion of pleura whitish with greenish tinge, venter brown; antennae pale yellow or whitish, with apices of segments and two terminal segments black; legs pale-yellow with yellowish-brown femora; wings hyaline except for small maculations along the veins and with a broad maculated band along the posterior border; abdomen more or less variegated.

*Structure.* Body of medium size, not robust. Head (**Fig. 69a**) quite long, including eyes, narrower than thorax, descending, finely and sparsely pubescent, conspicuously vermiculate; vertex flat, broader than long, slightly more than one and a half times as broad as long, with a fovea on each side of median suture, posterior to centre, and with a linear impression extending both dorsally and ventrally from each fovea, the sides straight between the eyes, converging to front, anterior margin invaginated at point of excision and also marked by an impressed line between vertex and genal cones, antero-lateral angles prominent; posterior margin truncate, angulate in centre; ocelli large, post-ocellar region somewhat swollen; genal cones short, broad, rather in the same plane as vertex, about two-thirds as long as vertex, contiguous, slightly emarginate laterad in front of antennae, broadly rounded at tip, finely rugulose and beset with short, stiff, white setae, each cone with one long ventral seta, setae longer than that of vertex. Eyes

large, hemispherical. Labrum narrowly visible from side. Antennal sockets large, situated between vertex and genal cones.

Antennae (**Fig. 69b**) small, ten-segmented, slender except two robust basal segments, 1st broadly transverse, 2nd subquadrate, as long as 1st, remaining segments imbricate, 3rd longest, 4th smaller than 3rd, 5th slightly smaller than 4th, 6th and 7th equal and each slightly longer than 4th, 8th slightly smaller than 3rd and longer than 6th, 9th slightly smaller than 4th, terminal segment smallest, bearing two unequal setae at apex; four sensoria present on segments 4, 6, 8 and 9. In one example, the number of segments vary, 9 segments on one side and 10 on the other.

Thorax large, moderately arched, finely and sparsely pubescent, finely reticulate; pronotum rather long, longest medianally, convex, descending, partly vermiculate-rugulose, sides parallel, with two foveal impressions on each side, the innermost the smallest; propleurites narrow; prescutum ascending, partly concealed anteriorly by pronotum, broader than long, about as long as scutum, weakly angled on each side of posterior margin; scutum very large, much broader than long, gradually sloping posteriorly, angulate both laterally and posteriorly; scutellum broadly transverse, with prominent antero-lateral angles, broad anteriorly and narrow posteriorly.

Legs (**Fig. 69c**) small, pubescent, and also beset with linear series of minute points, femora smaller than tibiae, all tibiae with apical comb of setae, hind femur with three thick, blunt setae near apex, and three sensoria-like structures on ventral side, hind tibiae without basal spur, and with four black tooth-like setae at apex (2 on each apical side); coxae large; basal tarsal joint a little smaller than apical, hind basal tarsal joint bearing two black claw-like spines at apex; meracanthus small, robust and triangular.

Forewings (**Fig. 69d**) rather thick, not coriaceous, very slightly rhomboidal in shape, slightly more than two and two-thirds times as long as broad, broadest across middle, narrowly rounded at apex, thickly beset with minute points, which becoming prominent in the posterior maculated band; pterostigma present, prominent; basal vein ( $R+M+Cu$ ) slightly longer than radius and also from cubital petiole, radius shorter than cubital petiole, radial sector ( $Rs$ ) quite long, curved upward to anterior margin near apex, cubital vein short, marginal cells unequal, first cell large, longer and wider than second; veins armed with microscopic setae.

Hind wings (**Fig. 69e**) comparatively large, slightly smaller than forewings, uniformly beset with minute points, the veins, although weak, clearly defined, costal margin with a few simple and hooked setae.

Abdomen small, finely and sparsely pubescent, and also beset with minute points arranged in lines, setae longer on sternites, last sternite protruding caudally and telescoping the base of hypandrium.

*Genitalia.* Male genital segment (**Fig. 69f**) smaller than abdomen, rounded. Anal valve simple, about 0.30 mm long, longer than forceps, somewhat pyriform, attenuate at tip, in lateral aspect, anterior margin rather straight, slightly deflexed apically, posterior margin a little convexly rounded, apical upper surface and margins beset with small, simple setae. Forceps (**Figs. 69g, h**) short, small but robust, about 0.18 mm long, broad basally and gradually narrowed apically, strongly bowed inward, posterior margin

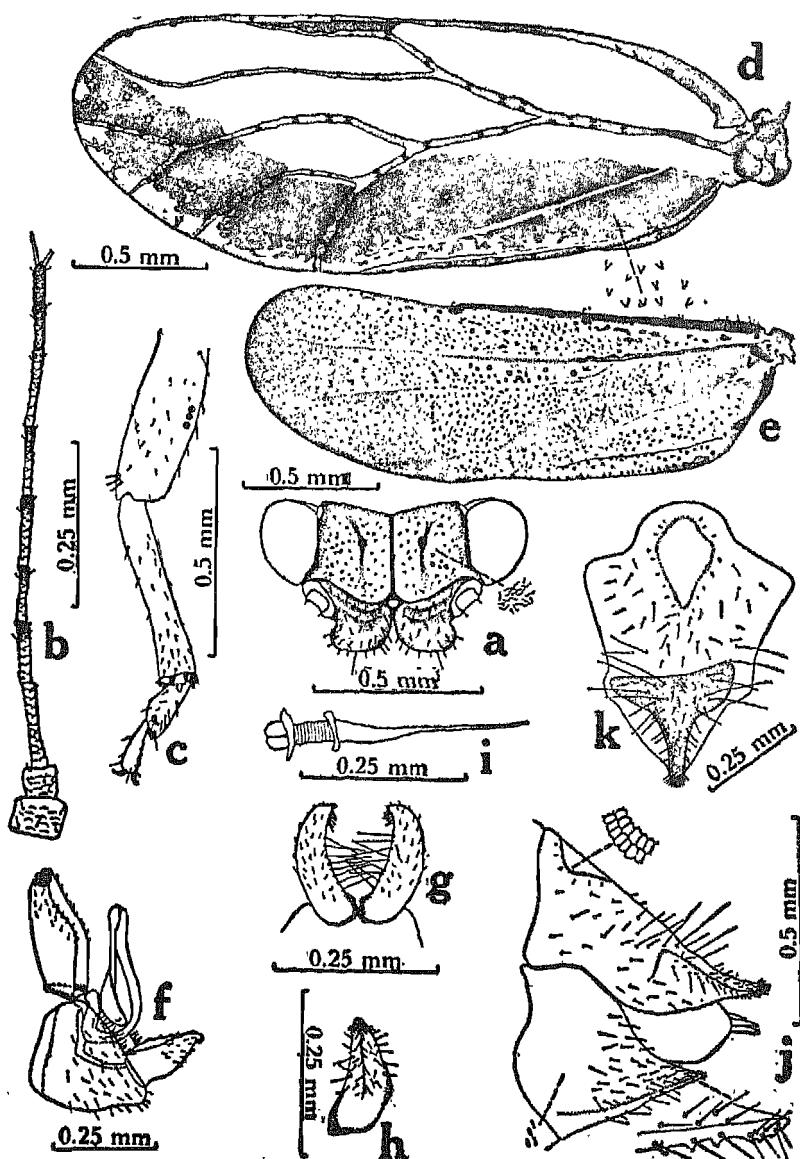


Fig. 69. *Euphalerus vittatus* Crawford—**a**: head, dorsal aspect; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: male genitalia, lateral aspect; **g**: parameres, caudal aspect; **h**: forceps, mesal aspect; **i**: sperm pump; **j**: female genitalia, lateral aspect; **k**: dorsal plate of female genitalia, dorsal aspect.

conspicuously sinuate, forming an apical hood and terminating in a black, acute point directed caudally, outer surface armed with simple setae, mesal surface beset with few thick setae, similar setae pointing downward also present just below the acute point, marginal setae slightly longer; hypandrium simple, of usual shape, bearing sparsely simple setae, group of setae also present on the dorso-lateral region; aedeagus long and slender, outer arm smaller than basal, with a prominent spoon end; sperm pump as figured (**Fig. 69i**).

Female genital segment (**Fig. 69j**) smaller than abdomen, both plates broad basally; dorsal plate (**Fig. 69k**) slightly longer than ventral, sub-acute at apex, bearing three or four pairs of long setae sub-medianally, and a brush of small simple setae apically; circum-anal pore ring somewhat trapezoid in shape and composed of a double ring of pores. Ventral plate acute apically, bearing saw-like teeth near apex, surface beset with simple setae of varying length and also with minute points; ovipositor acutely pointed.

*Host plant.* On young buds and fresh leaves of *Cassia fistula* Linn.

*Distribution.* Previously recorded from Calcutta, on *Cassia fistula* (N. Annandale); Narainganj (Bengal), on a bush.

New records are from New Forest, Dehra Dun (U.P.).

*Material examined.* One example from Naraingunj, Dacca, 2-7.vii.1911 (D.N.). A good series of specimens collected from New Forest, during June 1930, May to August, 1931 and 1932 (R.N. Mathur); 7 males and 10 females from New Forest, June 9, 1950 (R.N. Mathur); 1 male and 2 females from New Forest, May 21, 1960, and 3 males and 8 females also from New Forest, May 24, 1960 (R.N. Mathur); 2 males and 31 females from New Forest, June 5, 1928 (G.D. Bhasin); 6 males and 3 females from New Forest, 1930 (S. Bahadur). This material is present at the F.R.I., Dehra Dun. In addition, vials containing adults and nymphs (preserved in alcohol) collected from New Forest, Dehra Dun, on May 24, 1960, May 4, 1965 and June 9, 1966 (R.N. Mathur) are also present.

The collection at the Zoological Survey of India includes 1 male and 2 females (3804/HI, 3808/HI), Ind. Mus. of June 8, 1911; and 5 examples (in poor condition) from Calcutta (N. Annandale).

The collection at the Indian Agricultural Research Institute, New Delhi, includes 7 examples from Narainganj, Dacca (Bangla Desh), 2-7.vii.1911 (D.N.), "on a bush"; and 12 examples from New Forest, Dehra Dun, June 2, 1932, on leaves of *Cassia fistula* (R.N. Mathur).

*Comparison.* According to Crawford (1912), this species is somewhat similar to an American species, *E. vermiculosus* Crawford (1914). I have not seen this species, but *E. vittatus* Crawford differs greatly from the figures (39, 434) drawn by Crawford (1914) for *vermiculosus*, in the shape of head and wing.

#### Genus EUPHYLLURA Foerster 1848

##### *Ephyllura*

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 Crawford, D. L. 1914. *Bull. U.S. natn. Mus.* 85: 115-116.  
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 Tuthill, L. D. 1943. *Iowa State Coll. J. Sci.* 17(4): 520.

*Platystigma*

Enderlein, G. 1921. *Zool. Anz.* 52: 116-117.

*Syntomoza*

Enderlein, G. 1921. *Zool. Anz.* 52: 116-117.

Loginova, M. M. 1967. *Revue d'Entom. Acad. Sci. U.S.S.R.* 46(2): 340-345.

*Type species.* *Euphyllura phillyrae* Foerster 1848, a European species (original designation).

Body robust, strongly arched, coarsely punctate or finely rugulose, often more or less spotted. Head large, strongly deflexed, not vertical, flat, as broad as thorax, or broader; vertex large, usually rather flat more or less notched above, or extending over base of antennae, a tubercle next eye; genal lobes rectangular in shape and about as broad as vertex and not depressed from the level of vertex, either connate with the vertex or more or less indistinctly separated therefrom, contiguous on inner margin and either conjointly truncate or separately rounded slightly in front; anterior ocellus at base of genal lobes, apparently remote from front margin of vertex, visible only from above. Eyes large, strongly recessive and covering propleurites. Antennae short and thick. Thorax robust and arched. Pronotum extending far down laterad to a point lower than base of forewings; propleurites short. Legs short and stout; hind tibiae without basal spur, with small, black spines at apex; proximal tarsal segment of hind leg with two small, claw-like spines at apex. Forewings rhomboidal, coriaceous, not transparent, apex near anterior margin, regularly or not regularly rounded, venation somewhat variable, pterostigma variable from large to obsolete, second marginal cell often long and elongate, sometimes short.

The distinctive characters outlined above, have been drawn up from Schwarz (1904) and Crawford (1914) and expanded with my notes. In the collection examined by me, four species are represented, out of which three are new to science. *E. olivina* Costa has been redescribed from two female specimens, in poor condition, correctly determined by M. Bose, and present in the collection of I.A.R.I., New Delhi.

*Platystigma* Enderlein (1921) and *Syntomoza* Enderlein (1921) have been sunk in synonymy with *Euphyllura* by Tuthill (1943), but Loginova (1967) has retained *Syntomoza* as a valid genus on the characters that  $R_1$  gets cut off sufficiently away from costal margin and thereby not forming pterostigma, and some other features. Further, she has created a subgenus *Syringilla* of *Syntomoza*. On examination of my two species (sent in exchange), Dr M. M. Loginova of U.S.S.R., has communicated in her recent correspondence (20-10-1972) that "I think your two species must pick out independent new genus if they are not *Katacephala*". It is, therefore, proposed to name the new

genus *Loginoviana* after her, with great pleasure. The two species, *C. caudata* and *E. concolor* should be referred under this genus. The conclusion, however, has been suspended till the related members are studied and the species are retained in the present genus for the time being.

#### KEY TO THE SPECIES OF EUPHYLLURA

1. Forewing somewhat rhomboidal, coriaceous, with apex near anterior margin, much broader near base	...	...	...	...	...	...	...	2
—. Forewing elongate, somewhat parallelogram in shape, not broader near base.	...	...	...	...	...	...	...	3
2. Second marginal cell very small, $R_1$ obsolete distally	...	...	...	...	...	...	<i>E. caudata</i> , sp. n.	
—. Second marginal cell very large, $R_1$ not obsolete distally	...	...	...	...	...	...	<i>E. olivina</i> Costa	
3. Genae present, small, transverse	...	...	...	...	...	...	<i>E. concolor</i> , sp. n.	
—. Genae obsolete	...	...	...	...	...	...	<i>E. obsoleta</i> , sp. n.	

#### *Euphyllura caudata*, sp. n.

(Figs. 70, 71)

Length of body, in male, 1.55 mm; in female, 1.80 mm

Length of forewing, in male, 1.22 mm; in female, 2.0 mm

Width of head with eyes, 1.07 mm

Width of vertex, 0.50 mm

Length of antennae, 0.62 mm

**Colouration.** General colour light to dark-brown dorsally, yellowish-brown ventrally; female of light colour; genae, antennae (except at tip), and legs pale-brown; eyes pinkish red; labium black; wings light to dark-brown, with a dark macula in anterior basal cell; hind wing with a light brown band near clavus; male genitalia yellowish-brown; female genitalia somewhat lighter.

**Structure.** Body small, stout; head, thorax and wings rugulose. Head (**Fig. 70a**) slightly broader than thorax, strongly deflexed, rather shining, surface covered with weak sclerotic plates, finely pubescent, setae uniformly distributed; vertex broader than long, a little more than half as long as broad, shallowly impressed discally on each side of median line, posterior margin nearly straight, genae about one-fourth as long as vertex, coarsely pubescent with large setae, in the same plane as vertex, transverse, elliptical in shape and having narrowly rounded lateral projections below insertion of antennae, distinctly separated by darker vertex and by an impressed line, contiguous throughout except at apex; ocelli large and prominent, anterior ocellus bigger than posterior. Eyes large, subtriangular, prominently rimmed and narrowly rounded outwardly.

Antennae (**Fig. 70b**) short, ten-segmented, slightly more than half as long as width of head, the basal two segments robust, remaining segments slender, imbricate, 4th segment slightly smaller than 3rd, 5th smallest and others increasing progressively in length, segments 4, 6, 8 and 9 with conspicuous sensoria, apical segment with two unequal spines at tip.

Thorax very broad, moderately arched from middle of scutum, pronotum and prescutum strongly deflexed at the head, surface covered with numerous closely-set,

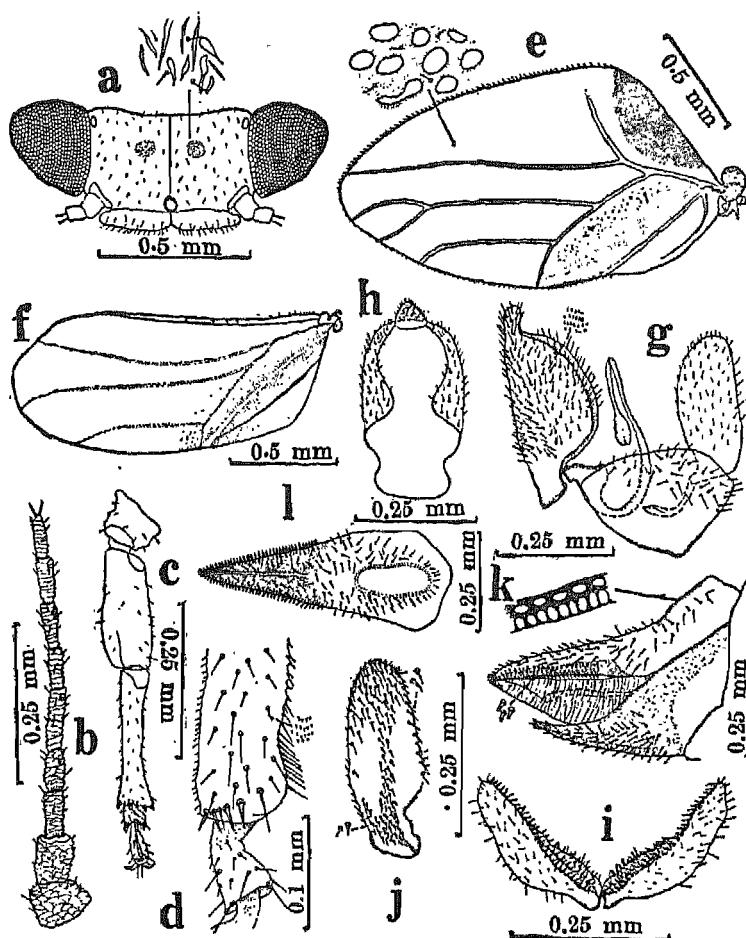


Fig. 70. *Euphyllura caudata*, sp. n.—a: head, front view; b: antenna; c: hind leg; d: part of tibia and basal tarsal joint of middle leg; e: forewing; f: hind wing; g: male genital segment, lateral view; h: anal valve, mesal view; i: parameres, caudal view; j: forceps, mesal view; k: female genital segment, lateral view; l: dorsal plate, dorsal view.

rounded or variously-shaped small sclerotic plates and also beset with fine sparse setae; pronotum comparatively long, flat, somewhat descending, anterior and posterior margins nearly parallel, with two sub-median foveal impressions, covered laterad with receding eyes; prescutum small, slightly longer than pronotum, trapezoid in shape when viewed dorsally, anterior margin wider than posterior, nearly three times wider than long, angulate laterally and posteriorly; scutum and scutellum gradually descending posteriorly, former about twice as long as prescutum, about two and a half times as broad as long, broadest before middle, anterior margin concave, angulate laterally; scutellum small,

transverse, anterior margin straight, broad anteriorly and narrow posteriorly, about twice as broad as long, posterior margin convexly rounded.

Legs (**Fig. 70c**) comparatively stout, uniformly covered with minute sclerotic areas, thickly beset with minute points and sparsely with fine setae, femora and tibiae of foreleg nearly of equal length, femora of middle and hind legs shorter than tibiae, femur of middle leg thick and stout than others, middle tibiae (**Fig. 70d**) with a row of dorsal setae just before apex, hind tibiae with five small black spines at apex, two small, black claw-like spines present on proximal posterior tarsus, basal tarsal joints smaller than apical, meracanthus extremely small.

Forewings (**Fig. 70e**) thick, about twice as long as broad, ovate, coriaceous, opaque, membrane covered with small sclerotic plates, finely and sparsely pubescent and thickly beset with minute points, both anterior and posterior margins armed with a series of setae, which are thicker along the anterior margin, apex near anterior margin, first marginal cell much longer than second, radial cell large, cubital petiole longer than radius, basal vein scarcely longer than cubital petiole,  $R_1$  obsolete distally,  $Rs$ , media and  $Cu_1$  running parallel in middle of wing.

Hind wings (**Fig. 70f**) relatively large, transparent, veins prominent, costal margin with a number of simple setae near base and a few hooked setae.

Abdomen small in female and moderately large in male, both tergites and sternites thickly beset with minute points and finely and sparsely with simple setae, which are present near the posterior border of tergites.

**Genitalia.** Male genital segment (**Fig. 70g**) about as long as abdomen, finely and coarsely pubescent; proctiger (**Figs. 70g, h**) about 0.38 mm long and longer than parameres, thickly beset with minute points, very narrow both basally and apically when viewed laterally, anterior margin nearly straight, posterior margin broadly convex between basal and apical areas, sometimes strongly inclined posteriorly, posterior margins bent deeply inwards, cephalad, outer surface beset with simple setae; parameres (**Figs. 70i, j**) about 0.28 mm long, somewhat slipper-shaped, outer surface beset sparsely with scattered fine setae, mesal surface armed with two kinds of setae, thick and long setae along the outer margin and near apex, while short, stout, somewhat dagger-shaped setae in middle and at base; hypandrium simple, of usual shape, having a few simple setae; outer arm of aedeagus relatively short, with a thick spoon end.

Female genitalia longer than abdomen, finely and sparsely pubescent (**Fig. 70k**); dorsal plate (**Fig. 70 l**) much longer than ventral, gently narrowed posteriorly into a moderately long, triangularly shaped apex, the ventral margin of the dorsal plate armed with a series of short, thick setae, circum-anal ring composed of a double ring of pores; ventral plate small, broad basally and narrow caudally with an acute apex; ovipositor scarcely exposed.

**Host plant.** Adults and nymphs feed between leaf curls of *Syzygium cumini* (L.) Skeels (= *Eugenia jambolana* Lam.).

**Type locality.** Dehra Dun (U.P.).

**Types.** Holotype male, Allotype female, from the type locality, June 7, 1950 (R.N. Mathur); Paratypes: 3 males, April 24, 1950; 18 females, April 28, 1950; 6 males

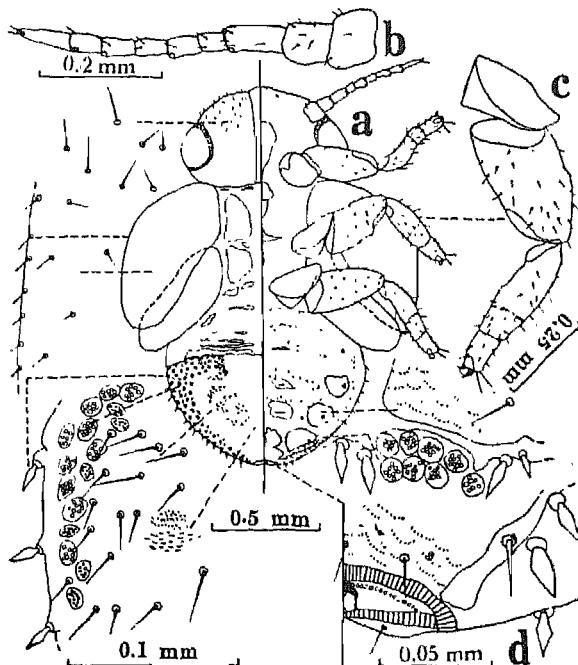


Fig. 71. *Euphyllura caudata*, sp. n.—a: fifth stage nymph; b: antenna; c: leg; d: circum-anal ring.

and 4 females, June 7, 1950; 1 male and 10 females, April 28, 1963; 9 males and 7 females, and 12 mixed sexes May 2, 1963, all from the type locality (R.N. Mathur). Additional specimens not designated as paratypes are: 38 examples, April 24, 1950, also from the type locality (R.N. Mathur). Some adults and nymphal stages were also preserved in alcohol. This preserved material, some slides having parts of adults and nymphal stages mounted on them and the type material are deposited at F.R.I., Dehra Dun. Six paratypes are also presented to I.A.R.I., New Delhi.

*Comparison.* This species has been described from a fairly good series of specimens. It differs from the other recorded species in shape of wings, having a broad dark band in anterior basal cell, second marginal cell smaller and in genital characters.

*Biological notes.* The adults and nymphs are commonly found on young flush of leaves, and by their feeding the leaves are curled up. The adults are sluggish in habits and nymphs feed in small clusters.

#### Nymphal stages

*Fifth stage.* (Fig. 71a). Length 2.0 mm. Of the psylline type; the wing-pads not produced forward, and projecting beyond the contour of the body, bluntly rounded posteriorly. Head well marked and separated from the thorax. Eyes small, bordered with a sclerotic rim. Derm membranous except the large sclerotic head plate, large

areas on the thorax, the wing-pads, small strip-like areas and a large posterior plate in the abdomen, as illustrated. Derm sparsely beset with simple ring-based setae, which are also arranged along the margin of wing-pads; the caudal sclerotic area strongly bearing, both dorsally and ventrally, simple pores arranged in definite bands throughout the entire border except antero-medianally, also small bands of clusters of pores sub-medianally, and beset with minute fringed processes and dagger-shaped setae along the posterior margin; posterior margin truncate, having the anal opening (**Fig. 71d**) in between which is enclosed within a very small pore-ring, the outer ring consisting of slit-like pores while the inner ring with small, more or less circular, indistinct pores.

Ventral side membranous throughout, except the anal plate, a small plate around each of the last four spiracles, and four pairs of small sub-median plates in the abdomen. Derm thickly beset with minute points and a transverse series of small, simple setae in the abdomen, sclerotic areas having fringed processes. Antennae (**Fig. 71b**) located partly ventrally, small and slender, about 0.54 mm long, nine-segmented, having a few setae, two basal segments broad and thick, 1st segment broadly transverse, 2nd longer than broad, 3rd and 9th segments longest and equal, 4th smallest, subquadrate, slightly longer than broad, 5th, 6th, 7th and 8th nearly equal, sensoria on 3, 5, 7 and 8 segments, apical joint with two setae. Legs (**Fig. 71c**) moderately large and stout, bearing a few setae, without trochanters, the femora not reaching the margin of body, tibio-tarsal articulation distinct, tarsus with two simple setae at apex; claws present with a minute empodium.

*Fourth stage.* Length 1.2 mm. Resembles the fifth stage, except in having smaller wing-pads and larger sclerotic plates on the dorsum, seven-segmented antennae, 3rd segment longest, with three sensoria, and tibio-tarsal articulation absent.

***Euphyllura concolor*, sp. n.**

(*Figs. 72, 73*)

Length of body, in male, 1.32 mm; in female, 1.55 mm

Length of forewings, in male, 1.41 mm; in female, 1.62 mm

Width of head with eyes, 0.70 mm

Width of vertex between eyes, 0.50 mm

Length of antennae, 0.50 mm

*Colouration.* General colour yellowish-orange or yellowish-brown, forewings pale-brown, venter dull white or pale-yellow, tip of antennae black, labium black.

*Structure.* Body small, moderately arched. Head (**Fig. 72a**) moderately deflexed, slightly broader than thorax, finely and sparsely pubescent, finely rugulose; vertex large, broader than long, about twice as broad as long, weakly rounded in front, emarginate over insertion of antennae, shallowly impressed on each side of median line, moderately emarginate on posterior margin; genal lobes small, finely and sparsely pubescent, about less than one-third as long as vertex, distinctly separated from vertex, tips of genae separately rounded slightly in front; anterior ocellus at base of genal lobes and at the end of front margin of vertex. Eyes large, strongly recessive and covering propleurites,

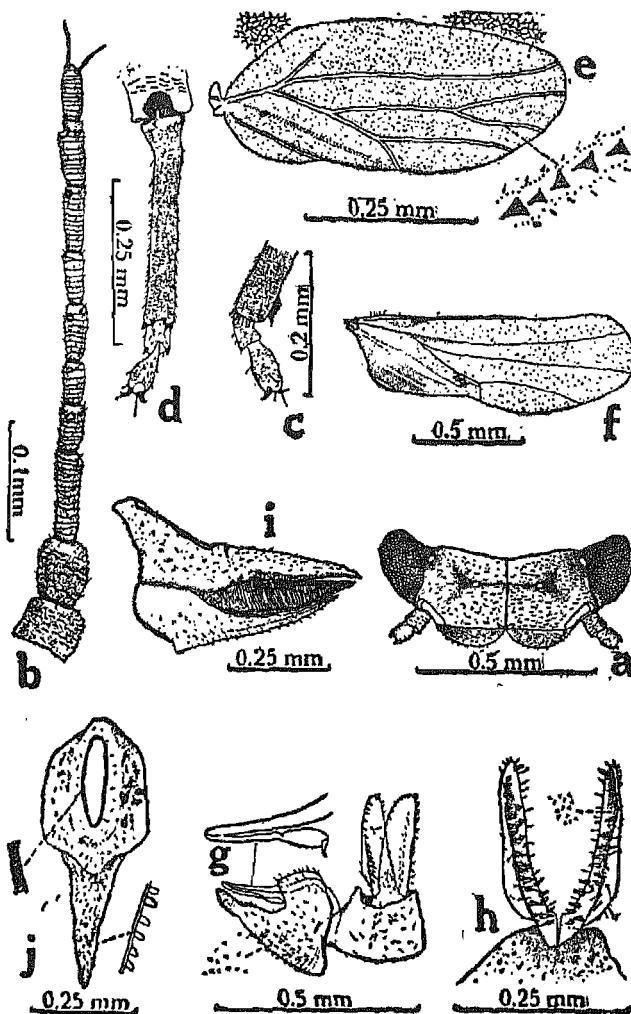


Fig. 72. *Euphyllura concolor*, sp. n.—a: head, front view; b: antenna; c: part of middle tibia and tarsal joints; d: hind tibia and tarsal joints; e: forewing; f: hind wing; g: male genitalia, lateral view; h: parameres, caudal view; i: female genitalia, lateral view; j: dorsal plate of female genitalia, dorsal view.

Antennae (Fig. 72b) short, ten-segmented, bearing a few setae, two basal segments large and robust, rugulose, 1st broadly transverse, subquadrate, 2nd slightly longer than broad and also longer than 1st, other segments long and slender, imbricate, 3rd segment longest, 4th half as long as 3rd, 5th smallest, 6th and 7th equal and slightly longer than 4th, 8th and 9th equal and each longer than 7th, apical segment as long as 5th, bearing two unequal terminal spines, sensoria present on 4, 6, 8 and 9 segments.

Thorax very broad, moderately arched, finely and sparsely pubescent, finely rugulose; pronotum broader than prescutum, slightly convex, descending, longer in middle and narrower laterally, with foveal impressions covered laterad with receding eyes; prescutum, scutum and scutellum resembling *E. caudata*.

Legs (**Figs. 72c, d**) comparatively stout, finely and sparsely pubescent, all femora rugulose, tibiae slightly longer than femora and beset with fine points arranged in lines (seen under high magnification), middle tibiae (**Fig. 72c**) with a series of dorsal setae just before apex, hind tibiae without basal spur, with five, small, black tooth-like spines at apex, and two small, black claw-like spines at apex on posterior basal tarsus, apical tarsal joint longer than basal, meracanthus extremely small, like a papilla.

Forewings (**Fig. 72e**) thick, somewhat like a parallelogram, coriaceous, opaque, slightly less than two and a half times as long as broad, membrane without any sclerotic markings, but rugulose in texture and thickly covered with minute points, basal and radial cells also bear small, scattered setae, apex narrowly rounded, first marginal cell a little longer than second,  $R_1$  obsolete distally, radial sector, media, forks  $M_{1+2}$  and  $Cu_1$  almost running parallel, cubital petiole slightly more than twice as long as radius, basal vein, cubital petiole and cubitus equal in length, anterior margin and all veins armed with minute setae.

Hind wings (**Fig. 72f**) relatively large, transparent, veins prominent, membrane uniformly beset with minute points, costal vein armed with a few simple and hooked setae.

Abdomen moderately large in male and smaller in female, finely and sparsely pubescent and also beset with minute points arranged in lines.

*Genititia.* Male genital segment (**Fig. 72g**) smaller than abdomen; proctiger (anal valve) about 0.42 mm long, slightly longer than parameres, distinctly demarcated into a broad basal portion and a long, somewhat cylindrical anal lobe, clothed with small, simple setae and minute points, in profile anterior margin slightly convex, posterior margin over middle two-thirds produced into rounded lobes and strongly emarginate subapically; parameres (**Fig. 72h**) about 0.27 mm long, each like a blade of knife, bearing simple setae on the outer surface, mesal surface armed with a thick and stout seta just below apex and a row of thick setae arranged along the mesal border and also with a few mesal setae and minute points; outer arm of aedeagus relatively shorter with a constricted spoon end; hypandrium simple, of usual shape, bearing a few simple scattered setae.

Female genitalia (**Fig. 72i**) longer than abdomen, sparsely pubescent, moderately thick at base and converging to an acute apex, dorsal plate (**Fig. 72j**) longer than ventral, notched in middle, and having rows of thick setae on the ventral margin in the posterior half, circum-anal ring composed of a double row of pores; ventral plate broad at base and narrow posteriorly and acutely pointed at apex; ovipositor scarcely exposed.

*Host plant.* Adults and nymphs feed between axils and flower buds of *Syzygium cumini* (L.) Skeels (= *Eugenia jambolana* Lam.).

*Type locality.* Dehra Dun (U.P.).

*Types.* Described from a small series of specimens. Holotype male; Allotype female, from the type locality and collected on February 17, 1953 (R. N. Mathur); Paratypes: 1 male and 6 females, February 28, 1951, 1 female, February 17, 1953,

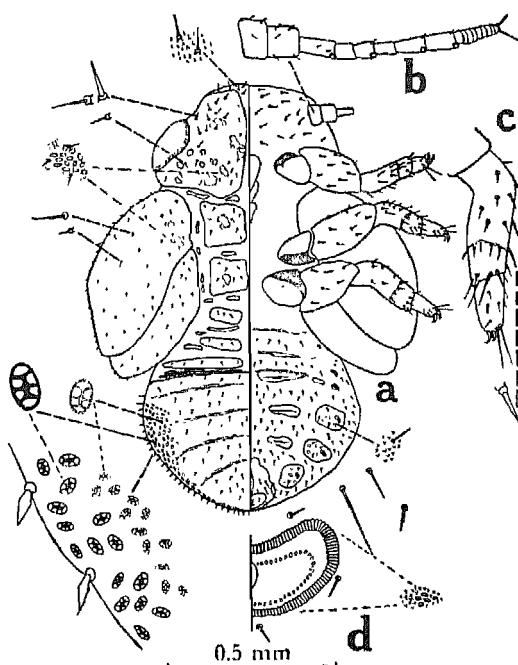


Fig. 73. *Euphyllura concolor*, sp. n.—a: fifth stage nymph; b: antenna; c: leg; d: circum-anal ring.

4 males and 6 females, April 26, 1963, all from the type locality (R. N. Mathur). Few adults of both sexes and nymphal stages were also preserved in alcohol (R. N. Mathur). Parts of male and female and nymphal stages were dissected and permanent mounts were made on slides. All types, preserved material and slides are deposited at F.R.I., Dehra Dun. Two paratypes (1♂, 1♀) are donated to the I.A.R.I., New Delhi.

*Comparison.* *E. concolor* is easily distinguishable by the shape of forewings, venation and genital characters. This species resembles in some characters with *Eurhinocola gravelyi* Crawford (1912, *Rec. Indian Mus.* 7: 422-423, Pl. xxxiii, Figs. G, H.; Pl. xxxiv, Fig. E; Pl. xxxv, Fig. T), but differs markedly in cephalic features and venation.

*Biological notes.* This species is generally found on the top flowering branches, feeding in the axils and flower buds. The adults are sluggish in habits and the nymphs produce waxy threads in small masses. The nymphal characters are described below.

#### Nymphal stages

Nymphs pale-yellow with head, thoracic and abdominal plates dusky, eyes pinkish-red. Body covered with dirty mass of cottony filaments.

*Fifth stage.* (Fig. 73a). Length 1.35 mm. Of the psylline type; the wing pads not produced cephalad and slightly projecting beyond the contour of the body, bluntly rounded posteriorly. Head clearly differentiated and separated from the thorax. Eyes

small, bounded with a sclerotic rim. Derm membranous, except the large sclerotic head plate, large thoracic plates, the wing pads, small, transverse plates in the abdomen, and a large posterior abdominal plate, as figured. Derm sparsely beset with simple ring-based setae and thickly with minute points, wing pads with small marginal setae, surface of sclerotic plates covered with weak sclerotic areas, the posterior abdominal plate bears at lateral borders clusters of oval-shaped pores, each consisting of six large loculi, and lanceolate setae present along the entire margin.

Ventral side membranous throughout, except the anal plate, a small plate around each of the last four spiracles, and four pairs of small, transverse, sub-median plates in the abdomen. Derm thickly beset with minute points and a transverse series of small, simple setae arranged inter-segmentally in the abdomen, sclerotic areas also bear fringed processes. Antennae (Fig. 73b) located ventrally, small, slender, about 0.4 mm long, apparently nine-segmented, having a few setae, two basal segments broad and stout, 3rd and last segments longest and equal, 4th smallest, subquadrate, 5th and 6th nearly equal, 7th and 8th equal, four sensoria on segments 3, 5, 7 and 8, apical segment with two setae. Legs (Fig. 73c) of moderate size, having a few thick setae, without trochanters, tibio-tarsal articulation distinct, tarsus with two simple setae at apex; claws present, with a minute empodium. Anus (Fig. 73d) ventral, surrounded by a double ring of pores, the outer ring with slit-like pores, the inner ring faintly represented, the pore-ring guarded by one anterior and two pairs of posterior setae.

*Fourth stage.* Length 0.95 mm. Differs from the fifth stage in having smaller wing-pads, large sclerotic plates, seven-segmented antennae, with three sensoria, and tibio-tarsal articulation absent.

*Euphyllura obsoleta*, sp. n.  
(Fig. 74)

Length of body, in male, 2.52 mm; in female, 3.12 mm

Length of forewings, in male, 1.12 mm; in female, 1.27 mm

Width of head with eyes, 0.55 mm

Width of vertex between eyes, 0.38 mm

Length of antennae, 0.55 mm

*Colouration.* (Specimens preserved in alcohol). General colour pale-yellow to yellowish-brown, with dark-brown bands on thorax, prescutum with a broad anterior band, scutum with two pairs of submedian longitudinal bands; wings sub-hyaline, speckled with pale spots in a reticulate pattern.

*Structure.* Body very small, robust, moderately arched. Head (Fig. 74a) large and broad, moderately declivous, slightly broader than thorax, finely and sparsely pubescent, rugulose, closely adpressed to thorax; vertex broader than long, about two and a half times as broad as long, disc somewhat plane or weakly swollen on either side of median suture with foveal impressions on each side of median line, roundly bent anteriorly, posterior margin slightly emarginate, anterior margin deeply emarginate or excavated over insertion of antennae, anterior ocellus visible in front, posterior ocelli slightly elevated; genae obsolete; frons visible from below. Eyes large, recessive. Clypeus visible in front.

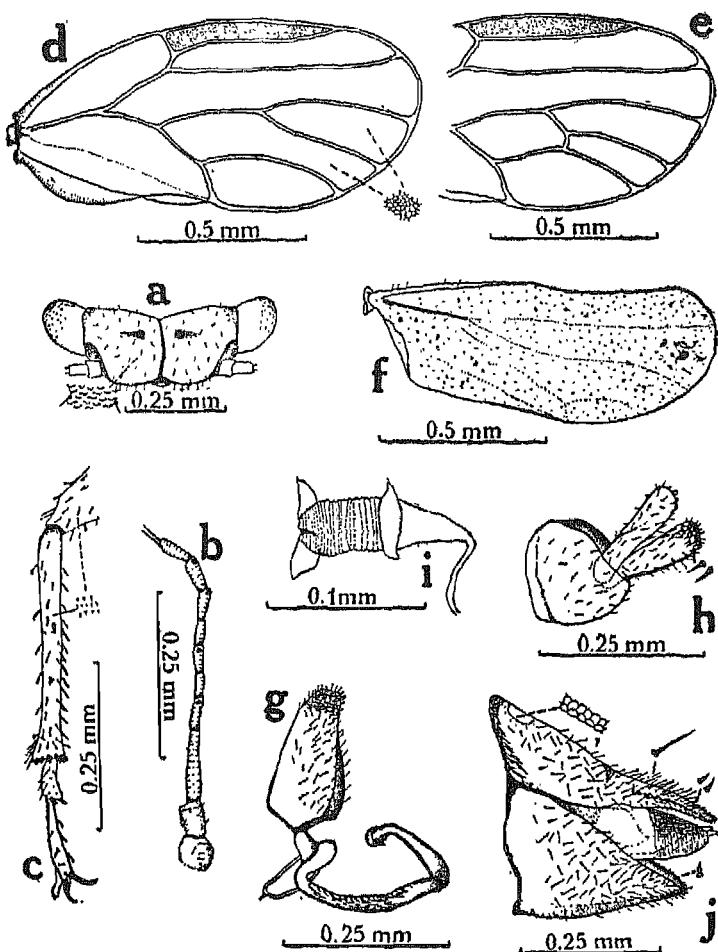


Fig. 74. *Euphyllura obsoleta*, sp. n.—a: head, front view; b: antenna; c: hind leg; d: forewing; e: part of forewing; f: hind wing; g: anal valve and aedeagus; h: hypandrium and parameres; i: sperm pump; j: female genitalia, lateral view.

Antennae (Fig. 74b) short, rather thick, imbricate, bearing few fine setae, ten-segmented, two basal segments robust, 1st somewhat quadrate, 2nd longer than broad, remaining segments slender, 3rd segment longest, 4th nearly half as long as 3rd, 5th, 6th and 7th equal but smaller than 4th, 8th, 9th and 10th equal to one another and each as long as 4th, terminal segment with two long, unequal setae at apex, four sensoria present on segments 4, 6, 8, and 9.

Thorax quite broad, robust, moderately arched, finely and sparsely pubescent, finely rugulose. Pronotum small, strongly deflexed behind head, ascending; pleurites mostly concealed by eyes; prescutum also deflexed and partly covered anteriorly by prothorax,

much broader than long, broadest in middle, posterior margin broadly convex, angulate laterally; scutum broader than prescutum, three and a half times as broad as long, narrower posteriorly, angulate laterally; scutellum small, transverse, broad anteriorly and narrow posteriorly.

Legs (**Fig. 74c**) short, pubescent and also beset with fine points, coxae small, femora shorter than tibiae, middle tibiae with a thick dorsal seta just below apex; hind tibiae without basal spur, with six or seven black, tooth-like spines at apex and two thick dorsal setae just below apex, basal tarsal segment smaller than apical, hind basal tarsal segment with two black claw-like spines at apex; mieracanthus very small, slender.

Forewings (**Fig. 74d**) oblong, sub-hyaline, about twice as long as broad, broadly rounded at apex, first marginal cell almost as long as but twice as broad as second along the posterior margin, pterostigma large and quite broad, radius (R) one and a half times as long as cubital petiole (M+Cu), basal vein as long as radius, cubitus as long as cubital petiole, veins somewhat running parallel and setigerous with microscopic setae. In one example, a cross vein present joining the fork  $M_{3+4}$  with Cu<sub>1</sub> (**Fig. 74e**).

Hind wings (**Fig. 74f**) small, thickly and uniformly beset with minute points, costal margin armed with a few simple and hooked setae, in basal half.

Abdomen small, slightly broader than long, finely and sparsely pubescent, finely rugulose.

*Genitalia.* Male genital segment (**Fig. 74h**) smaller than abdomen. Anal valve (proctiger) (**Fig. 74g**) about 0.22 mm long, longer than forceps; in lateral aspect, narrower both basally and apically, anterior margin nearly straight or weakly convex, posterior margin broadly convex, apical half sparsely beset with long setae, setae on lateral borders slightly longer; parameres (forceps) (**Fig. 74h**) about 0.18 mm long, club-shaped, narrow basally and broad apically, outer surface beset with a few simple setae, apical mesal surface armed with a group of 16 to 20 thick setae, directed downward and basal region bearing a group of small, simple setae, posterior margin with a small tooth just below apex; hypandrium (**Fig. 74h**) quite robust, of usual shape, sparsely beset with simple setae; outer arm of aedeagus (**Fig. 74g**) small, spoon end round; sperm pump as figured (**Fig. 74i**).

Female genital segment (**Fig. 74j**) smaller than or just as long as rest of abdomen, deflexed; dorsal plate longer than ventral, slender, sparsely pubescent, dorsal surface slightly depressed midway, tapering to a bluntly rounded apex, apical region with short setae which become more numerous and heavier along the ventral border, setae in middle longer, anal aperture surrounded by a double ring of pores; ventral plate sub-acute apically, sparsely beset with simple setae, setae small and heavier along the dorsal border; ovipositor acute, slightly bent downward.

*Host plant.* On young shoots of *Salvadora oleoides* Dene.

*Type-locality.* Changa Manga Plantation, Punjab (Pakistan). Fresh records are: Muktsar (Punjab); Ajmer, Pilani (Rajasthan); Delhi.

*Types.* Described from a small series. Holotype male; Allotype female, both from the type locality and collected on August 10, 1938, on *Salvadora oleoides*; Paratypes : 1 male and 5 females, data same (R. N. Mathur). Some specimens of this

species, preserved in alcohol and collected on 10.11.1968 from Muktsar, Punjab, (O. S. Bindra), were also received from the Entomologist, Punjab Agricultural University, Punjab. Part of this material has been incorporated in the collection at F.R.I., and two pairs (in alcohol) were returned to the Entomologist, in January 1970. All types and some slides having mounted parts of adults are deposited at F.R.I., Dehra Dun.

*Comparison.* *Euphyllura obsoleta*, sp. n. differs from other Indian species in shape and venation of forewings, obsolete genae and genital characters. With great reluctance, this species has been placed in the genus *Euphyllura* for the present.

*Biological notes.* This species was collected on the young and fresh bud of *Salvadora oleoides*, feeding there in cluster. The young leaves were somewhat curled up. The adults were not very active.

***Euphyllura olivina* Costa 1839**  
(Fig. 75)

*Thrips olivinus*

Costa, O. G. 1839. Monogr. degl.' insetti ospitanti sull' olivo e nelle olive, 2. ed., Napoli, p. 23-25, pl. I, fig. A, b, c, x (larvac).

*Euphyllura olivina*

Costa, O. G. 1857. Degl' insetti che attaccano l' olivo etc. pp. 35-42, pl. II B, fig. 3-4 (Larve auf *Olea europaea* L.).

Loew, F. 1882. Verh. zool.-bot. Ges. Wien. 32: 245.

Boyer de Fonscolombe, M. 1840. Annls. Soc. ent. Fr. p. 101, 111. (*Psylla olea*).

Oshanin, B. 1907. Verz. palaarkt. Hem. II, p. 390.

Aulmann, G. 1913. Psyllidarum Catalogus, Berlin, p. 67.

Hem Singh Pruthi and Batra, H. N. 1938. Bull. imp. Coun. agric. Res. No. 19, p. 14, (Biological notes).

Tuthill, L. D. 1943. Iowa State Coll. J. Sci. 17(4): 527-528.

Heslop-Harrison, G. 1946. Ent. mon. Mag. 82: 37.

Loginova, M. M. 1964. Inst. Biol. Acad. Sci. U.S.S.R. p. 448, pl. 202, figs. 9-12.

*Ephyllura oleae*

Foerster, A. 1848. Verh. naturh. Ver. preuss. Rheinl. 3: 93.

Flor, G. 1861. Bull. Soc. Nat. Moscou, p. 418, 420. (*Olea europaea* L.).

Meyer-Dur, 1871. Mitt. Schweiz. ent. Ges. 3: 403.

Ferrari, P. M. 1888. Ann. Mus. Civ. Genova (2) 6: 75 (*Olea europaea*).

Length of body, in female, 1.72 mm

Length of forewing, in female, 1.7 mm

Width of head with eyes, 0.78 mm

Width of vertex between eyes, 0.50 mm

Length of antenna, 0.51 mm

*Colouration.* General colour pale-green to apple green, apical segment of antenna black, legs pale yellow with greenish tinge, apical tarsal segments brown, forewings pale-brown and interspersed with small, numerous dark-brown maculae with clear spaces in between all over the surface.

*Structure.* Body small but robust, strongly arched. Head (Figs. 75a, b) broader than thorax, deflexed, finely and sparsely pubescent, finely punctate; vertex large, broad, about twice as broad as long, rather flat, with two pairs of shallow foveal impressions,

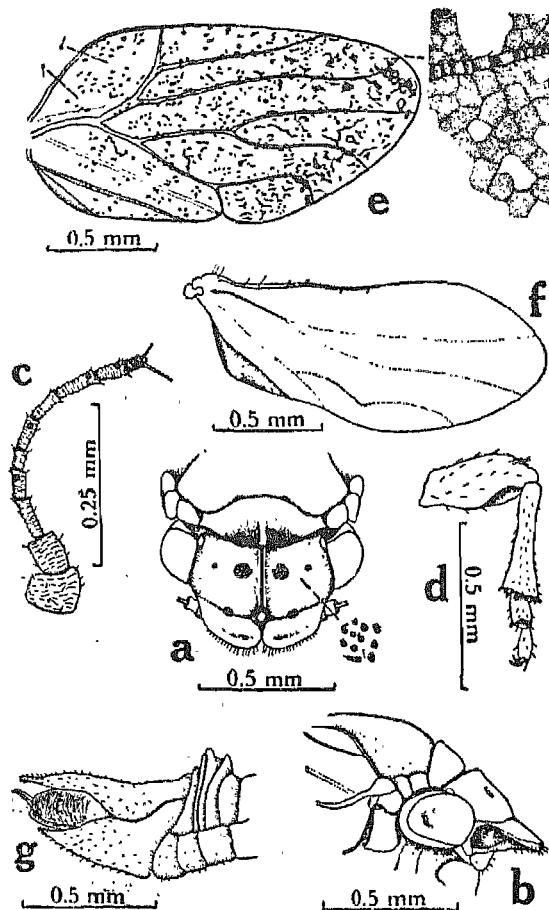


Fig. 75. *Ephyllura olivina* Costa.—a: head and a part of thorax, dorsal view; b: head and a part of thorax, lateral view; c: antenna; d: hind leg; e: forewing; f: hind wing; g: female genitalia and part of abdomen, lateral view.

posterior to centre and on each side of median suture, foveae near to median line larger, posterior margin moderately arcuate, anterior margin roundly emarginate above antennae, front ocellus visible from above; genal lobes sparsely pubescent, rectangular in shape, slightly smaller in width than vertex, not depressed from the level of vertex, contiguous on inner margin, separate and slightly rounded in front, anterior margin with longer setae. Eyes large, strongly recessive and covering propleurites.

Antennae (Fig. 75c) short, thick, arising beneath lateral edge of vertex bearing a few setae, ten-segmented, two basal segments robust, 1st subquadrate, 2nd cylindrical, as long as 1st, remaining segments imbricate, 3rd and 8th longest but equal, 4th, 6th, 7th and 9th equal to one another but smaller than 3rd, 5th smallest and about one-third

smaller than 4th, terminal segment slightly smaller than 9th, bearing two unequal setae at apex, four sensoria present on segments 4, 6, 8 and 9.

Thorax (**Fig. 75b**) short, robust, strongly arched, finely punctate, sparsely pubescent with small setae. Prothorax completely concealed by the head; prescutum small, descending, convexly rounded anteriorly, broad anteriorly and narrow posteriorly, about three and a half times as broad as long, lateral angles rounded; scutum large, broad, about twice as broad as long, broadest before middle, about twice as long as prescutum; scutellum somewhat vase-shaped, broad anteriorly, narrow posteriorly, anterior margin almost straight; post-scutellum of metathorax somewhat quadrate, rounded posteriorly.

Legs (**Fig. 75d**) small, stout, pubescent, femora thick and robust and smaller than tibiae, hind tibiae without basal spur, with six black teeth at apex, apex broad and thick, hind basal tarsal segment with two small, black claw-like spines at apex, basal tarsal segments smaller than apical; meracanthus small, thick, knob-like.

Forewings (**Fig. 75e**) small, thick, coriaceous and wrinkled, opaque, somewhat rhomboidal in outline, wholly constant in colour, maculated with small, numerous maculae, about twice as long as broad, broadest near base, narrowly rounded at apex, without pterostigma, marginal cells unequal, first cell small, second cell large and elongate, radial sector with loops and curved upward to costa, clavus large, cubital petiole nearly as long as radius, basal vein sinuate and longer than cubital petiole, veins armed with microscopic setae, minute setae also present in anterior basal cell.

Hind wings (**Fig. 75f**) almost as long as forewings, hyaline, transparent, membrane uniformly beset with minute points, costal vein armed with a few simple and hooked setae.

Abdomen small, sparsely pubescent; with posterior tergites produced as strong humps, setae longer on sternites.

*Genitalia.* Female genital segment (**Fig. 75g**) longer than abdomen; plates unequal, pubescent, dorsal plate longer than ventral, gradually narrowed caudally, acuminate at apex into a short, slender, rounded process turned upward, caudal end beset with a brush of minute setae; ventral plate broad basally and acutely pointed at apex; ovipositor acutely pointed and slightly exserted.

*Host plant.* On olive.

*Distribution.* Previously recorded from Spain, France, Italy, Austria, Yugoslavia, U.S.S.R., practically all over olive-growing regions.

In the collection of the Indian Agricultural Research Institute, New Delhi, are present two females, in poor condition, having this data: 1 female, from N.W.F.P., 18.4.35 (H.N. Batra) (1937/173-R. 8145); 1 female, from Tarnab Farm, Peshawar, 7.4.39 (H. N. Batra) (R. N. 205/R. 8144) (Pakistan). Both these specimens are from olive and determined by M. Bose.

*Comparison.* This species has been redescribed from two female specimens (in poor condition), loaned to me by the Indian Agricultural Institute, New Delhi. Its shape of forewing and venation are slightly different from the wing figured (257) and (9) by Tuthill (1943, pl. xv) and Loginova (1964, pl. 202) respectively. *E. olivina* has radius complete, unlike that of *caudata* and *concolor*, where radius is obsolete distally.

Genus **PSYLLA** Geoffroy 1972*Chermes*

Linnaeus, C. 1758. *Syst. Nat.* **10**: 453-455 (in part).

*Psylla*

Geoffroy, E. L. 1762. *Histoire Abregea des Insectes*, **1**: 482.

Scott, J. 1876. *Trans. ent. Soc. Lond.* p. 530

Loew, F. 1878. *Verh. zool.-bot. Ges. Wien.* **28**: 600, 608, t. 9, fig. 16-19.

Edwards, J. 1896. *Hem., -Hom. Br. Isl.*, p. 335, t. 2, fig. 29.

Froggatt, W. W. 1901. *Proc. Linn. Soc. N.S.W.* **26**: 243.

Kieffer, J. J. 1905. *Anz. Soc. Sci. Bruxelles* **29**: 164.

Oshanin, B. 1907. *Ver eichnis der Palaearktischen Hemipteren*, Vol. II, Lief. II, pp. 339-381, *Ann. e Mus. Zool. de l'Ac. imp. des Sc. Petersburg*, Bd. 12, p. 350.

Aulmann, G. 1913. *Psyllidarum Catalogus, Be lin.* p. 8.

Crawford, D. L. 1914. *Bull. U.S. natn. Mus.* **85**: 135-137.

Haupt, H. 1935. *Psylloidea, Tierwelt Mitteleur.* Vol. 4, p. X, 231.

Tuthill, L. D. 1943. *Iowa State Coll. J. Sci.* **17**(4): 455-457.

Vondracek, K. 1957. *Fauna C.S.R. Praha, Ceskoslovenska Akademie Ved. t. IX*, pp. 204-205.

Dobreanu, E. and Manolache, C. 1962. *Fauna Repub. pop. rom., Insecta, Homoptera, Psylloidea*, Vol. **8**, fasc. 3, pp. 168-169.

Miyatake, Y. 1963. *J. Fac. Agric. Kyushu Univ.* **12**(4): 331.

Loginova, M. M. 1964. *Inst. Biol. Acad. Sci. U.S.S.R.*, pp. 437-443, 457-472.

Loginova, M. M. 1964. *Proc. Inst. Zool. Acad. Sci. U.S.S.R.* **34**: 52-56, 71-107.

Loginova, M. M. 1967. *Annls. Zool. Warsz.* **24**(7): 427-461.

Klimaszewski, S. M. 1963. *Annls. Zool. Warsz.* **20**(20): 363-455.

*Psyllia*

Kirkaldy, G. W. 1905. *Entom. Ztg. Wien.* **24**: 268.

*Brachypsylia*

Crawford, D. L. 1914. *Bull. U.S. natn. Mus.* **85**: 129, 142.

*Labricia*

Enderlein, G. 1918. *Zool. Anz.* **49**: 318, 1921.

*Asphagiedella*

Enderlein, G. 1921. *Zool. Anz.* **52**: 120.

*Asphagis*

Enderlein, G. 1921. *Zool. Anz.* **52**: 120.

*Baeopelta*

Enderlein, G. 1926. *Ent. Mitt.* **15**(5/6): 399.

*Type species.* *Psylla alni* (Linn.) (= *Chermes alni* Linn. 1758). (original designation Geoffroy 1762).

Body variable in size. Head large, usually as wide as thorax or wider, triangular, transverse, more or less deflexed; vertex varies in shape, depressed discally; post-ocellar region usually elevated; occiput covered by pronotum, scarcely visible. Genal cones always present, variable in shape, and produced as more or less conical processes, often divergent, usually deflexed and depressed from plane of vertex. Frons covered by genae, not visible. Eyes large, prominent, semi-globose. Antennae typically ten-segmented, slender, always longer than width of head, often much longer, first two segments robust, segment third longest. Thorax robust, well arched, as broad as or broader than the head and eyes together. Pronotum narrow, collar shaped, more or less descending anteriorly, often vertical, not flat. Propleurites not equal at juncture with pronotum; pleural suture

oblique, extending to posterior edge of pronotum, or proepimeron not extending to pronotum at all. Prescutum long. Legs usually long and stout; hind tibiae often with a long or small basal spur, with 5 or 6 black apical spines; hind basal tarsal segment with a pair of black apical spines; meracanthus usually distinct, acute, projecting ventro-caudad or caudad. Forewings usually hyaline, transparent, sometimes maculated or flavus; long and broad, often elongate-ovate, rounded at apex; pterostigma distinct and long; cubitus and media always with a distinct petiole (cubital petiole), which is usually distinctly shorter than the basal portion of radius (discoidal subcosta); radial sector stout, seldom curving downward to any distance; clavus almost reaching apex of Cu<sub>2</sub>; veins beset with minute setae, usually biseriately; nerves stout. Male proctiger usually simple, sometimes produced caudad. Dorsal plate of female genitalia longer than ventral, usually broad basally and narrow or attenuate apically.

It is a very large genus and is widely distributed. Its members are subject to considerable variation, and, therefore, specific characters are difficult to outline. In the following key an attempt has been made to include 3 described species, viz. *P. cedrelae* Kieff., *P. zaicevi* Sulc. and *P. viburni* Loew. The two latter species are recorded for the first time from India. The identity of *P. simlae* Crawford could not be established. Eight species are new to science.

#### KEY TO THE SPECIES OF PSYLLA

- |  |                                   |
|--|-----------------------------------|
| 1. Antennae small and thick . . . . .  | 2                                 |
| —. Antennae long and slender . . . . .   | 3                                 |
| 2. Cubital petiole longer than cubitus . . . . .   | <i>P. hyalina</i> , sp. n.        |
| —. Cubital petiole almost as long as cubitus . . . . .   | <i>P. oblonga</i> , sp. n.        |
| 3. Forewings maculated . . . . .   | <i>P. quadrimaculata</i> , sp. n. |
| —. Forewings hyaline or with flavus tinge, transparent . . . . .   | 4                                 |
| 4. Radius almost or as long as cubital petiole . . . . .   | 5                                 |
| —. Radius longer than cubital petiole . . . . .  | 6                                 |
| 5. Forewings oblong-ovate . . . . .  | <i>P. eastopi</i> , sp. n.        |
| —. Forewings oblong . . . . .  | <i>P. bengalensis</i> , sp. n.    |
| 6. Forewings longer than 3·5 mm . . . . .  | 7                                 |
| —. Forewings smaller than 3·5 mm . . . . .   | 8                                 |
| 7. Veins of forewings conspicuously hairy; pterostigma long and narrow; hind tibiae without basal spur . . . . . | <i>P. cedrelae</i> Kieff.         |
| —. Veins not hairy as above; pterostigma small; hind tibiae with a strong basal spur . . . . .                   | <i>P. longigena</i> , sp. n.      |
| 8. Hind tibiae without basal spur . . . . .  | 9                                 |
| —. Hind tibiae with a basal spur . . . . .   | 10                                |
| 9. Genal cones thick and notched and weakly impressed in middle; pterostigma long . . . . .                      | <i>P. murrayi</i> , sp. n.        |
| —. Genal cones simple, not notched; pterostigma small . . . . .  | <i>P. santali</i> , sp. n.        |
| 10. Vertex strongly rounded; genal cones thick and approximate . . . . .   | <i>P. near simlae</i> Crawf.      |
| —. Vertex not rounded as above; genal cones divergent . . . . .  | 11                                |
| 11. Pterostigma short and broad . . . . .  | <i>P. zaicevi</i> Sulc.           |
| —. Pterostigma long and narrow . . . . .   | 12                                |
| 12. First marginal cell longer than second . . . . .   | <i>P. viburni</i> Loew.           |
| —. First marginal cell as long as second . . . . .   | <i>Psylla</i> sp. 1               |

*Psylla bengalensis*, sp. n.

(Figs. 76, 77)

Length of body, in male, 2.15 mm; in female, 2.7 mm

Length of forewings, in male, 1.90 mm; in female, 2.15 mm

Width of head with eyes, 0.65 mm

Width of vertex between eyes, 0.34 mm

Length of antennae, 1.32 mm

*Colouration.* (Specimens preserved in alcohol). General colour yellowish-brown with greenish tinge; antennae pale-yellow with apices of segments 3 to 8 and two apical segments black; wings hyaline and transparent.

*Structure.* Body moderately large. Head (**Fig. 76a**) declivous, slightly smaller than thorax, finely and sparsely pubescent, finely reticulate; vertex large, broader than long, gradually rounded in front, with two foveal impressions, one on each side of median suture, posterior to centre; posterior margin emarginate; anterior margin emarginate at the point of excision; post-ocellar region slightly swollen; anterior ocellus visible in front; genal cones large, about 0.22 mm long, deflexed vertically downward, separate but approximate, divergent distally, almost as long as vertex, subacute at apices, setae longer than that on vertex, and also beset with fine points arranged in lines, two setae much longer near apex. Eyes small, bulging.

Antennae (**Fig. 76b**) long and slender, except two basal segments which are robust, 1st broadly transverse, 2nd quadrate, slightly smaller than 1st, remaining segments slender, bearing simple setae, imbricate, 3rd longest, about one and a half times as long as 4th, 5th smaller than 4th, 6th, 7th and 8th equal to one another, slightly longer than 5th but slightly smaller than 4th, 9th and 10th equal, and each about half as long as 4th, terminal segment with two unequal spines at apex, four sensoria present on segments 4, 6, 8 and 9.

Thorax large, moderately arched, finely and sparsely pubescent; prothorax large, convexly rounded anteriorly, with two foveal impressions on each lateral side; prescutum broader than long, broadest beyond centre, gradually narrowed anteriorly, angulate both laterally and posteriorly; scutum a little longer than prescutum, a little more than twice as broad as long, angulate laterally and posteriorly; scutellum small, broadly transverse; post-scutellum of metathorax with three ridges, middle ridge black at top and stronger than lateral ridges.

Legs (**Fig. 76c**) moderately long, pubescent and also beset with minute points arranged in linear series; all tibiae longer than femora, each bearing an apical comb of setae; hind tibiae without basal spur, with five black tooth-like spines at apex; hind basal tarsus with two claw-like spines at apex, basal tarsal joint smaller than distal joint; meracanthus large, triangular.

Forewings (**Fig. 76d**) large, a little more than twice as long as broad, apex narrowly rounded; pterostigma large and broad; radial sector slightly deflexed downward in the apical half; radius as long as cubital petiole,  $R_1$  half as long as radius, basal vein as long as  $R + R_1$ , marginal cells unequal, first longer than second, veins armed with black setae,

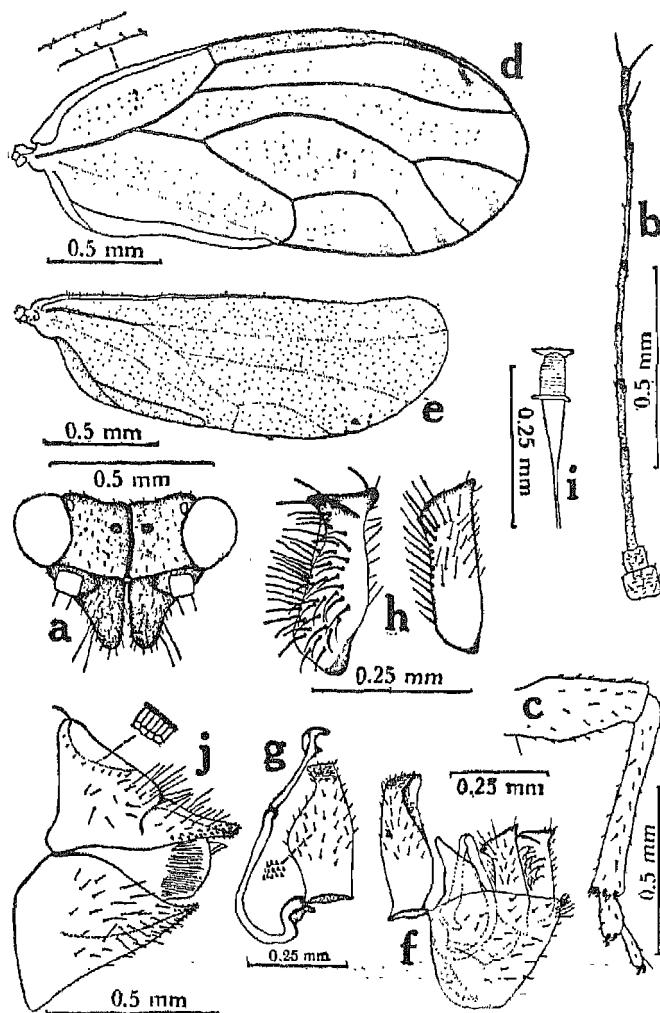


Fig. 76. *Psylla bengalensis*, sp. n.—a: head, front view; b: antenna; c: hind leg; d: forewing; e: hind wing; f: male genitalia, lateral view; g: anal valve and aedeagus, lateral view; h: parameres, mesal and outer surfaces; i: sperm pump; j: female genitalia, lateral view.

in membrane beset with minute points.

Hind wings (Fig. 76e) slightly smaller than forewings, membrane thickly beset with minute points, the basal half of the costal margin bearing a few simple and hooked setae.

Abdomen longer than broad, finely and sparsely pubescent and also beset with fine points arranged in lines.

**Genitalia.** Male genital segment (Fig. 76f) smaller than abdomen. Proctiger (Fig. 76g) about 0.38 mm long, longer than parameres, pear-shaped in anterior view, bearing

scattered simple setae and also beset with minute points arranged in lines; in profile, anterior margin nearly straight to weakly convex, posterior margin broadly convex, truncate at apex; parameres about 0.27 mm long (**Fig. 76h**) in lateral aspect, posterior margin almost straight, emarginate below apex both anteriorly and posteriorly, apex black, abruptly broadened out somewhat as T-shaped, posterior process broadly rounded while the cephalad process acutely pointed, in caudal view sides sub-parallel, broader basally and bowed at top, outer surface bearing scattered simple setae, mesal surface thickly beset with heavier setae pointing downward, marginal setae longer and thicker; hypandrium simple, of usual shape, but having an erect, long finger-like process on each dorsal side; outer arm of aedeagus (**Fig. 76g**) smaller than basal, with an arc-shaped spoon end, sperm pump as figured (**Fig. 76i**).

Female genitalia (**Fig. 76j**) smaller than abdomen, pubescent, plates unequal, dorsal plate longer than ventral, constricted beyond middle into two regions, broad basal and acuminate apical, apex narrowly rounded and armed with minute peg-like setae, setae longer in centre, circum-anal ring consisting of a double row of pores; ventral plate broad basally and acutely pointed at apex; ovipositor acutely pointed.

*Host plant.* On *Cedrela toona* Roxb.

*Type locality.* Pashok forest, Kalimpong (W. Bengal).

*Types.* Described from a few examples, in poor condition. The parts of male and female are mounted on slides. Holotype male and Allotype female, from the type locality, and collected on 9.7.1965 (V.R. Phalak) (on slides). One female specimen, in poor condition and few nymphal stages were preserved in alcohol, data same. A few nymphal stages were also mounted on slides.

*Comparison.* This species (*bengalensis*) differs from other species, in having longer antennae, shape of wing, radius and cubital petiole almost equal, cubitus longer than cubital petiole, genae long and thick, and characteristic genital structures.

*Biological notes.* This species appears to be rare and nothing is known about its life-history and economic importance. Its nymphal stages are described below.

#### Nymphal stages

*Fifth stage.* (**Fig. 77a**). Length 1.38 mm (on slide). Typical psylline form. Head narrower than abdomen. Eyes large, each bearing one seta. Wing-pads large and extend beyond the general margin of body. Dorsum with the derm largely membranous, except the wing-pads, a pair of large head plates, small plates in the thoracic region, small strip-like plates in the anterior half and a large single plate in the posterior half of abdomen. Derm beset with scattered, simple or thick setae, varying in length. Margin of wing-pads and abdomen armed with a series of simple or thick and few weakly spatulate setae, of different length; hind wing-pads also bear similar setae and one lanceolate seta at the distal end; posterior margin of abdomen angulated, having four pairs of lanceolate setae, one seta at each angle; all marginal setae borne on minute tubercles.

Ventral side membranous throughout, except for a small area below the antennae, a long patch in the forewing pad, thin slender areas in the anterior part, a small caudal plate and three small plates around spiracles in the abdomen. Derm beset with small,

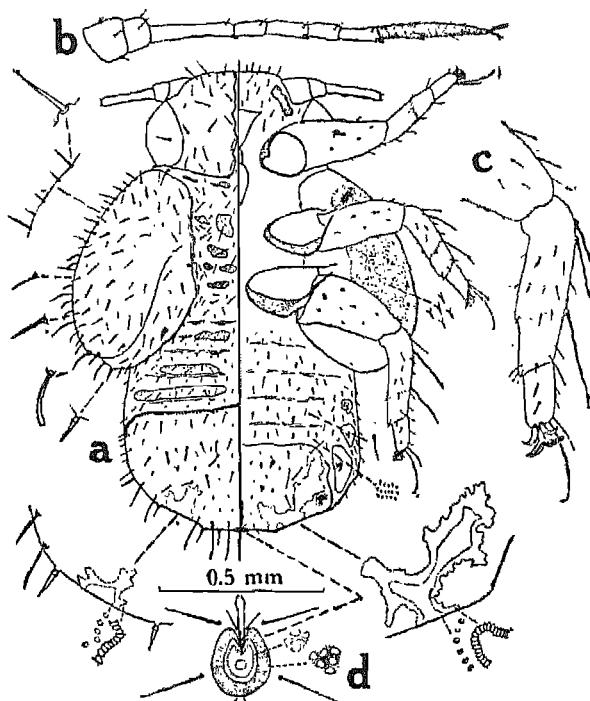


Fig. 77. *Psylla bengalensis*, sp. n.—a: fifth stage nymph; b: antenna; c: hind leg; d: anal aperture.

simple setae and also with microscopic points; these points becoming prominent and thicker in the forewing patch. Antennae (Fig. 77b) long and slender, about 0.72 mm long, eight-segmented, bearing few simple setae, apical segment black, imbricate, 1st segment broadly transverse, 2nd subquadrate, 3rd long but smaller than apical, 4th small, 5th and 7th equal and each half as long as 3rd, 6th slightly smaller than 5th and slightly longer than 4th, 8th longest bearing two unequal setae at apex, four sensoria present on segments 3, 5, 7 and 8.

Legs (Fig. 77c) moderately large, bearing simple setae, without trochanters; with tibio-tarsal articulation distinct; each middle and hind tibiae with two long slender setae; each tarsus with one golf club and one simple seta at apex; claws present, pulvillus petiolate, fish-tail like. Anal opening (Fig. 77d) situated at the extreme tip of the body and surrounded by a small, broad double band of pores, outer band more sharply defined than the inner band, aperture guarded by two anterior and two posterior pairs of setae; circum-anal pore ring much expanded, consisting of an extremely sinuous and narrow bands of double row of pores, and extending on both dorsal and ventral sides, outer row of slit-like pores clearly defined while the inner row is poorly differentiated.

*Fourth stage.* Length about 1.07 mm (on slide). Resembling the fifth stage, except in smaller size, smaller wing-pads, broader thoracic plates, tibio-tarsal articulation

absent; antennae five-segmented, with three sensoria; marginal setae somewhat spatulate.

**Psylla cedrelae** Kieffer 1905  
(Figs. 78, 79)

Kieffer, J. J. 1905. *Ann. Soc. Sci. Bruxelles*, p. 174, fig. 11; pl. II, fig. 20 (Bengal).  
Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26(6): 623 (Bengal).

Length of body, in male, 2.42 mm; in female, 2.51 mm

Length of forewings, in male, 3.60 mm; in female, 3.80 mm

Width of head with eyes, 0.80 mm

Width of vertex between eyes, 0.45 mm

Length of antennae, 1.85 mm

*Colouration.* General colour yellowish-brown, with purplish tinge on thorax, longitudinal bands on thorax purple, antennae and labium black, legs partly blackish-brown, tarsal segments darker, wings transparent, hyaline, veins dark-brown, occiput of head black.

*Structure.* Body robust. Head (Fig. 78a), including eyes, smaller than thorax, strongly deflexed, sparsely pubescent with long hairs; vertex about two and a half times as broad as long, swollen, rounded downward above level of antennae, posterior margin moderately emarginate, post ocelli elevated, anterior margin strongly invaginated in front over anterior ocellus; frons visible as a small sclerite, bearing front ocellus, which is visible in front; genal cones large, about 0.18 mm long, slightly shorter than vertex, broad at base, conical, vertical, sparsely pubescent with long hairs, separate and rather divergent at apex, curved outward and subacute at apex, scarcely visible directly from above, each cone with a long hair arising ventrally near apex. Eyes not very large, somewhat hemispherical. Beak large, protruding out between legs.

Antennae (Fig. 78b) long and slender, ten-segmented, longer than the width of head including the eyes, finely and sparsely pubescent, two basal segments robust, 1st broadly transverse, 2nd subquadrate, slender, segments imbricate, 3rd segment longest, 4th, 7th and 8th equal to one another but each smaller than 3rd, 5th and 6th equal but smaller than 4th, 9th and 10th smallest, terminal segment with two unequal spines at apex, four sensoria present on segments 4, 6, 8 and 9.

Thorax large, strongly arched, somewhat shining, pubescent with long hairs, weakly rugulose (visible under high magnification). Prothorax small, strongly descending cephalad, narrowly and convexly rounded, with two foveal impressions on each side; prescutum somewhat subtriangular, broadest posteriorly, narrowly rounded cephalad, about one and three-fourths times as broad as long, posterior margin invaginated medially; scutum large, depressed dorso-medianally, thus forming a shallow longitudinal channel, about twice as broad as long, broadest in middle, slightly longer than prescutum, angulate laterally; scutellum large, transverse, about two and a half times as broad as long, broad anteriorly and narrow posteriorly, with prominent antero-lateral angles; metascutellum large, transverse, with a conical epiphysis dorsad on each side.

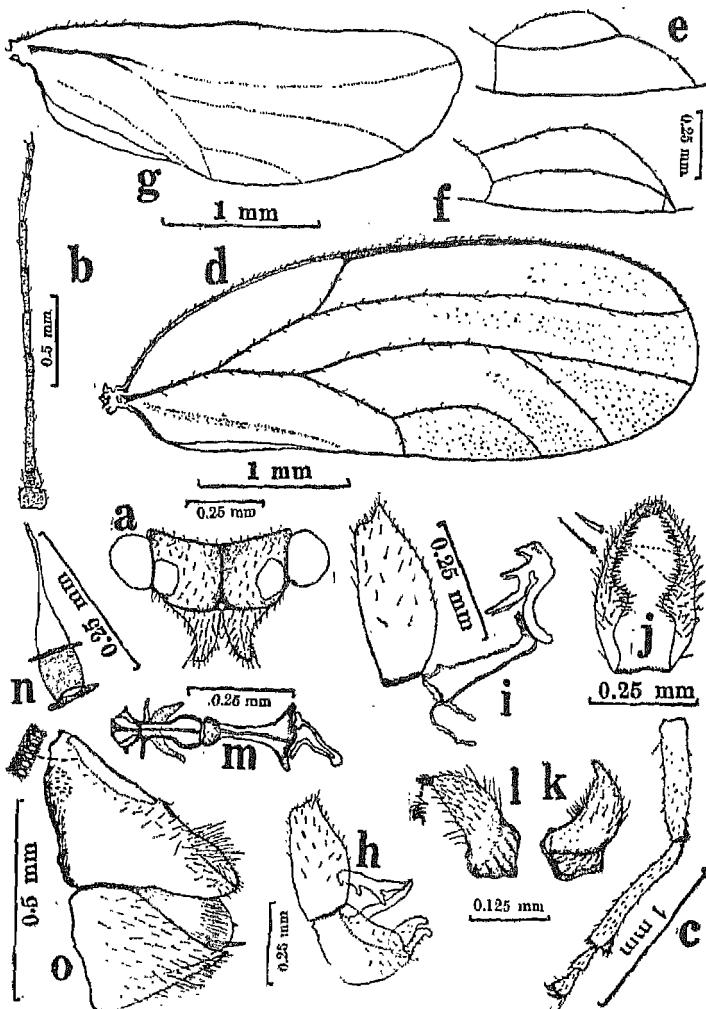


Fig. 78. *Psylla cedrelae* Kieffer—**a**: front view of head; **b**: antenna; **c**: hind leg; **d**: forewing; **e**, **f**: part of forewings of male, showing formation of extra cells; **g**: hind wing; **h**: male genital segment; **i**: lateral aspect of anal valve and aedeagus; **j**: posterior view of anal valve; **k**: outer view of forceps; **l**: mesal view of forceps; **m**: aedeagus; **n**: sperm pump; **o**: female genital segment, lateral aspect.

Legs (Fig. 78c) relatively large, pubescent, tibiae longer than femora, hind femur armed with a bunch of long, thick, dorsal setae near apex, hind tibiae without basal spur, with 7 to 8 black tooth-like spines at apex, all tibiae bearing an apical comb of setae, apical tarsal segment slightly longer and thicker than basal segment of fore and middle legs, while they are of equal length in hind leg, meracanthus large and conical.

Forewings large (Fig. 78d), elongate-ovate, slightly more than two and a half times

as long as broad, rounded at apex, pterostigma long and narrow, stem R longer than cubital petiole, media and radial sector running parallel,  $R_s$  slightly flexed up near apex, cubital petiole slightly smaller than cubitus, basal vein and cubitus almost equal, first marginal cell smaller than second in length, but broader than the latter along the posterior margin, veins armed with long hairs. In one male specimen, the first marginal cell in both forewings divided transversely across the middle, forming an extra cell (**Figs. 78e, f**). In another example, the fork  $M_{3+4}$  is absent.

Hind wings (**Fig. 78g**) also large, having a number of simple and hooked setae in the basal half of costal margin, membrane beset uniformly with minute points.

Abdomen large, longer than broad, venter sparsely beset with long hairs.

*Genitalia.* Male genital segment smaller than abdomen (**Fig. 78h**). Anal valve (**Figs. 78i, j**) longer than forceps, about 0.38 mm long, outer surface covered sparsely with simple setae; in profile, anterior margin weakly convex, posterior margin strongly convex, converging toward tip, in caudal view, the posterior margin is produced caudad into small flaps on each side in the basal half, each flap is folded inward, posterior margin thickly beset with stout setae; parameres about 0.18 mm long, much smaller than proctiger, arcuate inward, broad basally, narrow apically (**Figs. 78k, l**), sinuate, apex black, abruptly narrowed and finely denticulate, both outer and mesal surfaces armed with simple setae, marginal setae slightly longer; hypandrium simple, of usual shape, sparsely bearing setae; outer arm of aedeagus peculiarly shaped like an emerging nymph, having three pairs of small limbs (**Figs. 78i, m**).

Female genital segment much smaller than abdomen. Both plates (**Fig. 78 o**) broad at base, narrow caudally, sparsely pubescent, dorsal plate slightly longer than ventral and roundly pointed at apex, apical region armed with a bunch of long setae, anal opening quite large, triangular in shape when seen dorsally, surrounded by a double row of pores and guarded by small setae; ventral plate acutely pointed at apex; ovipositor small, acutely pointed.

*Host plant.* On young twigs and leaves of *Cedrela toona* Roxb. and *Chukrasia velutina* Roemer.

*Distribution.* Previously recorded from Bengal (Kieffer, 1905). Further records are from Dehra Dun, Naini Tal (U.P.) and Kalimpong (W. Bengal).

*Material examined.* This species is redescribed from a small series of both sexes, collected from New Forest, Dehra Dun; 4 males and 7 females, April 1947 (R.N. Mathur); 1 male and 1 female, 16.2.52, Dehra Dun, 3 males and 2 females, 2.2.53, 1 male of 6.2.53., all from Dehra Dun (R.N. Mathur). Various parts of adults and some nymphal stages were also mounted on slides, and some adults and nymphs of 15.2.52 and 9.2.53 were preserved in alcohol (in two phials). All this material has been deposited at F.R.I., Dehra Dun.

This species is also represented by 3 males and 1 female, from Jeolikote, Naini Tal (U.P.), collected on 2.1.51 (67/51) on toon leaves (*Cedrela toona*) (Z.A. Siddiqi); and also few adults and nymphs collected from Kalimpong (W. Bengal) on 23.6.66 (on *Cedrela toona*) (V. R. Phalak) (preserved in alcohol).

Two specimens have been donated to I.A.R.I., New Delhi.

*Comparison.* I have tried to ascertain the deposition of Kieffer's types, from all sources, but their whereabouts is not known. However, I have collected and examined three species on *Cedrela toona*, from Dehra Dun, U.P. and Kalimpong (W. Bengal). Recently, I consulted Dr V.F. Eastop of the British Museum and he has also examined the examples of two species sent to him and collected on *Cedrela toona*. He has agreed with me that the species redescribed above is *Psylla cedrelae* Kieffer. Dr Eastop writes (*in litt.*). "The ♂ genitalia are certainly much more like Kieffer's figure than the previous sample. I do not see anything that differs seriously from the description when the variation in pigmentation with age of psyllids is considered. I think your new sample should be called *Psylla cedrelae* Kieffer and your previous sample should be described as new, otherwise they will remain confused."

This species is distinguishable by the shape of head, wing venation and genitalic characters. Its long wings, antennae and genital structures are characteristic features.

*Biological notes.* This is a free-living species and is commonly found on young leaves and twigs of *Cedrela toona*, during February-April, at Dehra Dun. The nymphs move about actively, carrying waxy filaments sticking out from their body (Plate 2a). Nymphal stages are described below.

#### Nymphal stages

Mature nymphs pale-yellow with greenish tinge, eyes pinkish-red, tip of antennae blackish.

*Fifth stage.* (**Fig. 79a**) Length 1.7 mm. Of psylline type; wing-pads extending beyond the contour of the body, not extending at humeral angle. Head large, smaller than the width of abdomen. Eyes small. Derm membranous, except the large sclerotic head plates, very small thoracic areas, wing-pads, and the very large caudal area which occupies nearly half the abdomen, as figured. Derm beset with simple as well as dagger-shaped setae of various length; each anterior wing-pad with a marginal row of stout dagger-shaped setae and also with thick points; each hind wing with the same type of setae, about seven in number on the distal margin. The pore areas on the caudal sclerotic plate consist of two pairs of separate, large curved bands which are composed of many small pores. The anterior bands are mainly dorsal in position, while the posterior bands are located both on the dorsal and ventral sides of the body. Another pair of similar type of bands, somewhat weakly defined, is present below them. The caudal plate also bears small, dagger-shaped setae in small clusters.

Ventral side membranous throughout, except for the weak sclerotic areas at the base of the antennae, small areas around each spiracles and a small caudal area in the abdomen. Derm beset with both simple and slightly thick setae of various length. Antennae (**Fig. 79b**) situated ventrally, about 1.08 mm long, seven-segmented, imbricate, sparsely pubescent, segments 2 to 7 inclusive bearing short, stout dagger-shaped setae, 3rd and apical segments longest and equal, 4th segment about half as long as 3rd, 5th and 6th segments equal and smaller than 4th, four sensoria present on 3, 5 and 7 segments, 3rd and 7th segments show imperfect segmentations, apical segment with two terminal setae. Legs relatively long, having simple setae, without trochanter, femora longer than

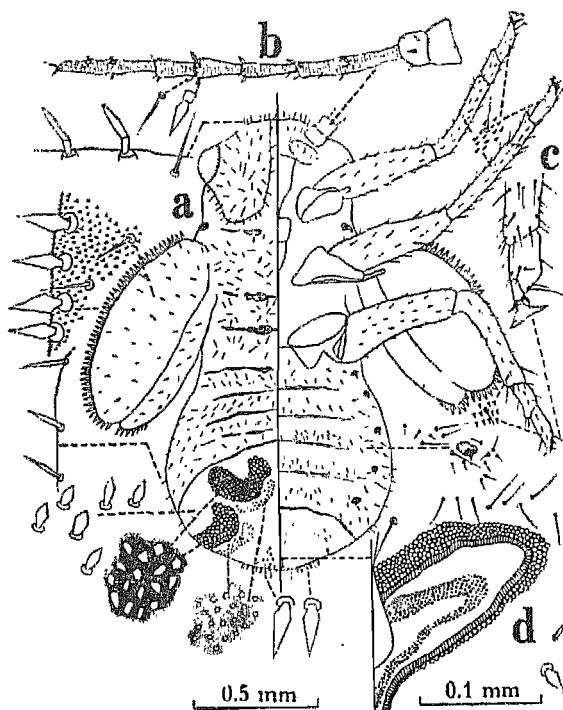


Fig. 79. *Psylla cedrelae* Kieffer—**a**: fifth stage nymph; **b**: antenna; **c**: part of leg; **d**: anal opening with circum-anal ring.

tibiae, tibio-tarsal articulation distinct (Fig. 79c), each tarsus with two dorsal setae (one hick and the other simple) near apex, except in the foreleg in which both setae are simple; claws present, pulvillus large, triangular, fish-tail like and petiolate. Anal opening (Fig. 79d) at tip of abdomen, surrounded by circum-anal pore ring, occupying partly dorsal and ventral sides. This pore-ring is greatly enlarged, consisting of numerous minute circular pores, with a single row of slit-like pores along its inner margin. Enclosed within this ring is a secondary ring composed of very minute and inconspicuous pores.

*Fourth stage.* Length 1.00 mm. Similar to fifth stage but differs in size, smaller wing pads, 5-segmented antennae bearing three sensoria, tibio-tarsal articulation absent, each hind wing with 4 to 5 dagger-shaped setae on distal margin.

*Third stage.* Length 0.77 mm. Smaller in size, having smaller wing pads, 3-segmented antennae with two sensoria, each hind wing pad with two dagger-shaped setae and one simple seta on distal margin.

#### *Psylla crataegi* (Schrank) 1801

*Chermes crataegi*

Schrank, F. 1801. *F. boic.* II, p. 142.

*Psylla crataegi*

- Loew, F. 1882. *Verh. zool.-bot. Ges. Wien.* 32: 235.  
 Reuter, O. M. 1876. *Medd. F. F. Fenn.* 1: 63 (Biology).  
 Reuter, O. M. 1881. *Ent. Tidskr.* 2: 155.  
 Frauenfeld, V. 1864. *Verh. zool.-bot. Ges. Wien.* p. 691, pl. XIV.  
 Kaltenbach, J. H. 1874. *Panzenfeinde*, p. 213, No. 99.  
 Loew, F. 1877. *Verh. zool.-bot. Ges. Wien.* 27: 131.  
 Loew, F. 1879. *ibid.* 29: 571, pl. 15, fig. 17 (nymph).  
 Férrari, 1888. *Ann. Mus. Civ. Genova* (2), 6: 75.  
 Dalla Torer, 1892. *Ber. nat. med. Ver. Innsbruck* t. 20, p. 118.  
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 Oshanin, B. 1907. *Verz. palaarkt. Hem.* 2: 353.  
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 Dobreanu, E. and Manolache, C. 1962. *Fauna Repub. pop. rom. Insecta*, 8, fasc. 8, Homoptera, Psylloidea, pp. 207-209, fig. 142-43.  
 Klimaszewski, S. M. 1963. *Annls. Zool., Warsz.* 20(20): 443-445, figs. 380-390.  
 Loginova, M. M. 1966. *Papers, Moldavia Res. Inst. Gardening, Grape-farming and wine making, Mini. Agric. U.S.S.R., Moldavia*, pp. 143.

*Psylla costatopunctata*

- Foerster, A. 1848. *Verh. naturh. Ver. preuss. Rheinl.* 3: 76.  
 Meyer-Dur, R. 1871. *Mitt. Scheueiz. ent. Ges.* 3: 396.  
 Scott, J. 1876. *Trans. ent. Soc. Lond.*, p. 547, pl. VIII, fig. 8.  
 Reuter, O. M. 1881. *Ent. Tidskr.* 2: 154.

*Psylla ferruginea*

- Foerster, A. 1848. *Ent. Tidskr.* p. 79.  
 Meyer-Dur, R. 1871. *ibid.* p. 396.  
 Scott, J. 1876. *ibid.* p. 546-47, fig. 7.

This species is not present in the collection studied by the author and, therefore, not included in the key. Its brief description is outlined below.

Its colour varies from reddish-yellow to pale brownish-red, with pale yellowish-white to dark brown-red streaks on thorax; antennae yellow with apices of segments 4th to 8th and two apical segments black; legs yellow or reddish-brown; wings clear, transparent, veins pale-yellow, pterostigma yellow or clear chocolate-brown, branch Cu<sub>1</sub> and apex of clavus brown or black. Head twice as broad as long, rounded downward in front; posterior margin concave. Genal cones large, broad basally and bluntly rounded apically, pubescence longer than on vertex. Venation of wings and genitalia characteristic.

*Distribution.* *P. crataegi* (Schr.) has a wide range of distribution throughout Europe

and is commonly found on *Crataegus oxyacantha* L. From India, it has been reported to occur at Naini Tal (U.P.), 2,135 m, on a species of *Crataegus*, in March 1945 (Heslop-Harrison, 1946).

**Psylla eastopi, sp. n.**

(Fig. 80)

Mathur, R. N. 1950. *Entomologists' mon. Mag.* (4), 86 (128): 226-27, figs. 1-3 (Nymphal stages, under *P. cedrelae* Kieff.)

Length of body, in male, 1.92 mm; in female, 2.32 mm

Length of forewings, in male, 2.11 mm; in female, 2.70 mm

Width of head with eyes, 0.72 mm

Width of vertex between eyes, 0.45 mm

Length of antennae, 2.00 mm

**Colouration.** General colour yellowish to dark-brown, head pale-yellow, disc brown in middle; genae lighter with greenish tinge; antennae pale-yellowish proximally and brownish distally; legs yellowish to dark-brown from hind to forelegs in male and lighter in female; prothorax yellowish with greenish tinge; prescutum with two anterior, submedian brownish bands; scutum with four longitudinal brown bands; mesosternum dark-brown; abdomen brownish dorsally and yellowish ventrally; wings hyaline, transparent, veins dark-brown, pterostigma pale-yellow, opaque; genitalia pale to dark-brown.

**Structure.** Body moderately long. Head (Fig. 80a) transverse, moderately deflexed, almost as broad as thorax, sparsely pubescent, finely rugulose; vertex broader than long, about twice as broad as long, gradually rounded in front, disc impressed on either side of median line, containing two large foveae having sides swollen all-round, posterior margin arcuate, post-ocellar region swollen, anterior margin invaginated at point of excision, anterior ocellus visible from above; genae quite long, about 0.22 mm in length, deflected obliquely downwards, cones as long as vertex, pubescent and also armed with minute points, broad basally and narrow apically, subacute at apex, divergent, hairs longer than that of vertex. Eyes large, bulging.

Antennae (Fig. 80b) quite long, longer than the width of head, inserted a little below middle of eyes, slender, imbricate, bearing a few setae, two basal segments robust, 1st subquadrate, 2nd cylindrical, shorter than 1st, 3rd longest, 4th and 6th equal and each about one-fourth smaller than 3rd, 5th slightly smaller than 4th, 7th slightly smaller than 5th, 8th slightly smaller than 7th, 9th a little shorter than apical, terminal segment with two unequal spines at apex; four sensoria present on segments 4, 6, 8 and 9.

Thorax large and broad, arched, finely and sparsely pubescent, finely rugulose; prothorax convexly rounded, descending, longer medially and narrower towards sides, with two foveal impressions on each lateral side; prescutum broader than long, broadest in centre, anterior margin narrowly rounded, posterior margin angulate; scutum large and broad, about two and a half times as broad as long, almost as long as prescutum, gradually sloping posteriorly, angulate laterally, posterior margin also angulate; scutellum broadly

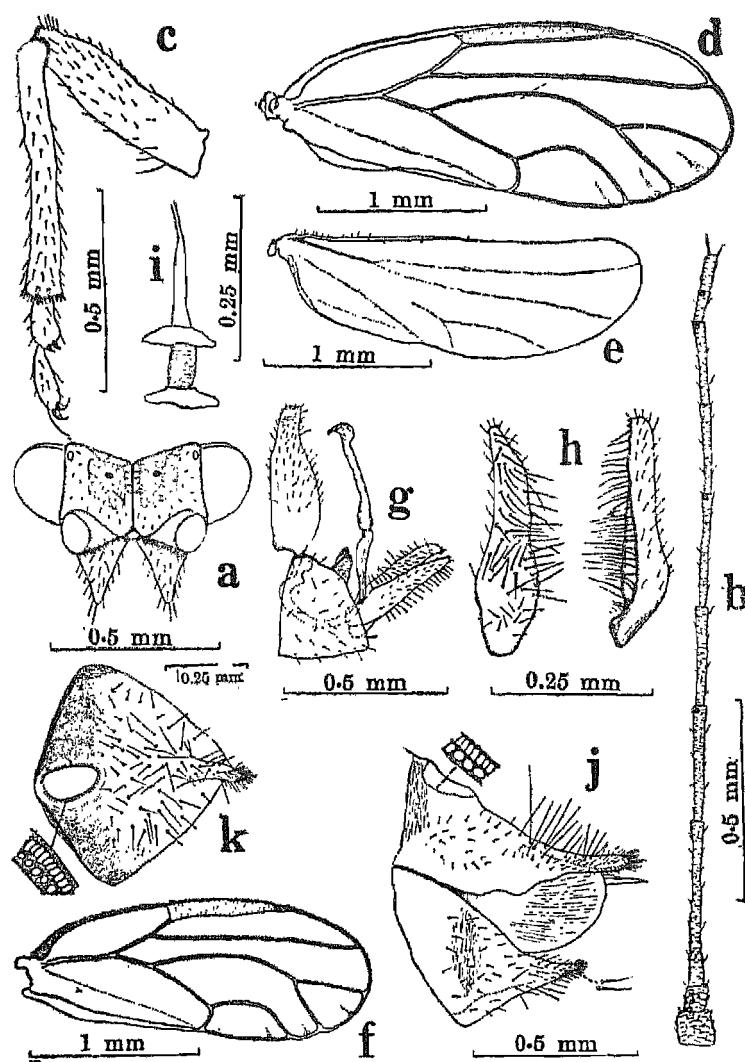


Fig. 80. *Psylla eastopi*, sp. n.—a: head, front view; b: antenna; c: hind leg; d: forewing; e: hind wing; f: forewing of male; g: male genitalia, lateral view; h: forceps, mesal and lateral surfaces; i: sperm pump; j: female genitalia, lateral view; k: dorsal view of dorsal plate.

transverse, about twice as broad as long, antero-lateral angles prominent, posterior margin broadly rounded.

Legs (Fig. 80c) moderately long, pubescent and also beset with minute points arranged in series, femora shorter than tibiae, all tibiae with apical comb of setae, hind femur with a group of 4 to 6 dorsal setae near apex, hind tibiae without basal spur, but armed with

six black spur-like spines at apex, basal tarsal joint a little thicker and smaller than apical; hind basal tarsal joint with two black claw-like spines at apex; meracanthus small, thick and triangular.

Forewings (**Fig. 80d**) hyaline, transparent, elongate-oval, about two and a half times as long as broad; pterostigma long and broad, about twice as thick as the costal nerve; in some males, pterostigma is shorter (**Fig. 80f**); apex narrowly rounded, radius (R) a little longer than cubital petiole (M+Cu),  $R_1$  almost as long as or slightly shorter than R, basal vein (R+M+Cu) almost twice as long as cubital petiole, first marginal cell longer and broader than second, veins armed with microscopic setae; microscopic and almost punctiform spinules present all over the surface, except the basal upper region.

Hind wings (**Fig. 80e**) small, with the surface covered with microscopic spinules, costal vein armed with some simple and hooked setae, in basal half.

Abdomen long, longer than broad, finely and sparsely pubescent, and also beset with minute points arranged in linear series.

*Genitalia.* Male genital segment (**Fig. 80g**) smaller than abdomen. Anal valve about 0.45 mm long, slightly longer than forceps, flask-shaped in caudal view, slightly broadened at middle converging toward tip, truncate at apex, anterior margin almost straight in profile, outer surface sparsely beset with strong, simple setae and with minute points arranged in small series; forceps (**Fig. 80h**) about 0.38 mm long, broad basally and gradually narrowed towards apex, terminating in a black bifid tooth, sides sub-parallel in profile, outer surface bearing small, simple setae, mesal surface and margins armed with strong, thick setae directed downwards, basal region bearing thinner setae; hypandrium simple (**Fig. 80g**), with small finger-like processes on dorsal margin, surface beset with simple setae; aedeagus (**Fig. 80g**) quite long, outer arm smaller than basal, having a hooked spoon-like end; sperm pump as figured (**Fig. 80i**).

Female genital segment (**Fig. 80j**) smaller than abdomen. Both plates subequal, divergent caudally; dorsal plate (**Fig. 80k**) longer than ventral, gradually sloping posteriorly in profile, broad basally, narrowly rounded apically, surface beset with simple setae of varying length, hairs longer in middle, caudal region slightly flexed upward, apex armed with a brush of setae; circum-anal pore ring composed of a double row of pores, outer row with oval pores and the inner row with slit-like pores; ventral plate broad basally and acutely pointed at apex, surface bearing simple setae and also armed with minute points arranged in lines; ovipositor acutely pointed, slightly exserted.

*Host plant.* On young leaves of *Cedrela toona* Roxb.

*Type locality.* New Forest, Dehra Dun (U.P.).

*Types.* Described from a long series of both sexes. Holotype male, 12.3.45 and Allotype female, 17.3.53, both from the type locality and collected on *Cedrela toona* (R. N. Mathur); Paratypes: 3 males and 4 females, of 12.3.45, 4 males and 11 females of 15.3.45; 10 males and 3 females of 10.3.47, 5 females of 18.3.47, 5 females of 22.4.47; all from the type locality (R. N. Mathur); 1 male and 4 females of 17.3.53 from Dehra Dun (R. N. Mathur); a good collection of both adults and nymphs collected from New Forest, Dehra Dun, in March 1961, 1962, 1963 and 1964 has been preserved in alcohol.

Some adults and nymphal stages were also mounted on slides. All types, wet material, and slides were deposited at F.R.I., Dehra Dun.

Two paratypes, male and female are also deposited at I.A.R.I., New Delhi.

*Comparison.* As the host plant of this species is *Cedrela toona*, it was provisionally placed under *Psylla cedrelae* Kieffer and its nymphal stages were also wrongly described under *cedrelae* (Mathur, 1950). Attempts to locate the type of *cedrelae* were unsuccessful, and so no comparison could be made. However, I was later fortunate to find another species collected on toon, resembling more closely with Kieffer's description of *cedrelae*. Dr Eastop has confirmed that these are really *P. cedrelae*. The present species is, therefore, considered quite distinct and described as a new species.

This species is separated from other species of *Psylla* by the characters of colouration, shape of wings and venation, radius almost as long as or slightly longer than  $R_1$ , shape of head, longer genal cones, and genital features.

*Biological notes.* This species is commonly found during March, on young and fresh buds and leaves of toon (*Cedrela toona*) in the Doon Valley. The nymphs feed gregariously and secrete cottony waxy mass of filaments from the body. Its nymphal stages are described by Mathur (1950), under *Psylla cedrelae*, and should now be considered under the species *Psylla eastopi*, sp. n.

#### *Psylla hyalina*, sp. n.

(Figs. 81, 82)

Length of body, in male, 1.70 mm; in female, 2.05 mm

Length of forewings, in male, 2.00 mm; in female, 2.32 mm

Width of head, with eyes, 0.61 mm

Width of vertex between eyes, 0.42 mm

Length of antennae, 0.57 mm

*Colouration.* General colour pale-yellow with greenish tinge, antennae pale-yellow with tip of segments 3 to 7 and apical segments black, eyes light greenish-gray, genae light green, legs pale-yellow with greenish tinge, wings hyaline, pterostigma pale-yellow.

*Structure.* Body relatively small. Head (Fig. 81a) with eyes, nearly as broad as thorax, moderately deflexed, finely and sparsely pubescent, finely rugulose, vertex slightly broader than long, with a median suture and an oval fovea on either side posterior to centre, gradually rounded downward in front, posterior submedian region and post-ocellar region swollen, posterior margin straight, anterior margin emarginate at point of excision, anterior ocellus visible in front; genal cones small, below the plane of vertex, finely pubescent, with a few long setae located ventrally, a little less than half as long as vertex, finely rugulose dorsally and beset with fine points ventrally, separate but approximate, sub-acute at apex. Eyes large, somewhat recessive.

Antennae (Fig. 81b) small, ten-segmented, slightly smaller than width of head including eyes, imbricate, bearing few simple setae, two basal segments robust, 1st subquadrate, 2nd cylindrical, about as long as 1st, remaining segments slender, 3rd segment longest, 4th about one-third as long as 3rd, 4th, 6th, 8th and 9th nearly equal

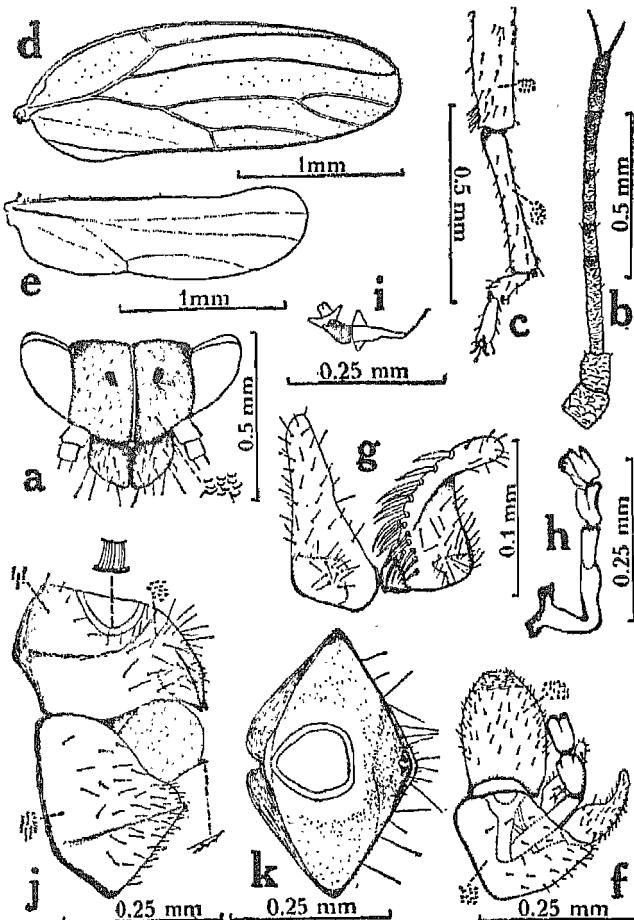


Fig. 81. *Psylla hyalina*, sp. n.—a: head, front view; b: antenna; c: hind leg; d: forewing; e: hind wing; f: male genitalia, lateral view; g: parameres, upper and mesal surfaces; h: aedeagus; i: sperm pump; j: female genitalia, lateral view; k: dorsal plate, under surface.

to one another, 5th smallest, 7th slightly longer than 5th, slightly smaller than 4th, 9th a little smaller than 10th, terminal segment with two quite long, unequal spines at apex, four sensoria present on segments 4, 6, 8 and 9.

Thorax large and broad, moderately arched, finely and sparsely pubescent, finely rugulose. Prothorax quite large, convex, sub-vertical, with two foveal impressions on each lateral side, posterior margin strongly concave; prescutum broader than long, somewhat reticulate antero-medianally, narrowly rounded anteriorly, widest posteriorly beyond centre, angulate both laterally and posteriorly; scutum slightly more than twice as broad as long, nearly as long as prescutum, widest before centre, angulate laterally; scutellum broadly transverse, with prominent antero-lateral angles, about twice as broad as long,

broadly convex posteriorly; post-scutellum of metathorax quite large, with a median ridge and a foveal depression on either side.

Legs (**Fig. 81c**) moderately long, bearing sparse stiff setae and also beset with fine points arranged in linear series, all tibiae with a comb of setae at apex, tibiae of first two pairs of legs longer than femora, while tibia and femur of hind legs almost equal in length, hind femur with a group of long, sub-apical setae, hind tibia without basal spur, with four spiniform teeth at apex, hind basal tarsus with two claw-like spines at apex, basal tarsal joint smaller than apical; meracanthus small, triangular.

Forewings (**Fig. 81d**) hyaline, elongate-ovate, leaf-like, about three times as long as broad, narrowly rounded at apex, pterostigma quite large and broad, radial sector quite long and slightly flexed, radius shorter than cubital petiole,  $R_1$  a little shorter than radius, basal vein nearly as long as cubital petiole, veins somewhat running parallel, and armed with a double row of fine setae, membrane beset with minute points, first marginal cell long and narrow and longer than second.

Hind wings (**Fig. 81e**) quite long, beset with minute points, costal margin in the basal half with a few simple and hooked setae.

Abdomen much longer than broad and rather depressed, finely and sparsely pubescent and also beset with fine points arranged in lines, setae slightly longer on sternites.

*Genitalia.* Male genital segment (**Fig. 81f**) rather small. Anal valve about 0.20 mm long, somewhat horizontal, longer than and overlapping the forceps, broad basally and gradually narrowed apically, bearing an anal aperture at tip, sparsely beset with simple stiff setae and also with minute points arranged in small series; parameres (**Fig. 81g**) relatively short, about 0.13 mm long, sub-globose basally, slender and narrowly rounded apically, outer surface beset with small simple setae, mesal surface armed with strong, thick setae directed downwards; hypandrium simple, of usual shape, bearing scattered simple setae and minute points arranged in series; aedeagus (**Fig. 81h**) of peculiar shape, outer arm smaller than basal, thick, with an invagination on the upper side and ending in a characteristic large spoon; sperm pump as figured (**Fig. 81i**).

Female genitalia (**Fig. 81j**) smaller than abdomen, short and blunt, bearing hairs of varying size, plates divergent, thickly beset with minute points, broad basally and narrow posteriorly. Dorsal plate (**Fig. 81k**) large, bent subvertically downward in the posterior half, terminating in a narrow bifurcate end, with a median invagination; anal opening large, caudal in position and located in a clear zone, circum-anal ring composed of a double ring of pores, the inner ring consisting of narrow slit-like pores; ventral plate smaller than dorsal, with the apex weakly invaginated medianally, in profile, apex acutely pointed; ovipositor acutely pointed, having a few saw-like teeth just below apex.

*Host plants.* On young and fresh leaves of *Albizzia procera* Benth. and *Cassia siamea* Lamk.

*Type locality.* New Forest, Dehra Dun (U.P.).

*Distribution.* Dehra Dun (U.P.); Coimbatore (Tamil Nadu).

*Types.* Described from a long series of specimens of both sexes. Holotype male; Allotype female; both from the type locality and bred on 15.8.34. (Expt. No. 499A) (R. N. Mathur); Paratypes: 3 ex. of 19.7.34; 13 ex. of 11.8.34; 17 ex. of 15.8.34;

8 ex. of 23.8.34; 18 ex. of 4.9.34; 35 ex. of 7.9.34; 34 ex. of 3.9.34; all from the type locality and bred on *Albizzia procera* (Expt. No. 499A) (R. N. Mathur); 3 females of 9.5.50; 2 males and 2 females of 6.6.50; 2 males and 2 females of 11.8.53, all from the same locality (R. N. Mathur); in addition to these mounted specimens, a good number of adults and nymphal stages were also preserved in alcohol on 1.8.34 from Expt. No. 499A. Some adults and nymphal stages from the same lot were dissected and their parts were mounted on slides. All types, preserved material and slides are deposited at F.R.I., Dehra Dun.

Two male and 2 female paratypes, from the type locality and belonging to lot No. 499A, are also donated to the I.A.R.I., New Delhi.

In the collection received from the Agriculture College and Research Institute, Coimbatore (Tamil Nadu), I found 2 female specimens belonging to this species and bearing the data: Coimbatore, 13.5.36, bred on leaves of *Cassia siamea* (Kylasam coll.). Both the specimens have been returned to the same institution.

*Comparison.* *Psylla hyalina*, sp. n. is readily recognised by the shape of forewings, venation, shape of head and genal cones, characteristic genital structures and other features. It resembles closely with *Psylla oblonga*, sp. n. recorded on *Albizzia odoratissima*, but differs from it in having narrow pterostigma and long first marginal cell in forewing and long genal cones.

*Biological notes.* This species is quite commonly found on *Albizzia procera* and the nymphs are not very active. The adults and nymphs are generally seen on young and fresh buds and leaves. The nymphs feed between unfolded leaves and in heavy infestations, the buds and young leaves droop due to the draining up of sap and ultimately drop down on the ground below. This species is sometimes found in close association with *Acizzia indica* H.-H. The nymphs feed gregariously and they are pale-green or pale-yellow with chrome lemon tinge in the abdomen, eyes silver grey, terminal antennal segments black, and legs and wing-pads creamy. The eggs are laid singly or in masses in the folds of young leaves and buds. Each egg is spindle-shaped, creamy white and smooth. The nymphs are sometimes covered with small waxy threads and exude copiously globules of honey dew. The nymphal stages are described below.

#### Nymphal stages

*Fifth stage. (Fig. 82a).* Length 1.56 mm (on slide). Body of psylline form; head narrower than abdomen; wing-pads not produced cephalad beyond the prothoracic legs, but project from the side of the body. Eyes prominent, with a distinct patch. Dorsum with the derm largely membranous, except for the weakly sclerotic head-plate occupying most of the head, wing-pads, small thoracic plates and nearly the posterior two-thirds of the abdomen, showing traces of segmentation; basal abdominal area having weakly sclerotic transverse strips. Derm partly vermiculate, and also armed with small, broad or flattened points, and with minute scattered clavate setae; anterior region of head bearing a number of long simple setae; wing-pads sparsely beset with a number of minute simple marginal setae; abdominal margin angulate, having six pairs of angles, each angle bearing a long, truncate seta; caudal margin slightly concavely arcuate; each wing pad with a long seta at the distal end. Antennae (Fig. 82b) small,

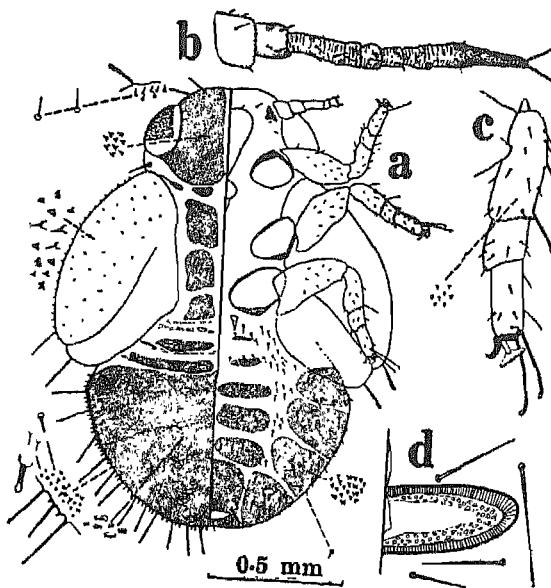


Fig. 82. *Psylla hyalina*, sp. n.—a: fifth stage nymph; b: antenna; c: leg; d: circum-anal pore ring.

about 0·03 mm long, apparently six-segmented, two basal segments robust, terminal segment longest, imbricate, bearing two sensoria and two apical spines, remaining two sensoria present on segments 3 and 5.

Ventral side membranous throughout, except for the sclerotic areas of various shapes in the abdomen, a small area around each of the last four spiracles, and three pairs of small sub-median areas, and a small area in front of the circum-anal ring and the region surrounding it. Derm beset with minute points and also with small, simple setae scattered over the surface. Legs (Fig. 82c) small, bearing small, simple and few spatulate setae, femora not reaching the margin of the body; without trochanters; tibio-tarsal articulation distinct; claws present, pulvillus large, triangular and markedly petiolate. Anal-opening (Fig. 82d) well in from the caudal margin, the circum-anal ring consisting of a single row of slit-like pores and an inner ring of a band of minute oval pores; both rings are interrupted medianally, and are guarded by two anterior, one lateral and one posterior pairs of small setae.

*Fourth stage.* Length 1·10 mm (on slide). Identical with the fifth stage, except in being smaller in body length and wing-pads, with antennae apparently four-segmented, having three sensoria and without tibio-tarsal articulation.

***Psylla longigena*, sp. n.**  
(Figs. 83, 84)

Length of body, in male, 2·68 mm; in female, 2·24 mm

Length of forewings, in male, 3·32 mm; in female, 3·94 mm

Width of head with eyes, 0.92 mm

Width of vertex between eyes, 0.61 mm

Length of antennae, 3.22 mm

**Colouration.** (Specimens in poor condition). General colour yellowish-brown, with greenish tinge, apex of beak black, tarsal segments light brown, antennae dark-brown distally and pale-yellow proximally, wings hyaline, transparent.

**Structure.** Body robust. Head (**Fig. 83a**) large, slightly broader than thorax, moderately deflexed, finely and sparsely pubescent, rugulose-reticulate; vertex broader than long, a little less than twice as broad as long, swollen on either side of median suture, inclined vertically downward anteriorly, post-ocellar region also swollen, with small foveal impressions on each side of median suture, from each fovea a narrow linear groove continues in a stellate form, posterior margin moderately arcuate; frons visible in front as a small sclerite, bearing anterior ocellus; genal cones large, about 0.35 mm long, sparsely hairy with long hairs, finely rugulose, inclined towards sternum, broad basally and narrow apically, contiguous near base, divergent apically, slightly smaller in length than vertex, roundly pointed at apex. Eyes small, somewhat sub-spherical.

Antennae (**Fig. 83b**) long, ten-segmented, finely and sparsely pubescent, two basal segments robust, finely rugulose, 1st segment subquadrate, 2nd cylindrical, slightly smaller than 1st, remaining segments slender, imbricate, 3rd slightly smaller than 4th, 4th longest, 5th slightly smaller than 3rd, 6th and 8th equal, but smaller than 5th, 7th about three-fourths as long as 4th, 9th about half as long as 5th, terminal segment slightly less than half as long as 9th, with two unequal spines at apex, four sensoria present on segments 4, 6, 8 and 9.

Thorax moderately arched, quite large, finely and sparsely pubescent, finely reticulate. Prothorax large, convex, moderately deflexed, with two large, prominent foveal impressions on each lateral side; prescutum somewhat triangular in shape, partly concealed anteriorly in the concavity of the posterior margin of prothorax, broader than long, broadest beyond middle, narrowly rounded anteriorly, posterior margin angulate; scutum broad, slightly more than twice as broad as long, nearly as long as prescutum, gradually sloping and angulate both laterally and posteriorly; scutellum small, transverse, broader than long, broad anteriorly and narrow posteriorly, anterior margin concave with prominent antero-lateral angles, posterior margin weakly invaginated medially; post-scutellum of metathorax quite large, having three dorsal carinae, median carina long and prominent.

Legs (**Fig. 83c**) quite long, pubescent with long hairs and also beset with minute points arranged in lines, femora of fore and middle legs shorter than tibiae, hind femur almost as long as hind tibia, with three sensoria-like structures on ventral side, all tibiae with a comb of setae at apex, hind tibia with a large basal spur and eight black tooth-like spines (arranged in groups of 4:2:1:1) at apex, basal tarsal segment of hind leg smaller than apical, bearing a strong sclerotic ventral pad and two black claw-like spines at apex; meracanthus large and conical.

Forewings (**Fig. 83d**) large, hyaline, transparent, a little more than two and a half times as long as broad, thickly beset with minute points, elongate-ovate, rounded at apex,

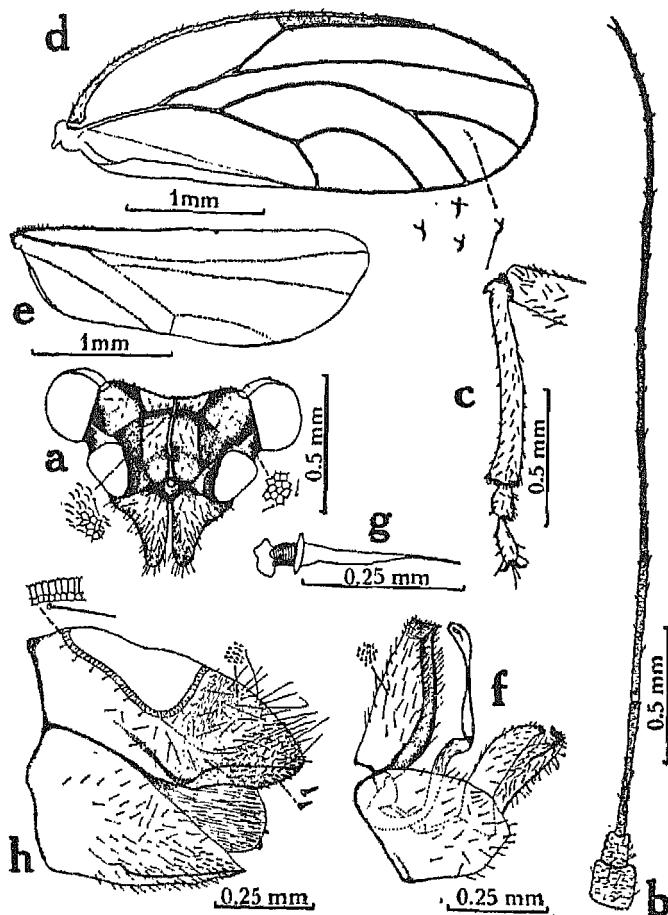


Fig. 83. *Psylla longigena*, sp. n.—a: head, front view; b: antenna; c: part of hind leg; d: forewing; e: hind wing; f: male genital segment; g: sperm pump; h: female genital segment.

basal vein ( $R+M+Cu$ ) slightly longer than radius ( $R$ ),  $R_s$  quite long and weakly arched,  $R_1$  slightly smaller than  $R$ , cubital petiole ( $M+Cu$ ) slightly smaller than  $R_1$ , pterostigma present, small and open, broad basally and narrow apically, first marginal cell longer and broader than second, veins armed with microscopic setae, anterior margin thickly beset with long setae.

Hind wings (Fig. 83e) also large, membrane thickly beset with minute points, costal margin armed with a few simple and hooked setae in the basal half.

Abdomen longer than broad, finely and sparsely pubescent, also beset with minute points, setae longer on sternites.

**Genitalia.** Male genital segment (Fig. 83f) smaller than abdomen. Anal valve simple,

pyriform, about 0.38 mm long, longer than parameres, broad in the basal half and gradually narrowed in the apical half, truncate at apex, anterior margin straight, posterior margin broadly convex basally, outer surface thickly beset with minute points and sparsely with long slender setae; parameres (forceps) about 0.30 mm long, broad basally and gradually narrowed apically, ending in a sharp black incurved point, apical mesal surface with a longitudinal keel, sides subparallel, outer surface sparsely armed with simple scattered setae, mesal surface bearing long setae, pointing downward, marginal setae also long and slender, few strong setae also present just below the black point; hypandrium simple, of usual shape, bearing simple, sparse setae; aedeagus quite long, outer arm smaller than basal, with a narrow spoon end; sperm pump as figured (Fig. 83g).

Female genital segment (Fig. 83h) smaller than abdomen, thickly beset with minute points and also with simple setae of various lengths; dorsal plate longer than ventral, with a roundly pointed apex, apical region armed with thick peg-like setae; anal ring large, composed of a double ring of pores; ventral plate acutely pointed at apex, both plates broad basally and narrow posteriorly; ovipositor acutely pointed.

*Host plant.* On *Bucklandia (Symingtonia) populnea* R. Br.

*Type locality.* Kurseong (Bengal).

*Types.* Described from 4 specimens. Holotype male; Allotype female (without forewings) from the type locality, and collected on September 20, 1932 (D.F.O. coll.) (R.R.D. 443); Paratypes: 2 females, from Kurseong division (Bengal), collected on July 4, 1932 (D.F.O. coll.). One male and one female dissected and their parts mounted on slides. All types and slides deposited at F.R.I., Dehra Dun. Two dry nymphs mounted on a card, July 4, 1932.

*Comparison.* *Psylla longigena*, sp. n. is readily recognised by shape of wings, long antennae, shape of head and quite long genae, small pterostigma, strong basal spur on hind tibia, and genital characters.

*Biological notes.* In the collection sent by the Divisional Forest Officer, in 1932, from Kurseong, few mature nymphal stages and exuviae were also present. These nymphs are reported to feed on the leaves of *Bucklandia populnea*. The description of the fifth stage nymph is given below.

#### Nymphal stage

*Fifth stage.* (Fig. 84a). Length 2.35 mm. Typical psylline form. Head noticeably narrower than abdomen. Eyes large. Wing-pads large and project prominently beyond the general margin of the body. Derm of the dorsum membranous, except for a pair of large head plates, the wing-pads, the apical half of the abdomen, and a number of small plates in the thoracic region and five pairs of small strip-like plates in the basal abdominal region. Derm beset with numerous simple scattered setae of various length, some setae are strong and thick. Wing-pads having a number of thick marginal setae; the posterior half of abdomen bearing a number of large, conspicuous, stout setae, some of which are long and variously curved, three pairs of small dagger-shaped setae also present at the angles of the posterior abdominal plate. Apex of hind wing with two strong setae.

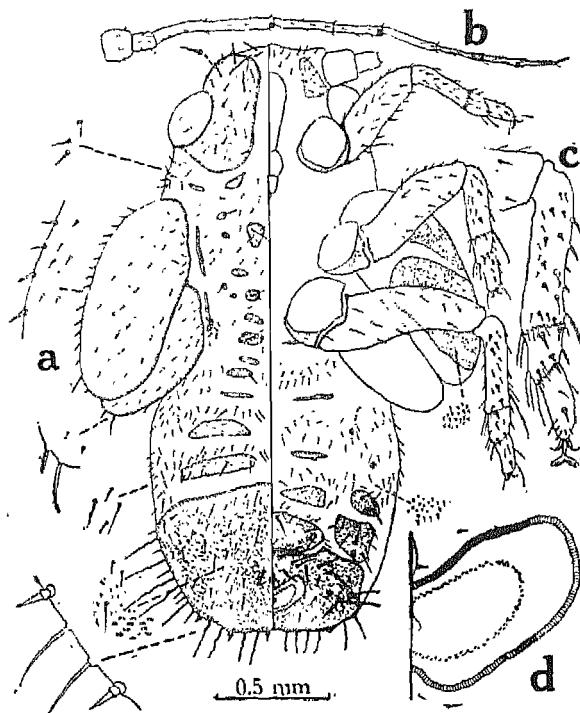


Fig. 84. *Psylla longigena*, sp. n.—a: fifth stage nymph; b: antenna; c: leg; d: circum-anal pore ring.

Posterior abdominal plate also ornamented with a few comb-like structures.

Antennae (Fig. 84b) long and slender, about 2.00 mm long, seven-segmented, beset with fine sparse setae, 1st segment broadly transverse, slightly broader than long, 2nd cylindrical, longer than broad, 3rd longer and slightly shorter than apical, showing faint traces of segmentation, 4th and 6th equal and slightly less than half as long as 3rd, 5th slightly smaller than 4th, terminal segment longest, bearing two apical spines; four sensoria present on segments 3, 5 and 7.

Ventral side membranous except for a small plate at the base of each antenna, two broad areas on wing-pads, small areas on the anterior two-thirds of abdomen and a large plate in the rest of abdomen. Wing-pads and abdomen thickly beset with minute points which become sharper in the abdominal plates. Legs (Fig. 84c) relatively large, beset with simple and dagger-shaped setae, the femora exceeding the margin of the body; without trochanters; the tibiae of the middle and hind pairs of legs having one large curved seta each; tibio-tarsal articulation distinct; claws present, the pulvilli large, petiolate, fish-tail like. Anal opening (Fig. 84d) set forward a short distance from the apex of the abdomen, surrounded by an outer ring of slit-like pores and an inner ring of oval pores; both rings interrupted medianally.

*Psylla murrayi*, sp. n.

(Figs. 85, 86)

Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 62-63 (Biological notes).

Length of body, in male, 1.32 mm; in female, 1.68 mm

Length of forewings, in male, 1.63 mm; in female, 1.97 mm

Width of head with eyes, 0.68 mm

Width of vertex between eyes, 0.41 mm

Length of antennae, 1.05 mm

*Colouration.* General colour pale cadmium yellow with greenish tinge, prothorax, posterior region of prescutum, lateral sides of scutum and scutellum greenish-grey; scutum with dark-brown longitudinal submedian bands; antennae pale-yellow with apices of slender segments and two apical segments black; legs pale-yellow; post-scutellum of metathorax with a black median epiphysis; wings hyaline, veins flavus.

*Structure.* Body small. Head (Fig. 85a) including eyes broader than thorax, declivous, finely and sparsely pubescent, finely rugulose; vertex about two and a half times as broad as long, with two circular foveae on either side of median suture and posterior to centre, each fovea with stellate impression, anterior region and post-ocellar region swollen, posterior margin moderately arcuate, anterior margin emarginate at point of excision; anterior ocellus visible in front; genal cones small and thick, about 0.12 mm long, slightly smaller than vertex, rugulose, separate, divergent, broad basally and narrow apically, notched and weakly impressed near about middle, with a rounded tip, hairs longer than that of vertex. Eyes large and bulging.

Antennae (Fig. 85b) small, ten-segmented, bearing a few setae, two basal segments robust, 1st broadly transverse, 2nd subquadrate and as long as 1st, remaining segments slender and imbricate, 3rd joint longest, slightly more than one and a half times as long as 4th, 4th and 8th joints nearly equal, 5th, 6th and 7th equal to one another but slightly smaller than 4th, 9th slightly smaller than 10th and half as long as 5th, terminal segment bearing two unequal, long setae; four sensoria present on segments 4, 6, 8 and 9.

Thorax moderately arched, finely and sparsely pubescent, rugulose. Prothorax narrow, convex, descending, with two pairs of prominent foveal depressions on each lateral side; prescutum broader than long, about twice as broad as long, broadest in centre, angulate both laterally and posteriorly, narrowly rounded and gradually sloping anteriorly; scutum large, nearly as long as prescutum, about two and a half times as broad as long, broadest before middle, anterior margin concave, disc flat dorsally, angulate both laterally and posteriorly; scutellum small, transverse, slightly more than twice as broad as long, anterior margin concave, having prominent antero-lateral angles, weakly invaginated laterally and posteriorly; post-scutellum of metathorax with three small, dorsal epiphysis, the median one strong, erect and black at tip.

Legs (Fig. 85c) moderately long, pubescent and also beset with minute points arranged in lines, femora shorter than tibiae, all tibiae with an apical comb of setae, hind tibiae

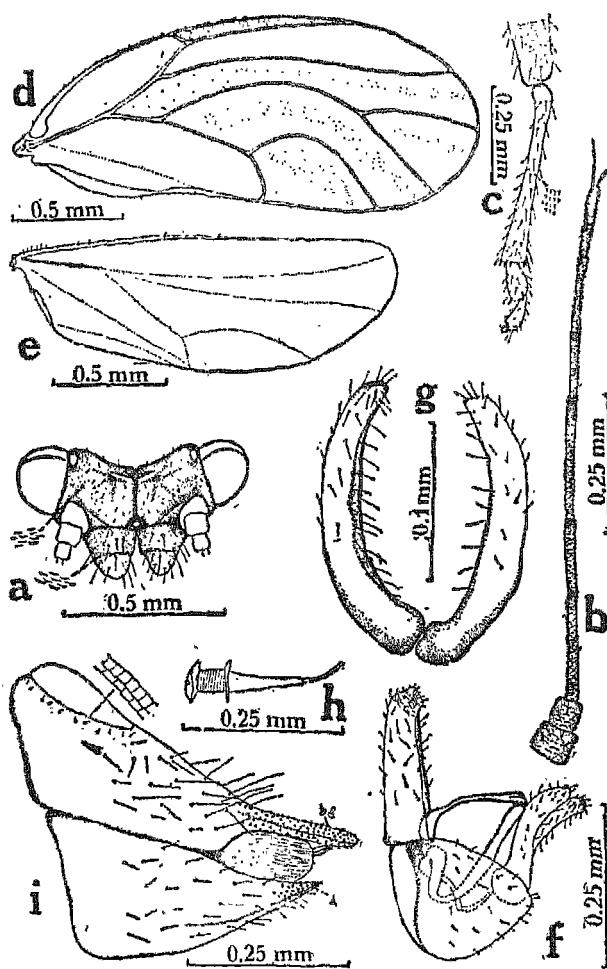


Fig. 85. *Psylla murrayi*, sp. n.—a: head, front view; b: antenna; c: hind leg; d: forewing; e: hind wing; f: male genitalia, lateral view; g: parameres; h: sperm pump; i: female genitalia, lateral view.

without basal spur, with five, black tooth-like spines at apex, tarsal joints robust, basal joint a little shorter than apical, proximal joint of meta-tarsus with two claw-like spines at apex; meracanthus small, slender and triangular.

Forewings (Fig. 85d) small, hyaline, elongate, slightly less than two and a half times as long as broad, anterior margin strongly arched, rounded at apex, pterostigma quite large and broad, radial sector slightly more than one and a half times as long as pterostigma, radius longer than cubital petiole,  $R_1$  slightly smaller than cubital petiole, basal vein a little longer than radius, marginal cells unequal, first cell longer and broader than second, veins armed with microscopic setae, membrane beset with minute points.

Hind wings (**Fig. 85e**) slightly smaller than forewings, membrane uniformly beset with minute points, basal half of costal margin bearing simple and hooked setae.

Abdomen small, finely and sparsely pubescent and also armed with minute points arranged in small lines, sternites furnished with longer hairs.

**Genitalia.** Male genital segment (**Fig. 85f**) smaller than abdomen. Anal valve about 0.25 mm long, longer than forceps, broad basally and gradually narrowed apically, elongate-oval, in profile, anterior margin almost straight, sides subparallel, posterior margin slightly invaginated near apex, outer surface beset sparsely with long, thick setae and also armed with minute points; parameres (**Fig. 85g**) small, about 0.20 mm long, slender, sides subparallel, converging gradually towards apex, apical end sharply curved inwards as a small, black subacute tooth, in caudal view, forceps bowed together, forming an ellipse, outer surface bearing sparse simple setae, marginal setae slightly longer, mesal surface with a few thick setae just below apex and pointing downward; hypandrium simple, of usual shape, bearing scattered simple setae; outer arm of aedeagus smaller than basal, with a thick spoon end; sperm pump as figured (**Fig. 85h**).

Female genital segment (**Fig. 85i**) smaller than abdomen. Dorsal plate longer than ventral, apical one-third slender and acuminate, terminating in a round point and armed with small, thick peg-like setae, broad basal region beset with long scattered setae, anal ring composed of a double row of pores; ventral plate acutely pointed, apical region bearing thick peg-like setae; ovipositor acutely pointed.

**Host plant.** On fresh and young leaves of *Murraya koenigii* Spreng.

**Type locality.** New Forest, Dehra Dun (U.P.).

**Types.** Described from a fairly large series of both male and female specimens. Holotype male, 24.4.50; Allotype female, 28.7.34, both from the type locality (R. N. Mathur), and collected on *Murraya koenigii*. Paratypes: 4 males and 2 females, of 28.7.34; 1 male of 13.1.34; 4 females of 28.3.34; 1 male of 29.3.34; 1 male of 23.8.33; 1 female of 26.9.33; 6 males and 4 females of 2.5.50; 4 males and 5 females of 22.5.50; all from the type locality (R. N. Mathur); 3 females of 21.4.67, from Dehra Dun (R. N. Mathur). Some adults and nymphal stages collected on 28.7.34 and 1.4.1941 from the type locality, were preserved in alcohol. The parts of both sexes and nymphal stages were also dissected and mounted on slides. All types, preserved material and slides are deposited at F.R.I., Dehra Dun.

Three females designated as paratypes, from the type locality and collected on 7.5.34, (R. N. Mathur), on the same host plant, are donated to I.A.R.I., New Delhi.

**Comparison.** *Psylla murrayi*, sp. n. is recognised by the shape of wing and venation, shape of head and genal cones and some other characters, as outlined in the key. Its smaller wings, long pterostigma, small and thick genal cones which are weakly impressed in middle, post-scutellum of metathorax with a thick, black median epiphysis, and genital structures are some characteristic features.

**Biological notes.** This psyllid was first recorded on *Murraya koenigii*, at Dehra Dun (U.P.), in early August 1933, and notes on its habits and biology are given by Mathur (1935). The nymphs are active, gregarious and feed at the axils of leaflets and between unfolded

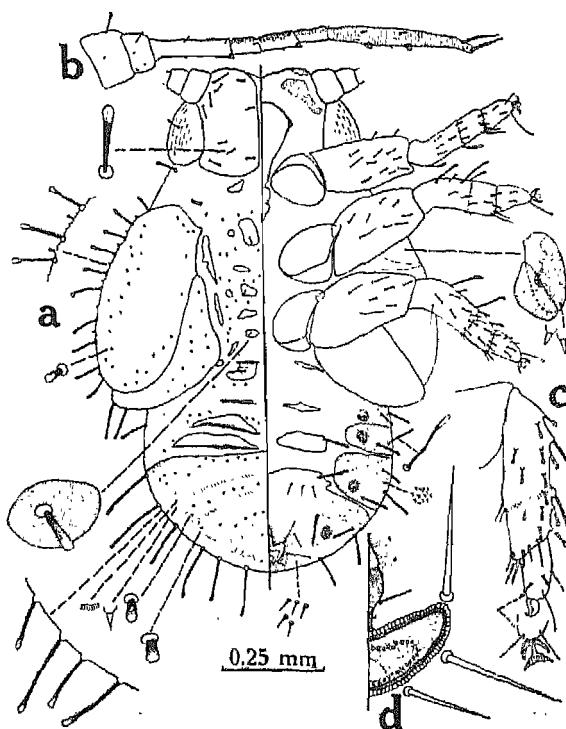


Fig. 86. *Psylla murrayi*, sp. n.—**a**: fifth stage nymph; **b**: antenna; **c**: part of leg; **d**: circum-anal pore ring.

buds. Young growths generally suffer from the psyllid attack. Its nymphal stages are described below.

#### Nymphal stages

**Fifth stage.** (Fig. 86a). Length 1.27 mm. Characteristic psylline form. Head noticeably narrower than abdomen. Eyes and wing-pads large and prominent; the wing-pads extending beyond the general margin of the body. Dorsum with the derm largely membranous, except the wing-pads, a pair of large areas occupying most of the head and the posterior two-thirds of the abdomen being strongly sclerotized. In addition to these areas, the thorax and the anterior one-third of the abdomen having a number of small sclerotic areas and strip-like plates respectively. Derm weakly vermiculate and beset with scattered clavate setae varying in size, and also armed with minute points, these becoming stronger in the abdomen and assuming flattened structures in the posterior plate. Margins of the anterior pair of wing-pads having a number of large spatulate setae, ranging from 10 to 14, while two large similar setae present at the distal end of each posterior wing-pad; margin of the posterior abdominal plates bearing a number of longer spatulate setae. Each eye with one spatulate seta.

Antennae (**Fig. 86b**) long and slender, 0·60 mm long, seven-segmented, bearing few simple and spatulate setae, two basal segments large and robust, 3rd joint long, longer than 4th and 5th joints combined together, 4th and 6th joints nearly equal to one another, but smaller than 5th, 7th joint longest, imbricate, bearing two apical spines, four sensoria present on segments 3, 5 and 7.

Ventral side largely membranous, except for the sclerotic areas at the base of the antennae, areas on the under side of wing-pads, small thin areas on the anterior half of the abdomen, while the posterior half almost strongly sclerotic. Derm beset with small simple setae and by numerous minute points becoming sharply pointed spines in the abdominal plates, these plates also armed with few spatulate setae of various length; the spiracles surrounded by concentric rings of minute points. Legs (**Fig. 86c**) moderately large, bearing simple and clavate setae, varying in size; without trochanters; each tibia with two spatulate setae, tibio-tarsal articulation distinct, each tarsus with one curved seta at apex; claws present, the pulvilli large, markedly petiolate, fish-tail like. Anal area (**Fig. 86d**) a short distance away from the apex of the abdomen; the circum-anal ring of pores consisting of a single row of slit-like pores, and an inner ring of oval pores, and guarded by three pairs (one anterior and two posterior pairs) of conspicuously thick setae.

*Fourth stage.* Length 0·93 mm. Resembling the fifth stage, except in having smaller size, large thoracic and abdominal plates, with antennae five-segmented, bearing three sensoria, and without tibio-tarsal articulation.

*Third stage.* Length 0·62 mm, differing from the fourth stage in having smaller wing-pads, with four-segmented antennae, bearing two sensoria; spatulate setae present in less numbers.

***Psylla oblonga*, sp. n.**  
(*Figs. 87, 88*)

Length of body, in male, 1·85 mm

Length of forewing, in male, 1·60 mm

Width of head with eyes, 0·58 mm

Width of vertex between eyes, 0·35 mm

Length of antennae, 0·32 mm

*Colouration.* (Preserved male specimen, in a partly damaged condition). General colour pale clay yellow, with pinkish-red eyes, dorsum and venter of thorax darker than abdomen.

*Structure.* Body long and slender. Head (**Fig. 87a**) smaller than thorax, deflexed, finely and sparsely pubescent and also covered with minute sclerotic plates; vertex large, somewhat flat, vertically deflexed, broader than long, about twice as broad as long, slightly swollen on either side of median suture, weakly rounded in front, with two pairs of foveal impressions on each side of median line, posterior to centre, larger pair circular, smaller pair somewhat linear, posterior margin almost straight, anterior margin invaginated at point of excision, front ocellus near base of genal cones, large, round, prominent and visible in front; genal cones below the level of vertex, and about one-third

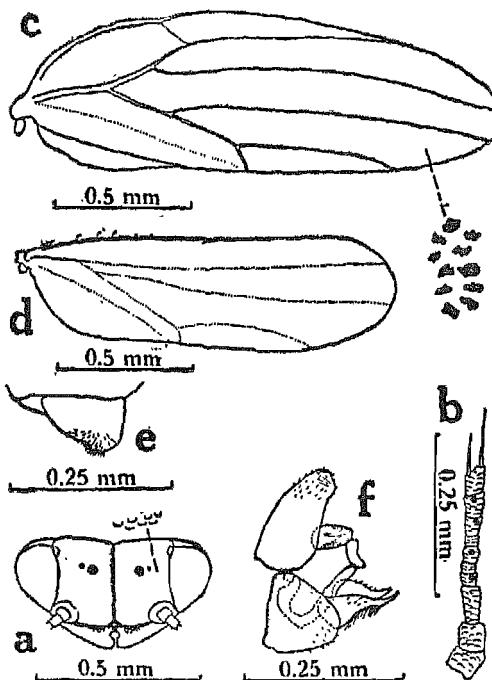


Fig. 87. *Psylla oblonga*, sp. n.—a: head, front view; b: antenna; c: forewing; d: hind wing; e: third abdominal segment with a papilla; f: male genitalia, lateral view.

as long as vertex, slightly broader than long, broad basally, narrow apically, apex subacute, contiguous on inner margin, surface finely rugulose. Eyes large, recessive.

Antennae (Fig. 87b) small, thick, ten-segmented, bearing few setae, imbricate, two basal segments robust, 1st broadly transverse, 2nd subquadrate, 3rd longest, broad apically, narrow basally, 4th about one-third as long as 3rd, 5th slightly smaller than 4th, 6th broad slightly less than half as long as 3rd, 7th equal to 4th, 8th equal to 6th but smaller in width, 9th and 10th broad and equal to one another, terminal segment bearing two, long, unequal apical setae, which are about as long as the last two segments together, four sensoria present on segments 4, 6, 8 and 9.

Thorax scarcely arched, finely and sparsely pubescent, finely rugulose. Prothorax transverse, narrower in middle, anterior margin irregular, with a prominent median point or epiphysis, posterior margin strongly invaginated medially, with two foveal impressions on each lateral side; prescutum small, broader than long, about twice as broad as long, broadest beyond middle, narrower anteriorly, angulate laterally, posterior margin angulate; scutum large, broadest in middle, two and a half times as broad as long, as long as prescutum, angulate both laterally and posteriorly; scutellum small, somewhat triangular in shape, broad anteriorly, gradually narrowed posteriorly; postscutellum of meta-thorax with a median ridge.

Legs (partly in damaged condition) small and moderately thick, pubescent and armed with minute points arranged in small lines, tibiae longer than femora, bearing apical comb of setae, hind femur with three sensoria-like structures on ventral side, hind tibiae without basal spur, apical spines not discernible, perhaps broken; apical tarsal segment longer than basal, basal tarsal joint of hind leg with two small claw-like spines at apex, fore and middle coxae moderately large; meracanthus small, thick and triangular.

Forewing (only left side wing present) (**Fig. 87c**) somewhat dull, obovate, leaf-shaped, about three times as long as broad, apex narrowly rounded, pterostigma long and broad at base, cubital petiole longer than radius, radius and  $R_1$  almost equal, first marginal cell long and narrow, second marginal cell absent in this wing, basal vein longer than cubital petiole, forks of veins almost running parallel to one another, veins armed with microscopic setae; membrane sculptured with small, irregular patches.

Hind wing (**Fig. 87d**) also quite long and narrow, costal vein armed with a few simple and hooked setae; membrane sculptured as in forewing, patches smaller in size.

Abdomen long, somewhat depressed, third abdominal segment (**Fig. 87e**) with a small papilla on each side, each papilla beset with a bunch of small setae; segments finely and sparsely pubescent and also beset with fine points arranged in lines.

*Genitalia.* Male genital segment (**Fig. 87f**) smaller than abdomen. Anal valve longer than forceps, broader near base and narrower at apex; in profile, anterior margin somewhat convex, posterior margin slightly convex but invaginated in apical half, outer surface sparsely beset with small, simple setae and with minute points arranged in lines, anal opening clearly demarcated from the rest of valve; parameres small, curved anteriorly, broad and sub-globose basally, slender, acuminate and acute apically, basal outer surface bearing small, simple setae, mesal surface armed with long, thick setae directed downward; hypandrium simple, of usual shape, finely and sparsely pubescent and armed with minute points arranged in linear series; outer arm of aedeagus very small, with a large and thick spoon end.

*Host plant.* On *Albizia odoratissima* Benth.

*Type locality.* Brook Bonds Tea garden, Borsala, Assam.

*Type.* Described from one male specimen, partly in damaged condition and preserved in alcohol, together with few nymphal stages. This specimen has been mounted on slide. Holotype male (on slide), from the type locality.

*Comparison.* *P. oblonga*, sp.n. is recognised by the obovate shape of forewings, quite broad pterostigma, short antennae, shape of head and genal cones and genital characters. It resembles closely with *P. hyalina*, sp.n. in shape of forewings and venation, but differs from it in having cubital petiole almost as long as cubitus.

*Biological notes.* Nothing is known about its biology and economic importance. Its nymphal stages are described below.

#### Nymphal stages

*Fifth stage.* (**Fig. 88a**). Length 1.56 mm. Body of psylline form; head narrower than abdomen; wing-pads not produced cephalad, but projecting from the side of the body beyond the prothoracic legs. Dorsum with the derm largely membranous except

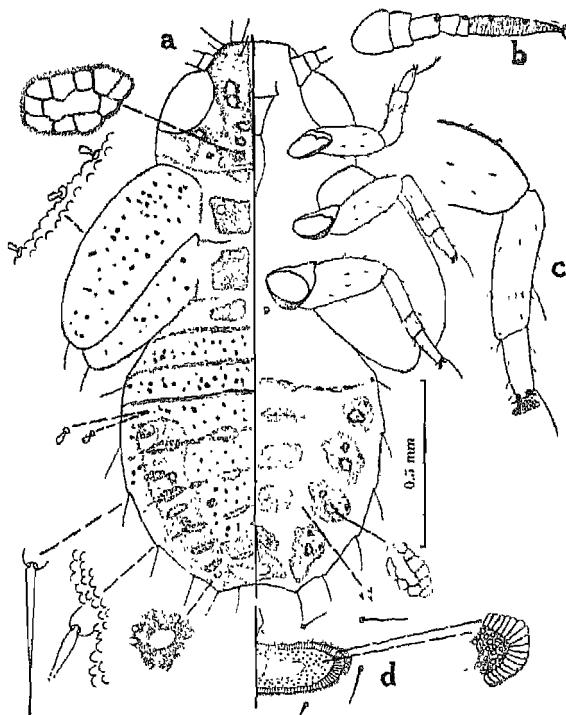


Fig. 88. *Psylla oblonga*, sp. n.—a: fifth stage nymph; b: antenna; c: leg; d: circum-anal pore ring.

for the weakly sclerotic head plate, occupying most of the head, wing-pads, small thoracic plates and nearly the posterior two-thirds of the abdomen, showing traces of segmentation; basal abdominal area with weakly sclerotic transverse strips. Derm partly vermiculate and also armed with small broad or flattened points, also beset with minute scattered clavate setae. Anterior head region with a number of long simple setae; wing-pads sparsely beset with a number of minute simple marginal setae; each wing-pad with a long seta at the distal end. Abdominal margin angulate, having six pairs of angles, each angle bearing a long seta, caudal margin concavely arcuate, having a pair of simple, long setae.

Antennae (Fig. 88b) small, 0.03 mm long, slender, apparently six-segmented, two basal segments robust, terminal segment longest, bearing two sensoria and two apical spines, remaining two sensoria present on segments 3 and 5.

Ventral side membranous throughout, except for weak sclerotic areas of various forms on the abdomen, a small area about each of the last four spiracles, and three pairs of small sub-median areas, and a small area in front of the circum-anal ring and the region surrounding it. Derm beset with minute points and also minute simple setae, scattered over the surface.

Legs (Fig. 88c) small, bearing small, simple setae, femora not reaching the margin

of the body; without trochanter; tibio-tarsal articulation distinct, claws present, pulvilli large, triangular and markedly petiolate.

Anal opening (**Fig. 88d**) set well in from the caudal margin, the outer circum-anal ring consisting of a single row of slit-like pores and an inner row of minute oval pores; both rings are interrupted medially, and are guarded by two anterior, one lateral and one posterior pair of small setae.

*Fourth stage.* Length 1.10 mm. Identical with the fifth stage, except in smaller body and wing-pads, with antennae apparently four-segmented having three sensoria and tibio-tarsal articulation absent.

***Psylla quadrimaculata*, sp. n.**

(**Fig. 89**)

Length of body, in male, 2.18 mm; in female, 2.52 mm

Length of forewings, in male, 2.80 mm; in female, 3.12 mm

Width of head with eyes, 0.70 mm

Width of vertex between eyes, 0.40 mm

Length of antennae, 1.82 mm

*Colouration.* (Specimens preserved in alcohol). General colour pale to dark-brown, head, antennae and legs lighter, apical segments of antennae and apices of segments 3 to 7 darker or blackish; thorax with dark-brown longitudinal bands; wings flavus, with large, broad, brown maculae in marginal cells, median cell and on clavus; abdomen with dark-brown segmental bands.

*Structure.* Body long and slender. Head (**Fig. 89a**) almost as wide as thorax, strongly deflected, sparsely pubescent, finely rugulose; vertex broader than long, about one and a half times as broad as long along the median suture, disc shallowly depressed, narrow and gradually rounded anteriorly, minute points present in the anterior region, sides parallel along the eyes, with two pairs of foveal impressions posterior to centre, one pair on each side of median suture, anterior pair larger than the posterior pair, posterior margin weakly arcuate, post-ocellar region slightly swollen, anterior ocellus visible from above and on level with the ventral margin of antennal sockets; genal cones large and robust, about 0.25 mm long, almost as long as vertex, sparsely pubescent with long hairs, broad basally, separate and divergent, nearly in the same plane with vertex but separated from it by impressed lines, deflexed sub-vertically, subacute at apex, a few long hairs present on the ventral side. Antennal sockets large and located at the sides, upper margin nearly on level with the lower margin of eyes. Eyes larae, somewhat recessive.

Antennae (**Fig. 89b**) long and slender, ten-segmented, sparsely pubescent, imbricate, two basal segments robust, 1st broadly transverse, broader than long, 2nd cylindrical, longer than broad, both segments equal in length, 3rd segment longest, segments 4 to 8 progressively decreasing in length, 9th as long as 2nd, terminal segment slightly longer than 9th, bearing two unequal spines at apex; four sensoria present on segments 4, 6, 8 and 9.

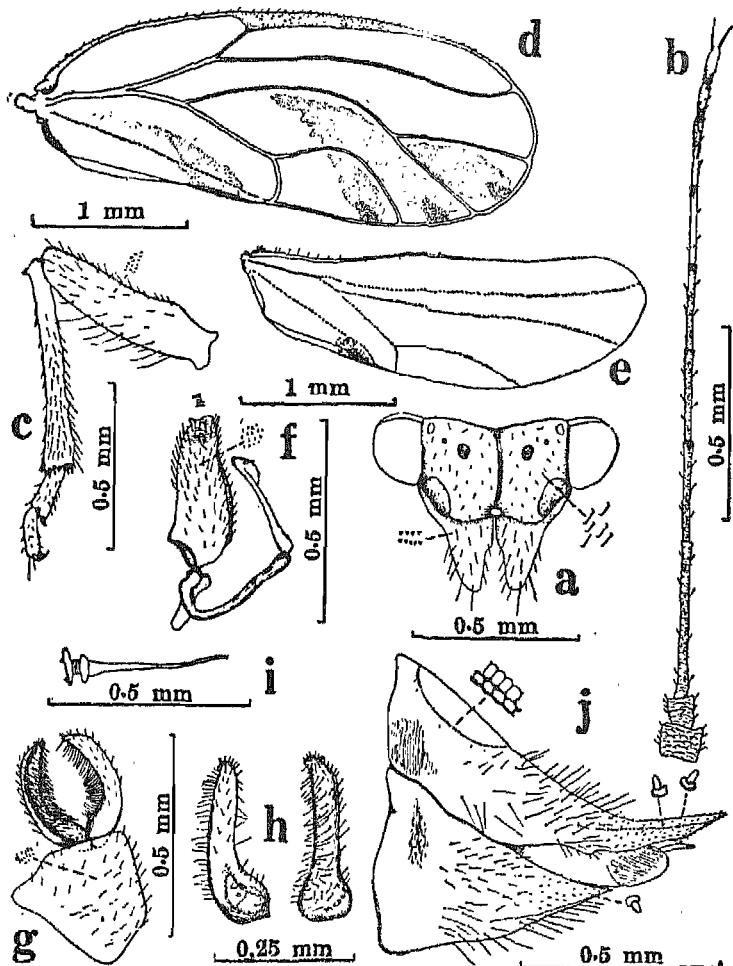


Fig. 89. *Psylla quadrimaculata*, sp. n.—a: head, front view; b: antenna; c: hind leg; d: forewing; e: hind wing; f: anal valve and aedeagus; g: forceps and hypandrium; h: forceps, upper and mesal surfaces; i: sperm pump; j: female genitalia, lateral view.

Thorax large, well arched, sparsely pubescent and finely rugulose. Prothorax collar-like, convexly rounded, descending and partly concealed below head, narrower medially and broader laterally, with two foveal impressions on each side; propleural suture oblique, not extending to middle of lateral termination of pronotum; prescutum broader than long, slightly more than one and a half times broader than long, broadest beyond middle, gradually sloping and narrowly rounded anteriorly, angulate laterally, posterior margin angulate sub-medianally; scutum large, much broader than long, slightly less than two and a half times broader than long, broadest before middle, about as long

as prescutum, angulate both laterally and posteriorly; scutellum small, vase-shaped, broad anteriorly and narrow posteriorly, about twice as broad as long, with prominent antero-lateral angles, posterior margin weakly invaginated; post-scutellum of metathorax large, broadly transverse, with a prominent median ridge.

Legs (**Fig. 89c**) long and slender, coarsely pubescent and also armed with minute points arranged in linear series, tibiae of fore and middle legs longer than femora, while of hind legs, tibia nearly as long as femur, all tibiae with apical comb of setae, hind tibiae with a strong basal spur, and with five black tooth-like spines at apex (three approximate and two wide apart), basal tarsal segments of fore and middle legs slightly smaller than apical, while the tarsi of hind legs are equal in length, basal tarsal segment of hind legs with two claw-like, black spines at apex; meracanthus large, long and slender.

Forewings (**Fig. 89d**) long, transparent, flavus, with large brown maculae present in marginal cells, median cell and on clavus, elongate-oval, about a little less than two and a half times as long as broad, rounded at apex, pterostigma long and prominent, basal vein slightly smaller than radius, radius about twice as long as cubital petiole, and slightly less than two and a half times as long as  $R_1$ ,  $R_1$  half as long as basal vein,  $Rs$  quite long and flexed upward near apex, marginal cells unequal, first cell longer and broader than second marginal cell, costal vein armed with a prominent row of strong setae, veins microscopically setigerous, membrane beset with minute points in the basal and marginal regions.

Hind wings (**Fig. 89e**) smaller than forewings, costal vein beset with a few simple and hooked setae, membrane bearing uniformly distributed minute points.

Abdomen long and slender, sparsely pubescent and also armed with minute points arranged in lines, pubescence longer on sternites.

*Genitalia.* Male genital segment smaller than abdomen. Anal valve (**Fig. 89f**) about 0.32 mm long, slightly longer than forceps; in profile, broad basally and narrow apically, anterior margin slightly convex and weakly concave basally, posterior margin broadly convex, outer surface beset with long, simple setae and also armed with strong minute points arranged in small lines; parameres (**Figs. 89g, h**) about 0.30 mm long, slender, broad basally, almost cylindrical in the apical two-thirds, narrowed at apex and terminating in a black, blunt point, bowed in caudal view, outer surface beset with small, simple setae, mesal surface thickly armed with strong curved setae, pointing downward, marginal setae longer than others, three or four thick setae present just below apical point and directed forward; hypandrium (**Fig. 89g**) of usual shape and sparsely beset with simple setae and also armed with strong minute points arranged in linear series; aedeagus (**Fig. 89f**) with the outer arm smaller than the basal, spoon end simple; sperm pump as illustrated (**Fig. 89i**).

Female genital segment (**Fig. 89j**) almost as long as abdomen; plates subequal, dorsal plate much longer than ventral, broad basally and narrow caudally, apical region acuminate, slender and slightly flexed upward, and sparsely armed with small peg-like setae, basal region beset with simple setae, setae in centre longer than others, apex roundly pointed, circum-anal ring composed of double ring of pores; ventral plate much broader

at base and acutely pointed at apex, setae numerous in the apical region; ovipositor acutely pointed.

*Host plant.* Not known.

*Type locality.* Jorhat, Assam.

*Distribution.* Jorhat (Assam); Darjeeling (W. Bengal).

*Types.* Described from a small series. Holotype, male; Allotype, female, mounted on cards, from the type locality, and collected during February-March 1960 (B. Datta); Paratypes: 1 female, also mounted on card, data same (deposited at F.R.I., Dehra Dun); 2 examples (male and female), collected during November 1959, from Botanical Garden, 1,830 m, Darjeeling (West Bengal) (preserved in alcohol) (B. Datta), deposited at Z.S.I., Calcutta.

*Comparison.* This species is easily separated from the other species, in having four large maculae in the forewing, long antennae, by the shape of head, with long and robust genal cones and genital characters.

***Psylla santali*, sp. n.**

(Fig. 90)

Length of body, in male, 1.25 mm; in female, 1.75 mm

Length of forewings, in male, 2.38 mm; in female, 2.7 mm

Width of head with eyes, 0.72 mm

Width of vertex between eyes, 0.47 mm

Length of antennae, 1.34 mm

*Colouration.* (Dried, mounted specimens). General colour pale clay yellow; tip of epiphysis on metathorax black; antennae pale-yellow, with two apical and apices of segments 4 to 8 black; wings hyaline, transparent, veins yellowish-brown.

*Structure.* Body moderately long. Head (Fig. 90a) large, slightly broader than thorax, declivous, finely and sparsely pubescent, finely rugulose; vertex broad, about half as long as broad along the median suture, disc becoming narrower anteriorly on each side of anterior ocellus, with two pairs of foveal impressions posterior to centre, on each side of median line, rounded downward in front, posterior margin weakly emarginate, post-ocellar region strongly swollen, front ocellus visible in front and located at the point of excision of median line; genal cones large, about 0.22 mm long, slightly shorter than vertex, deflexed vertically downward, but separated from vertex by impressed line, separate, divergent, subacute or narrowly rounded at apex, finely rugulose, setae on ventral side longer than that of vertex. Eyes large, bulging.

Antennae (Fig. 90b) long and slender, ten-segmented, bearing few setae, two basal segments robust, 1st broadly transverse, 2nd somewhat quadrate, remaining segments imbricate, 3rd and 7th longest but equal, 4th, 5th, 6th and 8th equal to one another and each slightly smaller than 3rd, 9th a little smaller than apical segment and about one-third as long as 8th, terminal segment having two unequal apical spines, four sensoria present on segments 4, 6, 8 and 9.

Thorax large, robust, strongly arched, slightly shorter than the width of head including eyes, finely and sparsely pubescent, strongly rugulose. Prothorax convexly rounded,

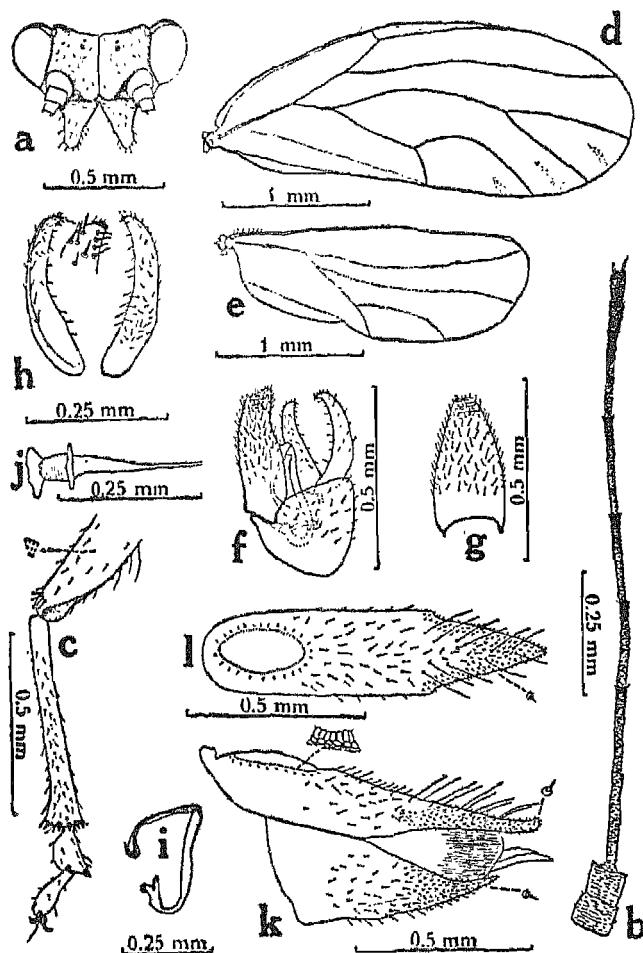


Fig. 90. *Psylla santali*, sp. n.—a: head, front view; b: antenna; c: hind leg; d: forewing; e: hind wing; f: male genitalia, lateral view; g: anal valve, outer surface; h: parameres, outer and mesal surfaces; i: aedeagus; j: sperm pump; k: female genitalia, lateral view; l: dorsal plate.

descending, longer in centre than at sides, with two dcpf foveal impressions and two small swollen areas on each lateral side; propleural suture extending obliquely to posterior part of lateral extremity of pronotum; prescutum broader than long, about twice as broad as long, broadest near about middle, narrower both anteriorly and posteriorly, angulate both laterally and posteriorly; scutum large, about twice as broad as long, broadest near about centre, disc somewhat shallowly depressed mid-dorsally, gradually sloping laterally, angulate posteriorly and laterally, slightly longer than prescutum; scutellum broadly transverse, anterior margin concave, with prominent antero-lateral angles, about twice as broad as long, slightly narrower posteriorly, posterior margin weakly invaginated in

middle; post-scutellum of metathorax also broadly transverse, somewhat rectangular in shape, with a strong, median, subacute, black epiphysis, area near posterior angles swollen.

Legs (**Fig. 90c**) long, pubescent, femora shorter than tibiae, all tibiae with apical comb of setae, hind femur with 3 to 4 thick, dorsal spines near apex; hind tibiae without basal spur, with five black tooth-like spines at apex (4 on one side and 1 on the other), basal tarsal segments smaller than apical segments, hind proximal tarsus with two black claw-like spines at apex; meracanthus large, triangular, having roundly pointed apex.

Forewings (**Fig. 90d**) somewhat smaller, variable in size, about two and a half times as long as broad, clear, transparent, with yellowish tinge, veins yellowish-brown; pterostigma rather small and long, broad at base, about half as long as radial sector; apex narrowly rounded, basal vein longer than radius, radius slightly longer than cubital petiole, cubitus almost as long as basal vein, radial sector quite long and slightly flexed, first marginal cell a little longer but much broader than second, veins beset with microscopic setae.

Hind wings (**Fig. 90e**) small, membrane beset with minute points, basal half of costal margin armed with few simple and hooked setae.

Abdomen small, sparsely pubescent and also beset with minute points arranged in serial lines, setae on sternites slightly longer, anterior segments with humps.

*Genitalia.* Male genital segment (**Fig. 90f**) smaller than abdomen, pubescent. Anal valve (**Fig. 90g**) about 0.38 mm long, longer than parameres, pear-shaped in anterior view, sometimes deflected caudad, in profile, anterior margin weakly convex, posterior margin convex basally and slightly invaginated in the apical half, upper surface beset with simple setae; parameres (**Fig. 90h**) about 0.28 mm long, rather slender, broad basally and gradually narrowed apically, terminating in an acute black point, sides subparallel, in caudal aspect evenly bowed to nearly touching sharp apices, upper surface beset with small simple setae, marginal setae slightly longer, a small group of thick setae present on the mesal surface just below apex; hypandrium simple, of usual shape, finely and sparsely pubescent; aedeagus (**Fig. 90i**) simple, outer arm smaller than basal; sperm pump as figured (**Fig. 90j**).

Female genitalia almost as long as abdomen, slender (**Fig. 90k**), pubescent. Dorsal plate (**Fig. 90 l**) longer than ventral, elongate, gradually sloping and weakly wavy and acuminate caudad, caudal end slightly upturned and narrowly rounded apically, apical region beset with minute peg-like setae, basal region armed with small simple setae, setae in middle long; circum-anal pore ring somewhat oval and composed of double ring of pores; ventral plate sparsely pubescent, broad basally and acutely pointed apically, apical region armed with minute peg-like setae; lateral valvulae with weakly sclerotic ridges on sides towards apex; ovipositor exserted and acutely pointed.

*Host plant.* On *Santalum album* Linn.

*Type locality.* Aiyur, North Salem (Tamil Nadu).

*Distribution.* North Salem and Vellore District (Tamil Nadu).

*Types.* Described from a small series of specimens, some specimens are in poor condition. Holotype male, 13.3.31 (plot 20); Allotype female, 16.7.31 (plot 19), both from the type locality (F.R.I. Sandal Survey); Paratypes: 2 males, 9.4.31 (No. 954, 955), 2 males of 12.4.31 (plot 19); 2 females of 6.3.31, 10 females of 13.3.31, 1 female

of 21.3.31, 2 females of 28.3.31 (plot 20); 2 females of 12.4.31 (plot 19), 1 female of 16.5.31 (plot 20), 1 female of 12.6.31 (plot 20); all from Aiyur, North Salem (F.R.I. Sandal Survey); 1 female of 4.9.31, Kottur 1,128 m, Vellore Dist. All types are deposited at F.R.I., Dehra Dun.

*Comparison.* *Psylla santali*, sp. n., is distinguishable from other species by having smaller wings, venation, radius longer than cubital petiole, pterostigma small, genae quite long, shape of genae, hind tibia without basal spur, and genital characters.

*Biological notes.* This species was collected during the Sandal Insect Survey, in order to find out the vector of the spike disease of sandal and is not incriminated in the transmission of disease. It is a rare species and has been recorded during March, April, May and June, from Aiyur, North Salem. From Kottur, Vellore District, it has been recorded in September also. Not much is known about this sap-sucker.

***Psylla* sp. near *simlae* Crawford  
(Fig. 91)**

- Crawford, D. L. 1912. *Rec. Indian Mus.* 7(5): 426, pl. xxxiii, figs. S, T; pl. xxxv, fig. S (Simla, West Himalayas, altitude 7,000 ft.).  
 Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 60-62 (*Psylla* sp.) (Biology).  
 Beeson, G. F. C. 1941. *Forest Insects*, p. 781 (Biological notes).  
 Mathur, R. N. 1954. *Indian J. Ent.* 16(8): 247-249, figs. 1-3 (Nymphal stages).

Length of body, in male, 1.34 mm; in female, 1.50 mm

Length of forewings, in male, 1.96 mm; in female, 2.27 mm

Width of head with eyes, 0.65 mm

Width of vertex between eyes, 0.37 mm

Length of antennae, 1.18 mm

*Colouration.* General colour brown, head, legs and antennae lighter brown, antennae black from apex of third to terminal segments, genal cones black, wings hyaline, transparent, with a black spot at tip of clavus.

*Structure.* Body small. Head (Fig. 91a) rather large and almost as broad as thorax, deflexed, finely and sparsely pubescent, finely rugulose. Vertex much broader than long, descending, almost flat or weakly swollen on either side of median suture, with a small fovea on each side of suture, posterior to centre, lobes rather triangular in shape, slightly rounded in front, post-ocellar region slightly swollen, posterior margin angulately arcuate, anterior margin emarginate at point of excision, front ocellus visible in front; genal cones large, about 0.2 mm long, almost as long as vertex, slightly declinate from plane of vertex; separated therefrom by a deeply impressed line, slightly divergent, subacute at apex, briefly pubescent and also armed with minute points arranged in lines, hairs slightly longer than that of vertex, each cone with a long ventral seta. Eyes large, recessive toward thorax, somewhat hemispherical.

Antennae (Fig. 91b) long, slender except two robust basal segments, ten-segmented, imbricate, having few setae, 1st segment broadly transverse, 2nd cylindrical, 3rd longest and about twice as long as 4th, 4th, 6th and 7th nearly equal to one another and about half as long as 3rd, 5th and 8th equal but slightly smaller than 4th, 9th half as long as

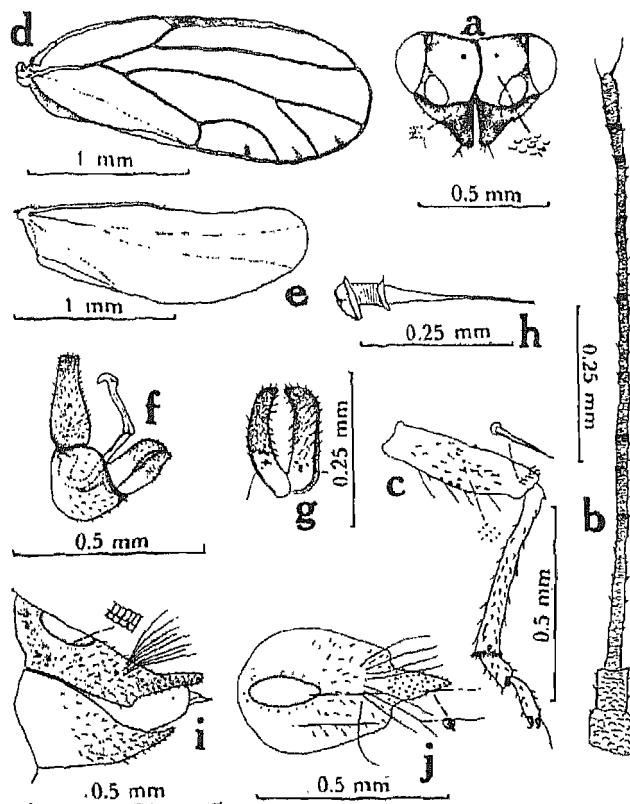


Fig. 91. *Psylla* sp. near *simlae* Crawford—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: male genitalia, lateral view; **g**: parameres; **h**: sperm pump; **i**: female genitalia, lateral view; **j**: dorsal plate.

8th, terminal segment slightly longer than 9th, bearing two unequal apical setae; four sensoria present on segments 4, 6, 8 and 9.

Thorax small, somewhat arched, finely and sparsely pubescent, reticulate. Prothorax rather small, descending, convex, with two foveal impressions on each lateral side; propleurites long, epimeron small; prescutum broader than long, gradually narrowed anteriorly, broad posteriorly beyond middle, angulate both laterally and posteriorly; scutum nearly as long as prescutum, much broader than long, angulate laterally, posterior margin also angulate; scutellum narrowly transverse, almost twice as broad as long, anterior margin somewhat straight, with prominent antero-lateral angles.

Legs (Fig. 91c) normal, sparsely pubescent with fine setae and also beset with minute points arranged in lines, femora smaller than tibiae, all tibiae with a comb of apical setae, hind femur armed with three to six thick lanceolate setae just near apex and with three sensoria-like structures in centre of ventral side, hind tibiae with a small basal spur and four black apical spines on one side and one on the other, basal tarsal segment

smaller than apical, hind basal tarsal joint with two black claw-like spines at apex; meracanthus small, slender and triangular.

Forewings (**Fig. 91d**) hyaline, oblong-ovate, membrane beset with minute points, with a long, rather broad pterostigma, radius long and slightly smaller than basal vein, cubital petiole smaller and a little more than half as long as radius, radial sector longer than media from point of forking, cubital petiole about one-third as long as cubitus, marginal cells sub-equal, first cell as long as second but broader than the latter; veins armed with microscopic setae.

Hind wings (**Fig. 91e**) quite large, uniformly bearing minute points, costal margin with a few simple and hooked setae.

Abdomen small, finely and sparsely pubescent and also armed with minute points arranged in lines, sternites with longer setae.

*Genitalia.* Male genital segment (**Fig. 91f**) smaller than abdomen. Anal valve about 0.27 mm long, longer than forceps, somewhat pear-shaped in dorsal aspect, in profile, anterior margin straight or weakly convex, posterior margin gradually narrowed from base to apex, becoming invaginated below apex, upper surface sparsely beset with simple setae and also armed with minute points arranged in lines; parameres (**Fig. 91g**) about 0.19 mm long, slender, sides sub-parallel, converging gradually to apex, apex sharply curved mesad and cephalad as a black, small, subacute point, in caudal view, forceps bowed together forming an ellipse, upper surface bearing sparse setae, mesal surface and margins armed with thick setae pointing downwards, a strong, thick seta directed downward also present just below apex; hypandrium of usual shape, bearing sparse simple setae; outer arm of aedeagus smaller than basal, with the spoon end like a hook; sperm pump as figured (**Fig. 91h**).

Female genitalia (**Fig. 91i**) smaller than abdomen, pubescent. Dorsal plate (**Fig. 91j**) longer than ventral, gradually sloping caudally, acuminate and subacute apically, four pairs of long hairs present in centre, apical region armed with minute peg-like setae, circum-anal ring longer than broad and composed of a double ring of pores; ventral plate broad basally, acutely pointed apically, bearing minute peg-like setae; ovipositor acutely pointed.

*Host plant.* On young and fresh leaves and inside flower buds of *Bauhinia variegata* Linn.

*Distribution.* Previously recorded from Simla, West Himalayas, altitude 2,135 m (N. Annandale) (Crawford, 1912).

*Material examined.* This species was recorded from New Forest, Dehra Dun, during 1932-33, on *Bauhinia variegata* and is quite common on this food-plant. In addition to 31 specimens, bred during March 14-15, 1932, there are three examples of 14.3.1932, 12 ex. of 15.3.32, 27 ex. of 22.3.32, 14 ex. of 25.3.32, and 6 ex. of 26.3.32 (Expt. No. 367), New Forest, Dehra Dun, bred on *Bauhinia variegata* (R. N. Mathur); the preserved material consisted of many adults and numerous nymphal stages, from New Forest and collected during 1932 (Expt. No. 367), 12.4.41, 30.4.45, 15.4.46 and 12.4.52 from Dehra Dun (R.N. Mathur); 20 examples from Dehra Dun U.P. and collected on 17.4.34, on *Bauhinia variegata* (G. D. Bhasin).

*Comparison.* Crawford (1912) described *Psylla simlae* from one female specimen and its type (No. 9701/18) is in very poor condition, at the Zoological Survey of India, Calcutta. On examination of the type, it was found that only head without antennae is present, sticking to the pin. No food plant data is available and Crawford's description is rather meagre, and therefore, the species bred on *Bauhinia variegata* could not be confirmed with the type. However, the characters show great resemblance to this species. Pending examination of material from the type locality, I am reluctantly placing the species only very close to *simlae*. This species is easily recognised in having black genal cones, vertex strongly rounded, oblong-ovate forewings, radius longer than cubital petiole, hind tibia with a basal spur and genital structures.

*Biological notes.* Its biology, seasonal history, etc., has been studied by Mathur (1935), under *Psylla* sp. Brief biological notes are also given by Beeson (1941). This species is quite common on *Bauhinia variegata* at Dehra Dun, and in heavy infestations, it causes serious damage to leaves and young buds and flowers. The leaves appear sickly and eventually succumb to the attack. The flowers shrivel, fail to develop and drop to the ground. The injury results in a reduced rate of growth and unthrifty condition of the infested trees. Young plants are dwarf and stunted.

The nymphal stages are described by Mathur (1954).

**Psylla** sp. 1.  
(Fig. 92)

Length of body, in male, 1.65 mm; in female, 2.20 mm

Length of forewings, in male, 2.5 mm; in female, 2.9 mm

Width of head with eyes, 0.68 mm

Width of vertex between eyes, 0.40 mm

Length of antennae, 1.32 mm

*Colouration.* General colour dark-orange to dark-brown, with greenish tinge, vertex dark-orange and white near point of excision, along median suture and posterior border; genal cones yellowish-brown basally, smoky distally; antennae dark-brown except terminal segments and apices of other segments black; pronotum black cephalad and white or variegated with orange along posterior half, dorsum of thorax dark-orange, prescutum bordered with white on hind margin, anterior lateral angles of scutellum white, post-scutellum of meta-thorax black, venter of thorax dark-brown; legs yellowish-brown, femora partly dark-brown, last tarsal segments black; abdomen fuscous, yellowish-brown inter-segmentally, first three abdominal segments white laterally; male and female genitalia fuscous; wings clear, hyaline, veins darker, with a conspicuous black spot at tip of clavus.

*Structure.* Body long and moderately robust. Head (Figs. 92a, b) slightly broader than thorax, moderately declivous, finely and sparsely pubescent, finely rugulose; vertex large and broad, slightly more than twice as broad as long, gradually bent forward and downward anteriorly, with two deep circular foveae near posterior margin and on either side of median line, anterior margin deeply emarginate at point of excision, posterior margin arcuate, regions near posterior ocelli and near inner margin of eyes

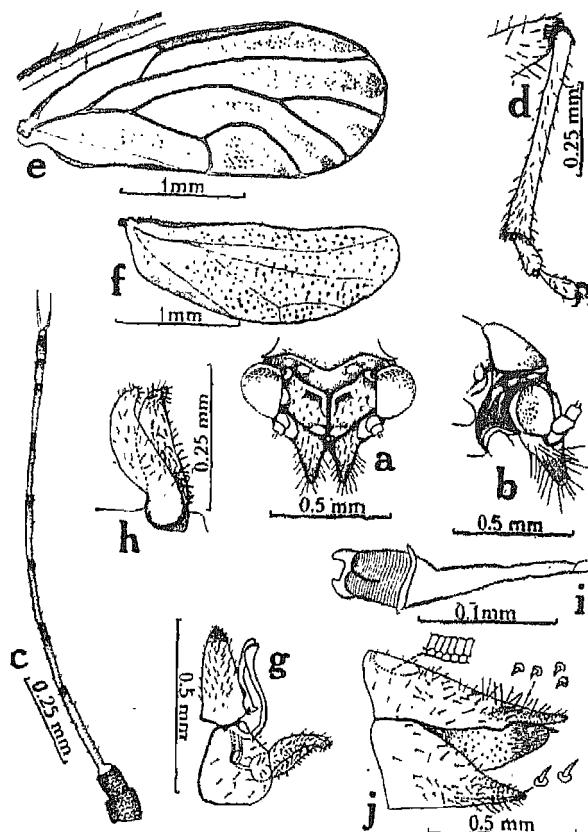


Fig. 92. *Pylla* sp. 1—**a**: head, front view; **b**: head and part of thorax, lateral view; **c**: antenna; **d**: hind leg; **e**: forewing; **f**: hind wing; **g**: male genitalia, lateral aspect; **h**: forceps, outer and mesal surfaces; **i**: sperm pump; **j**: female genitalia, lateral view.

swollen, front ocellus scarcely visible from above; genal cones large, about 0.18 mm long, almost as long as vertex, vertical, broad basally and subacute apically, not contiguous, divergent distally, beset with long setae and also with minute points arranged in linear series. Eyes large, somewhat hemispherical.

Antennae (Fig. 92c) long and slender, imbricate, two basal segments robust, 1st broadly transverse, 2nd subquadrate, 3rd longest, 4th about one-fifth smaller than 3rd, 5th, 6th and 7th equal but smaller than 4th, 8th about half as long as 3rd, 9th and 10th equal but smaller than other slender segments, terminal segment with two unequal, apical setae, four sensoria present on segments 4, 6, 8 and 9.

Thorax (Fig. 92b) large and robust, strongly arched, finely and sparsely pubescent, finely rugulose. Pronotum partly concealed by the head, convexly rounded, descending, bearing two transverse submedian, swollen pads and one round swollen knob on each lateral side and near the posterior border, with foveal impressions in between; prescutum

broader than long, about one and a half times as broad as long, broadest beyond middle, narrowly rounded anteriorly, angulate both laterally and posteriorly, scutum large and broad, almost as long as prescutum, about twice as broad as long, broadest before middle, disc flat dorsally, sloping laterally, angulate laterally, posterior margin extending medially into the concavity of scutellum; scutellum transverse, broad anteriorly and narrow posteriorly, anterior border concave, anterior lateral angles prominent, weakly invaginated laterally and posteriorly; post-scutellum of meta-thorax with three epiphysis.

Legs (**Fig. 92d**) long, pubescent, hairs longer ventrally, femora shorter than tibiae, all tibiae with a comb of setae at apex, hind tibiae with a small basal spur at base and five black thick setae at apex, tarsi nearly equal in length, hind basal tarsal segment with two claw-like spines at apex; meracanthus long and slender.

Forewings (**Fig. 92e**) large, hyaline, elongate-ovate, slightly less than two and a half times as long as broad, broadly rounded at apex, pterostigma long and broad, radius (R) about one and a half times as long as cubital petiole (M+Cu), basal vein slightly longer than radius, first marginal cell slightly longer and broader than second; veins setigerous, with microscopic setae.

Hind wings (**Fig. 92f**) large, transparent, thickly and uniformly beset with minute points, costal margin armed with a few simple and hooked setae.

Abdomen large and robust, longer than broad, finely and sparsely pubescent, and also armed with minute points arranged in rows.

*Genitalia.* Male genital segment (**Fig. 92g**) smaller than abdomen. Anal valve about 0.28 mm long and scarcely longer than forceps; when seen laterally, convex caudad, nearly straight or weakly convex cephalad, narrow both basally and apically, broadest in basal half, outer surface beset with long setae; parameres (forceps) (**Fig. 92h**) slender, in caudal view, strongly convex laterally, curved inside, terminating in a bluntly round apex, outer surface armed with small simple setae, mesal surface beset with thick setae pointing downward, a small group of thick setae also present directed downward, just below apex; outer arm of aedeagus small, with a weak loop; hypandrium simple, of usual shape, bearing sparse setae; sperm pump as figured (**Fig. 92i**).

Female genital segment (**Fig. 92j**) smaller than abdomen, nearly horizontal, pubescent with long hairs. Dorsal plate longer than ventral, broad basally, gradually sloping posteriorly, roundly pointed apically; ventral plate broad basally, acutely pointed apically; setae longer in the posterior half, apical region of both plates armed with minute, thick setae, anal pore ring composed of a double row of pores.

*Host plants.* On *Stranvaesia glaucescens* Lindl., *Pyrus pashia* Buch-Ham. and *Pyrus vistata* Wall., and *Pyrus communis* Linn.

*Material examined.* On *Stranvaesia glaucescens* Lindl.: 1 male and 7 females, collected on 18.3.59 and 5 males and 15 females, collected on 11.3.1960, all from New Forest, Dehra Dun (U.P.) (R.N. Mathur), with nymphal stages, the latter were preserved in alcohol.

On *Pyrus vistata* Wall.: 5 males and 7 females, collected on 27.2.51, from New Forest, Dehra Dun (R.N. Mathur), and some adults and nymphal stages, preserved in alcohol, having the same data.

On *Pyrus pashia* Buch-Ham.: 2 males and 8 females, collected on 13.3.59, from New Forest, Dehra Dun (R.N. Mathur).

On *Pyrus communis* Linn.: 33 examples collected during March-April, 1936; 3 examples of March, 1937 and 7 examples of February, 1963; and some adults and nymphal stages preserved in alcohol(4 phials), collected in February and March, 1938, 1941, 1953 and 1955.

*Comparison.* *Psylla* sp. resembles closely with *Psylla mali* Schmld. and *P. pyricola* Forst., in most characters. Two specimens ( $\delta$ ,  $\varphi$ ) were sent to Dr V.F. Eastop of the British Museum, for comparison with *P. mali*. He writes (*in litt.*): "They do not seem to be one of the European species, and we have a few nymphs from *Pyrus* sent in many years ago from the Himalayas which do not agree with the nymphs of any of the European Rosaceae-feeding *Psylla*". Heslop-Harrison (1946, *Ent. mon. Mag.* **82**, p.36) has mentioned: "No authentic records seem to exist for India, for the insects to which the name has been applied are polyvoltine, whereas *P. mali* is univoltine. However, the habits of the Indian insect may be different from those found in Europe." Its specific name is, therefore, deferred till more biological observations are known in detail. Attempts to subdivide them yet would result in confusion only.

***Psylla viburni* Loew 1876**

(Figs. 93, 94)

- Loew, F. 1876. *Verh. zool.-bot. Ges. Wien.* Bd. **26**: 194-196.  
 Oshanin, B. 1907. *Ann. d. Mus. Zool. de l' Ac. imp. des Sc. Petersburg*, Bd. **12**: 355.  
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 Horváth, G. 1918. *Faun. Reg. Hung.*, H. **8**: 58.  
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 Shinji, O. 1949. *Kontyu* **17**(6): 17.  
 Vondrácek, K. 1957. *Fauna C.S.R. Praha, Československa akademie Ved.* t. **9**:226-228.  
 Miyatake, Y. 1963. *J. Fac. Agric. Kyushu Univ.* **12**(4): 341-42.  
 Dobreanu, E. and Manolache, C. 1962. *Fauna Repub. pop. rom. Insecta Vol. 8, Fasc. 3*, pp. 210-12,  
 figs. 144-146.

Length of body, in male, 2.12 mm; in female, 2.69 mm

Length of forewings, in male, 2.71 mm; in female, 3.12 mm

Width of head with eyes, 0.80 mm

Width of vertex between eyes, 0.47 mm

Length of antennae, 1.35 mm

*Colouration.* (Preserved specimens in alcohol). General colour pale clay yellow, with a little darker thorax, apical segments of antennae and labium black. Wings transparent with flavus tinge, veins flavus, with a small dark-brown spot near clavus.

*Structure.* Body moderately robust. Head (Fig. 93a), including eyes, almost as broad as thorax, moderately deflexed, finely and sparsely pubescent, strongly rugulose; vertex

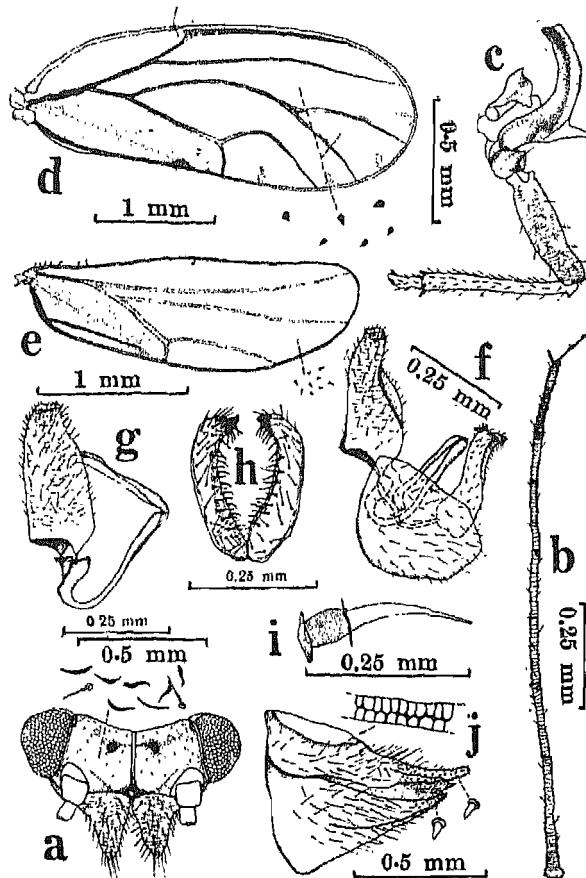


Fig. 93. *Psylla viburni* Loew—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: male genitalia, lateral view; **g**: anal valve and aedeagus; **h**: parameres; **i**: sperm pump; **j**: female genitalia, lateral view.

broader than long, about twice as wide as long, posterior margin arcuate, with deep foveal impressions, posterior to centre, one on either side of median suture, disc swollen anteriorly and along the eyes, post-ocellar region also swollen, anterior margin deeply emarginate, anterior ocellus visible from above; genal cones large, about 0.20 mm long, almost as long as vertex, pubescent, pubescence longer than on vertex, broad basally, divergent, subacute at apex, apices slightly directed outward, thickly beset with minute points.

Antennae (**Fig. 93b**) broken in all specimens, except the two basal segments; one antenna without two basal segments found in alcohol, with the preserved specimens and mounted on slide: 1st basal segment robust, quadrate, 2nd small, cylindrical, remaining segments slender, imbricate, having few setae, 3rd segment longest, one and a half times longer than 4th, 4th slightly longer than 5th, 6th and 7th equal to one another, 8th smaller

than 7th, 9th smallest, half as long as 8th, 10th slightly longer than 9th, having two, unequal spines at apex, sensoria present on 4, 6, 8 and 9 segments.

Thorax large, moderately arched, finely and sparsely pubescent, finely rugulose. Pronotum greatly deflexed, partly concealed behind head, descending, convexly rounded, slightly longer medianally and narrower laterally, with foveal impressions on each side; prescutum with a median line, slightly more than one and a half times broader than long, broadest in middle, narrowly rounded anteriorly, acutely angled laterally, posterior margin also angled submedianally; scutum somewhat flat dorsally, nearly as long as prescutum, about two and a half times as broad as long, broadest in middle, gradually sloping and angulate laterally; scutellum transverse, broad anteriorly with prominent antero-lateral angles, narrow posteriorly, anterior margin moderately concave, posterior margin with a tendency toward angulation and with a shallow median emargination; pseudonotum of metathorax quite large, broadly transverse, having a pair of papilla-like processes on the lateral sides and a prominent median ridge.

Legs (**Fig. 93c**) partly broken in all specimens, of medium size, pubescent and also thickly beset with rows of minute points, femora smaller than tibiae, hind tibia with a small basal spur and with five long, stout black spines at apex, basal segment of hind tarsi with two stout black spines at apex, apical tarsal segments slightly longer than basal segments of legs; meracanthus quite long, slender and acutely conical.

Forewings transparent (**Fig. 93d**), oblong-ovate, about two and a half times as long as broad, with rounded apex, pterostigma long and narrow,  $Rs$  flexed downward near apex, cubital petiole ( $M + Cu$ ) smaller than radius ( $R$ ),  $R_1$  as long as cubital petiole, basal vein slightly smaller than cubitus, first marginal cell as long as but broader than second, surface beset with minute points and all veins armed with minute setae (visible under high power).

Hind wings (**Fig. 93e**) moderately long, membrane thickly beset with minute points, costal margin armed with a few simple and hooked setae.

Abdomen longer than broad, finely and sparsely beset with minute points arranged in small lines.

*Genitalia.* Male genital segment (**Fig. 93f**) shorter than abdomen. Anal valve (**Fig. 93g**) slightly longer than parameres, about 0.32 mm long, when viewed laterally, broad basally, narrow apically, truncate at apex, anterior margin almost straight, posterior margin convex in basal two-thirds, concave below apical half, outer surface sparsely beset with long setae and rows of minute points; parameres (**Fig. 93h**) about 0.28 mm long, broad basally and gradually narrowed apically in lateral view, strongly bowed when seen posteriorly, outer surface beset with few simple setae, mesal surface armed with thick and curved setae directed downward, setae numerous in the basal region, apex terminating in a black acute point, a group of 4 or 5 thick setae pointing downward present just below apex; hypandrium simple, of usual shape, bearing sparse pubescence; outer arm of aedeagus slightly smaller than basal, with a simple spoon end (**Fig. 93g**); sperm pump as figured (**Fig. 93i**).

Female genital segment (**Fig. 93j**) nearly as long as abdomen, sparsely pubescent, setae longer in middle, both plates broad basally, dorsal plate longer than ventral, dorsal

surface slightly depressed midway, slender and acuminate in distal half, apex roundly pointed; ventral plate acutely pointed, the apical portion of both plates armed with short, heavier setae; circum-anal ring quite long, occupying nearly the basal half, with a double row of pores; ovipositor acutely pointed.

*Host plant.* On leaves of *Viburnum* sp.

*Distribution.* This species is fairly widely distributed and has been recorded from Central Europe; rare and very local in England. This insect feeds normally on *Viburnum lantana* (Heslop-Harrison, 1936); Tokyo (Shinji, 1949); Honshu, Kyshu, Tokyo (Miya-take, 1963); Austria, France, Czechoslovakia, Rumania (Dobreeanu and Manolache, 1962). From India, this is the first record from Lete, Central Nepal, and Chopal (H.P.).

*Material examined.* A small collection preserved in alcohol, was received from the I.A.R.I., New Delhi, having this data: Lete, C. Nepal, 4.5.61., on *Viburnum* sp. (No.V). (S.R. Wadhi). From this material 7 males and 2 females were mounted on cards, and the damaged parts of few examples were mounted on slides. Few nymphal stages were collected from Bhairog Chopal, 2,440 m (Himachal Pradesh), on 22.5.67. (*Viburnum* sp.). Four males and one female deposited at F.R.I., Dehra Dun, and the remaining material consisting of 3 males and 1 female returned to the former Institute, New Delhi.

*Comparison.* *Psylla viburni* Loew is redescribed here from the Indian material and is characterised by the shape of forewing which is oblong-ovate, radius longer than cubital petiole, genal cones long, thick and subacute at apices, hind tibia with a basal spur, and genital structures.

*Biological notes.* Its biology is not known. The nymphs are reported to have been collected feeding on the young leaves of *Viburnum* sp., growing in higher ranges of the Himalayas. The nymphal stages are described below.

#### Nymphal stages

*Fifth stage.* (Fig. 94a). Length 2.21 mm. Of the characteristic psylline type; head noticeably narrower than abdomen, wing-pads large and project beyond the contour of the body and not produced cephalad. Eyes large and prominent. Derm membranous, except the large sclerotic head plate, the wing pads, several small sclerites on the thorax and with four small strip-like plates on each of the first two abdominal segments and two large transverse plates on the next two, and a slightly more than half apical sclerotic plate. Derm weakly vermiculate in the sclerotic areas, and also beset with spatulate setae of various length and small clavate setae. The wing-pads and the caudal plate having a number of spatulate setae and long, variously curved setae along the margins, apex of hind wing-pads with two spatulate setae and posterior margin strongly armed with thick setae and points. Abdominal sclerotic areas also armed sparsely with thick points.

Ventral side largely membranous except for the sclerotic areas at the base of the antennae, an apical plate surrounding the circum-anal ring, small areas around each spiracle which are broad and conspicuous in the thoracic and in the last three abdo-

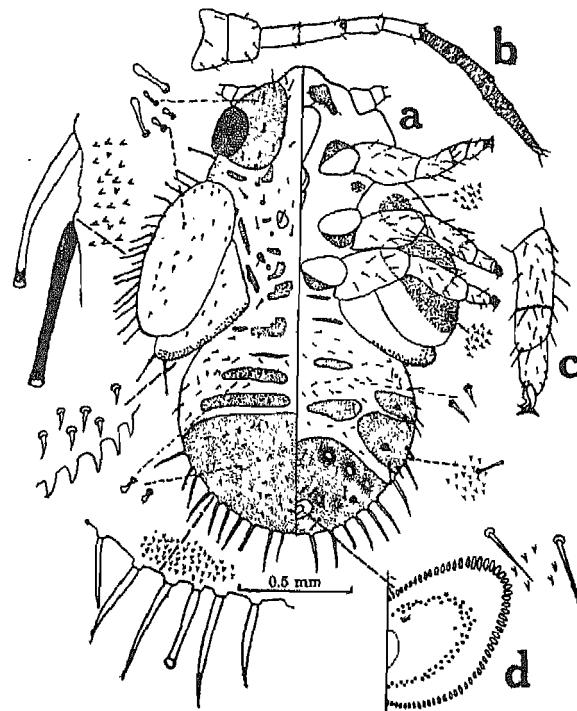


Fig. 94. *Psylla viburni* Loew—**a**: fifth stage nymph; **b**: antenna; **c**: part of leg; **d**: circum-anal pore ring.

minal spiracles, and four pairs of small submedian transverse abdominal plates. Ventral surface of the wing-pads armed with two zones having numerous thick points. Derm beset with minute points and sparsely with simple ring-based setae. Antennae (Fig. 94b) 1.27 mm long, situated ventrally, seven-segmented, two basal segments robust, rest all slender, penultimate and terminal segments imbricate, sparsely beset with simple and spatulate setae, 3rd segment long, 4th, 5th and 6th small, 7th segment longer than 3rd, bearing two unequal apical spines, four sensoria present on 3, 5 and 7 segments. Legs (Fig. 94c) small, bearing simple and spatulate setae, the femora not reaching the margin of the body; without trochanters; tibio-tarsal articulation well-defined; claws present; pulvilli large, fish-tail like and quite markedly petiolate. Anal opening (Fig. 94d) ventral, set forward a short distance from the end of the abdomen, surrounded by an outer row of slit-like pores and an inner ring of well-defined oval pores, both rings are interrupted medially, and are guarded by two anterior pairs of long setae.

*Fourth stage.* Length 1.25 mm. Identical with the fifth stage, except for smaller size, thoracic and abdominal sclerites quite broad, antennae five-segmented with three sensoria, one sensorium on 3rd and two sensoria on 5th segments; tibio-tarsal articulation absent.

**Psylla zaicevi** Sulc 1915  
 (Figs. 95, 96)

- Sulc, K. 1915. *Rozpr. ceske Akad. Trida II*, roc. XXIV, cis. 5, pp. 32-35, Tab. XXIV.
- Ossiannilsson, F. 1943. *Tromso Mus. Arshefter Naturhistorisk Avd.* Nr. 28, [Vol. 65 (1942), Nr. 1], pp. 24-25, figs. 3-7, (*Psylla sootryeni*).
- Ossiannilsson, F. 1951. *Kungl. Fys. Sallsk. Handl. N.F.* Bd. 61(2), Psyllina, pp. 55-57, (*Psylla sootryeni* Oss.).
- Ossiannilsson, F. 1952. *Ofusc. Ent.* 17: 198-99 (Norway, Finland; under *Psylla sootryeni*).
- Lindberg, H. and Ossiannilsson, F. 1960. *Fauna Fenn.* 8: 16 (*Psylla zaicevi* Sulc).
- Loginova, M. M. 1964. *Acad. Sci. Inst. Biology*, p. 472, pl. 215, figs. 9-11, U.S.S.R.
- Loginova, M. M. 1967. *Ann. Zool. Warszawa.* 24(7): 234-35, figs. 15-18.

*Psylla zaicevi* Sulc is redescribed from the specimens collected in India, for the first time.

Length of body, in male, 2.22 mm; in female, 2.40 mm

Length of forewings, in male, 2.90 mm; in female, 3.10 mm

Width of head with eyes, 0.70 mm

Width of vertex between eyes, 0.45 mm

Length of antennae, 1.13 mm

*Colouration.* General colour pale-brown, with black bands on thorax; pleurae and sternites black; tergites and sternites of abdomen partly black; vertex blackish around foveae; antennae blackish from segments 4 to 10; genae pale-brown dorsally and blackish ventrally; coxae and legs partly black; genital segments blackish-brown; forewings clear, bearing a light blackish area along margin at tip of clavus; pterostigma darker.

*Structure.* Body large and strong. Head (Figs. 95a,b) slightly smaller than thorax, moderately declivous, finely and sparsely pubescent, finely rugulose; vertex about twice as broad as long, swollen anteriorly and also on either side of median suture, leaving two deep foveal impressions, post-ocellar region also swollen; posterior margin moderately arcuate; anterior margin deeply emarginate at the point of excision; front ocellus visible from above; genal cones about 0.20 mm long and slender, below the level and about as long as vertex, bearing sparse hairs, separate, divergent distally, bluntly rounded apically, beset with microscopic points arranged in rows, hairs longer than that of vertex. Eyes large and bulging.

Antennae (Fig. 95c) quite long, longer than head including eyes, ten-segmented, hairy, two basal segments robust, 1st sub-quadrate, 2nd cylindrical, slightly longer than 1st, remaining segments slender and imbricate, 3rd joint longest, 4th, 6th and 7th equal to one another, but smaller than 3rd, 5th slightly smaller than 4th, 8th slightly smaller than 5th, 9th about half as long as 8th, terminal segment slightly longer than 9th, having two long, unequal setae at apex; four sensoria present on segments 4, 6, 8 and 9.

Thorax (Fig. 95b) quite large, moderately arched, finely and sparsely pubescent, prominently rugulose. Prothorax narrow, inclined downward under the head, convex, having two foveal impressions on each lateral side; prescutum broader than long, narrowly rounded anteriorly and broadly rounded posteriorly except at the weak posterior angles,

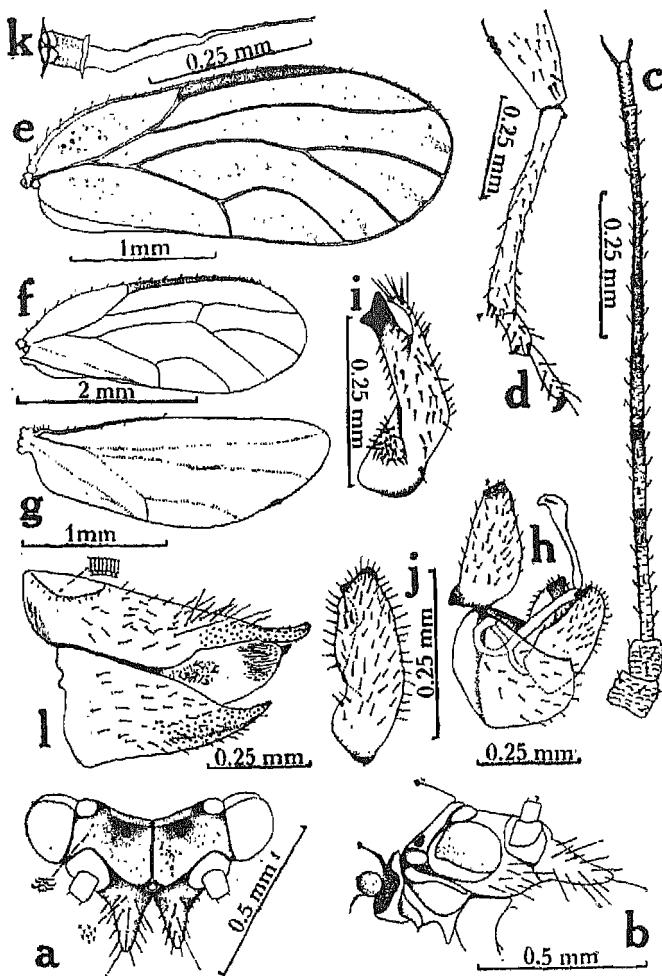


Fig. 95. *Psylla zaicevi* Sulc.—**a**: head, front view; **b**: head and part of thorax, lateral view; **c**: antenna; **d**: hind leg; **e**, **f**: forewings; **g**: hind wing; **h**: male genitalia, lateral view; **i**, **j**: parameres, mesal and outer views; **k**: sperm pump; **l**: female genitalia, lateral view.

angulate laterally; scutum quite broad, about twice as broad as long, nearly as long as prescutum, angulate laterally; scutellum small, broadly transverse, broad anteriorly and narrow posteriorly, posterior margin weakly invaginated medianally.

Legs (Fig. 95d) moderately long, coarsely pubescent with long setae, femora shorter than tibiae, all tibiae with a comb of setae at apex and a few thick setae just below apex, hind femur with three sensoria-like structures ventrally, hind tibia with a small basal spur and five black long setae at apex, basal tarsal joint with two claw-like black spines at apex; meracanthus small, slender and triangular.

Forewings (**Fig. 95e**) large, apex narrowly rounded, with a long pterostigma, radius about as long as basal vein,  $M+Cu$  smaller than radius and about as long as  $R_1$ , first marginal cell slightly smaller than second; veins armed with microscopic setae, membrane beset with minute points. In one example, a small vein joining the radial sector and media present in forewing (**Fig. 95f**).

Hind wings (**Fig. 95g**) small, beset with minute points, costal margin with a few simple and hooked setae, in the basal half.

Abdomen longer than broad, finely and sparsely pubescent, setae longer on sternites.

*Genitalia.* Male genitalia (**Fig. 95h**) smaller than abdomen. Anal valve about 0.35 mm long, longer than parameres; in lateral aspect, anterior margin nearly straight, posterior margin convex, gradually narrowed both apically and basally, upper surface beset with long simple setae; parameres (**Figs. 95i, j**) about 0.30 mm long, bilobate, inner lobe stout and thick, terminating in an abrupt black broad apex, posterior angle of apex broadly rounded while the anterior angle bluntly rounded, outer lobe slightly longer than inner lobe; in lateral aspect, broadest in middle and narrower both apically and basally, margins of outer lobe irregular, apical half black, outer surface sparsely beset with simple setae of varying size, mesal surface of inner lobe armed with somewhat thick setae pointing downwards and a cluster of strong and thick setae in the basal region; hypandrium of usual shape, bearing sparse, simple setae; outer arm of aedeagus smaller than basal; sperm pump as figured (**Fig. 95k**).

Female genital segment (**Fig. 95 l**) longer than abdomen; dorsal plate longer than ventral, pubescent with small hairs, slender towards subacute apex, thickened dorsally at extreme apex, with tip upturned, slender apical region armed with numerous peg-like setae; anal opening surrounded by a double ring of pores; ventral plate acute at apex, having numerous peg-like setae in the apical region; ovipositor acutely pointed.

*Host plant.* On *Salix* sp.

*Distribution.* Sulc (1915) has recorded from Poland, while Ossiannilsson (1943, 1951, 1952) has recorded from Norway, Finnish Lapland; not known from Sweden (under *Psylla soot-ryeni*).

*Material examined.* Through the kindness of the Commonwealth Institute of Biological Control Unit located at Kashmir, a small collection of this species was received, preserved in alcohol. This material includes few adults and nymphal stages, collected on *Salix* sp., in May 1965 (P.R.D. Kari). Two males and two females were mounted on cards; some slides were also prepared of the parts of adults and nymphal stages. All the mounted specimens, some adults and nymphal stages preserved in alcohol and some slides are deposited at F.R.I., Dehra Dun.

*Comparison:* One pair of specimens was sent to Professor F. Ossiannilsson, Sweden, for comparison and opinion and he identified the species as *P. zaicevi* Sulc. He writes (*in litt.*): "... a species described on material from Siberia but also present in arctic Scandinavia and Finland. The host plants in Sweden are *Salix lanata* and *S. glauca*."

This species is recognised by the characters outlined in the key, and is easily separated by the shape of head and forewing and venation. Its hyaline wings, long and divergent

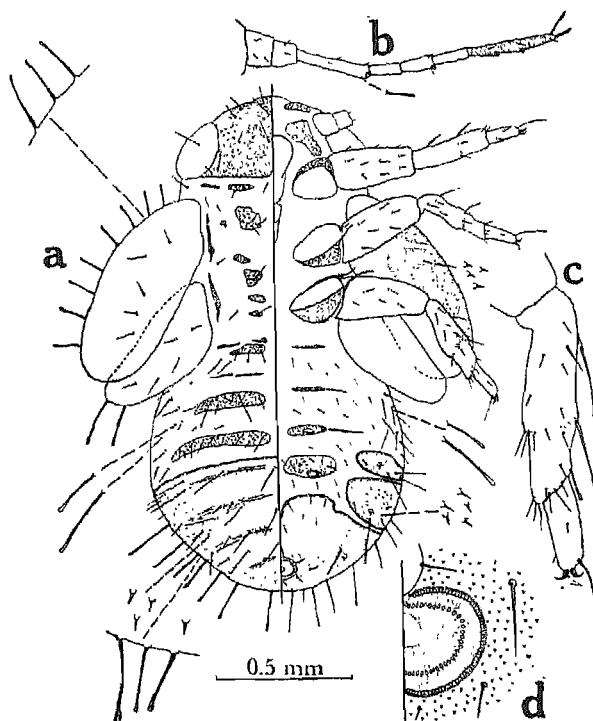


Fig. 96. *Psylla zaicevi* Sulc.—a: fifth stage nymph; b: antenna; c: leg; d: circum-anal pore ring.

genal cones and short and broad pterostigma and genitalia are characteristic features.

*Biological notes.* This species is quite common on willows (*Salix* sp.) in Kashmir. Its nymphal stages are described below.

#### Nymphal stages

*Fifth stage.* (Fig. 96a). Length 1.37 mm. Typical psylline form. Head narrower than abdomen. Eyes and wing-pads large and prominent. Wing pads extending beyond the general margin of the body. Dorsum with the derm largely membranous, except the wing-pads, a pair of large areas in the head, a number of small plates in the thorax, four narrow strip-like plates in the anterior half and a single large plate in the posterior half of abdomen, which are sclerotic. Derm sparsely beset with spatulate setae of various length, similar setae also present along the margin of wing-pads and the posterior abdominal plate. Hind wing-pads with two long spatulate setae. Derm also armed with minute points, these becoming stronger in the posterior abdominal plate.

Antennae (Fig. 96b) long and slender, about 0.79 mm long, seven-segmented, bearing few small spatulate setae, two basal segments robust, 1st broadly transverse, 2nd sub-

quadrate, 3rd joint long and slightly longer than 4th and 5th joints combined together, 4th, 5th and 6th joints nearly equal to one another, 7th joint longest, imbricate, having two unequal apical spines, four sensoria present on segments 3, 5 and 7.

Ventral side largely membranous, except for the sclerotic areas at the base of antennae, areas on the underside of wing-pads small, sub-median areas in the anterior and one caudal plate in the posterior region of abdomen, and two large areas around spiracles. Derm bearing scattered simple setae and beset thickly with minute points, becoming sharply pointed in the posterior abdominal plates. Legs (Fig. 96c) moderately large, bearing scattered simple setae, varying in size; without trochanters; with distinct tibio-tarsal articulation, each tibia with two spatulate setae; each tarsus with one curved seta at apex; claws present, the pulvilli large, petiolate, fish-tail like. Anal aperture (Fig. 96d) set forward a short distance from the end of the abdomen, surrounded by an outer ring of slit-like pores and an inner ring of somewhat oval pores; both rings are interrupted medianally and guarded by one anterior and two posterior pairs of setae, varying in size.

*Fourth stage.* Length 1.14 mm. Resembling the fifth stage, except in smaller size, having large thoracic and abdominal plates, antennae five-segmented, bearing three sensoria, and tibio-tarsal articulation absent.

#### Genus **PSYLOOPSIS** Loew 1878

##### *Psyllopsis*

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- Edwards, J. 1896. *Hem., Hom. Br. Isl.*, p. 233.
- Oshanin, B. 1907. *Acad. Imp. Sci. St. Petersb.* 12: 231-252.
- Aulmann, G. 1913. *Psyllidarum Catalogus, Berlin*, p. 71.
- Ferris, G. F. 1925. *Can. Ent.* 57: 46-50.
- Crawford, D. L. 1914. *Bull. U.S. natn. Mus.* 85: 132.
- Lal, K. B. 1935. *Trans. R. ent. Soc. Lond.* 82: 363-385.
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- Dobreanu, E. and Manolache, C. 1962. *Fauna Repub. pop. rom., Insecta, 8* (Fasc. 3), *Homop. Psylloidea*, pp. 148-149.

*Type species.* *Psyllopsis fraxinicola* (Foerster) (—*Psylla fraxinicola* Foerster 1848); England. The characters given by Crawford (1914) are reproduced, with some notes.

Head narrower than thorax, deflexed rather strongly; vertex more or less flattened on each side of median suture, not quadrate, narrowed distinctly anteriorly, not perpendicularly inclined but sometimes strongly descending, not sharply defined on anterior margin but merged into genae; genal concs perpendicularly inclined, acutely conical, divergent, not continuing plane of vertex. Antennae at least moderately long. Eyes moderately large, hemispherical. Thorax well arched, pleural suture of prothorax as in *Arytaina*, but pronotum not knob-like at lateral termination. Hind tibia without basal

spur and with a series of small, black apical spines, hind proximal tarsus with two black claw-like spines. Wings ovate, usually subopaque to hyaline, usually with a pterostigma, rounded at apex.

**Psyllopsis fraxini** (Linnaeus) 1761

*Chermes fraxini*

Linnaeus, C. 1761. *Faun. Suec.* No. 1013.

*Psylla fraxini*

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*Psyllopsis fraxini*

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Heslop-Harrison, G. 1942. *ibid.* 78: 155-160.

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Ossiannilsson, F. 1952. *Opusc. Ent.* 27: 196.

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 Loginova, M. M. 1954. *Proc. Inst. Zool. Acad. Sci. U.S.S.R.* **15**: 39-40.  
 Loginova, M. M. 1962. *ibid.* **31**: 37.  
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 Loginova, M. M. 1964. *Inst. Biol. Acad. Sci. U.S.S.R.*, p. 463.

This species is not represented in the collection studied by the author, and therefore, not included in the key. However, brief characters are outlined below.

Colour yellow or with orange tinge. Head and thorax with black patches and streaks; genal cones frequently black; antennae yellow with apices of segments 4th to 6th and the remaining distal segments black. Forewings clear, transparent, with a broad irregular fuscous-black band round the apex and then curving upward from the apex of first marginal cell to the furcation point of media, another short black streak present basally along the posterior margin and extending up to clavus; part of cubitus and fork Cu<sub>2</sub> black. Genal cones shorter than vertex along the median suture. Abdomen black with posterior segments yellowish. Genitalia characteristic.

*Distribution.* *Psyllopsis fraxini* (L.) is widely distributed throughout the countries of Europe, and has been recorded on several species of *Fraxinus*. From India, it has been recorded at Naini Tal (U.P.) at 1,525 m for the first time, producing galls on the terminal shoots of *Fraxinus ornus* (Heslop-Harrison, 1946).

#### Sub-family TRIOZINAE

- 1879, Triozinae, Loew, F. *Verh. zool.-bot. Ges. Wien*, **28**: 605-609.  
 1900, ———, Froggatt, W. W. *Proc. Linn. Soc. N.S.W.* **26**: 272-73.  
 1908, ———, Kuwayama, S. *Sapporo Trans. Nat. Hist. Soc.* **3**: 53.  
 1910, ———, Crawford, D. L. *Pomona Coll. J. Ent.* **2**: 228.  
 1913, ———, Aulmann, G. *Psyllidarum Catalogus*, Berlin, p. 36.  
 1914, ———, Crawford, D. L. *Bull. U.S. natn. Mus.* **85**: 64.  
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 1960, ———, Heslop-Harrison, G. *ibid.* (13), **3**: 497-504.  
 1963, ———, Klimaszewski, S. M. *Annls. Zool.* **20**(20): 363-374.  
 1886, Triozaria, Puton, A. *Cat. Hem. Fauna Palest.*, p. 93.  
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     Psylloidea, Acad. Rep. Pop. Romine, pp. 9-50, 62-63, 253.  
 1964, ———, Loginova, M. M. *Proc. Inst. Zool. Acad. Sci. U.S.S.R.* **34**: 52-56.

- 1964, ——, Loginova, M. M., *Inst. Biol. Acad. Sci. U.S.S.R.* pp. 437-443, 473-482.  
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Body small or large, slender. Head seldom as broad as thorax, more or less deflexed. Vertex usually sub-triangular to semi-circular in outline, not flat, usually sharply margined, with prominent median suture, usually with two discal sulci. Genae produced into conical or lobate processes, or sometimes merely swollen, more or less pubescent. Frons covered by genae except small portion bearing the front ocellus. Eyes hemispherical. Antennae ten-segmented, variable in length. Prothorax typically well arched (not in *Leuronota*). Pleurites not equal, suture not extending to middle of pronotum. Hind tibiae usually with or without basal spur or serrate carina, with three to four black spines at apex; basal tarsus of hind legs without claw-like apical spines; meta-coxae with metacanthi present, often with flattened anterior processes as in *Phylloplecta* group of *Trioza*. Forewings membranous, hyaline, sometimes maculated, more or less angulate at apex, sometimes narrowly rounded; no pterostigma; radius, media and cubitus leaving the basal vein at the same point or nearly so (except in *Ceropsylla*). *Rhinopsylla* Riley belonging to the sub-family *Ciriacreminae* also possesses this triozine venation. Anal valve (procotiger) in male usually with posterior lobes.

*Type genus.* *Trioza* Foerster.

The most distinguishing characters of this sub-family are the trichotomous branching of the basal vein of the forewing, the shape of forewings tending to be acute apically, the size and shape of head and the absence of claw-like spines on the basal tarsi of hind legs.

This sub-family includes eight Indian genera. Five of these, viz., *Ceropsylla* Riley, *Leuronota* Crawford, *Petalolyma* Scott, *Phylloplecta* Ferris and *Trioza* Foerster are represented in the collection. *Phylloplecta* has not been recognised as a valid genus by recent workers, and Tuthill (1944) has merged this genus in *Trioza*. However, for convenience, the Indian species are grouped separately, on the basis of presence or absence of the flattened anterior processes of metacoxae. Three genera *Cecidotrioza*, *Neotrioza* and *Ozotrioza*, described by Kieffer (1905), are not included in the synoptic key, as their representatives are not seen by me. The whereabouts of his types are also not known.

#### KEY TO THE GENERA OF TRIOZINAE

1. Cubitus, media and radius leaving the basal vein at the same point, i.e., strictly trichotomous . . . . . 2
- . Branching of basal vein variable, not quite trichotomous, R+M of forewing with short and prominent common base . . . . . *Ceropsylla*
2. Thorax scarcely arched; pronotum long, flat, with a prominent epiphysis near the anterior margin; genal cones directed forward . . . . . *Leuronota*
- . Thorax well arched; pronotum shorter, descending cephalad, without median anterior epiphysis . . . . . 3
3. Forewings maculated, elongate-ovate, narrowly rounded apically . . . . . *Petalolyma*
- . Forewings hyaline, with anterior margin arched or strongly so, acutely or subacutely angled at apex . . . . . *Trioza* 4

4. Metacoxae with flattened anterior process, in addition to meracanthi . . . . . *Phylloplecta* group  
 —. Metacoxae without anterior processes . . . . . *Trioza* group

The members of this sub-family are mostly gall-makers, spending the young stages enclosed in fleshy galls on leaves or branches of forest trees. In some cases, the insect form curious pits and blisters, in which the nymphs remain until full grown in their natural state, though firmly embedded. Few species are in the habit of curling and distorting the leaves and feed within such curls.

Genus **CEROPSYLLA** Riley 1883

*Ceropsylla*

- Riley, C. V. 1883. *Proc. biol. Soc. Wash.* **2**: 76.  
 Froggatt, W. W. 1901. *Proc. Linn. Soc. N.S.W.* **26**: 273.  
 Aulmann, G. 1913. *Psyllidarum Catalogus, Berlin*, p. 59.  
 Crawford, D. L. 1910. *Pomona Coll. J. Ent.* **2**: 229.  
 Crawford, D. L. 1911. *ibid.* **3**: 423.  
 Crawford, D. L. 1914. *Bull. U.S. natn. Mus.* **85**: 100-101.  
 Van Duzee, E. P. 1917. *Cat. Hemip. N. Am.*, p. 798.  
 Tuthill, L. D. 1945. *J. Kans. ent. Soc.* **18**(1): 19-20.

*Type species.* *Ceropsylla sideroxyli* Riley 1883 (original designation).

Body long and slender. Head narrower or almost as long as thorax, deflexed. Vertex flat or rounded anteriorly, with deep sulci, bulging lobately in front between antennal bases. Post-ocellar region elevated. Front ocellus not or scarcely visible from above. Genae swollen close behind antennal sockets, cones short to long, separate, but not strongly divergent, vertical or subvertical, sometimes porrect. Clypeus at least moderately large. Antennae long, slender, about one and a half times or twice as long as width of head, including eyes. Eyes very large, hemispherical. Thorax arched. Pronotum short, sometimes strongly descending cephalad and depressed below level of vertex and prescutum, usually roof-shaped. Pro-episternum produced laterad, plate-like. Prescutum strongly arched, as long as wide. Mesopleurites strongly developed. Episternum very large, swollen. Hind tibiae with a series of basal spurs, one or two spurs strongly developed than others, with two or three apical spines within, and one outside. Forewings large, membranous, hyaline, usually three or over three times as long as broad, usually acute apically; basal vein relatively longer, distinctly more than one-fourth the length of the wing, parallel to costa; cubitus branching separately, or media and cubitus scarcely or distinctly petiolate at base or with a distinct tendency toward such a character; radius short to obsolete;  $R_1$  rather long; radial sector short; first marginal cell larger than second; no pterostigma. Hind wings much shorter than forewings.

The material studied by me includes three species from India. The characteristic tendency of separate branching of cubitus or the type of origin of M and Cu with the tendency toward becoming petiolate, very short base of R, short radial sector, and the general appearance of the vertex and genal cones, and the long basal vein justify these species to be placed in the genus *Ceropsylla* Riley.

## KEY TO THE SPECIES OF CEROPSYLLA

1. Cubitus branching separately; radius and media of forewings with a prominent common base . . . . . *C. fulvida*, sp. n.
- . Cubitus not branching separately and media and cubitus with a tendency toward becoming petiolate . . . . . 2
2. Body small, less than 2 mm in length; apical half of forewing strongly arched; fork  $M_{1+2}$  slightly longer than  $M_{3+4}$ ; basal vein very long, about one-third as long as wing . . . . . *C. minuta*, sp. n.
- . Body long, more than 2 mm in length; apical half of wing gradually arched; fork  $M_{1+2}$  about twice as long as  $M_{3+4}$ ; basal vein short, about one-fourth as long as wing . . . . . *C. ferruginea*, sp. n.

***Ceropsylla ferruginea*, sp. n.**

(Figs. 97, 98)

Length of body, in male, 2.45 mm; in female, 2.92 mm

Length of forewings, in male, 3.87 mm; in female, 4.21 mm

Width of head with eyes, 0.62 mm

Width of vertex between eyes, 0.32 mm

Length of antennae, 1.45 mm

**Colouration.** General colour dark-brown to fuscous with greenish tinge, head with a pair of longitudinal orange-coloured bands in the form of parenthesis, extended to but not reaching tip of genal cones, with a yellowish median spot near the posterior margin; posterior ocelli bordered with pink; genal cones dark-brown at apices and ventrally; antennae dark-brown; dorsum of thorax with a yellowish median stripe and also with a lateral stripe of lighter colouration, on either side, running from prothorax to scutellum; pleural region partly pale-yellow; prosternum, clypeus and legs pale yellow; tarsal segments darker; last abdominal tergite of male pale-yellow medially; parameres (claspers) light yellowish-brown; venter of abdomen light yellowish-brown with greenish tinge; wings light flavus, transparent; veins pale-yellow; hind wings with a fuscous band near clavus.

**Structure.** Body long and slender. Head (Figs. 97a,b) almost as broad as thorax, sparsely hirsute with grey hairs, scarcely declivous; vertex about twice as broad as long, swollen medially near posterior border and also laterally, with a large foveal impression on each side of median line, posterior to centre; posterior margin strongly arcuate; posterior ocelli elevated; anterior margin deeply emarginate above front ocellus; anterior ocellus visible from above; genal cones about 0.20 mm long, slightly shorter than vertex, broad at base, subacute at apex, divergent, below the level of vertex, subvertical in basal one-third and rest horizontal, pubescent with long hairs. Clypeus somewhat circular and visible from below. Eyes quite large, semicircular.

Antennae (Fig. 97c) long, ten-segmented, finely and sparsely pubescent, two basal segments robust, 1st transverse, about twice as broad as long, 2nd subquadrate, remaining segments slender and imbricate, 3rd segment longest, 4th about two-thirds as long as 3rd, 5th half as long as 3rd; 6th, 7th and 8th equal and each slightly longer than 5th; 9th

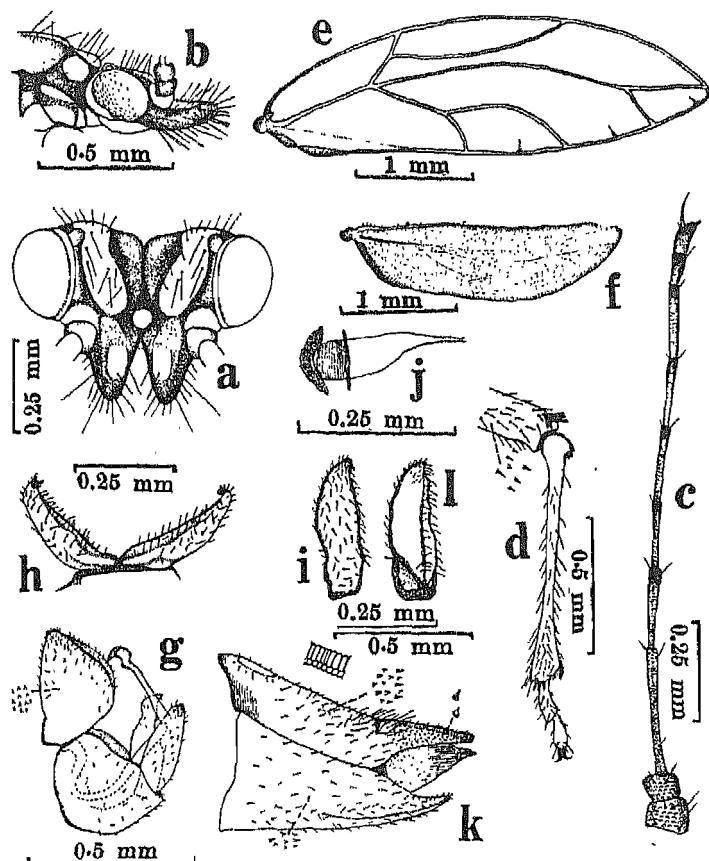


Fig. 97. *Ceropsylla ferruginea*, sp. n.—a: head, front view; b: head and part of thorax, lateral view; c: antenna; d: hind leg; e: forewing; f: hind wing; g: male genitalia, lateral view; h: forceps, caudal view; i: forceps, mesal view; j: sperm pump; k: female genitalia, lateral view; l: forceps, outer surface.

and 10th smallest but equal, and slightly broader than other slender segments; four sensoria present on segments 4, 6, 8 and 9.

Thorax (Fig. 97b) long and slender, sparsely pubescent with long grey hairs, reticulate-rugulose, moderately arched. Prothorax roof-shaped, longer in middle and narrower laterally, with an anterior, dorsal, median epiphysis, with two pairs of foveal impressions on lateral sides; pleurites large and extending forward below eyes; prescutum almost as long as broad, broadest in middle, angulate laterally, rather angulately narrowed cephalad, posterior margin angulated submedianally; scutum broader than prescutum, about two and a half times as broad as long, angulate both laterally and posteriorly; scutellum slightly broader than long, subtriangular, broad anteriorly.

Legs (**Fig. 97d**) long, pubescent with grey hairs and also beset with minute points; tibiae longer than femora; all tibiae with a comb of setae at apex; hind femur having five dorsal, thick setae near apex; hind tibiae with two thick and two small spurs at base, and with a strong apical tooth-like spine on one side and three on the other, apical end robust and thick; tarsal segments equal in length; meracanthus large and triangular.

Forewings (**Fig. 97e**) large and long, hyaline or light flavus, transparent, slightly more than three times as long as wide, acute at apex, radial sector short and flexed upward, meeting anterior margin in middle between apex and junction of  $R_1$ ;  $R_1$  smaller than radius, M and Cu with a small petiole or showing a distinct tendency toward such a character; basal vein long; cubitus about twice as long as radius; fork  $M_{1+2}$  meeting near apex; first marginal cell longer and broader than second; distance between  $Cu_2$ ,  $Cu_1$  greater than the distance between  $Cu_1$  and  $M_{3+4}$ ; veins finely setigerous.

Hind wings (**Fig. 97f**) small, slightly more than half as long as forewing, membrane thickly and uniformly beset with minute points, costal margin armed with a few simple and hooked setae, in the basal half.

Abdomen long and slender, finely and sparsely pubescent, hairs longer on sternites, both tergites and sternites thickly armed with minute points, arranged in series.

**Genitalia.** Male genital segment (**Fig. 97g**) smaller than abdomen. Anal valve about 0.35 mm long, slightly longer than forceps, in profile, anterior margin almost straight, posterior margin broadly convex, broadest in middle, outer surface sparsely beset with long setae and thickly with minute points; parameres (**Figs. 97h, i, l**) about 0.30 mm long, simple, broad basally and gradually narrowed apically in lateral aspect, in caudal view, strongly bowed, acute at apex and terminating in a sharp black point, outer surface having few simple, small setae, mesal margins armed with long and simple setae, while the mesal surface beset with thick setae directed downward; outer arm of aedeagus short, having a curved, scythe-shaped spoon end; hypandrium simple, of usual shape, sparsely pubescent; sperm pump as figured (**Fig. 97j**).

Female genital segment (**Fig. 97k**) almost as long as abdomen, both plates broad basally and narrow caudally, and thickly beset with minute points; dorsal plate longer than ventral, narrowly rounded at apex, slightly depressed dorsally and distally beyond middle, sparsely pubescent with small setae, setae longer in middle, apical region beset with small, thick setae, circum-anal ring with a double ring of pores; ventral plate acute at apex; ovipositor acutely pointed.

**Host plant.** Bred ex curled leaves of *Miliusa velutina* Hook. f. & Thoms.

**Type locality.** New Forest, Dehra Dun, (U.P.).

**Distribution.** Dehra Dun, Gorakhpur (U.P.).

**Types.** Described from a fairly long series of specimens. Holotype male; Allotype female; both from the type locality, July 31, 1957 (R. N. Mathur); Paratypes 30 males and 25 females, with the same data (R. N. Mathur); 1 female from Chanan-chasi, Gorakhpur, U. P., 7.2.1935 (S. N. Chatterjee); all these were bred or collected on *Miliusa velutina*. Some nymphs and adults were also preserved in alcohol. Parts of adults and nymphal stages are mounted on slides. All types, preserved material (collected from New Forest and Gorakhpur) and slides deposited at F.R.I., Dehra Dun.

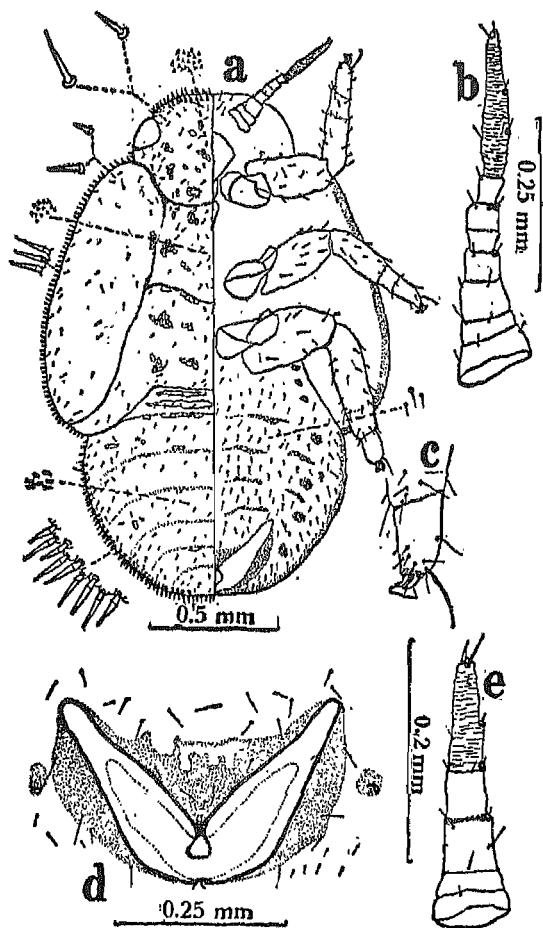


Fig. 98. *Ceropsylla ferruginea*, sp. n.—a: fifth stage nymph; b: antenna; c: part of tibio-tarsal joint of leg; d: circum-anal pore ring; e: antenna of fourth stage nymph.

One male and one female paratypes are presented to I.A.R.I., New Delhi.

*Comparison.* *Ceropsylla ferruginea*, sp. n. is easily recognised by its colouration, shape of head, genal concs, wings and venation.

*Biological notes.* This species causes curling and crinkling of young and fresh leaves (Plate 6 f) of *Miliusa velutina*, and the nymphs feed inside the curls. Due to the drainage of sap, the leaves become distorted and ultimately turn pale-yellowish in colouration. The nymphs are gregarious in habit, and the body margin and caudal abdominal margin are fringed with waxy cottony threads. They exude copious amount of honey dew and the globules are covered with cottony matter. Mature nymphs are

pale-yellow or yellowish-green, with antennae in the distal half black, legs creamy and eyes pinkish-red. The nymphal stages are described below.

### Nymphal stages

*Fifth stage.* (Fig. 98a). Length 1.96 mm. Of the typical triozine form, oval. Humeral angle of the wing-pads produced forward but not reaching the posterior margin of eyes. Dorsum strongly sclerotic throughout, except for a small area at the base of abdomen, abdominal plate showing traces of segmentation. Derm weakly vermiculate, bearing scattered ring-based setae of various length. Numerous minute points also present in the head and thorax near the median line, and appearing as comb-like structures in the abdomen. Margin of the body with a continuous series of quite closely set spear-shaped setae, which are arranged in a double row in the head and abdomen and in a single row on the wing-pads.

Ventral side membranous throughout, except for a faint sclerotic marginal zone on the wing-pads and abdomen, weak strip-like plates in the abdomen and minute plates around spiracles. Derm bearing simple setae. Antennae (Fig. 98b) situated ventrally, seven-segmented, having few simple setae, two basal segments narrowly transverse, 3rd broad at base and narrow at apex, 4th quadrate, 5th long with a weak constriction, 6th small, narrow basally and broad apically, 7th segment longest, imbricate, bearing two spines at apex, four sensoria present on segments 4, 5 and 7. Legs with the femora not attaining the margin of the body; without trochanters; with the tibio-tarsal (Fig. 98c) articulation distinct, tarsal segment with a curved seta at apex; claws present, the pulvilli triangular, not petiolate. Anal opening (Fig. 98d) set rather close to the apex, circum-anal pore ring large, broadly V-shaped, the outer ring consisting of a single row of slit-like pores, the inner ring with extremely faint pores.

*Fourth stage.* Length 1.21 mm. Resembling the fifth stage, except for smaller wing-pads, apparently with five-segmented antennae (Fig. 98e) bearing three sensoria, and tibio-tarsal articulation absent.

### *Ceropsylla fulvida*, sp. n. (Fig. 99)

Length of body, in male, 1.42 mm; in female, 1.63 mm

Length of forewings, in male, 2.32 mm; in female, 2.62 mm

Width of head with eyes, 0.40 mm

Width of vertex between eyes, 0.22 mm

Length of antennae, 0.52 mm

*Colouration.* General colour yellowish-brown, with dorsum of abdomen fuscous and the posterior margin of segments orange, dorsum of thorax with orange tinge, venter of abdomen pale-yellow, sternum pale-yellow, with mesosternum darker and smoky; vertex light brown with black foveae; genae dull white or greyish; legs pale-yellow, with apical tarsal segments blackish; antennae black distally; anal valve and forceps of male genitalia blackish.

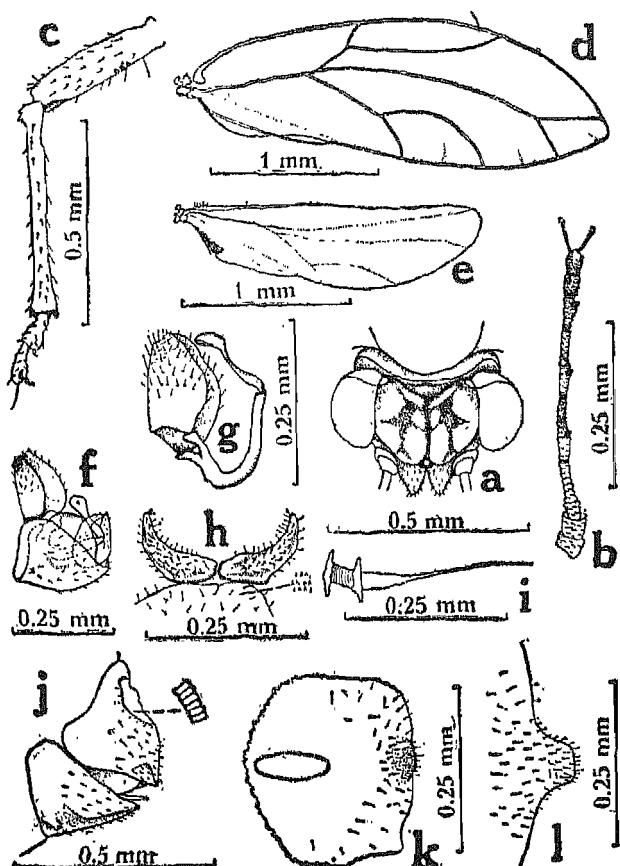


Fig. 99. *Ceropsylla fulvida*, sp. n.—a: head, front view; b: antenna; c: hind leg; d: forewing; e: hind wing; f: male genitalia, lateral view; g: anal valve and aedeagus, lateral view; h: parameres; i: sperm pump; j: female genitalia, lateral view; k: dorsal plate; l: apical region of ventral plate.

**Structure.** Body long and slender. Head (Fig. 99a) slightly broader than thorax, moderately declivous, finely and sparsely pubescent, finely rugulose, vertex somewhat W-shaped when viewed dorsally, with deep foveal impressions, linear in shape, on each side of median line, posterior to centre, disc swollen around foveal impressions, gradually rounded and converging anteriorly; posterior margin angulately emarginate; anterior ocellus visible in front; post-ocellar region swollen; anterior margin invaginated at point of excision; genal cones very small, about 0.12 mm long, somewhat porrect, separate, divergent distally, apices subacute, pubescent with long setae, finely rugulose. Eyes large, rather recessive. Antennal sockets lateral and located near the lower margin of eyes.

Antennae (**Fig. 99b**) small, ten-segmented, two basal segments robust, remaining segments slender and imbricate, 1st transverse, 2nd subquadrate, slightly longer than 1st, 3rd longest, having a weak constriction near base, 4th smaller than 3rd, 5th, 6th, 7th and 8th almost equal to one another, and each slightly smaller than 4th, 9th almost three-fourths as long as 8th, terminal segment about half as long as 8th and slightly smaller than 9th, bearing two unequal, quite long apical spines, three apical segments rather broad, 4th and 6th with slightly broader apices; four sensoria present on segments 4, 6, 8 and 9.

Thorax moderately arched, finely and sparsely pubescent, rugulose; prothorax short, strongly descending cephalad, almost concealed and deflexed below level of head and prescutum, visible as a bow-shaped strip in dorsal aspect, with a small, median, round projection, and two foveal impressions on each side; prescutum nearly as long as broad, broadest posteriorly beyond middle, narrowly and uniformly rounded cephalad, posterior margin angulate, angulate laterally; scutum broader than long, about twice as broad as long, broadest anteriorly before middle, smaller than prescutum in length, flat dorsally, sloping laterally, angulate both laterally and posteriorly; scutellum small, sub-triangular, broad anteriorly, narrow posteriorly, anterior margin almost straight.

Legs (**Fig. 99c**) moderately long, pubescent and also beset with minute points, arranged in lines; femora shorter than tibiae; all tibiae with apical comb of setae and also armed with thick, strong setae in the apical half; hind femur with three, thick dorsal setae near apex and three sensoria-like structures on the ventral side; hind tibiae with a series of small basal spurs, one spur stronger than others, with three, black tooth-like spines (2 on one side and 1 on the other); basal tarsal segment slightly smaller than apical, with weak claw-like processes at apex; meracanthus very small and slender.

Forewings (**Fig. 99d**) long and elongate, hyaline and transparent, slightly less than three times as long as broad, acute at apex, basal vein relatively longer, radial sector longer than basal vein and curved to costa, R+M with a prominent common base, radius slightly longer than  $R_1$ , cubitus branching separately, media almost running parallel to costal margin, fork  $M_{1+2}$  meeting near apex; marginal cells unequal, first marginal cell longer and broader than second; veins armed with microscopic setae.

Hind wings (**Fig. 99e**) moderately long, membrane beset with minute points, basal half of costal margin armed with a few simple and hooked setae.

Abdomen small, longer than broad, finely and sparsely pubescent, and also armed with minute points arranged in lines.

*Genitalia.* Male genital segment (**Fig. 99f**) smaller than abdomen. Proctiger (**Fig. 99g**) about 0.17 mm long, longer than parameres; in profile, anterior margin almost straight to weakly convex, posterior margin broadly convex, truncate at apex, outer surface beset with minute points arranged in lines, sparsely pubescent with simple setae, marginal setae longer and thicker; parameres short and stout, about 0.12 mm long, bowed, broad basally and narrowed towards apex, terminating in an acute point, two strong and thick setae directed downward present just below apex, mesal surface armed with small, thick setae, marginal setae slightly longer than others, outer surface bearing small, simple setae (**Fig. 99h**); hypandrium stout, of usual shape, armed with minute

points and simple setae; aedeagus (Fig. 99g) quite long, outer arm smaller than basal, with a thick spoon end; sperm pump as figured (Fig. 99i).

Female genitalia (Fig. 99j) smaller than abdomen, sparsely pubescent with setae of varying length; dorsal plate longer than ventral, curved downward, subacute at apex, apical region bearing small, closely set setae, circum-anal pore ring composed of a single ring of slit-like pores; ventral plate acute apically, apex with closely set setae; ovipositor small, acutely pointed.

*Host plants.* On *Ficus macrocarpa* L.f. (=*F. retusa* L.) and *F. rumphii* Blume.

*Type locality.* New Forest, Dehra Dun (U.P.).

*Types.* Described from a small series of specimens. Holotype male; Allotype female, both from the type locality, March 14, 1960 (R.N. Mathur); Paratypes: 7 males and 10 females, March 14, 1960 (R.N. Mathur); 1 female, collected on 15.3.60, from the type locality (R.N. Mathur), all these specimens are from *F. macrocarpa*. One male and one female, collected on 9.3.60, New Forest, Dehra Dun, from *Ficus rumphii* (R.N. Mathur). All these types, with some preserved specimens, and some slides, are deposited at F.R.I., Dehra Dun.

One male and one female (paratypes) are donated to I.A.R.I., New Delhi.

*Comparison.* *Ceropsylla fulvida*, sp.n. is readily recognised by the shape of head, genal cones, forewings and venation.

*Biological notes.* This species has been collected during March 1960, from new flush of leaves of *Ficus macrocarpa* (Plate 9g) and *F. rumphii*. It is rare on the latter plant species. Much is not known about its biology and economic importance.

#### *Ceropsylla minuta*, sp. n.

(Figs. 100, 101)

Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 58, Pl. 1, fig. 6.

Beezon, C. F. C. 1941. *Forest Insects*, p. 780.

Length of body, in male, 1.05 mm; in female, 1.19 mm

Length of forewings, in male, 1.55 mm; in female, 1.86 mm

Width of head with eyes, 0.37 mm

Width of vertex between eyes, 0.19 mm

Length of antennae, 0.50 mm

*Colouration.* General colour in live specimens, dark-brown or orange to sepia, males invariably of sepia or black colour, with legs and antennae pale-yellow, three apical segments of antennae black, femora of hind legs partly black; in female, head dark-brown, thorax with dark-brown dorsal bands, abdomen yellowish-brown or orange, dark-brown dorsad. In dry specimens, general colour brown dorsally, pale-yellow ventrally in female, dark-brown to chocolate in male. Wings hyaline, veins flavus.

*Structure.* Head (Fig. 100a), including eyes, somewhat broader than thorax, moderately declivous, finely and sparsely pubescent, finely rugulose; vertex emarginate on posterior margin, broader than long, about twice as broad as long, along the median line, with

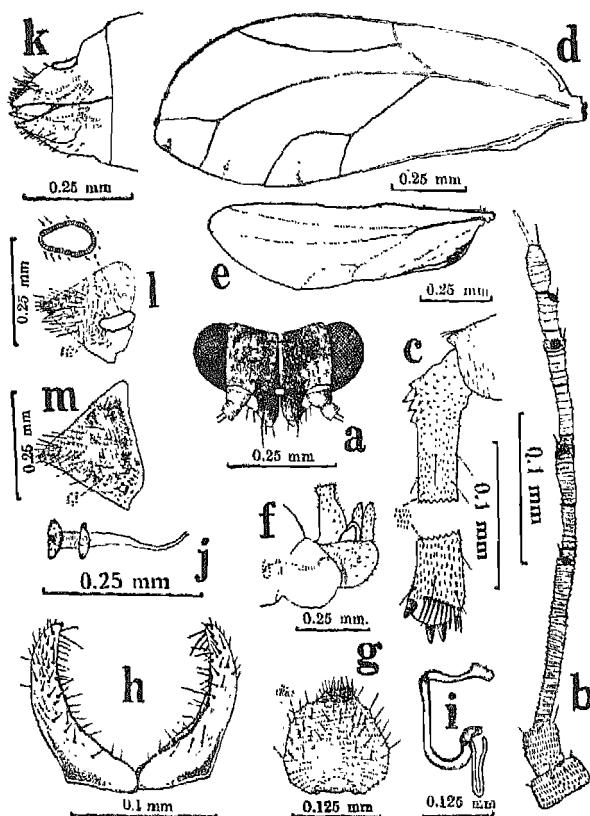


Fig. 100. *Ceropsylla minuta*, sp. n.—a: head, front view; b: antenna; c: hind leg, in parts; d: forewing; e: hind wing; f: male genitalia, lateral view; g: anal valve; h: parameres; i: aedeagus; j: sperm pump; k: female genitalia, lateral view; l: dorsal plate; m: ventral plate.

foveae on each side, posterior to centre, somewhat rounded in front, anterior margin with a deep sulcus near median line, post-ocellar region swollen, ocelli orange, anterior ocellus visible in front at base of cleft, not visible from above; genae small, approximate near base and divergent distally, finely and sparsely pubescent, and also beset with minute points arranged in linear groups, pubescence slightly longer than on vertex, vertical, about 0.11 mm long, half as long as vertex, broader at base, slightly flexed outward, bluntly rounded at apex, with a few long ventral setae. Antennal sockets lateral and almost on level with the lower margin of eyes.

Antennae (Fig. 100b) moderately robust, ten-segmented, about one and quarter times as long as head including eyes, two basal segments robust and beset with few setae and rows of minute points, 3rd joint longest, about one and a half times as long as 4th, 4th and 6th equal, 5th joint smallest, slightly more than half as long as 4th, 7th and 8th segments almost equal in length, 9th slightly smaller than terminal segment, apical

joint with two unequal spines at tip, four sensoria present on segments 4, 6, 8 and 9.

Thorax slightly arched, finely and sparsely pubescent, finely rugulose; prothorax roof-shaped, descending, with two foveal impressions on each lateral side; prescutum broader than long, and about one and a half times as broad as long, broadest in middle, gradually narrowed both anteriorly and posteriorly, posterior margin angulate; scutum depressed dorsally, broad, about two and a half times as broad as long, broadest beyond middle, slightly shorter in length than prescutum, angled laterally, surface finely reticulate in centre and rugulose laterally; scutellum small, vase-shaped, broad anteriorly, gradually narrowed posteriorly, about one and a half times as broad as long.

Legs (**Fig. 100c**) finely and sparsely pubescent, and thickly beset with rows of minute points, tibiae longer than femora, hind femur with two dorsal, subapical, blunt setae, all tibiae with a comb of small setae at apex, hind tibiae with three or four basal spurs and three black tooth-like spines at apex, tarsal segments of fore and middle legs almost equal in length, meracanthus small and triangular, basal tarsal segment of hind leg slightly longer than apical and slightly constricted near about basal half.

Forewings (**Fig. 100d**) long, about two and a half times as long as broad, without pterostigma, subacute at apex, basal vein ( $R+M+Cu$ ) quite long, longer than cubitus,  $M+Cu$  very slightly petiolate at base, cubitus a little more than twice as long as radius,  $Rs$  flexed upward, meeting the anterior margin, fork  $M_{1+2}$  meeting near apex, marginal cells subequal, first cell longer and broader than second. Hindwings (**Fig. 100e**) a little more than two-thirds as long as forewings, uniformly beset with minute points, costal margin armed with three simple setae near base and four hooked setae.

Abdomen longer than broad, finely and sparsely pubescent, and thickly beset with rows of minute points.

*Genitalia.* Male genital segment (**Fig. 100f**) smaller than abdomen, sparsely pubescent; anal valve (**Fig. 100g**) longer than parameres, about 0.24 mm long, pyriform, beset with rows of minute points, truncate at apex, in lateral view, broad at base and narrow at apex, anterior margin nearly straight, posterior margin broadly convex; parameres (**Fig. 100h**) about 0.15 mm long, with sides subparallel, bowed, outer margin curved, pointed at tip, outer surface armed with simple setae and also with rows of minute points, marginal setae thick and somewhat directed downward, apex ending in a thick, blunt, black point, just below apex, two thick setae present, pointing downward; hypandrium simple, of usual shape, bearing simple setae and minute points; outer arm of aedeagus (**Fig. 100i**) smaller than basal, having a thick spoon end; sperm pump as figured (**Fig. 100 j**).

Female genital segment (**Fig. 100k**) smaller than abdomen, sparsely pubescent, setae longer in the posterior half, dorsal plate (**Fig. 100 l**) slightly longer than ventral, narrower and rounded at apex, anal pore ring situated in a clear area and composed of a single row of slit-like pores; ventral plate (**Fig. 100m**) acute at apex, both plates broad basally, beset with rows of minute points; ovipositor acutely pointed.

*Host plant.* Bred from the nymphs occupying pit galls on the leaves of *Shorea robusta* Gaertn. f. (Plate 4a, b).

*Type locality.* New Forest, Dehra Dun (U.P.).

*Types.* Described from a long series of both sexes. Holotype male; Allotype, female, April 25, 1950 (R.N. Mathur); Paratypes : 12 females, April 21, 1933, 2 males, November 26, 1949, 10 females and 1 male, April 25, 1950. Additional specimens not designated as types are; 2 males, June 29, 1933, 8 males and 10 females, November 26, 1949, and 3 males and 9 females, April 25, 1950, all collected from the type locality (R.N. Mathur). A large number of adults and nymphs preserved in alcohol (in 3 phials) and some slides with mounted parts, together with the types, are deposited at F.R.I., Dehra Dun (U.P.). Two paratypes ( $\text{\female}$ ,  $\text{\male}$ ) are donated to I.A.R.I., New Delhi.

*Comparison.* This species differs from other species as given in the key.

*Biological notes.* This species is distributed throughout India, wherever *Shorea robusta* grows. Brief biological history and habits are described by Mathur (1935) and Beeson (1941). Its nymphal stages are described below.

### Nymphal stages

*Fifth stage.* (Fig. 101a). Length 1.07 mm. Form triozine and oval, but the continuity of the margin is interrupted at the sides of the head and the base of abdomen. Humeral angle of the wing-pads reaches almost to the anterior margin of the small eyes and bluntly rounded. Dorsum sclerotic throughout except for a small area at the base of the abdomen. Thick sclerotisation with a slightly vermiculate appearance present in the apical region of head, on either side of the dorso-median line and near the base of wings. Derm beset sparsely with simple setae and with numerous minute chitinous points. Few secta-setae also present on the dorsum. Abdomen composed for the most part of a single plate with traces of segmentation and two narrow plates at the junction between abdomen and thorax. These plates are medially interrupted. Entire margin of the body, except the eyes, beset with a continuous series of rather stout secta-setae.

Ventral side membranous throughout except for minute areas around spiracles, weak submedian abdominal strips, a small patch below antennae and circum-anal pore ring. Derm sparsely beset with simple ring-based setae and thickly with minute points. Antennae (Fig. 101b) ventral, stout, about 0.62 mm long, obscurely eight-segmented, armed with minute points, with four sensoria on 3rd, 5th, 7th and 8th joints, apical joint weakly imbricate, having two subequal spines at apex. Legs quite short, with a few simple setae, the femora far from attaining the margin of the body, without trochanter; tibio-tarsal articulation distinct; tarsal joint with a single golf-club seta; without claws; pulvilli of a peculiar shape, being in the form of a circular pad. Anal opening set well in from the apex of the body, surrounded by a double ring of pores (Fig. 101c) and armed with a few simple ring-based setae, the outer circumanal ring is composed of slit-like pores and is interrupted medially both anteriorly and posteriorly; the inner ring consists of minute, somewhat indistinct pores.

*Fourth stage.* (Fig. 101d). Length 0.73 mm. Identical with the fifth stage, except for smaller size, and having antennae obscurely six-segmented with three sensoria, and absence of tibio-tarsal articulation.

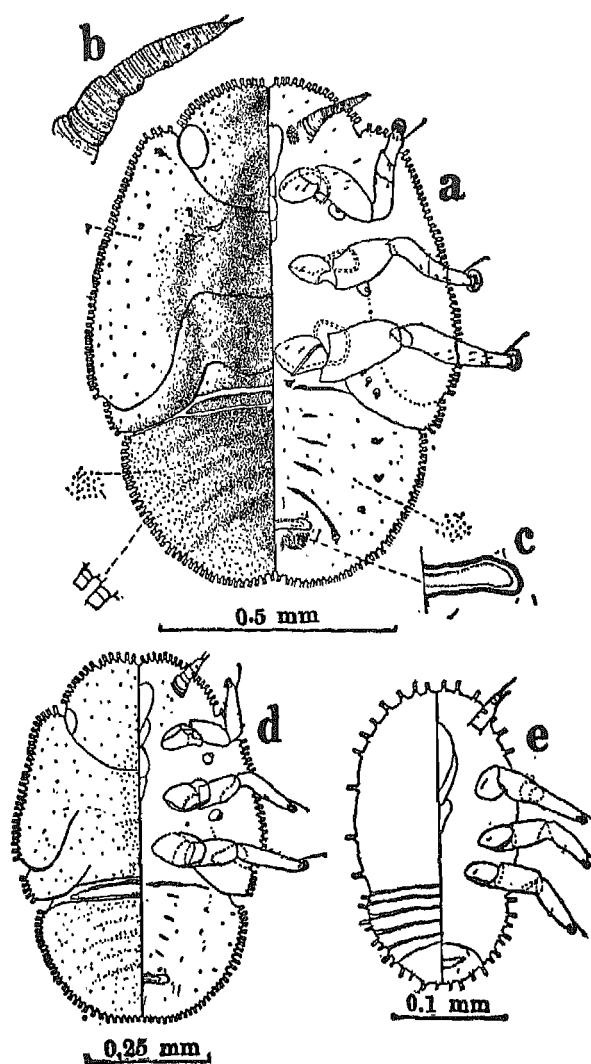


Fig. 101. *Ceropsylla minuta*, sp. n.—a: fifth stage nymph; b: antenna; c: circum-anal pore ring; d: fourth stage nymph; e: first stage nymph.

*First stage.* (Fig. 101e). Length 0.25 mm. This stage bears very few marginal sectasetae, alternating with smaller and larger ones; segmentation of antennae very obscure, with one sensorium.

Genus LEURONOTA Crawford 1914

*Leuronota*

Crawford, D. L. 1914. *Bull. U.S. Natn. Mus.* 85: 67-68

- Crawford, D. L. 1920. *Proc. Hawaii. ent. Soc.* 4 (2): 374-375.  
 Ferris, G. F. 1928. *Can. Ent.* 60: 240  
 Tuthill, L. D. 1943. *Iowa State Coll. J. Sci.* 17 (4): 598.  
 Tuthill, L. D. 1945. *J. Kansas Ent. Soc.* 18 (1): 17.  
 Tuthill, L. D. 1964. *Revista Peruana de Entomología* 7 (1): 31.

*Type species.* *Leuronota maculata* (Crawford) (= *Trioza maculata* Crawford 1910) (original designation by Crawford), from San Diego, Texas.

Body long and slender. Head not as broad as thorax, scarcely deflexed; vertex not as long as broad, deeply impressed discally, with a deep foveal impression on each side of median suture, produced into two small epiphyses close to front ocellus, posterior margin deeply invaginated; genal cones present, smaller than vertex, conical, porrect, divergent, bluntly rounded apically. Antennae slender, more than twice as long as width of head. Dorsum scarcely arched. Pronotum long, not descending cephalad, on same level with prescutum and vertex, roof-shaped, produced into three pairs of small, bluntly rounded epiphyses. Prescutum somewhat hexagonal in shape with a small median anterior epiphysis. Legs long and slender. Hind tibiae with small basal spurs and with three large, black tooth-like spines apically. Forewings long and slender, hyaline, about three times as long as broad, broadest subapically, subacute at apex, with or without prominent maculated bands in the apical region. Venation typically triozine.

Crawford (1914) writes, "This genus is erected to include two of the species formerly placed in *Allotrioza*, now in synonymy. The character of the pronotum is still used somewhat as it was in *Allotrioza*, but it is more restricted and more sharply differentiated from the usual type in *Trioza*." From India, only two species are represented in this genus, one is a new species and named *L. corniculata*, recorded on *Shorea robusta*, and the second species is *L. minuta* (Crawford). The specimens of the latter species from Hazaribagh determined and labelled by Crawford himself, do not show similarity with other members of the genus. However, since these have been determined by the progenitor of the genus, these are retained under *Leuronota*, with great hesitation.

***Leuronota corniculata*, sp. n.**  
 (Figs. 102, 103)

- Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 40; pl. II, fig. 20 (*Cerotrioza* sp.).  
 Beeson, C. F. C. 1941. *Forest Insects*, p. 777 (*Cerotrioza* sp.).

- Length of body, in male, 1.62 mm; in female, 2.10 mm  
 Length of forewings, in male, 2.71 mm; in female, 3.0 mm  
 Width of head with eyes, 0.60 mm  
 Width of vertex between eyes, 0.32 mm  
 Length of antennae, 1.16 mm

*Colouration.* (Dried specimens). General colour brown with a greyish vitta running laterally, margin of vertex and median suture dirty white, thorax with dirty white dorsal bands, pronotum with five greyish epiphyses, abdomen with dark-brown, transverse

segmental bands, antennae pale-yellow with apical segments and apices of segments four and six black, eyes dull red, legs pale-yellow, femora with a small brown spot which is darker in male, apical tarsal joints black, forewings partly hyaline and maculated conspicuously with two brown transverse bands, having numerous dark-brown spots scattered over the maculae.

**Structure.** Head (**Figs. 102a,b**) scarcely declivous, sparsely and finely pubescent, finely rugulose, as broad as thorax; vertex a little more than half as long as broad between eyes, disc impressed deeply, having large and prominent foveae on each side of median line, and also produced in front into two horn-like epiphyses close to front ocellus, epiphyses porrect, bluntly pointed apically and about one-fourth as long as genal cones, area on either side of median line slightly swollen, posterior margin deeply invaginated, front ocellus visible from above and located at the point of excision of median line; genal cones about two-thirds as long as vertex along the median suture, directed forward, divergent, bluntly rounded apically, sparsely pubescent with setae longer than on the vertex and also beset with fine points, cones slightly swollen near insertion of antennae. Eyes large, somewhat reniform.

Antennae (**Fig. 102c**) slender, ten-segmented, a little more than twice as long as width of head, basal segments robust, 1st segment rectangular, 2nd rather quadrate, remaining segments imbricate, sparsely pubescent, 3rd segment longest, about two and a half times as long as 4th, 4th, 5th and 6th equal to one another, 7th and 8th segments also equal and slightly smaller than 6th, 9th half as long as 4th, terminal segment slightly longer than 9th, bearing two unequal spines at apex, four sensoria present on segments 4, 6, 8 and 9, 9th segment with a spine near sensorium.

Thorax narrow, scarcely arched, finely and sparsely pubescent, finely rugulose and also armed with irregular rows of minute points. Prothorax (**Fig. 102d**) roof-shaped, narrow medianally and broader laterally, with three lateral and one median (incised in centre) epiphyses; prescutum large, almost as long as broad, somewhat hexagonal in shape, gradually sloping laterally; scutum also large, about twice as broad as long, broadest before middle, nearly as long as prescutum, with a median line, angled both laterally and posteriorly; scutellum small, somewhat triangular, broad anteriorly and narrow posteriorly, a little longer than broad, with a median longitudinal line; postscutellum of metathorax transverse, swollen in middle, with a median line.

Legs (**Fig. 102e**) long and slender, sparsely pubescent and also beset with rows of minute points, tibiae longer than femora, hind femora with 3 or 4 dorsal, subapical blunt setae, hind tibiae with very small basal spurs and with a comb of small setae and three large, black stout tooth-like spines at apex, basal tarsal joints thicker and slightly longer than apical joints, meracanthus small, slender and triangular, tibial groove quite large.

Forewings (**Fig. 102f**) large, nearly three times as long as broad, broadest subapically, narrower at base, subacute at apex, veins pale and armed with minute setae, the apical band stretches from near the apex of radial sector to middle of medial cell, leaving more or less clear spaces along the anterior margin and on the margin of the second marginal cell, the sub-apical band runs obliquely from the costal margin to the middle of the margin of the first marginal cell, area along the side of  $Cu_2$  also maculated,  $Rs$  quite long

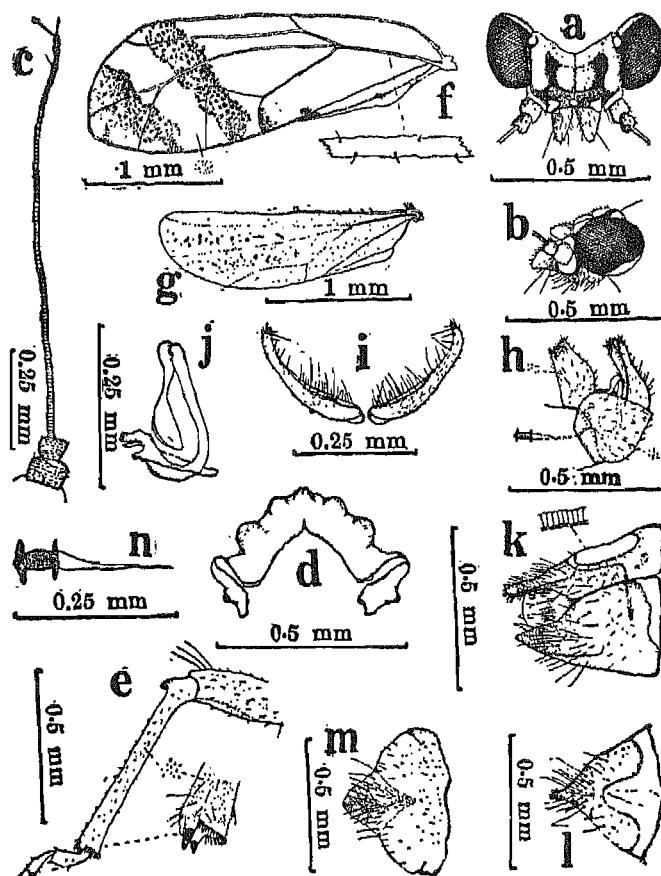


Fig. 102. *Leuronota corniculata*, sp. n.—a: head, dorsal view; b: head, lateral view; c: antenna; d: prothorax, dorsal view; e: hind leg; f: forewing; g: hind wing; h: male genitalia, lateral view; i: forceps, caudal view; j: aedeagus; k: female genitalia, lateral view; l: dorsal plate; m: ventral plate; n: sperm pump.

and longer than basal vein, cubitus a little more than twice as long as radius and slightly smaller than basal vein, both marginal cells equal in length and breadth, first marginal cell trapezoid in shape.

Hind wings (Fig. 102g) slightly shorter than forewings, venation as shown in the figure, costal margin bearing five basal stout setae and four hooked setae, the last seta strongly hooked. Both wings thickly beset with minute points.

Abdomen long and slender, finely and sparsely pubescent and thickly beset with minute points.

*Genitalia.* Male genital segment (Fig. 102h) smaller than abdomen, sparsely pubescent; proctiger (anal valve) darker and smaller than parameres, about 0.21 mm long, in profile,

broad basally, narrow apically, attenuate at tip, anterior margin almost straight, posterior margin broadly convex, outer surface beset with minute points; parameres (forceps) (Fig. 102i) about 0.27 mm long, broader at base and narrower at tip, terminating in an acute dark point, viewed from behind the outer margin of each forcep curves gently in towards each other, the inner margins irregular, bearing long, thick setae, three distinct, stout setae present in the apical mesal surface, just below apex, outer surface beset with small simple setae; hypandrium of usual shape, simple, beset with minute points; aedeagus (Fig. 102j) small and elbowed, outer arm smaller than basal, having a broad spoon end. Sperm pump as figured (Fig. 102n).

Female genital segment (Figs. 102k, l, m) smaller than abdomen, plates pubescent, broad basally and narrow caudally, dorsal plate (Fig. 102l) darker and nearly as long as ventral, narrowly rounded at apex and bearing a brush of setae, central region beset with long setae, basal portion clear, containing the anal opening surrounded by a double row of pores and armed with small setae; ventral plate (Fig. 102m) acutely pointed and with an elaborate set of ridges at apex, central region with long setae; ovipositor strongly pointed.

*Host plant.* Bred from the nymphs feeding inside leaf-folds of *Shorea robusta* Gaertn. f.

*Type locality.* New Forest, Dehra Dun (U.P.).

*Types.* Described from a long series of specimens. Holotype male, October 30, 1930; Allotype female, October 18, 1934, both from type locality (R. N. Mathur); Paratypes: 3 males, September 1, 1933, 2 males, September 5, 1933, 3 females, September 1, 1933, 3 females, September 2, 1933, 4 females, September 4, 1933; 1 male, October 20, 1934, 2 males, November 21, 1949, 1 male and 3 females, November 23, 1949, and 3 males and 1 female, November 26, 1949. Additional material not designated as types, are: 3 males, August 31, 1933; 9 males, September 1, 7 males, September 2; 5 males, September 4, 1933; 1 female, October 20, 1934; 6 males, November 23 and 3 males, November 26, 1949; all from the type-locality (R. N. Mathur). Some nymphs preserved in alcohol and some slides with mounted parts of adults and nymphal stages, and all types deposited at F.R.I., Dehra Dun. Three paratypes (1.9.33 and 27.10.33) from New Forest donated to I.A.R.I., New Delhi.

*Comparison.* *Leuronota corniculata*, sp. n. differs from all the known species—*L.acutipennis* Crawford from Nicaragua, *L.attenuata* Crawford from Borneo, *L.corniger* Crawford from Singapore, *L.leguminicola* Crawford from Brazil, *L.lengipennis* Crawford from Florida, *L.maculata* Crawford from Florida, *L.michoacana* Feris from Mexico, *L.microceros* Crawford from West Borneo, *L.celtidis* Tuthill and *L.sulcata* Tuthill, both from Peru—in having characteristic head, prothorax and maculated forewings. It is also easily recognised from *minuta* Crawford, by the above features.

*Biological notes.* Brief notes on its habits and biology are given by Mathur (1935) and Beeson (1941) under *Cerotriozza* sp. The description of its nymphal stages is given below.

#### Nymphal stages

*Fifth stage.* (Fig. 103a). Length 1.8 mm. Form triozine, somewhat broadly oval, the humeral angle of the wing pads produced cephalad to the posterior margin of the head,

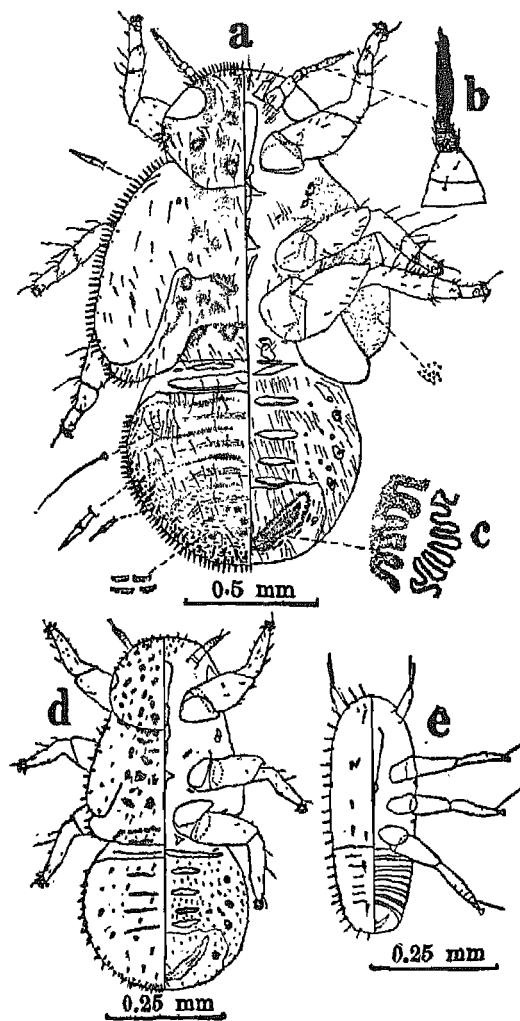


Fig. 103. *Leuronota corniculata*, sp. n.—a: fifth stage nymph; b: antenna; c: portion of circum-anal rings, highly magnified; d: third stage nymph; e: first stage nymph.

bluntly rounded. Eyes small. Dorsum strongly sclerotic throughout except for a small area at the base of the abdomen, the derm slightly vermiculate in appearance, having small scattered simple ring-based setae but entirely devoid of minute points. Head and wing-pads armed with a marginal series of small, slender, spear-shaped setae which are thickly present along the abdominal margin. Minute fringed processes also present in the abdomen.

Ventral side with the derm membranous except for two small plates near the antennae,

areas around the spiracles, small abdominal strips and an anal plate. Derm sparsely beset with simple ring-based setae, the wing pads thickly armed with minute points and the anal plate with minute fringed processes. Antennae (**Fig. 103b**) located ventrally, quite short, about 0.30 mm long and armed with a few setae, five segmented, two basal segments broad, other segments slender and darker, 5th segment nearly as long as the other four segments together, with four sensoria on 2nd, 3rd and 5th joints; two unequal spines at tip. Legs relatively short and stout, with a few setae, the femora nearly reaching the margin of the body; without trochanters; with the tibio-tarsal articulation well-defined, tibiae with two or three long setae, tarsus with a single golf club seta; claws present, pulvilli small, pad-like. Anal opening set well away from the apex of the abdomen, surrounded by extremely sinuous double row of circular pores (**Fig. 103c**), the inner row poorly defined; the anal pore-ring is guarded by three anterior and two posterior pairs of simple setae.

*Fourth stage.* Length 1.35 mm. Resembles the fifth stage except in having smaller wing pads, antennae four-segmented with three sensoria, tibio-tarsal articulation absent.

*Third stage.* (**Fig. 103d**). Length 0.75 mm. Identical with the fourth stage but differs in having smaller wing pads and antennae three segmented with two sensoria.

*Second stage.* Length 0.50 mm. Differing from the third stage in possessing knob-like wing pads; antennae two-segmented, with one sensorium.

*First stage.* (**Fig. 103e**). Length 0.30 mm. Resembles the second stage but differs in having comparatively longer legs, antennae two-segmented with one sensorium, broader abdominal plates and the golf club seta replaced by a long simple seta on legs.

**Leuronota minuta** (Crawford) 1912

(**Fig. 104**)

Crawford, D. L. 1912. *Rec. Indian Mus.* 7(5): 433-434, Pl. xxxiv, fig. R; Pl. xxxv, fig. F.  
(*Allotrioza minuta*).

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26(6): 625. (*L. ? (Allotrioza) minuta*).

Length of body, in male, 0.85 mm; in female, 1.05 mm

Length of forewings, in male, 1.47 mm; in female, 1.75 mm

Width of head with eyes, 0.35 mm

Width of vertex between eyes, 0.23 mm

Length of antennae, 0.45 mm

*Colouration.* General colour dark-brown or fuscous dorsad and pale-brown ventrad, except in male having abdomen completely dark-brown or fuscous; genal cones pale-brown; antennae dark-brown distally and pale-brown proximally; legs pale-brown, with tarsal segments darker; prescutum with pale median line, scutum with dark longitudinal bands.

*Structure.* Body small. Head (**Fig. 104a**) broader than thorax, moderately declivous, finely and sparsely pubescent, finely rugulose; vertex much broader than long, with a

circular fovea on either side of median line and posterior to centre, disc swollen on either side of median line and also anteriorly, post-ocellar region also swollen, posterior margin moderately arcuate, front ocellus visible in front, anterior margin angulately emarginate at point of excision; genal cones small, broad and contiguous at base, apices divergent, porrect and bluntly rounded, finely and sparsely pubescent and also armed with fine setae, ventral setae longer.

Antennae (**Fig. 104b**) small, ten-segmented, bearing few setae, two basal segments robust, 1st transverse, 2nd subquadrate, remaining segments slender and imbricate, 3rd segment longest, one and two-thirds as long as 4th, 4th, 6th, 7th and 8th nearly equal to one another, 5th slightly smaller than 4th, 9th slightly smaller than 10th, terminal segment about half as long as 3rd, bearing two unequal setae at apex, two apical segments slightly broader; four sensoria present on segments 4, 6, 8 and 9.

Thorax moderately arched, finely and sparsely pubescent, finely rugulose. Prothorax narrowly rounded anteriorly, with foveal impressions on each lateral side, sides extending forward below the eyes; prescutum nearly as broad as long, narrowly rounded anteriorly, anterior region inclined vertically downward, angulate both laterally and posteriorly; scutum shorter in length than prescutum, flat dorsally, angulate both laterally and posteriorly; scutellum somewhat triangular, broader than long, broad anteriorly and narrow posteriorly.

Legs (**Fig. 104c**) small, slender, finely pubescent and also beset with rows of fine points, femora shorter than tibiae, all tibiae with an apical fringe of long setae, hind femora with three sensoria-like structures located ventrally, hind tibiae with a series of small basal spurs, one spur stronger than others, with three tooth-like setae (two on one side and one on the other) at apex, basal tarsal joint slightly smaller than apical; meracanthus small, slender and triangular.

Forewings (**Fig. 104d**) small, transparent, about two and a half times as long as broad, without pterostigma, sub-acute at apex,  $R+M+Cu$  arising from the same point, radius slightly less than half as long as cubitus at point of furcation,  $R_s$  short and flexed upward, basal vein longer than Cu at point of furcation, fork  $M_1+2$  meeting near apex, first marginal cell longer and broader than second.

Hind wings (**Fig. 104e**) small, thickly beset with minute points, costal margin with a few simple and hooked setae.

Abdomen small, finely and sparsely pubescent and also beset with fine points.

*Genitalia.* Male genital segment (**Fig. 104f**) smaller than abdomen. Anal valve (proctiger) longer than parameres, about 0.19 mm long, broad basally and narrow apically, truncate at tip; in lateral view, anterior margin nearly straight, or weakly convex in basal two-thirds and weakly emarginate in apical one-third, posterior margin broadly convex, upper surface bearing fine, simple, scattered setae and also armed with minute points; parameres (forceps) (**Fig. 104g**) about 0.16 mm long, with sides subparallel, curved inwards and ending in a sharp point, outer surface beset with small, simple scattered setae, marginal setae longer and stouter, a group of small, thick setae directed downward present just below apex, mesal surface armed with similar scattered setae; hypandrium of usual shape, bearing sparse setae and beset with minute points; outer

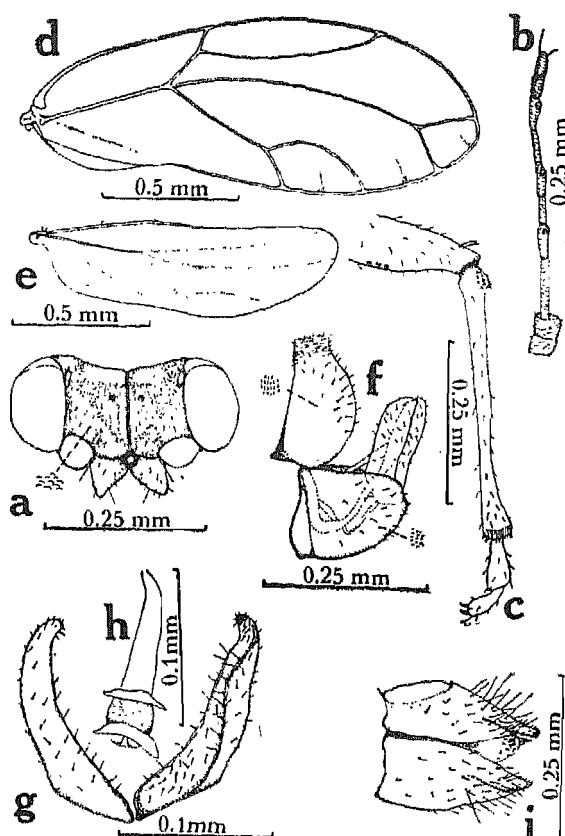


Fig. 104. *Leuronota minuta* (Crawford)—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: male genitalia, lateral view; **g**: forceps, caudal and partly mesal views; **h**: sperm pump; **i**: female genitalia, lateral view.

arm of aedeagus smaller than basal; sperm pump as figured (Fig. 104h).

Female genital segment (Fig. 104i) smaller than abdomen, pubescent, both plates almost equal and divergent posteriorly; dorsal plate broad basally, narrowly rounded apically, apical region armed with a group of small, thick setae, anal region somewhat horizontal; ventral plate acutely pointed; ovipositor acutely pointed.

**Host plant.** On new flush of leaves of *Mangifera indica* Linn.

**Distribution.** Previously recorded from Hazaribagh, Bihar, on leaves.

Fresh record is from Dehra Dun (U.P.).

**Material examined.** Two males and 2 females, collected on May 1962, from Dehra Dun (U.P.) (R. N. Mathur), on *Mangifera indica*.

The collection at the Agricultural Research Institute, New Delhi, includes a few specimens (R/7331, R/7332, R/7334), in poor condition, from Hazaribagh, 1997 ft, Bihar,

10-5-1911 (C.S.M.) and a small tube containing dried specimens, in poor condition (R/7335).

*Comparison.* The specimens collected from Dehra Dun resemble closely with the specimens from Hazaribagh and present at I.A.R.I., New Delhi. The specimens from Hazaribagh are labelled as *Allotriozia minuta* by D. L. Crawford. I have placed these specimens under the genus *Leuronota*, with great hesitation, as the characters differ greatly from that of *Leuronota*, known to me.

It may be noted here that *Allotriozia* has been considered synonymous with *Leuronota* by Crawford (1914) and this has been indicated by Ramakrishna Ayyar (1924) in the latter genus. The types of the two genera are, however, distinct.

#### Genus PETALOLYMA Scott 1882

##### *Petalolyma*

- Scott, J. 1882. *Trans. ent. Soc. Lond.* pp. 459-460.  
 Foggatt, W. W. 1901. *Proc. Linn. Soc. N.S.W.* **26**: 273.  
 Crawford, D. L. 1910. *Pomona J. Ent.* **2** (2): 228.  
 Aulmann, G. 1913. *Psyllidarum Catalogus, Berlin*, p. 60.  
 Tuhill, L. D. 1943. *Iowa State Coll. J. Sci.* **17**: 548.

*Type species.* *Petalolyma basalis* (Walker) (=*Psylla basalis* Walker 1858) (original designation).

Body large and robust, surface strongly rugulose, head and thorax clothed with long hairs. Head slightly shorter than thorax, moderately declivous. Vertex slightly broader than long, disc depressed, with two pairs of distinct foveal impressions, posterior margin slightly emarginate. Genal cones long, deflexed downward, separate but approximate at base, divergent apically, apices bluntly rounded, slightly porrect. Frons not visible from above. Eyes large, somewhat hemispherical. Antennae short, two basal segments robust, remaining filiform, sparsely hairy with long hairs, 3rd segment longest and longer than 4th. Thorax robust, strongly arched, wider than head. Prothorax narrow, convexly rounded, descending cephalad and almost concealed by the head, lateral margins not reaching beyond the outer margin of the eyes. Legs long and slender; hind tibiae without basal spur, apex broad and expanded into a strong spur on one side and three spurs on the other. Forewings large and elongate, shape unlike that of triozine form but venation typical triozine, without pterostigma, apex narrowly rounded, radial sector long and terminating near apex, basal vein slightly smaller than cubitus, fork Cu<sub>1</sub> strongly curved, radius as long as R<sub>1</sub>, fork M<sub>1+2</sub> slightly smaller than media, first marginal cell smaller than second, veins conspicuously hairy. Genitalia of characteristic shape.

"Crawford considered *Petalolyma* Scott as a synonym of *Trioza*. There is nothing in Scott's description to distinguish the two, but his figure of the wing does not appear to be that of a species of *Trioza*" (Tuhill, 1943).

This genus possesses triozine features and includes only one species, *Petalolyma basalis* (Walker, 1858), recorded from N. India. The combination of the characters of shape of genal cones, hairiness of veins and maculation of wings is distinctive.

**Petalolyma basalis** (Walker) 1858  
 (Fig. 105)

*Psylla basalis*

Walker, F. A. 1858. *List Hom. B. M., Supp.*, p. 275.

*Petalolyma basalis*

Scott, J. 1882. *Trans. ent. Soc. Lond.*, pp. 459-462, pl. xix, figs. 2-2f, (N. India).

Laing, F. 1930. *Indian Forest Rec.* 14(8) : 178.

Length of body, in male, 2.32 mm; in female, 2.58 mm

Length of forewings, in male, 3.50 mm; in female, 3.80 mm

Width of head with eyes, 0.70 mm

Width of vertex between eyes, 0.43 mm

Length of antennae, 1.10 mm

*Colouration.* (Preserved specimens in alcohol). Male: General colour of body, genae (except the tip), femora of legs, fore and middle tibiae fuscous; vertex dark-brown; tip of genae, hind tibiae and all tarsi, coxae and antennal sockets dirty white; antennae with basal joint light brown, apical joints black, remaining segments dirty white or yellow; forewings hyaline with flavus tinge; basal one-fourth area dark-brown with or without transparent area inside; in some specimens, another broad, dark-brown band present, of varying length and extending from anal vein to half of or completely the first marginal cell or along the entire posterior margin (**Figs. 105f, g**). Female: Body yellowish-brown with dark-brown longitudinal bands on mesothorax, antennae except the apical segments, and tarsi dirty white, abdomen and genitalia partly yellowish and dark-brown; forewings hyaline with a light brown basal one-fourth area; in rare cases, a broad fuscous band present along the posterior margin, extending only half the length of the first marginal cell. Hind wings with a smoky band near clavus, in both sexes.

*Structure.* Body large and robust, clothed with (except dorsum of abdomen) long yellow or dirty white hairs, surface strongly rugose. Head, including eyes (**Fig. 105a**), slightly shorter than thorax, moderately declivous, slightly shining, coarsely pubescent, finely rugulose along the borders and on either side of median suture (visible under high magnification), slightly broader than long, disc depressed, with two pairs of distinct circular foveae, posterior to centre, anterior foveae nearer the median suture and larger than the posterior foveae; posterior margin slightly emarginate; frons not visible, completely occupied by the front ocellus; posterior ocelli slightly elevated; genal cones about 0.20 mm long, slightly smaller than vertex, deflexed, not on the same level as the vertex, surface rugose and also beset with minute points, separate but approximate at base, divergent slightly near apex, densely hirsute, bluntly rounded and slightly porrect at apex. Eyes large, somewhat hemispherical when seen in front and oval from the side. Antennal sockets lateral and located near base of genal cones.

Antennae (**Fig. 105b**) short, ten-segmented, slender, filiform, clothed sparsely with long hairs, two basal segments robust, subquadrate, weakly rugulose, remaining segments imbricate, 3rd segment longest, thinner, about twice as long as 4th, 4th to 7th also thinner and nearly equal to one another, 8th slightly shorter than 7th, 9th and 10th almost

equal and smaller than others, apical segment with two unequal spines at apex, four sensoria present on segments 4, 6, 8 and 9.

Thorax (**Fig. 105c**) robust, strongly arched, coarsely pubescent, surface rugose and also armed with minute points when seen under high power. Prothorax narrow, convexly rounded, descending cephalad and almost concealed by the head, lateral sides broader, with two foveal impressions on each side; when viewed dorsally, prescutum broader than long, broadest beyond middle, gradually sloping anteriorly and narrowly rounded cephalad, somewhat acutely angled laterally, posterior margin with two weak angles; scutum large, flat, broadest before middle, about two and one-third broader than long, acutely angled at the sides, slightly shorter in length than prescutum; scutellum somewhat vase-shaped, broad anteriorly and narrow posteriorly anterior margin straight, with prominent antero-lateral angles.

Legs (**Fig. 105d**) long and slender, coarsely pubescent, tibiae longer than femora, tibial groove of fore and middle legs much longer than that of hind leg, hind tibiae without basal spur and a strong apical spur on one side and three spurs on the other, all tibiae with apical comb of setae, tarsal segments of fore and middle legs equal in length, while in hind leg, basal segment longer than apical; meracanthus large and sub-conical.

Forewings (**Fig. 105e**) large, clear, transparent except the basal region, about two and three-quarter times as long as broad, without pterostigma, anterior and posterior margins sub-parallel, apex narrowly rounded,  $R_s$  long and terminating at the apex,  $R$  as long as  $R_1$ , furcation  $M_{1+2}$  smaller than media, furcation  $Cu_1$  strongly curved and thrice as long as  $Cu_2$ , basal vein ( $R+M+Cu$ ) slightly smaller than cubitus, without cubital petiole (i.e., the radius, media and cubitus emerging at the same point), first marginal cell smaller than the second but nearly equal in width on the marginal nerve; veins sparsely hairy with long hairs.

Hind wings (**Fig. 105h**) relatively small, uniformly beset with minute points, costal margin armed with a few simple and hooked setae.

Abdomen moderately large, tergites telescoped, sternites coarsely hairy with long hairs, dorsum finely rugulose, both dorsum and venter thickly beset with minute points (visible under high magnification).

*Genitalia.* Male genital segment (**Fig. 105i**) smaller than abdomen, coarsely pubescent with long hairs; anal valve (proctiger) slightly longer than forceps, about 0.25 mm long, with large lateral lobes; in profile, anterior margin almost straight, apical fourth attenuate, outer surface thickly armed with minute points arranged in rows, marginal setae very long; parameres (**Figs. 105j, k**) about 0.20 mm long, slightly broad basally; in caudal view, bowed mesad to join other forceps, in lateral view posterior margin almost straight to near apex, while the anterior margin is produced dorsad apically into a strong flange just below apex and separated from the sharply notched antero-apical region, each forceps terminates distally in a horizontal black ridge having acute points both anteriorly and posteriorly, the anterior point is slightly longer than the posterior, apical region sinuate mesally, outer surface beset with simple setae, marginal setae slightly longer, mesal surface armed with short setae pointing downward; hypandrium (**Fig. 105j**) of usual

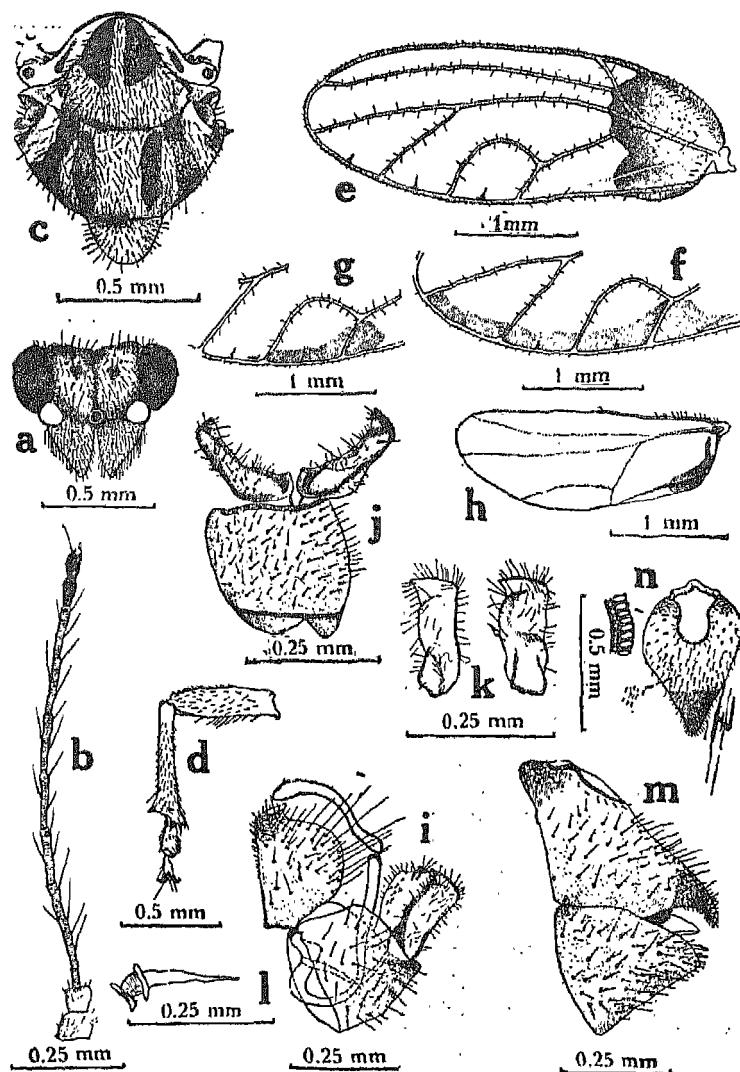


Fig. 105. *Petalolyma basalis* (Walker)—**a**: head, front view; **b**: antenna; **c**: thorax, dorsal view; **d**: hind leg; **e**: forewing; **f**, **g**: part of forewing; **h**: hind wing; **i**: male genitalia, lateral view; **j**: parameres and hypandrium, caudal view; **k**: forceps, outer and mesal views; **l**: sperm pump; **m**: female genitalia, lateral view; **n**: dorsal plate, dorsal view.

shape and coarsely beset with simple setae; outer arm of aedeagus smaller than basal and gradually becoming broader apically; sperm pump as figured (Fig. 105 l).

Female genitalia (Figs. 105m, n) smaller than abdomen, coarsely hairy with long hairs, both plates sub-equal in length, divergent posteriorly and sub-acute at apices, outer sur-

face of plates thickly armed with minute points, setae smaller and numerous near the apices, dorsal plate steeply sloping posteriorly; anal pore-ring large, with a double row of pores; ovipositor acutely pointed and serratulate.

*Host plants.* On young leaves and twigs of 'khandiara' (local name); on leaves of *Quercus dilatata*.

*Distribution.* Tehri and Chakrata (U.P.).

*Material examined.* A good series of adults, both males and females ( $6\delta\delta$ ,  $8\varphi\varphi$ ), 8,000ft, Akhori Sain Block, Tehri range, T.G. Forest Div. (U.P.) 5.6.62. (A.C. Mathur);  $3\delta\delta$ ,  $5\varphi\varphi$  from the same locality, collected 13.6.62, preserved in alcohol; and  $19\delta\delta$ ,  $7\varphi\varphi$  mounted on cards, same locality; also from Mundali, 2,565 m., Chakrata, U.P. 31.5.1934, (J.C.M. Gardner),  $2\delta\delta$ ,  $2\varphi\varphi$  (females immaturely developed), mounted on cards.

*Comparison.* This species is redescribed from a good collection of specimens from T.G. Forest division, during June 1962 (A.C. Mathur), and its identification has been confirmed by Dr V.F. Eastop, British Museum (Natural History), by comparing with Walker's Type specimen. One pair of this species has been donated to the British Museum.

#### Genus *TRIOZA* Foerster 1848

##### *Triozida*

- Foerster, A. 1848. *Verh. naturh. Ver. preuss. Rheinl.* 3: 67.  
 Flor, G. 1861. *Rhynch. Livland* 2: 484.  
 Flor, G. 1861. *Bull. Soc. Nat. Moscou.* 34: 336.  
 Frauenfeld, V. 1867. *Verh. zool.-bot. Ges. Wien.* 17: 804.  
 Scott, J. 1876. *Trans. ent. Soc. Lond.*, p. 551.  
 Loew, F. 1878. *Verh. zool.-bot. Ges. Wien.* 28: 609.  
 Maskell, W. M. 1890. *Trans. N. Z. Inst.* 22, pl. X.  
 Edwards, J. 1896. *Hem. Hom. Br. Isl.*, p. 253, Pl. 3, fig. 33.  
 Froggatt, W. W. 1901. *Proc. Linn. Soc. N.S.W.* 26: 273.  
 Aulmann, G. 1913. *Psyllitarum Catalogus*, Berlin, p. 37.  
 Crawford, D. L. 1910. *Pomona Coll. J. Ent.* 2: 229.  
 Crawford, D. L. 1911. *Pomona Coll. J. Ent.* 3: 423.  
 Crawford, D. L. 1914. *Bull. U.S. natn. Mus.* 85: 74.  
 Crawford, D. L. 1919. *Philipp. J. Sci.* 15: 186.  
 Crawford, D. L. 1920. *Ent. News* 31: 70.  
 Klyver, F. D. and Ferris, G. F. 1930. *Can. Ent.* 62(8): 169.  
 Haupt, H. 1935. *Psylloidea, Tierwelt Mitteleur.*, 4 (10): 242.  
 Tuthill, L. D. 1943. *Iowa State Coll. J. Sci.* 17(4): 546-548.  
 Tuthill, L. D. 1944. *J. Kans. ent. Soc.* 17(4): 145-146.  
 Tuthill, L. D. and Taylor, K. L. 1955. *Aust. J. Zool.* 3(2): 251.  
 Vondracek, K. 1957. *Fauna C.S.R. Praha, Ceskoslovenska akademie Ved.* t. 9: 304-305.  
 Dobrea, E. and Manolache, C. 1961. *Fauna Repub. pop. rom. Insecta*, Vol., 8 Fasc. 3, Homoptera Psylloidea, pp. 257, 258.

##### *Megatrioza*

- Crawford, D. L. 1915. *Philipp. J. Sci.* 10: 258, 265.

##### *Spanioza*

- Enderlein, G. 1926. *Ent. Mitt.* 15: 400.

*Colopelma*

Enderlein, G., 1926. *Ent. Mitt.* 15: 400.

*Phylloplecta*

Zacher, F. 1913. *Ent. Mitt.* 2: 148.

Ferris, G. F. 1926. *Canad. Ent.* 58: 16.

Laing, F. 1930. *Indian Forest Rec.* 14(8): 39.

Caldwell, J. S. 1938. *Bull. Ohio. biol. Surv.* 34: 248.

*Type species:* *Trioza urticae* (Linn.) (= *Chermes urticae* Linn.) (original designation Foerster, 1848).

*Phylloplecta* was erected by Zacher in 1913, with *Psylla tripunctata* Fitch (= *Trioza tripunctata* Fitch) as type species. Crawford (1915) named it *Megatrioza*, with *M. armata* as type species. Ferris (1926) and Laing (1930) consider *Megatrioza* as a synonym of *Phylloplecta*. Dr Russell (*in litt.*) has stated: "I have examined about 25 species from different parts of the world and all specimens have metacoxal spurs though they are better developed in some species than in others. They are present in *urticae*, the type species of *Trioza*, and in *tripunctata*, the type species of *Phylloplecta*. Therefore this character cannot be used to separate the two and I do not know of other characters that can be used for this purpose." However, for convenience it is proposed to treat this genus *Trioza* in two groups, *Phylloplecta* group (treated under *Megatrioza* or *Phylloplecta* by authors) and *Trioza* group.

## PHYLLOPLECTA GROUP

Head long, usually not as broad as thorax, more or less deflexed; vertex broader than long; genal cones usually rather short but in a few species long, usually thick, bluntly rounded and directed forward. Frons concealed. Thorax broad or narrow, moderately arched or sometimes nearly flat, usually sparsely clothed with long hairs. Pronotum long, not or only slightly depressed below level of mesonotum and vertex, with or without epiphysis. Prescutum sometimes with an anterior median point. Legs long, apparently strongly saltatory; hind tibiae with a small or large spur or a series of spurs at base, and expanded and armed with strong spurs at apex; hind coxae with an anteriorly directed spur in addition to the posteriorly directed spur. Forewings hyaline, sometimes coloured, long and narrow, acute at apex, venation triozine, with radius and clavus short, fork  $M_{1+2}$  meeting near apex. Hind wings seldom more than half as long as forewings. Abdomen usually long and narrow. Male anal valve usually broad, sometimes with lateral lobes produced caudad.

This group is represented by seven species from India, including three which are new to science. A key for five species, studied by me, is given below.

## KEY TO THE SPECIES OF PHYLLOPLECTA

1. First marginal cell unusually very large; genae almost wanting or represented as small swellings . . . . . *P. hirsuta* Crawf. 2
- . First marginal cell not large; genae present, small . . . . .

2. Radial sector and media long and looped . . . . .	<i>P. mallotica</i> Crawf.
—. Radial sector and media short and not looped . . . . .	3
3. Second marginal cell much smaller than first . . . . .	<i>P. piiformis</i> , sp. n.
—. Second marginal cell almost as long as first . . . . .	4
4. Prothorax with two submedian epiphysis . . . . .	<i>P. serrata</i> , sp. n.
—. Prothorax without epiphysis . . . . .	<i>P. lobata</i> , sp. n.

In the above key of this group, two species, viz., *M. vitiensis* Kirkaldy and *M. eugeniooides* Crawford, are not included, as these species are not seen by me. However, their descriptions are reproduced from the authors.

***Trioza eugeniooides* (Crawford) Comb. n.**

Crawford, D. L. 1917. *Philipp. J. Sci.* 12: 171-172. (under *Trioza eugeniooides*), (Mindanao Butuan).

Crawford, D. L. 1919. *ibid.* 15: 198. (under *M. eugeniooides*), (Mindanao, Butuan; India, Pusa, Bihar; Borneo, Sandakan).

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 625 (Pusa, Bihar; Philippines).

The description of this species is reproduced from Crawford (1917, 1919), "Length of body 1·9 millimetres; length of forewing 3·8 mm; width of head 0·7 mm. General colour brown to dark-brown, with lighter tawny stripes along dorsum and patches of the same colour on pleura and abdomen."

"Mindanao, Butuan (Baker), 3 females; no data on food habits given."

"The general appearance and structure are similar to *Trioza eugeniae* Crawford and *Trioza asiatica* Crawford, but the species differs from both in colour, wing venation, and a few other characters. These differences may be summarized as follows:

1. Thorax smooth, shining, black; wings very narrow, about three times as long as broad; second marginal cell about twice as long as greatest width; fourth furcal ( $M_{1+2}$ ) terminating in wing apex; male anal valve almost quadrate; genal cones about one third as long as vertex

*Trioza asiatica* Crawf.

2. Thorax punctate or rugulose, not smooth; light green or yellowish-green; wings about three times as long as broad; second marginal cell about two and one-half times as long as greatest width; fourth furcal ( $M_{1+2}$ ), extending to apex or near it. Male anal valve triangular. Genal cones half as long as vertex.

*T. eugeniae* Crawf.

3. Thorax punctate and brown with light stripes and blotches; wings about two and three-fourths times as long as broad; second marginal cell only a little longer than greatest width; fourth furcal ( $M_{1+2}$ ) terminating in front of apex within second marginal cell. Genal cones strongly decurrent, fully one half as long as vertex or more."

*T. eugeniooides* Crawf.  
(Crawford, 1917)

Its later description runs as follows:

"Length of body, 2 millimetres; forewing, 4. General colour chocolate brown with orange yellow markings; vertex flavous; dorsulum brown with a flavous stripe down center and flavous borders; mesoscutum with several tawny stripes and bands; legs

except hind femora and antennae except at tip yellowish; forewings clear with a black spot in clavus."

"Head nearly as broad as thorax, only a little declivous; vertex about half as long as broad, with a deep, brown, foveal depression on each side of median line; anterior ocellus in front; genal cones directed downward, about half as long as vertex, narrowly rounded at apex. Antennae very slender, about one and one-half times as long as width of head."

"Thorax somewhat arched, reticulately marked, sparsely pubescent. Hind tibiae with two small spurs at base close together, subapical spines moderately large. Forewings clear, very transparent; hind wings a little more than half as long as forewings."

"Female genital segment very short, bluntly pointed."

"Mindanao, Butuan (Baker), 3 females. India, Pusa, Bihar (Misra), 1 female taken on the wing, January 26, 1914. Borneo, Sandakan (Baker), 1 female. The last specimen differs slightly from the others in being less pubescent on the dorsum. This species appears to be a widely distributed one and may prove to be identical with some already-known species of *Trioza*." (Crawford, 1919).

*Distribution.* Mindanao, Butuan (Philippines); Sandakan (Borneo); Pusa, Bihar (India).

*Comparison.* This species is not examined by me and, therefore, it has not been included in the synoptic key.

***Trioza hirsuta* (Crawford) Comb. n.**

(Fig. 106)

- Crawford, D. L. 1912. *Rec. Indian Mus.* 7(5): 427-428, pl. xxxiii, figs. V, Y; pl. xxxv, fig. I, (*Kuwayama hirsuta*), (Igatpuri, Western Ghats, Bombay Presidency).  
 Crawford, D. L. 1919. *Philipp. J. Sci.* 15: 201 (*Megatrioza hirsuta*), (ex galls on *Terminalia tomentosa*; Lonavala, Bombay, India).  
 Crawford, D. L. 1924. *Rec. Indian Mus.* 26: 621 (*Megatrioza hirsuta*), (In galls on leaves of *Terminalia*; Mundakayam, Travancore, S. India).  
 Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 625.  
 Mani, M. S. 1935. *J. Asiatic Soc. Beng.* 1(2): 106-108 (Distribution, etc.).  
 Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 53-54 (Biology) (*P. hirsuta*).  
 Beeson, C. F. C. 1941. *Forest Insects*, p. 779 (Biological notes).  
 Mathur, R. N. 1949. *Indian J. Ent.* 8(2): 231-233, fig. 5 (Nymphal stages under *P. hirsuta*).  
 Mani, M. S. 1959. *Agra. Univ. J. Res. (Science)* 8(2): 170 (Plains of India), (*P. hirsuta*).

Length of body, in male, 2.52 mm; in female, 2.84 mm

Length of forewings, in male, 5.82 mm; in female, 5.61 mm

Width of head with eyes, 1.03 mm

Width of vertex between eyes, 0.55 mm

Length of antennae, 2.04 mm

*Colouration.* General colour light brown, with dark-brown markings on dorsulum, antennal segments black at tips, venter of abdomen lighter, wings hyaline, transparent, with a brown spot near tip of clavus,

*Structure.* Body large, long, entire surface covered with long, light brownish hairs. Head (**Fig. 106a**) large, including eyes about as broad as thorax, not deflexed, hirsute, surface armed with strong points when seen under high magnification; vertex about one and a half times as broad as long, sulcately impressed on each side of median suture, with two foveae posterior to centre, each lobe rounded forward in front, posterior margin deeply invaginated, post-ocellar regions strongly elevated, anterior margin strongly invaginated at point of excision; anterior ocellus visible in front and situated in a deep depression; genal cones wanting, with a slight rounded swelling at base of antennae. Eyes large, very prominent. Clypeus somewhat oval and visible in front. Labrum small.

Antennae (**Fig. 106b**) long, slender, ten-segmented, imbricate, two basal segments robust and transverse, 1st larger and longer than 2nd, each segment from 3rd onward with a long apical seta, 3rd and 4th nearly equal, 5th and 7th equal, but smaller than 4th, 6th slightly longer than 5th but smaller than 4th, 8th smaller than 7th, last two segments smallest and equal, terminal segment with two apical spines; four sensoria present on segments 4, 6, 8 and 9.

Thorax long, rather narrow, scarcely arched, hirsute, and armed with strong and thick points when seen under high power; pronotum moderately long, narrow transversely, roof-shaped, with two median epiphyses, one near the anterior border and the other on the posterior margin, anterior epiphysis weaker than the posterior, with two foveal impressions on each lateral side; propleurites large; episternum prominently bulging outward above; prescutum long, longer than broad, narrower both anteriorly and posteriorly, posterior margin angulate; scutum large, much broader than long, smaller in length than dorsulum, somewhat flat dorsally, gradually sloping laterally, angulate both laterally and posteriorly; scutellum broadly transverse, broad anteriorly and narrow posteriorly, convex dorsally.

Legs (**Fig. 106c**) long and thickly beset with minute points, pubescence long, femora stout and shorter than tibiae, with tibial groove long, tibiae with apical comb of setae, hind femur with three sensoria-like structures on ventral side and with a group of 6 to 8 long, blunt, dorsal setae near apex, hind tibiae with an extremely large and strong spur associated with a series of small spurs at base, apex expanded, swollen, bearing four black, stout, spur-like setae (3 on one side and 1 on the other), hind coxae very large, having prominent anteriorly and posteriorly directed spurs (**Fig. 106d**); meracanthus large and triangular; tarsal segments almost equal in length.

Forewings (**Fig. 106e**) very large, hyaline, transparent, about two and a half times as long as broad, broadest across middle, acutely angled at apex, R, M, Cu arising from the same point, this junction, tip of  $R_1$  and a loop in the basal vein brownish, Cu as long as  $R_1$  but slightly shorter than R, radius short, basal vein quite long with a small loop near base, first marginal cell unusually large and about twice as large as second and also wider,  $M_{1+2}$  terminating at tip of wing, veins armed with microscopic setae.

Hind wings (**Fig. 106f**) comparatively very small, costal vein armed with simple and hooked setae, membrane armed uniformly with minute points.

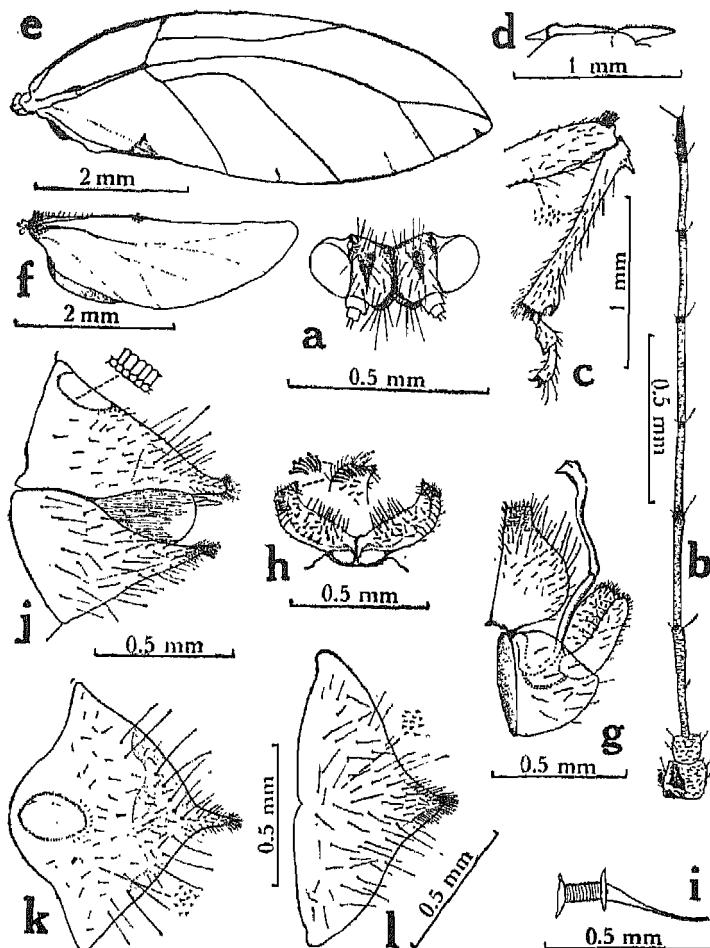


Fig. 106. *Trioza hirsuta* Crawford—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: metacoxal spurs; **e**: forewing; **f**: hind wing; **g**: male genitalia, lateral view; **h**: forceps, caudal view; **i**: sperm pump; **j**: female genitalia, lateral view; **k**: dorsal plate of female; **l**: ventral plate of female.

Abdomen short, thick, finely and sparsely pubescent and also beset with minute points arranged in lines.

**Genitalia.** Male genital segment (Fig. 106g) shorter than abdomen, somewhat retracted. Anal valve longer than forceps; in profile, anterior marginal most straight, lateral lobes strongly expanded, anal region narrower, somewhat cylindrical and truncate at apex, sparsely beset with simple setae, outer surface wrinkled, and beset with minute points, marginal setae long, mesal surface armed with small, simple setae; parameres (Fig. 106h) strong, stout, arched inward, two-toothed at apex, upper surface having small simple setae, marginal setae long and thick, setae on the mesal surface small

and curved, a group of thick, curved setae also present just below apex; hypandrium simple, of usual shape, bearing small, simple setae and also armed with minute points; outer arm of aedeagus quite long and a little shorter than basal; sperm pump (Fig. 106i) short, spoon-shaped, the ends with a heavily sclerotic flange, the median portion transversely striate.

Female genital segment (Fig. 106j) smaller than abdomen. Dorsal plate (Fig. 106k) longer than ventral, beset with hairs of varying length, broadest near base, gradually sloping caudally in profile, apical region acuminate with subacute apex, having 4 or 5 pairs of long setae and a brush of setae at apex; circum-anal ring large and composed of a double row of pores. Ventral plate (Fig. 106l) broad basally and gradually narrowed caudally, with acute apex, beset with long setae and also armed with thick points, apex with a brush of small setae; ovipositor acutely pointed.

*Host plants.* Bred *ex* hard leaf-curls of *Terminalia alata* Heyne *ex* Roth. var. *tomentosa* C.E. Parkinson (= *T. tomentosa* W. & A.), and *T. arjuna* (Roxb. *ex* DC) W. & A.

*Material examined.* The specimens present at I.A.R.I., New Delhi, are 1 example, July 1916, from Lonavla, Bombay, *ex* galls on *T. tomentosa*; 1 example, 27.8.34. and 4 examples, 4.9.34, from New Forest, Dehra Dun, recorded from *T. tomentosa* (R. N. Mathur).

The collection at the Z.S.I., Calcutta, includes the male type specimen, 20.xi.09, from Igatpuri, Western Ghats, Bombay Presidency (Type No. 9730/18); and 1 male and 1 female, of 11.9.63, from Kalyani, W. Bengal, on 'arjan' plant (A. K. Bhattacharya).

The collection at the F.R.I., Dehra Dun, consists of 15 males and 30 females, recorded from Jhajra, Dehra Dun (U.P.), 14.10.1925 and bred *ex* galls on *Terminalia tomentosa* (C. F. C. Beeson) (RRD. 481. 138. P.); 2 males, 2 females, from Dehra Dun, collected on 12.11.32 (R. N. Mathur); 2 examples, 27.9.37, from Ramnagar division (U.P.), on *T. tomentosa* (D.F.O.) and 32 examples from Amritsar (Punjab) bred *ex* galls on *Terminalia arjuna*, during October-November 1933 (G. D. Bhasin), (RRD. 579. 47. P3.).

*Distribution.* Apparently throughout the plains and low hills of India.

*Comparison.* *P. hirsuta* was described by Crawford (1912) from one male, under the name of *Kuwayama hirsuta*. Subsequently, it has been referred to the genus *Megatrioza* by him in 1924, and also listed by Ramakrishna Ayyar (1924) in the same genus.

This species is redescribed from a good series of male and female specimens, and is readily recognised by its triozine wing venation, hirsute body, remarkable hind tibial spur, large brown spot near clavus and an unusually large first marginal cell in forewing, and by other characters; genae represented by small rounded swellings at base of antennae.

*Biological notes.* Its brief life-history is given by Mathur (1935) and short notes by Beeson (1941). The description of nymphal stages is published by Mathur (1949).

***Trioza lobata*, sp. n.**  
(Figs. 107, 108)

Length of body, in male, 2.13 mm; in female, 2.24 mm

Length of forewings, in male, 2.91 mm; in female, 3.12 mm

Width of head with eyes, 0.53 mm

Width of vertex between eyes, 0.32 mm

Length of antennae, 1.12 mm

**Colouration.** General colour yellowish-brown to dark-brown, with head dark lemon, legs pale-yellow, antennae yellowish-brown with apical segments black, last abdominal sternites pale-yellow in both sexes, tergites and genitalia yellowish-brown in female, tip of labium black; wings hyaline, transparent, veins pale-yellow.

**Structure.** Body long and robust. Head (**Figs. 107a,b**) nearly as broad as thorax, moderately declivous, hirsute, finely rugose; vertex broader than long, about twice as broad as long, gradually inclined downwards, rounded and swollen anteriorly on either side of median suture, with deep circular foveal impressions near posterior margin and one on either side of median line, shallow depression extending from each fovea up to base of antenna; post-ocellar region elevated; posterior margin arcuate; anterior margin emarginate medianally at the point of excision; front ocellus visible from above; genal cones large, about 0.15 mm long and slightly smaller than vertex, vertical, hirsute, broad basally, subacute apically, divergent, hairs slightly longer than that on vertex. Eyes large, somewhat hemispherical. Clypeus large, circular.

Antennae (**Fig. 107c**) long, ten-segmented, bearing a few setae, two basal segments large and robust, remaining segments slender, imbricate, 3rd segment longest and twice longer than 6th, 4th a little longer than 6th, 5th slightly smaller than 6th, 7th and 8th equal but smaller than 5th, 9th and 10th smallest, but somewhat broader than others, 9th a little smaller than 10th, last segment with two unequal apical spines, four sensoria present on segments 4, 6, 8 and 9.

Thorax moderately arched, rugose, sparsely hirsute. Prothorax (**Fig. 107b**) scarcely visible from above, hidden behind head, posterior border prominently but shallowly excavated submedianally, lateral sides upturned anteriorly behind eyes, with deep lateral foveal impressions; prescutum large, longer than scutum, arched and sloping anteriorly, slightly longer than broad, narrowly rounded cephalad, with an anterior median, elevated point or epiphysis, broadest in middle, angulate both laterally and posteriorly; scutum large, two and a half times broader than long, broadest before middle, angulate laterally, posterior margin also angulate, disc flat dorsally and sloping laterally; scutellum small, subtriangular, broad anteriorly and narrowly rounded posteriorly, anterior margin straight, with antero-lateral angles; post-scutellum narrow, transverse; mesopleuræ large and prominent.

Legs (**Fig. 107d**) long and pubescent, also beset with minute points arranged in rows, femora shorter than tibiae, all trochanters and femora with long ventral setæ, all tibiae bearing a comb of setæ at apex, hind femur with four thick, dorsal setæ near apex, hind tibiae with a series of prominent basal spurs, and three thick spines at apex (two inside and one outside), anteriorly directed metacoxal spur somewhat weak, meracanthus comparatively longer, triangular and acutely pointed.

Forewings (**Fig. 107e**) large, clear, transparent, two and a half times as long as broad, radius, media and cubitus arising from the same point, costal margin somewhat arcuate

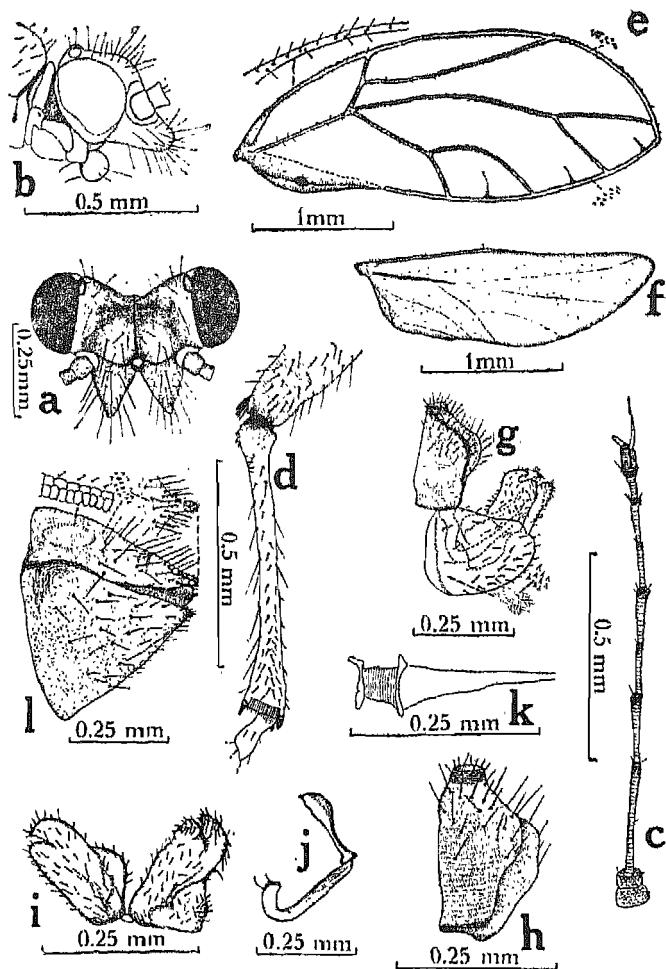


Fig. 107. *Triozella lobata*, sp. n.—a: head, front view; b: head and part of thorax, lateral view; c: antenna; d: hind leg; e: forewing; f: hind wing; g: male genitalia, lateral view; h: anal valve of male; i: parameres, dorsal and mesal views; j: aedeagus; k: sperm pump; l: female genitalia, lateral view.

than usual, apex rounded but not broadly so, basal vein slightly longer than cubitus, radial sector shorter than media to furcation point, radius and  $R_1$  almost equal in length, cubitus three times longer than radius, first marginal cell slightly longer than second, distance between  $Cu_2$  and  $Cu_1$  a little longer than the distance between  $Cu_1$  and  $M_{3+4}$ , veins armed with small setae.

Hind wings (Fig. 107f) small, uniformly and thickly beset with minute points, costal margin armed with a few simple and hooked setae.

Abdomen longer than broad, thickly beset with minute points, arranged in rows, sternites bearing long hairs.

*Genitalia.* Male genital segment (**Fig. 107g**) smaller than abdomen. Anal valve (**Fig. 107h**) longer than parameres, about 0.28 mm long, in profile, anterior margin somewhat straight, narrower both basally and apically, broadest in middle, posterior margin strongly convex, sparsely pubescent in upper half and also thickly beset with minute points, hairs longer on lateral sides; parameres (forceps) about 0.20 mm long, thick, bilobate, somewhat with parallel sides in middle when seen laterally, basal region broad, apical area narrow, divided into two short processes, posterior process small, subacute at tip, anterior process slightly longer than posterior, narrower, bent inward and ending in an acute black point, long and thick setae directed downwards present just below this point, basal anterior border also armed with short, thick setae directed upwards, short and thick setae pointing downwards also present on the posterior process near apex; hypandrium of usual shape, sparsely pubescent and also beset with minute points arranged in series; aedeagus with outer arm short, having the spoon end acutely pointed at apex (**Fig. 107j**); sperm pump as figured (**Fig. 107k**).

Female genital segment (**Fig. 107l**) smaller than abdomen, pubescent, posterior region bearing longer setae, dorsal plate longer than ventral, roundly pointed at apex and armed with short and thick setae, circum-anal ring composed of double row of pores; ventral plate also roundly pointed at apex; ovipositor short and pointed.

*Host plant.* Bred *ex* pit galls on leaves of *Duabanga grandiflora* (Roxb.) Walp. (= *D. sonneratiioides* Buch. -Ham.).

*Type locality.* Samsing, Kalimpong (Bengal).

*Types.* Holotype male; Allotype female, both from the type locality, and collected on October 25, 1934 (A. M. Posford); Paratypes: 3 males and 5 females, from the same locality and date of collection (A. M. Posford), and few adults and nymphal stages also preserved in alcohol, data same. All types, nymphal stages and some slides having mounted parts of adults and nymphs, deposited at F.R.I., Dehra Dun.

*Comparison.* *T. lobata*, sp. n. is characterized and differentiated by the shape of head and forewings, venation, legs and genital features.

*Biological notes.* The pit-galls formed by this species are deep, oval in shape and located on the under surface of leaves. They may be separate or congregated in a mass, and the area around each pit is thickened and light red in colour. Young nymphs are cream or pale-yellow in colour, with eyes pinkish-red, and broadly oval in shape. Mature nymphs are oval in shape, pale-yellow, with a fuscous median stripe, body adpressed to the leaf surface, while the venter is bulging and resting deep inside the pit. Their body is fringed with a continuous waxy secretion and the honey dew is exuded as small drops of globules. Its nymphal stages are described below.

#### Nymphal stages

*Fifth stage.* (**Fig. 108a**). Length 1.52 mm. Of the typical triozine form; somewhat broadly and regularly oval, but the continuity of margin is slightly interrupted near eye and at the base of abdomen, where the abdomen is narrower than the wing-pads; humeral

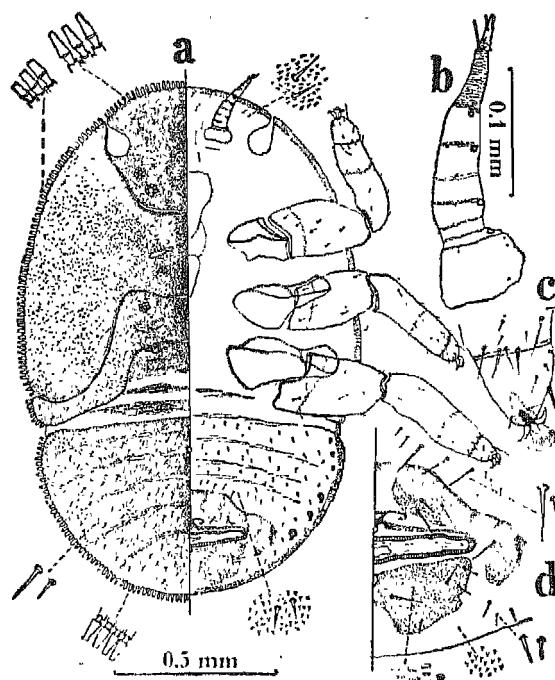


Fig. 108. *Triozalobata*, sp. n.—a: fifth stage nymph; b: antenna; c: tibio-tarsal segment of leg; d: circum-anal pore ring.

angle of the wing-pads not projecting beyond the contour of the body but produced cephalad beyond the eye. Dorsum strongly sclerotic throughout, except for a small area at the base of abdomen. Abdomen for the most part composed of a single posterior plate, showing traces of segmentation, and two narrow, medianally interrupted plates near base. Margin of the body, except at the base of abdomen, beset with a continuous series of secta-setae, borne upon distinct prominences; these secta-setae are of various length, long and slender on the margin of head and at the base of abdomen, thick and stout along the margin of wing-pads. Derm vermiculate and also beset with simple ring-based setae.

Ventral side membranous throughout except for a weakly sclerotic marginal zone, irregular areas around anal ring, weak submedian lines in the abdomen, and a small area about each spiracle. Derm strongly beset with minute points, and each abdominal segment with a transverse series of small simple setae, posterior caudal area with minute, fringed processes. Antennae (Fig. 108b) 0.91 mm long, ventral, short and thick, apparently seven-segmented, segmentation obscure, four sensoria present. Legs (Fig. 108c) short and thick, femora not reaching the margin of body; apparently without or with weak indication of trochanters; tibio-tarsal articulation distinct; claws present, pulvilli quite large, triangular. Anal-opening (Fig. 108d) set well away from apex of abdomen,

surrounded by an outer pore-ring consisting of a single row of slit-like pores and an inner ring of indistinct pores.

*Fourth stage.* Length 0.92 mm. Resembling the last stage nymph, except in being smaller in size, smaller wing-pads, antennae apparently five-segmented with three sensoria, tibio-tarsal articulation absent.

**Trioza mallotica** (Crawford) Comb. n.  
(Fig. 109)

- Crawford, D. L. 1928. *Ent. Mitt.* 17: 426, t. fig. (*Megatrioza mallotica*). (ex galls on *Mallotus philippinensis*, Fort de Kock, Sumatra).
- Laing, F. 1930. *Indian Forest Rec.* 14 (8): 43 (From galls on *Mallotus philippinensis*, Dehra Dun, U.P.).
- Mathur, R. N. 1935. *Indian Forest Rec.* 1 (2): 54-56 (Biology).
- Beeson, C. F. C. 1941. *Forest Insects*, p. 779 (Biological notes).
- Mathur, R. N. 1949. *Indian J. Ent.* 8 (2): 233-234, fig. 6 (Nymphal stages).
- Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* 14: 27-195.
- Mani, M. S. 1959. *Agra Univ. J. Res. (Sci.)*. 8.
- Weidner, H. 1961. *Sonderdr. Abh. Verl. der naturw. ver. Hamburg* 5: 31, 46.

Length of body, in male, 2.33 mm; in female, 2.62 mm

Length of forewings, in male, 4.35 mm; in female, 4.84 mm

Width of head with eyes, 0.73 mm

Width of vertex between eyes, 0.41 mm

Length of antennae, 1.01 mm

*Colouration.* General colour light ochreous brown; wings transparent, flavus, with a light black spot near clavus.

*Structure.* Large species. Head (Fig. 109a) slightly wider than thorax, somewhat declivous, sparsely hairy with long hairs, rugulose; vertex about twice as broad as long, with two circular foveae, posterior to centre, one on either side of median suture, disc deeply depressed on either side of median line, post-ocellar region swollen, bearing large ocelli, anterior ocellus visible from above, anterior margin invaginated at point of excision, posterior margin strongly emarginate; genal cones small, about 0.15 mm long, one-third smaller than vertex, clothed with long hairs, hairs longer than that of vertex, finely rugulose, cones situated below the level of vertex, divergent, subacute at apex. Eyes large.

Antennae (Fig. 109b) long, about one and a half times as long as head, ten-segmented, bearing a few setae, imbricate, two basal segments robust, 1st narrowly transverse, 2nd sub-square, broad apically, remaining segments slender, 3rd longest, one and three-fourth times as long as 4th, 4th slightly longer than 5th, 5th and 6th equal, 7th smaller than 6th, 8th slightly longer than 7th, 9th smallest and slightly smaller than apical segment; terminal segment with two unequal setae at apex; four sensoria present on segments 4, 6, 8 and 9.

Thorax strongly arched, broad, clothed dorsally with long hairs, finely rugulose. Prothorax short, roof-shaped, situated below the level of mesothorax, postero-lateral margin produced like a thin flange, with two foveal depressions on each lateral side; prescutum nearly as long as broad, gradually sloping anteriorly, anterior margin some-

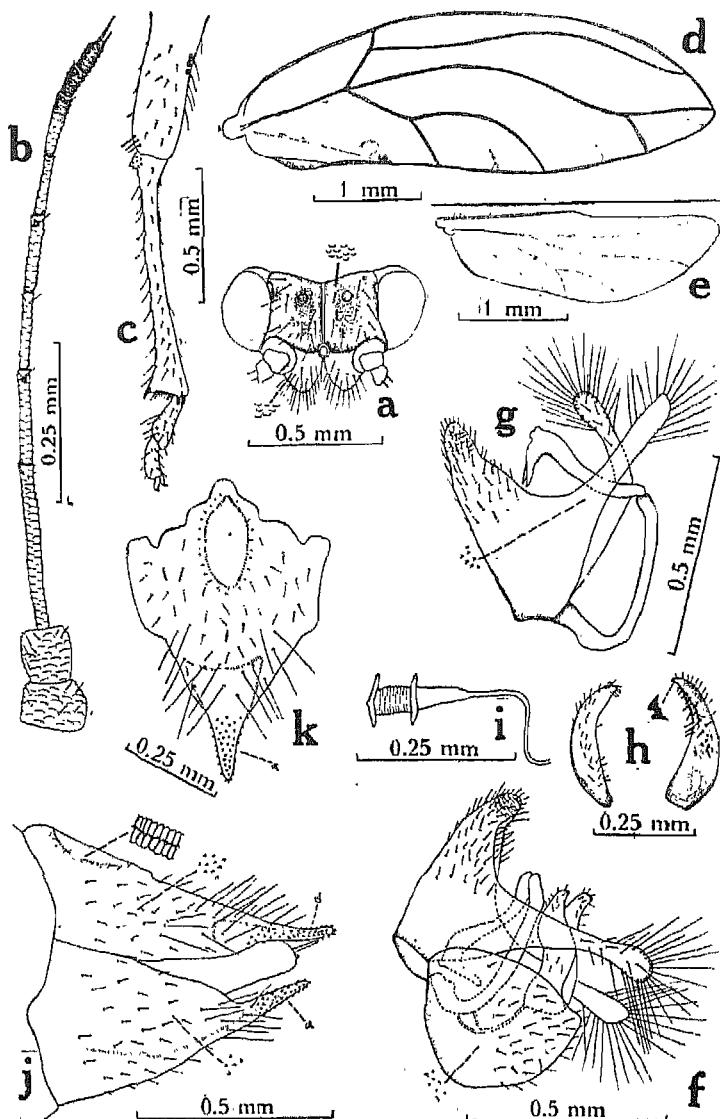


Fig. 109. *Trioza mallowicola* Crawford—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: male genitalia, lateral view; **g**: anal valve and aedeagus; **h**: forceps, lateral and mesal views; **i**: sperm pump; **j**: female genitalia, lateral view; **k**: dorsal plate of female.

what convex; scutum about twice as long, smaller in length than prescutum, depressed dorso-medianally and then gradually sloping on each lateral side, angulate posteriorly; scutellum somewhat triangular, swollen, broad anteriorly and narrow posteriorly.

Legs (**Fig. 109c**) moderately long and hairy, hairs arranged in longitudinal rows, also beset with minute points arranged in lines, tibiae longer than femora, all tibiae with a comb of apical setae, hind femur with a group of three or four dorsal, blunt setae near apex, hind tibiae with a series of small basal spurs and three black apical spines (one spine on one side and two approximate spines on the other), tarsal segments equal in length; meracanthus long, slender and triangular.

Forewings (**Fig. 109d**) quite long but variable in length, transparent, without pterostigma, subacute at apex, radius, media and cubitus arising from the same point, cubitus nearly twice as long as radius, basal vein longer than cubitus, radial sector ( $R_5$ ) usually long, and looped,  $R_1$  smaller than radius; first marginal cell longer and broader than second; fork  $M_{1+2}$  meeting near apex of wing.

Hind wings (**Fig. 109e**) clear, thickly beset with minute points, slightly more than half as long as forewings, costal margin armed with a few simple and hooked setae.

Abdomen sparsely hairy, hairs prominent on sternites, and also beset with minute points arranged in lines.

*Genitalia.* Male genital segment (**Fig. 109f**) smaller than abdomen. Anal valve (**Fig. 109g**) higher than forceps, in profile, anterior margin almost straight except at apex, where it is deflexed caudally, lateral lobe produced posteriorly from the basal region on each side into a long, slender club-like arm, basal region of these arms beset with minute points while the apical region with long simple setae, outer surface of valve armed apically with small simple setae, marginal setae on lateral lobes longer; parameres (**Fig. 109h**) small, curved inwards, in profile, narrower both basally and apically, broadest beyond centre, basal mesal region invaginated, apical region triangular, terminating in a bidentate black point, outer surface beset with simple setae, marginal setae slightly longer, apical mesal surface armed with rows of thick setae; hypandriuni simple and of usual shape, bearing simple setae and also beset with thick points; outer arm of aedeagus (**Fig. 109g**) smaller than basal, spoon end with a small hood and bifurcated into two acutely pointed processes; sperm pump as figured (**Fig. 109i**).

Female genital segment (**Fig. 109j**) moderately long and slightly smaller than abdomen, plates sub-equal and armed with strong points; dorsal plate (**Fig. 109k**) longer than ventral, broad basally, gradually sloping caudally, acuminate in the apical region and clearly differentiated from the basal region, basal region beset with simple setae, apical region armed with small peg-like setae, setae in centre longer, caudal end slightly upturned and subacute; circum-anal pore ring large and longer, and composed of a double ring of pores; ventral plate broad basally and acuminate apically, acutely pointed at apex, basal surface bearing simple setae while the apical region having small peg-like setae, setae longer in centre; ovipositor acutely pointed.

*Host plant.* Bred ex galls on leaves of *Mallotus philippinensis* Muell.-Arg. (= *M. philippensis* Muell.-Arg.) (Plate 4c, d).

*Distribution.* Previously recorded from Fort de Kock, Sumatra (Crawford, 1928) and Dehra Dun (U.P.) (Laing, 1930).

*Material examined.* The collection at F.R.I., Dehra Dun, consists of a good series of males and females, collected during March 1933 (Exp.No.435) and May 1934 and

March 1938, from New Forest, Dehra Dun (R.N. Mathur); 7 examples of 21.2.21, from Dehra Dun (M. Cameron); 5 examples of 25.10.25 and 2 examples of 19.3.27, from Dehra Dun (M. Bose), *ex M. philippinensis* (6 examples of 2.12.49 and 2 ex. of 6.3.50, from New Forest (R.N. Mathur); 1 ex. of 17.4.48 from Dehra Dun (R. N. Mathur); 8 ex. of 29.1.33 from Dehra Dun (M. Bose); and 3 phials containing adults and nymphs, in alcohol, and collected on 14.3.52, 28.3.53 and 18.3.62 from Dehra Dun, respectively.

Four examples are also present at I.A.R.I., New Delhi, and these specimens were collected from New Forest, Dehra Dun, on March 10, 1933 (R.N. Mathur).

*Comparison.* This species is easily recognisable in having long and narrow wings, shape of head, veins *Rs* and *media* longer and looped and with characteristic genitalia; genal cones about one-third smaller than vertex, narrowly and roundly pointed at apex, separate and divergent distally.

*Biological notes.* Mathur (1935) has described its biology and brief life-history notes are also given by Beeson (1941). Its nymphal stages are described by Mathur (1949).

**Trioza pitformis, sp. n.**  
(Figs. 110, 111)

Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 56-57, Pl. II, fig. 19. (*Phylloplecta* sp.).

Beeson, C. F. C. 1941. *Forest Insecta*, p. 779.

Length of body, in male, 1.25 mm; in female, 1.75 mm

Length of forewings, in male, 3.72 mm; in female, 4.10 mm

Width of head with eyes, 0.56 mm

Width of vertex between eyes, 0.24 mm

Length of antennae, 0.87 mm

*Colouration.* (Live specimens). General colour light yellowish-brown, with bluish-green abdomen; in dried examples, light yellowish-brown, head pale-yellow with dark-brown foveal impressions; genae pale-yellow basally and dark-brown or black at apices; antennae yellow, having bases of first two segments, tips of 4th and 6th segments and three terminal segments black; thorax with two light brown longitudinal dorsal bands on prescutum, two dorsal and two pairs of dorso-lateral bands on scutum; legs pale-yellow; abdomen bluish-green or yellowish with black segmental margins; wings hyaline, veins flavus.

*Structure.* Head (Fig. 110a) including eyes, slightly broader than thorax, slightly declivous, finely rugulose, sparsely pubescent with long hairs; vertex broader than long, about twice as broad as long, strongly emarginate in front, with a median suture and a pair of deep foveal impressions, posterior to centre, each half with a shallow depression extending forward from each fovea and bifurcating towards the anterior margin but not attaining it, conspicuously swollen anteriorly above antennae, posterior margin deeply emarginate; post ocelli orange, lateral, anterior ocellus visible from above; genal cones about 0.10 mm long, a little more than half as long as vertex, sparsely pubescent, pubescence almost as long as on the vertex, and also armed with rows of minute points,

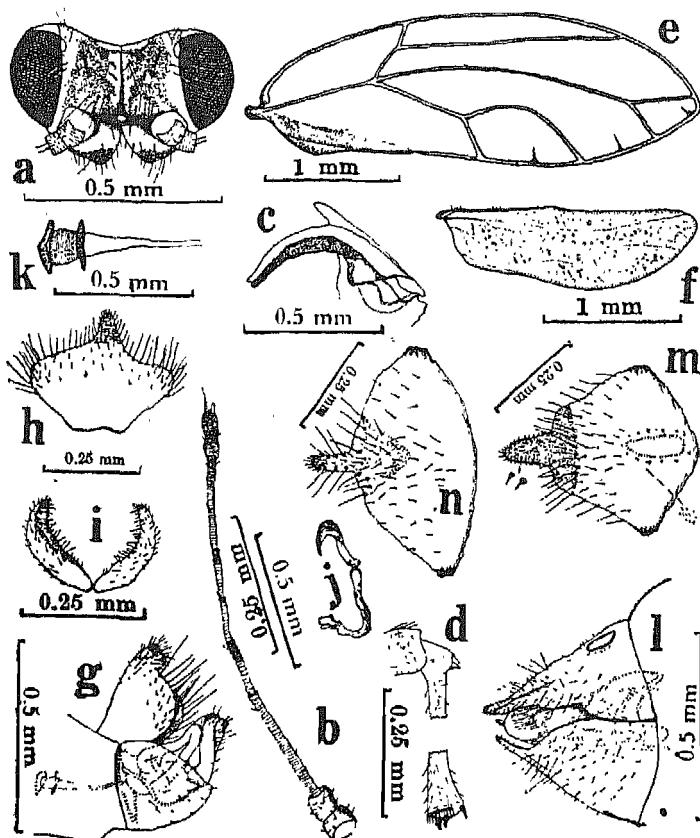


Fig. 110. *Trioza piliformis*, sp. n.—**a**: head, front view; **b**: antenna; **c**: hind coxa; **d**: hind leg, in two parts; **e**: forewing; **f**: hind wing; **g**: male genitalia, lateral view; **h**: anal valve, dorsal view; **i**: parameres, caudal and partly mesal view; **j**: aedeagus; **k**: sperm pump; **l**: female genitalia, lateral view; **m**: dorsal plate; **n**: ventral plate.

broader at base and bluntly rounded at apex, separate, divergent. Eyes large, somewhat hemispherical.

Antennae (Fig. 110b) long, slightly longer than head including eyes, ten-segmented, bearing a few setae, two basal segments robust and beset with rows of minute points, 1st joint rather rectangular, 2nd subquadrate, remaining segments slender, imbricate, 3rd longest, slightly less than twice as long as 4th, 5th and 7th equal and each smaller than 4th, 6th and 8th equal and each slightly longer than 5th, 9th and 10th smallest, but thicker than others, apical joint with two unequal spines at tip, four sensoria present on segments 4, 6, 8 and 9.

Thorax long and slender, moderately arched, finely and sparsely pubescent with long hairs, finely rugulose. Pronotum somewhat roof-shaped, beset with rows of minute points, slightly longer in middle and narrower laterally, with two distinct lateral foveae

located near the posterior border, posterior margin with a prominent thin flange; prescutum somewhat seven-sided in shape when seen from above, longer than broad, anterior margin with a small, median epiphysis; scutum much broader than long, about twice as broad as long, broadest before middle, smaller than prescutum in length, angled both laterally and posteriorly, disc flat dorsally; scutellum vase-shaped, broad anteriorly and narrow posteriorly, anterior margin straight; post-scutellum of metathorax broadly transverse, swollen and convexly rounded in middle.

Legs (**Fig. 110d**) long and slender, pubescent and also thickly beset with whorls of minute points, tibiae longer than femora, hind coxa with broad, black spot, hind femur with three subapical, dorsal, blunt setae, hind tibiae with a series of distinct basal spurs, and three black tooth-like spines at apex, tarsal segments of equal length, basal tarsal segment of hind leg narrower and constricted near base, thicker in apical half, hind coxae with an anteriorly directed spur (**Fig. 110c**), meracanthus long and slender, claws strong and dark-brown.

Forewings (**Fig. 110e**) long and narrow, about thrice as long as broad, acutely pointed at apex, radial sector long and almost straight, cubitus a little more than twice as long as radius, first marginal cell longer and broader than second, fork  $M_{1+2}$  meeting near apex, venation typical triozine type, veins armed with microscopic setae.

Hind wings (**Fig. 110f**) comparatively quite small, membrane uniformly and thickly beset with minute points, costal margin armed with a few basal stout setae and four hooked setae, last seta strongly hooked.

Abdomen longer than broad, slender, finely pubescent and thickly beset with minute points ventrally.

*Genitalia.* Male genital segment (**Fig. 110g**) smaller than abdomen, sparsely pubescent; anal valve (**Fig. 110h**) large, about 0.28 mm long, longer than parameres, in profile anterior margin almost straight, posterior margin arcuately rounded, forming strong lobes, marginal setae very long, apical anal region small, truncate at apex; parameres (**Fig. 110i**) about 0.20 mm long, broader at apex when seen laterally, with a black pointed tip, sides subparallel, each forcep curved towards inside, outer surface beset with small simple setae, marginal setae longer, mesal surface with a row of thick setae directed downward; hypandrium simple, of usual shape, sparsely beset with simple setae; aedeagus (**Fig. 110j**) short and robust, outer arm slightly smaller than basal, the spoon end with a small hook; sperm pump as figured (**Fig. 110k**).

Female genital segment (**Fig. 110l**) smaller than abdomen, pubescent with long hairs, posterior region dark brown; anal plate (**Fig. 110m**) slightly longer than ventral plate, beset with minute points, broad at base, acuminate posteriorly, roundly pointed at apex, circum-anal pore ring with a single row of pores, guarded by small setae; ventral plate (**Fig. 110n**) broad at base, acuminate, acutely pointed at tip; ovipositor acutely pointed.

*Host plant.* Bred from nymphs in pit galls on leaves of *Mallotus philippinensis* Muell.-Arg. (= *Mallotus philippinensis* Muell.-Arg.) (Plate 4e, f).

*Type locality.* New Forest, Dehra Dun (U.P.).

*Types.* Holotype male, March 6, 1950; Allotype female, March 6, 1933; Paratypes: 2 males, March 21, 1933; 2 males, March 6, 1950; 5 females, April

6, 1948; 2 females, March 6, 1950; 4 examples of July 24, 1933, and 9 examples of May 5, 1934; all from the type locality (R.N. Mathur). Additional specimens not designated as paratypes, are: 2 males and 1 female, March 6, 1933; 1 female, March 7, 1933; 2 examples, June 20, 1933; 4 examples, July 24, 1933; 10 examples, May 5, 1934; 1 example, May 6, 1934; 2 males and 10 females, March 6, 1950, all from the type locality (R.N. Mathur); 7 examples, April 6, 1948 and 1 male and 6 females, March 15, 1953, from Dehra Dun (U.P.) (R.N. Mathur). One phial containing some adults and nymphal stages, preserved in alcohol, on February 20, 1933, from the type locality (R.N. Mathur). All types, preserved material and some slides, are deposited at F.R.I., Dehra Dun. A few paratypes of 6.3.1950 are donated to I.A.R.I., New Delhi.

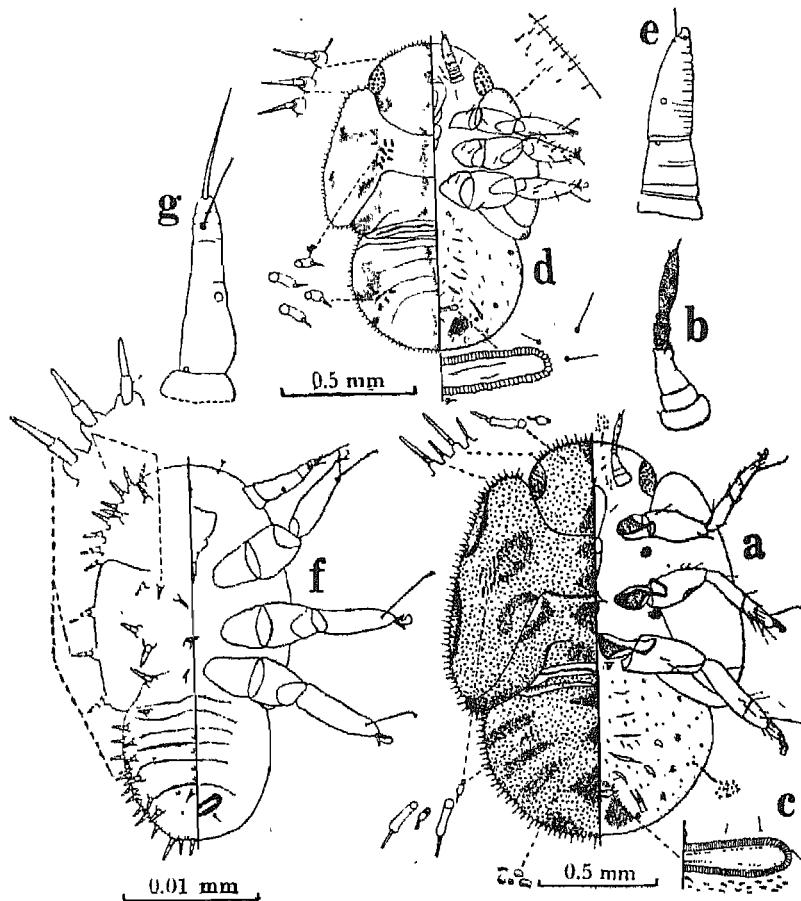
*Comparison.* This new species is easily distinguished from others, in shape of head and wings; wings long and narrow, and genitalia of characteristic shape; radial sector almost straight and not looped, second marginal cell smaller and near apex, vertex conspicuously swollen anteriorly, and genae small and divergent.

*Biological notes.* Brief life-history notes are given by Mathur (1935), and record of this species has also been mentioned by Beeson (1941). The top leaves of young, weak and semi-suppressed trees are more heavily infested. The leaves turn yellow in severe outbreaks. Young expanding buds are ruined by the draining out sap by the adults. The nymphal stages are described below.

#### Nymphal stages

*Fifth stage.* Length on slide, 1.75 mm. Of triozine form; broadly oval (**Fig. 111a**), being slightly interrupted near about the eyes and base of the abdomen. Humeral angles of the wing-pads produced forward almost to the middle of eyes, and rounded. Dorsum strongly sclerotic except for a small area at the base of abdomen, the abdomen being composed of a single plate showing traces of segmentation. Derm bearing conspicuous markings which are weakly vermiculate in appearance, and also thickly beset with minute seta-setae borne on large conspicuous tubercle-like prominences or shafts. These setae are arranged segmentally in the abdomen, intermixed with numerous comb-like structures. Body margin provided with a continuous series of large slender seta-setae interspersed alternately with small seta-setae, all borne on small tubercle-like prominences. Marginal prominences are smaller than those present on the dorsum.

Ventral side membranous throughout, except for small sclerotic areas about each spiracle, thin submedian abdominal strips and a pair of irregular plates below the circum-anal ring. Derm sparsely beset with simple ring-based setae, and minute points are restricted to the anterior marginal region of head and along the peripheral region of abdomen. Minute fringed processes present below the circum-anal ring. Antennae (**Fig. 111b**) ventral about 0.30 mm long, moderately thick in basal half, seven-segmented, apical four segments imbricate, 3rd segment large, broader at base and narrower at top, with four sensoria on 3rd, 5th and 7th joints, terminal joint with two small spines at apex. Legs small, slender, beset with few setae, femora not reaching the body



**Fig. 111.** *Triozapitiformis*, sp. n.—a: fifth stage nymph; b: antenna of fifth stage; c: circum-anal ring; d: third stage nymph; e: antenna of third stage; f: first stage nymph; g: antenna of first stage.

margin, without trochanters; with tibio-tarsal articulation distinct, and having a single golf-club seta on each tarsus; claws present, pulvillus petiolate and like a fish-tail. A strong papilla-like structure present just below each hind coxa. Anal opening (**Fig. 111c**) ventral, away from the apex of abdomen, and surrounded by an outer ring of slit-like pores and the inner ring of minute, weak, circular pores, both rings are interrupted medianally, and are guarded by two anterior and one lateral pairs of small setae.

*Fourth stage.* Length 1.07 mm. Resembling the fifth stage in form and markings; antennae five-segmented, with three sensoria; tibio-tarsal articulation absent.

*Third stage.* (**Fig. 111d**) Length 0.65 mm. Similar to the fourth stage in form; wing pads small; antennae (**Fig. 111e**) three-segmented, with two sensoria.

*Second stage.* Length 0.45 mm. Similar to the third stage, but with few setae; antennae two-jointed with a single sensorium; wing-pads smaller but distinct.

*First stage.* (**Figs. 111f, g**) Length 0.28 mm. Similar to the second stage, but with less number of body and marginal seta-setae. Rudiments of wing-pads represented by long seta-setae; claws absent and replaced by minute sclerites; pulvillus long and fish-tail like.

**Trioza serrata, sp. n.**  
(Fig. 112)

Length of body, in male, 1.97 mm; in female, 2.20 mm

Length of forewings, in male, 3.0 mm; in female, 3.82 mm

Width of head with eyes, 0.62 mm

Width of vertex between eyes, 0.40 mm

Length of antennae, 1.22 mm

*Colouration.* General colour pale-brown, venter of abdomen lighter; antennae and legs pale-yellow; apices of antennal segments 4 to 8, and two apical segments black; tip of labium black; wings hyaline, transparent.

*Structure.* Head (**Figs. 112a, b**) large, slightly broader than thorax, moderately declivous, sparsely pubescent with long setae; vertex large and broad, nearly twice as broad as long, finely rugulose, gradually rounded and bent downward and swollen anteriorly on each side of median line, with deep foveal impressions near posterior margin and one on either side of median suture, with a linear depression from each fovea extending towards anterior margin, posterior margin arcuate; emarginate in front at median line over front ocellus; anterior ocellus visible from above; post-ocellar region well elevated and disc deeply invaginated in between; genal cones short, about 0.18 mm long and smaller than vertex, vertical, broad at base, subacute at apex, divergent, depressed below plane of vertex, setae longer than on vertex. Clypeus large, somewhat circular, visible in front. Eyes large.

Antennae (**Fig. 112c**) long, ten-segmented, slender except two basal segments which are robust, bearing sparse pubescence, imbricate, 3rd segment longest, 4th about half as long as 3rd, 5th smaller than 4th, 6th and 7th nearly equal but shorter than 4th, 8th as long as 5th, 9th and 10th equal and smaller than 5th, but slightly broader than other segments, terminal segment with two unequal spines at apex, four sensoria present on segments 4, 6, 8 and 9.

Thorax large and robust, moderately arched, conspicuously rugose, finely and sparsely pubescent. Prothorax (**Fig. 112d**) narrow, roof-shaped, sometimes much inclined below head, slightly swollen dorso-medianally, with two knob-like epiphyses submedianally near posterior border, lateral sides slightly directed forward behind eyes, with prominent foveal impressions, posterior border margined, bearing long setae; prescutum large, longer than scutum, almost as long as broad, narrowly rounded cephalad,

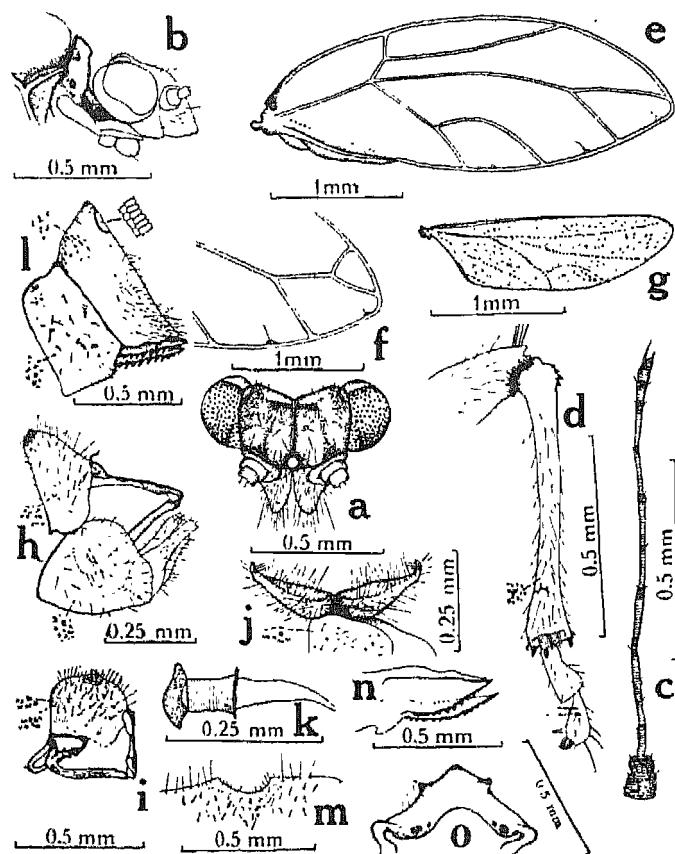


Fig. 112. *Triozaserrata*, sp. n.—**a**: head, front view; **b**: head and part of thorax, lateral view; **c**: antenna; **d**: hind leg; **e**: forewing; **f**: apical part of forewing; **g**: hind wing; **h**: male genitalia, lateral view; **i**: anal valve and aedeagus; **j**: parameres, mesal view; **k**: sperm pump; **l**: female genitalia, lateral view; **m**: posterior region of ventral plate; **n**: ovipositor; **o**: prothorax.

with an anterior median point, broadest in middle, angulate laterally, posterior margin also angulate; scutum large, much broader than long, about two and a half times as broad as long, posterior margin angulate; scutellum small, subtriangular, broad anteriorly, narrowly rounded posteriorly; mesopleurae large, projecting forward.

Legs (**Fig. 112d**) long, pubescent and also beset with minute points arranged in small series, femora shorter than tibiae, all trochanters and femora bearing a few long ventral setae, all tibiae with a comb of setae at apex, hind tibiae thicker apically, with prominent basal spurs and two strong, black spines at apex on inner side and one outside, hind femora with four thick, dorsal setae near apex, basal tarsal segments slightly longer than apical segments, meracanthus long and triangular, tibial groove of fore and middle legs longer than that of hind leg.

Forewings (**Fig. 112e**) large, clear, transparent, nearly two and three-fourths times as long as broad, subacute at apex, R, M, Cu arising from the same point, R and  $R_1$  nearly equal in length, radial sector shorter than media to furcation point, Cu three times as long as R, distance between  $Cu_1$ ,  $Cu_2$  equal to the distance between  $Cu_1$  and  $M_{3+4}$ , fork  $M_{1+2}$  meeting near apex, first marginal cell slightly longer and broader than second, veins armed with minute setae. In one female specimen, the stem  $M_{1+2}$  of right wing is branched (**Fig. 112f**).

Hind wings (**Fig. 112g**) small, thickly and uniformly beset with minute points, costal margin armed with a few simple and hooked setae.

Abdomen longer than broad, sternites sparsely pubescent, both tergites and sternites strongly beset with minute points arranged in series.

*Genitalia.* Male genital segment (**Fig. 112h**) much smaller than abdomen. Anal valve (**Fig. 112i**) scarcely longer than forceps, about 0.25 mm long, narrower both basally and apically, broadest slightly above middle in apical half when seen caudad, pubescent, setae longer on lateral borders, also strongly beset with minute thick points arranged in series, anterior margin nearly straight, posterior margin broadly convex when viewed laterally; parameres (**Fig. 112j**) broad basally and narrow apically, ending in a sharp point bent inward, just below this point a small knob-like process present, outer surface bearing a few small setae, both anterior and posterior borders with longer setae, apical half of mesal surface armed with a few thick setae directed downwards; hypandrium simple, of usual shape, sparsely pubescent and strongly armed with minute, thick points; outer arm of aedeagus (**Fig. 112k**) shorter than basal arm, with a broad spoon end; sperm pump as figured (**Fig. 112l**).

Female genital segment (**Fig. 112l**) much smaller than abdomen, pubescent, setae longer posteriorly, dorsal plate raised and not in plane of abdomen, triangular in shape in caudal view and longer than ventral, strongly inclined downward to apex from posterior part of anus when seen laterally, apex narrowly rounded and weakly invaginated medianally, bearing small thick setae; ventral plate (**Fig. 112m**) concavely emarginate at apex; ovipositor pointed, serrated ventrally (**Fig. 112n**); circum-anal pore ring composed of a double ring of pores.

*Host plant.* On *Sabia paniculata* Edgew.

*Type locality.* New Forest, Dehra Dun (U.P.).

*Types.* Holotype male; Allotype female, both from the type locality, and collected on July 11, 1958 (R.N. Mathur); Paratypes: 6 males and 7 females, from the same locality and collected on July 10-16, 1958 (R.N. Mathur). All types, 6 females preserved in alcohol and some slides, having dissected parts mounted on them, deposited at F.R.I., Dehra Dun.

*Comparison.* This species differs from others in shape of head, leaf-like forewings, presence of epiphysis on prothorax, legs and genital characters; genal cones longer than in other species.

*Biological notes.* *Trioza serrata* is commonly found on this creeper (*Sabia paniculata*) at New forest, Dehra Dun, during rainy months, but the nymphs are not located. The adults are active fliers and fly about with the slight disturbance.

**Trioza vitiensis** (Kirkaldy) Comb. n.  
 (Fig. 39)

- Kirkaldy, G. W. 1907. *Proc. Hawaii. ent. Soc.* 1: 103-104 (Viti, Rewa; under *Trioza vitiensis*).  
 Aulmann, G. 1913. *Psyllidarum Catalogus, Berlin*, p. 58.  
 Crawford, D. L. 1915. *Philipp. J. Sci.* 10: 265 (in galls on *Eugenia malaccensis*, under *Trioza eugeniae*).  
 Crawford, D. L. 1919. *Philipp. J. Sci.* 15: 195 (Under *Megatrioza vitiensis*).  
 Crawford, D. L. 1927. *Insects of Samoa*, pp. 31-32 (Tutuila).  
 Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 624.  
 Klyver, F. D. 1932. *B.P. Bishop Mus. Bull.* 98: 99-101.  
 Klyver, F. D. 1935. *ibid.* 113: 27.  
 Mani, M. S. 1935. *J. Asiatic Soc. Beng.* 1(2): 104-106 (Bred on galls on leaves of *Eugenia jambolana*; collected in different parts of India; also near Tanjore, Madras Presidency).  
 Mani, M. S. 1959. *Cecidothea Indica*, pp. 177-78 (Coromandal Coast; Java and Malaya).  
 Tuthill, L. D. 1942. *B. P. Bishop Mus., Occ. Papers* 17(6): 75.  
 Tuthill, L. D. 1951. *Pacif. Sci.* 5: 274-75.  
 Tuthill, L. D. 1964. *B. P. Bishop Mus. Insects of Micronesia* 6(6): 371.

This species is not seen by me, and, therefore, its description is reproduced below as given by Kirkaldy (1907) and Crawford (1915, 1919).

"♀. Vertex obscure testaceous with a narrow blackish-brown line down the middle and an obscure spot on each side at the base between this line and the ocelli. Frons orange, the middle ocellus pale-yellow, ringed with blackish-brown, the others at the posterolateral angles of the vertex and conspicuously orange. Antennae pale yellow. Eyes red-brown. Pronotum, dorsulum and mesonotum pitchy, with the following yellowish-ferruginous marks; dorsulum with a median and a curved lateral line. Mesonotum with 4 lines, the inner curved inwardly, the outer curved outwardly; scutellum pale with a black median line, abdomen black, genital segment yellowish. Tegmina and wings hyaline, veins pale fuscous. Legs yellowish-brown, femora basally more or less piceous. Vertex flat, transverse, forewing truncate, medio-longitudinally narrowly sulcate and shallowly pitted on each side near the base. Head nearly as wide as thorax, frontal cones rounded apically. Pronotum scarcely as wide as vertex, very short. Dorsulum longer than wide, suboval, narrower than the mesonotum, which is transverse. Scutellum small. Tegmen about  $2\frac{1}{4}$  times as long as wide, in form like that of *T. koebelei* Kirkaldy and with similar venation, except that the brachial (lower branch of cubital) forks basal of the middle."

"♂ largely orange yellow. Head dorsally yellow cinereous with a line down the middle as in other sex. Cones bright orange. Nota orange brown, rather feebly lined with fuscous and yellow brown. Abdomen ferruginous, last tergite deeply excavated apically, wavy reflexed, the reflexed part creamy, genital segment diamond-shaped."

"Length to apex of abdomen  $2\frac{1}{2}$  mill.; to apex of tegmina folded  $5\frac{1}{2}$  mill."

"Hab. Viti, Rewa (iii.06. Muir 1 ♂ 2 ♀)." (Kirkaldy, 1907).

The description of this species under *Trioza eugeniae* as given by Crawford (1915) is as follows:

"Length of body, 2 millimeters; length of forewing, 5·2 mm; width, 1·7 mm; width of head, 0·7 mm. General colour greenish-yellow; abdomen bright green, wings shining (field notes by Rutherford)."

"Head distinctly narrower than thorax, rather large; vertex concave on each side of median suture; genal cones scarcely half as long as vertex, broadly rounded, a little divergent, pubescent; antennae about one and one-half times as long as width of head, slender."

"Thorax broad, long; pronotum large; prescutum longer than broad; legs moderately long; hind tibiae with 4 black spines at apex, 3 together and 1 alone; wings hyaline, very long, acute at apex, more than half of length beyond abdomen; marginal cells long."

"Abdomen rather short, especially in male; forceps short, slender; anal valve larger, triangular, with a petiolate attachment at base. Female genital segment very short; dorsal valve longer than ventral; both subacute."

"Described from 9 males and females from Peradeniya (Ceylon), collected by A. Rutherford on May 12, 1913, in galls on leaves of *Eugenia malaccensis*. The galls were so numerous that they formed a continuous gall on the upper surface of the leaf."

"This.....species is closely related both in structure and habits to two American species of the same genus, *Trioza magnoliae* Ashmead and *T. koebelei* Kirkaldy. An Asiatic genus, *Coccotrioza* Kieffer, bears a close resemblance to these gall makers and is probably congeneric."

Again in 1919, Crawford has described it under *Megatrioza vitiensis* (Kirkaldy), as below.

"Length of body, 2·6 millimeters; forewing, 5 to 6. General colour brown, dorsum with a pale or yellow central streak and often two lateral ones; mesoscutum with several yellowish or pale longitudinal bands; femora dark-brown, tibiae lighter; antennae pale yellow, black at tip; forewings clear with a small brown spot at anal angle of both front and hind wings. Colour of newly emerged adults usually yellowish or pale brownish-yellow, without the markings described above."

"Head declivous, not as broad as thorax; vertex about half as long as broad between eyes, sparsely pubescent, deeply impressed on each side of median line, with a transverse sulcus connecting the two foveae, somewhat convex in anterior half; genal cones about half as long as vertex, broad, rounded, not much divergent, pubescent. Antennae about one and one-half times as long as width of head. Eyes large."

"Thorax strongly arched, rather broad, clothed sparsely with long hairs. Legs long and stout; hind tibiae stout, with basal spur not very large and apical spines moderately small. Forewings long, about three times as long as broad, acutely pointed, marginal cells very long. Hind wings about half as long as forewings or a little more."

"Abdomen short and broad. Male forceps about as long as anal valve or a little shorter, slender, basal two-thirds about three times as long as thick, rounded apically, and distal third abruptly narrowed with a finger-like process directed inward and acutely pointed; anal valve about as broad as long, lateral wings broadly convex. Female genital segment very short, much shorter than abdomen, dorsal valve a little longer than ventral, both subacute."

"Type locality. Fiji Islands, Rewa (Muir), March, 1906, 3 males and 2 females."

"Singapore (Baker), 1 pair. Amboina (Muir), 1 female. Pemalonga (Leeuwen-Reijnvaan), 1 male and 1 female, on *Eugenia malaccensis*, April, 10, 1912. Ceylon, Peradeniya (A. Rutherford), 9 males and females from galls on leaves of *Eugenia malaccensis*, May 12, 1913 (described as *Trioza eugeniae*)."

"This appears to be a widely distributed species in the South Pacific in tropical Asia, making galls on *Eugenia malaccensis* (known also as *Jambosa domestica*). The name *Trioza eugeniae*, applied to some newly emerged Ceylonese representatives of this species, was preoccupied by an Australian species named by Froggatt, but subsequent study shows the species to belong to *Megatrioza* and further to be synonymous with Kirkaldy's *T. vitiensis*. The Fiji specimens before me bear no identification mark indicating that they were examined by Kirkaldy, but they agree well with his description of *T. vitiensis* and probably are paratypes in as much as the date of collection and locality are identical in both lots." (Crawford, 1919).

*Distribution.* Widely distributed in several western and south western Pacific Islands, Strait Settlements and Ceylon, making galls on *Syzygium malaccensis*. Mani (1935) has recorded this species from different parts of India making galls on *Syzygium jambolana*; also from a scrub jungle near Tanjore, Madras Presidency, 30.xii.1928.

*Comparison.* This species is readily separated from other species of *Trioza*, having very long wings, colouration, long and large marginal cells, and second marginal cell meeting posterior margin of wing, quite below the apex.

#### TRIOZA GROUP

Body small to quite large. Head not broader than thorax, usually distinctly narrower, sometimes as wide as thorax, deflexed. Vertex much broader than long, usually deeply impressed discally, rounded downward in front, median suture prominent, sometimes deeply grooved, with more or less of an emargination in front between the two lobes, posterior margin moderately to strongly emarginate or arcuate; post-ocellar region usually swollen. Genal cones variable in length, shape and trend, depressed from plane of vertex and usually deflexed, usually subacute to roundly pointed, always more or less divergent. Clypeus pyriform or subglobose, scarcely visible from in front. Eyes large, hemispherical but variable in shape. Antennae slender, from one to two and a half times as long as width of head, sometimes pubescent with long hairs. Thorax usually arched, rather strongly. Pronotum short, collar-like and convexly rounded, descending quite strongly cephalad, often depressed below level of head and prescutum. Prescutum usually about as long as broad, narrowed conspicuously cephalad. Scutum large and broad. Propleurites as in *Psylla*; pleural suture oblique, not extending to middle of lateral extremity of pronotum; epimeron usually shorter than episternum. Legs usually slender; hind tibiae often with basal spur or carina, with two or three black spines at apex on inner side and one outside, in some species a conspicuous spur bearing a black spine present towards outside near apex; basal tarsal segment of hind legs without black claw-like spine at apex. Wings hyaline, membranous, usually acute apically,

sometimes rounded, radius, media and cubitus diverging at same point from basal vein ( $R+M+Cu$ ), and cubital petiole ( $M+Cu$ ) wanting. No pterostigma. Hind wings comparatively smaller and sometimes abortive. Male proctiger usually with caudal lobes.

*Trioza* is a very large genus of which many of the species are difficult to distinguish. It is widespread in distribution, being found all over the world. Fourteen species with two subspecies have been recorded from India, of which 6 are new to science. *T. analis* Crawf. is not seen author, but it has been added in the key by the characters given by Crawford.

#### KEY TO THE SPECIES OF TRIOZA

1. Hind wings greatly aborted, reduced to very small stubs . . . . . *T. obsoleta* Buckt.
- . Hind wings normally developed, at least half as long as forewings . . . . . 2
2. Insects large; veins of forewings setose . . . . . *T. gigantea* Crawf.
- . Insects small to medium in size . . . . . 3
3. Forewings more or less acutely angled or pointed at apex, not broadly rounded . . . . . 4
- . Forewings broadly rounded at apex, not angular nor acutely pointed . . . . . 12
4. Radial sector long and greatly deflexed
- . Radial sector short, curved to costa . . . . . 6
5. Forewings with apices of veins marked with black and a spot at apex of anal vein . . . . . *T. ceardi* Berg.
- . Apices of veins without black spots . . . . . *T. gigantea curta*, ssp. n.
6. Antennae small, not more than 1 mm long . . . . . 7
- . Antennae longer than 1 mm . . . . . 9
7. Basal vein almost as long as cubitus . . . . . *T. obliqua* Thom.
- . Basal vein longer than cubitus . . . . . 8
8. Second marginal cell small . . . . . *T. fletcheri* Crawf.
- . Second marginal cell long . . . . . *T. fletcheri minor* Crawf.
9. Hind tibia thick and swollen apically . . . . . 10
- . Hind tibia with a strong, conspicuous apical spur . . . . . 11
10. First marginal cell distinctly arched . . . . . *T. jambolanae* Crawf.
- . First marginal cell scarcely arched . . . . . *T. fusca*, sp. n.
11. Head subhorizontal; genal cones long . . . . . *T. longiantennata*, sp. n.
- . Head deflexed; genal cones small . . . . . *T. bifurcata*, sp. n.
12. Colour of body dark-brown to black . . . . . 13
- . Colour of body yellowish-brown to orange . . . . . 14
13. Colour dark-brown; radial sector forking distad of its mid point . . . . . *T. spinulata*, sp. n.
- . Colour black; radial sector forking at its mid point . . . . . *T. analis* Crawf.
14. Vertex with lateral epiphysis near each eye . . . . . *T. simplifica*, sp. n.
- . Vertex not as above . . . . . 15
15. Antennae three times as long as width of head, black at tip . . . . . *T. hyalina* Crawf.
- . Antennae twice as long as width of head, distal half black . . . . . *T. urtica* (Linn.)

#### *Trioza analis* Crawford 1912

(Fig. 38)

Crawford, D. L. 1912. *Rec. Indian Mus.* 7(5): 429, Pl. xxxiv, figs. C, D; Pl. xxxv, fig. L.

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 624.

I have examined the type at the Zoological Survey of India, Calcutta, which is in a very badly damaged condition (only remnants sticking to the pin), and therefore its description from Crawford is reproduced below.

"Length of body 2·4 mm; length of forewing 3·4 mm; greatest width 1·3 mm; width of vertex between eyes 0·30 mm; with eyes 0·57 mm. General colour black, with vertex, part of pronotum, abdomen ventrad, legs, basal half of antennae reddish-brown."

"Head not as broad as thorax, somewhat deflexed; vertex with a deep sulcus down median line and one on each side extending obliquely toward front margin of eye, pubescent; facial cones almost as long as vertex, slightly divergent, deflexed from plane of vertex, subacute at tip, pubescent. Antennae slender, about twice as long as width of head; eyes large."

"Prothorax moderately long; propleurites large, prominent; dorsulum long. Legs rather short and stout. Wings hyaline, about two and a half times as long as broad, roundly acute at tip; first marginal cell smaller than second; radius rather short; clavus black at tip."

"Female—Abdomen long, convergent to tip; genital segment very short, slightly longer than preceding segment; ventral valve very small, triangular in profile."

"Described from two females from Simla, West Himalayas, 2135 m (N. Annandale)."

"Type No. 9702/18" (Crawford, 1912).

**Trioza bifurcata**, sp. n.

(Figs. 113, 114)

Mathur, R. N. 1935. *Indian For. Rec.* 1(2) : 58-59, Pl. II, fig. 17 (*Phylloplecta*, sp. n. (Biology))

Beson, C. F. C. 1941. *Forest Insects*, pp. 780-781 (Biological notes).

Mani, M. S. 1959. *Agra. Univ. J. Res. (Sci.)* 8(2) : p. 233.

Length of body, in male, 2·12 mm; in female, 2·30 mm

Length of forewings, in male, 4·10 mm; in female, 3·10 mm

Width of head with eyes, 0·80 mm

Width of vertex between eyes, 0·42 mm

Length of antennae, 1·40 mm

**Colouration.** (Preserved specimens in alcohol). Flavus. Wings transparent but dull, veins pale-yellow.

**Structure.** Body quite large. Head (Fig. 113a) including eyes, smaller than thorax, moderately declivous, finely and sparsely pubescent, finely rugulose; vertex sub-square, convexly rounded downward in front and somewhat produced forward on each side of median suture, with two deep foveae posterior to the centre, posterior margin moderately arcuate, post-ocellar region slightly swollen, anterior margin somewhat emarginate at median line above front ocellus, anterior ocellus not visible from above; genal cones very small, sparsely pubescent, with setae slightly longer than on the vertex, contiguous near base, divergent and bluntly rounded at apex. Eyes quite large and bulging, somewhat hemispherical.

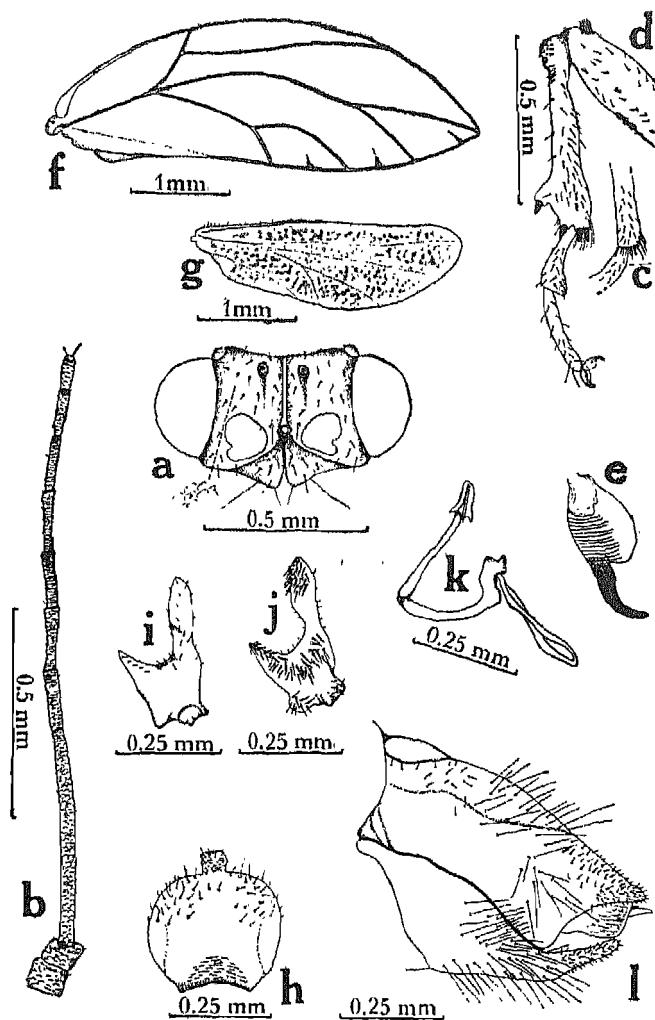


Fig. 113. *Trioza bifurcata*, sp. n.—a: head, front view; b: antenna; c: part of foreleg; d: hind leg; e: claw; f: forewing; g: hind wing; h: anal valve, upper surface; i, j: forceps, outer and mesal views; k: aedeagus; l: female genitalia, lateral view.

Antennae (Fig. 113b) long, ten-segmented, having a few setae, a little less than twice as long as head with eyes, two basal segments robust, sub-quadratae, remaining segments slender and imbricate, 3rd segment longest and slightly smaller than 4th to 7th combined, 4th, 5th and 7th equal to one another, 6th and 8th equal but slightly smaller than 4th, 9th slightly smaller than 8th, apical joint smaller than penultimate segment, having two unequal spines at tip, four sensoria present on segments 4, 6, 8 and 9.

Thorax moderately arched, finely and sparsely pubescent, finely rugulose. Prothorax of nearly equal length throughout, convexly rounded, sub-vertical, with two deep foveal impressions on each lateral side; prescutum nearly as broad as long, broadest in centre, narrowly rounded both anteriorly and posteriorly; scutum much broader than long, slightly smaller than prescutum in length; scutellum broadly transverse, twice as broad as long.

Legs (**Fig. 113d**) long, sparsely pubescent and also beset with minute points, hind femora with a series (apparently five) of subapical, dorsal, blunt setae, and having three sensoria-like structures ventrally, all tibiae with a comb of apical setae, fore tibia with one and middle tibia (**Fig. 113e**) with four subapical and thick setae, hind tibia with a series of small basal spurs and a large, conspicuous, strong subapical spur bearing a black tooth on one side and three apical spurs armed with black teeth on the other, fore and middle trochanters with a series of about five sensoria-like structures, apical tarsal segment longer than basal, claws (**Fig. 113e**) peculiarly shaped, being bladder-like at base, with microscopic ridges; meracanthus large and triangular.

Forewings (**Fig. 113f**) long and narrow, variable in sexes, about three times as long as broad, broadest across middle, anterior margin arched, angled at apex, posterior margin nearly straight, radius about half as long as cubital petiole ( $M+Cu$ ),  $R_1$  half as long as  $R$ , basal vein ( $R+M+Cu$ ) slightly shorter than  $M+Cu$ ,  $M_1+2$  terminating near tip of wing, second marginal cell a little longer than first, distance between  $Cu_1$  and  $Cu_2$  slightly longer than the distance between  $Cu_1$  and  $M_3+4$  and the distance between  $M_3+4$  and  $M_1+2$  along the hind margin,  $Cu_1$  longer and strongly arched in female.

Hind wings (**Fig. 113g**) small, thickly beset with minute points, costal margin armed with a few basal, stout setae and six hooked setae.

Abdomen longer than broad, sparsely pubescent ventrally.

*Genitalia.* Male genital segment smaller than abdomen, pubescent; anal valve (**Fig. 113h**) about 0.37 mm long, nearly as long as forceps; in lateral aspect, anterior margin nearly straight, posterior margin broadly convex basally, bearing long setae, anal region small, tubular, beset with minute setae; parameres (**Figs. 113i, j**) about 0.38 mm long, quite deeply bifurcate, the anterior branch sharply pointed and smaller than the posterior branch, outer surface beset with fine setae, mesal surface armed with groups of stout setae directed downwards; hypandrium of usual shape, bearing simple sparse setae; outer arm of aedeagus (**Fig. 113k**) slightly longer than basal.

Female genital segment (**Fig. 113 l**) slightly smaller than abdomen, pubescent. Dorsal plate a little longer than ventral, roundly pointed apically, setae longer in middle; ventral plate acuminate, gradually narrowed posteriorly and roundly pointed apically, central region furnished with a cluster of long hairs, apices of both plates armed with minute, thick setae; ovipositor acutely pointed.

*Host plant.* Bred *ex* galls on twigs of *Populus euphratica* Oliv.

*Type locality.* Ghazighat, Multan Forest Division (Pakistan).

*Types.* Holotype female, March 20, 1929; Allotype male, March 20, 1929; parts mounted on slide, as the specimen was in poor condition, from the type

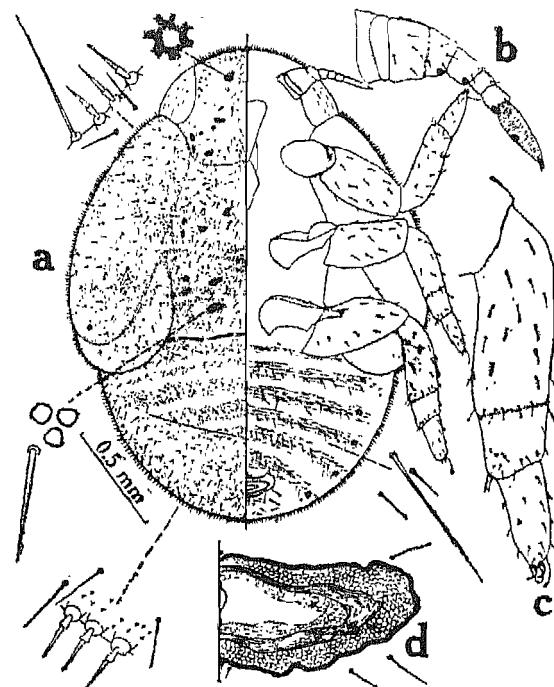


Fig. 114. *Trioza bifurcata*, sp. n.—a: fifth stage nymph; b: antenna; c: leg; d: circum-anal pore ring.

locality (R.N. Mathur). Several nymphal stages with the same data were also preserved in alcohol. Both the types (male on slide) and preserved material deposited at F.R.I., Dehra Dun.

*Comparison.* *Trioza bifurcata*, sp.n. has been described from one female and one male (in poor condition) and can be recognised by its head, shape of wings and genital characters.

*Biological notes.* Its brief biological history is given by Mathur (1935) and Beeson (1941) under *Phylloplecta* sp. This species is responsible for making galls on young shoots of *Populus euphratica*, growing along the banks of Indus in the Southern West Pakistan. The description of its nymphal stages is given below. The nymphs are pale-yellow with greenish tinge in the abdomen, with antennae and legs light grey and eyes pale grey. They are covered with flocculent mass and exude sticky liquid from the anus.

#### Nymphal stages

*Fifth stage.* (Fig. 114a). Length 2.0 mm. Of triozine form; broadly oval; the humeral angle of the wing-pads produced cephalad near about the posterior part of the eyes, and bluntly rounded. Dorsum weakly sclerotic throughout, except for the intersegmental portions of the abdomen. Thick sclerotic submedian patches present in the head and thoracic regions. Derm weakly vermiculate and also beset with simple setae of various

length. Minute points present along the border of abdomen. Body margin furnished with numerous small spear-shaped setae borne on small tubercles. Few spear-shaped setae also present along the anterior border of head.

Ventral side membranous throughout. Derm thickly beset with simple setae of various lengths. Antennae (Fig. 114b) ventral, 0·85 mm long, short and stout, apparently seven-segmented, bearing simple setae and four sensoria, 3rd joint broader at base and narrower at apex, with a weak division, 5th joint smallest, 6th slightly longer than 5th, terminal segment imbricate, showing weak segmentations and two spines at apex. Legs (Fig. 114c) stout, having simple setae, without trochanters; with distinct tibio-tarsal articulation, tarsal joint with a single golf-club seta; claws present, pulvillus small, somewhat tubular. Anal opening (Fig. 114d) ventral, surrounded by an irregular outer band of reticulate pores, and the inner band of the same pattern but weakly defined; outer ring armed with one anterior and two posterior pairs of minute, simple setae located medianally, and also another set of one anterior and two posterior pairs of long simple setae.

*Fourth stage.* Length 1·27 mm. Resembles the fifth stage, but the posterior half of the abdomen consisting of a single plate with faint traces of segmentations; antennae obscurely five-segmented, with three sensoria, and tibio-tarsal division weakly represented by a row of setae.

*Third stage.* Length 0·65 mm. Similar to the fourth stage, but with antennae obscurely three-segmented, having two sensoria; tibiotarsal indication by setae absent; few spear-shaped setae present on head, thorax and abdomen.

**Trioza ceardi** (De Bergevin) 1926

(Figs. 115, 116)

- De Bergevin, E. 1926. *Bull. Soc. Hist. nat. N. Afr.* 17: 149-153, pl. 1 (*Trioza ceardi*)  
 De Bergevin, E. 1931. *Boll. Lab. Zool.* 24: 268 (*Egerotrioza ceardi*).  
 Laing, F. 1930. *Indian Forest Rec.* 14(8): 170-172, fig. 3, (*Phylloplecta gardneri*).  
 Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 52, Pl. 2, fig. 12 (*Phylloplecta gardneri* Laing) (Biology).  
 Beeson, C. F. C. 1941. *Forest Insects*, p. 779 (Biological notes).  
 Heslop-Harrison, G. 1946. *Entomologist's mon. Mag.* 82: 37 (*Trioza ceardi*).  
 Loginova, M. M. 1958. *Entomological Rev.* 37: 94-99, figs. 18-33.  
 Mani, M. S. 1959. *Agra. Univ. J. Res. (Sci.)* 8(2): 233 (*Phylloplecta gardneri* Laing).  
 Klimaszewski, S. M. 1964. *Annls. Zool. Warsz.* 22(5): 36, fig. 47.

This species was placed under different genera by various workers and Heslop-Harrison (1946) writes: "Laing's species *Phylloplecta gardneri*, my own *Megatrioza rustamiya* and the two forms of *Aegerotrioza* described by Boselli in 1930 are all referable to this species, erected by De Bergevin in 1926." Its description given by Laing (1930) is reproduced as follows.

"General colour green and black (all the specimens have been preserved in alcohol, thus causing the green to fade to pale clay colour). Antennal segments 1 and 2 shaded with black, 3-7 with black tips, 8 distally, and the whole of 9 and 10 black; the extreme apical border of the genal cones, a narrow ring around the antennal insertions, and a

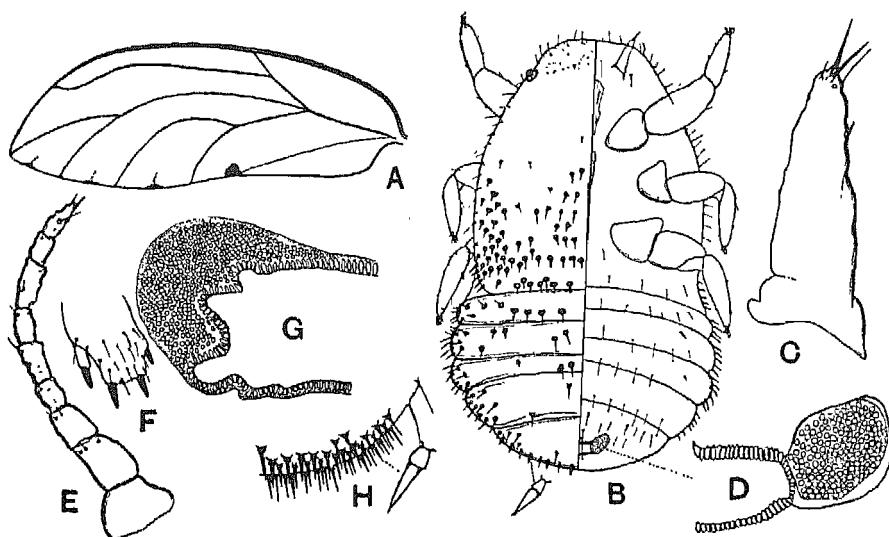


Fig. 115. *Trioza ceardi* (Berg).—(\**Phylloplecta gardneri* Laing).—Adult.—A: tegmen; B: larva (second instar); C and D: its antenna and circum-anal ring; E: antenna; F: spines on apex of hind tibia; G: circum-anal ring; H: part of fringe of secta-setae on margin of last abdominal segment of nymph (After Laing).

median fovea on each half of the vertex dark; a small spot on the extreme lateral margin of pronotum black; dorsulum with a lunulate dark area on either side of the median line, the patch, in front, paler in the centre, and sometimes showing signs of interruption at the middle; mesonotum, on each half, with two longitudinal dark areas, the outer usually with its basal third partially or completely separate and the posterior portion with pale narrow streak, the inner not quite reaching the front margin, and two subcircular spots on the lateral margin, one in front and one adjoining the wing insertion; abdominal segments with a varying amount of black, from quite a narrow area on the margin of each tergite leaving but a narrow median green area; legs with the tarsal segments and a small area on the tibiae distally dark, but there may be quite a considerable quantity of shading; tegmen with the apices of the veins slightly marked with black, a spot at the apex of the anal vein, and midway on the margin of the three posterior cells jet black. Under surface mainly dark-brown.”

“Antennae not quite twice the length of the head, including the eyes; genal cones with long pale hairs, the inner margins more or less parallel, the length scarcely reaching that of the vertex; lateral ocelli elevated; the median fovea deep; the hind margin of head rather deeply arcuate; dorsulum almost biconvex, the length and breadth subequal; tegmen with a length equal to  $2\frac{1}{2}$  times the breadth; ♂ genitalia: outer margin

\* The adults emerge in January and February; the formation of galls coincides with the appearance of new leaves in February and early March.

of anal valve with a sparse fringe of white hair, the outer and basal margins sub-equal; claspers simple, incurved apically; ♀ genitalia: valves rather short, the dorsal extending slightly beyond the ventral; the hind tibiae with 3 black apical spines, and a very strong, black-tipped, sub-equal spur, but no basal one. Length 3 mm; length of tegmen 3·5 mm."

"Larva (? second instar): material preserved in alcohol, but the general colour is probably green, with pale-green legs,\* and the abdominal segments, on the upper surface, barred with black. On the dorsal surface of the posterior half of the thoracic region are irregular rows of short, strong, sharp, spines, affixed to the body by conspicuously thickened bases; around the margin of the abdominal segments are also stout, sharp, spinose setae, more or less clustered together in bunches, but on the margin of the last segment these are replaced by secta-setae. Length 1·1 mm."

"Nymph (final stage) of the typical triozine form, but peculiar in that the secta-setae are confined to four dense rows on the apical margin of the last abdominal segment; on the remainder of the body and wing-pad margins there are long slender setae. Length 2·5 mm."

Gall: sub-globular, flattened somewhat from side to side, narrowing slightly at the point of contact with the leaf; smooth surface; unicellular. The galls may appear on both surfaces of the leaf, but judging from those in front of me most are on the lower surface. Exit from the gall is by a small circular opening on the other surface of the leaf from the gall. Length subequal to breadth, 4 mm; thickness 3 mm."

"Punjab: Ghazighat, Multan, ex leaf-galls on *Populus euphratica* (R.N. Mathur, per Forest Research Institute, Dehra Dun)."

*Host plant.* Bred ex galls on leaves of *Populus euphratica* Oliv.

*Distribution.* Common in Iraq on *Populus euphratica* Oliv.; Sind District (Pakistan); Tunisia (Heslop-Harrison, 1946); Ghazighat, Multan (Pakistan).

In the F.R.I. National Collection, there are 2 of Laing's paratypes of *P. gardneri*, February 1929 (Exp. No. 244, 245), 2 examples of 7.2.29 and 2 examples preserved in alcohol (Exp. No. 244, 245), all from Ghazighat, Multan, Punjab (now in Pakistan), bred ex leaf-galls, *Populus euphratica* (R.N. Mathur).

*Comparison.* Heslop-Harrison (1946) has synonymised *Phylloplecta gardneri* Laing with that of *Trioza ceardi* Bergevin, but the shape of forewing figured by Laing differs greatly with the figure given by Loginova (1958); in the former it is angulate apically while in the latter it is narrowly rounded apically; the shape of second marginal cell is also different. However, having been unable to make a critical comparison with the material from the type locality or Middle East, it is considered better to accept Heslop-Harrison's synonymy for the present.

#### Nymphal stage

*Fifth stage (Fig. 116a).* Length about 2·7 mm (on slide). Form triozine, rather narrowly oval. Head narrower than abdomen. Humeral angle of the wing-pads

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\* The colour of the young living larva is yellowish with the appendages darker and eyes reddish-brown; in the later stages the colour deepens to yellowish-brown.

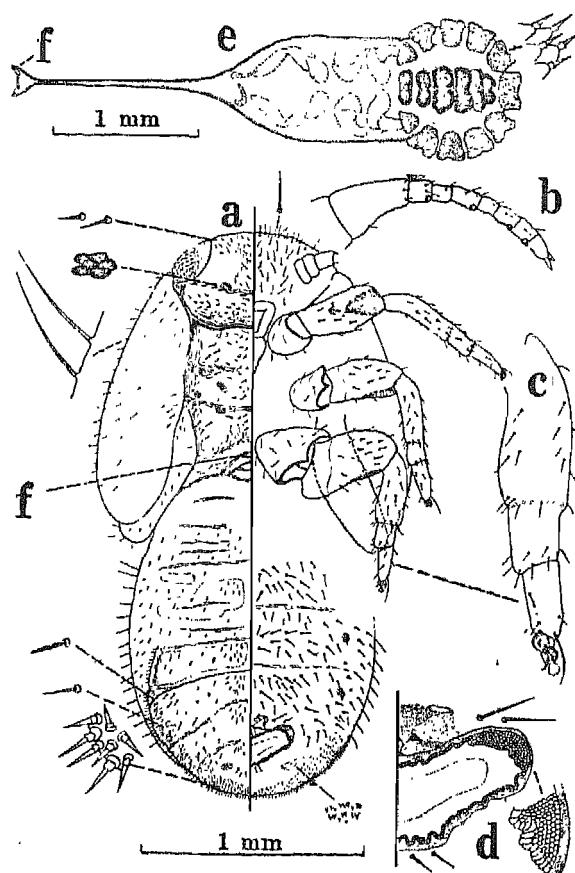


Fig. 116. *Trioza cardi* (Bergevin)—a: fifth stage nymph; b: antenna; c: hind leg; d: circum-anal pore ring; e: funnel-shaped structure; f: bifurcate triangular basal portion and place of attachment.

produced forward slightly beyond the posterior margin of eyes, and narrowly rounded. Dorsum strongly sclerotic throughout, except for the anterior half of abdomen, which is partly membranous containing narrow strip-like plates in the first four segments. Posterior half of abdomen covered by a single continuous plate, showing some traces of segmentation, the lateral margins of which are membranous and extending to the ventral side. Derm presenting a slightly vermiculate appearance. Eyes small; weakly demarcated in two zones. Margin of wing-pads with a continuous series of small simple setae, which are quite widely spaced. Small simple setae also occur sparingly on the dorsum; the posterior area of the caudal plate armed with a group of numerous lanceolate setae. Small groups of thick setae also present submedianally in the abdominal plates.

Ventral side membranous throughout, except for weak zones around the anal opening, the posterior marginal zone in the abdomen and small areas around spiracles. Derm beset with simple setae of varying length in the head region and intersegmentally in the abdomen; minute points and comb-like structures occur in the posterior region.

Antennae (**Fig. 116b**) about 0·61 mm long, quite short, ventral, apparently ten-segmented, sparsely bearing small setae, two basal segments robust and narrowly transverse, 3rd also robust, broad basally, gradually narrowed apically, remaining segments slender, 4th about one-third as long as 3rd, 5th and 7th smallest and equal, 6th slightly longer than 4th, 8th, 9th and 10th combined almost as long as 3rd, bearing two sensoria and two minute apical spines, 4th and 6th each having one sensorium. Legs (**Fig. 116c**) small, sparsely bearing simple setae, femora not reaching body margin, middle and hind legs having weak representation of trochanters; tibio-tarsal articulation well-defined, each tarsus with a long curved seta at apex; claws present, with a relatively large empodium. Anal opening at a short distance away from the apex of abdomen, surrounded by a prominent, sinuous, outer ring of slit-like pores (**Fig. 116d**), having an expanded band of pores on each lateral side; the inner pore-ring weakly defined; these rings are guarded by two anterior, two posterior and one lateral pairs of long setae; both rings are mesally separated.

Mature nymphs are provided with a curious funnel-shaped structure (**Fig. 116e**), attached near the junction between thorax and abdomen (**Fig. 116f**), by a small bifurcated triangular base. This funnel has a long shaft and resembles a cylindrical trophy cup, the apical margin armed with thick papillae, and each papilla beset thickly with lanceolate setae. It appears that this funnel probably acts in attaching firmly the nymph to the cell-wall of the gall and ultimately helps in shedding off the last moult (Mathur, 1935). The final skin bears this funnel-shaped structure with a stalk on the dorsal surface. This curious structure has also been mentioned and drawn by Loginova (1958, Figs. 32, 33). Within the body of the funnel, cast skins of the earlier nymphal stages are usually present.

*Trioza fletcheri* Crawford 1912

(**Fig. 117**)

- Crawford, D. L. 1912. *Rec. Indian Mus.* 7: 434, pl. xxxiv, fig. V; pl. xxxv, fig. Q (Pusa, Bihar).
- Crawford, D. L. 1917. *Philipp. J. Sci.* 12: 173 (Coimbatore, S. India).
- Crawford, D. L. 1919. *ibid.* 15: 190 (Singapore).
- Crawford, D. L. 1924. *Rec. Indian Mus.* 26(6): 621 (Coimbatore).
- Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26(6): 624.
- Enderlein, G. 1926. *Ent. Mitt.* 15 (5-6): 400 (*Sparioza fletcheri*).
- Rahman Khan, A. 1932. *Indian J. agric. Sci.* 2(4): 360, 372-74, pl. xxxix (Nymphal stages; Pusa, Bihar).
- Mathur, R. N. 1935. *Indian Forest Rec.* (n.s.), 1(2): 63.
- Beeson, C. F. C. 1941. *Forest Insects*, p. 781.
- Mani, M. S. 1935. *J. Asiatic Soc. Beng.* 1(2): 104 (Coimbatore, Vellore, Calcutta).
- Mani, M. S. 1959. *Agra. Univ. J. Res. (Sci.)* 8(2): 299 (Throughout India and Java).

Length of body, in male, 1·42 mm; in female, 1·83 mm

Length of forewings, in male, 2·41 mm; in female, 2·80 mm

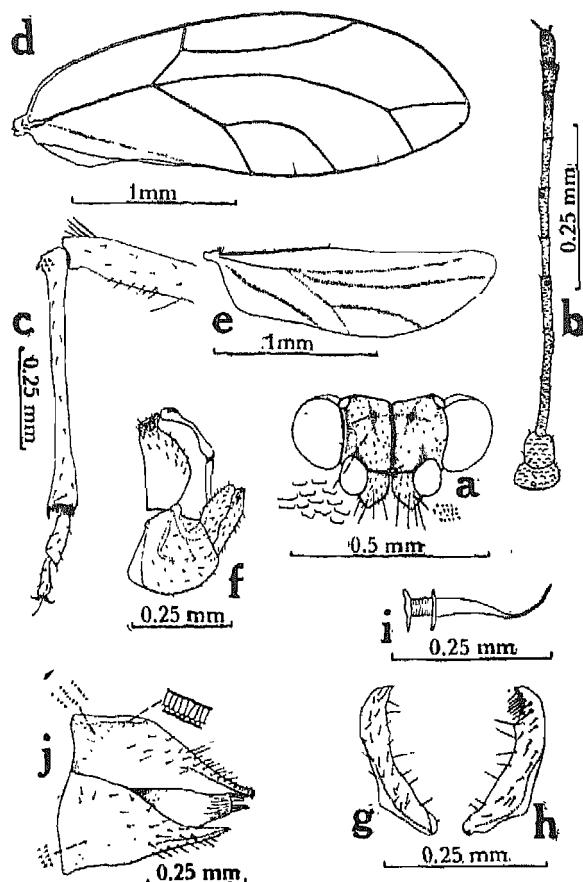


Fig. 117. *Trioza fletcheri* Crawford—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: male genitalia; **g**, **h**: forceps, lateral and mesal views; **i**: sperm pump; **j**: female genitalia, lateral view.

Width of head with eyes, 0·46 mm

Width of vertex between eyes, 0·25 mm

Length of antennae, 0·81 mm

*Colouration.* General colour flavus yellow with greenish tinge or dark yellowish-brown, apical antennal segments black.

*Structure.* Body rather small. Head (**Fig. 117a**) smaller than thorax, moderately deflexed, finely and sparsely pubescent, finely rugulose; vertex somewhat horizontal, swollen anteriorly, slightly more than twice as broad as long, with a prominent, circular fovea on each side of median suture and nearer to the posterior border, a prominent

longitudinal sulcate impression extends from each fovea, both anteriorly and posteriorly, another transverse impression extends up to the eye, posterior margin strongly arcuate, front ocellus visible from above, post-ocellar region slightly swollen; genal cones small, sub-vertical, about half as long as vertex, divergent, sub-acute at tip, bearing 3 or 4 long setae and also beset with minute points arranged in lines. Eyes hemispherical.

Antennae (**Fig. 117b**) long, ten-segmented, about twice as long as width of head, bearing a few setae, imbricate, two basal segments robust, 1st joint transverse, narrower anteriorly, 2nd sub-quadrangular, remaining joints slender, 3rd longest, 4th half as long as 3rd, 5th smaller than 4th, 6th, 7th and 8th nearly equal to one another but each slightly smaller than 4th and a little longer than 5th, 9th and 10th joints smallest but equal, terminal segment with two unequal apical spines, four sensoria present on segments 4, 6, 8 and 9.

Thorax arched, finely and sparsely pubescent, finely reticulate mid-dorsally, otherwise finely rugulose. Prothorax very narrow, roof-shaped; prescutum nearly as broad as long, broadest in middle, narrower both anteriorly and posteriorly, subacute antero-medianally, angulate both laterally and posteriorly; scutum slightly smaller in length than prescutum, about twice as broad as long, angulate posteriorly; scutellum somewhat triangular, broad anteriorly and narrow posteriorly.

Legs (**Fig. 117c**) moderately long, slender, bearing small setae and also beset with fine points arranged in lines, femora shorter than tibiae, all tibiae with an apical comb of setae, hind femur armed with four long dorsal setae just behind apex, hind tibiae beset with several conspicuous basal spurs and three tooth-like spines at apex (two on one side and one on the other), tarsal segments equal in length; mcracanthus small, slender and triangular.

Forewings (**Fig. 117d**) long, hyaline, elongate, more than two and a half times as long as broad; subacute at apex, basal vein quite long, R, M and Cu arising nearly from the same point, radius short, Cu a little less than twice as long as R, marginal cells unequal, first longer than second.

Hind wings (**Fig. 117e**) small, beset with minute points, costal margin armed with a few simple and hooked setae.

Abdomen long and slender; finely and sparsely pubescent and also beset with minute points arranged in linear series.

*Genitalia.* Male genital segment (**Fig. 117f**) smaller than abdomen. Anal valve (proctiger) nearly as long as parameres; in lateral aspect, anterior margin nearly straight, posterior margin moderately convex, emarginate near apex, narrower both dorsally and ventrally, surface finely rugulose and sparsely beset with setae dorsally and along the posterior border; parameres (**Figs. 117g, h**) irregular, broad basally, narrow apically, ending in an incurved sharp black point, outer surface bearing small simple setae, mesal surface with a cluster of thick setae just below apex and pointing downward, setae on inner margin slightly longer and stronger, inner caudal margin slightly projecting out like a thick spur; hypandrium of usual shape, sparsely beset with small simple setae and thickly with minute points arranged in lines; outer arm of aedeagus (**Fig. 117f**) slightly smaller than basal; sperm pump as figured (**Fig. 117i**).

Female genital segment (**Fig. 117j**) smaller than abdomen, stout, pubescent with hairs of various length, also armed with minute points; plates sub-equal, dorsal plate a little longer than ventral, roundly pointed at apex, caudal end armed with a small cluster of thick setae; ventral plate rather acutely pointed, ventral margin with a row of long and thick setae directed backward; ovipositor acutely pointed.

*Host plants.* On *Gmelina arborea* Linn.; ex galls on leaves of *Trewia nudiflora* Linn.

*Distribution.* Previously recorded from Pusa, Bihar, on *Gmelina arborea* (Crawford, 1912); from Coimbatore (S. India) in galls of *Trewia* sp. (Crawford, 1917, 1924); from Singapore (Crawford, 1919). Mani (1935) has recorded this species from Coimbatore, Vellore and Calcutta. Throughout India and Java (Mani, 1959).

*Material examined.* In the collection at the F.R.I., Dehra Dun, are present 4 males and 2 females, of 6.4.59, from New Forest, Dehra Dun, and collected on *Gmelina arborea* (R.N. Mathur); 5 males and 2 females of 4.8.53, from New Forest, Dehra Dun, and bred ex galls on *Trewia nudiflora* (R.N. Mathur); few examples of 27.12.37, from Hardwar (U.P.) (R.N. Mathur), ex galls on *Trewia nudiflora*; and some adults and nymphal stages, preserved in alcohol, in four phials, having same data.

The Z.S.I., Calcutta, collection contains 2 tubes containing 2 adults of 27.12.34, from Shibpore, Botanical Garden, ex *Trewia nudiflora*; and few adults and nymphs collected on 24.1.54, from Gobardanga, 24. Parganas (Bengal) (B. Dasgupta).

The collection at the I.A.R.I., New Delhi, consists of 3 ex. of 1.3.09 (C.S.M.); 4 ex. of 1.1.16 (U. Bahadur); 7 ex of 11.3.16 (C. S. Misra); 2 ex of 11.4.18. (Dwarka Pd.); all from Pusa, Bihar and collected on *Gmelina arborea*; and 1 ex. of 9.12.13, from Coimbatore (S. India) and galls on *Trewia* leaves (Y.R. Rao).

*Comparison.* Crawford has described this species from 3 females. It is redescribed and supplemented with some notes and figures here. This is a small species and is readily recognised by the shape of head and wings, legs and venation.

*Biological notes.* *Trioza fletcheri* Crawford is a common species damaging the leaves of *Trewia nudiflora* by the heavy formation of galls (Plate 6c). Fresh leaves on appearance are badly attacked and distorted or crumpled. Galls are found throughout the year at Dehra Dun and other places. Mani (1935, 1959) has given its distribution and description of the gall. Rahman (1932) has described its nymphal stages.

#### *Trioza fletcheri minor* Crawford 1912

(*Figs. 118, 119*)

Crawford, D. L. 1912. *Rec. Indian Mus.* 7(5): 434-435, Pl. xxxv, fig. R. (On *Terminalia arjuna*; Pusa, Bihar).

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26(6): 624.

Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 64-65 (Biology; New Forest).

Reeson, C. F. C. 1941. *Forest Insects*, p. 781.

Saksena, R. D. 1944. *Jl. R. Asiat. Soc. Beng.* 10: 123.

Mani, M. S. 1948. *Jl. R. Asiat. Soc. Beng. (Sci.)* 14(2): 80, 112.

Mani, M. S. 1959. *Agra Univ. J. Res. (Sci.)* 8(2): 170-171, 174-175.

Length of body, in male, 1·4 mm; in female, 1·8 mm

Length of forewings, in male, 1·85 mm; in female, 2·12 mm

Width of head with eyes, 0·52 mm

Width of vertex between eyes, 0·28 mm

Length of antennae, 0·55 mm

*Colouration.* General colour light yellowish-brown; antennae black at tip.

*Structure.* Body uniformly smaller. Head narrower than vertex, deflexed, finely and sparsely pubescent, finely rugulose (**Fig. 118a**). Vertex moderately long, slightly broader than long, with a deep fovea posterior to centre and a prominent, longitudinal sulcate impression on each side of median line, ocellar and lateral regions near the eyes swollen, gradually rounded anteriorly, posterior margin slightly emarginate, anterior margin invaginated at point of excision; anterior ocellus visible in front; genal cones small, about one-fifth as long as vertex, much below the level of vertex, beset with minute points, sub-vertical, slightly divergent, subacute at tip, pubescence longer than that of vertex. Eyes small.

Antennae (**Fig. 118b**) small, a little longer than width of head, ten-segmented, imbricate, bearing a few setae, slender, except two basal segments which are robust, 1st narrowly transverse, 2nd sub-quadrangular, 3rd longest, 4th about half as long as 3rd, 5th and 8th segments equal and each smaller than 4th, 6th a little longer than 5th, 7th and 10th equal and slightly smaller than 5th, 9th slightly smaller than 10th, terminal segment with two unequal spines at apex; four sensoria present on segments 4, 6, 8 and 9.

Thorax somewhat arched, finely and sparsely pubescent, finely rugulose; prothorax convex, roof-shaped, descending, sides narrower, with two foveal impressions on each lateral side; prescutum broader than long, broadest posterior to centre, narrower anteriorly, angulate laterally and on posterior margin; scutum much broader than long, slightly shorter than prescutum, weakly depressed dorso-medially, angulate laterally, posterior margin weakly invaginated along scutellum; scutellum trapezoid, broad anteriorly and narrow posteriorly, about twice as broad as long.

Legs (**Fig. 118c**) moderately long, slender, pubescent and also armed with minute points; femora shorter than tibiae, all tibiae with apical comb of setae, hind femur with four dorsal setae just before apex and three sensoria-like structures on ventral side, hind tibia with a small basal spur and three spur-like black setae at apex (2 on one side and 1 on the other); apical tarsal segment a little longer than basal; meracanthus small, slender and triangular.

Forewings (**Fig. 118d**) small, hyaline, three or a little more times as long as broad, subacute at apex, veins R, M, Cu arising from the same point, basal vein longer than Cu, radius short, shorter than cubitus, marginal cells subequal, first marginal longer and broader than second,  $M_{1+2}$  meeting just before apex; veins armed with microscopic setae.

Hind wings (**Fig. 118e**) moderately long, thickly beset with minute points, costal margin armed with a few simple and hooked setae in the basal half.

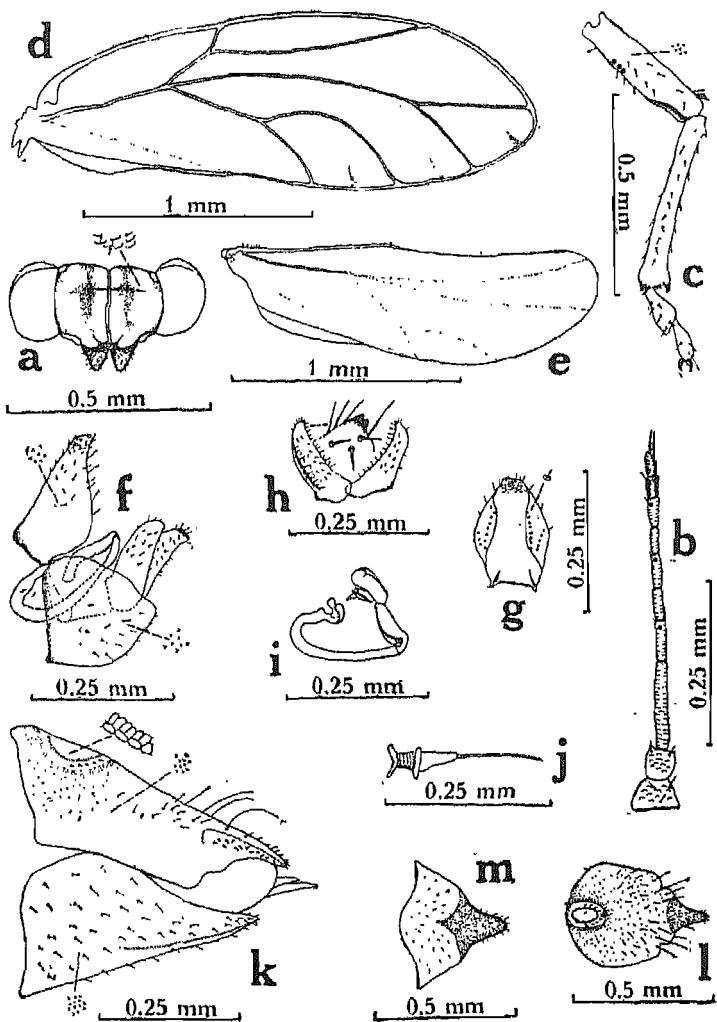


Fig. 118. *Trioza fletcheri minor* Crawford—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: male genitalia, lateral view; **g**: anal valve, caudal view; **h**: forceps; **i**: aedeagus; **j**: sperm pump; **k**: female genitalia, lateral view; **l**: dorsal plate; **m**: ventral plate.

Abdomen rather long, longer than broad, finely and sparsely pubescent and also beset with minute points, pubescence longer on sternites.

*Genitalia.* Male genital segment (Fig. 118f) small, smaller than abdomen. Anal valve (Fig. 118g) somewhat as long as forceps, broad basally, sub-triangular in profile, anterior margin almost straight, lateral lobes bent inwards, upper surface armed with minute points and the apical region and lateral lobes with simple setae, marginal setae somewhat longer; parameres (Fig. 118h) bowed, together forming an ellipse when

seen caudally, sides sub-parallel, converging gradually to apex, apex sharply curved mesad and cephalad, terminating in a small, black bifid tooth, upper surface bearing small simple setae, mesal surface armed with small thick setae directed downward, a group of thick setae also present just below apex, marginal setae slightly longer; hypandrium simple, of usual shape, bearing simple setae and also armed with minute points; outer arm of aedeagus (**Fig. 118i**) small and thick, spoon end divided into two lobes; sperm pump as figured (**Fig. 118j**).

Female genital segment (**Fig. 118k**) smaller than abdomen, both plates sub-equal, broad basally and gradually narrowed apically, armed with minute points and also beset with simple setae of varying length, setae longer in middle; dorsal plate (**Fig. 118l**) longer than ventral, gradually sloping from base to apex, subacute at apex, apical region armed with minute peg-like setae; ventral plate (**Fig. 118m**) acute at apex and similarly armed with peg-like setae; circum-anal pore ring composed of a double row of pores; ovipositor acutely pointed.

*Host plants.* Bred *ex* galls on leaves of *Terminalia alata* Heyne ex Roth. var. *tomentosa* C.E. Parkinson (= *T. tomentosa* W. & A.) and *T. arjuna* W. & A. and *T. catappa* Linn.

*Distribution.* Previously recorded from Pusa, Bihar (Crawford, 1912); from New Forest, Dehra Dun, U.P. (Mathur, 1935); and from South India and throughout the plains and low hills of India (Mani, 1959).

*Material examined.* 3 males and 3 females, 26.3.32, from New Forest, Dehra Dun (Exp. 364) (R.N. Mathur); 4 males and 2 females, 29.6.33, from New Forest (R.N. Mathur); and 5 males and 4 females, 1.6.50, from New Forest (R.N. Mathur); two tubes containing some adults, preserved in alcohol, and collected from New Forest, on 7.6.61 and 6.7.62 (R. N. Mathur), *ex* galls on *T. alata* var. *tomentosa*; few specimens collected on 13.9.1965 and received from Ludhiana, Punjab and bred *ex* galls on *T. arjuna* (O.S. Bindra); few nymphs *ex* galls on *T. catappa* Linn. (N.D. Paul), and received from Bapatla (Andhra Pradesh).

There are 4 examples of this species, collected on 26.9.09, from Pusa, Bihar (C.S.M.); and also few specimens from New Forest, Dehra Dun (U.P.), collected *ex* galls on *T. alata* var. *tomentosa*, March 1932 (R.N. Mathur), at the I.A.R.I., New Delhi.

*Comparison.* This species is uniformly smaller than *T. fletcheri* and differs from it in shape of head, genal cones, marginal cells in forewings and genital characters.

*Biological notes.* This gall-forming species is very common in many parts of India, severely damaging the leaves of *Terminalia alata* var. *tomentosa* (Plate 5c, d) and *T. arjuna*. Saksena (1944) has given the anatomical characters, while Mani (1959) has described the gall. Mathur (1935) has studied in detail its life-history and biology, and brief notes are also given by Beeson (1941). The structure of the nymphal stages resembles very much with the structure of the nymphs of *T. fletcheri*, with minor differences.

#### Nymphal stages

*Fifth stage.* (**Fig. 119a**). Length 1.6 mm (on slide). Typical triozine form. Body oval. Humeral angle of the wing-pads extending cephalad up to the posterior margin

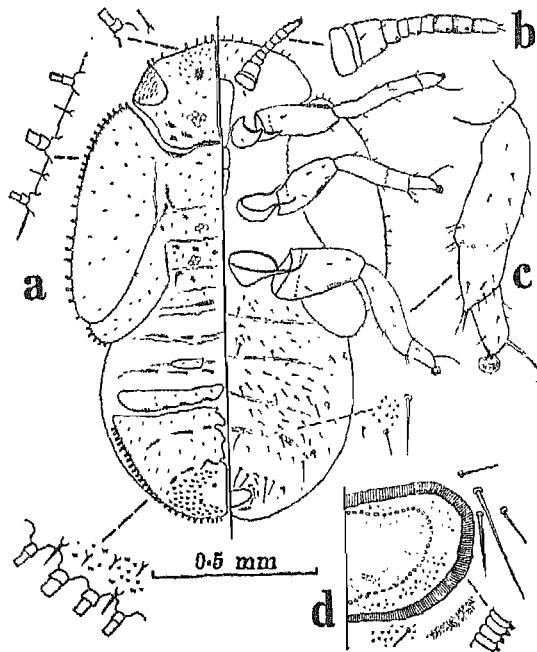


Fig. 119. *Trioza fletcheri minor* Crawford—**a:** fifth stage nymph; **b:** antenna; **c:** hind leg; **d:** circum-anal pore ring.

of eyes. Margin of body beset with closely spaced secta-setae of two sizes, borne on minute tubercles. Head narrower than abdomen. Dorsum with the derm strongly sclerotic throughout, except the anterior half of abdomen, in which thin sclerotic strips are present; the posterior half of abdomen having a single sclerotic plate, showing traces of segmentation and mesally separated. Derm weakly vermiculate, and bearing minute simple setae, the posterior abdominal plate armed with minute points and comb-like structures. Eyes small.

Ventral side membranous throughout. Derm beset with simple, small setae of varying length and thickly with minute points; a small weakly sclerotic zone present posterior to circum-anal ring. Antennae (Fig. 119b) ventral, about 0.27 mm long, apparently ten-segmented, bearing four sensoria, four apical segments imbricate and darker, terminal segment with two minute apical spines. Legs (Fig. 119c) small, sparsely bearing small, simple setae, femora not reaching margin of body; trochanters weakly represented; tibio-tarsal articulation distinct; each tarsus with a long golf-club seta; claws absent, pulvillus in the form of a circular pad. Anal opening located slightly away from the tip of abdomen, and surrounded by a double ring of pores (Fig. 119d), the outer ring consisting of slit-like pores, while the inner ring composed of minute and poorly defined pores; both rings are mesally interrupted and guarded by one anterior, three lateral and one posterior pairs of long setae.

*Fourth stage.* Length 0·83 mm. Resembling the fifth stage, except in being smaller in size; antennae apparently seven-segmented, bearing three sensoria; tibio-tarsal articulation absent.

*Third stage.* Length 0·55 mm. Resembling the above stage, with antennae apparently five-segmented, with two sensoria; wing-pads smaller.

*First stage.* Length 0·22 mm. Antennae apparently three-segmented, bearing one sensorium, apical setae very long; dorsum for the most part sclerotic, having few marginal setae; wing-pads knob-like, bearing one or two seta-setae; abdominal segments distinct.

**Trioza fusca, sp. n.**

(Figs. 120, 121)

Length of body, in male, 1·55 mm; in female, 1·60 mm

Length of forewings, in male, 3·10 mm; in female, 3·48 mm

Width of head with eyes, 0·71 mm

Width of vertex between eyes, 0·32 mm

Length of antennae, 1·0 mm

*Colouration.* General colour dark-chocolate to fuscous, shining; antennae lighter basally, with ninth and apex of eighth segment black; wings hyaline, transparent, veins black. In live specimens, general colour yellowish-brown with greyish tinge, prothorax and scutellum greenish-grey, scutum with two pairs of dark-brown longitudinal bands; abdomen with dark-brown dorsal segmental bands, ash grey ventrally; legs light brown, femora of hind legs light black ventrally.

*Structure.* Body small but robust. Head (Figs. 120a, b) slightly smaller than thorax, pubescent with long hairs and also strongly rugulose; vertex broader than long, about twice as broad as long, with a deep sulcus on either side of median suture extending laterally towards the eyes, foveae present posterior to centre in sulcus, disc swollen on either side of the deeply grooved median line and also along the eyes, gradually rounded downward in front, posterior margin moderately emarginate, anterior margin invaginated at the point of excision; anterior ocellus scarcely visible from above; genal cones small, about 0·18 mm long, shorter than vertex, divergent, deflexed vertically downward, somewhat decurrent, situated below the level of vertex, pubescent, setae longer than on vertex, finely rugulose, apices angulately rounded. Eyes small, somewhat hemispherical. Antennal sockets lateral and located below the level of eyes.

Antennae (Fig. 120c) long, ten-segmented, having a few setae, two basal segments robust, narrowly transverse, 2nd slightly longer than 1st, remaining segments slender and imbricate, 3rd longest, 4th about one-third as long as 3rd, 4th and 6th equal, 5th a little longer than 4th, 7th slightly smaller than 6th, 8th smaller than 7th, 9th a little longer than 10th, terminal segment smallest, bearing two unequal apical spines, four sensoria present on segments 4, 6, 8 and 9, two apical segments somewhat clavate and compressed.

Thorax (Fig. 120b) large, robust, moderately arched, sparsely pubescent with long hairs, strongly rugulose. Prothorax small, strongly convex, descending, with two foveal

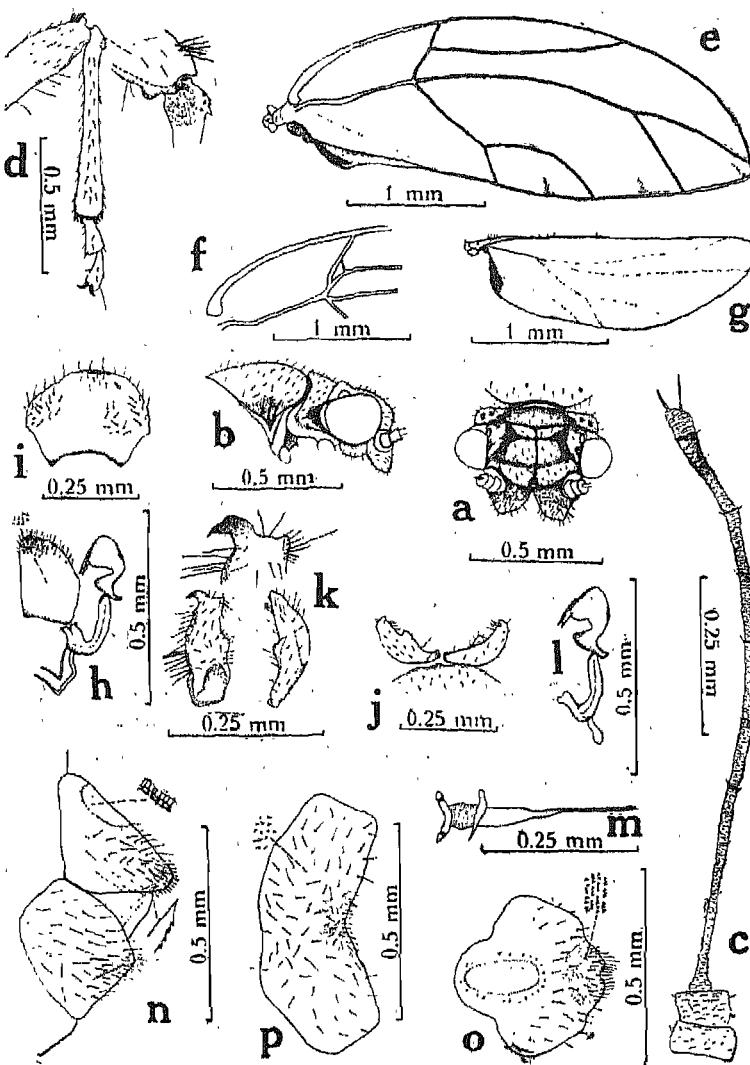


Fig. 120. *Trioza fusca*, sp. n.—**a**: head, front view; **b**: head and part of thorax, lateral view; **c**: antenna; **d**: hind leg; **e**: forewing; **f**: part of forewing of female; **g**: hind wing; **h**: anal valve and aedeagus; **i**: anal valve, mesal surface; **j**, **k**: parameres; **l**: aedeagus; **m**: sperm pump; **n**: female genitalia, lateral view; **o**: dorsal plate; **p**: ventral plate.

impressions on each side, posterior margin with a thick epiphysis medially; prescutum large, slightly broader than long, broadest in middle, gradually narrowed both anteriorly and caudally, angulate laterally, posterior margin angulate sub-medially; scutum large, slightly more than twice as broad as long, broadest before middle, angulate laterally,

slightly smaller in length than prescutum; scutellum vase-shaped, broadly transverse with prominent antero-lateral angles, twice as broad as long; post-scutellum of meta, thorax narrowly transverse, somewhat rectangular.

Legs (**Fig. 120d**) long, coarsely pubescent, and also beset with minute points, arranged in linear series, femora shorter than tibiae, tibiae with apical comb of setae, hind femur with three sensoria-like structures on ventral side, and six long, blunt, dorsal setae near apex, hind tibiae with a series of basal spurs, 3 or 4 spurs stronger than others, apical one-third thicker, having three or four spur-like spines at apex, tarsal segments almost equal in length, each tibia with a small but prominent basal process which fits in a concavity present at apex of each femur, meracanthus large and sub-triangular.

Forewings (**Fig. 120e**) quite long but variable in length, hyaline, transparent, about two and a half times as long as broad, broadest in middle, subacute to narrowly rounded at apex, radial sector not very long, straight, R, M and Cu arising from the same point, basal vein slightly longer than cubitus, radius a little less than half as long as cubitus, first marginal cell slightly longer and wider than second cell, veins armed with microscopic setae. In the forewing of a female example, a small callus present arising from near base of radial sector and extending to R<sub>1</sub> (**Fig. 120f**).

Hind wings (**Fig. 120g**) small, membrane uniformly beset with minute points, costal margin armed in the basal half with a few simple and hooked setae.

Abdomen rather globose, thickly beset with minute points, sparsely pubescent ventrally.

*Genitalia.* Male genital segment smaller than abdomen. Anal valve (**Figs. 120h,i**) about 0·25 mm long, longer than forceps, broadest near about middle, in profile, anterior margin almost straight, posterior margin broadly and convexly rounded, with a weak angulation below middle, outer surface thickly armed with minute points, pubescence sparse apically along posterior border, mesal surface beset with few small apical setae and two groups of small setae laterally; parameres (**Figs. 120j, k**) about 0·18 mm long, bowed, sides sub-parallel, anterior margin conspicuously sinuate, apical portion of each forcep enlarged, terminating in two divergent cephalic and caudal lobes, former smaller and subacute, while the latter lobe large, curved downward and acute, outer surface bearing small simple setae, mesal surface having long setae directed downward, marginal setae longer; hypandrium simple, of usual shape, wrinkled, with sparse pubescence; aedeagus (**Fig. 120l**) small, outer arm strong, robust, with the spoon-end like a hood, having two small, acute points; sperm pump as figured (**Fig. 120m**).

Female genitalia (**Fig. 120n**) smaller than abdomen, wide apart posteriorly. Dorsal plate (**Fig. 120 o**) longer than ventral, inclined with a steep slope caudally, pubescent and finely rugulose, broadest in middle, caudal end slightly invaginated medially, forming two small lobes, one on either side, strongly rugulose and also beset with strong, simple setae of varying length; circum-anal ring quite long and composed of a double row of pores, inner row of slit-like pores complete; ventral plate (**Fig. 120p**) pubescent with simple setae of varying length, subacute at apex, setae in the posterior region closely set; ovipositor provided with saw-like teeth on the ventral side and acutely pointed at apex.

*Host plant.* Bred *ex* pit galls on leaves of *Syzygium cumini* (L) Skeels (= *Eugenia jambolana* Lam.).

*Type locality.* New Forest, Dehra Dun (U.P.).

*Types.* Described from a very small series of specimens bred *ex* pit galls on leaves of *Syzygium cumini*. Holotype male; Allotype female; Paratypes: one male and one female, all from the type locality, and reared during February-March, 1950 (R.N. Mathur). Teneral specimens were dissected and their parts mounted on slides. All type-material deposited at the F.R.I., Dehra Dun. The preserved material in alcohol consists of some galls, few adults and nymphal stages, in two phials.

*Comparison.* This species and *Trioza jambolanae* Crawford resemble closely with each other, both in structure and habits, except the formation of galls on leaves of *Syzygium cumini* which is different. The shape of wing and venation match very much with the figure of *T. jambolanae* given by Crawford (1917). The male genitalia of one example from the collection of the I.A.R.I., New Delhi, and identified as *jambolanae* was also examined in detail and the structure agrees well with the male genital characters of *fusca*. Crawford (1917) has described *jambolanae* from two females, collected on February 3, 1915, from Pusa (Bihar). Both species occur at Dehra Dun and their emergences take place when the season warms up. It is quite possible that some confusion is likely to exist in mixing the two species together, and hence they are described separately for the present, until more specimens are examined in detail.

*Trioza fusca* is distinguishable by its vertically deflexed posture and shape of head, having deep sulci on disc and the deeply grooved median suture, small genal cones, shape of forewing, venation and genital structures.

*Biological notes.* This is a rare species and is met with during February-March. It forms pit-galls (Plate 5b) surrounded by an irregular, wavy, thick and elevated rim of crimson or carmine colour, while the pitted area is greenish-pink. Such galls are generally found on the under surface of young leaves of *Syzygium cumini*, and on the upper surface they are slightly raised and are coloured greenish-carmine. A leaf may contain 1 to 9 pit galls and each pit is tenanted by a nymph having a bulging venter occupying the depression. Young nymphs are usually pale-yellow, with pinkish-red eyes. Mature nymphs are yellowish-brown to smoky black, surrounded by a waxy fringe. The nymphs are described below.

#### Nymphal stages

*Fifth stage* (Fig. 121a). Length 2.00 mm. Form somewhat regularly oval, the continuity of margin interrupted near the head and at the base of abdomen. Wing-pads produced cephalad beyond the eyes. Dorsum quite strongly sclerotized. Entire margin of the body, except the eyes, beset with a continuous series of short, thick seta-setae, borne on distinct prominences. Derm vermiculate and beset with small, simple setae scattered over the entire dorsum. Abdomen composed for the most part of a single plate, with two narrow, medially interrupted plates at the junction between thorax and abdomen.

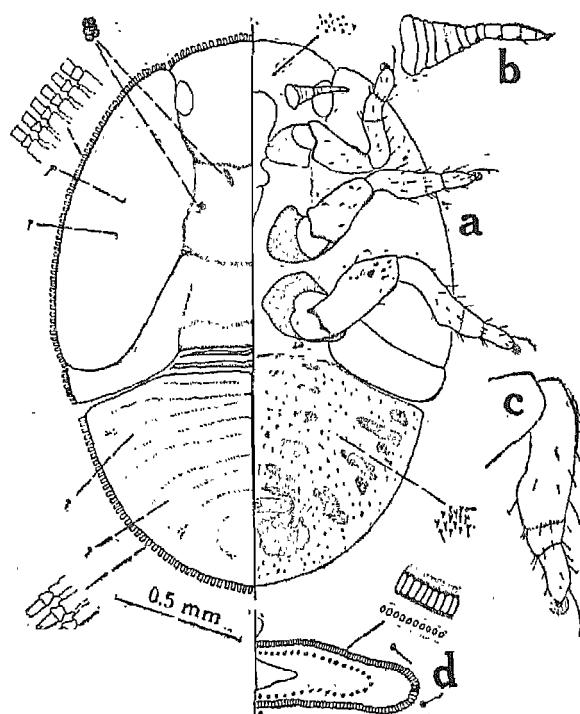


Fig. 121. *Trioza fusca*, sp. n.—a: fifth stage nymph; b: antenna; c: leg; d: circum-anal pore ring.

Ventral side membranous throughout, except for a small area about each spiracle, five pairs of small, strip-like, submedian plates and three pairs of lateral plates and a small, irregular plate surrounding the anal ring, which is interrupted anteriorly and inverted V-shaped posteriorly. Derm thickly beset with minute points throughout and with slender simple setae of various length in the abdomen. Antennae (Fig. 121b) very short, thick, about 0·24 mm long, the segmentations obscure, apparently seven-segmented, with four sensoria, basal segments broad basally, narrow apically, terminal segment with two small spines at apex. Legs (Fig. 121c) small and thick, femora scarcely reaching the margin of the body; without trochanters; tibio-tarsal articulation distinct; each tarsus with a long seta near apex; claws rather weak, the pulvillus in the form of a large circular pad. Anal opening (Fig. 121d) set well in from the apex of the body, the outer circum-anal pore ring consisting of a single row of slit-like pores, the inner ring indistinct, consisting of extremely minute somewhat circular pores; the circum-anal ring guarded by two pairs of anterior and posterior setae.

*Fourth stage.* Length 1·81 mm. Identical with the fifth stage, except in smaller size and wing-pads, without tibio-tarsal articulation, and with apparently five-segmented antennae, bearing three sensoria.

**Trioza gigantea** Crawford 1912  
 (Fig. 122)

Crawford, D. L. 1912. *Rec. Indian Mus.* 7: 428, Pl. xxxiii, figs. X, Z; Pl. xxv, fig. J (*Trioza gigantea*).  
 Darjeeling, E. Himalayas.

Enderlein, G. 1921. *Zool. Anz.* 52: 122 (*Dasymastix gigantea* Crawford 1912), Sikkim.  
 Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26(6): 624.

Length of body, in female, 4·12 mm  
 Length of forewing, in female, 5·51 mm  
 Width of head with eyes, 0·93 mm  
 Width of vertex between eyes, 0·53 mm  
 Length of antennae, 3·62 mm

*Colouration.* General colour black on dorsum, light brown on venter; vertex, eyes and antennae black; genal cones brown; pronotum brown; dorsulum shining black in anterior two-thirds and rest brown; scutum with one pair of submedian and one pair of lateral longitudinal black bands; metanotum dark-brown; scutellum bordered black laterally; tibiae of all legs dark-brown, apical tarsal segments light black.

*Structure.* Body very large and the surface clothed sparsely with long brown pubescence, which is not very prominent. Head (Figs. 122a,b) broad, much broader than prothorax and dorsulum, moderately deflexed, bearing sparse pubescence; vertex large, broadly concave between eyes, descending, smooth, glossy about half as long as broad, median suture longer than lateral edges, posterior margin strongly arcuate, disc with foveal impressions posterior to centre; anterior ocellus visible in front; frons slightly visible; post-ocelli strongly raised; genal cones about 0·25 mm long, about half as long as vertex, directed vertically downward, divergent, broad basally and bluntly rounded apically, sparsely hairy. Eyes large and prominent. Antennal sockets large.

Antennae (Fig. 122c) very long, smaller than body, moderately thick, densely hairy, with stiff setae, all segments long, except 1, 2 and 10; segments 1 and 2 short, thick and hairy, 1st subquadrate, 2nd narrowly transverse and smaller than 1st, 3rd longest, 4th and 5th nearly equal and each smaller than 3rd, 6th and 7th again equal but each smaller than 5th, 8th smaller than 7th, 9th much smaller than 8th, terminal segment extremely small, bearing two small, blunt apical spines.

Thorax (Fig. 122b) very broad, well arched, surface smooth and glossy, sparsely covered with hairs; prothorax short, narrow, depressed below head and prescutum, narrowly convex, with two foveal impressions on lateral sides; propleurites large; prescutum strongly arched, overhanging pronotum, nearly as long as broad, broadest in middle, narrowly rounded anteriorly, angulate laterally, broadly rounded posteriorly; scutum large, broad, slightly more than twice as broad as long, broadest in middle, smaller than prescutum in length, anterior margin concavely rounded, disc depressed medianally, forming a shallow longitudinal channel, sides sloping and angulate laterally, posterior margin weakly rounded; scutellum broadly transverse, somewhat trapezoid in

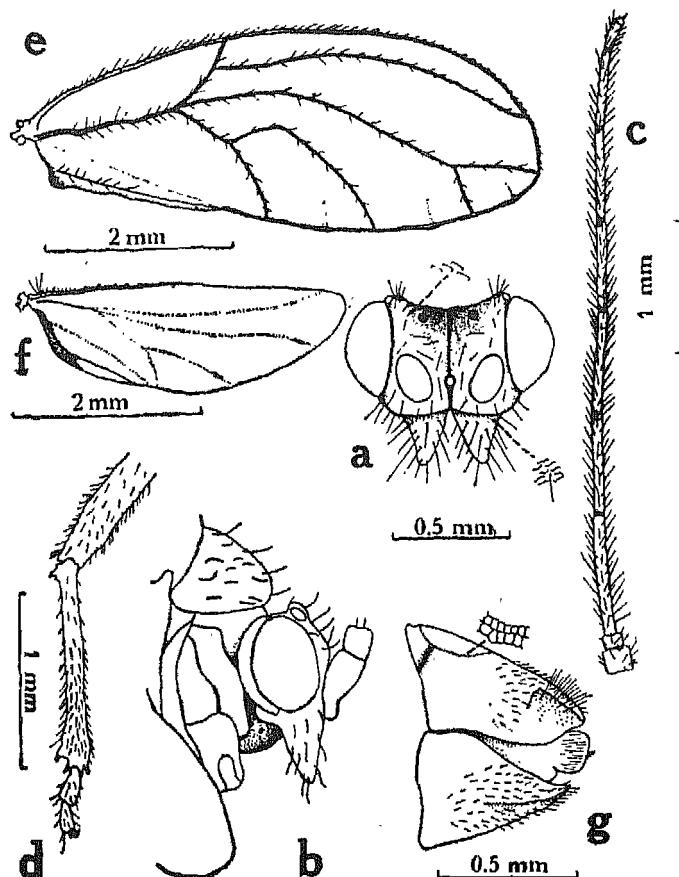


Fig. 122. *Triozagigantea* Crawford—**a**: head, front view; **b**: head and part of thorax, lateral view (copied from Crawford, 1912); **c**: antenna; **d**: hind leg; **e**: forewing; **f**: hind wing; **g**: female genitalia, lateral view.

shape, broadest anteriorly narrower posteriorly, anterior margin weakly concave, with prominent antero-lateral angles.

Legs (**Fig. 122d**) long, coarsely pubescent with long setae, tibiae longer than femora, each bearing an apical comb of setae, hind femur with a group of 3 or 4 dorsal setae near apex, hind tibiae with a moderately large basal spur and with 2 or 3 small spurs, apical region robust and armed with three stout spines on one side and one on the other; hind coxae very large; basal tarsal segments slightly longer than apical; meracanthus long and stout.

Forewings (**Fig. 122e**) large, hyaline, transparent, about two and a half times as long as broad, narrowly rounded at apex, almost triozine in venation, radius smaller than

cubitus,  $R_s$  very long, parallel with costa and flexed downward, first marginal cell much longer than second, about twice as large as second, veins setose, conspicuously so on basal portion of wing.

Hind wings (**Fig. 122f**) small, slender, hyaline, costa armed with some simple and hooked setae, membrane uniformly beset with minute points.

Abdomen long, large and stout, strongly rugulose and also armed with minute points, sternites coarsely pubescent with long setae.

*Genitalia.* Female genital segment (**Fig. 122g**) smaller than abdomen. Plates unequal, dorsal plate longer than ventral, broad basally and very narrowly rounded apically, pubescent, setae longer in middle and in the apical region, a strong lateral ridge present near base, on either side of circum-anal ring; circum-anal ring somewhat oval in shape, and composed of a double ring of pores; ventral plate acutely pointed at apex, coarsely pubescent with long setae; valvulae exserted; ovipositor acutely pointed.

*Host plant.* On trees locally named as 'uttis'.

*Distribution.* Previously known from Darjeeling (Bengal) and Sikkim.

*Material examined.* One female specimen (Type No. 9734/18) from Darjeeling (E. Himalayas), altitude 2135m (E. Brunetti), May 26, 1910 (slightly in poor condition), is present at the Z.S.I., Calcutta. Few specimens, all females, were also received from Mirik area (Darjeeling), collected on 16.3.67, on a tree locally named as *uttis* (V.R. Phalak).

*Comparison.* This species is redescribed from the type specimen present at the Zoological Survey of India, Calcutta, and also from the material received from Mirik area, Darjeeling. Crawford (1912) writes: "This is somewhat related to Kuwayama's *Stenopsylla nigricornis*, and probably does not belong in the genus *Trioza*. Until further evidence, however, is available, it will be included in the large genus." I have also retained this species under *Trioza*, for the present. *T. gigantea* is recognisable by its long body, large wings, hirsute antennae, shape of head and venation.

***Trioza gigantea curta*, ssp. n.**  
(*Figs. 123, 124*)

Length of body, in male, 2.25 mm; in female, 2.31 mm

Length of forewings, in male, 3.51 mm; in female, 4.12 mm

Width of head, with eyes, 0.60 mm

Width of vertex between eyes, 0.30 mm

Length of antennae, 1.25 mm

*Colouration.* General colour yellowish-brown, with thorax shining light brownish, antennae black or apices of segment 4 to 8 black, except three basal segments which are pale-yellow, legs pale-yellow, tarsal segments light black.

*Structure.* Body moderately long and slender, sparsely clothed with brown pubescence. Head (**Fig. 123a**) slightly broader than thorax, much broader than prothorax and prescutum, strongly deflexed, vertex almost plane on either side of median suture, glossy, sparsely pubescent with long setae and also finely rugulose along the sides and median

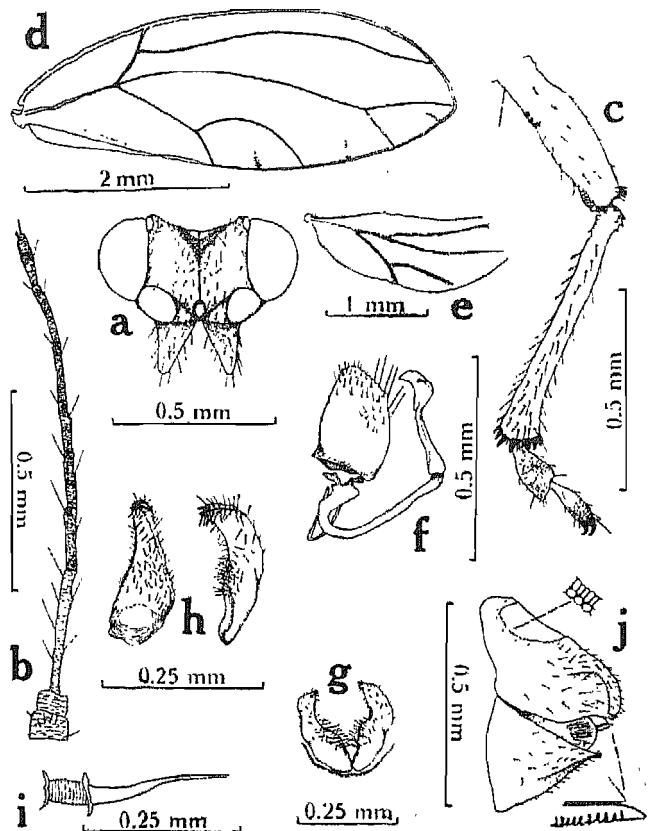


Fig. 123. *Trioza gigantea curta*, ssp. n.—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: anal valve and aedeagus; **g**, **h**: forceps, caudal, lateral and mesal views; **i**: sperm pump; **j**: female genitalia, lateral view.

suture, narrow and abruptly bent anteriorly; the two lobes appearing like a parallelogram, with two foveal impressions posterior to centre and near the median suture, posterior margin deeply invaginated, post-ocellar region strongly elevated, appearing as small papillae, anterior ocellus visible in front, anterior margin deeply invaginated at point of excision; genal cones large and about 0.18 mm long, and slightly more than half as long as vertex, beset with minute points arranged in lines, vertical, divergent, narrowly rounded at apex, pubescent, pubescence longer than that of vertex; antennal sockets large, lateral and situated below vertex. Eyes large, prominent and somewhat hemispherical.

Antennae (**Fig. 123b**) long and slender except two robust basal segments, ten-segmented, sparsely pubescent with long setae, imbricate, 1st and 2nd segments narrowly transverse, 2nd slightly smaller than 1st, 3rd longest, 4th, 7th and 8th equal to one another, and

each about half as long as 3rd, 5th and 6th equal and slightly smaller than 4th, 9th smaller and about half as long as 8th, terminal segment smaller than 9th, bearing two unequal apical spines, four sensoria present on segments 4, 6, 8 and 9.

Thorax long and slender, arched, sparsely pubescent. Pronotum short, collar-like, roof-shaped, deflexed below head and dorsum, finely rugulose, with two foveal impressions on each side; propleurites large and directed anteriorly; prescutum strongly arched, narrow, surface weakly rugulose, overhanging pronotum, nearly as long as broad, narrowly rounded both anteriorly and posteriorly, broadest in middle, angulate laterally; scutum broad, about twice as broad as long, shorter in length than prescutum, disc smooth, shallowly depressed longitudinally, finely rugulose and angulate laterally; scutellum small, broad anteriorly, narrow posteriorly, finely rugulose, with prominent antero-lateral angles; post-scutellum of meta-thorax large and broad, with a shallow median longitudinal channel.

Legs (**Fig. 123e**) long, sparsely pubescent and also beset with minute points arranged in linear series, femora thick, arched and shorter than tibiae, all tibiae with apical comb of setae, hind femur with five dorsal, long setae near apex and with three sensoria-like structures on ventral side, hind tibiae with three strong and a series of small spurs near base, and four spur-like spines (3 on one side and 1 on the other) at apex, apical portion of hind tibiae robust and thick, tarsal segments of fore and middle legs almost equal, basal tarsal segment longer than apical in hind leg, hind coxae very large; meracanthus large and triangular.

Forewings (**Fig. 123d**) quite large and long, hyaline, transparent, slightly less than three times as long as broad, broadest in middle, subacute at apex, R, M and Cu arising from the same point,  $R_s$  quite long and flexed subapically, radius longer than  $R_1$ , cubitus much longer than radius and almost as long as basal vein, marginal cells unequal, first cell longer and broader than second, veins armed with microscopic setae.

Hind wings (**Fig. 123e**) (partly broken) quite small, costal vein armed with few simple and hooked setae, membrane uniformly beset with minute points.

Abdomen long, slender, balloon-shaped, gradually tapering caudally, sparsely pubescent and also armed with minute points.

*Genitalia.* Male genitalia smaller than abdomen. Anal valve (**Fig. 123f**) about 0.25 mm long, longer than forceps, broadest at base, converging to narrow apex, in profile, anterior margin weakly convex, invaginated near base, posterior margin broadly convex, outer surface beset with minute points arranged in small linear series, apical region bearing sparse setae, marginal setae longer; parameres (**Figs. 123g, h**) about 0.22 mm long, strongly bowed inward in caudal view, sides irregular, inner margins conspicuously sinuate both in the apical and basal regions, broadest in middle, apex black, bidentate with acute points, outer surface beset with simple setae, mesal marginal setae thicker and longer, setae on inner surface also thicker but shorter and directed downward, below the apical teeth, a group of thick and strong setae present, arranged in rows and pointing downward; hypandrium of usual shape, bearing sparse setae and also strongly rugulose; outer arm of aedeagus smaller than the basal and sickle-shaped, sperm pump as figured (**Fig. 123i**).

Female genital segment (**Fig. 123j**) smaller than abdomen, sparsely pubescent, thick dorso-ventrally, plates wide apart, dorsal plate longer than ventral, descending sharply and abruptly bent downward posteriorly, narrowly rounded and blunt at apex, with a small median point, broad basally, thickly armed with minute points arranged in lines, apical caudal region beset with a bunch of small setae, circum-anal ring composed of a double row of pores; ventral plate subacute at apex, surface beset with simple setae and also with minute points; ovipositor small and acutely pointed.

*Host plant.* On unknown plant.

*Type locality.* Darjeeling (W. Bengal).

*Types.* Holotype male; Allotype female; Paratypes: one male and one female, of March 16, 1967 from the type locality (V.R. Phalak). A few damaged specimens and some nymphal stages, also from the type locality and same data, preserved in alcohol. All types, preserved material and few slides are deposited at the F.R.I., Dehra Dun. Shri Phalak has written to me that this species is also present at Kalimpong (W. Bengal).

*Comparison.* This sub-species is described from two males and two females, resembling closely with *T. gigantea* except in size and lack of hirsute body and antennae and some other characters. Since both *gigantea* and this lot have been collected on unestablished host plants and comparison could not be made of the male genitalia and of nymphal stages, it is preferred to treat this as only a sub-species. It differs from other species in shape of head, venation and genital characters. Its nymphal stages are similar to the nymphs of *Leuronota*, but the features of adult show great affinity with the genus *Trioza*, in having pronotum shorter, descending cephalad and depressed below head and prescutum.

*Biological notes.* Few adults and nymphal stages were received preserved in alcohol from Darjeeling (West Bengal) on March 16, 1967, collected from an unknown plant. Its nymphal stage is described below.

#### Nymphal stage

*Fifth stage.* (**Fig. 124a**). Length 1.78 mm on slide. Triozone form, except that the wing-pads are not produced cephalad. Entire dorsum sclerotic except for the sutural areas and a narrow basal area on the abdomen. Derm sparsely beset with small, simple setae borne on minute tubercles. Marginal setae on head, wing-pads and abdomen somewhat lanceolate, borne on small tubercles. Head large and broad, having a large head plate; thorax completely sclerotic; sclerotisation separated mesally. Abdomen bearing a large plate occupying about two-thirds of the posterior region. Derm sparsely beset with simple setae of various length, borne on minute tubercles.

Ventral side membranous throughout, except for a weak plate below each antenna, a small caudal plate, and very small, weakly sclerotic sub-median strips in the abdomen. Derm beset with simple setae of different length. Antennae (**Fig. 124b**) short, about 0.61 mm long, eight-segmented, weakly imbricate, bearing few simple setae borne on tubercles and four sensoria, 5th segment smallest, apical segment black, about as long as 4th, 5th, 6th and 7th segments together. Legs (**Fig. 124c**) large, the femora not at-

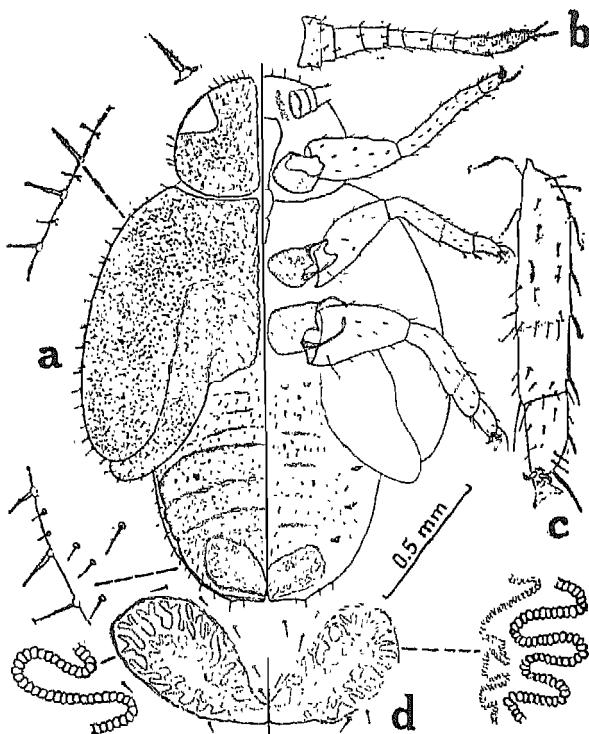


Fig. 124. *Trioza gigantea curta*, ssp. n.—a: fifth stage nymph; b: antenna; c: part of leg; d: circum-anal rings.

taining the margin of the body, bearing few simple setae, without trochanters, tibio-tarsal articulation distinct, each tarsus with a long curved seta near apex; claws present, the pulvillus triangular, fish-tail like, very slightly petiolate. Anal opening situated at the apex of the abdomen; circum-anal pore ring (Fig. 124d) encircling the anus and has become enormously enlarged, forming an outer, extremely sinuous, single row of slit-like pores, lying partly on the dorsal and partly on the ventral side of the abdomen, the inner ring also sinuous, very faint, consisting of extremely minute circular pores, a number of setae present guarding this sinuous band on both the dorsal and ventral sides.

***Trioza hyalina* Crawford 1912**  
(Figs. 38, 125)

Crawford, D. L. 1912. *Rec. Indian Mus.* 7(5): 428-429, Pl. xxxiv, figs. A, B; Pl. xxxv, fig. K.  
Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26(6): 624.

This species is described by Crawford (1912) from 3 males and 2 females, and one type male is only present in the collection of the Z.S.I., Calcutta. It is redescribed here

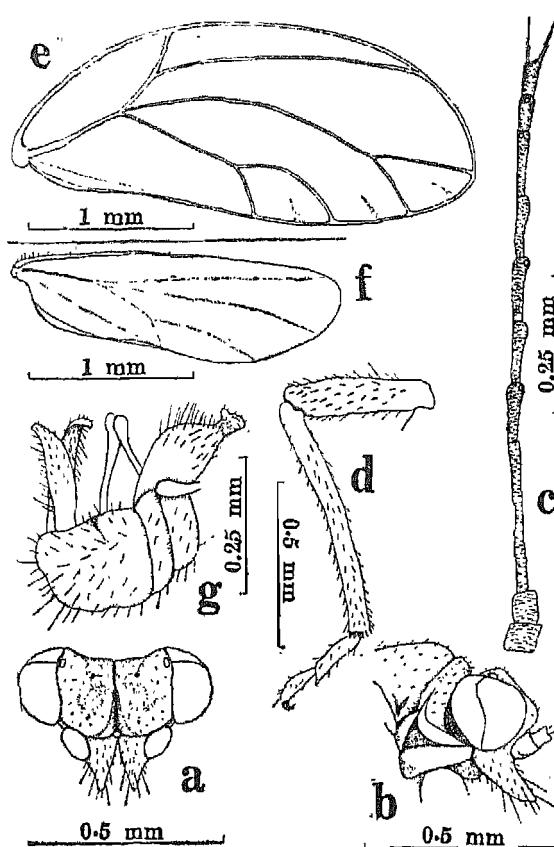


Fig. 125. *Trioza hyalina* Crawford—**a**: head, front view; **b**: head and part of thorax, lateral view; **c**: antenna; **d**: hind leg; **e**: forewing; **f**: hind wing; **g**: male genitalia, lateral view.

from this male type. According to Crawford, the measurements are: "Length of body, 1.9 mm; length of forewing, 2.9 mm; greatest width, 1.2 mm; width of vertex between eyes 0.33 mm, with eyes, 0.47 mm."

Length of body, in male, 1.75 mm

Length of forewing, in male, 2.6 mm

Width of head with eyes, 0.46 mm

Width of vertex between eyes, 0.30 mm

Length of antennae, 1.12 mm

**Colouration.** General colour lemon yellow; dorsum brown cephalad; antennae black at tip; head yellowish-brown with a light brown patch in middle; abdomen with male

genitalia yellowish-brown; legs yellowish-brown except apical tarsal joints and coxae which are light brown.

**Structure.** Body small. Head (**Figs. 125a, b**) small, deflexed; narrower than thorax, finely and sparsely pubescent; vertex broader than long, slightly less than twice as broad as long, impressed discally, bulging or swollen on each side of median line in front, with two round foveal impressions, posterior to centre, one on each side of median suture, posterior margin moderately invaginated, post-ocellar region swollen, anterior ocellus scarcely visible from above; genal cones slightly smaller than vertex, divergent, subvertical, subacute at tip, sparsely pubescent with long hairs. Eyes large, somewhat hemispherical. Antennal sockets lateral, located nearly on level with the lower margin of eyes. Clypeus somewhat oval, rostrum large, projecting between legs.

Antennae (**Fig. 125c**) long, slender, ten-segmented, bearing a few setae, imbricate, two basal segments robust, 1st subquadrate, 2nd cylindrical but equal in length, 3rd longest and about two and a half times as long as 4th, 5th, 6th and 7th equal to one another, and each a little longer than 4th, 8th slightly longer than 7th, 9th and 10th almost equal, terminal segment with two unequal spines at apex, segments 4 to 6 slightly broader at apices, last two segments thicker, four sensoria present on segments 4, 6, 8 and 9.

Thorax (**Fig. 125b**) not broad, sparsely pubescent, finely punctate; pronotum small, collar-like, convexly rounded, descending, narrower in middle, lateral sides large extending forward, with two foveal impressions on each side; prescutum slightly arched, almost as long as broad, broadest in middle, gradually narrowed both anteriorly and posteriorly, angulate laterally; scutum and scutellum damaged by the pin.

Legs (**Fig. 125d**) quite long, pubescent, tibiae longer than femora, all tibiae with apical comb of setae, hind tibiae without basal spur, with four black spines (three on one side and one on the other) at apex, basal tarsal joints longer than apical, hind coxae quite large, meracanthus long and slender.

Forewings (**Figs. 38g, 125e**) proportionately rather large, hyaline, transparent, about two and a third times as long as broad, costal margin arched, rather rounded at apex, R, M and Cu arising from the same point, radial sector long and almost straight, radius almost as long as  $R_1$ , basal vein about twice as long as radius, cubitus about thrice as long as radius, first marginal cell almost equally long and broad as second cell, fork  $M_{1+2}$  terminating at apex of wing, membrane uniformly beset with minute points.

Hind wings small (**Fig. 125f**), membrane uniformly beset with minute points, costal margin with few simple and hooked setae in the basal half.

Abdomen long and slender, finely and sparsely pubescent, setae longer on sternites.

**Genitalia.** Male genital segment (**Fig. 125g**) rather large. Anal valve about 0.22 mm long, longer than forceps, anterior margin weakly while the posterior margin broadly convex, both margins invaginated near apex, truncate at apex, apical region beset with simple setae, setae longer on posterior margins; forceps long and slender, about 0.19 mm long, bowed when seen caudally, broad basally and gradually narrowed at apex, terminating in an acute point, sides subparallel, sinuate mesally, outer surface beset with small, simple setae, mesal surface armed with long setae directed downward,

marginal setae slightly longer; hypandrium of usual shape, simple, sparsely beset with simple setae; outer arm of aedeagus smaller than basal, but quite long.

"Female genital segment about half as long as rest of abdomen; dorsal plate slightly longer than ventral, both acute." (Crawford, 1912).

*Host plant.* Unknown.

*Distribution.* Recorded from Simla, West Himalayas at 2135 m (Crawford, 1912).

*Material examined.* One male specimen, 12.5.08, Simla, 2135 m (N. Annandale) (C 9707/13), Type (Indian Museum), partly in poor condition.

*Comparison.* *Trioza jambolanae* Crawford can be readily separated from other species by the characters given in the key.

***Trioza jambolanae* Crawford 1917**  
(Figs. 38, 126)

- Crawford, D. L. 1917. *Philip. J. Sci.* 12: 173-174, pl. I, fig. 4 (Pusa, Bihar).  
 Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 624.  
 Enderlein, G. 1926. *Ent. Mitt.* 15(5-6): 400 (*Spanioza jambolanae*).  
 Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): (Biology), pl. 1, fig. 8:  
 Beeson, C. F. C. 1941. *Forest Insects*, p. 782 (Biological notes).  
 Mathur, R. N. 1949. *Indian J. Ent.* 8(2): 234-236, fig. 7 (Nymphal stages).  
 Mani, M. S. 1959. *Agra. Univ. J. Res. (Science)* 8(2): 178.  
 Weidner, H. 1961. *Sonderdr. Abh. Verh. der. naturw Ver. Hamburg* (1960) 5 : 37-46.

Length of body, in male, 2.35 mm; in female, 2.66 mm

Length of forewings, in male, 4.22 mm; in female, 4.61 mm

Width of head with eyes, 0.80 mm

Width of vertex between eyes, 0.48 mm

Length of antennae, 1.31 mm

*Colouration.* General colour reddish-brown, abdomen darker, antennae and legs a little lighter brown, antennae black at tip, apex of anal valve, forceps and bottom of ventral valve black, in male.

*Structure.* Body moderately robust. Head (Fig. 126a) scarcely narrower than thorax, deflexed, finely and sparsely pubescent, finely rugulose; vertex slightly more than half as long as broad, median suture with a deep furrow and a convexity on each side, and a deep furrow on each side of these convexities, two circular foveae present posterior to centre in furrows, post-ocellar region much elevated, posterior margin moderately arcuate, anterior margin deeply invaginated at point of excision, anterior ocellus visible in front; genal cones smaller than vertex, about 0.12 mm long, a little more than half as long as vertex, divergent, somewhat decurrent, pubescent, hairs longer than that of vertex, finely rugulose, apex subacute. Eyes large, somewhat hemispherical.

Antennae (Fig. 126b) small, about one and a half times as long as width of head, slender, except two robust basal segments, bearing a few setae, imbricate, 1st segment narrowly transverse, 2nd subquadrate and as long as 1st, 3rd segment longest, about two and a half times as long as 4th, 4th slightly longer than 5th, 6th and 7th equal and

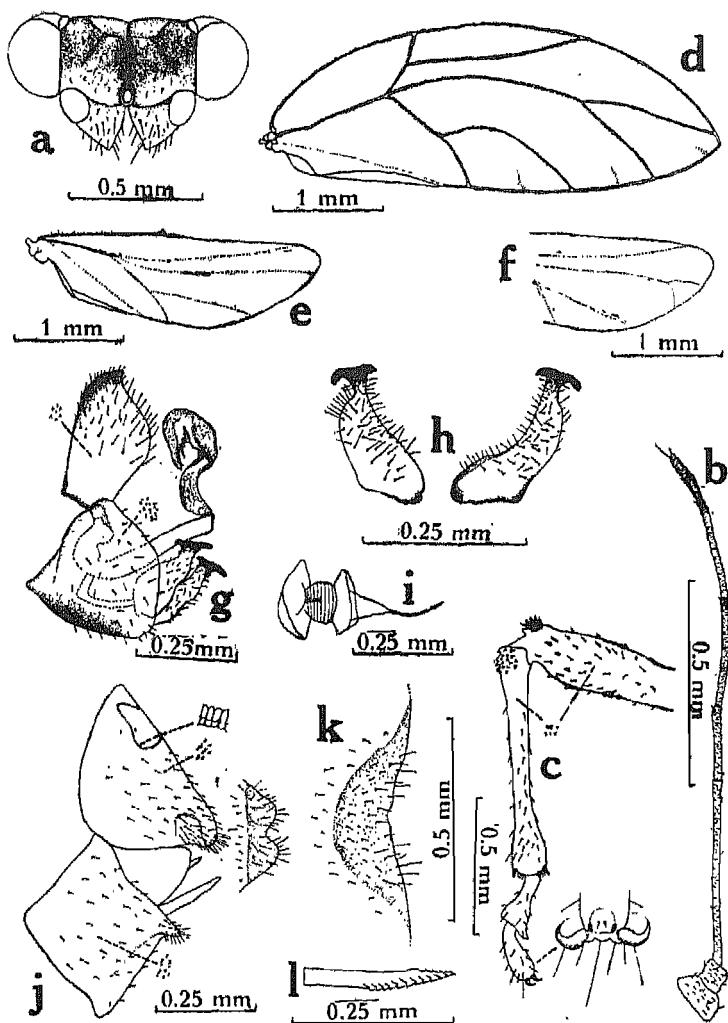


Fig. 126. *Trioza jambolanae* Crawford.—a: head, front view; b: antenna; c: hind leg; d: forewing (male); e: hind wing (male); f: part of hind wing of female; g: male genitalia, lateral view; h: forceps; i: sperm pump; j: female genitalia, lateral view; k: posterior part of ventral plate; l: part of ovipositor.

slightly smaller than 5th, 8th a little smaller than 7th, 9th and 10th smallest, 9th a little longer than apical segment, terminal segment with two unequal, small spines at apex; four sensoria present on segments 4, 6, 8 and 9.

Thorax broad, well arched, finely and sparsely pubescent, finely rugulose. Pronotum short, strongly deflexed, convexly rounded in dorsal view, longest in middle, with two

foveal impressions on each lateral side; prescutum as long as broad, broadest in middle, narrower both anteriorly and posteriorly, also angulate both laterally and posteriorly; scutum broad, twice as broad as long, but smaller in length than prescutum, angulate laterally; scutellum vase-shaped, broad anteriorly, with prominent antero-lateral angles, narrow posteriorly; post-scutellum of meta-thorax narrowly transverse.

Legs (**Fig. 126c**) of moderate size, pubescent, also beset with minute points arranged in lines, femora shorter than tibiae, all tibiae with apical comb of setae, hind femur with a group of 6 to 8 blunt dorsal setae near apex and three sensoria-like structures in centre on ventral side, hind tibiae with a series of small basal spurs and thickly swollen apically, bearing three black, thick spines (2 on one side and 1 on the other), basal tarsal segments of all legs slightly smaller than apical, claws with swollen, fleshy basal pads; meracanthus quite long, slender and triangular.

Forewings (**Figs. 38p, 126d**) long, hyaline, transparent, about two and three-fourth times as long as broad, broadest near middle, rather acute at apex, three veins (R, M, Cu) arising from the same point, basal vein about twice as long as cubitus, R and R<sub>1</sub> somewhat equal in length, cubitus slightly less than twice as long as radius, first marginal cell about as long as second but slightly wider, fork M<sub>1+2</sub> terminating slightly above apex.

Hind wings (**Figs. 126e, f**) small, veins clearly visible under high magnification, uniformly beset with minute points, costal vein with a few simple and hooked setae; media forked at apex in one specimen.

Abdomen longer than broad, finely and sparsely pubescent, also armed with minute points arranged in lines, venter with long hairs.

*Genitalia.* Male genital segment (**Fig. 126g**) smaller than abdomen. Anal valve about 0.35 mm long, longer than forceps, broadest above middle half and then becoming narrower apically when seen anteriorly; in profile, anterior margin almost straight, posterior margin broadly convex except for basal concavity, and produced into small lateral lobes bent inward, outer surface beset with simple setae and with minute points, marginal setae longer; parameres (**Fig. 126h**) about 0.25 mm long, in side view, broad basally and gradually narrowed apically, both anterior and posterior margins irregular, having concavities in the apical region, apex terminating in a black, anteriorly and posteriorly produced acute processes, the posterior process longer than the anterior, outer surface sparsely beset with small, simple setae, mesal surface bearing similar setae but slightly longer and thicker; hypandrium simple, of usual shape, having simple setae and also armed with minute points; outer arm of aedeagus (**Fig. 126g**) smaller than basal, with a thick and strong spoon end, bearing small, finger-like processes; sperm pump as figured (**Fig. 126i**).

Female genital segment (**Fig. 126j**) smaller than abdomen, very short, plates wide apart posteriorly; dorsal plate longer than ventral, deflexed vertically downward, beset with simple setae, setae longer in centre, broadest and rugulose in middle, basal and apical regions armed with thick points, apex sub-acute, with a moderately deep, small median invagination, apical setae also slightly longer; circum-anal ring composed of a double ring of pores, the inner ring being complete; ventral plate (**Fig. 126k**) bearing simple

setae and also armed with strong points, apex acute in profile, with a broad, weak median invagination, marginal setae longer and stronger; ovipositor acutely pointed, bearing also saw-like teeth (**Fig. 126 I.**).

*Host plant.* Bred *ex* galls on leaves of *Syzygium cumini* (= *Eugenia jambolana*) (Plate 5a).

*Material examined.* The collection at the Forest Research Institute, Dehra Dun, contains several specimens from New Forest, Dehra Dun and bred *ex* galls on *Eugenia jambolana*, as follows: 1 female, 14.3.32 (Exp.No.360); 1 male, 15.3.32 (Exp.No.365); 1 female, 21.3.34; 23 males and 26 females and 17 examples of both sexes, bred during 8th to 29th March 1936 (Exp.No.593); 1 female, 19.3.37 (Exp.No.724); 2 females, 18.3.41; 1 male and 1 female, 13.3.50; 1 male and 1 female, 23.3.50; 1 male, 26.2.51. Some adults and nymphal stages from these experiments were also preserved in alcohol (in phials).

The specimens present at the I.A.R.I., New Delhi, are mostly in poor condition, bearing the following data: Pusa, Bihar, 1 example, 11.2.14 (D.P.S.) (R7201); 12 examples, 16.2.14 (D.P.S.) (R/7298, 7299, 7300, 7302, 7304; 2 examples, 26.1.15 (D.P.S.) (R/7296, 7297), all collected on *jaman* leaves.

Some nymphal stages preserved in alcohol were also received from the Assistant Entomologist, Agricultural College, Bapatla (Andhra Pradesh), on 6th June 1966. They were collected on *Eugenia jambolana*.

*Distribution.* This species appears to have a wide distribution, and has been reported from Dehra Dun (U.P.); Pusa (Bihar); Bapatla (Andhra Pradesh); Mani (1959) has mentioned throughout India.

*Comparison.* This species is recognised by the shape of forewings, venation, first marginal cell, shape of head and the characteristic genal structures.

There is some confusion in identification of this species and *Trioza fusca*. The male genitalia of one specimen identified as *jambolanae* in the collection of the I.A.R.I., New Delhi, was examined by me and its structure resembles very much with that of *T. fusca*. Crawford (1917) has described *jambolanae* from two female specimens.

*Biological notes.* Mathur (1935) and Beeson (1941) have given brief life-history of this species; while Mani (1959) has described the gall. Its nymphal stages are described by Mathur (1949).

***Trioza longiantennata*, sp. n.**  
(*Figs. 127, 128*)

Length of body, in male, 2.0 mm; in female, 2.25 mm

Length of forewings, in male, 3.65 mm; in female, 3.90 mm

Width of head with eyes, 0.80 mm

Width of vertex between eyes, 0.45 mm

Length of antennae, 1.62 mm

*Colouration.* (Dried specimens). General colour light yellowish-brown with pinkish tinge; mesothorax having two light brown submedian, longitudinal bands, tips of

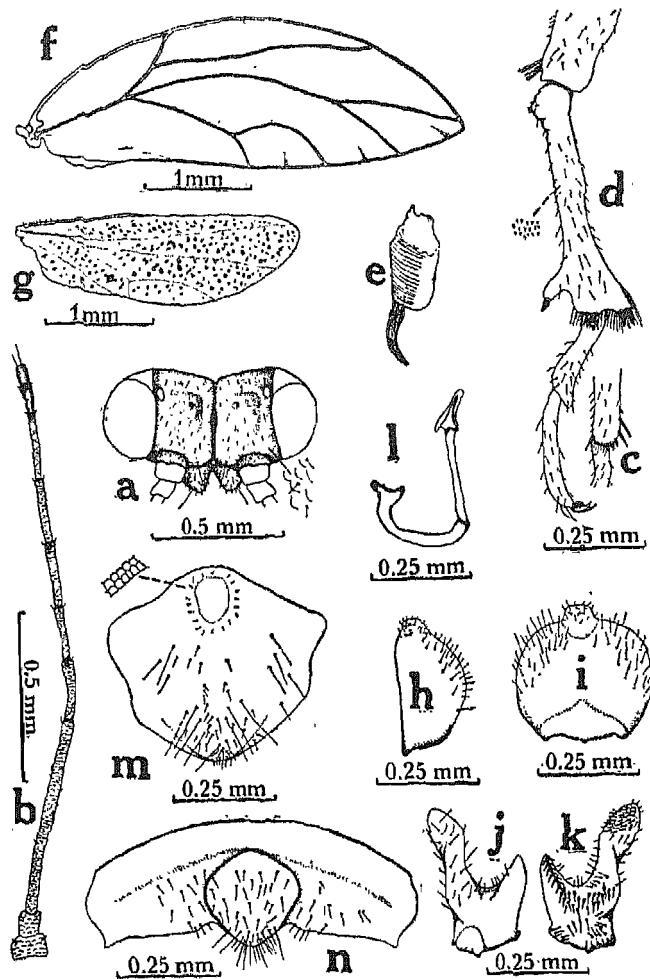


Fig. 127. *Triozalongiantennata*, sp. n.—a: head, front view; b: antenna; c: part of foreleg; d: hind leg; e: claw; f: forewing; g: hind wing; h, i: anal valve, lateral and outer view; j, k: parameres, lateral and mesal surfaces; l: aedeagus; m: dorsal plate; n: ventral plate.

antennae black, abdomen dark-brown dorsad and pale yellow ventrad in male, male genitalia dark-brown; wings hyaline, veins pale-yellow.

**Structure.** Body moderately large. Head (Fig. 127a) including eyes, broader than thorax, slightly declivous, finely and sparsely pubescent, finely rugulose; vertex large, much broader than long, slightly impressed discally, not entirely flat, divided by the median suture into two subquadrate lobes, rounded in front with a median sulcus, with a fovea on each side of median suture and posterior to the centre, posterior margin slightly emarginate; anterior ocellus visible in front; posterior ocelli orange, slightly

raised; genal cones small, about 0.18 mm long, much shorter than the length of vertex, directed vertically downward, broad and contiguous at base and bluntly rounded at apex, pubescent with setae slightly longer than on the vertex and also beset with rows of minute points. Eyes large and bulging.

Antennae (Fig. 127b) long, ten-segmented, having a few setae, basal two segments robust, having rows of minute points, remaining segments slender and imbricate, 3rd segment longest and a little longer than 4th, 5th and 6th segments together, 4th, 6th and 7th equal to one another, 5th slightly smaller than 4th, 8th slightly longer than 7th, 9th slightly less than half as long as 8th, two apical segments club-shaped, terminal segment smallest, bearing two unequal spines at apex; four sensoria present on segments 4, 6, 8 and 9.

Thorax moderately arched, finely and sparsely pubescent, finely rugulose. Prothorax roof-shaped, convexly rounded, moderately declivous, beset with minute points, with two foveal impressions on each lateral side; prescutum slightly broader than long, broadest beyond centre, anterior margin narrowly rounded, posterior margin broadly rounded, angulate laterally; scutum slightly smaller in length than prescutum, about twice as broad as long, flat dorsally; scutellum broadly transverse, slightly broad anteriorly and narrow posteriorly.

Legs moderately long, pubescent and thickly beset with minute points, all tibiae with an apical comb of setae, hind femora (Fig. 127d) armed with five long, dorsal, subapical, truncate setae and three sensoria-like structures ventrally, fore (Fig. 127c) and middle tibiae with two and four subapical lanceolate setae respectively, hind tibia with a series of minute basal spurs, containing 2 or 3 prominent spurs and also a conspicuously large subapical spur armed with a black tooth and three apical black teeth present on the other side; basal tarsal segment smaller than apical; claws peculiarly shaped (Fig. 127e), being bladder-like at base, bearing microscopic ridges; meracanthus large and triangular.

Forewings (Fig. 127f) long and narrow, broadest across middle, about thrice as long as broad, angled at apex, posterior margin nearly straight, anterior margin arched, cubital petiole slightly longer than basal vein and about two and a quarter times as long as radius,  $R_1$  slightly shorter than radius, radial sector irregularly curved, fork  $M_{1+2}$  terminating near tip of wing, distance between  $Cu_2$ ,  $Cu_1$  and  $Cu_1$  and  $M_{3+4}$  equal along the hind margin, second marginal cell longer than first.

Hind wings (Fig. 127g) a little more than half as long as forewings, membrane thickly beset with minute points, costal margin in the basal half armed with some simple and hooked setae.

Abdomen longer than broad, sternites bearing longer setae and also minute points.

*Genitalia.* Male genital segment smaller than abdomen, pubescent; anal valve (Figs. 127h, i) about 0.32 mm long, smaller than parameres, with a small apical anal lobe, anterior margin almost straight, posterior margin broadly convex, lateral and apical regions beset with setae of varying length; parameres (Figs. 127j, k) about 0.38 mm long, bifurcate, anterior branch bluntly pointed at apex and smaller than the posterior branch, which is rounded apically, both arms beset on the mesal surface with groups

of stout setae directed downward, outer surface having fine simple setae; hypandrium of usual shape, sparsely beset with scattered setae; outer arm of aedeagus (**Fig. 1271**) longer than basal, with a cap-shaped spoon end.

Female genitalia smaller than abdomen, pubescent; anal and ventral plates (**Figs. 127m, m**) widely separated distally and bluntly rounded apically, dorsal plate longer than ventral; anal opening surrounded by a double ring of pores and armed with simple setae, setae longer in middle and posterior regions.

*Host plant.* Bred from the pit galls on twigs of *Populus euphratica* Oliv.

*Type locality.* Ghazighat, Multan (Pakistan).

*Types.* Described from a small series of specimens. Holotype male, of 26.3.34, from the type locality (Forester collection) (R.R.D 668.203.Y5); Allotype female, of 3.4.29, from the same locality (R.N. Mathur) (R.R.D.960); Paratypes: 1 male of 3.4.29 (R.N. Mathur); 2 males of 26.3.34, 1 male and 1 female of 27.3.34, 1 male of 31.3.34; 1 male of 3.4.34, all from the type locality (Forester collection) (R.R.D. 668.203.Y5); 1 male of 7.4.34, from the same locality (Forester collection) (R.R.D. 676.217.Y6). Some slides with parts of adults and nymphal stages were prepared from the same material. All types, slides and some preserved material are deposited at the F.R.I., Dehra Dun.

*Comparison.* This species resembles in some characters with the other species recorded on *Populus euphratica*, but it is easily separated by the shape and venation of wings, shape of head and genal cones.

*Biological notes.* Mathur (1935) and Beeson (1941) have discussed its biology and economic importance. Pit galls are more abundant on poplars than the globular twig galls. This species is reported to check the growth of a twig entirely and kill it in one season, or reduce its growth in length, without killing it in the first season. Sometimes dying-back of the subsequent year's shoot is caused due to the distortion in the older part of the branch. The life-cycle appears to be annual. During February and March, nymphs of various stages are found abundantly and they transform into winged adults in March-April. The nymphs are broadly oval, with flat dorsal surface and bulging venter which occupies the pit. The sternal region has two pairs of long fleshy protuberances between the legs which evidently press against the sides and bottom of the pit and anchor the insect in position. Its nymphal stages are described below.

#### Nymphal stages

*Fifth stage.* (**Fig. 128a**). Length 2.12 mm. Typically of triozine form. Broadly oval, the humeral angle of the wing-pads produced forward beyond the eyes and almost to the anterior margin of the head. Dorsum with the derm strongly sclerotic, except for the joint between thorax and abdomen. Derm of the thorax ornamented by numerous small, strongly pigmented areas having honey-comb like structure. Derm also vermiculate and beset with small pores, each bearing a minute seta. A continuous fringe of long, slender seto-setae borne on small prominences present along the entire margin of the body. Eyes small.

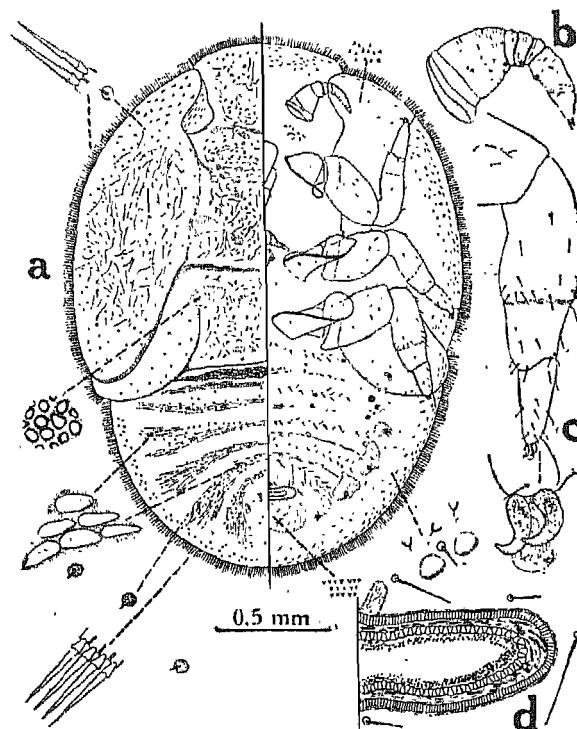


Fig. 128. *Trioza longiantennata*, sp. n.—a: fifth stage nymph; b: antenna; c: leg; d: circum-anal pore ring.

Ventral side membranous throughout, except for a small sclerotic strip at the base of each antenna, small areas around each spiracle, broad area encircling the circum-anal ring, and a continuous thick border along the body margin. Derm thickly beset with minute points and scattered simple setae of various length, which are arranged segmentally in the abdomen. Thick area along the border furnished with broad flattened points. Antennae (Fig. 128b) ventral, 0.35 mm long, short and stout, seven-segmented, bearing few setae and four sensoria, 3rd segment large, broader at base and narrower at apex, terminal segment weakly imbricate, having two spines at tip. Legs (Fig. 128c) short, and stout, bearing few simple setae; femora not reaching margin of the body; with trochanters; tibio-tarsal articulation distinct, each tarsus with a golf-club seta; with claws; pulvilli small, triangular. Anal aperture (Fig. 128d) ventral and at a distance from the apex of the abdomen, surrounded by two simple rings of slit-like pores, and guarded by two anterior, one lateral and one posterior pairs of long setae.

*Fourth stage.* Length 1.48 mm. Resembles the fifth stage except for small size, having numerous pores bearing minute setae; antennae obscurely five-segmented with three sensoria; tibio-tarsal division weak.

*Third stage.* Length 0.75 mm. Differs from the fourth stage in having small wing-pads; peculiarly shaped setca-setae along the body margin; antennae apparently three-segmented with sensoria; tibio-tarsal joint absent.

**Trioza obliqua** Thomson 1877  
(Figs. 129, 130)

*Trioza obliqua*

- Thomson, C. G. 1877. *Opusc. ent.* 8: 825.  
Ossiannilsson, F. 1944. *Opusc. ent.* 9: 154-156.  
Ossiannilsson, F. 1952. *ibid.* 17: 198.  
Dobreanu, E. and Manolache, G. 1962. *Fauna Repub. pop. rom., Insecta*, 8 Fasc. 3, pp. 344-348, figs. 252-256.

*Trioza horvathi*

- Loew, F. 1882. *Verh. zool.-bot. Ges. Wien.* 31: 263-264.  
Oshanin, B. 1907. *Ann. Mus. Zool. de l'Ac. imp. des Sc. Petersburgh*, Bd. XII: 373.  
Aulmann, G. 1913. *Psyllidarum Catalogus*, Berlin, 47.  
Sule, K. 1913. *Monogr. gen. Trioza* Foerster, pars IV, no. 36-49, pp. 4-8.  
Horvath, G. 1918. *Fauna Regni Hung.*, H. 8: 59.  
Schaefer, H. A. 1949. *Mitt. schweiz. ent. Ges.* 22: 71-72.  
Smreczynski St. sen. 1954. *Fragmента Faunistica* 7: 142.  
Vondracek, K. 1957. *Fauna C.S.R. Praha, Ceskoslovenska akademie Ved.*, t. 9: 360-362.

*Spanioza horvathi*

- Enderlein, G. 1926. *Ent. Mitt.* 15: 397-401.

Length of body, in male, 1.76 mm; in female, 1.74 mm

Length of forewings, in male, 2.28 mm; in female, 2.30 mm

Width of head with eyes, 0.38 mm

Width of vertex between eyes, 0.25 mm

Length of antennae, 0.85 mm

*Colouration.* (Specimens preserved in alcohol). General colour yellowish-brown; in male, head, genae, dorsum of thorax, two basal and distal antennal segments, clypeus, tip of labium, and apical tarsal segments black; in female, head and genae with blackish tinge, anterior and posterior borders of prothorax blackish, prescutum and scutum with two submedian, longitudinal blackish bands, each band in scutum with a yellowish stripe in between, two basal and apical antennal segments, clypeus, tip of labium, and apical tarsal segments of legs also black; wings transparent in both sexes.

*Structure.* Head (**Fig. 129a**) nearly as broad as thorax; finely and sparsely pubescent, finely rugulose, horizontal; vertex nearly twice as broad as long, swollen on either side of median line, rounded downward anteriorly, similarly median suture abruptly inclined downward anteriorly, with foveal impressions and linear depressions on each side of median line, the depression diverging and bifurcating anteriorly before reaching the anterior margin, posterior margin moderately arcuate, anterior margin emarginate medially, having front ocellus at the point of excision, post-ocelli small and lateral; frons small, visible in front with anterior ocellus; genal cones small, about 0.12 mm

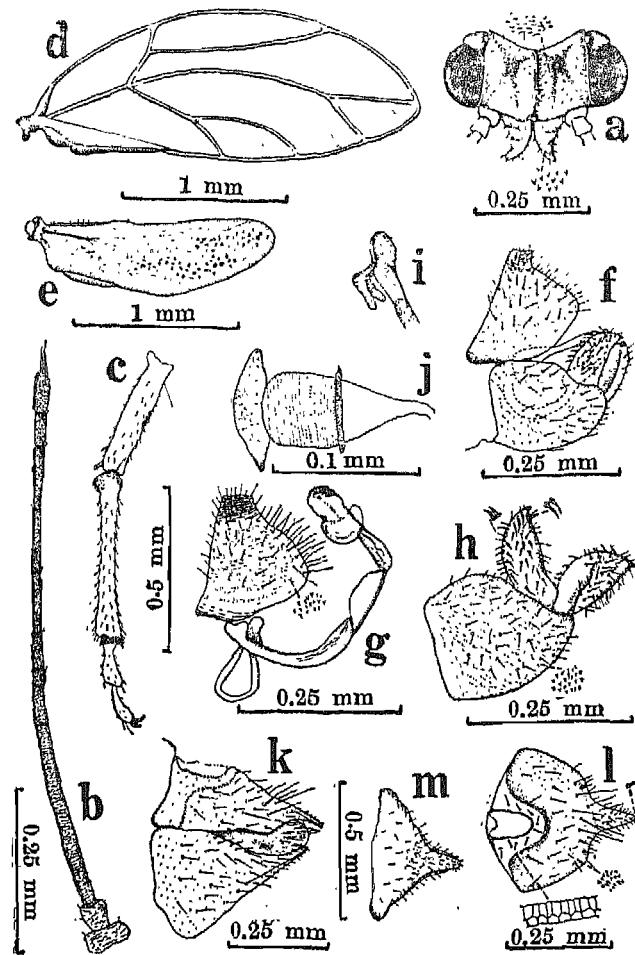


Fig. 129. *Trioza obliqua* Thomson—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: male genitalia, lateral view; **g**: anal valve and aedeagus; **h**: forceps and hypandrium; **i**: spoon end of aedeagus; **j**: sperm pump; **k**: female genitalia, lateral view; **l**: dorsal plate; **m**: ventral plate.

long and two-thirds as long as vertex, contiguous near base, divergent, subacute at apex, pubescent with long hairs and also beset with rows of minute points. Clypeus globular, visible in front. Eyes small, hemispherical. Antennal sockets lateral and located below the level of lower margin of eyes.

Antennae (Fig. 129b) ten-jointed, two basal joints robust, 1st transverse, 2nd subquadrate, remaining segments slender and imbricate, 3rd segment longest, about three times as long as 4th, 4th slightly longer than 5th, 5th smallest, 6th, 7th and 8th

equal to one another and each slightly longer than 4th, 9th slightly smaller than 10th, terminal segment with two unequal spines at apex, four sensoria present on segments 4, 6, 8 and 9.

Thorax slightly arched, finely and sparsely pubescent, finely rugulose. Prothorax roof-shaped, narrow in middle, lateral sides broad and upturned, with foveal impressions on each side; prescutum large, slightly broader than long, narrow anteriorly and broad posteriorly, angulate both laterally and posteriorly; scutum about twice as broad as long, slightly longer than prescutum, angulate laterally; scutellum small, transverse, about twice as broad as long, anterior margin straight.

Legs (**Fig. 129c**) moderately long, slender, sparsely pubescent, and also beset with rows of minute points, femora shorter than tibiae, hind femur with two dorsal, subapical, blunt setae, hind tibiae with a prominent basal spur together with a series of smaller spurs, with three stout, black tooth-like spines (2 on one side and 1 on the other) and also with a comb of small setae at apex, basal tarsal segments of fore and middle legs slightly longer than apical segments, while in hind leg, both are of equal length; meracanthus large and triangular.

Forewings (**Fig. 129d**) small, slightly more than two and a half times as long as broad, subacute apically, R, M and Cu arising together from the same point, cubitus slightly less than twice as long as radius,  $R_1$  smaller than radius, basal vein slightly longer than cubitus, fork  $M_{1+2}$  meeting near apex, marginal cells unequal, first marginal cell slightly longer and broader than second, distance between  $Cu_2$ ,  $Cu_1$  slightly longer than the distance between  $Cu_1$  and  $M_{3+4}$ , radular areas present in first and second marginal cells and medio-cubital cell, venation light brown and armed with microscopic setae.

Hind wings (**Fig. 129e**) small, membrane uniformly beset with minute points, costal margin armed with a few simple and hooked setae.

Abdomen moderately long, longer than broad, sparsely pubescent and also beset with minute points.

**Genitalia.** Male genital segment (**Fig. 129f**) smaller than abdomen, pubescent. Anal valve (**Fig. 129g**) large, about 0.20 mm long, longer than forceps, front margin almost straight, slightly invaginated near base, posterior margin arcuately rounded, outer surface beset with small setae, marginal setae longer, anal apical region short, outer surface also armed with minute points arranged in rows; parameres (**Fig. 129h**) short, about 0.13 mm long, asymmetrically pyriform in lateral view, anterior margin convexly rounded and armed with thick, curved setae, narrowed and pointed in a sharp black point distad, outer surface beset with small simple setae, mesal surface bearing thick setae directed downward; hypandrium simple, of usual shape, sparsely pubescent and also beset with rows of minute points; aedeagus (**Figs. 129g, i**) with the outer arm small, the inner arm curved, having a bulge distad, spoon end with two small processes directed downward. Sperm pump as figured (**Fig. 129j**).

Female genital segment (**Fig. 129k**) smaller than abdomen, sparsely pubescent and also beset with rows of minute points, both plates broad basally and acuminate posteriorly, dorsal plate (**Fig. 129 l**) longer than ventral, roundly pointed at apex, anal area clearly

differentiated from the rest, posterior region steeply inclined downward in lateral view, circum-anal ring composed of double ring of pores, surrounded by small setae, ventral plate (**Fig. 129m**) short, acute at apex; ovipositor small and pointed.

*Host plants.* *Chenopodium album* Linn. and *Atriplex* sp.

*Distribution.* Recorded for the first time from India and Pakistan: Chichawatni plantation, Montgomery forest division (Pakistan); and New Delhi.

Originally recorded from Europe, where this species is widely distributed: Poland, Sweden, Rumania, England, France, Czechoslovakia and U.S.S.R.; and also in Japan.

*Material examined.* A small series of both sexes, 6 males and 4 females, collected on May 13, 1939, from Chichawatni plantation, Montgomery (Pakistan) (R.N. Mathur); 5 males and 5 females collected from New Delhi, April 29, 1964, and May, 1964, (M.G. Raendas Menon). This material has been deposited at the F.R.I., Dehra Dun and the IARI, New Delhi. Some adults and nymphal stages, preserved in alcohol, also deposited at the former institute.

*Comparison.* Two pairs of adults of this species were sent to Professor Ossiannilsson, Sweden, for confirmation, and he agreed with my identification. Further, he writes: "..... However, in a letter dated 24.3.1966, Mr. Pavel Lauterer in Brno, Czechoslovakia, informed me that *Trioza obliqua* Thomson is only a photo-periodic saison form of *Trioza chenopodii* Reuter, according to the results of experimental work done by himself. These studies are still unpublished, as far as I know."

The characters drawn above are based on Indian specimens, and this species is recognised by the shape of head, genal cones, shape of wings and venation and several other characters.

*Biological notes.* Nothing is known about its life-history and economic importance, except that the adults and nymphal stages are found on young buds and leaves of *Chenopodium album*. The nymphal stages are described below.

#### Nymphal stages

*Fifth stage.* (**Fig. 130a**). Length 1.54 mm. Of triozine form, somewhat broadly and irregularly oval. Humeral angle of the wing-pads produced forward slightly beyond the posterior margin of the eyes and broadly rounded. Eyes rather small. Dorsum strongly sclerotic throughout, except for a small area at the base of abdomen. Derm vermiculate and also beset with small scattered seta-setae and a few simple setae; comb-like setae also present in the posterior part of abdomen. Margin of the body with a continuous series of short and stout seta-setae.

Ventral side membranous throughout, except small sclerotic areas near spiracles. Derm thickly beset with minute points and sparsely with scattered simple setae of various length. Antennae (**Fig. 130b**) ventral, 0.29 mm long, five-segmented, armed with a few simple setae, 1st basal segment small, transverse, 2nd robust, broad basally and narrow apically, having a weak constriction, remaining segments slender, 3rd segment subsquare, slightly longer than broad, with a weak constriction, 4th smallest, transverse, 5th longest, imbricate, having two sensoria and two unequal spines at apex; the other

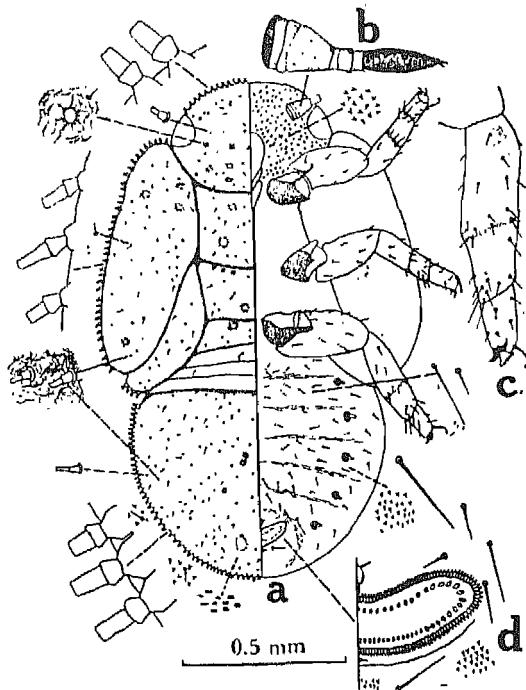


Fig. 130. *Trioza obliqua* Thomson—**a**: fifth stage nymph; **b**: antenna; **c**: leg; **d**: circum-anal pore ring.

two sensoria are present on 2nd and 3rd segments. Legs (**Fig. 130c**) quite short, sparsely beset with scattered setae, femora not reaching the margin of body; without trochanters; tibio-tarsal articulation distinct; each tarsal segment with a golf-club seta; claws present, the pulvillus broadly triangular, sessile. Anal-opening (**Fig. 130d**) ventral, set well away from the apex of abdomen, surrounded by an outer pore-ring consisting of a single row of slit-like pores and an inner ring with small, more or less oval pores, and guarded by two anterior, one lateral and one posterior pairs of long, simple setae.

*Fourth stage.* Length 0.93 mm. Resembling the fifth stage, except in being smaller in size, with smaller wing-pads, antennae apparently three-segmented, having three sensoria, tibio-tarsal articulation absent.

***Trioza obsoleta* (Buckton) 1900**  
(Figs. 131, 132)

- Buckton, G. B. 1900. *Indian Mus. Notes* 5(2): 35, pl. V, figs. 10-15, (ex leaf-galls on *Diospyros melanoxylon* Thana, Bombay) (*Psylla obsoleta*).  
 Froggatt, W. W. 1900. *Indian Mus. Notes* 5(3): 111-112.  
 Stebbing, E. P. 1902. *Dept. Notes* 1: 130-131.  
 Lefroy, H. M. 1909. *Indian Insect Life*, p. 743 [*Trioza (Psylla) obsoleta* Buckt.], fig. 516.  
 Aulmann, G. 1913. *Psyllidarum Catalogus*, Berlin, p. 50.  
 Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.* 26: 623.

- Laing, F. 1930. *Indian Forest Rec.* 14(8): 444.  
 Mathur, R. N. 1935. *Indian Forest Rec.* 1(2): 66.  
 Beeson, C. F. C. 1941. *Forest Insects*, p. 782.  
 Mani, M. S. 1959. *Agra Univ. J. Res. (Science)* 8(2): 202 (W. Ghats).

Length of body, in male, 1.71 mm; in female, 1.95 mm  
 Length of forewings, in male, 2.83 mm; in female, 3.20 mm  
 Width of head with eyes, 0.55  
 Width of vertex between eyes, 0.43 mm  
 Length of antennae, 0.82 mm

*Colouration.* General colour ferruginous and shining black ventrally, abdominal segments with pale borders, antennae pale-yellow, with two basal and apical segments and apex of eighth segment black, apices of segments fourth and sixth orange, wings hyaline and transparent, femora of legs black, fore tibiae partly black and pale-yellow, middle and hind tibiae pale-yellow, tarsi pale-yellow.

*Structure.* Body variable in length, short and robust. Head (**Fig. 131a**) narrower than thorax, moderately deflexed, sparsely beset with small setae and also with minute points arranged in lines. Vertex broader than long, slightly less than twice as broad as long, somewhat flat, rounded down in front, with two foveae posterior to centre, one on either side of median suture, posterior margin moderately emarginate, post-ocellar region swollen, bearing post ocelli, anterior ocellus visible in front; genae small, somewhat swollen and porrect, separate, divergent, bearing fine long pale hairs and also armed with minute points, narrowly rounded at apex. Eyes large, bulging. Antennal sockets large. Clypeus long, visible from below, somewhat cylindrical and protruding forward; labium long and also protruding forward between forelegs.

Antennae (**Fig. 131b**) small, ten-segmented, about one and a half times as long as head including eyes, bearing few setae, two basal segments robust, 1st transverse, 2nd subquadrate, broad basally, as long as 1st, remaining segments slender and imbricate, 3rd longest, 4th small, about half as long as 3rd, 5th to 8th equal to one another and slightly smaller than 4th, 9th slightly smaller than apical, terminal segment having two unequal apical spines, four sensoria present on segments 4, 6, 8 and 9.

Thorax robust, arched, sparsely bearing simple, stiff setae and also finely shagreened. Prothorax partly or completely concealed underneath head, armed with minute points, narrow, convexly rounded, sides produced like flaps and extending towards the eyes; prescutum slightly broader than long, narrowly rounded anteriorly, broadest in middle, angulate both laterally and posteriorly; scutum broad, much broader than long, slightly more than twice as broad as long, flat dorsally with a shallow median depression, sides gradually sloping, broadest slightly before middle, smaller in length than prescutum, angulate laterad, posterior margin also angulate; scutellum transverse, convex dorsally, broad anteriorly and narrowly rounded posteriorly, anterolateral angles prominent, anterior margin almost straight; post-scutellum of metathorax very large and broad, with a median and two submedian furrows, disc weakly swollen on either side of these furrows, and beset with minute points.

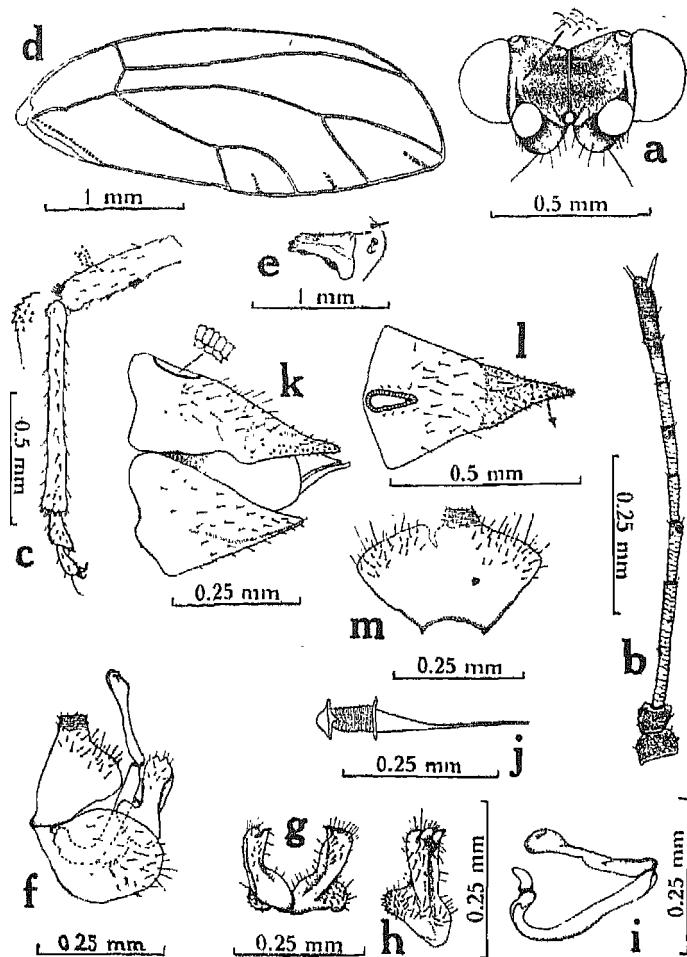


Fig. 131. *Triozza obsoleta* (Buckton)—**a**: head, front view; **b**: antenna; **c**: hind leg; **d**: forewing; **e**: hind wing; **f**: male genitalia, lateral view; **g**, **h**: parameres; **i**: aedeagus; **j**: sperm pump; **k**: female genitalia, lateral view; **l**: dorsal plate; **m**: anal valve of male.

Legs (Fig. 131c) long, pubescent, and also beset with fine minute points arranged in linear series, femora shorter than tibiae, all tibiae with apical comb of setae, hind femur with three sensoria-like structures on the ventral side, and with four dorsal blunt setae near apex, hind tibiae with a group of basal spurs, 3 or 4 spurs strong, three spur-like tooth present at apex (2 approximate teeth on one and 1 on the other); tarsal segments almost equal in length; meracanthus long and slender.

Forewings (Fig. 131d) long, elongate, hyaline, transparent, slightly more than two and a half times as long as broad, subacute to narrowly rounded at apex, R, M and Cu arising from the same point, cubitus longer than the basal vein,  $R_s$  usually long and slightly

arched near apex, R and R<sub>1</sub> almost equal in length, R<sub>s</sub> originating from middle, marginal cells sub-equal, second marginal cell slightly longer and wider than first, fork M<sub>1+2</sub> meeting near apex.

Hind wings (**Fig. 131e**) represented by very small membranous flaps, costal margin armed with a few simple and hooked setae.

Abdomen longer than broad, almost circular in outline, pubescent, and also beset with minute points.

**Genitalia.** Male genital segment (**Fig. 131f**) smaller than abdomen. Proctiger (anal valve) (**Fig. 131m**) longer than parameres (forceps); in profile, anterior margin slightly convex in basal half and weakly concave in distal half, posterior margin produced into large lateral lobes, broadest near about middle, narrow both basally and apically, apex truncate, distal half and lateral lobes beset with simple setae of varying length; parameres (**Figs. 131g, h**) broad basally, with sides sub-parallel in the apical half, terminating in a short but stout three-lobed apex, the two mesal processes acutely pointed, the outer process bluntly rounded, basal region produced into a thick round lobe, directed cephalad, outer surface of forceps bearing small, simple setae, mesal surface beset with small, thick setae, marginal setae slightly longer, basal lobe also armed with strong thick setae; hypandrium simple, of usual shape, bearing simple setae and also minute points; aedeagus (**Fig. 131i**) with a long outer arm having a median notch but smaller than inner, spoon end large and broad; sperm pump as figured (**Fig. 131j**).

Female genital segment (**Fig. 131k**) smaller than abdomen, strongly deflexed somewhat vertically downward, plates sub-equal, dorsal plate (**Fig. 131l**) longer than ventral, strongly sloping caudally, beset with minute points, broad basally, narrowly rounded apically, caudal end armed with small, thick setae, setae in middle longer, anal opening small, surrounded by a double ring of pores; ventral plate broad at base, acute at apex, surface beset with simple setae and with minute points; ovipositor acutely pointed.

**Host plants.** Bred *ex* galls on young leaves of *Diospyros melanoxylon* Roxb. and *D. tomentosa* Roxb.

**Distribution.** Previously recorded from Thana (Bombay), in galls on *Diospyros melanoxylon* (Buckton, 1900); while Lefroy (1909) has mentioned only from India. Mani (1959) has recorded from W. Ghats, on leaves of *Diospyros melanoxylon*. Its fresh distributional records are: Sambalpur, Orissa; and Chimnapur, East Asir Range, Nimar Forest Division (M.P.), bred *ex* galls on leaves of *D. melanoxylon* and *D. tomentosa*.

**Material examined.** Some adults and nymphal stages collected on February 15-18, 1955, from galls on leaves of *D. melanoxylon*, from Sambalpur Forest Division (R.N. Mathur); 5 males and 2 females from Chimnapur, East Asir Range (M.P.), of 23.3.57 (F.R.I. Project); 4 males and 4 females from East Asir Range (M.P.) of 20.3.59 (R.N. Mathur) and 6 males and 6 females from Chimnapur, of 21.3.59 (R.N. Mathur); all these specimens were bred from galls on leaves of *D. melanoxylon* and *D. tomentosa*; and six phials containing numerous adults and nymphal stages, preserved in alcohol, collected from the Nimar Forest Division (M.P.), *ex* galls on *D. melanoxylon*.

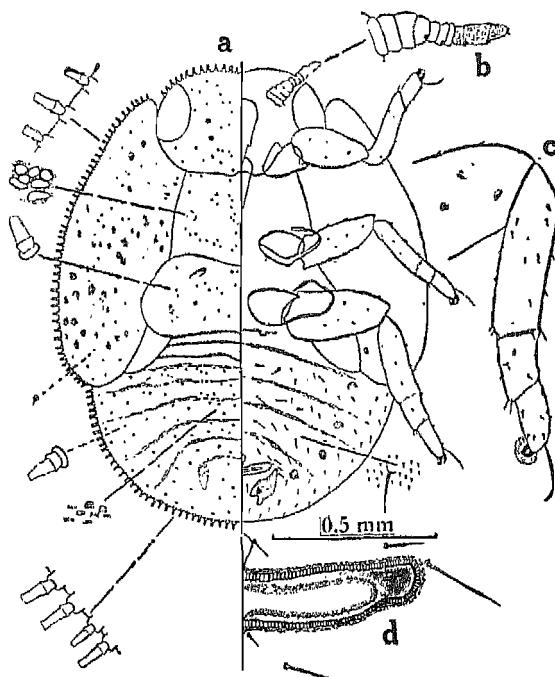


Fig. 132. *Trioza obsoleta* (Buckton) -- **a**: fifth stage nymph; **b**: antenna; **c**: hind leg; **d**: circum-anal pore ring.

*Comparison.* Buckton (1900) has not given specific characters and has placed the species under the genus *Psylla*; while Froggatt (1900) considered it to be under the genus *Trioza*, due to trioio venation. Laing (1930) has confirmed the species under *Trioza*. Stebbing (1902) has given detailed colouration notes. *Trioza obsoleta* is redescribed here with detailed specific characters and figures. It is easily separated from other species by the atrophied hind wings, form of head and other features.

*Biological notes.* This species is commonly met with, infesting the leaves of *D. melanoxylon* and *D. tomentosa*, wherever these trees are located. Young galls are of biscuit colour and appear like small vesicles, while the mature galls are pale-yellow, projecting on the ventral side of leaves (Plate 6b, c, d). On the dorsal surface they appear like small scars and pale-green in colour. The galls are finely hairy, unilocular and uninymphal, in rare cases binymphal. Dehiscence occurs on the ventral side, and usually the nymphs cast their last skin inside the galls. The freshly emerged adults crawl out from the slit, expand their wings and gradually become mature. Young nymphs are somewhat circular in shape, light brown, with pinkish red eyes, and fringed all round with white waxy threads. Mature nymphs are broadly oval, with dark-brown stripes on thorax. Emergence takes place in February when the season warms up. Its nymphal stages are described below.

### Nymphal stages

*Fifth stage* (**Fig. 132a**). Length 1·32 mm. Of triozine form, somewhat broadly and irregularly oval. Humeral angles of the wing-pads produced forward almost to the anterior margin of the eyes and bluntly rounded. Head large and broad. Eyes large. Derm weakly vermiculate. Dorsum strongly sclerotic throughout except for a small area at base of the abdomen. Margin of the body with a continuous series of short and stout seta-setae borne on small prominences, which are quite widely spaced. Similar setae of varying length also present, distributed on the dorsum in a rather definite arrangement. Derm also beset with small, simple scattered setae. Abdomen consisting mainly of a single plate with traces of segmentation, and also armed sparsely with minute points, and comb-like structures.

Ventral side with the derm apparently membranous throughout, except for faint areas around the anus, the marginal zone and small areas round the spiracles. Derm strongly beset with minute points, and with simple, scattered setae of varying length. Segmentation of the abdomen represented by very narrow transverse strips. Antennae (**Fig. 132b**) quite short, about 0·02 mm long, apparently consisting of seven segments, three basal segments robust, first two segments transverse, third broad basally, narrow apically, with a weak constriction, remaining segments slender, terminal segment long, bearing two apical spines and two sensoria, the other two sensoria present on segments 3rd and 5th. Legs (**Fig. 132c**) relatively short, the femora not or scarcely attaining the margin of the body; without trochanters; tibio-tarsal articulation well-defined, each tarsal joint with a golf-club seta near apex; claws present, the pulvilli in the form of a sub-circular pad. Anal opening (**Fig. 132d**) set well away from the apex of the abdomen, surrounded by a double ring of pores, the outer ring consisting of slit-like pores, while the inner ring is composed of somewhat indistinct oval pores, these rings are interrupted medially, both anteriorly and posteriorly, and also guarded by two anterior, two posterior and two lateral pairs of setae.

*Fourth stage.* Length 0·86 mm. Resembling the fifth stage, except in being smaller, antennae apparently five-segmented with three sensoria, and without tibio-tarsal articulation.

### *Trioza simplifica*, sp. n.

(**Fig. 133**)

Length of body, in female, 2·40 mm

Length of forewing, in female, 3·90 mm

Width of head with eyes, in female, 0·63 mm

Width of vertex between eyes, 0·38 mm

Length of antennae (missing)

*Colouration.* (Preserved specimens in alcohol, in partly damaged condition). General colour pale clay yellow, with light brown longitudinal, submedian bands on prescutum and scutum, labium black, venter of abdomen of lighter colour; wings dull.

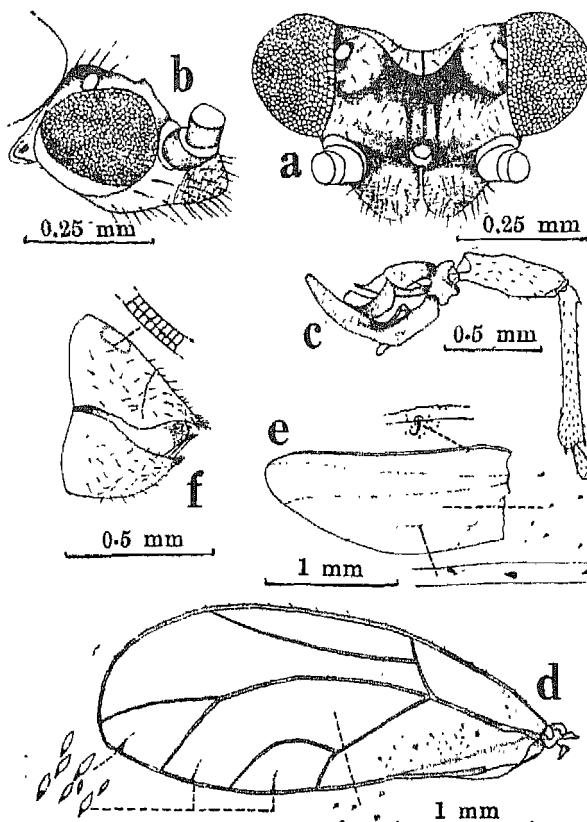


Fig. 133. *Trioza simplifica*, sp. n.—a: head, front view; b: head and part of thorax, lateral view; c: hind leg; d: forewing; e: hind wing, partly broken; f: female genitalia, lateral view.

**Structure.** Body robust. Head, (Figs. 133a, b) including eyes, slightly shorter than thorax, slightly deflexed, sparsely hairy with long hairs; vertex much broader than long, about twice as broad as long, rugulose, posterior margin strongly arcuate medially, deeply excavated discally in the shape of W, and produced on each side into a rather acute epiphysis near each eye, rounded and full on each side of median line anteriorly, post ocellar region elevated; anterior ocellus visible from above; frons visible in front; genal cones small, broad at base, narrow and broadly rounded at apex, divergent, descending below plane of vertex, hairs longer than on vertex. Antennae broken, except two basal segments, which are robust.

Thorax robust, moderately arched, rugulose, sparsely pubescent. Prothorax much deflexed and partly concealed below head; bearing long hairs, with conspicuous lateral foveae. Prescutum nearly as broad as long, acutely angled both laterally and posteriorly, scutum much broader than long; scutellum transverse, about twice as broad as long.

Legs (partly broken) (**Fig. 133c**) long, coarsely pubescent, femora shorter than tibiae, hind tibia with a series of weak spurs at base and three black apical teeth, 2 on one side and 1 on the other; meracanthus long, slender and triangular.

Forewings (**Fig. 133d**) (partly damaged) much longer than body, very large, about two and a half times as long as broad, narrowly rounded to subacute at apex,  $R_s$  as long as  $M$  to furcation point, radius, media and cubitus arising at the same point from basal vein,  $R$  about one-third as long as  $Cu$ , second marginal cell longer than first, veins armed with microscopic setae. Hind wings (**Fig. 133e**) (partly damaged) also quite large.

Abdomen robust, tergites rugulose, with sparse pubescence, pubescence longer on sternites, sternites also armed with minute points arranged in linear rows.

*Genitalia.* Female genital segment (**Fig. 133f**) smaller than abdomen, plates wide apart posteriorly; dorsal plate subacute apically, slightly longer than ventral and differentiated into two areas, the basal two-thirds area bears the small anal pore-ring, consisting of double row of pores, the distal one-third area is somewhat darker in colour and armed with a group of minute setae, pubescence sparse; ventral plate acutely pointed; ovipositor acutely pointed.

*Host plant.* On a wild shrub.

*Type locality.* Deviathan, Central Nepal.

*Types.* Described from four female specimens, which were in poor condition, antennae, legs and wings broken in pieces or missing. This material was received (preserved in alcohol) from the Head, Division of Entomology, I.A.R.I., New Delhi. Holotype female; Paratypes: one female; and one female dissected and mounted on slide, and one badly mutilated specimen kept in alcohol; all from the type locality, and collected on 22.4.61 (No. IV) (S.R. Wadhi). Type deposited at the F.R.I., Dehra Dun, and one paratype female deposited at the I.A.R.I., and also the mutilated specimen in alcohol.

*Comparison.* *Trioza simplifica*, sp.n. differs from other species in shape of head, bearing a small epiphysis near each eye on vertex, shape of genal cones and in some other characters.

*Biological notes.* This species has been collected on a wild shrub, from Central Nepal. Nothing is known about its life-history and economic importance.

***Trioza spinulata*, sp. n.**

(**Fig. 134, 135**)

Length of body, in male, 1.70 mm; in female, 2.12 mm

Length of forewings, in male, 2.98 mm; in female, 3.30 mm

Width of head with eyes, 0.75 mm

Width of vertex between eyes, 0.40 mm

Length of antennae, 1.25 mm

*Colouration.* General colour dark-brown to fuscous, with reddish tinge, wings hyaline, transparent, flavus; antennae lighter basally and black distally; veins pale-brown.

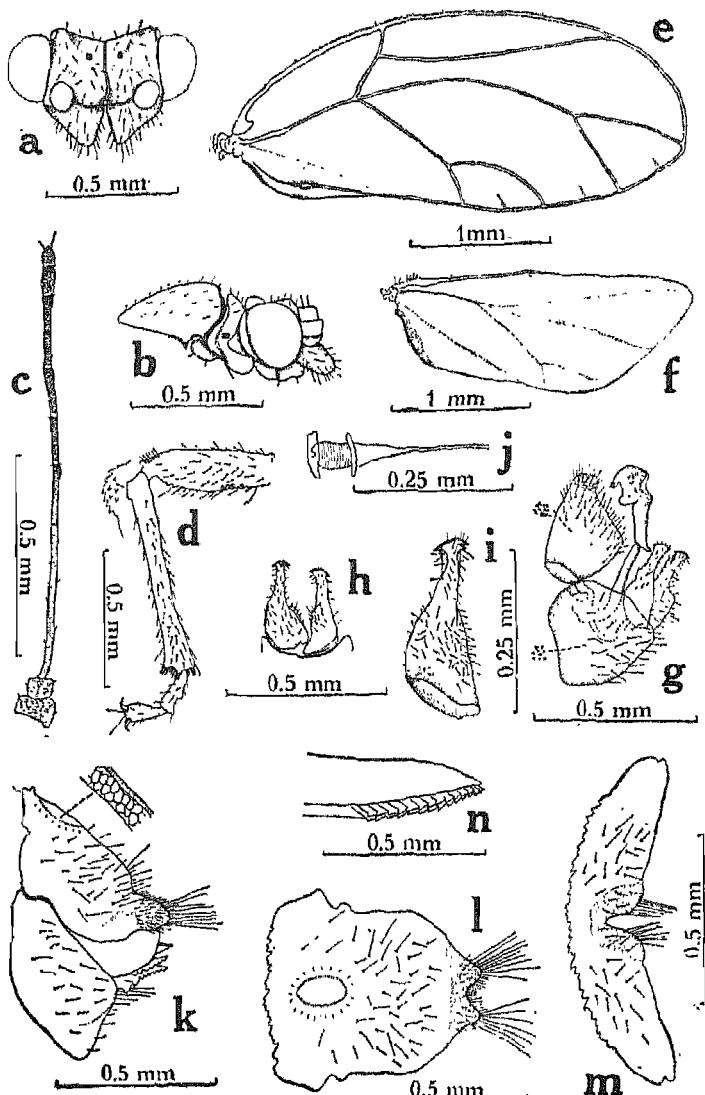


Fig. 134. *Triozaspinulata*, sp. n.—**a**: front view of head; **b**: head and part of thorax, lateral view; **c**: antenna; **d**: hind leg; **e**: forewing; **f**: hind wing; **g**: male genitalia, lateral view; **h**: parameres; **i**: forceps, mesal surface; **j**: sperm pump; **k**: female genitalia, lateral view; **l**: dorsal plate; **m**: ventral plate.

**Structure.** Body small but robust, hirsute. Head (Figs. 134a,b) slightly narrower than thorax, deflexed, pubescent with long hairs, finely rugulose; vertex broader than long; disc swollen on either side of median suture having a circular fovea posterior to

centre, abruptly rounded down in front, posterior margin deeply emarginate, post-ocellar region swollen, anterior margin deeply emarginate at point of excision, anterior ocellus visible in front; genal cones small, about 0·18 mm long, smaller than vertex, subacute at apex, divergent, sparsely pubescent with long hairs, finely rugulose, cones inclined vertically downward. Eyes large, recessive, somewhat hemispherical. Antennal sockets large, somewhat lateral.

Antennae (**Fig. 134c**) long, slender, ten-segmented, imbricate, having few simple setae, two basal segments robust, narrowly transverse, 1st broader than 2nd, but in length as long as 2nd, 3rd segment longest, as long as 4th, 5th and 6th combined together, 4th almost one-third as long as 3rd, 5th and 6th equal but smaller than 4th, 7th and 8th equal but each smaller than 6th, 9th a little longer than 10th, apical segment about half as long as 8th, bearing two unequal spines at tip, distal segments compressed, four sensoria present on segments 4, 6, 8 and 9.

Thorax (**Fig. 134b**) large, arched, sparsely pubescent, rugulose. Prothorax small, deflexed vertically downward, convexly rounded, posterior margin with a conspicuous median epiphysis, with two foveal impressions on each lateral side; prescutum broader than long, broadest somewhat in middle, narrower both anteriorly and posteriorly, convexly rounded anteriorly, having a small median epiphysis, angulate laterally, posterior margin also angulate; scutum broad, about twice as broad as long, and as long as prescutum, sloping and depressed posteriorly, angulate laterad; scutellum convex dorsally, broad anteriorly, gradually narrowed posteriorly, about twice as broad as long, anterior margin somewhat straight, with prominent antero-lateral angles; post-scutellum of metathorax narrowly transverse, broad posteriorly, narrow anteriorly, swollen middorsally, postero-lateral angles prominent.

Legs (**Fig. 134d**) long, coarsely pubescent and also beset with minute points arranged in serial lines, femora shorter than tibiae, all tibiae with apical comb of setae, tibial groove rather large, hind femur with a group of 5 to 7 long dorsal setae near apex, and with three or four sensoria-like structures on ventral side, hind tibiae swollen apically, beset with longitudinal rows of thick setae, with a series of small basal spurs and four spur-like thick spines at apex, apical tarsal segment slightly longer than basal; meracanthus slender, long and triangular.

Forewings (**Fig. 134e**) hyaline, transparent, somewhat oblong-ovate, about two and one-fourth times as long as broad, narrowly rounded to subacute at apex, marginal cells subequal, first cell slightly smaller but broader than second, basal vein longer than cubitus, cubitus slightly more than two and a half times as long as radius, media and cubitus arising slightly away from the point of emergence of radius; veins armed with microscopic setae.

Hind wings (**Fig. 134f**) small, uniformly beset with minute points, costal vein armed with a few simple and hooked setae.

Abdomen small and thick, strongly beset with minute points and sparsely with simple setae, setae longer on sternites.

*Genitalia.* Male genital segment (**Fig. 134g**) smaller than abdomen. Anal valve about 0·31 mm long, longer than parameres, broadest in middle, in profile, anterior

margin almost straight or weakly convex. posterior margin produced caudad into a large broad flap on each side, triangular in shape, abruptly narrowed apically, truncate at apex, upper surface strongly armed with minute points and also beset with simple setae in the apical region and on lateral lobes, marginal setae longer; parameres small, about 0·26 mm long (**Figs. 134h, i**), in caudal view, stout, swollen in basal two-thirds and very narrowly elongated like a triangular neck with three sides in the apical third, in dorsal view, apices round, trispinulate, angles black, acute and bent downward, outer surface having sparse simple setae, basal mesal surface armed with long, strong setae and also a cluster of setae present near the anterior margin, three sides of the apical neck bearing strong setae pointing downward; hypandrium simple, of usual shape, having long, simple setae and also beset with series of minute points; outer arm of aedeagus smaller than basal, spoon end strong, thick and somewhat globular and human head in shape ; sperm pump as figured (**Fig. 134j**).

Female genital segment (**Fig. 134k**) smaller than abdomen. Dorsal plate (**Fig. 134l**) longer than ventral, gradually sloping downward and then directed caudally, and ending in two subacute lobes with a deep median invagination, each caudal lobe armed strongly with simple thick setae and also with a bunch of very long setae, surface of plate strongly beset with thick minute points and also with simple setae, setae longer in the apical region, circum-anal pore ring large, longer than broad, and composed of a double ring of pores; ventral plate (**Fig. 134m**) subacute at apex, having a deep caudal invagination, surface armed with strong minute points and also with setae of varying length; ovipositor exserted, acutely pointed and also bearing saw-like teeth near apex (**Fig. 134n**).

*Host plant.* Bred *ex* globular cum pit galls on leaves of *Syzygium cumini* (L.) Skeels (= *Eugenia jambolana* Lam.).

*Type locality.* New Forest, Dehra Dun (U.P.).

*Types.* Described from a small series of specimens preserved in alcohol and later 5 examples were mounted on cards. Holotype male; Allotype female; from the type locality, collected on March 9, 1952 (R.N. Mathur); Paratypes: one male and one female of the same date and one female from the type locality but collected on March 20, 1937 (R.N. Mathur). Few females and some nymphs from the type locality and collected on April 1, 1951, and some nymphs collected on March-April 1936 and March 1950, from New Forest, Dehra Dun, were preserved in alcohol (R.N. Mathur). All types, preserved nymphal stages and some slides, deposited at the F.R.I., Dehra Dun.

*Comparison.* This species is recognised by the characters given in the key. The shape of head, genal cones and forewings are special features of this species.

*Biological notes.* Nothing is known about its life-history and economic importance, except that it has been recorded during March-April, and the nymphs are found located in deep pits formed inside a large globular gall, projecting out on the upper surface of leaves and having a large opening on the under surface. It is a compound gall, irregular in shape and pale green in colour. A gall may harbour 2 to 9 nymphal stages. The nymphs are broadly oval, with bulging venter and waxy fringe all round. Their colour is pale clay yellow, with eyes pinkish-red and abdomen of orange tinge. They excrete small globules of honey dew. The description of the nymphal stages is given below.

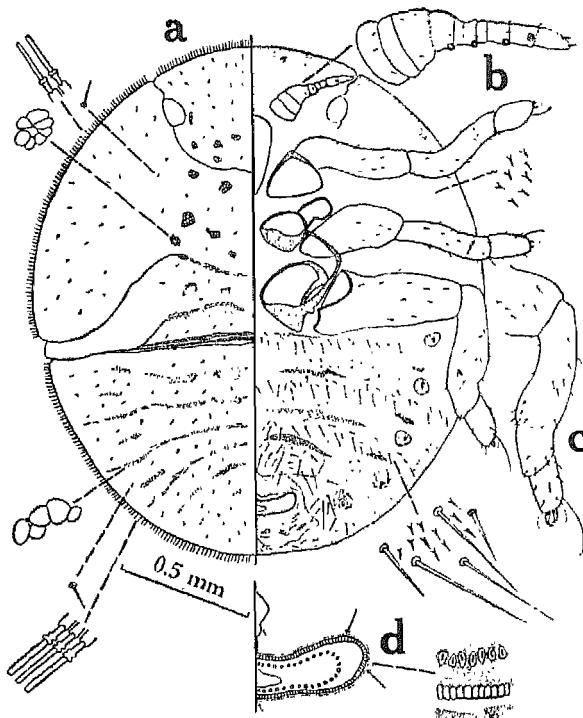


Fig. 135. *Trioza spinulata*, sp. n.—**a**: fifth stage nymph; **b**: antenna; **c**: leg; **d**: circum-anal pore ring.

#### Nymphal stages

*Fifth stage.* (Fig. 135a). Length 1.72 mm. Form very broadly oval, almost circular. Derm strongly sclerotic, except for the joint between thorax and abdomen. Wing pads not projecting beyond the contour of the body, produced cephalad beyond the eyes. Entire margin of the body beset with a continuous fringe of long, slender seta-setae, borne on low prominences. Derm finely vermiculate. Dorsum sparsely beset with small, simple setae.

Ventral side apparently membranous throughout and strongly bulging. Entire derm thickly beset with minute points, which become stronger and thicker towards the margin and in the caudal region. Small simple setae are also distributed, these setae becoming longer and thicker of varying lengths in the abdomen. Antennae (Fig. 135b) very short, about 0.30 mm long, thick, the segmentation obscure, apparently seven-segmented, basal segments thicker, broad basally, narrow apically, with four sensoria, terminal segment with two setae near apex. Legs (Fig. 135c) quite long, femora scarcely reaching the margin of the body, somewhat arched; without trochanters; division between tibia and tarsus distinct, each tarsus with one simple seta near apex; without claws, pulvillus in the form of a circular pad. Anal opening (Fig. 135d) situated well in from the apex of the body, both outer and inner circum-anal pore rings distinct, and

consisting of rows of slit-like pores, both the rings interrupted medianally, both anteriorly and posteriorly, and guarded by two anterior, one lateral and one posterior pairs of setae.

*Fourth stage.* Length 1·40 mm. Resembling the fifth stage, except for smaller size and wing-pads, antennae apparently five-segmented, with three sensoria, tibio-tarsal articulation absent.

*Trioza urticae* (Linnaeus) 1758  
(Fig. 136)

*Chermes urticae*

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Linnaeus, C. 1761. *Fauna suec. Holmiae*, No. 1006.

*Trioza urticae* (L.)

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This is quite typical of the European form of the same species.

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*Trioza emboda*

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*Trioza forcipata*

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 Meyer-Dur, R. 1871. *ibid.* p. 389.

*Trioza crassinervis*

Foerster, A. 1848. *ibid.* p. 83.  
 Meyer-Dur, R. 1871. *ibid.* p. 387.

*Trioza bicolor*

Meyer-Dur, R. 1871. *ibid.* p. 389-391.

Length of body, in male, 2·33 mm; in female, 1·73 mm

Length of forewings, in male, 2·7 mm; in female, 2·6 mm

Width of head with eyes, 0·52 mm

Width of vertex between eyes, 0·31 mm

Length of antennae, 0·9 mm

*Colouration.* General colour variable; fuscous-yellow or brownish-black, with yellowish-brown or black longitudinal streaks on thorax; head yellow or dark-brown, with genal cones black, sometimes yellow basally; antennae black, 2nd and 3rd segments pale-yellow or brown, 4th pale-brown basally and black apically, remaining distal segments black; legs fuscous yellow, femora yellow, somewhat blackish dorsally, tibiae brownish-black apically, tarsi somewhat black; forewings clear, transparent, veins pale-yellow; abdomen brown or black dorsally and yellowish-brown ventrally; genitalia partly dark-brown to black.

*Structure.* Body moderately long, slender. Head almost as broad as thorax, moderately deflexed, finely and sparsely pubescent; vertex about one and a half times as broad as long, along the median suture, disc more or less flat in dorsal view, gradually rounded downward in front, two foveal impressions, posterior to centre, one on each side of median line, linear depressions extending anteriorly and laterally from each fovea; post-ocellar region swollen; disc also swollen anteriorly on either side of median line; front ocellus visible from above and located at the point of excision; posterior margin weakly emarginate; genal cones vertical from plane of vertex, porrect anteriorly, broad basally, slightly smaller than vertex, separate but approximate basally, divergent and subacute at apex, bearing few long hairs. Antennal sockets lateral and situated below the anterior margin of vertex. Eyes small, somewhat hemispherical.

Antennae long, slender, ten-segmented, sparsely pubescent, imbricate, two basal segments robust, equal, 1st broadly transverse, 2nd subquadrate, 3rd longest, about one and one-fourth times as long as 4th, 4th, 6th, and 7th equal, each slightly longer than 5th, 8th a little longer than 7th, 9th and 10th almost equal and as long as 5th, terminal segment with two unequal apical spines, four sensoria present on segments 4, 6, 8 and 9.

Thorax large, arched, finely and sparsely pubescent. Prothorax collar-like, strongly convex, descending, narrow in middle, broad laterally, with two foveal impressions on each side; prescutum slightly broader than long, broadest beyond middle, narrowed behind

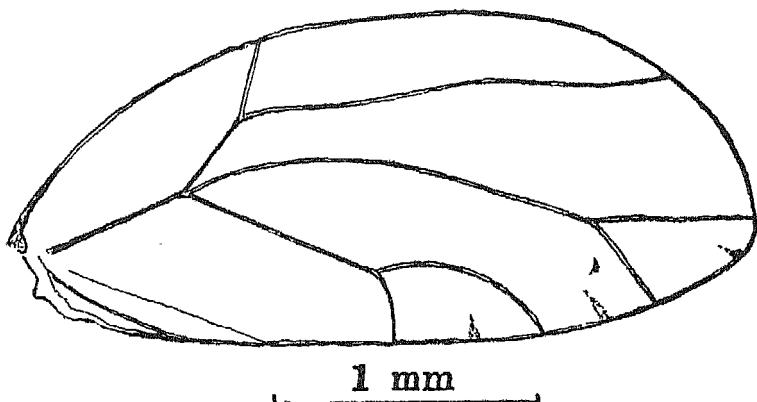


Fig. 136. *Trioza urticae* L.—Forewing.

anteriorly and posteriorly, narrowly rounded and bent vertically downward anteriorly, angulate laterally and posterior margin also angulate submedianally; scutum large, broad, slightly more than twice as broad as long, broadest before middle, slightly smaller than prescutum in length, disc flat dorsally and gradually sloping and angulate laterally, posterior margin also angulate; scutellum broadly transverse, slightly broad anteriorly, with prominent antero-lateral angles, both anterior and posterior margins almost straight and parallel.

Legs long, pubescent and also armed with minute points, femora shorter than tibiae, all tibiae with apical comb of setae, without basal spur, with three black spines at apex, basal tarsal segment longer than apical, meracanthus long, slender, sub-tubular.

Forewings (Fig. 136) small, transparent, hyaline, narrowly rounded at apex, about two and one-quarter times as long as broad, radial sector long and weakly sinuate, radius slightly longer than  $R_1$ , cubitus and basal vein almost equal, marginal cells unequal, first cell slightly longer and broader than second, veins armed with microscopic setae.

Hind wings small, membrane uniformly beset with minute points, costal margin in the basal half armed with a few simple and hooked setae.

Abdomen small, slender, finely and sparsely pubescent and also beset with minute points arranged in lines, setae slightly longer ventrally.

**Genitalia.** Male genital segment smaller than abdomen. Anal valve almost as long as parameres, about 0.25 mm long, in profile, anterior margin nearly straight, posterior margin broadly convex, thus forming lateral lobes, outer surface beset with simple setae, marginal setae slightly longer, anal region clearly demarcated and truncate at apex; parameres long and slender, bowed, broad basally, sides sub-parallel, with a conspicuous midway constriction, strongly narrowed abruptly and terminating in a hook-like point at apex; under high magnification, this process comprises three distinct stout setae, attached to the antero-mesal surface of the apex, apical seta conical in shape and directed anteriorly and mesally, while the two situated below are also conical with their halves strongly deflected and directed forward and mesally, outer surface beset with strong setae,

marginal setae slightly longer; hypandrium of usual shape and sparsely beset with simple setae; aedeagus with the outer arm smaller than basal, with the large spoon end.

Female genital segment smaller than abdomen, cocked up, sparsely pubescent, both plates broad basally and gradually narrowed posteriorly, dorsal plate almost as long as ventral, roundly pointed at apex, anal region depressed, setae longer in middle; ventral plate acutely pointed at apex; ovipositor acutely pointed.

*Host plants.* On nettle (*Urtica* sp.); *Urtica dioica* L. and *U. urens*; and *U. pilulifera* L. (Heslop-Harrison, 1946); *U. holosericia* (Klyver, 1930).

*Distribution.* Most abundant species all over the Palaearctic area and always associated with the nettles. In America, it is replaced by a very similar species, also feeding on nettles (*U. holosericia*). Common in Hebrides; British Isles; Scotland; throughout Europe: France; W. Poland; Norway; Finland; Denmark; Finnish Lapland; Siberia; Mongolia. Most common and variable species in Europe.

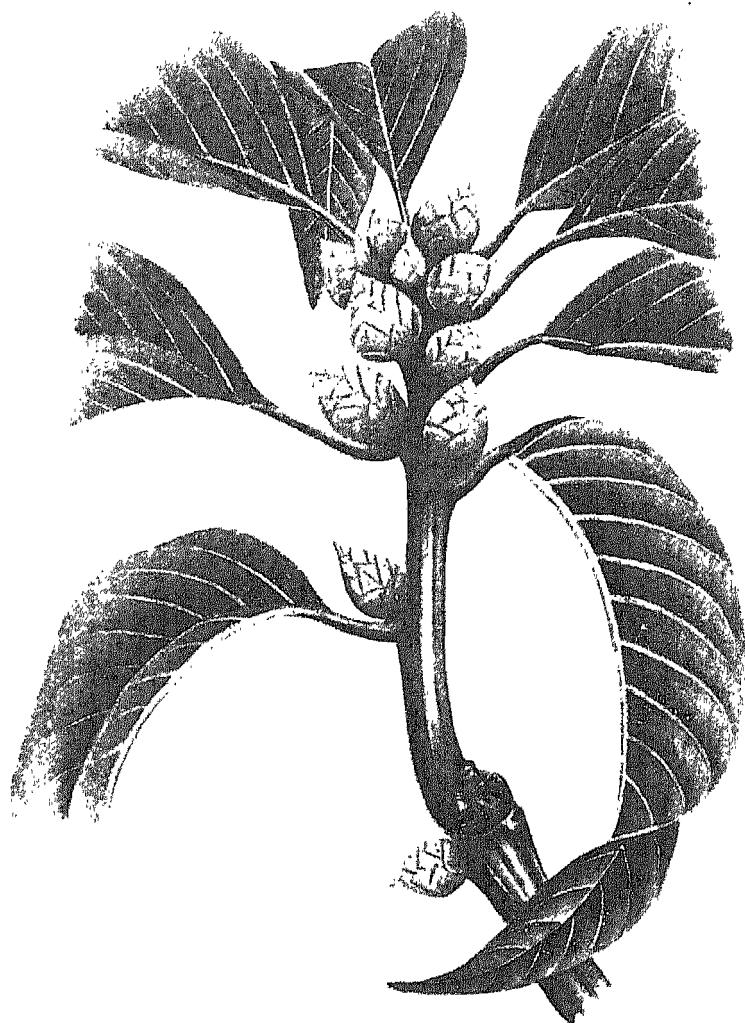
India: Recorded from Keonthal, Punjab; Dehra Dun and Naini Tal in Northern India.

*Material examined.* There are three examples, in very poor condition (wings, legs, antennae and abdomen missing), (R/7267, R/7268, R/7265), one female determined and labelled by D.L. Crawford, at the I.A.R.I., New Delhi. These specimens bear this data: Keonthal, Punjab, December 1908 (G.M.C), on nettle.

*Comparison.* *Trioza urticae* (Linn.) is easily recognised by the shape of forewings which are broadly rounded at apex, genal cones divergent, distal half of antennae black, and genital characters. Colouration and part of measurements are taken from fresh exotic material received from Dr Eastop of the British Museum.

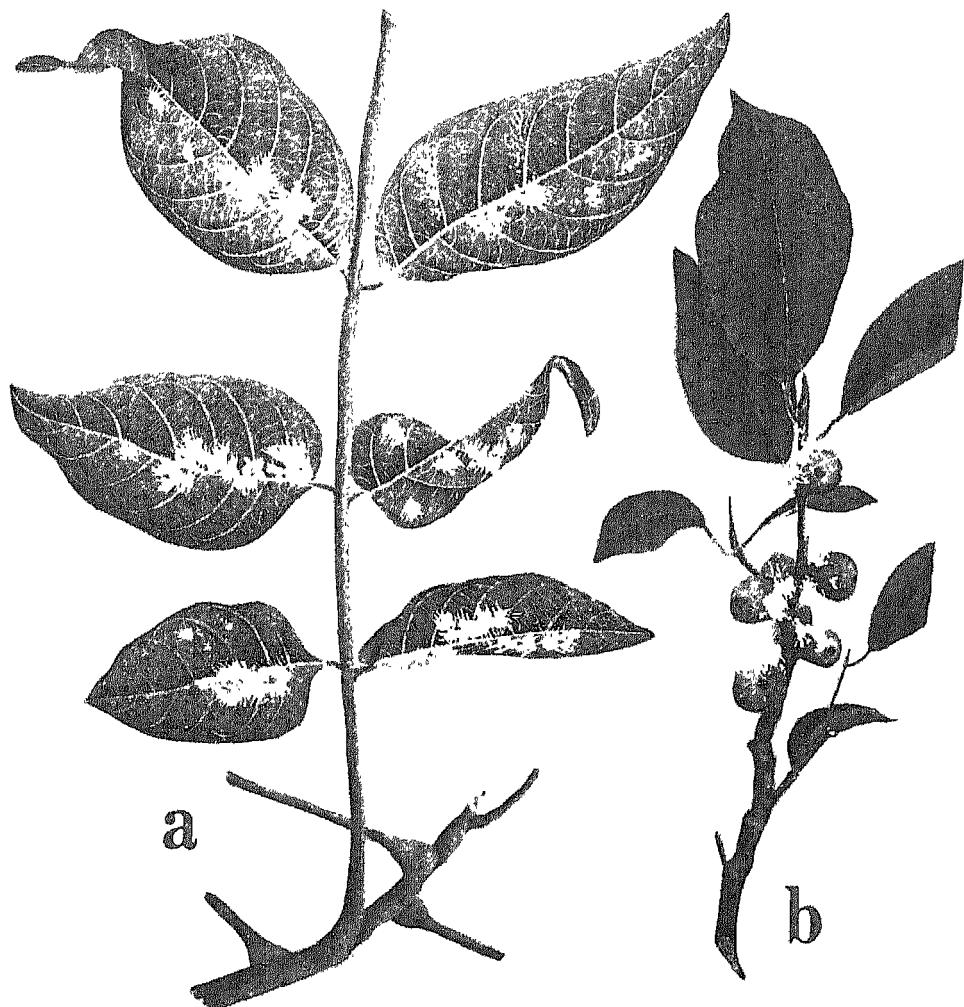
*Biological notes.* This species is very rare and is not commonly met with on nettles. Its nymphal stages are described by Ferris (1925).

## PLATE 1



Psyllid galls

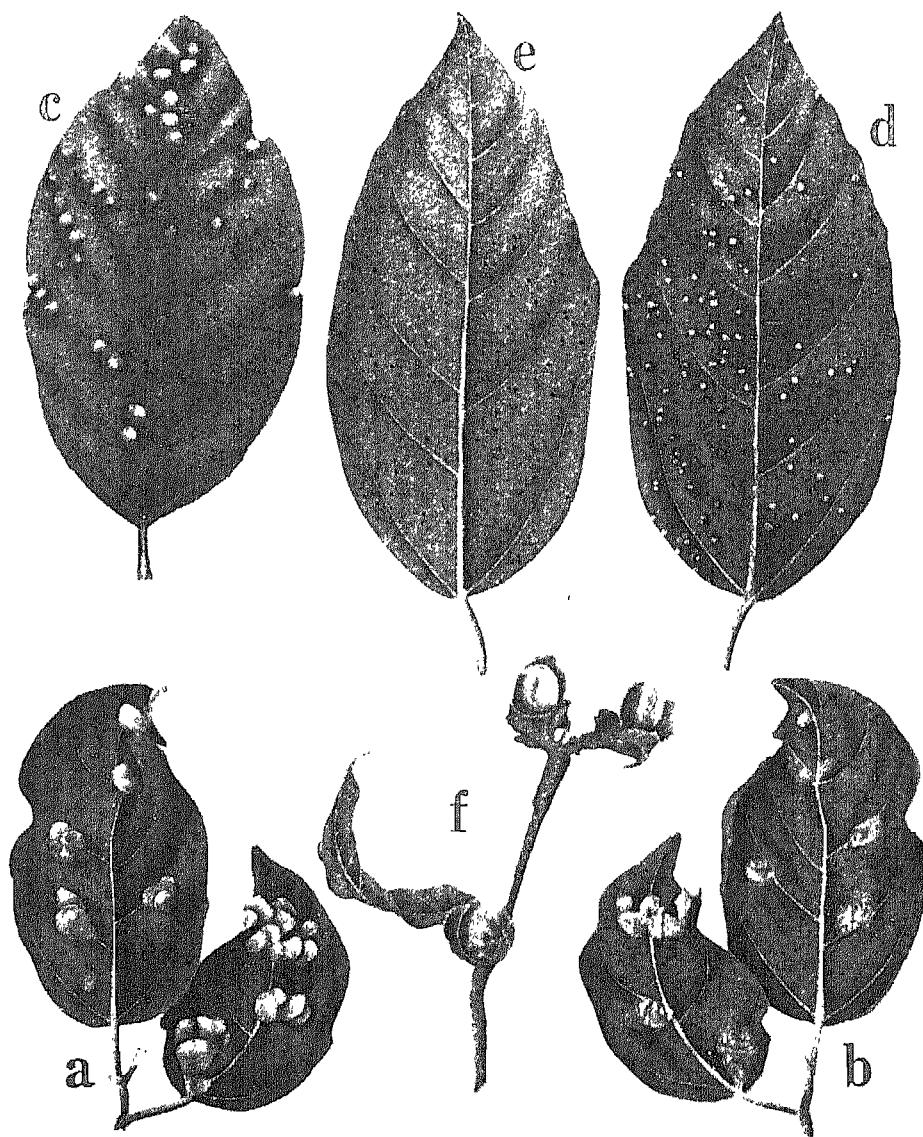
*Apsylla cistellata* Buckt. damaging bud galls on *Mangifera indica*.



Free-living psyllids with flocculent mass

a, nymphal stages of *Psylla cedrelae* Kieff. on leaves of *Cedrela toona*; b, nymphal stages of *Pslausia indica*, sp.n. feeding in the axils of fruits of *Ficus microcarpa*.

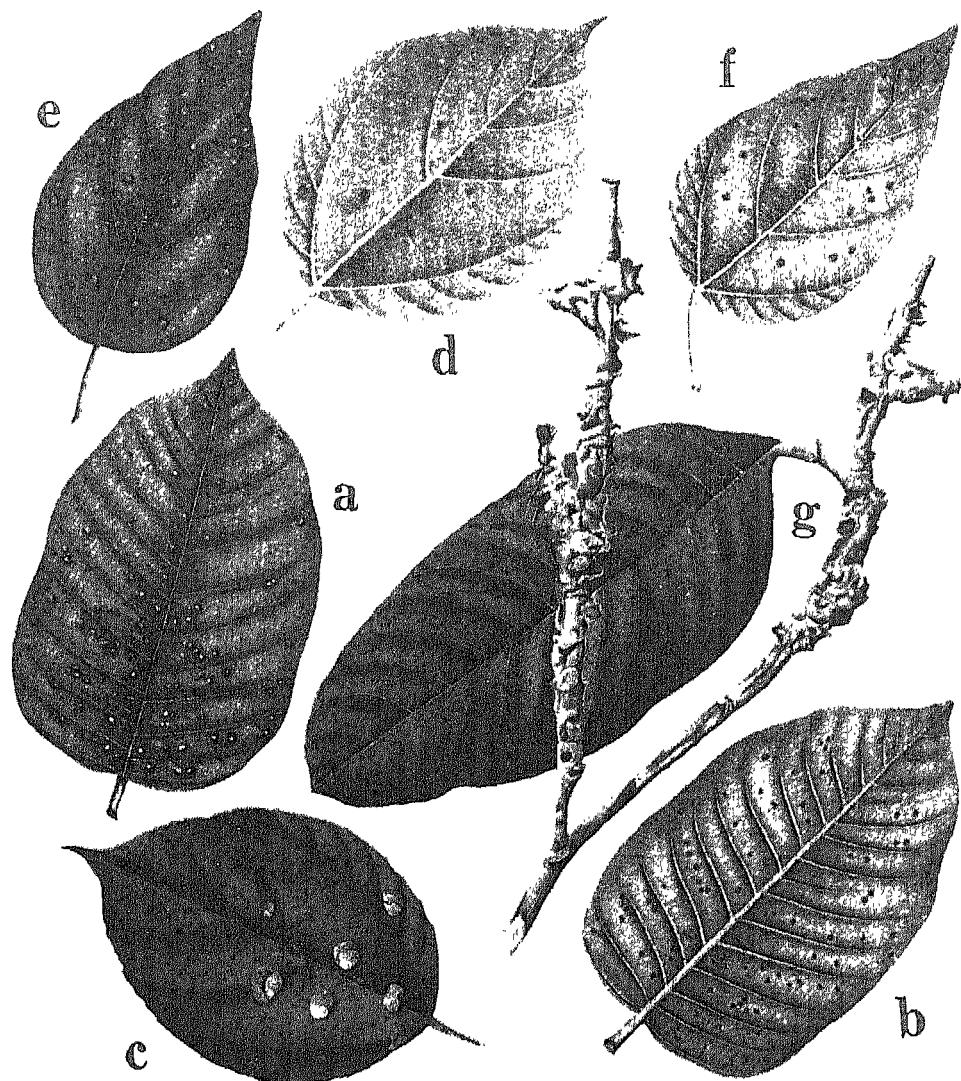
## PLATE 3



Psyllid galls

**a, b, c**, *Pauropsylla depressa* Crawf. galls on leaves of *Ficus racemosa* (upper and under surface); *P. heerosi* Laing galls on leaf of *Litsea monopetala*; **d, e**, pit galls of *P. purpurescens*, sp.n. on leaves of *Ficus racemosa* (upper and under surface); **f**, *Phacopteron lentiginosum* Buckt. galls on *Garuga pinnata*.

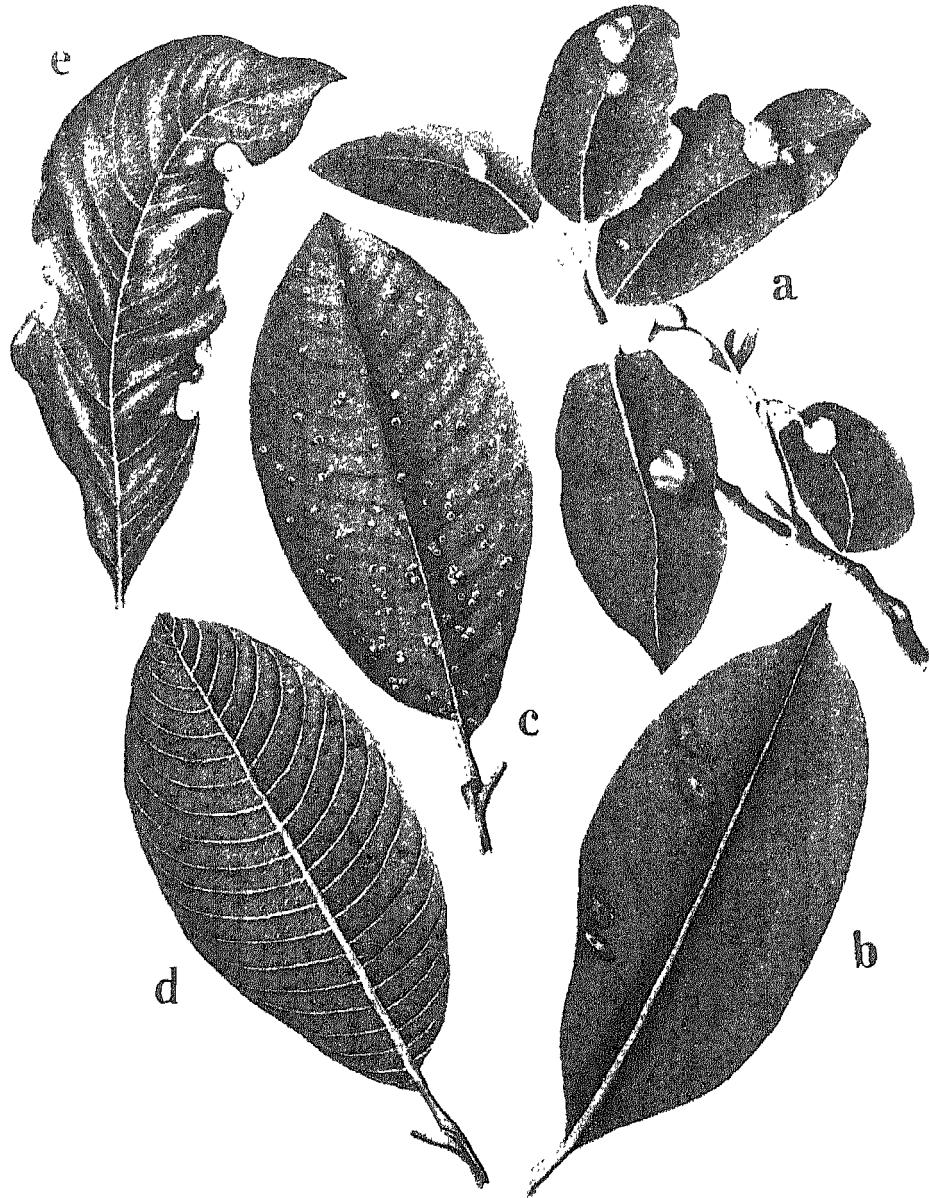
## PLATE 4



Psyllid galls

**a, b**, pit galls of *Ceropsylla minuta*, sp.n. on leaves of *Shorea robusta* (upper and under surface); **c, d**, *Trioza mallowicola* Crawf. galls on leaves of *Mallotus philippinensis* (upper and under surface); **e, f**, pit galls of *Trioza pitiformis* on leaves of *Mallotus philippinensis* (upper and under surface); **g**, galls on shoots of *Terminalia alata* var. *tomentosa*, made by an unidentified species of psyllid.

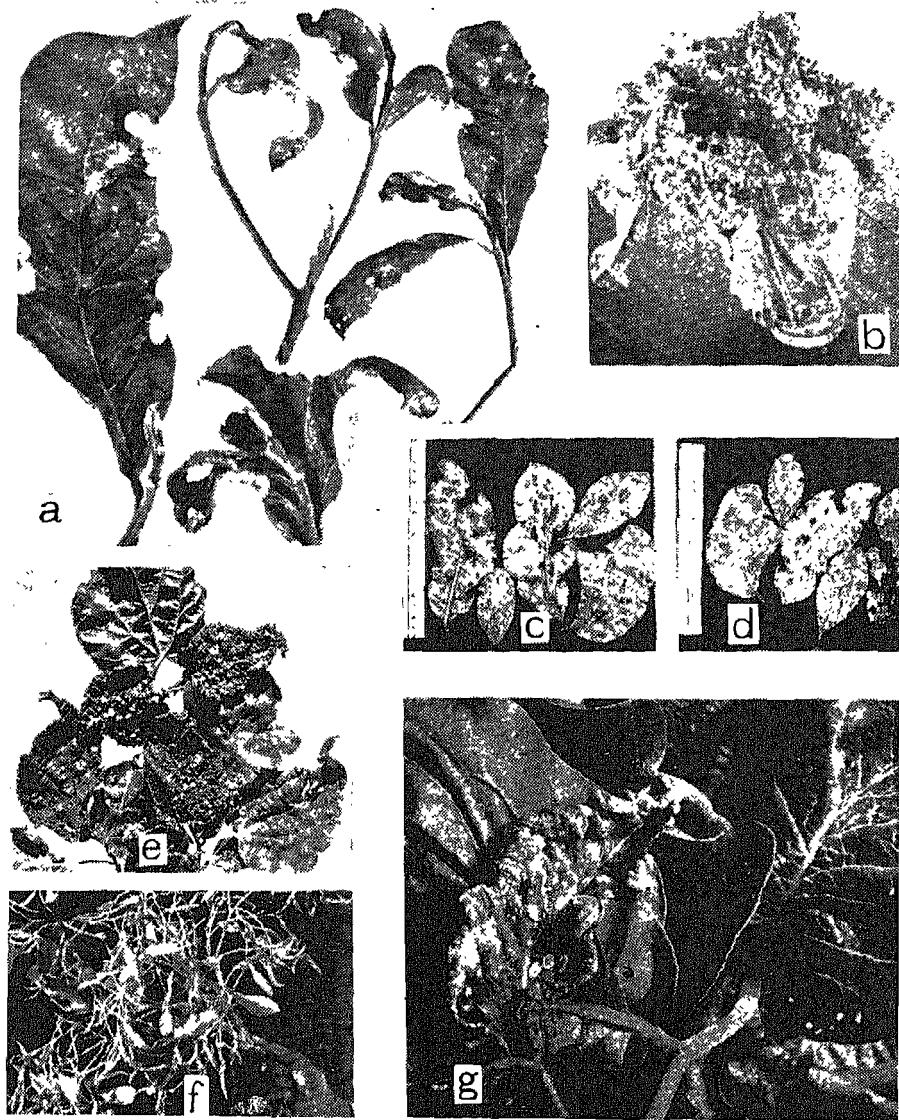
## PLATE 5



Psyllid galls

**a**, galls of *Trioza jambolanae* Crawf. on leaves of *Syzygium cumini*; **b**, pit galls of *T. fusca*, sp.n. on leaf of *S. cumini*; **c**, galls of *T. fletcheri minor* Crawf. on leaf of *Terminalia alata* var. *tomentosa*; **d**, same, under surface; **e**, rolled galls on margin of leaf of *Schima wallichii*, made by *Cecidopsylla schimae* Kieff.

## PLATE 6



Psyllid galls

**a**, rolled galls on leaves of *Schima wallichii* by *Cecidopsylla schimae* Kieff.; **b**, **c**, **d**, galls on leaves of *Diospyros melanoxylon* by *Trioza obsoleta* (Buckt.) (**c**, under side; **d**, upper side of leaves); **e**, galls on leaves of *Trewia nudiflora* by *Trioza fletcheri* Crawf.; **f**, rolled leaf margins of *Miliusa velutina* by *Ceropsylla ferruginea*, sp.n.; **g**, curled leaves of *Ficus microcarpa* by *Ceropsylla fulvida*, sp.n.

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