



Fauna of India

HOMOPTERA
APHIDOIDEA

SUBFAMILY PEMPHIGINAE

A. K. GHOSH

THE FAUNA OF INDIA
AND
THE ADJACENT COUNTRIES

HOMOPTERA

APHIDOIDEA

Part 3

SUBFAMILY PEMPHIGINAE

By

A. K. GHOSH



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EDITOR'S PREFACE

Aphids form the largest group of insect-vectors of plant-viruses and have worldwide importance as the most important family of crop-pests. Out of estimated world fauna of over 4000 species of aphids, placed under two families, Aphididae and Adelgidae of Aphidoidea, about 800 species are now known from India and adjacent countries. The "Fauna of India and the Adjacent Countries" on Aphidoidea has been planned to be published in several parts, of which part 1, dealing with General Introduction to the group and subfamily Chaitophorinae and part 2, dealing with subfamily Lachninae were published in 1980 and 1982, respectively. The present volume dealing with subfamily Pemphiginae covers 61 species out of world fauna of about 250 species. Dr. A. K. Ghosh, the author of first two volumes and also of the present volume is well known for his long experience of work and more than 100 contributions to the subject, in India and abroad. His continuing work has resulted in the fine volumes and I am sure that the present volume, like the earlier ones, will be considered as significant contributions to our knowledge of Indian Aphidoidea. I would like to record my deep sense of appreciation for his work.

Calcutta
24th September, 1984.

B. K. TIKADER
Director
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AUTHOR'S PREFACE

The subfamily Pemphiginae includes one of the most complicated group of aphids, largely because of their much unknown biology. In this volume, a total of 20 genera and 61 species have been dealt with ; information on biology in Indian region remains far from complete and to fill up this gap, extensive works from other region have often been cited. It is expected that in future, long-term bio-systematic research on this interesting group of aphids would yield much of the needed data from Indian region.

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ABBREVIATIONS

The following abbreviations have been used in the text : BMNH : British Museum (Natural History), London , CU=Department of Zoology, University of Calcutta, Calcutta ; DHRL=D. Hille Ris Lambers, Bennekom, The Netherlands ; ht₂=second segment of hind tarsus ; p.t.=processus terminalis, u.r.s.=ultimate rostral segment , Z.S.I.=Zoological Survey of India, Calcutta.

INTRODUCTION

The first record of Pemphiginae from India and its adjacent countries was published by Buckton (1893) and subsequently Buckton (1896), Keiffer (1908), Cholodkovsky (1912). Das (1918) added a number of gall-making pemphigid species from the region. Almost all other species of the subfamily have been subsequently recorded and or described during 1956-1981, mostly from Northwestern region, as majority of host-plants are distributed in that area, except the widely known species occurring on secondary hosts (Graminae and Cyperaceae) in peninsular India and adjacent region. No published record of Pemphiginae is known from Bangladesh but it can be well assumed that species occurring in the plains of Eastern India, are, in all likeliness, distributed in Bangladesh, specially in paddy growing areas of that country.

No comprehensive account of Pemphiginae of the region has been published till date except for the Pemphiginae of Eastern India and Bhutan (Raychaudhuri *et al.* 1980.).

Subfamily PEMPHIGINAE

Head without frontal tubercle (except in *Ceratopemphigus* which shows a pair of lateral prominences). Antennae 4-6 segmented in apterae, usually 6 segmented in alatae, always much shorter than the length of body ; secondary rhinaria absent in apterae, linear, oval, subcircular, very large ovoid, or reticulated in alatae, may be ciliated, sometimes with a "plaque" or islands ; primary rhinaria usually ciliated ; processus terminalis usually much less than half as long as the base of last antennal segment. Eyes of 3 facets in apterae, large in alatae. Ultimate rostral segment blunt, or acute, broad or slender, without any or with 2 to more than 30 accessory hairs, distinctly shorter than to much longer than the length of second segment of hind tarsus. Mesonotum and sometimes metanotum with wax glands ; wax glands may be distinct or absent on head ; the area secreting wax may be indistinct, or plate like or appear as well developed groups of glands, with or without central space, and may or may not bear hair ; wax gland cells may be large, ovoid or linear, stellar or irregular ; wax glands on abdomen may be present in spinal, pleural and marginal pairs or variably developed. Hairs on the dorsum of abdomen sparse or numerous, with fine, subacute, bent or expanded apices. Spiracles normal, those on 1st and 2nd tergite usually placed wide apart, sometimes placed on large rounded dark plates. 8th tergite with 2 to more than 25 hairs. Siphunculi absent or present as a mere ring or on elevated cones, often surrounded by hairs. Cauda semilunar with 2 to many hairs, sometimes enclosed by 8th abdominal segment (e.g. *Geoica* Hart) or may form a tube like anocaudal process (e.g. *Prociphilus* Koch). Subanal and subgenital plate with variable number of hairs, often arranged in rows and these may be long or short, thick or fine. Gonapophyses indistinct (*Eriosoma* Leach) or enlarged (*Tetraneura* Hartig). Legs with tibiae and tarsi smooth (*Aploneura* Pass., *Geoica* Hart) or variably spinulose (*Eriosoma* Leach, *Tetraneura* Hartig) ; tarsi one or two segmented, first tarsal segment with 2-5 hairs, sometimes with a median sense-peg ; empodial hairs very short, hardly $0.25 \times$ (*Geoica* Hart) to as long as the tarsal claws (*Eriosoma* Leach). Media of forewing simple or once forked, hind wing with 1 or 2 oblique veins.

Sexuales small, arostrate. Oviparae lay a single egg. Both male

and oviparae without wings. Baker (1915) has shown that embryos of sexuparae, initially possess 4 chambers on each side but by a process of degeneration only one ovary matures and the egg fills up the entire body (e.g. *Eriosoma*).

Fundatrix, alate migrants, aliencolae, sexuparae of the same species may differ considerably in morphological characters, including in the number of antennal segment, arrangement of wax-glands, first tarsel chaetotaxy, presence or absence of siphunculi etc. However, by their characteristic features of wax glands, reduced wing venation, siphunculi, arostrate sexuales, association with ants and gall formation, the members of Pemphiginae could be separated from other subfamilies of Aphididae.

Börner (1952) considered the subfamily as a family Pemphigidae and treated three subfamilies, viz. Schizoneurinae, Pemphiginae and Fordinae under Pemphigidae (Table 1). Zöwlfer (1958) followed Börner (op.cit.) in higher classification but suggested some change in the names of the tribes. Eastop (1966) considered Pemphigidae as a family being composed of two subfamilies, Pemphiginae and Hormaphidinae but later Eastop and van Emden (1972) treated Pemphiginae as a subfamily under Aphididae. Some earlier authors have used the name "Eriosomatidae" or "Eriosomatinae" (Baker, 1920 ; Palmer, 1952) for this group of aphids. In the present work, Pemphiginae has been treated as a subfamily, being composed of three tribes Eriosomatini, Fordini and Pemphigini and about 45 genera. Pemphigine aphids are mostly distributed over Palaearctic, Holarctic, Nearctic and Oriental regions. A total of about 270 species are known under the subfamily, representing the world Fauna. About 20 genera, under three tribes, and 65 species are known from the region under study, of which 5 genera and 37 species are endemic in origin ; besides the endemic fauna, the rest of the faunal-element, except 5 species which could not be definitely identified, indicate a predominant affinity with Palaeartic fauna.

Pemphiginae, is considered as a naturally defined group which has evolved during Permian to Cretaceous period involving Gymnosperms, earlier Angiosperms and Conifers ; an account of aphid fossils (Heie, 1980) includes 22 species that may come under Pem-

phiginae and these belong to 7 genera, including 3 recent genera viz. *Eriosoma* Leach, *Pemphigus* Hartig (a doubtful fossil record) and *Tetraneura* Hartig. Earliest known fossil evidence of Pemphiginae belongs to monotypic *Paleoforda* Kunonova, Type : *K. taymyrensis* Kunonova, and it was described from Baltic amber of last Cretaceous period ; however, *Paleoforda* has not been placed in any recent or fossil subfamily/family, although similarities with Pemphiginae may be considered pleisomorphic but monophyletic origin of the unknown family to which *Paleoforda* belongs and that of Pemphiginae, could not be definitely ascertained, (Heie, 1980). Most of the other fossils belong to Tertiary and of these, at least two, *Germaraphis dryeides* Germar and Berendt and *Succinaphis flauensgaardi* Heie, indicate close relation with Prociophilina. Another interesting fossil *Electronia antiqua* Heie, from Baltic amber resembles soldier-like morph of some *Astegopteryx* Karsch and *Colophina* Börner, described by Aoki (1977, 1980) but in this case, fossil does not belong to first instar larvae ; however, *Electronia antiqua* again suggests a close relation between wax-producing, gall-forming, heteroecious Pemphiginae and Hormaphidinae, as could also be evidenced from similarities in other characters between aphids of Pemphiginae and Hormaphidinae e.g. development of wax glands, reduced antennal segments and reduced eyes in apterae, reduced wing venation and 2 year cycle in primitive Hormaphidinae and Fordini or Pemphiginae ; however, sexuales of primitive Hormaphidinae still retain the rostrum, which has become degenerated in sexuales of Pemphiginae.

Most of the Pemphiginae are heteroecious, alternating between specific groups of primary and secondary host. In a typical life history, apterous fundatrix produces second and third generation alate, (fundatrigeniae) (on Anacardiaceae, Salicaceae, Ulmaceae), which migrate (virginoparae) to the roots of secondary host (Graminae, Dicots and Conifers) and produce apterae exules ; the apterous generations continue for sometime and later alate sexuparae migrate to primary host and produce small arostrate apterous males and apterous oviparous females ; these after copulation produce only one egg. The entire cycle in Pemphigini and Eriosomatini is annual while in Fordini the cycle takes 2 years to complete. Anholocyclic forms are often produced in warm and in temperate regions on secondary hosts.

On the primary host, fundatrix usually initiates a gall on the leaf and larvae of fundatrix may either develop within the same gall or initiate formation of a definitive galls. The plants of Ulmaceae (Eriosomatini), Salicaceae (Pemphigini) and Anacardiaceae (Fordini) are normally used for primary host. The galls may be (i) simple pseudo-leaf gall, formed by rolling along the length of leaf or sac-like, pear-like irregular, hairy or smooth (Eriosomatini), (ii) pocket-gall or pyriform, vesicular closed galls, or spiral galls (Pemphigini), (iii) bag-like galls of elongated cylindrical horn like structure formed on a single leaflet, irregular spherical gall on the underside of leaflet blade, bizzrre-shaped galls arising from resting buds (Fordini) ; besides the bag-like galls, some Fordini may produce pea-shaped pocket galls for development of fundatrices ; the fundatrices within the transitory galls of all species appear similar in colour, form, size and can not be separated easily , the permanent pocket galls are produced by first instar fundatrigeniae in adjacent young leaflet and fundatrix dies within the temporary gall after the period of reproduction is over. The galls are believed to provide the specific nutrient tissue for the developing larvae.

In the region under study, heteroecious-holocycle has been unknown for most of the Pemphigids, although only gall-forming morphs or root-feeding morphs are known for several species. In Eriosomatini, galls on *Carpinus* and *Ulmus* have been observed, the first being produced by *Kaltenbachiella carpinicola* Ghosh *et al.* and the second by *E. kashmiricus* Verma and *Schizoneurella indica* H. R. L. but only the latter species is known to be heteroecious between *Ulmus* and *Malus* , almost all other species are known by radicolous form or by vagrant alates except *E. lanigerum* (Haus.) which spends its cycle on Pormoidea. In Fordini, only two species viz. *Baizongia pistaceae* Linn., forming galls on *Pistacia integerrima* and *Kaburagia ailanthi* Chowdhury *et al.* forming galls on *Ailanthus glandulosus* are known and while heteroecious cycle of *B. pistaciae* is well known, the radicolous form of *Kaburagia ailanthi* remains unknown. Rest of the species of Fordini are mostly known by radicolous forms and primary host still remain unknown in the region. In Pemphigini, at least 17 species are known from their primary host (*Populus*, *Michelia* etc.) , but only two of these are also known from secondary hosts viz. *Epipemphigus*

imaicus from *Pinus* and *Pemphigus immunis* from *Euphorbia*. The apparent absence of secondary host or primary host, may be due to change to anholocyclic monoecious life cycle either on secondary or primary host or lack of knowledge about the alternate host, specially in the species where alate sexuparae from secondary host or alate virginoparae from primary host are known, indicating the possible heteroecious nature. In some cases, however, possibility of existence of holocyclic monoecious cycle on secondary host, in absence of primary host, may not be precluded. The existence of geographical paracycle in certain region of distribution of Fordini has been discussed by Davatchi (1975). An extensive study of gall inhabiting aphids in the known primary host-plant groups *i.e.* Ulmaceae, Salicaceae and Anacardiaceae and others in the Himalaya and their possible correlation with aphids feeding on the roots of Coniferae, Graminae and Dicots is needed, to have a clear picture of the biology of Pemphigid in the Indian region.

In the region under study, the Pemphigid aphids are mostly distributed in the areas having *ca* 600-2000 m. altitude in the Northern Himalaya (Northwest ; North Eastern) and Nilgiris in the South India and from Sri Lanka (1-2 species) ; obviously the occurrence of primary host-plant group in temperate region account for their distribution and the root-feeding Pemphigids on Graminae could be expected and are actually found in the lower altitudes down to the plains areas. The data on soil type and the depth upto which they have been recorded, indicate a wide range ; soil may be dry sandy to sandy loam, semiwet loam, wet-loam or wet-clay soil and the depth may be between *ca* 3-15 cm. in the Eastern Himalayan areas of their distribution. Most of the radicicolous forms have been recorded in late winter or early summer whereas the gallicolous forms have been noted from May to September. In general, the subradicicolous forms remain free from parasites and predators but otherwise the Syrphid, Coccinellid and Neuropteran predators are not very uncommon for these aphids, specially when they inhabit aerial part of the host plants. As for the parasites, *Aphelinus mali* has been introduced to control woolly apple aphid, *Eriosoma lanigerum* (Hansman) but no record of any other naturally occurring parasite is available. It is noteworthy that although 8 species of hymenopterous aphidiid para-

sites are known from 15 species of Pemphigids in Palaearctic region, only two species of parasites are restricted to the Pemphigid hosts (e.g. *Areopraon lepelleyi* (Waterson) on *Eriosoma*, *Monoctonia pistaciaecola* Stary on *Forda* & *Pemphigus*).

Radicolous aphids are known to have a trophobiotic relationship with ants. Most of the Pemphigids, specially inhabiting graminaceous host have myrmecophilous habit during the subterranean life. Some Pemphigids like *Prociphilus* (*S*) *himalayensis* Chakrabarti or *Prociphilus taxus* (Ghosh *et al*) are myrmecoxenous *i.e.* not being attended by ants, but none of the species in the region appear to be myrmecobiont or parasitic on ants as has been shown for *Paraclotus cimiciformis* Heyden, in Europe (Zwölfer, 1958). Ants of the genus *Camponotus* and *Solenopsis* are common with the Pemphigid aphids in the region, but many of the ant species remain undetermined.

Monzen (1929, 1930) and Shinji (1944) have dealt with insect-galls and gall insects, including those of Pemphigid aphids. Tsai & Tang (1946) have described *Rhus* infesting gall aphids from China. Wertheim (1954) has given excellent description of mechanism of gall formation and also of biology and ecology of some gall-producing aphids of Fordini, Remaudiere & Tao (1957) and Davatchi (1958) have provided extensive account of *Pistacia* infesting aphids. Mani (1973) has described all the galls produced by aphid-species in Indian region. Ghosh *et al.* (1981) have given account of Pemphigine galls of Indian region and Ghosh (In press) has also dealt with biology, ecology and host relation of Pemphiginae in India. Roberti (1938, 1939) and Zwölfer (1957, 1958) have given excellent descriptions of radicolous forms of Pemphiginae from Europe. Taxonomic works concerning the regional fauna of Pemphiginae include. Tullgren 1909), Mordvilko (1935), Börner (1952), Stroyan (1975) : Western Palaearctic region ; Hori (1938), Shinji (1941, 1944), Aoki (1973) Japan in Eastern Palaearctic region ; Tao (1970) : China ; Curtwright (1924), Palmer (1952), Smith (1969, 1974, 1980), Harpar (1959 a, b, 1966 a) : Sub-terranean and gall-forming Pemphiginae of Nearctic region, Eastop (1958, 1961) East & West Africa ; Eastop (1966) ; Australia, etc.

Key to the Tribes

1. Siphunculi present as cones or as rings, surrounded by few hairs (except in apterae of *Ghariesia*). Wax glands present, composed of a row of cells surrounding a central space. Secondary rhinaria in alatae annular. Media of forewings once branched or simple, hind wings with 1-2 oblique veins. Tarsi in apterae 1-2 segmented. On Ulmaceae as primary hosts and aerial parts or roots of Dicots and Graminae

.Eriosomatini
- Siphunculi absent or very feebly indicated, without any hairs. Wax glands may be present or absent, if present composed of a row of cells appressed together without any central space ; secondary rhinaria in alatae, oval, elongate or sub-annular. Media of forewings usually simple. Tarsi usually 2 segmented

2
2. Wax gland groups in apterae each bearing a hair, long or inconspicuous. Ultimate rostral segment with a few or without accessory hairs. Secondary rhinaria in alatae strongly transverse and narrow or may be reticulated (*Formosaphis* Takahashi). Cauda may be fused with anal plate forming a tube like anocaudal process, or normal and bearing few hairs. Apteræ usually with trochanters and femora separate. On *Populus* and Dicots as primary host, and on Roots of Coniferae, Compositae, Chenopodiaceae as secondary hosts

.. Pempighini
- Wax glands absent or inconspicuous, in aptera never with hair, or only the wax glands on 8th tergite may bear hair. Ultimate rostral segment with few (2) to many accessory hairs (nearing 20). Secondary rhinaria in alatae round, oval or transversely oval. Cauda never forms anocaudal process as above but subgenital plate may be enclosed on three sides by an inverted horse-shoe shaped 8th tergite. Apteræ may have fused femora and trochanters. On Anacardiaceae as primary host and roots of Graminae and Cyperaceae or dicots (apteræ often attended by ants) as secondary host

.. .. Fordini

TABLE 1 : *Borner's* (1952) classification of "Pemphigidae"

Family : "Schizoneurinae"	Family : "Pemphiginae"	Family : "Fordinae"
<p>(i) Gonochaetae on anterior margin of subanal plate in various arrangement, only in <i>Byrsocrypta</i> (i.e. <i>Tetraneura</i>) in two bulging tubercles.</p> <p>(ii) Secondary rhinaria narrow, reniform</p> <p>(iii) Fundatrix and progeny in leafgalls of <i>Ulmus</i>.</p> <p>(iv) Sexuparae appear in Autumn.</p>	<p>(i) Gonochaetae in three tubercles, close to anterior margin of subanal plate, median tubercle small or absent.</p> <p>(ii) Secondary rhinaria oval to linear</p> <p>(iii) Fundatrix and progeny (in holocyclic species) on leaf and shoot galls of deciduous trees.</p> <p>(iv) Sexuparae in Autumn</p>	<p>(i) Gonochaetae in two groups of flat tubercles on anterior margin of subanal plate, median one absent.</p> <p>(ii) Secondary rhinaria oval to circular not linear</p> <p>(iii) Fundatrix with progeny in the galls of <i>Pistacea</i> and <i>Rhus</i>.</p> <p>(iv) Sexuparae in Spring.</p>
<i>Tribe 1. Schizoneurini</i>	<i>Tribe 1. Pachypappini</i>	<i>Tribe 1. Fordini</i>
<p>(i) New born larvae not sclerotic</p> <p>(ii) Tarsi 2 segmented.</p> <p>(iii) Wax glands in 4 rows.</p> <p>(iv) Media of forewings furcated, hind wings with 2 obliques.</p> <p>(v) Fundatrix and progeny in leaf roll or bladder like galls originating from leaf disc.</p>	<p>(i) Empodial hairs of young larvae long.</p> <p>(ii) Terminal hairs on last antennal segment arched.</p>	<p>(i) Rhinaria not ciliated</p> <p>(ii) Virginonea attended by ants.</p>

<i>Tribe 2. Byrsocryptini</i>	<i>Tribe 2 Pemphigini</i>	<i>Tribe 2. Baizongiini</i>
<p>(i) New born larvae sclerotic, stigmata on sclerotic plate.</p> <p>(ii) Tarsi 1-2 segmented.</p> <p>(iii) Wax gland in 6 rows.</p> <p>(iv) Media rarely furcated, usually simple.</p> <p>(v) Fundatrix and progeny in small globular leaf galls.</p>	<p>(i) Empodial hairs of larvae short, straight.</p>	<p>(i) Primary rhinaria ciliated.</p>

Tribe ERIOSOMATINI

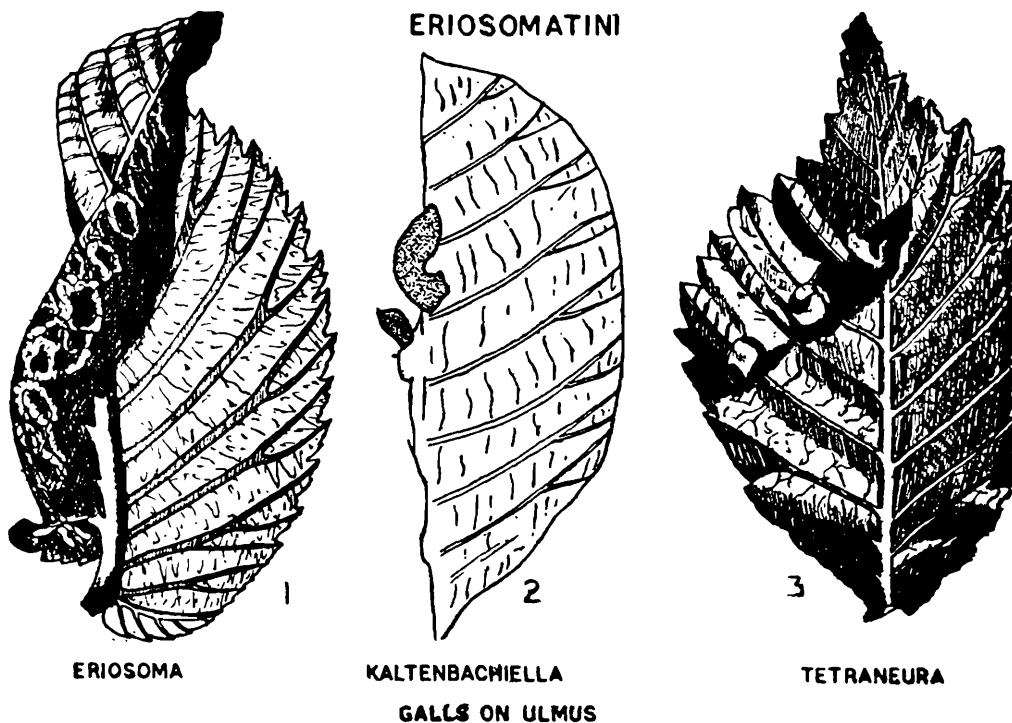
Börner (1952) considered Eriosomatini as a subfamily Schizoneurinae on the basis of arrangement of gonochaetae, narrow, reniform, secondary rhinaria in alatae etc., (Table 1) and divided it into two tribes viz. Schizoneurini having 4 rows of spinal and pleural wax glands in viviparae, new-born larvae not sclerotic, 2 segmented tarsi, media of forewing once branched, etc. (with genera *Eriosoma* Leach and *Schizoneura* Hartig) and Byrsocryptini, having 6 rows of spinal, pleural and marginal wax glands, new born larvae sclerotic, media of forewings generally simple (with genera *Colopha* Monell, *Kaltenbachiella* Schouteden, *Byrsocrypta* Haliday, now a synonym of *Tetraneura* Hartig). Hille Ris Lambers (1973) grouped *Schizoneurella* H.R.L., an endemic genus from this region along with Holarctic genera *Eriosoma* Leach, *Schizoneura* Hartig, and Nearctic genera *Georgiaphis* Maxon and Hottes and *Schizoneurata* H.R.L. under Schizoneurini, sensu Börner. He also observed that in the Nearctic members of this group of genera, embryos and first instar larvae have smooth or faintly imbricate tarsi and long dorso-apical hairs on second tarsal segments as against the spinulose tarsi and short dorso-apical hairs on second tarsal segment in similar morphs of the Palaearctic members of the group. Zwölfer (1957) proposed the name Tetraneurini for Byrsocryptini of Börner.

About 10 genera and two subgenera (*Colophina* Börner and *Schizoneura* Hartig, under *Eriosoma* Leach) and 54 species are known from the World, under Eriosomatini ; of these *Byrsocryptoides* Dzbl., *Gharesia* Stroyan, *Schizoneurella* H. R. L. are Oriental ; *Colopha* Monell, *Eriosoma* S. L. Leach, *Kaltenbachiella* Schouteden, *Patchiella* Tullgren, and *Tetraneura* Hartig are Holarctic and *Georgiaphis* Maxon & Hottes and *Schizoneurata* H. R. L. are Nearctic in distribution. Most of Eriosomatini have *Ulmaceae* as primary host and roots of Angiosperms (Graminae, Cyperaceae, Labiateae, Pomoidea etc.) as secondary host. In some cases, the heteroecious cycle has been modified by the loss of primary host or by the loss of secondary host ; one of the well known pest-species, Woolly apple aphid *Eriosoma lanigerum* (Hausman) is now known only from Pomoidea. Most of the heteroecious species have an annual cycle. The mem-

bers of this tribe often produce galls on primary host, and these may be small closed leaf galls, spherical, closed brightly coloured galls, bean-shaped closed galls, leaf-roll galls, or bubble-like galls etc. ; galls are usually produced in the spring in temperate region.

A total of 22 species including 12 endemic species under 5 genera are known from the region ; definite and complete heteroecious cycle was known only for *Schizoneurella indica* H.R.L. which alternates between *Ulmus* but *Malus* and the recent finding of *T nigriabdominalis* (Sasaki) in *Ulmus* galls indicates existence of a heteroecious cycle alternating between Ulmaceae and roots of Graminae ; so far this species was only recorded from roots of several secondary hosts of Graminae. Six of the species are known only from Primary hosts and rest from Graminae, Cyperaceae and Pomoidea, indicating a probable anholocyclic life cycle in this region.

Mani (1973) has recorded three aphid species causing ephiphyllous leaf galls on *Ulmus wallichiana* and *Ulmus villosa* (= *laevigata* in Kashmir and Northwest Himalaya ; one of the species has been recorded as "*Schizoneura campistris*", without authors'



Galls on *Ulmus*

1. *Eriosoma* ; 2. *Kaltenbachiella* ; 3. *Tetraneura*.

name, but no such species is otherwise known to this author ; other two species referred by Mani (op. cit) were undetermined. Only one species *Schizoneurella indica* H.R.L. is now definitely known from *Ulmus villosa* in the Northwest region and host of *Eriosoma kashmiricus* Verma, may also be an *Ulmus*. Besides the foregoing species, *Eriosoma lanuginosum* Hartig, has been recorded from *Ulmus* in Afghanistan, as *E. taskhiri* Ghulamullah and *Afghanaphis ulmi* Takahashi.

TABLE 2 : *Hosts of Eriosomatini in Indian Region*

Species	Primary Host	Secondary Host
1. <i>Eriosoma kashmiricus</i> L. K. Ghosh <i>et al.</i>	<i>Ulmus sp.</i>	—
2. <i>Eriosoma lanigerum</i> (Hausmann)	—	Pomoidea
3. <i>Eriosoma (S) lanuginosum</i> Hartig	<i>Ulmus sp.</i>	—
4. <i>Eriosoma (S) longipilosum</i> Chak. & Raychaudhuri	—	Cordifolia
5. <i>Eriosoma (S) phoenax</i> Mordvilko	<i>Ulmus montana</i>	<i>Androctine</i>
6. <i>Eriosoma (S) ulmi</i> (Linne')	<i>Ulmus wallichiana</i>	—
7. <i>Ghariesia polunini</i> Stroyan	—	<i>Carex sp.</i>
8. <i>Kaltenbachiella elsholtriae</i> (Shinji)	—	— —
9. <i>Kaltenbachiella carpinicola</i> Ghosh <i>et al.</i>	<i>Carpinus sp.</i>	—
10. <i>Schizoneurella indica</i> H.R.L.	<i>Ulmus villosa</i>	<i>Malus pumila</i> (Pomoidea)
11. <i>Tetraneura (I) basui</i> H. R. L.	—	Roots of Graminae
12. <i>Tetraneura indica</i> L. K. Ghosh	—	Roots of Graminae
13. <i>Tetraneura (I) javensis</i> v. d. Goot	—	Roots of Graminae

14. <i>Tetraneura kalimpongensis</i> Raychaudhuri <i>et al.</i>	—	Roots of Graminae
15. <i>Tetraneura (I) lambersi</i> Chakrabarti & Maity	—	Roots of Graminae
16. <i>Tetraneura multisetosa</i> Raychaudhuri <i>et al.</i>	—	Roots of Graminae
17. <i>Tetraneura (T) nigriabdominalis</i> (Sasaki)	<i>Ulmus</i> sp.	Roots of Graminae
18. <i>Tetraneura (T) polychaeta</i> H.R.L.	<i>Ulmus villosa</i>	—
19. <i>Tetraneura radicolica</i> Strand	—	Roots of Graminae
20. <i>Tetraneura sikkimensis</i> Raychaudhuri <i>et al.</i>	—	Roots of Graminae
21. <i>Tetraneura ulmi</i> (Linne')	<i>Ulmus</i> sp.	—
22. <i>Tetraneura utpali</i> Chakragarti <i>et al.</i>	—	<i>Apluda mutica</i>

Key to the Genera of ERIOSOMATINI

1. Abdominal tergites with spinal and marginal wax gland groups, pleural glands absent. Tarsi 2 segmented. Media of forewings furcated, hind wings with both obliques. New born larvae never sclerotic, with smooth or spinulose tarsi and with very long, spatulate or short subacute dorso-apical hairs on second tarsal segment. Parthenogenetic viviparae usually on roots of Pomoidea 2
- Abdominal tergites with spinal, pleural and marginal wax gland groups. Tarsi 1-2 segmented. Media of forewings usually simple. New born larvae sclerotic. Parthenogenetic viviparae usually on roots of *Carex*, Labiateae and Grass 3
2. Simphunculi absent in apterous exules and empodial hairs hardly discernible in embryos and exules. Wax glands of two different groups of cells, viz. small, circular

ones between large, indistinct linear cells. Tarsi spinulose. Antennae with secondary rhinaria on segments III-VI in alatae. Siphunculi distinct in apterae and alate vivipare, surrounded by hairs. First tarsal segment, with 2, 2, 2 hairs in exules and 3, 3, 3 or 3, 3, 2 hairs in other morphs. Alternating between *Ulmus villosa* and *Malus pumila*

Schizoneurella Hille
Ris Lambers.

—Siphunculi present in exules and empodial hairs distinct in embryos and exules. Wax glands composed of subcircular cells surrounding a central space. Tarsi spinulose or faintly imbricate. Other characters as above. Usually on Pomoidea also on *Alnus* and *Androctine* in the region.

.Eriosoma Leach S.I.

3. Wax-gland groups composed of even sized cells, without any central space or any hair. Siphunculi absent in apterae. Tarsi 2 segmented in all morphs. Apteræ viviparæ elongate, flagellar segments functional. Primary rhinarium on antennal segment V with an elongated horn shaped plaque directed apicad. Wax gland absent on 8th abdominal segment. First tarsal segments with 3, 2, 2 hairs, on *Carex*

Ghariesia Stroyan.

—Wax glands usually with an irregular or large central space. Siphunculi present in apterae and alatae. Tarsi of 1-2 segmented in apterae. Apteræ never as elongate as above. Primary rhinarium on antennal segment V never with a plaque as above. 8th abdominal tergite usually with wax gland.

.4

4. Primary rhinarium on antennal segment V in apterae, with a strongly transverse bifurcate structure. Antennal segment III in alatae distinctly longer than the other segments. Ultimate rostral segment distinctly shorter than second segment of hind tarsus and with 2-4 accessory hairs. 8th abdominal tergite usually with distinct wax glands. Tibiae and tarsi spinulose; tarsal segments may be indistinct in some instar of apterae. Exules on roots of Labiatae

Kaltenbachiella
Schouteden.

—Primary rhinarium on last antennal segment with trifurcate plaque. Antennal segment III in alatae, equal to segment V. Ultimate rostral segment much shorter than to $1.5\times$ as long as second segment of hind tarsus and with 2-32 accessory hairs. Legs with trochanters feebly fused with femora, tibiae sparsely spinulose ; tarsi one segmented with short stout claws in apterae, 2 segmented in alatae. Exules on roots of Graminae.

Tetraneura Hartig.

1. Genus *Eriosoma* Leach 1818

1818. *Eriosoma* Leach, W.E., *Trans. Hort. Soc. Lond.*, 3 : 60. Type species ; *Eriosoma mali* Leach = *Aphis lanigera* Hausmann.
1831. *Myzoxylus* Blot, F., *Mem. Soc. r. Agric. Comm. Caen.*, 3 : 332. Type species : *Myzoxylus mali* Blot = *Aphis lanigera* Hausmann.

Morphology.—Body 1.5—3.3 mm. long. Head smooth, with or without wax glands, which, when present, composed of a number of facets surrounding a central space. Antennae in apterous exules 5 segmented, $0.12-0.26\times$ as long as the body, in alatae 6 segmented and $0.25-0.40\times$ as long as the body ; secondary rhinaria absent in apterae, annular in alatae and primary rhinaria may be ciliated or not ; hairs on flagellum inconspicuous, upto 0.050 mm. long ; processus terminalis shorter than base of last antennal segment. Eyes in apterae of three ommatidia, large in alatae. Ultimate rostral segment usually slender, nearly equal to $1.5\times$ as long as second segment of hind tarsus and bearing 8—16 accessory hairs. Thorax with segmental wax gland groups in apterae. Abdominal dorsum pale, membranous in apterae, bearing paired, segmental, spinal and marginal wax gland groups, in alatae, dorsum may be dark, sclerotic and without wax glands ; cephalic, thoracic, and abdominal wax gland groups, without any hairs ; 8th tergite with 6—8 hairs. Siphunculi present as mere ring or on slightly elevated base, bearing a few hairs. Cauda rounded, usually bearing 2—4 hairs. Subanal plate rounded. Rudimentary gonapophyses nearly fused to the posterior part of the subanal plate. Subgenital plates with 12—38 hairs. Legs may be smooth or spinulose on tibiae ; first tarsal segments with 3, 3, 3 or 3, 3, 2 hairs ; empodial hairs

almost as long as the tarsal claws. Wing veins often dark, media of the forewing once branched, hind wing with both obliques.

Sexuales are known to be apterous and lack rostrum and siphunculi ; both oviparae and males are much smaller than viviparae (0.11mm. & 0.9mm.).

Embryos and first instar nymphs may have smooth or faintly imbricated tarsi or distinctly spinulose tarsi ; dorso-apical hairs on second tarsal segments may be very long with spatulate apices or short with blunt apices. (Hille Ris Lambers, 1973).

Discussion.—Eastop and Hille Ris Lambers (1976) have listed 18 species under *Eriosoma* Leach s.l. and recognised three subgenera viz. *Eriosoma* leach s.s. with 5 species, three from Nearctic and two from Palaeartic region, *Colophina* Börner 1932, with a single species viz. *clematis* Shinji from Japan, and *Schizoneura* Hartig, 1837 with 12 species, including six which were earlier described under *Eriosoma* s.s., having a wider distribution over Nearctic, Palaeartic and Oriental regions. Six species of *Eriosoma* s.l. including two endemic species are known from the region, five of which belong to *Schizoneura*. Members of *Eriosoma* s.s. are known to form rosette galls on *Ulmus* and their exules form waxy wooly masses on aerial parts and sometimes on the roots of Rosaceae ; the ones which form closed galls on *Ulmus* and migrate to the roots of Rosaceae, Grossulariaceae or Compositae are placed in *Schizoneura* but no satisfactory morphological characters exist to separate *Eriosoma* Leach and *Schizoneura* Hartig. Börner (1930) separated *Eriosoma* by the 5 segmented antennae in fundatrix as against 6 segmented antenna in the fundatrix of *Schizoneura* ; later Börner (1952) and Börner & Heinze (1957) separated *Eriosoma* in having non ciliated primary rhinaria on V of alate, non-spinulose tarsi and capitate dorso apical hairs on 2nd tarsal segment. Hille Ris Lambers (1973) described that following Börner and Börner & Heinze (op. cit.) all palaeartic *Eriosoma* Leach, should belong to *Schizoneura* Hartig and all nearctic *Eriosoma* should belong to *Eriosoma* s.s. Aoki (1976) has given detailed descriptions of first instar larvae of *Colophina elematis* (Shinji) and has also described a second species *arma* from Japan (Aoki, 1977) ; it is noteworthy that *clematis* and *arma* produce a type of larvae,

besides normal exule 1st instar larvae, termed as "Soldiers" due to their distinct character and behaviour and *arma* also produce a "midget" 1st instar larvae distinct from normal larvae and soliders (Aoki, 1977).

Biology.—Most members of this genus are known to alternate between various species of *Ulmus* and roots or aerial parts of Rosaceae and other dicotyledons but many may lead anholocyclic life cycle in Dicots ; often they produce rolled galls in the leaves of primary hosts. Details of biology, even for many well known species, remains to be worked out. Hille Ris Lambers (1968, Aphidologists News letters, 7 (5) : 4-5) pointed out that, the common belief that woolly apple aphid or *Eriosoma lanigerum* migrates from *Ulmus* to *Sorbus* and *Crataegus*, in U.S.A. besides to Apple, is not true. Morphological works have shown that at least 3 species of *Eriosoma* exist on *Cataegus* in U.S.A. and none of these is *E. lanigerum* Hausmann ; similarly the insect on *Sorbus* appears to be similar to one of three species on *Crataegus*, and not to *E. lanigerum*. He further stated that there is no good evidence that *E. lanigerum* from *Ulmus* successfully colonizes apples in U.S.A. although excellent evidence exists to prove that the species migrates from apples to trunks of Elm in the autumn. As mentioned earlier both the species of *Colophina* which are known from *Clematis* spp. in Japan are capable of producing a distinctly different larvae which act as soldiers and defend the colony ; Aoki (1977 a) stated that these larvae neither grow nor reproduce, as the normal exule 1st instar larvae do. This observation is unique in the biological studies of aphids and it is probable that pseudoscorpion type larvae of some Hormaphidinae may play the some role in the colony.

All the above facts only indicate inadequacy of our knowledge about the biology and functional morphology of aphids and Pemphigids, in particular, as the biology of many well known Pemphigids remains a mystery.

Distribution.—Widespread in various zoogeographic areas. Accounts of the members of the genus are available in Baker (1915)—for U.S.A., Börner (1952)—for middle Europe, Danelsson (1980)—for Sweden, Eastop (1966)—for Australia and Tao (1970)—for China.

Type species.—*Eriosoma mali* Leach 1818 = *Aphis lanigera* Leach 1802. Location of types not known.

Key to the species of subgenus *Schizoneura*

Apterous viviparous females (from galls)

1. Antennae 0.17—0.27 × long as the body ; cephalic hairs may be shorter than or up to 1.7 × as long as the basal diameter of antennal segment III, if shorter, then ultimate rostral segment shorter than second segment of hind tarsus. Empodial hair 0.66 × as long as the claws .2

—Antennae 0.36—0.40 × as long as the body ; cephalic hairs 0.75—1.0 × as long as the basal diameter of antennal segment III. Ultimate rostral segment never shorter than second segment of hind tarsus. Empodial 0.20—0.48 × as long as the claws .3

2. Cephalic hairs 0.05 mm. long, 1.7 × as long as the basal diameter of antennal segment III. Antennae 0.17 × as long as the body ; antennal hairs upto 0.02 mm. long, 0.70 × as long as the basal diameter of segment III. Ultimate rostral segment 2.1 × as long as second segment of hind tarsus and bears at least 20 accessory hairs. Dorsal cephalic hairs 0.03-0.04 mm. long, 1.1–1.3 × as long as the basal diameter of antennal segment III.

E. (S.) kashmiricum
L. K. Ghosh, *et al.*

—Cephalic hairs 0.02-0.04 mm. long, 0.05-0.73 × as long as the basal diameter of antennal segment III. Antennae 0.20-0.27 × as long as the body ; antennal hairs 0.006-0.016 mm. long, 0.13-0.33 × as long as the basal diameter of segment III. Ultimate rostral segment 0.76-0.79 × as long as the second segment of hind tarsus and bears only 4 accessory hairs. Dorsal cephalic hairs 0.016-0.050 mm. long, 0.33-0.93 × as long as the basal diameter of antennal segment III.

E. (S.) ulmi Linn.

3. Ultimate rostral segment with 8 accessory hairs. Dorsal abdominal hairs 0.02-0.05 mm. long, 0.75-1.7 \times as long as the basal diameter of antennal segment III. Subanal plate with about 10 hairs. Empodial hair 0.013 mm long, upto 0.20 \times as long as the claws

.*E. (S.) lanuginosum*
(Hartig)

- Ultimate rostral segment with 12-14 accessory hairs. Dorsal abdominal hairs 0.03-0.07 mm. long, 0.47-1.1 \times as long as the basal diameter of antennal segment III. Subanal plate with 20 hairs. Empodial hair 0.023-0.026 mm. long, 0.38-0.48 \times as long as the claws

E. (S.) phaenax
Mordvilko

Alate viviparous females (from galls)

1. Ultimate rostral segment shorter than (0.77-0.83 \times) second segment of hind tarsus. Antennal segment V without secondary rhinaria. Abdominal dorsum often with distinct transverse sclerotic bands. Subanal plate with 18-22 hairs

2

- Ultimate rostral segment longer than (1.0-1.23 \times) second segment of hind tarsus. Antennal segment V always with secondary rhinaria. Abdominal dorsum either completely pale or with pale broken bands. Subanal plate with 10-18 hairs.

.3

2. Antennal segment III with 22-37 secondary rhinaria. Ultimate rostral segment with 18-20 accessory hairs. Dorsal abdominal hairs 0.02-0.05 mm. long, 1.1-2.3 \times as long as the basal diameter of antennal segment III

.*E. (S.) kashmiricum*
L. K. Ghosh *et al.*

- Antennal segment III with 40-45 secondary rhinaria. Ultimate rostral segment with 4 accessory hairs. Dorsal abdominal hairs 0.016-0.026 mm. long 0.83-1.3 \times as long as basal diameter of antennal segment III

.*E. (S.) ulmi* Linn

3. Ultimate rostral segment with 8 secondary hairs. Antennal segment III with 25-28, IV with 6-8, V with 6-8 secondary rhinaria. Subgenital plate with 30-31 hairs and subanal plate with 10-11 hairs. Empodial hair $0.25\times$ as long as the tarsal claws.

E. (S.) lanuginosum
(Hartig)

Ultimate rostral segment with 12-15 accessory hairs. Antennal segment III with 40-45, IV with 10-14, V with 10-12 secondary rhinaria. Subgenital plate with 16 hairs and subanal plate with 18 hairs. Empodial hair $0.38-0.48\times$ as long as the tarsal claws

E. (S.) phaenax
Mordvilko

1. ***Eriosoma (Schizoneura) kashmiricum*** L. K. Ghosh, Verma, Raychaudhuri

(Figs. 4-13)

1976. *Eriosoma kashmiricum* L. K. Ghosh, Verma, K. D., Raychaudhuri, D. N., *Oriental Ins.*, 10 (4) : 530.
1980. *Eriosoma kashmiricum* Bhattacharya, D. K., Maity, S. P., Chakrabarti, S. *Entomon*, 5 (4) : 337.

Apterous viviparous female.—Body 2.8 mm. long with 1.99 mm. maximum width. Head dark brown bearing two pair of pale wax plates placed anteriorly and cauded ; dorsal cephalic hairs fine, about 10-12 in number, upto 0.05 mm. long, $1.7\times$ as long as the basal diameter of antennal segment III. Antennae brown, 6 segmented, $0.17\times$ as long as the body ; segment I and II roughened ; flagellum spinulose from apical 0.30 portion of segment III, apicad ; hairs on the flagellum short, on segment III upto 0.02 mm. long, $0.7\times$ as long as the basal diameter of the segment ; primary rhinaria on segment IV and V ciliated ; processus terminalis little over half the base of last antennal segment. Rostrum reaches mid coxae , ultimate rostral segment $2.1\times$ as long as second segment of hind tarsus and bears about 20 hairs. Abdominal dorsum pale, faintly spinulose ; hairs on the dorsum of abdomen long, on anterior tergites about 0.03 mm. long, on posterior tergites 0.044 mm. long, these being $1.1\times$ and $1.2-1.3\times$ as long as the basal diameter of antennal segment III respectively. Wax plates not discernible.

Siphunculi absent. Cauda broad with few fine hairs. Subgenital plate with 18 hairs, 3-4 of which are longer and arranged in an anterior row. Subanal plate with about 20 hairs. Legs stout, pale yellow ; tronchanter and femora partly differentiated ; hairs on femora and tibiae fine, thin and stiff, longest one on hind tibiae 0.03 mm. long, $0.60\times$ as long as the diameter at the middle of the tibiae ; first tarsal segments with 2, 2, 2 hairs ; empodial hair thin, flagellate 0.026 mm. long, $0.66\times$ as long as the claws.

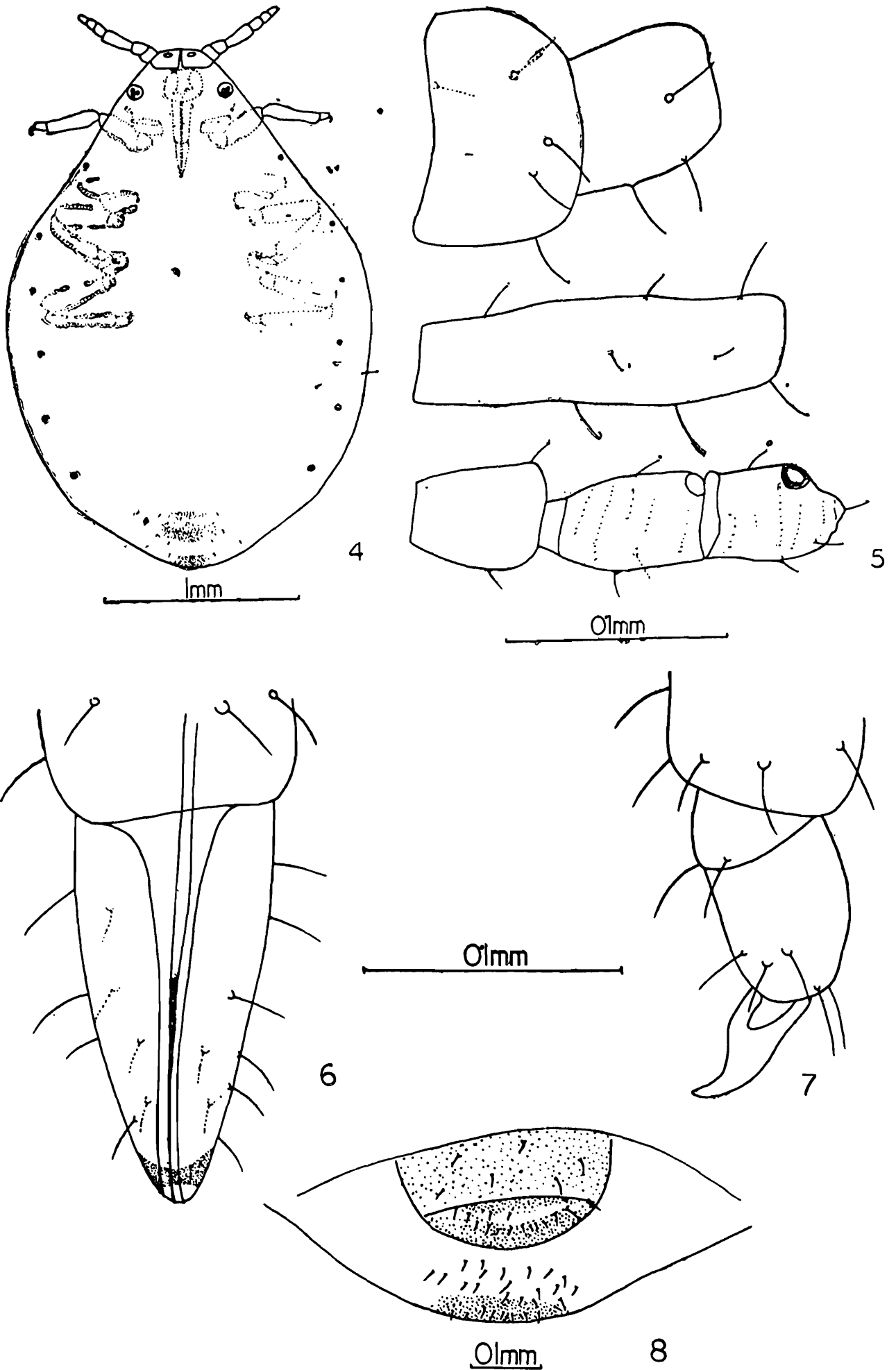
Colour.—Not recorded.

Measurements in mm.—

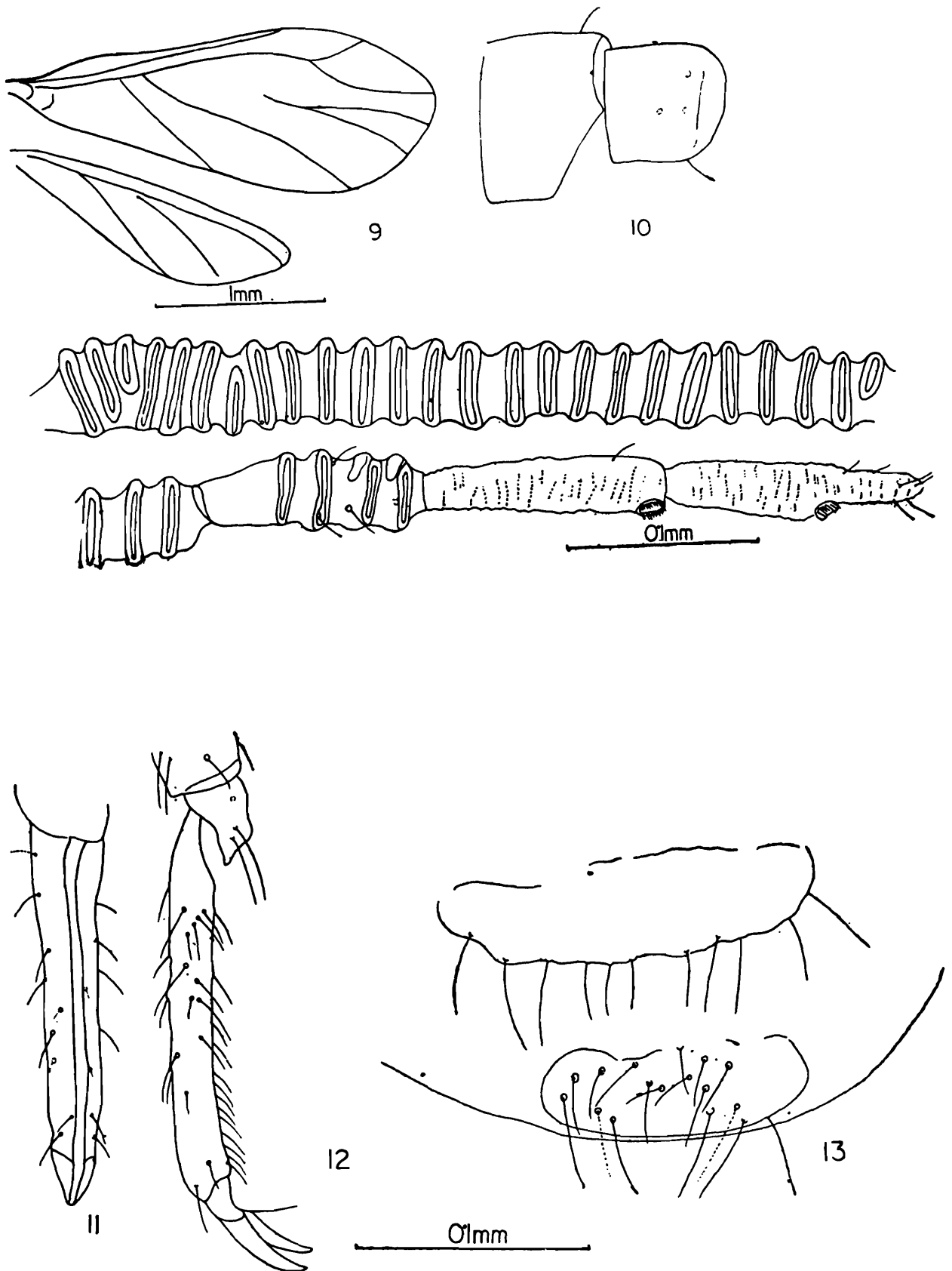
Length		Width		Antenna	
2.76		1.99		0.48	
Antennal segments					
III	IV	V	VI	urs.	ht ₂
0.16	0.05	0.06	0.05	0.15	0.07

(ex *Ulmus* gall, Ghangharia, U.P., INDIA, 10.6.1978, coll. S. Chakrabarti)

Alate viviparous females.—Body 1.9—2.6 mm. long with 0.75—1.17 mm. as maximum width. Head brown to black without any apparent wax plate ; dorsal cephalic hairs upto 0.016—0.018 mm. long, $1.0—1.20\times$ as long as the basal diameter of antennal segment III. Antennae brown, 6 segmented, $0.43—0.56\times$ as long as the body ; flagellum feebly imbricated, spinulose on segment V and VI ; hairs on the flagellum fine, sparse, on segment III, 0.006—0.018 mm. long, $0.28—0.60\times$ as long as the basal diameter of segment ; segment III, $1.0—1.3\times$ as long as segments IV+V+VI together and bears 22-27 linear secondary rhinaria ; segment IV subequal to V and VI and bears 4-10 similar rhinaria ; primary rhinaria ciliated ; processus terminalis $0.30—0.46\times$ as long as the base of antennal segment VI. Rostrum reaches near mid coxae ; ultimate rostral segment $0.83-0.94\times$ as long second segment of hind tarsus and bears about 18—20 accessory hairs. Abdominal dorsum pale, with some large brown spinopleural and marginal



Eriosoma (Schizoneura) kashmiricum L. K. Ghosh, Verma, Raychaudhuri ;
 Apterous viviparous female (from galls) : 4. whole body ; 5. antenna ;
 6. ultimate rostral segment ; 7. hind tarsus ; 8. posterior portion of
 abdomen.



Alate viviparous female (from galls) : 9. wings ; 10. antenna ; 11. ultimate rostral segment ; 12. hind tarsus ; 13. posterior portion of abdomen.

sclerites which may fuse to form transverse sclerotic bands, specially on 2nd-6th tergites ; hairs on the dorsum of abdomen short, on anterior tergites 0.02-0.05 mm. long, on posterior tergites upto 0.04-0.05 mm. long, these being 1.14—2.28 \times and 2.14—2.50 \times as long as the basal diameter of antennal segment III, respectively. Siphunculi on elevated base and with a distinct rim surrounded by 8—11 hairs. Cauda small with 2 hairs. Subgenital plate spinulose, with about 14-15 hairs. Subanal plate with about 18 hairs. Legs slender ; femora and tibiae smooth except at apices of tibiae, which are spinulose ; tarsi with spinulose striae , hairs on femora and tibiae fine, stiff, longest one on hind tibiae, 0.04—0.06 mm. long 1.2—1.6 \times as long as the diameter at the middle of the tibiae ; first tarsal segments with 3, 3, 3 or 3, 3, 2 hairs ; empodial hair 0.02—0.03 mm. long, 0.4—0.5 \times as long as the claws. Forewings with media once branched ; hind wings with both obliques.

Colour.—Not recorded.

Measurements in mm.—

	Length	Width	Antenna		
1.	1.86	0.89	1.05		
2.	2.10	0.97	0.99		
3.	2.16	1.03	0.95		
4.	2.13	0.97	0.96		
5.	2.57	1.07	1.20		
	Antennal segments			urs.	ht ₂
III	IV	V	VI		
0.54	0.13	0.13	(0.10+0.05)	?	0.18
0.44	0.13	0.14	(0.10+0.03)	0.15	0.18
0.52	0.13	0.14	(0.10+0.05)	0.16	0.18
0.40	0.13	0.14	(0.10+0.03)	0.15	0.18
0.62	0.16	0.13	(0.09+0.04)	0.16	0.19

(1-4, ex ? *Alnus* sp., Srinagar, Jammu & Kashmir, INDIA, 4.6. 1965, coll. K. D. Verma (Types) : 5, ex *Ulmus* sp., Ghangaria, U.P., INDIA, 10.6.1978, coll. S. Chakrabarti).

Other morphs.—Not known.

Material examined.—Four alate viviparous females from ? *Alnus* sp., Srinagar, Jammu & Kashmir, INDIA, 4.6.1965, coll. K. D. Varma (Types); Six alate viviparous females, one apterous viviparous female and two nymphs from leaf galls of *Ulmus* sp., Ghangharia, Uttar Pradesh, INDIA, 10.6.1978, coll. S. Chakraborti (S. Chakraborti's collections, Kalyani University).

Discussion.—This species was described from four alates from Kashmir, collected from a host perhaps erroneously identified as *Alnus*; further material consisting of alatae and apterae, from spiral leaf galls of *Ulmus* were collected in the same month from Uttar Pradesh; the latter material, however, appears to be larger in body size and antenna and show longer hairs on flagellum, larger number of secondary rhinaria on both segment III and IV (and even may possess a single secondary rhinarium on V), longer ratio of ultimate rostral segment to second segment of hind tarsus and larger number of accessory hairs on ultimate rostral segment; the apterae can also be correlated with alatae in the number of rostral hairs. It may be noted that original description states that antennae $1.7-2.2\times$ as long as the body but measurements show otherwise and obviously the error has crept in during conversion. A careful re-examination of both type series and additional material indicates that exact number of hairs on ultimate rostral segment in Holotype and Paratypes was perhaps not definitely ascertained due to faulty mounting; the species, as such, could be distinguished from related ones in having large number of accessory hairs on ultimate rostral segment, large number of secondary rhinaria and sclerotic pattern on abdomen in the alatae.

Distribution.—INDIA (Kashmir, Uttar Pradesh).

Types.—In the collection of Dr. L. K. Ghosh, Zoological Survey of India, Calcutta.

2. *Eriosoma lanigerum* (Hausmann) (Figs. 14-23)

1802. *Aphis lanigerum* Hausmann, J. F. L., *Illigers' Mag. Insekt.*, 1 (3-4) : 440.
1803. *Coccus mali* Bingley, W., *Animal Biography*, 3 : 200.

1816. *Aphis lanata* Salisbury, "Hints addressed to Proprietors of orchards etc"., 36.
1818. *Eriosoma lanigerum*, Becker, Geo, G., *Bull. Univ. Arkan. Agr. Exp. Stn.*, 154 : 3.
1818. *Aphis mali* Leach, W. E., *Trans. R. Hort. Soc. Lond.* 3 : 60.
1831. *Myzoxylus mali* Blot, F., *Mem. Soc. R. Agric. Com. Can.*, 3 : 332.
1841. *Schizoneura lanigerum* Hartig, Th., *Germars' Zeit. f. Ent.*, 3 : 367.
1909. *Schizoneura lanigerum*, Lefroy, H. M., *Indian Insect Life*, 748 pp.
1943. *Eriosoma lanigerum*, Fotedar, M. R., and Kapur, A.P., *Curr. Sci.*, 12 : 84.
1953. *Eriosoma lanigerum*, Cottier, W., *Bull. N. Z. Dep. Scient. Ind. Res.* 106-332.

Apterous viviparous female.—Body 1.93—2.0 mm. long with 1.24—1.38 mm. as maximum width. Head with 6-10 dorsal wax plates, of which few may be composed of 2-3 cells, rest with a clear central space surrounded by 6-10 cells. Antennae pale yellow, 6 segmented. 0.21—0.24× as long as the body ; flagellum with fine spinulose striae ; segment III longest, much longer than IV+V taken together ; hairs on flagellum sparse, on segment III 0.006-0.01 mm. long, 0.37-0.40× as long as the basal diameter of the segment ; primary rhinaria ciliated ; processus terminalis 0.35-0.40× as long as base of antennal segment VI. Rostrum reaches mid-coxae ; ultimate rostral segment 1.40-1.56× as long as second segment of hind tarsus and bears 7-10 accessory hairs. Thoracic tergum with 4 wax plates on each of the segments. Abdominal dorsum pale, bearing 4 wax plates (2 spinal and marginal) on each of 1st-7th tergites ; 8th tergite with 2 small spinal wax plates ; hairs on the dorsum of abdomen fine, 0.02-0.03 mm. long, 0.62-1.2× as long as the basal diameter of antennal segment III. Siphunculi present as mere pore, surrounded by few hairs. Cauda small, semilunar, with 2 hairs. Subanal plate with 32-34 hairs. Subgenital plate with 16-21 hairs. Legs pale brown ; hairs on femora and tibiae fine, longest one on hind tibiae 0.03-0.04 long, 0.7-0.8× as long as the diameter at the middle of the tibiae ; first tarsal segments with 3, 3, 3 hairs ; empodial hair 0.02 mm. long, 0.6× as long as the claws.

Colour.—Body dusky, reddish-brown covered with white floccous secretion.

Measurements in mm.—

	Length	Width	Antenna
1.	1.93	1.38	0.38
2.	2.0	1.30	0.48
3.	1.93	1.24	0.41
4.	?	?	0.48

III	Antennal segments			urs.	ht ₂
	IV	V	VI		
0.12	0.03	0.07	(0.05+0.02)	0.15	0.10
0.18	0.05	0.07	(0.05+0.02)	0.15	0.11
0.13	0.04	0.06	(0.06+0.02)	0.15	0.10
0.19	0.06	0.07	(0.06+0.02)	0.16	0.11

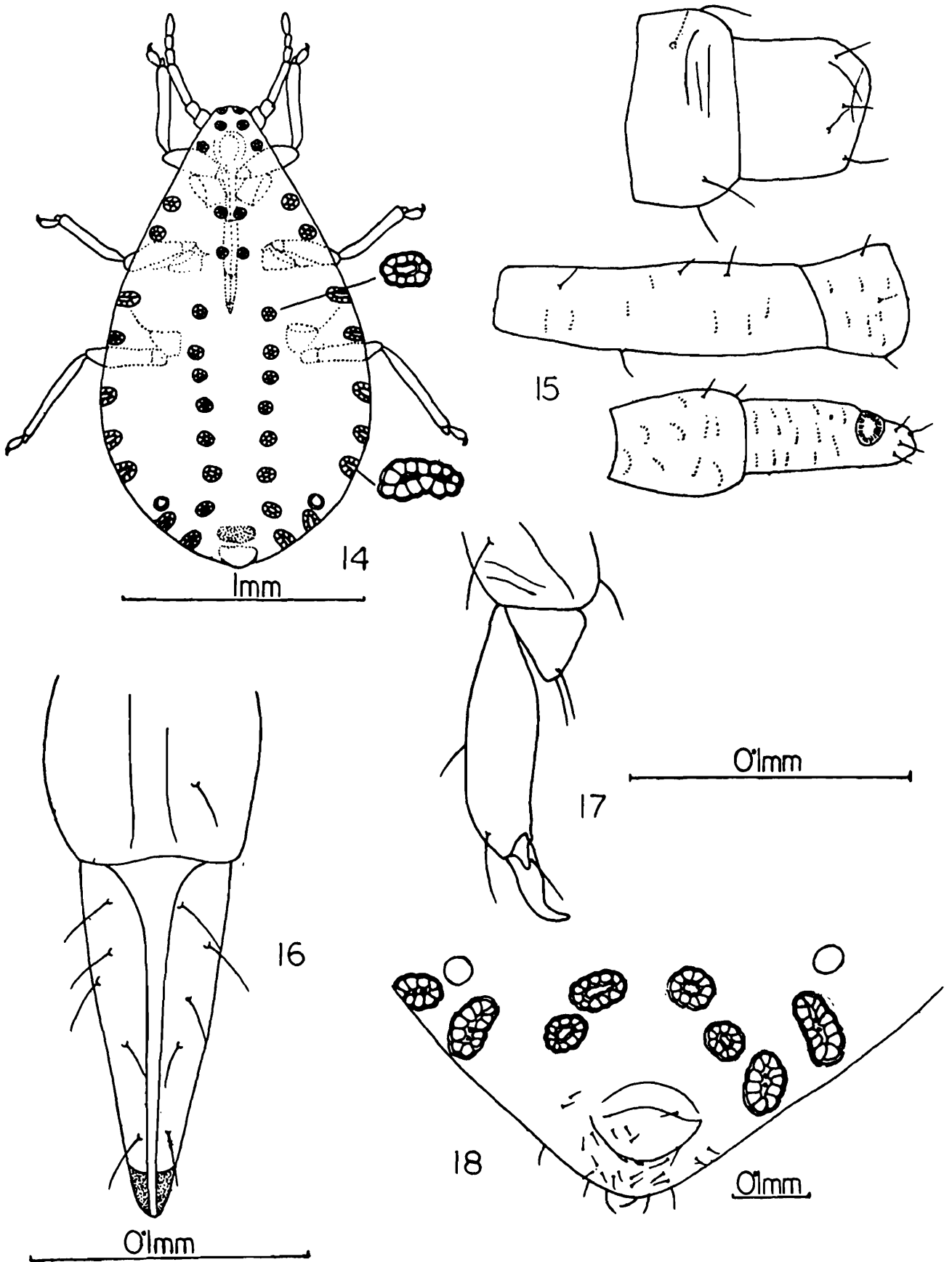
(1, 2, ex *Pyrus malus*, Srinagar, INDIA, 11.11.1968, coll. K. Narayanan ;

3, ex *Pyrus malus*, Shillong, INDIA, 9.7.1973, coll. J. Sen ;

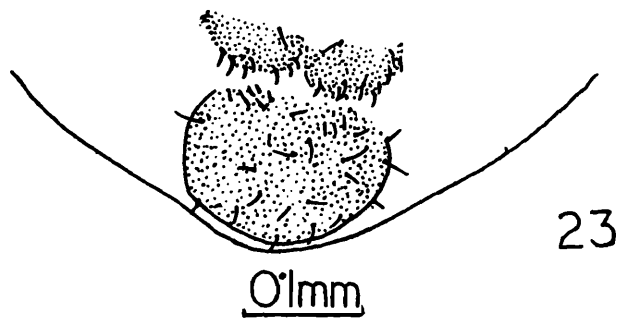
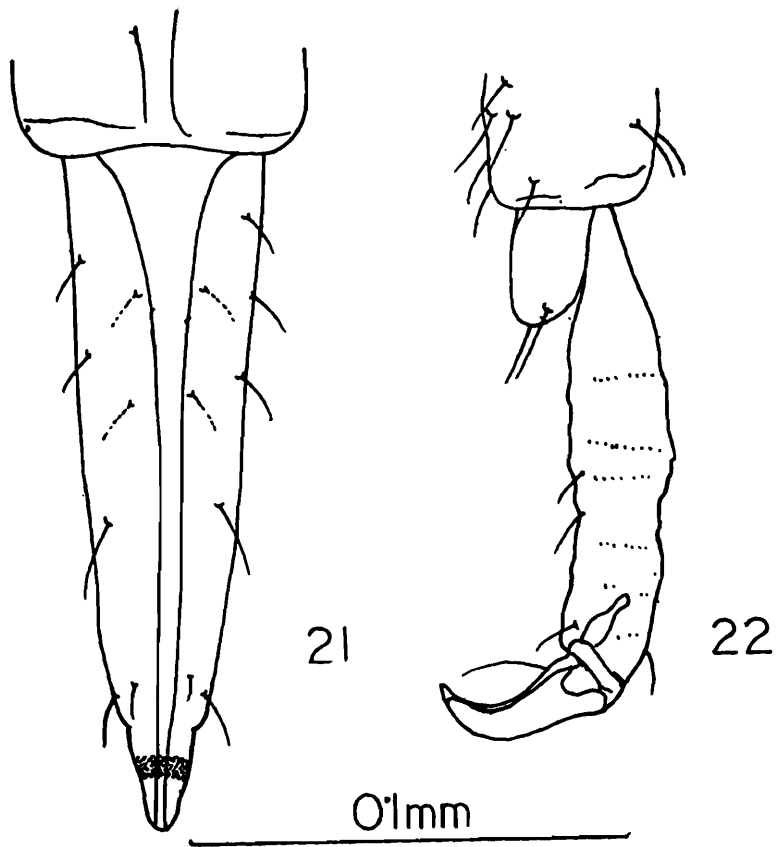
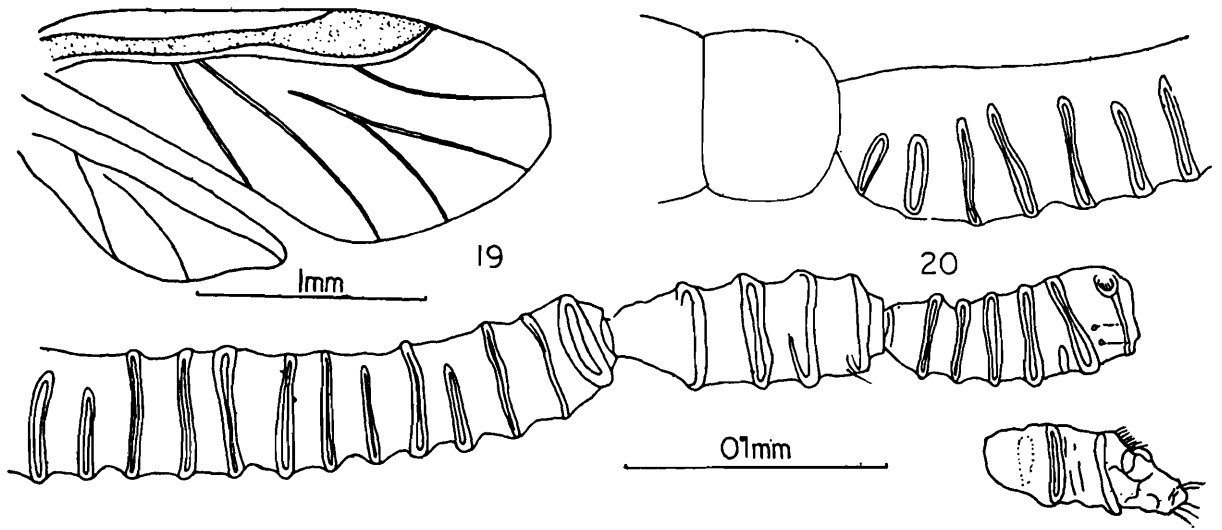
4, ex *Pyrus polycarpa*, Shillong, INDIA, 18.7.1972, coll. A. C. Sukla).

Larva (from Palmer, 1952). : Body 0.65-0.75 mm. long. Antennae 5 segmented, 0.27 mm. long. Very dark to dusky green in life. Hibernates under bark of apple tree.

Alate viviparous female.—Body elongate (mean length 1.7 mm.). Head flat, smooth ; dorsal cephalic hairs minute. Antennae 6 segmented, 0.40× as long as the body ; segment III longer than IV+V+VI taken together and bears 19-20 (15-20) linear secondary rhinaria ; segment IV with 4-6 (3-6), V with 4-6 (3-6) and basal part of VI with a single secondary rhinaria ; base of segment III imbricate, rest of the flagellum with fine spinulose imbrications ; hairs on flagellum fine, on segment III, 0.006-0.010 mm. long. 0.33-0.83× as long as the basal diameter of the segment ; processus terminalis 0.28× as long as base of segment VI. Rostrum reaches mid coxae ; ultimate rostral segment 1.3-1.4× as long as second segment of hind tarsus and bears about 10 accessory hairs. Abdominal dorsum with paired marginal wax plates on 1st-8th tergites, besides small, paired, spinal wax plates, which may be difficult



Eriosoma lanigerum (Hausmann) ; Apterous viviparous female :
 14. whole body ; 15. antenna ; 16. ultimate rostral segment ; 17. hind
 tarsus ; 18. posterior portion of abdomen with wax glands.



Alate viviparous female : 19. wings ; 20. antenna ; 21. ultimate rostral segment ; 22. hind tarsus ; 23. posterior portion of abdomen.

to distinguish ; hairs on the dorsum of abdomen 0.01-0.03 mm. long $0.66-2.0\times$ as long as the basal diameter of antennal segment III. Siphunculi with dark chitinised rim, surrounded by few hairs. Cauda sclerotic, semilunar with 2 hairs, subanal plate with 32 hairs. Subgenital plate with 22-24 (14-16) hairs. Legs long, slender, brownish ; longest hair on hind tibiae 0.02-0.03 mm. long, $0.55-0.80$ as long as the diameter at the middle of tibiae ; first tarsal segments with 3, 3, 3 hairs, empodial hair 0.02-0.03 mm. long, $0.6-0.7\times$ as long as the claws.

Colour.—Blackish in life, covered with white powdery wax.

Measurements in mm.—

	Length		Width	Antenna	
1.	?		?	0.74	
2.	?		?	0.82	
	Antennal segments			urs.	ht ₂
III	IV	V	VI		
0.34	0.10	0.10	(0.07+0.02)	0.16	0.12
0.38	0.12	0.12	(0.07+0.02)	0.17	0.12

(1, 2, ex *Cotoneaster horizontalis*, Leatherhead, Surrey, ENGLAND, 6.11.1966, BMNH collections).

Sexual forms.—(Not examined ; from Fotedar & Kapur, 1943 ; Palmer, 1952 and Cottier, 1953).

Ovipara.—Apterous. Body 0.7-0.9 mm. long. Antenna 5 segmented, 0.03-0.06 mm. long, slightly roughened, all segments subequal to one another but usually segment V longer than others. Rostrum absent. Siphunculi not visible.

Colour.—Reddish brown or dusty yellow.

Male.—Apterous. Body 0.5-0.7 mm. long. Antennae 5 segmented, each segment with several small hairs ; segment III subequal

to segment V (0.07-0.08 mm. long) ; length of segments ; I : 0.03-0.04, II : 0.03-0.04, III : 0.07, IV : 0.05, V : 0.07-0.08 mm. Rostrum absent. Siphunculi not visible. Abdomen hairy on terminal segments ; claspers small, curved, aedeagus protruding in between.

Colour.—Reddish brown with purplish tinge.

Note.—Fotedar & Kapur (1943) mentioned that sexupara lay 4-7 nymphs during October-November during a span of 6 days, which turn into male and ovipara ; each of these moult 4 times, male is short lived (12 days) and the ovipara live for about 20 days. The ovipara die at or immediately after laying a single egg, which is 0.32 mm. long, ovoid and light brown in colour.

The species is believed to be heteroecious in North America and form curled terminal leaf clusture on *Ulmus americana* but Hille Ris Lambers (1968) has expressed his doubt on its identity ; the description of different morphs on *Ulmus americana* in North America has been provided by Palmer (1952) as follows :

Fundatrix.—Body 2.0-2.6 mm. long ; antennae 0.46-0.55 mm. long. Rostrum reaches mid or hind coxae. Hind tibia 0.36-0.40 mm. long.

Colour.—Dark slaty, nearly black.

Nymph.—Yellowish brown to cinnamon brown, with head, prothorax, caudal region and legs dusky to black, covered with heavy wax-secretion.

Apterous viviparous female.—(2nd generation). Body 2.5 mm. long. Head with prominent wax plates. Antennae 0.82-1.0 mm. long. Rostrum reaches second coxae, ultimate rostral segment 0.20 mm. long. Siphunculi present as mere rings, 0.06-0.07 mm. in diameter, with few hairs on chitinised base.

Colour.—Pink in life with head, antennae and caudal region dusky, remains covered with waxy secretion.

Nymph.—New born larvae appear very pale yellow with dusky head and appendages and dorsum covered with waxy secretion ; after the larvae start feeding, colour change to rusty brown.

Alate viviparous female (*Fundatrigenia migrants*).—Body 2.2 mm. long. Antennae 0.82-1.0 mm. long, with 22-27 linear secondary rhinaria on segment III, and 4-7 and 5-6 similar ones in IV and V respectively ; flagellum with spinulose striae ; length of antennal segments III : 0.37-0.46, IV : 0.10-0.14, V : 0.11-0.13, VI : (0.07-0.08 0.02). Rostrum reaches between fore and mid coxae ; ultimate rostral segment 0.15-0.18 mm. long, equal to second segment of hind tarsus and with 14-16 accessory hairs. Siphunculi present as ring on slightly raised bases, surrounded by a few hairs ; siphuncular pore 0.05-0.06 mm. in diameter. Hind tibia 0.75-0.86 mm. long with a number of fine hairs.

Note.—Palmer (1952) has mentioned that the species is not very common on *Ulmus* ; fundatrices were collected from the end of April to last part of June and apterous viviparae and alate vivipare were collected during middle of May to end of July. The Elm trees appear deserted after July, when evidently the migrants return to Apple trees.

Material examined.—4 apterous viviparous female from Apple Trees, Laban, Shillong, Meghalaya, INDIA, 12.4.1968, coll. *S. Biswas* ; 18 apterous viviparous females from Apple tree, Fruit Garden, Shillong, Meghalaya, INDIA, 9.7.1973, coll. *J. Sen* ; 7 apterous viviparous female and 3 nymphs from *Pyrus polycarpa*, Risa Colony, Shillong, Meghalaya, INDIA, 18.8.1972, coll. *A. C. Sukla* ; one apterous viviparous female from *Pyrus malus*, Coonor, INDIA, 16.7.1952, coll. *S. K. David* ; 2 apterous viviparous females from *Pyrus malus*, Srinagar, Jammu & Kashmir, INDIA, 11.11.1968, coll. *K. Narayanan* ; one apterous and two alate viviparous females from *Cotoneaster horizontalis*. Leatherhead, Surrey, ENGLAND, 6.11.1966, coll. *J. Banks* (BMNH collections).

Discussion.—The species, originally, a heteroecious one had a cycle involving alternation between Elm trees and Apples and also other Rosaceae , but the heteroecious holocycle is now only known to exist in North America where, along with *E. americanum* (Riley),

E. craetegi (Oestland), and *E. rileyi* (Thomas), it is known to feed on *Ulmus americana* during April to July and on *Pyrus malus* between June to October but this has been contradicted by Hille Ris Lambers (1968). In most other parts of the World, where the species is now distributed, it remains confined to a monoecious cycle (holocycle or anholocycle) on *Pyrus malus*. Described by Hausmann (1802), the species was found well settled in India as far back as in 1891 and is now widely known as major apple-pest in all Apple growing areas in the North and in the southern part. Fotedar and Kapur (1943) described in brief about its life cycle in Kashmir. According to them, apterae on apple, produces alate forms in May-July which disappear after July and sexuparous alatae return to the host plant during August-November in large number and produce arostrate gamic forms. The female lay egg near the crown of the root of the apple tree, these being light brown in colour and 0.32 mm. long and ovoid ; this cycle on apple resemble closely with the one described by Palmer (1952) for *E. lanigerum* in U.S.A.

Baker (1915) has given a detailed account of biology of wooly apple aphid and compared the morphology of closely related *Ulmus* feeding *Eriosoma* in North America. Palmer (1952) and Cottier (1953) have described the species from U.S.A. and New Zealand, the latter being more extensive but includes morphs only from apple. Hoyt and Madsen (1960) have described the dispersal behaviour of first instar nymph of *lanigerum*.

Aphelinus mali Haldm, a parasite is now known as a major control agent for *E. lanigerum*, being introduced in several zoogeographic areas of distribution of the pest. Fulmek (1957) has listed 14 coccinellid predators of *lanigera* from California and South Africa, and Behura (1963) has listed *Adonia variegata* (Geoze) *Ballia eucharis* Muls. *Chiloconis bijugus infernalis* Muls. *Coccinella septempunctata* Linn., (Coccinellidae) besides two Neuroptera and one Syrphid predator of *lanigerum* in INDIA.

Distribution.—Cosmopolitan.

Types.—According to Palmer (1952) the type is deposited in United States National Museum, Washington, (No. 59324) and

Paratypes in Colorado Exp. Station collections but Louise M. Russell (in *litt.*) informed that "the type material of *E. lanigerum* is not in U.S.N.M. ; the type number 59324 should not be associated with this species"

3. *Eriosoma* (*Schizoneura*) *lanuginosum* (Hartig) (Figs. 24—34)

1849. *Schizoneura lanuginosum* Hartig, Th., *Germar's Z. Ent* , 3 : 367.
 1775. *Aphis ulmi* Fabricius, J. C., *Syst. Ent.*, : 738.
 1884. *Schizoneura piri* Goethe, H., *Pomol. Monatsh* , 10 (30) : 81.
 1942. *Eriosoma taskhari* Gulamullah, *Indian J. Ent* , 3 : 237.
 1953. *Eriosoma lanuginosum*, Cottier, W., *Bull. N. Z. Dep. Scient. Ind. Res.*, 106 : 336.
 1966. *Afghanaphis ulmi* Takahashi, R., *Results of Kyoto Univ. Scient. Expd. to Karakorum and Hindukush*, 1955, 8 : 267.

(This species was described as a new species, *E taskhari* by Gulamullah (1942) from Afganisthan. Specimens from the region were not available ; described from specimens collected on *Ulmus* galls in England & Hungary, BMNH collections)

Apterous viviparous female.—Body 2.09-2.41 mm. long, with 1.3-1.5 mm. as maximum width. Head dark sclerotic, with a pair of wax plates and some scattered cells ; dorsal cephalic hairs 0.053 mm. long, equal to the basal diameter of antennal segment III. Antennae stout, dark brown, 6 segmented, 0.36-0.41× as long as the body ; flagellum with fine spinulose striae ; hairs on the flagellum fine, stiff, sparse, on segment III, 0.013-0.030 mm. long, 0.25-0.56× as long as the basal diameter of the segment ; primary rhinaria subcircular, small, ciliated ; processus terminalis 0.20× as long as base of segment VI. Eyes of 3 facets. Rostrum reaches mid coxae ; ultimate rostral segment slender, 1.36-1.46× as long as the second segment of hind tarsus and bears 8 short, stiff, accessory hairs. Abdominal dorsum pale, membranous, with segmentation distinct ; hairs on the dorsum of abdomen conspicuous, with subacute to acute apices, 0.026-0.050 mm. long, 0.75-1.7× as long as the basal diameter of antennal segment III. Wax glands not visible. Siphunculi with incomplete rim around pores, little elevated and surrounded by a few hairs. Cauda semilunar with 2-3 hairs. Subanal plate with 9-10 hairs. Subgenital plate with

21-24 hairs. Legs brownish, stout ; femora and tibiae with spinulose striae ; hairs on the femora and tibiae stiff, longest one on hind tibiae 0.03-0.04 mm. long, 0.7-0.8 \times as long as the diameter at the middle of tibiae ; first tarsal segments with 2, 2, 2 or 2+1, 2+1, 2+1 hairs ; empodial hair 0.013 mm. long, 0.20 \times as long as the claws.

Colour.—Body greyish green covered with mealy waxy powder (Cottier, 1953).

Measurements in mm.—

	Length	Width	Antenna		
1.	2.41	1.51	0.89		
2.	2.09	1.32	0.87		
	Antennal segments			urs.	ht ₂
	III	IV	V	VI	
	0.35	0.14	0.14	(0.083+0.016)	0.178 0.130
	0.37	0.14	0.12	(0.083+0.016)	0.178 0.134

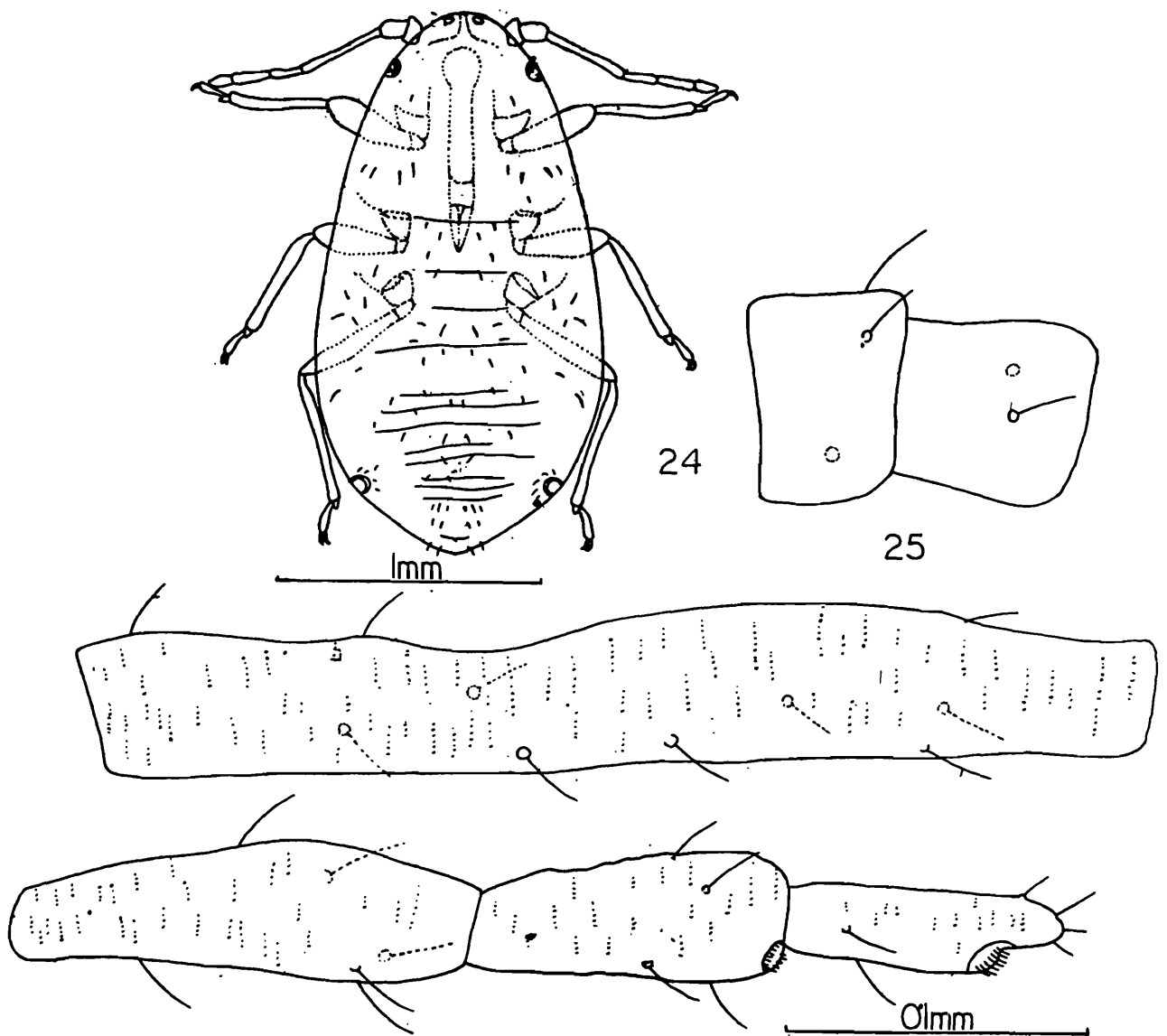
(1, ex *Ulmus campestris*, Balaton, Fured, HUNGARY, 26. 6. 1965, BMNH 538/65 ;

2, *Ulmus* galls, Herts, Ware, ENGLAND, 13. VII. 1965, BMNH 364/65).

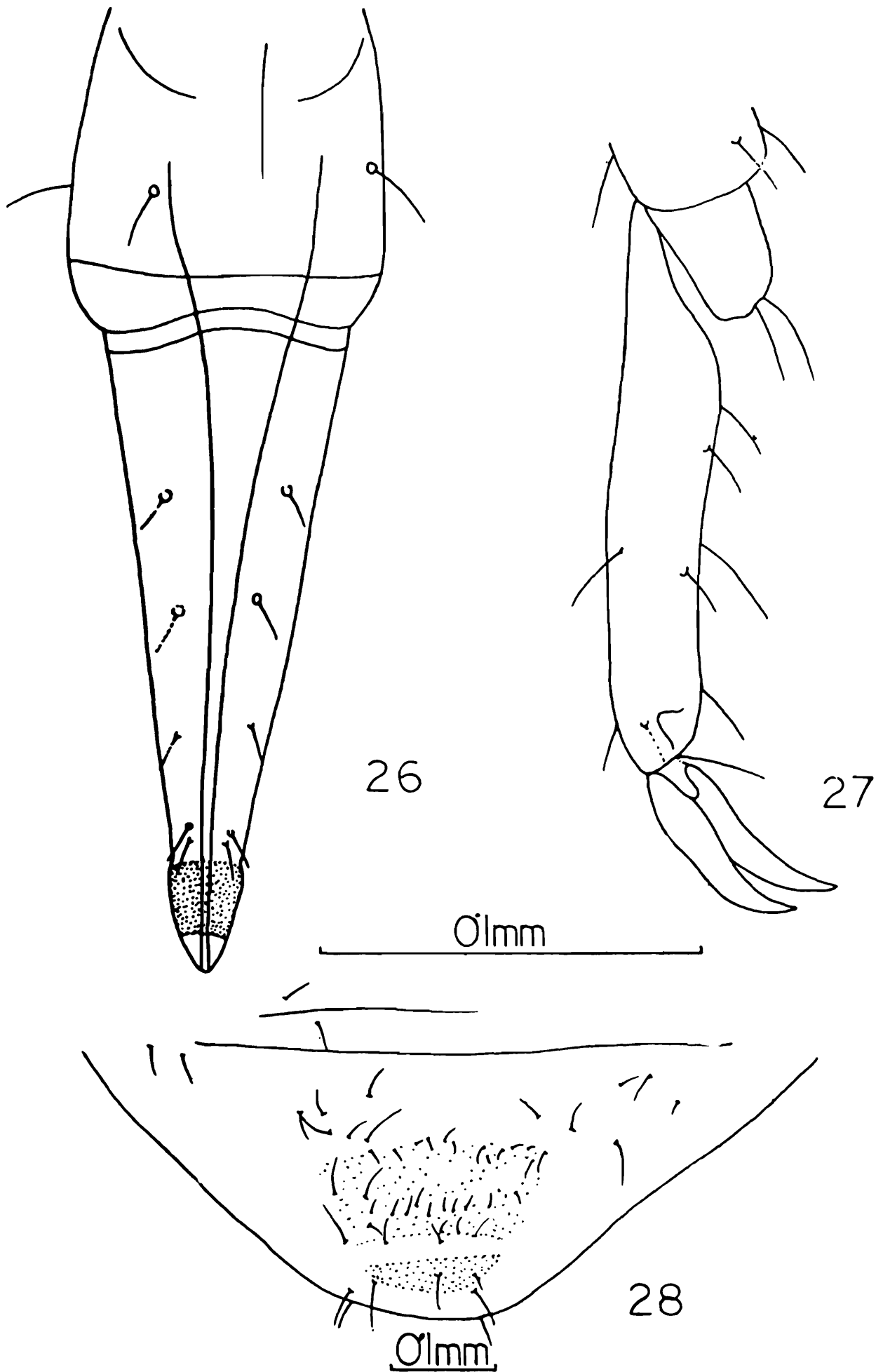
Nymph (Early stage).—Body 1.13 mm. long with 0.49 mm. as maximum width. Head with a dusky brown sclerotic shield ; dorsal cephalic hairs 0.030-0.040 mm. long, 0.75-0.80 \times as long as the basal diameter of antennal segment III. Antennae 6 segmented, pale on segment III, rest pale brown, 0.28 \times as long as the body ; flagellum with fine spinules, densely so on V and VI ; hairs on the flagellum fine, on segment III 0.016-0.020 mm. long, at most 0.50 \times as long as the basal diameter of the segment. Rostrum broken.

Dorsum of thorax and abdomen pale, membranous ; hairs on the dorsum of abdomen long, fine, 0.033-0.040 mm. long, nearly equal to the basal diameter of antennal segment III. Siphunculi distinct, surrounded by few hairs. Legs brown, trochanters and femora partly fused ; hairs on femora and tibiae, stiff, some flagellate, longest one on hind tibiae 0.033 mm. long, $0.77\times$ as long as the diameter at the middle of the tibiae ; first tarsal segments with 2, 2, 2 hairs, some with an extra sensilla.

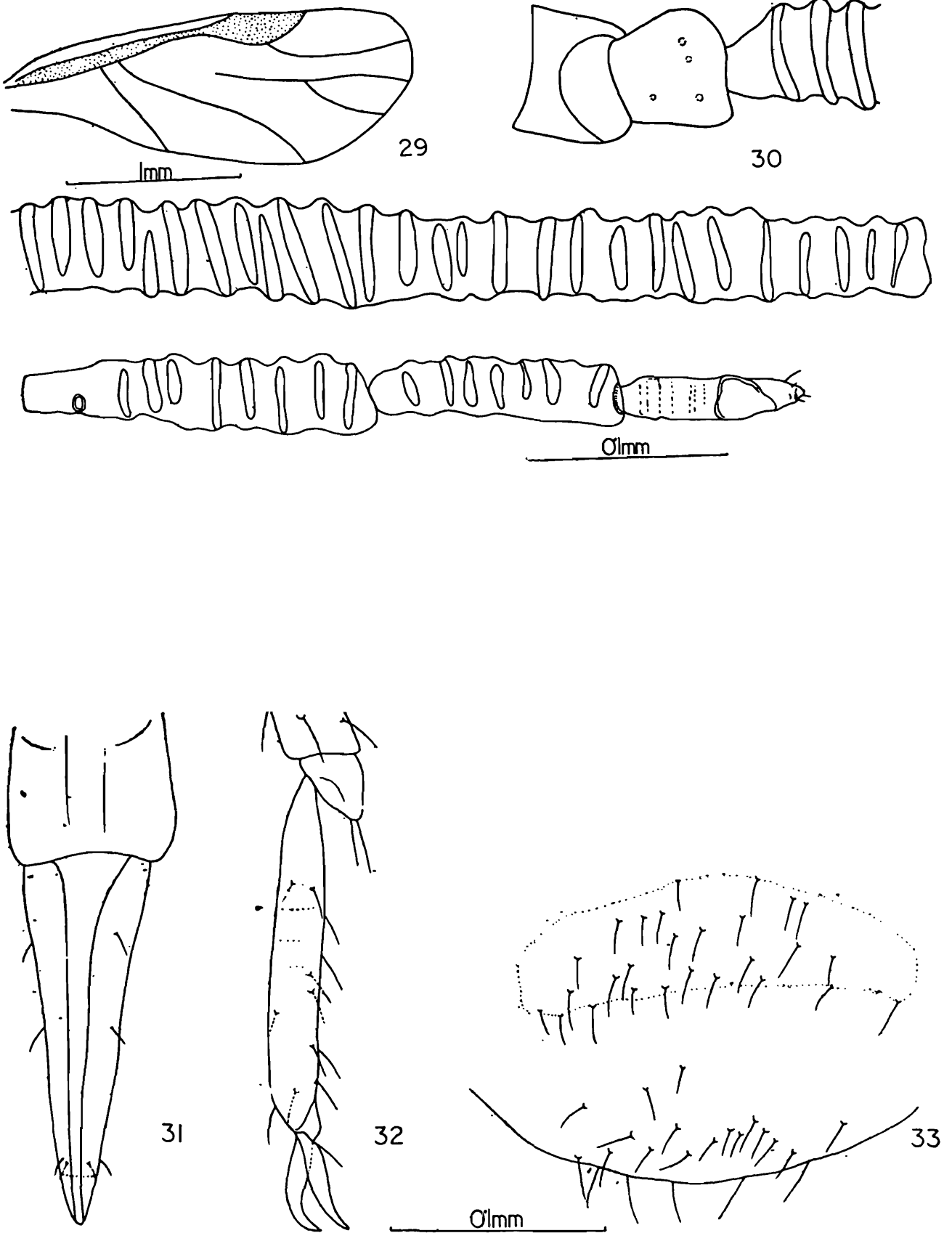
Colour.—Not known.



Eriosoma (Schizoneura) lanuginosum (Hartig); Apterous viviparous female (from galls): 24. whole body ; 25. antenna

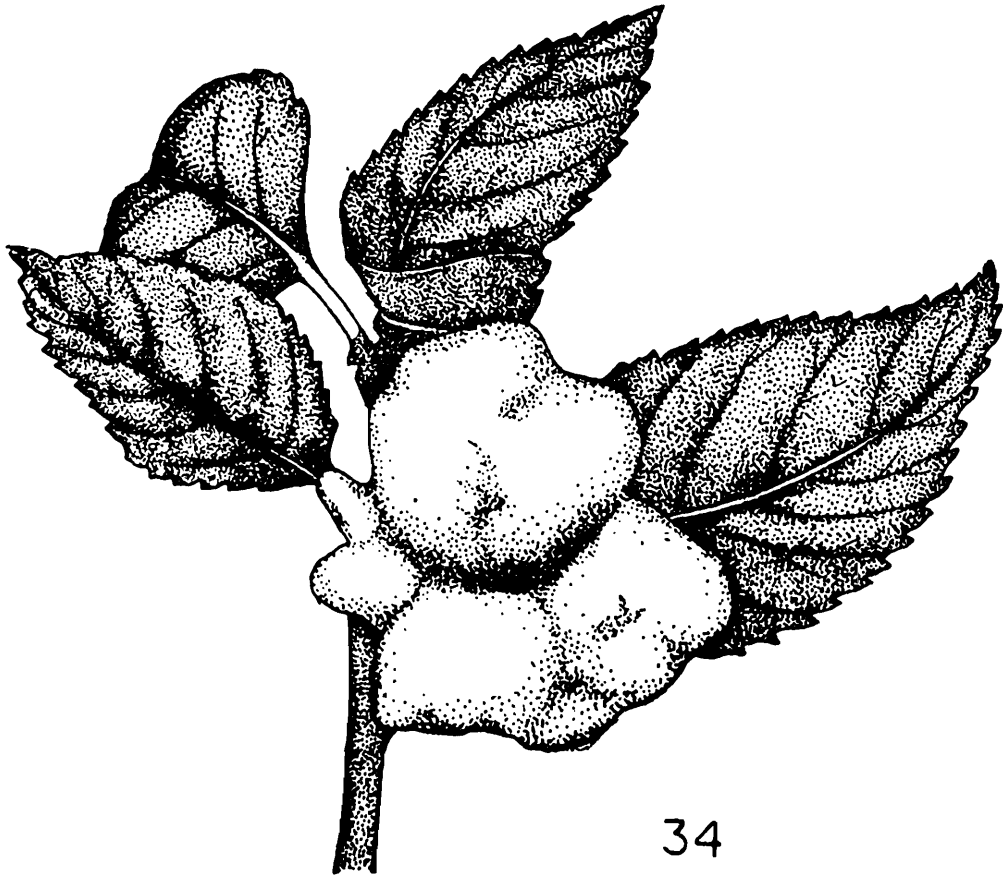


Eriosoma (Schizoneura) lanuginosum (Hartig); 26. ultimate rostral segments :
 27. hind tarsus ; 28. posterior portion of abdomen.



Alate viviparous female (from galls) :

29. wing ; 30. antenna ; 31. ultimate rostral segment ; 32. hind tarsus ;
33. posterior portion of abdomen ;

34. gall on *Ulmus*.

Measurements in mm.—

	Length	Width		Antenna			
	1.13	0.49		0.32			
	Antennal segments					urs	ht ₂
	I	II	III	IV	V	VI	
	0.03	0.04	0.08	0.04	0.05	0.07	? 0.05

(ex. *Ulmus campestris*, Balaton-Fured, HUNGARY, 26.IV.1965, coll *P. Andru's Falvy*, BMNH 538/65).

Alate viviparous female.—Body elongate oval, 2.4-2.9 mm. long with 0.99-1.30 as maximum width. Head dark sclerotic; dorsal cephalic hairs minute, at most 0.020 mm. long, equal to the basal diameter of antennal segment III. Antennae brown, 6 segmented, 0.37-0.44× as long as the body; segment I wider than long, segment II barrel shaped, segment III longest, longer than

IV+V+VI taken together, bearing 25-28 (24-34) linear secondary rhinaria over its entire length, segment IV longer than V and bears 6-8 (5-8) similar rhinaria over entire length, segment V longer than VI and bears 6-8 (2-5) similar rhinaria, segment VI with fine spinules; primary rhinaria on V small, on VI large and ciliated; hairs on the flagellum fine, on III, 0.013 mm. long, $0.66\times$ as long as the basal diameter of the segment; processus terminalis $0.21\times$ as long as base of segment VI. Rostrum reaches near mid coxae; ultimate rostral segment $1.14-1.23\times$ as long as second segment of hind tarsus and bears 8 accessory hairs. Abdominal dorsum completely pale (in specimens collected in June) or with irregular sclerotic broken band like pigmentations on 3rd-8th (in specimens collected in July); often these are very faint and narrow; hairs on the dorsum of abdomen fine, 0.020-0.040 mm. long, $1.0-2.0\times$ as long as the basal diameter of antennal segment III. Siphunculi with incomplete rim, surrounded by brownish sclerotic area and few fine hairs. Cauda small with 2 (3-5) hairs. Subanal plate with 10-11 fine, hairs. Subgenital plate sclerotic, spinulose, with 30-31 (24-30) hairs. Legs brownish, long, slender; femora, tibiae and tarsi with fine spinules, these being more distinct on second tarsal segment; longest hair on hind tibiae 0.02-0.03 mm. long, $0.80-1.0\times$ as long as the diameter at the middle of the tibiae; first tarsal segments with 2+1, 2+1, 2+1 hairs; empodial hair 0.018 mm. long, $0.25\times$ as long as the claws. Forewings with media once branched, cubital and anal wide apart at base; hind wings with both obliques.

Colour.—Blackish green to black (Cottier, 1953).

Measurements in mm.—

	Length	Width	Antenna		
1.	2.92	1.30	1.10		
2.	2.41	0.99	1.07		
	Antennal segments			urs.	ht ₂
III	IV	V	VI		
0.56	0.19	0.14	(0.076+0.016)	0.205	0.187
0.52	0.18	0.15	(0.076+0.016)	0.166	0.163

(1, ex *Ulmus campestris*, Balaton-Fured, HUNGARY, 26.6.1965, BMNH 538/65 ; 2, ex *Ulmus* gall, Herts, Ware, ENGLAND, 13. 7.1965, BMNH 364/65).

Sexual morphs.—Not known.

Apterous viviparous females—(exules, from roots of *Pyrus communis*, not recorded in India ; description based on Cottier, 1953). Body 2.1 mm. long. Head smooth with 8 wax plates, each with a group of 6-9 cells surrounding a central space ; dorsal cephalic hairs of moderate length. Antennae 6 segmented, $0.10\times$ as long as the body ; segment I, II, IV and V subequal ; flagellum roughend on basal segment, finely spinulose on V and VI ; hairs on the flagellum of moderate length to long ; primary rhinaria ciliated ; processus terminalis almost $0.50\times$ as long as the base of segment VI. Rostrum reaches mid coxae. Thoracic and abdominal segments (upto 7th tergite), each with a pair of marginal and a pair of spinal wax plate, 8th tergite with a pair of median wax plates ; each of the plates with 7-12 cells around a central space. Siphunculi on slightly raised bases, with an incomplete chitinous rim surrounded by few hairs. Cauda short, imbricated, with 4 hairs. Subgenital plate with about 20 hairs.

Measurements in mm.—

Length	Antenna	Antennal segments					
		I	II	III	IV	V	VI
2.1	0.24	0.04	0.03	0.07	0.03	0.05	0.06

(ex. roots of *Pyrus communis*).

Colour.—Not recorded.

Alate viviparous female (Autumn migrant from roots of *Pyrus communis* : not recorded in India, description based on Cottier, 1953) : Appear similar to alate viviparous female (Spring migrant) from *Ulmus* galls, but the primary rhinaria on segment V is ciliated.

Material examined.—Three alate viviparous females, one apterous viviparous female and one apterous nymph from *Ulmus*

campestris, Balaton-Fured, HUNGARY, 26.6.1965, coll. P. Andru's Falvy, (BMNH 538/65) ; three apterous viviparous females and two nymphs from *Ulmus* galls, Herts, Ware, ENGLAND, 13.7.1965, coll. R. B. Benson (BMNH 364/65).

Discussion.—The species is heteroecious alternating between *Ulmus campestris* and other *Ulmus* sp. and *Pyrus communis* and perhaps also infest roots of other Rosaceae. Börner (1952) mentioned that the leaves on *Ulmus* appear pushed out to large bubble like galls, which may remain closed or sometime may remain open through a slit ; the galls finally open when matured, by “secondary slits”, the petiole become thickened and galls remain in the plant for some period. Exules on roots form colonies and may overwinter in the Pear trees. Cottier (1953) while describing the species in details, mentioned some minor differences between large-sized fundatrix-apterae and small second generation apterae. Evidently, the wax plates in the morphs on *Ulmus*, which were not observed by Cottier (op. cit) are difficult to distinguish, as has also been seen in the present study. Bodenheimer & Swirski (1957) mentioned about its occurrence in Middle East during May-August on *Ulmus campestris*, where they form large pocket like leaf-galls, upto 10 cm. long, at the end of the twigs. The species appears rare in occurrence in the Indian region.

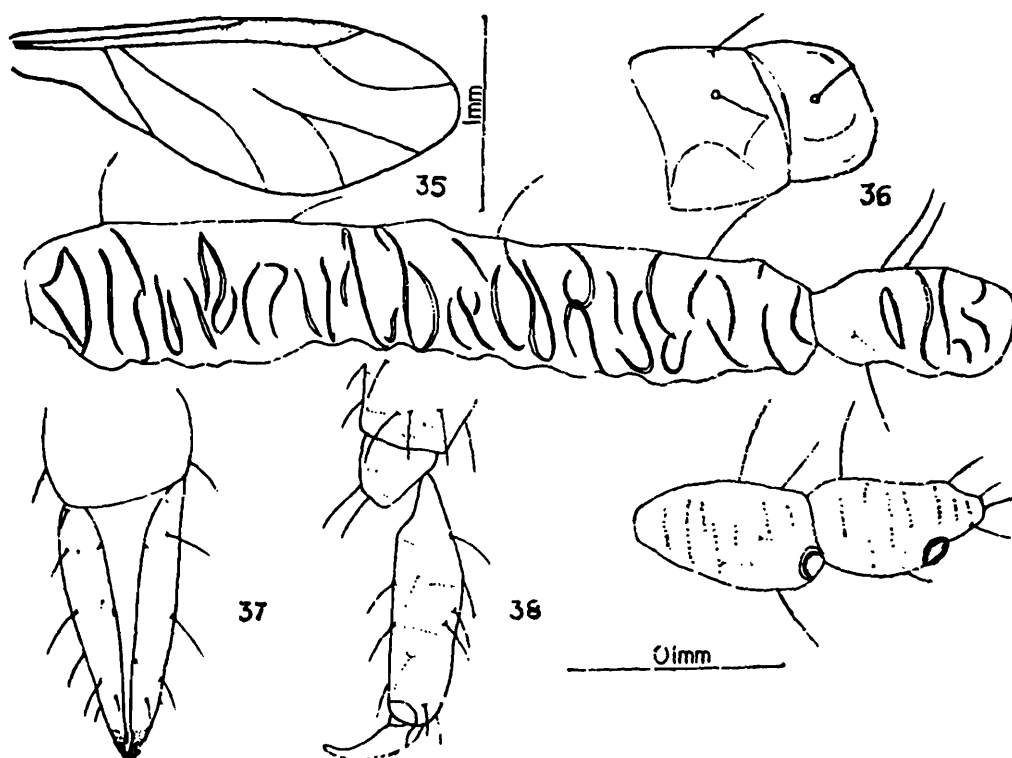
Distribution.—INDIA ; IRAN ; IRAQ ; SYRIA ; TURKEY ; MOROCCO ; FRANCE ; ENGLAND ; GERMANY ; U.S.S.R. ; AUSTRALIA ; NEW-ZEALAND.

Types.—Location of Types not known. Type of *taskhiri* Gullamullah, 1942 is reported to be in “Imperial Pusa Collections Laboratory” IARI, New Delhi (IPC No. R/8061, R/8062-8066).

4. *Eriosoma* (*Schizoneura*) *longipilosum* Chakrabarti & Raychaudhuri (Figs. 35-38)

1975. *Eriosoma longipilosum* Chakrabarti, S. and Raychaudhuri, D. N., *Oriental Ins.*, 9 (2) : 209.

Alate sexuparous female.—Body 1.60-1.62 mm. long with 0.65-0.69 mm. as maximum width. Head brown, dorsum smooth ;



Eriosoma (Schizoneura) longipilosum Chakrabarti and Raychaudhuri Alate sexuparous female : 35. forewing ; 36. antenna ; 37. ultimate rostral segment ; 38. hind tarsus.

dorsal cephalic hair fine, upto 0.045 mm. long, $2.5\times$ as long as the basal diameter of antennal segment III. Antennae brownish, darker towards apex, 6 segmented, $0.43-0.44\times$ as long as the body ; flagellum gradually more distinctly imbricated apicad, spinulose on segments V and VI ; segment III, $1.42\times$ as long as segments IV+V+VI taken together and bears 16-18 annular secondary rhinaria distributed over the entire length, segment IV subequal to V and VI and bears 3-4 similar rhinaria ; primary rhinaria on segments V and VI strongly ciliated ; hairs on the flagellum fine, on segment III 0.020-0.053 mm. long, $1.2-2.6\times$ as long as the basal diameter of the segment ; processus terminalis $0.33-0.40\times$ as long as the base of antennal segment VI. Rostrum reaches near mid coxae ; ultimate rostral segment $0.81-0.83\times$ as long as the second segment of hind tarsus and bears 14-16 accessory hairs. Abdominal dorsum pale with broken scleroites on 8th tergites ; hairs on the dorsum of abdomen fine, flagellate, on anterior tergites 0.03-0.05 mm. long, $1.6-2.6\times$ as long as the basal diameter of antennal segment III, on posterior tergites upto 0.05-0.06 mm. long, $2.7-3.0\times$ as long as the mentioned diameter ;

7th tergite with 6 hairs and 8th tergite with 4 hairs. Siphunculi on elevated bases, siphuncular pore large, surrounded by a complete chitinous ring and few hairs. Cauda with 2 hairs. Subanal plate brown sclerotic, spinulose with 10-12 hairs. Legs brown, femora with scattered spinulose striae ; apices of tibiae and tarsi with fine spinules ; hairs on femora fine, on tibiae thicker : longest hair on hind tibiae 0.07 mm. long, $1.6\times$ as long as the diameter at the middle of the tibiae ; first tarsal segments with 3, 3, 2 hairs ; empodial hair fine, 0.02 mm. long, $0.54\times$ as long as the claws. Forewings with pterostigma short, media once branched ; hind wings with both obliques.

Colour.—Not recorded.

Measurements in mm.—

	Length		Width		Antenna
	1.6		0.69		0.72
	Antennal segments				
III	IV	V	VI	urs.	ht ₂
0.37	0.09	0.09	(0.06+0.02)	0.10	0.12

(ex *Pteris* sp. (vagrant), Lokharkhet, U.P., INDIA, 20.10.1970, coll. S. Chakrabarti ; Holotype).

Other morphs.—Not known.

Material examined.—One alate sexupara from *Pteris* sp. (vagrant), Lokharkhet, Almora, Uttar Pradesh, INDIA, 26.10.1970, coll. S. Chakrabarti, (Holotype, Calcutta University Collections).

Discussion.—The sexupara was described as new on the basis of long dorsal hairs and large number of accessory hairs on ultimate rostral segment. The original description however differs from the present one, in the ratio of p.t. to base, longest hair on anterior tergites to basal diameter of antennal segment III, and in the number of caudal hairs, besides some minor differences in the morphology of the holotype. Both the primary and secondary hosts as also the morphs other than sexupara, remain unknown since the description of the species.

Distribution.—INDIA (Uttar Pradesh, Almora).

Types.—In the collections of Entomology Laboratory, Department of Zoology, University of Calcutta (Holotype), and with D. Hille Ris Lambers, Bennekom, THE NETHERLANDS, (Paratype).

5. *Eriosoma* (*Schizoneura*) *phaenax* Mordvilko

(Figs. 39-48)

1921. *Eriosoma phaenax* Mordvilko, A. K., *Izv. Pterogr obl. St. Zasc Rost.*, 3 (3) : 1-72.
 1923. *Eriosoma phaenax* Mordvilko, A.K., *Dokl. Akad. Nauk. SSSR.* (= *Comp. Rend. Acad. Sci. Russie*), 1 : 41.
 1972. *Eriosoma phaenax*, Chakrabarti, S., Ghosh, A.K., Raychaudhuri, D. N., *Oriental Ins.*, 6 (3) : 389.
 1975. *Eriosoma phaenax*, Ghosh, A. K., *J. Bombay nat. Hist. Soc.*, 71 (2) : 210.

Apterous viviparous female.—Body 1.97-2.02 mm. long with 1.03-1.30 mm. as maximum width. Head dark, sclerotic, with two pairs of pale, whitish wax plates ; dorsal cephalic hairs fine, 0.033-0.050 mm. long, upto $0.75\times$ as long as the basal diameter of antennal segment III. Antennae brownish, 6 segmented, $0.39-0.49\times$ as long as the body ; flagellum finely spinulose, segment III longer than IV+V+VI together ; hairs on the flagellum fine, segment III with 8-12 hairs, 0.01-0.04 mm. long, $0.23-0.61\times$ as long as the basal diameter of the segment ; primary rhinaria on V small, nearly sunken, ciliated, on VI larger and with few accessory rhinaria, ciliated ; processus terminalis $0.42-0.43\times$ as long as base of antennal segment VI. Eyes of 3-4 facets. Rostrum reaches mid coxae ; ultimate rostral segment $1.20-1.28\times$ as long as second segment of hind tarsus and bears 12-14 accessory hairs. Abdominal dorsum pale, membranous ; hairs on the dorsum of abdomen fine, flagellate, on anterior tergites 0.030-0.060 mm. long, on posterior tergites 0.06-0.07 mm. long, these being $0.47-1.1\times$ and $1.0-1.1\times$ as long as the basal diameter of antennal segment III, respectively ; 8th tergite with 4 hairs. Siphunculi on elevated bases, surrounded by few fine flagellate hairs. Cauda semioval with 2 hairs. Subanal plate dusky, spinulose, with about 20 hairs. Subgenital plate dusky with about 18 hairs, all arranged in posterior margin, except two long fine hairs, placed anteriorly. Legs pale brown, pubescent ; longest hair on hind tibiae 0.03 mm. long, $0.40-0.50\times$ as long as

the diameter at the middle of the tibiae ; first tarsal segments with 3, 3, 3 hairs , empodial hair fine, flagellate, 0.023-0.026 mm. long, 0.38-0.48 \times as long as the claws.

Colour.—Light brown in life.

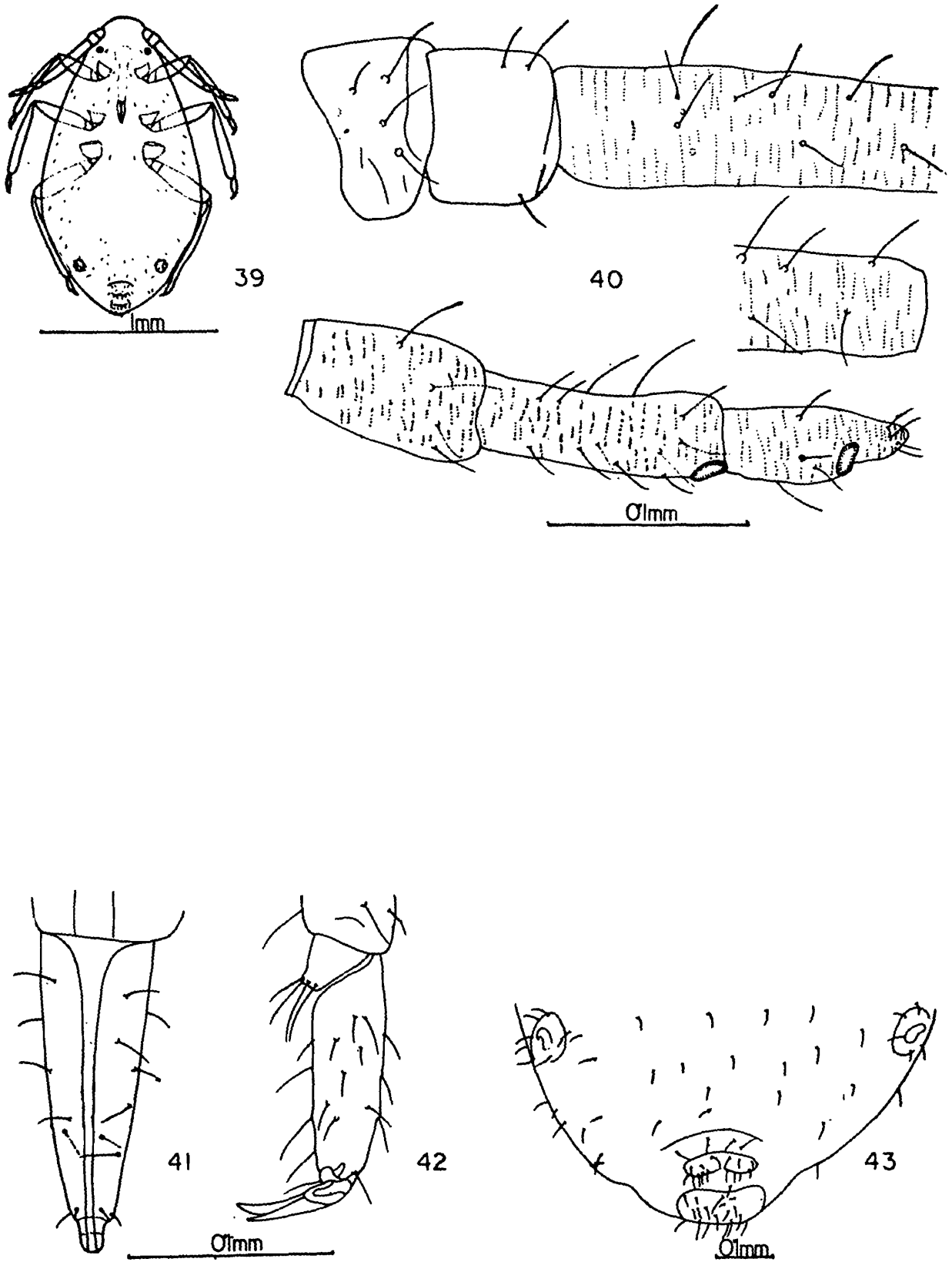
Measurements in mm.—

	Length	Width	Antenna
1.	2.02	1.03	0.79
2.	2.0	1.13	0.99
3.	1.97	1.28	0.79
4.	2.0	1.14	0.82

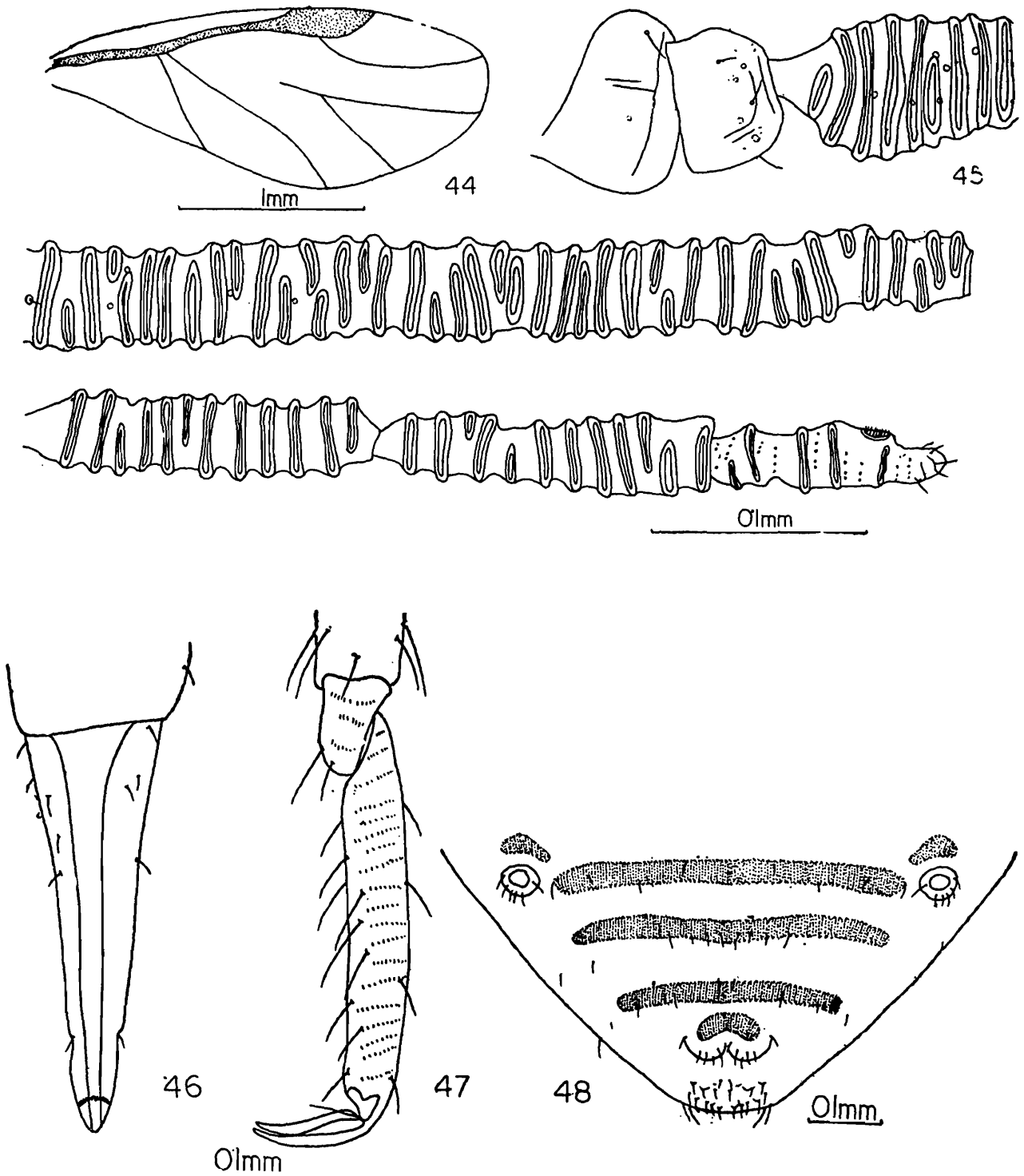
III	Antennal segments			urs.	ht ₂
	IV	V	VI		
0.32	0.10	0.10	(0.07+0.03)	0.17	0.14
0.41	0.14	0.14	(0.07+0.03)	0.18	0.15
0.31	0.12	0.14	(0.07+0.03)	0.17	0.14
0.35	0.12	0.12	(0.065+0.03)	0.18	0.14

(ex *Ulmus montana*, pseudogall, Bhowali, U.P., INDIA, 24.5.1969 coll. S. Chakrabarti).

Nymph (Early stage).—Body pale, 1.17 mm. long with 0.62 mm. as maximum width. Antennae 6 segmented, 0.50 \times as long as the body ; flagellum spinulose from apices of segment III, apicad ; segment III with 6-8 fine hairs, 0.006-0.026 mm. long, 0.10-0.38 \times as long as the basal diameter of the segment ; primary rhinaria small, ciliated ; processus terminalis 0.44 \times as long as base of segment VI. Rostrum reaches mid coxae, ultimate rostral segment 1.36 \times as long as second segment of hind tarsus and bears 10 accessory hairs. Abdominal dorsum whitish, pale ; hairs on the dorsum of abdomen fine, 0.02-0.05 mm. long, 0.33-0.76 \times as long as the basal diameter of antennal segment III. Siphunculi pale, surrounded by a few hairs. Legs pale ; longest hair on hind tibiae 0.03 mm. long, 0.52 \times as long as the diameter at the middle of the tibiae ; first tarsal segments with 3, 3, 3 hairs ; empodial hair fine, 0.02 mm. long, 0.41 \times as long as the claws.



Eriosoma (Schizoneura) phoenax Mordvilko; Apterous viviparous female (from galls): 39. whole body; 40. antenna; 41. ultimate rostral segments; 42. hind tarsus; 43. posterior portion of abdomen.



Alate viviparous female (from galls) : 44. forewing ; 45. antenna ; 46. ultimate rostral segment ; 47. hind tarsus ; 48. posterior portion of abdomen.

Colour.—Pale in life.

Measurements in mm.—

Length
1.17

Width
0.62

Antenna
0.51

III	Antennal segments			urs.	ht ₂
	IV	V	VI		
0.29	0.17	0.09	(0.060+0.026)	0.15	0.11

(ex *Ulmus montana*, pseudogall, Bhowali, U.P., INDIA, 24.5.1971, coll. S. Chakrabarti).

Alate viviparous female.—Body 2.20-2.44 mm. long with 0.89-0.93 mm. as maximum width. Head brown, without any apparent wax glands ; dorsal cephalic hairs short, 0.013-0.020 mm. long, at most equal to the diameter at the constricted base of antennal segment III. Antennae 6 segmented, brown, 0.56-0.61× as long as the body ; hairs on the flagellum minute, on segment III, 0.006-0.010 mm. long, 0.25-0.42× as long as the basal diameter of the segment ; segment III with 40-45, IV with 10-14, V with 10-12 and base of segment VI with 2-4 annular secondary rhinaria, distributed over their entire lengths, primary rhinaria on segment V small, subcircular, ciliated, on VI irregular, ciliated ; processus terminalis 0.25-0.33× as long as base of antennal segment VI. Rostrum reaches near mid coxae ; ultimate rostral segment slender, 1.0-1.05× as long as second segment of hind tarsus and bears about 12-14 accessory hairs. Abdominal dorsum pale, sometimes with faint brownish pigmentation ; wax glands not discernible ; hairs on the dorsum of abdomen fine, on anterior tergites 0.02-0.04 mm. long, on posterior tergites, 0.03-0.04 mm. long, these being 0.85-1.6× and 1.2-1.6× as long as the basal diameter of antennal segment III, respectively. Siphunculi on small brown sclerotic bases, surrounded by a few hairs. Cauda with 2 hairs. Subanal plate with about 18 hairs. Subgenital plate with about 16 hairs. Legs long, slender, brownish, darker on apical 0.50 portion of femora ; femora, tibiae and tarsi with fine spinulose striae, these being more distinct on second tarsal segments ; hairs on femora and tibiae, erect, with acute apices, longest one on hind tibiae 0.03 mm. long, 0.5-0.8× as long as the diameter at the middle of the tibiae ; first tarsal segments with 3, 3, 3 hairs ; empodial hair 0.02 mm., 0.38-0.48× as long as the claws. Forewings with media once branched, hind wings with both obliques.

Colour.—Brownish in life with head, thorax and appendages darker.

Measurements in mm.—

	Length	Width	Antenna		
1.	2.20	1.93	1.32		
2.	2.20	1.89	1.36		
3.	2.29	1.89	1.32		
4.	2.44	1.93	1.32		
	Antennal segments			urs.	ht ₂
III	IV	V	VI		
0.67	0.23	0.19	(0.08+0.02)	0.18	0.17
0.69	0.24	0.18	(0.08+0.02)	0.18	0.17
0.69	0.19	0.16	(0.08+0.02)	?	0.17
0.64	0.20	0.20	(0.09+0.03)	0.17	0.17

(1, 2, ex *Ulmus montana*, pseudogalls, Bhowali, U.P., INDIA, 24.5.1969, coll. S. Chakrabarti, 3, 4, ex *Androchne cordifolia*, Muree, PAKISTAN, 6.10.1972, coll. C.I.B.C., BMNH 472/64).

Other morphs.—Not available.

Material examined.—Six apterous viviparous females and 4 apterous nymphs, two alate viviparous females and two nymphs, from pseudogalls on leaf on *Ulmus montana*, Bhowali, Uttar Pradesh, INDIA, 24.5.1969, coll. S. Chakrabarti, det. D. Hille Ris Lambers (S. Chakrabarti collections, Kalyani University) ; 4 alate viviparous females from *Androchne cordifolia* Muree, PAKISTAN, 6.10.1962, coll. C.I.B.C. (BMNH 472/64, 1818, C.I.E. 19727).

Discussion.—Eastop and Hille Ris Lambers (1976) mentioned "1923" as the year of publication of original description. Mordvilko (1923) while discussing the woolly apple aphid *Eriosoma lanigerum* Hausmann and other *Eriosoma*, mentioned that "in the Palaearctic region *E. ulmosedens* Marchala, 1919 (*E. phaenax* Mordvilko 1921) (France, Transcaucasia, Turkestan ; does not, it seems, migrate).....Although *E. ulmosedens* causes on *Ulmus campestris* and *U. montana* the same deformities (elm leaf rosette) as *E. lanigerum* on *Ulmus americana*, they are not corresponding species.....

their morphology being too different (the structure of integumental wax glands, the antennae and the feet)." It indicates that *E. phaenax* was described in 1921 and not in 1923 and forms elm leaf rosette. Tao (1970) followed Mordvilko (1923) and considered *phaenax* as a synonym of *ulmosedens* Marchal, but again wrongly cited 1923 as the year of publication of original description. Both *ulmosedens* Marchal and *phaenax* Mordvilko are now regarded as distinct valid species, former belonging to *Eriosoma* s.s. while *phaenax* has been placed under subgenus *Schizoneura*.

Distribution.—INDIA ; PAKISTAN ; USSR.

Types.—Location of types not known ; may be deposited in the collections of Institute of Zoology, Academy of Sciences, Leningrad, USSR.

6. *Eriosoma* (*Schizoneura*) *ulmi* (Linnaeus) (Figs. 49-63)

1758. *Chermes ulmi* Linnaeus, C., *Systema naturae*, 10 : 455.
 1773. *Aphis ulmi campestris* de Geer, C., *Mem. Pour. servir a'l' historie des Insectes*, 3 : 81.
 1773. *Aphis foliorum ulmi* de Geer, C., *Mem. pour. servir a'l' historie des Insectes*, 3 : 81.
 1843. *Schizoneura ulmi*, Kaltenbach, J. H., *Monog. Pflanz.*, 173.
 1881. *Schizoneura fodiens*, Buckton, G. B., *Monogr. Brit. Aphides*, 3 : 94.
 1887. *Schizoneura grossulariae* Taschenberg, E. D., *Verh. Bl. deutsch. Pomol ver.*, 1887, 80.
 1909. *Schizoneura ulmi*, Tullgren, A., *Ark. Zool.*, 5 (14) : 163.
 1916. *Schizoneura soror* Börner, C. and Blunk, E., *Mitt. Kaiserl. Biol. Anst, Land Forstwirtschaft.*, 16 : 25-42.
 1957. *Eriosoma ulmi*, Bodenheimer, F. S. and Swirski, E., *The Aphidoidea of the Middle East*, 314.
 1969. *Eriosoma ulmi*, Janiszewska-Cichocka, E., *Ann. Zool. Warszawa*, 27 : 205.
 1970. *Eriosoma ulmi*, Tao, C.C.C., *Sc. Yb. Taiwan Mus.*, 13 : 5.
 1976. *Eriosoma* (*Schizoneura*) *ulmi*, Eastop, V. F. and Hille Ris Lambers, D., *Survey of the World's Aphids*, 192.
 1979. *Eriosoma* (*Schizoneura*) *ulmi*, Danielsson, R., *Ent. Scand.*, 10 (3) : 206.

Apterous viviparous female : Body elongate oval 2.34-2.37 mm. long with 1.35-1.38 mm. as maximum width. Head dark sclerotic over frons and vertex ; dorsal cephalic hairs 0.026-0.036 mm. long, 0.50-0.73 × as long as the basal diameter of antennal segment III. Antennae 6 segmented, pale, except on segment I and II which are

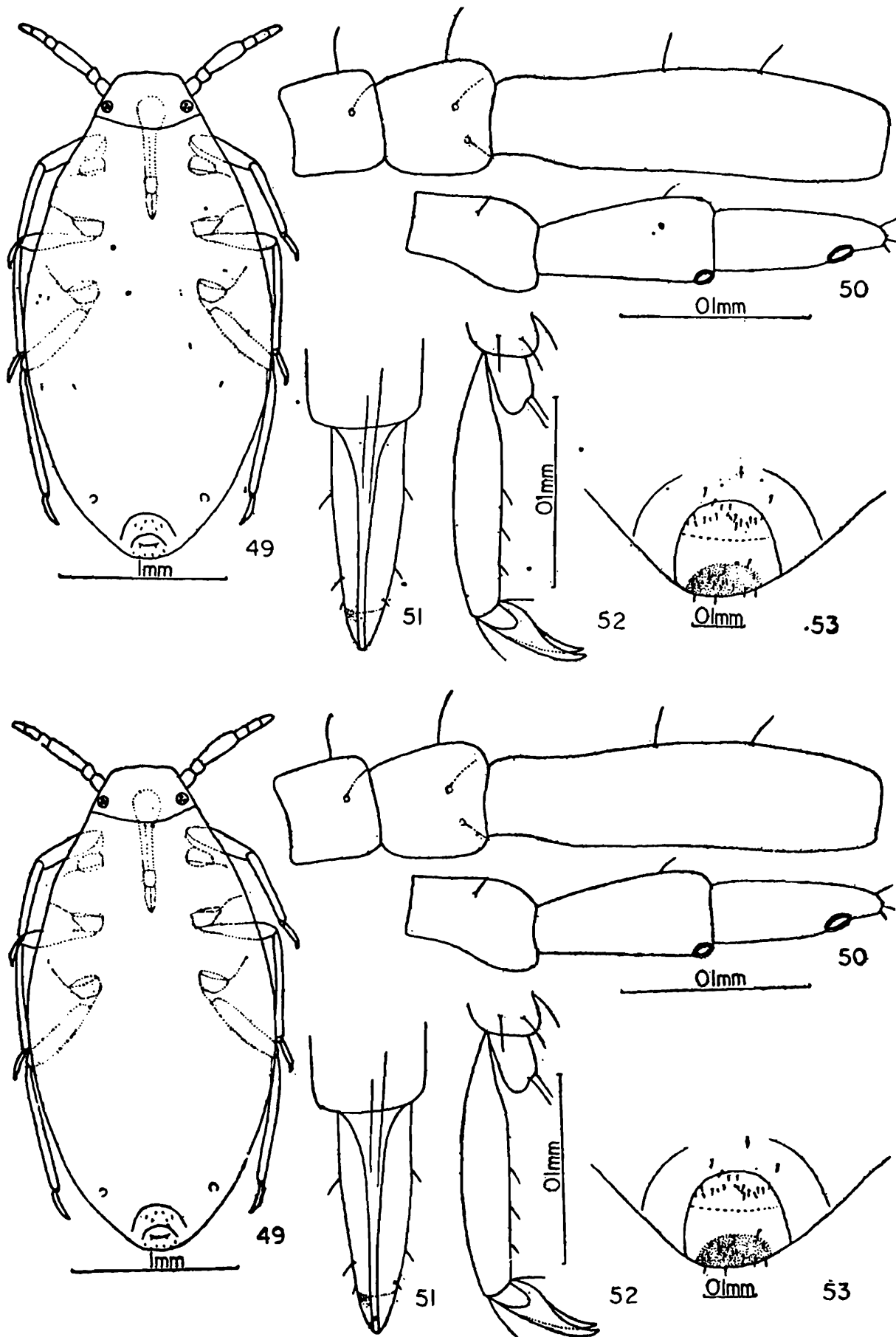
brownish, $0.20-0.27 \times$ as long as the body ; segment III longer than segments IV + V + VI taken together ; flagellum nearly smooth, except for some fine spinules ; hairs on the flagellum fine, on segment III, $0.006-0.016$ mm. long, $0.13-0.33 \times$ as long as the basal diameter of the segment ; primary rhinaria ciliated ; processus terminalis about $0.20 \times$ as long as base of segment VI. Eyes of 3-4 facets. Rostrum reaches near mid coxae ; ultimate rostral segment $0.76-0.79$ —as long as second segment of hind tarsus and bears a few (4 ?) accessory hairs (could not be clearly ascertained). Abdominal dorsum pale, membranous, with large pale marginal wax gland groups (could not be clearly observed) on 1st-7th tergites ; hairs on the dorsum of abdomen fine, on anterior tergites $0.016-0.026$ mm. long, on posterior tergites, $0.036-0.050$ mm. long, $0.33-0.50 \times$ and $0.73-0.93 \times$ as long as the basal diameter of antennal segment III, respectively. Siphunculi with an incomplete rim, on slightly raised base and surrounded by 6-7 hairs. Cauda small, semioval with 2 hairs. Subanal plate with 18 hairs. Subgenital plate with about 20 hairs. Legs pale brown, slender ; hairs on femora and tibiae with acute apices, longest one on hind tibiae $0.016-0.020$ mm. long, $0.35-0.40 \times$ as long as the diameter at the middle of the hind tibiae ; first tarsal segments with 3, 3, 3 hairs ; empodial hair long, fine, 0.033 mm. long, $0.66 \times$ as long as the claws.

Colour.—Dark green with whitish wax cover.

Measurements in mm.—

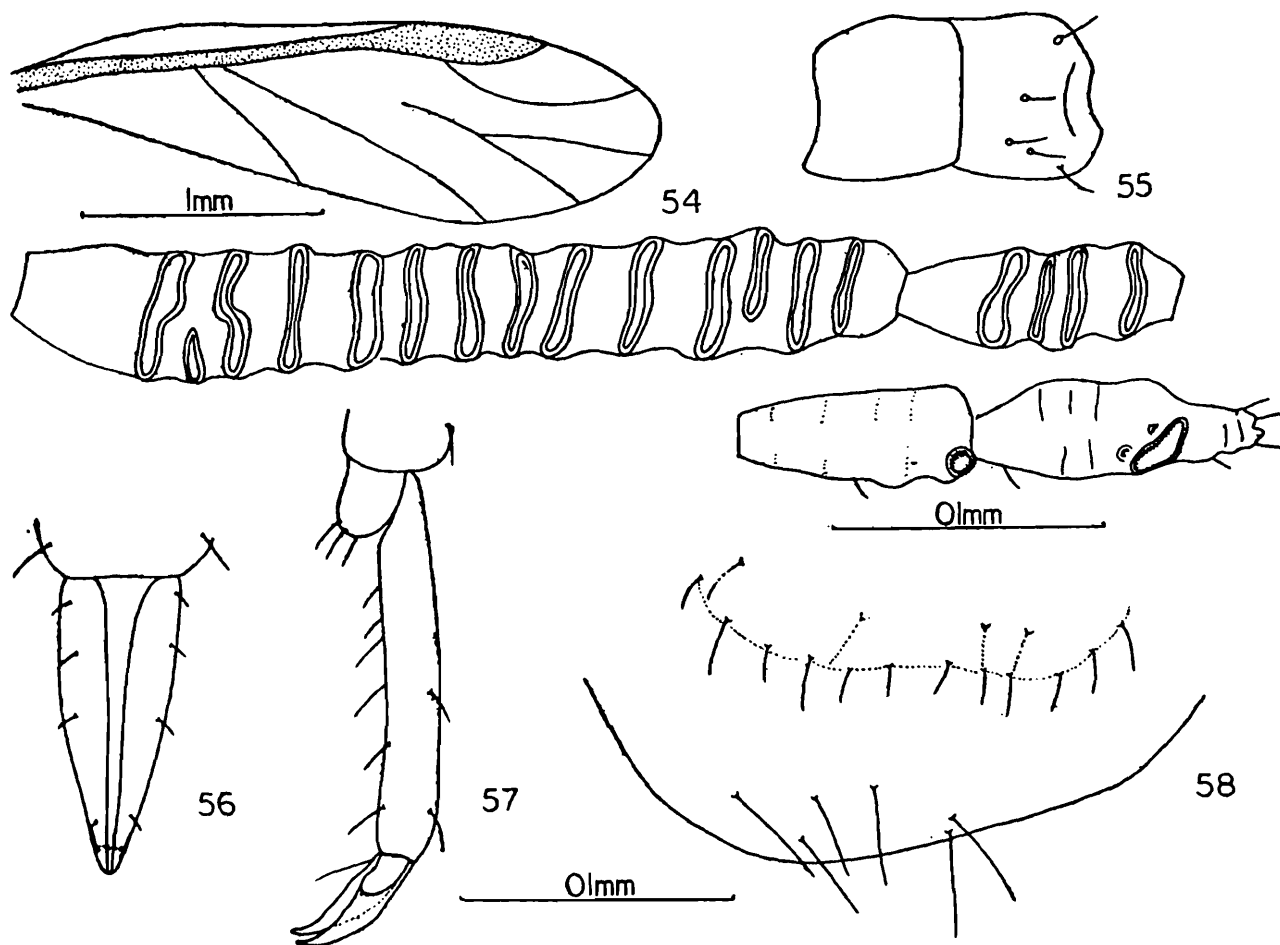
	Length		Width	Antenna	
1.	2.37		1.35	0.69	
2.	2.34		1.38	0.65	
	Antennal segments			urs.	ht ₂
III	IV	V	VI		
0.27	0.08	0.09	(0.080+0.016)	0.115	0.149
0.24	0.06	0.09	(0.080+0.016)	0.115	0.143

(1, 2, ex "Rosaceae" galls, Kashmir, INDIA, 22.5.1979, coll. S. Chakrabarti).

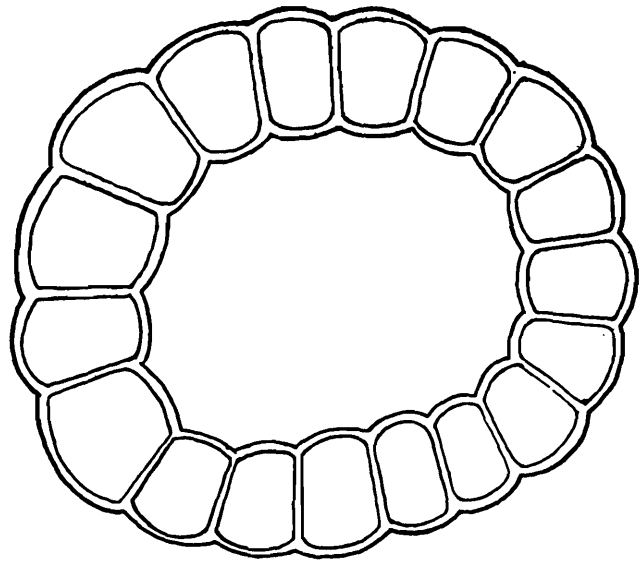
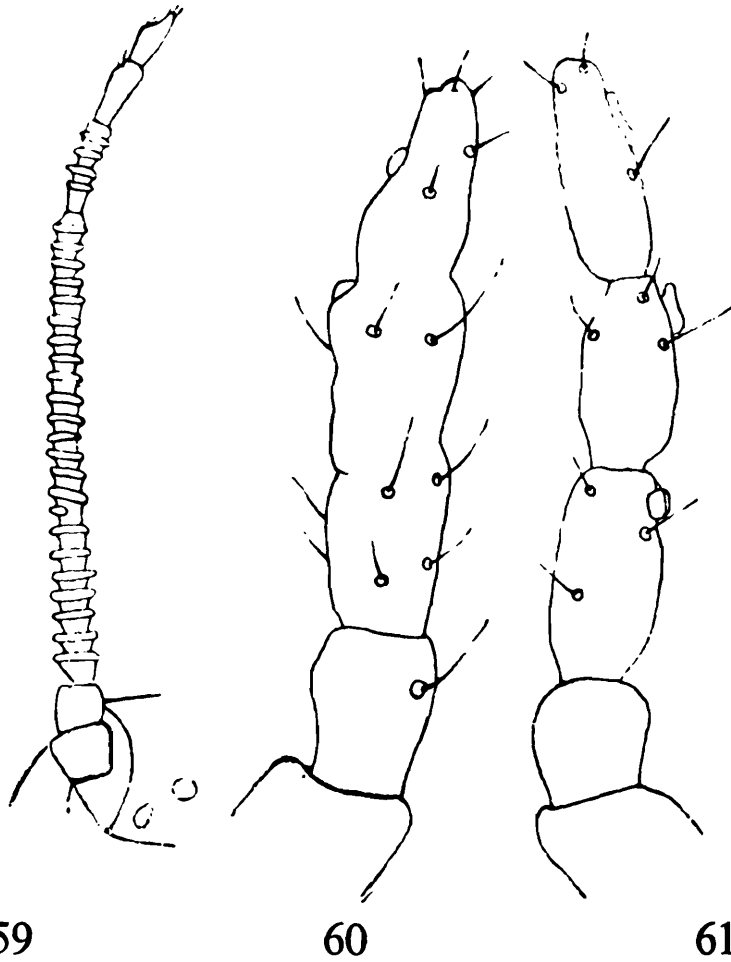


Eriosoma (Schizoneura) ulmi Linn. ; Apterous viviparous female (from galls) :
 49. whole body ; 50. antenna ; 51. ultimate rostral segment ; 52. hind
 tarsus ; 53. posterior portion of abdomen.

Alate viviparous females : Body 2.20 mm. long with 0.89 mm. as maximum width. Head dark, sclerotic ; dorsal cephalic hairs upto 0.016 mm. long, $0.83\times$ as long as the basal diameter of antennal segment III. Antennae brown, 6 segmented, $0.33\times$ as long as the body ; segment III with 14 linear secondary rhinaria and segment IV with similar rhinaria ; hairs on the flagellum not discernible ; processus terminalis $0.26\times$ as long as base of segment VI. Rostrum reaches near mid coxae ; ultimate rostral segment $0.77\times$ as long as second segment of hind tarsus and bears at least 6 accessory hairs. Abdominal dorsum pale, with broken segmental sclerotic bars, which may fuse to form bands on 3rd-7th tergites ; hairs on the dorsum of abdomen fine, 0.016-0.026 mm. long, $0.83-1.3\times$ as long as the basal diameter of antennal segment III. Wax plates not discernible. Siphunculi with complete rim. Cauda semilunar. Subanal plate with ± 22 hairs, subgenital plate with ± 20 hairs. Legs brown ; hairs on femora and tibiae with acute

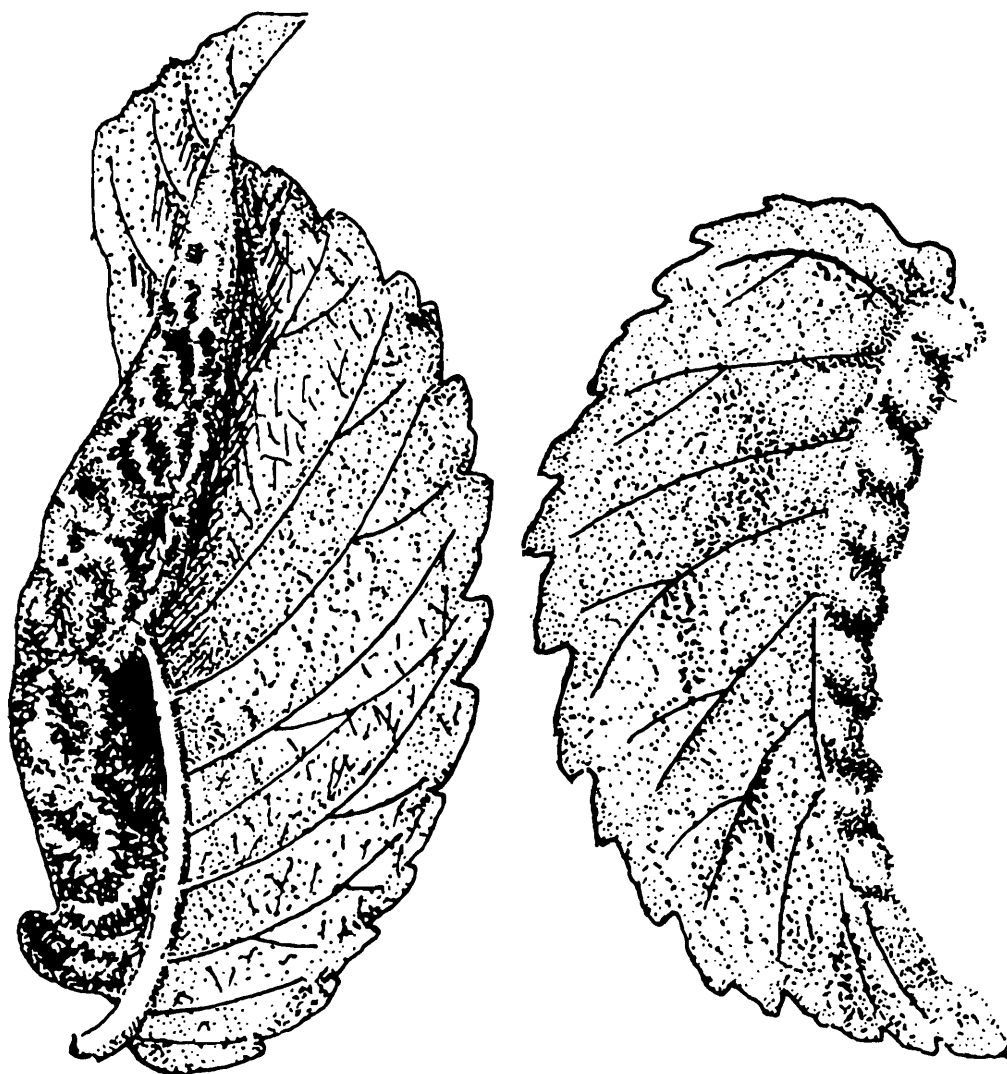


Alate viviparous female (from galls) : 54. forewing ; 55. antenna ; 56. ultimate rostral segment ; 57. hind tarsus ; 58. posterior portion of abdomen.



62

Alate sexuparous female : 59. antenna (from Tullgren 1909) ; Sexuales :
60. antenna of male ; 61. antenna of female (from Tullgren 1909) ; larva
of sexupara: 62. wax gland (from Tullgren 1909)



63

63A

Leaf galls : 63 & 63A. On *Ulmus* (from Tullgren 1909)

apices, longest one on hind tibiae 0.023 mm. long, $0.08 \times$ as long as the diameter at the middle of the tibiae ; first tarsal segments with 3, 3, 3 hairs. Forewing with media once branched, hind wings with both obliques.

Colour.—Blackish brown in life.

Measurements in mm.—

Length	Width	Antenna
2.20	0.89	0.74

III	Antennal segments			urs.	ht ₂
	IV	V	VI		
0.33	0.10	0.11	(0.086+0.023)	0.115	0.146

(ex "Rosaceae" gall, Kashmir, INDIA, 22.5.1979, coll. S. Chakrabarti)

Sexuales (Not recorded in India ; description based on Tullgren, 1909). *Male*.—Body 0.53 mm. long ; antennae 0.19 mm. with distal segments, distinctly separated ; *Ovipara* : Body 0.87 mm. long ; antennae 0.20 mm. long with 3 distal segments nearly fused and possess only two rhinaria.

Material examined.—Two apterous and one alate viviparous females from "Rosaceae" gall, Kashmir, INDIA, 22.5.1975, coll. S. Chakrabarti ; three apterous fundatrices from *Ulmus glabra*, Lund, Sweden, 29.5.1973, coll. R. Danielsson ; two alate fundatrigeniae from *Ulmus glabra*, Lund, SWEDEN, 10.7.1973, coll. R. Danielsson ; two sexuparous alates from *Ulmus glabra*, Lund, SWEDEN, 13.10.1973 ; coll. R. Danielsson ; one alate viviparous female from *Liusfolla pernoff*, Beentarp Stampen, SWEDEN, 16.10.1969, coll. R. Danielsson ; one alate viviparous female from *Abies* sp., Berglwara, SWEDEN, 23.6.1973, coll. R. Danielsson ; two alate viviparous females from *Heracleum manthegazzianum* Berglwara, SWEDEN, 3.7.1972, coll. R. Danielsson.

Discussion.—Tullgren (1909) provided detailed description of apterous fundatrix, alate fundatrigeniae, alate sexuparae and briefly mentioned about males and ovipara ; the alate fundatrigeniae, in Sweden, as mentioned by Tullgren (1909) and figured by Danielsson (1979) distinctly show a very long antenna bearing more than 35 secondary rhinaria on III and more than 5 on IV ; the sexuparous alates, according to Tullgren (op. cit) exist in two forms, one with 22-26 secondary rhinaria, other with 17-22 secondary rhinaria on segment III besides differing in the length of body ; the single alate collected from gall in the month of May, appears to belong to sexuparous alate, considering its length, length of antennae and also number of rhinaria and in that case, the apterae should be of 2nd generation ; in Palaearctic region, however,

alate migrants leave galls in July and migrate to roots of goose-bearries. Börner (1952) mentions the species infest *Ulmus scabra* (*montana*) and *U. campestris* and form rolled galls ; parthenogenetic forms live on roots of currant and goose-berries e.g. *Ribes alpinum*, *grassularia*, *nigrum* and *rubrum*. Danielsson (1979) mentions that *ulmi* is the most common species in Sweden and is responsible for yellow leaf roll of *Ulmus glabra*. Danielsson (op. cit) indicated that *E. (S.) ulmi* is probably a mixture of two different but equally distinct species, as evidenced from two different types of wax glands in the larvae of alate migrants and exules from roots of *Ribes* ; however, fundatrices, second generation apterae and sexuparae from *Ulmus* could not be certainly correlated with two forms. Till the details of the study is available, the Indian material could only be identified as common *E. (S.) ulmi*.

Distribution.—INDIA ; Widely distributed in Palaearctic region.

Types.—Location of types not known.

2. Genus *Gharesia* Stroyan 1963

1963. *Gharesia* Stroyan, H. L. G., *Proc. R. ent. Soc. Lond.*, (B) 32 : 81. Type species : *Gharesia polunini* Stroyan.

Morphology.—Body elongate, small. Head with three pairs of spinal wax glands (ventrofrontal, facial and occipital) comprising of equal sized facets. Antennae 5 segmented in apterae hardly $0.20\times$ as long as the body ; secondary rhinaria absent in apterae ; primary rhinaria small, thick rimmed on segment V with an elongated horn shaped "plaque"; processus terminalis short, conical, $0.25\times$ or less, the length of base of last antennal segment and bearing 1 apical and 4 subapical setae. Eyes in apterae represented by triommatidia. Rostrum short ; ultimate rostral segment bearing a pair of accessory hairs. All thoracic and 1st-6th abdominal tergites with paired spinal wax-gland groups ; paired pleural wax-gland groups present on meso and metanota and on 1st-7th abdominal tergites, whereas marginal wax-gland groups present on all thoracic tergites and on 1st-7th abdominal tergites ; dorsal hairs never arising from any gland group. Hairs on the dorsum of abdomen arranged segmentally in a row ; 8th tergite with 6-10 hairs.

Siphunculi absent. Cauda short and broad with 2-3 hairs. Legs short with sparse hairs ; first tarsal segments with 3, 2, 2 hairs, empodial hair fine.

Embryos with short rostrum and horn shaped primary rhinarial plaque on last antennal segment and with long anterhinarial hairs. First instar nymph with 5 segmented antennae, same wax gland arrangement as in adults, spinulose tarsi, and with F.T.C. 3. 2. 2.

Alate and sexuales not known.

Discussion.—Stroyan (1963) has elaborately discussed the relationship of the genus with *Kaltenbachiella* Schoutedon, *Tetraneura* Hartig, *Colopha* Monell and *Byrsocryptoides* Dzhibladze, the last named genus being considered as closest to *Gharesia* ; the embryones from alate migrants of *Byrsocryptoides* differ from the embryones from apterae of *Gharesia*, in having longer rostrum and ultimate rostral segment transverse or oblique, primary rhinarial plaque on last antennal segment and short anterhinarial hairs. The only member of the genus further differs from two known species of *Byrsocryptoides* which feed on *Zelkova* in being associated with *Carex* or *Kobresia*. Eastop and Hille Ris Lambers (1976) however, included the type species of *Gharesia* under *Byrsocryptoides* and considered *Gharesia* as a synonym of the former ; Stroyan (*in litt*) opines that he is not yet convinced that *Gharesia* is a synonym of *Byrsocryptoides*. The present study supports stroyans opinion.

Biology.—Stroyan (1963) mentioned that search for primary host of the type species may be directed to *Celtis australis*, a common plant in the region but subsequent report of *Gharesia polunini* from a Compositae in the white mountains, California, U.S.A. (Hille Ris Lambers, 1966), indicates its occurrence on a different host plant family, where alate nymphs were also collected and thus suggests a host association with Cyperaceae and Compositae. In both the localities, altitude is above C 4000 m and this indicates its restrictive distribution even at widely separated zoo-geographical regions of Northwest Himalaya and U.S.A.

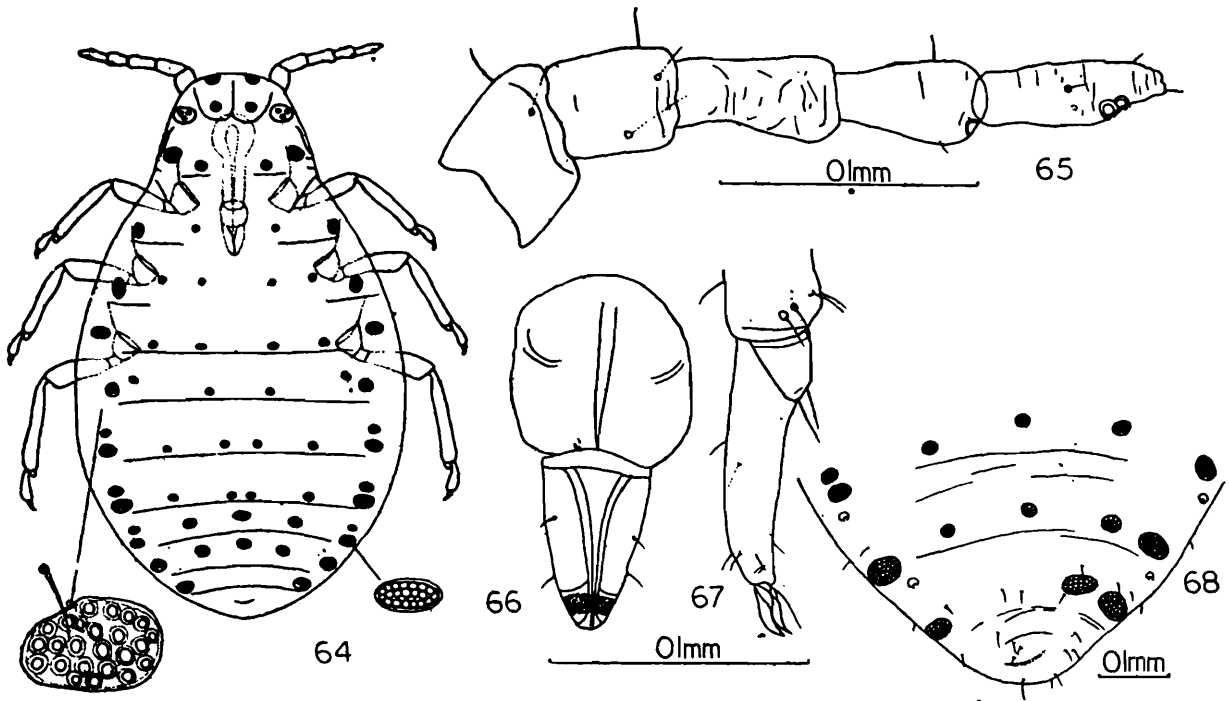
Distribution.—PAKISTAN (Northwest Himalaya) and U.S.A. (Western U.S.A.).

Type species.—*Gharesia polunini* Stroyan. Holotype in the collections of H.L.G. Stroyan, Plant Pathology Laboratory, Harpenden, Herts, ENGLAND ; Paratypes in H.L.G.S collections, in the collections of British Museum (Nat. Hist.) London, D. Hille Ris Lambers, THE NETHERLANDS, A.A. Dzhibladze, Tiflis, U.S.S.R.

7. *Gharesia polunini* Stroyan (Figs. 64-68)

1963. *Gharesia polunini* Stroyan, H. L. G., *Proc. R. ent. Soc. Lond. (B)*, 32 : 81.
 1966. *Gharesia polunini*, Hille Ris Lambers, D. *Hilgardia*, 37 (15) : 584.
 1976. *Byrsocryptoides polunini*, Eastop, V. F. and Hille Ris Lambers, D., Survey of the World's Aphids, 206.

Apterous viviparous females.—Body 1.9-2.1 mm. long with 1.0-1.2 mm. as maximum width. Head capsule with about 17-20 hairs, 0.010-0.013 mm. long, $0.33-0.40\times$ as long as the basal diameter of antennal segment III. Antennae 5 segmented, blackish brown, $0.15-0.21\times$ as long as the body ; segment I with 2, II with 2, III with 0-1, IV with 3-4 and base of V with 2 hairs, longest one being on segment IV, 0.013 (0.017-0.022 mm.) long, $0.44-0.46\times$ as long as the basal diameter of the segment ; primary rhinaria with thick rim, ciliated, on segment V with "an elongate horn-shaped plaque" Rostrum reaches mid coxae, ultimate rostral segment 0.85-0.86 ($0.67-0.83\times$) as long as second segment of hind tarsus and bears 2 accessory hairs. Abdominal dorsum pale, membranous ; hairs on dorsum of abdomen minute ; on anterior tergites upto 0.028-0.036 mm. long, on 8th tergite 0.038 (0.040-0.048 mm.) mm. long, these being $0.80-0.95\times$ as long as the basal diameter of antennal segment IV Wax glands present on head (3 pairs ; ventrofrontal, facial and occipital) and pronotum (1 pair, spinal) ; from mesonotum to 7th tergites, wax glands arranged in marginal, pleural and spinal pairs, each of which is composed of a number of cells (4-38), but the marginals being always larger than the others. Siphunculi absent. Cauda with 2 (2-3) hairs. Subgenital plate with 2-3 long hairs placed anteriorly and 12-13 smaller ones on posterior side. Legs dark brown, with distinctly 2



Gharesia polunini Stroyan ; Apterous viviparous female : 64. whole body ; 65. antenna ; 66. ultimate rostral segment ; 67. hind tarsus ; 68. posterior portion of abdomen.

segmented tarsi ; hairs on femora and tibiae small, erect, sparse, on hind tibia upto 0.013 mm. long, $0.36\times$ as long as the diameter at the middle of the tibiae ; first tarsal segments with 3, 2, 2 hairs, empodial hair fine, 0.030 mm. long, $1.0\times$ as long as the claws.

Colour.—Greyish in life covered with wax.

Measurements in mm.—

	Length	Width	Antenna		
1.	1.93	1.0	0.33		
2.	1.99	1.1	0.36		
	Antennal segments			urs.	ht ₂
III	IV	V			
0.07	0.06	(0.06+0.016)	0.08	0.11	
0.08	0.06	(0.07+0.016)	0.08	0.11	

(ex *Carex* or *Kobresia*, Gharesia Glaceir, PAKISTAN, 14.8.1961, coll. O. Polunin, det. H.L.G. Stroyan).

Other morphs.—Not known.

Material examined.—3 apterous viviparous females ex *Carex* or *Kobrusia*, Ghahesia Glacier, PAKISTAN, 14.8.1961, coll. O. Polunin, det H.L.G. Stroyan, (Paratypes).

Discussion.—The species is so far known from Cyperaceae and Compositae at High altitudes in widely separated geographical area. The distinctiveness of the species has been established by Stroyan (1963) but generic status of *Ghahesia* remains to be fully investigated to find out whether it is congeneric with *Byrsocryptoides*; in case it turns out to be a member of latter genus, *polunini* remains distinctive in its host association, from *Zelkova* infesting *Byrsocryptoides*.

Types.—In the collections of H.L.G. Stroyan, Harpenden, Herts, ENGLAND (Holotype and Paratypes, British Museum, National History, London (Paratypes), D. Hille Ris Lambers, Bennekom, THE NETHERLANDS, A. A. Dzhibladze, Tiflis, U.S.S.R.

Distribution.—PAKISTAN, U.S.A.

3. Genus *Kaltenbachiella* Schoutedon 1906.

1906. *Kaltenbachiella* Schoutedon, H., *Mem. Soc. r. ent. Belg.*, 12 : 194, Type species: *Kaltenbachiella menthae* Schoutedon=*Byrsocrypta pallida* Haliday.
1917. *Gobaisha* Matsumura, S., In Nagano, K. A., *Collections of Essays for Yasushi Nawa*, Gifu, 3 : 75, Type species: *Gobaisha japonica* Matsumura.

Morphology.—Body elongate, ovoid. Head without any frontal prominence; dorsum of head scabrous and striated in alatae; cephalic hairs fine. Antennae in apterae, 4-5 segmented and 0.14-0.34× as long as the body, in alatae 6 segmented and 0.30-0.45× as long as the body; segment III in alatae distinctly longer than any other antennal segments; secondary rhinaria strongly annular; present on segments III, IV, V and base of segment VI of alatae; flagellum often spinulose on segment IV onwards, at least in alatae,

primary rhinaria rounded in apterae, irregular in shape in alatae ; accessory rhinaria on segment VI in alatae, round, ciliated ; processus terminalis short, hardly $0.20\times$ as long as base of segment VI. Ultimate rostral segment slender, distinctly shorter ($0.66-0.80\times$) than second segment of hind tarsus and bearing 1-2 pair of accessory hairs. Abdominal dorsum pale, in apterae with many wax glands, consisting of a single row of facets surrounding an irregular area ; hairs on the dorsum of abdomen fine, shorter on anterior tergites, much longer and conspicuous on posterior tergites ; 8th tergite with 4-6 hairs on a brown sclerotic band. Siphunculi with large pore, surrounded by a sclerotic area sometimes hardly discernible. Cauda semioval with 2-4 hairs. Subanal plate spinulose ventrally with some short fine hairs on anterior end and some long fine hairs on posterior margin. Subgenital plate with a number of medium to long hairs (18-21) with acute apices. Legs with femora often scabrous ventrally, apices of tibiae and whole of tarsi often spinulose ; hairs on femora and tibiae short, conspicuous ; first tarsal segments at least with 2 long fine hairs besides 2 much shorter and thicker hairs. Empodial hairs fine, almost as long as claws. Forewings with media simple (basal portion often indistinct) radial sector distinctly curved, stigma truncate ; hind wings with both obliques.

Antennae in young larvae, 4 segmented with segment III little longer than I and II taken together, and segment IV being subequal to segment II, with very short and obtuse processus terminalis (Schouteden, 1906) ; in later stages antennae appear as 5 and 6 segmented.

Discussion.—*Kaltenbachiella* was described by Schouteden (1906) on the basis of a single species *K. menthae* collected on roots of *Mentha arvensis* and known only by apterous viviparae and nymphs. Matsumura (1917) described *Gobiashia* as a new genus with two species *japonica* Mats, and *nirecola* Mats, first one collected on *Ulmus* spp. and *Elsholtzia ciliata* and the second on *Ulmus* and other graminaceous hosts. Baker (1920) considered *Kaltenbachiella* as a synonym of *Geica* but recognised *Gobiashia* as a distinct genus with two species, *G. japonica* Mats., and *Byrsocrypta pallida* Haliday ; he also considered *Tetraneura alba* Ratz. as a

synonym of *G. japonica* Mats. American authors, have for long, continued to follow Baker and listed the only nearctic species *ulmifusa* (Walsh & Riley) as under *Gobiashia*. Later, *Gobiashia* has been considered as a complete synonym of *Kaltenbachiella* and presently five species are recognised in the genus viz. *carpinicola* Ghosh, A. K. *et al.*, *elshotriae* (Shinji), *japonica* (Matsamura), *pallida* (Haliday) [of which *T. alba* is a synonym and not of *japonica*] and *ulmifusa* (Walsh & Riley); of these, the first species is known only from India, next three species are mostly known from Palaearctic region except for the records of *japonica* from Sri Lanka and *pallida* from West Africa and the last one is widely distributed in United States of America. Ghosh, A. K. (1981) has recently published a review of the genus.

Biology.—*K. pallida* (Haliday) is a heteroecious holocyclic species, alternating between galls of *Ulmus* and roots of *Mentha arvensis* and other Labiatae; Börner (1952) has described its galls on *Ulmus* (*campestris*, *scabra*, *montana*) as spherical, closed-galls, bright green and densely setose, protruding over the leaf surface at the base of leaves on the upper side. *K. japonica* (Matsumura) was considered to have *Ulmus* as primary host and *Elshotzia* as secondary host (Mordvilko, 1935) but it has now been demonstrated that this species does not have host alternation and completes its cycle on *Ulmus* (*japonica*, *laciniata* etc.) (Hille Ris Lambers, 1967), as also *K. elshotriae* (Shinji) which is known only from *Elshotzia ciliata* (*E. patrini*) and perhaps completes its cycle on this host. *K. ulmifusa* (Walsh & Riley) is mostly known to feed on *Ulmus fulva* besides on few other *Ulmus* spp. where they produce spindle-shaped, bag-like galls on upper surface of leaves; sometimes galls are reported to be abundant on all elms and most of the collection-records indicate occurrence of *alatae* in May-July. *K. carpinicola* forms pouch-like galls on *Carpinus* in June-July.

Distribution. SRI LANKA ; JAPAN ; WEST AFRICA ; EUROPE ; U.S.A.

Types species.—*Kaltenbachiella pallida* (Haliday, 1838) [= *K. menthae* Schouteden, 1906]. Location of types not known.

*Key to the species of Kaltenbachiella**Alate viviparous female.* —

Body large 2.2-2.6 mm. long. Antennal segment III with 20-29, IV with 7-10, V with 10-13 and VI with 15-17 secondary rhinaria; processus terminalis $0.14-0.18\times$ as long as base of antennal segment VI. Ultimate rostral segment $0.54-0.62\times$ as long as second segment of hind tarsus. Longest hair on 8th tergite, 0.020-0.033 mm. long. On *Carpinus*

K. carpinicola Ghosh *et al.*

—Body small, 1.38-1.40 mm. long. Antennal segment III with 7-10, IV with 2-3, V with 3-5 and VI with 2-3 secondary rhinaria; processus terminalis $0.25\times$ as long as base of antennal segment VI. Ultimate rostral segment $0.68-0.86\times$ as long as second segment of hind tarsus. Longest hair on 8th tergite 0.020 mm. long. On *Ulmus*

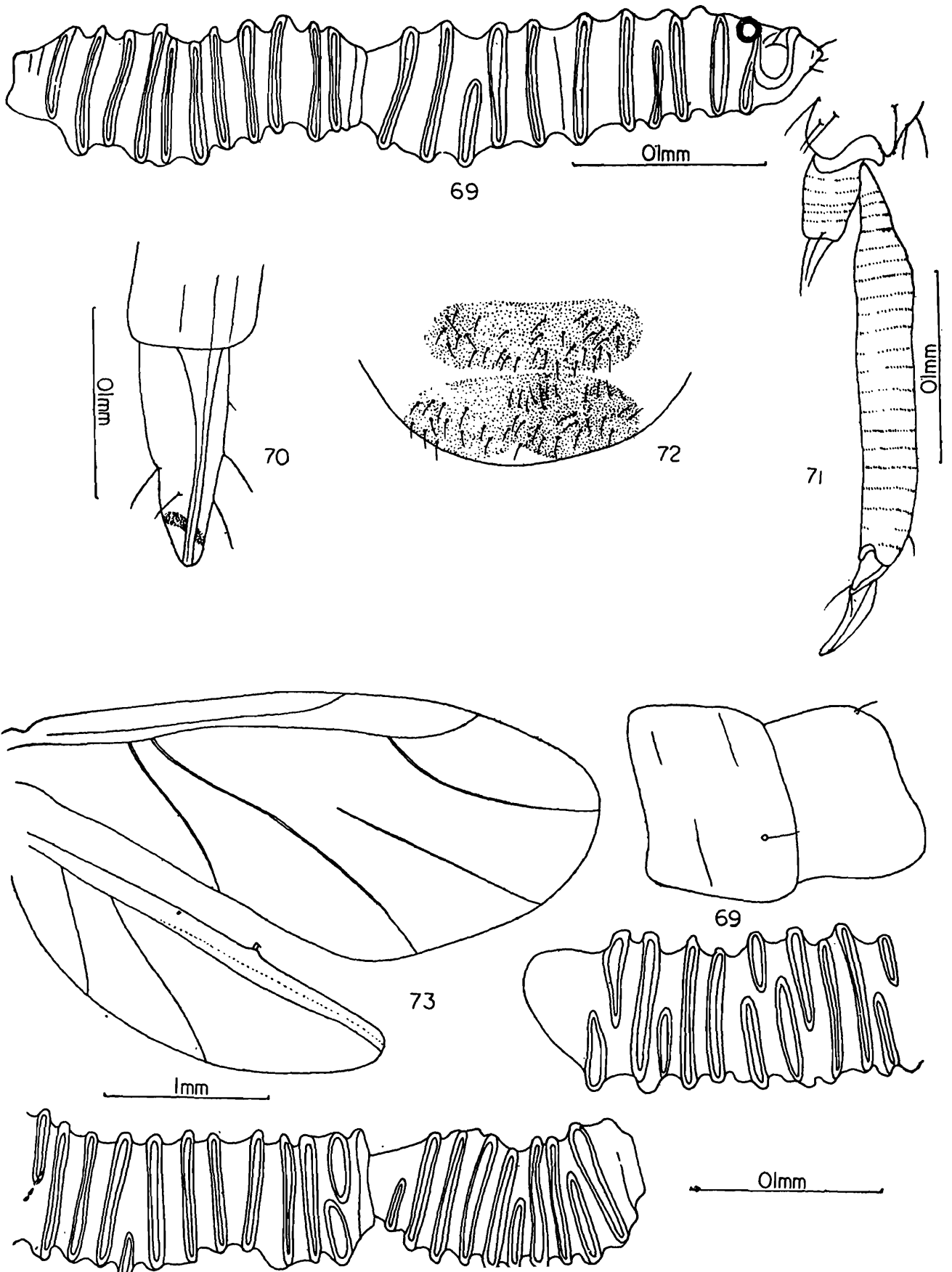
.K. japonica (Mats).

8. *Kaltenbachiella carpinicola* Ghosh, Chakrabarti, Bhattacharya
(Figs. 69-73)

1981. *Kaltenbachiella carpinicola* Ghosh, A. K., Chakrabarti, S. and Bhattacharya, D. K., *Bull. zool Surv. India*.

1981. *Kaltenbachiella carpinicola*, Ghosh, A. K., *Oriental Ins.*, ...

Alate viviparous female.—Body 2.23-2.55 mm. long with 0.89-1.24 mm. as maximum width. Head brown to blackish brown; vertex slightly rugose with many scattered wax pores and with 4 pairs of short hairs and a single hair placed laterad, with acute to acuminate apices, longest one about 0.010 mm. long and about $0.50\times$ as long as the basal diameter of the antennal segment III; dorsal median suture present on posterior half of the head; lateral and median frontal prominence not developed. Eyes with indistinct ocular tubercles, median ocellus not viewed from the dorsal side. Antennae 6 segmented, brown to blackish brown, about $0.36-0.42\times$ as long as the body; segment I and II, each with 4 short, pointed hairs; hairs on the flagellum sparse, acute, longest one on segment III about 0.010 mm. long and $0.45-0.50\times$ as long as the basal diameter of the segment; secondary rhinaria non-ciliated, annular, nearly encircling the width of the segments;



Kaltenbachiella carpinicola A. K. Ghosh, Chakrabarti, Bhattacharjee ;
 Alate viviparous female (from galls) : 69. antenna ; 70. ultimate rostral
 segment ; 71. hind tarsus ; 72. posterior portion of abdomen ; 73. wings.

segment III with 20-29, IV with 7-10, V with 10-13 and VI with 15-17 secondary rhinaria ; primary rhinaria ciliated ; processus terminalis about $0.14-0.18\times$ as long as the base of segment VI. Ultimate rostral segment about $0.54-0.62\times$ as long as the second segment of hind tarsus, bearing 2-4 accessory hairs. Thorax blackish brown and with scattered wax pores particularly on mesothoracic lobes. Abdomen pale brown, tergum membranous, hairs on the dorsum of abdomen thin, with acuminate apices, mostly arranged in rows, anterior tergites each with 10-12 hairs, (usually 1 pair of spinal, 1 pair of pleural, and 2-3 pair of marginals), longest one about 0.022-0.030 mm. long and about $1.0-1.5\times$ as long as the basal diameter of antennal segment III ; 7th tergite with 8-10 hairs upto 0.026-0.030 mm. long and 8th tergite with 6 hairs upto 0.029-0.033 mm. long, these being $1.3-1.6\times$ and $1.3-1.7\times$ as long as the basal diameter of antennal segment III, respectively ; Siphunculi black, sclerotized, ring-like, about 0.029-0.044 mm. in diameter. Cauda semilunar with 12-14 hairs. Subanal plate sclerotised, slightly indented, with 29-31 hairs. Subgenital plate with about 24 pair of hairs in 2-3 rows on posterior margin ; ventral hairs stouter than dorsal hairs. Legs brown. Femora stout, scabrous ; femoral hairs short and pointed ; tibiae with long and fine hairs, longest hair on hind tibiae 0.023-0.026 mm. long, $0.58-0.66\times$ as long as the diameter at the middle of hind tibiae ; tarsi and anteriormost portion of tibiae spinulose, spinules on tarsi arranged in rows. First tarsal segments with 4, 4, 5 hairs ; empodial hair 0.023-0.030 mm. long. $0.63-0.69\times$ as long as the claws. Forewings with media simple, veins little dusky.

Colour.—Not recorded.

Measurements in mm.—

	Length	Width	Antenna
1.	2.23	1.07	0.95
2.	2.33	1.13	0.93
3.	2.20	1.08	0.93
4.	2.34	0.89	0.96

III	Antennal segments			urs.	ht ₂
	IV	V	VI		
0.34	0.11	0.16	(0.16+0.03)	0.09	0.16
0.35	0.11	0.13	(0.16+0.03)	0.09	0.16
0.34	0.11	0.14	(0.16+0.03)	0.09	0.16
0.35	0.12	0.16	(0.17+0.03)	0.09	0.15

(1-4 ex *Carpinus* sp. Trijuginarayan, Uttar Pradesh, INDIA, 5.6.1978, coll. S. Bhattacharjee).

Nymph.—(late stage) : Body 2.4 mm. long with 1.24 mm. as maximum width. Head pale. Antennae 6 segmented, pale, 0.25× as long as the body, with secondary rhinaria on III-VI segment ; segment III longer than IV+V taken together , primary rhinaria ciliated. Rostrum reaches little beyond fore coxae ; ultimate rostral segment 0.8× as long as second segment of hind tarsus. Abdominal dorsum pale, membraneous ; stigmal pori with sclerotic rims ; dorsal hairs upto 0.013 mm. long. Siphunculi distinct. Legs with trochanters indistinctly separated from femora ; tibiae of hind legs long 1.25× as long as tibiae of fore legs ; tarsi two segmented ; first tarsal segment with at least two hairs.

Colour.—Pale brown in life.

Measurements in mm.—

Length	Width	Antenna
2.41	1.25	0.62

III	Antennal segments			urs.	ht ₂
	IV	V	VI		
0.20	0.07	0.07	0.16	0.10	0.12

(ex *Carpinus* sp., Trijuginarayan, Uttar Pradesh, INDIA, 5.6. 1978, coll. D. K. Bhattacharjee).

Other morphs.—Not known.

Material examined.—13 alate viviparous females and 3 alate nymphs (Holotype and Paratypes) from galls of *Carpinus* sp., Trijugarayan, Uttar Pradesh, INDIA, 5.6.1978, coll. S. Bhattacharjee. (S. Chakrabarti's collections and Z.S.I. collections).

Discussion.—The present species forms open galls, appearing as swollen pouch, on leaf blades, of *Carpinus* sp., and as such differs from all other known species of *Kaltenbachiella* in its host association. It appears otherwise closest to North American *ulmi-fusa*, but differs in having larger size of the body, in the ratio of body to the antenna, ultimate rostral segment to second segment of hind tarsus and in the number of secondary rhinaria etc.

Distribution.—INDIA (Uttar Pradesh).

Types.—Holotype and 10 paratypes (alates) in the collections of Dr. S. Chakrabarti, Dept. of Zoology, Kalyani University ; 6 paratypes (alate and nymphs) in the collection of Zoological Survey of India, Calcutta.

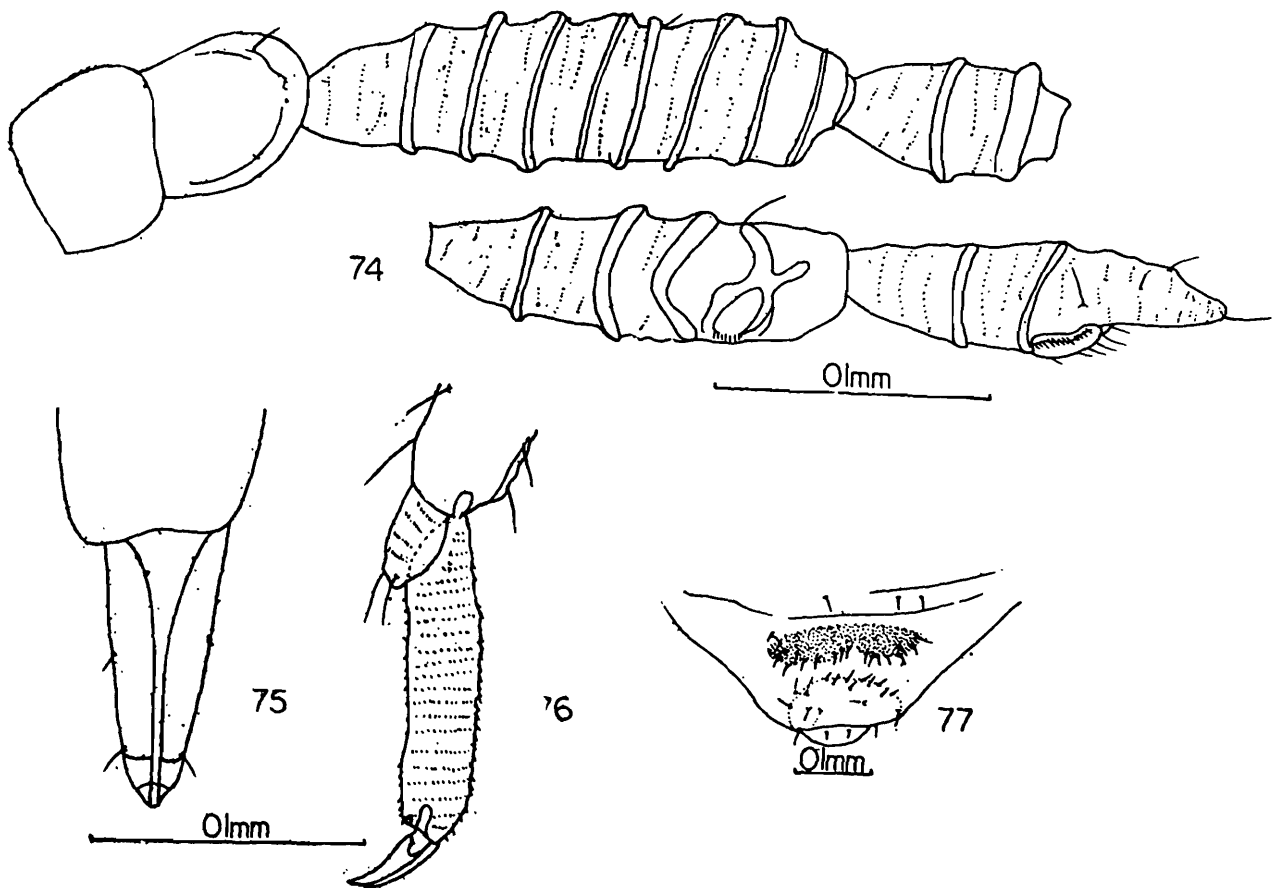
9. *Kaltenbachiella japonica* (Matsumura)

(Figs. 74-77)

1917. *Gobaishia japonica* Matsumura, S., Synopsis of the Pemphigidae of Japan, Gifu, 75.
 1920. *Gobaishia japonica*, Baker, A. C., *Bull. U. S. Dep. agric.*, 826 : 67.
 1963. *Kaltenbachiella* sp., Judenko, E. and Eastop, C. F., *Entomologist's mon. Mag.*, XCIX : 62.
 1967. *Kaltenbachiella japonica*, Hille Ris Lambers, D. *Entom. Bericht.*, 27 : 88.
 1969. *Kaltenbachiella japonica*, Higuchi, H. and Mizazaki, M., *Insecta matsum. suppl.*, 5 : 55.
 1976. *Kaltenbachiella japonica*, Eastop, V.F. and Hille Ris Lambers, D., Survey of the World's Aphids, 232.
 1981. *Kaltenbachiella japonica*, Ghosh, A. K., *Oriental Ins.*,

Alate viviparous female.—Body small, 1.38-1.40 mm. long with 0.69-0.72 mm. as maximum width. Head dark brown, without any suture or wax plates ; dorsal cephalic hairs with acuminate apices, upto 0.010 mm. long, 0.60× as long as the diameter at the constricted base of antennal segment III. Antennae brown, 6 segmented, 0.34-0.38× as long as the body ; flagellum finely spinulose, segment III longest but shorter than segment IV and V taken together, with

7-10 annular secondary rhinaria distributed over their entire lengths ; segment IV smallest of all flagellar segment, with 2-3 similar rhinaria ; segment V subequal to VI, with 3-5 similar rhinaria ; segment VI densely spinulose, with 2-3 secondary rhinaria at the basal portion ; primary rhinaria on segment VI ciliated ; hairs on the flagellum sparse, on segment III upto 0.03mm. long, $0.20\times$ as long as the basal diameter of the segment ; processus terminalis $0.23-0.25\times$ as long as base of antennal segment VI. Rostrum reaches midcoxae, ultimate rostral segment slender $0.68-0.86\times$ as long as the second segment of hind tarsus. Abdominal dorsum pale, membranous ; wax gland cells not visible ; hairs on the dorsum of abdomen $0.010-0.020$ mm. long, $0.66-1.2\times$ as long as the basal diameter of antennal segment III ; 8th tergite with 6 hairs, upto 0.020 mm. long. Siphunculi absent. Cauda small, semioval, bearing 2 hairs. Subanal plate with 16 hairs.



Kaltenbachiella japonicus Matsumura ; Alate viviparous female (from galls) :
74. antenna ; 75. ultimate rostral segments ; 76. hind tarsus ; 77. posterior portion of abdomen.

Subgenital plate spinulose with about 22 hairs, arranged in posterior margin. Legs brownish ; trochanters nearly fused with femora ; apices of tibiae and whole of tarsi finely spinulose ; hairs on femora and tibiae fine, longest one on hind tibiae 0.016 mm. long, $0.71 \times$ as long as the diameter at the middle of the tibiae ; first tarsal segments with 2, 2, 2 hairs ; empodial hair 0.020 mm. long, $0.66 \times$ as long as the claws. Forewings with pterostigma short, media simple, obsolete near basal 0.30 portion, cubitus and anal fused at base ; hind wings with both obliques.

Colour.—Yellowish brown in life (Shinji, 1936).

Measurements in mm.—

	Length	Width	Antenna		
1.	1.38	0.69	0.51		
2.	1.40	0.71	0.48		
3.	1.38	0.57	0.48		
4.	1.40	0.55	0.46		
	Antennal segments			urs.	ht ₂
III	IV	V	VI		
0.13	0.06	0.10	(0.08+0.02)	0.073	0.106
0.14	0.05	0.09	(0.08+0.02)	0.083	0.096
0.13	0.06	0.10	(0.08+0.02)	0.070	0.100
0.12	0.06	0.10	(0.09+0.02)	0.076	0.090

(1, ex trap, Kandy, SRI LANKA, 19.6.1962 ; 2, ex trap, Kundasale, SRI LANKA 25.1.1962, coll. E. Judenko, No. 481, and 306, BMNH collection ; 3-4, ex *Ulmus davidiana* var. *japonica*, galls, Hokkaido, Sapporo, JAPAN, 28.7.1973, coll. S. Aoki, No. 588).

Other morphs.—Not available.

Material examined.—One alate viviparous female, trapped, Kundasale, SRI LANKA 14-18.12.1961, coll. E. Judenko (No. 78 BMNH, labelled ? *Kaltenbachiella*) ; one alate viviparous female' trapped, Kundasale, SRI LANKA, 25.1.1962, coll. E. Judenko, (No'

306, BMNH, labelled *K. elsholtriae*) ; one alate viviparous female, trapped, Kandy, SRI LANKA, 19.12.1962, coll. E. Judenko (No. 48, BMNH, labelled *elshoitziae*) ; 4 alate viviparous females from closed pouch galls of *Ulmus davidiana* var. *japonica*, Sapporo, Hokkaido, JAPAN, 28.7.1973, coll. S. Aoki (No. 588, labelled *K. japonica* ; Hokkaido univ. collections).

Discussion.—Matsumura (1917) erected the genus *Gobaishia* with *japonica* as the type, which was characterised in having stem mother with 4 segmented antennae and alatae with 6 segmented antennae, annular secondary rhinaria, simple media in the forewing and two obliques in the hind wings, and by the presence of siphunculi. This species was stated to be very similar to *pallida* Haliday, type of *Kaltenbachiella*, and has subsequently been shifted to the latter genus. Mordvilko (1935) suggested that *japonica* is a heteroecious species, alternating between *Elsholtria* and *Ulmus* but Hille Ris Lambers (1967), observed that the embryos from alatae within the galls of *Ulmus*, collected during July-August in Japan, indicate that this species is autoecious on *Ulmus*. Aoki (in litt.) supported Hille Ris Lambers view. Alate material from yellow pan trap collections in SRI LANKA, when compared with Japanese material of *japonica* from *Ulmus* gall, suggested that the former should belong to *japonica* and not to *elsholtriae*.

Distribution.—SRI LANKA, JAPAN, U.S.S.R. (Vladivostock).

Types.—Location of types not known.

4. Genus *Schizoneurella* Hille Ris Lambers, 1973

1973. *Schizoneurella* Hille Ris Lambers, D. *Oriental Ins.*, 7 (2) : 249. Type species : *Schizoneurella indica* Hille Ris Lambers.

Morphology.—Body 1.2-2.3 mm. long. Head without wax glands in apterous and alate viviparae (from primary host), with a pair of dorsal and ventral wax glands in exules apterae viviparae (from secondary host). Antennae 5 segmented in exules, 0.14-0.16× as long as the body, 6 segmented in other apterae and alatae, 0.26-0.33× as long as the body ; flagellum sparsely spinulose from middle of segment III or only on segment VI ; secondary rhinaria absent in apterae, present in segment III-VI in alatae ; primary rhinaria

distinctly ciliated, large, sometimes fused with a secondary rhinarium on segment V and on VI ; hairs on the flagellum much longer in apterae (0.015 mm.) than in alatae (0.005 mm.) ; processus terminalis short, $0.20-0.33 \times$ as long as base of antennal segment VI. Ultimate rostral segment bearing 4-6 accessory hairs. Wax glands absent in alatae, present spinally and marginally from pronotum to 7th abdominal tergite in exules (from *Malus*) and only on 1st-6th abdominal tergites in other apterae (from *Ulmus*) ; wax glands in exules with groups of circular cells surrounded by some elongate radiating cells, and in the other viviparae, composed of only small polygonal cells. Abdominal dorsum, in alate viviparae, with fragmented spinal and pleural sclerites and dotted or solid linear bars of inter-segmental sclerites ; 8th tergite with 2-5 hairs. Siphunculi absent in apterous exules, present in others, surrounded by 5-11 hairs. Cauda with 2-3 hairs. Legs pale ; tarsi spinulose ; first tarsal segments with 2,2,2 (in exules) or 3,3,3 or 3,3,2 hairs ; empodial hairs $0.33-0.50 \times$ as long as the claws seemingly absent in exules. Forewings with media once branched, hind wings with both obliques.

Embryos have 4 segmented antennae, spinulose flagellum, strongly transverse primary rhinarium and 6 hairs on each of 1st-6th tergites ; wax glands either absent or poorly developed ; legs with tarsi spinulose ; empodial hairs not visible and dorso-apical hairs at apices of second tarsal segments, short with blunt apices ; alatoid nymphs appear similar to apterae from *Ulmus* galls.

Sexuales.—Not known.

Discussion.—Hille Ris Lambers (1973) while describing the genus discussed its relationship with other genera and pointed out the similarities of embryos of Palaearctic species of *Schizoneura* with the present genus ; however in the absence of siphunculi in exules, and apparent absence of empodial hairs in embryos and adult exules, the present genus differs from other related genera ; it has however, similarities with North American *Schizoneurata* H.R.L. in having two types of wax glands and in the absence of siphunculi in apterae but differs in having spinulose tarsi in embryos of emigrants and exules.

Biology.—The only species, so far known, alternates between galls formed on *Ulmus villosa* and roots of *Malus pumila*; the generations on *Ulmus* are mostly formed during May-June and the exules on *Malus*, during September-October; the type of galls produced on *Ulmus* was not known (H.R.L. 1973). Recently, Bhagat (1980) while dealing with Parasitoid complex of aphids of Kashmir, reported that *Schizoneurella indica* forms clavate lopsided galls on *Ulmus wallichiana* and epiphyllous leaf-roll galls on *Ulmus laevigata* (*villosa*). A parasite, *Aeropraon lepelley* (Waterson) is reported from *S. indica* in Kashmir.

Distribution.—INDIA (Jammu & Kashmir), PAKISTAN.

Type species.—*Schizoneurella indica* Hille Ris Lambers 1973. In the collections of D. Hille Ris Lambers. Bennekom, The Netherlands.

10. *Schizoneuralla indica* Hille Ris Lambers (Figs. 78-86)

1973. *Schizoneuralla indica* Hille Ris Lambers, *Oriental Ins.*, 7 (2) : 250.

Apterous viviparous female.—(from gall) : Body pale 2.35 mm. long with 1.5 mm. as its maximum width. Head light yellow. Antennae 6 segmented; flagellum finely spinulose; hairs on flagellum fine, longest one on segment III 0.016 mm. long, nearly $0.50\times$ as long as the basal diameter of the segment; processus terminalis $0.20\times$ as long as base of segment VI; primary rhinaria rounded to oval, ciliated. Eyes of 3 facets only. Rostrum slender; ultimate rostral segment $0.75\times$ as long as second segment of hind tarsus and bears 4 accessory hairs. Abdominal dorsum pale without any sclerites; very small rounded polyginal wax gland cells present in marginal and spinal areas, without having any border and extending over a broad field, these being more easily visible on posterior tergites; hairs on the dorsum of abdomen long and fine, upto 0.050 mm. long and $1.40\times$ as long as the basal diameter of antennal segment III. Siphunculi with a dark rim and surrounded by 5-6 hairs. Cauda pale with long, fine hairs. Legs pale yellow, nearly smooth, hairs on hind tarsi upto 0.016 mm. long, nearly $0.50\times$ as long as the width at middle of hind tarsi.

Colour.—Not recorded.

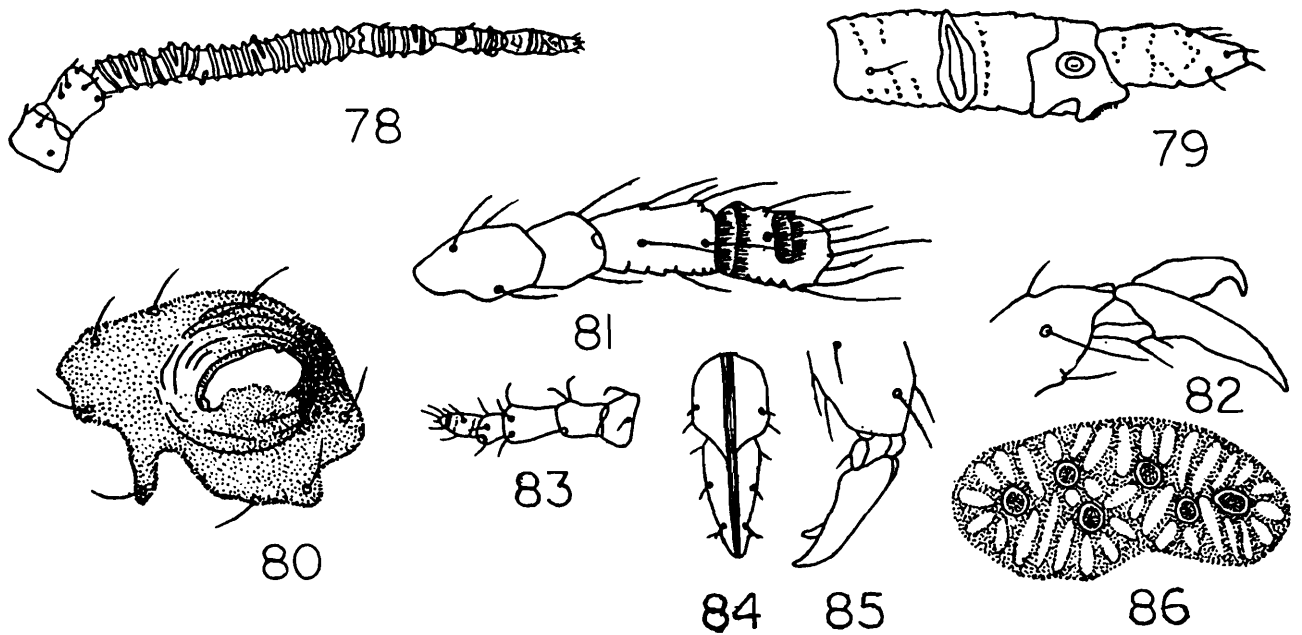
Measurements in mm.—

Length		Width		Antenna			
2.35		1.15		0.65			
Antennal segments				urs.	ht ₂	Siphun- culus diam.	Cauda
III	IV	V	VI				
0.28	0.07	0.09	(0.07+0.02)	0.10	0.13	0.03	0.05

(ex *Ulmus laevigata*, gall, Rawalkot, PAKISTAN, 9.6.1967, coll. Ghani).

Apterous viviparous female (Exules from roots of *Malus* ; description based on H.R.L., 1973).—Body small 1.27-1.29 mm. long. Head with a pair of dorsal and a pair of large ventral wax glands ; a pair of marginal and a pair of spinal glands present from pronotum to 7th tergite ; each gland with 2-9 circular cells from which radiate or between which lie, linear, faintly bordered cells. Antennae 5 segmented, 0.14-0.16× as long as log body ; segment III little longer than IV or V Ultimate rostral segment 0.095 mm. long with 4 accessory hairs. Tergum not sclerotic ; 8th tergite with a pair of wax glands and with 4-5 hairs. Siphunculi absent. Cauda with 3 hairs. First tarsal segments with 2, 2, 2 hairs.

Alate viviparous female.—(Emigrants from gall). Body 2.35-2.43 mm. (1.83-2.30 mm.) long with 1.05-1.13 mm. as its maximum width at the middle of abdomen. Head and thorax blackish, head with a median suture and without any wax glands. Antennae 6 segmented, dark brown, 0.35-0.37× as long as the body ; segment III, with 27-29 (19-29) annular secondary rhinaria, segment IV with 7-8 (4-8), V with 6 (1-6) and VI with 0-1 (2) similar secondary rhinaria ; primary rhinaria irregular in shape ; processus terminalis little less than 0.33× as long as the base of segment VI ; hairs on the flagellum minute, 0.005-0.006 mm. long, longest one on segment III hardly 0.33× as long as the diameter



Schizoneurella indica Hille Ris Lambers (from Hille Ris Lambers, 1973) ;
 Alate viviparous female (emigrant) : 78. antenna ; 79. last antennal
 segment ; 80. siphunculus ; 81. antenna of embryo from emigrant ;
 82. claws of hind tarsus of alate emigrant.

Apterous viviparous female (exules) : 83. antenna ; 84. ultimate rostral
 segments ; 85. claws of hind tarsus ; 86. wax glands on 3rd
 abdominal tergite.

at narrowed base of the segment. Eyes large with ocular tubercles. Rostrum reaches near mid-coxae ; ultimate rostral segment slender and acute at apex, $0.75\times$ as long as second segment of hind tarsus and bears 4 (—6) accessory hairs. Abdominal dorsum pale with brownish transverse intersegmental sclerites and some fragmented spinal and pleural sclerites, without any wax gland ; hairs on the dorsum of abdomen inconspicuous, on anterior tergites 0.006-0.016 mm. long, on posterior tergite 0.035 mm. long, these being $0.33-0.80\times$ and upto $1.5\times$ as long as the basal diameter of antennal segment III. Siphunculi on dark sclerites, surrounded by 7-11 hairs, with a distinct rim. Cauda broad semioval, brown, sclerotic and bears 2 hairs. Legs brown to dark brown, slender, nearly smooth ; hairs on hind tibiae upto 0.018 mm. long, $0.60\times$ as long as the width at the middle of the tibiae ; first tarsal segments with 3, 3, 3 or 3, 3, 2 hairs ; empodial hairs about $0.50\times$ as long as the claws. Forewings with media once branched, hind wings with both obliques.

Colour.—Not recorded.

Measurements in mm.—

	Length				Width		Antenna	
	III	IV	V	VI	urs.	ht ₂	Siphunculi diam.	Cauda
1.	2.43				1.10		0.90	
2.	2.35				1.17		0.82	
	0.42	0.13	0.12	(0.08+0.025)	0.10	0.13	0.13	0.05
	0.42	0.13	0.12	(0.08+0.025)	0.10	0.13	0.03	0.05

(1, 2, ex *Ulmus laevigata*, galls, Rawalkot, PAKISTAN, 9.6.1967, coll. Ghani)

Sexual forms.—Not known.

Larvae and nymphs (from H.R.L. 1973).—Embryos with 4 segmented antennae ; distal half of segment III and whole of IV spinulose ; segment III with 8 hairs ; primary rhinaria strongly transverse. Wax glands usually invisible, groups of circular cells sometimes very distinct. Abdominal tergites 1st-7th, each with 6 hairs, of about 0.022 mm. long. Tarsi spinulose. Empodial hairs invisible ; dorso-apical hairs on second tarsal segment absent.

Alatoid nymphs from galls of *Ulmus* show similar characters as apterous viviparous females from galls.

Material examined.—One apterous viviparous female and two alate viviparous females (Paratypes) from *Ulmus laevigata* (galls) ; Rawalakot, PAKISTAN, 9.6.1967, leg. Ghani (No. 891), det. D.H.R.L. (D. Hille Ris Lamber's collections).

Discussion.—This species, by the absence of siphunculi in exules, apparent absence or very short empodial hairs in embryos and in adult apterous exules and the round and linear cells of wax glands in the latter, could easily be separated from members of the related

genera. Obviously with only alate viviparous female or only apterous viviparous female from *Ulmus* gall, it would be difficult to identify the species.

The fact that the apterae-exules from *Malus pumila* could be co-related with alate and apterae from *Ulmus villosa* (= *laevigata*), indicates its clear host alteration from roots of Apple to leaves of Elm. All collection from Elm were obtained during May and June and from apple during November.

Distribution.—INDIA (Srinagar, Jammu & Kashmir) , PAKISTAN (Balakot, Rawalpindi, Bagh, Rawalakot, Muzaffarabad, Muree).

Types.—In the collection of D. Hille Ris Lambers, Bennekom, The Netherlands.

5. Genus *Tetraneura* Hartig 1841

1841. *Tetraneura* Hartig, T *Z. ent.*, (Germar) 3 : 366. Type species. *Aphis ulmi* L.
1838. *Byrsocrypta* Haliday, A. H. *Ann. nat. Hist.*, 2 : 189. Type species *Eriosoma ulmi gallarum* Haliday = ? *Aphis ulmi* Linnaeus.
1846. *Tetraneura* Agassiz, J. L. R., *Nomenclator zoologici index univorsalis* Solothurn, 366, emendation of *Tetraneura* Hartig.
1857. *Amycla* Koch, C.L., *Die Pflazenlaus Aphiden*, Nurnberg, 301, Type species : *Amycla fusifrons* Koch = *Aphis ulmi* Linnaeus.
1857. *Endeis* Koch, C.L., *Die Pflazenlaus Aphiden*, Nurnberg, 312. Type species : *Endeis bella* Koch = *Aphis ulmi* Linnaeus.
1904. *Dryopeia* Kirkaldy, G. W. *Entomologist*, 37 : 279. Type species : *Endeis bella* Koch = *Aphis ulmi* Linnaeus.

Morphology.—Body oval in apterae, elongate in alatae, usually 1.5-3.1 mm. long. Head usually smooth, with a dorsal median suture without lateral tubercles. Antennae, 0.10-0.33× as long as the body, shorter and 3-6 segmented in apterae with various types of fusion in between segments III to VI, in alatae usually 6 segmented but sometimes segments III and IV or V and VI may be fused, usually segments III and V are equal in length and much longer than segments IV and VI which are about equal in length to one another ; secondary rhinaria absent in apterae, annular and present on segment III (7-32), IV (2-10), V (3-28) in alatae ; primary rhinaria ciliated. Ultimate rostral segment short, blunt bearing

2-32 accessory hairs and may be much shorter than ($0.25\times$) to $1.5\times$ as long as second segment of hind tarsus. Abdominal dorsum smooth or feebly reticulated, with a brown transverse intersegmental band between 7th and 8th tergites. Spiracles normal, those on 1st and 2nd tergites placed wide apart. Wax glands variably present on head and abdomen, often consisting of a group of cells surrounding an open space. Siphunculi mere ring-like or present as elevated cones. Cauda rounded and bearing 2-6 hairs, rarely with 8-10 hairs, 8th tergite with 2-12 hairs. Subanal plate dark, sclerotic, usually with few long hairs (4-14) besides some finer hairs and the hairs on gonapophyses ; sometimes the finer hairs may be absent or numerous. Subgenital plate with dense pubescence on posterior margin. Legs with trochanters often indistinctly fused with femora, tarsi one segmented in apterae but normal and 2 segmented in alatae ; femora and tibiae may be sparsely spinulose but tarsi densely spinulose ; dorso-apical hairs on second tarsal segment as long as or longer than the claw and empodial hair nearly equal to or longer than the claws. First tarsal segments with 3, 2, 2 or 3, 3, 2 or 4, 2, 2 hairs. Forewings with media simple, hind wings with 1-2 oblique veins.

Embryos may exhibit enormous variation in the length of the hairs (Zwölfer, 1957) but setal pattern, wax glands, length of and hairs on ultimate rostral segment appear consistent in the same species (Hille Ris Lambers, 1968-69) ; however, embryos from sexuparae differ considerably from those inside virginoparae ; normally number of hairs on antennal segment IV (4-10), number of marginal hairs on 1st-4th tergites (2-10), composition of ventro-lateral wax glands, spinulosity or smoothness of tarsi, normal or enlarged claws of hind tarsi are used to separate embryos from galls and virginoparous females (Hille Ris Lambers, op. cit.).

Sexuparae (alatae) are known to have large wax glands, longer antennae and more secondary rhinaria and may differ strongly from emigrant alatae from primary host, but sexuparae resemble alate virginoparae in most of the characteristic features within the same species.

Discussion.—The single segmented tarsus in apterae separates the members of the genus from other related genera but enormous

variability amongst the members of the same colony may often lead to confusion ; often fundatrix appears very different from the root-inhabiting third generation. Eastop and Hille Ris Lambers (1976) listed 14 species under the genus ; in the region, about 12 species are recognised including 8 endemic species described in recent years, mostly based on the apterous exules collected from roots of gramineaceous plants ; only 3 species, *nigriabdominalis*, *polychaeta* and *ulmi* are now known from *Ulmus* galls in the region.

Hille Ris Lambers (1968-69) while reviewing the genus *Tetraneura* erected a subgenus *Tetraneurella* on the basis of hind tarsal claws in embryos from galls and virginoparous exules. Out of 12 species dealt by him, six species viz., *basui* H.R.L., *akinire* Sasaki, *sorini* H.R.L., *nigriabdominalis* (Sasaki), *javensis* v.d. Goot, *polychaeta* H.R.L. are placed under *Tetraneurella* and four species, *caerulescens* (Passerini), *africana* v.d.G., *yezoensis* Mats., and *radicicola* strand are placed under *Tetraneura* s.s. Chakrabarti and Maity (1978) while erecting another subgenus *Indotetraneura* on the basis of asymmetrical tarsal claws, transferred *basui* and *javensis* to *Indotetraneura*. Embryos and larvae of some species were not available for the present study ; however, a key to the subgenera has been provided, and the species wherever possible have been keyed under the subgenera or otherwise in the nominate genus.

Biology.—Members of the genus are known to form globular leaf galls on *Ulmus* (Primary host) and migrate to roots of Graminae (and perhaps Cyperaceae, according to Eastop, 1966). In the subregion, none of the species have been collected from galls of *Ulmus* except *T nigriabdominalis* (Sasaki), *T polychaeta* H.R.L. and *T ulmi* Linn., and all the apterous exules and alate viviparae have only been noted from roots of secondary hosts, indicating a probable change to anholocyclic life cycle on Graminae. Some of the species, at least the apterae, are known to occur all through the year (e.g. *T basui* or *T nigriabdominalis* in Kalimpong region) at a depth of 1.0-10.00 cm. below the soil (Pal, 1975, Ph.D. Thesis, C.U.) at various altitudinal levels *ca* 200-*ca* 2700 m., whereas others are known only during mid-winter to summer. Many of the species are attended by ants. Most of the records from galls in

Palaeartic region indicate the occurrence of *Tetraneura* species on *Ulmus* during April-July.

Distribution.—Cosmopolitan. Earlier, Mordvilko (1935) and Zwölfer (1957) have given account of *Tetraneura* specially of subterranean forms. In recent times, Eastop (1966) has published a key (for some species) to the apterae and alatae and Hille Ris Lambers (1968-1969) has given an extensive account of all the species of the genus known till that period.

Type species.—*Aphis ulmi* Linnaeus. Location of type not known.

Key to the Subgenera

- | | |
|--|--|
| 1. First instar nymph with tarsal claws equal and shorter than the tarsal segments. Embryos with hind tarsal claws less than 0.050 mm. long | Tetraneura Hartig |
| —First instar nymph with tarsal claws variable, equal to or longer than the tarsal segments. Embryos with only hind tarsal claws enlarged or unequal |2 |
| 2. Tarsal claws unequal, at least in hind legs of embryos and first instar nymph, 0.050 mm. -0.098 mm. long. .. | .Indotetraneura
Chakrabarti and Maity |
| —Tarsal claws never unequal on the same tarsal segment, enlarged on hind tarsal segment, upto 0.060 mm. long | .. Tetraneurella H.R.L. |

Key to the species

A. Subgenus *Tetraneurella*

Apterous viviparous female (from galls)

- | | |
|---|--|
| Abdominal dorsum with single marginal (0.048 mm.), pleural and spinal hair (0.026-0.035 mm.) on 1st-5th tergites, 7th tergite without spinal hair | .polychaeta H.R.L. |
| —Abdominal dorsum with paired marginal and 4-6 spinopleural hairs (0.066-0.100 mm.) on 1st-5th tergites, 7th tergite with spinal hairs |nigriabdominalis
(Sasaki) |

Alate viviparous females (from galls)

Head with 32-42 hairs, 0.012-0.022 mm. long. Antennal segment III with 17-18 hairs and 20-32 secondary rhinaria. Ultimate rostral segment with 14-18 accessory hairs.

.polychaeta H.R.L.

—Head with 28-32 hairs, 0.030-0.042 mm. long. Antennal segment III with 9-12 hairs and 12-18 secondary rhinaria. Ultimate rostral segment with 5-6 accessory hairs

.nigriabdominalis
(Sasaki)

B. Subgenus *Indotetraneura**Apterous viviparous females* (exules from roots)

1. Antennae with 8-10 hairs. Abdominal dorsum with spinal and pleural wax gland very small, usually 0.010-0.016 mm. in diameter or at most 0.025 mm. in diameter. Subanal plate with 4 long and few short hairs

.basui H.R.L.

—Antennae with 21-55 hairs. Abdominal dorsum with variable wax glands. Subanal plate with 8-14 hairs

.2

2. Dorsal abdominal hairs numerous, on anterior tergites 0.050-0.115 mm. long, 8th tergite with 10 hairs. Spinal and marginal wax plates present on 1st-5th tergites and ventro-lateral wax plates present on 1st-6th tergites (0.020-0.090 mm. in diameter). Empodial hair 0.036 mm. long, equal to the claws

.utpali Chakrabarti *et al.*

—Dorsal hairs never numerous, at most upto 16-20 per segment. 8th tergite with 6 hairs. Wax plates variable. Empodial hair 0.043-0.053 mm. long

.3

3. Dorsal hairs of variable apices, e.g. acuminate, blunt, spatulate or furcated. Antennae 5 segmented, with 39-55 hairs. 8th tergite with 6 hairs, 0.093-0.105 mm. long. Subanal plate with 8-10 hairs. Marginal hairs on abdomen 0.083-0.215 mm. long

.lambersi Chakrabarti
and Maity

—Dorsal hairs fine. Antennae usually 4 segmented, with 21-38 hairs. 8th tergite with 6 hairs 0.07-0.08 mm. long. Marginal hairs on abdomen 0.04-0.14 mm. long. Subanal plate with 10-14 hairs.

.javensis v.d. Goot

Alate viviparous females (virginoparae)

1. Dorsal cephalic hairs 0.040-0.070 mm. long, 2.2-3.5 × as long as basal diameter of antennal segment III. Antennal segment III with 12-17 secondary rhinaria. Processus terminalis 0.35-0.60 × as long as base of last antennal segment. Ultimate rostral segment 0.70-0.82 × as long as second segment of hind tarsus. Cauda with 2 hairs. Subgenital plate with 25-35 hairs

.basui H.R.L.

- Dorsal cephalic hairs 0.030-0.046 mm. long, 1.7-2.4 × as long as basal diameter of antennal segment III. Antennal segment III with 7-14 secondary rhinaria. Processus terminalis 0.25-0.35 × as long as the base of last antennal segment

.2

2. Ultimate rostral segment 0.10-0.11 mm. long, 0.68-0.72 × as long as the second segment of hind tarsus and bears 6-8 accessory hairs. Dorsal hairs on posterior tergites 0.060-0.090 mm. long, upto 5.0 × as long as the basal diameter of antennal segment III. Cauda with 4 hairs

.lambersi Chakrabarti
and Maity

- Ultimate rostral segment 0.13-0.14 mm. long. 0.90-0.93 × as long as second segment of hind tarsus and bears 8-10 accessory hairs. Dorsal hairs on posterior tergites 0.033-0.048 mm. long upto 2.6 × as long as the basal diameter of antennal segment III. Cauda with 2 hairs. Marginal and pleural abdominal wax plates distinct. On *Apluda mutica* ..

.utpali Chakrabarti *et al.*C. Subgenus *Tetraneura* s.s.*Apterous viviparous females (exules from roots)*

1. Dorsal hairs sparse, 0.013-0.022 mm. long. 8th tergite with 2 stout hairs, 0.170 mm. long. Antennae 5-6 segmented, segment III with 1-4 hairs. Body 1.9-3.0 mm. long with distinct wax plates on head, thorax and abdomen.
- Dorsal hairs variable, 0.026-0.083 mm. long. 8th tergite with 4-14 hairs. Antennae 4-6 segmented, segment III with 7-50 hairs.

.ulmi (Linn.)

- Body 1.4-2.9 mm. long with wax plates variably developed .2
2. 8th tergite with 4-6 hairs. Antennae 5-6 segmented, 0.18-0.26 × as long as the body. Subanal plate with 4-10 hairs. Cauda with 2-6 hairs .3
 —8th tergite with 9-14 hairs. Antennae 4 segmented, 0.15-0.28 × as long as the body. Subanal plate with upto 18 hairs. Cauda with 6-8 hairs .5
3. Antennal segment I with 2 hairs. Empodial hair 0.023 mm. long, 0.50 × as long as the tarsal claws. 8th tergite with 4 hairs. Cauda and subanal plate each with 4 hairs. Subgenital plate with 10-11 small hairs. Paired wax plates present on head, meso and meta-nota and 1st-7th abdominal tergites *.indica*. L. K. Ghosh
 —Antennal segment I with at least 4 hairs. Empodial hair 0.030-0.040 mm. long, 1.0-1.2 × as long as the tarsal claws. 8th tergite with 4-6 hairs, if with 4 hairs, wax plates small .4
4. Head pale smooth without any apparent wax plates. Dorsal cephalic hairs upto 2.6 × as long as the basal diameter of antennal segment III. Antennal segment II with 7-8 and III with 9-16 hairs. Ultimate rostral segment 0.17-0.20 mm. long with 12-13 hairs. 8th tergite with 2 long thick hairs and 2 fine hairs, 0.146-0.149 mm. long, upto 5.0-5.2 × as long as the basal diameter of antennal segment III. Wax plates small, composed of diffused cells *sikkimensis* Raychaudhuri *et al.*
 —Head with a distinct pair of wax plates. Dorsal cephalic hairs upto 1.25 × as long as the basal diameter of antennal segment III. Antennal segment II with 10-24, III with 25-38 hairs. Ultimate rostral segment 0.21-0.26 mm. long, with 15-26 accessory hairs. 8th tergite with 4-6 thick hairs, 0.163-0.178 mm. long, upto 2.5-4.2 × as long as the basal diameter of antennal segment III. Wax plates small, cells faintly stippled *radicicola* Strand
yezoensis Mats.

5. Antennae 0.24-0.28 × as long as the body, pubescent with 69-85 hairs on segments I-IV; segment III with 40-50 hairs, upto 0.060 mm. long. Dorsal cephalic hairs, numerous, fine, flagellate, 0.083-0.090 mm. long. Abdominal dorsum with numerous long, flagellate hairs on anterior tergites, 0.198-0.260 mm. long, 5.4-6.7 × as long as the basal diameter of antennal segment III, besides some small fine hairs (0.033-0.040 mm. long). Longest hair on hind tibia 0.056-0.060 mm. long, 0.60-0.66 × as long as the width at the middle of tibia. Empodial hair 0.046-0.050 mm. long, 1.2 × as long as the claws *.multisetosa* Raychaudhuri *et al.*

- Antennae 0.15-0.20 × as long as the body, with 38-51 hairs, on segments I-IV; segment III with 20-25 hairs, upto 0.040 mm. long. Dorsal cephalic hairs about 8-10, 0.033-0.073 mm. long. Abdominal dorsum never extremely pubescent, bearing hairs of variable length, longest one upto 0.178 mm. in anterior tergite. Longest hair on hind tibia 0.040-0.050 mm. long, 0.54-0.60 × as long as the diameter at the middle of the tibia. Empodial hair 0.030-0.036 mm. long, 0.75-0.90 × as long as the claws *kalimpongensis* Raychaudhuri *et al.*

Alate viviparous females (virginoparae)

Ultimate rostral segment 1.3-1.7 × as long as second segment of hind tarsus and bears 18-22 accessory hairs. 8th tergite usually with 4 hairs, of which marginals 0.100-0.160 mm. long, 6.5-9.0 × as long as the basal diameter of antennal segment III. Subanal plate with 8 long hairs. Ventro lateral wax plates distinct

radicicola yezoensis
Matsumura

- Ultimate rostral segment 1.2-1.3 × as long as second segment of hind tarsus and bears 6-8 accessory hairs. 8th tergite with 2 long hairs. Subanal plate with 6 long hairs. Wax plates variable, but usually well developed

.ulmi (Linn.)

11. *Tetraneura* (*Indotetraneura*) *basui* Hille Ris Lambers
(Figs. 87-95)

- 1968-69. *Tetraneura* (*Tetraneurella*) *basui* Hille Ris Lambers, D., *Boll zool. agr. Bachic.*, Ser II, 9 : 44.
 1978. *Tetraneura basui*, Raychaudhuri, D. N., Pal, P.K. and Ghosh, M. R., *Entomon*, 3 (2) : 253.
 1978. *Tetraneura* (*Indotetraneura*) *basui*, Chakrabarti, S. and Maity, S. P., *Entomon*, 3 (2) : 269.

Apterous viviparous female.—Body 1.65-1.86 mm. long, with 1.1-1.4 mm. as maximum width, pale with appendages, siphunculi and cauda yellowish. Antennae 5 segmented, 0.17-0.20× as long as the body, segment I with 2 hairs, II with 2-3 hairs, III without any hairs, IV with 4 long hairs ; hairs on antennal segments I-IV mostly long and stout, 0.030-0.05 mm. long, upto 0.7-1.2× as long as the basal diameter of segment IV, segment V with one hair 0.03 mm. long, and some short bristle-like hairs. Rostrum stout ; ultimate rostral segment, 1.3-1.6× as long as hind tarsus (without claws) and bears 6-7 accessory hairs, besides the preapicals. Abdominal dorsum pale with many long, stiff hairs ; marginal hairs both long (0.15-0.17 mm.) and short (0.03-0.04 mm.), 4-8 per segment, 3.7-5.5× and 1.4-1.8× as long as the basal diameter of segment IV respectively , spinal and pleural hairs numerous on 1st-5th tergites, short and long, up to 0.03-0.05 mm. long ; 8th tergite with 6 hairs, longest one 0.10-0.12 mm. long, 3.0-4.0× as long as the basal diameter of antennal segment IV Wax glands roundish ; ventrolateral glands 0.02-0.03 mm. in diameter, composed of 2-6 large cells which normally do not touch each other, and some very small cells filling up the space between large cells ; spinal glands 0.010-0.015 mm. in diameter composed of one or few large cells and few small cells ; pleural glands composed of 1-3 large cells only and 0.012-0.016 mm. in diameter. Siphunculi short, 0.05 mm. truncate with thick apical flange. Cauda with 2 hairs. Subanal plate with 4 long and a few short hairs. Legs stout bearing many stiff, erect hairs, longest one on hind tibiae 0.04-0.05 mm. long, 0.41-0.50× as long as the diameter of the middle of the tibia.

Colour.—Creamy brown in life.

Measurements in mm.—

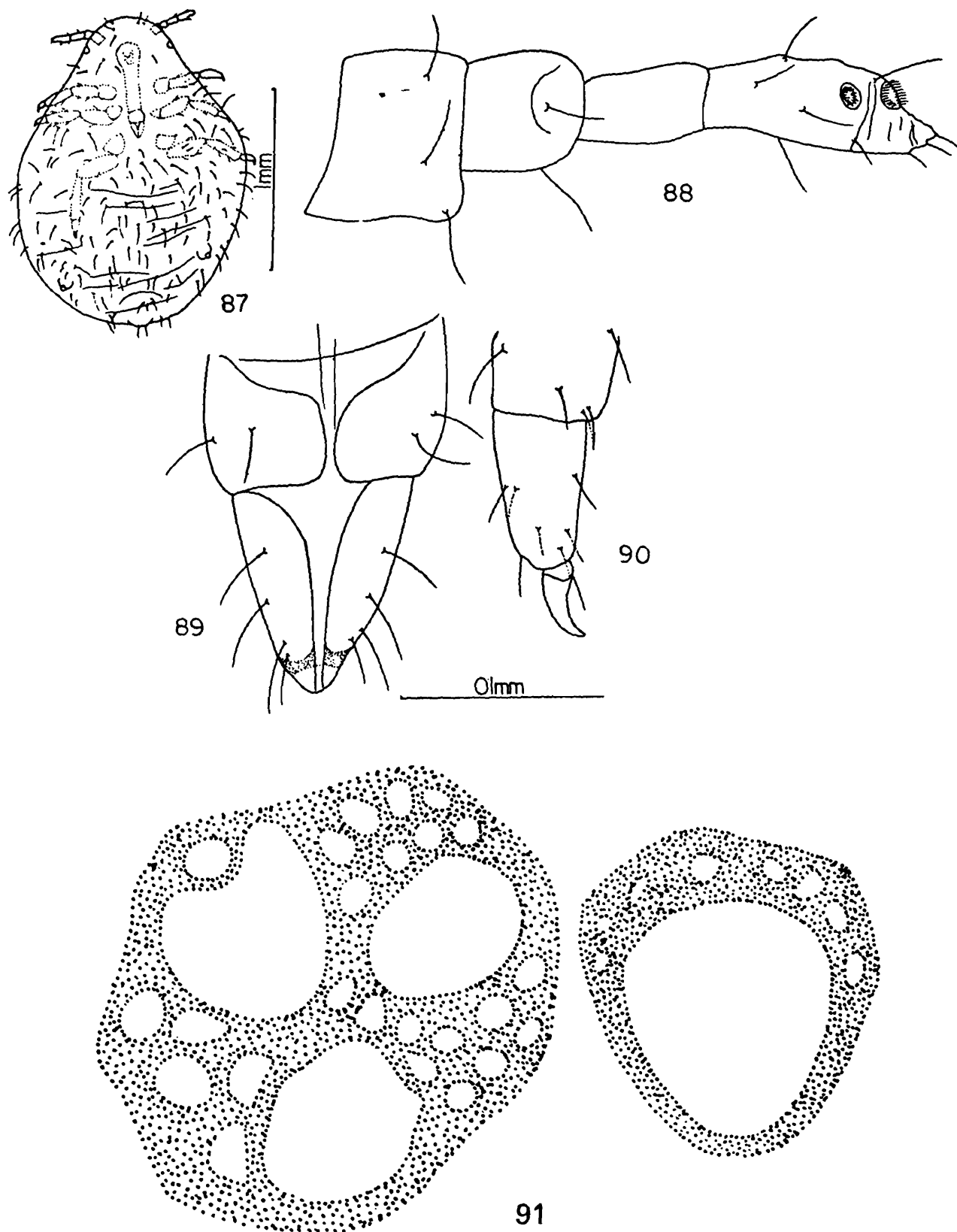
	Length	Width	Antenna
1.	1.84	?	0.36
2.	1.79	1.38	0.31
3.	1.65	1.19	0.33
4.	1.79	?	0.31

Antennal segments			urs.	ht ₂
III	IV	V		
0.08	0.09	0.07	0.11	0.07
0.06	0.08	0.05	0.11	0.07
0.06	0.09	0.06	0.11	0.08
0.06	0.09	0.05	0.11	0.07

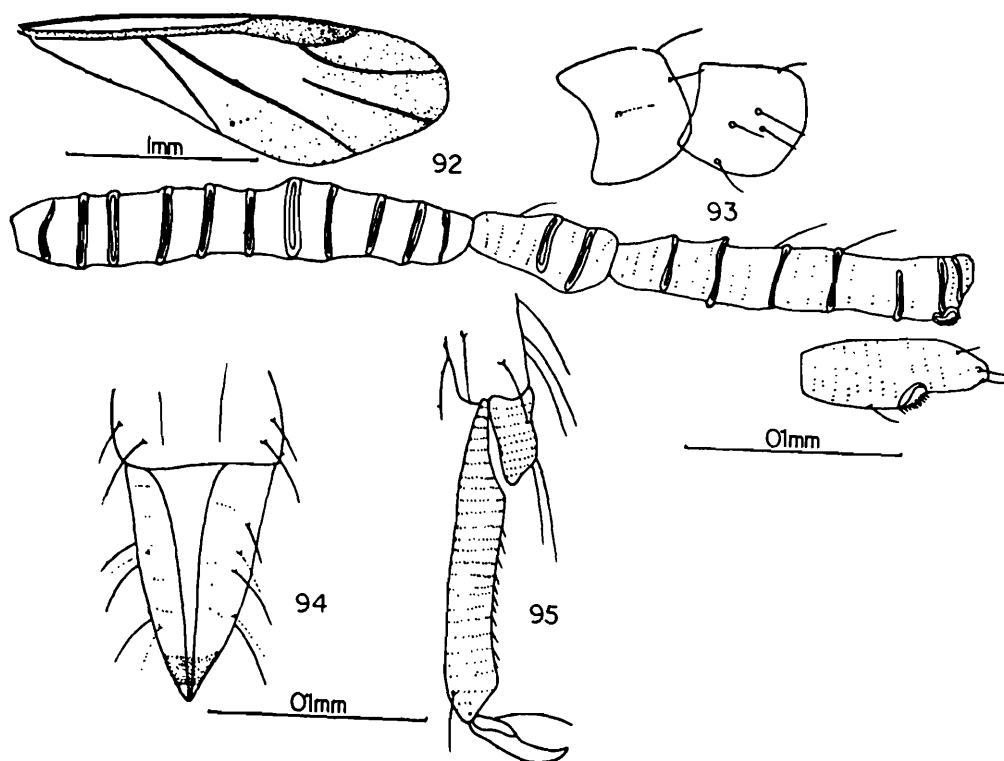
(1, ex grass root, Kalimpong, West Bengal, INDIA, 7.3.1958, coll. A. N. Basu (Paratype), H.R.L. collns. ; 2, ex Grass root, Kerbul, Manipur, INDIA, 10.4.74, 3, Grass, Kalimpong, West Bengal, INDIA, 19.1.1972, 4, ex *Paspalum commensoni*, Peshoke, West Bengal, INDIA, 24.1.1972, colls. P. K. Pal, Calcutta University collections).

Embryos (from H.R.L. 1968-69).—Antennae 5 segmented, spinulose except on segment I ; hairs on antennae 0.045-0.065 mm. long. Ultimate rostral segment 0.060 mm long with 8 accessory hairs. Dorsal hairs stout ; abdominal tergites 1st-5th (6th ?) with paired, marginal, pleural and spinal hairs, 7th and 8th tergite without any pleural hairs ; marginal and spinal hairs thicker and longer (up to 0.120-0.150 mm. long) than pleural ones (up to 0.035-0.060 mm. long). Wax gland plates with 2-5 roundish ventrolateral cells. Subanal plate with 4 stout hairs. Legs with tibiae and tarsi spinulose ; tibial hairs blunt, stout up to 0.050 mm. long ; claws on hind tarsi strongly assymmetrical, 0.050-0.067 mm. long.

Alate viviparous female.—Body 1.72-1.86 mm. long with 0.75-0.91 mm. as maximum width. Head brownish yellow to dark



Tetraneura basui Hille Ris Lambers ; Apterous viviparous female (from roots) :
 87. whole body ; 88. antenna ; 89. ultimate rostral segments ; 90. hind
 tarsus ; 91. pleural glands on abdomen and antenna of exules (from Hille
 Ris Lambers, 1968-69).



Alate viviparous female (from roots): 92. forewings; 93. antenna; 94. ultimate rostral segments; 95. hind tarsus.

brown; dorsal cephalic hairs up to 0.040-0.066 mm. long, 2.2-3.5 \times as long as the basal diameter of antennal segment III. Antennae usually 5 segmented, sometimes 6 segmented, yellow to brown, 0.30-0.31 \times (0.24-0.37 \times) as long as the body; flagellum finely spinulose; hairs on flagellum sparse on segment III, up to 0.020 mm. long, 1.0-1.2 \times as long as the basal diameter of the segment; segment III usually with 12-14 (sometimes up to 17), IV with 4-5 (up to 9) secondary rhinaria in 5 segmented antennae and segment III with 11-13, IV with 2-4, V with 4-6 secondary rhinaria in 6 segmented antennae; primary rhinaria protruberant, strongly ciliated; processus terminalis usually 0.35-0.45 \times (0.60 \times) as long as the base of last antennal segment. Rostrum reaches mid coxae; ultimate rostral segment 0.70-0.82 \times as long as the second segment of hind tarsus and bears 4(?) accessory hairs. Mesonotum with a pair of suboval wax plates. Abdominal dorsum pale; hairs on the dorsum of abdomen with subacute apices, on anterior tergites 0.05-0.07 mm. long, on posterior tergites 0.07-0.09 mm. long, these being 2.5-4.4 \times and 3.6-4.7 \times (5.90 \times) as long as the basal diameter of antennal segment III, respectively; each of

the abdominal tergites with a pair of marginal hairs, up to 0.055-0.062 mm. long ; 8th tergite with 4 hairs on a transverse sclerotic band. Each of 1st-7th tergites with a pair of suboval, pale, wax plates, composed of oval cells, the plates becoming larger caudad. Siphunculi with a thick chitinised rim. Cauda semioval, with 2 hairs. Subgenital plate with 25-35 hairs ; Legs long, brown, with fine stiff hairs, longest one on hind tibiae 0.040-0.043 mm. long, 1.2-1.3 \times as long as the diameter at the middle of the tibiae ; apices of tibiae faintly and whole of tarsi densely spinulose ; first tarsal segments usually with 3, 2, 2 hairs ; empodial hair 0.030 mm. long, 0.90-0.95 \times as long as the claws. Forewings with veins little dusky, media simple ; hind wings with one oblique.

Colour.—Pale brown with dark head, antennae, legs and caudal region.

Measurements in mm.—

	Length	Width	Antenna		
1.	1.86	0.95	0.63		
2.	1.81	0.91	0.62		
3.	1.93	0.98	0.65		
4.	1.72	0.75	0.57		
	Antennal segments			urs.	ht ₂
III	IV	V	VI		
0.28	0.15	(0.05+0.03)	—	0.10	0.13
0.29	0.15	(0.05+0.03)	—	0.09	0.13
0.23	0.17	0.14	(0.06+0.03)	0.11	0.13
0.20	0.07	0.12	(0.05+0.02)	0.10	0.13

(1-4, ex Grass, Imphal, Manipur, INDIA, 1.4.1974, coll. P.K. Pal).

Material examined.—One apterous viviparous female (Paratype) from grass roots, Kalimpong, West Bengal, INDIA, 7.3.1958, coll.

A. N. Basu, det. D. Hille Ris Lambers (D. Hille Ris Lamber's collections) ; Many apterae from *Capillipidium* sp., Pashoke, West Bengal, INDIA, 30.4.1972, (K 5954), *Paspalum cemmaessonii*, Peshoke, West Bengal, INDIA, 24.1.1972, (K 5634), unidentified Grass, Kalimpong, West Bengal, INDIA, 23.9.1972 (K 6288) ; 5 alate viviparous females from unidentified grass, Imphal, Manipur, INDIA, 1.4.1974 (M 4), many apterous viviparous females from unidentified grass, Kangduip, Manipur, INDIA, 4.4.1974 (M 39), Keibul, Manipur, INDIA, 10.4.1974 (M 1), Leimakhong, Manipur, INDIA, 3.4.1974 (M 21, 22), all collections by P. K. Pal (Calcutta University Collections).

Discussion.—Hille Ris Lambers (1968-69) placed *basui* as a species under subgenus *Tetraneurella* H.R.L. on the basis of longer claws on hind tarsi in relation to fore and mid tarsal ones in embryos, and first instar nymphs having claws longer than tarsal segments, on which they are borne. Chakrabarti & Maity (1978) while describing a new species, *lambersi*, grouped it with *basui*, *javensis* v.d. Goot, on the basis of asymmetrical hind tarsal claws, in both embryos and first instar nymph and placed these three species under a new subgenus *Indotetraneura*. However, description of first instar nymph has not been provided by Chakrabarti & Maity (op. cit) for *lambersi*, or by Hille Ris Lambers (1968-69) for *basui* and *javensis*. Hille Ris Lambers (op. cit) distinguished *basui* from related species by long, stout abdominal hairs and by the presence of 4 hairs on penultimate rostral segment, in apterae-exules. Hosts of *basui* include *Eichonchola colonum*, *Eleusine indica*, *Oryza sativa*, *Pagohantherum saccharum*, *Polypogon monspeliensis*, *Setaria glaucae* and many unidentified grasses. No morph from Ulmaceae has so far been recorded. Apterae, at least in semi-temperate climate, occur throughout the year while the alatae occur during winter and early summer months. Colonies on roots are normally formed at a depth of 1.25-7.6 cm. in dry to wet soils, at localities between 300-2200 m. Usually ants are seen in association (Pal, P. K., Ph.D. Thesis, C.U., 1975).

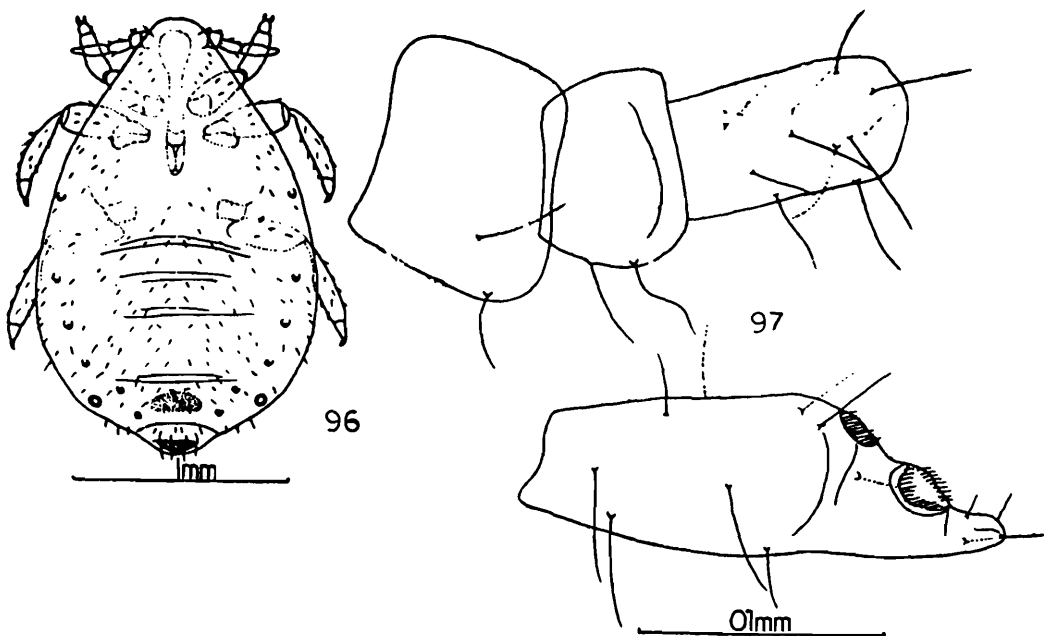
Distribution.—INDIA (West Bengal, Sikkim, Manipur, Nagaland).

Types.—In the collections of D. Hille Ris Lambers, Bennekom, The Netherlands.

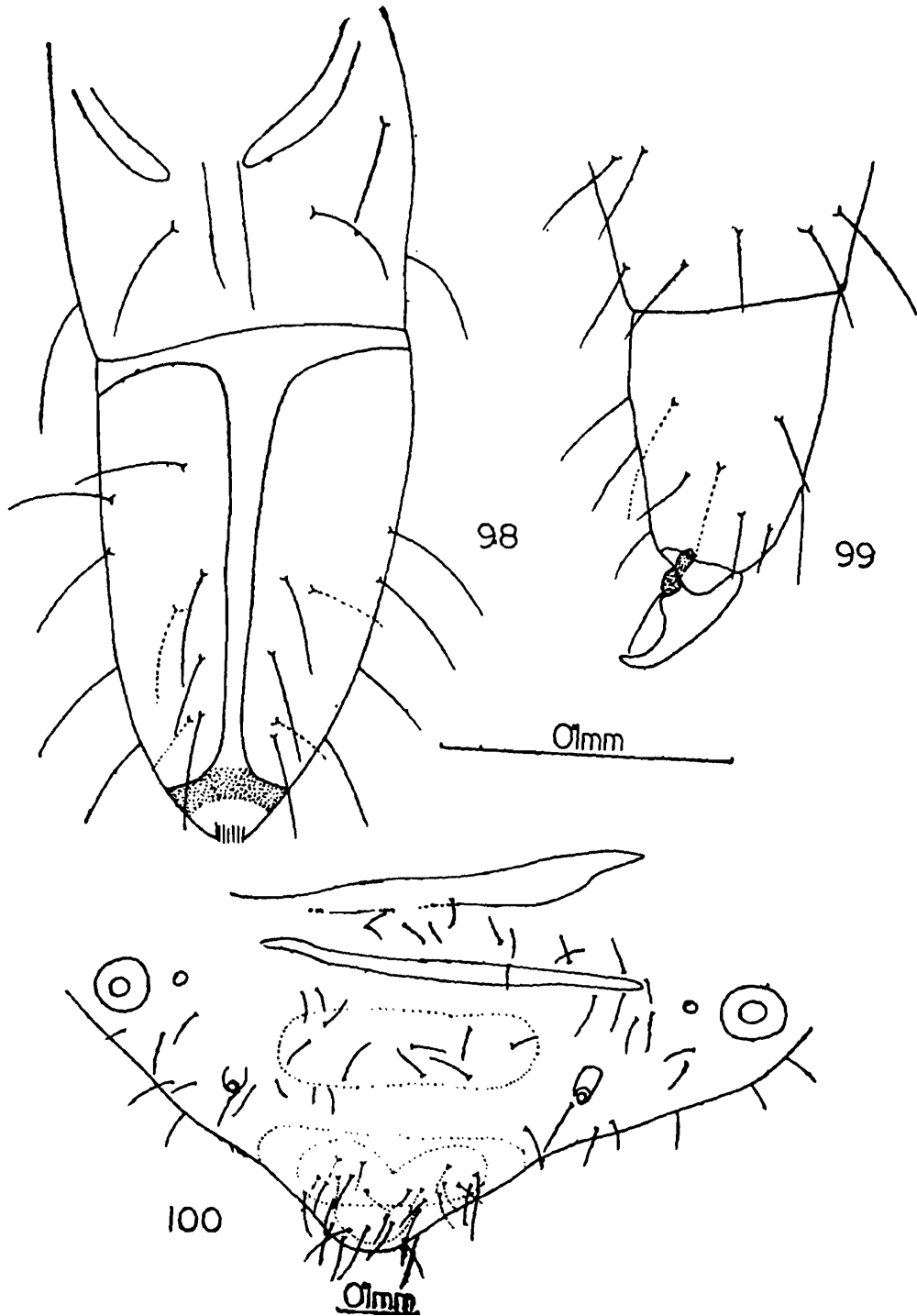
12. *Tetraneura indica* L. K. Ghosh
(Figs. 96-100)

1977. *Tetraneura indica* Ghosh, L. K. A study of Aphids of Himachal Pradesh in North west Himalaya, India, Ph.D. Thesis, University of Calcutta, p. 291-293.

Apterous viviparous female.—Body globular, yellowish brown pubescent 1.95-2.28 mm. long, with 1.52-1.65 mm. as maximum width. Head brownish, smooth, free from prothorax, with a median dorsal suture and a small frontal pair of wax plates ; dorsal cephalic hairs stout, stiff, acute at apices, 0.033-0.040 mm. long, at most equal to the basal diameter of antennal segment III. Antennae brown, 5 segmented, $0.18-0.20\times$ as long as the body, smooth or with some spinulose imbrication on apical segments ; antennal segment I with 2, II with 3-4, III with 7-10 and IV with 9-11 and base of V with 2 long, stout hairs, those on segment III, 0.023-0.050 mm. long, $0.40-1.07\times$ as long as the basal diameter of the segment ; primary rhinaria densely ciliated ; processus terminalis about $0.30\times$ as long as base of last antennal segment. Rostrum reaches mid coxae ; ultimate rostral segment, $2.10-2.12\times$ as long as the hind tarsus and bears 10-12 accessory hairs. Meso- and Metanota each with a pair of marginal and spinal wax plates, the former being longer in size, composed of diffused, pale cells. Abdominal



Tetraneura indica L. K. Ghosh ; Apterous viviparous female (from roots) :
96. whole body ; 97. antenna,



Tetraneura indica L. K. Ghosh ; Apterous viviparous female (from roots) :
 98. ultimate rostral segments ; 99. hind tarsus ; 100. posterior portion
 of abdomen.

dorsum pale, with fine spinules ; hairs on the dorsum of abdomen similar to those on thoracic dorsum, on anterior tergites 0.040-0.076 mm. long, on posterior tergites 0.083-0.130 mm. long, these being 0.85-1.64 \times and 1.78-2.85 \times as long as the basal diameter of antennal segment III, respectively ; 7th and 8th tergites, each with a

broad, brown, transverse, sclerotic band ; 8th tergite with 4 long, stout hairs ; 1st-7th tergites, each with paired spinal, pleural and marginal wax plates, the latter being larger than the others. Siphunculi on elevated cones, with large chitinised rim around the pores. Cauda large, brown, with 4 hairs. Subanal plate strongly spinulose with 4 long hairs besides some smaller, stiff hairs on gonapophyses. Subgenital plate with about 10-11 small hairs. Legs yellowish brown, stout, with stiff hairs, longest one on hind tibiae 0.043-0.063 mm. long $0.4-0.7\times$ as long as the diameter at the middle of the tibiae ; tarsi of one segment, tarsal claws equal (0.046 mm. long) ; empodial hair 0.023 mm. long, $0.50\times$ as long as the claws.

Colour.—Yellow in life.

Measurements in mm.—

	Length	Width	Antenna		
1.	2.28	1.58	0.43		
2.	2.11	1.52	0.43		
	Antennal segments			urs.	ht ₂
	III	IV	V		
	0.08	0.13	(0.061+0.020)	0.17	0.08
	0.10	0.12	(0.070+0.023)	0.16	0.07

(1, Holotype, 2, Paratype, ex *Calamogostriis pilosa* (roots), Narkauda, H.P., INDIA, 20.9.1974, coll. L. K. Ghosh).

Other morphs.—Not known.

Material examined.—Two apterous viviparous females from *Calamogostriis pilosa* (roots), Narkauda, Himachal Pradesh, INDIA, 20.9.1974, coll. L. K. Ghosh (Holotype and Paratype, in Zoological Survey of India Collections, Calcutta).

Discussion.—The species has been described only by apterae from colonies on the roots of withering plant ; L. K. Ghosh (Ph. D.

Thesis, 1977) compared the species with *basui* H. R. L. and *kalimpongensis* Raychaudhuri et al., but it can be separated from both by length of ultimate rostral segment and chaetotaxy of antennae and abdominal tergum.

Distribution.—INDIA (Himachal Pradesh).

Types.—In the National Zoological Collections, Zoological Survey of India, Calcutta.

13. *Tetraneura* (*Indotetraneura*) *javensis* van der Goot (Figs. 101-108)

1917. *Tetraneura javensis* van der Goot, P. *Contr. Faune Ind. Neerl*, **1** (3) : 260.
 1927. *Tetraneura cynodotis coimbatorensis* George, C. J., *J. Asiat. Soc. Beng.* (N. S.), **23** : 9.
 1968-69. *Tetraneura* (*Tetraneurella*) *javensis*, Hille Ris Lambers, D., *Boll. zool. agr. Bachic.*, Ser. II, **9** : 49.
 1978. *Tetraneura* (*Indotetraneura*) *javensis*, Chakrabarti, S. and Maity, S. P., *Entomon*, **3** (2) : 269.

Apterous viviparous female.—Body 1.65-1.9 mm. long, plump and pale with 1.2-1.35 mm. as maximum width ; appendages, last abdominal segment and cauda pale brownish. Head pale, without median suture ; dorsal cephalic hairs fine, up to 0.080-0.085 mm. long, 2.0-2.3 \times as long as the basal diameter of antennal segment III. Antennae 4 segmented (may be 5, H.R.L. 1968-69), 0.20-0.21 \times or little less than 0.20 \times the length of body ; segment I with 3-5 stout hairs, II with 7-9, III with 18-22 and IV with 3-4 hairs besides terminal spines ; hairs on segment III, 0.020 mm. to 0.050 mm. long, 0.40-1.2 \times as long as the basal diameter of the segment ; primary rhinaria on III small, sunken, ciliated on segments III and IV ; processus terminalis spinulose, 0.33 \times as long as the base of segment IV. Rostrum stout, reaching almost hind coxae ; ultimate rostral segment blunt, 1.2-1.7 \times as long as the hind tarsus, and bears 8 accessory hairs, besides the preapicals. Thoracic and abdominal segments with conspicuous marginal hairs, 2-3 pair per segment, of these shorter ones 0.04 mm. long, longer ones 0.14 mm. long, equal to or upto 4.0-5.0 \times as long as basal diameter of antennal segment III ; spinal and pleural hairs thinner,

finer and smaller, up to 0.05 mm. long ; 8th tergite with 6 hairs up to 0.07-0.08 mm. long. Ventrolateral wax glands, large, consisting of a large sell surrounded by smaller cells (usually 15-24) the number of the latter being lowest on 6th tergite (6-11) ; spinal and pleural wax glands much smaller, often consisting of one large cell and often the small cells are smaller than in the ventrolateral glands. Siphunculi small, truncate with dark sclerotic flange. Cauda dusky, bearing 4 hairs. Subanal plate with 10-14 hairs (H.R.L. op.cit.). Legs stout, concolorous with antennae and rostrum, bearing many short bristly hairs, longest one on hind tibiae, 0.033-0.046 mm. long, 0.35-0.70 \times as long as the diameter of the middle of the tibiae ; empodial hair 0.046 mm. long, 1.1-1.2 \times as long as the claws.

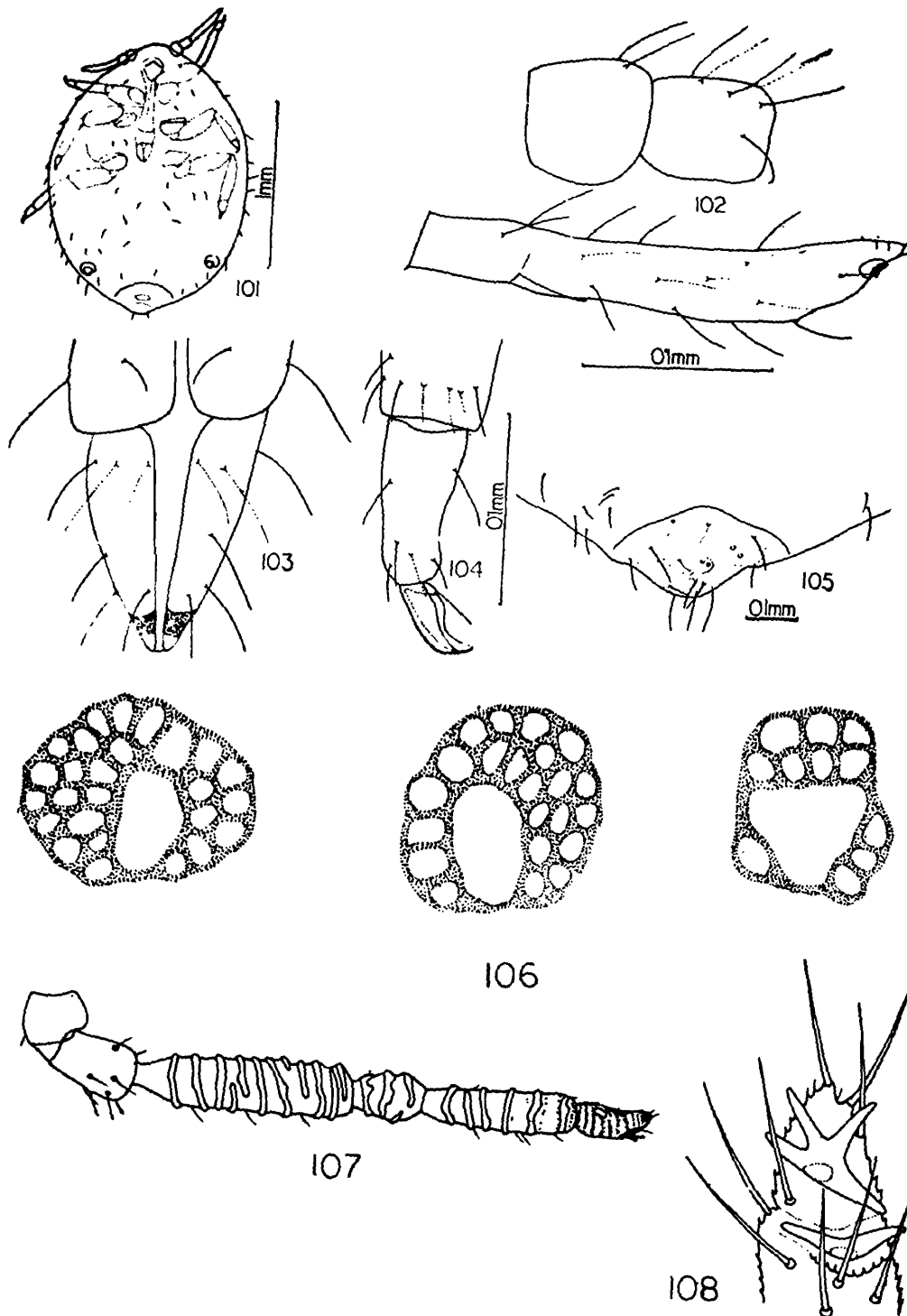
Colour.— Whitish to yellowish white in life (v.d. Goot, 1917).

Measurements in mm.—

	Length	Antennae	Antennal segments		urs.	ht. ₂
			III	IV		
1.	1.69	0.34	0.15	0.05	0.09	0.07
2.	1.89	0.35	0.17	0.05	0.10	0.08

(1, 2, ex *Saccharum officinarum* (roots), Nartu, INDIA, 10.4.1934, coll. S. Ghosh).

Embryos (from apterous exules, H.R.L. 1968-69).—Antennae of 4 segments ; segment I with 7+1 minute hairs, II with 10, III with 23 hairs ; antennal hairs stout, erect, 0.035-0.045 mm. long. Abdominal dorsum with marginal group of hairs, one long (0.070-0.090 mm.) and 3-5 shorter (0.025-0.035 mm.) besides 14-16, spinal and pleural hairs, of the same length as shorter marginal hairs. Ventrolateral wax glands of a single large oval cell, 0.010-0.017 mm. in diameter and with one or two groups of small cells, half encircling the large cell. Hind tarsal claws of different length, longer one 0.070-0.075, smaller one 0.050-0.055 mm. long ; tarsi spinulose.



Tetraneura javensis van der Goot ; Apterous viviparous female (from roots) :
 101. whole body ; 102. antenna ; 103. ultimate rostral segments ; 104. hind
 tarsus ; 105. posterior portion of abdomen ; 106. ventro-lateral wax
 gland.

Alate viviparous female (emigrant) : 107. antenna ; 108. last antennal
 segment of embryo from emigrant (from (Hille Ris Lambers, 1968-69).

Alate viviparous female (emigrants from galls of *Ulmus*, after H.R.L., 1968-69).—Body 1.8-2.0 mm. long. Head with a pair of strongly rimmed wax plate (0.030 mm. in diameter) ; dorsal cephalic hairs 0.016-0.040 mm. long. Antennae 5-6 segmented, less than $0.33\times$ as long as the body, apically spinulose, antennal segment III with 11-14 secondary rhinaria encircling 0.25-0.60 portion of the segment, segment IV with 3-5 and V with 4-7 similar rhinaria ; segment VI may be distinct or fused with V ; processus terminalis about $0.50\times$ as long as base of last antennal segment ; ultimate rostral segment $0.50\times$ as long as second segment of hind tarsus and bears 5-6 accessory hairs. Wax glands not discernible. 8th abdominal tergite with 8-10 hairs. Siphunculi apparently absent. Cauda with 4 hairs. Legs short, hairs on hind tibiae 0.020-0.022 mm. long.

Colour.—Not recorded.

Measurements in mm.—

	Length	Antennae	Antennal segments			
			III	IV	V	VI
1.	2.09	0.61	0.20	0.07	0.16	0.05
2.	1.96	0.58	0.19	0.06	0.16	0.05
3.	1.04	0.61	0.21	0.06	0.17	0.06

Embryos (from spring migrants, after H.R.L., 1968-69).—

Antennae as in embryos of apterous exules ; antennal hairs little longer, up to 0.050 mm. long. Abdominal dorsum with more numerous marginal hairs in group of 5-7, 0.045-0.070 mm. long ; dorsal hairs 24-32 per segment. Wax glands placed ventro-laterally, with a large cell and few minute cells, may be of more distinct clustures of small cells, caudad. Hind tarsal claws asymmetrical, longer one 0.065 mm. long, shorter one 0.045 mm. long ; tarsi spinulose.

Material examined.—Two apterous viviparous females from *Saccharum officinarum*, Nartu, INDIA, 10.4.1934, coll. S. Ghosh, det D. Hille Ris Lambers (H.R.L. collections) ; three apterous

viviparous females from roots of Sugarcane, "Mysore", INDIA, —.2.1927, coll. K. Kanhimannan, (BMNH collections).

Discussion.—The species, described from apterous exules, was known from roots of sugarcane in South India. George (1927) while describing it as a subspecies of *T. cynodontis* from Coimbatore, included the description of alatae from graminaceous host, which, however, appears inadequate. Hille Ris Lambers (1968-69) while redescribing the species correlated the alates collected from galls of *Ulmus wallichiana* in Pakistan, because of the resemblances that the embryos of exules and alatae exhibit, in asymmetry of tarsal claws, chaetotaxy of abdominal dorsum, antennae and cauda, besides a four-branched rim around primary rhinarium. Chakrabarti and Maity (1978) nominated *javensis* as type of subgenus *Indotetraneura*, on the basis of asymmetrical hind tarsal claws; Bhattacharya, D. (in litt.) stated that emigrant alatae from galls of *Ulmus* have also been collected in N. W. India.

Distribution.—INDIA, PAKISTAN, JAVA.

Type.—Location of types not known.

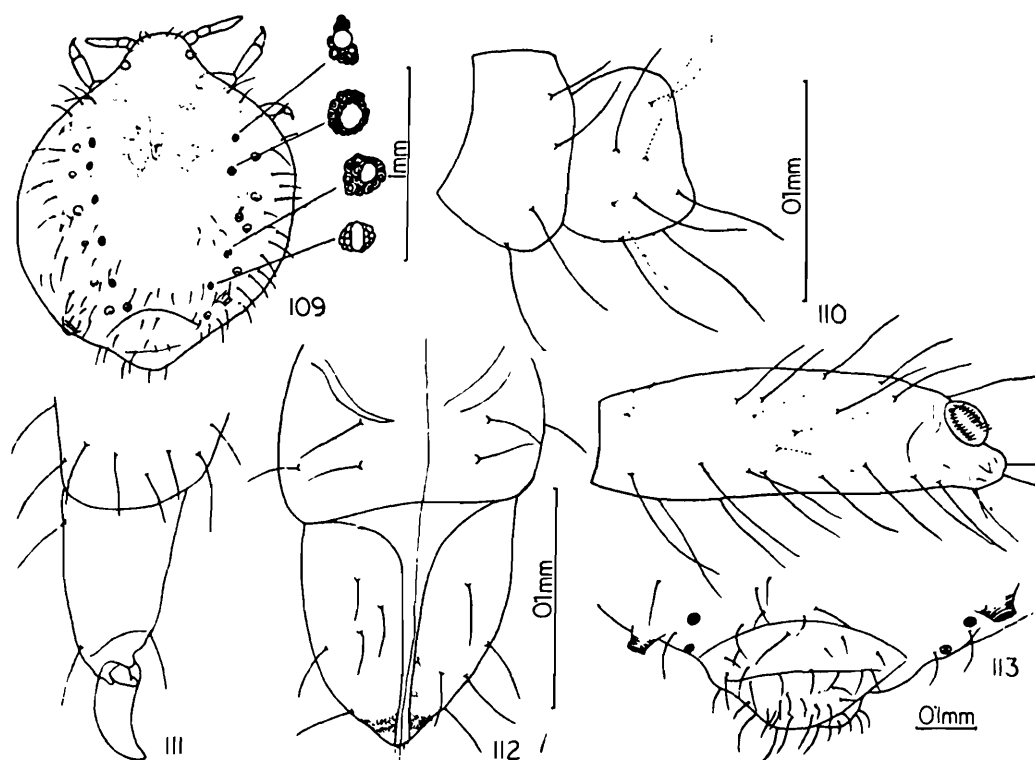
14. ***Tetraneura kalimpongensis*** Raychaudhuri, Pal, Ghosh, M.R.
(Figs. 109-113)

1978. *Tetraneura kalimpongensis* Raychaudhuri, D. N., Pal, P. K. and Ghosh, M. R., *Entomon*, 3 (2) : 255.

1980. *Tetraneura kalimpongensis* Raychaudhuri, Pal, Ghosh, A. K. Aphids of North East India and Bhutan, 430.

Apterous viviparous female.—Body 1.8-2.1 mm. long with 1.48-1.72 mm. as maximum width. Head yellowish brown, with a median suture and a pair of ventral wax plates, composed of two rows of cells; dorsal cephalic hairs stout, 0.033-0.073 mm. long, 1.0-2.2× as long as the basal diameter of antennal segment III. Antennae 4 segmented, concolorous with the head, except at the darker apices of segment IV, 0.15-0.20× as long as the body, nearly smooth except on I and IV which are sparsely spinulose; hairs on antennae with acute apices, segment I with 5-7, II with 9-12, III with 20-25 and IV with 4-7 hairs, on segment III 0.036-0.040 mm. long, 1.0-2.0× as long as the basal diameter of the

segment ; primary rhinaria ciliated ; processus terminalis usually $0.40-0.45\times$ as long as the base of last antennal segment. Eyes of 3 facets. Rostrum reaches mid coxae ; ultimate rostral segment $1.65-1.90\times$ ($1.70-2.25\times$) as long as the hind tarsus and bears 10-12, long accessory hairs. Thoracic tergum pale, with paired pleural wax plates, at least on meso—and metanota, composed of a large cell surrounded by 10-22 small cells ; marginal hairs on thoracic tergum, $0.100-0.146$ mm. long, $3.0-4.5\times$ as long as the basal diameter of antennal segment III. Abdominal dorsum pale ; hairs on the dorsum of abdomen of various length, marginal ones longest ; hairs on anterior tergites $0.043-0.178$ mm. long, on posterior tergites, $0.090-0.109$ mm. long, these being $1.20-5.5\times$ and $2.45-3.3\times$ ($3.75\times$) as long as the basal diameter of antennal segment III, respectively ; 7th and 8th tergites, each with a broad brown transverse sclerotic band, bearing many fine hairs, (16-23 on 7th, 12-14 on 8th) ; wax plates present in 1st-6th tergites, placed pleurally and spinally, the former being larger and well defined, with a central or peripheral large cell and smaller satellite cells ; spinal wax plates appear much smaller, scattered and often semi-



Tetraneura kalimpongensis Raychudhuri, Pal, M. R. Ghosh ;

Apterous viviparous female (from roots) : 109. whole body ; 110. antenna ; 111. hind tarsus ; 112. ultimate rostral segments ; 113. posterior portion of abdomen.

circular. Spiracles on sclerotic plates. Siphunculi truncate, dusky at apices with a thick apical flange. Cauda dark brown, broad, with 6-7 hairs. Subanal plate dark brown with at least 16-18 long fine hairs. Subgenital plate broad, hairs not clearly countable (12-15) ; Legs yellowish brown, short, stumpy, pubescent, longest hair on hind tibiae 0.040-0.050 mm. long, $0.54-0.62 \times$ as long as the diameter at the middle of the tibiae ; empodial hair 0.030-0.036 mm. long, $0.75-0.90 \times$ as long as the claws.

Colour.—Whitish in life with waxy filaments.

Measurements in mm.—

	Length	Width	Antenna		
1.	1.80	1.52	0.34		
2.	1.80	1.48	0.31		
3.	1.80	?	0.36		
	Antennal segments			urs.	ht ₂
I	II	III	IV		
0.05	0.06	0.16	(0.044+0.016)	0.109	0.066
0.06	0.06	0.13	(0.44+0.016)	0.112	0.066
0.07	0.07	0.17	(0.046+0.013)	0.124	0.066

(1, 2, ex Napier grass, Tashiding, West Bengal, INDIA, 25.5.1972, coll. P. K. Pal, 3, ex *Saccharum officinarum*, Kalimpong, West Bengal, INDIA, 24.5.1972, coll. P. K. Pal).

Embryos.—Embryos clearly indicate larger hind tarsal claws which, are 0.056-0.060 mm. long, as against tarsal claws of fore legs, (0.040 mm.) and hind legs (0.046 mm.) and as such the species may be placed under *Tetraneurella* H.R.L.

Other morphs.—Not known.

Material examined.—Seven apterous viviparous females from *Saccharum officinarum*, Kalimpong, West Bengal, INDIA, 24.5.1972 (K 6073) ; four apterous viviparous females from Napier grass, Tashiding, West Bengal, INDIA, 25.5.1972 (K. 6088), coll. P. K. Pal, (Paratypes, from Calcutta University collections).

Discussion.—The species with peculiar dorsal chaetotaxy, having much short spino-pleural hairs, and long stout marginal hairs appear distinct from related ones. The long hind tarsal claws of embryos within exules, suggest its inclusion within the subgenus *Tetraneurella* Hille Ris Lambers or *Indotetraneura* Chakrabarti & Maity, but non-availability of first instar nymph prevents definite subgeneric grouping. Original extensive description, is erroneous in the ratio of dorsal hair to basal diameter of antennal segment III (it can never be 8-15×), length of marginal thoracic hair (which can never be 1.10-1.20 mm.) and ratio of empodial hair to claws (which never exceeds the length of claws).

These insects form large colonies on the roots of Graminae in moist sandy loam soil at a depth of 3.8-7.6 cm. and are always associated with ants ; this species occurs during summer months at an altitude of *ca* 800-1300 m. in Darjeeling district of West Bengal ; besides, *Saccharum officinarum*, *Pennisetum* sp. is the other grass which this species infest.

Distribution.—INDIA (West Bengal).

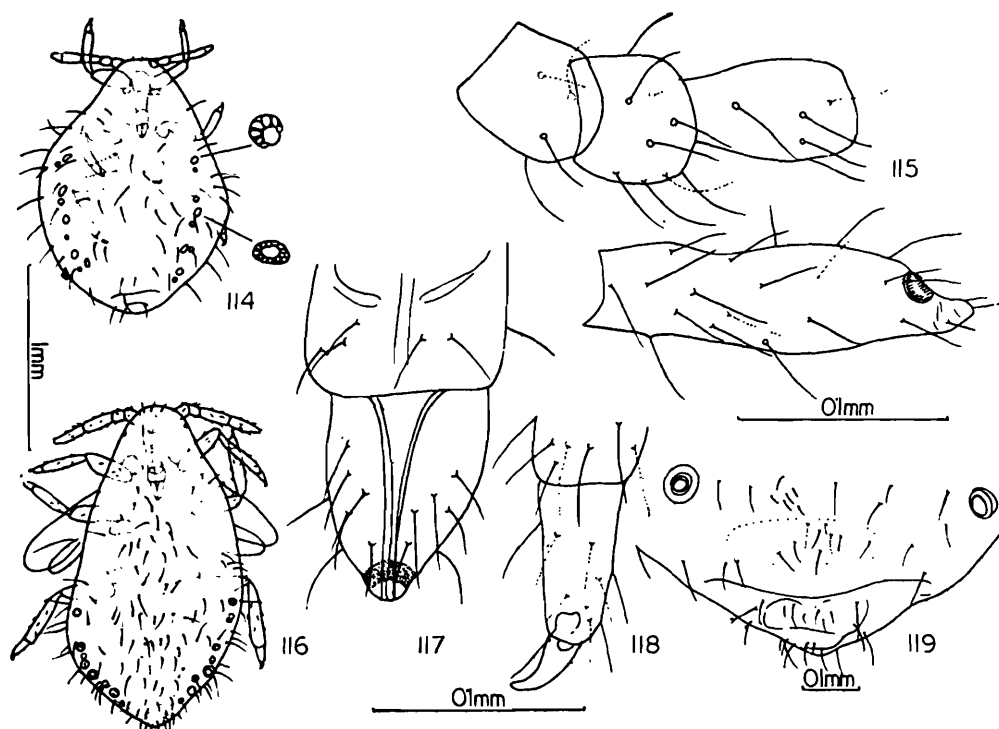
Types.—In the Entomology Laboratory, Department of Zoology, University of Calcutta, India.

15. *Tetraneura* (*Indotetraneura*) *lambersi* Chakrabarti & Maity (Figs. 114-123)

1978. *Tetraneura* (*Indotetraneura*) *lambersi*, Chakrabarti, S. and Maity, P. *Entomon*, 3 (2) : 269.

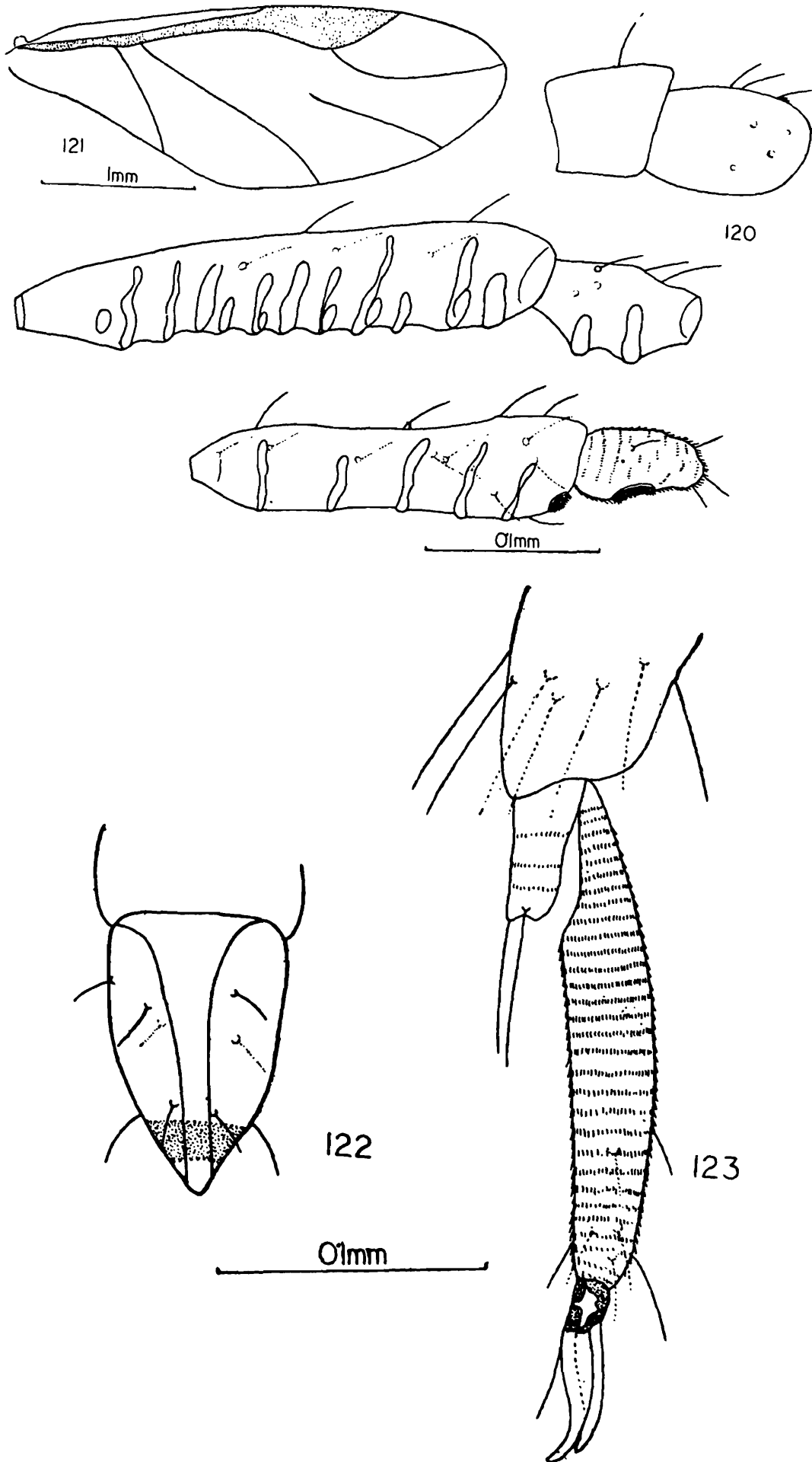
Apterous viviparous female.—Body globular, 1.65-1.77 mm. long with 1.24-1.38 mm. as maximum width bearing many long, stout

hairs all over. Head brown, rugose, with about 16 thick dorsal cephalic hairs, arranged in pairs, these being 0.045-0.090 mm. long, 1.4-3.2 \times as long as the basal diameter of antennal segment III ; cephalic wax plates usually not discernible, (occasionally a pair of wax plates may be present). Antennae usually 5 segmented, brown, darker on last segment, 0.23-0.30 \times as long as the body ; antennal segment I with 3-5 long and I short hair ; II with 9-13, III with 3-6, IV with 21-27, V with 3-4, hairs ; hairs on antennae much thinner than the dorsal hairs, flagellate, with acute apices, on segment III, 0.050-0.060 (0.038-0.055) mm. long, 1.23-1.60 \times (1.8-2.0 \times) as long as the basal diameter of the segment ; primary rhinaria ciliated ; processus terminalis 0.30-0.33 \times as long as the base of last antennal segment. Eyes of 3 facets, (sometimes multifaceted). Rostrum reaches bases of hind coxae ; ultimate rostral segment thick, stout, 1.50-1.71 (1.43-1.57 \times) as long as the hind tarsus and bears 6-10 accessory hairs. Thoracic tergum brown, striate, with stout marginal hairs, arranged in pairs as follows ; prothorax—1 pair, mesothorax—1 pair, metathorax-2



Tetraneura (Indotetraneura) lambersi Chakrabarti and MaitY ;

Apterous viviparous female (from roots) : 114. whole body ; 115. antenna ; 116. alate nymph ; 117. ultimate rostral segments ; 118. hind tarsus ; 119. posterior portion of abdomen (117-119), all of apterous viviparous female.



Alate viviparous female (from roots): 120. antenna; 121. forewing; 122. ultimate rostral segments; 123. hind tarsus.

pairs, on each side, these being 0.104-0.140 mm. long (0.166-0.194 mm.), $2.0-4.0 \times$ as long as the basal diameter of antennal segment III. Abdomen pale, smooth, with brown transverse sclerotic bands on 7th and 8th tergites ; hairs on the dorsum of abdomen with acuminate, blunt, spatulate or furcated apices, 16-20 per segment on 1st-6th tergites; spinal and pleural hairs, 0.073-0.178 mm. long, marginal hairs 0.083-0.215 mm. long, these being $1.9-6.0 \times$ as long as the basal diameter of antennal segment, III ; 8th tergite with 6 hairs, 0.093-0.105 mm. long, $2.2-2.7 \times$ ($2.7-3.75 \times$) as long as the mentioned diameter ; wax plates present pleurally and spinally, on all thoracic and at least up to 7th abdominal segment, composed of one or two rows of cells around a large one, these becoming smaller caudad and varying between 0.008-0.023 mm. in diameter. Siphunculi brown or dark brown, with a thick apical flange, about half as long as its basal width. Cauda dark brown, spinulose, bearing 2 small and 2 long hairs. Subanal plate spinulose, dark, with about 8-10 hairs. Gonapophyses with 10-12 fine hairs in each lobe. Legs pale to dark brown, smooth, pubescent, longest hair on hind tibiae 0.043-0.053 mm. long, $0.55-0.60 \times$ as long as the diameter at the middle of the tibiae ; empodial hair somewhat flattened, 0.046-0.050 mm. long, $0.93-0.95 \times$ as long as the claws.

Colour.—Not recorded.

Measurements in mm.—

	Length	Width	Antenna				
1.	1.77	1.38	0.43				
2.	1.65	1.24	0.44				
	Antennal segments					urs.	ht ₂
	I	II	III	IV	V		
	0.08	0.07	0.07	0.14	(0.040+0.015)	0.124	0.070
	0.07	0.08	0.07	0.15	(0.039+0.013)	0.115	0.073

(1, 2, ex unidentified grass, Mussourie, U.P., INDIA, 22.6.1976, coll. S. P. Maity, Paratypes).

Embryos.—(from Chakrabarti and Maity, 1978) : Antennae 4 segmented ; segment I with 3 long and 1 short hair, II with 8 hairs, III with 20 hairs, IV with 7 hairs, upto 0.046 mm. long. Rostrum spinulose, ultimate rostral segment 0.124 mm. long and bears 4 hairs. Dorsal hairs long or short, abdominal tergites with paired marginal (2), pleural (1) and spinal (1) hairs, spinal ones being up to 0.098 mm. long and pleural ones 0.057 mm. long ; each of 7th and 8th tergite with 6 hairs up to 0.080 and 0.115 mm. long, respectively ; Ventrolateral wax plates (0.008-0.026 mm. in diameter) present, composed of 4-14 small cells surrounding a large central cell. Legs with tarsal claws unequal, 0.052-0.055 mm. to 0.092-0.098 mm. long.

Alate viviparous females.—Body 1.70-1.95 mm. long with 0.90-1.04 mm. as maximum width. Head dark brown, dorsal cephalic hairs fine, up to 0.035 mm. long 1.7-2.4 × as long as the basal diameter of antennal segment III. Antennae 6 segmented, brown, about 0.34-0.36 × as long as the body ; flagellum with long fine hairs, longest one on segment III up to 0.020-0.023 mm. long, 1.2-1.4 × as long as the basal diameter of the segment ; antennal segment III with 7-12 annular secondary rhinaria, segment IV with 1-2, and V with 4-7 similar rhinaria ; processus terminalis spinulose, 0.25-0.35 × as long as the base of antennal segment VI. Ultimate rostral segment 0.68-0.71 × as long as second segment of hind tarsus and bears 6-8 accessory hairs. Abdominal dorsum pale, bearing a brown sclerotic transverse band on 8th tergite ; hairs on the dorsum of abdomen fine, on anterior tergites upto 0.04-0.05 mm. long, on posterior tergites upto 0.06-0.09 mm. long, these being 2.0-2.8 × and 2.8-5.0 × as long as the basal diameter of antennal segment III. Siphunculi brown, truncate with thick flange. Cauda with 4 hairs. Subgenital plate with at least 24 (24-28) hairs. Legs brown with many long, fine hairs ; empodial hair subequal to the claws. Forewings with media once branched. Veins pale.

Colour.—Not recorded.

Measurements in mm.—

Length	Width	Antenna
1.9	1.04	0.60

III	Antennal segments			urs.	ht ₂
	IV	V	VI		
0.21	0.06	0.18	(0.04+0.01)	0.103	0.137

(ex *unidentified* grass, Mussourie, U.P., INDIA, 22.6.1976, coll. S. P. Maity).

Material examined.—7 apterous viviparous females, 3 alate viviparous females and one alatoid nymph from roots of unidentified grass, Mussourie, Uttar Pradesh, INDIA, 22.6.1976, coll. S. P. Maity, det. S. Chakrabarti (Paratypes ; S. Chakrabarti's collections).

Discussion.—The present species was accommodated in a new subgenus *Indotetraneura* to which *basui* H.R.L. and *javensis* v.d. Goot were transferred, the latter being nominated as the type ; the unequal tarsal claws of larvae and 1st instar nymphs, separates the member of this subgenus, which appears extremely close to subgenus *Tetraneurella* H.R.L. ; the present species is distinctive in its chaetotaxy, specially in length of spinal and pleural hairs and number of hairs on subanal plate, and composition of wax glands, besides having fewer antennal hairs on basal segments and marginal hairs on abdominal tergites in the embryos of exules. Further collections in the areas of type-locality, indicate its occurrence from June to at least September on the roots of grasses in the Mussourie hill region.

Distribution.—INDIA (Uttar Pradesh).

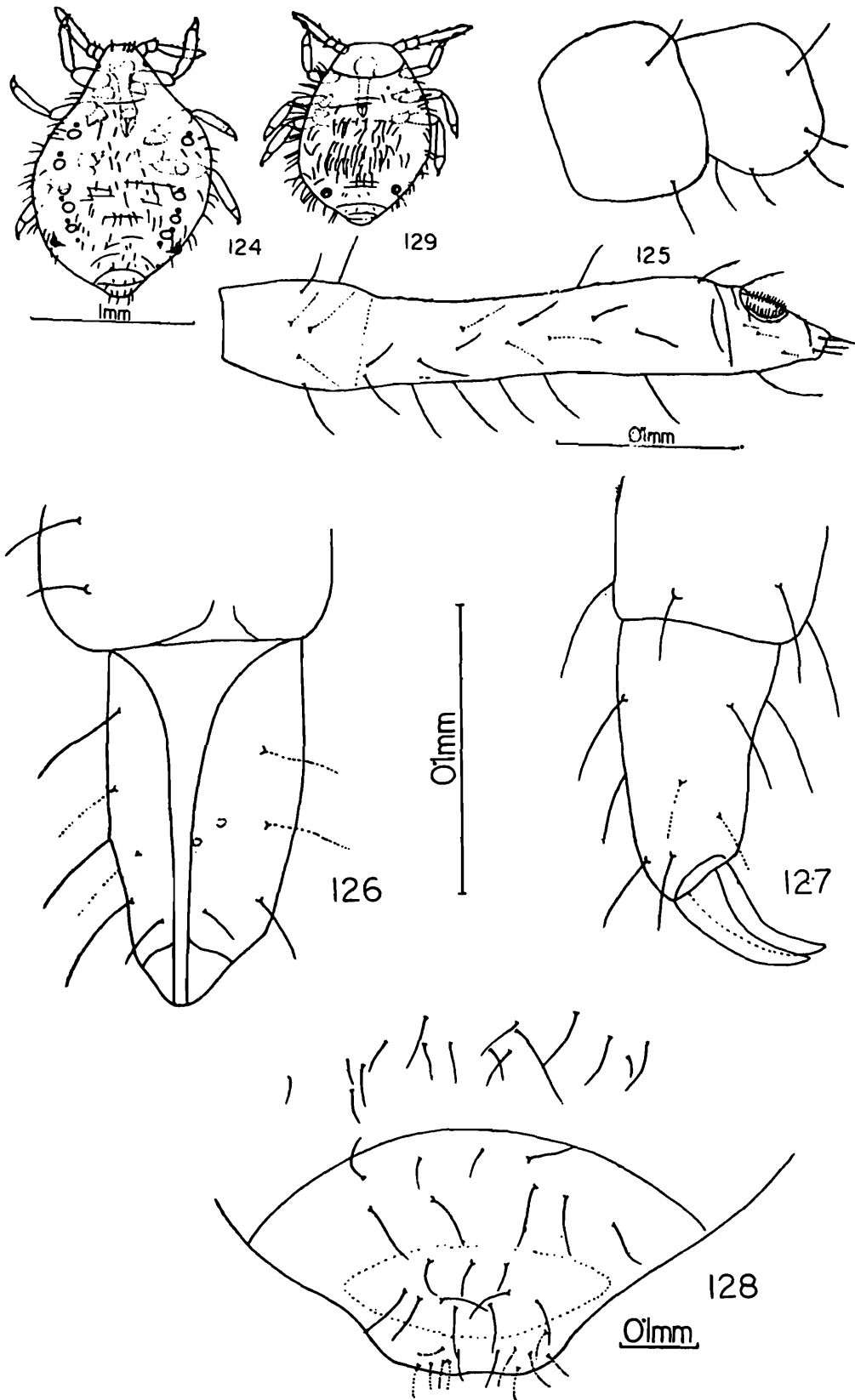
Types.—In the collection of Dr. S. Chakrabarti, Department of Zoology, Kalyani University.

16. ***Tetraneura multisetosa*** Raychaudhuri, Pal, Ghosh, M. R.
(Figs. 124-129)

1978. *Tetraneura multisetosa* Raychaudhuri, D. N., Pal, P. K. and Ghosh, M. R., *Entomon*, 3 (2) : 257.

1980. *Tetraneura multisetosa*, Raychaudhuri, D. N., Pal, P. K. and Ghosh, A. K., *Aphids of North East India and Bhutan*, 430.

Apterous viviparous female.—Body globular, 1.42-1.86 mm. long, with 1.17-1.41 mm. as maximum width. Head brownish, nearly fused with prothorax, spinulose over vertex, with a distinct median suture; dorsal cephalic hairs numerous, fine, flagellate, up to 0.083-0.090 mm. long, $2.2-2.5 \times$ as long as the basal diameter of antennal segment III ($2.80-5.35 \times$); a pair of wax plates with diffused cells could be observed ventrally. Antennae brown, 4 segmented, $0.24-0.28 \times$ as long as the body and extremely pubescent; segment I with 10-12, II with 16-18, III with 40-50 and IV with 3-5 hairs which are fine, and somewhat stiff, those on segment III 0.030-0.060 mm. long, $0.90-1.50 \times$ ($1.60-3.35 \times$) as long as the basal diameter of the segment; primary rhinaria ciliated; apices of segment III and whole of segment IV finely spinulose; processus terminalis $0.45-0.50 \times$ as long as base of last antennal segment. Eyes of 3 facets. Rostrum stout, reaching mid coxae, ultimate rostral segment $1.80-1.85 \times$ as long as the hind tarsus, bearing 10-12 accessory hairs. Thorax with many long, stout hairs longest one being placed marginally, up to 0.25-0.28 mm. long, $6.0-7.0 \times$ as long as the basal diameter of antennal segment III. Abdominal dorsum pale brown, striate, with many long, stout flagellate hairs, besides some smaller ones, those on anterior tergites 0.033-0.260 mm. long, on posterior tergites upto 0.083-0.140 mm. long, and $0.90-6.7 \times$ and $2.8-3.3 \times$ as long as the basal diameter of antennal segment III, respectively; 7th and 8th tergites each with a brown transverse band, bearing 18-20 hairs (0.083-0.115 mm. long) and 9-12 hairs (0.080-0.106 mm. long) respectively. Wax plates on abdomen, of two types, viz. pleural ones, on 1st-7th tergites, each composed of a large cell surrounded by one or two tier of cells, along most part of periphery and becoming smaller in size, caudad, and marginal and spinal ones, composed of one large cell and 1-2 small satelliate cells located usually at the top or also at the bottom; a few wax plates may have composite group of cells of equal size. Spiracles on dark sclerotic plates. Siphunculi dark brown with a thick apical rim. Cauda brown, little spinulose with about 7-8 hairs (8-10). Subgenital plate large, spinulose, with many fine hairs. Legs brown, short, with trochanters partly fused with femora; hairs on femora and tibiae short, erect, longest one on hind tibiae 0.056-0.060 mm. long, $0.60-0.66 \times$ as long as the diameter at the middle of the tibiae; empodial hair 0.046-0.050 mm. long, $1.2 \times$ as long as the claws.



Tetraneura multisetosa Raychaudhuri, Pal, M. R. Ghosh ;
 Apterous viviparous female (from roots) : 124. whole body ; 125. antenna ;
 126. ultimate rostral segments ; 127. hind tarsus ; 128. posterior
 portion of abdomen ; 129. early stage nymph.

Colour.—Yellowish to yellowish grey.

Measurements in mm.—

	Length	Width	Antenna
1.	1.58	1.26	0.45
2.	1.52	1.17	0.44
3.	1.79	1.47	0.44

I	Antennal segments				urs.	ht ₂
	II	III	IV			
0.07	0.07	0.24	0.06	0.130	0.076	
0.08	0.08	0.23	0.07	0.130	0.080	
0.08	0.07	0.23	0.07	0.127	0.076	

(1, 2, 3, ex *Capillipidium parviflorum*, Peshoke, W B., INDIA 24.1.72, coll. P. K. Pal, K. 5641).

Nymph.—(early stage) : Body pale, 1.13 mm. long with 0.82 mm. as maximum width. Head pale yellow, with some fine dorsal hairs, 0.033-0.040 mm. long. Antennae 4-segmented with indication of segmentation on III, $0.33 \times$ as long as the body ; hairs on segment I : 8, II : 11, III : 38, IV : 4, those on III, 0.036-0.043 mm. long, $0.96-1.08 \times$ as long as the basal diameter of the segment. Rostrum reaches mid coxae ; ultimate rostral segment $1.71 \times$ as long as hind tarsus and bears 10 accessory hairs. Dorsal hairs mostly long, fine, flagellate, dense on mid dorsum of abdomen, shorter ones 0.070 mm. long, longer ones more than 0.200 mm. long, these being $1.7 \times$, and $5.6 \times$ as long as the basal diameter of antennal segment III ; 8th tergite brownish, bearing 8 hairs upto 0.073 mm. long. Wax plates mostly placed pleurally, composed of a large cell and surrounded by much smaller cells, incompletely so along the margin, or group of one large and 1-2 small cells. Siphunculi with large pores. Legs pale brown, trochanters fused with femora ; hairs on femora and tibiae fine, pale, longest one on hind tibiae 0.056 mm. long, $0.8 \times$ as long as the diameter at the middle of the tibiae ; claws of all tarsi equal, empodial hair 0.043 mm. long, just longer than claws.

Colour.—Yellowish in life.

Length	Width	Antenna	Antennal segments		urs.	ht ₂
			III	IV		
1.13	0.82	0.38	0.18	0.050	0.121	0.070

(ex *Capillipidium parviflorum*, Peshoke, W. B., INDIA, 24.1.72, coll. P. K. Pal, K. 5641).

Other morphs.—Not known.

Material examined.—4 apterae and 7 nymphs from roots of *Capillipidium parviflorum*, Pashoke, Darjeeling, West Bengal, INDIA, 24.1.1972, coll. P. K. Pal (Paratypes, No. PLK 5641, Calcutta University collections).

Discussion.—This is a recently described species and distinctive in the chaetotaxy of dorsum. Myrmecophilous in habit, these insects form small to medium size colony at a depth of 2.5-6.4 cm. in sandy loam soil, independent of moisture content, during middle of winter to early summer, at ca 800-1300 m. in Darjeeling area of West Bengal (Pal, P. K. 1975, Ph.D. Thesis C.U.). Besides, *Capillipidium* the species also feeds on *Imperata cylindrica* and other unidentified gramineae.

Distribution.—INDIA (West Bengal).

Types.—In the collections of Entomology Laboratory, Department of Zoology, University of Calcutta, India.

17. ***Tetraneura* (*Tetraneurella*) *nigriabdominalis* (Sasaki)**
(figs. 130-141)

1899. *Schizoneura nigriabdominalis* Sasaki, C., Manual of Insect Pests of crops in Japan (in Japanese), 435.
 1917. *Tetraneura fusiformis*, Matsumura, M., A collection of essays for Mr. Yasushi Nawa, Gifu, 3 : 74.
 1921. *Dryopeia hirsuta* Baker, A. C., *Monthly Bull. Calif. Dep. agric.*, 10 : 159.
 1923. *Tetraneura myzae* van der Goot, P., in van Heurn., *Meded. Inst. Plantenziekten Batavia*, 61 : 41.

1924. *Pemphigus agrimoniae* Shinji, O., *Zool. Mag. Tokyo*, **35** (431) : 371.
 1968-69. *Tetraneura (Tetraneurella) nigriabdominalis*, Hille Ris Lambers, D.,
Boll. Zool. agr. Bachic., Ser. II, **9** : 52.
 1978. *Tetraneura nigriabdominalis*, Raychaudhuri, D. N., Pal, P. K. and
 Ghosh, M. R., *Entomon*, **3** (2) : 258.
 1980. *Tetraneura nigriabdominalis*, Raychaudhuri, D. N., Pal, P. K. and
 Ghosh, A. K., *Aphids of North East India and Bhutan*, 430.

Apterous viviparous female.—(Exules) : Body pale yellow to brownish, 1.6-2.3 mm. long with 1.25-1.44 mm. as maximum width. Head partly fused with prothorax smooth or feebly scabrous; dorsal cephalic hairs subacute, sparse, upto 0.095-0.105 mm. long and $2.4-2.5 \times$ as long as the basal diameter of antennal segment III. Antennae 3-5 segmented, pale yellow, darker at apices, $0.15-0.21 \times$ as long as the body; segment I with 2-4 stout, hooked hair, 0.040-0.070 mm. long and a minute hair, segment II with 3-4 similar stout hairs, segment III with 0.3 small hair, 0.002 mm. long and segment IV with 15-20 hairs, these being 0.023-0.045 mm. long, $0.63-1.27 \times$ as long as the basal diameter of the segment, (in 4-segmented antennae, III+IV bears 15-20 hairs on apical half, basal part remaining hairless); last two antennal segments spinulose; primary rhinaria ciliated; last antennal segment usually with 2-3 small hairs (0.01 mm. long) on basal part. Rostrum stout, reaches beyond mid coxae; ultimate rostral segment obtuse, usually with 4 accessory hairs (sometimes with 6-8), and $1.5-1.6 \times$ as long as the hind tarsus. Abdominal dorsum pale to pale brown, with a sclerotic transverse band on each of 7th and 8th tergite; hairs on the dorsum of abdomen with variable apices, marginal hairs long and thick with blunt, swollen or subacute apices, 0.130-0.215 mm. long (0.170-0.260 mm., H.R.L. 1968-69) $4.0-6.5 \times$ as long as the basal diameter of antennal segment III; spinal and pleural hairs distinctly thinner and much shorter (0.004-0.025 mm. long, H.R.L. 1968-69) on anterior tergites, but appear much longer on 7th and 8th tergites; 7th tergite with 4 spinopleural hairs (0.050 mm. long) between the paired marginal hairs (0.083 mm. long); 8th tergite with 2 thick hairs (0.146-0.165 mm. long); wax plate usually composed of several long and small gland cells, very variable in nature; spinal and pleural wax plate of one large cell (sometimes with a few wax cells), ventro-lateral wax plate with both large and small cells (0.025-0.050 mm. in diameter, H.R.L., 1968-69); 7th tergite with a transverse, sometime appearing paired,

spinal wax plates composed of only large gland-cells Spihunculi on slightly elevated sclerotic cones. Cauda brown with a pair of hairs. Subanal plate with 4 hairs, 0.040-0.073 mm. long (0.11mm. long, H.R.L. 1968-69) besides some smaller hairs (24-45, 0.035-0.043 mm. long, H.R.L. 1968-69); gonapophyses with more than 10 hairs, in each lobe. Legs stumpy, brownish yellow, smooth, hairs on femora and tibiae fine, longest one on hind tibiae 0.033-0.035 mm. long, at most $0.50 \times$ as long as the diameter at the middle of the tibiae ; empodial hair fine, equal to or little longer than the claws.

Colour.— Dirty to dark brown in life.

Measurements in mm.—

	Length	Width	Antenna
1.	1.90	1.69	0.33
2.	2.00	1.70	0.42
3.	1.93	1.38	0.38
4.	2.18	1.44	0.37

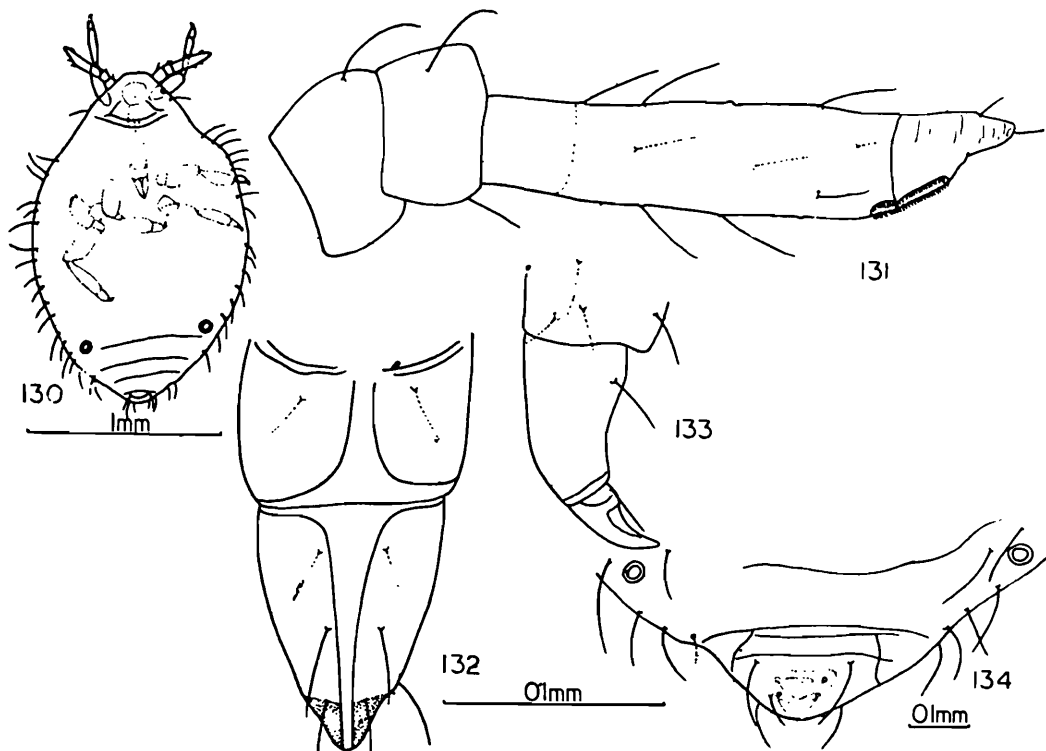
I	Antennal segments				V	urs.	ht ₂
	II	III	IV				
0.06	0.07	0.02	—	—	0.12	0.06	
0.07	0.07	0.22	0.06	—	0.11	—	
0.06	0.04	0.09	0.14	0.05	0.12	0.07	
0.05	0.04	0.10	0.13	0.05	0.115	0.07	

(1, 2, ex roots of unidentified grass, Kalimpong, INDIA, November, 1971, coll. P. K. Pal ; 2, 4, ex roots of *Oryza sativa*, Aizawl, Mizoram, INDIA, 31.7.74, coll. *Khound*).

Embryos.—(Not available for present study, description based on Hille Ris Lambers, 1968-69, on embryos from Japanese specimens). Head with 8 hairs and a pair of ventral wax plates of 5-7 cells. Antennae 5-segmented, flagellum variably spinulose ; segment I with 3 stout hairs, 0.040-0.050 mm. long and one short hair, II with 4 long hairs, III without any hair, IV with 14-19 fine

hairs, 0.045 mm. long ; segment V with a trifurcate primary rhinaria. Ultimate rostral segment feebly spinulose with 4 accessory hairs besides preapicals. Pronotum with 4 marginal and 4 spino-pleural hairs, meso- and metanota, each with 4 marginal + 6 spino-pleural hairs. Abdominal tergites 1st-6th, each with 2 marginal + 6 spino-pleural hairs, 7th tergite with 2 marginal + 4 spino-pleural hairs, 8th tergite with only 2 spinal hairs ; most of the dorsal hairs stout, curved and acuminate at apices, nearly swollen, marginal hairs 0.055-0.080 mm. long, spino-pleural hairs 0.020-0.045 mm. long. Wax gland plates on pronotum and on 7th tergite composed of 8-12 large cells, on other tergites hard to discern ; ventro-lateral wax gland (0.021 × 0.030 mm) composed of 2-7 large cells and a group of minute cells. Subanal plate with 4 hairs. Legs with distal part of tibiae and whole of tarsi spinulose ; hind tarsal claws symmetrical, 0.070-0.087 mm., long.

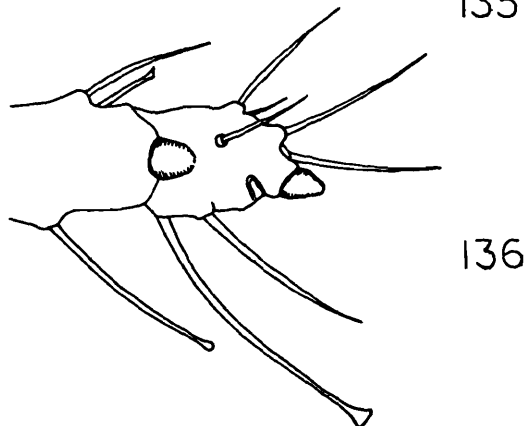
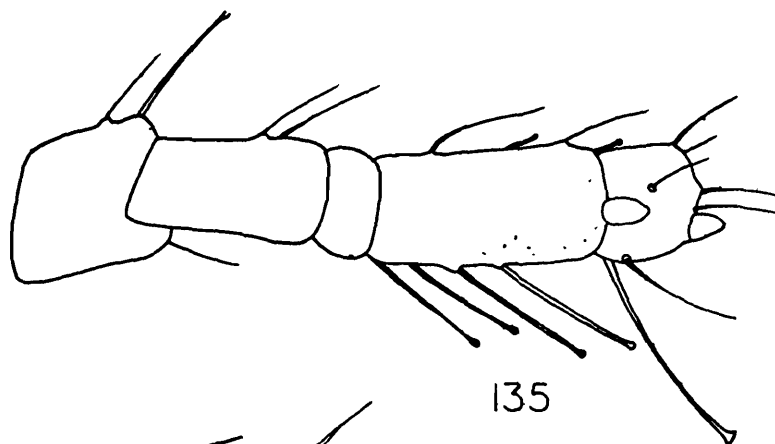
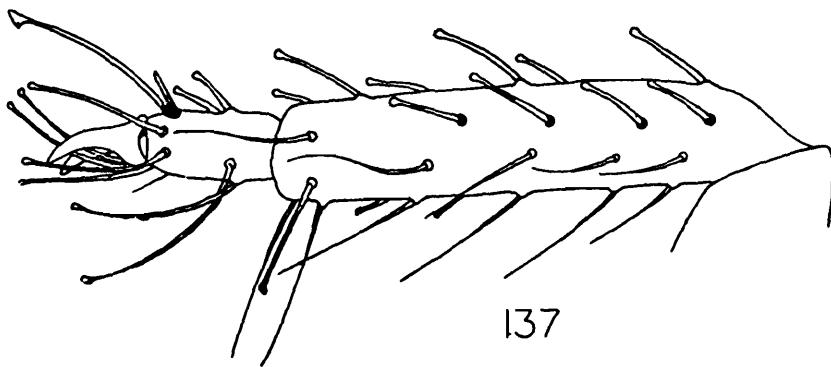
Alate viviparous female.—Body 1.85-2.20 mm. long with 0.98-1.10 mm. as maximum width. Head brown, sclerotic ; dorsal cephalic hair 0.024-0.040 mm. long, 1.2-3.0 × as long as the basal diameter



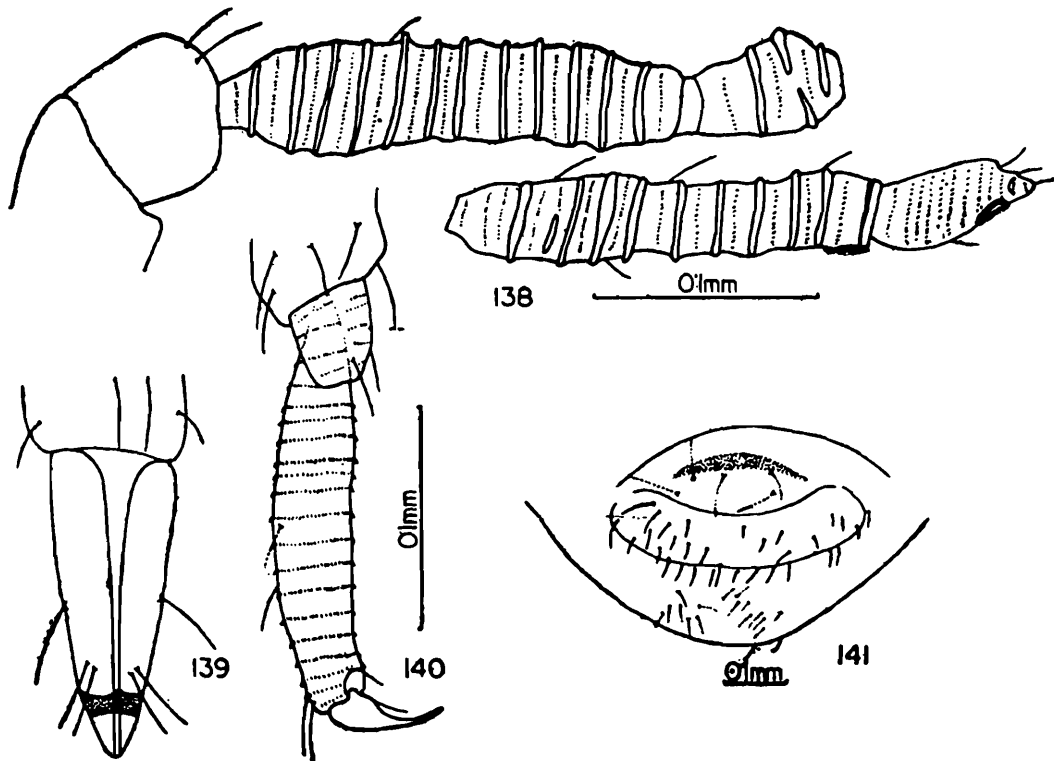
Tetraneura (Tetraneurella) nigriabdominalis (Sasaki) ;

Apterous viviparous female (from roots) : 130. whole body ; 131. antenna ; 132. ultimate rostral segments ; 133. hind tarsus ; 134. posterior portion of abdomen.

of antennal segment III. Antennae 6-segmented, $0.28-0.36 \times$ as long as the body ; segment I with 3-4, II with 3-4, III with 6-13, IV with 0-2, V with 13-20 hairs, those on segment III $0.013-0.020$ mm. long, $0.80-1.25 \times$ as long as the basal diameter of the segment ; flagellum gradually more densely spinulose from segment IV apicad ; antennal segment III with 11-15, IV with 2-4 and V with 8-12, non-ciliated linear secondary rhinaria ; processus terminalis $0.60-0.70 \times$ as long as base of antennal segment VI. Rostrum



First instar larva of fundatrix : 135. antenna ; 136. apex of antenna ; 137. hind leg (all from Hille Ris Lambers, 1968-69).



Alate viviparous female (from roots) : 138. antenna ; 139. ultimate rostral segments ; 140. hind tarsus ; 141. posterior portion of abdomen.

reaches mid-coxae, ultimate rostral segment with spinules, $0.64-0.80 \times$ as long second segment of hind tarsus and bears 6-7 accessory hairs. Abdomen pale dorsally, finely spinulose ventrally ; spinopleural hairs on the dorsum of abdomen with subacute apices on 1st-7th tergites, $0.013-0.016$ mm. long ; marginal hairs fine, much longer, on 1st-6th tergites, $0.043-0.066$ mm. long, on 7th tergite $0.060-0.086$ mm. long, these being $1.0-1.2 \times$, $3.0-4.0 \times$, and $5.2-6.1 \times$ as long as the basal diameter of antennal segment III, respectively ; 8th tergite with 2 hairs $0.097-0.106$ mm. long ; large paired marginal wax plates present on 1st-7th segment, those placed anteriorly 0.065×0.066 mm., posteriorly 0.046×0.053 mm ; spinal wax plates much smaller, upto 0.030×0.033 mm. Siphunculi with dark, sclerotic rim. Cauda with 2 hairs. Subanal plate with 24-28 hairs. Gonapophyses with 32-38 hairs. Legs brown to dark brown, feebly spinulose over femora and tibiae, densely so over tarsi ; hairs on femora and tibiae stiff, longest one on hind tibiae, $0.033-0.043$ mm. long, $0.76-0.92 \times$ as long as the diameter at the middle of the tibiae ; empodial hair fine, $0.036-0.040$ mm. long, subequal to the claws. Forewings with media obsolete at base and cubitus and anal fused at base.

Colour.—Pale grey with dark head, abdomen and wing veins.

Measurements in mm.—

	Length	Width	Antenna		
1.	1.85	0.98	0.67		
2.	2.20	1.01	0.75		
3.	2.12	1.17	0.67		
		Antennal segments		urs.	ht ₂
	III	IV	V	VI	
	0.22	0.06	0.19	0.06	0.11
	0.23	0.06	0.22	0.06	0.11
	0.21	0.07	0.20	0.06	0.11

(1, 2, ex *Poa* sp., Shillong, Meghalaya, INDIA, 21.5.1970, coll. H. Banerjee ; 3, ex *Cynodon dactylon*, Geyzing, Sikkim, April, 1972, coll. P. K. Pal).

Embryos.—(from Hille Ris Lambers, 1968-69, based on Indian specimens) Embryo of alate viviparous female resembles the embryos of apterous exules in chaetotaxy, except that hairs on 1st-5th abdominal tergites with acute apices, marginal ones about 0.105-0.110 mm. long, spinal and pleural ones 0.052-0.067 mm. long.

Apterous viviparous female (Fundatrix).—Body globular, 1.38-1.50 mm. long with 0.86-1.13 mm. as maximum width. Head dark sclerotic, with a faint median suture ; dorsal cephalic hairs 0.060-0.066 mm. long, with acute apices, 3.0 × as long as the basal diameter of antennal segment III. Antennae 3-4-segmented, the 3 segmented antennae with a faint division, 0.11-0.14 × as long as the body, brown, faintly spinulose ; antennal hairs 0.013-0.023 mm. long, 0.57-1.0 × as long as the basal diameter of antennal segment III ; primary rhinaria strongly ciliated. Rostrum short, thick, reaches mid-coxae ; ultimate rostral segment with 2 pairs of accessory hairs. Dorsum pale membranous, hairs on the dorsum thick, conspicuous, arranged in pairs, marginal and 4-6 on spino-pleural region, these

being 0.066-0.100 mm. long, (spino-pleural ones 0.045 mm. long, Hille Ris Lambers, 1968-69) $3.0-4.3 \times$ as long as the basal diameter of antennal segment III ; 7th tergite with 6 long hairs including the marginal ones and 8th tergite with 2 long hairs, 0.066-0.83 mm. long; wax plates absent but groups of brownish scattered cells appearing like "muskeplatten" present on posterior margin of head and on marginal and pleural region of thorax and 1st-6th abdominal tergites. Siphunculi absent. Cauda with 2 hairs. Subanal plate with 4 hairs. Gonapophyses with 6-7 small fine hairs. Legs dark, stumpy, smooth ; longest hair on hind tibiae 0.033 mm. long, $0.58 \times$ as long as the diameter at the middle of the tibiae.

Colour.—Not recorded.

Measurements in mm.—

	Length	Width	Antenna		
1.	1.58	1.13	0.18		
2.	1.38	0.87	0.18		
			Antennal segment		urs.
	I	II	III	IV	
	0.03	0.03	0.08	0.03	0.090
	0.03	0.03	0.09	0.04	0.090

(1, 2, ex *Ulmus* sp., Ghangharia, U.P., INDIA, 22.5.1979, coll. S. Chakrabarti).

Larva (from Hille Ris Lambers, 1968-69) : Body black, heavily sclerotised, with segmented borders pale. Antennae 5-segmented, black, smooth ; segment I with 3 hairs, II with 2 hairs, III without any hair, IV with 8 hairs, mostly with knobbed apices, and V with 6 hairs, of which at least one, very long and knobbed at apex. Ultimate rostral segment slender, 0.150 mm. long with 4-6 fine accessory hairs. Dorsal hairs knobbed at apices, arranged in 6 rows on 1st-5th tergites, marginal ones 0.050 mm. long, spinal and pleural ones thinner, 0.022 mm. long. Wax glands absent. Legs black, smooth, hairs on hind tibiae very long, with incrassate apices ; hind tarsal claws 0.060 mm. long, shorter than the hind tarsus which is 0.070 mm. long.

Alate viviparous female (emigrant).—(Not known from India, description from Hille Ris Lambers, 1968-69, based on Japanese specimens). Body about 1.7-2.25 mm. long. Head with 28-32 hairs, 0.030-0.042 mm. long; wax plates absent. Antennae 6-segmented, $0.33 \times$ as long as the body; segment I with 3-4 hairs, II with 3-6, III with 9-12, IV with 2-4, V with 5-6 hairs; hairs on antennal segment III, 0.010-0.015 mm. long; segment III with 12-18, IV with 3-6, V with 6-12 secondary rhinaria. Ultimate rostral segment 0.090-0.105 mm. long, about $0.60 \times$ as long as second segment of hind tarsus and bears 5-6 accessory hairs. Dorsal marginal hairs in single pair, 0.045-0.055 mm. long, 7th tergite with 2 spinal hairs, upto 0.060 mm. long, besides 2-4 shorter hairs. Wax glands not discernible. Siphunculi absent. Cauda with 2-3 hairs. Subanal plate with 4 stout hairs besides 6-12 slightly shorter hairs.

Colour.—Not recorded.

Measurements in mm.—

	Length	Antenna	Antennal segments			
			III	IV	V	VI
1.	1.74	0.58	0.20	0.07	0.16	0.06
2.	1.95	0.64	0.22	0.09	0.18	0.07
3.	2.23	0.69	0.22	0.09	0.19	0.08

(ex *Ulmus davidiana* var., *japonica* (galls), Sapporo, Hokkaido, JAPAN, 4.7.1966, coll. M. Sorin).

Embryos.—(from Hille Ris Lambers, 1968-69). Head with a pair of frontal wax plate of 2-4 cells and ventral plates of 7-9 cells. Antennae 5-segmented, with last two segments spinulose; segment I with 3 hairs, 0.060 mm. long and one small hair, 0.008 mm. long, II with 2-3 long hairs, III with 0-1, IV with 13-17 hairs (0.065-0.075 mm. long); primary rhinaria on segment V with trifurcate membrane. Ultimate rostral segment 0.110-0.118 mm. long with 6 accessory hairs. Dorsal hairs with acute apices; each of abdominal tergites 1st-5th, with paired marginal hairs (0.100-0.110 mm. long) and 6 thinner, spino-pleural hairs (0.080-0.090 mm. long); 7th

tergite with 2 marginal hairs and 3-4 spino-pleural hairs (0.100 mm. long) ; 8th tergite with 2 thick hairs. Wax glands with both large and small cells, the latter often indistinct ; 1st-5th tergite with ventro-lateral wax plates of 5-9 large cells, and sometimes with, up to 7 small cells around the large cells ; 7th tergite with a transverse wax plate of large and small cells. Legs with hind tibiae smooth, apices of fore-and mid-tibiae spinulose as also fore-and mid-tarsi ; hind tarsi feebly spinulose ; hind tarsal claws 0.065-0.078 mm. long.

Material examined.—Several apterous and alate viviparous females collected from *Axonopus compressus*, *Brachiaris remosa*, *Capillipidium parviflorum*, *Chrysopogon sciculatus*, *Cynodon dactylon*, *Dacthloctinum aegypticum*, *Echinochola colonum*, *Eleusine coracana*, *E. indica*, *Imperata arundinaceae*, *I. cylindrica*, *Oplismannus burmanni* *Oryza sativa*, *Paspalum cemmenssonii*, *P. conjugatum*, *Pogonatherum saccharoideum*, *Polypogon fugax*, *P. monspeliensis*, *Setaria glauca*, *Triticum vulgare* and many unidentified grasses, from several localities of Darjeeling district, West Bengal and Sikkim, Manipur, Nagaland, INDIA, November, 1971—May 1974, colls. H. Banerjee, R. C. Basu, A. K. Ghosh, P. K. Pal ; (Calcutta University collections) two apterous fundatrices and nymphs from galls of *Ulmus* sp., Ghangharia, Uttar Pradesh, INDIA, 22.5.1979, coll. (S. Chakraborti's collections).

Discussion.—Hille Ris Lambers (1968-69) described in details, adult and embryos of this species and recognised 4 distinct groups of material from different geographical areas, which differ in the chaetotaxy of adults and embryos ; however, considering these as clones of the same species, 3 groups were put under *nigriabdominalis* Sasaki, while 4th group with 2 spinal hairs on 7th tergite in apterous exules (which are similar to marginal ones) and 4 spino-pleural hairs in embryos of emigrant and virginoparae, was put under a new subspecies "*bispina*", apparently this homogeneous group being found only in Africa and North America ; Raychaudhuri, et al. (1978, 1980) mentioned that specimens from India exhibit a variable number of hairs on 8th tergite of abdomen (2-6) and such variation in chaetotaxy should not warrant formation of a new sub-species, but Hille Ris Lambers (op. cit.) mentions that particularly differences in embryonic chaetotaxy made him consider "*bispina*" group as a subspecies.

The species is widespread in Indian region, being recorded from both Northern and Southern India and infestation on young rice-plant may sometimes be very heavy. In the hill region of Eastern India (*ca.* 200-2700 mm.) these insects infest roots of gramineae, growing in dry sandy to wet clay soil, at depths of 0.88-1.020 cm. throughout the year (Pal, P. K., 1975) ; myrmeocophily is common ; the populations, studied in this region exhibit some variation in the apices of cephalic and marginal hairs (Raychaudhuri, Pal, Ghosh, 1980). The collection of fundatrices of *nigriabdominalis* on *Ulmus* in Uttar Pradesh, were made from epiphyllous, conical, short, bladder-like greenish galls during June, 1978, but so far the alate emigrant from the galls and also sexuales, have not been collected in the region.

Distribution.—Widely distributed except in Europe.

Type.—Types of *nigriabdominalis* Sasaki is probably lost ; Hille Ris Lambers (1968-69) selected Neotype and Neoparatypes from Japanese specimens, which are probably deposited in the collections of Drs. T Tanaka, Utsonomiya, JAPAN and D. Hille Ris Lambers, Bennekom, The Netherlands.

18. ***Tetraneura (Tetraneurella) polychaeta* Hille Ris Lambers**
(Figs. 142-146)

1968-69. *Tetraneura (Tetraneurella) polychaeta* Hille Ris Lambers, D., *Boll. Zool. agr. Bachic.*, Ser II, 9 : 64.

(Material not available for examination; description based after Hille Ris Lambers, 1968-69).

Apterous viviparous females (Fundatrix).—Body 1.68 mm. long. Antennae 3-4-segmented, 0.14 × as long as the body ; antennal hairs sparse. Ultimate rostral segment 0.087 mm. long, acute, with 4 accessory hairs. Wax plates absent. Abdominal dorsum with single marginal, pleural and spinal hair on 1st-5th tergites marginal ones 0.048 mm. long, spinal and pleural ones 0.026-0.035 mm. long ; 7th tergite without any spinal hair. Legs with fore-and mid-tibiae sparsely spinulose apicad ; tarsi smooth.

Colour.—Not recorded.

Alate viviparous female (emigrants from galls).—Body 2.00-3.15 mm. long. Head with about 32-42 hairs, 0.012-0.022 mm. long ; ventral wax glands absent. Antennae 6-segmented, little more than $0.33 \times$ the length of body ; flagellum nearly smooth except at apices of V and whole of VI which are spinulose ; segment I with 5-7 hairs and II with 7-10 hairs ; segment III with 17-18 hairs and with 20-32 secondary rhinaria, segment IV with 5-8 hairs and 3-10 similar rhinaria and segment V with 12-18 hairs and 9-15 similar rhinaria. Ultimate rostral segment 0.10-0.12 mm. long, $0.66 \times$ as long as second segment of hind tarsus and bears 14-18 accessory hairs. Thorax apparently without wax glands. Abdominal dorsum without any wax glands, with dark sclerotic bands on 2nd-5th tergites ; 8th tergite with 2 hairs. Siphunculi absent. Cauda with 2 hairs. Subanal plate with 6-7 long hairs. Legs with tibiae spinulose apically ; hairs on hind tibiae acute, thorny, about 0.016-0.020 mm. long.

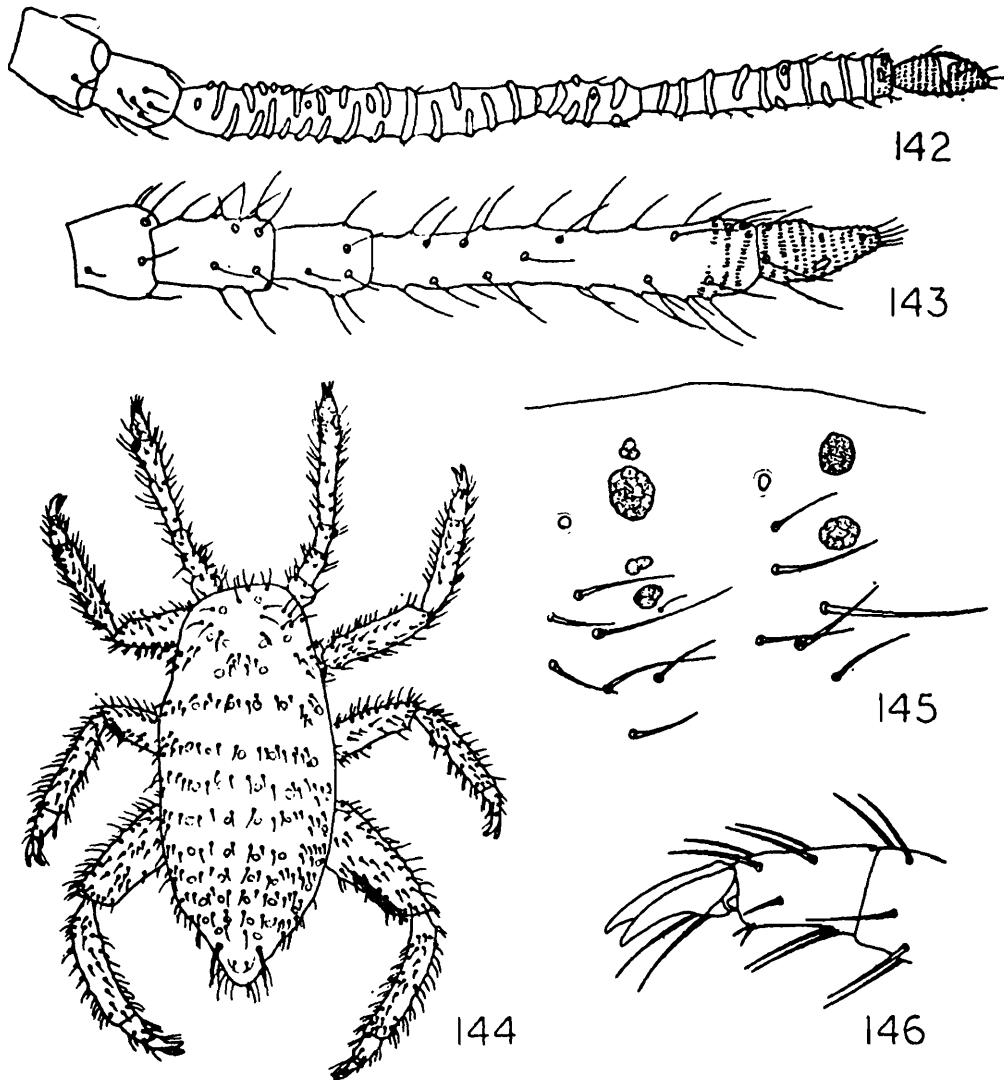
Colour.—Not recorded.

Measurements in mm.—

	Length	Antenna	Antennal segments			
			III	IV	V	VI
1.	3.09	1.07	0.40	0.12	0.27	0.12
2.	2.02	0.78	0.30	0.10	0.19	0.09
3.	1.34	0.73	0.26	0.09	0.18	0.09

(ex galls of *Ulmus villosa*, Balakot, PAKISTAN, 19.4.1967, coll. M. A. Ghani).

Embryos.—Antennae 5-segmented, 0.12 mm. long ; segment I with 4-7 hairs, 0.075 mm. long and a short hair ; II with 10-14 long hairs, III with 5-7, IV with 30-38 and V with 3-4 hairs ; segment IV longest, 0.065 mm. long ; primary rhinaria on V with trifurcate membrane. Ultimate rostral segment 0.20 mm. long, with 14-18 accessory hairs. Abdominal tergites 1st—6th with marginal hairs in a group of 4-7, (0.013-0.060 mm. long) and spinal and pleural hairs in groups of 6, (0.052 mm. long) besides few shorter ones (0.006 mm. long) ; 7th tergite with 3 spinal hairs, 1-2 very



Tetraneura (Tetraneurella) polychaeta Hille Ris Lambers ; Alate viviparous female (emigrant) : 142. antenna.

Apterous viviparous female (3rd generation) : 143. antenna.

First instar larva of apterous viviparous female (3rd generation) : 144. whole body ; 145. ventro-lateral wax gland ; 146. hind tarsus (all from Hille Ris Lambers, 1968-69).

small pleural hairs and 4-5 marginal hairs in each group ; 8th tergite with 2 hairs, 0.10-0.11 mm. long. Abdominal wax glands very variable; in some specimens, spinal, marginal and ventro-lateral wax glands on 2nd-6th tergites, of similar shape and size, roundish, 0.014-0.026 mm. in diameter ; ventro-lateral gland on 1st tergite oval, 0.016×0.042 mm., and often duplicated ; sometimes the surface of glands may appear reticulated, dividing the stippled area into variable number (5-24) of cells; some free wax gland cells may

also be present. Legs with hind tarsal claws symmetrical, 0.085-0.12 mm. long, just, longer than hind tarsal segment ; all tibiae and tarsi smooth.

Alate viviparous female (Sexupara).—Body 2.68 mm. long ; head with 55-60 hairs ; ventral wax glands 0.023×0.015 mm. Antennae 6-segmented, segment I with 3, II with 13-15, III with 18-21, IV with 9-11 and V with 27 (?) hairs ; segment III with 22, IV with 5-6 and V with 28 secondary rhinaria. Ultimate rostral segment 0.22 mm. long, $1.33 \times$ as long as second segment of hind tarsus and bears 12 accessory hairs. Abdominal dorsum with ventro-lateral glands, round or oval, of one stippled cell, 0.015-0.024 mm. in diameter ; hairs on the dorsum of abdomen variable, spinal and pleural ones scarce, 0.013-0.030 mm. long, marginal ones numerous on 1st-5th tergites, all except one (0.060-0.075 mm. long), 0.052-0.065 mm. long, usually bend over basal one third part ; 7th tergite with 2 short spinal and 10-12 marginal hairs ; 8th tergite with 2 long bent hairs. Cauda with 2 hairs. Subanal plate with 6 long hairs.

Measurements in mm.—

Length	Antenna	Antennal segments				urs.	ht ₂
		III	IV	V	VI		
2.68	?	0.30	0.10	0.23	?	0.22	0.16

(ex trap, Yellow Pan, KOREA, 7.10.1963, coll. J. C. Harwell, BMNH 339154).

Discussion.—The long embryonic hind tarsal claws separate this species from other *Ulmus* or Grass feeding *Tetraneura*, and although exules are yet to be found, Hille Ris Lambers (1968-69), assumed that they should have a long ultimate rostral segment with many hairs and very pubescent antennae. The sexupara, although resemble *yezoensis*, show different ratio between antennal segment III and V, different number of rhinaria besides difference in abdominal chaetotaxy. Hille Ris Lambers (op.cit.) mentioned that emigrants measure 2.0-3.15 mm. but include 10 specimens ranging from 1.34-3.09mm.

Distribution.—PAKISTAN ; KOREA.

Types.—In the collections of D. Hille Ris Lambers, Bennekom, The Netherlands.

19. *Tetraneura radicolica* Strand *yezoensis* Matsumura group
(Figs. 147-160 ; 190-196)

1917. *Tetraneura yezoensis* Matsumura, S. A., Collection of essays for Mr. Yasashi Nawa. Gifu, 9 : 73.
 1923. *Tetraneura takahashii* Mordvilko, A., *Compt. Rend. Acad. Sc. USSR.* (A) 8 : 279.
 1929. *Tetraneura radicolica* Strand, E., *Acta Univ. Latviensis*, 20 : 22.
 1961. *Tetraneura heterohirsuta* Carver, M., and Basu, A. N., *Proc. R. ent. Soc. Lond.* (B) 30 : 83 (Partim, Indian specimen).
 1968-69. *Tetraneura heterohirsuta*, Hille Ris Lambers, D., *Boll. Zool. agr. Bachic.*, Ser II, 9 : 68.
 1978. *Tetraneura radicolica*, Raychaudhuri, D. N., Pal, P. K. and Ghosh, M. R., *Entomon*, 3 (2) : 260.
 1980. *Tetraneura radicolica yezoensis*, Raychaudhuri, D. N., Pal, P. K., Ghosh, A. K., *Aphids of North East India and Bhutan*, 432.

Apterous viviparous female (exules).—Body pale brown 2.15-2.90 (3.50 mm.) long with 1.52-1.79 mm. as maximum width. Head brown, sclerotic, bearing a pair of wax plates ; dorsal cephalic hairs numerous, fine, upto 0.040-0.050 mm. long, $0.75-1.25 \times$ as long as the basal diameter of antennal segment III. Antennae brown, slender, usually 5-segmented, sometimes 6-segmented, $0.22-0.26 \times$ as long as the body ; last antennal segment spinulose, rest smooth ; segment I with 4-6 fine hairs, 0.033-0.050 mm. long, II with 10-24 hairs, III with at least 25 hairs and up to 38 hairs, IV with 32-49 hairs and base of V with 3 hairs ; hairs on segment III, 0.016-0.056 mm. long, $0.20-1.21 \times$ as long as the basal diameter of the segment ; primary rhinaria strongly ciliated ; processus terminalis small. Rostrum reaches near hind coxae ; ultimate rostral segment stout, with 15-26 accessory hairs. Dorsum pale brown, membranous, with numerous fine hairs, these on anterior abdominal tergites 0.026-0.083 mm. long, $0.66-1.25 \times$ as long as the basal diameter of antennal segment III ; 7th tergite usually with 1-2 thick, long marginal hairs, 0.100-0.163 mm. long, $1.5-3.8 \times$ as long as the basal diameter of antennal segment III, besides 4 fine marginal hairs and 4-9 spino-pleural hairs ; 8th tergite

usually with 1-2 thick marginal hairs 0.163-0.178 mm. long, 2-5-4.2 \times as long as the basal diameter of antennal segment III besides 4 thick hairs, similar to the marginal ones, in a transverse sclerotic band. Wax plates small, paired, ventro-lateral glands longer than (upto 0.023 \times 0.040 mm.) the spinal ones (0.006 \times 0.015 mm); wax plate cells appear faintly stippled, or partly subdivided. Siphunculi small, with large thick apical flange. Cauda with 2 long thick hairs. Subanal plate with about 10 long thick hairs. Gonapophyses with 9-12 fine hairs on each lobe. Legs thick, stumpy, brown, densely pubescent ; longest hair on hind tibiae 0.043-0.073 mm. long, 0.43-0.68 \times as long as the width at the middle of the tibiae ; empodial hair fine, 0.036-0.040 mm. long, 1.05-1.2 \times as long as the claws.

Colour.—Whitish to yellowish pink in life.

Measurements in mm.—

	Length	Width	Antenna		
1.	2.34	1.58	0.52		
2.	2.18	1.52	0.49		
3.	2.00	1.65	0.52		
4.	2.90	1.79	0.69		
	Antennal segments			urs.	ht ₂
	III	IV	V		
	0.115	0.198	0.066	0.24	0.073
	0.093	0.196	0.050	0.21	0.066
	0.106	0.178	0.053	0.23	0.076
	0.076	0.248	0.060	0.26	0.093

(1, 2, 3, ex Grass, Kalimpong, INDIA, 18.11.1973, 12.2.1974, 28.4.1972 ; coll. P. K. Pal ; 4, ex Grass, Cinnamara, Assam, INDIA, 1.3.1967, BMNH CIE 1564).

Larva (early stage). —Antennae 5-segmented ; segment I with 6 hairs (up to 0.026 mm. long), II with 9 hairs, III with 6 hairs and IV with 20 hairs (up to 0.043 mm. long). Rostrum reaches middle of abdomen ; ultimate rostral segment spinulose, with some short (0.023 mm.) and long (0.050 mm.) accessory hairs besides 6 preapicals ; marginal hairs in group of 10-16, those on anterior tergites

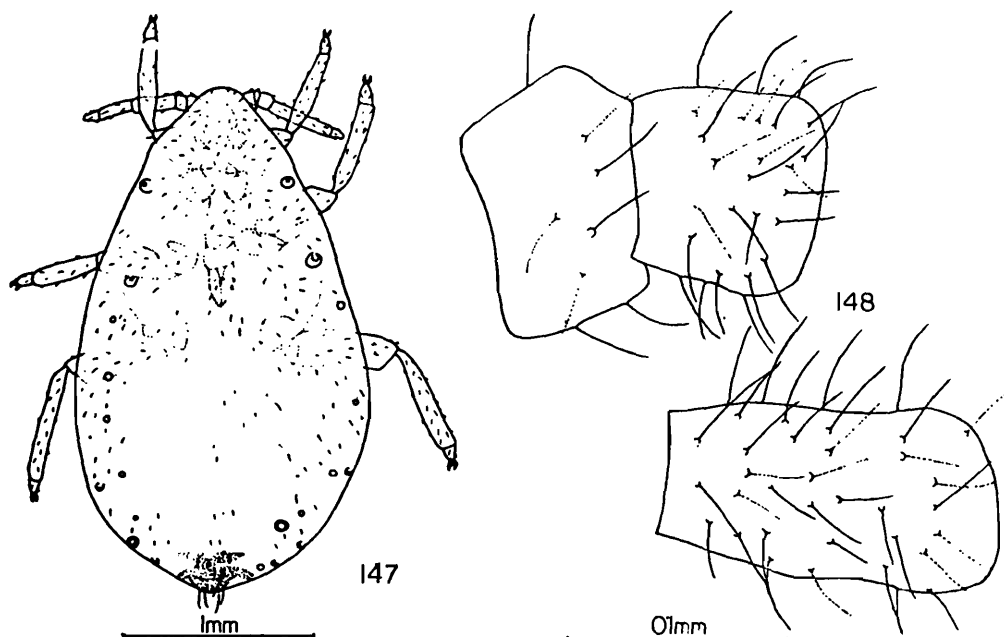
0.023 mm. long, on 6th tergite 0.053 mm. long ; spino-pleural hairs numerous, 0.016-0.030 mm. long ; 7th tergite with about 10 hairs, of which at least two hairs, up to 0.083 mm. long ; 8th tergite with 4 hairs, of which outer ones much thicker, 0.090-0.093 mm. long. Wax glands distinct ; ventro-lateral gland, composed of 1-3 cells with indistinct borders, 0.010-0.020 in diameter. Cauda with 2 hairs. Subanal plate with 5 hairs. Legs with numerous fine hairs ; tarsi spinulose, hind tarsal claws 0.033 mm. long.

Colour.—Not recorded.

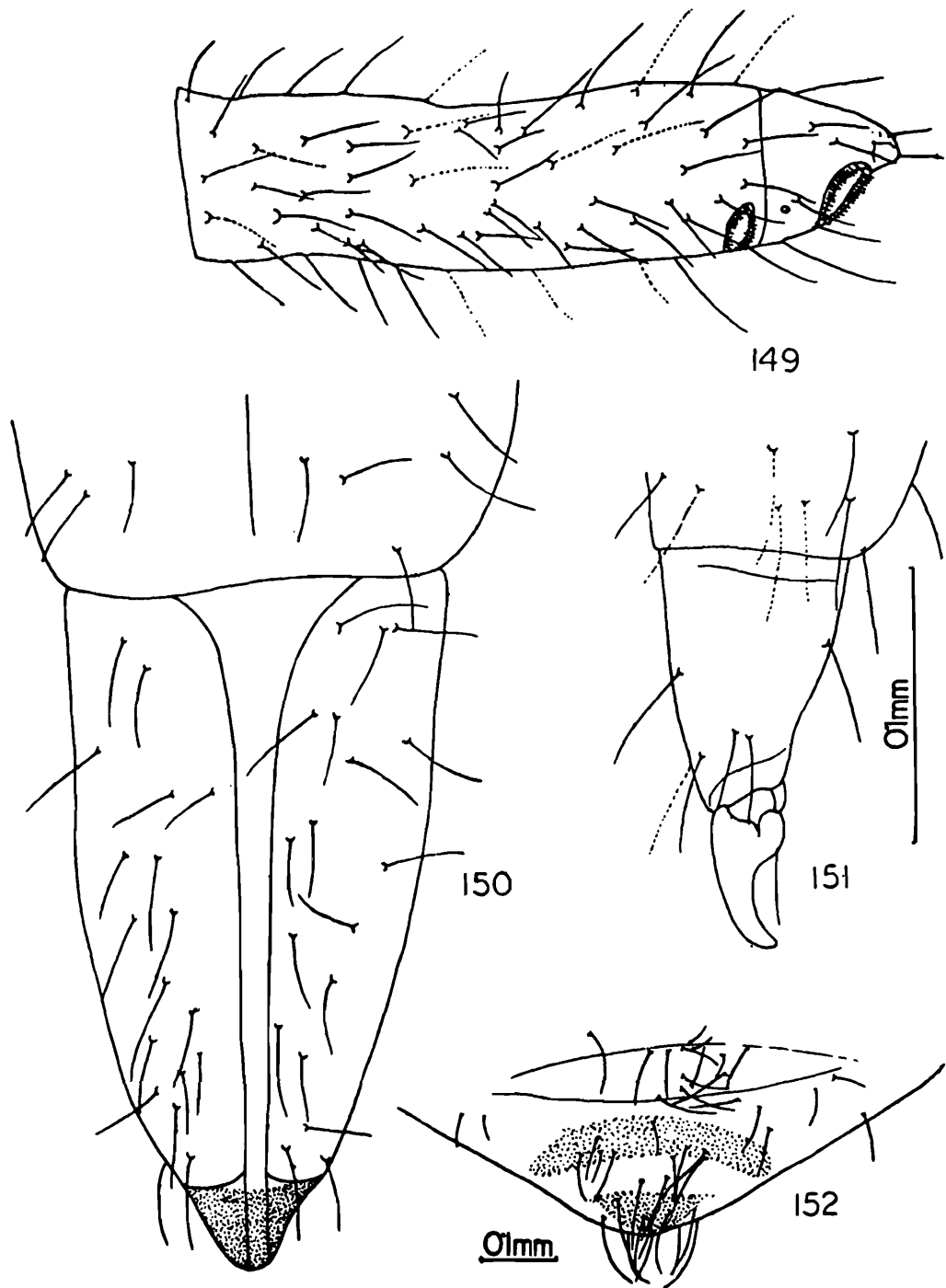
Measurements in mm.—

Length	Width	Antennae			
0.87	0.44	0.23			
		Antennal segments		urs.	ht ₂
		I	II	IV	
		0.046	0.040	0.106	0.046
					0.115
					0.066

(ex Grass, Kalimpong, INDIA, 18.11.1973, coll. P. K. Pal).



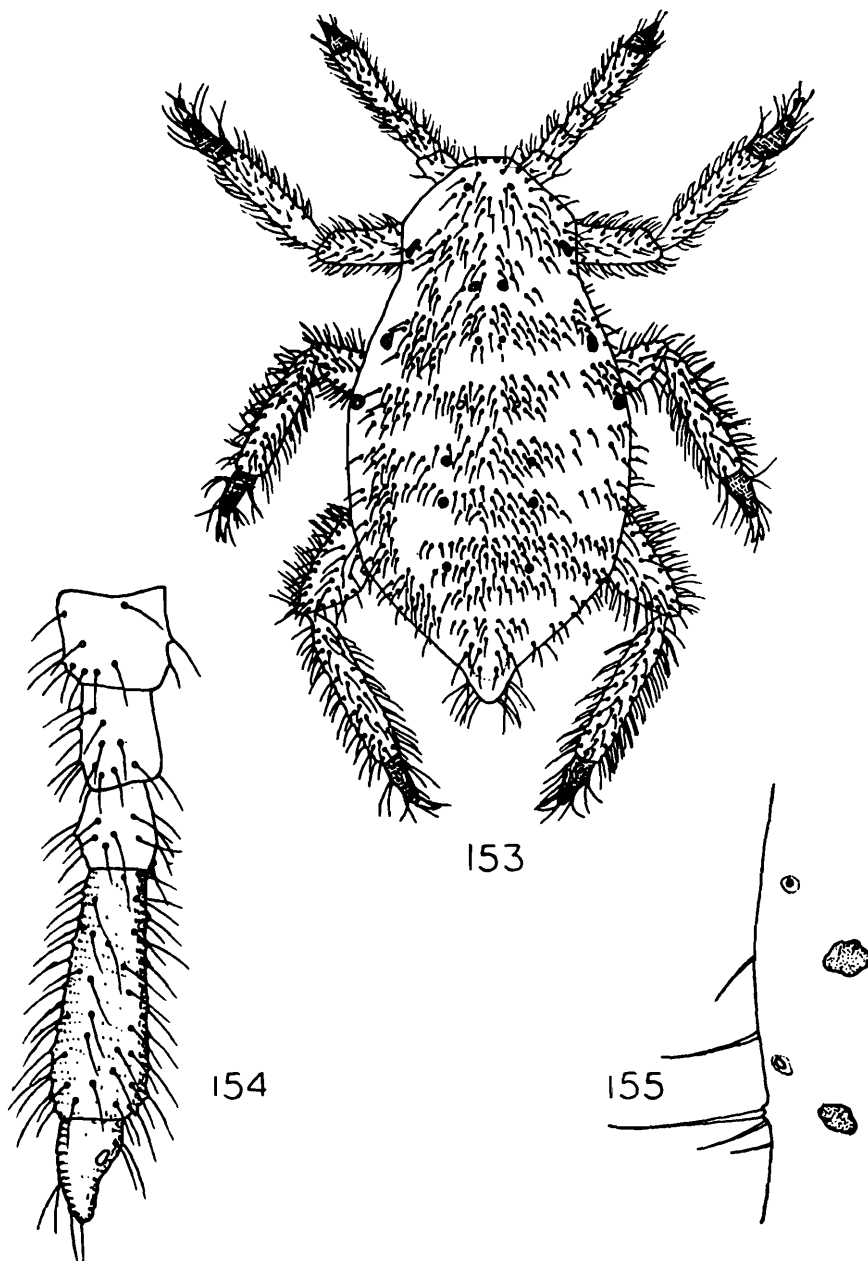
Tetraneura radicolica Strand ; Apterous viviparous female (from roots) :
147. whole body ; 148. antennal segments I, II, III.



Tetraneura radiculicola Strand ; Apterous viviparous female (from roots) :
 149. Antennal segments IV and V ; 150. ultimate rostral segments ; 151.
 hind tarsus ; 152. posterior portion of abdomen.

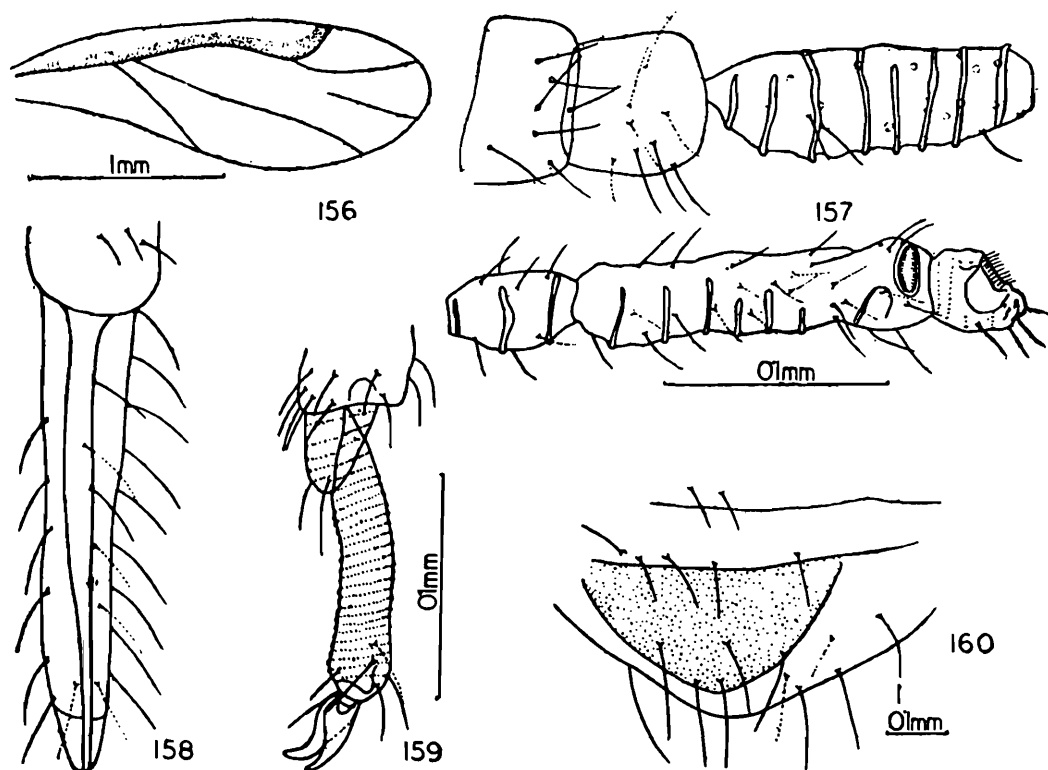
Alate viviparous female (Virginoparae).—Body 1.7-2.4 mm. long. Head dark sclerotic, dorsal cephalic hairs 0.047-0.070 mm. long, 3.2-4.5 \times as long as the basal diameter of antennal segment III. Antennae brown, 6-segmented, about 0.20-0.34 \times as long

as the body ; segment I with 5-8, II with 12-22, III with 17-28, IV with 12-21, V with 37-50 and base of VI with 3, hairs ; longest hair on segment III, 0.040-0.045 mm. long, $2.5-3.2 \times$ as long as the basal diameter of the segment ; flagellum spinulose ; segment III with 6-12, IV with 2-4, V with 6-10 annular, naked, secondary rhinaria. Eyes small. Rostrum reaches at least hind coxae ; ultimate rostral segment $1.3-1.7 \times$ as long as second segment of hind tarsus and bears at least 18-22 accessory hairs. Dorsal hairs fine, on

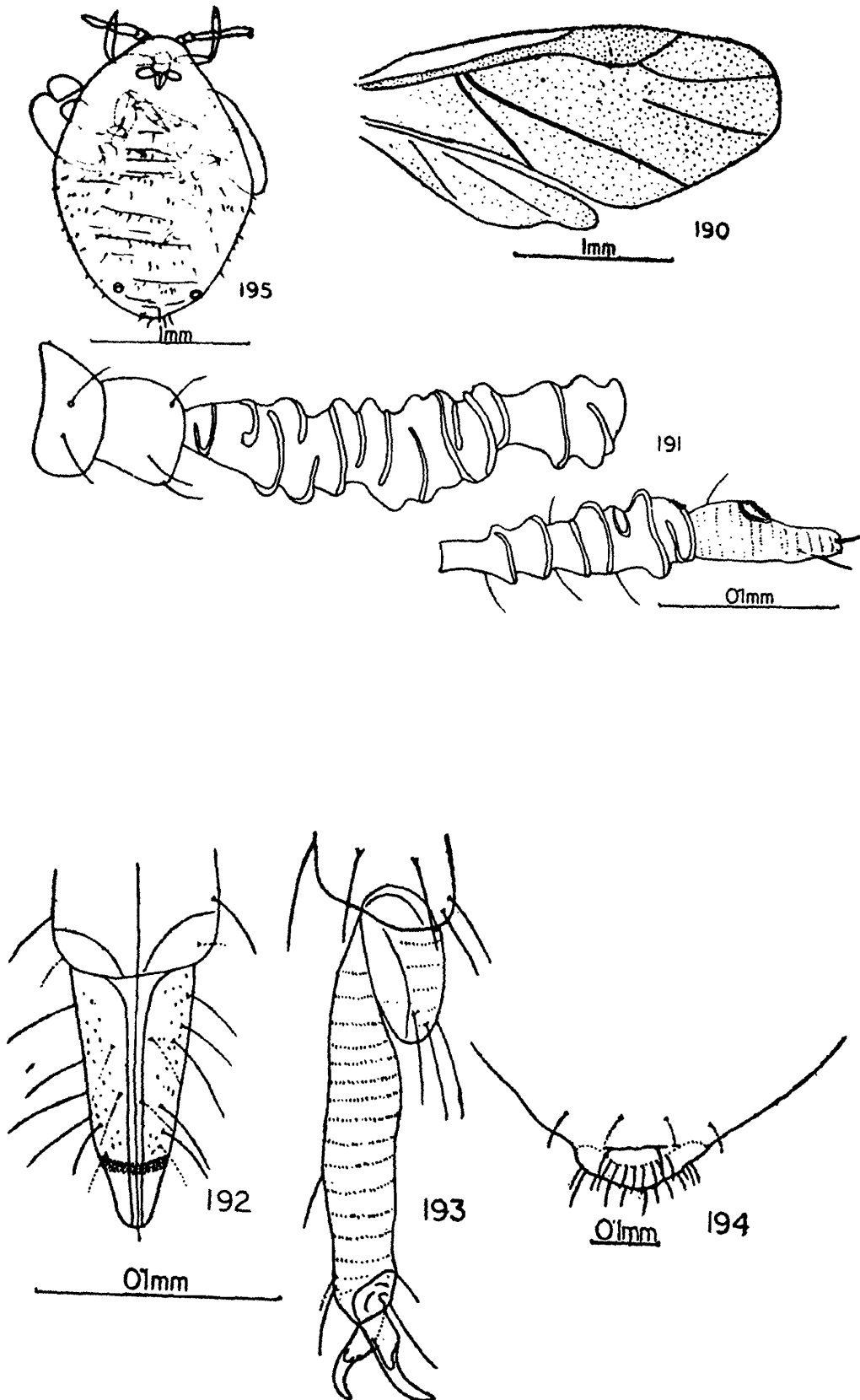


First instar larva of apterous viviparous female :
 153. whole body ; 154. antenna ; 155. ventro lateral wax gland on abdomen.

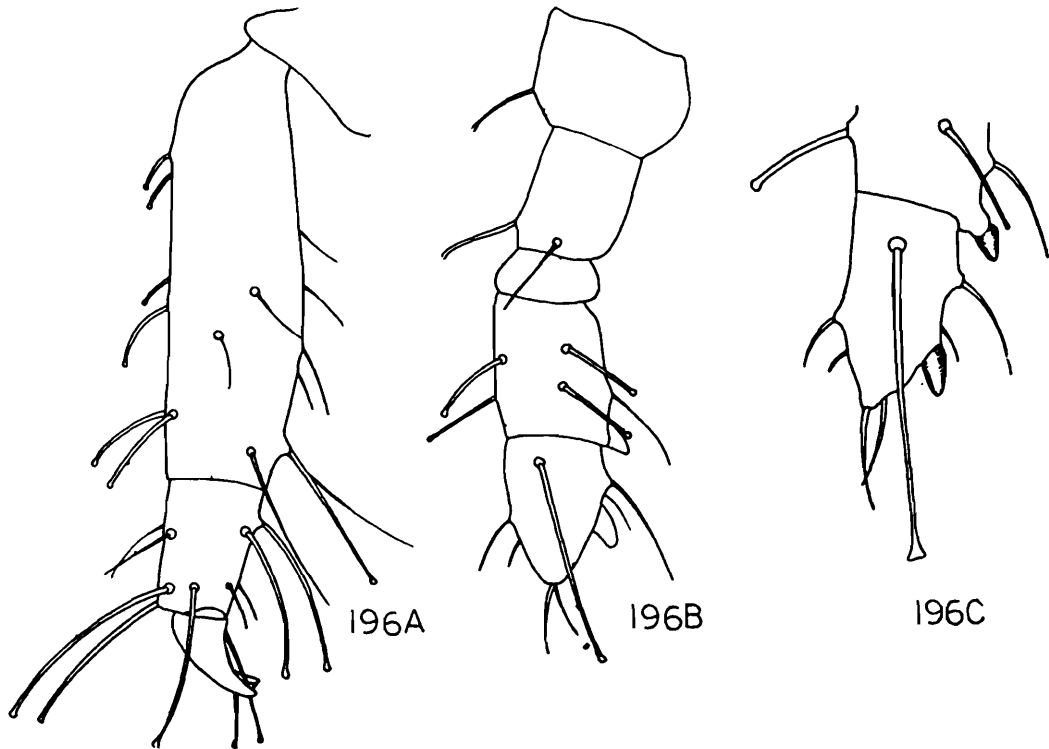
anterior tergites upto 0.050-0.056 mm. long, $3.0-3.7 \times$ as long as the basal diameter of antennal segment III, on posterior tergites, upto 0.090 mm. long, and $6.0 \times$ as long as the mentioned diameter ; marginal hairs in groups, numerous ; 7th tergite with at least one long marginal hair, exceeding 0.110-0.113mm. besides a few shorter spino-pleural ones ; 8th tergite with 4 hairs, of which the marginals much longer and thicker, 0.100-0.0160mm. long, and $6.5-9.0 \times$ as long as the mentioned diameter. Vento-lateral wax plate distinct, composed of many indistinct cells. Siphunculi conspicuous. Cauda with 2 thick hairs. Legs with apices of tibiae and whole of tarsi spinulose ; hairs on femora and tibiae fine ; first tarsal segments with 4,4,2 hairs ; empodial hair 0.026 mm. long, nearly equal to the claws. Forewings with media basally obsolete, hind wings with one faint oblique vein.



Alate viviparous female (from roots) : 156. forewing ; 157. antenna ; 158. ultimate rostral segments ; 159. hind tarsus ; 160. posterior portion of abdomen.



Tetraneura yezoensis Matsumusa ; Alate viviparous female : 190. wings ; 191. antenna ; 192. ultimate rostral segments ; 193. hind tarsus ; 194. posterior portion of abdomen ; 195. nymph.



First instar larva : 196A. hind leg ; 196B. antenna ; 196C. apex of antenna (all from Hille Ris Lambers, 1968-69).

Colour.—Dirty yellow with head, thorax and appendages dark in life.

Measurements in mm.—

	Length	Width	Antenna		
1.	1.95	0.87	0.50		
2.	2.34	0.96	0.69		
3.	2.28	1.10	0.72		
4.	1.95	0.82	0.65		
5.	2.38	1.28	0.73		
	Antennal segments			urs.	ht ₂
III	IV	V	VI		
0.18	0.07	0.22	0.06	0.19	0.14
0.20	0.08	0.22	0.05	0.20	0.15
0.20	0.08	0.22	0.06	0.20	0.15
0.18	0.06	0.21	0.05	0.20	0.14
0.19	0.08	0.23	0.05	0.22	0.15

(ex 1, roots *Triticum vulgare*, Munsung, Darjeeling district,

West Bengal, 16.12.1971 (K 5182) ; 2-4, Yellow Pan Trap, Munsung, Tindharia, Darjeeling District, West Bengal, INDIA, 14.5.1972—24.5.72, coll. P. K. Pal).

Material examined.—Several apterous viviparous females (exules), 12 alate virginoparae and nymphs from many unidentified species of grass and other Gramineous hosts and in yellow Pan Water traps, from localities around Kalimpong, Kurseong and Darjeeling, West Bengal, INDIA, 12.2.1972 to 18.11.1973, colls. P. K. Pal (Calcutta University collections) ; 5 apterous exules and nymphs from unidentified grass, Kangchup, Manipur, INDIA, 4.4.1974 (Calcutta University collections).

Discussion.—Eastop (1966) while discussing *heterohirsuta* Carver and Basu from Australia, mentioned that it is possible that there is only one species, *radicicola* Strand, in this group, which changes on different host plants and in different climatic condition. Hille Ris Lambers (1967) mentioned that *radicicola* Strand might be the same as *yezoensis* Mats. Later, Hille Ris Lambers (1968-69) treated *radicicola* Strand 1929, as a distinct species to which Indian material of *heterohirsuta* should belong, while the Australian material of *heterohirsuta* was considered by him as under *yezoensis* Matsumura, 1917 ; he provided key to separate *radicicola* and *yezoensis* basing on chaetotaxy of abdomen, antennal segment III and ultimate rostral segment in embryos, from emigrants (gall forming) and virginoparous exules ; apterous exules were separated on the basis of number of hairs on antennal segment IV and alate sexuparae on the basis of chaetotaxy of rostrum and posterior tergites and by the number of secondary rhinaria on antennal segment III. Large number of specimens collected in Darjeeling district, West Bengal provided an extremely interesting picture, when a complete gradation of chaetotaxy, in both apterae and alatae, collected during the months of November to April, on various secondary hosts, could be noted and this had led Raychaudhuri, Pal, Ghosh, M. R. (1978) and Raychaudhuri, Pal, Ghosh, A. K. (1980) to treat these specimens under “*radicicola/yezoensis* group”. It may be mentioned that even within the same population, larvae with fewer rostral hairs (12) or more hairs (20), with siphunculi and without siphunculi etc. could be noted. Alate emigrants or sexuparae for *radicicola/yezoensis* were not available

from the present study area, both of which (according to Hille Ris Lambers, 1968-69) form galls on *Ulmus davidiana* var. *japonica*. In order to avoid confusion in identification, and considering the extreme variability of chaetotaxy of both apterous exules, and their embryos and alate virginoparae collected in the region, the earlier decision of treating the Indian material under "*radicicola/yezoensis*" is maintained, although the apterae and alatae appear much closer to *radicicola* [Table 1, 2 ; data under *radicicola* and *yezoensis* are from Hille Ris Lambers (1968-69).]

TABLE—3.

Apterae (exules).—

	<i>radicicola</i>	<i>yezoensis</i>	<i>Indian material</i>
Body length	: 2.0—3.55 mm.	2.0—2.4 mm.	2.15—2.55 mm.
Antennae	I : 5—7	5—6	5—8
hairs	II : 16—26	9—14	16—24
	III : 40—45	16—21	25—38
	IV : 37—60	18—27	32—49
	V : 2+1	2—3+1	3+1
Hairs on 7th tergite marginal	: 7—13	2+12—16	4+1
spinopleural	: 8—14	2+2—6	4—9
Hairs on 8th tergite	: 4—8	4	2—4
urs.	: 0.20—0.25	0.22	0.23
Accessory hairs on urs.	: 18—30	16—18	15—26
Dorsal hairs			
a) On anterior tergites	: 0.050—0.080	0.09—0.10	0.026—0.083
b) marginals			
Wax glands	: 0.150—0.200	0.220	0.100—0.178
a) ventrolateral	: 0.048 × 0.022	0.030	0.040 × 0.023
b) spinal	: 0.015	0.009—0.006	0.006—0.015
Subanal plate hairs	: 12—14	8	10

TABLE—4.

Alate virginoparae.—

	<i>radicicola</i>	<i>yezoensis</i>	<i>Indian material</i>
Body length	: 2.0—2.40	1.90—2.70	1.75—2.15
Cephalic hairs	: 0.040—0.052	0.021—0.035	0.048—0.068
Antennal hairs and secondary rhinaria	I : 6—9 ; 0 II : 15—24 ; 0 III : 13—24 ; 8—12 IV : 11—19 ; 2—3 V : 40—65 ; 9—14	3—6 ; 0 11—15 ; 0 12—20 ; 9—14 6—11 ; 3—5 19—32 ; 7—12	5—8 ; 0 12—22 ; 0 17—28 ; 6—12 12—21 ; 2—4 39—51 ; 6—10
urs.	: 0.21—0.23	0.19—0.23	0.19
Accessory hairs on urs.	: 24—33	14—21	15—26
urs./ht ₂	: 1.5 ×	1.5 ×	1.3—1.7 ×
wax gland	: many celled	one celled ; ventro lateral	many celled
marginal hairs	: large group, few, upto 0.15 0.080		numerous
hairs on 7th tergite	: 6—8, 0.095—0.120 ?		0.056—0.113
hairs on 8th tergite	: 4—6	2—4	4
tibial hairs	: 0.060	0.045	?

Gall forming specimens are unknown in the Indian region but Hille Ris Lambers (1968-69) has given detailed description of alate emigrants, embryos of emigrants, embryos of alate virginoparae of *radicicola* and fundatrix, larvae of fundatrix, alate emigrant and embryos of emigrant of *yezoensis*, besides the morphs described here (for both the species) and these extensive descriptions should help to identify species of this complex.

Exules of this group have been found throughout the year and alate during summer to middle of winter, in Darjeeling district, between 400-2700 m. ; colonies may be small to very big on the roots of a host of gramineae, growing in dry sandy to moist clay loam soil; myrmecophyly is common. The host plants on which these have been collected include *Brachicaria ramosa*, *Capillipidium* sp., *Eichonchola crusgalli*, *Eleusine coracana*, *Eragrostis gangetica*, *E. tenella*, *Imperata arundinacea*, *T. cylindrica*, *Polypogon fugax*, *Triticum vulgare* and *Setaria galuca*.

Distribution : INDIA (West Bengal, Assam, Manipur), NEPAL, SRI LANKA, MALAYA, JAPAN, TAIWAN, PHILLIPINES, AUSTRALIA, U.S.A.

Types : According to Hille Ris Lambers (op. cit) types of *radicicola* Strand, if has been selected, is in the collections of Taiwan Agricultural Research Institute, Taipei, Taiwan and those of *yezoensis* Matsumera, are probably lost.

20. ***Tetraneura sikkimensis*** Raychaudhuri, Pal, Ghosh, M. R.
(Figs. 161-165.)

1978. *Tetraneura sikkimensis* Raychaudhuri, D. N., Pal, P. K. and Ghosh, M. R., *Entomon*, 3 (2) :262.

1980. *Tetraneura sikkimensis*, Raychaudhuri, D. N., Pal, P. K. and Ghosh, A. K., *Aphids of North East India and Bhutan*, 433.

Apterous viviparous females : Body pale, globular 1.85-2.17 mm. (1.85-1.90 mm.) long with 1.26-1.52 mm. as maximum width. Head pale, brownish, smooth without any apparent wax plates, dorsal cephalic hairs fine, arising from high sockets, 0.03-0.046 mm. long, $1.3-1.5 \times (2.6-2.7 \times)$ as long as the basal diameter of antennal segment III. Antennae brownish, 5 segmented, $0.18-0.23 \times$ as long as the body ; flagellum sparsely spinulose ; hairs on antennal segment I : 4-5, II : 7-8, III : 9-11 (12-16), IV : 18-24 (30), V : 2-3, on segment III. 0.026-0.053 mm. long, $0.66-1.55 \times$ (upto $2.0-3.10 \times$) as long as the basal diameter of the segment ; primary rhinaria round to oval, ciliated, processus terminalis $0.65-0.70 \times (0.40-0.65 \times)$ as long as the base of last antennal segment. Rostrum very stout, reaches hind coxae ; ultimate rostral segment darker at apex, spinulose, $2.5-3.0 \times (3.40-4.75 \times)$ as long as hind tarsus and bears about 12 accessory hairs besides preapicals. Dorsal

hairs fine, numerous on thoracic and abdominal segments, mostly erect, a few flagellate ; on anterior abdominal tergites, 0.040-0.100 mm. long, 1.20-3.0 \times as long as the basal diameter of antennal segment III ; 7th tergite with about 14 hairs, marginals being longest, up to 0.124 mm. long, 3.16 \times as long as the mentioned diameter ; 8th tergite with 2 very long thick hairs and 2 finer hairs, upto 0.146-0.149 mm. long, 5.0-5.2 \times as long as the mentioned diameter ; wax plates small, composed of diffused cells, paired, placed pleurally from mesothorax to 7th abdominal tergite, sometimes single celled gland, in pair, may be seen on 1st-2nd abdominal tergites. Siphunculi with large chitinised rims. Cauda small, brown spinulose with 2 hairs (6 hairs). Subanal plate with 4 hairs, outer ones being much thicker and longer (0.115 mm.) than inner ones (0.066 mm.). Gonapophyses with 8-10 hairs in each lobes. Legs pale brown, trochanters nearly fused with femora ; hairs on femora and tibiae numerous, fine, thin, longest one on hind tibiae, 0.046-0.066 mm. long, 0.69-0.85 \times as long as the diameter at the middle of the tibiae ; empodial hair 0.030 mm. long, equal to the claws.

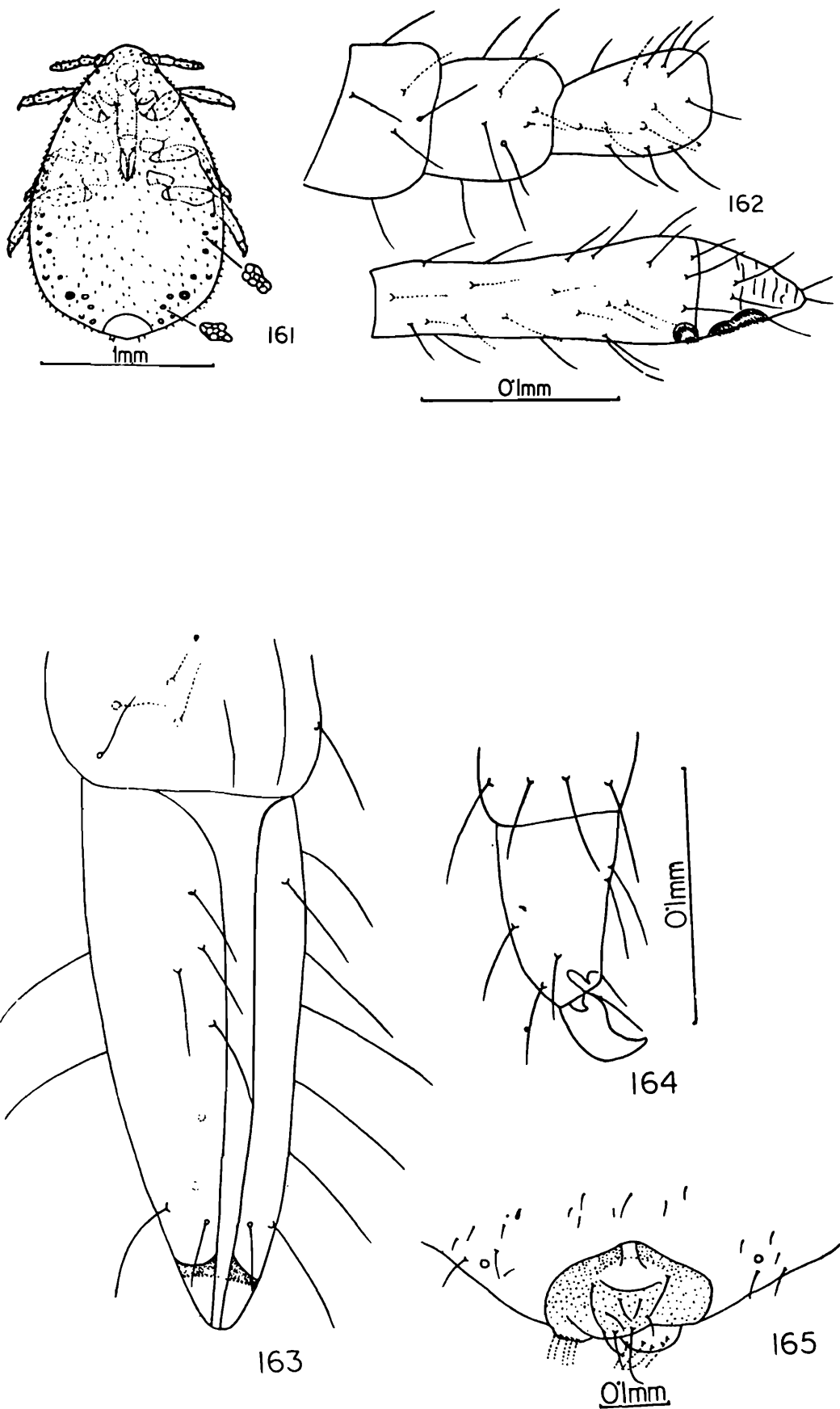
Colour.—Yellowish white in life.

Measurements in mm.—

	Length	Width	Antenna		
1.	1.87	1.26	0.44		
2.	2.17	1.52	0.45		
3.	1.87	1.38	0.38		
	Antennal segments			urs.	ht ₂
	III	IV	V		
	0.08	0.16	0.060	0.20	0.066
	0.10	0.16	0.056	0.20	0.066
	0.07	0.13	0.053	0.17	0.060

(1, 2, 3, ex *Eragrostis nigra*, Geyzing, Sikkim, 22.4.1972, coll. P. K. Pal).

Embryos (of exules) : Tarsal claws of all legs similar, 0.030-0.033 mm. long.



Tetraneura sikkimensis Raychaudhuri, Pal, M. R. Ghosh ; Apterous viviparous female (from roots) : 161. whole body ; 162. antenna ; 163. ultimate rostral segments ; 164. hind tarsus ; 165. posterior portion of abdomen.

Nymph (Early stage) : Body pale 0.80-0.82 mm. long with 0.41 mm. as maximum width. Dorsal hairs numerous, fine, on head, 0.040-0.050 mm. long, 1.2-1.5 \times as long as the basal diameter of antennal segment III. Antennae stout, 5 segmented, with segment IV longest, and V appearing as a club, distinctly spinulose in IV and V ; hairs on flagellum fine, dense, longest one on segment III, 0.046-0.050 mm. long, 1.4-1.5 \times as long as the basal diameter of the segment ; primary rhinaria ciliated ; processus terminalis sharply conical with long apical setae (0.030 mm.), 0.50 \times as long as the base of last antennal segment. Rostrum reaches middle of abdomen ; ultimate rostral segment slender, 0.164-0.190 mm. long, densely spinulose, with 12-14 accessory hairs. Abdominal dorsum pale ; hairs on the dorsum fine, numerous, on anterior tergites, 0.060 mm. long, on 7th, 0.083 mm. long and on 8th 0.115 mm. long, these being 1.5 \times , 2.0 \times and 3.0 \times as long as the basal diameter of antennal segment III, respectively ; 8th tergite with a sclerotic band, bearing 2 long and 2 shorter hairs ; paired pleural wax plates present on 1st-7th tergites. Siphuncular pore not discernible. Legs with many fine hairs ; apices of tibiae and whole of tarsi spinulose ; longest hair on hind tibiae 0.043 mm. long, 0.76 \times as long as the diameter at the middle of the tibiae ; empodial hair 0.020 mm. long, equal to the claws.

Colour.—Pale yellowish white.

Measurements in mm.—

Length	Width	Antenna	Antennal segments			urs.	ht ₂
			III	IV	V		
0.82	0.41	0.29	0.07	0.026	0.043	0.107	0.080

(ex *Eragrostris nigra*, Geyzing, Sikkim, 22.4.1972, coll. P. K. Pal, Calcutta University collections).

Material examined.—Four apterous viviparous females (exules) and 5 nymphs from *Eragrostris nigra*, Geyzing, Sikkim, 22.4.1972, coll. P. K. Pal (No. SK 58, Paratypes, Calcutta University collections).

Discussion The species belongs to *Tetraneura* s. s., on the basis of embryonic tarsal claws ; of the species under *Tetraneura* s. s., it comes closest to *radicicola* Strand and *yezoensis* Matsumura, having very fine, uniformly distributed dorsal hairs on 1st-5th abdominal tergites, but differs in having longer hairs, in the absence of conspicuously thicker marginal hairs and in having much fewer hairs on antennal segment III, of 5-segmented antennae. These insects form large colonies on the roots at depth of 3.0-4.0 cm. in semimoist sandy loam soil and secrete wax which cover their entire body ; ants are associated with these insects (Pal, P. K., 1975).

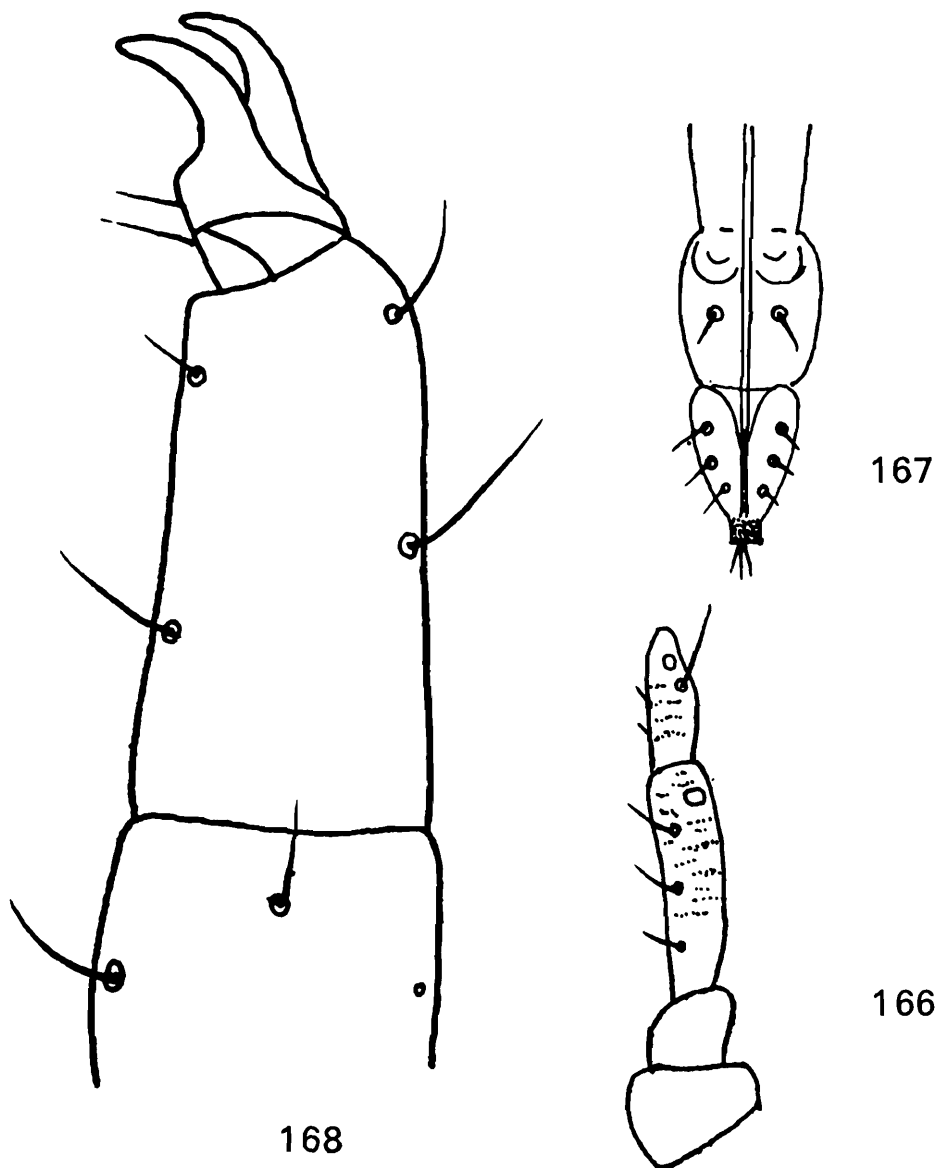
Distribution : INDIA ; Sikkim (ca. 1800 m.).

Types : In the Entomology Laboratory, Department of Zoology, University of Calcutta, India.

21. *Tetraneura ulmi* Linnaeus (Figs. 166-184)

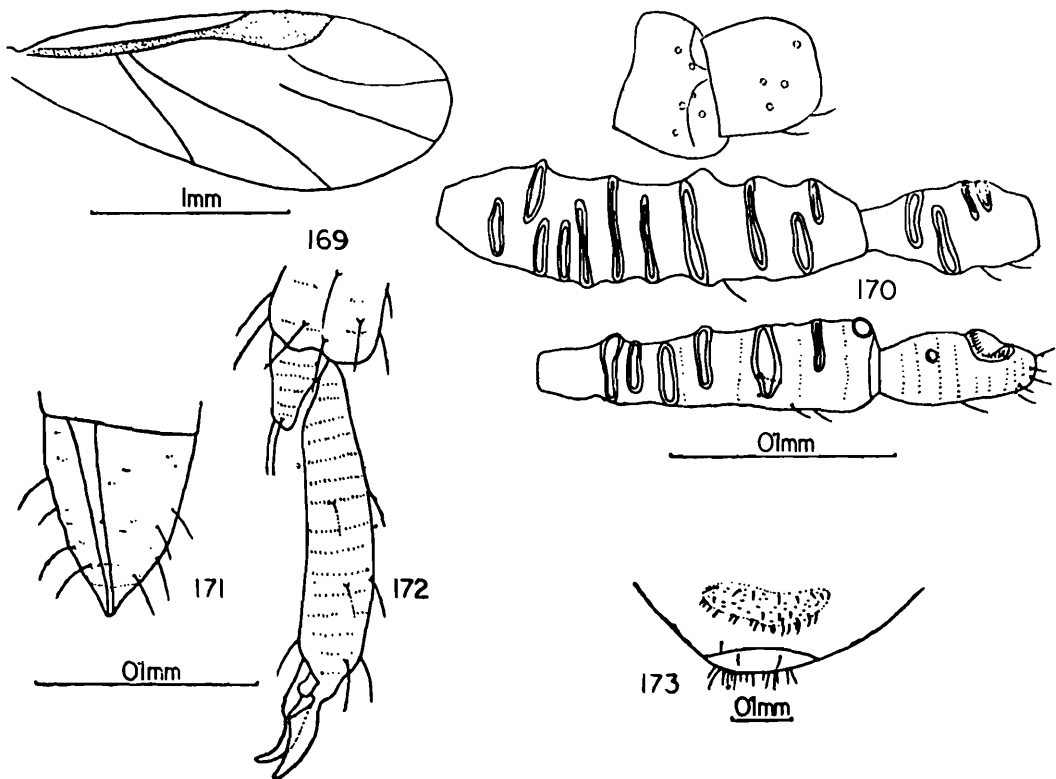
1758. *Aphis ulmi* Linnaeus, C., *Syst. nat.*, 10 : 738.
 1790. *Aphis gallarum*, Gmelin, J. F., *Caroli a Linne Systema Naturae per Regna. tria Naturae* etc. ed. XII, 2201.
 1838. *Eriosoma ulmi-gallarum* Haliday, A. H., *Ann. Mag. nat. Hist.*, 2 : 189.
 1841. *Tetraneura ulmi*, Hartig Th., *Germars' Z. ent.*, 3 : 366.
 1856. *Pemphigus boyeri* Passerini G., *Gli Insetti, Giornale Gairdini*, 3 : 262.
 1857. *Amycla fuscifrons* Koch, C. L., *Pflanz Aphiden*, 3 : 30 (?)
 1857. *Endeis helle* Koch, C. L., *Pflanz. Aphiden.*, 301.
 1857. *Endeis rosae* Koch, C. L., *Pflanz. Aphiden.*, 313.
 1909. *Tetraneura ulmi*, Tullgren. A., *Ark. zool.*, 5 : 171.
 1910. *Tetraneura ulmisaculi* Patch, E. M., *Bull. Maine Agric. Expt. Stn.*, 181 : 216.
 1920. *Tetraneura ulmifoliae* Baker, A. C., *U. S. Dep. Agric. Farmers Bull.*, 1128 : 68.
 1950. *Brysocrypta personata* Börner, C., *Neue europaeische Blattlausarten*, Numburg, 17.
 1952. *Colopha ulmisaculi*, Palmer, M., *Aphids of the Rocky Mountain Region*, 348.
 1958. *Tetraneura theobaldi*, Zwölfer, H., *Z. angew. Ent.*, 40 (4) : 543.
 1968-69. *Tetraneura ulmi*, Hille Ris Lambers D., *Boll. Zool. agr. Bachie Ser.*, II, 9 : 75.
 1976. *Tetraneura ulmi*, Eastop V.F. and Hille Ris Lambers, D., *Survey of the World's Aphids*, The Hauge, 419 (Synonymy).

Apterous viviparous female (Fundatrix) : Body large, globular 2.48-2.7 mm. (1.90-2.10 mm., H.R.L.) long, with 1.93 mm. as



Tetraneura ulmi Linnaeus ; Apterous viviparous female (Fundatrix) :
 166. antenna ; 167. ultimate rostral segments ; 168. hind tarsus.

maximum width. Head dark sclerotic ; dorsal cephalic hairs stiff, with acuminate apices, 0.016 mm. long. Antennae thin, 4 (3-4)-segmented, 0.09-0.10 \times as long as the body ; segment I and II subequal, segment III longest, subequal to IV+V together ; hairs on flagellum sparse, on segment III, 0.013-0.016 mm. long, 0.4-0.5 \times as long as the basal diameter of the segment ; primary rhinaria minute. Rostrum hardly reaches mid-coxae ; ultimate rostral segment with 4 accessory hairs. Abdominal dorsum pale with segmental divisions distinct ; hairs on the dorsum of abdomen



Alate viviparous female (emigrant): 169. forewing; 170. antenna; 171. ultimate rostral segments; 172. hind tarsus; 173. posterior portion of abdomen.

sparse, on anterior tergites, 0.016-0.026 mm. long, on posterior tergites upto 0.033 mm. long, these being 0.55-1.0 \times and 1.1 \times as long as the basal diameter of antennal segment III, respectively; 7th tergite with 4 and 8th tergite with 2 hairs. Wax plate absent. Siphunculi absent. Subgenital plate with about 18-21 hairs. Subanal plate with 16 long thick hairs. Legs short stumpy; tibiae and tarsi thin, hairs on the hind tibiae up to 0.016 mm. long, 0.45 \times as long as the diameter at the middle of the tibiae.

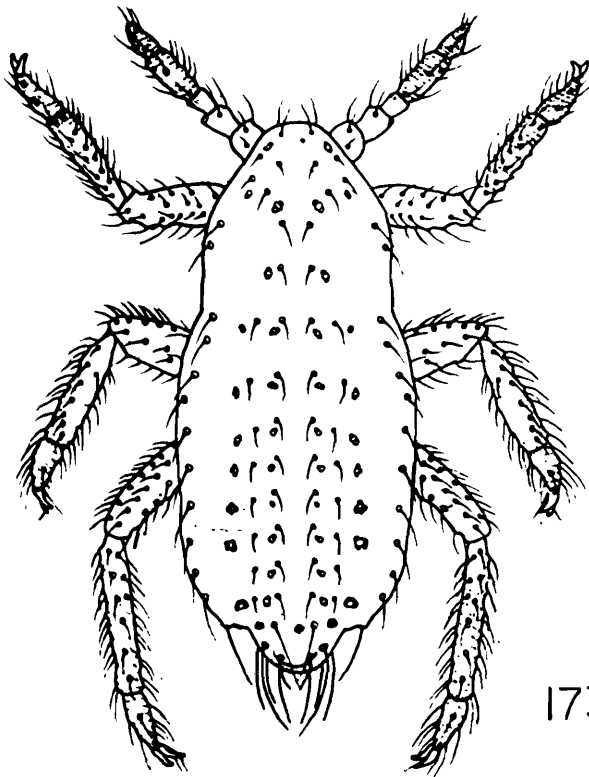
Colour : Light olive green.

Measurements in mm. :

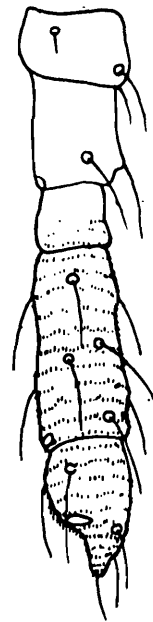
	Length	Width	Antenna
1.	2.48	1.93	0.24
2.	2.70	1.93	0.24

Antennal segments					urs.
I	II	III	IV	V	
0.04	0.03	0.08	0.04	0.04	0.10
0.04	0.03	0.07	0.05	0.04	0.10

(1, 2, ex. *Ulmus* galls, Kashmir, INDIA, 22.5.1979, coll. S. Chakrabarti).



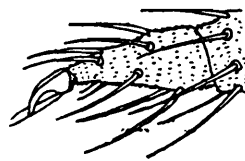
173A



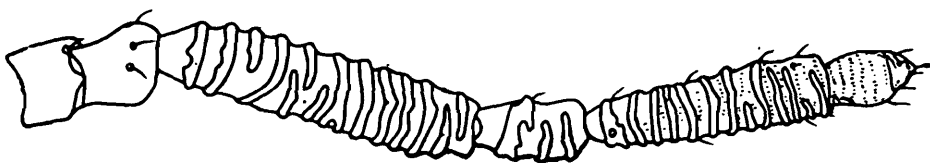
174



175



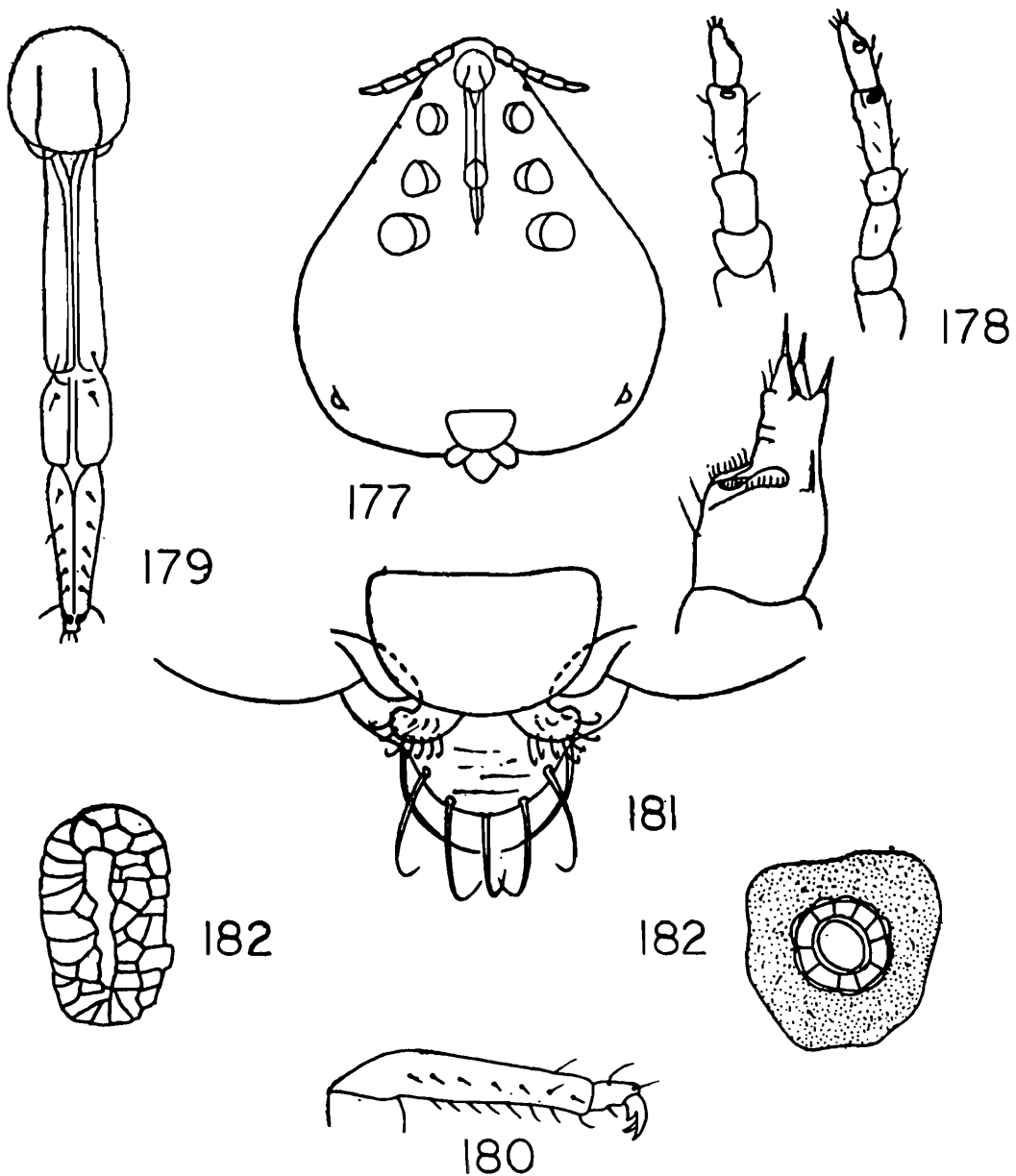
176



183

First instar larva of 3rd generation : 173A. whole body ; 174. antenna ;
175. ventro lateral wax gland on abdomen ; 176. hind tarsus (all from
Hille Ris Lambers, 1968-69).

Alate sexuparous female : 183. antenna ;



Apterous viviparous female (virginogenia) : 177. whole body ; 178. antenna ; 179. rostrum ; 180. hind leg ; 181. posterior part of abdomen ; 182 wax glands (all from Tullgren, 1909).

Alate viviparous female (emigrant from galls) : Body 1.9-2.03 mm. long, with 0.87-0.96 mm. as maximum width. Head dark sclerotic, dorsal cephalic hairs minute, 0.010-0.013 mm. long ; wax glands not discernible. Antennae 6-segmented, 0.28-0.30 \times as long as the body ; segment I with 3-4, II with 5-6, III with 7-9, IV with 4-5, V with 7-8 hairs, those on III 0.010-0.013 mm. long, 0.60-1.0 \times as long as the diameter at the constricted base of the segment ; segment III with 9-11, IV with 2-3, V with 5-6 secondary rhinaria, those on III and IV mostly spread over entire width, primary rhinaria irregular, ciliated. Rostrum hardly reaches mid-

coxae ; ultimate rostral segment hardly $0.60 \times$ as long as second segment of hind tarsus, with few spinules and 6 accessory hairs besides preapicals. Wax glands distinct on meso— and metathorax and 1st-6th abdominal tergites, arranged in marginal, pleural and spinal groups, the marginal ones 0.026×0.023 mm., spinal ones 0.013×0.010 mm., each gland being composed of a number of pale cells around a central space, which may be encroached upon by peripheral cells ; 7th tergite with paired, marginal and spinal wax plates. Dorsal chaetotaxy hardly clear due to excessive number of nymphs within the abdomen ; hairs on 8th tergite, 0.05-0.06 mm. (Zwölfer, 1957). Siphunculi not discernible. Stigmata on sclerotic plates. Cauda small, sclerotic with 2-3 hairs. Subanal plate with 6 (?) long hairs. Gonapophyses with 12-14 fine hairs. Legs brown to dark brown, paler on basal portion of femora ; hairs on femora and tibiae small, longest one on hind tibiae, 0.023-0.030 mm. long, $0.70-0.90 \times$ as long as the diameter at the middle of the tibiae ; apices of tibiae and whole of tarsi spinulose ; empodial hair 0.040 mm. long, $0.80-0.90 \times$ as long as the claws. Wings with very pale venation.

Colour : Head, thorax, appendages black with blackish green abdomen (Zwölfer, 1957).

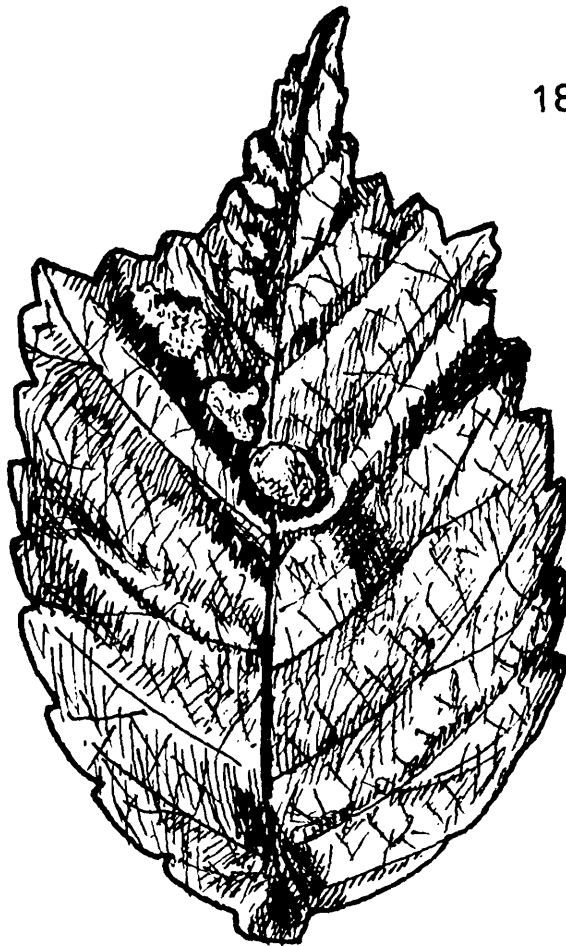
Measurements in mm. :

	Length	Width	Antenna			
1.	2.03	0.87	0.62			
2.	1.99	0.96	0.59			
	Antennal segments				urs.	ht ₂
	III	IV	V	VI		
	0.18	0.08	0.16	0.08	0.083	0.146
	0.20	0.07	0.16	0.08	0.083	0.146

(ex. *Ulmus* sp. galls, Kashmir, INDIA, 22.5.1979, coll. S. Chakrabarti)



184



Galls : 184. on Ulmus leaf.

Embryos of Larva (after Hille Ris Lambers, 1968-69) : Antennae 5-segmented, last two segments spinulose ; segment I with 4 hairs, II with 2, III with 0, IV with 8-11, long hairs. Ultimate rostral segment 0.14-0.15 mm. long with 8 accessory hairs. Abdominal tergites 1st-5th with 6 hairs, of which marginal pair longest, 0.045-0.12 mm., but marginal and spinal hairs highly variable ; 7th tergite with 4 and 8th tergite with 2 long hairs. Wax glands as in apterous exules, those on 7th with cells elongated. Legs with tibiae, distally, and tarsi spinulose ; hind tarsal claws 0.030-0.038 mm. long.

Other morphs : (Not recorded on India, after Zwölfer, 1957, Hille Ris Lambers, 1968-69).

Apterous viviparous females (exules) : Body 1.90-3.00 mm. long, with 1.15-2.45 mm. as maximum width. Antennae 5-6-segmented, 0.16-0.30 × as long as the body ; flagellum smooth or spinulose apically ; segment I with 9 hairs, II with 3, III with 1-4 (1-2 in 6-segmented antennae), and penultimate segment with 8-12 hairs, (2-4, in 6-segmented antennae) hairs. Rostrum hardly reaches hind coxae ; ultimate rostral segment 0.19-0.22 mm. long, with 10-12 accessory hairs. Abdominal dorsum with short sparse hairs 0.013-0.022 mm. long ; marginal hairs on 7th and sometimes on 5th and 6th, usually 0.100 mm. long, occasionally spinal hairs may also be very long ; 8th tergite with 2 stout hairs, 0.17 mm. long. Wax glands present on head (3-4 pair), prothorax (4, marginal-spinal), meso, metathorax and 1st-6th abdominal tergites (6, marginal, pleural, spinal) ; 7th tergite with only spinal and marginal glands ; each gland composed of a central cell and 1-2 rows of surrounding cells, sometimes central cell may be subdivided. Siphunculi pale with 6 hairs, 0.15 mm. long. Gonapophyses 2 each with about 10 hairs, 0.045 mm. long. Legs thin in the middle of tibiae ; hind tarsi 0.075-0.080 mm. long.

Colour : Very variable, light pink, deep purple yellowish or even red in life.

Measurements in mm. :

Length	Width	Antenna
2.10-3.00	1.15-2.45	0.40-0.45

Antennal segments

I	II	III	IV	V	—	—
0.06-0.07	0.06-0.07	0.07-0.08	0.10	0.07		
			0.15	0.03		

Embryos : Embryos resemble embryos of emigrants ; wax plates as in the adults. Antennae 5-segmented ; hairs on antennae upto 0.087 mm. long, or less than half the length in short-haired specimens. Dorsal hairs on anterior tergites shorter than in embryos of emigrants, stouter, bent or with abnormal apices ; pleural hairs usually short (0.012-0.024 mm.) or even absent, marginal (0.01-0.12 mm. on 1st, 0.03-0.14 mm. on 7th tergite) and spinal hairs (0.01-0.06 mm. on 1st, 0.02-0.13 mm. on 7th tergite) may be highly variable in length. Siphunculi absent.

Colour.—Orange brown in life.

Alate viviparous females (Virginoparae) : Body 2.0-2.6 mm. long with 0.84-1.50 mm. as maximum width. Antennae 6-segmented, with III and IV sometimes completely fused ; segment V with 7-13 secondary rhinaria. Ultimate rostral segment 0.18-0.20 mm. long, 1.25-1.33 × as long as second segment of hind tarsus and bears 6-8 accessory hairs. Wax glands similar to apterous exules but may be variable, peripheral cells may even be absent. 8th tergite with 2 long hairs. Siphunculi present. Cauda with 2-3 hairs. Subanal plate with 6 long hairs besides finer hairs in gonapophyses.

Colour : Blackish brown with olive green abdomen.

Measurements in mm. :

Length	Width	Antenna
2.0	0.84	0.66
—	—	—
2.65	1.50	0.83

Antennal segments

I	II	III	IV	V	VI
0.04	0.06	0.21	0.07	0.18	0.07
—	—	—	—	—	—
0.06	0.07	0.30	0.09	0.21	0.10

Sexuales : Males appear greenish olive and females orange brown in life, the latter with a single winter egg.

Material examined : 3 alate viviparous females and two apterous viviparous females from galls of *Ulmus* sp., Kashmir, INDIA, 22.5.1979, coll. S. Chakrabarti.

Discussion : Zwölfer (1957) in his extensive description of *ulmi* mentioned that in complete holocycle, in Europe, eggs laid upon stem of *Ulmus* in the winter hatch out in April and larvae form bean-shaped flat walled, closed, vesicular galls where fundatrices develop ; on splitting of gall, alate emigrants start to leave the same from middle of June to middle of July and settle on roots of Gramineous plants which includes species of *Agrostis*, *Alopecurus*, *Apera*, *Bromus*, *Dactylis*, *Festuca*, *Hordeum*, *Lolium*, *Poa*, *Setaria*, *Triticum*, *Zea*, etc., besides others ; they pass through apterous exules, alate virginoparous, and alate sexuparous phases, on these secondary hosts ; last batch of sexuparae could be found up to end of October, which migrate back to *Ulmus* and produce sexuales in the crevices or bark of the elm-trees. Besides, holocycle, Zwölfer (op. cit) also mentions of possible occurrence of paracyclic colonies at higher altitudes between ca 1800-2200 m. in the Alps ; these anholocyclic population passes the winter as larvae or subadults in ants nests (*Lasius flavus* and *L. niger*). Hille Ris Lambers (1968-69) confirmed Zwölfer's observation that sexuparae produced in grass roots during Autumn are rare, and added that, even virginoparous alatae without secondary rhinaria in antenna, could also be produced during the same period.

The species is positively myrmecophilus, having association with ants of genera *Lasius*, *Formica*, *Myrmica*, *Tetramorium*, *Solenopsis* ; 50% of the colonies were noted to be attended by ants.

Aphidiid parasite of genus *Aphidius* parasitise 50-80% of adults in a colony and occasionally syrphids were seen to predate on these insects.

Tetraneura personata Börner, was considered to be only a form of *ulmi* but differs in some features from typical *ulmi* (Zwölfer, 1957). The Indian specimens agree fairly well with *personata*, except in the apparent absence of siphunculi and in this respect it agrees with form *typica*.

Hille Ris Lambers (op. cit) mentioned that eastern most limit of *ulmi* is extended up to Iran and material from Japan, China, Indonesia probably relate to other species ; the present specimens indicate the extension of areas of geographical distribution of *ulmi*, although the specimens differ marginally from the European *ulmi*, except in length of ultimate rostral segment (0.083 mm. as against 0.11-0.13 mm., in H.R.L., 1968-69)

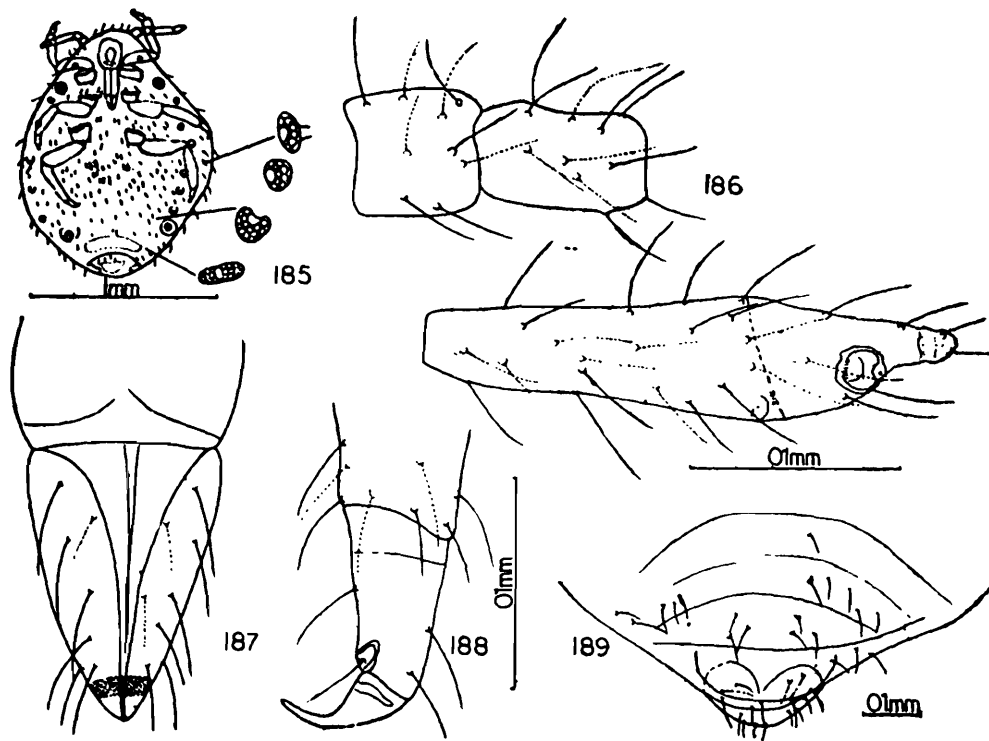
Distribution : INDIA, IRAN, EUROPE, ENGLAND, CANADA.

Types : Location of types not known.

22. *Tetraneura* (*Indotetraneura*) *utpali* Chakrabarti, Maity and
Bhattacharjee
(Figs. 185-189)

1982. *Tetraneura* (*Indotetraneura*) *utpali*, Chakrabarti, S., Maity, S. P. and Bhattacharjee, D. K. *Oriental Ins.*, 16 (1) : 108

Apterous viviparous females : Body 1.70-1.88 mm. long with 1.16-1.53 mm. as maximum width. Head brown with two pair of wax plates, one placed between the antennal bases and composed of 5-6 cells and the other placed posteriorly, often indistinct and with few scattered cells ; dorsal cephalic hairs conspicuous, with acuminate apices, up to 0.060-0.070 mm. long, 1.8-2.1 × as long as the basal diameter of antennal segment III. Antennae usually 4-segmented, sometimes antennae may be 5- or even 6-segmented, brown, 0.20-0.22 × as long as the body ; flagellum smooth on basal part, gradually more densely spinulose apiced ; hairs on antennae fine, segment I with 7 long and one 1 short hair,



Tetraneura (Indotetraneura) utpali Chakrabarti, Maity, Bhattacharjee ;
 Apterous viviparous female (from roots) :
 185. whole body ; 186. antenna ; 187. ultimate rostral segments ; 188. hind
 tarsus ; 189. posterior portion of abdomen.

II with 9-11 hairs, III with 7-8 hairs, IV with 16-18 (in 4-segmented antennae) or 5-6 hairs (in 6-segmented antennae), V with 4 (in 5-segmented antennae) or 22-24 hairs (in 6-segmented antennae) and VI with 4-5 hairs ; hairs on segment III, 0.026-0.046 mm. long, $0.80-1.45 \times$ as long as the basal diameter of the segment ; primary rhinaria ciliated ; processus terminalis $0.54-0.70 \times$ as long as base of last antennal segment. Rostrum reaches mid coxae ; ultimate rostral segment spinulose, $1.6-1.9 \times$ as long as hind tarsus and bears at least 10 accessory hairs. Abdominal dorsum pale with pale brown sclerotic band on 7th tergite and darker one on 8th tergite ; hairs on the dorsum of abdomen numerous, on anterior tergites 0.050-0.060 mm. (spinal) and 0.090-0.115 mm. (marginal) long, $1.5-1.8 \times$ and $2.7-3.5 \times$ as long as basal diameter of antennal segment III, respectively, hairs on 7th tergite 0.050-0.073 mm. long and on 8th tergite, 0.066-0.083 mm. long, these being $1.5-2.2 \times$ and $2.0-2.5 \times$ as long as the mentioned diameter, respectively ; 8th tergite with 10 hairs. Dorsal wax plates present on 1st-5th abdominal tergites, being composed of a large eccentric cell and 1-4 smaller cells (0.020 mm), usually arranged in pair on marginal

and spinal region ; large ventral wax plates (marginal and spinal) present on thoracic and on 1st-6th abdominal segments, marginal ones with a large eccentric or central cell and number of smaller cells in 2-4 rows (0.030-0.090 mm. diam.), spinal ones being smaller and composed of a central cell and 2-12 smaller cells (0.030-0.051 mm. diam) ; 7th tergite with paired marginal and spinal wax plates. Siphunculi dark brown with a distinct flange. Cauda dark, sclerotic, with 4 hairs. Subanal plate dark brown, with 8-10 conspicuous hairs. Gonapophyses 2, each with 8-10 fine hairs. Legs brown, stout, hairs on femora and tibiae fine, numerous, longest one on hind tibiae. 0.033-0.036 mm. long, $0.50 \times$ as long as the diameter at the middle of the tibiae ; empodial hair 0.036 mm. long, equal to the claws.

Colour Not recorded.

Measurements in mm. :

	Length	Width	Antenna			
1.	1.79	1.55	0.37			
2.	1.88	1.17	0.41			
	Antennal segments				urs.	ht ₂
	I	II	III	IV		
	0.07	0.06	0.17	(0.036+0.020)	0.118	0.07
	0.06	0.04	0.13	(0.033+0.023)	0.127	0.08

(1, 2, ex. *Apluda mutica* roots Mussourie, U.P., INDIA, 29.10.1977, coll. U. K. Dey).

Embryos (material not available ; based on Maity, S. P. Ph.D. Thesis, 1979) : Head with frons flat, with 12 long hairs, upto 0.033-0.048 mm. long. Antennae 4-segmented, segment I with 9 long and one minute hairs, II with 7-9, III with 24-26 and IV with 11-13 hairs. Ultimate rostral segment without any accessory hairs. Each of the thoracic tergites with 18-20 hairs. Abdominal dorsum with 5 pair of spino-pleural hairs and 2 pair of long and 4 pair of

short pleural hairs, on each of 1st-6th tergites ; 7th tergite with 12 and 8th tergite with 10 hairs ; ventro lateral wax plates present, 0.006-0.009 mm. in diameter : Legs with tarsi spinulose ; hind tarsal claws asymmetrical, long one 0.081-0.088 mm. long, short one 0.055-0.059 mm. long ; empodial hair equal to longer claws.

Alate viviparous female : Body 1.7-2.0 mm. long with 0.90-0.97 mm. as maximum width. Head dark brown ; dorsal cephalic hairs fine upto 0.030-0.040 mm. long, 1.8-2.1 \times as long as the basal diameter of antennal segment III, Antennae 6 segmented, 0.30-0.32 \times as long as the body ; segment I with a minute hair besides 6 long fine hairs ; hairs on the flagellum fine, on segment III upto 0.022-0.026 mm. long, 1.2-1.4 \times as long as the basal diameter of the segment ; antennal segment III with 10-14, IV with 2-3, V with 6-9 secondary rhinaria ; processus terminalis 0.33 \times as long as base of antennal segment VI. Rostrum reaches mid-coxae ; ultimate rostral segment 0.90-0.93 \times as long as second segment of hind tarsus and bears 8-10 accessory hairs. Mesothoracic wax plates small, pale (0.040 \times 0.033 mm.). Abdominal dorsum pale, smooth with a brown transverse band on 8th tergite ; hairs on the dorsum of abdomen fine, on anterior tergites upto 0.018-0.022 mm. long, 1.0-1.2 \times as long as the basal diameter of antennal segment III, on posterior tergites upto 0.033-0.048 mm. long, upto 2.2-2.6 \times as long as the mentioned diameter ; marginal and spinal wax plates present on 1st-7th tergites, composed of 4-20 cells ; 8th tergite with spino-pleural wax plate. Siphunculi brown, with apical flange. Cauda brown sclerotic with 2 hairs. Subanal plate with 15 long stout hairs. Gonapophyses 2, each with 8-10 hairs. Legs brown with tarsi spinulose ; first tarsal segments with 4, 4, 3 hairs. Forewings with media once branched ; veins pale.

Colour : Not recorded.

Measurements in mm. :

	Length	Width	Antenna
1.	1.7	0.90	0.55
2.	2.0	0.97	0.60

Antennal segments				urs.	ht ₂
III	IV	V	VI		
0.17	0.05	0.14	(0.040+0.012)	0.13	0.14
0.21	0.05	0.16	(0.040+0.013)	0.14	0.14

(1,2, ex. *Apluda mutica*, Mussourie, U.P., INDIA, 29.10.1977, coll. U. K. Dey).

Material examined 7 apterous viviparous females and two alate viviparous females, from roots of *Apluda mutica*, Mussorie, Uttar Pradesh, INDIA, 29.10.1977, coll. U. K. Dey (Paratypes, S. Chakrabarti's collections).

Discussion : This species forms another member of subgenus *Indotetraneura*, in having asymmetrical hind tarsal claws in embryos and differs from other species of the subgenus in having different chaetotaxy in both adult and embryos, as mentioned in the key.

Distribution INDIA (Uttar Pradesh).

Types : In the collections of Dr. S. Chakrabarti, Department of Zoology, Kalyani University, Kalyani, India.

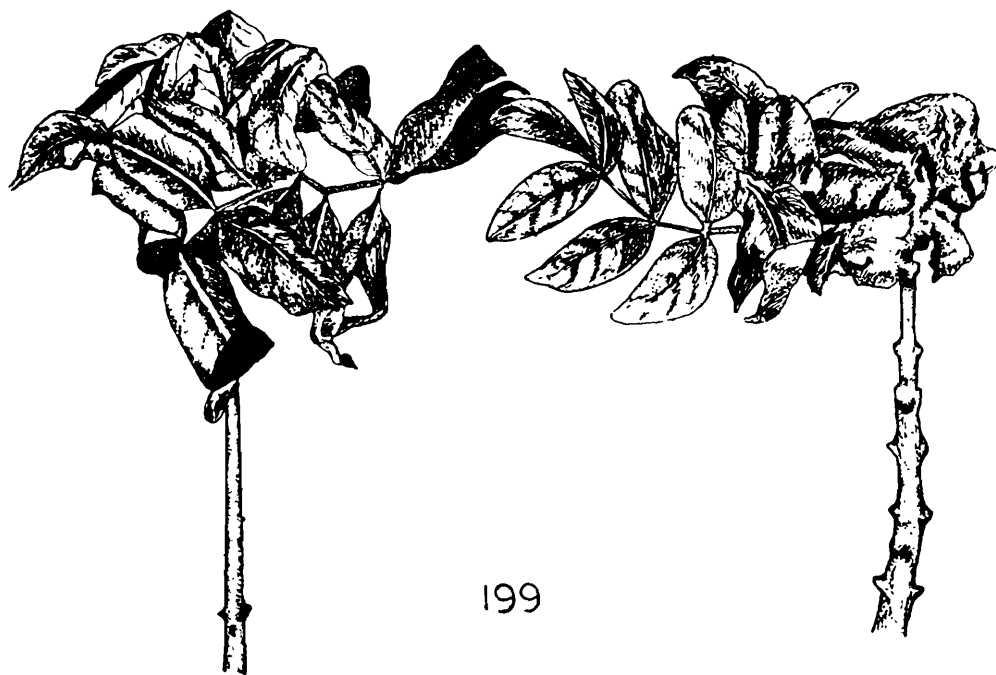
Tribe PEMPHIGINI

Börner (1952) has considered the tribe as a subfamily Pemphiginae under family Pemphigidae and recognised two tribes, viz., Pachypappini (with genera like *Patchiella* Tullgren, *Asiphon* Koch, *Pachypappa* Koch, *Prociphilus* Koch etc.) with long empodial hairs in young larvae of fundatrigeniae and Pemphigini with short empodial hairs in larvae of fundatrigeniae. However, Hille Ris Lambers (1966) while erecting *Epipemphigus* showed that the new genus unites a number of important characters of Börner's Pachypappini and Pemphigini and as such no definite demarcation could possibly be made to group the genera under one tribe or the other. Most of the authors now consider Pemphigini as composed of two ill defined subtribes, Pemphigina & Prociphilina ; members of these two subtribes are separated on the basis of host association

viz., members of Pemphigina, use *Populus* as primary host and dicot roots as secondary host and those of Prociphilina have a bewildering array of primary hosts and conifer roots as secondary host. Eastop (1966) stated that as the secondary coniferhosts of Prociphilina are more closely related to one another than the diverse primary hosts, it may be possible that many of the primary hosts of Prociphilina have been secondarily acquired.

The majority of Pemphigini are well known as gall makers (Figs. 197-202) and difficulty in constructing a sound generic classification has been attributed mainly due to the morphological uniformity of exules (in secondary host) in contrast to the wide diversity of gall-inhabitants (Aoki 1975). Taxonomy on the basis of first instar larvae of Fundatrix and Emigrant forms has been attempted (Aoki, op. cit.) in some group of species.

A total of approximately 20 genera and 4 subgenera [viz. *Neoparacletus* Strom, *Paraprociophilus* Mordvilko, *Stagona* Koch under *Prociophilus* Koch and *Parathecabius* Börner under *Thecabius* Koch, which have been considered as separate genera by some authors (Smith, 1974)] are now recognised from the World, of which four genera are typically oriental, four are Nearctic, six are Holarctic and six others are Palacratia in distribution. A total of about 156 species are now recognised, of which largest number of species

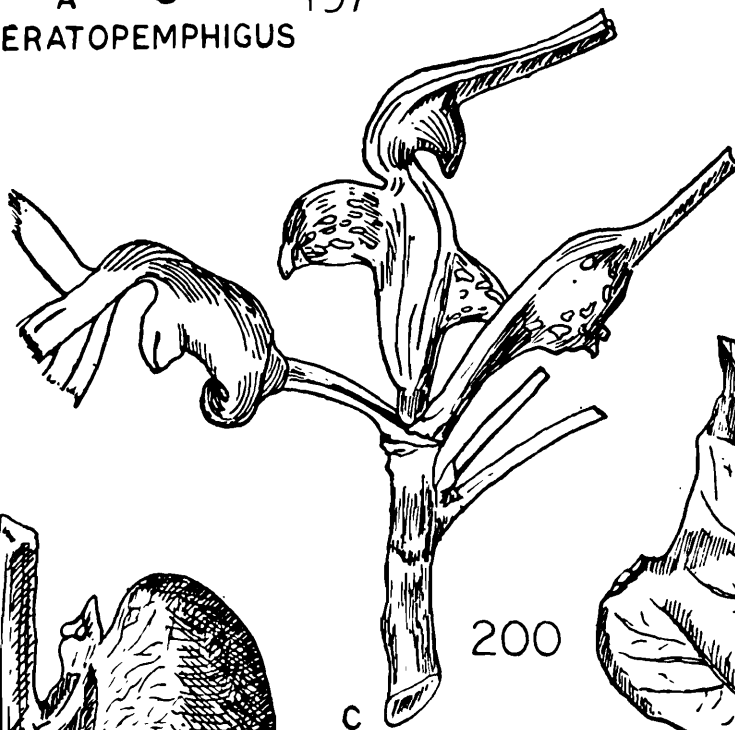




A 197
CERATOPEMPHIGUS



B 198
PROCIPHILUS



C 200
PEMPHIGUS



D 201

PEMPHIGUS



E 202

THECABIUS

GALLS ON (A) BRUNFELSIA
(B) FRAXINUS (C-E) POPULUS

Galls of Pemphigini : 197. On *Brunfelsia* by *Ceratopemphigus zehntnari* Schouteden ; 198 (see page 155) and 199. on *Fraxinus* by *Prociphilus* spp ; 200-201. on *Populus* by *Pemphigus* spp ; 202. on *Populus* by *Thecabius affinis*.

come under the genera *Pemphigus* Hartig and *Prociphilus* Koch ; many genera like *Cornaphis* Gillette, *Ceratopemphigus* Schoutedon, *Ceratopemphigella* Menon and Pawar, *Geopemphigus* H.R.L., *Fagiaphis* Smith, *Mimeura* Börner, *Mordvilkoja* Del Guercio, *Neoprociphilus* Patch. *Patchiella* Tullgren, *Tiliphagus* Smith and *Watabura* Matsumura, remain monotypic.

Most of the species are known to produce a waxy secretion and also galls or other malformation on their primary hosts. Life cycle in Holarctic region is mostly of Holocyclic-heteroecious type and consists of eggs, fundatrix, emigrant fundatrigeniae on primary host and aliencolae and sexuparae in the secondary hosts ; sexuales are usually produced on primary hosts. Some species are also known to lead holocyclic or anholocyclic life-cycle only on the secondary host (Smith, 1974).

A total of 30 species under 7 genera and 4 subgenera are known from the region, including a few (3) undetermined species of *Prociphilus* and two yet to be described species of *Pemphigus*. Some of these (13) are known from galls of their primary host-plants while the others are only known from aerial or subterranean parts of host-plants. Almost all the species, except *Cerertopemphigus zehntneri* Schouteden from Ceylon and *Ceratopemphigella delhiensis* Menon and Pawar from Delhi, are distributed in the Northern temperate hill region. Holocyclic-heteroecious cycle is known for only two of the species in the region viz., *Epipemphigus imaicus* (Cholod) alternating between galls of Poplar and roots of Pine trees and *P. immunis* Buekt., from galls of Poplar to roots of *Euphorbia*.

Ghosh *et al.* (1981) have given an account of Galls of Pemphigini in the Indian region and Rehana Habib and Ghani (1970) have dealt with Pemphigini on Poplars and their natural enemies in West Pakistan.

TABLES : Hosts of Pemphigini in Indian Region

<i>Species</i>	<i>Primary Host</i>	<i>Secondary Host</i>
1. <i>Ceratopemphigiella delhiensis</i> Menon & Pawar	—	—
2. <i>Ceratopemphigus zehntneri</i> (Schoutedon)	<i>Brunfelsia uniflora</i>	? Indet host

3. <i>Epipemphigus imaicus</i> (Chold)	<i>Populus ciliata</i>	<i>Pinus wallichiana</i>
4. <i>Formosaphis micheliae</i> Tak.	<i>Michelia champaka</i>	—
5. <i>Pemphigus eastopi</i> P. K. Mondal	—	Indet host
6. <i>Pemphigus immunis</i> Buckton	<i>Populus sp.</i>	<i>Euphorbia helioscopia</i>
7. <i>Pemphigus indicus</i> Keiffer	Indet Host	—
8. <i>Pemphigus mordvilkoii</i> Cholod.	<i>Populus ciliata</i>	—
9. <i>Pemphigus nainitalensis</i> Cholod	<i>Populus ciliata</i>	—
10. <i>Pemphigus napeus</i> Buckton	<i>Populus sp. P. euphratica</i>	—
11. <i>Pemphigus siphunculatus</i> H. R. L.	<i>Populus ciliata</i>	—
12. <i>Pemphigus spyrothecae</i> Passerini	<i>Populus nigra</i>	—
13. <i>Pemphigus vesicarius</i> Passerini (= <i>spirothaecifacies</i> Gulamullah)	<i>Populus sp.</i>	—
14. <i>Pemphigus vulgaris</i> Raychaudhuri	—	Roots of Graminae
15. <i>Prociphilus caryae fitchii</i> Baker and Davidson	—	<i>Alnus sp.</i>
16. <i>Prociphilus cornifoliae</i> Singh, Das, Raychaudhuri	—	<i>Cornus sp.</i>
17. <i>Prociphilus (N) ghanii</i> H. R. L.	—	<i>Salix wallichiana</i>
18. <i>Prociphilus micheliae</i> H. R. L.	<i>Michelia champaka</i>	—
19. <i>Prociphilus oriens</i> Mordv.	—	<i>Fraxinus sp.</i>
20. <i>Prociphilus osmanthae</i> E. & K.	—	—
21. <i>Prociphilus taxus</i> (A. K. Ghosh et al.)	<i>Taxus baccata</i> (Roots)	—

22. <i>Prociphilus</i> sp. A.	—	<i>Photinia notoniana</i>
23. <i>Prociphilus</i> sp. B.	—	<i>Fraxinus floribunda</i>
24. <i>Prociphilus</i> (<i>S</i>) <i>himalayensis</i> Chak.	<i>Pinus</i> (Roots)	—
25. <i>Prociphilus</i> (<i>S</i>) <i>xylestei</i> De. Geer	—	—
26. <i>Prociphilus</i> (<i>S</i>) sp.	—	—
27. <i>Prociphilus</i> sp.	<i>Tsuga brunoniana</i>	—
28. <i>Tnecabius affinis</i> Kalt.	—	<i>Ranunculus histellus</i>

Note : In addition to the species listed above, Habib & Ghani (1970) mentioned about two undescribed species of Pemphigus from *Populus ciliata* in Pakistan.

Key to the Genera of PEMPHIGINI

1. Secondary rhinaria reticulated. Head rounded. Rostrum reaches hind coxae. Ultimate rostral segment distinctly longer than second segment of hind tarsus. Antennae 5 segmented in alatae, 4-5 segmented in apterae. Wax glands subcircular to oval, each with a seta and composed of 30-45 pores in a clusture, rudimentary or absent on head and thorax, present on abdomen. On stem and bark of *Michelia* . **Formosaphis** Takahashi
- Secondary rhinaria in alatae, narrow, transverse, never as above. .2
2. Antennal segment III may be with a denticle near the base. Mesonotum with paired median wax glands. Secondary rhinaria narrow, ciliated. .3
- Antennal segment III never with a denticle. Mesothoracic wax glands evident or not. Secondary rhinaria non-ciliated or ciliated. .5

3. Frons with a pair of prominent protruberances. Antennal segment III-VI in alata with transverse, ciliated, secondary rhinaria. Primary rhinaria ciliated. Wax glands present on head (except in adult) and on thoracic and abdominal segments. Rostrum never reaches mid coxae. Siphunculi absent. Empodial hairs of first stage larva curved, longer than claws. Trochanters and femora fused. On *Brunfelsia* . **Ceratopemphigus Schoutedon**
 —Head never with frontal prominences. .4
4. Antennal segments III and IV with secondary rhinaria in alatae. . **Ceratopemphigella Menon & Pawar**
 —Antennal segment III-IV with secondary rhinaria. Mesothoracic wax glands large. Abdominal wax gland groups well developed. Secondary rhinaria ciliated. Dorsal hairs short or sparse or long and numerous. Ultimate rostral segment thick or slender with 2 to many accessory hairs, subequal or equal to second segment of hind tarsus. Cauda and anal plate may form an anocaudal process, Empodial hair $0.33-1.0 \times$ as long as tarsal claws. On an array of Dicot host (*Fraxinus*, *Lonicera* etc.) and on roots of Conifera . **Prociphilus Koch, S. I.**
5. Secondary rhinaria ciliated, present on segment III-V in alate. Siphunculi hardly discernible. Ultimate rostral segment without any accessory hairs. Fundatrix without wax glands. Empodial hair in adult and larvae, short, usually $0.33-0.40 \times$ as long as the claws. . **Epipemphigus H.R.L.**
 —Secondary rhinaria ciliated. Fundatrix with wax glands. Empodial hair may be short or upto $2/3 \times$ as long as the claws. .6
6. Mesothoracic wax glands not evident. Siphunculi ring like, usually present in alatae. Secondary rhinaria non-ciliated. Hairs inconspicuous. Ultimate rostral segment without accessory hairs, shorter than second segment of hind tarsus. Fundatrix without wax glands on head and with 4 segmented antennae. Lives in true galls (Fundatrix and fundatrigeniae) of *Populus* and roots of herbaceous host. . **Pemphigus Hartig**

—Mesothoracic wax glands evident but their diameter less than distance between the glands. Siphunculi absent (except in one species). Ultimate rostral segment blunt or slender with 0.6 accessory hairs, much shorter than second segment of hind tarsus. Empodial hair 0.25-0.33 × as long as tarsal claws. Fundatrix with wax glands on head and with 5-6 segmented antennae. On transitory galls (Fundatrix) and pocket galls (Fundatrigeniae) of *Pipulus* and on a number of secondary hosts.

.Thecabius Koch

6. Genus *Ceratopemphigella* Menon & Pawar 1958

1958. *Ceratopemphigella* Menon, M.G.R., Pawar, J. G. *Proc. 45th Indian Sci. Congr.*, 3 : 348.

Morphology.—Body elongate. Head dark sclerotic with 3 large ocelli besides the compound eyes. Antennae 6-segmented, less than 1/3 length of body ; antennal hairs short ; secondary rhinaria transverse, completely encircling the diameter of the segment, present on segments III and IV, with distinct rims, without any cilia ; primary rhinaria, subcircular, distinctly ciliated ; processus terminalis finger-shaped. Ultimate rostral segment shorter than second segment of hind tarsus, pale, slender, bearing a pair of accessory hairs near base, which are hardly discernible. Thorax without discernible wax glands. Abdominal dorsum with distinct spinal wax gland groups, from each of which arises a single seta ; each gland-group composed of closely appressed cells and appear oval or elongate-oval. Stigmata placed on sclerotic plates. Legs with trochantors apparently immovable, although distinct from femora ; femora with groups of irregular or circular pale areas ; tibiae scabrous ; second tarsal segments with some blunt spinules apicad ; first tarsal segments at least with 5, 5, 4 (?) hairs. Empodial hairs fine, 0.50 × as long as the tarsal claw. Forewings with media simple ; hind wings with anal and cubitus united at base.

Apterae, sexuales and nymphs not known.

Discussion.—The genus was erected with *delhiensis* as the type-species and remains monotypic. While agreeing with *Prociphilus*

s.l., and *Ceratopemphigus* Schoutedon, it differs from the latter by the absence of antennal process on inner margin of segment III, and from both, in having non-ciliated secondary rhinaria only on segments III and IV, and in the tarsal chaetolaxy.

Biology.—Nothing has been mentioned about the biology of the type species but recently Dr. S. Ghai, I.A.R.I., (in litt) has informed about its mass occurrence on the fodder crop around Delhi area.

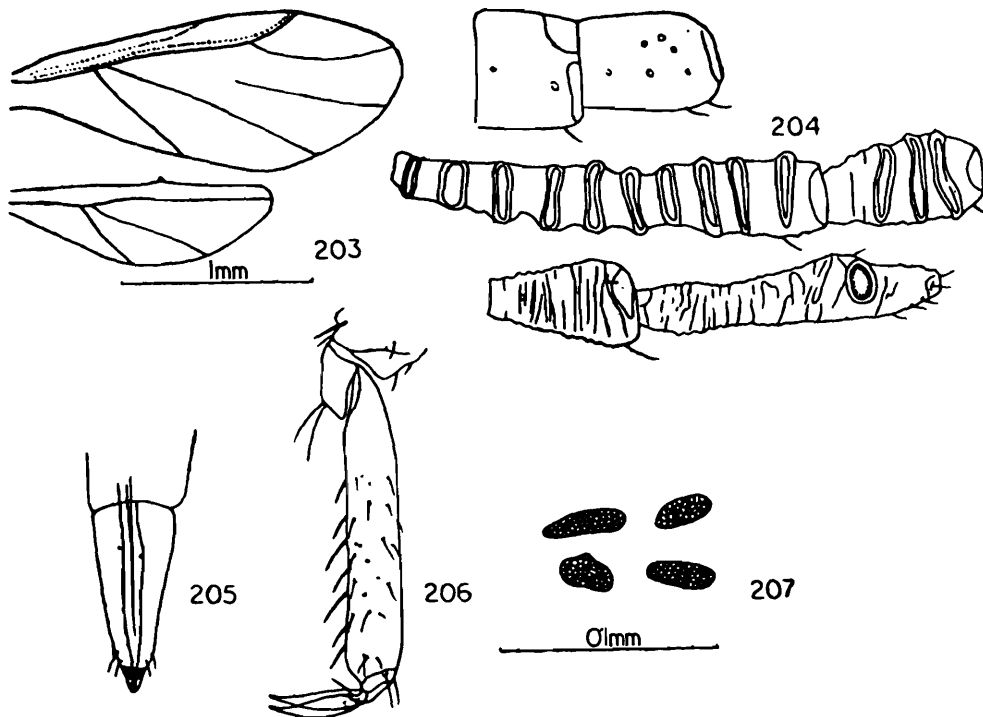
Distribution.—INDIA (Around Delhi).

Type species.—*Ceratopemphigella delhiensis* Menon and Pawar, 1958. Deposited in National Pusa Collection, Indian Agricultural Research Institute, New Delhi.

23. *Ceratopemphigella delhiensis* Menon & Pawar (figs. 203-207)

1958. *Ceratopemphigella delhiensis*, Menon, M.G.R. and Pawar J.G., *Proc 45th Indian Sci. Congr.*, 3 : 348.

Alate viviparous females.—Body elongate with head, thorax, antennae and legs dark sclerotic, abdomen pale. Antennae 6-segmented, about $0.30\times$ as long as the body ; segment I broad, rectangular, segment II elongate with 5 hairs ; segment III longest about $1.5\times$ as long as segments IV+V taken together ; segment VI equal to segment IV+V ; antennal segment III with 9-10 and segment IV with 3 strongly transverse non-ciliated secondary rhinaria ; segment V and VI scabrously imbricated, each with a round strongly ciliated primary rhinarium ; hairs on flagellum, sparse, minute ; processus terminalis, short, finger-shaped, hardly $0.20\times$ as long as base of antennal segment VI. Rostrum reaches at least mid coxae, ultimate rostral segment slender, $0.53\times$ as long as second segment of hind tarsus and bears a pair of accessory hairs, which are much shorter than the preapicals. Abdominal dorsum pale, with paired spinal wax-gland groups at least on anterior tergites, each bearing a small hair ; hairs on the dorsum of abdomen 0.013-0.016 mm. long, $0.80-1.0\times$ as long as basal diameter of the



Ceratopemphigella delhiensis Menon and Pawar ; Alate viviparous female :
 203. wings ; 204. antenna ; 205. ultimate rostral segments ; 206. hind tarsus ;
 207. dorsal wax-glands on abdomen.

antennal segment III. Siphunculi absent. (Cauda, anal, plate, subgenital plate not discernible, damaged in the single type-specimen available). Legs slender, dark ; hairs on femora and tibiae fine, longest one on hind tibiae 0.023 mm. long, $0.77\times$ as long as the diameter at the middle of the tibiae. First tarsal segments with 5, 5, 4 hairs. Empodial hair fine, $0.37\times$ as long as the claws. Forewings with pterostigma brown, radial sector faint, slightly curved, media indistinct, simple, cubital and anal arising separately ; hind wings with obliques united at base with the subcosta, which appear as a single vein with 3 branches.

Colour.—Not known.

Measurements in mm.—

Length	Width	Antenna
2.07(?)	?	0.74

III	Antennal segments			urs.	ht ₂
	IV	V	VI		
0.24	0.09	0.08	(0.14+0.03)	0.09	0.17

(ex. light trap, New Delhi, 31.3.1957, IARI collections).

Material examined.—One alate viviparous female from Light trap collections, New Delhi, INDIA, 31.3.1957, coll. J. G. Pawar (Paratype, IARI collection No. 105).

Discussion : The genus and species is known only by the alate viviparae. Due to scarcity of material the species and the genus can not be as fully described as desired, specially in view of very brief original description. Its occurrence in fodder-crop may, as reported by S. Ghai (in litt.) help to have a more detailed account and clarify its position in future.

Distribution.—INDIA (New Delhi).

Types.—In the National Pusa collections, Division of Entomology, Indian Institute of Agricultural Research, New Delhi.

7. Genus *Ceratopemphigus* Schoutedon 1905

1905. *Ceratopemphigus* Schoutedon. H. *Spolia zeylan.*, 2 : 187.

Morphology : Body elongate-oval, 2.6-3.0 mm. long. Head with frons narrow, bearing a pair of distinct protuberances, small in adult, conical or finger shaped in last stage nymph and absent in first nymphal stage. Antennae 6-segmented, about one third the length of body ; flagellum with narrow, elliptical, transverse, ciliated secondary rhinaria on segments III-VI, (segment III with 8-12 and others with 9-6) ; primary rhinaria oval, ciliated ; hairs on the flagellum short, erect, 0.013-0.016 mm. long ; processus terminalis finger shaped, 0.25 × as long as base of antennal segment VI ; segment III often with a small denticle on anterior margin in the basal region. Eyes large, with large ocular tubercles. Rostrum slender, ultimate rostral segment with a pair of accessory hairs besides primaries, and always distinctly much shorter than second

segment of hind tarsus. Abdominal dorsum pale, membranous. Wax glands present on meso- and metanotum, and on 1st-7th abdominal tergites, each with one or more hair. Hairs on dorsum of abdomen up to little over twice as long as antennal hairs. Siphunculi absent. Cauda rounded with 3-4 hairs. Legs slender, smooth, bearing fine, erect hairs; trochanters nearly fused to femora; first tarsal segments with 2, 2, 2 hairs; claws large. Forewings with media simple, hind wings with two oblique veins, sometime first oblique may be once branched; both the oblique veins usually arise at or near the same point.

Nymphs with distinct paired frontal protruberances, a pair of wax glands on vertex and 1-2 pair of glands on each of the thoracic tergites, besides paired spinal, pleural and marginal glands on 1st-6th abdominal tergites; first stage larvae without any horn-like cephalic projection and have long empodial hairs, which may be longer than tarsal claws.

Apterae and sexuales unknown.

Discussion.—Only one species, *Ceratopemphigus zehntneri* Schoutedon, is known from alate and nymphs. The genus is distinctive in having frontal protruberances, narrow transverse ciliated secondary rhinaria, presence of small denticle near base of antennal segment III, besides other characters.

Biology.—The only species was described from an unidentified host plant in SRI LANKA (Ceylon) in 1905 and after a long lapse of time, Doncaster (1956) while redescribing the genus and the species, recorded *Brunfelsia uniflora* as its host in Ceylon. It may be probable that *Brunfelsia uniflora* is one of the host plants of the species; E. E. Green's material on which Schoutedon based his description had been collected from a different host plant. Details about the biology of the species is not available.

Distribution.—SRI LANKA.

Type species.—*Ceratopemphigus zehntneri* Schoutedon 1905. Syntypes in the collections of British Museum (Nat. Hist.) London and D. Hille Ris Lambers, The Netherlands.

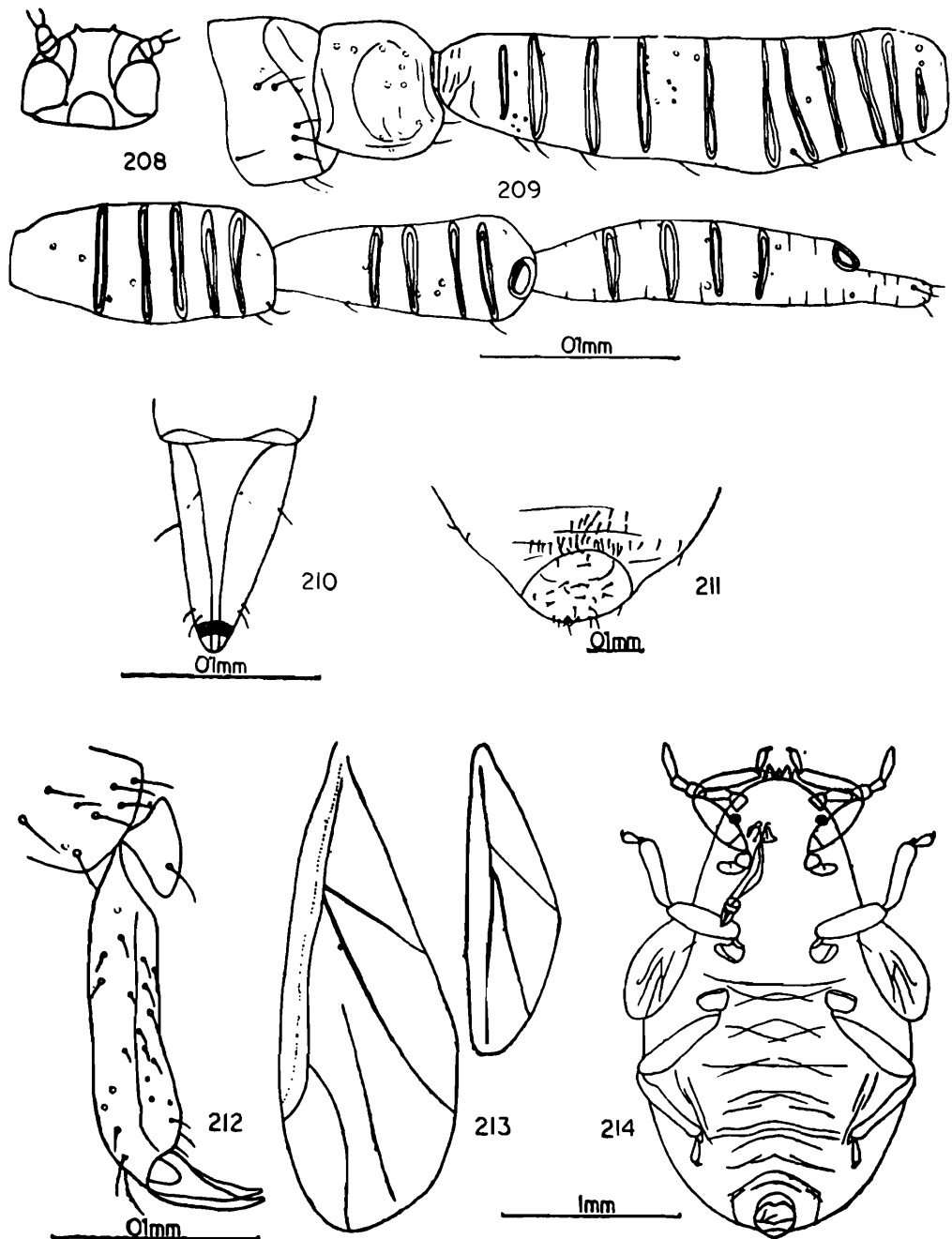
24. *Ceratopemphigus zehntneri* Schoutendon
(figs. 208-214)

1905. *Ceratopemphigus Zehntneri* Schoutendon, H., *Spolia Zeylan.*, 2 : 187

1956. *Ceratopemphigus zehntneri*, Doncaster, J. P., *Proc. R. ent. Soc. Lond.*, (B), 25 : 113.

Alate viviparous female.—Body 2.76-3.0 mm. long. Head dark sclerotic with small, distinct frontal processi, without any wax glands and median suture. Antennae stout, 6-segmented, about 0.27-0.33 \times as long as the body, hairs on the flagellum sparse, on segment III 0.01-0.02 mm. long 0.44-0.55 \times as long as the basal diameter of the segment, segment III longest and bears 8-12 transverse secondary rhinaria, segment IV and V almost equal and as broad as segment III, with 4-6 and 4 (2-5) similar rhinaria, respectively, segment VI thinner than preceding segments and bears 4 (3-5) similar rhinaria; primary rhinaria ciliated; processus terminalis 0.20 \times (0.25 \times) as long as the base of antennal segment VI. Rostrum pale, reaches mid coxae, ultimate rostral segment stout, 0.60 \times as long as second segment of hind tarsus and bears 4 (2) accessory hairs. Meso- and Metanota with paired spinal wax-plates. Abdominal dorsum pale, membranous, with spinal (1st-4th tergites), pleural (5th and 6th tergites) and marginal (1st-7th tergites) wax plate besides a median spino-pleural one on 7th tergite. Hairs on the dorsum of abdomen fine, on anterior tergites 0.02-0.03 mm. long, 0.7-0.9 \times as long as the basal diameter of antennal segment III; 8th tergite with 2 hairs, upto 0.04 mm. long, 1.2-1.3 \times as long as the mentioned diameter. Siphunculi absent. Cauda brown, sclerotic, broad and round bearing 3-4 hairs. Subgenital plate sclerotic, with more than 40 hairs in two groups. Subanal plate with 32-34 hairs. Legs dark brown smooth; hairs on femora and tibiae fine, longest one on hind tibiae 0.020 mm. long, nearly half as long as the diameter at the middle of hind tibiae. First tarsal segments with 2, 2, 2 hairs. Forewings with short radial sector gently curved, media simple, cubital and anal separated at base; hind wings with obliques united at base, sometime 1st oblique once branched.

Colour.—Not known.



Ceratopemphigus zehntneri Schoutedon ; Alate viviparous female (from galls) :
 208. head ; 209. antenna ; 210. ultimate rostral segments ; 211. posterior
 portion of abdomen ; 212. hind tarsus ; 213. wings ; 214. nymph-whole
 body.

Measurements in mm.—

	Length	Width	Antenna
1.	2.76	1.24	1.03
2.	2.90	1.38	1.08

III	Antennal segments			urs.	ht ₂
	IV	V	VI		
0.30	0.16	0.17	(0.20+0.04)	0.12	0.20
0.32	0.16	0.18	(0.20+0.04)	0.12	0.20

(1—2 ex. *Brunfelsia uniflora*, Norwood, SRI LANKA, 6.3.1954, BMNH collection)

Larva.—Body pale ovoid. Head with a median suture but without any horn. Antennae 5-segmented, 0.32× as long as the body; segment I and II shorter than segment III but equal to segment IV, segment V longest; processus terminalis 0.20× as long as the base of last segment. Rostrum reaches hind coxae, ultimate rostral segment 0.93× as long as second segment of hind tarsus and bears 4 accessory hairs. Abdominal dorsum pale, with distinct segmentation; hairs sparse, 0.016-0.020 mm. long, 0.30-0.50× as long as the basal diameter of antennal segment III. 8th tergite with 2 hairs upto 0.016 mm. long. Wax glands not discernible. Siphunculi absent. Cauda and subanal plate each with 4 hairs. Legs pale, stout, trochanters fused; femora and tibiae smooth; hairs on hind tibiae 0.010 mm. long, hardly 0.15× as long as the diameter at the middle of the tibiae. First tarsal segments with 2, 2, 2 hairs. Empodial hair fine, curved, (according to Doncaster, (op. cit) longer than claw, but the tip of hair is not discernible in the specimen available).

Colour.—Not known, apparently pale in life.

Measurements in mm.—

I	Antennal segments			urs.	ht ₂
	II	III	IV		
0.06	0.5	0.07	0.05 (0.12+0.02)	0.09	0.10

(ex. *Brufelsia uniflora*, Norwood, SRI LANKA, 6.3.1954, BMNH collections).

Nymph (Late stage).—Head dark sclerotic with distinct paired frontal prominence and a median suture ; hairs on vertex 0.013-0.016 mm. long. Antennae pale brown, stout, 6 segmented, $0.27\times$ as long as the body ; segments III and VI subequal to one another as also IV and V ; flagellum smooth ; hairs on flagellum, 0.006-0.010 mm. long ; primary rhinaria round, ciliated ; Rostrum reaches mid coxae, ultimate rostral segment $0.74\times$ as long as second segment of hind tarsus. Abdominal dorsum pale ; hairs on the dorsum stiff, fine, 0.023-0.026 mm. long ; wax gland not discernible (paired spinal, pleural and marginal plates on 1st-6th tergites, Doncaster op. cit). Siphunculi absent. Subanal plate with about 16 hairs. Legs stout, brown, smooth ; first tarsal segments with 2, 2, 2 hairs.

Colour.—Not known.

Measurements in mm.—

Length		Width		Antenna	
?		1.4		0.82	
Antennal segments					
				urs.	ht ₂
III	IV	V	VI		
0.17	0.10	0.13	0.19	0.12	0.16

Material examined.—Two alate viviparous females, two nymphs and one larva from *Brunfelsia uniflora* Norwood, SRI LANKA, 6.3.1954 (BMNH collections, 10/54, C.I.E. No. 13590).

Discussion.—The species seems to be restricted to SRI LANKA (=CEYLON) and the records appear to be rather very scanty. Schoutedon (1905) mentions that primary host plant may be a species of *Pistacia* but no member of Pemphigini is known from *Pistacia*. The identity of large leaf gall (44 mm. or larger in diameter) referred by him, as such, remains unknown.

Distribution.—SRI LANKA.

Types.—Paratypes in the collections of British Museum (Nat. Hist.) London and D. Hille Ris Lambers, The Netherlands. Holotype may be present in the collections of H. Schoutedon, Bruxelles, Belgium.

8. Genus **Epipemphigus** Hille Ris Lambers 1966

1966. *Epipemphigus* Hille Ris Lambers, D. *Tijdschr. Ent.*, 109 : 204.

1975. *Epipemphigus*, Aoki, Shigeyuki, *Insecta matsum.*, 5 : 40.

Head smooth, without median suture ; dorsal hairs fine, with acute apices, short in apterae, and inconspicuous in alatae ; wax glands absent on head and thorax. Antennae 4-5-segmented in apterae, 6-segmented in alatae, $0.15-0.36\times$ as long as the body ; flagellum in apterae, without secondary rhinaria, in alatae with irregular, narrow, wide rimmed and ciliated secondary rhinaria on segments III-V ; primary rhinaria, rounded in apterae, large and irregular in alatae, distinctly ciliated ; hairs on the flagellum sparse ; processus terminalis $0.18-0.36\times$ as long as base of last antennal segment, may be sparsely spinulose in apterae, with 8-10 hairs near apex in alatae. Rostrum short reaching mid-coxae, ultimate rostral segment distinctly shorter than second segment of hind tarsus and bears only subapical hairs. Abdominal dorsum membranous, without wax glands in apterae, in alatae with small paired marginal glands in 1st-7th tergites and irregular transverse ones on 1st-6th tergites ; hairs on the dorsum of abdomen long, numerous in apterae, short inconspicuous in alatae ; 8th tergite with 4 hairs. Siphunculi absent but alatae may have minute, unpigmented, hardly discernible siphunculi. (Hille Ris Lambers, 1966). Cauda broad with 2-3 hairs. Rudimentary gonapophyses 2. Subanal and subgenital plate dark. Legs dark, tarsi spinulose ; first tarsal segments with very variable chaetotaxy, bearing 2-4 hairs (4, 4, 4 ; 4, 2, 4 ; 4, 2, 2 ; 2, 2, 2 ; 3, 3, 3 ; 3, 3, 2) ; empodial hair short, $0.33-0.50\times$ as long as the claws. Forewings with media simple, hind wings with both obliques.

Larvae inside apterous fundatrices have 4-segmented antennae, short empodial hairs and exhibit few wax gland cells ; larvae inside

alatae fundatrigeniae have distinct mouth parts, minute siphunculi, short empodial hairs as in adult *alatae*.

Discussion.—The genus was erected for *Pemphigus imaicus* Chodod., as this species shows a peculiar combination of short empodial hairs in both larval and adult stages and distinctly ciliated secondary rhinaria, besides a very irregular tarsal chaetotaxy, *P. imaicus* was originally described from Dehra-Dun, India and another Japanese species *Pemphigus niisimae* Matsumura 1917, has been included under this genus besides *imaicus* by Aoki (1975), who has given detailed description of all stages (larva and adult) of *niisimae*.

Biology.—*P. imaicus* is known to form sausage-shaped galls along mid-rib on the upper surface of larvae of *Populus ciliata*, Mani (1973) has described the gall as elongately cylindrical, compressed, yellowish green, sessile, hard, unilocular and 3-4 on each leaf gall cavity appears elongate smooth and harbours numerous individuals ; size 70 mm. long, 15-20 mm. thick and 25 mm. high. Both apterae fundatraces and alate migrants have been collected during May and June in Kumaon, Garhwal and North Western Himalaya between altitude of c 1500 m.-2500 m. Chakrabarti et. al. (1970) have also reported the species from *Ailanthus glandulosus*, at Simla, where they form galls on undersurface of the leaves during September. *P. niishimae* Matsumura, has been reported from *Agrimonia piliosa*, *Bidens tripartita*, *Fatoua villosa*, *Larix leptolepis* and *Populus maximowiczii* (Shinji, 1941, 1944; Higuchi & Miyazaki, 1969) but only the last named plant definitely serve as the primary host in Japan where they form Cockscomb like, loosely closed leaf gall along the mid-rib ; the emigrants exit through a longitudinal split on the ventral surface ; Aoki (op. cit) mentions that between middle of May of first part of July, various stages from first instar larva of fundatrix to Emigrant adults complete their development within the galls. Mordvilko (1935) apparently recorded the same species on *Populus suaveoleus* in Ussuri region of U.S.S.R.

Distribution.—INDIA (North West) ; PAKISTAN ; JAPAN ; U.S.S.R.

Type species.—*Pemphigus imaicus* Chold. Location of types not known.

25. *Epipemphigus imaicus* (Cholodkovsky)
(Figs. 215-223)

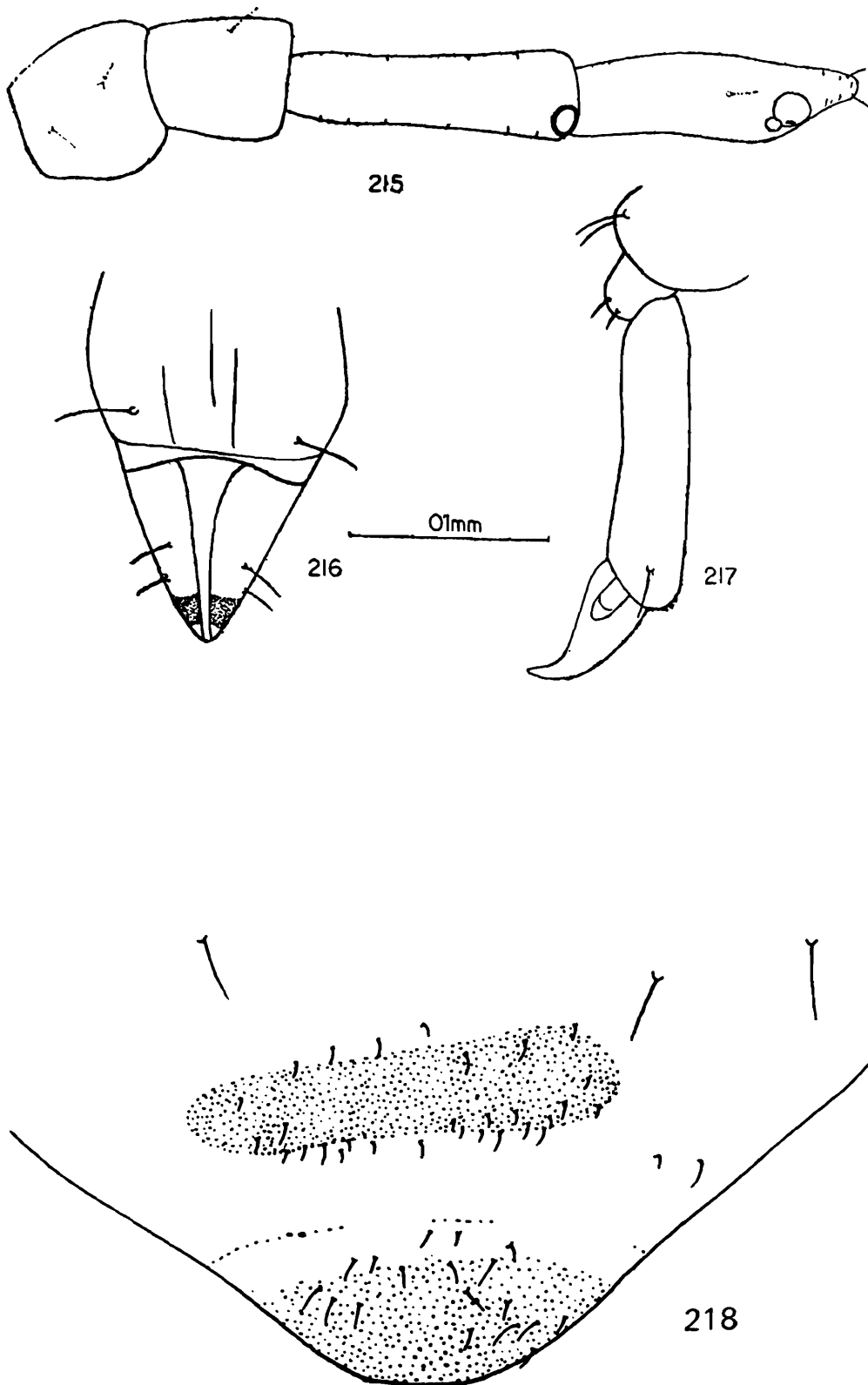
1912. *Pemphigus imaicus* Cholodkovsky, N. *Revue Russe d' Entom.*, 12 : 495
 1917. ? *Pemphigus niisimae* Matsumura, S., *Essays Nawa*, Gifu, 85.
 1966. *Epipemphigus imaicus*, Hille Ris Lambers, D., *Tijdschr. Ent.*, 109 : 204.
 1970. *Epipemphigus imaicus*, Habib, Rehana and Ghani M. A., *Tech. Bull. Commw. Inst. Biol. Control*, 13 : 49.

Apterous viviparous female.—Body 2.0-2.50 mm. long, rounded oval, pale except on head, prothorax, bases of legs on meso- and metathorax, which are dark sclerotic. Head flat, without any prominence. Antennae 4-5-segmented, concolourous with the head, 0.17-0.20× as long as the body ; division between segments IV and V never complete ; hairs on flagellum short, on segment III with 0.02 mm. long, 0.66-1.5× as long as the basal diameter of the segment ; primary rhinaria circular, ciliated ; processus terminalis faintly spinulose, 0.22× as long as base of last antennal segment. Rostrum reaches mid-coxae, ultimate rostral segment stout, 0.90-0.97× as long as the second segment of hind tarsus, without any accessory hairs. Abdominal dorsum pale, membranous without any wax glands, may be with some scattered sclerotic patches ; stigmal pori on sclerotic bases, hairs on dorsum of abdomen sometimes arising from sclerotic bases, on anterior tergites 0.03-0.08 mm. long, 1.0-2.4× as long as the basal diameter of antennal segment III ; 7th and 8th tergite each with 4 hairs, upto 0.08-0.11 mm. long, 2.5-3.0× as long as the mentioned diameter. Cauda broad, pale with 2 hairs. Subanal plate with about 18 hairs ; subgenital plate with about 25 hairs. Legs almost black, short ; hairs on femora and tibiae fine, on hind tibiae upto 0.03 mm. long, 0.50-0.55× as long as the diameter at the middle of the tibiae ; first tarsal segments with 2, 2, 2 hairs. Empodial hairs 0.02 mm. long, 0.33× as long as the claws.

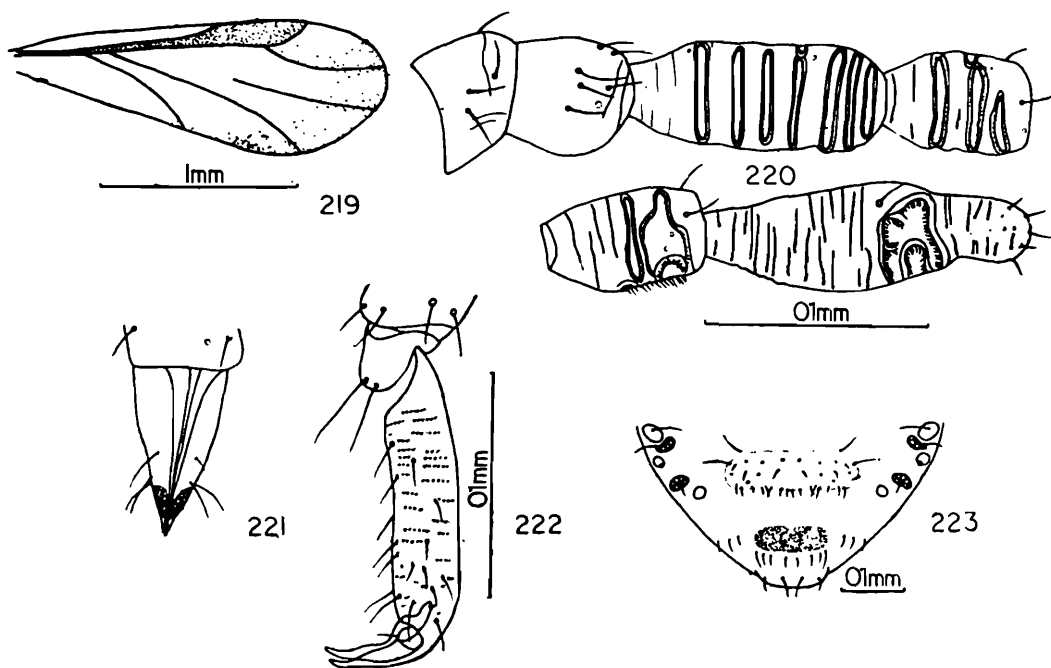
Colour.—Pale brown except on dark head, thorax and legs.

Measurements in mm.—

	Length	Width	Antenna
1.	2.20	1.52	0.37
2.	2.50	1.80	0.39



Epipemphigus imaicus (Chold.); Apterous viviparous female (Fundatrix):
 215. antenna; 216. ultimate rostral segments; 217. hind tarsus; 218. posterior portion of abdomen.



Alate viviparous female : 219. forewing ; 220. antenna ; 221. ultimate rostral segments ; 222. hind tarsus ; 223. posterior portion of abdomen.

I	Antennal segments				urs.	ht ₂
	II	III	IV			
0.06	0.08	0.13	(0.9+0.02)		0.11	0.12
0.08	0.09	0.13	(0.10+0.02)		0.10	0.11

(1, ex. *Ailanthus glandulosus*, Simla, H.P., INDIA, 27.7.1969, Calcutta University Collections, 2, ex. *Populus ciliata*, Chaubattia, U.P., INDIA, 29.5.1969, Calcutta University Collections).

Alate viviparous females.—Body 1.8-2.5 mm. long, elongate ovoid. Head black, sclerotic. Antennae blackish, 6-segmented 0.28-0.33× as long as the body ; segment III equal to segments IV+V taken together, segment IV and V equal, segment VI equal to or slightly longer than III ; hairs on flagellum sparse, upto 0.013-0.020 mm. long, 0.66-0.80× as long as the basal diameter of segment III ; segment III with 4-9 irregular, narrow, ciliated, secondary rhinaria, IV with 2-5, V with 0-1 similar rhinaria ; primary rhinaria irregular with protuberant islands and strongly ciliated which may be furcated ; processus terminalis thick, finger shaped, 0.31-0.33× as long as the base of antennal segment VI.

Rostrum reaches near mid coxae, ultimate rostral segment 0.46-0.51 \times as long as second segment of hind tarsus and without any accessory hairs. Abdominal dorsum pale, membranous ; 1st-7th tergites with small paired marginal wax glands ; fragmented, scattered spinal ones may be variably present on 1st-6th or even on 8th tergite. Hairs on the dorsum of abdomen sparse, on anterior tergites 0.02-0.03 mm. long, 0.8-1.6 \times as long as the basal diameter of antennal segment III ; hairs on 8th tergite upto 0.05-0.06 mm. long, 2.3-3.0 \times as long as the mentioned diameter. Siphunculi hardly discernible. Cauda broad with 2-3 hairs. Subgenital plate with 35-40 hairs. Subanal plate with 12-14 hairs. Legs blackish brown ; longest hair on hind tibiae 0.02-0.03 mm. long, 0.5-0.6 \times as long as the diameter at the middle of the tibiae ; tarsi spinulose ; first tarsal segments usually with 3-4 hairs (4, 3, 3 ; 4, 3, 4 ; 3, 3, 3) ; empodial hair 0.020 mm. long, 0.35-0.40 \times as long as the claws. Forewings with pterostigma brown, veins dark brown, media simple, cubital and anal separated at base ; hind wings with both obliques.

Colour.—Pale in life with dark head, thorax and wing veins.

Measurements in mm.—

	Length		Width	Antenna	
1.	2.41		1.17	0.76	
2.	2.20		1.04	0.74	
3.	1.79		?	0.56	
4.	2.48		?	0.70	

	Antennal segments			urs.	ht ₂
III	IV	V	VI		
0.20	0.10	0.10	(0.15+0.05)	0.09	0.19
0.20	0.10	0.10	(0.15+0.05)	0.09	0.18
0.16	0.08	0.08	(0.12+0.04)	0.09	0.18
0.19	0.09	0.09	(0.15+0.05)	0.09	0.18

(1, 2, ex. *Populus ciliata*, Mussuorie, U.P., INDIA, 21.6.1976, S. Chakrabarti's Collections ; 3, 4, ex. *Ailanthus glandulosus*, Simla, H.P., INDIA, 21.7.1969, Calcutta University collections).

Embryos (from H.R.L. 1966).—Antennae 4-segmented, primary rhinaria transversely oval, on segment III half as large as on segment IV ; processus terminalis with 5 hairs. Wax glands rectangular, probably 4 per segment, arranged in transverse rows and each bearing a hair. Empodial hair $0.33-0.40\times$ as long as the claws.

Material examined.—Seven alate viviparous female and one apterous viviparous female, from galls of *Alianthus glandulosus*, Mashobra, Simla, Himachal Pradesh, INDIA, 27.7.1969, coll. A. N. Chowdhury ; one apterous viviparous female from *Populus* sp., Ranikhet, Uttar Pradesh, INDIA, 29.5.1969, coll. S. Chakrabarty (Calcutta University collections) ; one apterous viviparous female, 6 alate viviparous female and 9 alate nymphs, from *Populus ciliata*, Mussourie, Uttar Pradesh, INDIA, 20.6.1976, 21.6.1976, coll. S. P. Maity and S. Chakrabarti ; six alate viviparous females from *Populus ciliata*, Mussourie, Uttar Pradesh, INDIA, 16.10.1976 ; one aptera and 10 alate viviparous females from *Populus* sp., Ghangaria, Uttar Pradesh, INDIA, 10-12.6.78. coll. S. Chakrabarti and S. P. Maitry (S. Chakrabarti's collections) (also six alate emigrants and one apterous fundatrix of *E. niisimae* (Mats) from *Populus maximowiczii*, Sapporo, Hokkaido, Japan, June 1972, det. S. Aoki).

Discussion.—The species appears to be common in Hills of North West India and forms galls on *Populus ciliata* and *Ailanthus glandulosus*, the latter host is rather unusual for a popular infesting aphid ; however, it is also known to serve as host for another pemphigini i.e. *Kaburgagia ailanthi* in the same region ; the secondary host of *imaicus* remained unknown (as also for *niisimae*) for a long time but recently Habib & Ghani (1970) reported that *Pinus wallichiana* acts as the alternate host for *imaicus* in Pakistan region ; they also collected dark green eggs on old twig-galls and under bark of *P. ciliata* ; galls, pale green to crimson in colour, appear in April-May, on undersurface of mid-rib of leaf ; fundatrigeniae began emerging in May-June and continue to do so till July-August. *Aphelinus nikolskajae* Jashnosh was seen to parasitise the aphid in May-July.

Distribution.—INDIA (Northwest and Sikkim), PAKISTAN, JAPAN, U.S.S.R. (Asiatic part).

Types.—Location of types not known.

9. Genus *Formosaphis* Takahashi 1925

1925. *Formosaphis* Takahashi, R., *Rep. Govt. Res. Inst. Dep. Agric.*, Formosa, 6 : 52. Type species : *Formosaphis micheliae* Takahashi.

Morphology.—Body elongate oval. Head in apterae with large sclerite ; dorsal cephalic hairs minute, little longer in alatae. Antennae 4-5-segmented, upto $0.33\times$ as long as the body ; flagellum smooth, without secondary rhinaria in apterae, in alatae, segments III-V with a large convex area bearing reticulated secondary rhinaria ; primary rhinaria small, circular, ciliated in apterae but without cilia in alatae ; hairs on the flagellum short ; processus terminalis (in apterae) $0.16-0.25\times$ as long as base of last antennal segment. Ultimate rostral segment much longer than the second segment of hind tarsus and bears a pair of accessory hairs. Mesosternal furea slender, distinctly separated. Wax plates present in both apterae and alatae, poorly developed on thorax and basal abdominal tergites, otherwise elliptical, subcircular or oval, bearing a single seta and upto 45 pores ; alatae often with marginal wax plates on 1st-6th tergites. Hairs on the dorsum of abdomen short in apterae, longer and upto twice as long as the basal diameter of antennal segment III in alatae ; 8th tergite with 2-3 hairs. Siphunculi absent. Cauda small, dark, rounded bearing a pair of short hairs. Anal plate rounded with few short hairs (in apterae) and with many long hairs (in alatae). Genital plate shallowly indented, sclerotic, with 18 or more hairs. Gonapophyses 2, each with 5 hairs. Legs with femora fused with trochanters (in apterae) or distinctly separated (in alatae) ; tibiae smooth ; first segments of tarsi with 2, 2, 2 hairs. Forewings with radial sector slightly curved, media simple ; hind wings with media and cubitus united at base.

Sexuales and early nymphal stages not known.

Discussion.—This is a monotypic genus, easily distinguishable from all other related genera by the reticulated rhinaria in alatae and typical host association with Magnoliaceae.

Biology.—The only species is known from *Michelia longifolia* in Formosa, *Michelia compressa* in Japan and *Michelia champaka*, *Magnolia camphelli* and *Magnolia stellata* in India. In the region,

it has only been recorded in localities of North east India, usually at higher altitudes. In China-Japan region, most reports indicate its occurrence during December-April and in India during January to May.

Distribution.—INDIA, CHINA, JAPAN.

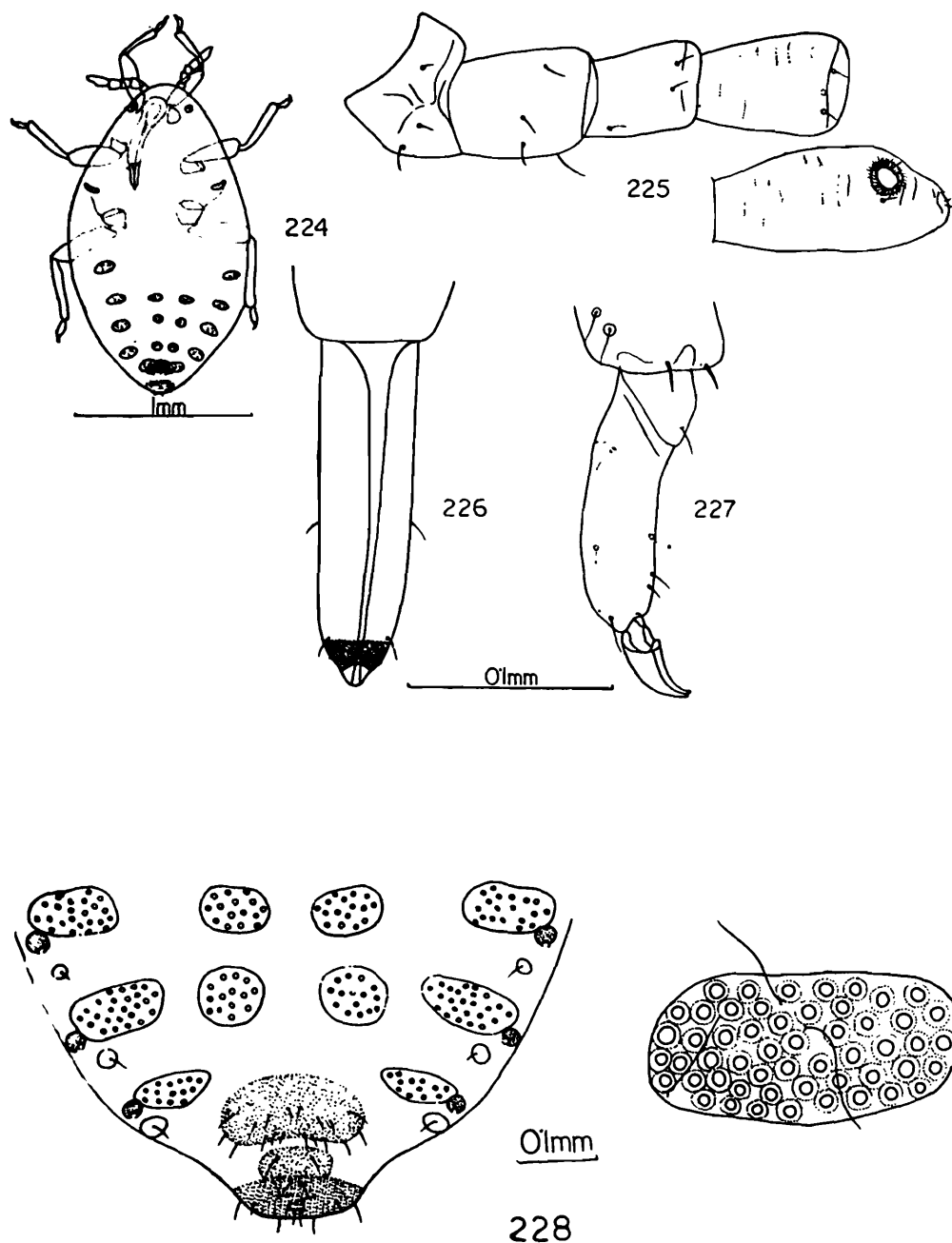
Types.—Probably in the collections of Taiwan Agricultural Research Institute, Taipei, Formosa.

26. *Formosaphis micheliae* Takahashi (Figs. 224-232)

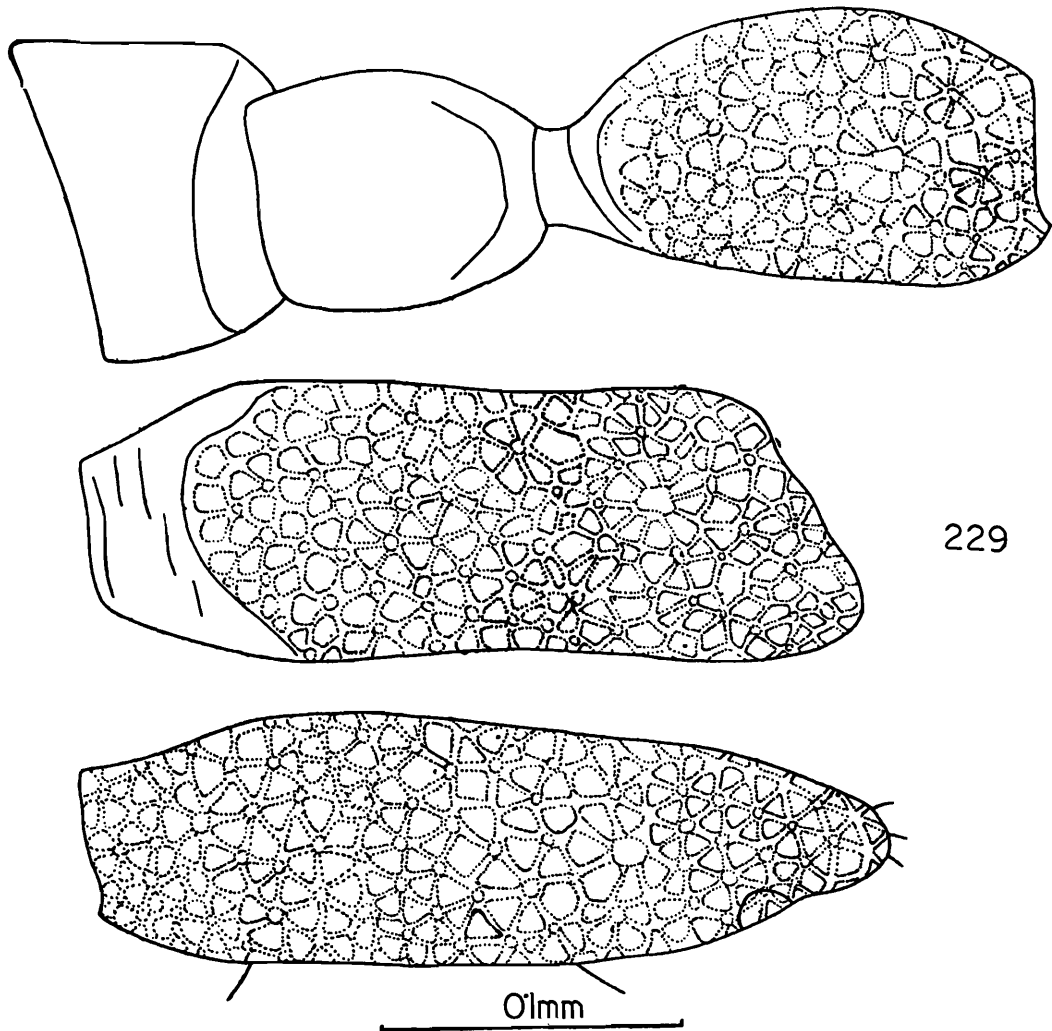
1925. *Formosaphis micheliae* Takahashi, R., *Rep. Govt. Res. Inst. Dep. Agric. Formosa*, 4 : 53.
 1961. *Formosaphis micheliae*, Basu, A. N., *Curr. Sci.*, 30 : 390.
 1963. *Formosaphis micheliae* Takahashi, R., *Kontyu*, 31 (3) : 166.
 1980. *Formosaphis micheliae*, Raychaudhury, D. N., Pal, P. K., Ghosh, A.K., *Aphids of North East India and Bhutan*, 417.

Apterous viviparous females.—Body pale, 1.9-2.1 mm. long with 1.16-1.26 as maximum width. Head with a dusky dorsal sclerite ; dorsal cephalic hairs minute. Antennae dusky, 5-segmented 0.16-0.21 \times as long as the body, segment II longer than wide and longer than segments I, III and IV ; flagellum spinulose ; hairs on the flagellum minute, 0.003-0.006 mm. long, 0.10-0.20 \times as long as the basal diameter of antennal segment III ; primary rhinaria, small, round, ciliated ; processus terminalis 0.16-0.20 \times as long as the base of last antennal segment. Eyes of 3 facets. Rostrum reaches hind coxae, ultimate rostral segment 1.4-1.5 (1.8-1.9 \times) as long as second segment of hind tarsus and bears a pair of accessory hairs. Pronotum usually with a pair of small dorsal sclerites. Wax-gland plates on thorax hardly discernible. Abdominal dorsum with distinct, paired, marginal, elongate wax plates on 3rd-7th tergites and oval, subcircular spinal wax plate on 4th-6th tergites ; each wax plate with a number of pores and one hair ; small wax plate may also be present marginally at the base of a hair ; hairs on the dorsum of abdomen short, on anterior tergites 0.01-0.03 mm. long, 0.36-1.0 \times as long as the basal diameter of antennal segment III, on 7th and 8th tergite 0.03-0.04 mm. long, 1.0-1.2 \times as long as

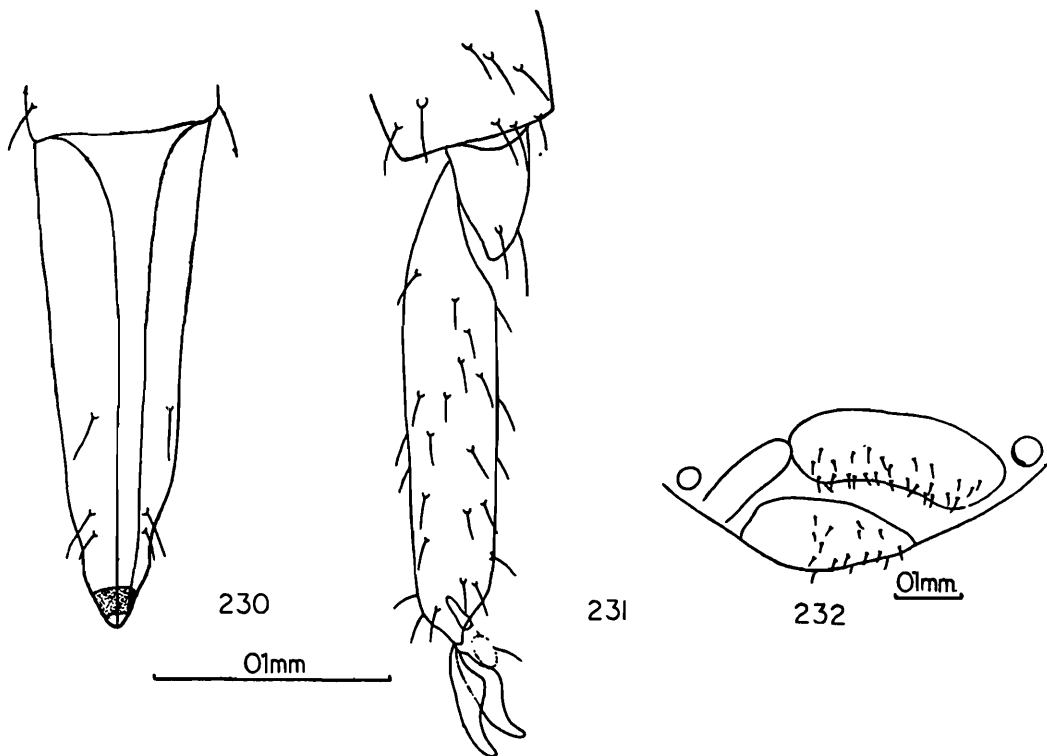
the mentioned diameter. Stigmal pori on sclerotic plates. Siphunculi absent. Cauda small, rounded, blackish with a pair of hairs. Subanal plate dusky, rounded, with about 16-18 short hairs. Subgenital plate sclerotic, with about 18 hairs. Legs dusky, trochanters and femora fused ; hairs on tibiae short, longest one on hind tibiae 0.02-0.03 mm. long, $0.35-0.42\times$ as long as the diameter at the middle of the tibiae ; apical tibial hairs differentiated from others



Formosaphis micheliae Takahashi ; Apterous viviparous female :
 224. whole body ; 225. antenna ; 226. ultimate rostral segments ; 227. hind
 tarsus ; 228. posterior portion of abdomen.



229



230

231

232

Alate viviparous female : 229. antenna ; 230. ultimate rostral segments ;
 231. hind tarsus ; 232. posterior portion of abdomen.

as stout setae (4) ; first tarsal segments with 2, 2, 2 hairs ; empodial hair fine, 0.01 mm. long, about $0.25\times$ as long as the claws.

Colour.—Pale to pale brown with waxy cover.

Measurements in mm.

	Length	Width	Antenna				
1.	1.93	1.16	0.34				
2.	1.93	1.13	0.32				
3.	2.07	1.22	0.43				
4.	2.13	1.26	0.37				
	Antennal segments				urs.	ht ₂	
	I	II	III	IV	V		
	0.05	0.07	0.04	0.05	(0.10+0.016)	0.18	0.12
	0.04	0.08	0.05	0.06	(0.11+0.02)	0.18	0.12
	0.04	0.09	0.06	0.08	(0.11+0.02)	0.18	0.12
	0.04	0.09	0.05	0.07	(0.12+0.02)	0.17	0.12

(1, ex. *Magnolia stellata*, Darjeeling, W.B., INDIA, 9.1.1971, Calcutta University collections ; 2-4 ex. ? *Magnolia* sp., Lamahat, Darjeeling dist., W.B., INDIA, 3.5.1970, Calcutta University collections).

Nymph : Body 1.03 mm. long, pale except on vertex, antennae, legs, and caudal region, which are brown. Antennae 4-segmented, stout, about $0.25\times$ as long as the body ; segment II longer than wide, III with a faint suture (showing demarcation of III and IV), segment IV longest ; hairs on flagellum upto 0.006 mm. long, $0.15\times$ as long as the basal diameter of antennal segment III ; primary rhinaria small, subcircular, ciliated ; processus terminalis $0.14\times$ as long as base of last antennal segment. Rostrum reaches abdomen ; ultimate rostral segment nearly parallel sided, $1.7\times$ as long as second segment of hind tarsus and bears a pair of accessory hairs. Abdominal dorsum pale, showing segmentation ; 3rd-7th tergites each with a pair of elongate oval wax plates ; 4th and 6th tergite each with paired oval, spinal wax plates ;

most of the wax plates with a fine, stiff dorsal hair ; hairs on the dorsum of abdomen sparse, on anterior tergites 0.02-0.03 mm. long $0.62-1.2\times$ as long as the basal diameter of antennal segment III, on posterior tergites 0.03-0.04 mm. long, $1.1-1.4\times$ as long as the mentioned diameter. Siphunculi absent. Cauda with 2 hairs. Subanal plate with 9 hairs. Legs stout, trochanters fused with femora ; first tarsal segments with 2, 2, 2 hairs.

Measurements in mm.—

Length				Antenna	
1.03				0.26	
Antennal segments				urs.	ht ₂
I	II	III	IV		
0.04	0.05	0.08	(0.086+0.013)	0.16	0.09

(ex. *Magnolia stellata*, Darjeeling, W.B., INDIA, 9.1.1971, Calcutta University collections).

Alate viviparous females : Body 2.7 mm. long (2.5-2.7). Head dark brown to black with a distinct median suture ; dorsal cephalic hairs flagellate, always shorter than the basal diameter of antennal segment III. Antennae 5-segmented, stout, $0.33\times$ as long as the body ; segment II half as long as segment III and equal to segment I ; hairs on the flagellum minute ; each of antennal segments III, IV and V with a large reticulated secondary rhinaria ; primary rhinaria small, non-ciliated ; processus terminalis about $0.25\times$ as long as base of last antennal segment. Rostrum reaches beyond mid coxae, ultimate rostral segment $1.3\times$ as long as second segment of hind tarsus and bears a pair of accessory hairs. Thoracic tergum without any wax plate. Abdominal dorsum with a median sclerite ; dorsal wax plates composed of subcircular, oval or polygonal pores present on 3rd-7th tergites arranged in a median longitudinal row, their number varying between 2-4 (4, 4, 2, 2, 4, 2) ; besides these, marginal wax plates present on 1st-6th tergites ; hairs on the dorsum on abdomen fewer on posterior tergites, at most $2.0\times$ as long as the diameter at the constricted base of antennal segment III ; 8th tergite with 2-3 hairs. Siphunculi absent.

Cauda broad. Subanal plate rounded with numerous hairs. Subgenital plate slightly indented with many hairs on posterior margin. Legs with trochanters and femora distinct ; longest hair on hind tibiae hardly 0.40-0.50× as long as the diameter at the middle of the tibiae ; first tarsal segments with 2, 2, 2 hairs. Forewings with pterostigma short, media simple ; hind wings with 2 obliques, fused at base.

Colour.—Apparantly dark brown in life.

Measurements in mm.—

Length	Width					Antenna	
2.71	1.57					?	
	Antennal segments					urs.	ht ₂
I	II	III	IV	V			
0.08	0.08	0.15	0.22	(0.28+0.07)	0.22	0.17	

(ex. *Magnolia stellata*, Darjeeling, W.B., INDIA, 9.1.1971, Calcutta University collections).

Material examined.—One alate, two apterous viviparous females and two nymphs, from *Magnolia stellata*, Lloyds Botanical Garden, Darjeeling, West Bengal, INDIA, 9.1.1971 (PLK 3605) ; Five apterous viviparous females from unidentified host, Lamahat, Darjeeling, West Bengal, INDIA, 3.5.1970, (PLK 1979) (Calcutta University collections).

Discussion.—The species appears to be common in localised area of Darjeeling district West Bengal, on Magnoliaceae. The Indian specimens as pointed out by Ray Chaudhuri, Pal, Ghosh (1980) differ from Japanese ones, in having always 5-segmented antennae, spinulose flagellum, absence of wax plates on 1st-2nd tergite in alatae etc., besides antennal segment II is always longer than III in apterae in this region. Life-cycle of the species remains unknown.

Distribution.—INDIA (West Bengal, Manipur) ; FORMOSA, JAPAN.

Types.—Probably in the Agricultural Research Institute, Taipei, Taiwan.

10. Genus *Pemphigus* Hartig, 1839.

1839. *Pemphigus* Hartig. Th., Jber Fortschr, Forstwiss u. forstl. naturk. im. Jahre 1836 u 1837, 1(4) : 645. Type species *Aphis bursaria* Linnaeus (designated by Fitch, 1855, p. 73).
1835. *Rhizobius* Burmeister, H., *Handbuch der Entomologie*, Berlin, 87. Type species : *Rhizobius pilosellae* Burmeister=*Aphis bursaria* Linnaeus.
1840. *Rhizophthiridium* van der Hoeven, *Handboek der Dierkunde* Ed. 2. Amsterdam 1 : 508, Type species : *Rhizobius pilosellae* Burmeister=*Aphis bursaria* Linnaeus.
1847. *Aphioides* Rondani, C., *Nuovi Ann. Sci. nat. Bologna*, (2) 8:439. Type species : *Aphis bursaria* Linnaeus.
1860. *Rhizobius* Passerini, G., *Gli Afidi*, Parma, 30. Type species : *Rhizobius sonchi* Passerini=*Aphis bursaria* Linnaeus.
1885. *Kessleria* Lichtenstein, J., *Monographie des Pucerons du peuplier*, Montpellier, 16. Type species : *Pemphigus spirothecae* Passerini=*Pemphigus spyrothecae* Passerini.
1904. *Hamadryaphis* Kirkaldy, G. W., *Entomologist*, 37:279. Type species : *Pemphigus spirothecae* Passerini=*Pemphigus spyrothecae* Passerini.
1930. *Pemphiginus* Börner, C. *Arch. Klassif phytogen. Ent.*, 1:153. Type species : *Pemphigus populi* Courchet.
1944. *Baizongiella* Blanchard, E. E. *Acta zool. lilloana*, 2:44. Type species : *Baizongiella solanophila* Blanchard=*Pemphigus canadensis* Del Guercio.

Morphology : Body 1.5-3.8 mm. long. Antennae 0.10-0.33× as long as the body, usually 4-segmented in fundatrices, 5-6 segmented in apterae and 6-segmented in alatae ; secondary rhinaria absent in apterae, annular in alate migrants and present on segments III-VI, much fewer and elongate oval in alate exules and sexuparae and present only on segments III-IV ; antennal segment III with at most 15 secondary rhinaria and other segments with fewer than 10 secondary rhinaria ; secondary rhinaria non-ciliated, primary rhinaria distinctly ciliated ; processus terminalis in alatae, short, stout or long and slender, 0.16-0.25× as long as the base of antennal segment VI. Ultimate rostral segment usually about 0.50× as long as second segment of hind tarsus and without any accessory hairs at any stage of development. Thorax usually with wax glands at least in fundatrices and apterous exules and often in alate sexuparae, the latter morphs may also bear a pair of small wax glands on head, which are otherwise absent in other morphs. Abdominal dorsum with 6 rows of longitudinal wax glands on 1st-7th tergites in fundatrices and with 4 similar rows in apterous exules ; alatae usually with some small glands on anterior abdominal

tergites or these may be absent ; abdominal was gland may be composed of distinctly separated facets or facets may be appressed together. Spiracles on 1st and 2nd abdominal tergites placed wide apart. Hairs on the dorsum of abdomen usually long and fine ; 8th abdominal tergite with 2-8 hairs. Siphunculi usually present as mere rings, only in spring migrants, otherwise absent in other morphs (except in apterae and first instar larvae of monoecious species *siphunculatus* H.R.L.). Cauda rounded, usually with 2-5 (sometimes 8) hairs. Subgenital plate with 9-44 hairs arranged in two groups. Legs with tibiae and tarsi usually smooth but tarsi may be ventrally spinulose [as in *P. microsetosus* Aoki, *P. (Parathecabius) saliciradicis* (Börner)]. First tarsal segments with 2-4 hairs, sometimes these may be short and spine like. Empodial hairs at most $0.66\times$ as long as the claws. Forewings with media simple, stigma short, truncate, radial sector curved ; hind wings with both obliques.

First instar larvae of fundatrices have 4-segmented antennae, partially or wholly sclerotized thoracic and abdominal tergites (at least in some species e.g. *dorocola*), well developed dorsal hairs and pointed or capitate lateroapical hairs on second tarsal segment. First instar larva of emigrants also have 4-segmented antennae and often traces of siphunculi and short, pointed or long capitate empodial hairs. First instar larvae of exules are reported to be similar to the adults in general (Aoki, 1975).

Sexuales apterous, very small and arostrate. Oviparae usually lay single egg.

Discussion.—The genus has been recognised as a difficult one by most of the aphidologists and taxonomy of many of the species remain unsatisfactory due to lack of information on their biology. Eastop and Hille Ris Lambers (1976) listed about 60 valid species from the World and also indicated the changed status of a number of species recorded earlier under this genus.

The genus *Parathecabius* Börner, 1950, was erected for a group of species including *saliciradicis*, related to *Thecabius*. Later, Hille Ris Lambers (1952) indicated strong similarity between apterous exules of *Parathecabius saliciradicis* Börner and *Pemphigus*

species and transferred *saliciradicis* to *Pemphigus* ; Stroyan (1969) considered *Parathecabius* as a subgenus of *Pemphigus*. Aoki (1975) tentatively synonymised both *Thecabius* and *Parathecabius* with *Pemphigus*. Eastop and Hille Ris Lambers (op. cit), however, retained separate identity for all three taxa and considered *Parathecabius* as a subgenus of *Thecabius* and all the species of *Pemphigus* have been listed by them under a single genus.

A total of 12 species have been recorded from the region including four recently described/recorded species not enlisted by Eastop and Hille Ris Lambers (op. cit) ; of these 12, Buckton (1896) described two species, *immunis* and *napaeus* from Poplar galls in Kashmir region ; later, Keiffer (1908) described *P. indicus* from leaf gall of unidentified plant and Cholodkovsky (1912) described three other species, *mordwilkoii*, *nainitalensis* and *imacius* from galls of *P. ciliata* in N.W. Himalaya (subsequently *imacius* has been designated as the type species of *Epipemphigus* by Hille Ris Lambers) ; Ghulamullah (1941) described *spirothecaefacies* from Poplars in Afghanistan but it is now considered as a synonym of *vesicarius* and Mathur and Singh (1959) recorded *spirothecae* Passerini on leaves and twigs of *Populus nigra* in India ; Hille Ris Lambers (1973) described *siphunculatus* from galls of *Populus ciliata* in Murree Hills, Pakistan. Pal (1975) while working on subterranean aphids from Darjeeling and Sikkim, Himalaya described *vulgaris* from roots of *Triticum vulgare* and Mondal (1977) described another species *eastopi* from petiole galls and pseudogalls of an unidentified host, in Sikkim. Habib and Ghani (1970) mentioned about two more new species *P. venosus* and *P. ignotus* from West Pakistan. As such ten species appear to be endemic in origin and most of the species are known only by either alate or apterous forms collected in the galls.

Biology.—Most of the species are known to form true galls on leaf and petiole of *Populus* spp. (winter host) and at least some are known to alternate between Poplar galls and roots of herbaceous plants including Chenopodiaceae, Compositae, etc. (summer host); many species may be holocyclic on Poplar and some species may be anholocyclic on roots of herbaceous hosts. Lange (1964) has stated that in Nearctic region majority of the species are associated with Black Poplar group and are restricted to these hosts ; a few

species have Balsam group of Poplar as hosts and fewer ones are associated with White Poplars.

Galls of many species are yellow green in colour but may be distinctive and attempts have been made to identify the aphids from the shape and location of the galls on the plant (Harper, 1959) but as Lange (op. cit) has mentioned that occasionally members of one species may crawl into the galls of another species, this can lead to misidentification of the species only on the basis of galls. Most of the galls produced by *Pemphigus* species indicate a swelling and twisting and with age they seem to develop a type of differential stress leading to the opening for escape of alate migrants; fundatrices have often been credited for the initiation and development of galls, as the galls show no significant change even when harbouring progeny of next generation. Spiral galls of *Pemphigus* provide protection from parasite, predators and adverse weather condition and in case of holocyclic monoecious species, only the sexuales spend their life outside the gall, under the bark (Chan and Forbes, 1975).

Tullgren (1909) and Börner (1952 a) have given accounts of biology of several Palaeartic species. Aoki (1975) while describing Japanese species of *Pemphigus* has shown the details of galls produced by them and Dunn (1970) has discussed the formation of galls by members of this genus.

Details of biology for most of the species in the region remain unknown. Biology of *P. immunis* Buck, which is widely distributed in Palaeartic and temperate Oriental regions, has been known from Europe under the name of *lichtensteini* Tullgren.

Distribution.—Cosmopolitan ; Roberti (1938), Palmer (1952), Zwölfer (1957), Stroyan (1964), Harper (1959), Aoki (1975) have given accounts of the species from some areas of Palaeartic and Nearctic regions.

Type species.—*Aphis bursaria* Linnaeus, 1758. Earlier authors e.g. Baker (1920) credited Passerini for fixing the type of *Pemphigus* but Eastop and Hille Ris Lambers (1976) mentioned that Fitch (1855) had designated *busaria* as the type of *Pemphigus*, in a foot note on p. 73.

Key to the species of *Pemphigus**Apterous viviparous females* (from Galls)

1. Siphunculi present. Antennae 6-segmented.
Cephalic wax glands absent .2 (2nd generation)

—Siphunculi absent. Antennae 4-5-segmented.
Cephalic wax gland present or absent. .3 (fundatrix)

2. Body 1.4-1.5 mm. long. Ultimate rostral segment 0.07-0.08 mm. long, 0.7-0.8 × as long as the second segment of hind tarsus. Wax plates large, present on 1st-7th abdominal tergites, at least 4 on all segments, wax plate on 4th tergite 0.05 × 0.08 mm. (marginal) 0.104 × 0.065 mm. (pleural) 0.104 × 0.052 mm. (spinal), on 7th, 0.078 × 0.117 mm. (pleural), 0.138 × 0.052 mm. (spinal). Dorsal hairs minute, 0.01-0.02 mm. long. Subanal plate with 20 hairs. Subgenital plate with 10-12 hairs. Empodial hairs minute .*P. spyrotheceae* Passerini

—Body 1.9-3.3 mm. long. Ultimate rostral segment 0.085-0.105 mm. long, 0.56-0.59 × as long as second segment of hind tarsus. Only one pair of small marginal wax plates, present on 1st-2nd tergites, wax plate on 4th tergite, 0.061 × 0.069 mm. (marginal), 0.069 × 0.061 mm. (pleural), 0.050-0.061 mm. (spinal), on 7th tergite, 0.056 × 0.102 mm. (pleural) and 0.069 × 0.093 mm. (spinal). Dorsal hairs 0.02-0.04 mm. long. Empodial hair 0.33-0.50 × as long as the tarsal claws .*P. siphunculatus* H. R. L

3. Ultimate rostral segment 0.17 mm. long, equal to second segment of hind tarsus. Antennae 5-segmented. Wax plates present on 1st-7th abdominal tergites. Subanal plate with 17 hairs. Subgenital plate with 36 hairs .*P. napeus* Buckton

—Ultimate rostral segment 0.57-0.65 × as long as second segment of hind tarsus. Antennae 4-segmented. Subanal plate with 24-40 hairs

4. Subanal plate with 24 and subgenital plate with 16 hairs. Dorsal cephalic hairs 0.016-0.018 mm. long. Antennae 0.16-0.18 × as long as the body. Dorsal hairs 0.016-0.030 mm. long. Processus terminalis 0.13-0.15 × as long as the base of segment IV. Empodial hair 0.014-0.016 mm. long

.P. eastopi Mondal

—Subanal plate with 30-40 and subgenital plate with 20-25 hair. Antennae 0.11-0.16 × as long as the body. Dorsal hairs 0.020-0.033 mm. long. Processus terminalis up to 0.25 × as long as the base of segment IV. Empodial hair 0.006-0.013 mm. long

.5

5. Dorsal wax plate composed of one large cell surrounded by incomplete ring-like narrow peripheral cell. Marginal wax plates, 0.138 × 0.117 mm. (4th tergite) and 0.104 × 0.065 mm. (7th tergite) ; spinal wax plates 0.138 × 0.078 mm. (4th tergite) and 0.117 × 0.078 mm. (7th tergite). Dorsal hairs 0.020-0.026 mm. long, 0.28-0.44 × as long as the basal diameter of antennal segment III. Subanal plate with 36-40 hairs. Subgenital plate with 20 hairs. Longest hair on hind tibia 0.010 mm. long. Empodial hair 0.013 mm. long. On *Populus ciliata* (Twig galls)

P. mordvilkoii Cholod.

—Dorsal wax plates at most always with only a large central cell and without any narrow peripheral cells ; marginal plates 0.0138 × 0.104 mm. (4th tergite) and 0.151 × 0.091 mm. (7th tergite) ; spinal wax plates 0.104 × 0.104 (4th tergite) and 0.078 × 0.104mm. (7th tergite). Dorsal hairs 0.023-0.033 mm. long, 0.60-0.83 × as long as the basal diameter of antennal segment IV. Subanal plate with 30 hairs. Subgenital plate with 24-25 hairs. Longest hair on hind tibiae 0.016 mm. long. Empodial hair 0.006 mm. long. On *Populus nigra* (Twig galls)

.P. immunis Buckton

Alate viviparous females : (from galls)

1. Antennal segment III equal to segments IV+V+VI taken together ; segment IV with 12, IV 5-6 and V with 3 and VI and 2 secondary rhinaria. Leaf galls on unidentified plant.

.P. indicus Keiffer

- Antennal segment III always distinctly shorter than segment IV+V+VI taken together ; secondary rhinaria variable in number and distribution. .2.
2. Antennae 1.0 mm. long, $0.50 \times$ as long as the body, segment III with 15, IV with 4, V with 4 and VI with 5 secondary rhinaria. Abdominal dorsum with 1-2 pair of wax plates on 1st-7th tergites and a submedian plate on 8th. Galls of Hazel-nut size. On Poplar .*P. nainitalensis* Cholod
- Antennae never 1.0 mm. long, always much shorter than $0.50 \times$ as long as the body. Wax plates variably present. Galls of variable size. 3.
3. Siphunculi present, pale, pore-like or a ring. Antennae with or without secondary rhinaria on V and VI. Ultimate rostral segment 0.08-0.10 mm. long, second segment of hind tarsus 0.16-0.19 mm. long. Subgenital plate with at most 24 hairs. Hairs on hind tibiae up to 0.020-0.026 mm long. .4.
- Siphunculi absent. Antennal segment III with 7-16, IV with 2-6, V with 2-6 and VI with 0-6, elongate, irregularly placed secondary rhinaria. Ultimate rostral segment 0.12-0.13 mm. long, second segment of hind tarsus 0.19-0.24 mm long. Subgenital plate with at most 40 hair. Hairs in tibiae up to 0.020-0.037 mm. long. Galls roundish, shiny green. .5.
4. Antennae without secondary rhinaria on V and VI, secondary rhinaria large (7-9 on IV, 2-4 on IV) encompassing the width of the segment ; primary rhinaria on segment V very large, 0.057×0.057 mm. ; processus terminalis $0.23-0.25 \times$ as long as base of segment VI. Dorsal hairs up to $1.1-1.6 \times$ as long as the basal diameter of antennal segment III. 8th tergite with 2 hairs on the median wax plate. Subanal plate with 20 hairs. Galls on *Populus nigra* .*P. immunis* Buckton

—Antennae with secondary rhinaria, on III : 11-13, IV : 3-5, V : 3-5, VI : 3-5, primary rhinaria on V elongate never as large as above ; processus terminalis 0.17-0.18 \times as long as base of segment VI. Dorsal hairs up to 0.64-0.83 \times as long as the basal diameter of antennal segment III. 8th tergite with 4 hairs. Subanal plate with about 12 hairs. Galls on *Populus ciliata*

.*P. mordvilko*i Cholod.

5. Secondary rhinaria large, vesicular, irregularly distributed, on segment III : 10-16, IV 4-6, V 3-6, VI : 3-6 ; processus terminalis 0.16 \times as long as base of segment VI. Ultimate rostral segment slender, 1.5 \times as long as its width, 0.61 \times as long as second segment of hind tarsus. Hairs on tibiae up to 0.037 mm. long. Galls green, variegated. On Poplar

.*P. napeus* Buckton

—Secondary rhinaria transversely elongated, distributed on segment III : 7-9, IV : 2-4, V : 0-2 ; processus terminalis 0.25 \times as long as base of segment VI. Ultimate rostral segment twice as long as wide, 0.50-0.54 \times as long as second segment of hind tarsus. Hairs on tibiae up to 0.020 mm. long. Galls up to 4 cm. dark green to reddish. On *Populus nigra*.

.*P. vesicarius* Passerini

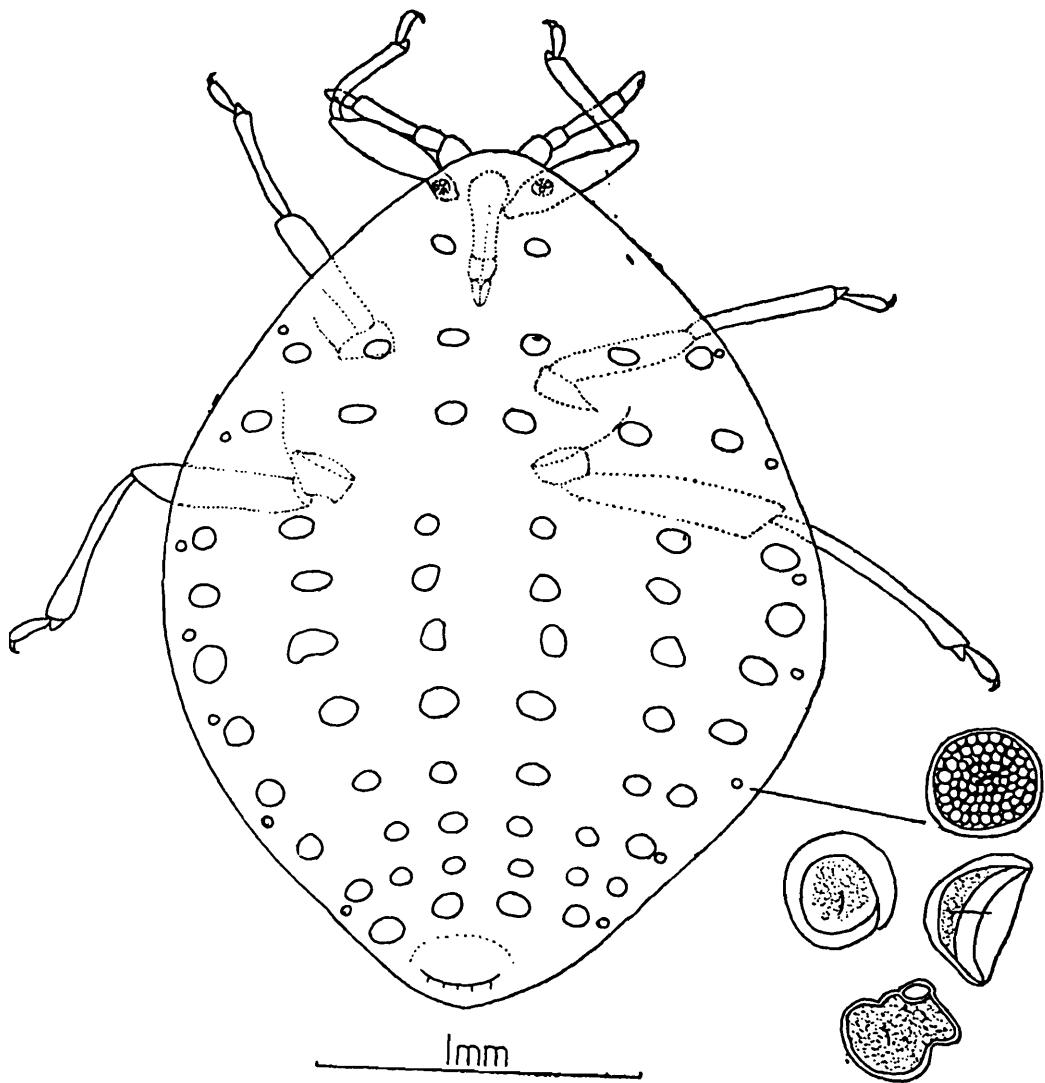
[Sexuparae of *spyrothecae* is not included ; it may be separated by few rhinaria on III, IV, V (0-3), few hairs on subanal plate (10-11), ratio of antennae to body (0.25-0.29 \times).

27. *Pemphigus eastopi* Mondal (Figs. 233-237)

1977. *Pemphigus eastopi* Mondal. P. K. Aphids of Sikkim, PhD. Thesis, Univ. Calcutta, p. 345.

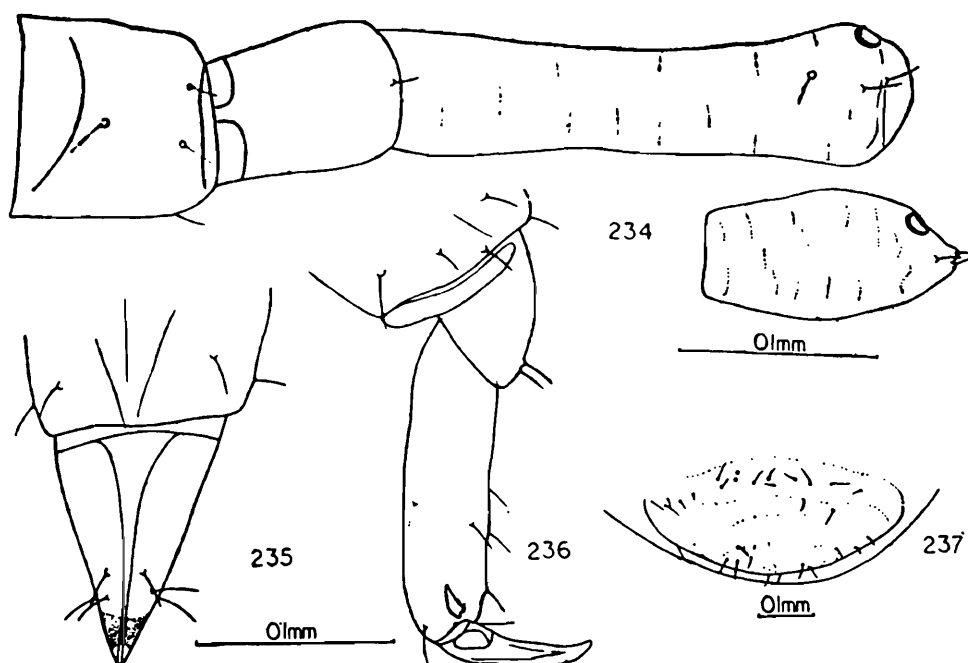
Apterous viviparous female (Fundatrix).—Body large, ovoid 2.77-3.03 mm. long with 1.93-2.07 mm. as maximum width. Head with a brown sclerite and a distinct median suture, partly fused with prothorax ; vertex scabrous, dorsal cephalic hairs sparse, 0.016-0.018 mm. long, about 0.33 \times as long as the basal diameter

of antennal segment III. Eyes of 3 facets. Antennae 4-segmented (sometimes with a trace of segmentation on segment III), pale, $0.16-0.18\times$ as long as the body ; flagellum imbricated ; hairs on flagellum minute, on segment III, 0.001 mm. long, $0.22-0.25\times$ as long as the basal diameter of the segment ; primary rhinaria round, ciliated , processus terminalis $0.13-0.15\times$ as long as base of last antennal segment. Rostrum short, reaches near midcoxae ; ultimate rostral segment $0.62-0.64\times$ as long as the second segment of hind tarsus and bears only 3 pair of preapical hairs. Wax plates present in pair, spinally and marginally on all thoracic and 1-7th abdominal tergites ; pleural wax plates present on meso- and meta-thoracic segments and on 1st-6th abdominal tergites ; those on 7th tergite, become confluent with the marginal ones ; each of the



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Pemphigus eastopi : apterous viviparous female (fundatrix) : 232. whole body



Pemphigus eastopi Mondal ;

apterous viviparous female (fundatrix) :

234. antenna ; 235. ultimate rostral segments ; 236. hindtarsus ; 237 posterior portion of abdomen.

wax-plate with a number of round rather indistinct wax pores, and some of these plates bear a fine hair. Abdominal dorsum pale ; hairs on the dorsum of abdomen fine, on anterior tergites upto 0.016-0.021 mm. long, on posterior tergites 0.023-0.030 mm. long, these being 0.38-0.50 \times and 0.53-0.58 \times as long as the basal diameter of antennal segment III, respectively. Siphunculi absent. Cauda sclerotic, broad, semicircular with few (7 ?) hairs. Subanal plate with about 24 hairs. Subgenital plate sclerotic, with about 16 hairs (0.023-0.026 mm. long) arranged in two groups, besides some minute hairs (0.006 mm. long). Gonapophyses 2, each with 5-6 hairs. Legs brownish, imbricated on femora and tibiae ; longest hair on hind tibiae, 0.013-0.020 mm. long, 0.21-0.38 \times as long as the diameter at the middle of hind tibiae ; first tarsal segments with 2, 2, 2 hairs ; empodial hair 0.014-0.016 mm. long, 0.20-0.23 \times as long as the claws.

Colour.—Pale with head and legs dusky, remains covered with powdery-waxy coating.

Measurements in mm. :

	Length	Width	Antenna		
1.	2.72	1.93	0.45		
2.	3.03	2.01	0.52		
3.	2.80	2.07	0.45		
4.	2.80	2.02	0.52		
	Antennal segments			urs.	ht ₂
I	II	III	IV		
0.06	0.07	0.18	(0.10+0.010)	0.11	0.17
0.07	0.07	0.19	(0.10+0.013)	0.10	0.16
0.06	0.07	0.22	(0.10+0.013)	0.11	0.17
0.07	0.08	0.23	(0.11+0.016)	0.10	0.16

(1-4 ex. galls of unidentified plant Lachung, Sikkim, 6.6.1975, coll. P. Mondal, Paratypes (PE 29), Calcutta University collections).

Larva.—Not known.

Alate viviparous female.—Not known.

Material examined.—One apterous viviparous female from unidentified plant, Taungthung, Sikkim, 9.6.1975, (Holotype), 4 apterous viviparous females (Paratypes) from an unidentified plant, Lachung, Sikkim, 6.6.1975, coll. P. Mondal (Calcutta University collections).

Discussion.—Mondal (Ph. D. Thesis, C.U.), mentions that *P. eastopi* was collected at Taungthung (ca. 1666 m., 9.6.1975) and at Lachung (ca. 3000 m., 6.6.1975) from leaf-galls (pseudogall and petiole-gall) of an unidentified plant. Mondal (op. cit) also recorded *E. imaicus* from the same locality, on the same date, from "Stem-galls" of an unidentified plant but did not indicate whether unidentified host-plants of *P. eastopi* and *E. imaicus* are the same; the latter species is known to form only leaf-gall on *Populus ciliata* and in case the host of *P. eastopi* and *E. imaicus* is the same then

it should be a *Populus*. Examination of type-series of *P. eastopi*, at Calcutta University further confirms the supposition as it also contains two fundatrices and 4 nymphs of *E. imaicus*; the report of *E. imaicus*, from Stem-gall, if correct, should be of additional importance as both the species of *Epipemphigus* i.e., *nisimae* and *imaicus* are only known from leaf-galls.

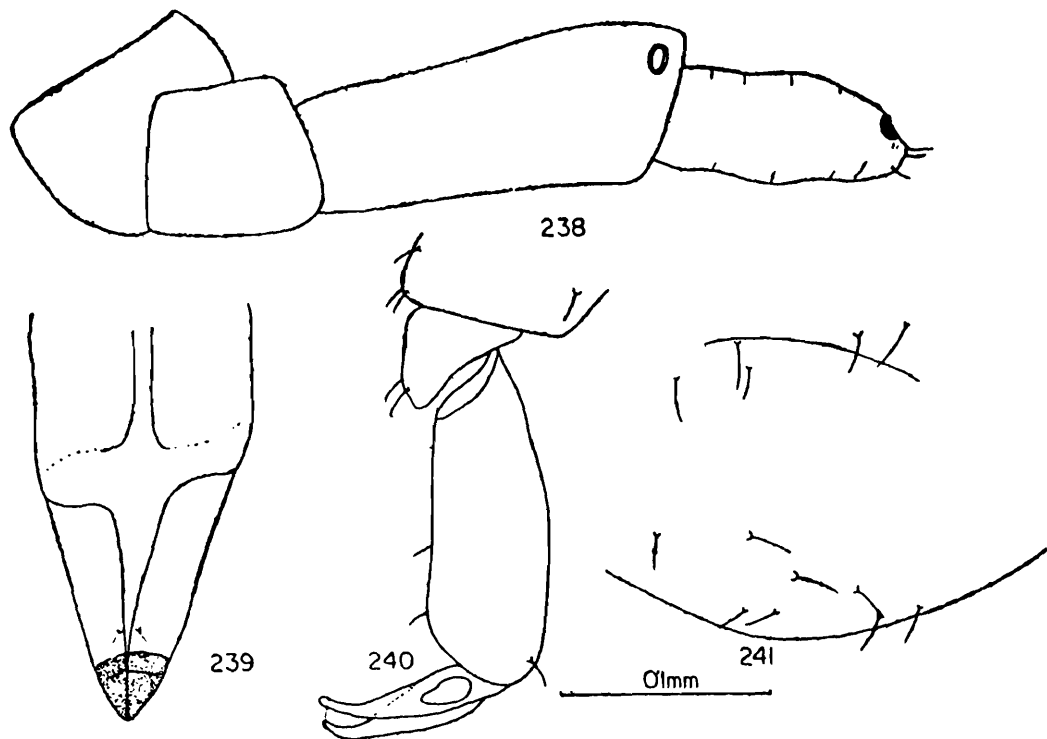
Distribution.—INDIA (Sikkim).

Types.—In the collections of Entomology Laboratory, Department of Zoology, University of Calcutta, India.

28. *Pemphigus immunis* Buckton (Figs. 238-246)

1896. *Pemphigus immunis* Buckton, G.B., *Indian Nus. Notes*, 4 : 51.
 1896. *Pemphigus bursarius*, Lichtenstein, J. *Monog. des. Pucerons du Peuplier*, Montpellier, 29.
 1909. *Pemphigus lichtensteini* Tullgren, A., *Ark. Zool.*, 5 (14) : 148.
 1915. *Pemphigus globolus* Theobald, F.V., *Bull. ent. Res.*, 6 : 147.
 1936. *Pemphigus napaeus*, Tseng, S. and Tao, C. C., *Entomology Phytopath.*, 4 : 168.
 1941. *Pemphigus paghnanensis* Ghulamullah, *Indian J. Ent.*, 3 : 233.
 1969. *Pemphigus immunis*, Doncaster, J. P. *Proc. R. ent. Soc. Lond.*, (B) ; 38 (11-12) : 158.
 1970. *Pemphigus lichtensteini*, Habib, Rehana & Ghani, M.A. *Tech. Bull Commw. Inst. Biol. Control.*, 13 : 47.
 1971. *Pemphigus immunis*, Ghosh, A. K., Chakrabarti, S., Raychaudhuri, D. N., *Curr. Sci.* 37 : 248.

Apterous viviparous female. : (fundatrix ; description based on material from Iraq.). Body 3.70 mm. long (3.5-4.0 mm.), suboval, appears considerably enlarged, with 3.2 mm. as maximum width. Head distinctly sclerotic, dark on vertex, much wider than long and bears two round wax plates on the dorsum. Antennae 4-segmented, pale except on segment IV which is brownish, 0.41 mm. long (0.40-0.50 mm.), 0.11 × as long as the body ; segment I much wider than long, segment II half as long as segment III which is longest and enlarged distally ; hairs on the flagellum minute, sparse ; primary rhinaria round, ciliated ; processus terminalis extremely short, with 5 preapical setae. Rostrum reaches near midcoxae, ultimate rostral segment 0.64 × as long as second segment of hind tarsus

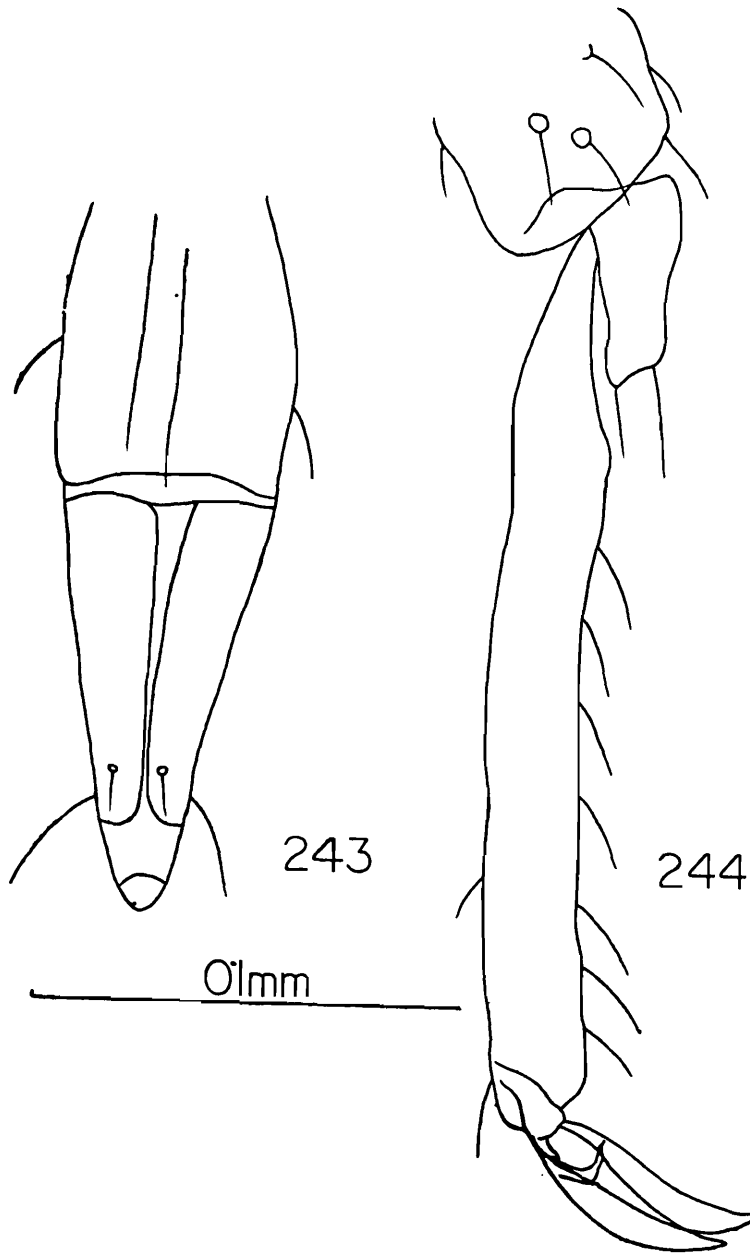
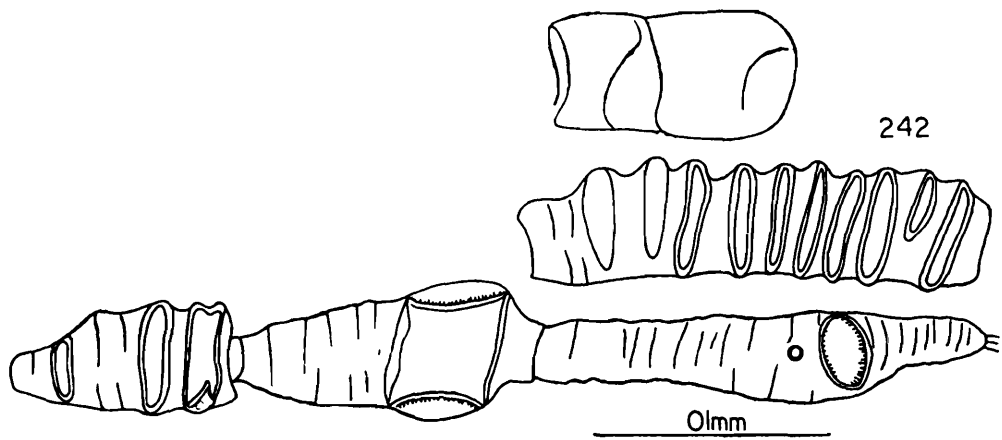


Pemphigus immunis Buckton ; Apterous viviparous female (fundatrix) :
 238. antenna ; 239. ultimate rostral segments ; 240. hind tarsus ; 241. posterior portion of abdomen.

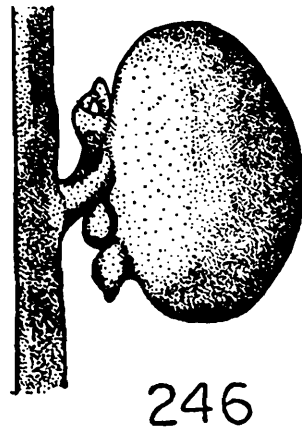
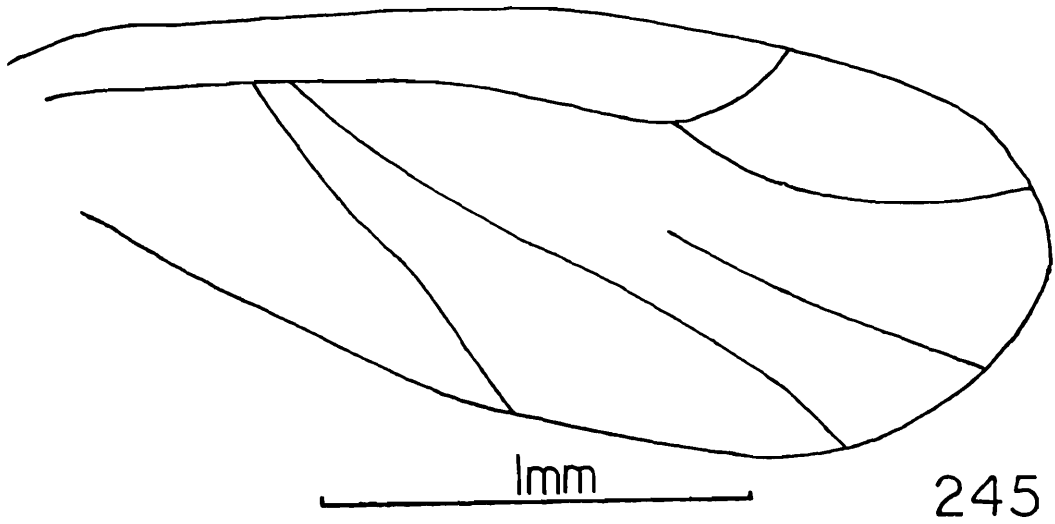
and without any accessory hairs. Thoracic tergum pale, with 4 wax plates on prothorax and 6 each on meso—and metathorax. Abdominal dorsum pale, with 6 wax plates on 1st-6th tergites, 4 on 7th tergite, the lateral ones being larger than others ; each wax plate with a large number of small, round to elliptical, pale wax pores. Hairs on the dorsum of abdomen fine, on anterior tergites upto 0.023 mm. long, on posterior tergites 0.026-0.033 mm. long, these being $0.60\times$ and $0.66-0.83\times$ as long as the basal diameter of antennal segment III, respectively. Siphunculi absent, Cauda small, little brownish with a few fine, stiff hairs. Subanal plate with about 30 hairs. Subgenital plate with 24-25 hairs. Legs dark brown, fore—and mid-femora longer than tibiae ; trochanters fused with femora ; hairs on legs fine, longest one on hind tibiae 0.016 mm. long, $0.27\times$ as long as the diameter at the middle of the tibiae ; first tarsal segments with 2, 2, 2 hairs ; empodial hair minute, 0.006 mm. long.

(figures in parenthesis from Roberti, 1938).

Colour.—Glaucus green, according to Roberti (1938).



Alate viviparous female (fundatrigenia) : 242. antenna ; 243. ultimate rostral segments ; 244. hind tarsus.



Alate viviparous female (fundatrigenia) : 245, forewing
Galls : 246. stem gall on *Populus nigra*.

Measurements in mm.—

Length		Width		Antenna	
3.70		3.20		0.41	
Antennal segments				urs.	ht ₂
I	II	III	IV		
0.5	0.8	0.16	0.12	0.11	0.16

(ex. *Populus nigra*, Mosul, IRAQ, 26.6.1965, coll. H. E. Knopf, BMNH 848/68).

Larva (from Roberti, 1938) : Body about 0.50 mm. long, with a number of sclerotic plates on thoracic and abdominal dorsum, indicative of the future wax plates. Antennae 4-segmented, sclerotic, about $0.25\times$ as long as the body ; segment I wider than II, which is longer than III, segment IV longest, nearly equal to segments II+III taken together. Abdominal dorsum with a series of sclerotic plates, each bearing a stiff hair. Legs chitinous bearing long hairs ; femora enlarged, as long as tibiae ; first tarsal segments with long hairs ; empodial hair fine, longer than claws.

Colour.—Dark green to nearly olive.

Alate viviparous female.—(fundatrigenia) : Body elongate 2.25-2.48 mm. long with 1.10-1.30 mm. as maximum width. Head dark, sclerotic. Antenna 6-segmented $0.30\times$ as long as the body, almost concolourous with the head ; segment I broader than long, equal to segment II, hairs on the flagellum sparse, minute, those on segment III hardly 0.003 mm. long and $0.25\times$ as long as the basal diameter of the segment ; segment III with 7-9 narrow transverse, secondary rhinaria, segment IV with 2-3 similar rhinaria, primary rhinaria on segment IV very large, almost encompassing the entire width (0.050×0.049 mm.), on VI much smaller (0.023×0.021 mm.) and distinctly ciliated ; processus terminalis $0.23-0.25\times$ as long as the base of segment VI. Rostrum dark, reaches near mid-coxae ; ultimate rostral segment $0.50-0.54\times$ as long as second segment of hind tarsus and bears 0 (1) accessory hairs. Abdominal dorsum pale, at least with paired spinal wax plates on 1st-4th tergites ; each of the 1-7th tergites may also bear paired marginal plates ; 8th tergite with a single large median wax plate bearing two hairs. Hairs on dorsum of abdomen sparse, on posterior tergites 0.026-0.033 mm. long, $1.1-1.6\times$ as long as the basal diameter of antennal segment III. Siphunculi pore-like. Cauda small, with 2 long hairs. Subanal plate with about 20 hairs. Subgenital plate brown, sclerotic with 23 hairs. Gonapophyses 2, each with 6 hairs. Legs dark brown, long, slender ; trochanters distinct but appear immobile ; hairs on femora and tibiae fine, longest one on hind tibiae 0.020-0.023 mm. long, $0.66-0.77\times$ as long as the diameter at the middle of the tibiae ; first tarsal segments with 2, 2, 2 hairs ; empodial hair 0.013 mm. long, $0.22\times$ as long as the claws. Forewings with pterostigma blunt, radial sector faint, gently curved, media simple,

cubital and anal arising separately, hind wings with very faint venation.

Colour.—Green with head thorax, antennae and legs blackish.

Measurements in mm.—

	Length	Width	Antennal		
1.	2.48	1.10	0.75		
2.	2.48	1.30	0.75		
	Antennal segments			urs.	ht ₂
III	IV	V	VI		
0.18	0.10	0.12	(0.14+0.04)	0.09	0.16
0.20	0.10	0.12	(0.14+0.04)	0.09	0.18

(1, 2 ex. *Populus nigra*, Mosul, IRAQ, 26.6.1968, coll. H. E. Knopf. BMNH 848/68).

Larva (from Roberti, 1938).—Body 0.55-0.60 mm. long, sub-elliptical. Antenne 4-segmented, 0.33-0.36 × as long as the body, segment I and II cylindrical, III and IV narrowed at base, each with a ciliated primary rhinaria; ratios of antennal segments I : II : III : IV :: 30 : 35 : 35 : 65. Rostrum reaches hind coxae. Abdominal dorsum with 4 wax gland plates on 3rd-6th tergites and 2 on 7th tergite, each bearing a hair. First tarsal segments with 2, 2, 2 hairs.

Sexupara (from Roberti, 1938).—Body 1.5-2 mm. long, with 0.5-0.6 mm. as maximum width. Antennae 6-segmented, 0.5-0.6 mm. long; segment I cylindrical; segment III subequal or equal to segments IV+V taken together and bears 5-7 transverse secondary rhinaria and a small sharp protuberance; segment IV subequal to V and bears 2-3 similar rhinaria; segment V and VI distinctly imbricated, ratios of antennal segments I : II : III : IV : V : VI :: 25 : 30 : 80 : 42 : 40 : 80; processus terminalis short, with 4-5 subapical and apical hairs. Rostrum reaches mid-coxae. Thorax with small paired wax-plates present on meso- and metanota. Abdominal dorsum with paired marginal wax

plates on 1st-7th tergites, besides paired spinal wax plates on 1st-2nd tergites ; 8th tergite with a single median transverse wax plate ; each wax plate with a single hair ; lateral wax plates increase in size caudad. Legs with tibiae somewhat enlarged distally ; first tarsal segments with 3, 2, 2 hairs. Forewings with media simple.

Colour.—Head, thorax, antennae and tarsi blackish ; abdomen greyish green to orange yellow.

Ovipara (from Roberti, 1938).—Body sub oval, enlarged posteriorly, 0.80-0.90 mm. long with 0.38-0.42 mm. as maximum width. Antennae 4-segmented, 0.12 mm. long ; segment I, II and III equal in length ; ratios of antennal segments I : II : III : IV : : 25 : 25 : 25 : 50. Eyes of 3 facets. Rostrum absent. Abdominal dorsum with paired lateral wax plates on each of 5th and 6th tergites, these extending over the venter. Legs with tibiae and femora of equal lengths ; first tarsal segment with 2, 2, 2 hairs. Eggs sub-elliptical white, 0.48 mm. long.

Colour.—Canary yellow.

Male (from Roberti ; 1938).—Body oval, 0.26-0.65 mm. long with 0.20-0.25 mm. as maximum width. Head large, little smaller than thorax. Antennae 4-segmented, 0.10-0.12 mm. long ; segment I, II and III almost equal in length and half as long as segment IV ; processus terminalis short. Rostrum absent, with a small trilobed swelling on the ventral side of head. Abdomen with a distinct genitalia, (penis 0.044 mm. long) formed of two close set chitaneous valves, slightly wider basally and curved backward anteriorly.

Colour.—Citrus yellow.

Material examined.—Four fragmented alate fundatrigeniae and two nymphs, from Aspen tree, bury, Gilgit Pass, N. W. Himalaya, (c 1550 m.), 2.7.1895, coll. A. Alcock, det. J. P. Doncaster, 1960 (Paratypes, Zoological Survey of India collections, 7262/H7 and 7263/H7) ; three alate and one apterous viviparous females, from *Populus nigra*, Mosul; IRAQ, 26.VI.1968, coll. H.E Knopf, (BMNH 848/68, C.I.E. A 2519, A 97)

Discussion.—Buckton (1896) described *immunis* from galls of Aspen trees, collected in North west Himalaya ; while describing the species he clearly mentioned that *immunis* differs from *bursarius* of Europe by its characters of galls, live colour of thorax and abdomen and “in several particulars” Later, Tullgren (1909) described *Pemphigus lichtensteini* from Europe, which, according to Roberti (1938) refers to the same species recorded as *bursarius* Linnaeus, by Passerini (1863), Lichtenstein (1886) and Del Guercio (1900). Ghulamullah (1941) described *paghmarensis* from Afghanistan indicating its close resemblance to *lichtensteini* Tullgren. Börner (1952) recorded *Pemphigus lichtensteini* Tullgren, 1909 and puts *P. bursarius* Lichtst. 1883 non L. 1758, as a synonym ; he also mentions that fundatrigeniae are viviparae and “parthenogenetic females” are unknown, which is obviously not true. Doncaster (1969) first mentions that *immunis* appears to be that species described by Tullgren (1909) as *lichtenstenini* and can be distinguished by the very large primary rhinarium on segment V of alatae ; the form of galls, as described and figured by Buckton also agreed with that of *lichtensteini* ; Doncaster (op. cit) also designated and described lectotype and paratypes. Raychaudhuri *et al.* (1980) however, considered many alatae, earlier recorded as *immunis* under *bursarius* L., because the primary rhinarium on V does not cover entire width, although in all other respects these alatae agree with those of *immunis*, no mention was however made about the galls from which these alatae were collected. It now appears that in the region only *P. immunis* occurs on *Populus nigra* and *Populus euphratica* where they form woody, hard, sessile and smooth galls, with a deeply furrowed interior and a apical ostiole ; these galls may be 2.5-5.0 mm. long and 2.5 mm. thick.

Biology of *P. immunis* (= *lichtensteini*) has been described in details by Roberti (1938) from Europe. He mentioned that eggs hatch in April and May, larvae of fundatrices form galls on apical part of branches and undergo 4 moults and the adults lay 300-500 larvae, which develop upto fundatrigeniae, and leave the galls during June-August ; sexuparae develop in September and lay 6-8 “amphigoni” larvae of both sexes in a protective place offered by dried gall, scars and cracks in the bark, or even among the dried leaves and grasses at the base ; male and female adults develop in 3-4 days, copulate and the female lays single egg in the crack of

bark ; Roberti (op. cit) while redescribing the species mentions that virginogeniae (migrants) are not known. However, Doncaster (1969) described the lectotype as "Fundatrigenia migrants" The secondary host of *immunis* remained unknown (although the species has been studied in many parts of Europe, Middle East) till the recent time when *Euphorbia heliscopia* was located as the alternate host. Habib and Ghani (1970), reported their observation on Phenology of *P. immunis* in Pakistan (under *lichtensteini*) ; according to them, sexuparae and sexuales were collected in December, from under the cracked bark and old galls of *Populus nigra* ; yellowish white eggs hatch in April-May and larvae initiate formation of gall as tiny protuberances on twigs ; fundatrigeniae emerge from May-June and continued to emerge till July-August. It was further noted that this species use an introduced hybrid apicies of Poplar, *P. euramericana* for depositing eggs under the bark but never form galls on this plant, although *P. nigra*, growing in the same locality were heavily infested ; further, *P. nigra* growing above ca 2000 m. was not infested by the species. A hymenopteran parasite *Aphelinus nikolskajae* Jashnosh, which also attacks *E. imaicus* and *P. mordvilkoii* was observed to parasitise the aphid during June-July in West Pakistan region.

Distribution.—INDIA (North West), PAKISTAN ; ASIA (Central and South west) MIDDLE EAST ; EUROPE (Western) ; AFRICA (North).

Types.—Types of *immunis* Buckton, in the collection of Zoological Survey of India, Calcutta and British Museum (Nat. Hist.) London. Location of types of *lichtensteini* not known ; types of *pahagensis* Ghulamullah, 1941, are reported to be at I.A.R.I., New Delhi (IPC R/8046, R 8047-8051).

29. *Pemphigus indicus* Keiffer (fig. 247 A)

1908, *Pemphigus indicus* Keiffer, J. J *Marcellia*, 7: 161

Alate viviparous female (material not available ; description based on original description, in french, by Kieffer) : Body reddish brown 2.8 mm. long. Antennae 6-segmented ; segments I and II



247A

Pemphigus indicus Keiffer ; Gall : 247A. leaf gall on unidentified plant (from Keiffer, 1908)

smooth, hardly longer than wide ; segment III equal to IV+V+VI together, with 12 transverse secondary rhinaria, segment IV, $0.25\times$ as long as segment V and with 5-6 similar rhinaria ; segment V, $3.0-4.0\times$ as long as wide and with 3 similar rhinaria , segment VI, $0.25\times$ as long as segment V and with 2 rhinaria, processus terminalis hardly twice as long as wide and with 3 preapical setae. Thoracic dorsum dark brown. Abdomen wide. Forewings with cubital and anal close together, media arising midway and radial

sector arising from middle of pterostigma ; hind wings with 2 obliques ; wing veins somewhat brownish.

Discussion.—This species has never been reported again from this region. It was originally described from galls collected in Kurseong, West Bengal, INDIA, from an unidentified plant, whose leaves are reported to be elongate and glabrous, and with entire margin. Leaf-galls formed by this species appear irregular with unequal and humpy surface, opening irregularly at maturity; the gall cavity is large and contains many aphids. Kieffer (op. cit) observed close morphological affinity of *indicus* with *Thecabius affinis* Koch and mentioned that the galls resemble these of *Eriosoma (Schizoneuea) ulmi* Linne. Houard (1922) while listing the gall of *indicus* presumably from description of Kieffer (1908), mentioned its resemblance with *E (S) lanuginosa* Hartig. Mani (1973) while reporting gall only referred to Kieffer (1908) and Houard (1922). Eastop and Hille Ris Lambers (1976) listed *indicus* Kieffer under *Pemphigus* without any comments. As such the exact identity of *indicus* remains unknown, till material from the type-locality or host, becomes available.

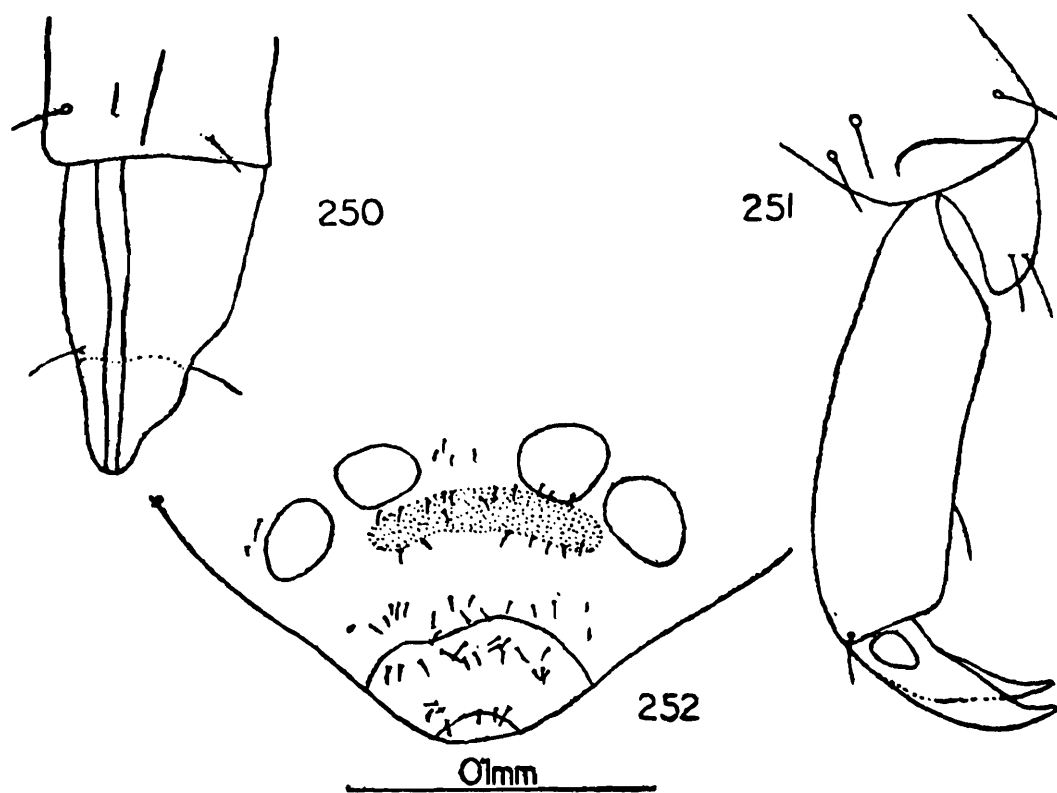
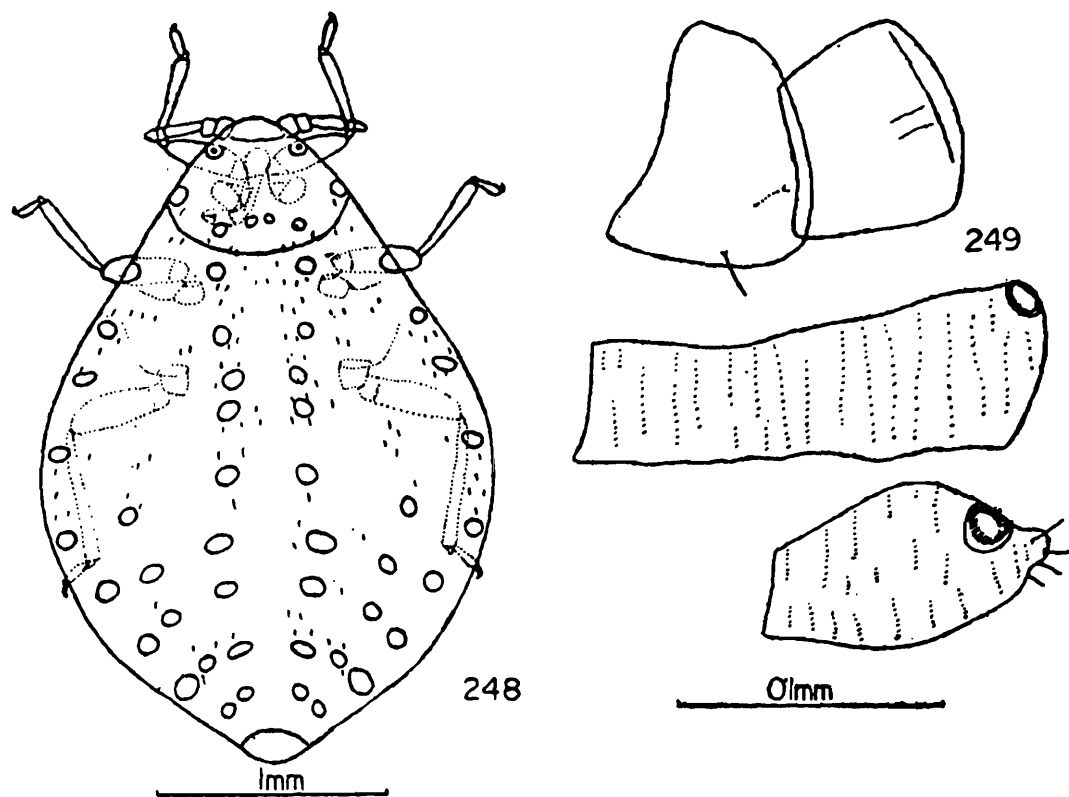
Distribution.—INDIA (West Bengal).

Types.—Location of types not known.

30. *Pemphigus mordvilkoii* Cholodkovsky (figs. 248-258)

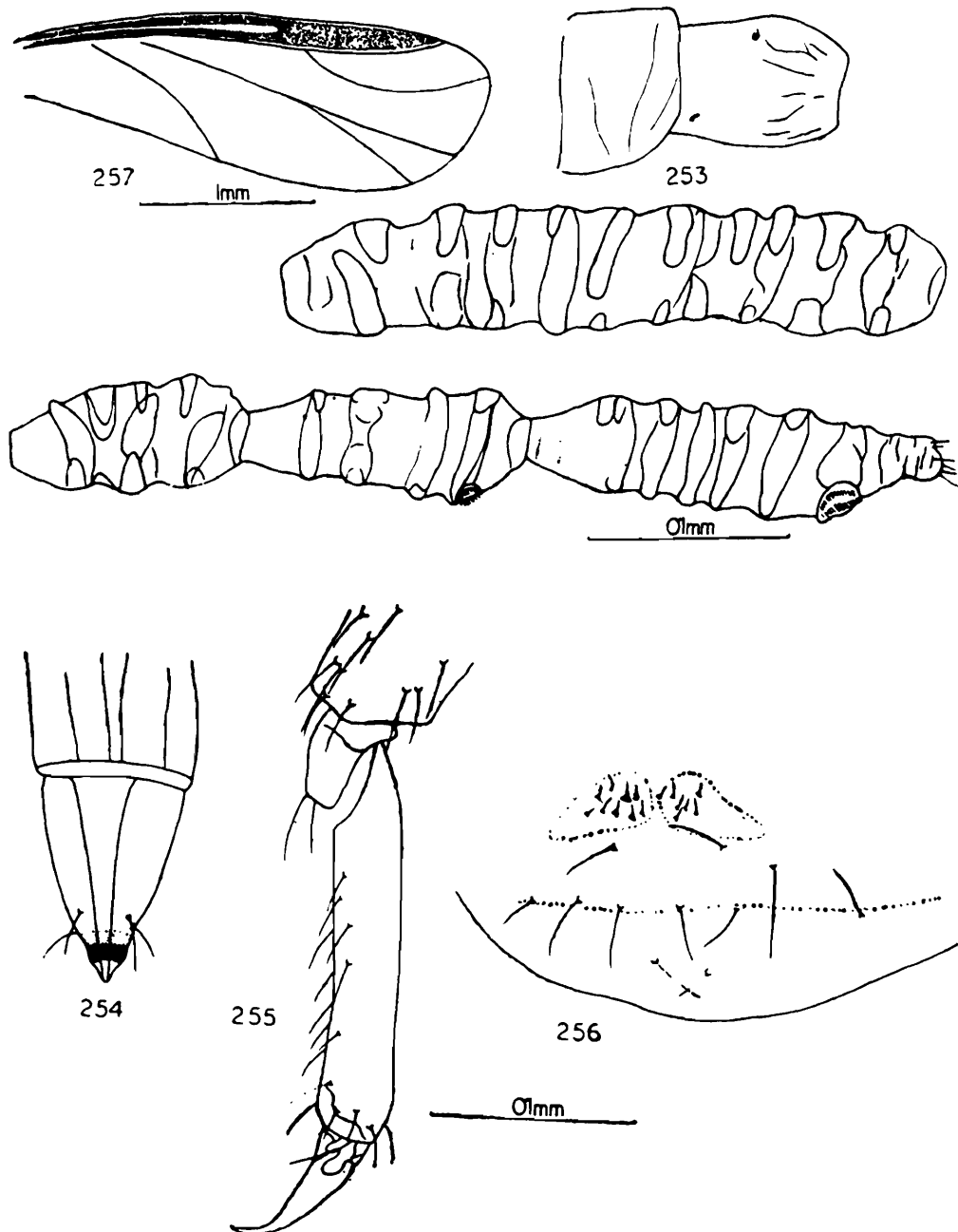
1912. *Pemphigus mordvilkoii* Cholodkovsky, N., *Russk. Zool. Zh.*, (= *Revue Russe d' Entom*), 12 (3) : 493.

Apterous viviparous female (Foundatrix).—Body 2.8-3.5 mm. long, ovoid, with 1.8-2.8 mm. as maximum width at the middle of abdomen. Head small, dark, sclerotic, partly fused with prothorax. Antennae 4-segmented, paler than head with a faint indication of segmentation on III ; segment I broader than long, almost equal to segment II ; segment III equal in length to I, II and IV taken together ; flagellum with some faint spinular imbrications ; primary rhinaria on III very small, non-ciliated, on IV larger and distinctly ciliated ; hairs hardly discernible, segment I with a single hair,



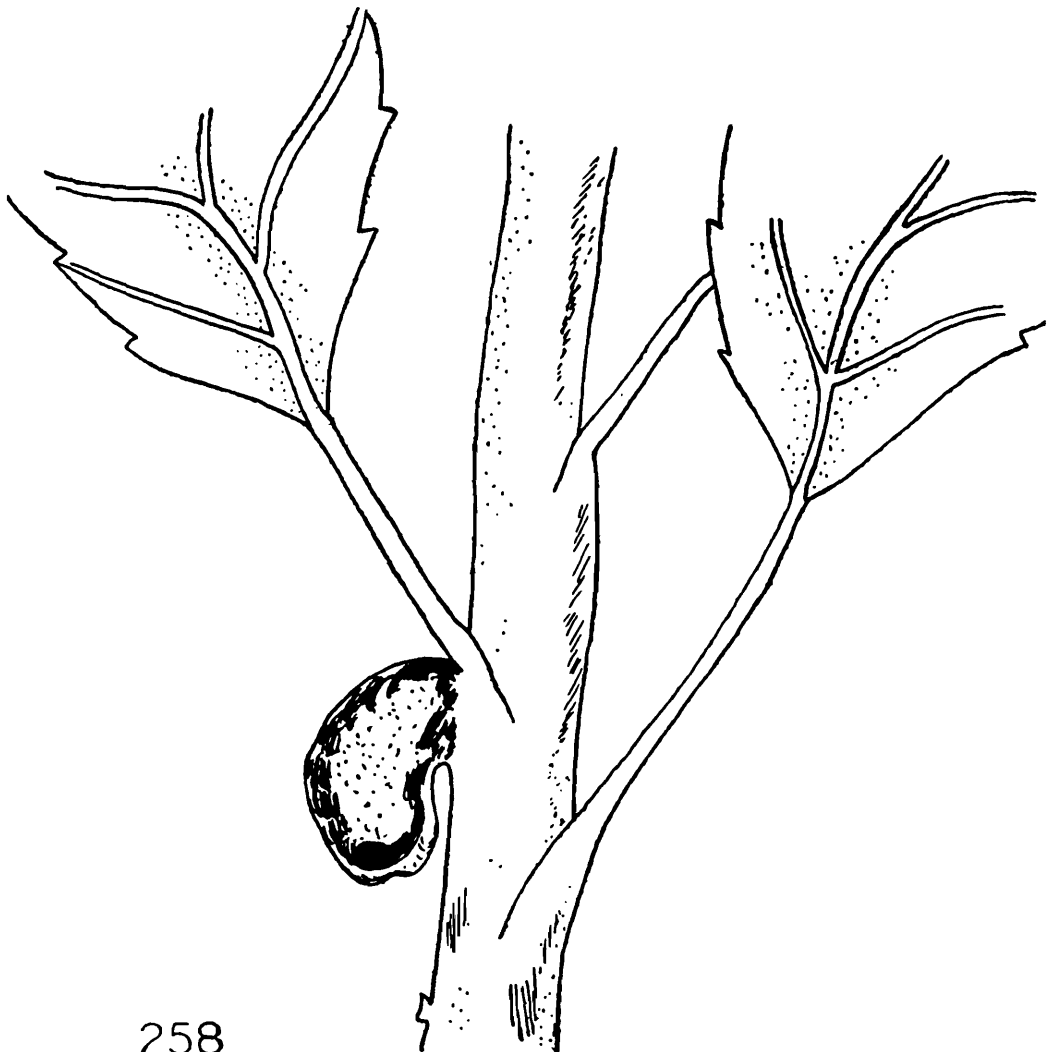
Pemphigus mordvilkoii Chold. : Apterous viviparous female (fundatrix) :
 248. whole body ; 249. antenna ; 250. ultimate rostral segments ; 251. hind
 tarsus ; 252. posterior portion of abdomen.

0.006 mm. long ; processus terminalis $0.25\times$ as long as base of last antennal segment. Rostrum reaches little beyond fore-coxae ; ultimate rostral segment $0.57-0.65\times$ as long as second segment of hind tarsus and without any accessory hairs. Thorax pale, except, on irregular sclerotic areas in the venter near the bases of the legs ; pronotum with a pair of round, spinal wax plate, meso-and meta-nota as also 1st-6th abdominal tergites each with 6 wax plates



Alate viviparous female (fundatrigenia) : 253. antenna ; 254. ultimate rostral segments ; 255. hind tarsus ; 256. posterior portion of abdomen ; 257. forewing.

(spinal-2, pleural-2, marginal-2) of ovoid, spherical or irregular shape and often bearing a single hair ; 7th tergite with 4-6 similar wax plates , 8th tergite with 4 elongate wax plates ; hairs on the dorsum of abdomen sparse, on anterior tergites 0.020-0.023 mm. long, on posterior tergite 0.026 mm. long, these being $0.27-0.38\times$ and $0.44\times$ as long as the basal diameter of antennal segment III, respectively. Siphunculi absent. Cauda small, sclerotic with 2-3 hairs. Subgenital plate brown, sclerotic with about 20 hairs. Legs brown, stout, trochanters fused with femora ; hairs on tibiae and femora very sparse, longest hair on hind tibiae 0.010 mm. long, $0.20\times$ as long as the diameter at the middle of the tibiae ; apical hairs on tibiae stout and much thicker than others ; first tarsal segments with 2, 2, 2 hairs ; dorso apical hairs on second tarsal segment fine, 0.020 mm. long ; empodial hair 0.013 mm. long, $0.20\times$ as long as the claws.



258

Gall : 258. stem gall on Poplar.

Colour.—Pale green with head, antennae and legs brownish.

Measurements in mm.—

	Length	Width	Antenna		
1.	3.5	2.8	0.45		
2.	3.2	2.6	0.47		
3.	2.8	1.8	0.45		
	Antennal segments			urs.	ht ₂
I	II	III	IV		
0.06	0.07	0.22	(0.10+0.23)	0.100	0.169
0.07	0.07	0.20	(0.09+0.023)	0.106	0.163
0.06	0.06	0.20	(0.10+0.020)	0.093	0.155

(1, 2, 3 ex. *Populus ciliata* Mussourie, U.P., INDIA, 16.10.1976, S. Chakrabarti's collections).

Alate viviparous female (Fundatrigenia).—Body elongate 2.20-2.34 mm. long. Head dark, sclerotic without any median suture. Antennae 6-segmented, dark brown, 0.37-0.39× as long as the body ; flagellum slender ; hairs on flagellum sparse, on segment III, 0.006 mm. long, 0.28-0.40× as long as the basal diameter of the segment ; segment III, with 11-13, IV with 3-5, V with 3-5 and VI with 3-5, narrow, transverse, secondary rhinaria, primary rhinaria on V, elongate, on VI large, irregular, ciliated ; processus terminalis 0.17-0.18× as long as the base of antennal segment VI. Rostrum reaches near mid coxae, ultimate rostral segment 0.42-0.50× as long as the second segment of hind tarsus and without any accessory hairs. Abdominal dorsum pale, with paired, elongate, oval spinal wax plates at least on 1st-4th tergites ; paired small marginal wax plates present on 6th-7th and a median wax plate present on 8th tergite ; other wax plate not discernible ; hairs on the dorsum of abdomen fine, on anterior tergites upto 0.013-0.016 mm. long, on posterior tergites, 0.016-0.030 mm. long, these being 0.64-0.66× and 0.66-0.83× as long as the basal diameter of antennal segment III, respectively. Siphunculi hardly discernible, appearing as pale rings. Cauda with 2 hairs. Subanal plate with 12 hairs ;

Subgenital plate with 20-24 hairs, in two rows. Gonapophyses 2, each with 5 hairs. Legs long, slender, femora medially imbricated; tibiae broadened at apices; longest hair on hind tibiae 0.020-0.026 mm. long, $0.66-0.80\times$ as long as the diameter at the middle of the tibiae, first tarsal segments with 2, 2, 2 hairs. Empodial hair 0.016 mm. long, $0.25\times$ as long as the claws.

Colour.—Blackish green (?)

Measurements in mm.—

	Length	Width	Antenna		
1.	2.20	0.89	0.84		
2.	2.20	0.82	0.87		
3.	2.34	0.96	0.88		
4.	?	?	0.79		

	Antennal segments				urs.	ht ₂
III	IV	V	VI			
0.29	0.10	0.14	(0.16+0.03)	0.10	0.19	
0.32	0.10	0.14	(0.17+0.03)	0.09	0.19	
0.32	0.12	0.12	(0.16+0.03)	0.08	0.19	
0.30	0.09	0.10	(0.16+0.03)	0.08	0.17	

(1-2, ex. *Populus ciliata*, Mussourie, U.P., INDIA, 16.10.1976, coll. S. P. Maity, S, Chakrabarti's collections)

3-4, ex. *Populus ciliata*, Swat, PAKISTAN, 2.10.1968, BMNH collections)

Nymph (late stage).—Body pale, 2.10 mm. long. Head dusky with a median suture; dorsal cephalic hairs minute. Antennae 6-segmented, nearly $0.33\times$ as long as the body; segments I, II and IV subequal, segment III longest; flagellum smooth, except VI which is sparsely imbricated; hairs hardly discernible; primary rhinaria on segment V and VI round to oval, distinctly ciliated; processus terminalis $0.20\times$ as long as base of antennal segment VI. Eyes of 3 facets. Rostrum reaches near mid-coxae, ultimate rostral segment half as long as second segment of hind tarsus and without

any accessory hairs. Abdominal dorsum pale, membraneous ; wax-plates not differentiated ; dorsal hairs 0.006-0.016 mm. long, 0.10-0.25 \times as long as the basal diameter of antennal segment III. Siphunculi present as pale rings. Cauda with 2 hairs; Subanal plate with 12 hairs. Legs pale brown, trochanters fused with femora; hairs on femora and tibiae sparse, minute, 0.003-0.006 mm. long ; apical tibial hairs stout, 0.013 mm. long ; first tarsal segment with 2, 2, 2 hairs.

Colour.—Pale in life.

Measurements in mm.—

Length		Width		Antenna	
2.10		0.82		0.61	
Antennal segments					
III	IV	V	VI	urs.	ht ₂
0.16	0.07	0.08	(0.130+0.026)	0.083	0.163

(ex. *Populus* sp., Mussourie, U.P., INDIA, 16.10.1976, coll. S. P. Maity).

Sexuparae and sexuales.—Not available.

Material examined.—Three apterous and one alate viviparous females from *Populus ciliata*, Mussourie, Uttar Pradesh, INDIA, 21.6.1976 ; 10 alate viviparous females, one apterous fundatrix and one nymph from *Populus ciliata*, Mussourie, Uttar Pradesh, INDIA, 16.10.1976 ; Four alate viviparous females from *Populus ciliata*, Swat, PAKISTAN, 21.10.1968, coll. C.I.B.C., (C.I.E. 19727 : 1811, BMNH 467/64, collections).

Discussion.—Description of this species was originally based on the material from stem-galls of *Populus ciliata*, sent by Forest Research Institute, Dehra Dun to Dr. Choldkovsky (along with *P. nainitalensis* and *P. imaicus* (now *Epipemphigus*) ; the original description includes only alate fundatrigeniae, which by its character

of secondary rhinaria, wax-plates and characteristic galls on stem, appeared distinctive. Recently Habib and Ghani (1970) while working on Eriosomatinae and their natural enemy in West Pakistan, reported that sexuparae and sexuales were collected by them in April and May, at Muree and other areas of West Pakistan; mating and egg laying was observed under laboratory condition, the yellowish egg hatch after 6 days (May) to 9 days (April); twig-galls were formed in May (Muree) and June (Shogran), fundatrigeniae emerge in August (Muree)—September (Ranalkot). Efforts to find secondary host was futile. Galls formed by *mordvilkoii* are sub-spherical, sessile, unilocular, smooth, solitary or in a group of 1-2, 10-30 mm. in diameter and yellow, yellowish-green to dark brown in colour. The species is widely distributed in North western Himalaya from Kumaon to Kashmir and Pakistan, upto ca 2500 m.

Distribution.—INDIA (North west), PAKISTAN.

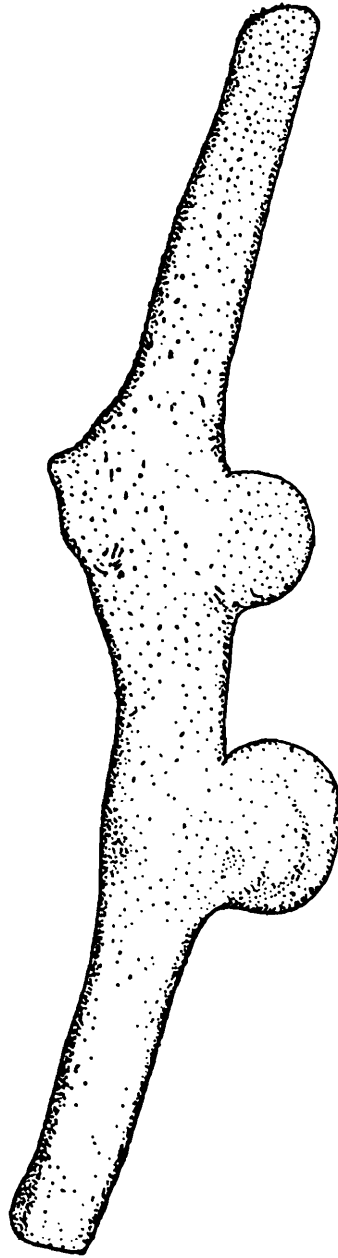
Types.—Location of types not known. Dr. P. K. Sen Sarma, Forest-Entomologist from F.R.I. Dehra Dun writes (22.10.1978) “that no type specimens are with us. Most probably all the type specimens of N. Cholodkovsky in 1910 might have been deposited in British Museum” but types have not been deposited in BMNH, according to BMNH sources.

31. *Pemphigus nainitalensis* Cholodkovsky (fig. 247 B)

1912. *Pemphigus nainitalensis* Cholodkovsky, N., *Russk. zool. Zh.*, (= *Revue Russe d' Entom.*), 12 (3) : 494.

(Material not available, description based on original description in French by Cholodkovsky, 1917).

Alate viviparous female (fundatrigenia).—Body 1.75—2.0 mm. long. Antennae 6-segmented, 1.0 mm. long, $0.50\times$ as long as the body; segment III longer than segments IV and V taken together; segment IV $0.80\times$ as long as V, which in turn is $0.66\times$ as long as segment VI; antennal segment III with 15 narrow transverse secondary rhinaria, IV with 4, V with 4 and VI with 5 similar rhinaria; primary rhinaria on VI large, sinuated. Abdominal



247B

Pemphigus nainitalensis Chold ; Gall : 247B. stem gall on Poplar.

dorsum with few inconspicuous wax plates and many glandular pores (as in *P. mordvilkoii*) ; 1st tergite with a pair of wax plates and each of the following tergites upto 7th, with 1-2 pair of wax plates ; 8th tergite with a median glandular group.

Colour.—Greenish.

Apterous viviparous female (Fundatrix).—Body 3.0 mm. long. Antennae 4-segmented, segment III, $3.0\times$ as long as segment IV. Thick whitish in life.

Discussion.—No material of *nainitalensis* could be obtained from British Museum (Nat. Hist.) London, Z.S.I., Calcutta, Forest Research Institute, Dehra Dun, or from Institute of Zoology, Leningrad, U.S.S.R. As such the description is based on very inadequate data of original description. Galls produced by this species is reported to be of size of a Hazel-Nut and are found on young branches of Poplar ; many nymphs, larvae of diverse size, beside alatae were found by Cholodkovsky (1912) in the gall, sent to him by Forest Research Institute at Dehra Dun.

No further record of *nainitalensis* is known and Eastop and Hille Ris Lambers (1976) have listed it as a valid species without comments.

Distribution.—INDIA (Nainital, Uttar Pradesh).

Type.—Location of types not known.

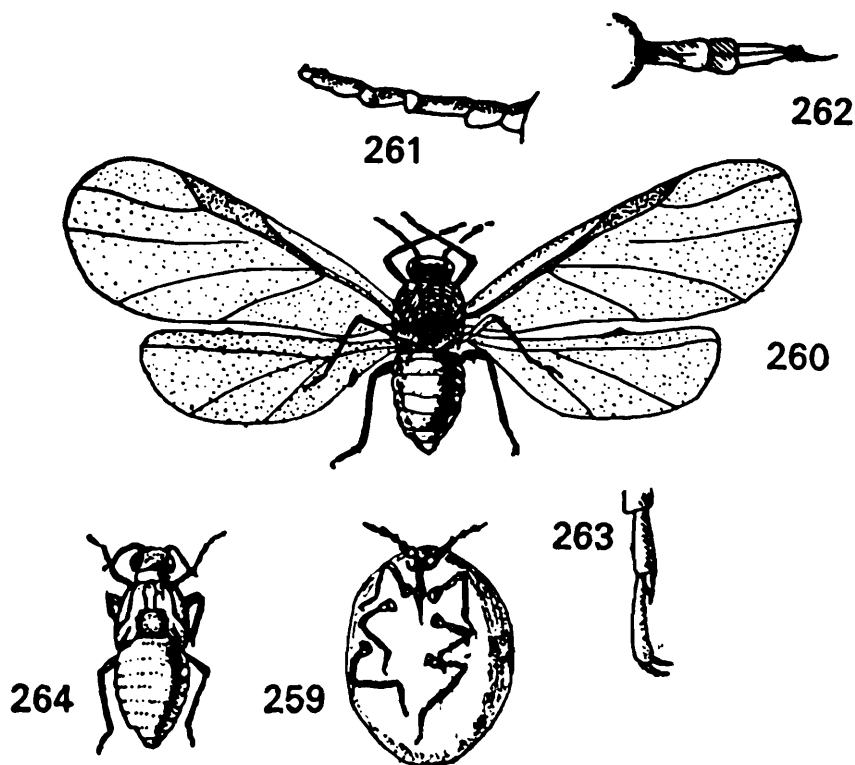
32. *Pemphigus napeus* Buckton (figs. 259-265)

1896. *Pemphigus napeus* Buckton, G. B. *Indian Mus. Notes*, 4 : 50.

1969. *Pemphigus napeus*, Doncaster, J. P., *Proc. R. ent. Soc. Lond.*, (B), 38 (12-12) : 160.

1970. *Pemphigus napeus*, Tao, C.C.C., *Sc. Yb. Taiwan Mus.*, 9 : 5.

Apterous viviparous female (Fundatrix) (Material not available, adapted from Doncaster, 1969).—Body broadly oval, 3.26 mm. long with 2.5 mm. as maximum width. Frons flat, dorsal cephalic hairs upto 0.020 mm. long. Antennae 5-segmented, $0.17\times$ as long as the body ; segments I, II and IV subequal to one another, segment III nearly twice as long as preceding ones, and equal to or little longer than segment VI ; primary rhinaria ciliated ; processus



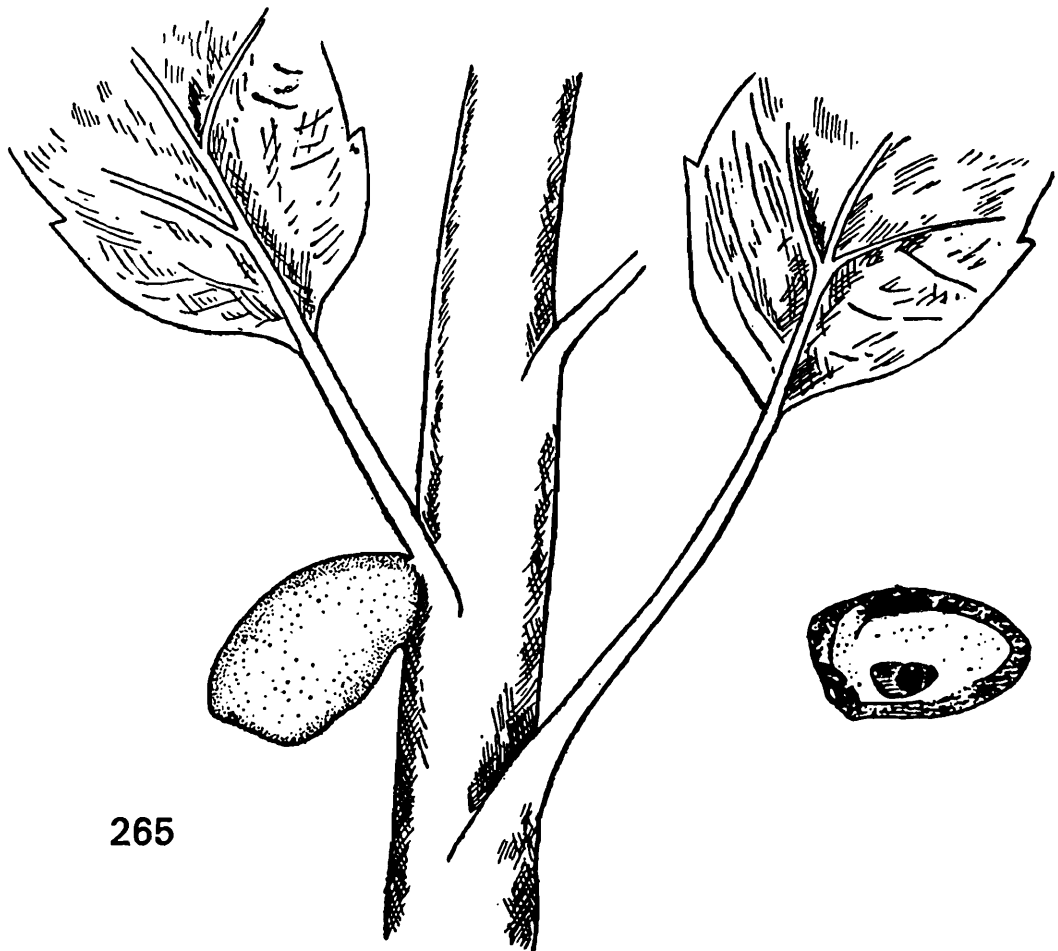
Pemphigus napeus Buckton (from Buckton, 1896) ; Apterous viviparous female (fundatrix) : 259. whole body.
Alate viviparous female (emigrant) : 260. whole body ; 261. antenna ; 262. rostrum ; 263. hind tarsus ; 264. nymph.

terminalis $0.16\times$ as long as the base of last antennal segment. Rostrum reaches just passed the fore coxae ; ultimate rostral segment twice as long as wide, equal to second segment of hind tarsus. Mesonotum, metanotum and abdominal tergites 1st-7th, each with paired spinal, pleural and marginal wax plates, each bearing a single hair ; 8th tergite with a large submedian wax plate which bears 4 hairs. Siphunculi absent. Cauda with 2 hairs. Subanal plate with 17 and subgenital plate with 36 hairs, 0.020-0.044 mm. long. Legs, short, thick ; first tarsal segments with 2, 2, 2 hairs.

Colour.—Not known.

Measurements in mm.—

Length		Width	Antenna	
3.26		2.5	0.52	
Antennal segments			urs.	ht ₂
III	IV	V		
0.14	0.07	(0.12+0.02)	0.177	0.172



265

Gall :

265. stem-gall on Poplar and its sectional view.

Alate viviparous female (Fundatrigenia, Migrants; not available, adapted from Doncaster, 1969).—Body 2.2-3.5 mm. long. Antennae 6-segmented, segment III 0.240-0.325 mm. long, bearing 10-16 transverse, irregular secondary rhinaria, IV 0.085-0.130 mm. long, bearing 4-6, V 0.122-0.160 mm. long, bearing 3-6 and VI (0.120-0.170+0.025-0.031) mm. long bearing 3-6 similar rhinaria ; primary rhinaria on VI irregular, distinctly ciliated ; hairs on flagellum sparse, 1-3 per segment ; processus terminalis $0.16\times$ as long as base of antennal segment VI. Rostrum reaches little beyond fore-coxae, ultimate rostral segment 0.118-0.130 mm. long, $0.61\times$ as long as the second segment of hind tarsus. Abdominal dorsum pale ; wax plates present marginally on 1st-7th tergites and spinally on 1st-2nd tergites and each of these bears a single hair ; 8th tergite with an elongate median wax plate bearing 4

hairs, 0.034-0.068 mm. long. Siphunculi absent. Subgenital plate with 28-40 hairs. Legs slender ; hairs on femora and tibiae sparse, fine, 0.030-0.037 mm. long ; first tarsal segments with 2, 2, 2 hairs. Wing span 6.5-10.3 mm.

Colour.—Not known.

Note—Material of *napaeus*, consists of 7 alate fundatrigeniae and 1 apt. fundatrices, having status of type, are all deposited in British Museum (Nat. Hist.) London : efforts to procure the same on loan was not materialised “we can not therefore loan you this material” J. H. Maitin, (in litt. 17/7/78) BMNH.

Measurements in mm. (of one paratype).—

Length		Width		Antenna	
2.83		?		?	
Antennal segments				urs.	ht ₂
III	IV	V	VI		
0.30	0.11	0.15	(0.17+0.03)	0.12	0.24

Larvae, Sexuparae and sexuales.—Not known.

Discussion.—The original description was based on collections from Poplar galls made at *ca* 3000 m., near Darkot Pass. No further authentic record of *napaeus* is available ; Doncaster (1969) described and figured in details the alate and aptera after remounting Buckton's material present at the British Museum, and also designated the Lectotype and Paratypes. Tao (1970) also listed *P. napaeus* from Poplar in Taiwan.

Buckton (op. cit) described the galls as roundish, irregular 1.10×0.50 inches, shining green on surface, veined with brown and

variegated with yellow patches, containing a single chamber. Doncaster (op. cit) while discussing the affinity of the species opined that it is closest to *Pemphigus iskanderkuli* Narzykulov, 1957, which infest *Populus densa* between ca 2000-2600 m. in Tadji-kistan, U.S.S.R., but the fundatrix of *napaeus* differs from the former in having 5-segmented and much longer antennae and ciliated primary rhinaria; *iskanderkuli* forms pinkish or red leaf-gall and as such it differs from the green twig-gall of *napaeus*, but Doncaster (op. cit) doubted about the authenticity of description of gall of *napaeus*, as an isolated-gall collected by some one other than author (Buckton), may not provide all necessary data.

Distribution.—INDIA : Kashmir (Gilgit, Darkot Pass) ; TAIWAN.

Types.—In the collections of British Museum (Nat. Hist.) London.

33. *Pemphigus siphunculatus* Hille Ris Lambers

1973. *Pemphigus siphunculatus* Hille Ris Lambers, D. *Oriental Ins.*, 7 (2), 245.

Apterous viviparous female (2nd generation).—Body pale, broadly oval, 2.96-3.10 (1.90-3.35) mm. long with 1.80-1.90 mm. as its maximum width. Head dark brown, sclerotic, with a distinct median suture and without any wax gland. Antennae pale yellow, 6-segmented, (sometimes both or one, of 5-segments), $0.18-0.20\times$ ($-0.25\times$) as long as the body ; flagellum finely spinulose and bears minute hairs 0.006-0.008 mm. long, and upto $0.30\times$ as long as the basal diameter of antennal segment III ; processus terminalis $0.20-0.25\times$ as long as base of segment VI and bears 5 terminal spines ; primary rhinaria ciliated. Rostrum reaches between fore-and mid-coxae, ultimate rostral segment blunt, $0.56-0.59\times$ as long as second segment of hind tarsus and without accessory hairs. Thorax without any wax glands. Abdominal dorsum with round to oval distinct wax glands arranged as follows : 1st and 2nd tergites each with a pair of marginal glands, 3rd tergite with paired marginal and pleural glands, 4th to 6th tergites with paired marginal, pleural and spinal glands, 7th tergite with pleural and spinal pairs but without any marginal glands ; hairs on dorsum thin and fine, on anterior tergites 0.02-0.03 mm. long, on posterior

tergites 0.03-0.04 mm. long ; marginal wax glands sometimes with one fine hair ; stigmal plates dark. Siphunculi dark, ring-like, placed antero-laterally on the marginal gland of 6th tergite. Cauda pale, broad and rounded $2.50 \times$ as long as its width at base and bears upto 8 hairs (4-6). Legs dark brown ; tibiae gradually thicker apicad ; hairs on tibiae minute, upto 0.012 mm. long, longest one 0.21-0.23 as long as the width at middle of hind tibiae ; first tarsal segments with 2, 2, 2, hairs ; empodial hair $0.33-0.50 \times$ as long as claws.

Colour.—Not known.

Measurements in mm.—

Length		Width		Antenna	
3.30		2.0		0.65	
3.13		2.1		0.66	
Antennal segments				urs.	ht ₂
III	IV	V	VI		
0.17	0.06	0.07	(0.14+0.03)	0.10	0.16
0.17	0.06	0.08	(0.25+0.03)	0.10	0.16

(1, 2, ex. *Populus ciliata*, Murree, WEST PAKISTAN, 23.9.1966, Hille Ris Lambers collections).

Alate viviparous female.—Not known.

Sexual forms.—Not known.

Embryos & larvae.—According to Hille Ris Lambers (1973), the embryos or first instar larvae possesses siphunculi 0.012-0.016 mm. in diameter, long and moderately curved claws in hind tarsi and empodial hairs longer than claws.

Material examined.—Two apterous viviparous females (Paratypes) from twig-galls of *Populus ciliata*, Murree, WEST PAKISTAN, 23.ix.1966, leg M.A. Ghani (No. 853), det. D.H.R.L.

Discussion.—Habib and Ghani (1970) first mentioned about "*siphunculatus* sp. nov.", which is autoecious on Poplar in West Pakistan. Later Hille Ris Lambers (1973) described the species and

compared it with three other gall producing autoecious *Pemphigus* species, but they have either much larger or much smaller wax glands, more hooked claws or shorter empodial hairs, *Pemphigus siphunculatus* possess siphunculi in apterae and larvae, as in the case of foregoing species but differs in shape and size of wax glands, nature of tarsal claw and ratio of tarsal claws to empodial hairs.

Distribution.—WEST PAKISTAN.

Types.—In the collections of D. Hille Ris Lambers, Bennekom, The Netherlands.

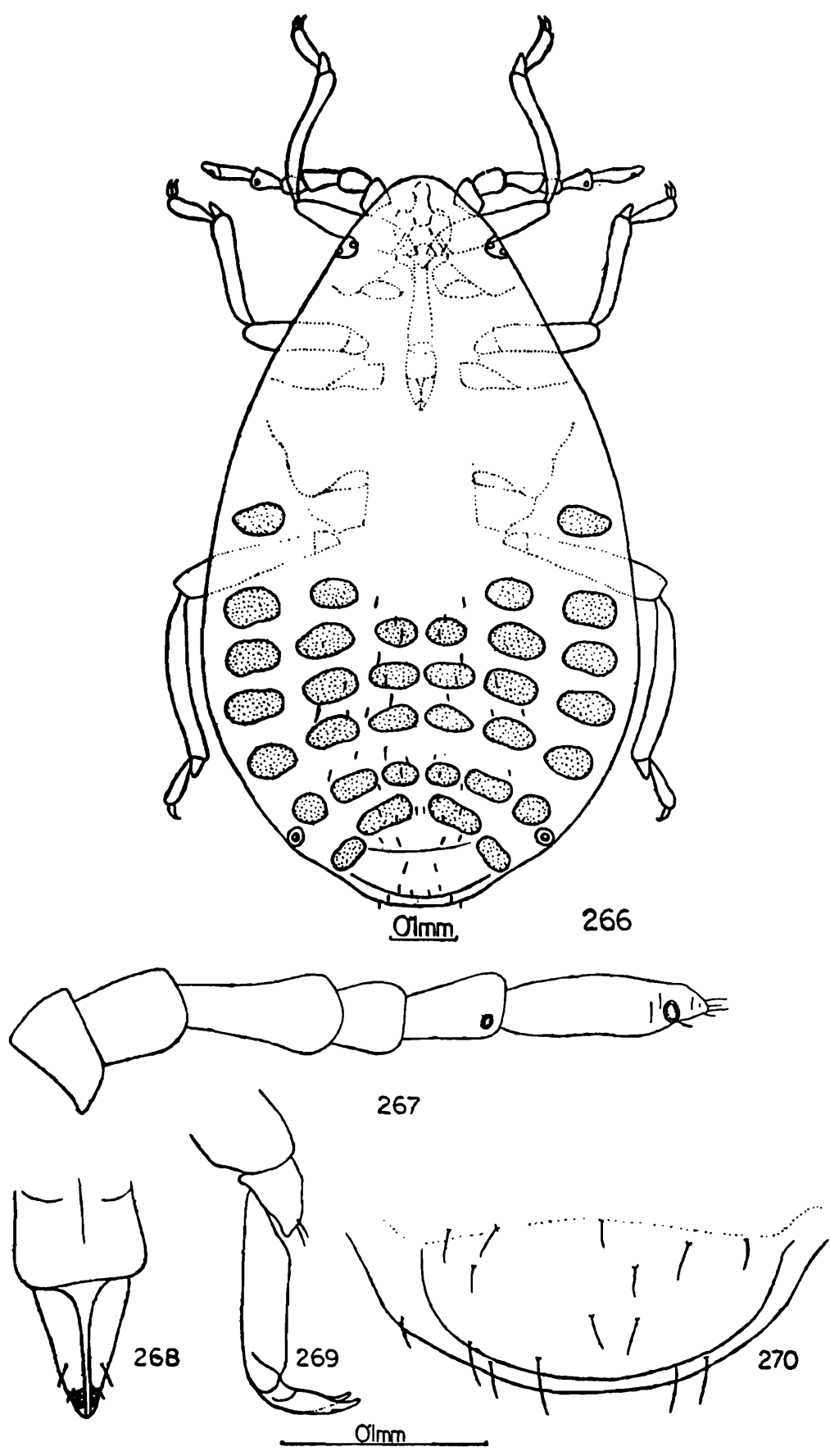
34. *Pemphigus spirothecae* Passerini

(figs. 266-294)

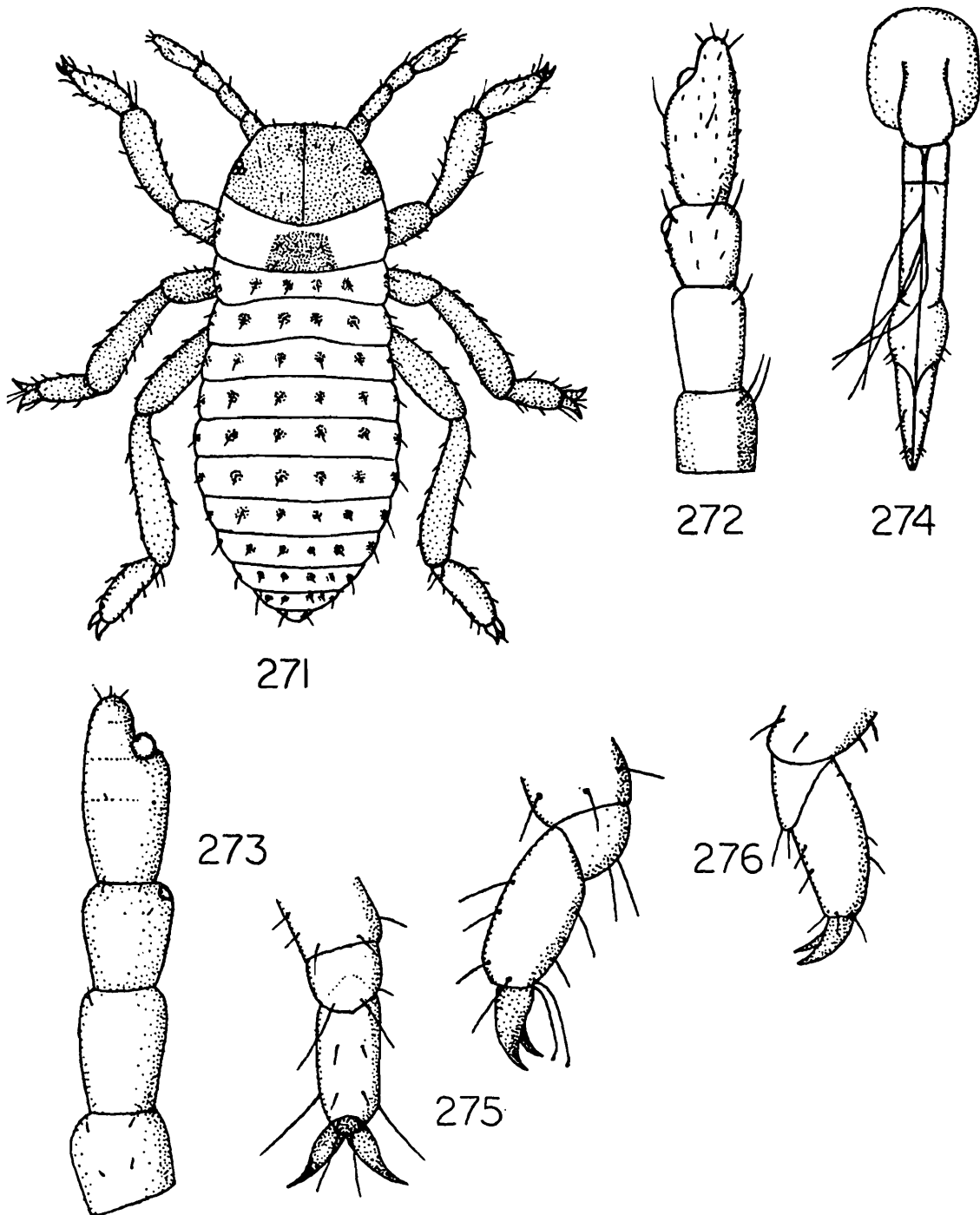
1856. *Pemphigus spirothecae* Passerini, G., *Giornale Giardini*, 3 : 258-265.
 1860. *Pemphigus spirothecae* Passerini, G., *Gli afidi*, Parma, 39.
 1875. *Pemphigus tortuosus* Rudow, F., *Z. Gesamten Naturwiss*, 46 : 248.
 1911. *Pemphigus inflatae* del Guercio, G. *Redia*, 7 : 303.
 1938. *Pemphigus spirothecae*, Roberti, D. *Bull. Lab. zool. Portici*, 30 : 182.
 1948. *Pemphigus spirothecae*, Davatchi, A., *Ent. Phytop. appl. Teharan*, (6-7) : 7
 1959. *Pemphigus spirothecae*, Mathur, R. N. and Singh, B., *Ind. For. Bull.*, 17
 (7) : 53-55.

(The Indian material for the species was not available ; description based on material from BMNH, London and from Roberti ; 1938).

Apterous viviparous female (Fundatrix) (from Roberti, 1938).—
 Body oval, posteriorly enlarged, 1.50-1.80 mm. long with 0.8-1.0 mm. as maximum width. Antennae 4-segmented, 0.25 mm. long, 0.13-0.16 × as long as the body ; segment I shorter but wider than II ; segment III subequal to IV ; primary rhinaria on III ciliated ; ratio of antennal segments I : II : III : IV : : 20 : 34 : 52 : 55. Rostrum reaches mid-coxae, ultimate rostral segment conical. Pronotum with 3-4, metanotum with 4-5 and mesonotum with 5-6 wax plates. Abdominal dorsum with 6 wax plates on each of 1st, 5th tergites, 4 on 6th tergite and 2 on 7th tergite, the lateral ones being larger than the others. Subanal plate sclerotised and with 15 hairs. Subgenital plate sclerotised, hairy, Gonapophyses 2. Legs with femora as long as the tibiae ; first tarsal segment with 2, 2, 2 hairs.



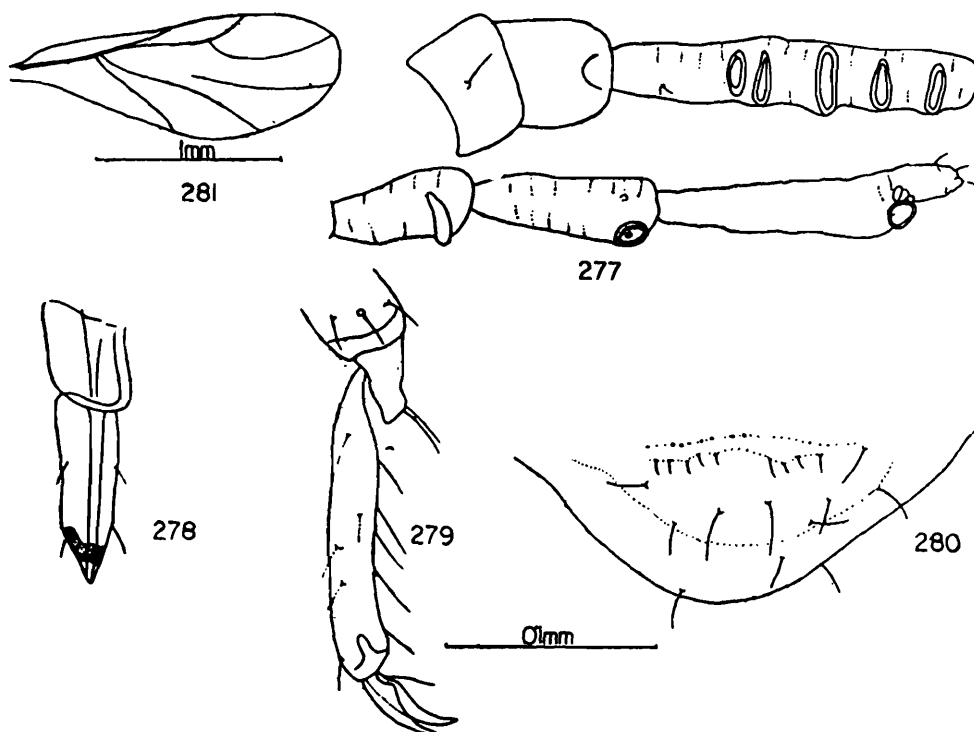
Pemphigus spyrothecae Passerini; Apterous viviparous female (fundatrix) :
 266. whole body (fundatrigenia) ; 267. antenna ; 268. ultimate rostral segments ; 269. hind tarsus ; 270. posterior portion of abdomen.



Larva of fundatrix :

271. whole body ; 272. antenna ; 273. antenna of second instar larva ; 274. rostrum ; 275. hind tarsus, ventral new and lateral view ; 276. hind tarsus of second instar larva (all of first instar larva except Figs. 273, 276 ; from Roberti, 1938).

Colour.—Green with head, eyes, antennae, tarsal claws olivaceous, covered with abundant wax in life.



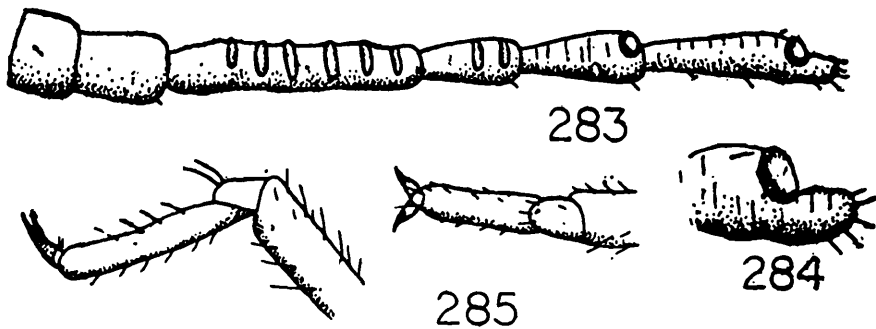
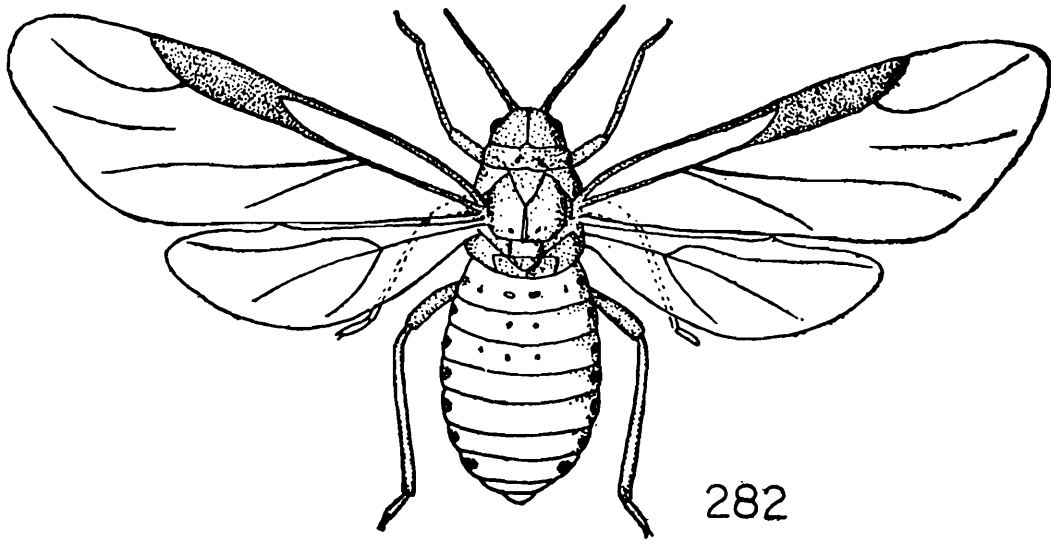
Alate viviparous female (? sexupara) :

277. antenna ; 278. ultimate rostral segments ; 279. hind tarsus ; 280. posterior portion of abdomen ; 281. forewing.

Larva.—(new born) (from Roberti, 1938). Body 0.55 mm. long. Head twice as long as wide with 4 hairs on frons and 6 on vertex. Antennae 4-segmented, 0.15 mm. long, $0.27 \times$ as long as the body ; segment I with 3-4 hairs, II with 2 hairs, III with 3 hairs and IV with 3 hairs, all appearing as stiff setae ; flagellum with some spinular imbrications ; ratio of antennal segments I : II : III : IV :: 20 : 26 : 22 : 48. Rostrum reaches beyond hind coxae Thoracic tergum with 4 sclerotised plates on pronotum, 6 each on meso-and metanota. Abdominal dorsum with 6 sclerotised plates on each of 1st-6th tergites, 4 on 7th tergite, each of the plates bearing a stiff, stout hair ; 8th tergite with 4 hairs. Cauda with 2 hairs. First tarsal segment with 2, 2, 2 hairs ; second tarsal segments with 4 short dorsal and 4 ventral hairs and two long dorsopical hairs ; empodial hair longer than claws.

Colour.—Olivaceous green.

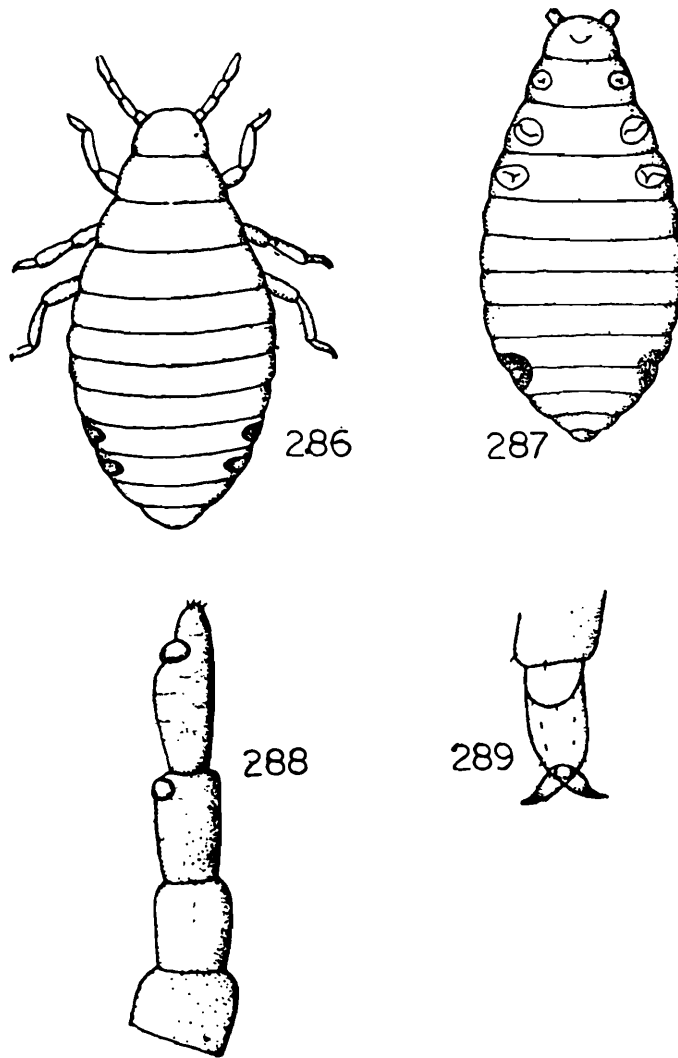
Apterous viviparous female (fundatrigenia).—Body 1.40-1.50 mm. long with 0.75-0.80 as maximum width. Head dusky with a



Alate viviparous female (Sexupara) :

282. whole body ; 283. antenna ; 284. apex of antenna ; 285. hind tarsus, ventral and lateral views (from Roberti, 1938).

distinct median suture, without any wax plate. Antennae 6-segmented, pale brown, $0.25-0.28 \times$ as long as the body ; flagellum finely spinulose ; hairs on flagellum minute ; primary rhinaria ciliated ; processus terminalis $0.22-0.25 \times$ as long as base of antennal segment VI. Rostrum reaches mid-coxae, ultimate rostral segment stout, acute, triangular, $0.70-0.80 \times$ as long as second segment of hind tarsus and without any accessory hairs. Mesonotum with a pair of lateral wax plates. Abdominal dorsum pale, with paired spinal and marginal, round to suboval wax plates on 1st-7th tergites, these increasing in size posteriorly, besides the pleural wax plates present at least on 3rd-6th tergites ; 8th tergite with a single elongate, median wax plate ; hairs on the dorsum of abdomen fine, sparse, $0.010-0.020$ mm. long, $0.37-0.75 \times$ as long as the diameter at the constricted base of antennal segment III ; 8th tergite with 6



Oviparous female :

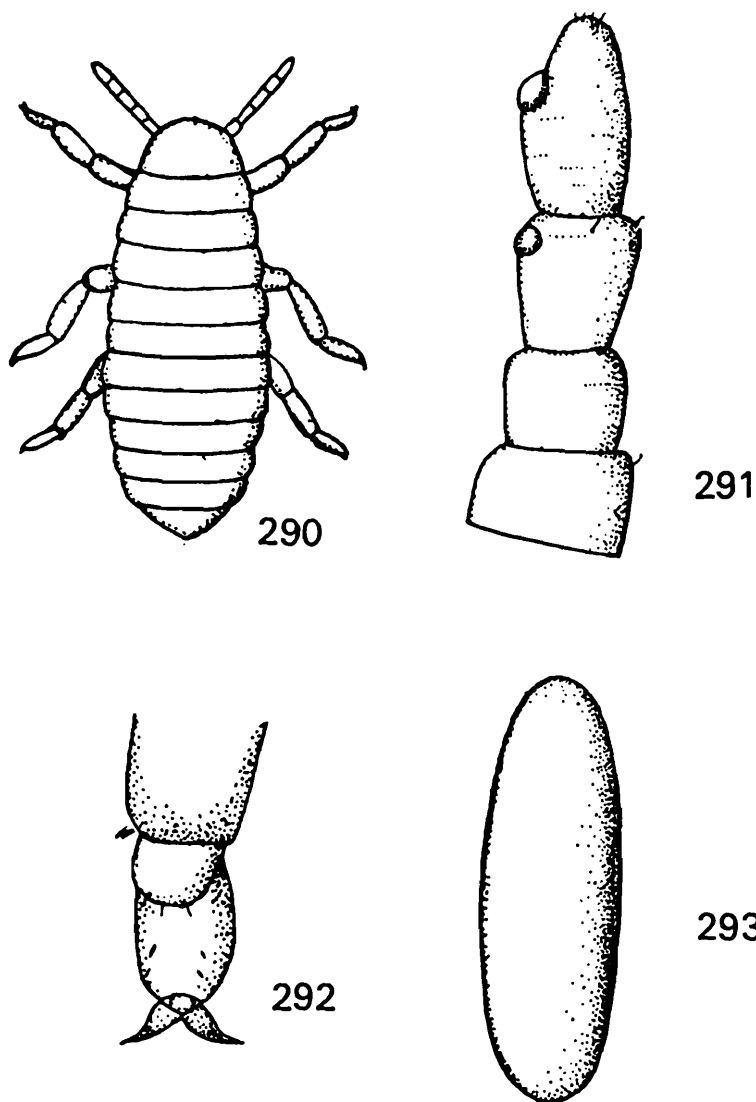
286-287. whole body ; 288. antenna ; 289. hind tarsus.

hairs on the median wax plates. Siphunculi present as mere ring. Subgenital plate with about 20 fine hairs. Subanal plate with few (10-12 ?) hairs. Legs pale, short ; hairs on femora and tibiae sparse, longest one on hind tibiae 0.006-0.010 mm. long, $0.20-0.25 \times$ as long as the diameter at the middle of the tibiae ; first tarsal segments with 2, 2, 2 hairs.

Colour.—Dark honey-bay with a wax cover (from Roberti, 1938).

Measurements in mm.—

	Length	Width	Antenna
1.	1.41	0.82	0.38
2.	1.42	0.80	0.41
3.	1.48	0.82	0.38



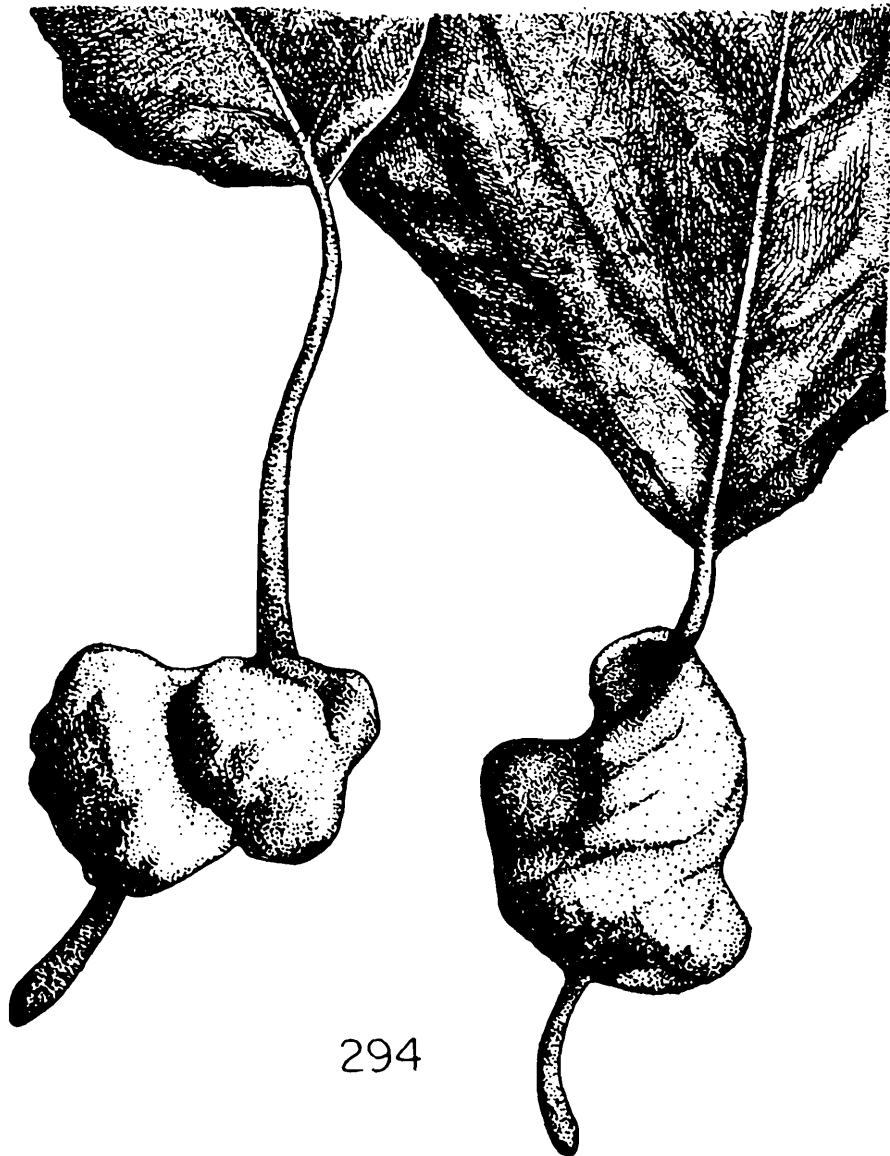
Male :

290. whole body ; 291. antenna ; 292. hind tarsus ; 293. egg of female.

III	Antennal segments			urs.	ht ₂	Siph.
	IV	V	VI			
0.07	0.04	0.06	(0.09+0.02)	0.07	0.10	0.030
0.08	0.04	0.06	(0.08+0.02)	0.08	0.10	0.030
0.08	0.03	0.05	(0.08+0.02)	0.07	0.10	0.031

(1-3 ex. *Populus* galls, London, ENGLAND, August, 1963, coll. Sr. M. Andrew, BMNH 658/63).

Alate viviparous female (Sexupara ?). —Body elongate, 2.30-2.38 mm. long with 1.0-1.04 mm. as maximum width. Head dark brown with a median suture, a pair of small wax plates discernible on



Gall : 294. leaf base-gall on *Populus nigra*.

the vertex. Antennae brown, paler than head, 6-segmented, $0.25-0.29 \times$ as long as the body ; flagellum gradually more distinctly imbricated from apical 0.30 portion of segment III, apicad ; hairs on flagellum not discernible ; segment III twice or more than twice as long as segments IV + V together and bears 4-5 narrow secondary rhinaria, segment IV with 1-2 similar rhinaria ; primary rhinaria distinctly ciliated ; processus terminalis $0.13-0.14 \times$ as long as base of antennal segment VI. Rostrum reaches near mid coxae, ultimate rostral segment $0.57-0.66 \times$ as long as the second segment of hind tarsus and bears 2 accessory hairs. Thorax dark brown,

bearing a pair of wax plates at least on meso-and metanota. Abdominal dorsum pale, bearing paired marginal wax plates on 1st-7th, beside much smaller spinal wax plates on 1st-3rd tergites ; 8th tergite with a large, transverse, submedian wax plate which bears 4-5 hairs ; hairs on the dorsum of abdomen fine, sparse, 0.006-0.020 mm. long, $0.33-1.0 \times$ as long as the basal diameter of antennal segment III. Siphunculi absent. Cauda with 2 hairs. Subgenital plate with 20 hairs. Subanal plate with 10-11 hairs. Legs brownish, hairs on femora and tibiae sparse, longest one on hind tibiae 0.016 mm. long, $0.50 \times$ as long as the diameter at the middle of tibiae ; first tarsal segments with 2, 2, 2 (3, 3, 2 according to Roberti, 1938) hairs. Forewings with pterostigma long.

Colour.—Body green with head, thorax and legs black, covered with waxy secretion on abdomen.

Measurements in mm.—

	Length	Width	Antennae
1.	2.38	1.04	0.64
2.	2.30	1.00	0.59

Antennal segments				urs.	ht ₂
III	IV	V	VI		
0.20	0.09	0.10	(0.14+0.02)	0.11	0.15
0.18	0.07	0.09	(0.13+0.02)	0.09	0.15

(1-2, ex. *Populus* galls, London, ENGLAND, August, 1963, coll. Andrew, BMNH 658/63).

Sexuales.—[from Roberti, 1938].

Ovipara.—Body 0.90 mm. long with 0.40 mm. as maximum width. Antennae 4-segmented, 0.16 mm. long ; ratio of antennal segments I : II : III : IV : : 25 : 25 : 30 : 50. Eyes of 3 facets. Rostrum absent. Abdominal dorsum with ventro lateral wax-plates, besides a dorsal one on 5th and 6th tergites. First tarsal segments with 2, 2, 2 hairs. Eggs strawish white, elliptical, 0.45 mm. long, covered with wax when laid.

Colour.—Dark green.

Male.—Body 0.55 mm. long with 0.22 mm. as maximum width. Antennae 4-segmented, 0.12 mm. long ; segments I ; II ; III almost equal in length ; ratio of antennal segments I : II : III : IV :: 22 : 20 : 37. Eyes of 3 facets. Rostrum absent. Abdominal dorsum with wax glands. Claspers curved. First tarsal segments with 3, 3, 3 hairs.

Colour.—Green in life.

Material examined.—Two apterae and two alatae viviparae from *Populus* galls, London, ENGLAND, August, 1963, coll. Sr. M. Andrew, (BMNH coll. No. 658/63) ; two alate vivipare, November, 1963, other data same as before.

Discussion.—This species has only been referred to by Mathur and Singh (1959), as occurring on Poplars in Indian region. However, no material from this area was available for examination and the description is based on material from England and from Roberti (1938) who was given a detailed description (in Italian) of this species from Europe. Roberti (op. cit) stated that biological cycle consists of 4 generations viz. apterous fundatrix, apterous fundatrigeniae, alate sexupara and apterous sexuales ; the cycle begin in the first part of April when new born larvae hatch out of egg and initiate the spiral-leaf gall (Petiole), undergo 4 moults and become adult and lay larvae ; fundatrices produce apterous fundatrigeniae which in their turn produce the alate sexupara in August-September ; during this period, the gall in a twisted spiral form grow to a diameter of 2 cm. and can contain about 1000 individuals, of which 5 percent appear to be adult sexuparae ; Sexuparae leave the galls in August-September, [however, alate from galls of *Populus*, collected in London, November, 1963, were seen during present study], and lay apterous sexuales on branches and trunk of the same host-plant, which mature in 3 days after passing through 4 moults, copulate and oviparae lay single wax covered egg. This observation of Roberti contradicts that of Tullgren (1909) who believed that *spyrotheceae* has only 3 generations.

The species is known to form spiral petiole gall on *Populus nigra* and *Populus italica* (Pyramidalis) and is wide spread in Europe.

Distribution.—INDIA (North west) : IRAN : EUROPE.

Types.—Location of types not known.

35. *Pemphigus vesicarius* Passerini (figs. 295-308)

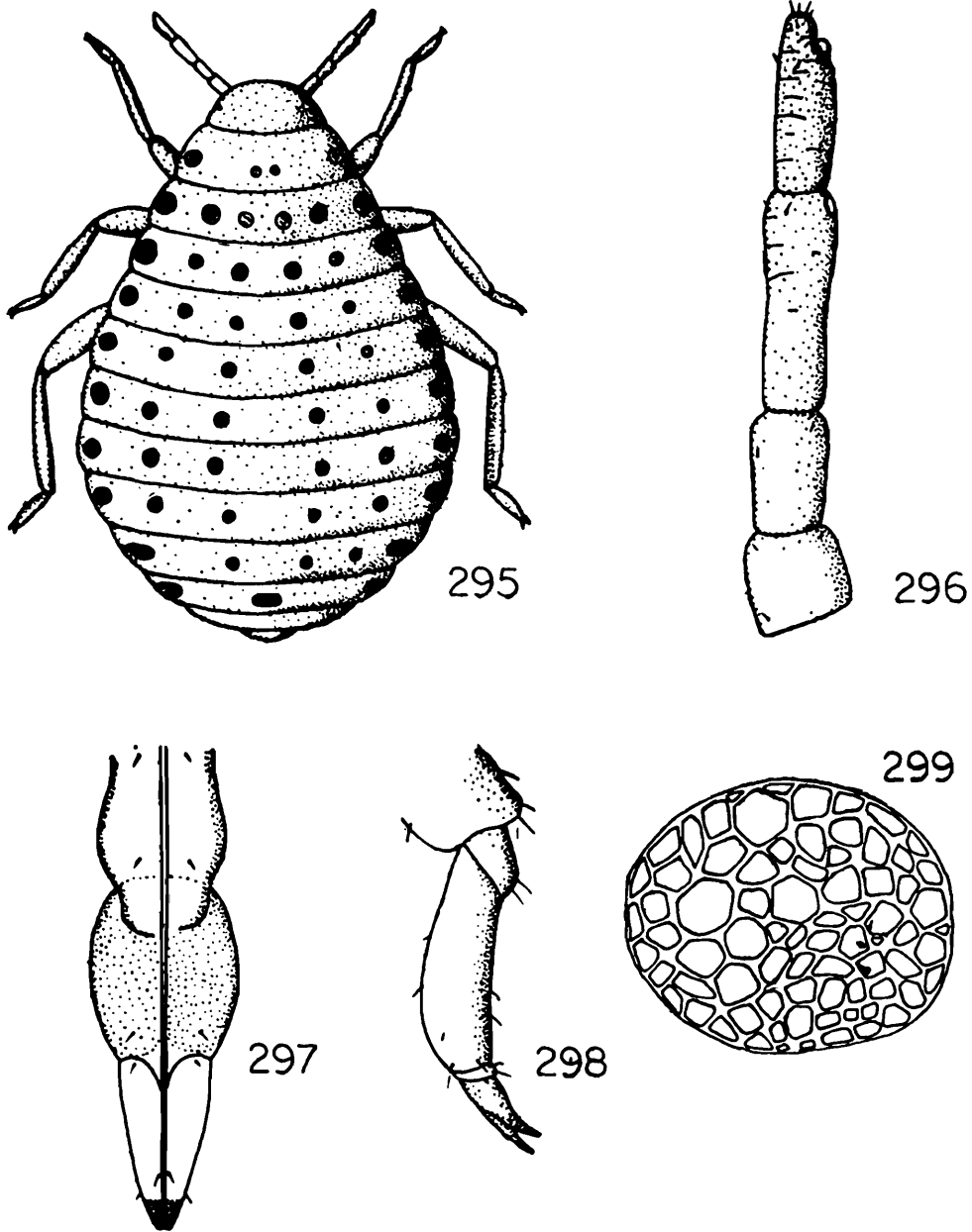
1861. *Pemphigus vesicarius* Passerini, G., *Atti Soc. Ital. Sci. natur.*, 3 : 401.
 1938. *Pemphigus vesicarius*, Roberti, D. *Bull. Lab. zool. Portici*, 30 : 214.
 1941. *Pemphigus spirothecaefacies* Ghulamullah, *Indian J. Ent.*, 3 (2) : 236.
 1957. *Pemphigus vesicarius*, Bodenheimer, F. S. and Swirski, E., *The Aphidoidea of the Middle East*, 317.

[Indian material were not available ; description based on the redescription of the species in Italian, by Roberti (1938) and some alate material from Bulgaria (BMNH collections)].

Apterous viviparous female.—(Fundatrix) : Body ovoid, 3.0 mm long with 2.0 mm. as its maximum width. Head wider than long ; dorsal cephalic hairs sparse. Antennae 4-segmented, 0.42 mm. long ; segment II half as long as III and $0.75 \times$ as long as IV ; flagellum with spinulose imbrication ; primary rhinaria ciliated ; ratio of antennal segments I : II : III : IV :: 30 : 40 : 80 : 60. Rostrum reaches mid-coxae ; ultimate rostral segment more than twice as long as its width. Wax plates small, round, present on pronotum (4), meso- and metanota, 1st-6th tergites (6), and on 7th tergite (3-4), with an average diameter of 0.10 mm. Legs with femora as long as tibiae ; first tarsal segments with 2, 2, 2 hairs.

Colour.—Dark slate coloured, with dark green abdominal venter and olivaceous antennae, rostrum and tarsi.

Larva (new born).—Body 0.70 mm. long. Antennae 4-segmented 0.20 mm. long ; segment I, II and III, subequal, segment IV, twice or more than twice as long as the preceding segments ; flagellum with spinular imbrication ; hairs on flagellum long, fine ; primary rhinaria ciliated ; ratio of antennal segments, I : II : III : IV :: 30 : 35 : 37 : 70. Ultimate rostral segment long, tapering. Tergam



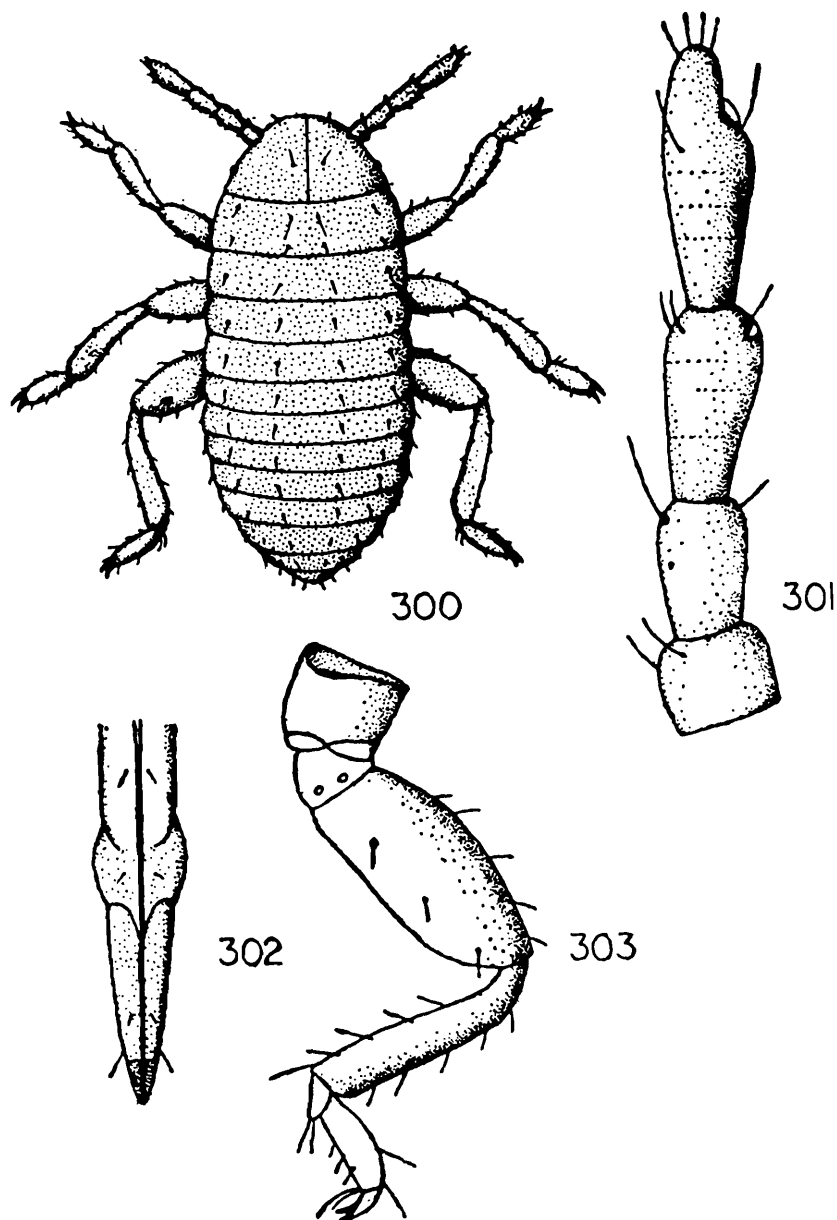
Pemphigus vesicarius Passerini (from Roberti, 1938) ;

Apterous viviparous female (fundatrix) :

295. whole body ; 296. antenna ; 297. ultimate rostral segment ; 298. hind tarsus ; 299. wax gland.

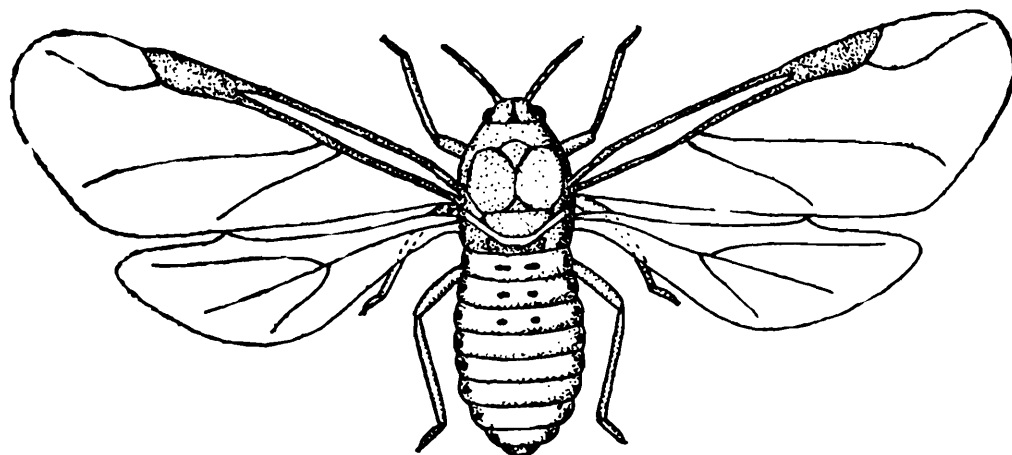
thickened. Abdominal dorsum with 7 hairs on each of 1st-7th tergites and 4 hairs on 8th tergite. Legs with femora enlarged ; first tarsal segments with 2, 2, 2 hairs; empodial hair long.

Colour.—Dark, olive in life.



First instar larva of fundatrix : 300. whole body ; 301. antenna ;
302. ultimate rostral segments ; 303. hind leg.

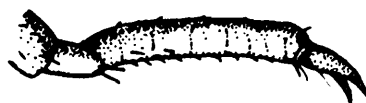
Alate viviparous female (Fundatrigenia).—(based on specimens from Bulgaria and description provided by Roberti, 1938). Body 2.0-2.5 mm. long with 0.75-0.85 mm. as maximum width. Antennae 6-segmented, 0.65-0.75 mm. long ; segment I cylindrical, shorter than II ; segment III as long as IV and V taken together, and bears 7-9 transversely elongated secondary rhinaria ; segment IV little shorter than or equal to V and has 2-4 similar rhinaria ; segment V with 0.2 secondary rhinaria besides a sub-apical primary rhinarium ; segment VI without any secondary rhinaria ; hairs



304



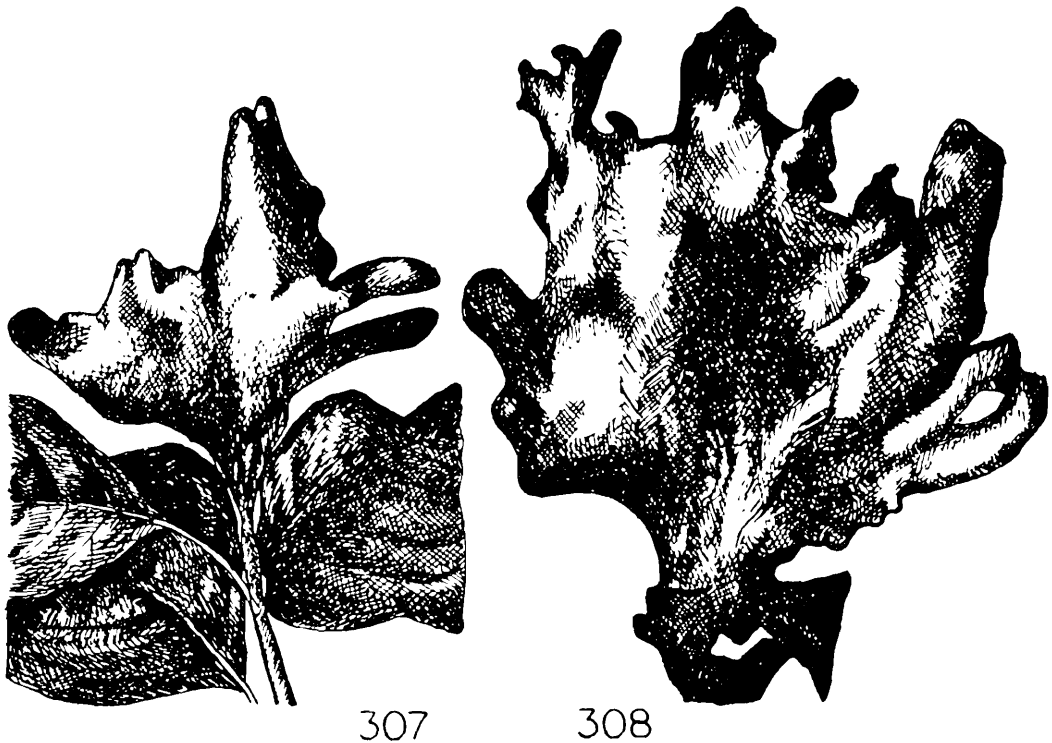
305



306

Alate viviparous female (fundatrigenia) : 304. whole body ; 305. antenna
306. hind tarsus.

on the flagellum not discernible ; processus terminalis $0.25 \times$ as long as the base of segment VI. Rostrum reaches mid-coxae ; ultimate rostral segment more than $2.0 \times$ as long as its maximum width and $0.50-0.54 \times$ as long as second segment of hind tarsus, without any accessory hairs. Metanotum with a pair of wax plates. Abdominal tergites 1st-3rd, each with 2 marginal and 2 submedian oval wax plates, decreasing in size, caudad ; 4th-7th tergites with only paired marginal wax plates and 8th with a large median wax plates extending along its width. Siphunculi absent. Legs with tibiae somewhat enlarged apically ; longest hair on hind tibiae 0.020 mm. long, $0.50 \times$ as long as the diameter at the middle of the tibiae ; first tarsal segments with 2 or 3 hairs but may bear 4 hairs on mid and hind tarsi ; empodial hair 0.013 mm. long, $0.20 \times$ as long as the claws. Forewings with stigma dark, not elongate.



Galls :

307. on *Populus nigra*—tubiform gall on leaves ; 308. matured gall.

Measurements in mm.—

	Length	Width		Antenna		
1	?	?	?	0.69		
2.	?	?	?	0.73		
		Antennal segments			urs.	ht ₂
	III	IV	V	VI		
	0.23	0.09	0.10	(0.12+0.03)	0.12	0.24
	0.22	0.10	0.10	(0.12+0.03)	0.13	0.24

(1, 2 ex. *Populus* gall, BULGARIA, 8.6.1969, BMNH, 1970-152).

Colour.—Slate grey to green over abdomen, rest blackish.

Larva (new born).—(from Roberti, 1938) Body 0.70 mm. long. Antennae 4-segmented, 0.24 mm. long, 0.34 × as long as the body; segments I and II cylindrical, sub equal, III longer than II and IV, little less than twice as long as III; primary rhinaria ciliated;

processus terminalis $0.25 \times$ as long as base of last antennal segment ; ratio of antennal segments I : II : III : IV :: 30 : 40 : 50 : 80. Rostrum reaches posterior end of abdomen, ultimate rostral segment $3.0 \times$ as long as with maximum width. Abdominal tergites 3rd-6th, each with 4 large sub-rectangular wax plates, 7th with only 2 such wax-plates, all bearing a single short hair. First tarsal segments with 2, 2, 2 hairs; empodial hair $0.50 \times$ as long as the claws.

Alate sexupara (from Roberti, 1938).—Body 1.80 mm. long and 0.60 mm. wide at thorax. Antennae 6-segmented, 0.65 mm. long, $0.36 \times$ as long as the body ; segment I shorter than II, segment III, little longer than IV and V taken together, IV little shorter than V, and segment VI, little longer than III ; segment III with 4-7 transversely elongate secondary rhinaria and IV with 1-3 similar rhinaria ; primary rhinaria ciliated ; processus terminalis $0.25 \times$ as long as the base of segment VI ; ratio of antennal segments I : II : III : IV : V : VI :: 25 : 35 : 90 : 35 : 45 : 95. Rostrum reaches mid coxae, ultimate rostral segment little longer than, $2.0 \times$ as long as its maximum width. Meso-and metanota each with a pair of submedian wax-plates. Abdominal dorsum with paired marginal, semi oval wax-plates on 1st-7th tergites, increasing in size caudad besides the paired, sub median wax-plates on 1st-3rd, which decreases in size cauded, and may be completely lacking ; 8th tergite with a single large transversely elongate wax-plate. Cauda with 2 hairs. Legs with tibiae enlarged distally, first tarsal segments with 2, 3 or 4 hairs. Forewings with media slightly curved.

Colour.—Dark green over abdomen, rest black.

Sexuales.—(from Roberti, 1938).

Apterous ovipara.—Body sub-oval, 0.80 mm. long with 0.40 mm. as its maximum width. Antennae 5-segmented, 0.15 mm long, $0.18 \times$ as long as the body ; ratio of antennal segments I : II : III : IV : V :: 20 : 25 : 15 : 21 : 45. Eyes of 3 facets. Rostrum absent. Abdominal dorsum with paired ventrolateral wax plates. First tarsal segments with 2, 2, 2 hairs. Eggs laid by female 0.45 mm. long, whitish and remain covered in waxy secretion.

Colour.—Greenish yellow in life.

Apterous male.—Body elongate, 0.61 mm. long, with 0.20 mm. as its width. Antennae 5-segmented, 0.60 mm. long ; ratio of antennal segments I : II : III : IV : V :: 25 : 23 : 15 : 25 : 40. Eyes of 3 facets. Rostrum absent. Abdominal dorsum without wax plate. Claspers well developed.

Colour.—Greenish yellow in life.

Material examined.—Two damaged alate fundatrigeniae and 3 nymphs from *Populus* galls, Balgoevgrad to Simitli Rd. BULGARIA, 8.6.1969, (BMNH 58/70, 1970-158).

Discussion.—Gulamullah (1941) described this species as *Pemphigus spirothecaeticias* on Poplar from Afghanistan and related it to *spirothecae* Pass. Since then, no information of its occurrence has been recorded from this region. The species is otherwise well known from Europe and forms galls on *Populus nigra*. Roberti (1938) mentions that virginogeniae are unknown as also its alternate host ; while redescribing the species in details, Roberti (op. cit) mentioned that in Naples, Italy, eggs hatch by end of March, larvae form bud-galls, which appear vesicular, green and attains 1 cm. in diameter as the fundatrix become adult and start to lay hundreds of larvae by middle of May ; alate fundatrigeniae emerge and leave the galls in large number between may and first part of June, when galls become 4 cm. in diameter, appear dark green and tend to become reddish ; sexuparae settle on Poplar by end of August and become numerous in September, and lay sexuales on trunk and branches ; sexuales undergo 4 moults and copulate ; oviparous female lays a single egg under bark or inside old gall. Syrphid larvae may be seen within galls. Borner (1952) mentions that species definitely need further study.

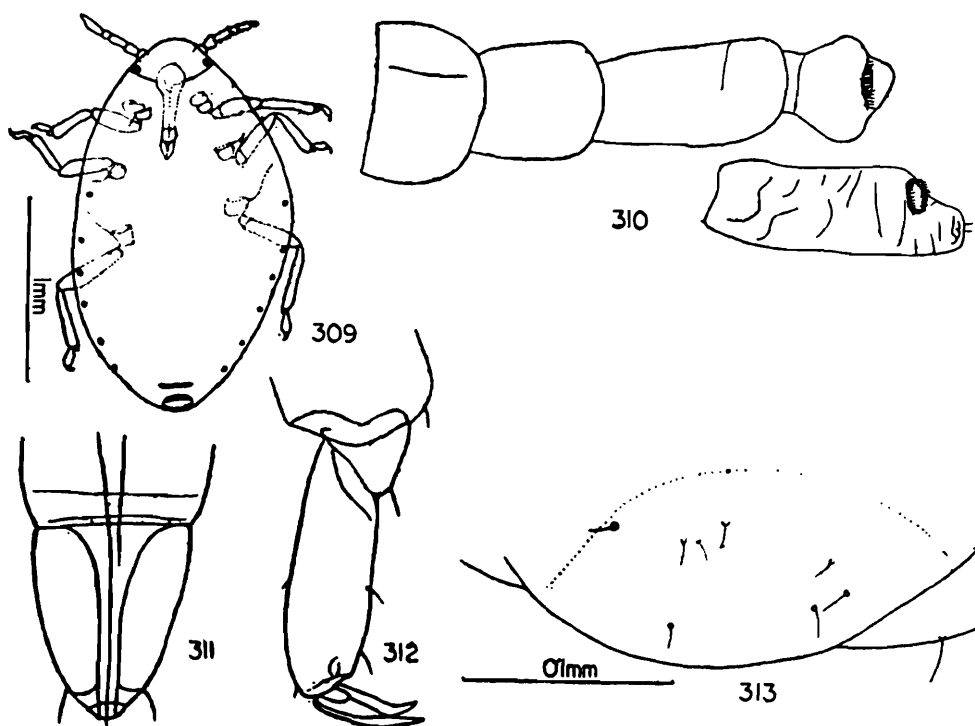
Distribution.—AFGHANISTAN ; IRAN ; IRAQ ; TURKEY ; ALGERIA ; FRANCE ; ITALY

Types.—Location of types not known ; type of *spirothecaefacies* Ghulumullah, 1941 is reported to be in IARI, New Delhi (IPC K 8052, R 8053-8059).

36. *Pemphigus vulgaris* Raychaudhuri, Pal, Ghosh, M. R.
(figs. 309-313)

1978. *Pemphigus vulgaris* Raychaudhuri, D. N., Pal, P. K. and Ghosh, M.R.,
Entomon, 3 (2) : 250.
1980. *Pemphigus vulgaris*, Raychaudhuri, D. N., Pal, P. K. and Ghosh, A. K.
Aphids of North East India and Bhutan, 422.

Apterous viviparous female—Body pale, ovoid, about 1.90-2.10 mm. long. Head fused with prothorax, with a dark sclerotic area over vertex and along the eyes ; hairs on the dorsum of head 0.007-0.015 mm. long, $0.25-0.41 \times$ as long as the basal diameter of antennal segment III. Eyes of 3 facets. Antennae 5-segmented (with a faint segmentation on apical 0.66 portion of III), pale, slender, usually $0.17-0.19 \times$ (upto $0.23 \times$) as long as the body ; segment I wider than long, II longer than I, segment III and V equal, IV shortest of all the 5 segments ; flagellum with spinulose imbrications ; hairs on flagellum, minute, hardly discernible ; primary rhinaria on segment IV sunken, on V irregular ovoid, ciliated ; processus terminalis $0.16-0.19 \times$ ($0.19-0.25 \times$) as long as base



Pemphigus vulgaris Raychaudhuri, Pal, M. R. Ghosh ; Apterous viviparous female (from roots) : 309. whole body ; 310. antenna ; 311. ultimate rostral segment ; 312. hind tarsus ; 313. posterior portion of abdomen.

of antennal segment V. Rostrum reaches near mid-coxae; ultimate rostral segment obtuse, usually $0.85-0.90 \times (0.75-0.96 \times)$ as long as second segment of hind tarsus and without any accessory hairs. Abdominal dorsum pale; paired suboval, spinal and pleural wax plates present, at least on posterior tergites (3rd-6th), gradually increasing in size, caudad; 7th tergite with a pair of spinoplural wax plates; all wax plates with a number of rather pale pores and bearing a single hair; hairs on the dorsum of abdomen short, on anterior tergites 0.006-0.010 mm. long, on posterior tergites 0.013-0.016 mm. long, these being $0.20-0.30 \times$ and $0.40-0.50 \times$ as long as the basal diameter of antennal segment III, respectively ($0.30-0.46 \times$, $0.55-1.25 \times$); 8th tergite with 4 hairs. Spiracles on sclerotic plates. Siphunculi absent. Cauda semicircular, little sclerotic with 2 hairs. Subanal plate with very few hairs (6-7?). Subgenital plate yellowish, sclerotic with 10-12 hairs. Legs brownish, trochanters fused with femora, tibiae sparsely imbricated, hairs on tibiae sparse, longest one on hind tibiae, 0.006-0.010 mm. long, $0.20-0.21 \times$ as long as the diameter at the middle of the tibiae; apical tibial hairs differentiated from others, short, thick and spine like; tarsi finely and sparsely spinulose; first tarsal segments with 2, 2, 2 hairs.

Colour.—Pale whitish in life.

Measurements in mm.—

	Length	Width	Antenna		
1.	2.10	1.38	0.39		
2.	2.07	1.40	0.37		
				Antennal segments	
	III	IV	V	urs.	ht ₂
	0.09	0.04	(0.12+0.02)	0.10	0.11
	0.08	0.05	(0.11+0.02)	0.09	0.11

(1, 2, ex. *Triticum vulgare*, Rimbik, Sikkim, 20.4.1972, Paratypes, Calcutta University collections).

Material examined.—3 apterous viviparous female from *Triticum vulgare* (roots), Rimbik, Sikkim, 20.4.1972, coll. P. K. Paul (Holotype and Paratypes, Calcutta University collections, No. SK 25).

Discussion.—The species is only known by exules on secondary host and appears to be restricted to Darjeeling, Sikkim areas of Eastern India occurring during November to April on roots of Grasses and other Graminae. Pal, P. K. (Ph. D., Thesis, 1975) states that it occurs in sandy loam soil between 5.0-7.0 cm. at an altitude of *ca* 2000-2300 m. and are not associated with ants. Long ultimate rostral segment, feeble wax pores, slender legs and antennae and sparse minute flagellar hairs, help to separate the species from allied ones. However, till the other morphs are available, its identity cannot be fully ascertained.

Distribution.—INDIA (Darjeeling ; Sikkim).

Types.—In the collections of Entomology Laboratory, Department of Zoology, University of Calcutta.

11. Genus *Prociphilus* Koch, 1857.

1857. *Prociphilus* Koch, C. L., *Die Pflanzenlause Aphiden*, Nurnberg, p. 279, Type species : *Aphis bumeliae* Schrank.
1875. *Holzneria* Lictitenstein, J., *Bull. Soc. ent. Fr.* (5) 5:76. Type species : *Pemphigus poschingeri* Holzner=*Aphis bumeliae* Schrank.
1906. *Pulvius* Sanborn, C. E., *Bull. Unvi. Kans.*, 3:225. Type species : *Pulvius probosceus* Sanborn.
1917. *Nishiyana* Matsumura, S., In Nagano, K ; A collection of Eassys for Mr. Yasushi Nawa, Gifu 3:90. Type species : *Nishiyana anomoriensis* Matsumura.
1969. *Anocaudus* Ghosh, A. K., Chakrabarti, S., Chowdhuri, A. N. and Raychaudhuri, D. N., *Oriental Ins.* 3 : 328. Type species : *Anocaudus taxus* Ghosh, Chakrabarti, Chowdhury, Raychaudhuri.
1974. *Meliaphizophagus* Smith, C. F., *Tech. Bull., N. Carol. Agric. Exp. St.*, 226:17. Type species : *Pemphigus fraxinifalii* Riley.

Morphology.—Body semioval or subglobular, 3.0-6.0 mm. long. Head with or without wax gland groups. Antennae 4-5-segmented in fundatrices, 5-6-segmented in apterae viviparae, 6-segmented in alatae, always distinctly much shorter than the body ; secondary

rhinaria absent in apterae, annular and ciliated in alatae, usually present on segment III-VI ; primary rhinaria rounded and ciliated ; processus terminalis always much shorter than base of last antennal segment, may be very short and blunt or long, slender, finger-like ; hairs on the flagellum short, inconspicuous or may be long, numerous, and as long as the basal diameter of antennal segment III. Ultimate rostral segment thick or slender, may be with a pale sub-opical zone (*Prociphilus*) or without any trace of such pale zone (*Stagona*), usually bearing at least 2 to many fine accessory hairs, and subequal or equal to the second segment of hind tarsus. Thoracic tergites, specially mesothoracic tergites with large, conspicuous, wax gland groups in alatae. Abdominal dorsum almost always with well developed wax gland groups, these may be on spinal, pleural and marginal areas, but often only marginal and lateral groups are present on 1st-7th tergites ; 8th tergite may bear a large wax gland group ; hairs on the dorsum may be short and sparse or long and more numerous. Siphunculi absent (except in fundatrigeniae of *Paraprocephalus* ; Smith, 1974). Cauda semilunar with 4 to numerous hairs or may form an anocaudal process with anal plate, the latter appearing as a distinct collar around the base of cauda, and in such cases it may bear upto 60 hairs. Subgenital plate with 20-40 setae, most of these arranged in single or double rows along caudal margin but fewer ones on anterior margin. Legs with tibial hairs fine or these may appear spine-like at distal end ; first tarsal segment with 2-6 hairs, and tarsal formula may vary in different morph of the same species (2-3 in apterae and 4-6 in sexuparae of *P. carolinensis* Smith) ; empodial hairs may be $0.33\times$, to equal to the length of tarsal claws. Forewings with stigma blunt or elongate, media simple, vins may be often bordered brown ; hind wings with both oblique.

First instar larvae of the fundatrices, resulting in emigrants, may differ from the larvae of emigrants which result in exules, in having broader body, shorter rostrum and shorter hairs etc., (Mordvilko, 1935). Some characters of the first instar larve of fundatrigeniae, mostly based on American species of the subgenera of *Prociphilus*, have been given in Table (6), following Smith (1974).

Discussion.—Nearly 50 species are recognised under the genus ; of these two species *corrugatus* Serrine, *ghanii* Hille Ris Lambers

have been included under the subgenus *Neoparacletus* Storm 1942 ; two species, *baicalensis* (Cholodkovsky) and *tesselatus* (Fitch) have been included under a second subgenus *Paraprociophilus* Mordvilko 1923, and 8 species including one from the region (*himalayensis* Chakrabarti) have been included under the third subgenus *Stagona* Koch 1856, while rest of the species are considered under the nominate genus. Some characters of fundatrices, fundtrageniae and sexuparae for members of each of the subgenera, (mostly based on American species) have been given in the Table (6) following Smith (1974). Smith (op. cit) has, however, considered these as distinct genera, as has also been considered by Stroyan (1975) ; the subgeneric classification has been followed here after Eastop and Hille Ris Lambers (1976) ; Smith (1981) mentions that *Pulvius* Sanborn, should be retained as a valid subgenus under *Prociophilus*, because the only species *probosceus* (Sanborn) differ from the type of *Prociophilus* in having longer rostrum, numerous setae on antennae, rostrum and abdomen and short empodial hair in the embryos.

Seven species, including one each under *Neoparacletus* (*ghanii* H.R.L.) and *Stagona* (*himalayensis* Chakrabarti) have been recorded in the region, of these, 5 are endemic and two are Palaearctic (Japan, Amur region of U.S.S.R.) ; besides records of alates of 4 undetermined species of *Prociophilus* from *Fraxinus floribunda* and *Photinia notoniana* (Ghosh, A. K. et al. 1970), *Tsugabrunoniana* (Basu 1961) and an undetermined host (Chowdhuri et al. 1969) are also available.

Biology.—The members of the nominate genus are known to have *Amelanchier*, *Crataegus*, *Fraxinus*, *Heteromeles* as primary host and migrate to roots of Conifers e.g. *Abies*, *Pinus* or other hosts e.g. *Artemesia*, *Erigeron*, *Helianthus* and Grasses etc. On the primary host, they form pseudo-galls on leaves or live under bark, sometimes petioles may crumple or roll up and the whole group of leaves may be pressed into a mass, due to sucking of sap by fundatrices and their progeny ; alate emigrants in Palaearctic region, develop in June-July and the sexuparae return to Primary host during October-November ; many species are monoecious, on either the Primary or secondary host-plant groups ; often these insects, specially apterae, remain covered with white waxy secre-

tion ; in many cases apterae are found in ants' nests at the roots of the host plant.

Of the two species of *Neoparaclletus*, *corrugatans* (Sirrinc), a North American species, has *Crataegus* spp. as the primary host where it causes a cupping of the leaves and *Juncus* spp. as the secondary hosts ; this species is often attended by ants, and may live throughout the year on the crown of *Juncus* ; sexuparae are also common in cracks and crevices on the trunk of *Pyrus malus* in North Carolina, U.S.A. (Smith, 1972) ; the second species, *ghanii* Hille Ris Lambers, is only known by the apterae collected from *Salix wallichiana* in Pakistan region.

Of the two species under *Paraprociophilus*, *baicalensis* Cholod., is mainly known from leaves of *Alnus* spp. in Siberian region upto Ural, where they suck on the underside of leaves and may also attack shoot and often remain covered by thick, long, white fuzzy wax. Mordvilko (1935), while dealing in details about the species, opined that due to disappearance of Maple (*Acer* spp.) the species lead anholocyclic life and remains confined to *Alnus*, but Börner (1952) recorded a small colony on *Acer negundo* in Hungary ; the second species, North American, *tesselatus* (Fitch) has *Acer saccharinum* as the primary host, where it causes a slight cupping of leaves and *Alnus* as secondary host, living primarily on the stems ; *tesselatus* may also live continuously on *Alnus* (Smith, 1974).

Many species of *Stagona* viz. *xylostei* (De Geer) *piceaerubensis* (Smith), *crataegistrobi* (Smith) are known to alternate between *Crataegus* and *Lonicera* (Primary hosts) and *Pinus* and *Picea* (secondary host) and on the latter, they are associated with the microrhizae of the roots (Smith, op. cit.) ; similarly other species of the genus e.g. *konoii* (Shinji), *pini* (Burmeister) etc., are known from *Lonicera/Picea* or only from *Crataegus*. On *Lonicera*, some species may curl the leaves and roll them into tube like structure (*xylostei* De Geer) and the fundatrices remain covered with wax ; sometimes progeny of fundatrices may develop on the bark of young shoots ; anholocyclic life cycle may also be pursued in area where primary hosts are mostly absent (Mordvilko, 1935). Table (7) shows the usual host plants of members of the genus *Prociophilus* S. I.

Mordvilko (1935), Börner (1952) and Smith (1969, 1974) have discussed the life cycle and biology of a number of *Prociphilus* species from Palaeartic and Nearctic regions.

Distribution.—Oriental, Palaeartic and Nearctic regions. Smith (1969, 1974) has dealt with the species known from North America and provided keys for different morphs. Mordvilko (1935) has given detailed description of a number of species from Palaeartic region.

Type species.—*Aphis bumeliae* Schrank 1801 (for *Prociphilus* Koch) *Neoparaclctus caricis* Strom 1942=*Pemphigus corrugatana* Serrine (for *Neoparaclctus* Strom) ; *Pemphigus baicalensis* Cholodkovsky, 1921 (for *Paraprocephilus* Mordvilko) ; *Aphis xylostei* De Geer 1773 (for *Stagona* Koch) ; Location of *bumeliae* and *xylostei* not known ; material of *caricis* Strom and *baicalensis* Cholod, may be in the U.S.N.M. Washington, and Institute of Zoology, Academy of Sciences, Leningrad, U.S.S.R. respectively.

Key to the subgenera of Prociphilus Koch

(based on alate viviparae unless otherwise stated)

1. Pterostigma elongate, acute. Head with distinct wax gland. Ultimate rostral segment with or without accessory hairs. Hairs on first segment of hind tarsus in apterae aliencolae spine-like, similar to those near apices of tibia. Antennae in apterae 5-6 segmented. Siphunculi absent. On curled leaves of *Crataegus* and *Lonicera*, aliencolae on roots of Conifers . *Stagona* Koch
- Pterostigma short, nearly blunt. Head with or without wax glands. Ultimate rostral segment always with accessory hairs. Hairs on the first segment of hind tarsus in apterae never spine-like . 2

2. Head without wax glands. Abdominal wax glands distinct. Antennal segment VI with 4 or more secondary rhinaria ; antennal segment II with 3-5 hairs. Antennae 5-6 segmented in apterae aliencolae, 4-5 segmented in fundatrices. Head with 2-4 wax gland groups in fundatrices. On *Acer* and *Alnus*

.**Paraprociphilus** Mordv.

—Wax glands on head may be well developed, feebly developed or absent. Antennal segment VI with 0-3 secondary rhinaria ; antennal segment II with 5-8 hairs. Antennae 5-6 segmented in apterae aliencolae and fundatrices. Head with large wax gland group in fundatrices. Never on *Acer* or *Alnus*

.3

3. 8th abdominal tergite with 2-4 hairs. Cauda with 2-15 hairs and may form an elongate tube like process along with anal plate and if so, bearing numerous hairs. Marginal wax gland groups on 6th and 7th tergite smooth on edges. Antennal segment VI with 0-2 secondary rhinaria. Abdominal dorsum, in apterae aliencolae without wax glands, in fundatrices with 3 rows of wax gland groups. On *Crataegus*, *Juncus*, *Salix*

.**Neoparaclletus** Strom.

—8th abdominal tergite with 4-6 hairs. Cauda, never forming anocaudal process, with 9-14 hairs. Marginal wax gland groups on 6th and 7th tergites irregular on edges. Abdominal dorsum in apterae aliencolae and fundatrices with distinct wax gland groups. On *Fraxinus*, *Crataegus* and roots of Conifers, Grasses and Dicots

.**Prociphilus** Koch

TABLE 6 : Some diagnostic characters of subgenera of *Prociphilus* S.I.
(modified from Smith, 1974)

FUNDATRICES	Wax plate on head	Antennal segments	Accessory hairs on urs.	Abdominal wax plates	Siphunculi
<i>Prociphilus</i>	Large	5-6	Present	Present	Absent
<i>Neoparacletus</i>	Large	5	Present	Present	Absent
<i>Paraprociophilus</i>	Moderate	4-5	Present	Present	Absent
<i>Stagona</i>	Large	5-6	Present	Present	Absent
FUNDATRIGENIAE	Wax plates on head	Antennal segments and secondary rhinaria	Accessory hairs on urs.	Thoracic & Abdominal wax plates	Siphunculi
<i>Prociphilus</i>	Present or absent	6-ciliated	Present	Present; abdominal plate	Absent
<i>Neoparacletus</i>	Absent or traces only	6-ciliated	Present	Present	Absent
<i>Paraprociophilus</i>	Absent	6-slightly ciliated	Present	Present	Present
<i>Stagona</i>	Present	6-ciliated	Present or Absent	Present	Absent

SEXUPARAE					
<i>Prociphilus</i>	Present	6-ciliated	Present	Present	Absent
<i>Neoparacetus</i>	Absent	6-ciliated	Present	Present	Absent
<i>Paraprocephilus</i>	Present	6-ciliated	Present	Present	Absent
<i>Stagona</i>	Present	6-ciliated	Present	Present	Absent
FIRST INSTAR LARVAE OF FUNDATRIGENIAE	Antennal segments	Accessory hairs on urs.	Abdominal wax plates	Empodial hair : tarsal claw	
<i>Prociphilus</i>	4	Present	Present	1.0 ×, curved pointed	
<i>Neoparacletus</i>	4	Present	Absent	Longer than claw, pointed	
<i>Paraprocephilus</i>	4	Present	Present	Longer than claw, bent, knobbed	
<i>Stagona</i>	4	Present	Present	0.66-1.0 × as long as claw	

TABLE 7 : Hosts of *Prociphilus* S.I.

	Primary Hosts	Secondary Hosts
<i>Prociphilus</i> s.s.	<i>Amelanchier, Crataegus, Fraxinus, Heteromeles</i>	<i>Abies, Artemisia, Drigeron, Helianthus, Grass roots, Pinus</i>
<i>Neoparacletus</i>	<i>Crataegus</i>	<i>Juncus</i> (or only on <i>Salix</i>)
<i>Paraprocephilus</i>	<i>Acer</i>	<i>Alnus</i>
<i>Stagona</i>	<i>Crataegus, Lonicera</i>	<i>Picea, Pisus</i>

*Key to the species of Prociphilus S.I.*A. *Subgenus Prociphilus s.s.**Apterous viviparous females* (from primary host)

1. Antennal hairs upto 0.070-0.100 mm. long, 1.7-2.3 × as long as the basal diameter of antennal segment III. Head with 2 pair of wax plates. Subanal plate with more than 50 hairs. Subgenital plate with about 50 fine hairs. Longest hair on hind tibiae equal to the diameter at the middle of hind tibiae. On *Fraxinus* (galls) .P. *oriens* Mordvilko
- Antennal hairs upto 0.05 mm. long, at most 1.3 × as long as the basal diameter of antennal segment III. Wax plates on head either indistinct or only one pair. Subanal plate with 18-20 hairs. Subgenital plate with 30-33 hairs. Longest hair on hind tibiae shorter than the diameter at the middle of hind tibiae. On *Cornus* and *Michelia* .2
2. Body 4.2 mm. long. Head with a pair of wax plates. Ultimate rostral segment 0.73 × as long as second segment of hind tarsus and bearing 3 accessory hairs. Empodial hair 0.60 × as long as the basal claws. On *Cornus* sp. .P. *cornifoliae* Singh et al.
- Body 2.5 mm. long. Wax plate on head not clearly discernible. Ultimate rostral segment 1.26 × as long as second segment of hind tarsus and bearing 10 accessory hairs. Empodial hair 0.37 × as long as the tarsal claws. On *Michelia* .P. *osmanthae* Essig & Kuwana

Alate viviparous females (from primary host).

1. Antennal segment III with 35-48 and IV with 12-17 secondary rhinaria ; segment V without any secondary rhinaria. Ultimate rostral segment 0.19-0.20 mm. long, with accessory hairs, 0.50-0.57 × as long as second segment of hind tarsus, which is 0.35-0.41 mm. long. Subgenital plate may be with 60 or more hairs, if with fewer hairs, they antennae more than 20 mm. long. .2.

- Antennal segment III with 13-36 and IV with 4-14 secondary rhinaria and segment V always with few secondary rhinaria. Ultimate rostral segment 0.09-0.22 mm. long, with 0.10 accessory hairs which is 0.20-0.47 mm. long and 0.4-0.6 × as long as second segment of hind tarsus. Subgenital plate with at most with 40 hairs .3.
2. Antennae 1.6-1.7 mm. long ; antennal segment V with 4-5 secondary rhinaria. Ultimate rostral segment with 10 accessory hairs. Subgenital plate with more than 60 hairs. Hairs on flagellum 0.02 mm long, on dorsum of abdomen, 0.04-0.05 mm. long. Body 3.4-3.8 mm. long. On *Osmanthus* .*P. osmanthae* Essig & Kuwana
- Antennae 2.1 mm. long, antennal segment V without secondary rhinaria. Ultimate rostral segment with fewer (?) accessory hairs. Hairs minute. On *Fraxinus* .sp. B.
3. Wax plates absent on head and thorax. Ultimate rostral segment 0.09-0.10 mm. long with 4 accessory hairs. Antennae 0.33 × as long as the body. Abdominal dorsum with only marginal wax plates on 1st-7th tergites. Body 1.6-1.8 mm. long. On *Michelia champaka* .*P. micheliae* H. R. L.
- Wax plates present variably, on head and thorax. Ultimate rostral segment 0.11-0.22 mm. long with 0.10 accessory hairs. Antennae 0.30-0.47 × as long as the body. Wax plates on 1st-7th tergites variably developed. Body 1.8-4.2 mm. long. On various plants, never on *Michelia* .4.
4. Ultimate rostral segment 0.22 mm. long, 0.51-0.56 × as long as second segment of hind tarsus and bearing 9-10 accessory hairs. Subanal plate with about 15 hairs. Antennae 0.38-0.43 × as long as the body ; segment III with 30-31, IV with 9-12, V with 9-10 secondary rhinaria ; hairs on segment III 0.02 mm. long. Empodial hair 0.023 mm. long, hardly 0.30 × as long as the tarsal claws. Body 4.5-4.8 mm. long. On *Fraxinus* sp .*P. oriens* Mordv.

- Ultimate rostral segment not more than 0.15 mm. long, with 0-5 accessory hairs. Antennae 0.30-0.52 × as long as the body ; segment III with 13-36, IV with 4-14, V with 2-11 secondary rhinaria. Subanal plate with 20 hairs, if with less than 20 hairs, antennae with much fewer rhinaria and empodial hair 0.013 mm. long. Body 1.8-4.2 mm. long .5
5. Antennal segment III with 13-19, IV with 4-5, V with 2-3 secondary rhinaria. Ultimate rostral segment 0.11-0.12 mm. long with 4-5 hairs. Subanal plate with 14-16 hairs. Wing veins dusky. Body 1.8-3.2 mm. long. On *Lonicera* .*P. carvae fitchii* Baker & Davidson.
- Antennal segment III with 31-36, IV with 9-14, V with 10-15 secondary rhinaria. Ultimate rostral segment 0.13-0.15 mm. long with 0.2 accessory rhinaria. Subanal plate with at least 20 hairs. Wing veins pale or dusky. Body 2.9-4.2 mm. long .6
6. Ultimate rostral segment 0.61-0.64 × as long as second segment of hind tarsus and bearing 2 accessory hairs. Antennal segment VI with 6-9 secondary rhinaria in the basal part. Antennae 0.47-0.52 × as long as the body. Body 2.9-3.5 mm. long. On unidentified plant .*P. cornifoliae* Singh *et al.*
- Ultimate rostral segment 0.51-0.55 × as long as second segment of hind tarsus and without accessory hairs. Antennal segment VI usually without or at most with 1-2 small, nearly oval secondary rhinaria. Antennae 0.38 × as long as the body. Body 4.10-4.20 mm. long. On *Photinia* .sp. A.

B. Subgenus *Stagona*.

Apterous viviparous female (from primary host)

- Body 4.0-4.1 mm. long. Dorsal cephalic hairs up to 0.050 mm. long. Ultimate rostral segment 0.70 × as long as second segment of hind tarsus. Subanal plate with 30-32 hairs. Empodial hair 0.55-0.58 × as long as the tarsal claws. On *Syringea* .. .*P.(S) xylostei* (De Geer)

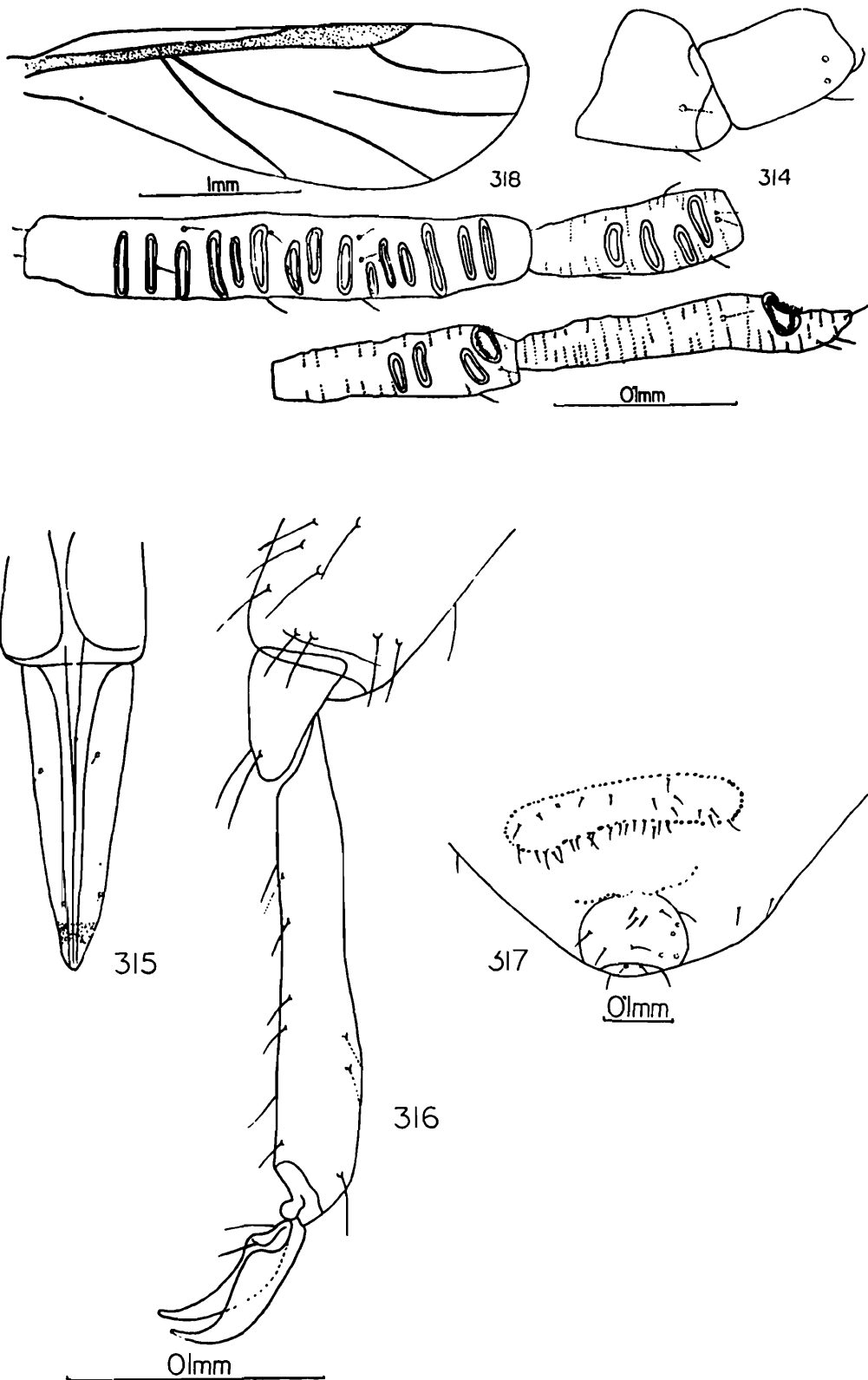
—Body 1.9-2.2 mm. long. Dorsal cephalic hairs up to 0.016 mm. long. Ultimate rostral segment 0.93-1.1 \times as long as second segment of hind tarsus. Subanal plate with only 6 hairs. Empodial hair 0.15-0.17 \times as long as the tarsal claws. On unidentified host

P. (S) himalayensis Chakrabarti

37. *Prociphilus caryae fitchii* Barker and Davidson (figs. 314-318)

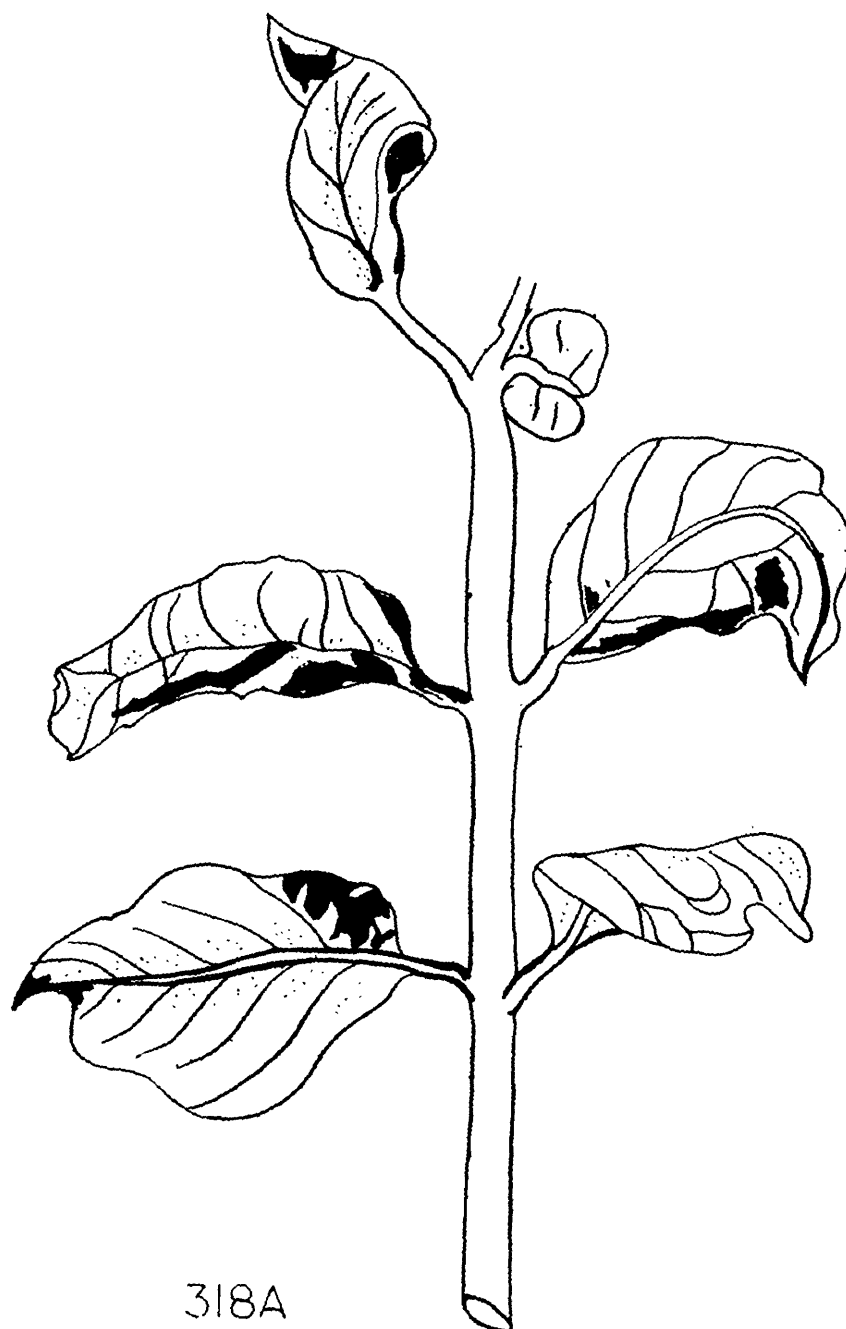
1911. *Pemphigus alnifoliae* Williams, T. A., *Univ. Stud. Univ. Neb*, **10** : 91.
 1917. *Prociphilus fitchii* Baker, A and Davidson, W. M., *J. Agr. Res.*, **10** : 66.
 1969. *Prociphilus alnifoliae fitchii*, Smith, C. F., *Ann. ent. Soc. Am.*, **62** : 1130.
 1978. *Prociphilus caryae fitchii*, Smith, C. F. and Parron, C. S., *N. C. Agr. Exp. Sta. Tech. Bull.*, **255** : 246.

Alate viviparous female (Fundatrigenia). : Body 3.2 mm. (1.82-3.25 mm.) long with 1.38-1.44 mm. as maximum width. Head brown sclerotic, with a distinct median suture, and 1-2 pairs of wax plates; dorsal cephalic hairs fine, upto 0.076 mm. long, 0.62 \times as long as the diameter at the constricted base of antennal segment III. Antennae 6-segmented, brown on basal segments, rest pale brown, 0.30 \times as long as the body; hairs on flagellum fine, on segment III 0.010-0.016 mm. long, 0.37-0.71 \times as long as the basal diameter of the segment; segment III with 13-19, IV with 4-5, V with 2-3 narrow transverse secondary rhinaria; primary rhinaria distinctly ciliated; processus terminalis 0.17 \times as long as base of segment VI. Rostrum long, reaching at least mid coxae; ultimate rostral segment pale, 0.52-0.55 \times as long as the second segment of hind tarsus and bears 4-5 accessory hairs. Thoracic tergum dark, sclerotic bearing a pair of mesothoracic wax plates. Abdominal dorsum pale, with paired large marginal wax plates increasing in size, caudad; (8th tergite with 2 large wax plates); hairs on dorsum of abdomen with acute apices, longer one placed marginally on anterior tergites, upto 0.033 mm. long, 1.2-1.3 \times as long as the basal diameter of antennal segment III. Siphunculi absent. Cauda with 2-3 hairs. Subanal plate with 14-16 hairs. Subgenital plate with 32-35 hairs. Gonapophyses with 4-4-5 or 5-5-5 hairs. Legs normal; longest hair on hind tibiae 0.040 mm. long, 0.80 \times as long as the diameter at the middle of tibiae; first



Prociphilus caryae fitchii Baker and Davidson; Alate viviparous female (fundatrigenia):

314. antenna ; 315. ultimate rostral segments ; 316. hind tarsus ; 317. posterior portion of abdomen ; 318. forewing ;



318A. leaf galls on *Lonicera*.

tarsal segments with 2,2,2 hairs ; empodial hair 0.013 mm. long, 0.20 \times as long as the claws. Forewings with veins dusky and bordered.

Figures within parenthesis from Smith (1969).

Colour.—Not recorded.

Measurements in mm. :

	Length	Width	Antenna
1.	3.2	1.38	0.96
2.	3.2	1.44	0.98

III	Antennal segments			urs.	ht ₂
	IV	V	VI		
0.30	0.14	0.17	(0.17+0.03)	0.12	0.21
0.30	0.14	0.15	(0.17+0.03)	0.11	0.21

(1, 2 ex. *Lonicera quinqueloenlasis*, Simla, Himachal Pradesh, INDIA, 13.5.1979, S. Chakrabarti's collections).

Other morphs.—(not available in India ; descriptions based on Smith, 1969).

Larva (first instar).—Antennae 4 segmented ; hairs on antennae sparse, 2-3 on basal segments, 3-5 on III and 5-6—on basal part of segment IV. Rostrum reaches beyond the length of body ; ultimate rostral segment with 4-8 accessory hairs. Hairs on the dorsum of abdomen almost of similar length, upto 0.02 mm. long. Cauda with 2-3 hairs. First tarsal segments with 2,2,2 hairs ; second segment of hind tarsus with 14 hairs ; empodial hair as long as or longer than claws.

Apterous (fundatrix).—Body 2.94-3.53 mm. long. Head with 4 large wax plates covering entire area. Antennae dark, 5-6-segmented ; hairs on antennae sparse, upto 3 on segment III, 3-4 on base of segment VI. Rostrum reaches mid coxae. Ultimate rostral segment with 4-6 accessory hairs. Abdominal dorsum with paired marginal wax plates. Siphunculi absent. Cauda with 2-3 hairs. Subgenital plate with about 30 hairs. Hind tibiae with hairs of similar lengths ; first tarsal segments with 2,2,2 hairs.

Measurements in mm.—

Length

2.94-3.53

Antennal segments				urs.
III	IV	V	VI	
0.15-0.22	0.07-0.10	0.06-0.08	(0.11-0.13 + 0.03-0.05)	0.11-0.12

Apterous viviparous female (aliencoliae).—Head dark with both dorsal and ventral wax plates, the latter smaller. Eyes of 3 facets. Antennae dark, 5-6-segmented ; flagellum with 3-7 hairs per segment. Rostrum reaches past middle of the abdomen ; ultimate rostral segment with 4-8, but usually 6 accessory hairs. Abdominal dorsum with large, paired marginal wax plates. Siphunculi absent. Cauda with 4-8, but usually 6 hairs. Subgenital plate with about 30 hairs in two groups. Hair on tibiae fine, apical tibial hairs differentiated, appearing spine-like ; first tarsal segments with 3,2,2 hair (but chaetotaxy may vary), those of hind tarsus spine-like.

Sexuparae.—Body 2.23-3.22 mm. long. Head with 2 round wax-plates on posterior area, and 2 similar ones placed anteriorly. Antennae of 6-segments; hairs on the flagellum sparse, those on segment III upto $0.33 \times$ as long as the basal diameter of the segment ; segment III with 20-35, IV with 7-13, V with 8-13 and VI with 3-9, narrow, scattered, denticulate secondary rhinaria, mostly covering more than half the diameter of the segment. Rostrum reaches second abdominal segment ; ultimate rostral segment with 10-14 accessory hairs. Mesothoracic wax plates triangular, placed 0.03 mm. apart. Abdominal dorsum with large marginal wax plates on 1st-7th tergite ; 8th tergite with a median wax plate. Siphunculi absent. Cauda with 4-7 hairs. Subgenital plate with 34 hairs in two groups. Gonapophyses with 7-6-7 hairs. Hairs on hind tibiae fine on basal portion, apically spine-like ; first tarsal segment with 4,4,4 or 5,5,5 hairs, but it may be variable. Wings-veins distinctly bordered.

Measurements in mm.—

Length

2.23-3.22

Antennal segments				urs.
III	IV	V	VI	
0.45-0.57	0.18-0.25	0.19-0.25	(0.17-0.22 + 0.04-0.06)	0.20-0.25

Material examined.—Four alate viviparous females and one alate nymph, from leaf-galls of *Lonicera guingueloenlasis*, Simla, Himachal Pradesh, INDIA, 13.5.1979, coll. D. K. Bhattacharja, [S. Chakrabarti Collections, University of Kalyani].

Discussion.—The subspecies, originally known from North America as *Eriasoma pyri* Fitch and later named as *Prociphilus fitchii* by Baker and Davidson, has been described in detail, under *alnifoliae fitchi* by Smith (1969) along with two other subspecies, *alnifoliae* Williams and *arbutifoliae* Smith; the latter has now been recognised as a distinct species; later Smith and Parron (1978) considered *alnifoliae* as a synonym of *caryae* and as such *fitchii* is considered as a subspecies of *caryae*. In North America, it is known from *Amelanchier*, *Betula*, *Castanea*, *Crataegus*, *Prunus*, *Pyrus* and roots of *Pinus*; this species overwinters as egg on *Pyrus* and *Amelanchier*, and causes curling of leaves in spring; alate migrants move to roots of *Pinus*, where they are attended by ants. Sexuparae return to primary hosts by November and settle on base of young trees (Apple, *Amelanchier*) and produce young which develop into ovipara and male; oviparous females deposit yellowish-orange eggs in the crevices, under leaves etc., which hatch on following spring (Smith, 1969).

Distribution.—INDIA ; U.S.A.

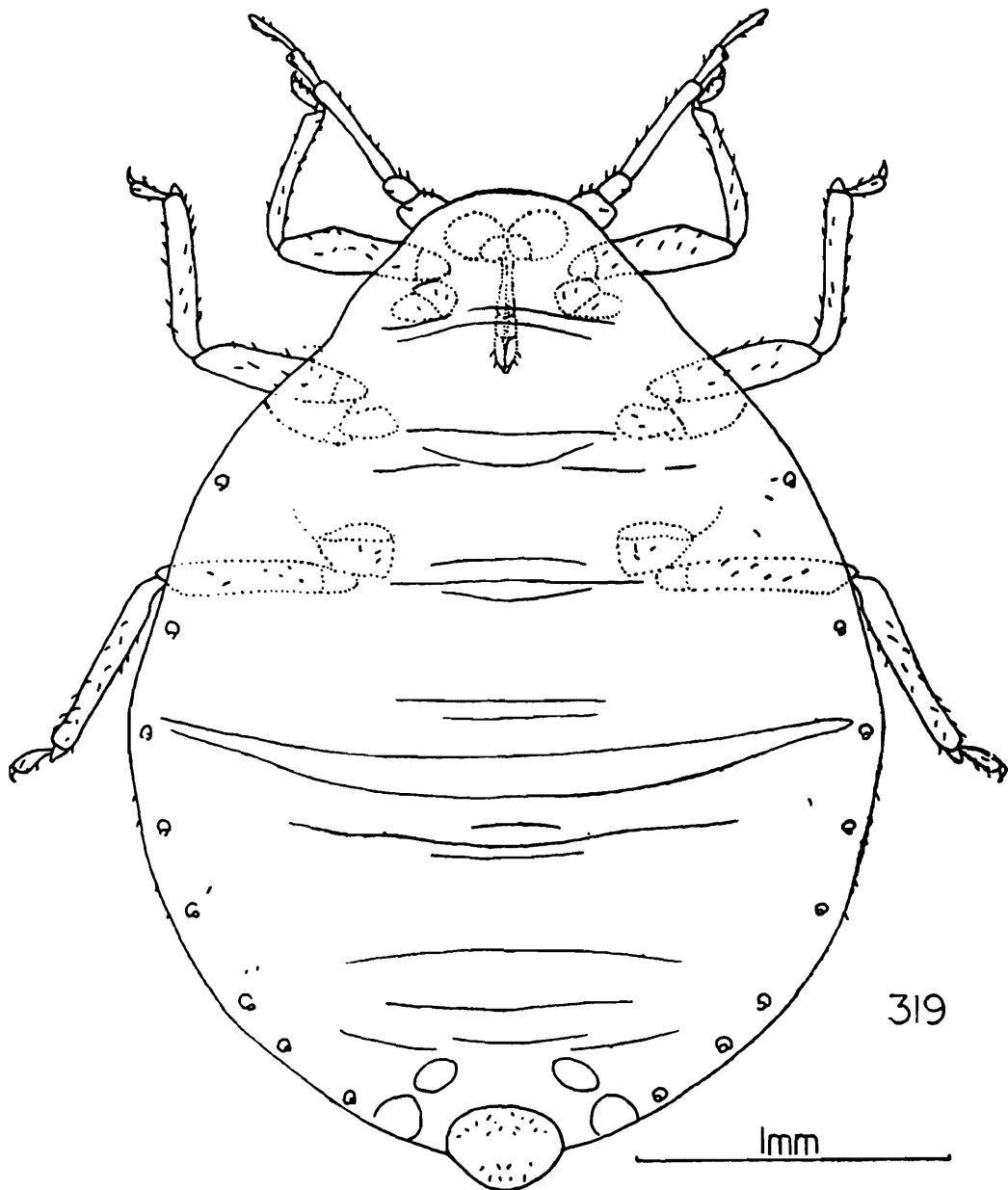
Types.—In the collection of U.S. National Museum, Washington, D.C

38. ***Prociphilus cornifoliae*** Singh, Das, Raychaudhuri
(figs. 319-328)

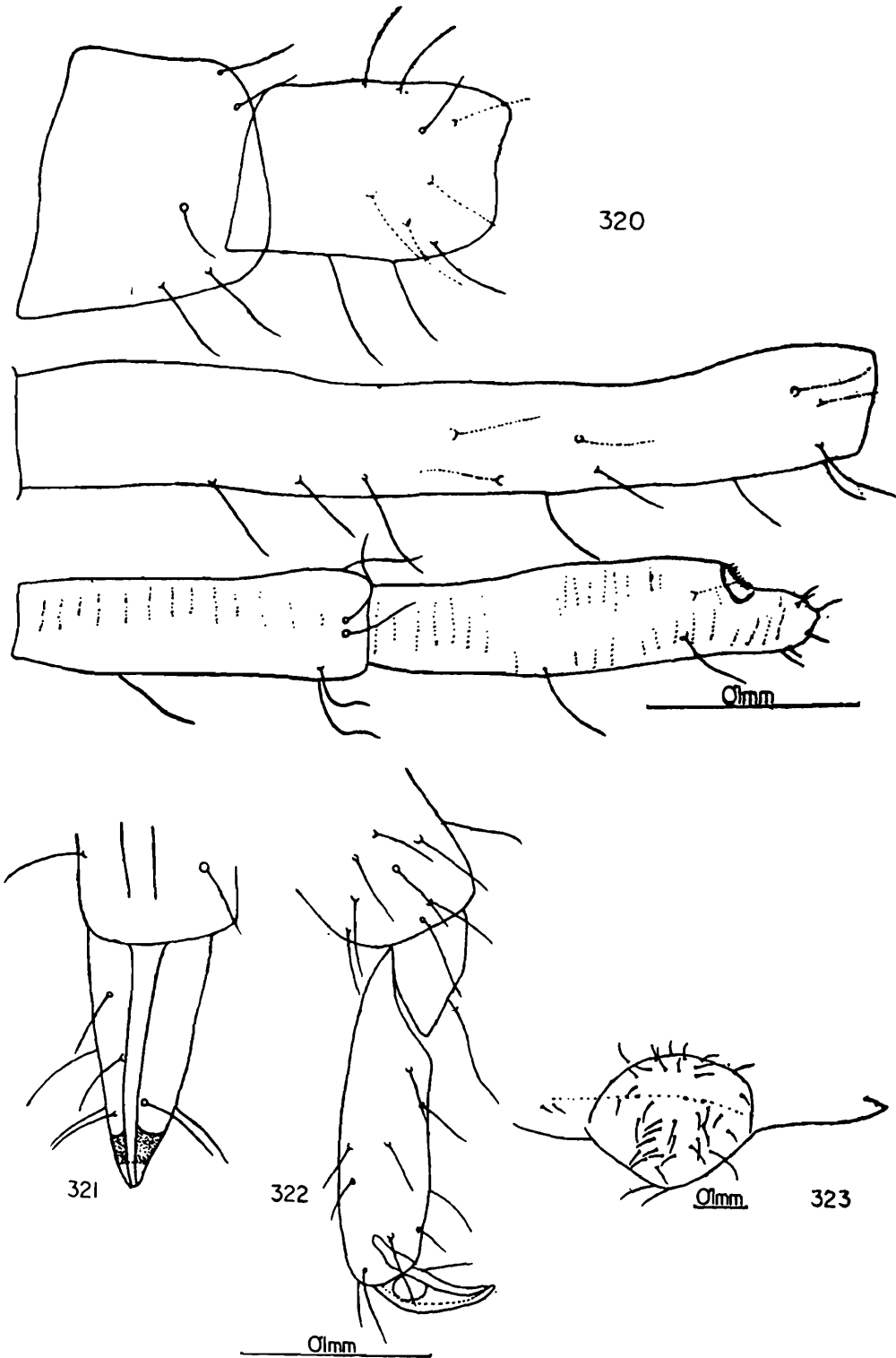
1977. *Prociphilus cornifoliae* Singh, T. K., Das, B., Raychaudhuri, D. N., *Entomon*, 2 (2) : 221.

Apterous viviparous female.—Body ovoid, 4.2 mm. long with 3.05 mm. as maximum width. Head pale brown, with a distinct

median suture ; dorsal ephalic hairs fine, upto $1.30 \times$ as long as basal diameter of antennal segment III ; a pair of wax plates present on head, each with a hair, upto half as long as the other dorsal hairs. Antennae pale to slightly dark, 5—segmented, $0.26 \times$ as long as the body ; segment I as long as wide, II much longer than wide with about 7 hairs ; segment III equal to IV + V together ; flagellum with spinulose imbrications ; hairs on flagellum sparse, fine, longest one on segment III 0.050 mm. long, $1.3 \times$ as long as the basal diameter of the segment ; primary rhinaria semioval, ciliated ; processus terminalis $0.20 \times$ as long as base of last antennal segment. Eyes of 3 facets. Rostrum reaches near mid—coxae, ultimate rostral segment $0.73 \times$ as long as second segment of hind



Apterous viviparous female (from roots) : 319. Whole body.



Apterous viviparous female (from roots): 320. antenna; 321. ultimate rostral segments; 322. hind tarsus; 323. posterior portion of abdomen.

tarsus and bears 3 (?) accessory hairs. Thoracic tergum pale with a pair of mesothoracic wax plates, composed of marginal cells.

Abdominal dorsum pale, bearing paired marginal wax plates on 1st-7th tergites besides paired pleural wax plates on 7th and 8th tergite, these being gradually increasing in size caudad ; hairs on the dorsum of abdomen fine, longest one $1.5 \times$ as long as the basal diameter of antennal segment III ; 8th tergite with 2 hairs. Siphunculi absent. Cauda semioval bearing 4 hairs. Subgenital plate with about 30 hairs, Subanal plate with 18 hairs. Legs brown to dark brown, trochanters nearly fused with femora, femora and tibiae with some wax cells ; hairs on femora and tibiae fine ; longest one on hind tibiae 0.066 mm. long, $0.73 \times$ as long as the diameter at the middle of tibia ; first tarsal segments with 2,2,2 hairs, empodial hair 0.040 mm long, nearly $0.60 \times$ as long as the claws.

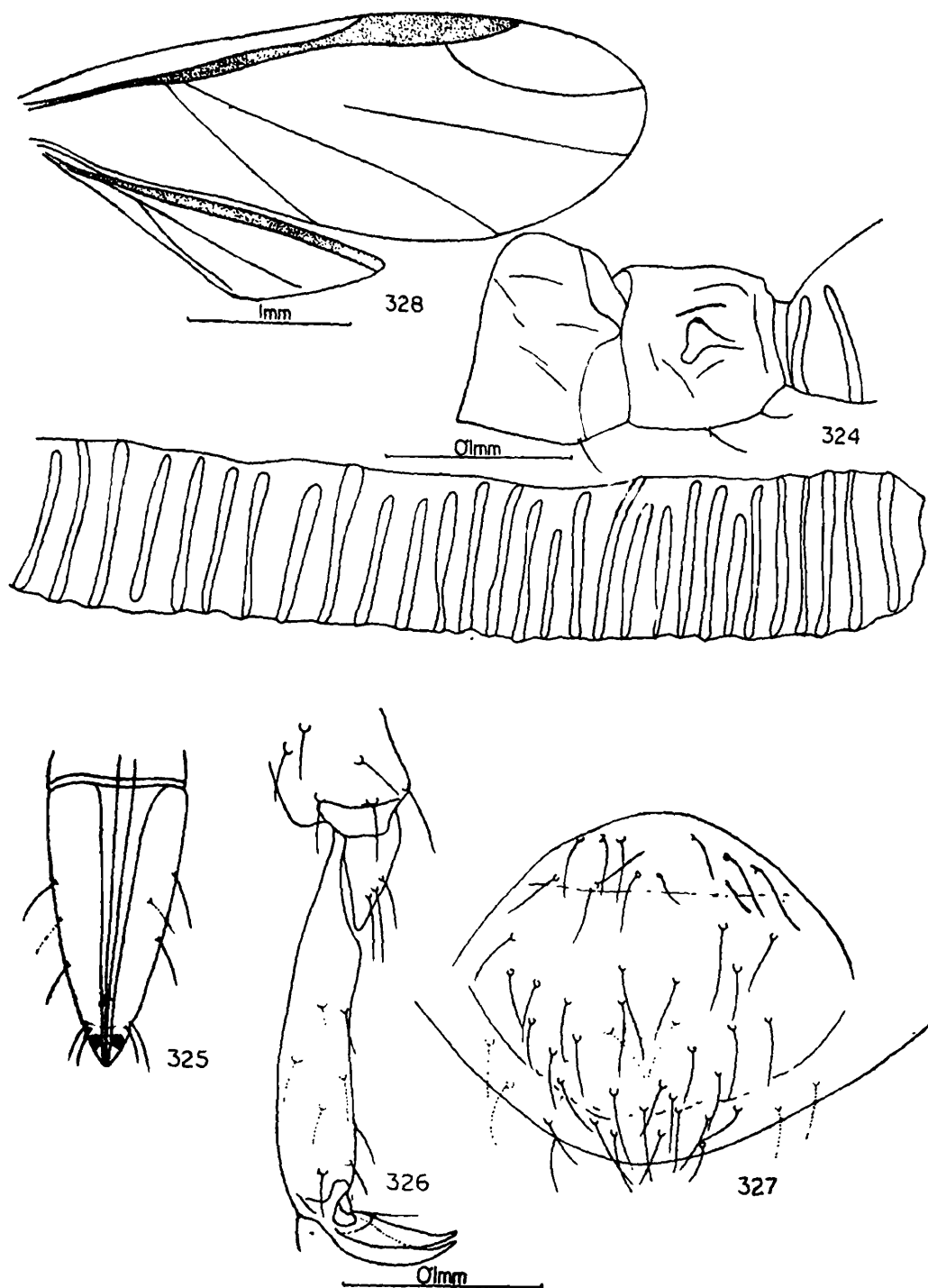
Colour.—Not known, apparently pale to brownish in life.

Measurements in mm.—

Length	Width	Antenna		
4.2	3.05	1.08		
			Antennal segments	urs. ht ₂
			III IV V	
			0.47 0.21 (0.21+0.04)	0.14 0.19

(ex. *Cornus* sp., Mao, Manipur, INDIA, 15.4.1974, coll. T. K. Singh, Calcutta University collections).

Alate viviparous females.—Body elongate oval, 2.9-3.5 mm long with 1.5-1.7 mm. as maximum width. Head dark, with a distinct median suture and pair of small wax plates ; dorsal cephalic hairs fine, 0.023-0.040 mm. long, upto $0.83-1.2 \times$ as long as the basal diameter of antennal segment III. Antennae 6—segmented, brown, $0.47-0.52 \times$ as long as the body ; flagellum stout, imbricated ; segment III longest, with 31-33 elongate, narrow, transverse secondary rhinaria extending over the entire width, segment IV



Alate viviparous female : 324. antenna ; 325. ultimate rostral segments ;
326. hind tarsus ; 327. posterior portion of abdomen ; 328. wings.

with 13-14, V with 14-15, and base of segment VI with 6-9 similar rhinaria. Hairs on the flagellum minute ; primary rhinaria small, and semioval on segment V, larger on segment VI ; processus terminalis small, narrow, finger shaped, $0.16-0.20 \times (0.30 \times)$ base of antennal segment VI. Rostrum reaches mid-coxae, ultimate

rostral segment 0.61-0.64 \times as long as second segment of hind tarsus and bears 2 accessory hairs. Mesothoracic lobes with cribriform wax pores on small plates. Abdominal dorsum pale, with paired marginal wax plates at least on posterior tergites (3rd-7th) ; 8th tergite with a pair of spino-pleural plates ; hairs on dorsum of abdomen fine, sparse 0.030-0.040 mm long, 0.9-1.1 \times as long as the basal diameter of antennal segment III. Siphunculi absent. Cauda small, semioval. Subanal plate with about 20 hairs. Subgenital plate brown, with at least 30 hairs. Legs dark brown, longest hair on hind tibiae 0.06 mm. long, 1.2 \times as long as the diameter at the middle of hind tibiae ; first tarsal segment with 2,2,2 hairs (0.046 mm. long). Forewings with media simple, cubital and anal separated at base ; pterostigma distinctly fuscous ; hind wings with a trifold vein ; formed of radial and obliques.

Colour.—Not known.

Measurements in mm.—

	Length	Width	Antenna
1.	3.38	1.72	1.48
2.	2.90	1.51	1.51

Antennal segments				urs.	ht ₂
III	IV	V	VI		
0.55	0.27	0.27	(0.21+0.036)	0.15	0.24
0.55	0.25	0.27	(0.22+0.040)	0.14	0.22

(1-2, ex. unidentified plant, Balaju, NEPAL, 14.4.1975, coll. B. C. Das, Calcutta University collections).

Nymph (late stage).—Body 3.03 mm., long with 1.10 mm. as maximum width. Dorsal cephalic hairs upto 0.07 mm. long. Antennae pale brown, 6—segmented, $0.36 \times$ as long as the body ; segment III little longer than segments IV+V ; hairs on flagellum hardly discernible ; secondary rhinaria, linear as in adult alatae ; primary rhinaria on V and VI ciliated ; processus terminalis $0.17 \times$ as long as base of antennal segment VI. Ultimate rostral segment $0.73 \times$ as long as second segment of hind tarsus and bears a pair of accessory hairs. Abdominal dorsum pale ; wax plates not clearly discernible except the marginal ones on 7th tergite. Siphunculi absent. Cauda small, pale brown with 5 long fine hairs. Subanal plate with about 22 fine hairs. Legs concolorous with abdomen ; femora (marginally) and tibiae imbricated ; first tarsal segments with 2 long and 1 short hairs.

Colour.—Not known.

Measurements in mm.—

Length	Width		Antenna		
3.03	1.10		1.10		
	Antennal segments			urs.	ht ₂
III	IV	V	VI		
0.35	0.15	0.18	0.19	0.146	0.198

(ex. unidentified host, Balaju, NEPAL, 14.4.1975, coll. B. C. Das, Calcutta University collections).

Material examined.—One apterous viviparous female from *Cornus* sp., Mao, Manipur, INDIA, 15.4.1974, Coll. T. K. Singh (Holotype) ; two alate viviparous females and one nymph from unidentified plant, Balaju, NEPAL, 14.4.1975, coll. B. C. Das (Paratypes).

Discussion.—Singh, *et al.* (1977) while describing the species did not mention about the habitat of the species and related the species with *P. cheni* Tao, described from Formosa, by the nature

of primary rhinaria on antennal segments V and VI which according to them are "linear" and circular respectively but Tao's figure clearly indicate subcircular to oval primary rhinaria on both V and VI (linear primary rhinaria could not be seen even in *cornifoliae*) ; however in the nature of secondary rhinaria, longer ultimate rostral segment, it comes close to *cheni* differing in having secondary rhinaria also on VI and much fewer accessory hairs on ultimate rostral segment, besides host association. The species appears to be distributed in high altitude areas of Nepal and Eastern India (ca. 1400 m.—2103 m.).

Distribution.—INDIA (Manipur), NEPAL.

Types.—In the collections of Entomology Laboratory, Department of Zoology, University of Calcutta.

39. *Prociphilus* (*Neoparacletus*) *ghanii* Hille Ris Lambers

1973. *Prociphilus* (*Neoparacletus*) *ghanii* Hille Ris Lambers, D. *Oriental Ins.* 7 (2) : 247.

Apterous viviparous female.—Body oval (-1.30) 1.70 mm. long with 1.1 mm. as its maximum width. Head and pronotum brown, smooth and sclerotic, vertex with a pair of flat tubercle, perhaps representing obsolete wax glands ; pronotum with a pair of spinal and a pair of marginal glands as above, the latter distinctly bulging. Antennae concolourous with head, 5-segmented, (-0.25 ×) 0.30 × as long as the body ; flagellum finely spinulose on outer margin ; hairs on flagellum 0.03-0.05 mm. long, thick and often curved, 3-7 on each segment, longest one on segment III 1.9-2.1 × as long as the diameter at the narrowed base of segment III ; primary rhinaria ciliated ; processus terminalis finely spinulose, (-0.38) 0.49 × as long as base of segment V and bears 5 short spines near apices. Eyes of 3 facets. Rostrum reaches almost to middle of abdomen, ultimate rostral segment long and nearly acute, about 1.4 × as long as second segment of hind tarsus and bears 4 accessory hairs, besides pre-apicals. Abdominal dorsum pale, membranous, bearing faintly pigmented marginal sclerites ; nearly colourless round wax gland like structure present marginally on these sclerites from 1st-7th tergites ; spinal and pleural glands

incomplete and hard to recognise ; hairs on dorsum of abdomen stout, conspicuous and large in number, those on anterior abdominal tergites 0.045 mm.—0.075 mm. long, 2.0-3.5 × as long as the basal diameter of antennal segment III ; 8th tergite with 5 hairs (-6) 0.06-0.07 mm. long. Siphunculi absent. Cauda brown, sclerotic, broad, and bears 10 (6) hairs of which at least 4 are longer than others. Subanal plate rounded to trapezoid, about twice as wide as its length and covers the whole cauda ; rudimentary gonapophyses 3. Legs concolourous with head and antennae, hairs on legs of similar nature as on antennae, those on hind tibiae 0.05-0.06 mm. long, 1.1-1.3 × as long as the width at middle of hind tibiae ; tarsi smooth first tarsal segment with 2,2,2 hairs ; empodial hairs 0.26-0.30 × as long as the claws.

Colour.—Not known.

Measurements in mm.—

Length	Width	Antenna			
1.69	1.1	0.55			
	Antennal segments		urs.	ht ₂	Cauda
III	IV	V			
0.14	0.09	(0.13+0.05)	0.16	0.10	0.06

(ex. *Salix wallichiana*, Muree, PAKSISTAN, 28.2.1967, coll. M. A. Ghani, DHRL collections).

Alate viviparous female.—Not known.

Sexual forms.—Not known.

Nymph.—In a nearly adult apterous nymph the characters were almost identical as in adult apterous viviparous female. The only differences as expected are in the measurement level and is given below :

Length	Width	Antenna
1.26	0.68	0.45

III	Antennal segments		urs.	ht ₂
	IV	V		
0.09	0.08	(0.10+0.04)	0.14	0.10

Material examined.—One apterous viviparous female and one semi adult nymph (Holotype) from *Salix wallichiana*, Murree, PAKISTAN, 28.2.1967, leg. M. A. Ghani, No. 880, det, D.H.R.L.

Discussion.—The conspicuous hairs, tubercle-like non-functional wax gland, shape of cauda and subanal plate would make the diagnosis easy for this species.

No data on its biology has so far been reported.

Distribution.—PAKISTAN (Murree).

Types.—In the collection of D. Hille Ris Lambers, Bennekom, The Netherlands.

40. *Prociphilus micheliae* Hille Ris Lambers (figs. 329-333)

1933. *Prociphilus micheliae*, Hille Ris Lambers, D., *Stylops* ; 2, 197.

1969. *Prociphilus micheliae*, Verma, K. D., *Sci. Cult.*, 35, 28.

Alate viviparous female.—Body 3.90-3.96 mm. long with maximum width 1.66-1.79 mm. Head and thorax brownish sclerotic, remainder pale with only stigmal plates and cauda sclerotic. Head without any wax glands. Antennae 6-segmented, about $0.33 \times$ as long as the body, segments I and II brownish, former with 3 hairs, latter with 8 hairs, about 0.03 mm. long, rest of the flagellum pale ; segment III with 8-9 fine hairs, longest one being equal in length to the basal diameter of the segment, IV with 5 hairs, V with 4 hairs ; secondary rhinaria annular, 31-34 (28-35) on segment III, 6-14 (8-13) on segment IV and none on V ; primary and secondary rhinaria ciliated ; processus terminalis $0.18-0.20 \times$ as long as base of segment VI, $0.07-0.08 \times$ as long as base of segment VI, $0.07-0.08 \times$ as long as segment III. Eyes large. Rostrum reaches near second coxae ; ultimate rostral segment $0.44-0.50 \times$ as long

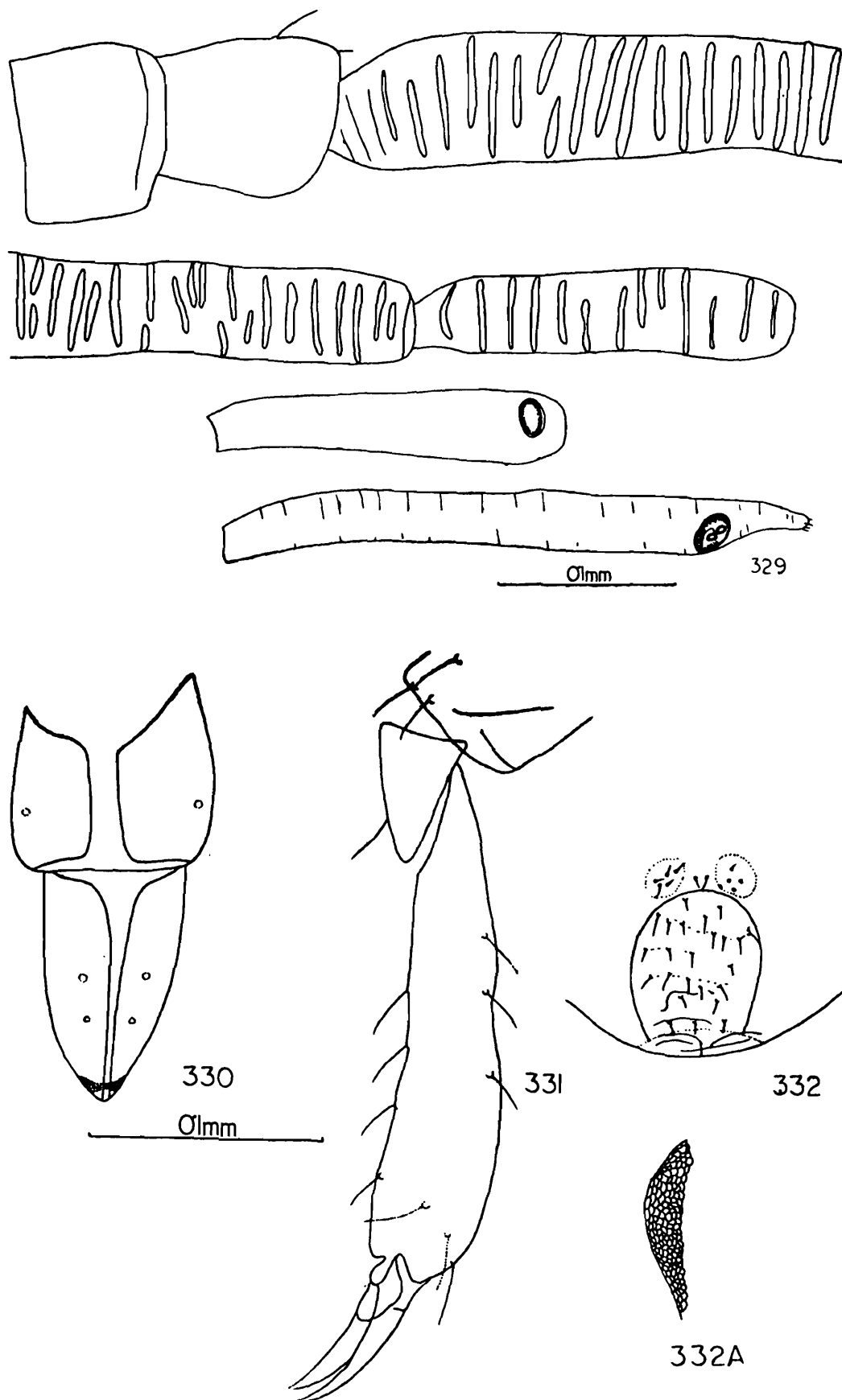
as second segment of hind tarsus and bears 4 accessory hairs, of about 0.02-0.03 mm. long. Mesoscutum with a pair of wax glands. Abdominal dorsum with a pair of large marginal wax gland plates on each segment, besides very small inconspicuous pleural plate on 1st tergite ; 8th tergite with a pair of large spine-pleural wax plates ; all wax plates without central facets ; hairs on the dorsum of abdomen fine, acute 0.03-0.05 mm. long, $1.1-2.0 \times$ as long as the basal diameter of antennal segment III, more numerous on posterior tergites. Siphunculi absent. Cauda ill developed. Rudimentary gonapophyses 3. Legs brownish ; hind femora with trochanter 0.96-0.37 mm. long, hind tibiae 1.24-1.38 mm long, hind tarsi 0.20-0.21 mm. long, claws 0.06-0.07 mm. long ; hairs on femora fine, upto equal to basal diameter of antennal segment III, these on tibiae also fine and upto $1.5 \times$ as long as mentioned diameters, first tarsal segment with 2, 2, 2 hairs of about 0.03 mm. long.

Colour.—Not recorded.

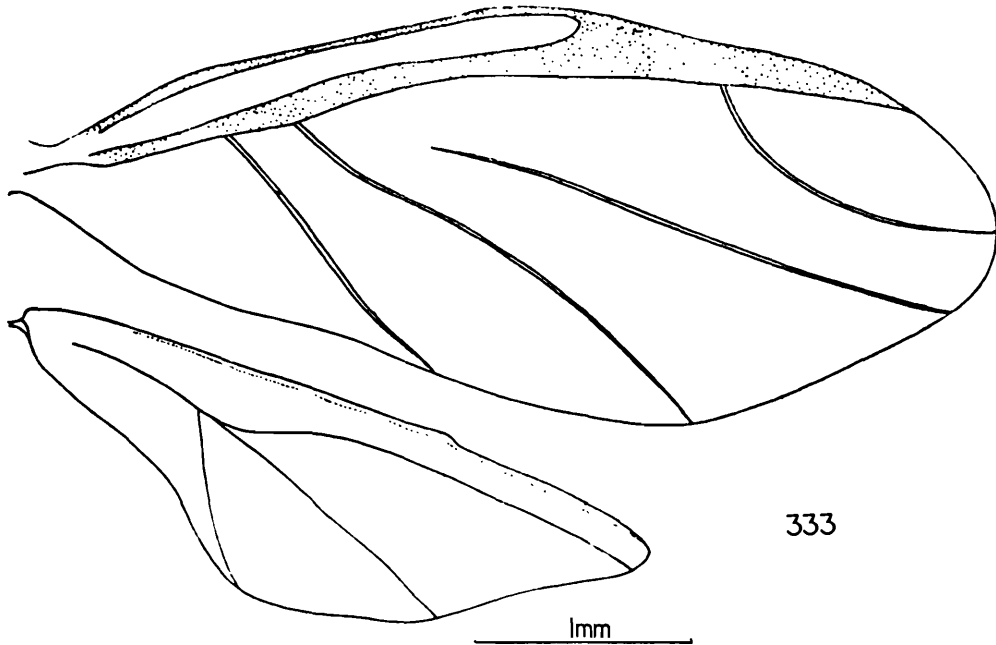
Measurements in mm.—

	Length	Width	Antenna			
1.	3.90	1.66	1.24			
2.	3.96	1.79	1.36			
3.	3.92	1.68	1.30			
4.	4.0	1.70	1.40			
	Antennal segments			urs.	ht ₂	
	III	IV	V	VI		
	0.53	0.14	0.20	(0.20+0.04)	0.09	0.22
	0.49	0.22	0.22	(0.23+0.04)	0.10	0.20
	0.55	0.23	0.23	(0.20+0.04)	0.10	—
	0.53	0.26	0.22	(0.22+0.04)	0.10	0.23

(1, 2, 3, ex. *Michelia champaka*, Jalpaiguri district, INDIA, 25.9.1931 ; (DHRL collection) ; 4, ex. *Michelia champaka*, Jammu, Tawi, INDIA, 6.4.1964, coll. K. D. Verma).



Prociphilus micheliae Hille Ris Lambers ; Alate viviparous female :
 329. antenna ; 330. ultimate rostral segment ; 331. hind tarsus ; 332. posterior
 portion of abdomen ; 332A. lateral wax gland.



333. wings.

Sexual forms.—Not known.

Embryos & Larvae.—Not known.

Material examined.—Three alate viviparous females (Co-types) from *Michelia* sp., “Jalpaiguri Division”, INDIA, 25.9.1931, leg. D.F.O. (R.R.D. 188), det. D.H.R.L. (D. Hille Ris Lambers’s collections) ; one alate viviparous female from *Michelia champaka*, Jammu, Tawi, INDIA, 6.4.1964, leg. K. D. Verma, det. D.H.R.L. (K. D. Verma collections).

Discussion.—Hille Ris Lambers (1933) provided a brief description of this species while describing it as new and mentioned that absence of cephalic wax-glands and tarsal chaetotaxy are main distinguishing features of this species.

Although ‘Champa’ or *Michelia champaka* is a fairly common plant in Northern India, it is surprising that no further record of this species has been evident till Verma (1969) reported it from N. W. India.

The species is reported from curled leaves of the host.

Distribution.—INDIA (Jalpaiguri District of North Bengal and Himachal Pradesh, Jammu & Kashmir).

Types.—In the collections of British Museum (Natural History) and in D. Hille Ris Lambers collections, Bennekom, The Netherlands.

41. *Prociphilus oriens* Mordvilko
(figs. 334-342)

1935. *Prociphilus oriens*, Mordvilko, A., *Ergeb. Fortschr. Zool.*, 8 : 89.

1940. *Prociphilus oriens*, Kono, 4, *Debats, Zasshi*, 12 (3 & 4) : 149.

1969. *Prociphilus oriens*, Higuchi, H. and Miyazaki, M., *Insecta. matsum. Suppl.*, 5 : 56.

(only material, an alate from Kulu, Himachal Pradesh, available from BMNH, was totally damaged ; description based on Paratypes material collected at Hokkaido, Japan and original description of Mordvilko, 1935).

Apterous viviparous female (Fundatrix).—Body 4.69 mm. long with 3.81 mm. as maximum width. Head dark, sclerotic with a distinct median suture and three pair of wax plates ; dorsal cephalic hairs fine, numerous, 0.050-0.066 mm. long, arising from distinct dark bases. Antennae 5-segmented, dark brown, 0.25 × as long as the body ; segment I broad, 0.75 × as long as II, with 10 hairs, II with 12 hairs, segment III longest and with 14 hairs, IV and V subequal, with 0-1 hair each ; flagellum roughened over its surface ; hairs on the flagellum fine, 0.07-0.010 mm. long, 1.7-2.3 × as long as the basal diameter of antennal segment III ; primary rhinaria round, with very fine fringe ; processus terminalis 0.14 × as long as base of last antennal segment. Prothorax dark sclerotic, meso and metathorax sclerotic near the bases of legs. Rostrum reaches hind-coxae ; ultimate rostral segment slender, brown, 0.81 × as long as second segment of hind tarsus and bears at least 8-10 (?) accessory hairs. Abdominal dorsum pale, membranous, bearing some broken, band-like segmentally arranged (“muskelplatten” like) sclerotic areas on 1st-7th tergites ; stigmal pori on dark sclerotic plates ; hairs on the dorsum (and venter) numerous, fine, arising from dark little bases, on anterior tergites 0.03-0.05 mm. long, 0.76-1.15 × as long as the basal diameter of antennal segment III, on posterior tergites 0.07-0.08 mm. long, 1.7-1.9 × as long as the mentioned diameter. Siphunculi absent. Cauda brown sclerotic with a few fine hairs. Subgenital plate sclerotic brown with about 50 fine hairs. Subanal plate with more than 50 hairs,

arranged in two groups. Legs stout, dark brown ; hairs on femora and tibiae fine, longest one on hind tibiae 0.106 mm. long, equal to the diameter at the middle of the tibiae ; first tarsal segment with 2,2,2 hairs ; empodial hair 0.033 mm. long, little over half as long as the claws.

Colour.—Not recorded.

Measurements in mm.—

Length	Width		Antenna				
4.69	3.81		1.16				
	Antennal segments					urs.	ht ₂
	I	II	III	IV	V		
	0.12	0.18	0.45	0.19	0.22	0.22	0.25

(ex. galls of *Fraxinus mandshurica*, Sappora, Hokkaido, JAPAN, 23.5.1956, coll. Takagi, det. R. Takahashi, Hokkaido University collections).

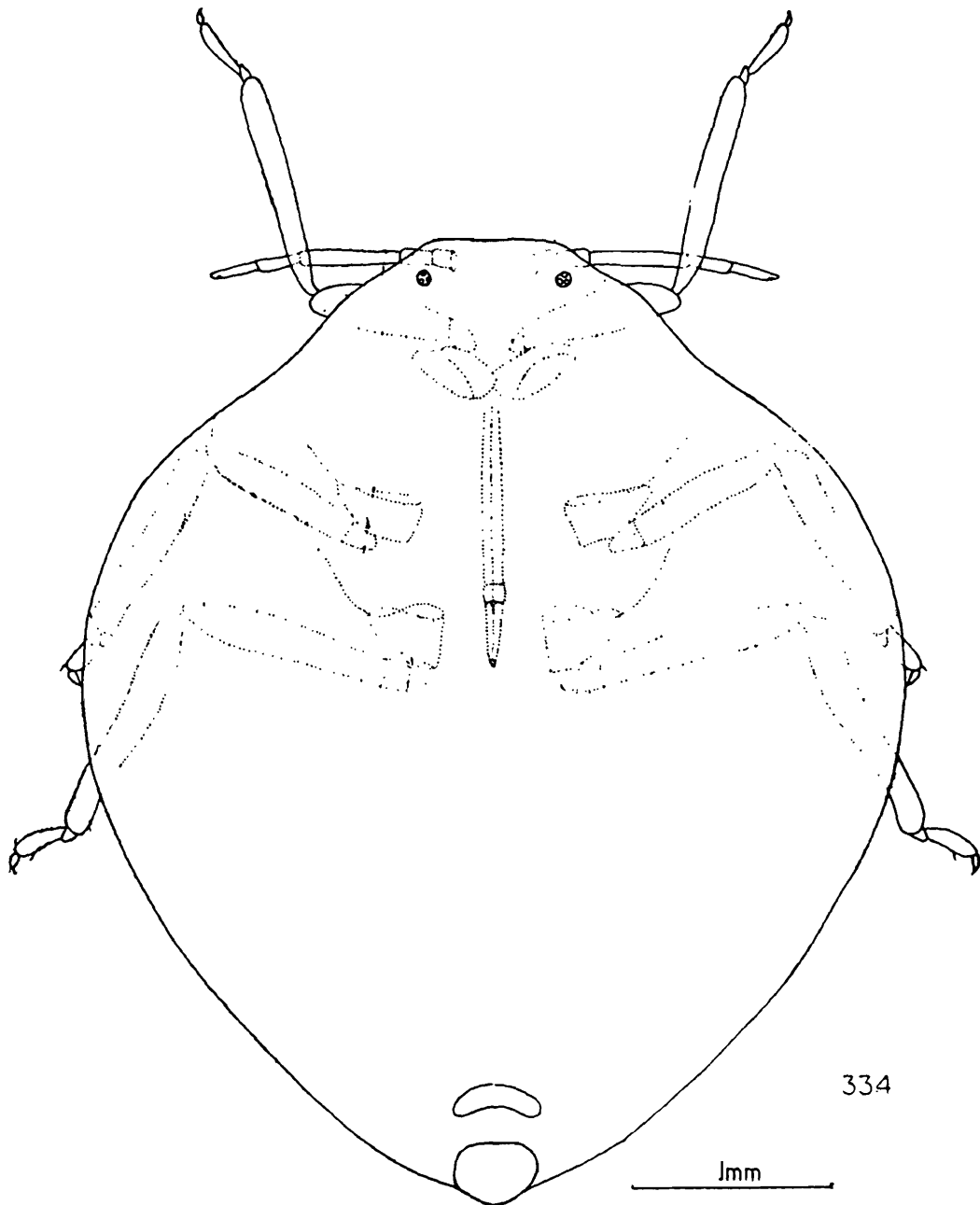
Nymph (Early instar).—Body pale elongate, 1.40 mm. long with 0.56 mm. as maximum width ; dorsal cephalic hairs fine, 0.060-0.066 mm. long. Antennae pale, 4-segmented, 0.42 × as long as the body ; flagellum finely spinulose apicad ; hairs on the flagellum fine, on segment III, 0.040-0.050 mm. long, 1.0-1.25 × as long as the basal diameter of the segment ; processus terminalis 0.18 × as long as base of last antennal segment. Rostrum reaches middle of abdomen, ultimate rostral segment long, slender, 1.20 × as long as second segment of hind tarsus and bears 10 fine accessory hairs. Abdominal dorsum pale, bearing 6-8 fine hairs, arranged segmentally, 0.035-0.040 mm. long, and subequal or equal to the basal diameter of antennal segment III. Siphunculi absent. Cauda small, sclerotic. Legs stumpy, pale, hairs on femora and tibiae fine, on hind tibiae upto 0.050 mm. long.

Colour.—Not recorded.

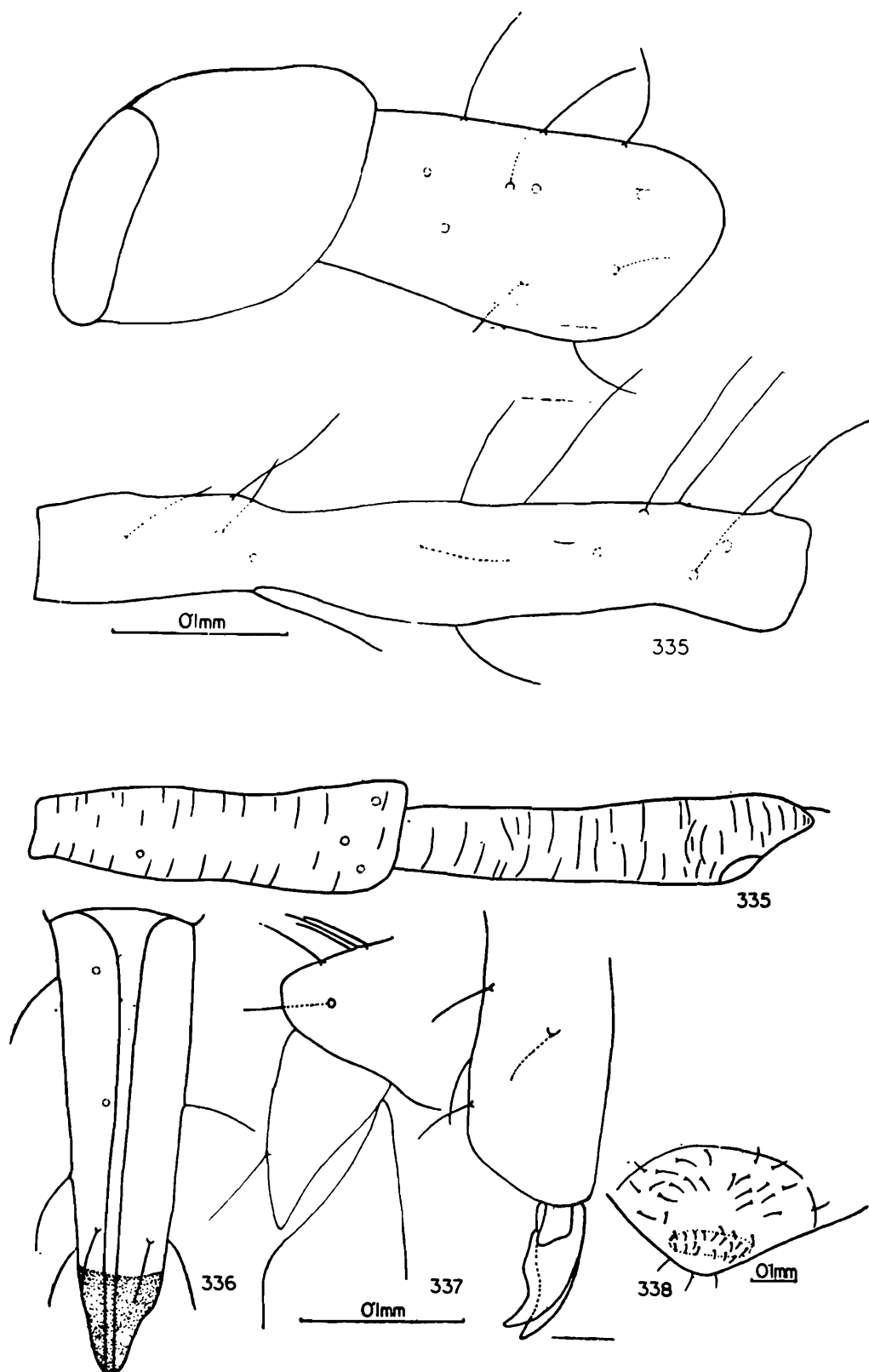
Measurements in mm.—

Length	Width	Antenna			
1.40	0.56	0.57			
			urs.	ht ₂	
Antennal segments					
I	II	III	IV		
0.07	0.07	0.25	0.18	0.24	0.20

(ex. *Fraxinus mandshurica*, Sapporo, Hokkaido, JAPAN, 23.5.1956, coll. Takagi, det. R. Takahashi, Hokkaido University collections).

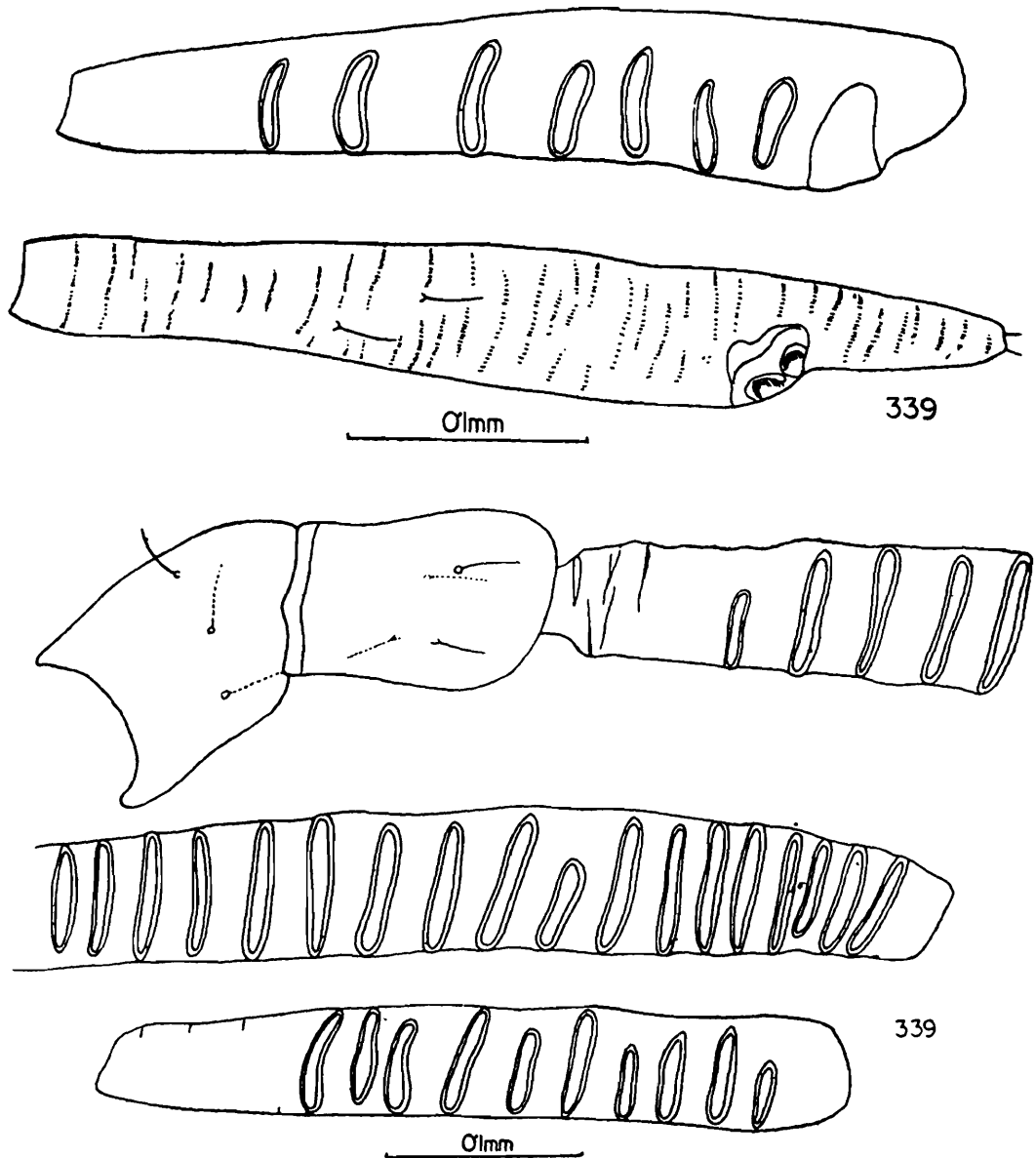


Prociphilus oriens Mordvilko ; Apterous viviparous female : 334. fundatrix

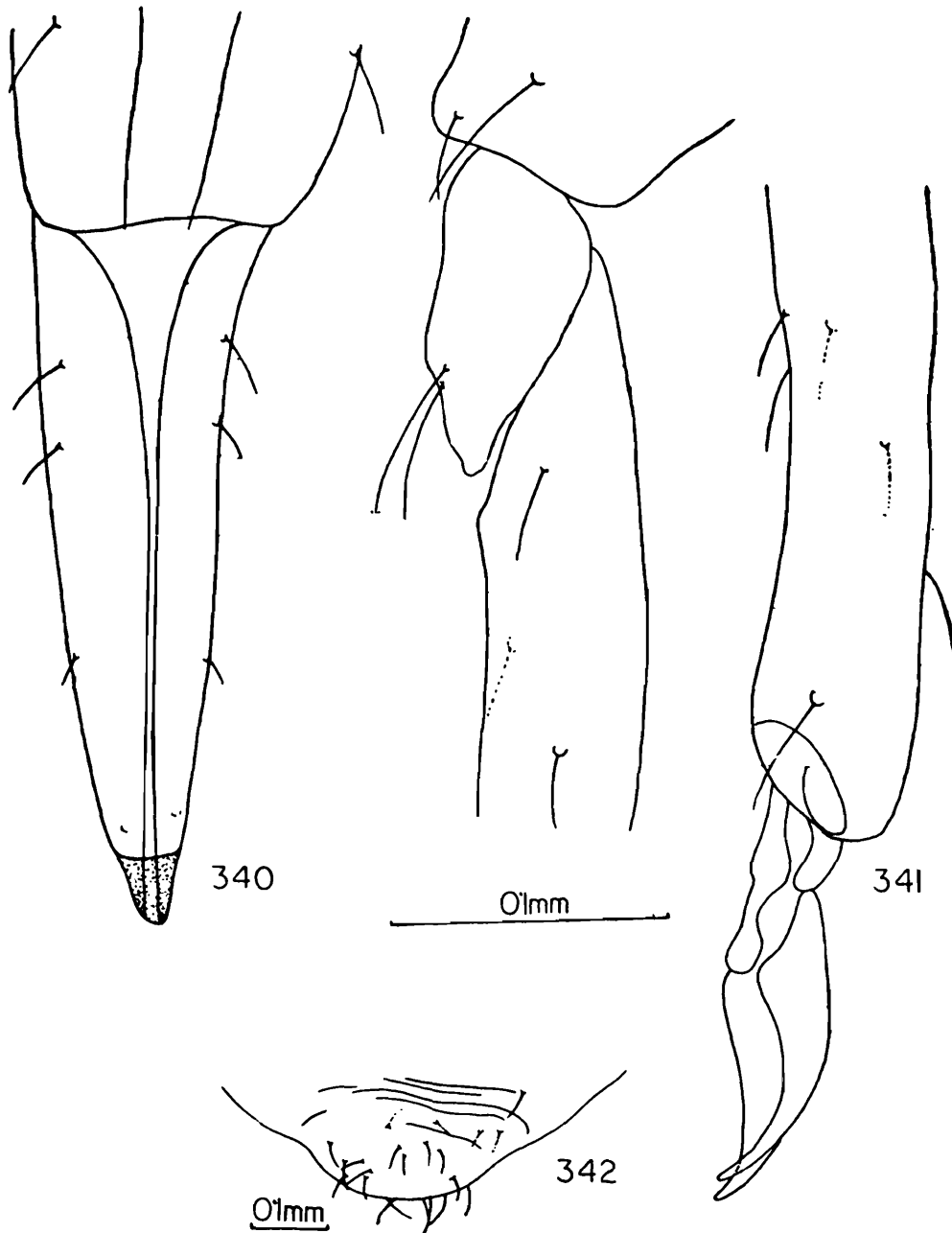


Prociphilus Oriens Mordvilko ; Apterous viviparous female :
 335. antenna ; 336. ultimate rostral segments ; 337. hind tarsus ;
 338. posterior portion of abdomen.

Alate viviparous females.—(Emigrants) Body 4.55-4.57 (4.65-4.96 mm.) long with 1.93-2.27 (1.79-2.22 mm.) as maximum width. Head with a distinct median suture, dorsal cephalic hairs fine, upto 0.053-0.060 mm. long, 1.25-1.50 \times as long as the basal diameter of antennal segment III (paired cephalic wax glands, as described by Mordvilko (1935) not discernible). Antennae pale, 6-segmented, 0.38-0.43 \times (0.36-0.40 \times) as long as the body; segment I and II, equal in length, each with 6-7 fine hairs, and 0.16-0.18 \times as long as the segment III; segment III with 30-31 (21-32), IV with 9-12 (6-13), V with 9-10 (7-10) annular secondary rhinaria, mostly covering 0.80 portion of the width of the segment and arranged in a row; primary rhinaria on V small, on VI large and irregular



Alate viviparous female (emigrant) : 339. antenna.



Alate viviparous female (emigrant) :

340. ultimate rostral segments ; 341. hind tarsus ; 342. posterior portion of abdomen.

in shape ; hairs on the flagellum fine, on segment III upto 0.02 mm. long. (on IV 0.033 mm. long), $0.42-0.54 \times$ as long as the basal diameter of the segment ; processus terminalis slender, $0.26-0.27 \times$ as long as the base of segment VI. Rostrum reaches beyond mid-coxae, ultimate rostral segment $0.51-0.56 \times$ as long as second segment of hind tarsus, bearing 9-10 fine accessory hairs. Abdominal dorsum pale, membranous, except on sclerotic stigmal plates

subgenital plate, and cauda and subanal plate which appear brownish ; hairs on the dorsum of abdomen fine, sparse, much fewer than in apterae at most 0.040-0.050 mm. long. Siphunculi not discernible. Cauda with few fine hairs. Subgenital plate with about 38 (?) hairs in two groups ; gonapophyses with 8.7-8 hairs. Subanal plate with at least 15 long fine hairs. Legs long, stout, brown to pale brown, with many fine, thin hairs, longest one on hind tibiae 0.07 mm. long, equal to the width at the middle of the tibiae ; second tarsal segment long, slender, roughend over the surface, empodial hair fine, 0.023 mm. long, hardly $0.30 \times$ as long as the claws.

Colour.—Dull reddish green in colour.

Measurements in mm.—

	Length	Width	Antenna
1.	4.55	2.27	1.75
2.	4.57	1.93	2.00

Antennal segments				urs.	ht ₂
III	IV	V	VI		
0.65	0.30	0.27	0.30	0.22	0.39
0.66	0.31	0.35	0.35	0.22	0.43

(1, 2, ex. *Fraxinus mandshurica*, Abasir, Hokkaido, JAPAN, 11.6.1956, coll. S. Taking, det. R. Takahashi).

Larva (from Mordvilko, 1935).—Body 1.0 mm. long, pubescent. Antennae 4 segmented, $0.60 \times$ as long as the body ; segment I and II subequal ; hairs on flagelum 0.01-0.08 mm. long ; processus terminalis $0.23 \times$ as long as the base of last antennal segment. Rostrum extends little beyond end of abdomen ; ultimate rostral segment $2.5 \times$ as long as the preceding segment. Legs well developed, tibiae 0.40-0.43 mm. long, tarsi 0.13-0.14 mm. long.

Measurements in mm.—

	Length	Width	Antenna
1.	1.10	0.36	0.66
2.	1.08	0.41	0.68

Antennal segments				Rostrum	Tarsus
I	II	III	IV		
0.07	0.09	0.34	0.14	1.15	0.13
0.07	0.10	0.31	(0.13+0.03)	1.07	0.14

Apterous viviparous females (exules from roots of *Picea obovata* : from Mordvilko, 1935).—Body 1.85-1.95 mm. long with 0.82-1.09 mm. as maximum width. Antennae 5-6—segmented, 0.31-0.37 × as long as the body ; hairs on the flagellum 0.04mm. long ; processus terminalis 0.25 × as long as the base of last antennal segment. Rostrum reaches beyond hind coxae ; ultimate rostral segment nearly equal to the second segment of hind tarsus. Legs well developed, femora 0.35-0.42 mm. long, tibia 0.56-0.73 mm. long, tarsus 0.16-0.20 mm. long, claws 0.06-0.07 mm. long.

Measurements in mm.—

	Length	Width	Antenna
1.	1.95	1.09	0.73
2.	1.85	0.82	0.58

Antennal segments				urs.	ht ₂
III	IV	V	VI		
0.11	0.10	0.16	(0.16+0.04)	0.20	0.19
0.17	0.13	(0.13+0.03)		0.13	0.15

Material examined.—One alate viviparous female from indet host, Kulu, INDIA, 2.6.1936, coll. A. Wahed Khan (BMNH 1937-58) ; one apterous viviparous female and 9 nymphs from *Fraxinus mandshurica*, Sapporo, Hokkaido, JAPAN, coll. Takagi, det. R. Takahashi and 3 alate viviparous females and one alate nymph from *Fraxinus mandshurica*, Abasiri, Hokkaido, JAPAN, coll. S. Takagi, det. R. Takahashi (R. Takahashi collections, Entomology Laboratory, Hokkaido University, Japan) ; three alate viviparous female from *Fraxinus*, Vladivostok, 10.6.1926 (Paratypes), Inst. of Zoology, Leningrad ; collections. coll. A. Mordvilko.

Discussion.—Single specimen collected in Kulu, INDIA, on 2.6.1936 from an unidentified plant was available from British Museum, (Nat. Hist.) London, (No. 6. BM 1937-58), in which only the ultimate rostral segment could be measured (0.28 mm.) which bears II accessory hairs ; the specimen was otherwise completely damaged.

Mordvilko (op. cit) mentioned that fundatrices develop at base of leafbuds of *Fraxinus* (*manshurica* and *rhynchophylla*) in the Amur and Ussuri region of U.S.S.R. and emigrants develop on the petioles and under surface of leaves resulting in deformation of leaves and formation of a clusture or lump ; emigrants develop in the month of June. The apterous exules were collected, apparently from roots of *Abies* sp. during April in Vladivostok region, thus indicating a *Fraxinus-Abies* cycle, although sexuparae and sexuales were not recorded by Mordvilko. Kono (1940) published a note on primary host plant of *Prociphilus oriens* and Higuchi & Miyazaiki (1969) listed plant species of *Abies*, *Celtis*, *Forsythia*, *Fraxinus*, *Ligeostrum*, *Lonicera*, *Malus*, *Prunus*, *Rhus*, *Salix*, *Sorbus*, *Styrax*, *Syringia*, *Tilia*, *Ulmus* etc., under host plant list of *oriens*, which according to them, was recorded as *Prociphilus bumeliae* (Schrank) by Matsumura (1917) and *P. nidificus* Low, by Monzen (1929) from Japan ; Tao (1970), however, regarded these records as also that of *oriens* of Hori (1938) as *Prociphilus bumeliae* (Schrank), to which its affinity was discussed by Mordvilko (1935).

Distribution.—INDIA (Kulu), U.S.S.R., CHINA, JAPAN.

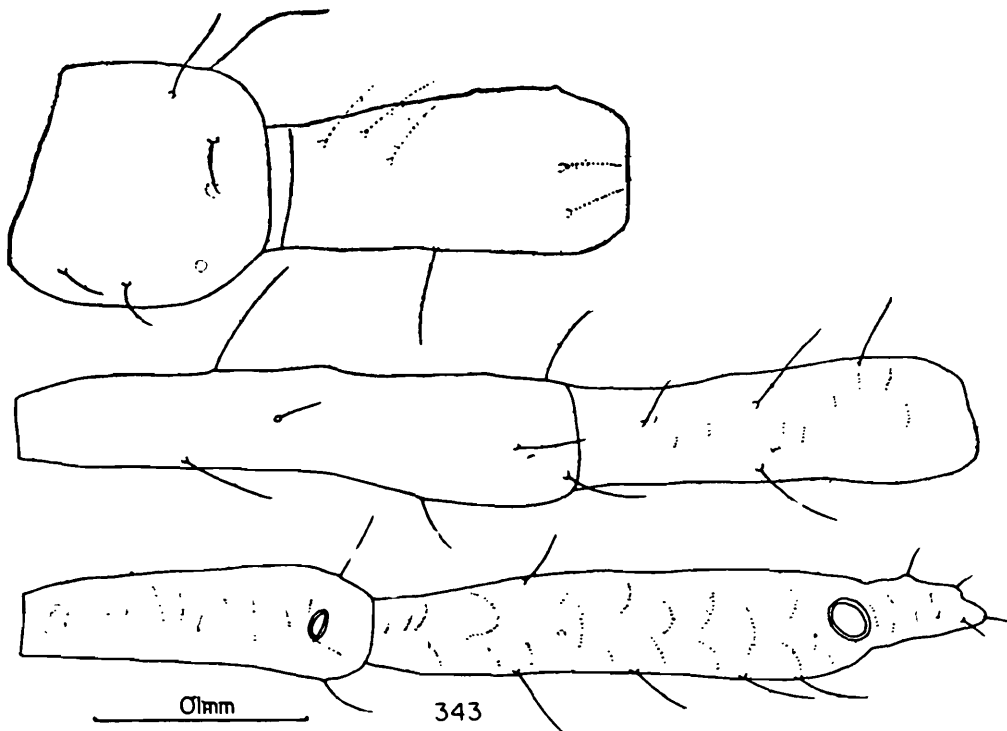
Types.—In the collections of Institute of Zoology, Academy of Sciences, Leningrad, U.S.S.R.

42. *Prociphilus osmanthae* Essig & Kuwana (figs. 343-354)

1918. *Prociphilus osmanthae* Essig, E.O. and Kuwana, S. I., *Proc. Calif. Acad. Sci.*, **8** (3) : 105.
1968. *Prociphilus osmanthae*, Ghosh, A. K., and Raychaudhuri, D. N., *Bull. Ent.*, **9** (2) : 148.

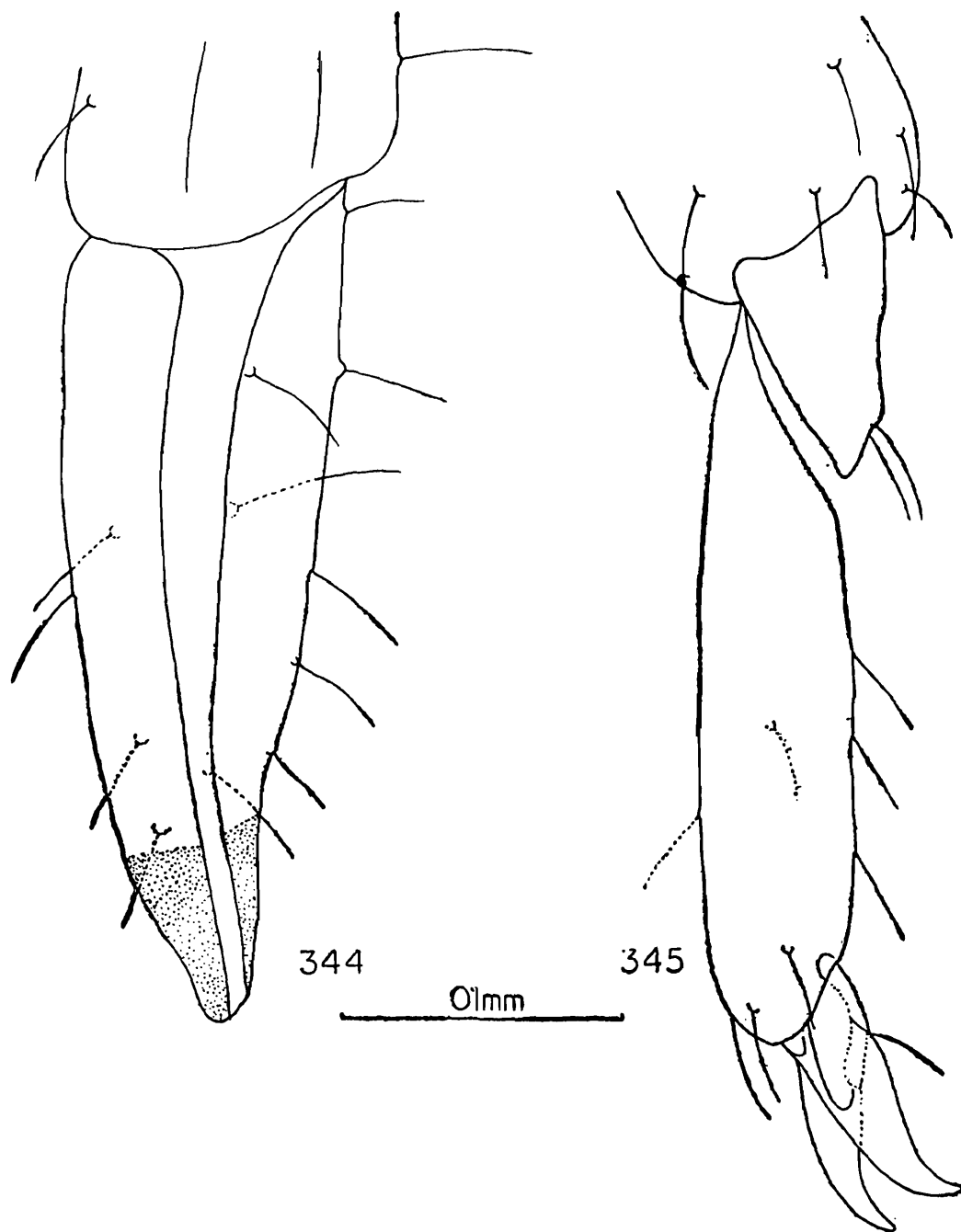
Alate viviparous female.—Body large, elongate, oval 3.4-3.8 mm. long with 1.4-1.6 mm. as maximum width. Head dark sclerotic

without any median suture, with 3 ocelli and a pair of wax plates. Antennae stout, black, except near bases of segments III-IV, or may be pale brown throughout, 6 segmented, $0.46-0.50 \times$ as long as the body ; flagellum smooth except segment V and VI which are distinctly imbricated ; hairs on flagellum, short, inconspicuous, longest one on antennal segment III, 0.02 mm. long, upto $0.40 \times$ as long as the basal diameter of the segment, segment III with 35-48 (27-31), IV with 12-13 (9-12), V with 4-5 (8-12), narrow transverse, secondary rhinaria, extending over the entire length of the segments ; primary rhinaria, small, semioval, ciliated ; processus terminalis $0.16-0.20 \times$ as long as the base of segment VI. Eyes large. Rostrum reaches beyond hind coxae, ultimate rostral segment $0.50-0.57 \times$ as long as the second segment of hind tarsus and bears at least 10 accessory hairs. Mesothoracic wax plate oval. Abdominal dorsum pale, with paired, pale, marginal wax plates on 1st-7th tergites ; hairs on the dorsum of abdomen $0.04-0.05$ mm. long, $0.80-1.0 \times$ as long as the basal diameter of antennal segment III. Stigmal plates large, sclerotic. Siphunculi absent. Cauda small, semilunar. Subanal plate with about 25 long fine hairs. Subgenital plate sclerotic, with more than 60 hairs. Gonapo-



Prociphilus Osmanthae Essig and Kuwana : Apterous Viviparous female :
343. antenna.

physes with 7, 6, 7 hairs. Legs dark to brown stout, always darker at knee-joints, with some scattered wax pores on outer margin of femora ; tibiae much thinner than femora, widened at apices ; hairs on femora and tibiae short, rather stiff, with acute apices, longest one on hind tibiae 0.05 mm. long, $0.60-0.85 \times$ as long as the diameter at the middle of the tibiae ; first tarsal segments with at least 3,3,3 hairs ; empodial hair 0.02 mm. long, $0.16-0.17 \times$ as long as the claws. Wings infuscated along costal imagin.



Prociphilus osmanthae Essig and Kuwana ; Apterous viviparous female :
 344. ultimate rostral segments ; 345. hind tarsus ; 346. posterior portion
 of abdomen.

0.16-0.50 \times as long as the basal diameter of the segment ; segment III with 32-34, IV with 13-14, V with one linear secondary rhinaria ; processus terminalis 0.18 \times as long as base of segment VI. Eyes large. Mesothoracic wax plate not discernible. Abdominal dorsum pale, except on stigmal plates, and caudal area which are brown, sclerotic ; hairs on the dorsum of abdomen 0.04-0.05 mm. long, 0.40-0.50 \times as long as the basal diameter of antennal segment III. Siphunculi absent. Cauda brown, sclerotic with 4-5 hairs. Subanal plate large, sclerotic, with many fine, flagellate hairs. Legs stout, brown, darker at knee joints ; longest hair on hind tibiae 0.05 mm. long, 0.50 \times as long as the diameter at the middle of the tibiae , first tarsal segments bearing 3,3,3 hairs, with 2 hairs at the apex, and one placed much below.

Colour.—Dark with abdomen brownish, thorax pale green (Essig & Kuwara, 1918).

Measurements in mm. —

Length	Width		Antenna		
3.8	2.2		1.8		
	Antennal segments			urs.	ht ₂
III	IV	V	VI		
0.62	0.30	0.30	(0.32+0.06)	0.26	0.32

(ex. unidentified plant, Shillong, Meghalaya, INDIA, 22.5.1962, coll. A. K. Ghosh).

Other morphs.—Not known from India ; description of apterae (ex. *Michelia*) and alate sexupara (ex. *Osmanthus*) based on specimen collected in Japan.

Apterous viviparous female (from *Michelia*).—Body large globular, 4.10-4.14 mm. long with 2.32-2.55 mm. as maximum width. Head broad sclerotic, pale brown. Antennae 5-6-segmented, dark brown, 0.25-0.26 \times as long as the body ; segment I broader than long, segment II long, slender, with 10-12 fine hairs ; segment III longest,

nearly smooth with 5-6 hairs, IV with fine spinulose striae and 3-4 hairs, V with spinulose striae forming a reticulate pattern, with 2-3 hairs, and VI with more distinct spinulose reticulation and 3-5 hairs ; primary rhinaria small, round, with fine fringe ; hairs on flagellum fine, on segment III, 0.040-0.053 mm. long, $1.0-1.3 \times$ as long as the basal diameter of the segment ; processus terminalis $0.21-0.22 \times$ as long as base of last antennal segment. Rostrum reaches at least hind coxae ; ultimate rostral segment $1.26 \times$ as long second segment of hind tarsus and bears at least 10 accessory hairs. Wax plates pale, large, decreasing in size posteriorly, arranged in pair as follows ; marginal ; thoracic and 1st-6th abdominal segments ; pleural ; 1st-6th abdominal segment ; spinal ; mesothorax and posterior abdominal segments ; 7th and 8th tergite each with a much smaller pair of wax plate ; hairs on the dorsum of abdomen fine, 0.016-0.050 mm. long, $0.42-1.25 \times$ as long as the basal diameter of antennal segment III. Siphunculi absent. Cauda small, semilunar, sclerotic with few fine hairs. Subgenital plate sclerotic brown with about 7-8 hairs on anterior margin and a group of 25 hairs on posterior margin. Subanal plate trapezoid, with about 25 long fine hairs. Legs dark brown, hairs on femora and tibiae fine, longest one on hind tibiae 0.060 mm. long, $0.81 \times$ as long as the diameter at the middle of the tibiae ; first tarsal segments with 2,2,2 hairs ; empodial hair fine 0.030 mm. long, $0.37 \times$ as long as the claws.

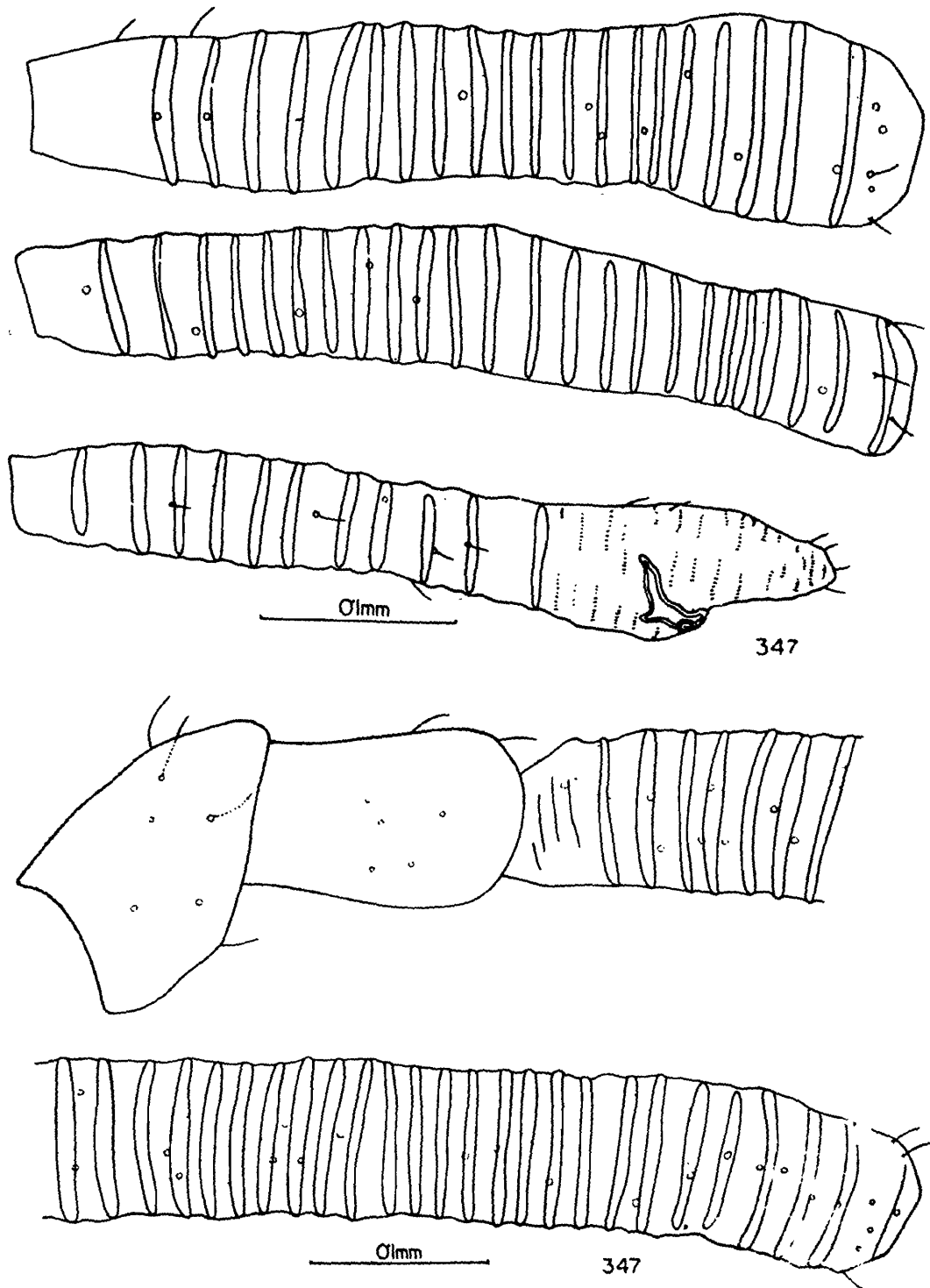
Colour.—Not known.

Measurements in mm.—

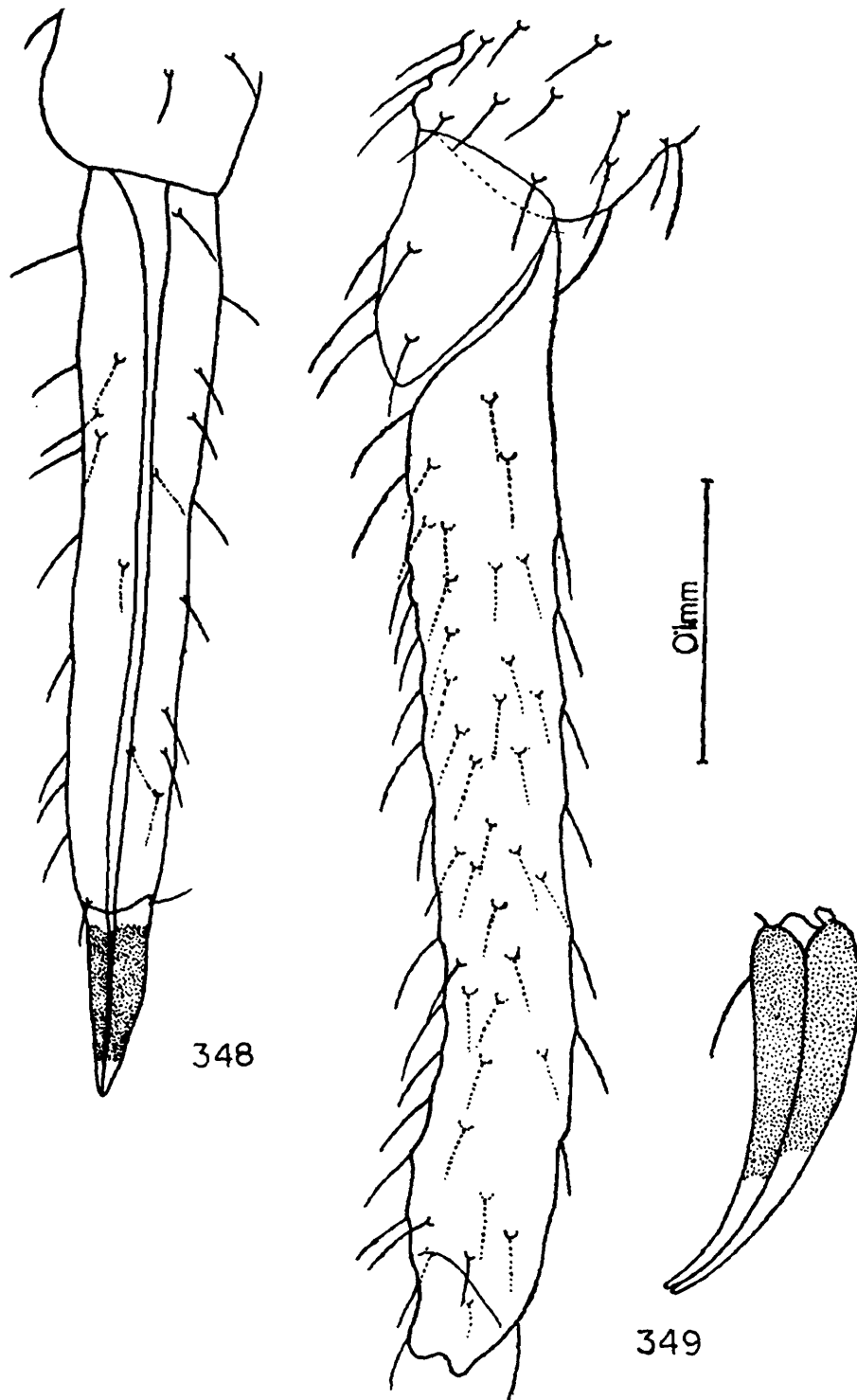
	Length		Width		Antenna			
1.	4.10		2.55		1.03			
2.	4.14		2.32		1.03			
	Antennal segments						urs.	ht ₂
	I	II	III	IV	V	VI		
	0.09	0.15	0.37	0.15	(0.18+0.04)	—	0.255	0.20
	0.06	0.14	0.24	0.14	0.14	(0.20+0.043)	0.255	0.20

(ex. *Michelia* sp., Osaka, JAPAN, 14.5.1954, R. Takahashi, Hokkaido University collections).

Alate sexupara.—Body 3.92-4.4 mm. long with 1.80-1.93 mm. as maximum width. Head dark brown sclerotic ; dorsal cephalic hairs upto 0.033-0.050 mm. long, subequal to or little longer than the basal diameter of antennal segment III. Antennae dark brown,



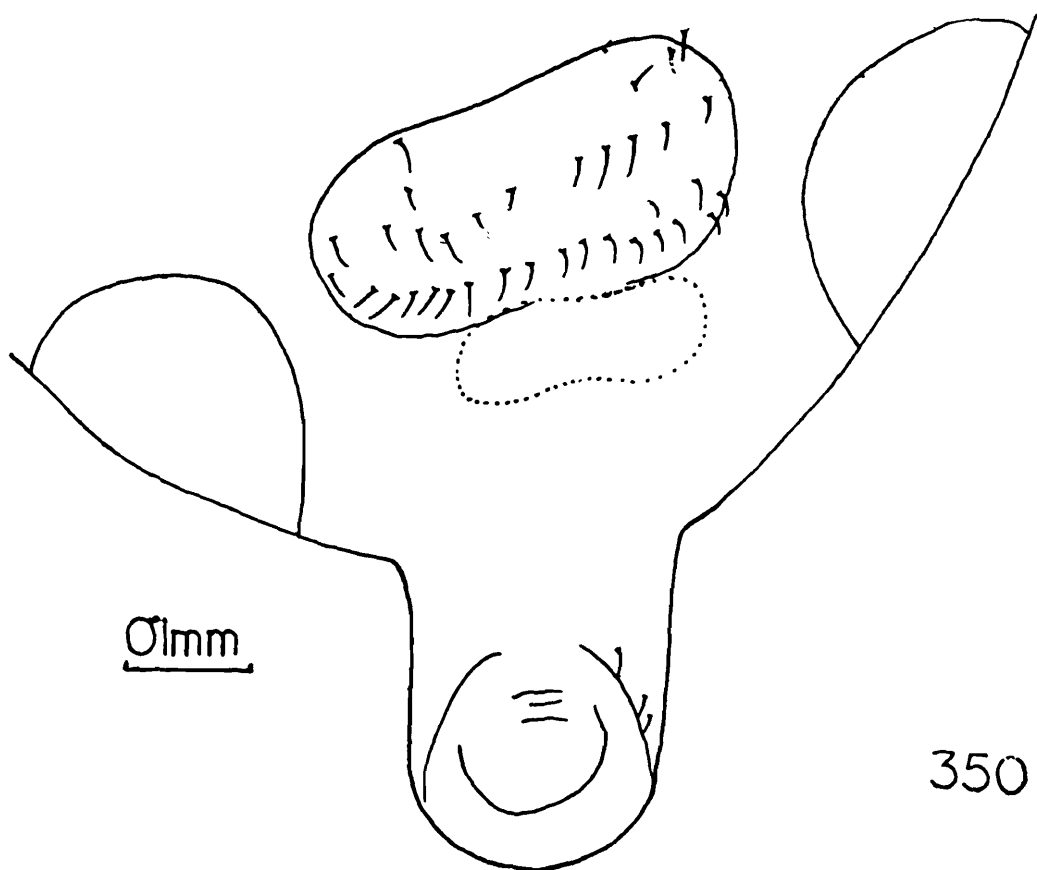
Alate viviparous female : 347. antenna



Alate viviparous female : 348. ultimate rostral segments ; 349. hind tarsus.

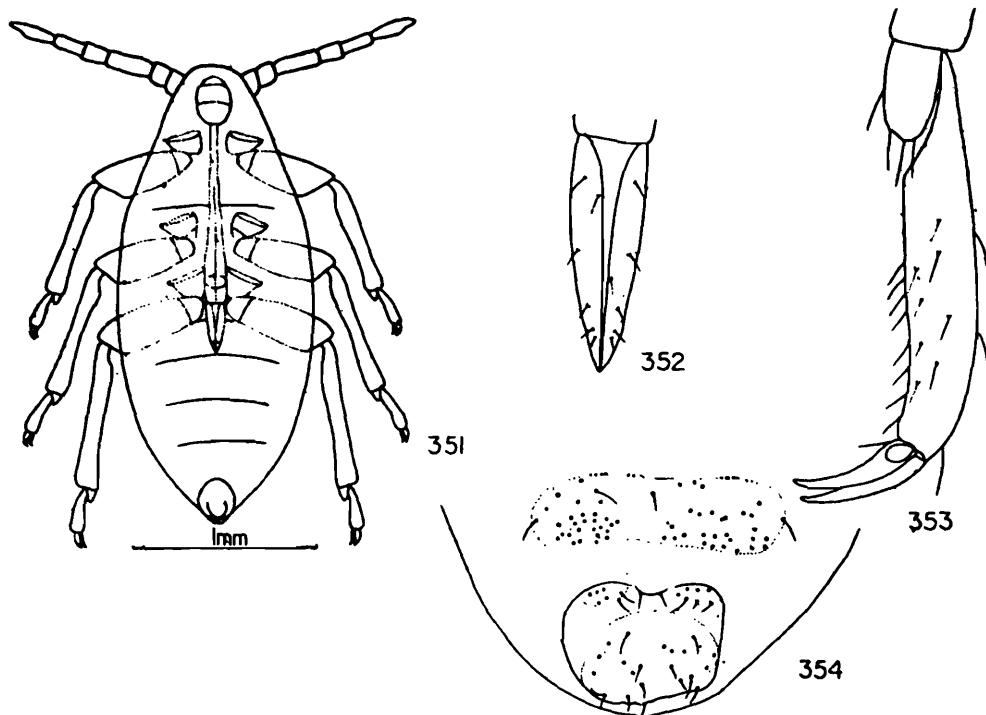
sclerotic, $0.53 \times$ as long as the body, segment I with 4 and II with 6-7 fine hairs, 0.016-0.020 mm. long ; flagellum spinulose apicad, with narrow transverse secondary rhinaria on segment III (30-32),

IV (20-21), V (22-23), and base of segment VI (9-12) ; hairs on flagellum sparse, minute, hardly 0.010 mm. long ; primary rhinaria on segment V linear, ciliated, on VI trifurcate and ciliated ; processus terminalis $0.22 \times$ as long as base of segment VI. Rostrum reaches at least hind coxae, ultimate rostral segment pale, slender, $0.83-0.84 \times$ as long as second segment of hind tarsus and bears at least 20 fine accessory hairs. Abdominal dorsum pale with large, paired, marginal wax plates, on 1st-6th tergites (0.016×0.027 mm. to 0.0276×0.0367 mm.) which decreases in size caudad ; 7th tergite with a pair of small wax plates ; hairs on the dorsum of abdomen fine, 0.040-0.070 mm. long, $1.0-1.7 \times$ as long as the basal diameter of antennal segment III. Siphunculi absent. Cauda and anal plate fused as a tube-like sclerotic "anocaudal process" bearing about 16 fine hairs. Subgenital plate with 10-12 hairs on anterior half and a posterior group of about 25 hairs. Legs dark brown, slender, with many fine hairs, longest one on hind tibiae 0.050-0.056 mm. long, subequal to the diameter at the middle of the tibiae ; first tarsal segments with 5,5,5 hairs ; empodial hair fine,



Alate sexupara :

350. posterior portion of abdomen.



Apterous nymph : 351. whole body ; 352. ultimate rostral segments ;
353. hind tarsus ; 354. posterior portion of abdomen.

0.036 mm. long, $0.33 \times$ as long as the claws. Forewings with media simple, cubitus and anal not fused at base, veins brown, stigma dark brown.

Colour.—Not known.

Measurements in mm.—

	Length	Width	Antenna
1.	4.41	1.85	2.34
2.	3.92	1.93	—

Antennal segments						urs.	ht ₂
I	II	III	IV	V	VI		
0.09	0.12	0.69	0.45	0.47	0.43	0.33	0.37
0.08	0.12	0.78	—	—	—	0.32	0.38

(1, 2, ex. *Osmanthus*, Tokyo, JAPAN, 7.2.1953, R. Takahashi, Hokkaido University collection).

Material examined.—Four alate viviparous females and one nymph collected from an unidentified plant, Shillong, Meghalaya, INDIA, 22.5.1967, coll. A. K. Ghosh, (Calcutta University collections) : three alate viviparous females, (21.5.1949) and two alate sexupara (12.1953) from *Osmanthus*, Tokyo, JAPAN, R. Takahashi ; two apterous viviparous females from *Michelia* sp., Osaka, JAPAN, 14.5.1954, R. Takahashi ; three alate viviparous females and two alate nymphs, from *Ligustrum ibetum*, Osaka, JAPAN, 18.5.1954, R. Takahashi, (Hokkaido University collections).

Discussion.—Essig and Kuwana (1918) described this species based on alatae and nymphs collected from *Osmanthus heterophyllus* (*Osmanthus aguifolium*) in Japan and observed its close affinity with *P. crataegi* Tullgren, differing, however, in the number of secondary rhinaria and in having infuscated wings. Ghosh, A. K. and Raychaudhuri, D. N. (1968) recorded this species, again only from alatae and nymphs collected in the month of May from an unidentified plant in Shillong, India ; the indian specimens, however, differ, in having more rhinaria on segment III and less on V, as was pointed out by V F. Eastop (in *litt*) ; material obtained on loan from R. Takahashi's collection at Hokkaido University, Japan, further reveals that japanese *osmanthae* have shorter flagellar hairs, and longer ultimate rostral segment (0.125-0.26 mm.) ; Takahashi's collection also included apterae, from *Michalia* and alatae from *Ligustrum ibotum*, besides alate sexuparae from *Osmanthus* ; apterae and alate sexuparae were so far undescribed ; sexuparae show the typical "anocaudal process" earlier recorded in sexuparae of two species from North America (on *Pinus*) and one from India (on *Taxus baccata*)(See *P. taxus* p.), but it is interesting to note that in this case sexuparae have been collected on the same host as the adult fundatrigeniae ; the record of apterae on *Michelia* indicates a possible host association of *osmanthae* involving Oleaceae (*Osmanthus* and *Ligustrum*) and Magnoliaceae (*Michelia*) ; Shinji (1941) recorded *Mahonia japonica* as a host of *osmanthae*, and it has been followed by Higuehi and Miyazaki (1969) but Aoki (in *litt.*) expressed his doubt about this host identification.

Sexuparae of *osmanthae* and *taxus* and also the North American species with anocaudal process could be separated by the following Key.

1. Secondary rhinaria 5-8 on segment III and 1-4 on IV, none on segment V, mostly covering half the width of III antennal segment. Cauda with 30-40 hairs. On *Pinus*, North America .*piniradicivorus* Smith
Secondary rhinaria present on segment III, IV, , and VI ; Cauda with variable number of hairs .2
2. Ultimate rostral segment with 10 accessory hairs ; segment III with 18-22, IV with 8-10, V with 6-10 and base of VI with 3-5 strongly annular secondary rhinaria. On *Taxus baccata*, India *taxus* (Ghosh & Raychaudhuri)
—Ultimate rostral segment with 14-20 hairs. Antennal segment III with 20-32, IV with 5-21, V with 9-23, VI with 0-12 secondary rhinaria .3
3. Ultimate rostral segment with 14-18 hairs ; antennal segment III with 20-30, IV with 5-10, V with 9-15, VI with 0-3 secondary rhinaria. On *Pinus*, N. America .*caroliensis* Smith
—Ultimate rostral segment with 20 hairs ; Antennal segment III with 30-32, IV with 20-21, V with 22-23, VI with 9-12 secondary rhinaria, On *Osmanthus*, Japan .*osmanthae* E. & K.

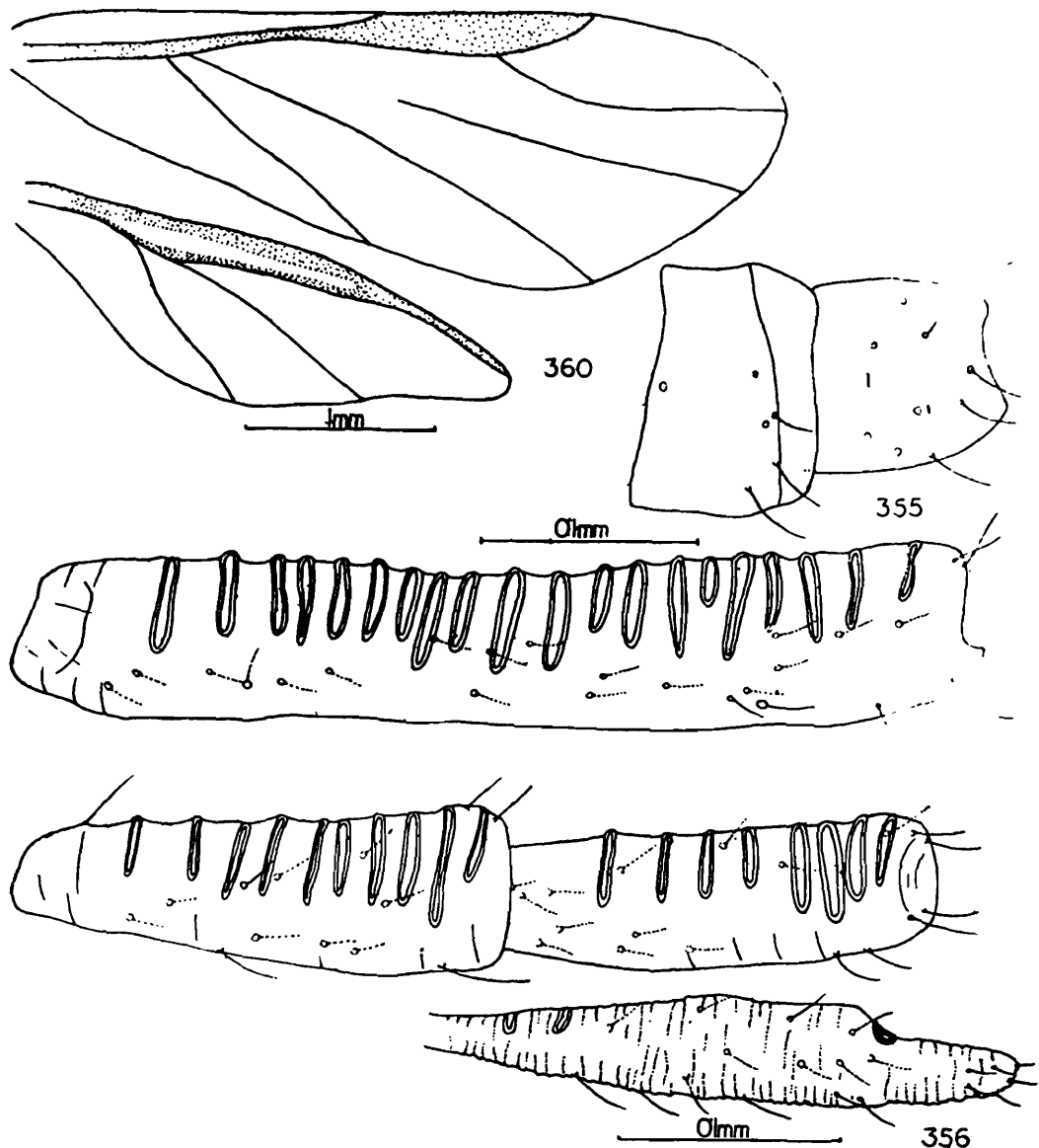
Distribution.—INDIA (Meghalaya), Japan.

Types.—Probably in the Essig, Collection at the Department of Entomology, University of California, Berkeley, California, U.S.A.

43. *Prociphilus taxus* (Ghosh, Chakrabarti, Chowdhuri, Raychaudhuri)
(figs. 355-360)

1969. *Anocaudus taxus* Ghosh, A. K., Chakrabarti, S., Chowdhuri, A. W., and Raychaudhuri, D. N. *Oriental Ins.*, 3 (4) : 329.
1973. ? *Prociphilus taxus*, Hille Ris Lambers, D., *Oriental Ins.*, 7 (2) : 249.
1976. *Prociphilus taxus*, Eastop, V. F. and Hille Ris Lambers, D., Survey of the World's Aphids, 360.

Alate sexupara.—Body large with head, antennae, thorax, legs and anocaudal process dark sclerotic, rest pale, 2.4-3.0 mm. long with 1.3-1.5 mm. as maximum width. Head without any median suture, dark sclerotic ; dorsal cephalic hairs fine, on forns upto 0.03 mm. long, 0.80 × as long as the basal diameter of antennal segment III. Antennae dark brown, except the very pale bases and apices of segments III-V and base of VI, 6-segmented, 0.50 × (or



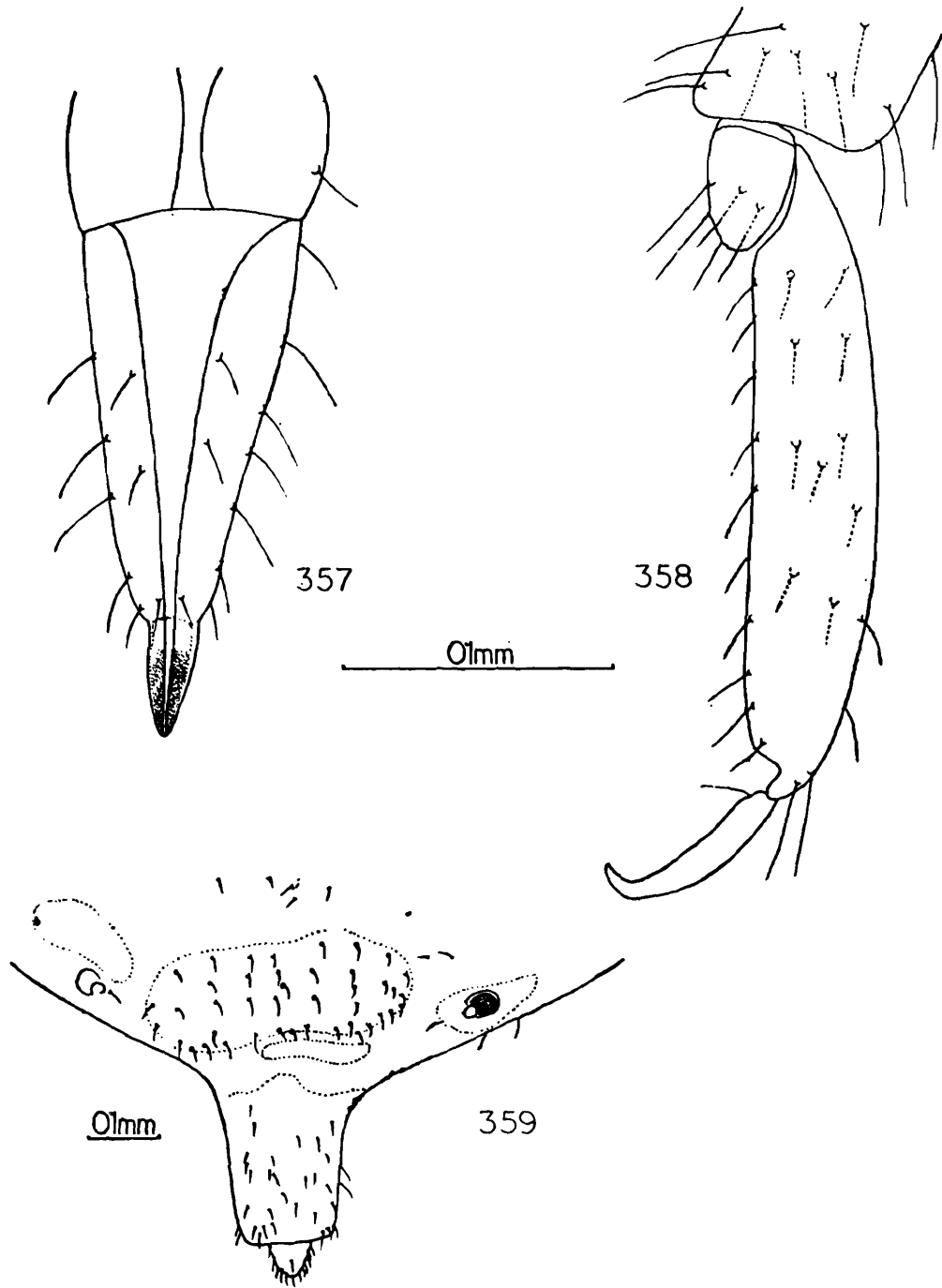
Prociphilus taxus (A. K. Ghosh, et al.) ;

Alate sexupara :

355. antennal segments, I, II, III ; 356. antennal segments IV, V, VI ;

360. wings.

little longer), as long as the body ; flagellum stout, imbricated ; hairs on the flagellum with acute apices, on segment III, 0.02-0.03 mm. long, $0.50-1.15 \times$ as long as the basal diameter of the segment ; segment III with 18-22, IV with 8-10, V with 6-10 and basal part of segment VI with 3-5, strongly annular and ciliated, secondary rhinaria ; processus terminalis $0.25-0.30 \times$ as long as the base of antennal segment VI. Rostrum reaches beyond mid-coxae ; ultimate rostral segment long, narrow, $0.75-0.82 \times$ (and not $1.3-1.5 \times$ which was erroneously put in original description) as long as second segment of hind tarsus and bears 10 accessory hairs. Thoracic

**Alate sexupara :**

357. ultimate rostral segments ; 358. hind tarsus ; 359. anocaudal process ;

tergum sclerotic black ; mesothoracic wax plates not discernible. Abdominal dorsum pale, bearing paired marginal wax plates on 1st-7th tergites (wax pores faint, hardly visible) and a median wax plate on 8th tergite ; hairs on the dorsum of abdomen sparse, with acute apices, those on 8th tergite 0.04 mm. long, $1.2 \times$ as long as the basal diameter of antennal segment III. Siphunculi absent

A cylindrical anocaudal process, (the subanal plate forming a protruded collar-like structure around cauda, 0.25-0.30 mm. long); present posteriorly, with a normal semilunar cauda, bearing about 25 fine hairs ; subanal plate (the process) bears 25 hairs. Subgenital plate dark sclerotic with at least 40-45 hairs. Legs dark brown, hairs on femora and tibiae fine, rather flagellate, longest hair on hind tibiae 0.060-0.066 mm. long, $1.3 \times$ as long as the diameter at the middle of the tibiae , first tarsal segments with 5,5,5 hairs ; empodial hair 0.020 mm. long, $0.28 \times$ as long as the claws. Wing venation fuscous, radial sector slightly curved.

Colour.—Not known.

Measurements in mm.—

	Length	Width	Antenna		
1.	3.45	1.44	1.41		
2.	2.93	1.43	1.53		
				Antennal segments	
	III	IV	V	VI	urs. ht ₂
	0.50	0.24	0.22	(0.21+0.04)	0.24 0.28
	0.53	0.29	0.25	(0.21+0.05)	0.24 0.29

(1, 2, ex. *Taxus baccata*, Khadralla, H. P., INDIA, 26.11.1968, coll. A. N. Choudhuri).

Other morphs.—Not known.

Material examined.—Four alate sexupara from roots of *Taxus baccata*, Khadralla, Simla Hills, Himachal Pradesh, INDIA, 26.11.1968, coll. A. N. Choudhuri, (Types, Calcutta University collections).

Discussion.—The alatae were described as belonging to a new genus *Anocaudus* Ghosh, A. K., *et al.* 1969, on the basis of the structure of protruded anal plate and cauda, which was thought to be unique. In the same year, Smith (1969) published an account of Pemphiginae associated with roots of conifers in North America

and illustrated a similar "anocaudal process" in the sexuparae of *P. carolinensis* Smith and *P. piniradicivorus* Smith, inhabiting roots of *Pinus* spp. Sexuparae of *osmanthae* (Essig & Kuwana) also exhibit a similar "process" However, the present species differs in the shape of the "process" and also in the number of secondary rhinaria, number of caudal hairs etc. ; besides, it inhabits roots of a completely different and primitive host plant, *Taxus baccata* ; Hille Ris Lambers (1973) first indicated that *Anocaudus* seems to be a synonym of *Prociphilus* and subsequently the present species was listed under *Prociphilus* by Eastop and Hille Ris Lambers (1976). Smith (in litt.) mentioned that "*Anocaudus* is close to two species of *Prociphilus*, I described. I have a third species still closer to your *Anocaudus*. The embryos from the aptera have plantal (empodial) setae expanded at tip whereas *Prociphilus* has them pointed. I hope you can find aptera of *Anocaudus* so that we can check this point", but till date, apterae or other morphs remain unknown.

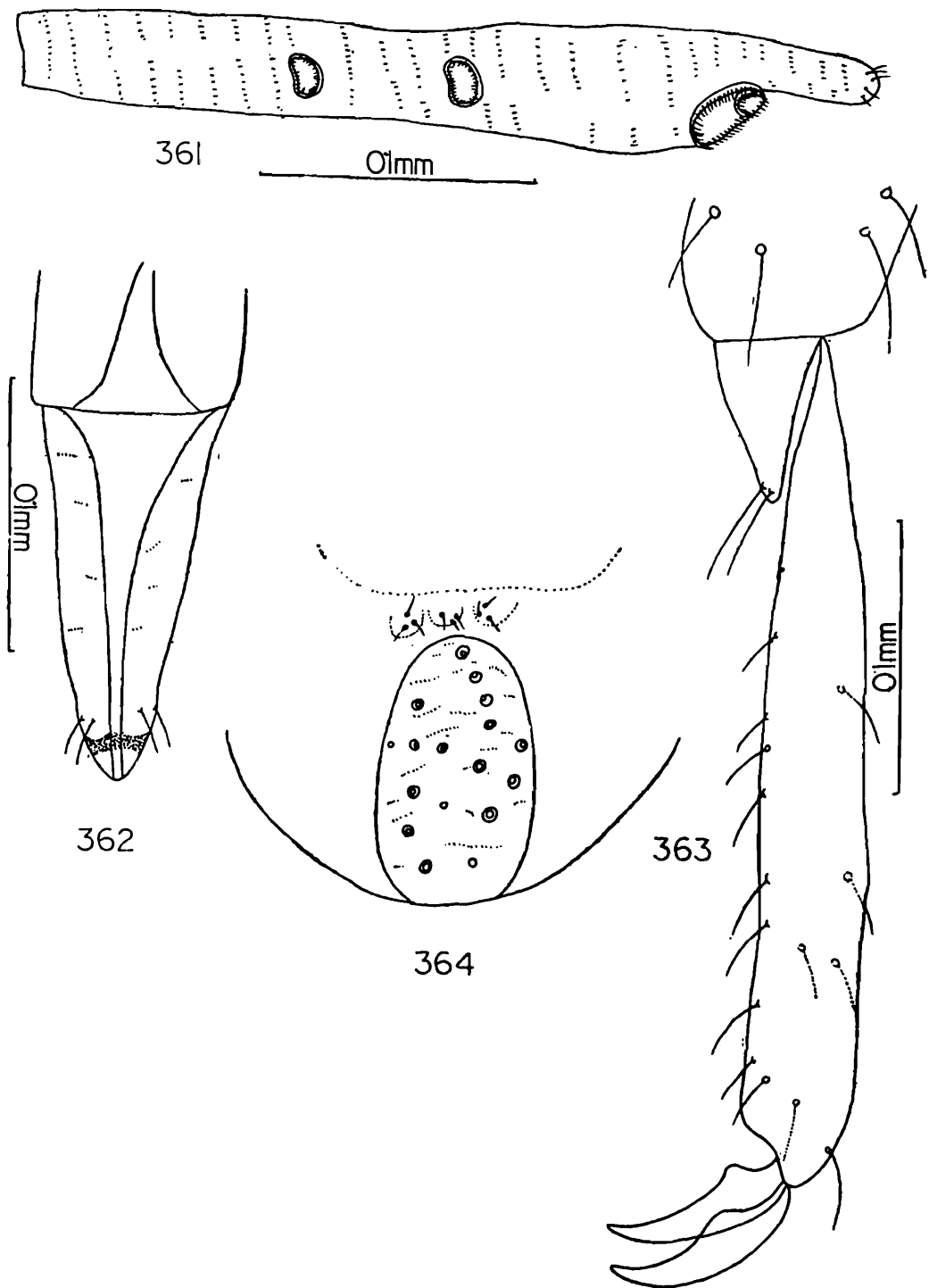
Distribution.—INDIA (Himachal Pradesh).

Types.—In the collection of Entomology Laboratory, Department of Zoology, University of Calcutta ; one paratype with Dr. Clyde F. Smith, Dept. Entomology, North Carolina State University, Raleigh, U.S.A.

44. *Prociphilus* sp. A (figs. 360-365)

1970. *Prociphilus* sp. A Ghosh, A. K., Basu, R. C., Raychaudhuri, D. N., *Oriental Ins.*, 4 (1) : 72.

Alate viviparous female.—Body 4.10-4.20 mm. long with 1.92-1.93 as maximum width. Head dark sclerotic, with a pair of wax plates. Antennae 6-segmented, dark, $0.38 \times$ as long as the body ; segment III longer than IV+V together ; hairs on the flagellum sparse, those on segment III 0.01-0.02 mm. long, $0.33-0.50 \times$ as long as the diameter at the constricted base of the segment ; segment III with 35-36, IV with 9-10, V with 10-11 linear, ciliated secondary rhinaria, most of which cover 0.75-0.90 portion of the diameter of the segment ; segment VI usually without but rarely with 1-2

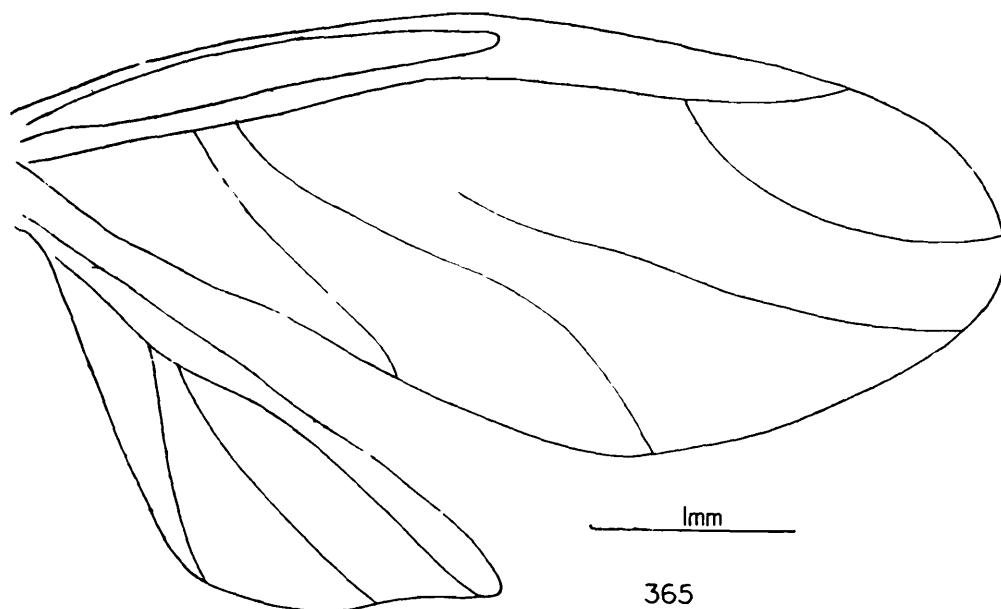


Prociphilus sp. A ;

Alate viviparous female :

361. antenna ; 362. ultimate rostral segments ; 363. hind tarsus ; 364. posterior portion of abdomen ;

much small, almost oval secondary rhinaria ; flagellum with spinular imbrication ; processus terminalis $0.20 \times$ as long as base of antennal segment VI. Rostrum reaches at least mid coxae ; ultimate rostral segment slender, $0.54-0.55 \times$ as long as second seg-



Alate viviparous female :
365. wings.

ment of hind tarsus and without any accessory hairs, but with some denticles. Mesothoracic wax glands not clearly discernible. Abdominal dorsum pale, bearing paired latero-ventral wax plates on 1st-7th tergites, each with a fine hair, 0.030-0.033 mm. long ; 8th tergite with paired elongate transverse plates, bearing 2-3 hairs, 0.050 mm. long ; hairs on the dorsum of abdomen 0.02-0.05 mm. long, 0.75-1.4 \times as long as the basal diameter of antennal segment III. Stigmal plates dark, sclerotic. Siphunculi absent. Cauda sclerotic with few (4-5 ?) hairs. Subanal plate elongate oval with about 20 hairs. Legs dark, hairs on femora and outer margin of tibiae fine, flagellate ; on inner margin of tibiae, thick, stiff and spiny ; first tarsal segments with 2,2,2 hairs. Forewings with stigma elongate (distance between tip of stigma and base of radial sector and between tip of stigma and tip of radial sector subequal).

Measurements in mm.—

	Length	Width	Antenna
1.	4.10	1.92	1.58
2.	?	1.93	1.58

III	Antennal segments			urs.	ht ₂
	IV	V	VI		
0.60	0.23	0.27	(0.25+0.05)	0.13	0.24
0.55	0.20	0.25	(0.25+0.05)	0.14	0.27

(1, 2, ex. *Photinia notoniana*, Shillong, Meghalaya, 10.3.1969, coll. S. Biswas, Calcutta University collections).

Material examined.—Nine alate viviparous females from *Photinia notoniana*, Shillong, Meghalaya, INDIA, 10.3.1969, coll. S. Biswas (Calcutta University collections).

Discussion.—The alatae were reported in 1970 and could not be identified due to lack of other morphs, and inspite of intensive survey in the area, the species has never been collected again. As such, the identity of the species from fundatrigeniae could not be ascertained. Raychaudhuri *et al.* (1980) mentioned that alatae of this species recorded as *Prociphilus* sp. A and alatae from *Fraxinus floribunda*, recorded as sp. B in 1970, belong to the same species but the description clearly indicates their differences in the distribution of secondary rhinaria on III-VI, relative length of antennal segment III, IV and V, ratio of processus terminalis to base of segment VI, and length of both ultimate rostral segment and second segment of hind tarsus.

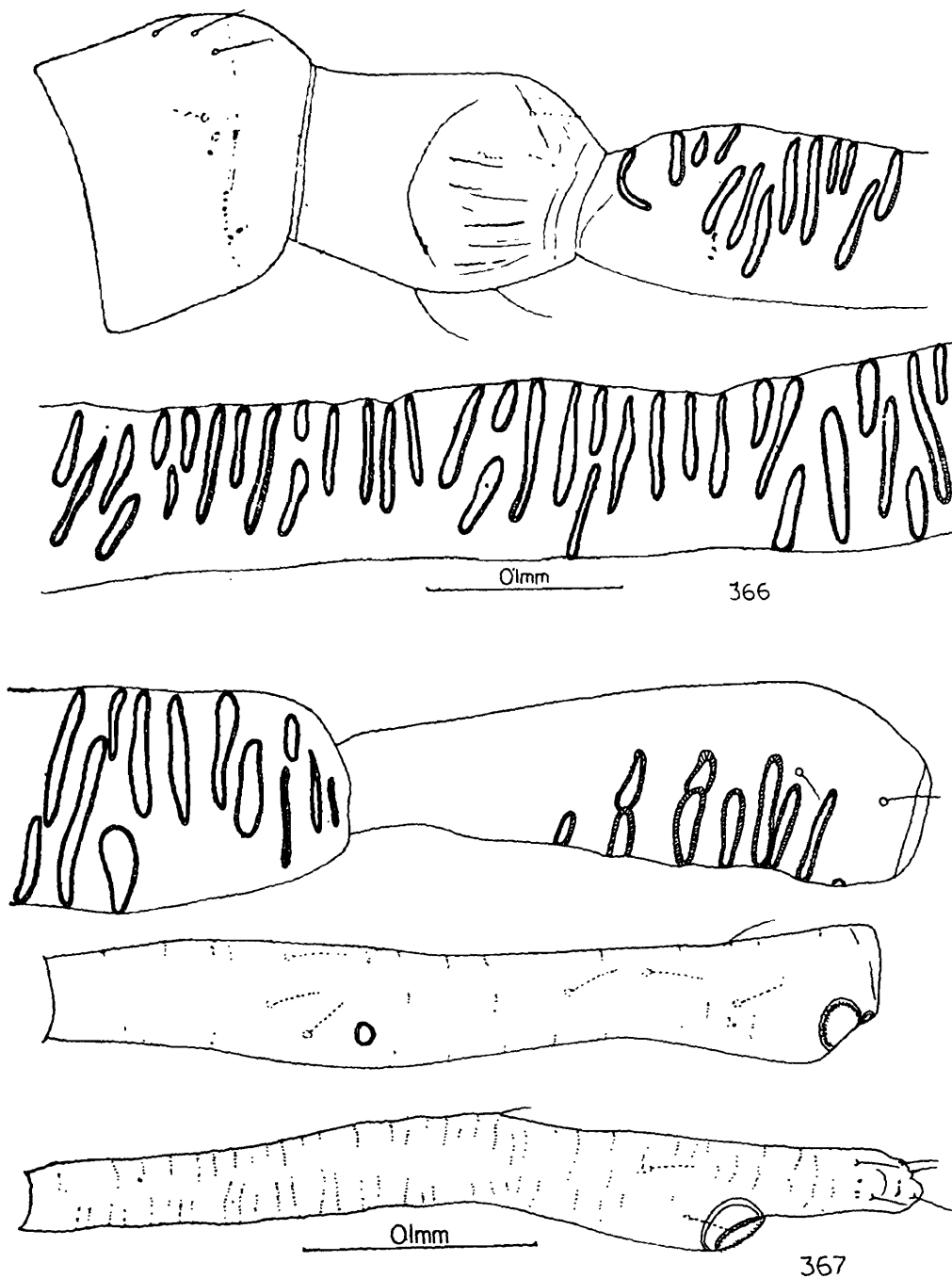
Distribution.—INDIA (Meghalaya).

45. *Prociphilus* sp. B (figs. 366-367)

1970. *Procipilus* sp. B. Ghosh, A. K., Basu, R. C., Raychaudhuri, D. N., *Oriental Ins.*, 4 (1) : 72.

Alate viviparous female.—Body large oval. Head dark brown, wax plates not discernible. Antennae 6-segmented, segment III equal to segment IV+V or little longer; hairs on the flagellum not discernible; segment III with 45-48, IV with 6-7 linear or irregular secondary rhinaria; segment V and VI without any secondary rhinaria; processus terminalis 0.15-0.16 × as long as base of antennal segment VI and 0.06 × as long as antennal segment III. Ultimate rostral segment 0.50 × as long as second

segment of hind tarsus. Abdominal dorsum pale ; hairs and wax plates not discernible. Siphunculi absent. Caudal region otherwise damaged. Longest hair on hind tibiae 0.106 mm. long, equal to the diameter at the middle of the hind tibiae ; other characters not discernible.



Prociphilus sp. B ;

Alate viviparous female :

366. antennal segments I, II, III (part) ; 367. antennal segments III (apex), IV, V, VI.

Measurements in mm.—

Length	Width		Antenna		
?	?		2.10		
	Antennal segments			urs.	ht ₂
III	IV	V	VI		
0.74	0.30	0.41	(0.32+0.05)	0.20	0.41

(ex. *Fraxinus floribunda*, Shillong, Meghalaya, 24.3.1969, coll. S. Biswas, Calcutta University collections).

Material examined.—Two alate viviparous females from *Fraxinus floribunda*, Shillong, Meghalaya, INDIA, 24.3.1969, coll. S. Biswas, (Calcutta University collections).

Discussion.—Record of only damaged alatae renders it difficult to identify the species ; however, another unidentified species from *Photinia* could easily be separated by the characters noted under discussion for *Prociphilus* sp. A.

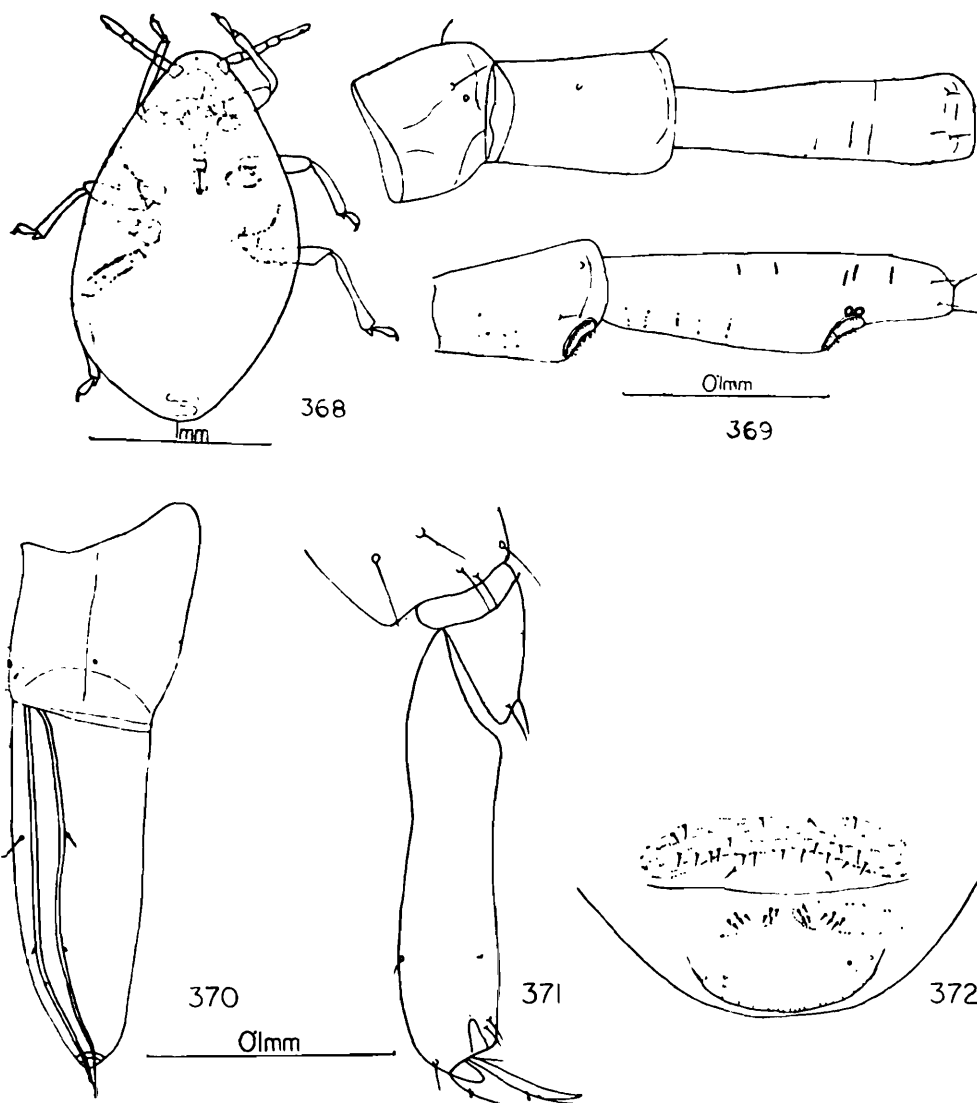
Distribution.—INDIA (Meghalaya).

46. *Prociphilus* (*Stagona*) *himalayensis* Chakrabarti (figs. 368-377)

1976. *Prociphilus* (*Stagona*) *himalayensis* Chakrabarti, S., *Zool. J. Linn. Soc.*, **58** : 263.

Apterous viviparous female.—Body elongate oval, 1.9-2.2 mm. long with 1.2-1.4 mm. as maximum width pale except antennae, legs and cauda which are brown. Head fused with prothorax, sclerotic brown except near bases of antennae, which are pale, with an indistinct median suture ; dorsum of head with 4 wax plates besides numerous small wax pores ; dorsal cephalic hairs fine, upto 0.016 mm. long, 0.50-0.55 × as long as the basal diameter of antennal segment III. Antennae pale brownish, darker on basal segments, 5-6-segmented, 0.18-0.26 × (5-segmented) and 0.24-

0.25 × (6-segmented) as long as the body ; segment I wider than long, with 4 fine hairs and numerous scattered wax pores ; segment II much longer than wide ; flagellum with spinulose imbrication on outer margin, more distinctly so from distal 0.33 portion of segment III, apicad ; hairs on the flagellum fine, sparse, on segment III 0.006-0.018 mm. long, 0.22-0.50 × as long as the basal diameter of the segment ; primary rhinaria ciliated ; processus terminalis 0.22-0.26 × as long as the base of last antennal segment. Rostrum reaches mid coxae, ultimate rostral segment 0.93-1.1 × as long as the second segment of hind tarsus and bears 4 (2-4) acces-



Prociphilus (Stagona) himalayensis Chakrabarti ;

Apterous viviparous female :

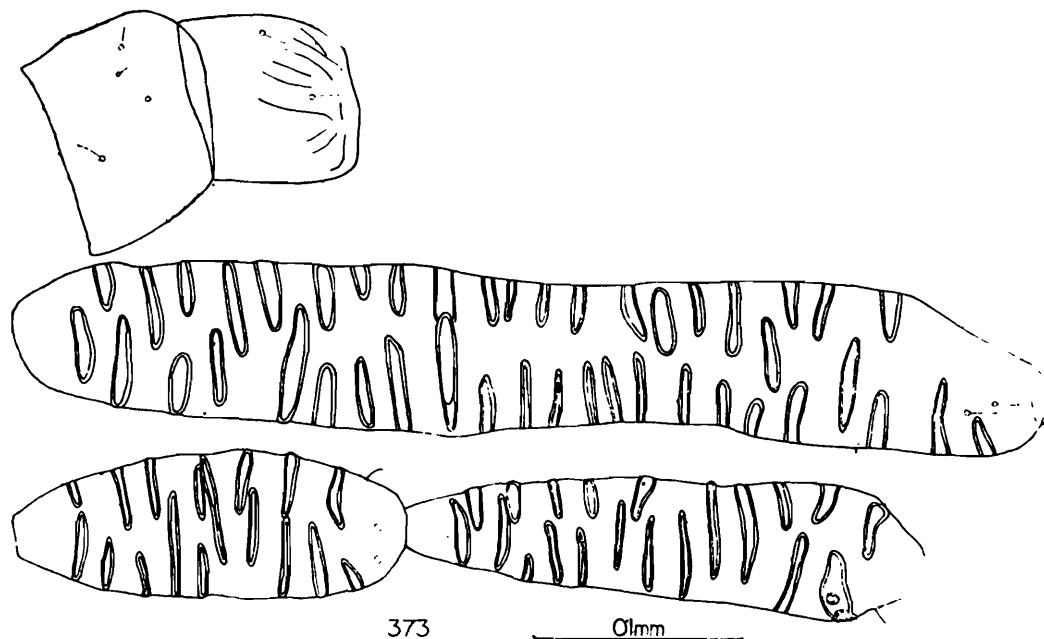
368. whole body ; 369. antenna ; 370. ultimate rostral segments ; 371. hind tarsus ; 372. posterior portion of abdomen.

sory hairs. Thoracic tergum with many minute, wax pores. Abdominal dorsum pale, membranous, except on stigmal plates and cauda which are brown ; hairs on the dorsum of abdomen short, sparse, 0.008-0.016 mm. (0.021) long, $0.25-0.55 \times$ as long as the basal diameter of antennal segment III ; paired marginal wax plate present on 1st-7th tergite ; 8th tergite with a pair of median wax-plates, fused in the middle. Siphunculi absent. Cauda brownish, small. Subanal plate small with only 6 hairs. Subgenital plate transverse, sclerotic with 20-21 hairs ; Gonapophyses with 5-2-4 hairs. Legs brown, trochanters partly fused with femora ; hairs on tibiae fine, a few in apical tibial hairs differentiated as 4 short, thick, spines ; longest hair on hind tibiae 0.016 mm. long, $0.33 \times$ as long as the diameter at the middle of the tibiae ; first tarsal segments with 2,2,2 hairs ; empodial hair 0.09-0.10 mm. long, $0.15-0.17 \times$ as long as the claws.

Colour.—Light yellow.

Measurements in mm.—

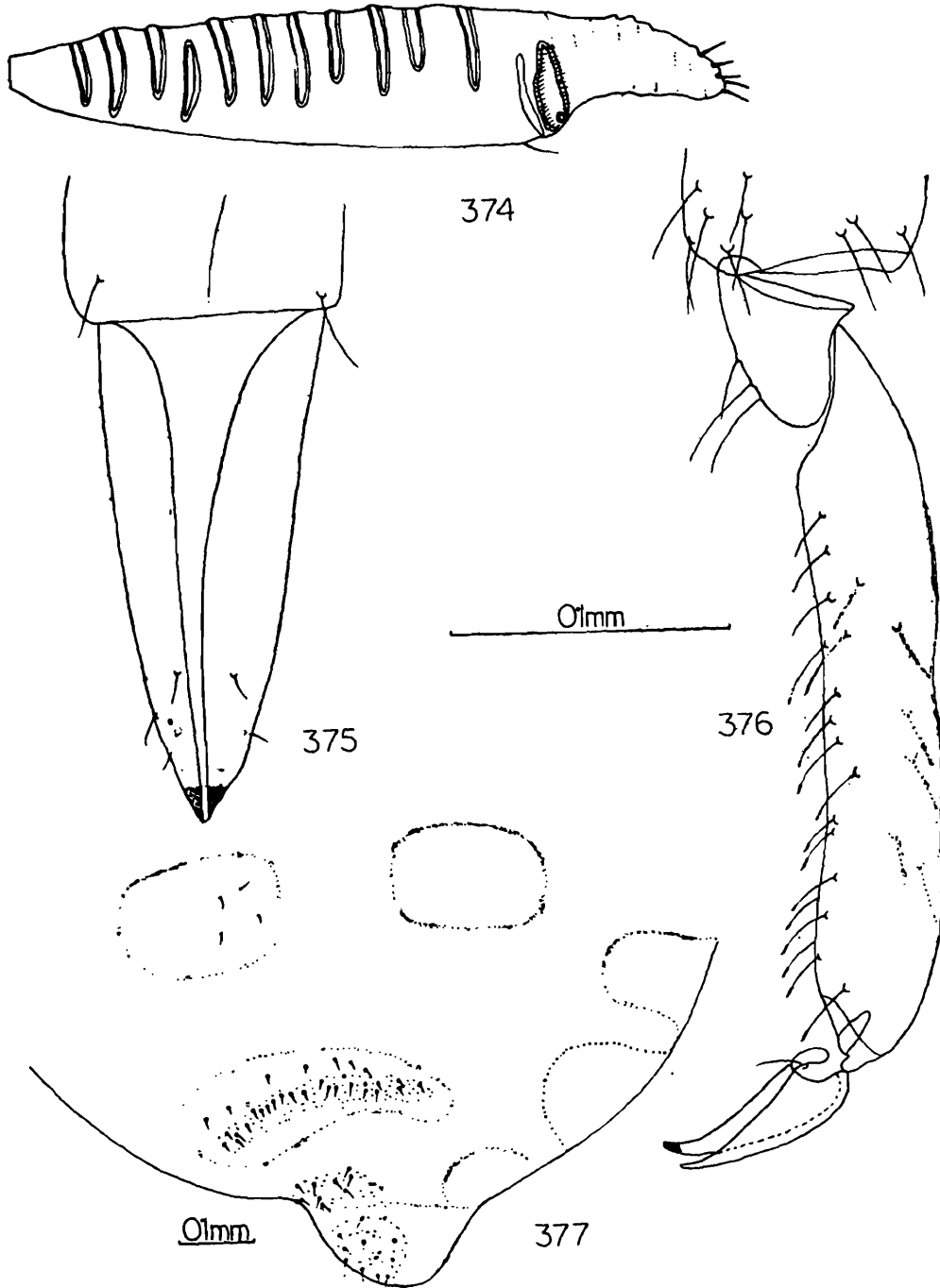
	Length	Width	Antenna
1.	2.04	1.44	0.55
2.	1.94	1.20	0.36



Alate sexupara :

373. Antennal segments I—V.

III	Antennal segments		urs.	ht ₂
	IV	V		
0.14	0.08	(0.13+0.03)	0.146	0.155
0.08	0.07	(0.11+0.03)	0.130	0.132



Alate sexupara :

374. antennal segment VI ; 375. ultimate rostral segments ; 376. hind tarsus ; 377. posterior portion of abdomen.

(1, 2, ex. unidentified host, Simla, Himachal Pradesh, INDIA, 20.10.1970, coll. A. N. Chowdhuri, Paratypes).

Embryos.—Terminal tibial hairs not differentiated ; empodial hair as long as claws, (Chakrabarti, 1976).

Alate sexupara.—Body 2.6-3.3 mm. long with 1.1-1.5 mm. as maximum width. Head brown to dark brown with a distinct median suture ; dorsal cephalic hairs long, fine, upto 0.015-0.020 mm. long, $0.40-0.50 \times$ as long as the basal diameter of antennal segment III. Antennae brown, dark on basal segments, 6-segmented, $0.36-0.42 \times$ as long as the body , antennal segment I and II stippled , flagellum nearly smooth except on last segment which is with spinulose imbrications , hairs on the flagellum sparse, fine, 4-8 per segment, (on III-V), longest one on segment III, 0.004-0.006 mm. long, $0.16-0.20 \times$ as long as the basal diameter of the segment ; segment III with 38-49, IV with 12-17, V with 14-21 and basal part of VI with 9-14 secondary rhinaria which are narrow, ciliated, and shorter than the width of the segments , primary rhinaria semi oval, ciliated , processus terminalis $0.22-0.31 \times$ as long as the base of antennal segment VI. Rostrum reaches beyond mid-coxae ; ultimate rostral segment $0.77-0.82 \times$ as long as the second segment of hind tarsus and bears 4-6 accessory hairs, Meso-thoracic wax glands distinct, each bearing a single hair. Abdominal dorsum pale, membranous, except on stigmal plates and anal region which are brown , paired marginal wax plates present on 1st-7th tergites, each bearing 2 fine hairs (except a single pair of wax plates on 1st tergite) ; 8th tergite with large paired transverse spino-pleural wax plate, each with 2-3 fine hairs, hairs on the dorsum of abdomen sparse, long, fine, on anterior tergites 0.040-0.050 mm. long, $1.0-1.25 \times$ ($1.4 \times$) as long as the basal diameter of antennal segment III, on 8th tergite 0.050 mm. long, $1.25 \times$ ($2.0 \times$) as long as the mentioned diameter ; Siphunculi absent. Cauda brownish, semioval, with a pair of hairs. Subanal plate rounded with 13-15 hairs. Subgenital plate brownish, sclerotic, with about 36-38 hairs ; Gonapophyses with 8-4-7 hairs. Legs stout, pale at bases of femora, rest brown ; femora and tibiae nearly smooth, longest hair on hind tibiae 0.023 mm. long, $0.36 \times$ as long as the diameter at the middle of tibiae ; first tarsal segments with 3+1-2, 1-2+1-2, 1-2+1-2 hairs ; empodial hair 0.020 mm. long, upto $0.30 \times$ ($0.33-0.66 \times$)

as long as the claws. Wings venation normal, venis distinctly fuscous.

Colour.—Not known.

Measurements in mm.—

	Length	Width	Antenna			
1.	3.3	1.5	1.17			
2.	2.6	1.1	1.14			
		Antennal segments			urs.	ht ₂
	III	IV	V	VI		
	0.44	0.18	0.22	(0.175+0.024)	0.175	0.255
	0.30	0.13	0.18	(0.172+0.040)	0.180	0.234

(1, 2, ex. *Pinus excelsa*, Simla, H.P., INDIA, 30.10.1970, coll. A. N. Choudhuri, Paratypes).

Nymph (of alate sexupara).—Body completely pale, little dusky only on antennae, legs, wing pads, 1.90 mm. long, with 0.89 mm. as maximum width. Head with a median suture. Antennae very stout, 6-segmented, 0.37 × as long as the body ; antennal segments I, II, IV almost subequal ; flagellum with sparse spinulose imbrications, from apical 0.30 portion of segment III ; hairs on flagellum not discernible, except the preapical ones on processus terminalis ; primary rhinaria ciliated ; processus terminalis 0.31 × as long as base of antennal segment VI. Rostrum longstout, reaches at least hind coxae ; ultimate rostral segment uniformly pale, 0.83 × as long as second segment of hind tarsus and bears 5 accessory hairs. Meso-thoracic wax plates not clearly discernible. Abdominal dorsum pale, membranous ; hairs on the dorsum of abdomen. 0.006-0.016 mm. long, 0.10-0.25 × as long as the basal diameter of antennal segment III ; paired marginal wax glands present on 1st-7th tergites, which are very faintly demarcated ; 8th tergite with a pair of small plates. Siphunculi absent. Cauda with 2-3 hairs. Subanal plate with 12 hairs, 8 of which arranged in 2 parallel longitudinal rows. Legs pale, trochanters fused with femora ;

tibiae enlarged at apices ; longest hair on hind tibiae 0.020 mm. long, $0.35 \times$ as long as the diameter at the middle of hind tibiae, first tarsal segments with 2,2,2 hairs.

Colour.—Pale yellow (?)

Measurements in mm.—

Length	Width	Antenna			
1.90	0.89	0.71			
	Antennal segments			urs.	ht ₂
III	IV	V	VI		
0.21	0.09	0.11	(0.12+0.04)	0.15	0.18

(ex. *Pinus excelsa*, Simla, H.P., INDIA, 30.10.1970, coll. A. N. Choudhuri, Paratype).

Material examined.—Two apterous viviparous females from unidentified plant, Tolash, Simla, Himachal Pradesh, INDIA, 20.10.1970, coll. A. N. Chowdhuri, det. S. Chakrabarti ; two alate sexupara and one nymph from roots of *Pinus excelsa*, Tolash, Simla, Himachal Pradesh, INDIA, 30.10.1970, coll. A. N. Chowdhuri, det. S. Chakrabarti (Paratypes, S. Chakrabarti's collections).

Discussion.—Root feeding Pemphiginae on coniferae has been discussed in details by Smith (1969) ; Chakrabarti (1976) related sexupare of this species with the north American *crataegistrobi* Smith, which alternates between *Crataegus* and *Pinus strobus*, but the latter species has more secondary rhinaria, more wax plates and more hairs on 8th tergite ; another species of *Stagona* described from Taiwan by Tao (1970) from *Pinus*, viz. *P. pini*, differs from *himalayensis* in having lesser number of rhinaria, first tarsal hairs and shorter antennal segment III with relation to IV and V.

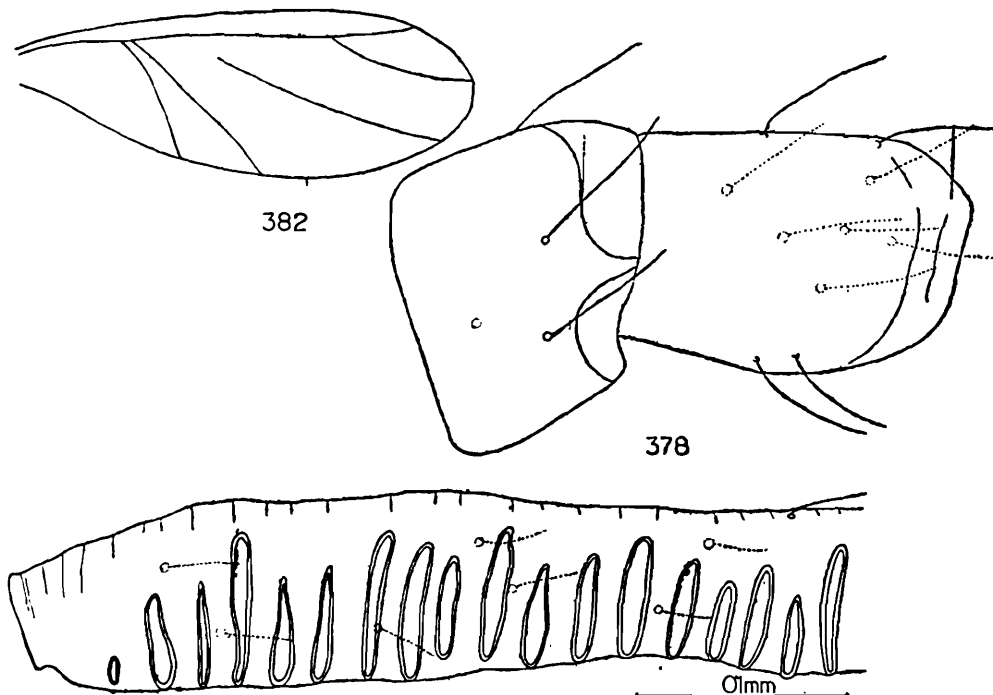
Distribution.—INDIA (Himachal Pradesh).

Types.—In the collections of Dr. S. Chakrabarti, Department of Zoology, University of Kalyani.

47. *Prociphilus* (*Stagona*) *xylostei* (De Geer)
(figs. 378-386)

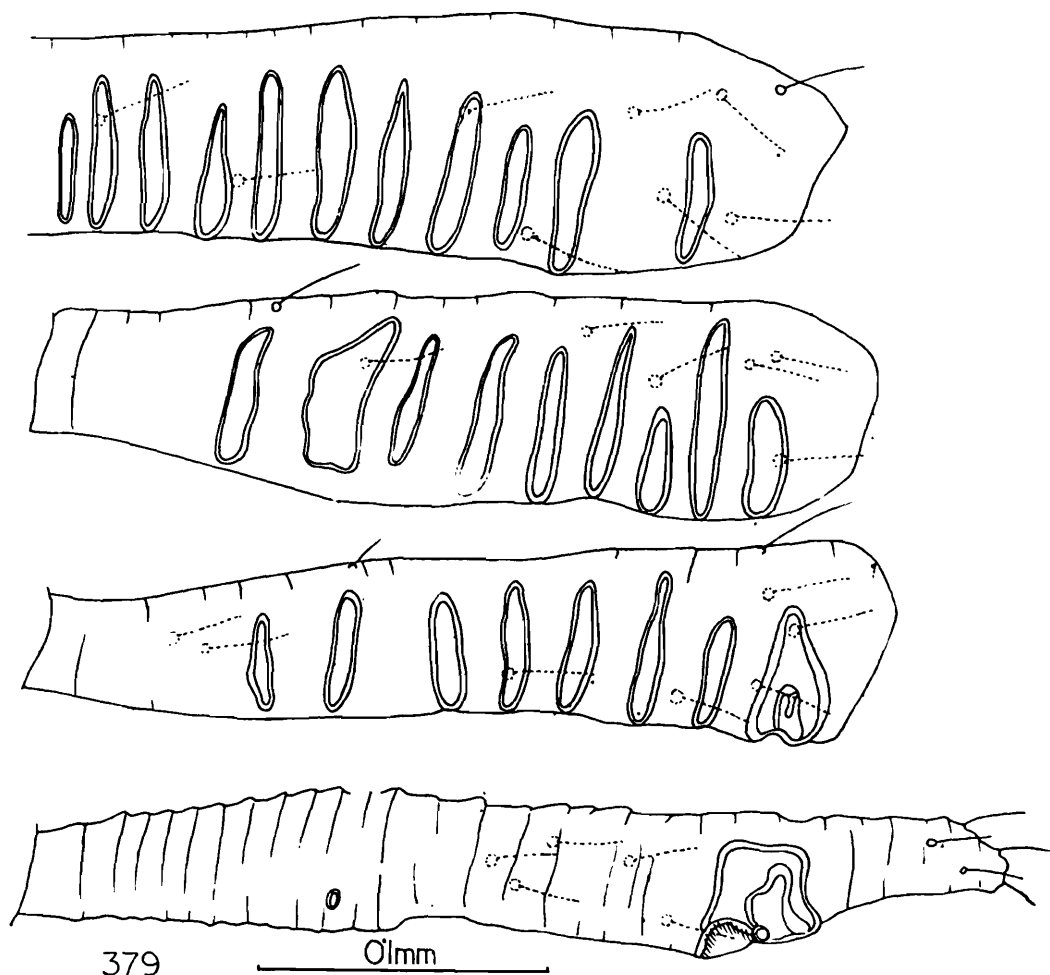
1773. *Aphis xylostei* De Geer, C., *Memoir pour servir a' l' historic des insectes*, 3 : 96.
 1841. *Pemphigus loniceræ* Hartig, T., *Germars Z. Ent.*, 3 : 285.
 1843. *Pemphigus degeeri* Kaltenbach, J., *Mon. Fam. Pflanz.*, 186.
 1857. *Stagona xylostei*, Koch, C. L., *Die Pflanz. Aphiden.*, 285.
 1909. *Prociphilus xylostei*, Tullgren, A., *Ark. Zool.*, 5 (14) : 83.
 1935. *Prociphilus* (*Stagona*) *xylostei*, Mordvilko, A., *Ergeb. Fortschr. Zool.*, 8 : 92.
 1952. *Stagona xylostei*, Börner, C., *Mitt. thuring bot Ges.*, 3 (182) : 192.
 1969. *Stagona xylostei*, Smith, C. F., *Ann. ent. Soc. Am.*, 62 (5) : 1150.

Alate fundatrigeniae.—Body large 5.2-5.5 mm. long with 2.1-2.8 mm. as maximum width. Head dark sclerotic, with two pair of wax plates, one pair near the bases of antennae and the other, much larger placed medially. Eyes large with distinct tubercles. Antennae 6-segmented, dark on basal segments, rest lighter, dusky, 0.30-0.32 × as long as the body ; segment III with a distinct denticle and bears 25-29 linear secondary rhinaria, mostly covering



Prociphilus (*Stagona*) *xylostei* (De Geer) ;
 Alate viviparous female (fundatrigenia) :
 378. antennal segments I, II and part of segment III ; 382. forewing.

the entire width of the segment ; segment IV with 9-11, V with 7-9 and base of segment VI with 0-2 secondary rhinaria ; primary rhinaria on VI large, ciliated ; hairs on the flagellum fine, on segment III 0.020-0.026 mm. long, $0.40-0.53 \times$ as long as the basal diameter of the segment ; processus terminalis $0.16 \times$ as long as the base of segment VI. Rostrum reaches mid coxae ; ultimate rostral segment $0.60 \times$ as long as the second segment of hind tarsus and bears 10-11 accessory hairs. Abdominal dorsum pale, membranous, except on the stigmal plates and sclerotic transverse band on 7th segment and subanal plate, which are dusky to brown ; hairs on the dorsum of abdomen fine, upto 0.040-0.050 mm. long, $0.60-1.1 \times$ as long as the basal diameter of antennal segment III. Wax plates not discernible. Siphunculi absent. Cauda small, semioval with few fine hairs. Legs dark, except on the trochanters and bases of femora, which are pale, almost whitish ; hairs on femora and tibiae fine, longest hair on hind tibiae 0.093-0.103 mm.



Alate viviparous female (fundatrigenia)
379. antennal segment III (apical part)—VI.



Alate viviparous female (fundatrigenia)

380. ultimate rostral segment; 381. hind tarsus

long, 1.1-1.3 \times as long as the diameter at the middle of the tibia ; apical tibial hairs not differentiated ; first tarsal segments with 2, 2, 2, hairs ; second tarsal segments slender, with fine dorso-apical hairs ; empodial hair 0.023-0.026 mm. long, 0.18-0.20 \times as long as the claws. Wing large, forewings with pterostigma elongate, media simple, almost invisible basally, cubitus and anal arising in close proximity ; hind wings with oblique veins united basally.

Colour.—Probably greenish-grey with blackish head, antennae and legs (Tullgren, 1909).

Measurements in mm.—

	Length	Width		Antenna		
1.	5.23	2.1		1.70		
2.	5.50	2.8		1.70		
		Antennal segments			urs.	ht ₂
	III	IV	V	VI		
	0.51	0.25	0.25	(0.28+0.05)	0.24	0.39
	0.51	0.27	0.27	(0.30+0.05)	?	0.39

(1-2, ex. *Syringea* sp., Govindaghat, U.P., INDIA, 13.6.1978, S. Chakrabarti's collections).

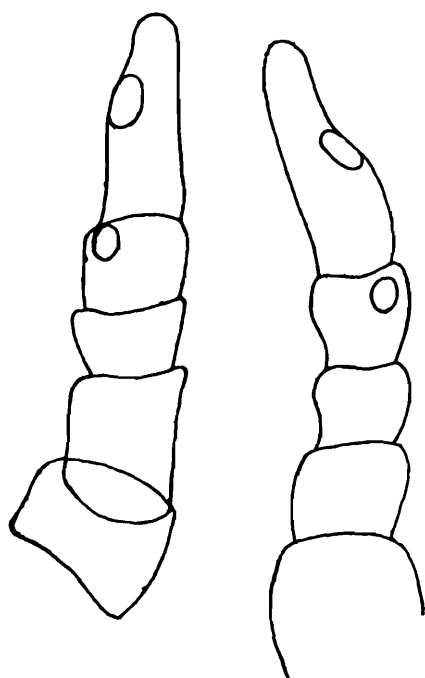
Larva (from Smith, 1969)—Antennae 4-segmented ; segment I with 3, II with 3-4, IV with 2 hairs ; primary rhinaria on IV with two accessory rhinaria. Ultimate rostral segment with 0.2 accessory hairs. Abdominal dorsum apparently with 4 wax plates on 3rd-6th tergites, 2 on 7th and one on 8th tergites. Cauda with 2 hairs. Empodial hair fine, as long as claws.

Measurements in mm. (from Mordvilko, 1935)—

Length	Width		Antenna
0.41-0.51	0.16-0.20		0.20
	Antennal segments		
I	II	III	IV
0.03	0.04	0.05	0.067+0.013-0.016

Apterous viviparous female (fundatrix).—Body broad oval, 4.0-4.01 (2.0-4.68 mm.) long with 2.60-2.64 mm. as maximum width. Head with 4 wax plates ; dorsal cephalic hairs fine, upto 0.050 mm.

long. Antennae 5-segmented, brown on basal segments and at apices of segments III, IV and V, rest pale, $0.20-0.21 \times$ as long as the body ; segment I and II almost equal in length, each with 4-6 fine hairs, segment III longest, with 4-5 hairs, these being $0.023-0.046$ mm. long and $0.63-1.27 \times$ as long as the basal diameter of the segment ; segment IV with 2-3 hairs, and base of V with 1-2 hairs ; flagellum smooth basally, with fine spinulose striae from apex of



383

384



385

386

Sexuales :

383. antenna of male ; 384. antenna of ovipara ; 385. posterior portion of abdomen in male showing aedeagus. 386. hind tarsus in ovipara (all from Tullgren, 1909).

segment III apicad ; primary rhinaria small, round and ciliated ; processus terminalis $0.28 \times (0.20 \times)$ as long as base of last antennal segment. Rostrum reaches near mid coxae ; ultimate rostral segment stout, $0.70 \times$ as long as second segment of hind tarsus and bears 4 accessory hairs besides preapicals. Dorsum pale except on brown stigmal plate, and some scattered 'muskelpatten' like structure ; hairs on the dorsum fine, on lateral margin, upto 0.050 mm. long, (usually 0.023-0.033 mm. long) $0.70-1.7 \times$ as long as the basal diameter of antennal segment III ; wax plates not discernible except some pale structure on lateral margin. Siphunculi absent. Cauda dark brown. Subgenital plate brown, sclerotic, with more than 30 hairs. Subanal plate with 30-32 hairs. Legs dark brown, stout, with many fine hairs, longest ones on hind tibiae, 0.060-0.062 mm. long, equal to the width at the middle of hind tibiae ; first tarsal segments with 2,2,2 hairs ; empodial hair fine, 0.033-0.036 mm. long, $0.55-0.58 \times$ as long as the claws.

Colour.—Grey or yellowish green (Tullgren, 1909).

Measurements in mm.—

	Length	Width	Antenna				
1.	4.00	2.64	0.82				
2.	4.01	2.62	0.85				
			Antennal segments		urs.	ht ₂	
	I	II	III	IV	V		
	0.09	0.10	0.33	0.12	(0.14+0.04)	0.124	0.175
	0.09	0.09	0.35	0.14	(0.14+0.04)	0.118	0.169

(1, 2, ex. *Syringea* sp., Gobindaghat, U.P., INDIA, 13.6.1978, coll. D. Bhattacharjee), S. Chakrabarti's collections).

Larva (from Mordvilko, 1935) :

Measurements in mm.—

Length	Width	Antenna
0.75-0.77	0.20-0.25	0.29

Antennal segments			
I	II	III	IV
0.04	0.04	0.11-0.12	(0.08+0.02)

Sexupara (from Tullgren, 1909).—Body 1.7 mm. long. Head without median suture and bearing two large wax plates. Antennae 6 segmented ; segment III, 1.5 × as long as segment IV and bears 7-12 secondary rhinaria ; segment IV with 4-6 and V with 4-6 similar rhinaria ; hairs on flagellum fine. Each of thoracic tergites with 2 wax plates. Abdominal dorsum with wax plates as follows : 1st-4, 2nd-4, 3rd to 7th-2, 8th-1.

Colour.—Greenish grey.

Measurements in mm.—

	Length	Width	Antenna
1.	1.70	?	0.74
2.	1.74	0.82	0.89
3.	2.05	0.89	1.06
4.	1.78	0.72	1.01

Antennal segments				Rostrum hind tarsus	
III	IV	V	VI		
0.19	0.13	0.15	0.15	0.34	0.20
0.26	0.14	0.18	0.19	—	0.21
0.32	0.21	0.19	0.19	—	0.24
0.32	0.18	0.19	(0.14+0.04)	—	—

(1) from Tullgren, 1909, on *Lonicera* ; 2-4, from Mordvilko, 1935, on spruce root (2), and *Lonicera* (3-4).

Apterous viviparous female (*Exules* on *Picea* roots, from Mordvilko, 1935).—Appear similar to exules of *Thecabius* and *Pemphigus* in respect of arrangement of wax-plates.

Measurements in mm.—

	Length	Width	Antenna		
1.	1.02	0.51	0.50		
2.	1.11	0.58	0.48		
		Antennal segments		Rostrum	ht ₂
	III	IV	V		
	0.15	0.08	(0.11+0.026)	0.46	0.14
	0.12	0.08	(0.11+0.026)	0.45	0.14

Larva (from Mordvilko, 1935). Larvae appear similar to larvae of fundatrigeniae. Wax glands present only on abdomen, 4 on each of 4th-7th tergites ; 8th tergite with a median wax gland.

Measurements in mm.—

Length	Width	Antenna		
0.70	0.26	0.30		
	Antennal segments		Rostrum	ht ₂
	I	II	III	
0.04	0.06	(0.09+0.13)	0.53	0.08

Material examined.—Five alate viviparous females (fundatrigeniae) and three apterous viviparous females (fundatrix) from galls of *Syringea emodi*, Gobindaghat, Ghangharia, Uttar Pradesh, INDIA, 13.6.1978, coll. D. Bhattacharya (S. Chakrabarti's collections, Kalyani University, No. 617).

Discussion.—Koch (1857) established the genus *Stagona* with *Aphis xylostei* De Geer 1773, described from *Lonicera xylosteum*. Tullgren (1909) treated *A. xylostei* as *Prociphilus xylostei*, (De Geer) and described fundatrix, fundatrix, fundatrigenia (forms, maxima and minima), sexupara (forms, maxima and minima) and sexuales, in details ; he also indicated the cycle of host alternation from *Lonicera* to *Picea* and observed that new born virginogeniae

search for fine roots of “*Fichten*” or *Picea* but did not describe *Virginogeniae* and stated earlier (p. 89) that “*Virginogenia*” are unknown. Mordvilko (1935) described this species as *Prociphilus* (*Stagona* Koch) *xylostei* De Geer from USSR and included larvae of fundatrices, emigrant alate, larvae of emigrants, new born larvae on the roots of *Picea* which appear similar to emigrant (from rearing experiment), adult apterous viviparous females on *Picea* (from rearing experiment), and sexuparae from spruce roots in pot culture and from *Lonicera* ; he further speculated that in Ussuri district of USSR, the exules perhaps develop on both *Abies* and *Pinus* and stated that “East Siberian form can probably be separated as a special subspecies *xylostei orientalis*” Morphometric measurements of *xylostei* as given by Tullgren (1909) and Mordvilko (1935) while agreeing in case of alate fundatrigeniae on *Lonicera*, differ widely in the number of secondary rhinaria in sexuparae (Tullgren : III, 7-12, IV 4-6, V 4-6 ; Mordvilko : III 10-22, IV 7-12, V 7-13). Smith (1969) described fundatrix, fundatrigeniae and embryos of *Stagona xylostei* (De Geer) from North America and observed that North American specimens correspond with “maxima” form of Tullgren (1909) but failed to differentiate “maxima” and “minima” forms, other than in the size of body, size and shape of stigma, relative size of wax plates and ocelli etc. Smith’s (op. cit) record of North American specimens, however indicate much larger body size than noted by Tullgren for his “maxima” both in the case of Fundatrix and Fundatrigeniae. Smith (op. cit) also described two new species, *Stagona crataegistrobi* from *Crataegus*, *Pinus* and *Stagona picearubensis* from roots of *Picea rubeus*, the latter, according to Smith, shows a definite possibility to be the same as *Stagona xylostei* form “minima” of Tullgren (1909), but even in that case the actual identity of “minima” and “maxima” of Tullgren need to be ascertained (i.e. whether they are one species or subspecies).

The alatae from Indian region, as described here, differ from the description given by Tullgren (1909) for alate fundatrigenia “maxima” (p. 85) ; the following characters either differ or are not visible in Indian specimens : Antennae with secondary rhinaria only on segment III (19-25) and IV (4-6). Pronotum with 4 large wax plates, mesonotum with two large wax plates and metanotum with 4 plates. Abdominal dorsum with paired, spinal, pleural

(0.43 mm. diameter) and marginal wax plate on 1st-6th tergites, of which marginals are largest (0.90 mm. diameter) ; 7th and 8th tergite each with 4 and 2 wax plates, respectively , measurements as provided by Tullgren (given below) also differ from those of Indian specimens.

Measurements in mm. (Tullgren).—

Length	Width	Antenna				Rostrum
2.3-2.7	0.8-1.1	1.2-1.32				
		Antennal segments				
	III	IV	V	VI		
	0.39-0.49	0.17-0.18	0.18-0.20	0.23-0.24	0.55-0.70	

On the other hand, fundatrigenia from North America, (Smith, 1969) closely agrees in size (3.9-4.40) with the Indian specimens but differs in the length of antennal segments (III 0.43-0.48, IV 0.19-0.22, V 0.22-0.25, VI 0.21-0.22+0.04-0.06), length of ultimate rostral segment (0.12-0.14) and number of accessory hairs (8) etc. ; number and distribution of abdominal wax plates as given by Tullgren (1909) was confirmed by Smith (op. cit) but he did not mention anything about thoracic wax plates and none of these were discernible in Indian specimens. According to Smith (op. cit), genital plate in fundatrigeniae bears 50 hairs and gonapophyses bear 5-2-5 hairs, which, however, could not be counted in the available specimens.

The apterous specimens from *Syringea* in India while agreeing otherwise with description of apterae from *Lonicera* (Tullgren 1909, Smith 1969) differ in the apparent absence of pleural and spinal wax plates and in the fewer accessory hairs on ultimate rostral segment.

Biology of *xylostei* in Holarctic region involves egg laying on *Lonicera* and as the fundatrix hatches out, it forms tube-like malformation on leaf as a result of curling ; the colony develop on leaf and remain covered by waxy secretion ; alate emigrants leave

Lonicera during the months of July-August and migrate to roots of *Picea* ; sexuparae develop towards the end of September-October and fly back to *Lonicera* where they produce sexuales.

Distribution.—INDIA (Uttar Pradesh) : Holarctic.

Types.—Location of types not known.

12. Genus *Thecabius* Koch 1857

1857. *Thecabius* Koch C. L., *Die Pflanzenlause Aphiden*, Nurnberg, 294. Type species : *Thecabius populncus* Koch = *Pemphigus affinis* Kaltenbach.
 1896. *Bucktonia* Lichtenstein, J., *Monographie des Pucerons du Peuplier*, 19. (as subgenus of *Pemphigus* Hartig 1839). Type species. *Pemphigus affinis* Kaltenbach.

Morphology.—Body oval or elongate, 2.0 to more than 5.0 mm. long. Head with or without wax gland groups, number of which may vary between 2-4 and sometimes these may be only 3 and located on one side [*latisensoria* (Hori)]. Antennae 5-segmented in fundatrices, 6-segmented in other morphs, always distinctly shorter than the body, (0.20-0.25 × in fundatrices and 0.33-0.50 × in alatae) : flagellum in fundatrices smooth on basal segments, faintly to distinctly spinulose apicad, without secondary rhinaria ; in alatae with series of annular secondary rhinaria on segments III (6-25), IV (2-8), V (2-11) and basal part of segment VI (0-9) : secondary rhinaria may be narrow or broad, their width distinctly less than the space between adjacent rhinaria or broader than the space between the adjacent rhinaria, never ciliated ; primary rhinaria round, ciliated ; adult sexuparae usually with fewer rhinaria only on segment III and IV [e.g. *populi-conduplicifolius* (Cower), *populi monilis* Riley] or on segments III, IV and V [e.g. *affinis* (Kaltenbach)] ; hairs on flagellum short and sparse. Rostrum reaches at most hind coxae, ultimate rostral segment smooth or sparsely spinulose, without any or at most with 6 accessory hairs (usually 0-4), usually $\pm 0.5 \times$ as long as the second segment of hind tarsus. Thorax usually with a pair of wax gland group on mesonotum and sometimes also on metanotum [*orientalis* Mordv., *latisensoria* (Hori)]. Abdominal dorsum in fundatrices with distinct wax gland groups arranged in 6 rows (spinal, pleural and

marginal) on 1st-7th tergites, and usually with 4 wax gland groups on 8th tergite ; sometimes these may be present on 4th-8th tergites (4 on each of 4th-7th and 2 on 8th) in alatae, wax gland groups on abdomen may be indistinct [e.g. *affinis* (Kltb.)] normal, pigmented and irregular [*orientalis* Mordv.] or arranged as in fundatrices [*gravicornis* (Patch)] ; wax gland groups on head, may be indistinct, numerous in apterae viviparae. Dorsal wax gland groups usually with a distinct border, and the cells may be closely appressed together or may have space between them ; ventral wax gland groups may be without a border. Hairs on the dorsum of abdomen may be short, or long and stout and upto 0.03-0.04 mm. long. Siphunculi absent [except in emigrant of *latisensoria* (Hori)]. Cauda semilunar with 2-4 hairs. Genital plate in alate (emigrant) with 15-40 hairs. Gonapophyses 2, with few setae. Legs with tarsi often spinulose, first tarsal segments usually with 1-3 hairs [5,5,5 in emigrant of *affinis* (Kltb)], and sometimes with a sense-peg or spine-like seta between the normal hairs. Empodial hairs 0.25-0.33 × as long as the claws. Forewings with media simple, hind wings with both obliques.

First instar larvae of emigrants are characterised by antennae (4-segmented in *Parathecabius* Börner, and 5-segmented in *Thecabius*), segmented spinulose tarsi, 3 pairs of dorsal hairs on abdominal tergites, presence of at least spinal and pleural wax gland groups at least on 3rd-6th tergites and capitate empodial setae. Aoki (1975) considered that capitate-setae have some function in migration when the larvae move from the leaf, bearing the primary gall to another leaf, to make the secondary gall.

Sexuales much smaller in size (less than 1.0 mm.) male and ovipara, apterous, arostrate ; oviparae lay only one egg (Baker, 1920).

Discussion.—A total of 14 species are known under *Thecabius* s. l. from The World, of which 7 species each come under *Thecabius* s.s. and subgenus *Parathecabius* Börner, 1950 ; of these 14 species, 5 species are typically Western Palaearctic, viz. *T. affinis* (Koch.), *T. (P) auriculae* (Murray), *T. (P) ceraetii* Börner, *T. (P) lynimachiae* (Börner), *T. (P) stammeri* (Zwölfer), 2 are typically Eastern Palaearctic (Japan), viz. *T. anomoni* (Shinji), *T. (P) latisensorius* Hori,

3 are oriental, viz. *T kelloggi* (Takahashi), *T orientalis* Mordv. and *T (P) luppovae* Narzikulov and 4 are Nearctic. viz. *T patchii* Gillette, *T populiconduplifolius* (Cowen), *T populimonilis* (Riley) and *T (P) gravicornis* (Patch).

Börner (1950) erected the genus *Parathecabius* with *lysimachiae* as the type and included *saliciradicis* (now considered under *Pemphigus*) and *cerastii* under the same, on the basis of 1st instar larva exule having 4-segmented antennae and short processus terminalis. Stroyan (1964) included *auriculae*, *pseudoauriculae* (now considered synonym of *auriculae*), *globae* (now considered as a probable synonym of *lysimachiae*) and *stammeri* under *Parathecabius* but excluded *saliciradicis* and also *cesastii* from *Parathecabius*, which he considered as a subgenus of *Pemphigus*. Aoki (1975) considered *Thecabius* and *Parathecabius* as synonyms of *Pemphigus*, as according to him, both morphological and ecological gaps between *affinis* group and other *Pemphigus* are not large. Eastop and Hille Ris Lambus (1976) however recognised *Parathecabius* as a subgenus of *Thecabius* as mentioned earlier, having representatives from a wide geographical area as that of *Thecabius*. The subgenus is usually separated from the nominate genus by the nature of antennae in the first instar larvae of exules (5-segmented in *Thecabius*, 4-segmented in *Parathecabius*) by the nature of ultimate rostral segment in fundatrices, (blunt in *Thecabius* and acute in *Parathecabius*), by the nature of galls produced by fundatrices (marginal or apical fold galls in *Thecabius* and pouch-like growth of leaf lamina in *Parathecabius*), by the number of hairs on first tarsal segments in emigrants (usually fewer (2) in *Parathecabius*) and presence and absence of mesothoracic wax glands (usually present in *Thecabius s.s.*) etc.

Biology.— Members of *Thecabius s. l.* may be heteroecious, alternating between *Populus* spp. and *Lysimachia*, *Ranunculus* etc. [e.g. (*affinis*, (*Kltb*) *lysimachiae* Börner, *orientalis* Mordv., *populiconduplifolius* (Cowen)] or monoecious being restricted to *Populus* [e.g. *populimonilis* (Riley)]. Holocyclic life cycle is known for most of the species, but some like *cerastii* (Börner) is mostly known by parthenogenetic forms on the base of the stem of *Cerastium* in European Alps. Some of the species like *latisensoria* (Hori) or *gravicornis* Patch are known only from *Populus* but they

are believed to be heteroecious as the 1st instar larva laid by alate viviparae appear to be exule type and similar to the 1st instar larva of exule of *lysimachiae* which is a heteroecious species (Aoki, 1975), Aoki (op. cit) also considered *gravicornis*, *latisensoria* and *lysimachiae* (under *Pemphigus*, but considered under *Parathecabius* here) as one group, i.e. "*lysimachiae* group" because of the similarity in the nature of primary galls produced by fundatrices and secondary galls produced by fundatrigeniae, and morphological similarities of fundatrix, emigrant and larvae, of these species.

Fundatrices of *Thecabius* usually produce primary galls, which may be pocket-like swelling on upper side of the leaf between mid-rib and edge of the leaf with openings located ventrally, or a gall in leaf margin folded underside or a true pocket-like gall with a ventral opening or just a slender swelling on leaf opening beneath etc., usually a single fundatrix occupies a single gall (except in *patchii* Gillette); fundatrigeniae form secondary galls, which may be on the underside of leaves which are folded downwards together on mid-rib or a series of bead-like galls along leaf margin etc. Galls may be red or green and sometimes are produced at top part of the tree and may escape attention.

At least three species, viz. *affinis* (Kltb.), *orientalis* Mordvilko and *populiconduplifolius* (Cowen) are known have *Ranunculus* as secondary host and Aoki (1975) considered these holarctic, obligatory, heteroecious species as under one group i.e.—"*affinis* group" because of the similarities in different morphological characters of fundatrix, larvae, and adults, Emigrant adults and Exule 1st instar larvae etc.; usually parthenogenetic females are found at the base of the stem or runners or off-shoots of *Ranunculus*; fundatrix and emigrants are noted in later part of May to July on *Populus* and exule adult in August on *Ranunculus*, in Japan, (Aoki, 1975); sexuparae develop in October, on *Ranunculus* in U.S.A. (Smith, 1974).

Ants are not normally known to attend the members of the genus.

Distribution.— Oriental, Palaearctic and Nearctic region. Palmer (1952) and Smith (1974) have dealt with the Nearctic species including *affinis* and *lysimachiae* (Börner) which are Holarctic in

distribution, Stroyan (1964) and Zwolfer (1957) have dealt with Western Palaearctic species and Aoki (1975) has given an extensive account of *Thecabius orientalis* Mordvilko and *Thecabius* (*Parathecabius*) *latisensoria* (Hori) [under *Pemphigus*] from Japan.

Type species.— *Thecabius populneus* Koch 1857 = *Pemphigus affinis* Kaltenbach 1843. Location of type not known. Smith (1974) has given a detailed description of *affinis* from U.S.A.

Type of subgenus *Parathecabius* Börner : *Thecabius lysimachiae* Börner 1916 [syn. *Pemphigus* ? *glebae* Jackson 1918], deposited in the Dutsches Entomologisches Institut, Berlin.

48. *Thecabius affinis* (Kaltenbach) (figs. 387-396)

1843. *Pemphigus affinis* Kaltenbach, J., *Mon. Fam. Pflanz.*, 182.
 1843. *Pemphigus ranunculi* Kaltenbach, J., *Mon. Fam. Pflanz.*, 185.
 1857. *Thecabius populneus* Koch, C. L., *Die. Pflanz. Aphiden*, 295.
 1909. *Thecabius affinis*, Tullgren, A., *Ark. Zool.*, 5 : 103.
 1916. *Thecabius agnotus* Börner, C. and Blunck, E., *Mitt. Kaiserl. Biol. Anst Lond. Forstwirtschaft*, 16 : 38.
 1978. *Thecabius affinis*, Chakrabarti, S. and Maity, S. P., *Entomon*, 3(2) : 27.

The species is known only by apterous exules from *Ranunculus* in the Indian region and descriptions of other morphs which are quite common in Europe, have been adopted from Tullgren (1909) and Roberti (1938).

Apterous viviparous female (Fundatrix).—(from Tullgren, 1909 and Roberti, 1938). Body 3.5-4.5 mm. long, with 2.0-3.2 mm. as the width at the middle of abdomen. Head usually with 3 pair of wax-plates of 0.017-0.068 mm. diameter ; dorsal cephalic hairs short, numerous ; Antennae 5-segmented, 0.20-0.27 × as long as the body ; segment I and II subequal ; flagellum with spinulose imbrications ; segment III subequal or equal to segments IV+V ; hairs on flagellum short, sparse. Rostrum reaches second pair of coxae. Thoracic tergum with 4-6 wax plates on pronotum, and 6 each on meso and metanota. Abdominal dorsum with paired spinal, pleural and marginal wax plates on 1st-6th tergites and 4 wax plates on 7th tergites, the former being 0.05-0.08 mm. in diameter,

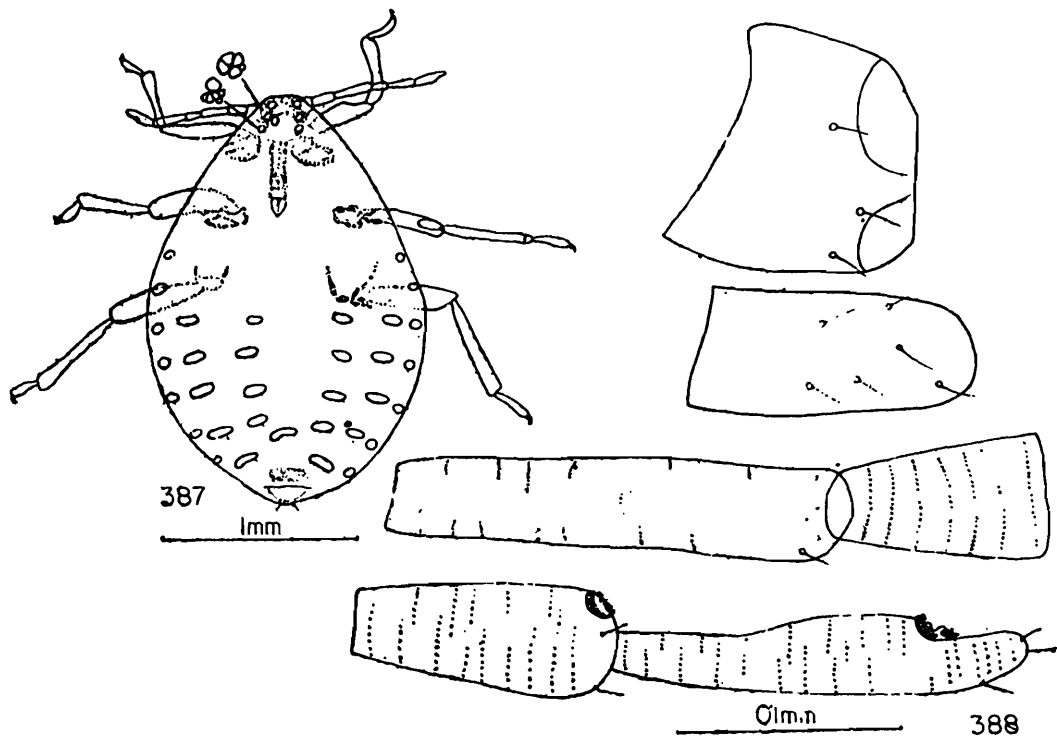
the latter larger and upto 0.137 mm. in diameter ; hairs on the dorsum of abdomen short, numerous. Legs relatively short, with fine spinulose imbrications on tarsi ; first tarsal segments with 2, 2, 2 hairs.

Colour.—Greyish-green to slate grey, covered with powdery wax in life ; head, antennae and legs blackish.

Measurements in mm.—

	Length	Width	Antenna		
1.	4.5	3.2	0.89-0.94		
2.	3.5	2.0	0.85-0.95		
	Antennal segments			Rostrum	hind tarsi
	III	IV	V		
	0.275-0.362	0.120-0.137	0.206	0.448-0.517	0.189-0.206
	—	—	—	0.700	—

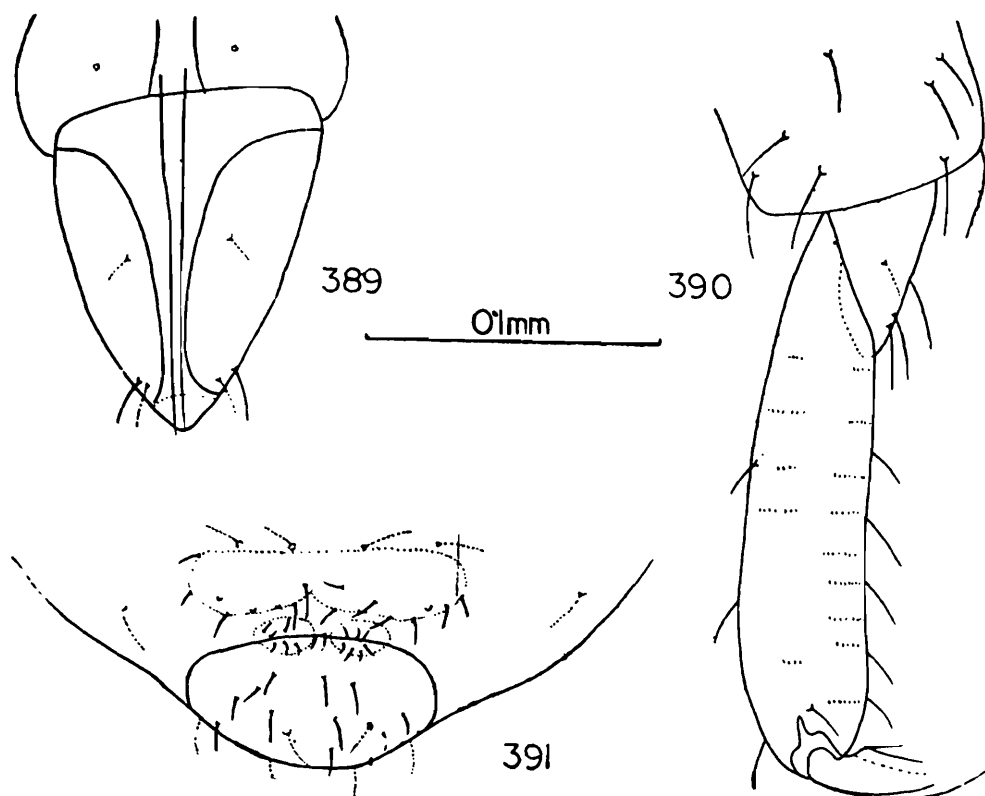
(1, from Tullgren, 1909 ; 2, from Roberti, 1938)



Thecabius affinis (Kalt.) ;

Apterous viviparous female (exules) :

387. whole body ; 388. antenna ;



Apterous viviparous female (exules) :

389. ultimate rostral segments ; 390. hind tarsus ; 391. posterior portion of abdomen.

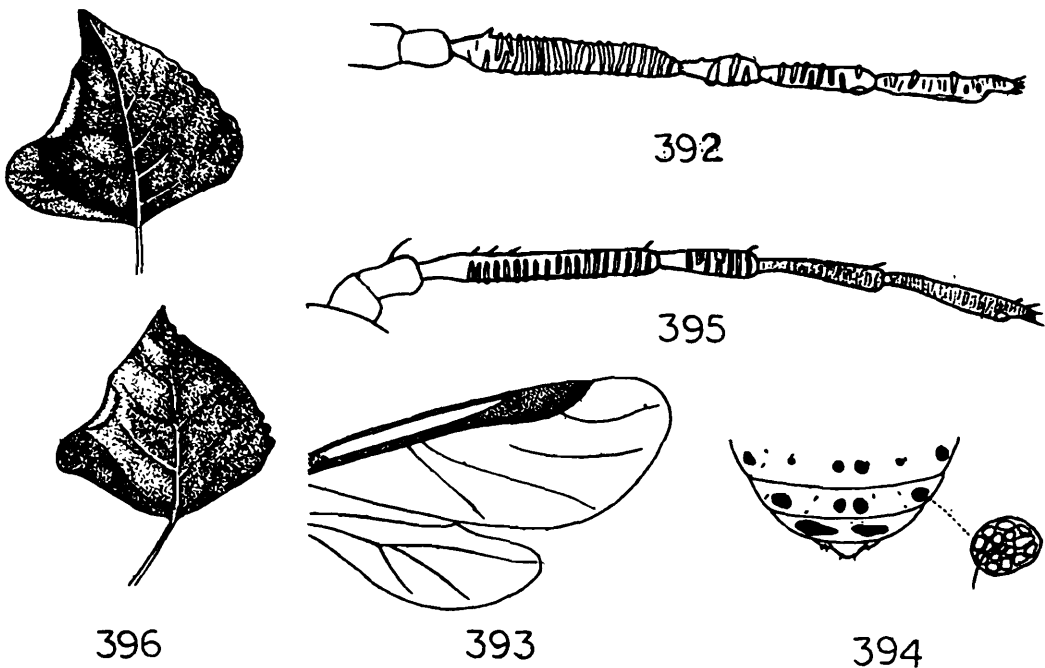
Alate viviparous female (Fundatrigeniae) : [from Tullgren, 1909 and Roberti, 1938]. Body 2.2-2.7 mm. long with 0.87-1.06 mm. as maximum width. Head without any wax gland ; dorsal cephalic hairs sparse. Antennae 6 segmented, segment I and II subequal ; segment III with a short projection near base, about $2.5 \times$ as long as segment IV and bears 15-22 narrow, secondary rhinaria ; segment IV with 4-5, V with 5-9, and base of segment VI with 3-4 similar rhinaria ; all secondary rhinaria without cilia ; primary rhinaria ciliated ; flagellum gradually more conspicuously imbricated from segment IV apicad. Rostrum reaches hind coxae, apical rostral segment subequal to preceding one. Thoracic tergum may be with or without a pair of wax plates on pronotum, and always with a large submedian pair on mesonotum. Abdominal dorsum usually with 2 spinal, 2 pleural and 2 marginal wax plates on each of 1st-6th tergites, of which the spinals are closely placed ; 7th tergite with 4 wax plates and 8th with oval large wax plates ; all abdominal wax plates may be extremely variable in shape, size and also in total number due to fusion into larger or splitting

into smaller ones ; usually each wax plate with a hair. Legs with many fine hairs on tibiae , first tarsal segments with 3, 4, 4 hairs ; in mid and hind tarsi two hairs placed apically are shorter than the others placed basally and these may even be lacking in some legs. Forewings with stigma long, media almost invisible on basal part ; hind wings with both obliques fused at base.

Colour.—Head and thorax blackish brown, abdomen greyish green with blackish anal plate.

Measurements in mm.—

Length	Width	Antenna
2.15	0.87	1.068
—	—	—
2.65	1.06	1.327



Alate viviparous female (fundatrigenia) :

392. antenna ; 393. wings ; 394. posterior portion of abdomen.

Alate sexupara :

395. antenna (from Tullgren, 1909)

Gall :

396. Leaf gall by fundatrix on *Ranunculus* (from Tullgren, 1909).

III	Antennal segments			Rostrum hind tarsi	
	IV	V	VI		
0.344	0.120	0.189	0.223	0.415	0.223
—	—	—	—	—	—
0.448	0.172	0.214	0.275	0.534	0.258

(from Tullgren, 1909).

Apterous viviparous female (exules).—Body 2.5-2.9 mm. long, elongate oval with 1.0-1.7 mm. as maximum width. Head with a distinct median suture ; dorsal cephalic hairs sparse, short ; four pair of wax plates present anterodorsally, each with a hair, besides 3 pair placed rather inconspicuously on postero-dorsal region near the eyes ; number of cephalic wax plates may be difficult to ascertain for not being distinctly delimited. Antennae dark brown, 6-segmented, $0.28-0.30 \times$ as long as the body ; segment I distinctly shorter than II ; segment III subequal to IV+V (more than the length of IV+V taken together) ; flagellum distinctly imbricated ; hairs on flagellum very sparse ; on segment, III, 0.006-0.013 mm. long, $0.22-0.40 \times$ as long as the basal diameter of the segment. Rostrum reaches mid-coxae ; ultimate rostral segment short and thick, $0.55 \times$ as long as second segment of hind tarsus and bears 2 accessory hairs. Abdominal dorsum with 4 large, suboval wax plates on each of 3rd-6th tergites and 2 elongated wax plates on 7th tergite, each of these bearing a single hair ; diameter of abdominal wax plates varies between 0.164-0.220 mm. (0.24-0.38 mm) ; hairs on the dorsum of abdomen fine, on anterior tergites 0.016-0.023 mm. long, on posterior tergites 0.023-0.033 mm. long, these being $0.36-0.63 \times$ and $0.63-0.90 \times$ as long as the basal diameter of antennal segment III. 8th tergite with 2 hairs. Siphunculi absent. Cauda semioval with 2 hairs. Gonapophyses with 8-3-8 hairs. Subgenital plate with 20 hairs. Subanal plate with about 20 hairs. Legs dark brown, very long ; hairs on tibiae sparse, longest ones hind tibiae 0.026-0.035 mm. long, $0.57-0.64 \times$ as long as the diameter at the middle of the tibiae ; first tarsal segments with 3,3,3 [5 (2+3), 4, 4] hairs ; apices of tibiae and tarsi with spinulose imbrications ; empodial hair short. Figures within parenthesis from Tullgren (1909) and Roberti (1938).

Colour.—Greyish green or yellowish green, densely covered with wax ; head, antennae, legs and anal region blackish (Tullgren, 1909) ; according to Roberti (1938), body appear creamish, when cleared of wax.

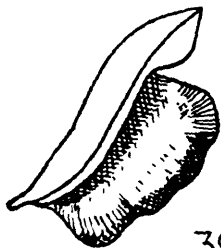
Measurements in mm.—

	Length	Width	Antenna			
1.	2.62	1.58	0.77			
2.	2.55	1.58	0.72			
3.	2.48	?	0.76			
		Antennal segments			urs.	ht ₂
	III	IV	V	VI		
	0.17	0.078	0.13	0.15+0.03	0.10	0.18
	0.16	0.078	0.12	0.15+0.03	0.11	0.18
	0.18	0.080	0.12	0.15+0.03	0.10	0.18

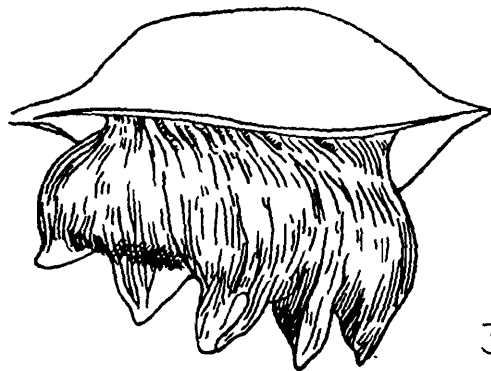
(1, 2, 3, ex. *Ranunculus histellus*, Kedarnath, U.P., INDIA, 3.6.1978, Coll. S. Chakrabarty).

Alate sexuparae (from Tullgren 1909 and Roberti, 1938).—Body 1.9-2.7 mm. long with 0.8-1.1 mm. as its width. Head with two conspicuous wax plates on vertex, besides a rather indistinct pair on the frons, each bearing a hair. Antennae 6-segmented ; segment I short, cylindrical, little longer than half the length of segment III which bears 10-15 short hairs ; flagellum imbricated at least on segments IV-VI ; segment III as long as segments IV+V and bears 18-24 secondary rhinaria ; segment IV with 5-8 and V with 0-3 similar rhinaria ; secondary rhinaria narrow, without any cilia ; hairs on flagellum sparse. Rostrum reaches beyond mid coxae. Thoracic tergum with 6 wax plates on pronotum, 4 of which arranged in a square and 4 each on meso- and metanota, of which submedian ones (2) are longer and oval. Abdominal dorsum with numerous wax plates, varying in number and arrangement but typically with 6 wax plates on each of 1st-6th tergites, 4 on 7th tergite and 2 on the 8th, of which submedian ones are elongated, rest rounded and each plate bears a single hair ; 8th tergite with 2 hairs. Legs long, tibiae enlarged at apices and bear numerous hairs ; first tarsal segments with 5, 4, 4 hairs. Wings with stigma elongate (Tullgren, 1909) or short (Roberti, 1938).

Colour.—Head, thorax, antennae and legs dark brown ; abdomen dark greyish to green with 4 distinct longitudinal rows of black spots.



397
APLONEURA



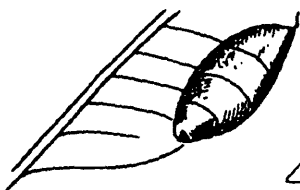
398
ASIPHONELLA



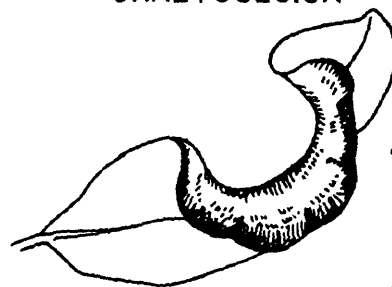
399
BAIZONGIA



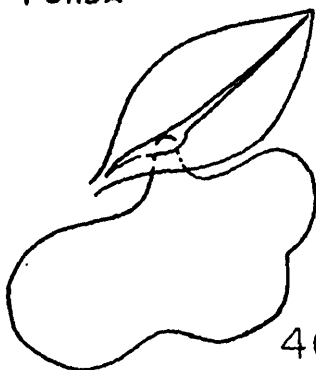
400
CHAETOGEOICA



401
FORDA

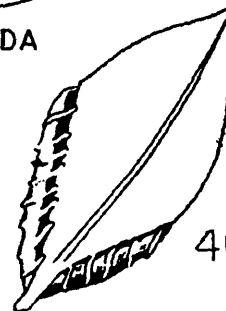


402
FORDA



403
GEOICA

FORDINI



SMYNTHURODES

GALLS ON PISTACIA

Galls on *Pistacia* by members of Fordini :

397. *Aploneura* ; 398. *Asiphonella* ; 399. *Baizongia* ; 400. *Chaetogeonica* ;
401-402. *Forda* ; 403. *Geoica* ; 404. *Symnthurodes*.

Measurements in mm.—

Length	Width	Antenna				Rostrum	hind tarsus
1.9	0.8	1.12					
—	—	—					
2.6	1.1	1.32					
	Antennal segments						
III	IV	V	VI				
0.43	0.20	0.22	0.24	0.65	0.258		
—	—	—	—	—	—	—	
0.44	0.21	0.25		0.72	0.275		

(from Tullgren, 1909).

Oviparous female (from Roberti, 1938).—Body oval, 0.80 mm. long with 0.40 mm. as its width at the middle of abdomen. Antennae 5-segmented, 0.161 mm. long ; segment I and II equal, III shorter than IV, V equal to I+II ; proportion of antennal segments I : II : III : IV : V :: 25 : 25 : 20 : 23 : 50. Eyes of 3 facets. Rostrum absent. Abdominal tergites 5 and 6 each with a pair of latero-ventral, elongate wax plates. First tarsal segments with 2, 2, 2 hairs.

Male (from Roberti, 1938).—Body 0.55 mm. long with 0.27 mm. as maximum width. Antennae 5-segmented, 0.77 mm. long ; proportion of antennal segment I : II : III : IV : V :: 30 : 30 : 25 : 30 : 55. Rostrum absent. Wax glands absent. Claspers 0.028 mm. long, with many small hairs. First tarsal segments with 3, 3, 3 hairs.

Material examined.—Four apterous exules from *Ranunculus histellus*, Kedarnath, Uttar Pradesh, INDIA, 3.6.1978, coll. S. Chakrabarty (S. Chakrabarti's collections).

Discussion.—The species is widespread in Palaearctic region and alternates between *Populus nigra* where it forms leaf pseudo-galls and *Ranunculus repens* in most part of its geographic distribution. In the region, it has not been recorded from primary host, (which is however present in North western part of India and Pakistan)

and has only been recorded from secondary host, *Ranunculus* at high altitudes in N.W. India. Tullgren (1909) and Roberti (1938) described all morphs of the species from Sweden and Italy respectively but their descriptions while agreeing in general, differ widely in the length of rostrum of fundatrix, distribution of thoracic (pro & meta) wax plates in alate fundatrigeniae and in the length of pterostigma of forewing of fundatrigenia and sexupara.

In Europe, the winter eggs hatch with the emergence of new foliage on Poplar, *P. nigra* ; new born larvae of fundatrices settle near edge of leaf, which bends over the aphid and form a pouch like leaf gall (15 mm. long, 6-7 mm. wide), which arches downwards ; larvae of fundatrices leave pseudo gall and feed on undersurface of new leaves along the mid-rib, which may lead to the formation of blister like reddish galls where fundatrigeniae undergo 4 moult before becoming adult and migrating to *Ranunculus repens*. This cycle on primary host takes place between May-July ; by end of September, sexuparae which are slow in movement, return to Poplars, lay larvae of sexuales, which in turn become adult within 4-5 days. Oviparous female lay single egg in sheltered places of trunk. Syrphid larvae are known to predate upto fundatrigeniae on Poplar during June in Italy. No ants are known to visit this species.

Distribution.—INDIA : Palaearctic region (TURKEY, BELGIUM, FRANCE, NETHERLANDS, ITALY, GERMANY, SWEDEN, USSR etc.).

Types.—Location of types not known.

Tribe FORDINI

Börner (1952) considered Fordini as a subfamily Fordinae on the basis of arrangement of gonochaetae, shape of secondary rhinaria, biological association with Anacardiaceae etc. and divided it into Tribe Fordini, having primary rhinaria non-ciliated and Tribe Baizongiini, having ciliated primary rhinaria, the first group being represented by *Paracletus* v. Heyden., *Hemitrama* Mordv. (now considered as a synonym of *Paracletus*) and *Forda* von Heyden, and the second group being divided into subtribe Baizongina, represented by *Baizongia* Rondani and *Aploneura* Passerini and

subtribe *Geocina* represented by *Geoica* Hart. Zwölfer (1957) followed Börner but considered two subtribes of *Baizongiini* as distinct tribes. Davatchi (1958), while giving a comparative account of biology and polymorphism in gall forming aphids on *Pistacia*, pointed out that division of "Fordinae" on the basis of ciliation of primary rhinaria may lead to confusion as in some species of "Baizongiini", ciliation may be absent or indistinct e.g. alate emigrants of some *Geoica* species, similarly the genus *Rectinasus* Theobald or the species *Forda riccobinii* Steff, may be difficult to place in "Baizongiini" and "Fordini" respectively. Alternatively, Davatchi (op. cit.) separated emigrants of "Baizongiini" and "Fordini" on the basis of pigmentation of mesonotum, sclerotisation of ventre of head, wax glands on abdomen, wing veins, pigmentation of abdominal dorsum, tarsal chaetotaxy, and ciliation of rhinaria etc. (Table 8), He included *Smynthuroides* Westwood, *Paracletus* v. Heyden, *Forda* v. Heyden under Fordini, and *Chaetogeica* Remaudiere and Tao, *Rectinasus* Theobald, *Geoica* Hart, under "Geocina" and *Baizongia* Rondani, *Aploneura* Passesini, *Asephonella* Theobald, *Slaivum* Mordvilko, under "Baizongina" of Baizongiini.

In the present work, Fordini has been considered to be a single tribe with two subtribes Fordina and Melaphidina; the members of Fordina use *Pistacia* as primary hosts and roots of Graminae and other plants as secondary host; members of Melaphidina usually have *Rhus* as primary host and mosses and roots of some angiosperm as secondary host. (except *Kaburagia ailantai* Chowdhuri *et al.*, an endemic species from this region, which has *Ailanthus* as primary host.).

The formation of galls (Figs. 397-404) by Fordine aphids has been extensively investigated and homogeneity in view of morphological and biological aspect has been observed by Davatchi (1958); most of the galls of Fordina are produced by folding of leaves along the margin and some species of Fordina may also produce transitory galls, besides definite-galls; galls of Melaphidina are produced by invagination of a portion of leaf in the vicinity of median vein. Wertheim (1954) has broadly grouped the galls as Bag-like gall and pocket-galls. The subterranean forms of some *Aploneura*, *Forda*, *Paracletus* and *Baizongia* are known to be

TABLE 8. Characteristics of Alate emigrants (After Davatchi, 1958) of FORDINI AND BAIZONGINI

	"FORDINI"	"BAIZONGINI"
Head Sclerotisation on the Ventre	Extend upto the margin of eyes	No such margir.al sclerotisation
Mesonotum	With median depigmented spot	Not with any spot but may bear paired wax gland groups.
Abdomen	(a) may be diffusely pigmented (b) wax glands in spinal groups, with marginal pair only on 7th tergite	(a) neither sclerotised nor pigmented (b) wax glands in spinal, and marginal groups on 1st-7th
Forewings	Cubitals never fused at base	May be fused or separated
F.T.C.	2+1, 2+0, 2+0, 2+1, 2+1, 2+0, 2+2, 2+1, 2+0 2+0, 1+0, 1+0	2+1, 2+1, 2+1, 2+2, 2+2, 2+1, 2+3, 2+3, 2+3
	Hind tarsi never with sensorial hair	Hind tarsi with sensorial hairs
Cauda	Never united with anal plate	Sometime united with anal plate
Gonapophyses	Gonapophyses included in anal plate	Gonapophyses (3), never united with anal plate
Rhinaria	Never ciliated	Variably ciliated.

thermophilus and xerophilous and in general the species prefer dry steppe like Meadow in Europe (Zwölfer, 1957). The life cycle of Fordine aphids, may be holocyclic-heteroecious, (e.g. *Forda marginata* Koch) or monoecious (e.g. *Slaivum wertheimae* H.R.L.) or anholocyclic (e.g. *Smynthuodes betoc* Westwood in some parts of Europe and U.S.A.). Typically, the fundatrix emerges from overwintering eggs in spring on the primary host (*Pistacia* or *Rhus*), start feeding on young leaves causing formation of gall and during the period of spring, summer and early autumn, the generations develop parthenogenitically within the galls, which finally open in the Autumn/fall and emigrants leave the gall and produce apterae viviparae on grass roots/moss, these virgogeniae form alate sexuales, during spring and these in turn during summer of 2nd year, produce sexuales and eggs on primary host (Tsai & Tang, 1946; Wertheim 1954). As such a 2 year cycle of host alternation may be noted in typical temperate areas of the distribution of Fordini. However, in warm and also in some temperate region, anholocyclic forms on secondary hosts (roots of grasses, dicots) are quite common. Some species of Fordini are well known for their myrmecophilous habit. These species exist with certain species of ants in a trophobiotic relationship, the extent of which is variable; definite connection between extent of myrmecophily and degree of anholocycly has been noted by Zwölfer (1958); mention may be made of *Baizongia pistaciae*, *Forda marginata*, *Forda formicaria*, *Geoica urticularia*, *Geoica setulosa* and *Smynthuodes betoe* which exhibit 70%-90% myrmecophily (in terms of population studied) and 100% anholocycly.

TABLE 9. Characteristic of new born larvae.

	"FORDINI"			"BAIZONGINI"
Rostrum	Rostrum reaches at least 3rd abdominal segment.			Of variable length
F.T.C.	4+0, 4+3,	4+0, 4+3,	4+0, 4+3	2, 2, 2
9th sternite (anal plate)	Hairs uniformly distributed, never in two rows			Hairs arranged in two rows
Cauda	Placed ventrally or laterally			Placed dorsally.

TABLE 10. Hosts of Fordini in Indian Region

Species	Primary Host	Secondary Host
1. <i>Aploneura</i> sp.	—	—
2. <i>Asiphonella cynodontii</i> (Das)	—	Roots of Graminae
3. <i>Baizongia nistaciae</i> Linne'	<i>Pistacia integerrima</i>	Roots of Graminae
4. <i>Chaetogeoica graminiphaga</i> Raychaudhuri <i>et al.</i>	—	Roots of Graminae
5. <i>Chaetogeoica polychaeta</i> Raychaudhuri <i>et al.</i>	—	Roots of Graminae
6. <i>Forda marginata</i> Koch	—	Roots of Graminae
7. <i>Forda (P) orientalis</i> George	—	Roots of Graminae
8. <i>Forda riccoboni</i> (Stefani)	<i>Toona ciliata</i> (?)	Roots of Graminae
9. <i>Geoica lucifuga</i> (Zehnt.)	—	Roots of Graminae
10. <i>Geoica sikkimensis</i> Raychaudhuri <i>et al.</i>	—	Roots of Graminae
11. <i>Kaburagia ailantnni</i> Chowdhury <i>et al.</i>	<i>Ailanthus glandulosus</i>	—
12. <i>Smynthuodes betoe</i> (Westwood)	—	Roots of Graminae

At least 14 genera are known under Fordini of which 4 genera are Oriental, 6 are Palaearctic, 3 are Holarctic and one is Nearctic in distribution. Over 50 species are known from these genera from the World. A total of 8 genera, all exotic in origin, are known from this region and these include 13 species of which 6 are endemic in origin. Most of the species are known from secondary host except gall-forming *Baizongia pistaciae* and *Kaburagia ailanthi* and also *Forda riccobonii*; complete information on the biology of any of the species is lacking but in all likelihood many may be leading anholocyclic life cycle on Graminae.

Key to the genera of FORDINI

1. Secondary rhinaria large, ovoid, one on each segment (III-VI) and with island-shaped setigerous plates. Head rectangular. Rostrum, in apterae, reaches hind-coxae, in alatae reaches upto mid-coxae. Ultimate rostral segment shorter than second segment of hind tarsus and bears few accessory hairs. Wax gland groups distinct on head, mesonotum and abdominal dorsum. On *Rhus* and *Ailanthus* galls . Kaburagia Takagi
- Secondary rhinaria never as above . 2
2. Primary or secondary rhinaria without any cilia. Marginal wax glands on 1st-5th tergite absent in alatae and at least not evident in apterae. Head ventrally sclerotised along the margin of eyes in the alatae . 3
- Primary or secondary rhinaria variably ciliated. Marginal wax glands on 1st-5th tergites present. Head never sclerotised as above . 4
3. Antennae 5-6-segmented in apterae, 6 segmented in alatae. Wax glands never evident but few facets may be present on posterior tergites. Rhinaria with sclerotised rim. First tarsal segments with 5, 5, 4 hairs. Subgenital plates placed more dorsally and enclosed by an inverted horse-shoe shaped 8th abdominal tergite. Dorsal hairs fine. Ultimate rostral segment 0.70-1.2 × as long as second segment of hind tarsus. Hind wings with posterior cubital vein inserted perpendicularly in the subcosta. New born larvae with 5-segmented antennae. Usually on roots of Dicots, sometimes on gramineae . Smynthurodes Westwood
- Antennae 5-segmented in both apterae and alatae. Wax glands on abdomen never evident and dorsum except on 7th tergite in alatae, may be stippled. Rhinaria without sclerotised margin. First tarsal segments with 6 hairs. Subgenital plate never placed dorsally or enclosed by inverted horse-shoe

shaped 8th abdominal tergite, as above. Dorsal hairs with incompressible apices. Ultimate rostral segment at least equal to the second segment of hind tarsus. Hindwings with Cubital veins almost parallel. New born larvae with 5-segmented antennae, on *Pistacia* and roots of Graminae

.Forda V. Heyden

4. Head often reticulated in apterae. Ultimate rostral segment with 2-12 accessory hairs. Spinal wax gland groups on abdomen (in alatae) less coherent. First tarsal segment in alatae with 3, 3, 3 hairs or 5, 5, 5 hairs, in the latter the secondary rhinaria ciliated and arranged irregularly on III antennal segment. Subgenital plate may be enclosed by an inverted horse-shaped 8th tergite. Wax gland groups absent in new born larvae

.5

—Head without reticulation in apterae. Ultimate rostral segment with 0-4 accessory hairs. Spinal wax gland groups on abdomen (in alatae) regular, coherent. First tarsal segment in alatae, with 4, 4, 4 or 5, 5, 5 hairs, in the latter the ciliated secondary rhinaria arranged in a row. Wax gland groups present all over the body in new born larvae

.6

5. Cephalic hairs in apterae, broadened at apices, in alatae blunt. First tarsal segment with 3, 3, 3 hairs (sometimes 3, 3, 2); secondary rhinaria in alatae round to oval, protruberant, always present on segment III, variably so on segments IV-VI, without any cilia. Processus terminalis (in alatae) not exceeding $0.20 \times$ the base of segment VI. Alatae with a pair of spinal wax gland on metanotum. 8th abdominal tergite enclosing cauda and sub-anal plate. On *Pistacia* and roots of Graminae

.Geonica Hart.

—Cephalic hairs never as above. First tarsal segment with 2 long fine hairs and 2-3 short sensory spines. Secondary rhinaria in alatae, oval, protruberant and ciliated, usually present on antennal segments III-IV. Processus terminalis (in alatae) $0.33-0.66 \times$ base of segment VI. Alatae with spinal wax glands on pronotum and metanotum. 8th

abdominal tergite never enclosing cauda and subanal plate as above. On *Pistacia* and roots of Graminae

.*Chaetogeoica* Remaudiere & Tao.

6. Cauda and anal plate completely united and form a ring. Apteræ with 4 rows of abdominal wax glands. Secondary rhinaria in alatae without cilia. Ultimate rostral segment without accessory hairs. Wings tectiform in repose. On *Pistacia* and on roots of Graminae

.*Baizongia* Rondani

—Cauda and anal plate never united as above and at least with a median depression. Abdominal wax glands variably developed, may be indistinct or upto 6 rows in apteræ. Secondary rhinaria in alatae usually ciliated. Ultimate rostral segment with 1-2 pair of accessory hairs. Wings flat or roof like in repose. On *Pistacia* and roots of Graminae or Vine roots

7

7. Antennae 4-5 segmented in apteræ, 6-segmented in alatae, segment III and IV each with a single apical rhinarium ; primary and secondary rhinaria ciliated. Flagellum and Legs never spinulose. Empodial hair about $0.50 \times$ as long as claws. Thoracic wax glands absent in alatae, spinal wax glands on 1-5th abdominal tergite often reduced ; 8th tergite with a single median gland group. Wings held flat in repose. New born larvae with 5-segmented antennae

.*Aploneura* Pass

—Antennae 6-segmented in apteræ and alatae ; antennal segment III with 2-10 and IV with 1-4 ciliated, or naked oval secondary rhinaria in alatae ; primary rhinaria on segments V and VI large and often with sclerotised ciliated island. Flagellum and legs spinulose. Empodial hair $0.25-0.33 \times$ as long as the tarsal claws. Pronotum and Metanotum each with one pair wax glands. Spinal wax glands present on 1st-7th abdominal tergites ; 8th tergite in alatae without wax gland. Wings held roof-like in repose. New born larvae with 4-segmented antennae

.*Asiphonella* Theobald.

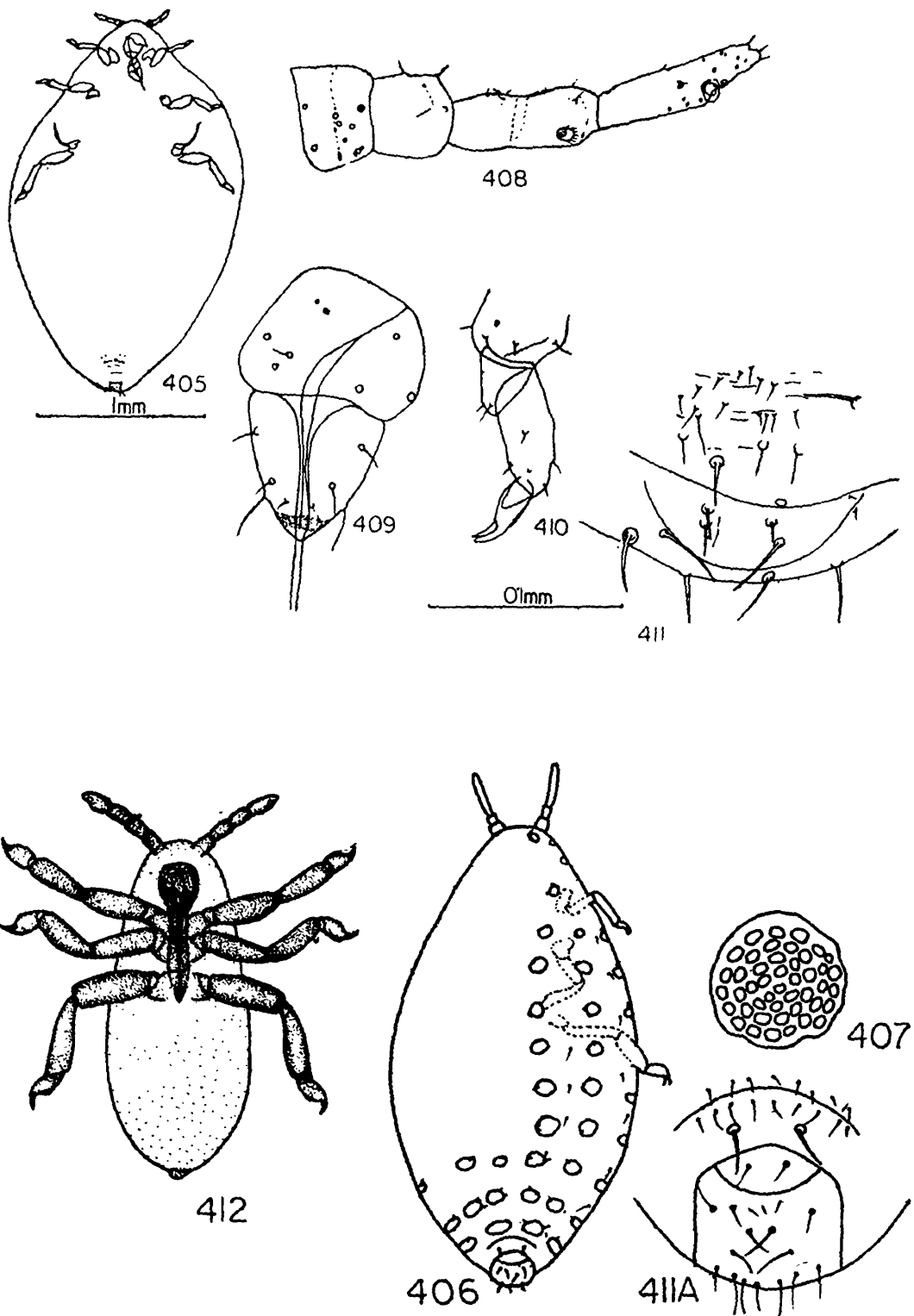
13. Genus *Aploneura* Passerini 1863
(Figs. 405-416)

1863. *Aploneura* Passerini, G., *Archiv. zool. anat. fisiol.*, 2 : 201, Type species : *Tetraneura lentisci* Passerini.
1896. *Rhizocyonus* Mokrzecky, S., *Trudy russk. ent. Obshch.*, 30 : 439. Type species : *Rhizoctonus ampelonus* Mokrzecky.
1906. *Tycheoides* Schouteden, H., *Mem. Soc. r. ent. Belg.*, 12 : 194. Type species : *Tychea eragrostidis* Passerini of Schoutiden nec Passerini 1860 = *Tetraneura tentisci* Passerini.

Morphology.—Body elongate, spindle shaped 1.5-3.0 mm. long. Antennae short, 4-5-segmented in apterae and 0.5-0.10 × as long as the body, 6-segmented in alatae, and upto 0.30 × as long as the body ; flagellum without any secondary rhinarium in apterae, with a single apical rhinarium on each of segment III and IV in alatae ; all rhinaria (primary and secondary) appear similar and ciliated ; hairs on the flagellum, short, fine 0.010-0.012 mm. long ; processus terminalis nearly 0.33 × as long as base of last antennal segment. Eyes three faced in apterae, large in alatae. Ultimate rostral segment short, with a pair of accessory wairs, about equal in length to the second segment of hind tarsus in apterae, and hardly exceeding 0.50 × as long as second segment of hind tarsus in alatae. Abdominal dorsum pale, without any distinct glands in apterae, and with 6 longitudinal row of large, multifaceted wax plates in alatae, but the latter except marginal ones may often be inconspicuous ; 8th tergite with a single median wax plate. Hairs on the dorsum of abdomen inconspicuous. Siphunculi absent. Cauda sclerotic, semilunar with hairs. Subgenital plate sclerotic with a number of (10-28) conspicuous hairs. Legs, long and slender in alatae, short and stout in apterae, sclerotic, never spinulose ; hairs on femora and tibiae fine ; first tarsal segments with 3, 3, 3 or 4, 4, 4 hairs. Empodial hairs fine, about 0.50 × as long as the claws.

Wings pale, media of forewing simple or once branched, cubitus and anal fused at base ; hind wings with one or two oblique veins. Wings are disposed flat at rest.

First instar larva elongate, with spinal, pleural and marginal wax plates ; antennae 4-segmented ; dorsal hairs sparse. 6-8 per segment.



Aploneura lentisci (Passerini);

Apterous viviparous female :

405. whole body ; 406. whole body (exules) ; 407. wax gland (exules) ;
 408. antenna (fundatrix) ; 409. ultimate rostral segment (fundatrix) ; 410.
 hind tarsus (fundatrix) ; 411. posterior portion of abdomen ; 411A.
 posterior portion of abdomen (exules).

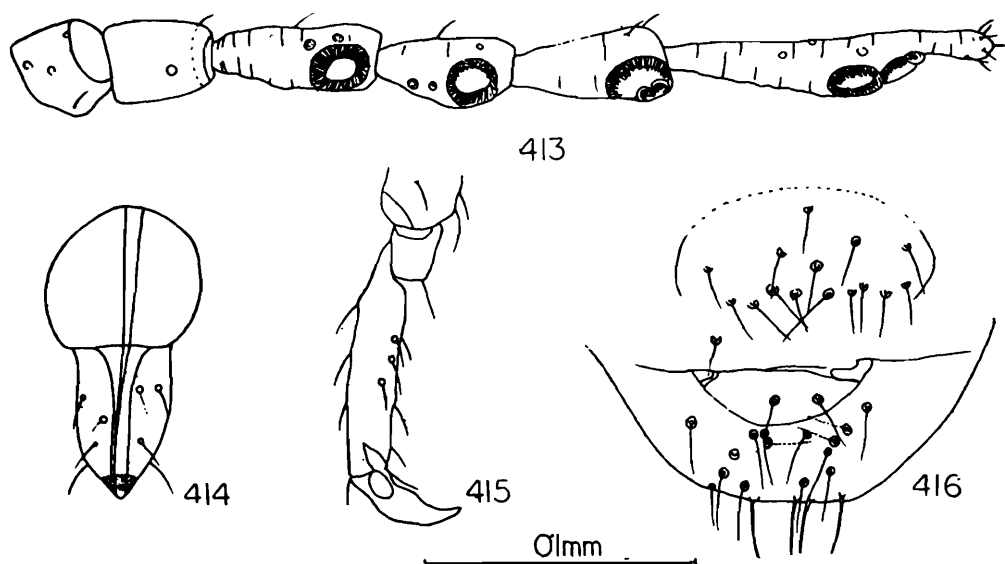
Alate emigrant :

412. first instar larva.

Discussion.—This is a small genus with three species, including *ampelina* (Mokrzecky) of *Rhizoctonus*, which has been tentatively considered as a synonym of *Aploneura* by Eastop and Hille Ris Lambers (1976). *A. lentisci* (Pass) is by far the most well known species and all the three species appear to be palaeartic in origin.

Biology.—The members of this genus are believed to be associated with *Pistacia* (Galls) as primary host and number of monocots (roots) as secondary hosts except *ampelina* Mokrzecky which has been recorded from Vine roots ; anholocyclic forms on grass roots or *Poa*, *Bromus*, *Triticum*, *Anthoxanthum* and *Dactylis* are more common and could easily be recognised by their yellow colour with a coating of white waxy secretion. On *Pistacia*, fundatrices produce bean shaped galls with opening on upper sides ; fundratigeniae are produced during August to October and sexuparae during March to June. Börner (1952), Zwölfer (1958) and Davatchi (1958) have given excellent accounts of the biology and Bodenheimer & Swirski (1957) have dealt with two of the three valid species. Mordvilko (1935) and Eastop (1966) have given description of the genus along with biological notes. Myrmecophily is unknown in this group.

Distribution.—Palaeartic region, AUSTRALIA and Southern parts of AFRICA.



Alate viviparous female :

413. antenna ; 414. ultimate rostral segment ; 415. hind tarsus ; 416. posterior portion of abdomen.

Type species.—*Tetraneura lentisci* (Passerini) 1856. Cottier (1953) and Zwölfer (1958) have given detailed description of *lentisci* and Eastop & Hille Ris Lambers (1976) have given complete synonymies. Location of type unknown.

49. *Aploneura* sp.

1975. *Aploneura* sp., Ghosh, A. K., *J. Bombay nat. Hist. Soc.*, 71 (2) : 205.

Alate viviparous female.—Body 1.65 long. Left antenna abnormal, the right has segments III-IV, 0.075, 0.064, 0.074, 0.120, 0.038 mm. long. Antennal segment III bears a small rhinarium in addition to the rigid apical rhinarium; antennal segment IV bears the usual apical rhinarium, that on V rather small 0.015-0.018 mm. inner and 0.020-0.025 mm. outer diameter. Ultimate rostral segment 0.089 mm. long and bears 2 accessory hairs. Hind tibiae 0.53 mm. long and second segments of hind tarsi 0.15 mm-0.16 mm. long, 8th abdominal segment bears 4 hairs. Cauda with 2 hairs. Abdominal segment 1-7 bearing small, paired, spinal and lateral wax plates.

Discussion.—The specimen was trapped at Kathmandu, Nepal, in Feb., 1966 by K. C. Sharma and has been deposited in the collections of British Museum (Nat. Hist.) London. Being on unique slide, it was not available on loan and the brief description given above was kindly sent by Dr. V. F. Eastop.

14. Genus *Asiphonella* Theobald 1923

1923. *Asiphonella* Theobald, F. V. *Bull. Soc. ent. Egypte*, 1922 : 76. Type species : *Asiphonella dactylonii* Theobald.

Morphology.—Body elongate oval. Head pale in apterae, dark sclerotic in alatae, with at least two wax gland groups in apterae and a pair of dorso-anterior group in alatae; dorsal cephalic hairs fine, flagellate. Eyes with 3 ommatidia in apterae and appears nearly pedunculate, normal and large in alatae. Antennae 6-segmented about 0.20-0.66× as long as the body; flagellum with distinct spinulose imbrications; secondary rhinaria absent in apterae, round to elongate oval in alatae, naked or distinctly ciliated and present on segment III and IV; primary rhinaria ciliated,

small, round in apterae, larger and often with islets in alatae ; hairs on the flagellum short, erect, at most $0.33 \times$ as long as the basal diameter of antennal segment III.

Antennal segment II in apterae equal to or longer than segment IV ; segment III in alate emigrants shorter or longer than the antennal segment VI ; processus terminalis $0.20-0.54 \times$ as long as the base of antennal segment VI and $0.25-0.66 \times$ (in apterae) and $0.20-0.37 \times$ (in alatae) as long as antennal segment III. Rostrum hardly reaches beyond mid coxae ; ultimate rostral segment short, stout or slender, $0.25-0.65 \times$ second segment of hind tarsus and bears at most 2 pairs of accessory hairs. Thoracic tergites with distinct wax gland groups at least on pronotum and metanotum. Abdominal dorsum pale, membranous with six longitudinal row of wax gland groups, arranged spinally, pleurally and marginally on 1st-6th tergites, 7th tergite with 4 wax gland groups in apterae and 6 in alatae, 8th tergite with one pair of gland groups in apterae and 2 pairs of large groups in alatae ; often wax glands may be very small and in alatae pleural glands may be hardly discernible and thoracic wax glands may be absent ; hairs on the dorsum of abdomen fine, $0.016-0.040$ mm. long. Spihunculi absent. Cauda brown, short, rounded with 2 short hairs. Cauda may appear to be united with anal plate, which when combined show a median suture. Subanal and subgenital plate each with 17-20 hairs. Legs brown, trochanters fused with femora ; femora and tibiae with faint to distinct spinulose ventral imbrications ; second tarsal segments with spinulose imbrications ; dorso apical hairs on second tarsal segments, short and acute ; empodial hairs $0.20-0.33 \times$ as long as the claws ; first tarsal segments with 4, 4, 4, 4, 4, 3 or 3, 2, 2 hairs. Forewings with pterostigma and subcosta dark brown, media simple ; hind wings with both obliques.

Sexuales are known for both the species of the genus and they appear alike to alate exules. Embryos within alate emigrants of *A. dactylonii* show 5-segmented antennae, very sparse dorsal hairs (4 on each thoracic and abdominal tergites), paired spinal, pleural, marginal wax gland groups on each of 1st-6th tergites, and spinal and pleural groups on 7 tergite (Remaudiere & Tao, 1957).

Discussion.—This is an interesting genus showing some atypical characters amongst Baizongini viz. 5-segmented antennae, small,

circular primary rhinarium, sparse dorsal hairs in new born and large triommdial eyes in apterae. Only two species are known in the genus. *Asiphonella dactylonii* Theobald, 1922 and *A. cynodontii* (Das, 1918).

Biology.—Both the species were first known to infest *Cynodon dactylon*, subsequently, it was found that *A. dactylonii* has *Pistacia sinensis* as primary host while for *A. cynodontii*, *Pistacia khinjuk* serves as the primary host, where they form leaf galls in the shape of “Cocks-crest” Das (1918) has mentioned that *A. cynodontii* reproduces parthenogenetically during October to May and forms malformation on grasses; he rightly suspected *Pistacia* as primary host but however failed to locate the exact species of *Pistacia*, which has been later described by Davatchi & Remaudiere (1957) in Iran. Unlike the case of *A. dactylonii*, which is reported to have produced matured galls in May on *P. sinensis*, *A. cynodontii* perhaps start to migrate to *P. khinjuk* only in May and galls mature at later months of August-September. Secondary hosts of *A. dactylonii* also include *Oplismenus*, *Compositus* and *Paspalum ciliata*.

Distribution.—INDIA, PAKISTAN, IRAN, EGYPT, CHINA, U.S.A.

Remaudiere and Tao (1957) have given an account of the genus and indicated the differences between two species so far known.

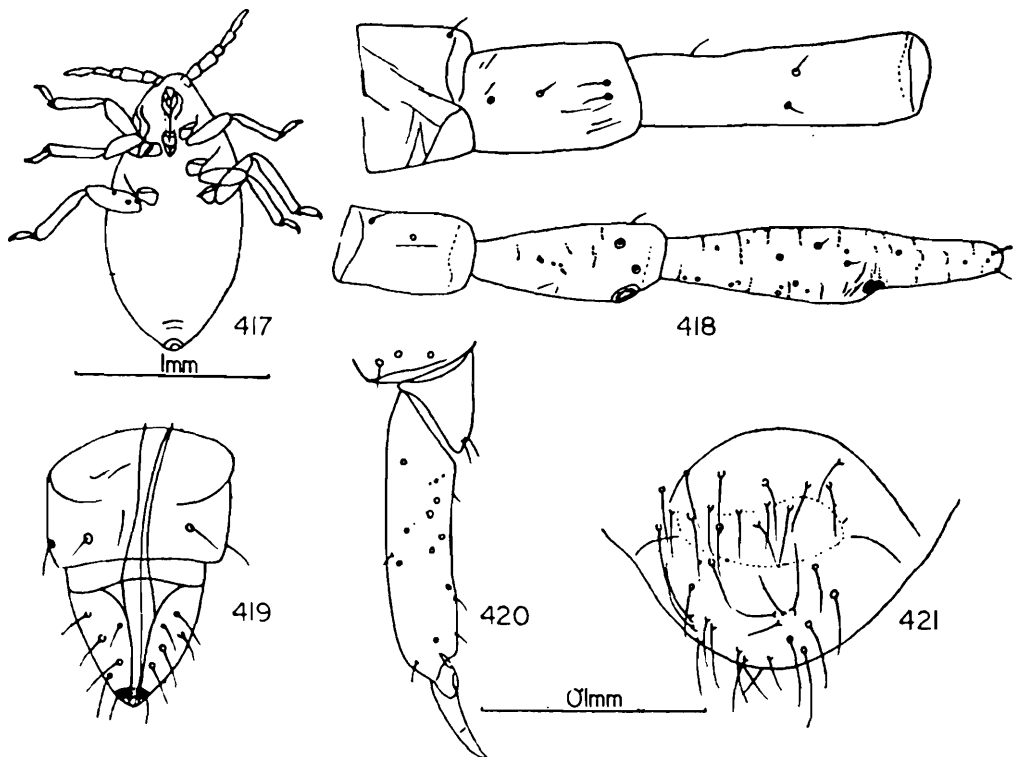
Type species.—*Asiphonella dactylonii* Theobald, 1922. Deposited in the collections of British Museum (Nat. Hist.), London.

50. *Asiphonella cynodonti* (Das)

(Figs. 417-428)

1902. *Pemphigus* sp., Rubaamen, Ew. H., *Zool. Jahrb. Abt. Syst. Geogr. Biol. Tiere*, **16** : 243-336.
1918. *Pemphigus* (?) *cynodonti* Das. B. D., *Mem. Indian Mus.*, **6** : 153.
1928. *Geoica cynodonti*, George, C. J., *J. Proc. Asiat. Soc. Beng.*, (N. S.) **23** : 40.
1957. *Asiphonella cynodonti*, Remaudiere, G. and Tao, C. C., *Revue Path. veg. Ent. agric. Fr.*, **36** (4) : 230.
1958. *Asiphonella cynodonti*, Davatchi, A. G., *Revue Path. veg. Ent. agric. Fr.*, **37** : 141.
1978. *Asiphonella cynodontii*, Raychaudhuri, D. N., Pal, P. K. and Ghosh, M. R., *Entomon*, **3** (2) : 240.

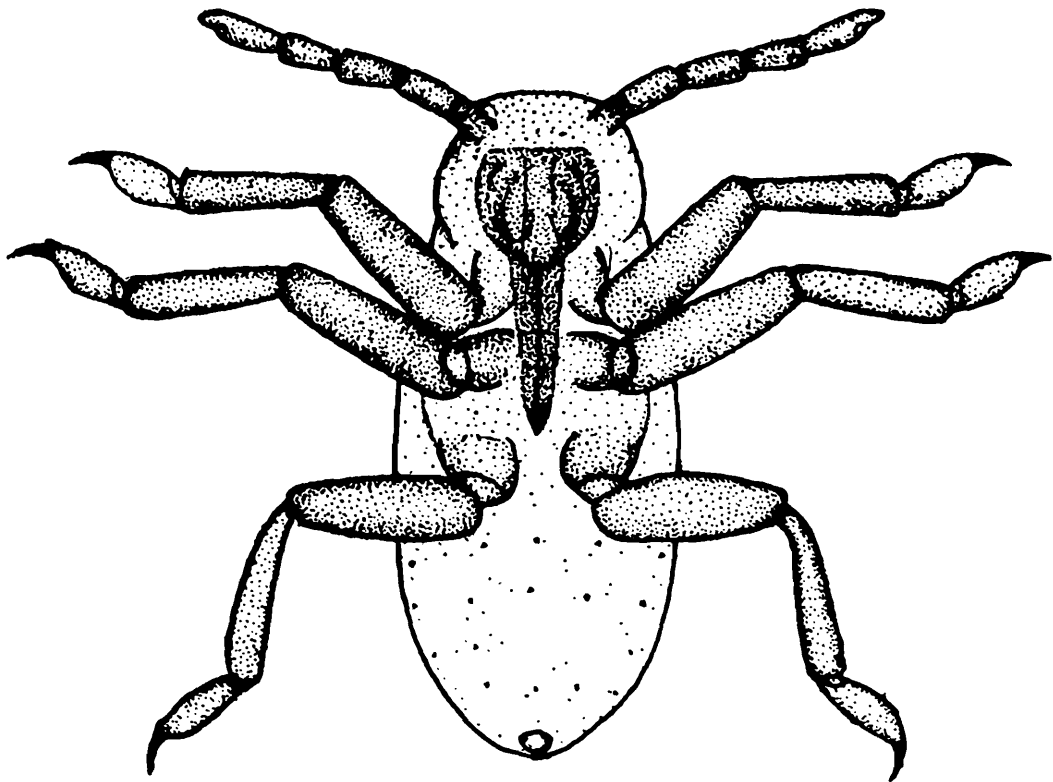
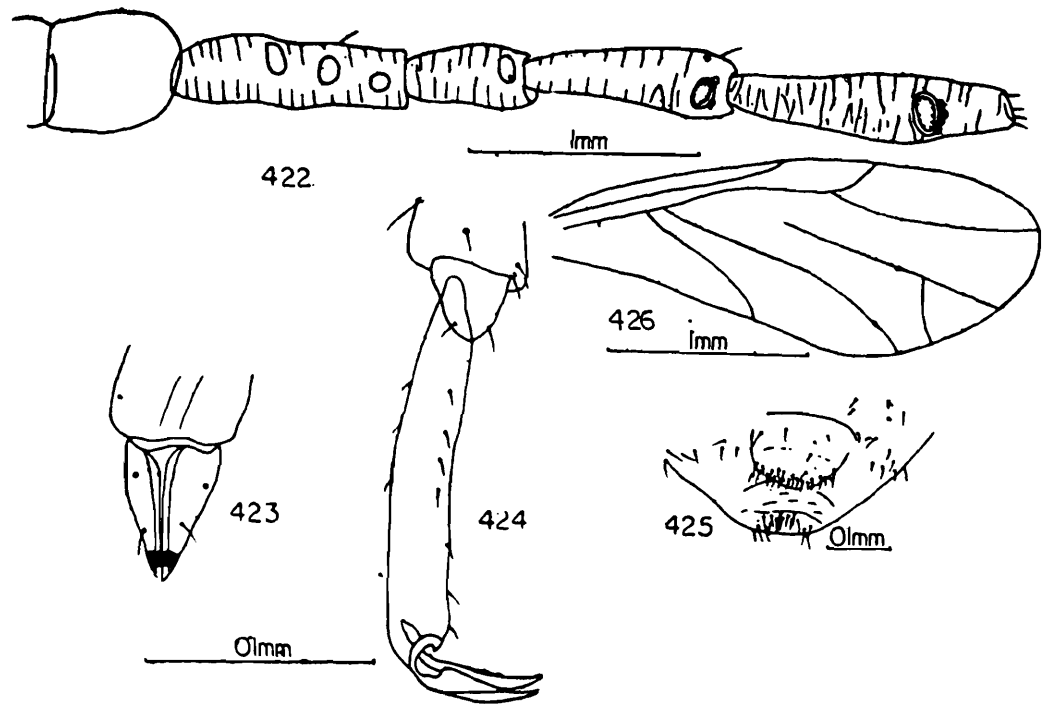
Apterous viviparous female.—Body pale, ovoid 1.5-2.0 mm. long. Head brownish, frons flat, with three pairs of round wax plates, each composed of single rimmed 20-30 cells of irregular shape and variable size ; cephalic hairs fine, $0.50-0.70\times$ as long as the basal diameter of the antennal segment III. Antennae slender, concolourous with the head, 6-segmented, $0.35-0.42\times$ as long as the body ; flagellum with spinular imbrications, which become denser apical ; hairs on the flagellum sparse, segment IV usually with 5-7 hairs, (0.006 to 0.010 mm), $0.15-0.40\times$ as long as the basal diameter of the segment, occasionally a few may be as long as $0.60\times$ the mentioned diameter ; segment V with a single, round, small apical rhinarium segment VI with a similar rhinarium besides 2-3 small satellite rhinaria ; primary rhinaria ciliated ; processus terminalis $0.44-0.50\times$ as long as the base of last antennal segment. Rostrum reaches mid-coxae, ultimate rostral segment stout, short, $0.40-0.50\times$ as long as second segment of hind tarsus, bearing 2 accessory hairs. Abdominal dorsum pale, bearing 6 longitudinal rows of wax-gland groups (spinal, pleural and marginal) on 1-7th



Asiphonella cynodonti (Das) ;

Apterous viviparous female (exules) :

417. whole body ; 418. antenna ; 419. ultimate rostral segments ; 420. hind tarsus ; 421. posterior portion of abdomen.

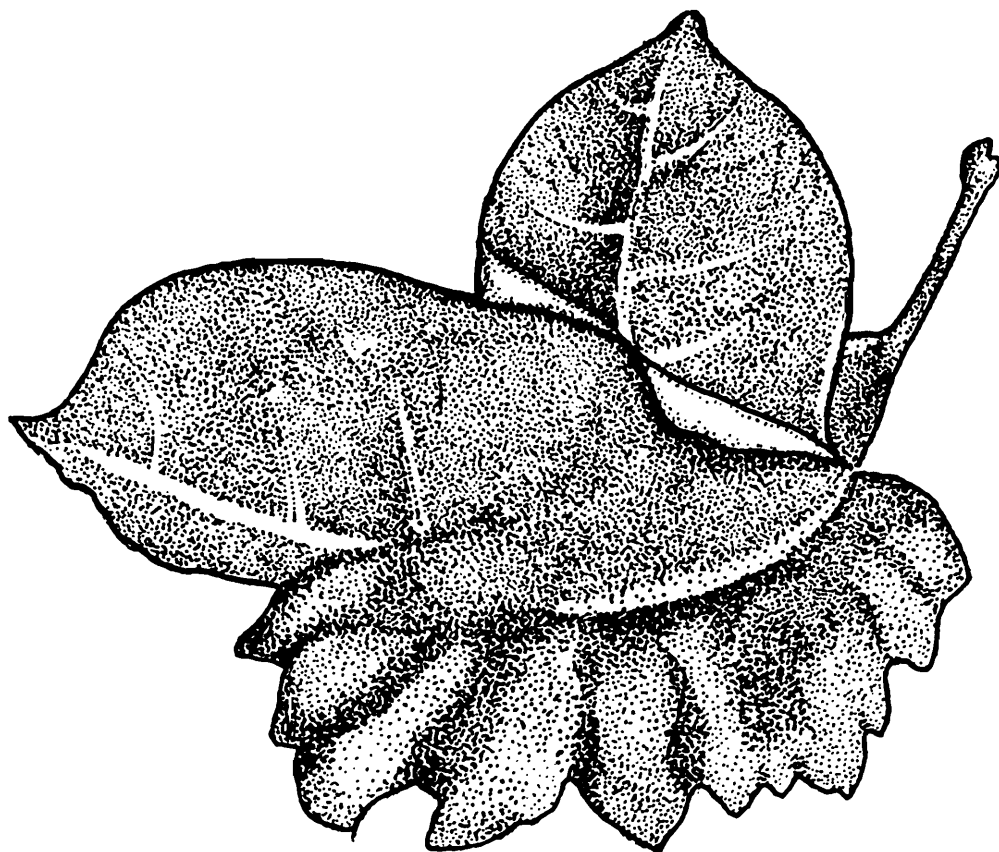


427

Alate viviparous female (emigrant) :

422. antenna ; 423. ultimate rostral segments ; 424. hind tarsus ; 425. posterior portion of abdomen ; 426. forewing ; 427. first instar larva of alate emigrant.

tergites ; those on 7th may contain as many as 35-40 cells ; all dorsal wax gland with double rims, occasionally these may appear indistinct ; hairs on the dorsum of abdomen sparse, straight with acute apices ; those on anterior tergites 0.013-0.020 mm. long, $0.30-0.53\times$ as long as the basal diameter of antennal segment III, on 8th tergite 0.026-0.030 mm. long, and $0.70\times$ as long as the mentioned diameter, sometimes a few may be $0.8-0.9\times$ as the mentioned diameter. Siphunculi absent. Cauda rounded, almost united with subanal plate, and bears 2 hairs ; subanal plates with about 20-22 hairs, longest one nearly equal to the basal diameter of antennal segment III. Subgenital plate with 18-20 hairs. Legs brown, trochanters fused with femora ; femora and tibiae with marginal spinular imbrications ; hairs on tibiae and tarsi, short sparse longest one on hind tibiae, 0.012-0.013 mm. long, and



428

Gall :

428. Leaf gall on *Pistacia khinjuk*.

0.23-0.26 × as long as the middle diameter of tibiae. First tarsal segments with 3, 3, 2 or 3, 2, 2 hairs ; dorso-apical hairs on second tarsal segments fine, usually longer than the longest hair on antennal segment III ; empodial hair very short, thick, 0.18-0.21 × as long as the claw.

Colour.—Dark to dirty green in life.

Measurements in mm. —

	Length	Width			Antenna	
1.	1.20	1.31			0.75	
2.	1.79	0.96			0.65	
3.	1.90	1.28			0.77	

Antennal Segments				urs.	ht ₂
III	IV	V	VI		
0.18	0.09	0.12	(0.15+0.07)	0.07	0.17
0.15	0.05	0.09	(0.12+0.05)	0.07	0.14
0.18	0.08	0.14	(0.15+0.07)	0.07	0.13

(1-3, ex. grass, Darjeeling district, INDIA, PLK 5897, 6087, 6052, Calcutta University collections).

Alate viviparous female (exules).—(from Das, 1918). Body ovoid 1.70-1.80 mm. long. Head blackish. Antennae segmented, segment III equal to segments IV+V taken together ; segment III with 10-13 irregular secondary rhinaria arranged in a row and segment IV with 2-3 similar rhinaria ; processus terminalis 0.25 × as long as base of segment VI. Rostrum short and thick, reaching midway between fore-and mid-coxae. Abdominal dorsum with paired spinal, pleural and marginal wax gland groups as in apterous exules but these appear smaller in size. Legs longer than in apterae. Cauda narrow ridge-like. Subanal plate rectangular, vertical, black. Wings large, cubital vein simple and obsolete on its basal part ; hind wings with both obliques.

Colour.—Dark green almost black and covered with nearly covering of wax.

Measurements in mm.—

Length	Width	Antennae		
1.70+1.80	0.70+0.80	0.85—0.95		
	Antennal segments			
III	IV	V	VI	
0.25	0.10	0.14	0.15+0.06	

Alate viviparous female (emigrant).—Head dark brown, frons with a distinct median suture. Antennae 6-segmented, 0.28-0.30× as long as the body, segment III and VI almost equal ; segment IV always shorter than segment V ; hairs on the flagellum short, sparse, hardly discernible ; flagellum with spinular imbrication ; secondary rhinaria ciliated, round to oval, 2-4 on segment III and usually a single apical one on segment IV ; these resemble the primary rhinaria on segments V and VI in having thick sclerotised margin ; processus terminalis 0.25-0.33× as long as the base of antennal segment VI and appears, almost truncated at apex. Rostrum short, ultimate rostral segment less stout than in apterae, 0.40-0.42× as long as the second segment of hind tarsus. Wax glands usually present on pronotum and metanotum. Abdominal dorsum pale ; hairs on dorsum of abdomen sparse, on anterior tergites 0.020-0.030 mm. long, 1.2-1.8 × as long as the basal diameter of antennal segment III, on 8th tergite 0.030-0.040 mm. long and upto 2.20× as long as the mentioned diameter. Abdominal tergites 1-7 with paired spinal and marginal wax-gland groups, which are mostly discernible marginally. Siphunculi absent. Cauda with 2 hairs. Subanal plate with atmost 19-20 hairs. Subgenital plate with about 22-24 hairs. Legs dark brown, longest hair on hind tibiae 0.013 mm. long, 0.36× as long as the middle diameter of the tibiae. First tarsal segments with 2 fine hairs and 1-2 short sensory spine.

Colour.—Not known.

Measurements in mm.—

	Length	Width	Antenna		
1.	1.79	0.82	0.55		
2.	1.93	0.96	0.55		
	Antennal segments			urs.	ht ₂
III	IV	V	VI		
0.12	0.07	0.10	(0.10+0.03)	0.07	0.17
0.14	0.06	0.09	(0.10+0.03)	0.07	0.16

(1, ex. *Pistacia khinjuk*, IRAN, 8.10.1956, (BMNH, 1958-34);
2. *Pistacia khinjuk*, IRAN, 17.9.1955, Z.S.I. collections).

Sexuales.—Not available for the present study.

Material examined.—Numerous apterae and nymphs from roots of *Cynodon dactylon* and other unidentified grass, Darjeeling, Musung, Tashiding, West Bengal, INDIA, 11.4.1972 to 30.5.1972, coll. P. R. Pal (Calcutta University collections) ; One alate emigrant from *Pistacia khinjuk*, IRAN, 8.10.1956, coll. Mirzain (Z.S.I. collections, 6810 H 7) ; Two alate emigrants from *Pistacia khinjuk*, Hun-i-Sor, IRAN, 17.9.1955, coll. G. Remaudiere, det. G. Remaudiere, (BMNH collection, 1958-34).

Discussion.—Das (1918) recorded this species from leaves of *Cynodon dactylon* growing in moist places in Lahore region (Pakistan) ; these insects are reported to live within pseudogall-like structures formed by hypertrophied leaves of lowest suckers of the plant and remain covered with long threads of 'iridescent gray flocculence' Mostly apterous viviparae were reported which first appear in October or November and reproduce throughout the winter till the month of March or atmost upto May, when they presumably migrate to some other host (now known from large Cocks-crest gall of *Pistacia khinjuk*). Coccinellid larvae (*Scymnus*), and Neuropteran and Syrphid larvae feed on these insects. Pal

(Ph.D., Thesis, 1975) mentions about its occurrence during April-June on aerial and subaerial parts of graminaceous plants including *Cynodon dactylon* at a depth of 0.88-2.54 cm., in moist sandy soil (c 6000-2000 m altitude) at Kalimpong, West Bengal.

Remaudiere and Tao (1957), while describing *Asiphonella dactyloni* Theobald, mentioned certain morphometric ratio of apterous exules of *A. cynodonti* (antennae : body 0.45-0.47 ; p.t. to antennal segment III, 0.25 : 0.36 p.t. to base of last antennal segment, 0.25 : 0.41) which, however, appear somewhat different in the Indian specimens from Darjeeling district (Raychaudhuri *et al.* 1978) and the species may be considered to have a wider range of morphological variations.

Distribution.—INDIA (West Bengal), PAKISTAN, IRAN.

Types.—Das (1918) designated no types for his species and his collections at the Zoological Survey of India do not contain any specimen of *Asiphonella cynodonti*.

15. Genus *Baizongia* Rondani 1848.

1848. *Baizongia* Rondani, C. *Nuovi Annale. Sci. nat. Bologna*, 9 : 35. Type species : *Aphis pistaciae* Linnaeus.
 1909. *Pemphigella* Tullgren, A. *Ark. zool.*, 5 : 171. Type species : *Tetraneura cornicularia* Passerini, errore pro *Pemphigus cornicularius* Passerini.
 1918. *Dasia* van der Goot, P. *Mem. Indian Mus.*, 6 : 152. Type species : *Pemphigus aedificator* Buckton.

Body oval 1.5-2.5 mm. long. Antennae little less than or upto 0.25 × as long as the body. 5 segmented in apterae, 6-segmented in alatae ; flagellum without any secondary rhinaria in apterae, with oval to transversely oval secondary rhinaria on segments III-V of alatae ; primary rhinaria distinctly ciliated ; hairs on flagellum short, fine ; processus terminalis finger shaped, 0.33-0.48 × as long as base of last antennal segment. Eyes small in apterae, well developed in alatae. Ultimate rostral segment short, triangular, without any secondary hair, in apterae 0.80 ×, and in alatae 0.50 ×, as long as the second segment of hind tarsus. Abdominal dorsum in apterae with a series of wax glands (4 rows), composed of a number of polygonal or circular cells. Hairs on

the dorsum of abdomen fine. Siphunculi absent, Cauda with some short setae. Anal plate large, rectangular, nearly vertical with about 10 long fine hairs arranged in two longitudinal rows. Rudimentary gonapophyses two in number. Legs short in apterae, slender in alatae ; hairs on tibiae and tarsi short, sparse ; first tarsal segments with 3 short sensillae and 2 fine acute hairs. Forewings with stigma dark, radial sector nearly straight, media simple ; hind wings relatively larger with both obliques.

Sexuparae have been described by Roberti (1939) ; first tarsal segments of sexuparae show 4 hairs and embryos within their abdomen show atrophied mouth parts.

Discussion.—Only one species *B. pistaciae* (Linn.) is known to be representing to genus ; Eastop and Hille Ris Lambers (1976) have included another species e.g. *paglianoi* (Gaumont) with a query mark under this genus. *B. pistaciae* has been described under five different names including *aedifactor* which was described by Buckton (1893) from this region. Doncaster (1969) has redescribed *aedifactor* and designated the Lectotype and paralectotype of the species. The emigrants of *Baizongia* as pointed by Davatchi (1958) are characterised by fusion of cauda with anal plate ; new born larvae of emigrants have one pair of spinul hairs and one pair of pleural hairs, on abdomen.

Biology.—Das (1918) has described the biology of *pistaciae* from Indian region under the name of *P. (?) aedifactor* (Buckt.). In Lahore region foliage buds of *Pistacia* could first be noticed in February and almost at the same time small tiny protuberances appear at the bases of leaflets. Each of these galls contain a single aphid which reproduces parthenogenetically and a number of generations are formed within the galls, which in turn grow to a very large size to harbour the colonies of aphids ; usually galls appear as straight or curved pod-like structures at the terminations of branches and are green or partly pinkish in colour. Aphid colonies within the galls remain covered by white waxy secretions. Galls mature in November and through a slit in ripe gall, alate fundatrigeniae leave the host plants. Das (op. cit), however, could not locate the secondary host of the species. It is now known that roots of various gramineae act as secondary hosts where apterous exules

are produced. Hille Ris Lambers (1957) has mentioned that an alate virginoparous exule was also noted by him a culture on *Agrostis stolonifera* which was attended by an ant species, *Lasius flavus* Linn.

The alate virginoparous exules appear similar to sexuparae but differ in having 3 hairs on first segment of tarsi and normal mouth parts in embryos contained in its abdomen.

The species is now known from both the host plants, viz. primary and secondary, in the Indian region but in palaeartic region of Europe, it is known to live anholocyclically on Graminae ; Hille Ris Lambers (1957) has indicated the probability of migration of alate fundatrigeniae from *Pistacia* galls in Mediterranean area over long distance and reproducing on Graminae in Western Europe. Das (1918) has also stated that C. F. Elliot first observed the swarms of aphids leaving *Pistacia* galls in November at Harnai (Baluchistan) at an altitude of ca 1000 m. ; these aphids may also take part in long range dispersal. A number of species of *Pistacia* including *P. khinjak*, *P. palestina*, *P. terebinthus* are now known to act as host plants.

Distribution.—Widely distributed in Mediterranean region and extend upto North India. Zwölfer (1957) recorded anholocyclic forms in Central Europe from roots of Graminae.

Type species.—*Aphis pistaciae* Linnaeus. Location of types not known Lectotypes of *aedificator* Buckton, and *formicina* Buckton, both being regarded as synonyms of *pistaciae* are in the collections of Zoological Survey of India, Calcutta and British Museum (Nat. Hist.) London, respectively.

51. *Baizongia pistaciae* (Linnaeus)

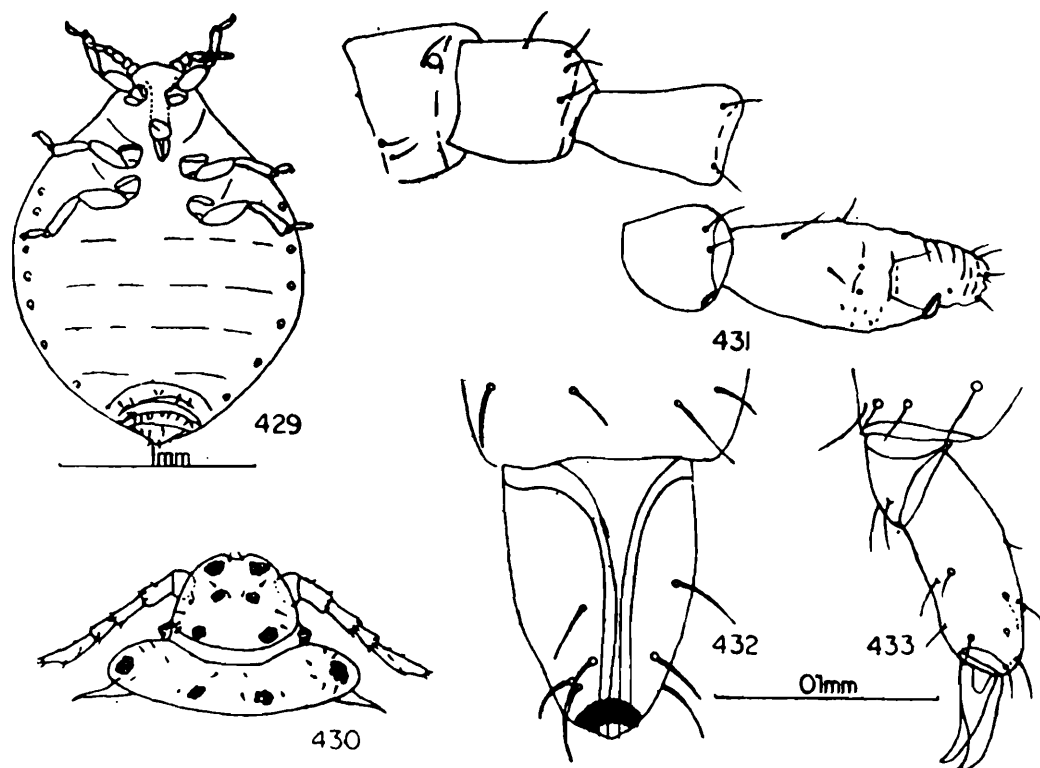
(Figs. 429-442)

1767. *Aphis pistaciae* Linnaeus, C. *Syst. Nat.*, XII, 3 : 737.
 1856. *Pemphigus cornicularius* Passerini, G., *Giardini G. Orticolt.*, 6 : 1-8.
 1880. *Pemphigus corniculoides* Lichtenstein, J., *Feuille Jeunes Natur.*, 10.
 1883. *Endeis formicina* Buckton, G. B., *Monograph of the British Aphids*, 4 : 91.
 1893. *Pemphigus aedificator* Buckton, G. B., *Indian Mus. Notes*, 3 : 71.

1918. *Dasia aedificator* ven der Goot, P., (in Das, B. D.), *Mem. Indian Mus.*, 6 : 144.
 1921. *Baizongia pistaciae*, Schumacher, F., *Zool. Anz.*, 53 : 281.
 1949. *Baizongia oestlundi* Hottes, F., *Pan-Pacif. Ent.*, 25 (2) : 86.
 1958. *Baizongia pistaciae*, Davatchi, A. G., *Revue Path. veg. Ent. agric. Fr.*, 37 : 133.
 1969. *Baizongia pistaciae*, Doncaster, J. P., *Proc. R. ent. Soc. Lond.*, (B) ; 38 (11-12) : 157.

Apterous viviparous female (Exules).—[Not recorded in the region. Description based on specimen from BMNH and Zwölfer, 1958.]

Body ovoid, 1.40-2.34 mm. long with 1.05-1.79 mm. as maximum width. Head and prothorax marginally separated from the rest. Head usually with 3 pair of spinal wax glands ; dorsal cephalic hairs sparse, shorter than basal diameter of antennal segment III. Antennae 5-segmented 0.33-0.43 mm. long, darker than dorsum of abdomen, 0.15-0.16 × as long as the body ; segment I, 0.043-0.060 mm., segment II, 0.049-0.073 mm., segment III, 0.060-0.071

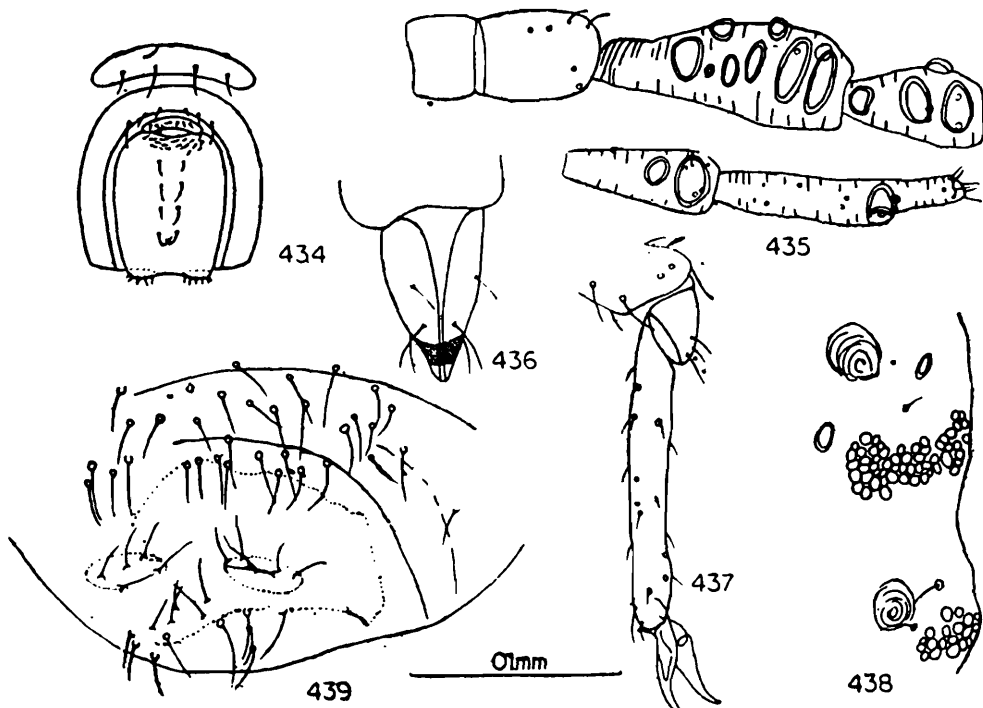


Baizongia pistaciae (Linnaeus) ;

Apterous viviparous female (exules) :

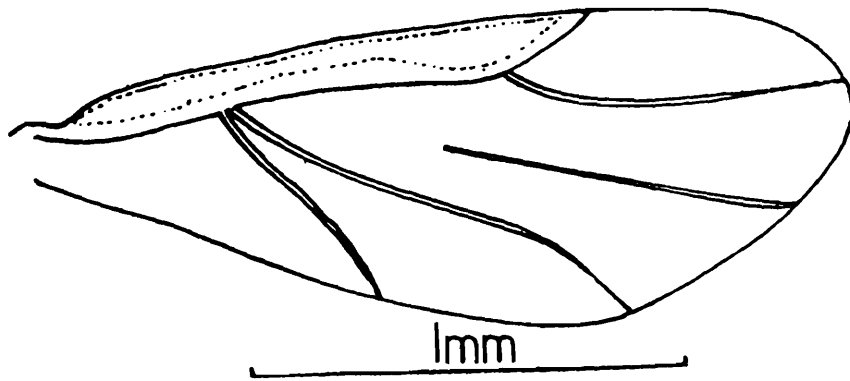
429. whole body ; 430. head capsule and prothorax of exules (from Zwölfer, 1958) ; 431. antenna ; 432. ultimate rostral segments ; 433. hind tarsus ;

mm., segment IV, 0.049-0.060 mm. and segment V, 0.110-0.140 mm. long ; flagellum nearly smooth ; hairs on flagellum sparse, not more than 3-4 in any segment, longest one on segment III, 0.02 mm. long, equal to the basal diameter of the segment ; primary rhinaria small, oval, ciliated ; processus terminalis short nearly $0.25 \times$ as long as base of last antennal segment. Eyes of triommatidia. Rostrum short and wide, 0.30-0.40 mm. long, reaching little beyond mid-coxae ; ultimate rostral segment stout, dark brown, $1.13 \times$ as long as second segment of hind tarsus and bears a pair of accessory hairs besides the preapicals. Prothorax with one marginal and one spinal pair of wax glands ; mesothorax, metathorax and 1st-6th abdominal tergites each with 3 pairs of wax gland plates viz. spinal on mid-dorsal, pleural and marginal, of which marginal wax-gland groups appear most well developed. Abdominal dorsum pale ; hairs on the dorsum of abdomen sparse, may or may not arise from wax-gland groups and marginal hairs appear to be longest than the others ; longest marginal hair on posterior tergites 0.08-0.120 mm. long and may be upto $4.0-5.0 \times$ as long as the basal diameter of antennal segment III. 8th tergite with about 6-8 hairs. Cauda with a few short hairs. Subanal plate

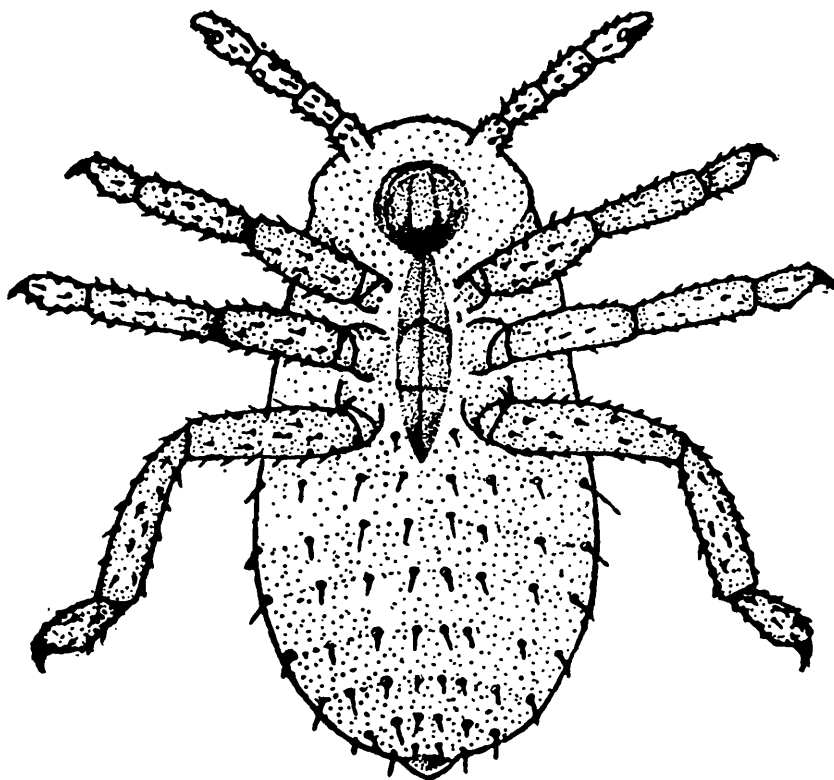


Alate viviparous female (emigrant) :

434. Cauda, anal plate and gonapophyses (from Zwölfer, 1958).
 435. antenna ; 436. ultimate rostral segments ; 437. hind tarsus ; 438. lateral wax gland groups ; 439. posterior portion of abdomen ;



440



441

Alate viviparous female (emigrant) :

440. forewing ; 441. first instar larva.

with 2 longitudinal rows of 6-10 long (0.060-0.120 mm.) hairs. Gonapophyses small, weakly sclerotised with 5-8 setae. Legs short, stout, trochanters fused with coxae ; hairs on femora and tibiae short, sparse (0.01-0.02 mm. long) ; first tarsal segments with 2, 2, 2 hairs ; empodial hair very short, hardly $0.20 \times$ as long as the claws ; dorso apical hairs on second tarsal segment, upto 0.026-0.028 mm. long.

Colour.—Dirty white to yellowish, covered with whitish grey, waxy flocculent substance (Zwölfer, 1958).

Measurements in mm. —

Length	Width	Antenna		
2.34	1.79	0.38		
	Antennal segments		urs.	ht ₂
	III	IV	V	
	0.08	0.06	(0.11+0.03)	0.14
				0.12

(ex. Grass roots, Herts, ENGLAND, 25.6.76, BMNH).

Larvae (first instar, exules) [from Zwölfer, 1958].—Body elongate, oval 0.90-1.10 mm. long with 0.40-0.60 mm. as maximum width. Head and prothorax brown. Antennae 4-segmented, setose, often the hairs may be longer than the diameter of the segment ; primary rhinaria ciliated. Rostrum reaches beyond hind coxae. Wax glands distributed as in apterae exules. Hairs on dorsum of abdomen 6-8 per segment, upto 0.060 mm. long, marginal hairs may be upto 0.100 mm. long. Subanal hairs short, only 2, perianal circle of hairs as in adult. First tarsal segments with 2, 2, 2 hairs.



442

Gall :

442. on *Pistacia khinjuk*.

Apterous viviparous female (fundatrigeniae).—Body ovoid, 1.50 mm. long with 0.70 mm. as maximum width. Head usually with 4 wax-gland plates, concolourous with the body. Antennae 5-segmented, short, stout, little over 0.20 to 0.25 × as long as the body ; segment III always longer than segment IV ; segment IV and V with ciliated apical primary rhinarium ; processus terminalis blun-tish, finger—shaped, nearly 0.50 × as long as the base of last antennal segment. Rostrum reaches near hind coxae ; ultimate rostral segment subequal or equal to the second segment of hind tarsi and bears 2 (according to Doncaster, 1969) accessory hairs. Dorsum of abdomen usually with 4 segmental wax-gland plates (not seen in the specimen examined) dorsal hairs fine, on anterior tergites 0.016-0.023 mm. long, on posterior tergites upto 0.030 mm. long. Anal plate vertical, elongate almost rectangular, with few (10 ?) hairs. Legs short ; first tarsal segment with at least 3-4 hairs including sensillae. (not discernible in the paratype).

Colour.—Bright yellow to yellowish orange (Das, 1918).

Measurements in mm. —

	Length	Width	Antenna				
1.	1.51	0.90 (?)	0.34				
2.	1.25	?	0.37				
	Antennal segments				urs.	ht ₂	
	I	II	III	IV	V		
	0.053	0.050	0.085	0.059	0.093	0.110	0.100
	0.050	0.052	0.075	0.060	0.130	0.100	0.125

(1, ex. *Pistacia*, Simla, INDIA, 12.7.1968, Calcutta University collections).

(2, ex. *Pistacia terebinthus*, Quetta, 16.11.1890, Z.S.I. collection, paratype of *aedificator*).

Nymph (early stage, apt. fundatrigeniae).—Body pale, membranous, about 1.10 mm. long. Antennae 5-segmented about 0.33 × as long as the body ; segment II longer than segment IV and almost equal to segment V ; primary rhinaria ciliated. Ulti-

mate rostral segment broad, about equal to second segment of hind tarsus and bears 2 accessory hairs. Dorsal hairs sparse, 0.010-0.020 mm. long, at most $0.50 \times$ as long as the basal diameter of antennal segment III. Subanal plate with about 10 hairs in two rows.

Colour.—Pale in life.

Measurements in mm. —

Length	Width		Antenna		urs.	ht ₂	
1.10	?		0.38				
	Antennal segments						
	I	II	III	IV	V		
0.040	0.040	0.083	0.040	(0.066+0.020)	0.096	0.096	

(ex. *Pistacia* sp., Simla, INDIA, 12.7.1968, Calcutta University Collections, No. 1950).

Alate viviparous female (emigrants).—Body elongate oval, 2.20-2.35 mm. long. Head narrow, with a distinct median suture; cephalic hairs short, sparse 0.013-0.016 mm. long, at most equal to the basal diameter of antennal segment III. Antenna 6-segmented, $0.25-0.34 \times$ as long as the body; segment III narrowed at base, with 3-6 transversely oval secondary rhinaria, segment IV with 1-3 similar rhinaria and V usually with one small rounded rhinarium which may be absent, besides the primary one; hairs on flagellum short, on segment III, 0.06-0.010 mm. long, $0.40-0.50 \times$ as long as the diameter at the constricted base of the segment; processus terminalis finger shaped, $0.33-0.40 \times$ as long as the base of antennal segment VI; primary rhinaria ciliated. Rostrum reaches little beyond fore-coxae, ultimate rostral segment $0.50 \times$ as long as second segment of hind tarsus and bears 0-2 accessory hairs. Abdominal dorsum with large transverse spinal, small pleural and large marginal wax gland groups on 1st-6th tergites; 7th tergite without any apparent spinal wax gland group. Hairs on the anterior tergites 0.010-0.013 mm. long, on posterior tergites

0.040 mm. long, these being $0.60-0.80 \times$ and $2.8 \times$ as long as the basal diameter of antennal segment III, respectively. 8th tergite with a brown sclerotic band and bears 4 hairs. Cauda with 4 hairs. Subanal plate with about 10 hairs. Gonapophyses two, each with 5 setae. Subgenital plate with about 35 setae. Legs slender, hairs on femora and tibiae sparse, acute, on hind tibiae upto 0.015 mm. long ; first tarsal segment with 2 fine hairs besides 2-3 sensillae. Forewings with media simple, cubital and anal fused at base ; radial sector gently curved at base ; pterostigma fuscous.

Colour.—Dull black or very dark green, (Das, 1918).

Measurements in mm. —

	Length	Width	Antennae		
1.	2.17	1.10	0.67		
2.	1.72 (?)	0.69 (?)	0.59		
3.	2.09	0.85	0.57		
				Antennal segments	
	III	IV	V	VI	urs. ht ₂
	0.16	0.11	0.12	(0.13+0.04)	0.10 0.20
	0.15	0.08	0.09	(0.11+0.04)	0.09 0.17
	0.15	0.08	0.04	(0.12+0.04)	0.09 0.17

(1. ex. *Pistacia* sp. Almora, INDIA, 25.10.1970, S. Chakrabartis collections ; 2. ex. *Pistacia terebinthus*, Provence, FRANCE, BMNH collections ; 3. ex. *Pistacia terebinthus* Quetta, PAKISTAN, 16.11.1890, Z.S.I. collections).

Larva (first instar).—Body pale. Antennae 5-segmented, stout, $0.37 \times$ as long as the body ; segment V equal to antennal segment III ; primary rhinaria ciliated ; processus terminalis nearly $0.33 \times$ as long as base of last antennal segment. Rostrum stout, short , ultimate rostral segment equal to second segment of hind tarsus and bears two accessory hairs. Wax gland group not discernible (appear clearly as elongated transverse, segmental spino-pleural group and marginal group on abdominal dorsum, at a later stage

with the development of wing-buds). First tarsal segments with 2-3 hairs. Other characters not discernible.

Measurement of one specimen in mm. —

Length		Width		Antenne			
0.82		?		0.32			
		Antennal segments				urs.	ht ₂
I	II	III	IV	V			
0.05	0.07	0.10	0.05	(0.07+0.03)	0.09	0.09	

(ex. *Pistacia* sp., Simla, INDIA, 12.7.1968, Calcutta University collections).

Sexual forms.—Not available.

Material examined.—34 alate nymphs and one apterous viviparous female from galls of *Pistacia* sp., Simla, Himachal Pradesh, INDIA, 12.7.1968, coll. A. N. Chowdhuri [Calcutta University Collections]; one alate fundatrigenia (Lectotype) from galls of *Pistacia terebinthus*, Quetta, PAKISTAN (labelled INDIA), 16.11.1890, coll. C. F. Elliot, det. J. P. Doncaster, [7282/H7, Zoological Survey of India collections]; two alate fundatrigeniae from *Pistacia terebinthus*, 9. 1906, IRAN, coll. & det. G. Remeudiere (No. 6806/H7, Zoological Survey of India collections); two alate fundatrigeniae from *Pistacia terebinthus*, Provence : FRANCE, coll. JPM Canon [373/73, BMNH collections]; one apterous exule from grass roots, Hampstead; Herts, ENGLAND, 25.6.76, coll. R. Paul, [R. P. 2007, BMNH collections]; 7 alate fundatrigeniae from galls of *Pistacia* sp., Dhakuri, Almora, Uttar Pradesh, INDIA, 25.10.1970 coll. & det. S. Chakrabarti [S. Chakrabarti's collections, Univ. of Kalyani].

Discussion.—Exules (not recorded in the region) are reported to feed on the roots of *Agrostis*, *Dactylus*, *Poa* etc. The root-inhabiting population have uniformity of character at morphometric level, in the length of marginal hairs. The gall inhabiting

colony on *Pistacia*, (which may have very large-size gall) may by very large and composed of fundatrix and fundatrigeniae and emigrants ; as many as more than 700 apterous fundatrigeniae and 12,000 alate emigrants besides several young larvae could inhabit one mature gall (Davatchi, 1957). In case of anholocyclic paracycle, as in Central Europe, the species overwinters in the nests of ants, *Lasius flavus* and young larvae migrate to roots of gramineae by end of March and population return to ant nest by the end of November. This cycle more or less coincides with the annual holocycle of the species, alternating between *Pistacia* (Feb—March to November) and roots of Graminae (November-February) as mentioned earlier (see under “Biology” of the genus).

The species is positively myrmecophilous and ants of genera *Lasius* (*flavus/niger*), *Solenopsis* (*fugax*) and *Tetramorium* (*caespitum*) are known to be associated with this species.

Different generations of *B. pistaciae* have been described by Das (1918) Mordvilko (1935), Roberti (1939) and Zwölfer (1958).

Distribution.—INDIA (Uttar Pradesh, Himachal Pradesh, Punjab); PAKISTAN, IRAN and other Mediterranean region, Central Europe, ENGLAND.

Type.—Location of Linnaeus’s types not known. Doncaster (1968) designated Lectotypes and Paratype from Buckton’s materia described as *aedificator*, now deposited in the collection of Z.S.I Calcutta.

16. Genus *Chaetogeioica* Remaudiere and Tao 1957

1957. *Chaetogeioica* Remaudiere, G. and Tao, C.C.C., *Revue Path. veg. Ent. agric. Fr.* 36 : 226. Type species : *Pemphigella foliodentata* Tao.

Morphology.—Head with distinct polygonal reticulation in apterae. Frons with a distinct median suture. Dorsal cephalic hairs long and fine. Antennae 5-segmented in apterae, 6-segmented in alatae, 0.17-0.35 × as long as the body ; last antennal segment spinulose ; secondary rhinaria absent in apterae, oval, protruberant and ciliated in alatae, usually present on segments III-IV but often

also on segments V and VI ; primary and accessory rhinaria ciliated ; processus terminalis at most $0.66 \times$ as long as base of last antennal segment ; hairs on the flagellum fine (0.04-0.12 mm.), always longer than and may be more than twice as long as the basal diameter of antennal segment III. Eyes three faceted in apterae, large in alatae, ultimate rostral segment shorter or longer than second segment of hind tarsus and bears 2-7 accessory hairs. Prothorax separated from head. Abdominal dorsum usually with small brown hair-bearing scleroites ; hairs on the dorsum of abdomen may be long, stout and arranged in rows (cf. *graminiphaga*) or thin, short and numerous (cf. *polychaeta*, *foliidentata*) and may be more than $4.0 \times$ as long as the basal diameter of antennal segment III ; 8th tergite with a sclerotic pigmented horse-shoes shaped band. Stigmapori large, on sclerotic plates. Siphunculi absent. Cauda small, semilunar. Subanal and subgenital plates each with a number of hairs (20 in *foliidentata*). Wax glands, in apterae, when present, placed marginally in sclerotic plates ; in alates, present spinally on pronotum and metanotum and marginally and spino-pleurally on abdominal tergites 1-7 ; marginal groups of abdominal wax glands appear more coherent ; spino pleural wax glands may be absent on 4-7. Gonapophyses large, with a rudimentary median gonapophyses each with about 12-14 hairs. Legs brown, sometimes sparsely spinulose ; trochanters ill defined ; hairs on tibiae and femora stiff ; first tarsal segments with 2 long fine hairs and usually with 2-3 short sensory spines, but one spine may be absent or 1-2 may be additionally present ; second tarsal segments with numerous hairs. Empodial hairs fine. Forewings with few small hairs on subcosta, media simple and anals united at base ; hind wings with two obliques.

Nymphs without any wax glands and bear only four pairs of hairs on each tergite, two of these pairs being very long and other two pairs being normal ; first tarsal segments of nymphs with only 2 hairs.

The genus is easily distinguishable, considering the alate emigrants, from related genera in having separated cauda and anal plate, which are otherwise united in most of the members of *Geocina* ; besides, the supplementary sensory spine on first tarsal segment, ciliated secondary rhinaria, rudimentary median

gonapophysis etc., also help to separate the genus from related genera. Remaudiere and Tao (1957), while erecting the genus, stated that absence of wax glands and presence of 4 pairs of hairs on each tergite and two hairs on first tarsal segments in the larvae of gonotype (*foliidentata*), separate the genus from related genera viz. *Geoica* Hart., and *Boctinasus* Theobald. Two new species under the genus have recently been described from India (Raychaudhuri, Pal and M. R. Ghosh, 1978) but in none of these species larvae have been described, which would have confirmed the observation of Remaudiere and Tao.

Biology.—*Chaetogeoica foliidentata* (Tao) has *Pistacia sinensis* as its primary host where it forms a sac-like elongate leaf-gall and its' secondary host was reported to be unknown. (Remaudiere and Tao 1957). Raychaudhuri, Pal and M. R. Ghosh (1978), however, reported two new species from Eastern India, both from Gramineous hosts, which apparently serve as secondary hosts for the members of this genus ; it is not clear whether the latter two species live anholocyclically throughout the year only on Graminae in Eastern India ; only a single vagrant alate of *foliidentata* was recorded from Sikkim, which, as also Darjeeling district, is known to have more than one species of *Pistacia* but this species has now been regarded under *C. graminiphaga*. A detailed study of aphids on *Pistacia* and Graminae in the region may provide data to understand the cycle of three species of *Chaetogeoica* in the region.

Distribution.—INDIA, CHINA, FORMOSA.

Type species.—*Pemphigilla foliidentata* Tao. Probably present in the collections of Taiwan Agricultural Research Institute Taipei, FORMOSA : Paratypes in the collections of a British Museum (Nat. Hist.) London and D. Hille Ris Lambers, Binnokom, THE NETHERLANDS.

Key to the species of *Chaetogeoica*

Apterous viviparous females :

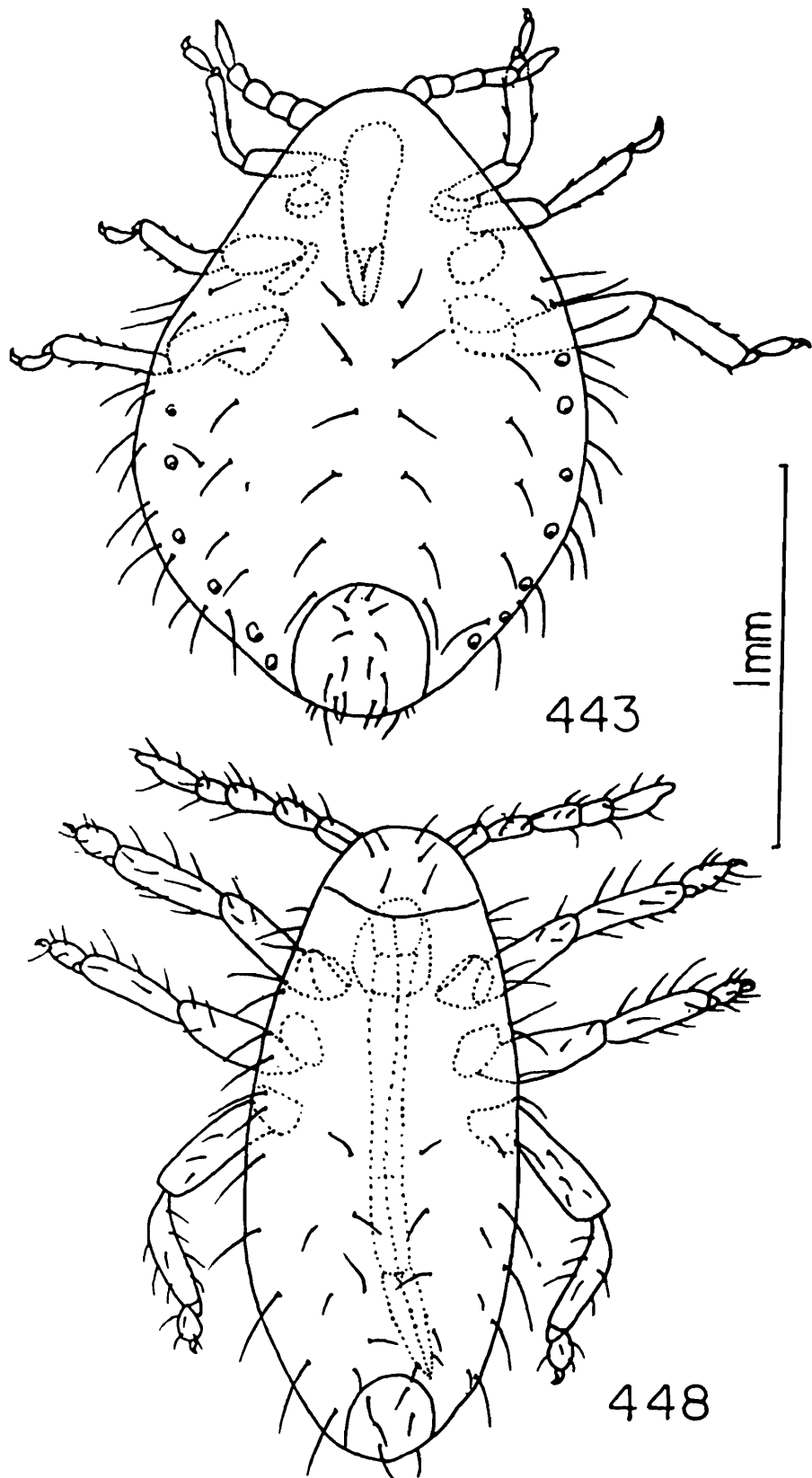
1. Body conspicuously pubescent (fig. 454).
Ultimate rostral segment 1.2-1.4 × as long as second segment of hind tarsus and bears 4 accessory hairs. Processus terminalis

- usually 0.28-0.33 \times as long as base of last antennal segment *C. polychaeta* Raychaudhuri *et al.*
- Body never pubescent as above (fig. 443). *C. graminiphaga* Raychaudhuri *et al.*
- Ultimate rostral segment 1.7-2.1 \times as long as second segment of hind tarsus and bears 5-6 accessory hairs. Processus terminalis 0.47-0.52 \times as long as base of last antennal segment

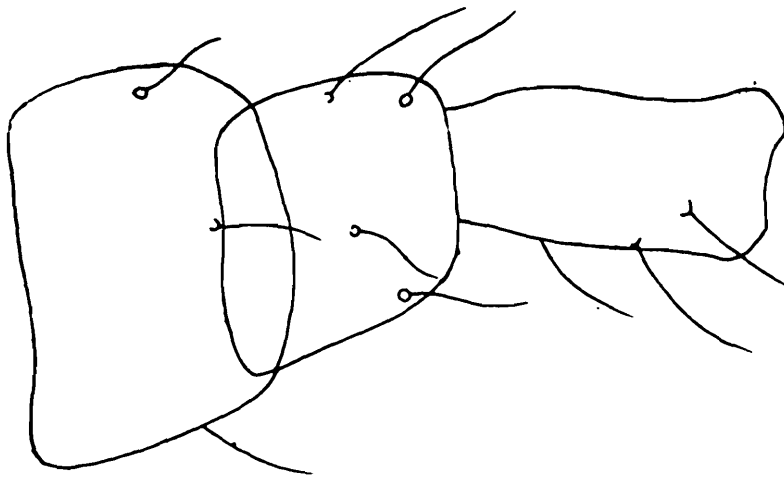
52. *Chaetogeoica graminiphaga* Raychaudhuri, Pal, M. R. Ghosh (figs. 443-453)

1968. *Chaetogeoica foliodentata*, Ghosh, A.K. and Raychaudhuri, D. N., *Proc. zool Soc., Calcutta*, 21 : 190 (Misidentification).
1978. *Chaetogeoica graminiphaga* Raychaudhuri, D. N., Pal, P. K. and Ghosh, M. R., *Entomon* 3 (2) : 242.
1980. *Chaetogeoica graminiphaga*, Raychaudhuri, D. N., Pal, P. K. and Ghosh, A. K., *Aphids of North East India and Bhutan*, 413.

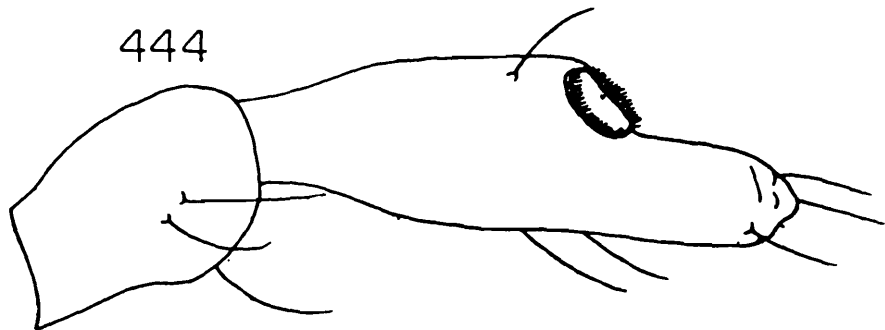
Apterous viviparous female.—Body globular, 1.79-1.86 mm. long. Forns with a reticulated sculpturing pattern and bears about 6 hairs, 0.05-0.07 mm. long. Antennae 5-segmented, usually 0.23-0.27 \times as long as the body, (sometimes may be considerably shorter); flagellum gradually more densely spinulose apicad; segment I, II and IV nearly subequal to one another and 0.60-0.65 as long as antennal segment III, which is usually equal to segment V (may be shorter, 0.70 \times); hairs on the flagellum sparse, longest one on segment III, 0.04-0.05 mm. long, upto 1.50 \times (2.60 \times) as long as the body; processus terminalis 0.47-0.52 \times as long as the base of last antennal segment and 0.34-0.36 \times as long as antennal segment III. Eyes 3 faceted. Rostrum reaches near mid coxae; ultimate rostral segment long, stout, about 1.7-2.10 \times as long as second segment of hind tarsus and bears 5-6 accessory hairs (2-6). Thoracic tergum variably reticulated and with irregular wax plates, distribution of which is not clearly discernible. Abdominal dorsum variably reticulated and with at least paired marginal wax-plates on 1st-7th tergites; hairs on the dorsum of abdomen sparse, on anterior tergites 0.04-0.18 mm. long, 1.4-5.7 \times as long as the basal diameter of the antennal segment III; longest hair on 7th tergite 0.16-0.17 mm. long and on 8th 0.13-0.15 mm. long, these being 5.0-5.7 \times (\times 3) and 4.4-4.5 \times (\times 3.35)



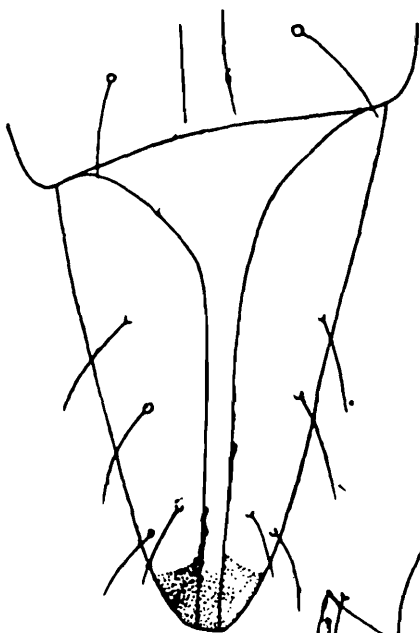
Chaetogeoica graminiphaga Raychaudhuri, Pal, M. R. Ghosh ;
Apterous viviparous female (from roots) :
443. whole body ; 448. young nymph.



444

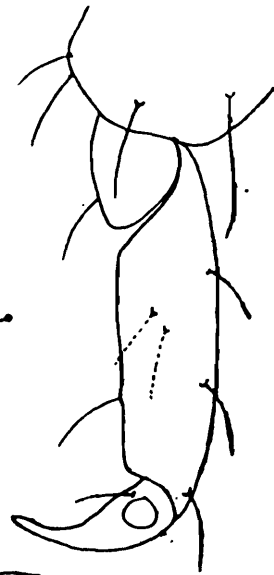


0.1mm

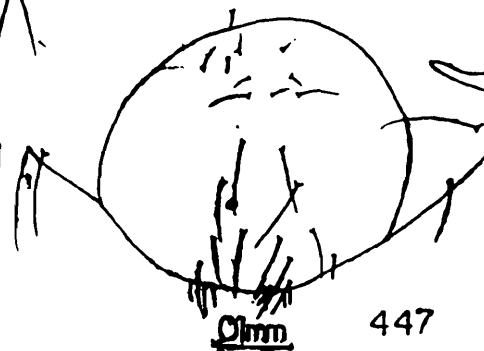


445

0.1mm



446



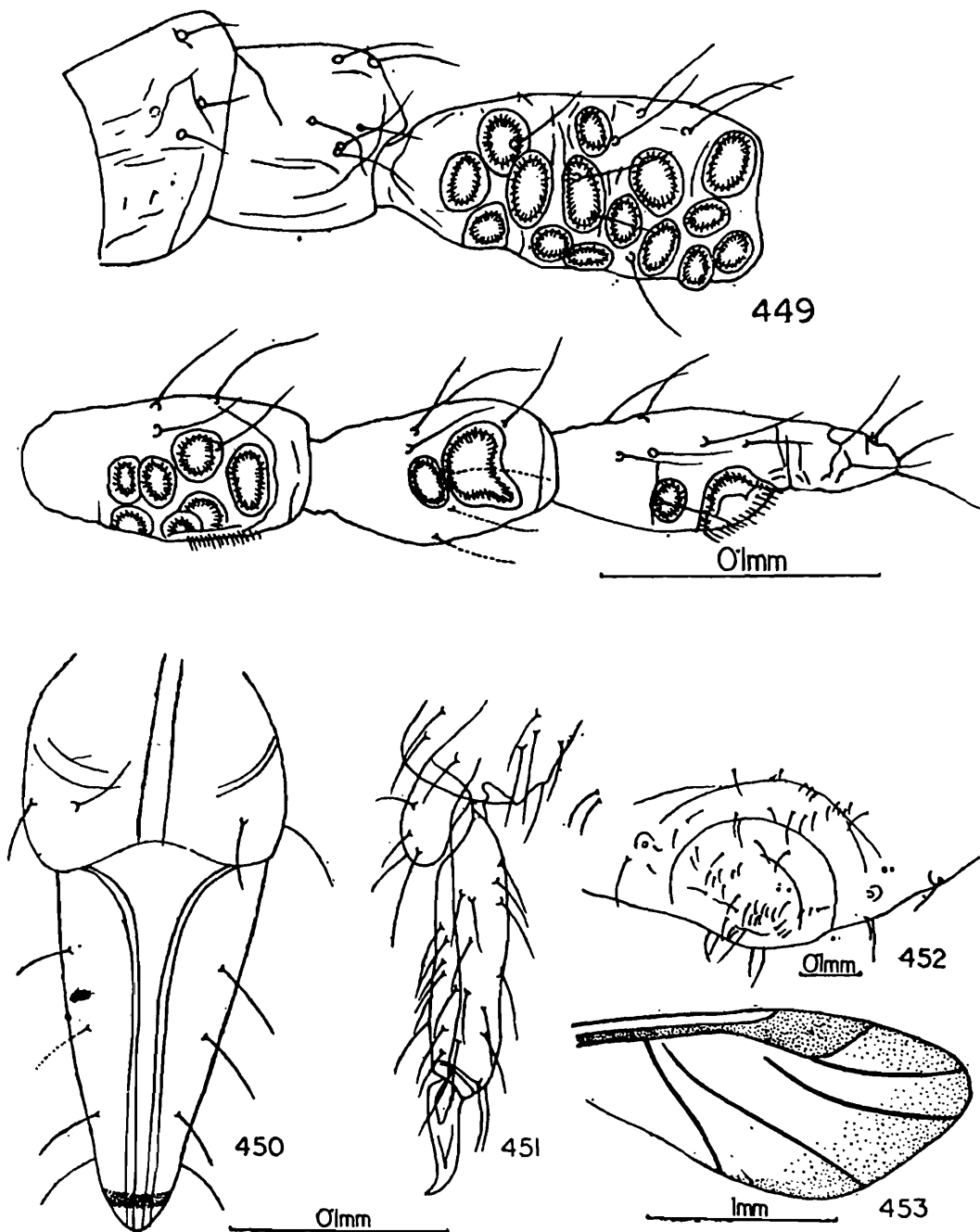
447

0.1mm

A pterous viviparous female (from roots) :

444. antenna ; 445. ultimate rostral segments ; 446. hind tarsus ;
447. posterior portion of abdomen.

as long as the mentioned diameter ; 8th tergite with about 8 (4 spinals and 2 pairs of marginal) hairs. Siphunculi absent. Subanal plate pale with about 20-22 hairs in two equal groups. Gonapophyses 2, (with an indistinct median one) each with about 6 fine hairs. Legs pale brown ; hairs on tibiae and tarsi sparse, longest hair on hind tibiae 0.06-0.07 mm. long. $0.95-1.0 \times$ as long as the diameter at the middle of hind tibiae ; first tarsal segments with 3, 2, 2 hairs.



Alate viviparous female (from roots) :

449. antenna ; 450. ultimate rostral segments ; 451. hind tarsus ; 452. posterior portion of abdomen ; 453. forewing.

Colour.—Orange to reddish in colour.

Measurements in mm. —

	Length	Width	Antenna
1.	1.79	1.24	0.43
2.	1.79	1.27	0.40
3.	1.86	1.47	0.45

III	Antennal segments			urs.	ht ₂
	IV	V			
0.11	0.06	(0.08+0.04)		0.20	0.11
0.11	0.06	(0.08+0.04)		0.20	0.10
0.11	0.06	(0.08+0.03)		0.21	0.10

(1, ex. Grass, Munsing, Kalimpong, INDIA, 16.11.1971, No. 4628, 2-3 ex. Grass, Munsing, Kalimpong, INDIA, 23.3.1972, No. 5823, Calcutta University collections).

Larva.—Body 0.82 mm. long with many long hairs. Antennae 5 segmented, $0.39 \times$ as long as the body ; segment I, II, III and IV almost subequal, segment V longest ; hairs on antennal segment III, 0.03-0.04 mm. long, $1.2-1.3 \times$ as long as the basal diameter of the segment ; processus terminalis $0.66 \times$ as long as base of antennal segment V and also of antennal segment II. Ultimate rostral segment $1.85 \times$ as long as second segment of hind tarsus and bears 8 accessory hairs. Wax gland cells hardly discernible. Marginal hairs on the dorsum of abdomen arising from strong sockets, those on anterior tergites 0.08-0.12 mm. long, on 7th and 8th tergites, 0.12-0.13 mm. long, these being $3.1-4.5 \times$ and $4.75-5.0 \times$ as long as the basal diameter of antennal segment III, respectively. Siphunculi absent. Subanal plate with 6 hairs. Legs stout ; longest hair on hind tibiae 0.04 mm. long, $0.65 \times$ as long as the middle diameter of the tibiae. First tarsal segments with 2, 2, 2 hairs.

Colour.—Apparently pale in life.

Measurements in mm. —

Length		Antenna					urs.	ht ₂
0.82		0.32						
		Antennal segments						
I	II	III	IV	V				
0.04	0.06	0.05	0.05	(0.06+0.04)		0.16	0.09	

(ex. Grass, Monsung, Kalimpong, INDIA, 16.11.1971, No. K. 4628, Calcutta University collections)

Alate viviparous females.—Body elongated oval, pale 1.8-2.42 mm. (1.45-2.30 mm.) long. Head brownish to brownish black with a distinct median suture, frons flat; dorsal cephalic hairs sparse (6-8), 0.04-0.05 mm. long, 1.7-2.0 × as long as the basal diameter of antennal segment III. Antennae 6-segmented, concolourous with the head, 0.26-0.28 × (0.25-0.35 ×) as long as the body; flagellum with spinulose imbrications; segment III with 16-18 (26), IV with 7-8 (13) and V with 0-3 (5), irregular, slightly protruberant, ciliated secondary rhinaria of variable sizes; primary rhinaria ciliated; hairs on the flagellum of variable lengths and with acute apices, those on segment III, 0.03-0.04 mm. long, 1.4-1.7 × (1.8-2.2 ×) as long as the basal diameter of the segment; processus terminalis stout, 0.46-0.50 × as long as the base of antennal segment VI. Rostrum reaches midcoxae, ultimate rostral segment long, stout, 1.2-1.4 × as long as the second segment of hind tarsus and bears 6-7 accessory hairs (0.06 mm. long). Thoracic dorsum without any apparent wax-gland groups. Abdominal dorsum pale to pale brown and with a brownish transverse sclerotic band on each of the 7th and 8th tergites; paired marginal wax gland groups and spino-pleural scattered wax gland cells present on 1st-7th abdominal tergites; hairs on the dorsum of abdomen arising from distinct sclerotic bases, usually segmentally arranged in a pair of spinal, two pairs of pleural and two pairs of marginal groups, those of spinal and marginal pairs distinctly longer; hairs on anterior tergites 0.05-0.09 mm. (upto 0.11 mm.) long and 2.0-4.0 × as long as the basal diameter of antennal segment III;

longest hair on 7th tergite 0.10 mm. (0.06-0.09 mm.) and on 8th tergite 0.08-0.10 mm. (0.07-0.09mm.) long, these being $4.2 \times (2.5-4.4 \times)$ and $3.5-4.0 \times (3.0-4.4 \times)$ as long as the mentioned diameter. 8th tergite usually with 6 hairs. Spiracles large, on brown sclerotic plates. Siphunculi absent. Cauda with 2 hairs. Subanal plate with about 12 long hairs. Subgenital plate with 23-25 (30) hairs. Gonapophyses 2, (+1) each with 8-9 short setae. Legs pale to dark brown, trochanters distinct from femora ; longest hair on hind tibiae 0.08-0.09 mm. long, $0.75-0.80 \times$ as long as the diameter at the middle of hind tibiae. First tarsal segments usually with 6, 6, 6 (6, 7, 7 or 7, 7, 7) hairs. Empodial hair short, upto $0.50 \times$ as long as the claws. Forewings with media simple, hind wings with both obliques ; all veins fuscous.

Colour.—Appear to be dark on life with conspicuous fuscous wing venation.

Measurements in mm. —

	Length	Width	Antenna
1.	2.42	1.24	0.69
2.	2.20	0.97	0.65
3.	2.42	?	0.65

III	Antennal segments			urs.	ht ₂
	IV	V	VI		
0.17	0.12	0.10	(0.10+0.05)	0.20	0.15
0.17	0.11	0.10	(0.10+0.05)	0.20	0.11
0.18	0.12	0.11	(0.09+0.05)	?	0.14

(1-3 ex. Grass, Munsung, Kalimpong, INDIA, 16.11.1972, Calcutta University collections, Paratypes).

Larva.—Not available.

Alate Emigrant and Apterous Fundatrigeniae.—Not known.

Sexual forms.—Not known.

Material examined.—Two alate viviparous female from roots of unidentified grass, Munsung, Darjeeling, INDIA ; 16.11.1972, Numerous apterous viviparous females and nymphs from roots of *Capillipicium parisflorum*, *Eleusine indica*, *Ischaemum* sp., and *Polygonum fugax* and unidentified grasses, Munsung, Darjeeling, West Bengal, INDIA, collected during 17.1.1972 to 22.5.1972 and 19.10.1972 ; 6 apterous viviparous female from roots of unidentified grass, Rimbik, Sikkim, INDIA, 20.4.1972 ; 2 apterous, viviparous females and nymphs from roots of unidentified grass, Kangelup, Manipur, INDIA, 4.4.1974, (all paratypes, in Calcutta University collections).

Discussion.—*C. foliidentata* (Tao) was recorded from a single alate collected in Sikkim. Subsequent collections from Eastern India including Sikkim indicate that Indian species is different from the Chinese one in the ratio of urs to ht_2 and number of secondary rhinaria. The exules apterae, differ from alatae in having a much reduced tarsal chaetotaxy. The apterae appear to be common during January to April on roots of various gramineae while alate are produced in late winter ; whether the species lives a anholocyclic life cycle on secondary host or migrate to *Pistacia* is not yet known. The root-feeding aphids form dense columns in the depth of 2.5-6.3 cm. (Pal, 1975, Ph.D., Thesis) and occur between 700-2000 m. It occurs in areas between Sikkim to Manipur in Eastern India.

Distribution.—EASTERN INDIA.

Types.—In the collections of Entomology Laboratory, Department of Zoology, University of Calcutta.

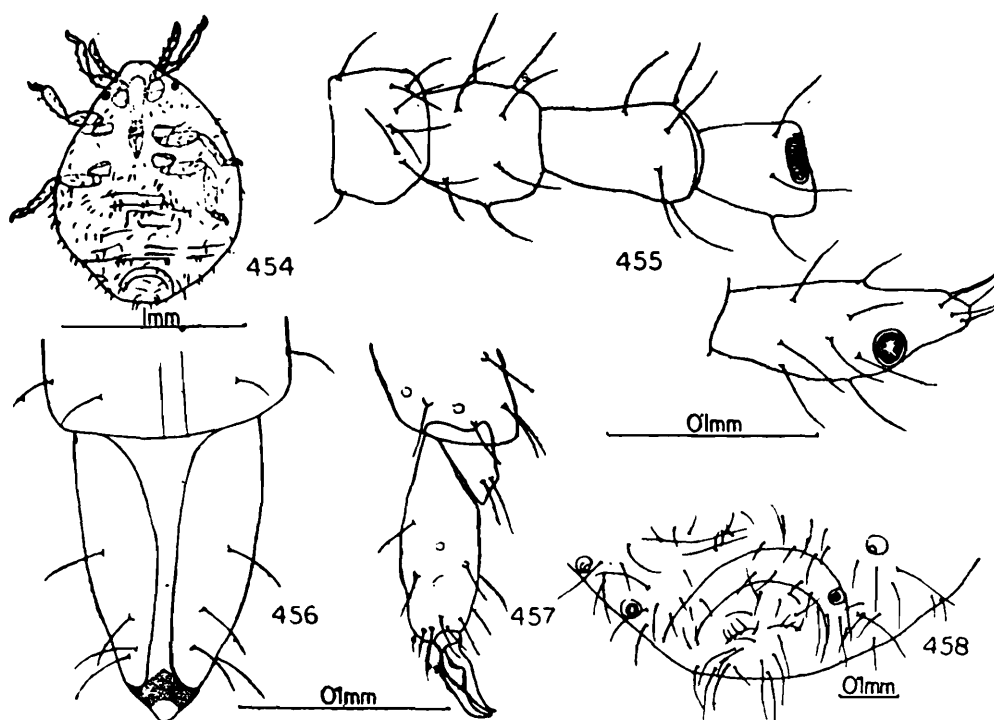
**53. *Chaetogeoica polychaeta* Raychaudhuri, Pal, M. R. Ghosh
(Figs. 454-458)**

1978. *Chaetogeoica polychaeta* Raychaudhuri, D. N., Pal, P. K. and Ghosh, M. R., *Entomon*, 3 (2) : 245.

1980. *Chaetogeoica polychaeta*, Raychaudhuri, D. N, Pal, P. K. and Ghosh, A. K., *Aphids of North East India and Bhutan*, 413.

Apterous viviparous female.—Body pale to pale brown almost globular, 1.50-2.30 mm. long, conspicuously pubescent. Head with

a reticulated pattern on the fons appearing as ill developed wax-plate ; dorsal cephalic hairs upto 0.06 mm. long, about $1.5 \times$ as long as the basal diameter of antennal segment III. Antennae 5-segmented, pale brown, $0.17-0.27 \times$ as long as the body ; segment I, II and IV subequal, segment V longest ; hairs on the flagellum, sparse, 3-5 on each of segments I-IV, on segment III usually 0.05-0.07 mm. long (sometimes upto 0.12 mm.), $1.1-1.5 \times$ as long as the basal diameter of the segment (sometimes upto $2.0 \times$) ; primary rhinarium oval and ciliated ; processus terminalis usually $0.28-0.33 \times$ ($0.50 \times$) as long as the base of antennal segment V. Rostrum reaches hind coxae, ultimate rostral segment stout, usually $1.20-1.40 \times$ ($1.60 \times$) as long as the second segment of hind tarsus and bears 4 accessory hairs. Thoracic tergites reticulated and with dense pubescence. Abdominal dorsum pale, reticulated ; each of 7th and 8th tergite with horse-shoe shaped brownish sclerotic band ; hairs on the dorsum of abdomen numerous, arising from distinct sockets ; marginal hairs in groups of 3-4 and longer than others ; hairs on the anterior tergites 0.05-0.14 mm. long, and $1.0-3.0 \times$ as long as the basal diameter of antennal segment III ;



Chaetogeoica polychaeta Raychaudhuri, Pal, M. R. Ghosh ;

Apterous viviparous female (from roots) :

454. whole body ; 455. antenna ; 456. ultimate rostral segments ; 457. hind tarsus ; 458. posterior portion of abdomen.

longest hair on 7th and 8th tergites, 0.13-0.15 mm. and 0.12-0.14 mm. long and $3.1-3.3 \times$ and $2.5-3.0 \times$ as long as the mentioned diameter, respectively. Siphunculi absent. Cauda with about 6-8 hairs. Gonapophyses 2, (+ ?I) each with about 6-7 hairs. Subanal plate with two longitudinal row of 6-7 fine hairs besides some (15) short hairs. Legs brown; hairs on femora and tibiae sparse; longest one on hind tibiae 0.06-0.07 mm. long, $0.75-1.0 \times$ as long as the diameter at the middle of the tibiae; dorsoapical hairs on second tarsal segments about equal to the claws, empodial hair short, about $0.50 \times$ as long as the claws. First tarsal segments with 2, 2, 2 (3, 2, 2) hairs.

Colour.—Creamy white to Pink in life (Pal, P. K., Ph.D. Thesis 1975).

Measurements in mm. —

	Length		Width	Antenna			
1.	1.65		1.28	0.38			
2.	1.82		1.44	0.44			
3.	1.93		1.52	0.48			
	Antennal segments				urs.	ht ₂	
	I	II	III	IV	V		
	0.05	0.06	0.09	0.07	(0.11+0.03)	0.16	0.11
	0.06	0.07	0.10	0.07	(0.11+0.04)	0.17	0.12
	0.08	0.07	0.10	0.08	(0.12+0.04)	0.18	0.14

(1, 2, 3 ex. *Oryza sativa*, Durbin, Kalimpong, INDIA, 13.12.1971, Calcutta University collections, Paratypes).

Larva.—Not available. Late stage apterous nymph resembles the adult in morphological and biometric characters.

Material examined.—Many apterae and nymphs from roots of *Oryza sativa*, and unidentified grass, Durbin and Kamshi, Darjeeling District, West Bengal, INDIA, 3.12.1971-11.2.1972 and 13.10.1972, 19.10.1972; 3 apterous viviparous female from roots of *Capillipidium* sp., Kamshi, Darjeeling District, West Bengal, INDIA, 3.12.1970; two apterous viviparous female from roots of *Cynodon*

dactylon, Morang, Manipur, INDIA, 12.4.1970 (Calcutta University collections).

Discussion.—The findings of exules apterae on the roots of *Oryza sativa* and other grass., again indicate the secondary host of *Chaetogeoica* but occurrence of only apterae limit the knowledge about the cycle and other morphs for the species which appear distinctive in the nature of its pubescence. It is known from a depth of upto 10 cm. and shows gregarious habit and positive myrmecophily.

Distribution.—EASTERN INDIA.

Types.—In the collections of Entomology Laboratory, Department of Zoology, University of Calcutta.

17. Genus **Forda** von Heyden 1837.

1837. *Forda* von Heyden, C., *Ent. Beitr Mus. senckenb.*, 2 : 291. Type species : *Forda formicaria* von Heyden.
 1841. *Rhizoterus* Hartig, T., *Z. Ent. (Germar)* 3 : 363. Type species : *Rhizotervacca* Hartig = *Forda formicaria* von Heyden.
 1896. *Pentaphis* Horvath, G. de., *Wien. ent. Ztg.* -5 : 2. Type species : *Forda marginata* Koch.
 1935. *Fordona* Mordvilko, A. K., *Ergebn Fortschr. Zoo.*, 8 : 141. Type species : *Fordona italica* Mordvilko = *Forda rotunda* Theobald.

Morphology.—Body oval ; head may be spinulose dorsally. cephalic hairs usually short, stout and with incrassate apices ; Antennae 5-segmented in both apterae and alatae, much shorter than the body ; flagellum smooth or somewhat stippled, segment III may be shorter or longer than last two segments taken together ; secondary rhinaria absent in apterae, subcircular to oval, and are present on segments III and IV and sometimes also on segment V, in alatae ; primary rhinaria without cilia, small to large and protruberant ; processus terminalis always much shorter than the base of antennal segment V ; hairs on the flagellum distinct, short, sometimes numerous or very few. Eyes, in apterae of 3 facets, in alatae well developed. Ultimate rostral segment stout, elongate, usually with a number of accessory hairs and at least equal to the length of second segment of hind tarsus. Mesothoracic furca with separate arms. Abdominal dorsum may be densely spinulose or

feebly so ; wax glands never evident but dorsum may be stippled ; 7th and 8th tergites with dorsal sclerotic bands ; dorsum of abdomen in alatae may bear dusky bands on all segments ; hairs on the dorsum of abdomen sparse or numerous, short and with incrassate apices, those on 7th and 8th tergites distinctly longer ; spiracles large, on sclerotic plates. Siphunculi absent. Cauda semilunar with many hairs. Subanal plate entire. Subgenital plate slightly indented, bearing many long, fine, hairs. Legs smooth on margin, may be stippled over dorsal surface and spinulose ventrally at least on basal segments ; tibiae and tarsi may be densely pubescent or with usual hairs ; first tarsal segments with 6 hairs ; dorso-apical hairs on second tarsal segment fine ; empodial hair fine, at least $0.66 \times$ as long as the claws. Forewings with media simple, hind wings with both obliques.

Discussion.—More than 40 species have been described under the genus and currently only 8-9 are recognised as valid species (Eastop and Hille Risshambers, 1976). Many new species were described from the apterous forms living in subterranean condition and often in ants' nests, which later turned out to be synonyms of one of the few valid species. The taxonomy of the genus still remains far from satisfactory till the life cycles of the species are fully studied and different morphs (exules, fundatrix, emigrant, sexuparae etc.) are known. Only two species including an endemic one are recorded from the area, both of which appear to lead anholocyclic life cycle in the region.

Biology.—Some species of *Forda* are only known from graminaceous plants (secondary hosts) or from *Pistacia* (primary host), while others are known to have a complete cycle alternating between the above hosts. Davatchi (1958) listed six species *formicaria* von Heyden, *hirsuta* Mordvilko, *kaussarii* Davatchi & Rem (now considered as a probable synonym of *orientalis* George, by Eastop and H.R.L., op. cit.), *marginata* Koch, *riccobonii* (Stephens) and *sichangensis* Rem & Tao, which are known to live on *Pistacia* and recognised by three distinct types of galls produced by these species, one with a hairy felt (*formicaria*) others without hairy felt but may be with one lobe (*kaussarii*, *marginata*, *sichangensis*) or many lobes (*hirsuta*, *riccobonii*) ; he also correlated three distinct types of morphological alate emigrants to these three types of galls ;

all the six species listed above are now accepted as valid species (except for *kaussari*) and the remaining species of the genus are known only from their secondary hosts (e.g. *dactylidis* Börner, which is remarkable due to numerous facets of eyes in apterae, and *rotunda* Theob. etc.). The primary hosts include *Pistacia khinjuk*, *P. mutica*, *P. sinensis*, *P. terebinthus* and *P. vera* while an array of gramineae and cyperaceae like *Agropyrum*, *Agrostis*, *Bromus*, *Carex*, *Cyperus*, *Poa*, *Triticum* etc. serve as secondary hosts. Galls produced on *Pistacia* may appear as moon-shaped flat bubbles which occur due to folding up of edge of the leaf or as small marginal fold and may sometimes be arranged in several rows. Bodenheimer & Swirski (1957) have mentioned that in case of some species (e.g. *formicaria* Heyden, *riccoboni* Stefani) Fundatrix form temporary galls and first generation of fundatrigeniae form permanent galls, within which a second generation of apterae fundatrigeniae followed by a third generation of alate fundatrigeniae are produced ; alatae migrate the roots of gramineae and produce secondary viviparae ; sometimes small summer population may be found on roots in ants nest (e.g. *formicaria* Heyden). Subterranean forms which live in the roots of gramineae may often be found in ants nests, specially in the nests of *Formica* and *basius*.

Distribution.—Mostly in Palaearctic region and Middle-East and also in some Nearctic and oriental areas. Börner (1952) has given account of Central European species, and Davatchi (1958) has elaborately dealt with the 6 gall forming species of the genus.

Types species.—*Forda formicaria* von Heyden 1837. Location of type not known.

Key to the species of *Forda*

Apterous viviparous female :

1. Flagellum smooth or rough on margins ;
processus terminalis at most 0.33 × as long
as the base of last antennal segment ;
ultimate rostral segment with 10-12 accessory
hairs ; subgenital plate with 35-40 hairs

—Flagellum rough over the surface ;
processus terminalis upto 0.46 × as long as base
of last antennal segment ; ultimate rostral

segment with 11-20 short, fine, hairs ; sub-genital plate with 25 short, fine hairs *.marginata* Koch

2. Marginal hairs in groups of 6-9 on each of abdominal tergite ; 8th tergite with 15-16 hairs ; empodial hair more than half as long as the claws *.orientalis* George

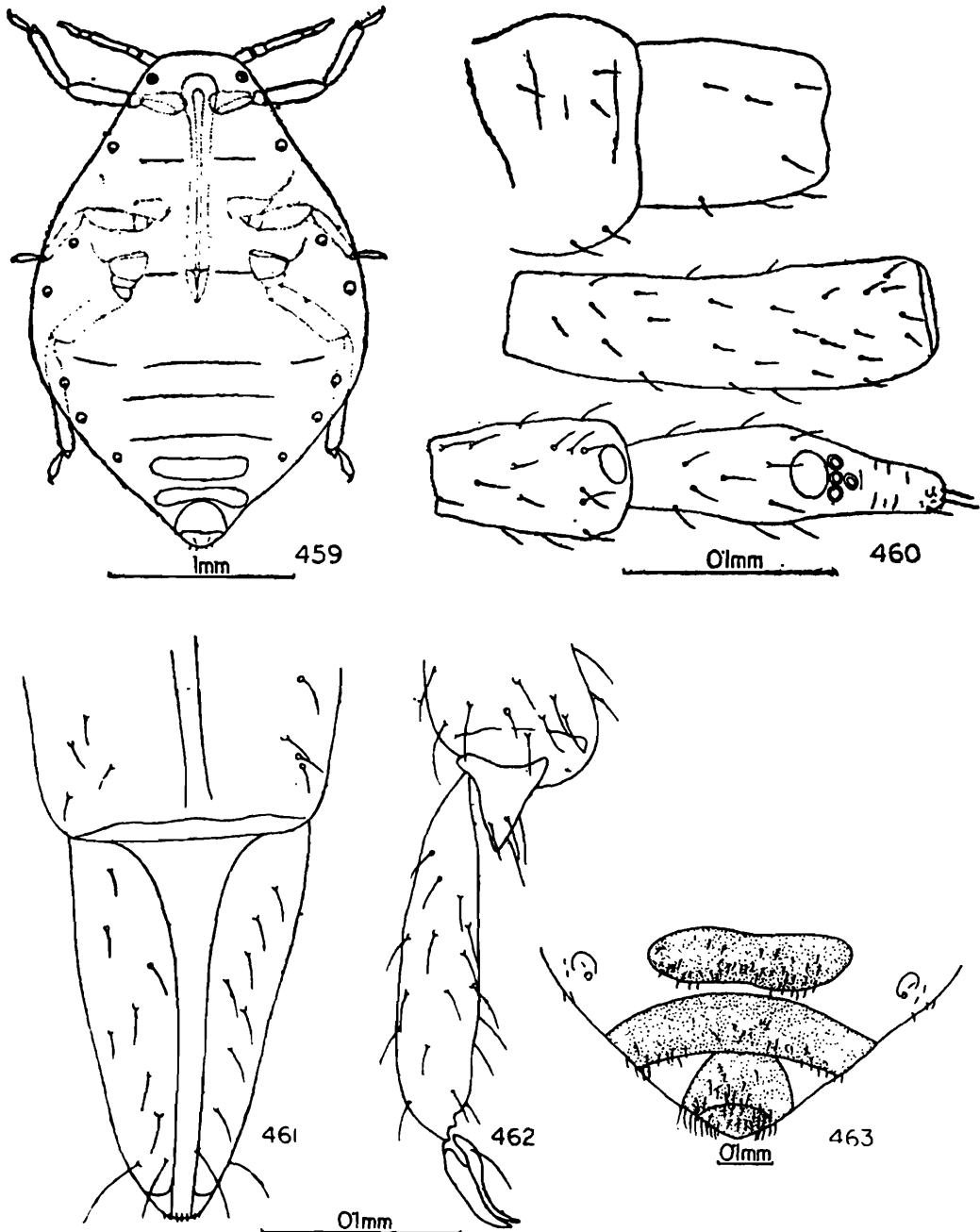
—Marginal hairs in groups of 35-36 ; 8th tergite with 22-25 hairs ; empodial hair $0.33 \times$ as long as the claws *.riccobonii* (Stefani)

54. *Forda marginata* Koch (Figs. 459-463)

1857. *Forda marginata* Koch, C. L., *Die Pflanzentanz Aphiden*, : 237.
 1860. *Tychea trivialis* Passerini, G., *Gli afidi*, Parma, 40.
 1913. *Forda trivialis*, Lombardi, D., *Boll. Lab. Zool. gen. agr., Portici*, 7 : 149.
 1939. *Forda trivialis*, Roberti, D., *Boll. Lab. Ent. agr. Portici*, 3 : 58.
 1976. *Forda marginata*, Eastop, V. F. and Hille Ris Lambers, D., *Survey of the World's Aphids*, 200.
 1978. *Forda trivialis*, Raychaudhuri, D. N., Pal, P. K., Ghosh, M. R. *Entomon*, 3 (2) : 246.
 1980. *Forda trivialis*, Raychaudhuri, D. N., Pal, P. K., Ghosh, A. K. *Aphids of North East India and Bhutan*, 416.

Apterous viviparous female (exules).—Body pale, 3.04-3.45 mm. (1.85-3.65 mm.) long. Head dorsally spinulose with some stout, short, cephalic hairs, longest one being 0.02-0.025 mm. long, about $0.35-0.38 \times$ as long as the basal diameter of antennal segment III. Antennae brownish, 5-segmented, usually $0.21-0.29 \times$ ($0.17-0.25 \times$) as long as the body ; flagellum rough on surface ; hairs on the flagellum short, on segment III 0.01-0.02 mm. long, $0.23-0.38 \times$ ($0.042 \times$) as long as the basal diameter of the segment ; processus terminalis $0.45-0.46 \times$ as long as base of last antennal segment, (sometimes it may be $0.30-0.40 \times$) ; primary rhinarium small, circular, non-ciliated. Rostrum reaches near hind coxae, ultimate rostral segment $1.0-1.20 \times$ as long as second segment of hind tarsus and usually bears 11-20, short fine hairs. Thoracic tergum faintly stippled. Abdominal dorsum pale, with faintly stippled transverse bands on 7th and 8th tergites ; hairs on the dorsum of abdomen sparse, minute, with subacute apices, on anterior tergites 0.01-0.02 mm. long, $0.23-0.38 \times$ as long as the basal diameter of antennal segment III, longest hair on 7th tergites 0.03-0.04 mm. long and

on 8th tergite 0.05-0.06 mm. long, these being $0.71-0.84 \times (1.25 \times)$ and $1.07-1.30 \times (1.45 \times)$ as long as the mentioned diameter, respectively. Siphunculi absent. Cauda semilunar, with many long stout hairs. Subanal plate entire with about 35 hairs of various length. Subgenital plate with about 25 short, fine hairs. Legs



Forda marginata Koch. ;

Apterous viviparous female (exules) :

459. whole body ; 460. antenna ; 461. ultimate rostral segments ; 462. hind tarsus ; 463. posterior portion of abdomen.

smooth marginally, brown, somewhat, stippled dorsally and spinulose ventrally, at least on basal segments ; longest hair on hind tibiae 0.03 mm. long, $0.40-0.45 \times$ as long as the diameter at the middle of the tibiae. First tarsal segments with 6, 6, 6 (7, 7, 7) hairs. Empodial hair 0.02-0.03 mm. long $0.28-0.33 \times$ as long as the claws (Figures within parenthesis from Raychaudhuri, *et al.* 1978).

Colour.—Greenish pink to yellowish pink in life.

Measurements in mm.—

	Length	Width	Antenna
1.	3.45	2.10	0.73
2.	3.10	2.12	0.76
3.	3.04	2.07	0.66
4.	3.10	2.07	0.74

Antennal segments				urs.	ht ₂
III	IV	V	IV		
0.24	0.09	0.18	(0.13+0.06)	0.24	0.20
0.23	0.09	0.16	(0.13+0.06)	0.24	0.20
0.24	0.10	0.16	(0.12+0.05)	0.23	0.20
0.24	0.14	0.18	(0.13+0.06)	0.24	0.20

(1, 2 ex. unidentified grass, Munsung, Darjeeling, INDIA, 27.4.1972, No. K. 5913, 3, ex. unidentified grass, Kalimpong, INDIA, 20.3.1972, No. K. 5811, 4, ex. *Imperata arundinacea*, Kalimpong, INDIA, 24.5.1972, No. K. 6074, Calcutta University collections).

Nymph.—Body pale 0.89 mm. long with stout hairy antennae and legs. Antennae 5-segmented, $0.35 \times$ as long as the body ; flagellum nearly smooth with long flagellate hairs, those on segments IV and V conspicuously longer than the ones on segment III ; hairs on segment III upto 0.03 mm. long, on VI upto 0.05 mm. long, these being $0.66 \times$ and $1.2 \times$ as long as the basal diameter of antennal segment III ; processus terminalis long, slender, $0.55 \times$ as long as base of antennal segment V and with 5 apical and subapical hairs,

0.011-0.020 mm. long. Rostrum long, stout, ultimate rostral segment $1.30 \times$ as long as the second segment of hind tarsus and bears at least 13 hairs. Abdominal dorsum pale, with distinct segmentation, somewhat spinulose ; hairs on the dorsum of abdomen short, on anterior tergites, 0.006 mm. long, and on posterior tergites, 0.013 mm. long, these being nearly $0.17 \times$ and $0.33 \times$ as long as the basal diameter of antennal segment III, respectively. Siphunculi absent. Cauda semilunar with many fine hairs. Subanal plate entire, sclerotic. Legs long, stout, pubescent ; longest hair on hind tibiae 0.04 mm. long, $0.66 \times$ as long as the diameter at the middle of hind tibiae ; First tarsal segments with 4, 4, 4 hair, Empodial hairs, fine, 0.04 mm. long, upto $0.83 \times$ as long as the claws.

Colour.—Pale in life.

Measurements in mm.—

Length	Width	Antenna		
0.89	?	0.49		
	Antennal segments		urs.	ht ₂
	III	IV	V	
	0.16	0.07	(0.09+0.05)	0.18
				0.14

(ex. Grass, Durbin, Kalimpong, INDIA, 22.6.1972, No. K 6120, Calcutta University collection).

Alate viviparous female.—(Not recorded in the region ; description based on Zwölfer, 1958). Body 2.14-2.60 mm. long. Antennae 5-segmented ; hairs on the flagellum short, 0.004 mm. long, segment III with 12-18, IV with 1-2 and V with 0-1, narrow secondary rhinaria ; primary rhinaria on IV and V large, irregular. Abdominal dorsum with segmental transverse sclerotic areas, which developed into wider bands on 4th-8th tergites ; dorsal hairs short. Gonapophyses 2, indistinctly developed, each with 3-4 curved hairs.

Colour.—Head and prothorax and margin of body brownish black ; abdomen olive green.

Measurements in mm.—

Length	Antenna	Antennal segments			Rostrum	hind tibia
		III	IV	V		
2.14	0.63	0.29	0.10	0.127	0.60	0.72
2.60	0.72	0.32	0.12	0.134	0.72	0.84

Other morphs.—Not available.

Material examined.—One apterous viviparous female and several nymphs, from *Triticum vulgare*, Kalimpong, INDIA, 19.2.1972 (K 5720) ; Two apterous viviparous females from Grass, Kalimpong, INDIA, 20.3.1972 (K 6811) ; Four apterous viviparous females from Grass, Munsung, Kalimpong, INDIA, 27.4.1972 (K 5913) ; Three apterous viviparous female from *Imperata arundinaceae*, Kalimpong, INDIA, 24.5.1972 (K 6074) ; Three apterous viviparous females from Grass, Tashiding, Kalimpong, INDIA, 25.5.74 (K 6079) ; Two apterous viviparous nymphs from Grass, Durbin, Kalimpong, INDIA, 22.6.1972 (K 6120), (all colls. P. K. Pal, Calcutta University collections).

Discussion.—The species was originally described from Italy. It leads a holocyclic life in Mediterranean region but mostly anholocyclic in other parts of Europe and Central Asia. The cycle involves alternation between galls of *Pistacia terebinthus* and *Pistacia palestina* and roots of a number of graminaceous hosts. This species has recently been recorded only from secondary hosts in Darjeeling district of West Bengal, and appears to be common on the roots of *Eragrostis uniloides*, *Eragrostris nigra*, *Imperata arundinacea*, *Triticum vulgare* and a number of other grasses between January to June, at an altitude of 1000-2000 m. These insects are reported to form large colonies at a depth between 1 cm.-8 cm. on roots, in sandy loam soil (Pal, P. K. 1975) and are always associated with ants. Roberti (1939) Zwölfer (1958) have redescribed the species, including apterous, alate and larval morphs. Zwölfer (1958) has discussed at length the morphological variability, and biology and also mentioned its association with 7 species of ants of genera *Lasius*, *Tetramorium*, *Myrmica* and *Solenopsis* of which

Lasius flavus was found to be the most common visitor ; only once a population was found to be parasitised by *Aphidius* sp.

Distribution.—INDIA (West Bengal) ; ISRAEL, LEBANON, SYRIA, TURKEY, CENTRAL ASIA, EUROPE.

Types.—Location of types not known.

55. *Forda orientalis* George
(Figs. 464-468)

1924. *Forda* sp. George, C. J., *J. Asiat. Soc. Bengal (N. S.)*, 20 : 308.
1927. *Forda orientalis* George, C. J., *J. Asiat. Soc. Bengal, (N. S.)*, 23 : 10.
1935. *Forda ussuriensis* Mordvilko, A., *Ergebn. Fortschr. Zool.*, 8 : 170.
1957. ? *Forda kaussarii* Davatchi, G. A. and Remaudiere, G., *Rev. Path. veg.*, 36 : 165.
1958. *Forda hirsuta*, David, S. K., *J. Bombay nat. Hist. Soc.*, 55 (5) : 112.

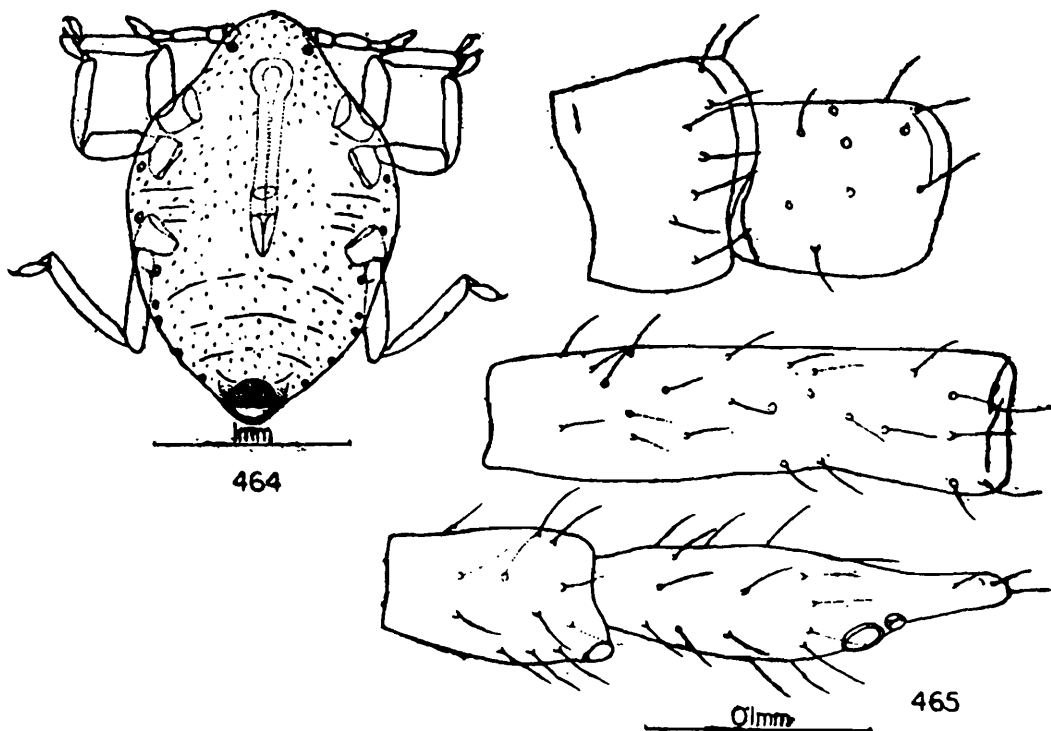
Apterous viviparous female.—Body 2.76-3.32 mm. long with 1.94-2.48 mm. as maximum width. Head and pronotum distinctly spiculose, yellowish brown ; dosal cephalic hairs stiff, fine, 0.020-0.023 mm. long, hardly $0.38 \times$ as long as the basal diameter of antennal segment III. Antennae 5-segmented, concolourous with the head, $0.26-0.27 \times$ as long as the body ; flagellum nearly smooth stippled only along the margin, segment III longest ; hairs on the flagellum stiff, conspicuous, on segment III, 0.02-0.04 mm. long, $0.37-0.68 \times$ as long as the basal diameter of the segment ; primary rhinaria round to oval, naked, processus terminalis slender, nearly $0.33 \times$ as long as the base of segment V. Eyes of 3 facets, placed on a sclerotic plate. Rostrum long stout, reaches hind coxae, ultimate rostral segment $1.04-1.09 \times$ as long as second segment of hind tarsus and bears 10-12 sccessory hairs. Abdominal dorsum pale, very finely spinulose ; 7th tergite with a broken, brownish sclerotic band, 8th tergite with a solid sclerotic band ; hairs on the dorsum of abdomen somewhat arranged segmentally, with 8-10 hairs on spino-pleural region and 6-9 hairs on each of the segmental marginal group ; 8th tergite with 15-16 hairs ; hairs on anterior tergites 0.02-0.04 mm. long, $0.42-0.71 \times$ as long as the basal diameter of antennal segment III, on posterior tergites 0.03-0.05 mm. long, $0.71-1.14 \times$ as long as the mentioned diameter. Spiracles on large sclerotic plates. Siphunculi absent. Cauda brown, sclerotic

semilunar with about 20 hairs. Subgenital plate brown, sclerotic, spinulose with 35-38 hairs. Subanal plate brown sclerotic with a number (?) of hairs. Legs brownish yellow ; hairs on femora and tibiae fine, longest one on hind tibiae 0.04 mm. long, $0.6 \times$ as long as the diameter at the middle of the tibiae ; first tarsal segment with 7, 7, 7 hairs; empodial hair fine 0.03-0.04 mm. long, $0.54-0.55 \times$ as long as the claws.

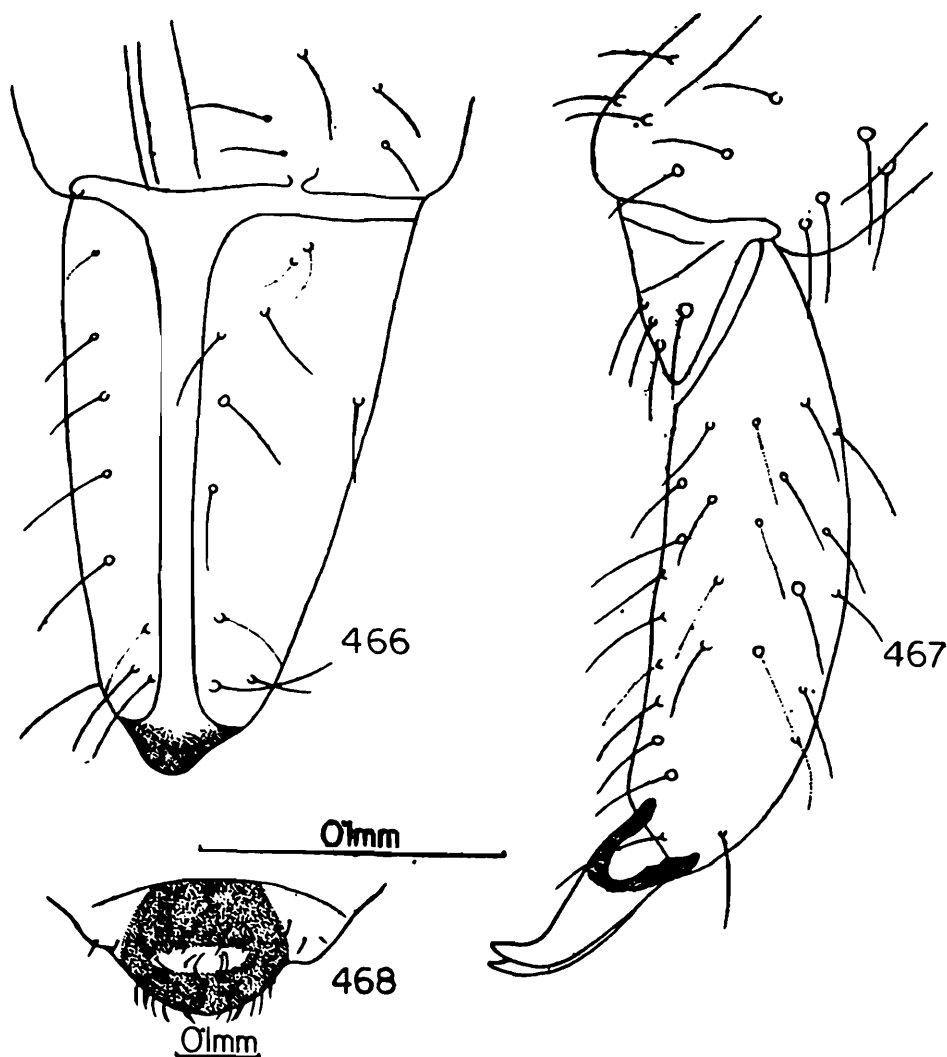
Colour.—Pale yellow in life.

Measurements in mm.—

	Length	Width	Antenna
1.	2.76	1.94	0.72
2.	3.32	2.48	0.92



Forda orientalis George ;
 Apterous viviparous female (exules) :
 464. whole body ; 465. antenna ;



Apterous viviparous female (exules) :

466. ultimate rostral segments ; 467. hind tarsus ; 468. posterior portion of abdomen.

III	Antennal segments		urs.	ht ₂
	IV	V		
0.24	0.10	(0.15+0.05)	0.23	0.22
0.37	0.15	(0.16+0.05)	0.23	0.21

(1, ex. *Sorghum vulgare*, Coimbatore, INDIA, 6.11.1969, S. K. David's collection 2, ex. roots of wheat, Quetta, PAKISTAN, 6.2.1959, BMNH collections).

Alate viviparous female.—Not available.

Nymph.—Body pale with head, antennae and legs yellow.

Antennae 5-segmented, $0.39 \times$ as long as the body ; hairs on the flagellum stiff, on segment III, 0.02-0.03 mm. long, $0.45-0.72 \times$ as long as the basal diameter of the segment ; processus terminalis about $0.30 \times$ as long as base of last antennal segment. Rostrum stout reaches beyond hind coxae, ultimate rostral segment $1.23 \times$ as long as second segment of hind tarsus and bears 10 hairs. Abdominal dorsum pale ; dorsal hairs on the anterior tergites 0.02-0.03 mm. long, on posterior tergites 0.03-0.04 mm. long, these being $0.45-0.72 \times$ and $0.90-1.0 \times$ as long as the basal diameter of antennal segment III, respectively. longest hair on hind tibiae 0.03 mm. long, $0.53 \times$ as long as diameter at the middle of the tibiae ; first tarsal segments with at least 6 hairs.

Measurements in mm.—

Length	Width	Antenna		
1.58	1.10	0.63		
			urs.	ht ₂
III	IV	V		
0.19	0.09	(0.14 + 0.04)	0.21	0.17

(ex. *Sorghum vulgare*, Coimbatore, INDIA, 6.11.1969, S. David's collections).

Sexual forms.—Not available.

Material examined.—Three apterous viviparous females and one nymphs from *Sorghum vulgare*, Coimbatore, Tamil Nadu, INDIA, 6.11.1969, (S. K. David's collections) ; One apterous viviparous female from roots of Wheat, Quetta, PAKISTAN, 6.2.1959, coll. E. S. Brown, (CIE 16504 : 1066, BMNH collections).

Discussion.—David (1958) provided a short redescription of the species under the name of *Forda hirsuta* Mordv. ; while measurements of a single specimen provided by David (op. cit) shows a smaller body size, the measurement and ratio of u.r.s. : ht₂ appears identical with the present material. David (op. cit.) stated that these aphids have been found feeding on *Pennisetum typhoides*

while George (1927) recorded it from *Sorghum vulgare*. It may be added that *F. hirsuta*, a central asiatic species, for which, like *F. orientalis*, no holocyclic generation is known, is now considered a distinct species (Eastop and Hille Ris Lambers, 1976).

While working for the present study, one apterous adult and three late stage apterous nymph from Grass root, Dehra-Dun, Uttar Pradesh, INDIA, 18.6.1976, coll. S. P. Maity and three alate viviparae, from plant of Maliceae, Tapakeswar, Uttar Pradesh : INDIA, 21.6.1975, coll. S. Chakrabarty, Labelled *F. orientalis* George, were available from the collections of S. Chakrabarti, Kalyani University. Apteræ indicate much longer ratio of u.r.s. : ht₂, (1.25 ×), much shorter dorsal hairs on anterior tergites (0.33-0.58 × as long as the basal diameter of antennal segment III) and shorter ratio of p.t. : base of antennal segment V (0.27) ; alatae differ considerably in having a much shorter ultimate rostral segment (0.08 mm.) and in the ratio of u.r.s/ht₂ (0.57-0.61) besides shorter ratio of p.t. : base of segment VI (0.22). As such these appear to belong to a different *Forda* species whose identity remains to be found out.

Distribution.—INDIA ; IRAN (?) ; CENTRAL ASIA (?).

Types.—Location of types not known. May be in the collection of Tamilnadu Agricultural University, Coimbatore, Tamil Nadu, INDIA.

56. *Forda riccobonii* (Stefani)
(Figs. 469-473)

1899. *Pemphigus riccobonii* Stefani—Perez, T. De., *Riv. Ital. Sci. nat.*, 19 : 1.

1903. *Pemphigus riccobonii*, Trotter, A., *Nuovo G. bot. ital.*, 10 : 33.

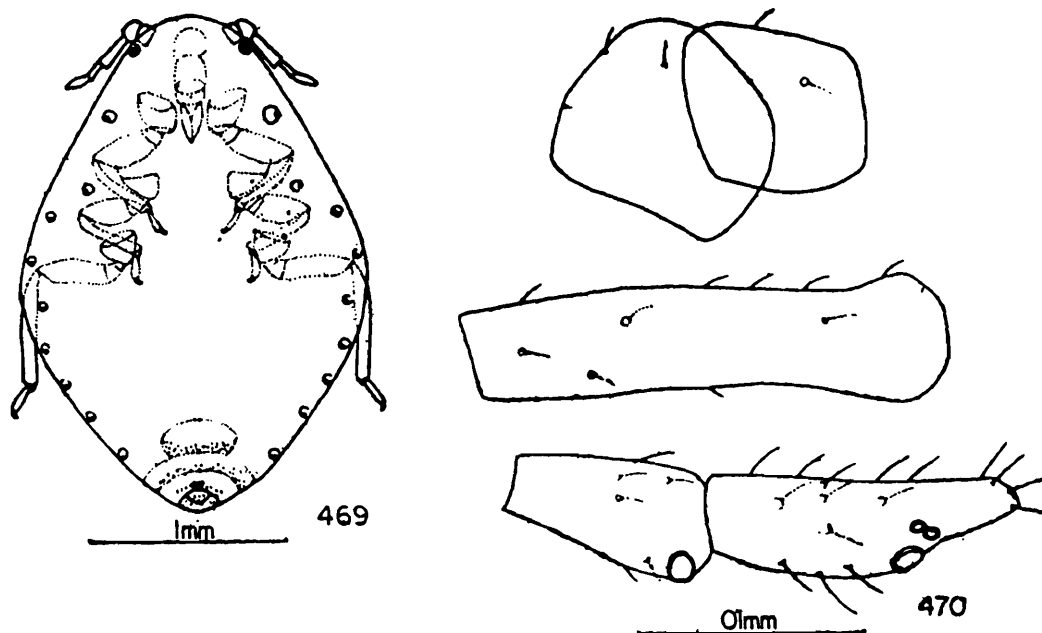
1954. *Forda riccobonii*, Wertheim, G., *Trans. R. ent. Soc. Lond.*, 105 (5) : 79.

1957. *Forda riccobonii*, Bodenheimer, F. S., and Swirski, E., *The Aphidoidea of Middle East*, Jerusalem, 321.

1979. *Forda riccobonii*, Maity, S. P., *Aphids of Northwest India with special reference to Garhwal Himalaya*, Ph.D. Thesis, Univ., Kalyani, 428.

Apterous viviparous female.—Body 2.6-3.0 mm. long with 2.0-2.20 mm. as maximum width. Head brown on frons, paler on vertex-spinulose ; dorsal cephalic hairs short, sparse, with fine apices upto 0.011-0.014 mm. long, nearly 0.30-0.40 × as long as the basal

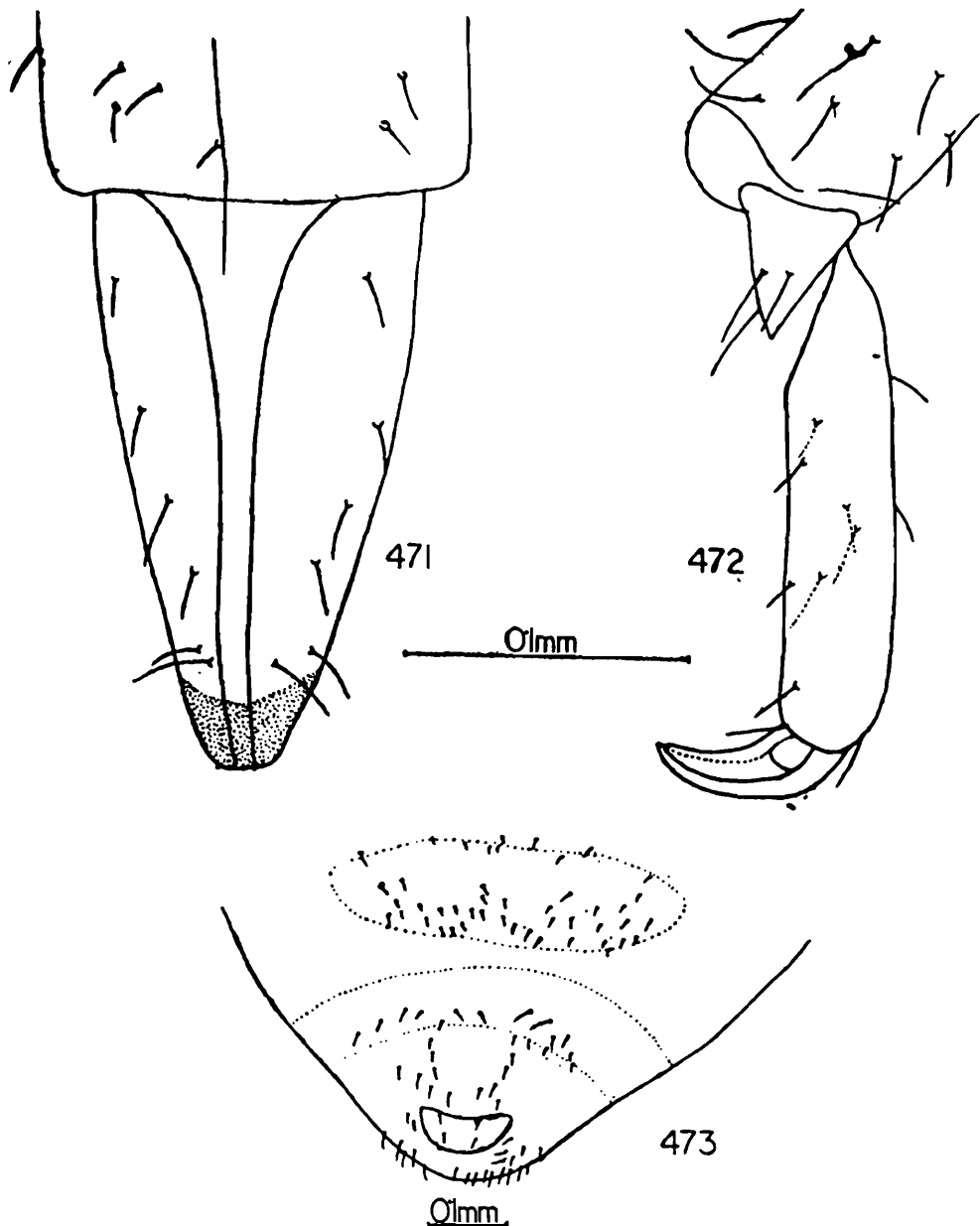
diameter of antennal segment III. Antennae 5-segmented, concolourous with the head, about $0.19-0.22 \times$ as long as the body ; flagellum smooth ; hairs on the flagellum short, fine, on segment III upto $0.009-0.015$ mm. long and $0.28-0.40 \times$ as long as the basal diameter of the segment ; primary rhinaria round, little protruberant, non-ciliated ; processus terminalis about $0.27-0.30 \times$ as long as the base of antennal segment V. Rostrum reaches hind coxae ; ultimate rostral segment about $1.1-1.3 \times$ as long as the second segment of hind tarsus and bears 10 accessory hairs. Abdominal dorsum pale, spinulose, faintly so on anterior tergites but distinctly so, cauded ; 7th and 8th tergites, each with a transverse sclerotic band ; hairs on the dorsum of abdomen, short, scattered except in the marginal groups, which have more hairs on anterior tergites (36), becoming lesser cauded (12) ; hairs on anterior tergites $0.013-0.026$ mm. long, $0.30-0.65 \times$ as long as the basal diameter of antennal segment III ; 7th tergite with 14-16 spinopleural hairs and 8-9 in each of marginal groups, these being at most $0.024-0.035$ mm. long ; 8th tergite with about 22-25 hairs, upto $0.035-0.050$ mm. long, these being $0.6-0.9 \times 0.9-1.5 \times$ as long as the mentioned diameter. Spiracles large, on brown sclerotic plates. Siphunculi absent. Cauda semilunar. Subanal plate sclerotic bearing many (?) long fine hairs. Subgenital plate, sclerotic with about 40 hairs.



Forda riccobonii (Stefani) ;

Apterous viviparous female (exules) :

469. whole body ; 470. antenna ;



Apterous viviparous female (exules) :

471. ultimate rostral segments ; 472. hind tarsus ; 473. posterior portion of abdomen.

Legs pale brown, stout, hind legs much longer than the others, hairs on tibiae and femora fine, longest hair on hind tibiae 0.03 mm. long, $0.40 \times$ as long as the diameter at the middle of the tibiae ; first tarsal segment with 5, 5, 5 hairs (or $5 + 2$, $5 + 1$, $5 + 0$, according to Davatchi, 1958); empodial hair fine, upto $0.33 \times$ as long as the claws.

Colour.—Not recorded.

Measurements in mm.—

	Length	Width	Antenna		
1.	2.71	1.65	0.59		
2.	2.80	2.10	0.63		
				Antennal segments	
	III	IV	V	urs.	ht ₂
	0.20	0.07	(0.11+0.03)	0.20	0.18
	0.22	0.10	(0.11+0.03)	0.20	0.18

(1, 2 ex. *Bothrichola pertusa*, Mussorie, U.P., INDIA, 26.10.1976 S. Chakrabarti's collections).

Larva (new born).—(from Davatchi, 1958).

Characterised by stiff setae on apical antennal segment and on the preceding segment.

Alate viviparous female.—(Not recorded in the region ; description based on Davatchi, 1958). Antennae 6-segmented ; segment III with 10-20 oval secondary rhinaria and segment IV with 5-9, V with 3-6 and VI with 4-5 similar rhinaria. Wax glands distributed typically as in other species, but marginal wax-gland groups absent. First tarsal segments with 2+1, 2+10, 2+0 hairs or these may vary as 3+1, 2+1, 2+0 or 2+1, 2+0, 2+0 ; hairs on tibiae relatively short, upto 0.035-0.040 mm.

Larva (new born) (From Davatchi, 1958).—Frons and pronotum spinulose. Antennae 5-segmented ; antennal segment II almost as long as segment IV, segment III, shorter than segments IV+V ; hairs on flagellum hardly discernible, never exceeding diameter of antennal segment III ; antennal segment V with transverse large primary rhinarium extending over the diameter of the segment ; segment IV with small circular rhinaria hardly surpassing half of the diameter of the segment. Rostrum reaches 7th abdominal segment. Dorsal abdominal hairs arranged in two marginal groups on 1st-3rd tergite and only one group of hairs present on 4th-8th.

First tarsal segment with 5+1, 5+1, 5+0 or 4+2, 5+1, 5+0 hairs.

Sexuales.—Not available.

Material examined.—Two apterae and two late stage nymph from roots of *Bothriocola pertusa*, Mussourie, Uttar Pradesh, INDIA, 26.10.1976, coll. S. P. Maity (S. Chakraborti's collections, Kalyani University).

Discussion.—This species has only been recently recorded from Indian region and is so far known from secondary host. Besides *Bothriocola*, specimens have also been collected from *Dichanthium* sp. and unidentified grass, during the months of May-June and October-November in Dehra-Dun, Mussorie area of Uttar Pradesh (Maity, S. P., Ph.D., Thesis). Red ants were associated with these insects. The species apparently lead, a anholocyclic paracycle on secondary host in the region.

Wertheim (1954) while studying the biology and ecology of gall-producing aphids in Israel, mentioned that four species of Fordini occur on *Pistacia atlantica*, including *Forda riccobonii* (Stef.). Fundatrices develop in temporary pocket-galls and the larvae deposited by fundatrix leave the gall and these first instar fundatrigeniae settle on young leaflets and produce permanent pocket galls ; two generations of aphids are produced with a maximum number of 116 insects counted, (as against 10, 173 for *Bai-zongia pistaciae* with 3 generations). Bodenheimer and Swiscki (1957) mentions about the occurrence of this species both on *Pistacia atlantica* and roots of Graminae in Israel and noted that permanent galls appear in second part of April, after first instar fundatrigeniae settle on young leaflets ; these galls open in first part of November when large number of fundatrigeniae alatae could be noted and galls become empty by end of November. Davatchi (1958) mentioned that inhabitants of multilobed galls of *P. atlantica* have reduced pubescence on tibiae and tarsi of emigrants (as against pubescence of other *Forda* species, inhabiting unilobed galls of *Pistacia*). Davatchi (op. cit.) considered *F. hexagona* Theobald, as described by Mimeur, a synonym of *riccobonii* but Eastop and

Hille Ris Lambers (1976) listed *hexagona* as a synonym of *F. marginata*.

Distribution.—INDIA (U.P.) ; SICILY, SPAIN, CANARY ISLAND, MOROCCO, ALGERIA, ISRAEL, TURKEY.

Types.—Location of types not known.

18. Genus *Geoica* Hart 1894.

1894. *Geoica* Hart, C. A., *Rep.*, III. *St. Ent.*, 18 : 101, Type species : *Geoica sguamosa* Hart, = *Pemphigus urticularius* Passerini.
1912. *Schoutedenia* Mordvilko, A. K., *Izv. Sev. Oblast. Sta. Zasluch. Rest. Vredit.*, 3 : 63. Type species : *Geoica cyperi* Schoutedon.
1913. *Trinacriella* del Guercio, G., *Redia*, 9 : 169. Type species : *Trinacriella magnifica*.
1917. *Serrataphis* van der Goot. P., *Contrib. Faune Indes Neerl.*, 1 (3) : 262, Type species : *Tetraneura lucifuga* Zehntner.
1923. *Neoschoutedenia* Schumacher, F., *Dt. ent. Z.*, 1923 : 403, Type species : *Geoica cyperi* Schoutedon = *Pemphigus urticularius* Passerini.
1928. *Pemphigetum* Mordvilko, A. K., *Bull. Soc. zool. Fr.*, 53 : 359. Type species : *Pemphigetum muticae* Mordvilko.
1928. *Schoutedenum* Mordvilko. A. K., *In Philipjev, Key for identification of Russian Insects*, Moscow, 173. Type species : *Geoica cyperi* Schoutedon.

Morphology.—Body 0.8-3.0 mm. long, elliptical or globular. Head distinctly separated from prothorax, some what reticulated over dorsum in apterae or wrinkled in alatae ; cephalic hairs, in apterae broadened at apices, in alatae somewhat blunt and longer. Antennae 0.10-0.25 × as long as the body, usually shorter and 5-segmented in apterae and 6 segmented in alatae ; flagellum faintly imbricated ; apterae without secondary rhinaria, alatae with small round to oval, protruberant secondary rhinaria on segment III (2-45), segment IV (0+7) segment V (0-8) and segment VI (0-2) ; secondary rhinaria without cilia ; primary and accessory rhinaria on segment V and VI strongly ciliated in apterae but non-ciliated or partly ciliated in alatae ; hairs on the flagellum similar to those on dorsum of head. Eyes of 3 facets in apterae, large and normal in alatae. Ultimate rostral segment always longer than and may be upto nearly twice as long as the second segment of hind tarsus and bearing 5-12 accessory hairs. Abdominal dorsum pale in apterae, with separate or confluent marginal and spinopleural sclerotic

bands in alatae ; 7th and 8th tergites with sclerotic bands in both apterae and alatae ; hairs on the dorsum of abdomen with expanded apices and often bent (in apterae) or with subacute to acute apices (in alatae), may be dense or sparse and sometimes may be of very different lengths. Wax glands usually absent, sometimes a few facets may be evident on posterior tergites of alatae. Spiracles large, rounded, on dark plates, those on 1st and 2nd abdominal segments placed widely apart. Siphunculi absent. 8th abdominal segment enclosing cauda and subanal plate, in the form of an inverted horse-shoe ; cauda bearing 5-20 hairs : Subanal plate bearing uniformly distributed even sized hairs or hairs of different size and thickness arranged in separate groups. Subgenital plate with 4 hairs on anterior portion and about 16 along posterior margin. Legs with faintly indicated trochanters ; hairs on femora and tibiae with bluntish or expanded apices ; tibiae and tarsi smooth, dorso-apical hairs on second tarsal segments with incrassate apices ; first tarsal segment with 3, 3, 3 hairs or 3, 3, 2 hairs ; empodial hairs fine, short and 0.25-0.33, \times as long as the claws. Media of forewing simple, cubitus and anal fused basally ; hind wings with both obliques, faint and sometimes inconspicuous.

Larvae may have fine pointed hairs or hairs with expanded apices. (Börner 1952). Sexuales small, apterous and arostrate (Baker, 1920).

Discussion.—Numerous species of the genus have been described, specially basing on the specimens collected from roots of Graminae. Zwölfer (1957) has stated that majority of these species belong to two valid species *urticularia* Passerini and *setulosa* Passerini. Davatchi (1958) recognised three species from specimens collected on *Pistacia*, viz. *urticularia*, *setulosa* and *mimeuri* Gaumont and stressed on the formation of separate keys for alate emigrants and apterous fundatrigeniae. Eastop and Hille Ris Lambers (1976) recognised 7 distinctly valid species besides the *urticularia* group consisting of 9 species ; apparently till date it has not been possible to define the status of the members of the group due to extraordinary variations. Eastop (1966) stressed on the distribution and length of hairs on body and subanal plate besides shape of primary rhinarium on segment V, while providing a key for apterose exules and Davatchi (1958) showed the extreme variability in the number of

secondary rhinaria of alates, which was earlier used by Mordvilko to separate closely related species.

Only two species including an endemic species are known from India, both from roots of Graminae (except a single alate from yellow Pan Trap collections) in Eastern India. No record of the genus from area, where *Pistacia* is known to occur, is available so far.

Biology.—Most of the species were originally believed to be heteroecous, alternating between roots of Graminae (*Agrostis*, *Festusa*, *Agropyrum*, *Hordeum*, *Panicum*, *Phleum*, *Poa*, *Setaria*, *Triticum* etc.) and *Pistacia* spp. (*atlantica*, *khinjuk*, *mutica*, *terebinthus* etc.) , however, in many region of their distribution, the members of the genus are now known to lead anholocyclic life cycle on roots of Graminae and also on roots of Cyperaceae.

On *Pistacia*, they are known to form galls as big as a hazel nut or walnut, underside on the central vein of the pinnule ; in central european region galls mature in early summer or midsummer (Borner, 1952) ; Davatchi (1958) has given an account and key to the gall forming species. While in roots of Graminae, these species are often attended by ants. Of the two species known from India, apterae of *lucifuga* has been reported to occur all through the year upto an altitude of *c* 2150 m. (P. K. Pal, Ph.D., Thesis 1975.) while alatoid nymphs were collected during early summer at lower altitude *c* 1550 m. in Sikkim-Darjeeling region.

Distribution.—Widely distributed all over the World.

Type species.—*Geoica squamosa* Hartig 1894 = *Pemphigus urticularius* Passerini, 1856. Location of type not known.

Key to the species of *Geoica*

Apterous viviparous female :

Body large globular 2.2-3.2 mm. long.
Processus terminalis 0.18-0.20 ×, sometimes upto 0.30 × as long as base of last antennal segment. Hairs on 8th tergite

0.08-0.14 mm. long, 1.2-3.5 × as long as basal diameter of antennal segment III. Subanal plate very large (fig. 474) with at least 14-16 thick hairs

.*G. lucifuga* (Zehntner)

Body nearly globular, usually 1.4-1.6 mm. long, sometimes upto 2.05 mm. long. Processus terminalis 0.44-0.47 × as long as base of last antennal segment. Hairs on 8th tergite 0.03-0.04 mm. long, 1.2-1.3 ×, or at most 1.6 × as long as the basal diameter of antennal segment III. Subanal plate not large as above, with about 10 thick hairs

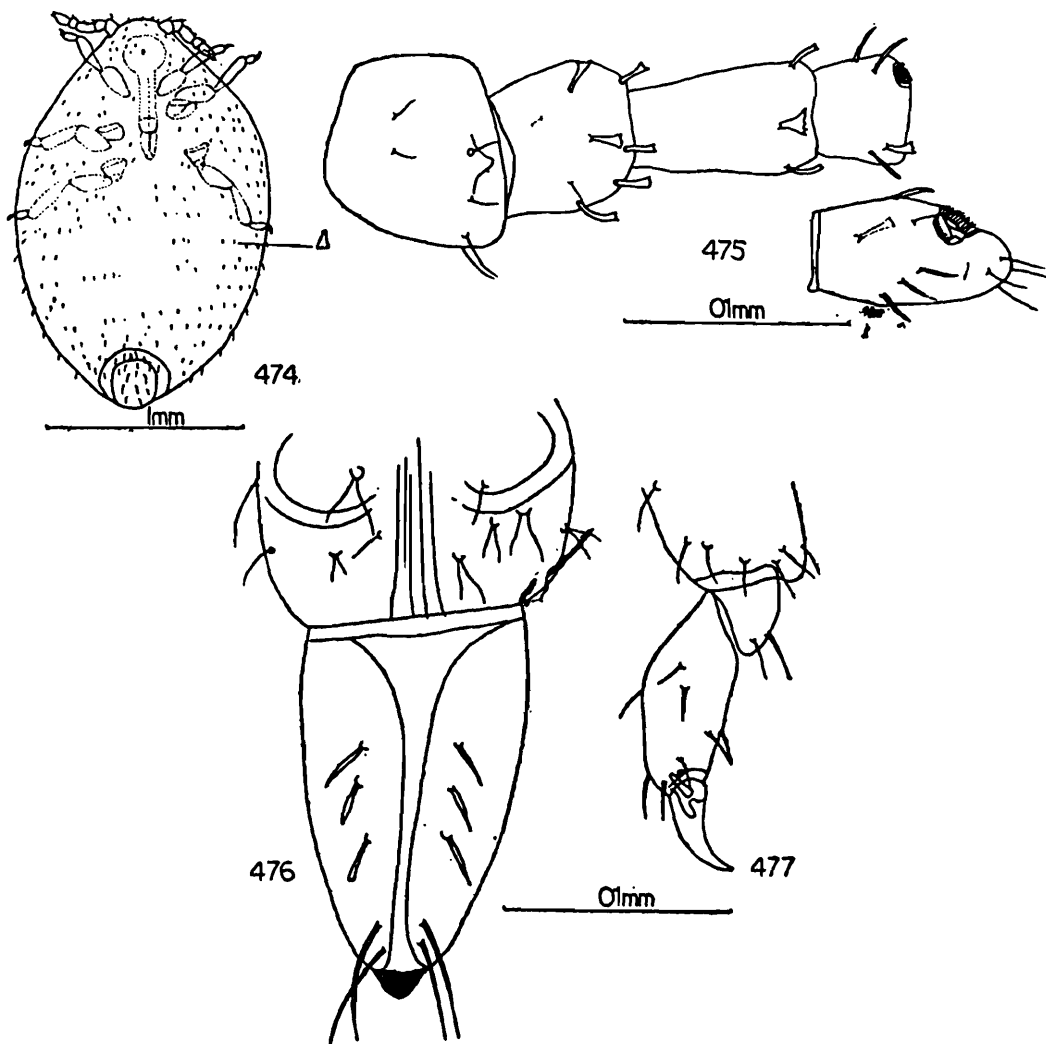
.*G. sikkimensis* Raychaudhuri, *et al.*

57. ***Geoica lucifuga*** (Zehntner)
(Figs. 474-482)

1898. *Tetraneura lucifuga* Zehntner, L., *Arch. Suikerind. Ned. Ind.*, 6 : 555.
 1917. *Serrataphis lucifuga*, van der Goot. P., *Contrib. Faune Indes Neerl.*, 1 (3) : 262.
 1921. *Geoica lucifuga*, Takahashi, R. *Agric. Exp. St. Formosa Spec. Rept.*, 20 : 96.
 1922. *Geoica spatulata* Theobald, F. V., *Bull. Soc. ent. Egypte*, 7 : 73.
 1924. *Geoica pseudosetulosa* Theobald, F. V., *Bull. Ent. Res.*, 19 : 179.
 1929. *Geoica horvathi* Nevsky, V. P., *Zool. Anz.*, 82 : 224.
 1953. *Geoica lucifuga*, Cottier, W., *Bull. N. Z. Dep. Scient. Ind. Res.*, 106.
 1958. *Geoica golbachii* Blanchaid, E. E., *Acta zool. Lilloana*, 15 : 155.
 1978. *Geoica lucifuga*, Raychaudhuri, D. N., Pal, P. K., Ghosh, M. R., *Entomon*, 3 (2) : 248.
 1980. *Geoica lucifuga*, Raychaudhuri, D. N., Pal, P. K., Ghosh, A. K., *Aphids of North East; India and Bhutan*, 420.

Apterous viviparous female.—Body globular, brown, about 2.27-3.20 mm. long, strongly pubescent. Head brown without any tubercle, dorsum of head smoother in the median region, rest somewhat stippled, or reticulated; dorsal cephalic hairs conspicuous, fan-shaped and often serrated at apices. Antennae almost concolourous with the head, 5-segmented, usually 0.17-0.19 × as long as the body but sometimes upto 0.23 × as long as the body; segment I, II, IV subequal, segment III nearly 2.0 × as long as the formers; hairs on antennal segments I and II with blunt or incrassate apices, occasionally fan-shaped; hairs on the flagellum may be bent, spatulate or with acuminate apices, on antennal

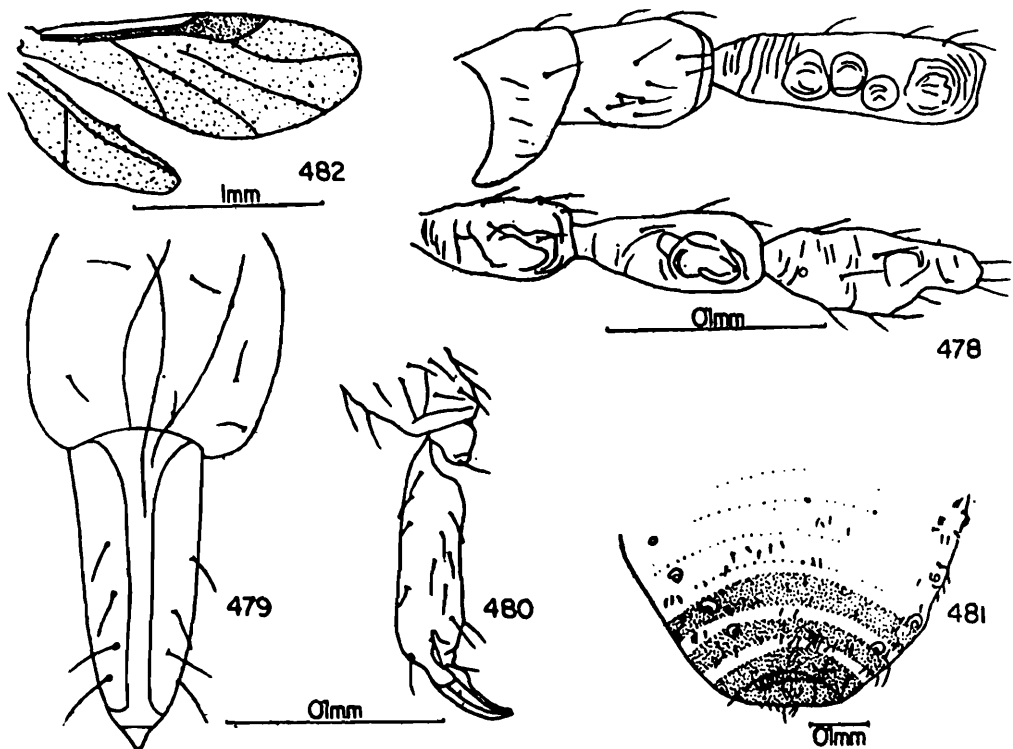
segment III, 0.02-0.04 mm. long, $0.43-1.0\times$ as long as the basal diameter of the segment ; primary rhinaria circular, protruberant and strongly ciliated , processus terminalis usually $0.18-0.20\times$ as long as the base of last antennal segment. Eyes of 3 facets. Rostrum extends little beyond hind coxae, ultimate rostral segment $1.5-1.7\times$ as long as second segment of hind tarsus and bears 4-6 accessory hairs (sometimes the number may be as many as 10). Abdomen pale brown with a pattern of reticulation ; hairs on the dorsum of abdomen sometimes arise from faintly pigmented bases, mostly fan-shaped or spatulate and serrated at apices, the marginal hairs being usually considerably thinner than the spinals, on anterior tergites, 0.04-0.13 mm. long, $0.90-3.2\times$ as long as the basal



Geoica lucifuga (Zehntner) ;

Apterous viviparous female (from roots) :

474. whole body ; 475. antenna ; 476. ultimate rostral segments ; 477. hind tarsus.



Alate viviparous female (from roots) :

478. antenna ; 479. ultimate rostral segments ; 480. hind tarsus ; 481. posterior portion of abdomen ; 482. wings.

diameter of antennal segment III ; 7th tergite with a number of stout hairs, 0.04-0.11 mm. long, $0.75-2.7\times$ as long as the mentioned diameter ; 8th tergite in the form of inverted horse-shoe and usually bearing 6-8 hairs with acute to acuminate apices, these being 0.08-0.14 mm. long, $1.18-3.5\times$ as long as the mentioned diameter. Siphunculi absent. Cauda small, Subanal plate very large, rectangular with about 14-16 thick hairs arranged in the longitudinal rows, besides 25-30 shorter fine hairs. Subgenital plate with 20 hairs in two groups. Legs dark brown, femora and tibiae smooth on margin, sometimes pitted medially ; hairs on femora and tibiae with blunt, subacute or serrated apices, longest one on hind tibiae 0.03-0.04 mm. long, $0.40-0.80\times$ as long as the diameter at the middle of the tibiae. First tarsal segment with 3, 3, 3 hairs. Empodial hairs about $0.25-0.30\times$ as long as the claws.

Colour.—Pale to dark brown in life.

Measurements in mm.—

	Length	Width	Antenna	
1.	2.48	1.80	0.44	
2.	2.27	1.57	0.41	
3.	2.64	2.00	0.50	
4.	2.41	1.72	0.46	

	Antennal segments			urs.	ht ₂
III	IV	V			
0.12	0.07	(0.10+0.02)	0.18	0.12	
0.10	0.05	(0.08+0.02)	0.18	0.11	
0.15	0.06	(0.10+0.02)	0.21	0.13	
0.12	0.07	(0.10+0.02)	0.19	0.12	

(1, ex. *Paspalum conyugatum*, Cote D' vore, FRANCE, 15.3.1965, coll. G. Ramaudiere collections ; 2, ex. *Oryza sativa*, Kalimpong, INDIA, 8.11.1971 coll. P. K. Pal, Calcutta University collections ; 3, ex. Grass, Peshak, Darjeeling, INDIA, 16.2.1972, coll. P. K. Pal, Calcutta University collections ; 4, ex. *Cynodon dactylon*, Mao, Manipur, INDIA, 14.4.1974, coll. P. K. Pal, Calcutta University collections).

Larva.—Body pale, 1.03 mm. long, oblong, pubescent. Head with short stiff hairs. Antennae 4-segmented, dusky on apical segments, $0.28\times$ as long as the body ; segment I and II with 4 hairs, segment III with 6 and base of IV with 5 hairs with acute apices ; hairs on segment III 0.03-0.04 mm. long, $0.80-1.20\times$ as long as the basal diameter of the segment ; processus terminalis short, blunt, with 5 stiff hairs ; primary rhinaria round, ciliated. Rostrum reaches beyond hind coxae, ultimate rostral segment, stout, $1.4\times$ as long as second segment of hind tarsus and bears 4 stiff hairs besides the preapicals. Abdominal dorsum pale ; hairs on the dorsum of abdomen arranged in transverse rows, 2 spinal, 3 pleural on each side and 2-3 marginals, (of which one is always longer than any others). On each side, these being mostly spatulate and serrated, except the long marginals ones, which have subacute to acute apices ; spinal hairs on anterior tergites 0.02-0.04 mm. long

marginals 0.06 mm. long, these being 0.6-1.2 \times and 2.0 \times as long as the basal diameter of antennal segment III, respectively ; 7th tergite with 4 spinopleural and 6 marginals (3 on each side), and 8th tergite with 8 hairs, arranged in a horse-shoe shaped transverse band, these being 0.04-0.08 mm. long and 0.06-0.10 mm. long, 1.2-2.5 \times and 2.0-3.0 \times as long as the mentioned diameter, respectively. Subanal plate with about 12 hairs, mostly in two longitudinal rows. Legs short, stumpy, hairs on femora sparse, on tibiae conspicuous, with subacute to furcated apices, longest one on hind tibiae 0.04 mm. long, 0.52 \times as long as the diameter at the middle of the tibiae ; first tarsal segments with 2, 2, 2 hairs ; empodial hair fine, almost as long as the claws.

Colour.—Not recorded.

Measurements in mm.—

Length		Width		Antenna	
1.03		0.69		0.29	
	Antennal segments			urs.	ht ₂
I	II	III	IV		
0.05	0.05	0.11	(0.06+0.02)	0.13	0.09

(ex. *Carex* sp., Kalimpong, INDIA, 16.12.1971, coll. P. K. Pal, Calcutta University collections).

Alate viviparous female.—Body 2.40-2.50 mm. long with 1.2-1.25 mm. as maximum width. Head dark brown with a distinct median suture ; hairs on frons, bent, upto 0.03 mm. long, 1.25 \times as long as the basal diameter of antennal segment III. Antennae brownish, 6-segmented, 0.24-0.26 \times as long as the body ; flagellum paler on basal portion of segments III and IV ; hairs on the flagellum, fine, 4-6 per segment on III, IV, V and basal portion of VI, those on segment III 0.016-0.020 mm. long 0.71-1.4 \times as long as the basal diameter of the segment ; secondary rhinaria large, non-ciliated, oval to irregular, 4-5 on segment III and 1-2 on segment IV ; primary rhinaria large, ciliated ; processus terminalis 0.15-0.16 \times

as long as base of antennal segment VI and bears 4-5 stiff subapical hairs. Eyes large. Abdominal dorsum pale, finely spinulose, with dark transverse spinal sclerotic bands on 1st-3rd tergites, these becoming darker, wider and longer on 4th-7th tergites ; each of 1st-7th tergites with brownish marginal sclerotic patch. Spiracles large, on distinct sclerotic plates ; hairs on the dorsum of abdomen fine, with acute apices, or flattened apiced, marginal ones longer than the ones on spino-pleural region, on anterior tergites upto 0.04-0.06 mm. long, 2.4-4.0 \times as long as the basal diameter of antennal segment III, on 7th and 8th tergites, 0.06-0.09 mm. long, 3.5-5.0 \times as long as the mentioned diameter ; 8th tergite with 6 hairs. Siphunculi absent. Cauda with few fine short hairs ; Subanal plate with about 55-60 hairs in two groups, of which 16 long hairs are arranged in two median longitudinal rows ; gonapophyses 2, each with 7 long hairs. Legs brownish, hairs on tibiae and femora, stiff, longest one on hind tibiae 0.030-0.036 mm. long, 0.6-0.7 \times as long as the diameter at the middle of the tibiae , first tarsal segments with 3, 3, 3 hairs (2 fine hairs and one short sensilla) ; empodial hair fine, 0.02 mm. long, 0.040-0.046 \times as long as the claws.

Colour.—Brownish to black in life.

Measurements in mm.—

	Length	Width	Antenna			
1.	2.48	1.23	0.64			
2.	2.48	1.20	0.65			
	Antennal segments				Urs.	ht ₂
	III	IV	V	VI		
	0.04	0.03	0.02	(0.10+0.06)	0.16	0.14
	0.04	0.2	0.02	(0.10+0.016)	0.16	0.13

(1, ex. Yellow Pan Trap, Shillong, INDIA, 2.4.1969, Calcutta University collections. 2, ex. Moericke bowl, Mokwa, NIGERIA, 28.7.—3.8.1963, BMNH collections).

Sexual forms.—Not available.

Material examined.—Several apterae and nymphs from *Carex* sp., *Cynodon dactylon*, *Oryza sativa* and unidentified grasses, Kalimpong, West Bengal, INDIA 18.11.1971, 6.12.1971, 15.2.1972, 17.2.1972 ; two apterous viviparous females. Mao, Manipur, INDIA, 14.4.1974 ; 3 apterous viviparous females from *Oryza sativa*, Bally, West Bengal, INDIA, 1.9.1969 (Calcutta University collections) ; one apterous viviparous female from *Paspalum conjugatum*, Cote d'ivoire, 15.3.1965, det. G. Ramaudicre, (Pasteur Inst., Paris) ; One alate viviparous female from yellow Pan trap, Shillong, Meghalaya, INDIA, 2.4.1969 (Calcutta University collections) ; one alate viviparous female from Moericke Trap, Mokwa, NIGERIA, 28.7.—3.8.1963, Coll. J. A. Brook, (BMNH collections).

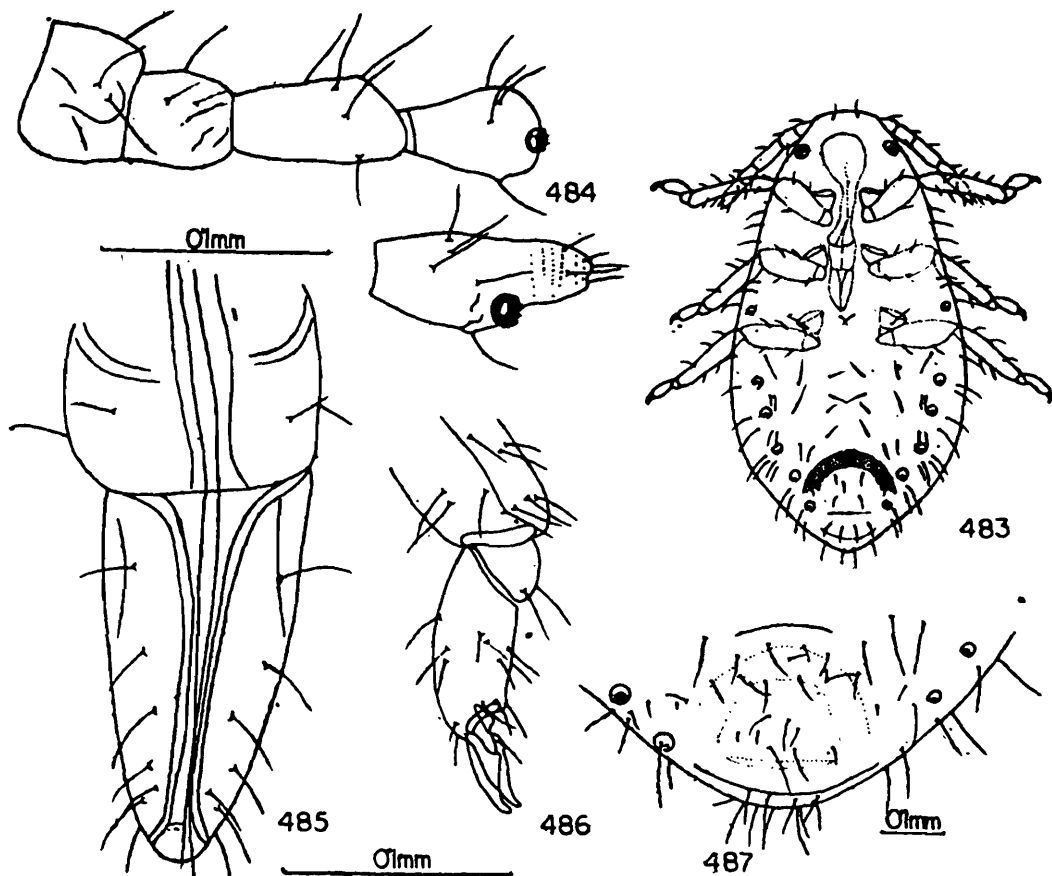
Discussion.—The apterae of the species is easily recognised by their characteristic chaetotaxy, although considerable variation in shape and length of hairs is well known. Similar variations in Palaearctic species like *Geoica urticularia* sensu Mordvilko and *Geoica setulosa* Passerini have been described by Zwölfer (1958) who has described the variations as due to seasonal polymorphism. The original holocycle for all *Geoica* is believed to be involved in alternation between *Pistacia*—Graminae/Cyperaceae but the *G. lucifuga* is now known to lead a anholocyclic paracycle on Graminae and Cyperaceae in most of the parts of its distributional area. The Graminaecus hosts include roots of several economic crops like barley, wheat, rice, maize and sugarcane. In the region of Northeast India, apterae appear to be common throughout the year on the roots of grasses growing in semi-dry to sandy loam soil upto an altitude of 2200 m. ; the colonies are formed at depth between 1.25—7.00 cm. and are always attended by ants.

Distribution.—INDIA (West Bengal, Sikkim, Meghalaya, Manipur), PAKISTAN, SRI LANKA, MALAYA, CENTRAL ASIA, CHINA, JAVA, PHILLIPINES, AUSTRALIA, MIDDLE EAST (EGYPT, ISRAEL).

Types.—Location of types not known.

58. *Geoica Sikkimensis* Raychaudhuri, Pal, Ghosh, M.R.
(figs. 483-487)

Apterous viviparous female (Exules).—Body nearly globular, 1.44-1.58 mm. (1.90-2.05) mm.) long with 1.03-1.19 mm. as maximum width. Head brownish; dorsal cephalic hairs thick, 0.020-0.025 mm. long, upto $0.80 \times$ as long as the basal diameter of antennal segment III. Antennae 5-segmented, pale brown, $0.22-0.24 \times$ as long as the body, segment I-IV subequal to each other; flagellum with spinulose imbrications apicad; hairs on the flagellum with acuminate apices, on segment III 0.02-0.03 mm. long, $0.70-0.90 \times$ as long as the basal diameter of the segment, primary rhinaria protuberant, round, ciliated; processus terminalis $0.44-0.47 \times$ ($0.40-0.65 \times$) as long as base of segment V. Eyes of 3 facets. Rostrum reaches mid coxae, ultimate rostral segment $1.2-1.4 \times$ ($1.45-1.60 \times$) as long as second segment of



Geoica sikkimensis Raychaudhuri, Pal, M. R. Ghosh ;

Apterous viviparous female (exules) :

483. whole body ; 484. antenna ; 485. ultimate rostral segments ; 486. hind tarsus ; 487. posterior portion of abdomen.

hind tarsus and bears 6-8 (4) accessory hairs. Abdominal dorsum pale reticulated ; hairs on the dorsum of abdomen short, on anterior tergites 0.02-0.03 mm. long, $0.66-1.2 \times$ as long as the basal diameter of antennal segment III ; 8th tergite with 10-12 hairs, upto 0.03-0.04 mm. long, $1.2-1.3 (1.3-1.65 \times)$ as long as the mentioned diameter ; Siphunculi absent. Cauda small, subanal plate with 10 long thick hairs besides some much shorter and thinner hairs ; gonapophyses 2, each with 6 hairs. Legs short, stumpy ; hairs on femora and tibiae short, stiff, longest one on hind tibiae 0.016-0.020 mm. long, $0.27-0.29 \times$ as long as the diameter at the middle of the tibiae. First tarsal segments with 3, 3, 2 hairs.

Colour : Pinkish in life.

Measurements in mm.—

	Length	Width	Antenna		
1.	1.58	1.19	0.35		
2.	?	?	0.37		
	Antennal segments			urs	ht ₂
	III	IV	V		
	0.06	0.05	(0.083+0.033)	0.14	0.10
	0.07	0.07	(0.083+0.036)	0.13	0.10

(1, ex. *Polypogon fugax*, Tashiding, West Bengal, INDIA, 25.5.1972, No. K. 6091, 2, ex. unidentified grass, Rimvik, West Bengal, INDIA, 7.10.1972, No. SK 158, Calcutta University collections).

Larva (apterous : early instar).—Body pale with head, antennae, legs, hair bearing sclerites on abdomen, sclerotic bands on 7th and 8th tergites and subanal plate variably brownish. Head with about 6 hairs, 0.023-0.026 mm. long, nearly equal to the basal diameter of antennal segment III. Antennae 5-segmented, $0.28 \times$ as long as the body ; segment I, II, III, IV subequal, with 2, 5, 6, 5 hairs, respectively, segment V longest and equal to segment I+II or III+IV and bears 6 hairs on the basal part and 5 on the processus terminalis ; flagellum distinctly spinulose apical ; hairs on the flagellum, long,

fine, flagellate, 0.023-0.026 mm. long, at most $1.1 \times$ as long as the basal diameter of antennal segment III ; primary rhinaria at the apex of IV and on V, ciliated ; processus terminalis $0.25-0.40 \times$ as long as base of antennal segment V. Rostrum reaches hind coxae, ultimate rostral segment stout, $1.4-1.5 \times$ as long as second segment of hind tarsus and bears about 12 accessory hairs. Abdominal dorsum pale ; hairs on the dorsum of abdomen arising from small to large sclerotic plates, arranged in paired spinal and 2-3 pleural rows besides the marginal ones ; each of spinal sclerites with 2 hairs, pleural ones with 1-2 hair and marginals with 2-3 hairs ; 7th tergite with 5 pairs of spino-pleural hairs besides two pairs of marginal groups ; spinal hairs on the anterior tergites 0.02-0.030 mm. long, marginal hairs 0.040-0.050 mm. long, these being $0.90-1.2 \times$ and $1.8-2.0 \times$ as long as the basal diameter of antennal segment III respectively ; 8th tergite with 9-10 long thick hairs, longest one 0.04 mm. long, nearly $2.0 \times$ as long as the mentioned diameter. Siphunculi absent. Caudal region with 12 small hairs and 10 long thick hairs. Legs stout pubescent ; tibial hairs much longer than the femoral ones, on hind tibiae, upto 0.030-0.036 mm. long, $0.75-0.84 \times$ as long as the diameter at the middle of the tibiae ; apical part of tibiae and tarsi with spinulose imbrications ; first tarsal segments with 2 long flagellate hairs + 2 sensellae. Empodial hair fine, 0.053 mm. long, equal to or little longer than the claws.

Colour : Not recorded

Measurements in mm.—

	Length	Width	Antenna				
1.	1.04	0.58	0.30				
2.	1.01	0.59	0.30				
	Antennal segments				urs	ht ₂	
	I	II	III	IV	V		
	0.05	0.05	0.04	0.05	(0.08+0.02)	0.13	0.07
	0.05	0.06	0.04	0.05	(0.07+0.03)	0.14	0.09

(1, 2 ex. roots of unidentified grass, Rimvik, Darjeeling district, West Bengal, INDIA, 7.10.72, Calcutta University collections).

Other morphs : Not known.

Material examined : One apterous viviparous female from *Polypogon fugax*, Tashiding, Kalimpong, West Bengal, INDIA, 25.5.1972, coll. P. K. Pal (No. K. 6091) ; one apterous viviparous female and 2 larvae from roots of unidentified grass, Rimvik, Sikkim, 7.10.1972, coll. P. K. Pal (No. K. 158) ; (Paratypes in Calcutta University's collections).

Discussion : The peculiar reticulated dorsum, short dorsal hairs, longer processus terminalis, help to distinguish the species from other *Geoica*. One late stage nymph from *Polypogon fugax* exhibits completely different chaetotaxy and much longer ultimate rostral segment (0.18 mm.) and dorsal hairs (0.12-0.14 mm. on 7th and 8th tergite) and as such appear to belong to different species. The published date of holotype and paratypes apparently bear an erroneous date, 25.10.72, and should be actually 25.5.72. The alternate host remains unknown and as such the species may belong to the group of Fordini adopted to a paracycle on secondary host belonging to Graminaceae. The apterae form colonies at a depth of 4.0-6.0 cm. on the roots, in semi moist sandy soil and are associated with ants (Pal, P. K., 1975).

Distribution.—INDIA (West Bengal, Sikkim).

Types : In the collections of Entomology Laboratory, Department of Zoology, University of Calcutta.

19. Genus *Kaburagia* Takagi, 1937

1937. *Kaburagia* Takagi, G., *Bull. Forest Exp. Stn. Chosen*, 26 : 20, 22. Type species : *Kaburagia rhusicola* Takagi.
1945. *Macrorhinarium* Tsai, P. H. and Tang, T., *Agric. Assoc. China Circular*, 50 : 33. Type species : *Macrorhinarium ovogallis* Tsai and Tang=*Kaburagia rhusicola* Takagi.

Morphology.—Body elongate 1.0 to less than 2 mm. long. Head without any median suture or frontal tubercles ; cephalic hairs short, inconspicuous ; dorsum of head with 2-3 pair of small wax glands, each with 2-5 cells, or wax glands may be absent ; ocelli large. Antennae 5-segmented in apterae, 6-segmented in alatae,

much shorter than the length of the body ; antennal segments III and IV subequal, distinctly shorter than segment V and base of segment VI ; secondary rhinaria ciliated, unusually large, ovoid to elongate, one on each of segments III-IV, sometimes segments III and IV may exhibit some additional circular, much smaller rhinaria-like structure, besides the usual large ones ; primary rhinaria on segments V and VI in alatae appear similar to secondary rhinaria ; primary rhinaria on segments IV and V on apterae, small, round, ciliated ; hairs on the flagellum short, fine, shorter than basal diameter of antennal segment III ; processus terminalis very short, hardly $0.16 \times$ as long as base of the segment VI. Eyes large in alatae, 3 faceted in apterae, ocular tubercles small. Thoracic segments, at least meso—and metathorax with a pair of wax glands. Ultimate rostral segment bearing 6 accessory hairs. Abdominal dorsum pale with large paired spinal, pleural and marginal wax glands on anterior tergites , 7th tergite and 8th tergite only with spinal and pleural glands ; sometimes abdominal wax glands may be inconspicuous or absent ; hairs on the dorsum of abdomen, short, longest one on posterior tergites hardly exceeding the basal diameter of antennal segment III , 8th tergite with 4 hairs. Siphunculi absent. Cauda semioval with few hairs. Legs smooth, trochanters distinct from femora , hairs on femora and tibiae short, erect with acute apices ; first tarsal segments with 3, 3, 3 or 3, 3, 2 hairs. Empodial hair short, fine, hardly $0.40 \times$ as long as the sharp claws. Forewings with stigma truncate, radial sector slightly curved, media simple, all veins slightly bordered brown , hind wings with both obliques.

Embryos possess 4-segmented antennae, well developed rostrum and may exhibit distinct paired wax glands group on thoracic and abdominal segments and scattered ones on head.

Discussion.—The genus was erected with *rhusicola* (= *ovogallis* Tsai & Tang, *ensigallis* Tsai & Tao), a species forming galls on *Rhus* in Chosen and subsequently in 1969 another species from *Ailanthus* was described from North West India. The genus is distinctive in having large elongate secondary rhinaria, 6-segmented antennae, truncate pterostigma and in the absence of median suture and could be separated from related genera viz., *Melaphis* Walsh and *Schlechtendalia* Licht., by above combinations of characters.

Biology.—*K. rhusicola* is only known from galls (at leaf base) of *Rhus punjabensis sinica* (Anacardiaceae). These galls are reported to be egg-shaped or elongate, with a shallow furrow, and may be of variable size (from 30 mm. \times 10 mm. to 100 \times 40 mm.). Young galls appear pale green to green, and mature galls become yellowish green. *K. ailanthi* is known from petiole galls of *Ailanthus glandulosus* (Simarubeae) in North-western Hill areas of India. Most of the collection records of *ailanthi* from the host indicate its occurrence in August-September, and few alatae in Yellow Pan Trap collection in October perhaps relate to the alate migrants. No secondary host has so far been known for *Kaburgia* although members of related genera are known to alternate between *Rhus* and Mosses.

Distribution.—NORTH WEST INDIA, CHINA. Takahashi (1938) has dealt with *Kaburgia*, and Tsai & Tao (1946) have dealt with *Macrorhinarium* which is considered as a synonym of *Kaburgia*.

Type species.—*Kaburgia rhusicola* Takagi, 1937. May be in the collections of Forest Experimental Station, Chosen. Type species of *Macrorhinarium*, *M. ovogallis* Tsai & Tang which is now considered as a synonym *K. rhusicola* Takagi is deposited in the Entomology Laboratory, College of Agriculture, National University of Chekiang, China.

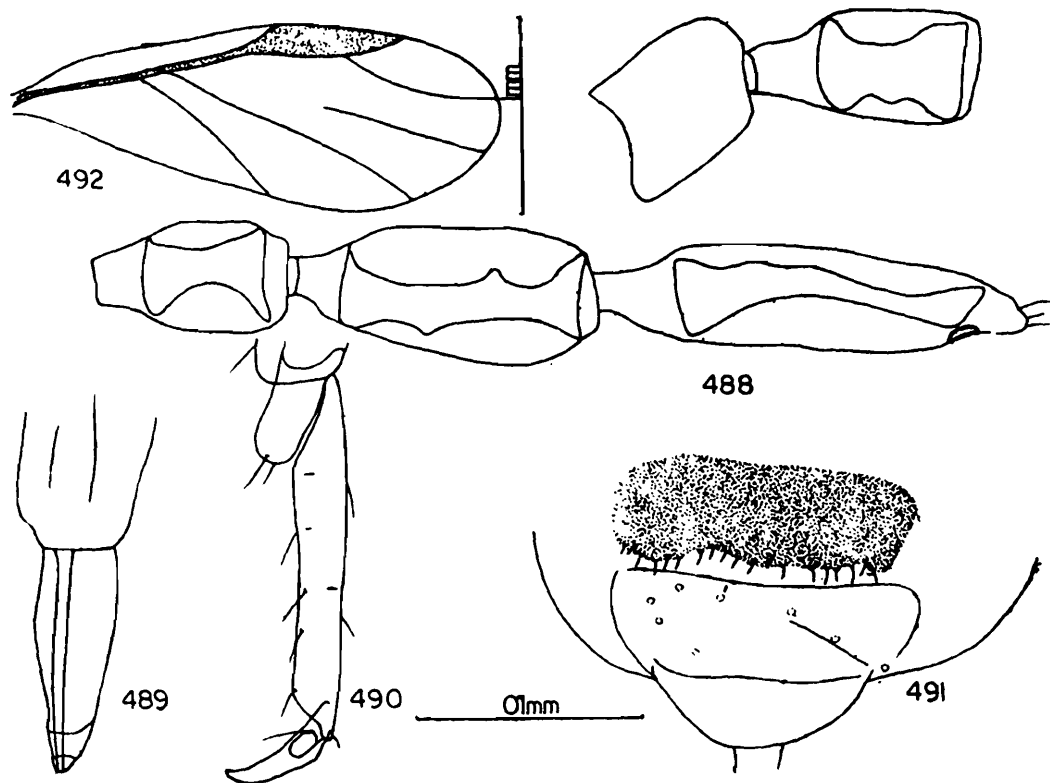
59. *Kaburgia ailanthi* Chowdhuri, Basu,
Chakrabarti & Raychaudhuri
(figs. 488-492)

1969. *Kaburgia ailanthi* Chowdhuri, A. N., Basu, R. C., Chakrabarti, S. and Raychaudhuri, D. N., *Oriental Ins.*, 3 (1) : 86.

1975. *Kaburgia ailanthi*, Chakrabarti, S. and Raychaudhuri, D. N., *Oriental Ins.* 9 (2) : 210.

Alate viviparous female.—Body elongate 1.7-2.07 mm. long with 0.70-0.80 mm. as its maximum width. Head dark brown, with a brownish black patch around middle ocellus ; a large wax gland plate present in the middle of the frons, besides two smaller ones, one on each side ; vertex with a small group of wax gland cells placed on each side of median ocellus and two groups near the elypeus ; dorsal cephalic hairs short, sparse, at most 0.006 mm.

long and $0.40 \times$ as long as the diameter at the constricted base of antennal segment III. Eyes very large. Antennae pale, 6-segmented, $0.24-0.27 \times (0.33 \times)$ as long as the body ; hairs on flagellum with acute apices, very short and sparse ; segment III and IV subequal, V and VI much longer than III and IV ; each of segments III-IV with a large, elongated pale, rhinaria of characteristic shape, besides some circular rhinaria-like structure ; primary rhinaria on segment VI with a small group of circular accessory rhinaria ; processus terminalis very short, about $0.12-0.15 \times$ as long as base of segment VI and bears two subapical setae. Rostrum reaches mid coxae, ultimate rostral segment slender, subacute, $0.60-0.63 \times (0.60-0.75 \times)$ as long as second segment of hind tarsus and bears 2 short accessory hairs. Thoracic dorsum dark, sclerotic, with small pale wax gland plates, on pronotum and mesonotum, sometimes these may be hardly discernible. Abdominal dorsum pale, each of 1st to 6th tergites with segmental paired spinal, pleural and marginal wax-plates, 7th tergite with 2 spinal and 2 pleural wax plates, and 8th tergite with a single median and two pleural wax



Kaburagia ailanthi Chowdhuri *et al.* ;

Alate viviparous female (fundatrigenia) :

488. antenna ; 489. ultimate rostral segments ; 490. hind tarsus ; 491. posterior portion of abdomen ; 492. forewing.

plates ; hairs on the dorsum of abdomen fine, on anterior tergites 0.006-0.013 mm. long, $0.50-1.0 \times$ as long as the basal diameter of antennal segment III ; each of 7th and 8th tergites with 4 hairs, those on 7th upto 0.010 mm. long and those on 8th 0.016 mm. long, these being $0.75 (1.2 \times)$ and $1.2 \times (1.3-1.5 \times)$ as long as the mentioned diameter. Siphunculi absent. Cauda pale, small with 2 hairs. Subgenital plate with 10-11 hairs in two groups. Subanal plate with about 22 stiff hairs. Legs brownish, tibiae faintly to strongly imbricated ; hairs on femora and tibiae short, stiff, longest hair on hind tibiae, 0.014-0.023 mm. long, $0.40-0.70 \times$ as long as the diameter at the middle of the tibiae ; first tarsal segment with 3, 3, 3 or 3, 3, 2 hairs ; empodial hair 0.010 mm. long, $0.25-0.27 \times$ as long as the claws.

Colour.—Not recorded.

Measurements in mm.—

	Length	Width	Antenna
1.	2.00	0.75	0.49
2.	2.07	?	0.56
3.	2.00	?	0.55

III	Antennal segments			urs	ht ₂
	IV	V	VI		
0.07	0.06	0.12	(0.13+0.016)	0.07	0.11
0.09	0.06	0.12	(0.13+0.020)	0.07	0.11
0.09	0.07	0.12	(0.13+0.002)	0.07	0.11

- (1. ex. *Ailanthus glanduloses*, Simla, Himachal Pradesh, INDIA, 27.8.1969, coll. A. N. Chowdhury, Calcutta University Collection.
 2. ex. Y P. T. Sundardunga, U.P., INDIA, 19.10.1970, coll. S. Chakrabarti, Calcutta University collection).

Larva.—(from abdomen of alate viviparae) Body pale 0.41 mm. long. Antennae 0.08 mm. long, pale, $0.20 \times$ as long as the body ; Ultimate rostral segment 0.033 mm. long. Hairs hardly discernible. 0.003 mm. long ; Wax glands not visible. Legs of 5 segments, tarsi not differentiated.

Material examined.—4 alate viviparous females and 6 larvae from *Ailanthus* sp., Simla, Himachal Pradesh, INDIA, August 1966, coll. A. N. Chowdhury, (Paratypes, No 2/26) ; 10 alate viviparous females from *Ailanthus glandulosa*, Simla, Himachal Pradesh, INDIA, 27.8.1969, coll. A. N. Chowdhury, (No 15/69) ; one alate viviparous female from Yellow Pan water trap, Sundardunga, Uttar Pradesh, INDIA, 16.10.1970, coll. S. Chakrabarti ; one alate viviparous female, from Yellow Pan trap, Sundardonga, Uttar Pradesh, INDIA, 19.10.1970, coll. S. Chakrabarti (all material in Calcutta University collections).

Discussion.—The species, as has already been pointed out, is only known by alatae collected from petiole galls of *Ailanthus* and the secondary host remains unknown. The species differs from the only other species of *Kaburagia*. e.g. *rhusicola* in having some circular rhinaria-like structure on segment III and IV and more wax gland cells in thoracic tergum.

Distribution.—INDIA (Himachal Pradesh, Uttar Pradesh).

Types.—In the collections of Entomology Laboratory, Department of Zoology, University of Calcutta ; Paratypes also in the collection of British Museum (Nat. Hist.), London.

20. Genus *Smynthuodes* Westwood, 1849

1849. *Smynthuodes* Westwood, J. O., *Gdnr's chron.*, 1849 : 420. Type species *Smynthuodes betae* Westwood.
 1860. *Tychea* Passerini, G., *Gli Afidi*, Parma, 30. Type species : *Tychea phaseoli* Passerini = *Smynthuodes betae* Westwood.
 1909. *Trifidaphis* del Guercio G., *Pomona coll. J. Ent.*, 1 : 75. Type species : *Pemphigus radicolica* Essig = *Smynthuodes betae* Westwood.
 1912. *Tullgrenia* van der Goot, P. *Tijdschr. Ent.*, 15 : 96. Type species : *Tychea phaseoli* Passerini, = *Smynthuodes betae* Westwood.

Morphology.—Body globular, 2-3 mm. long. Head smooth with a faint median ventral suture. Antennae 5-6-segmented in apterae, 6-segmented in alatae, 0.17-0.25 × as long as the body, flagellum without secondary rhinaria in apterae, with irregular, variously sized secondary rhinaria on antennal segments III-V and sometimes also on segment VI, in alatae ; primary rhinaria with

sclerotised rim ; primary and secondary rhinaria without any cilia, accessory rhinaria ciliated ; antennal segment II unusually long, subequal to or even longer than antennal segment III in apterae and bearing more than 20 hairs ; flagellum nearly smooth ; processus terminalis very short, sparsely spinulated, $0.15-0.20 \times$ as long as the base of last antennal segment. Rostrum reaching hind coxae, ultimate rostral segment longer in apterae, $0.70-1.12 \times$ as long as the second segment of hind tarsus and bearing 9-17 accessory hairs. Abdominal dorsum pale in apterae, except for a dark sclerotic band 8th tergite ; spiracles placed on large elongate, sclerotic plates. Wax glands absent. Hairs on the dorsum of abdomen fine, numerous, 8th abdominal tergite inverted U-shaped, enclosing the cauda and subanal plate and bearing 10 to more than 60 hairs. Siphunculi absent. Cauda semilunar, bearing 20 to more than 40 hairs. Subanal plate with numerous long and short hairs. Subgenital plate with 30-40 hairs. Legs smooth, first tarsal segments of fore and mid legs with 4 long and one short hair, of hind legs with 3 long and one short hair ; dorso-apical hairs on second tarsal segments long and fine ; empodial hairs fine, $0.66-0.72 \times$ as long as the claws. Forewings with veins dark, media simple ; hind wings with both obliques, which may appear very faint.

Newborn youngs with 4-segmented antennae and exhibit the same sclerotised ring around the primary rhinaria ; gall forming newborns on *Pistacia* are characterised by a very dark pigmentation.

Discussion.—A number of species have been assigned to the genus at different times, mostly because of great extent of variations in morphological characters of different populations from a wide range of secondary hosts. Eastop (1966) has discussed the variations in the number of hairs on 8th tergite, in the ratio of antennal segment III to VI and II to III+IV, and the number of secondary rhinaria on segment V and VI and indicated how different specific names have been applied to the populations, which may be separated by these characters. Later, Eastop and Hille Ris Lambers (1976) have listed 11 species, including two species with (?) mark, as synonyms of the genotype, *Smynthuodes betae* Westwood, and as a result *betae* remains the only valid species under the genus. In view of the possibility of existence of several genetically isolated population

on a wide range of secondary host plants and all with some peculiar morphological characteristic, the synonymical list of Eastop and Hille Ris Lambers (op. cit) appears to be reasonable.

Biology.—Mordvilko (1935) has shown that *S. betae* could form galls on *Pistacia mutica* and these appear as red, narrow-ribbed, marginal folds opening on the upper side of pinnules, and he has also described the different generations of the complete cycle. Davatchi (1958) confirmed that besides *P. mutica*, *betae* also forms galls on *Pistacia atlanticus* and *Pistacia vera* in Morocco and Syria respectively. Holocyclic forms are now restricted to Central Asia upto Morocco through Asia Minor and North Africa (Davatchi, op. cit) where the species is known to alternate between *Pistacia* and roots of Graminae. Anholocyclic forms are wide spread and have been reported from several host plant families viz. Boraginaceae, Cactaceae, Crassulaceae, Compositae, Cruciferae, Dipsacaceae, Graminae, Leguminosae, Liliaceae, Malvaceae, Onagraceae, Solanaceae, Umbelliferae etc., (Eastop, 1966). In Indian region, *betae* has been reported from roots of Graminae, Compositae and Malvaceae.

Distribution.—Cosmopolitan. Mordvilko (1935), Börner (1952), Davatchi (1958) and Eastop (1966) have dealt with the genus.

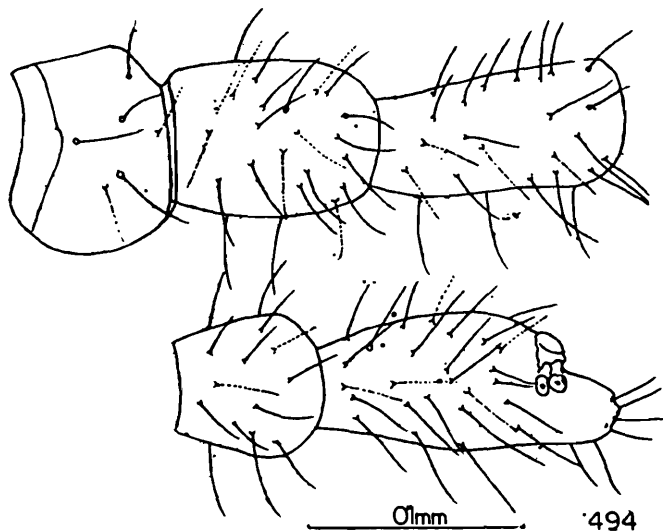
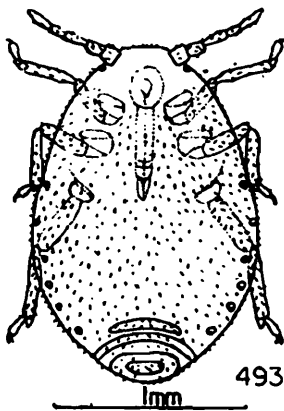
Type species.—*Smynthuodes betae* Westwood, 1849. Location of type not known.

60. *Smynthuodes betae* Westwood (figs. 493-500)

- 1849. *Smynthuodes betae* Westwood, J.O., *Gdnr's chron.*, 7 vii, 1849, 240.
- 1852. *Pemphigus globosus* Walker, F., *List. Homopt. Ins. Brit. Mus.*, 4 : 105.
- 1856. *Amycla albicornis* Koch, C. L., *Die Pflanz. Aphiden.*, 301.
- 1860. *Tychia phaseoli* Passerini, G., *Gli Afidi*, Parma, 39.
- 1867. *Aphis ? myrnicaria* Boisduval, M. *Essai sur l'entomologie morticole*, 1867 : 278.
- 1885. *Schizoneura ? karschii* Lichtenstein, J., *Ent. nachr.*, 12 : 82.
- 1909. *Pemphigus radicolica* Essig, E.O., *Pomona Coll. J. Ent.*, 1 : 9.
- 1915. *Tullgrenia phaseoli*, van der Goot, P., *Tijdschr. Ent.*, 15 : 96.
- 1915. *Pemphigus trifolii* del Guercio, G., *Redia*, 10 : 249.
- 1920. *Forda natalensis* Theobald, F.V. *Bull. ent. Res.*, 11 : 71.

1925. *Geoica radicolica*, Curtwright, C.R., *Bull. Ohio Agric. Expt. Stn.* **387** : 212.
1929. *Trifidaphis phaseoli*, Theobald, F.V. *The Plant lice or Aphididae of Great Britain*, **3** : 208.
1929. *Trifidaphis perniciosus* Nevsky, V.P., *Zool. Anz.*, **8** : 226.
1935. *Trifidaphis silvestrii* Mordvilko, A., *Ergeb. Fortschr Zool.*, **8** : 196.
1956. *Trifidaphis gossypii* Kulkarny, H.L. *Curr. Sci.*, **25** : 21.
1958. *Smynthuodes betae*, Davatchi, G.A., *Revue Path. Veg. Ent. Agric. Fr.*, **37**.
1958. *Smynthuodes betae*, Zwölfer, H. *Z. angew. Ent.*, **42** (2) : 171.
1962. *Smynthuodes betae*, Channa Basavanna, G.P. *Indian J. Ent.*, **24** : 80-85,
1978. *Smynthuodes betae*, Raychaudhuri, D. N., Pal, P. K. and Ghosh, M.R. *Entomon*, **63**(2) : 251.
1980. *Smynthuodes betae*, Raychaudhuri, D. N., Pal, P. K., Ghosh, A. K. *Aphids of North East India and Bhutan*, 426.

Apterous viviparous female.—Body pale, round to spherical, 1.5-2.5 mm. long. Head pale, brown, (head and prothorax feebly demarcated from rest of the body) with a faint median suture; hairs on the dorsum of head numerous, with acute apices, upto 0.07-0.08 mm. long, $2.4-2.6 \times$ as long as the basal diameter of antennal segment III. Antennae 5-segmented; short, stout, $0.25-0.32 \times$ as long as the body, strongly pubescent; segment II subequal to segment III and $1.5 \times$ as long as segment I; hairs on the flagellum fine, on segment III, 0.02-0.06 mm. long, $0.63-1.5 \times$ as long as the basal diameter of the segment; primary rhinaria non-ciliated,

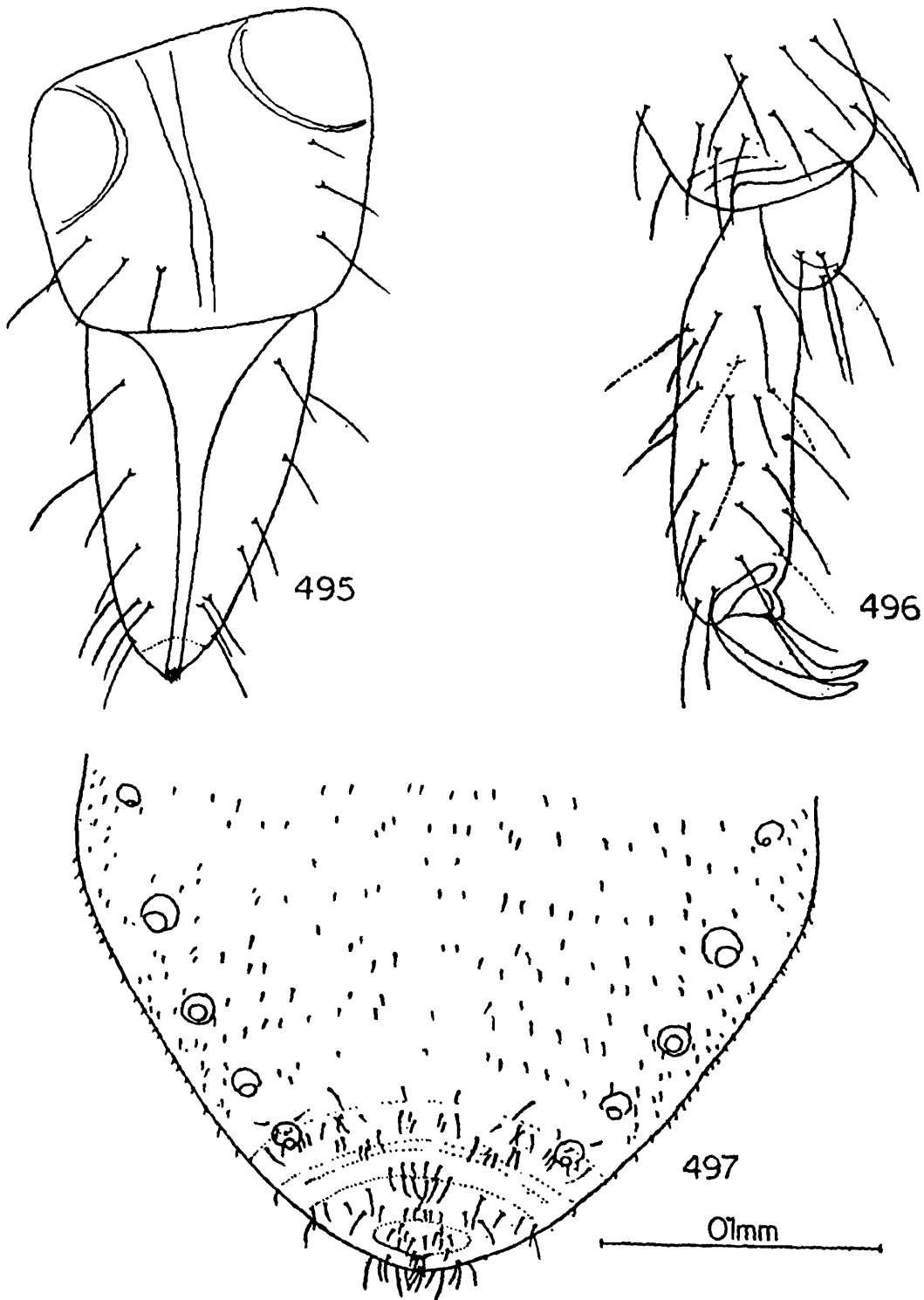


Smynthuodes betae Westwood ;

Apterous viviparous female (exules) :

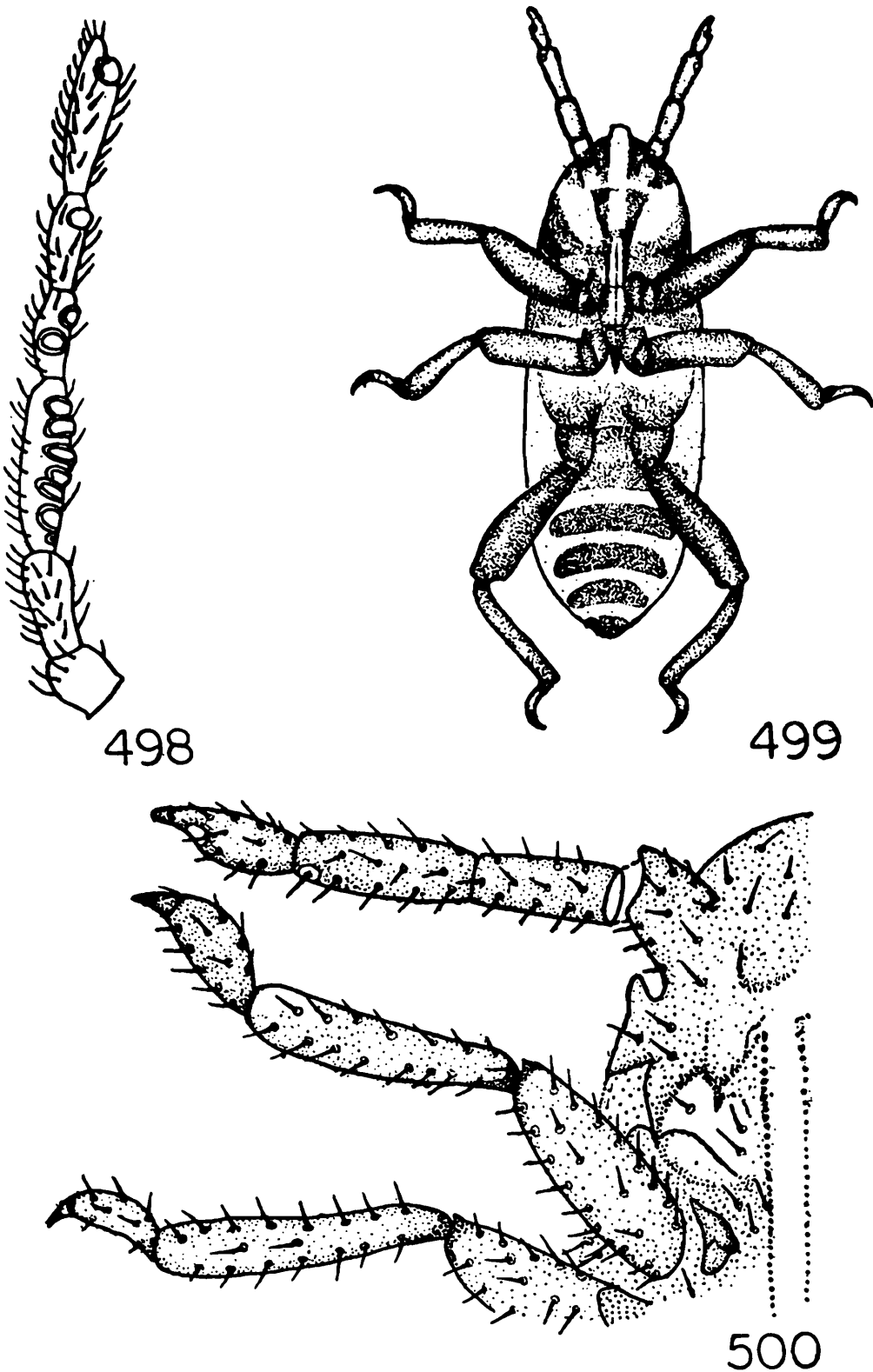
493. whole body ; 494. antenna ;

rounded on segment IV, transversely oval on segment V ; processus terminalis 0.15-0.17 \times as long as base of last antennal segment. Eyes of 3 facets. Rostrum long slender, reaching hind coxae ; ultimate rostral segment 1.0-1.10 \times as long as second segment of



Apterous viviparous female (exules) :

495. ultimate rostral segments ; 496. hind tarsus ; 497. posterior portion of abdomen.



Alate viviparous female :

498. antenna ; 499. exuvae of larva of fundatrigenia within gall ;
500. anterior portion of head, antenna and legs of first instar larva
of emigrant.

hind tarsus and bears 9-12 accessory hairs. Abdominal dorsum pale densely pubescent ; hairs on the dorsum of abdomen fine, on anterior tergites 0.03-0.05 mm. long, $0.90-1.4 \times$ as long as the basal diameter of antennal segment III, on posterior tergites 0.04-0.07 mm. long, $1.3-2.2 \times$ as long as the mentioned diameter ; 8th tergite with a brown transverse band. Siphunculi absent. Cauda subanal and subgenital plates sclerotised ; with many fine hairs. Gonapophyses 2, each with 5-7 hairs. Legs brownish, smooth except on tarsi which are faintly spinulose, hairs on femora and tibiae fine, longest hair on hind tibiae 0.036-0.040 mm. long, $0.57-0.61 \times$ as long as the diameter at the middle of hind tibiae ; first tarsal segments with 5, 5, 4 hairs ; empodial hair 0.026-0.090 mm. long, $0.55-0.62 \times$ as long as the claws.

Colour.—Yellowish white to brownish yellow.

Measurements in mm.—

	Length	Width	Antenna
1.	1.65	1.20	0.43
2.	2.20	1.28	0.59
3.	1.52	1.17	0.46
4.	2.48	0.96	0.60

	Antennal segments			urs.	ht ₂
	III	IV	V		
	0.12	0.07	(0.12+0.02)	0.14	0.14
	0.11	0.06	(0.13+0.02)	0.15	0.14
	0.11	0.09	(0.11+0.02)	0.13	0.12
	0.11	0.07	(0.11+0.02)	0.13	0.12

(1, ex. *Eunomia oppositifolia*, Herts, Herpenden, ENGLAND, 25.7.1965, BMNH collections ; 2, ex. *Setaria palmiflora*, Peshoke, Darjeeling, INDIA, 16.2.1972, Calcutta University collections ; 3, ex. *Cynodon dactylon*, Durbin, Kalimpong, INDIA, 20.5.1972, Calcutta University collections ; 4, ex. *Indet. grass*, Leimakhong, Manipur, INDIA, 3.5.1974, Calcutta University collections.)

Larva (first instar).—Body 0.90 mm. long with 0.46 mm. as width. Antennae pale brown, 4-segmented, pubescent, stout, $0.47 \times$ as long as the body ; primary rhinaria on both segment III and IV transverse ; hairs on the flagellum 0.036-0.050 mm. long, $0.73-1.0 \times$ as long as the basal diameter of antennal segment III ; processus terminalis $0.34 \times$ as long as base of last antennal segment. Rostrum reaches middle of abdomen ; ultimate rostral segment $1.0 \times$ as long as second segment of hind tarsus. Hairs on the dorsum of abdomen fine, on anterior tergites 0.03-0.04 mm. long, $0.6-0.8 \times$ as long as the basal diameter of antennal segment III, on posterior tergite upto 0.07 mm. long, $1.4-1.5 \times$ as long as the mentioned diameter ; 8th tergite with 12 hairs. Legs stout pubescent, longest hair on hind tibiae 0.05 mm. long, equal to the diameter at the middle of hind tibiae ; first tarsal segment with at least 3 hairs ; empodial hair 0.046 mm. long, equal to the claws.

Colour.—Brownish orange.

Measurements in mm.—

Length	Width			Antenna		
0.93	0.46			0.44		
	Antennal segments				urs.	ht ₂
I	II	III	IV			
0.05	0.09	0.14	(0.10+0.04)	0.13	0.13	

(ex. *Setaria palmiflora*, Peshoke, Darjeeling, 16.2.1972, Calcutta University collections).

Alate viviparous female.—(from Cottier, 1953). Body 2.2 mm. long. Antennae 6-segmented, $0.30 \times$ as long as the body, pubescent ; segments I-0.07, II-0.11, III-0.18, IV-0.09, V-0.010, VI-0.14 + 0.02 mm. Segment III with 7-11 small to large, circular to transverse secondary rhinaria, segment IV with 2-3 large, transverse and V with 0-1 small circular secondary rhinaria, primary rhinaria at the apex of segment V and VI large, irregular, non-ciliated ; Rostrum reaches mid coxae. Dorsum of abdomen smooth, pubescent ;

ventral hairs smaller. Siphunculi absent. Cauda very short with about 40 hairs. Subanal plate large, rectangular with many long hairs. Legs pubescent.

Sexupara.—Not available in India. Davatchi (1958) described sexuparae as follows : Head ventrally sclerotised along the margin of eyes ; mesonotum with a clear median spot ; wax glands absent. Antennae with subelliptical rhinaria, primary ones encircled by sclerotised margin, rhinaria non-ciliated ; Abdominal dorsum with pigmented sclerotic bands. Cauda covers anal plate ; Gononapophyses united with anal plate. Legs with hind coxae normal and first tarsal segments with 4+1, 4+1, 4+0 hairs.

Sexual forms.—Not available.

Material examined.—Four apterous viviparous females from *Eunomia oppisitifolia*, Herts, Herpenden, ENGLAND, 25.7.1965, coll. J. P. Doncaster (338/66, BMNH) ; Ten apterous viviparous females and two nymphs from *Setaria palmiflora*, Peshoke, Darjeeling, West Bengal, INDIA, 16.2.1972, coll. P. K. Pal ; Two apterous viviparous females from *Cynodon dactylon*, Kalimpong, West Bengal, INDIA, 20.5.1972, coll. P. K. Pal ; Two apterous viviparous females from unidentified host plant, Leimakhong, Manipur, INDIA, 3.4.1974, coll. P. K. Pal (all from Calcutta University collections).

Discussion.—The variability of morphological characters in this species has already been mentioned as also its extreme polyphagism. It can cause serious damage to beans and other vegetables. No alate viviparae from the region was available but the generic and specific diagnoses include characters for both apterae and alatae. The species appear to lead anholocyclic paracycle in this region and are normally available in winter and early summer, forming medium size colonies in sandy loam to loam soil at depth of 2.5-4.5 mm. (Pal, P. K. Ph.D. Thesis 1975). Zwölfer (1958) mentions that overwintering takes place in nests of ants, *Lasius flavus* in Central Europe and colonies are found outside ant nest towards end of March to first part of November when return movement to nests occurs ; myrmecophily was noted in 85% of the populations by

Zwölfer (op. cit) but it was observed to be always associated with ants, in this region.

No parasite or predator is known for the species in Central Europe or India ; Fulmek (1957) recorded two parasites *Aphidius ervi* Haliday and *Praon abjectum* (Haliday) in Britain and a predator *Chloropisca glabta* Mg. in U.S.A. but Mackawar (1968) did not include *S. betae* as one of the hosts, for any of the above braconid parasites.

Distribution.—Cosmopolitan.

Types.—Location of types not known.

REFERENCES

- AOKI, SHIGEYUKI. 1975. Descriptions of the Japanese species of *Pemphigus* and its allied genera (Homoptera : Aphidoidea). *Insecta matsum.*, N. S., **5** : 1-63.
- BASU, A. N. 1961. Some aphids new to India with description of a new subspecies. *Curr. Sci.*, **30** (10) : 390.
- BAKER, A. C. 1915. The woolly apple aphid. *Rep. U. S. Dep. agric.*, **101** : 1-55.
- BAKER, A. C. 1921. Generic classification of the Hemipterous family Aphididae. *Bull. U. S. Dep. agric.*, **826** : 1-109.
- BEHURA, B. K. 1963. Aphids of India : A survey of published information. *Proc. First Summer School of Zoology*, (Simla, 1961) : 25-78.
- BHATTACHARYA, D. K., MAITY, S. P., AND CHAKRABARTI, S. 1980. Aphids (Homoptera : Aphididae) of North West India. VII Hitherto unknown morphs of three species described from India and Pakistan. *Entomon*, **5** (4) : 335-339.
- BODENHEIMER, F. S. AND SWIRSKI, E. 1957. The Aphidoidea of the Middle East. Weizmann, Jerusalem, 1-378.
- BÖRNER, C. 1950. Neue europäische Blattlausarten. Selbstverlag. Naumberg, 1-19.
- BÖRNER, C. 1952. Europe Centralis Aphides. Die Blattläuse Mitteleuropas. Namen, Synonyme, Wirtspflanzen, Generationszyklen. *Mitt. thuring Bot. Ges.*, **3** : 1-488.

- BUCKTON, G. B. 1893. A new gall making aphid. *Indian Mus. notes*, **3** (1) : 71-73.
- BUCKTON, G. B. 1896. Notes on two new species of gall aphids from North Western Himalayan region. *Indian Mus. notes*, **4** (2) : 50-51.
- CHAKRABARTI, S., GHOSH, A. K., CHOWDHURI, A. N. 1970. Aphids (Homoptera) of Himachal Pradesh, India, III. *Oriental Ins.*, **4** (4) : 447-452.
- CHAKRABARTI, S., 1976. Two new species of aphids (Homoptera : Aphididae) from North West India. *Zool. J. Linn. Soc.*, **58** : 263-271.
- CHAKRABARTI, S. AND MAITY, S. P., 1978. Aphids (Homoptera : Aphididae) of North West India : new subgenus, new species and new records of root inhabiting aphids. *Entomon*, **3** (2) : 265-272.
- CHAN, CHO-KAI AND FORBES, A. R. 1975. Life cycle of a spiral gall aphid. *Pemphigus spirothecae* (Homoptera : Aphididae) on Poplar in British Columbia. *J. Ent. Soc. Br. Columbia*, **72** (1975) : 26-30.
- CHOLODKOVSKY, N., 1912. Sur quelques insectes exotiques. *Rev. Ent. St. Petersburg*. **12** : 491-496.
- CHOWDHURI, A. N., BASU, R. C. AND RAYCHAUDHURI, D. N. 1969. A new species of *Caveriella* Del Guercio and other newly recorded aphids (Homoptera : Aphididae) from Simla, Himachal Pradesh, *Sci. Cult.*, **35** : 334.
- COTTIER, W 1953. Aphids of New Zealand. *Bull. N. Z. Dep. Scient. Ind. Res.*, **106** : 1-382.
- CURTWRIGHT, W 1925. Subterranean aphids of Ohio. *Bull. Ohio. agr. exp. Stn.*, **387** : 175-238.
- DAS, B., 1918. The Aphididae of Lahore. *Mem. Indian Mus.*, **6** : 135-274.
- DANIELSSON, ROY, 1976. Gallbildande bladloss pa asp och poppel i Sverige. *Entomologen*, **5** (1) : 1-14.
- DANIELSSON, ROY 1979. The genus *Eriosoma* Leach in Sweeden, with descriptions of two new species. Studies on Eriosomatidae 1 (Homoptera : Aphidoidea). *Ent. Scand.*, **10** (3) : 193-208.
- DAVATCHI, A. G. AND REMAUDIERE, G. 1957. Quelques Fordinae nouveaux ou peu connus des *Pistacia* (Hom. Aphidoidea). *Rev. Path. Veg. Ent. Agr. Fr.*, **36** : 165-183.

- DAVATCHI, A. G., 1958. Etuele biologique de la faune entomologique des *Pistacia* sauvages et cultivées. *Rev. Path. Veg. Ent. Agr. Fr.*, **37** : 1-166.
- DAVID, S. KANAKARAJ. 1958. Some rare Indian aphids. *J. Bombay nat. Hist. Soc.*, **55** (1) : 110-116.
- DEL GUERCIO, G. 1900. Prospetto dell afidofauna Italica. *Nuove Relaz. R. Staz. Ent Agr. Firenze.* **2** : 1-236.
- DONCASTER, J. P. 1956. Two aphids from the Indian region. *Proc. R. ent. Soc. Lond.*, (B), **25** : 111-116.
- DONCASTER, J. P. 1969. Some species of *Pemphigus* (Homoptera : Aphididae) described from the Indian region by G. B. Buckton. *Proc. R. ent. Soc. Lond.*, (B), **38** : 157-164.
- DUNN, J. A. 1960. The formation of galls by some species of *Pemphigus* (Homoptera : Aphididae). *Marcelia*, **30** (Suppl.) ; 155-167.
- EASTOP, V F. 1958. A study of Aphididae (Homoptera) of East Africa. H. M. S. O. London, 1-126.
- EASTOP, V F. 1961. A study of Aphididae (Homoptera) of West Africa. British Museum (Nat. Hist.). London, 1-93.
- EASTOP, V F. 1966. A taxonomic study of Australian Aphidoidea (Homoptera). *Aust. J. Zool.*, **14** : 399-592.
- EASTOP, V. F. AND VAN EMDEN, H. F. 1972. "The Insect Material" P. 1-45, in *Aphid Technology*, ed. H. F. van Emden, Academic Press, London and New York, 1-344.
- EASTOP, V. F. AND HILLE RIS LAMBERS, D. 1976. Survey of the World's Aphids. Dr. W. Junk b. v. Publishers, The Hauge, 1-573.
- ESSIG, E. O. AND KUWANA, S. I. 1918. Some Japanese Aphididae. *Proc. Calif. Acad. Sci.*, **8** : 95-112.
- FITCH, ASA. 1855. The first report on the noxious, beneficial and other insects of the state of New York. *Trans. N. Y State agr. Soc.*, **14** : 705-880.
- FOTEDAR, M. R. AND KAPUR, A. P. 1943. First record of the sexual forms and oviparous reproduction of woolly aphid. *Eriosoma lanigerum* Hausm., from Kashmir *Curr. Sci.*, **12** : 84-85.
- FULMEK, L. 1957. Insectn als Blattlausfeinde. *Annl. naturh. Mus. Wien.*, **61** (1956/57) : 110-226.
- GHOSH, A. K. AND RAYCHAUDHURI, D. N. 1968. Two new records of aphids from India. *Bull. Ent.*, **a**(2) : 147-148.

- GHOSH, A. K., CHAKRABARTI, S., CHOWDHURI, A. N. AND RAYCHAUDHURI, D. N. 1969. Aphids (Homoptera) of Himachal Pradesh, India, II. *Oriental Ins.*, **3** (4) : 327-334.
- GHOSH, A. K., BASU, R. C. AND RAYCHAUDHURI, D. N. 1970. Studies on aphids (Homoptera : Aphididae) from Eastern India. New species and new records from Assam. *Oriental Ins.*, **4** (1) : 65-76.
- GHOSH, A. K. 1981. Ecology of subterranean aphids (Homoptera : Insecta) in India, 223-228. In "Progress in Soil Biology and Ecology" ed. G. K. Veeresh. *UAS Tech. Ser.*, **37** : 1-351.
- GHOSH, A. K., CHAKRABARTI, S. AND BHATTACHARYA, D. K. 1981. Galls of Pemphiginae (Homoptera : Aphidoidea) in the Indian region with description of a new species. *Bull. zool. Surv. India.* **4** (3) : 319-330.
- GHOSH, A. K. 1981a. Review of *Kaltenbachiella* Schoutedon (Homoptera : Aphidoidea). *Oriental Ins.*, **15** (2) : 127-138.
- GHOSH, A. K. (In Press). (b) Biology of Pemphiginae (Homoptera : Aphididae) in hillregion of India. *Proc. Workshop High altitude Entomology & Wild Life Ecology*, 1979. Solan.
- GHOSH, L. K. 1977. A study of Aphids (Homoptera) of Himachal Pradesh in North West Himalaya. Ph.D. Thesis, University of Calcutta, 1-339.
- GEORGE, C. J. 1927. South Indian Aphididae. *J. Asiat. Soc. Beng.* (N. S.), **23** ; 1-12.
- GULAMULLAH, 1941. Aphididae and some other Rhyncota from Afghanistan. *Indian J. Ent.*, **3** (2) : 225-243.
- HABIB, REHANA, AND GHANI, M. A. 1970. Eriosomatinae on Poplars and their natural enemies in West Pakistan. *Tech. Bull. C. I. B. C.*, No. 13 : 43-58.
- HARPER, A. M. 1959 a. Gall aphids on poplar in Alberta. I. Description of galls and distributions of aphids. *Can. Ent.*, **91** : 489-496.
- HARPER, A. M. 1959 b. Gall aphids on poplar in Alberta II. Period of emergence from galls, reproductive capacities and predators of aphids in galls. *Can. Ent.*, **91** : 680 : 685.
- HARPER, A. M. 1966a. Chromosomes of galls aphids in the subfamily Eriosomatinae (Homoptera : Aphididae). *Can. J. Genet. Cytol.*, **8** : 788-791.
- HARPER, A. M. 1966b. Three additional poplar gall aphids from southern Alberta. *Can. Ent.*, **98** : 1212-1214.

- HAUSMANN, F. 1902. Beitrage zuden Materialien fur eine kunstrige Bearbeitung der Gattung der Blattlaus. *Mag. Insektenk.*, **1** : 426-445.
- HIGUCHI, H. AND MIYAZAKI, M. 1969. A tentative catalogue of host plants of Aphidoidea in Japan. *Insecta matsum. Suppl.*, **5** : 1-66.
- HILLE RIS LAMBERS, D. 1952. The aphid fauna of Greenland. *Meddeel. Gronland*, **136** : 1-33.
- HILLE RIS LAMBERS, D. 1957. On some *Pistacia* aphids (Homopt. : Aphididae) from Isreal. *Bull. Res. Council Israel*, Section B, Biol. Geol., **6** : 170-175.
- HILLE RIS LAMBERS, D. 1966. Notes on California aphids with descriptions of new genera and new species (Homoptera : Aphididae). *Hilgardia*, **37** : 569-623.
- HILLE RIS LAMBERS, D. 1967. Notes on some Japanese Eriosomatinae. (Hompt. : Aphididae) and their life cycle. *Ent. Bericht.*, **27** : 86-89.
- HILLE RIS LAMBERS, D. 1968. The mystery of woolly apple aphid. *Aphidologists, News Letter*, **7** (5) : 4-5.
- HILLE RIS LAMBERS, D. 1968-69. A study of *Tetraneura* Hartig 1841 (Homoptera : Aphididae) with descriptions of a new subgenus and new species. *Bull. Zool. Agr. Bahic.*, (2), **9** : 21-101.
- HILLE RIS LAMBERS, D. 1973. Notes on some oriental aphids with descriptions of a new genus and four new species (Homoptera : Aphididae). *Oriental Ins.*, **7** (2) : 239-258.
- HORI, M. 1938. A revision of the species of the tribe Pemphigini occurring in Hokkaido and Saghalien, *Insecta matsum.*, **12** : 109-130.
- HOUARD, C. 1922-1923. Les Zooecidies des Plantes d' Afrique d' Asie et. d' Oceanie, **1** : 1-498 ; **2** : 499-1058.
- KOCH, C. L. 1857. Die Pflanzenlaus Aphiden, getreu nact dem Leben abgebildet and beschrieben. Nurnberg, 237-328.
- KONO, H. 1938. Uber die Lebensweise von *Prociphilus oriens* Mordvilko and *P. konoii* Hori, (I). *Kontyu*, **12** : 210-211.
- KIEFFER, J. J. 1908. Description de galles et d' insects gallicoles d' Asie. *Marcellia*, **1** : 149-167.
- LANGE, W. H. Jr. 1964. Biosystematics of *Pemphigus* ; In Seminar on Current Status of Research on Aphids. Berkely, California, p. 13 Abstracts 1-49.

- LICHTENSTEIN, J. 1886. Monographie des pucerons du peuplier. Montpellier, 1-42.
- MAITY, S. P. 1980. Aphids of North West India with special reference to Garhwal, Himalaya. Ph.D. Thesis, University of Kalyani, 1-441.
- MANI, M. S. 1973. Plant galls of India. Macmillan, India, 1-354.
- MACKAUER, M. 1968. Hymenopterorum Catalogus, Part 3, Aphididae. Dr. W. Junk. N. V., 95—Gravenhage (9.10.1968), 1-103.
- MATHUR, R. N. AND SINGH, B. 1959. A list of insect pests of forest plant in India and the adjacent countries. *Ind. For. Bull.*, **177** (7) : 53-55.
- MATSUMURA, S. 1917. Synopsis of the Pemphigidae of Japan. *Collections of Essays for Mr. Y. Nawa*, Gifu.
- MONDAL, P. K. 1977. Aphids of Sikkim. Ph.D. Thesis. University of Calcutta, 1-353.
- MONZEN, K. 1929. Studies on some gall-producing aphids and other galls. *Saito Ho-on Kai Monog.*, **1** : 1-80.
- MONZEN, K. 1930. Studies on insect galls. *Ann. Rep. Saito Ho-on Kai*, **6** : 270-288.
- MORDVILKO, A. A. 1935. Die Blattlause mit Unvollständigem Generationszyklus and ihre Entstehung. *Ergeb. Fortschr. zool.*, **8** : 36-228.
- NARZIKULOV, N. 1957. New Plant lice (Homoptera : Aphididae) from the mountain regions of Tadjikistan. *Rev. Ent. U.R.S.S.*, **36** : 671-694.
- PAL, P. K. 1975. Studies on the Aphids of Gramineous plants in North Eastern Himalaya with special reference to those infesting the subaerial parts. Ph. D. Thesis, University of Calcutta, 1-222.
- PALMER, MIRIAM, 1952. Aphids of the Rocky Mountain region. The Thomas Say Foundation, **5** : 1-452.
- PASSERINI, G. 1863. Aphididae Italicae hucusque observatae. *Arch. Zool. Anat. Fisiol.*, **2** : 129-212.
- RAYCHAUDHURI, D.N., PAL, P. K. AND GHOSH, M. R. 1978. Root Infesting aphids (Homoptera : Aphididae : Pemphiginae) from North East India, *Entomon*, **3** (2) : 239-264.
- RAYCHAUDHURI, D.N., PAL, P.K. AND GHOSH, A.K. 1980. Subfamily Pemphiginae, 409-433 ; In "Aphids of North East India and Bhutan" ed. D. N. Raychaudhuri, The Zoological Society, Calcutta, 1-521.

- REMAUDIÈRE, G. AND TAO, C. CHIA CHU, 1957. Les Fordinae (Hom. : Aphidoidea) du *Pistacia sinensis*. *Revu. Path. Veg. Ent. Agric. Fr.*, **36** (4) : 223-236.
- ROBERTI, D. 1938. Contributi alla conoscenza delgi Afidi d' Italia. I. I Pemfigini del Pioppo. *Boll. Lab. Zool. gen. agr. Portici*, **30** : 169-239.
- ROBERTI, D. 1939. Contributi alla conoscenza delgi Afidi d' Italia. III. I. Fordini. *Boll. R. Lab. Ent. agr. Portici.*, **3** : 34-105.
- SHINJI, O. 1941. Monograph of Japanese Aphididae. Shinkyō Sha Shein, Tokyo, 1-1215.
- SHINJI, O. 1944. Galls and gall insects. Shungo-Do, Tokyo, 1-580.
- SINGH, T. K., DAS, B. C. AND RAYCHAUDHURI, D. N. 1977. A new species, *Prociphilus cornifoliae* (Homoptera : Aphididae) from Nepal and Manipur (India). *Entomon*, **2** (2) : 221-223.
- SMITH, C. F. 1969. Pemphiginae associated with roots of conifers in North America. (Homoptera : Aphididae). *Ann. ent. Soc. Am.* **62** : 1128-1152.
- SMITH, C. F. 1972. Synonymy, redescription and biology of *Neoparaclotus corrugatans* (Homoptera : Aphididae). *Ann. ent. Soc. Am.* **65** (6) : 1328-1331.
- SMITH, C. F., 1974. Keys to and descriptions of the genera of Pemphigini in North America (Homoptera : Aphididae : Pemphiginae). *Tech. Bull. N. C. Agric. Exp. Stn.*, **226** : 1-61.
- SMITH, C. F. 1981. Pemphiginae in North America, Symp. Evolution and Biosystematics of Aphids, Warszawa, 1981, 1-26 (Separatum).
- STROYAN, H. L. G., 1963. A new genus and species of Eriosomatinae (Homoptera : Aphidoidea) from North West Himalayas. *Proc. R. ent. Soc. Lond.*, (B), **32** : 81-85.
- STROYAN, H. L. G., 1964. Notes on British species of *Pemphigus* Hartig (Homoptera : Aphidoidea) forming galls on Poplar, with description of a new species. *Proc. R. ent. Soc. Lond.*, (B), **33** : 92-100.
- STROYAN, H. L. G. 1975. The life cycle and generic position of *Aphis tremulae* L., 1761 (Aphidoidea : Pemphiginae), with a description of viviparous morphs and a discussion of spruce root aphids in the British Isles. *Biol. J. Linn. Soc.*, **7** (1) : 45-72.
- TAKAHASHI, R. 1938. List of aphid genera proposed in recent years (Hemiptera) *Tenthredo*, **2** : 1-18.

- TAO, C. CHIA, CHU., 1970. Revision of Chinese Eriosomatinae. Aphidae, Homoptera. *Quart. J. Taiwan Mus.*, **23** : 135-149.
- TSAI, P. H. AND TANG, C., 1946. The classification of the chinese gall aphids with descriptions of three new genera and six new species from Meitan, Kweichow. *Trans. R. ent. Soc. Lond.*, **97** : 405-418.
- TULLGREN, A. 1909. Aphidologische studien. *Ark. Zool.*, **5** (14) : 1-190.
- WERTHEIM, GUTA. 1954. Studies on the biology and ecology of the gall producing aphids of the tribe Fordini (Homoptera : Aphidoidea) in Israel. *Trans. R. ent. Soc. Lond.*, **105** : 79-96.
- ZWÖLFER, H. 1957. Zur Systematik Biologie und Okologie unterirdisch lebender Aphiden (Homoptera: Aphidoidea)(Anoeciinae, Tetraneurini, Pemphigini und Fordinae). Teil. II. Tetraneurini und Pemphigine, *Z. angew. Ent.*, **40** : 528-575.
- ZWÖLFER, H. 1958. Zur Systematik, Biologie und okologie unterirdisch lebender Aphiden (Homoptera : Aphidoidea). Teil III (Fordinae). *Z. angew. Ent.*, **42** : 129-172.
- ZWÖLFER, H. 1958. Systematik, Biologie und okologie unterirdisch lebender Aphiden (Homoptera : Aphidoidea). Teil. IV Okologische und Systematische Erosterungen. *Z. angew. Ent.*, **43** : 1-52.

HOST PLANTS OF PEMPHIGINAE RECORDED
IN THE REGION

- Ailanthus glandulosus
Kaburagia ailanthi
- Alnus sp.
Prociphilus caryae fitchii
- Androctine cordifolia
Eriosoma (S) longipilosum
- Apluda mutica
Teraneura utpali
- Axonopus compressus
Tetraneura nigriabdominalis
- Bothrichola pertusa
Forda riccobonii
- Brachiaria ramosa
Tetraneura radiciala yezoensis
- Brunfelsia uniflora
Ceratopemphigus zehntneri
- Capilipidium sp.
Tetraneura nigriabdominalis
Tetraneura radiciala|yezoensis
- Capillipidium pervilorum
Chaetogcoicagraminiphaga
- Carex sp.
Geoica lucifuga
Gharsia polunini
- Carpinus sp.
Kaltenbachiella carpinicola
- Chrysopogo sciculatus
Tetraneura nigriabdominalis
- Cornus sp.
Prociphilus cornifoliae
- Cynodon dactylon
Geoica lucifuga
Smynthuodes betae
- Dicanthium sp.
Forda riccobonii
- Dachyloctinum aegypticum
Tetraneura nigriabdominalis
- Echinocola crusgalli
Tetraneura radiciala|yezoensis
- Eichonocola colonum
Tetraneura basui
Tetraneura nigriabdominalis

- Eleusine indica
 Chaetoyeoica graminiphaga
 Tetraneura basui
 Tetraneura nigriabdominalis
- Eragrostris gangeticus
 Tetraneura nigriabdominalis
 Tetraneura radiculicola|yezoensis
- Eragrostris nigra
 Forda marginata
 Tetraneura nigriabdominalis
 Tetraneura sikkimensis
- Eragrostris tenella
 Tetraneura nigriabdominalis
 Tetraneura radiculicola|yezolensis
- Eragrostris uniloides
 Forda marginata
- Ericharis remosa
 Tetraneura nigriabdominalis
- Euphorbia helioscopia
 Pemphigus immunis
- Fraxinus floribunda
 Prociphilus sp.
- Fraxinus sp.
 Prociphilus oriens
- Imperata arundinacea
 Forda marginata
 Tetraneura nigriabdominalis
- Imperata cylindrica
 Tetraneura multisetosus
 Tetraneura nigriabdominalis
 Tetraneura radiculicola|yezoensis
- Malus pumila
 Schizoneurda indica
- Michelia champaka
 Formosaphis micheliae
- Oplismenus burmanni
 Tetraneura nigriabdominalis
- Oryza sativa
 Chaetogeoica polychaeta
 Geoica lucifuga
 Tetraneura basui
 Tetraneura nigriabdominalis
- Pagonantherum saccharum saceharoideum
 Tetraneura basui
 Tetraneura nigriabdominalis
 Tetraneura radiculicola|yezoensis
- Paspalum commessonii
 Geoica lucifuga

- Paspalum conjugatum**
Tetraneura nigriabdominalis
- Pennisetum sp.**
Tetraneura kalimpongensis
- Pennisetum typhoides**
Forda orientalis
- Photinia notoniana**
Prociphilus sp. A
- Pistacia integerrima**
Baizongia pistaciae
- Pistacia terebinthus**
Chaetogeoica foliodentata
- Pinus sp.**
Prociphilus (S) himalayensis
- Polypogon fugax**
Chaetogeoica graminiphag
Geoica sikkimensis
Tetraneura nigriabdominalis
Tetraneura radicecola/yezoensis
- Polypogon monspeiensis**
Tetraneura basui
Tetraneura nigriabdominalis
- Populus sp.**
Pemphigus immunis
Pemphigus vesicarius
- Populus ciliata**
Epipemphigus imaicus
Pemphigus mordvilkoii
Pemphigus nainitalensis
Pemphigus siphunculatus
- Populus euphratica**
Pemphigus napaeus
- Populus nigra**
Pemphigus spyrothecae
- Pyrus malus**
Eriosma lanigerum
- Pyrus polycarpa**
Eriosoma lanigerum
- Ranunculus histellus**
Thecabius affinis
- Saccharum officinarum**
Tetraneura kalimpongensis
- Salix wallichiana**
Prociphilus (N) ghanii
- Setaria glauca**
Tetraneura basui
Tetraneura nigriabdominalis

- Setaria pallida* fusca
Tetraneura nigriabdominalis
- Sorghum vulgare*
Forda margianata
- Sporobolus* sp.
Geoica luceifuga
- Taxus baccata*
Prociphilus taxus
- Triticum vulgare*
Forda marginata
Pemphigus vulgaris
Tetraneura radiccicola/yezoensis
- Tsuga brunoniana*
Prociphilus sp.
- Ulmus* spp.
Eriosoma kashmiricum
Eriosoma (S) lanuginosum
Tetraneura nigriabdominalis
Tetraneura ulmi
- Ulmus montana*
Eriosoma (S) phaenax
- Ulmus villosa*
Schizoneurella indica
Tetraneura polychaeta
- Ulmus wallichiana*
Eriosoma (S) ulmi

INDEX TO GENERA AND SPECIES

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ERRATA/ADDENDA

<i>For</i>	<i>Read</i>
Pages 9, 62, paras 1, 3, lines 1, 5.	Byrscocryptini <i>Byrscocryptoides</i>
Page 10, para 1, line 15	<i>Schizoneurta</i>
Pages 12, 34, 158, paras 1, 3, 1, lines 7, 4, 17	Gulamullah
Pages 16, last para, line last but one	<i>elematis</i>
Page 20, para 4, line 3	<i>Eriosoma Kashmiricum</i> Bhattacharya
Page 45, para 3, line 3	<i>Eriosima phdenax</i> Mordvilko
Pages 63, 64, 69, 72, paras 3, 1, 5, 1, lines (4, 8), 3, 3, 1	<i>Gobiashia</i>
Page 65, para 5, line 2	<i>Bull. zool. Surv.</i> <i>India,</i> .
Page 65, 69, paras, 5, 5 lines 3, 11	<i>Oriental Ins.,.</i>
Pages 50, 78, paras 4, 3, lines 6, 2	<i>Muree</i>
Pages 80, 154, 158, 161, 358, paras 2, 7, 1,5,1, lines (2, 9), 7, 17, 1, 2, Pages, 91, 120, 136, paras 2, 2, 1, lines 17, 8, last	errected, errecting
Page 95, para 4, line 3	<i>Setaria glaucae,</i> <i>Setearia galuca</i> <i>Setaria galuca</i>
Page 111, last para, line 3	<i>Tetraneura cynodotis</i> <i>Tetraneura</i> <i>fusiformis, Matsumara</i>
Pages 140, 141, paras 4, 1, lines 1, 1.	<i>Tetraneura ulmi</i> Linnaeus (Synonymps)
Page 140, para 5 last line	<i>P. imaicus</i>
Page 171, para 3, line 1	<i>Genus Pepiphigus</i>
Pages 187, 189, top	<i>Byrscocryptini,</i> <i>Byroscryptoides</i> <i>Schizoneurata</i> Ghulamullah <i>clematis</i> <i>Eriosoma kashmiricum,</i> Bhattacharya <i>Eriosoma phaenax,</i> Mordvilko <i>Gobaisha</i> <i>Bull. zool. Surv. India,</i> 4 : 319 <i>Oriental Ins., 15 : 127</i> <i>Murree</i> erected, erecting <i>Setaria glauca</i> <i>Tetraneura cynodontis</i> <i>Tetraneura fusiformis</i> Matsumara <i>Tetraneura ulmi</i> (Linnaeus) (Synonyms) <i>E. imaicus</i> <i>Genus Pemphigus</i>

	<i>For</i>	<i>Read</i>
Pages 188, 214, 215, paras 7, 7, 1, lines 6, 1, 1, Page 237, para 1, line 1 Page 255, para 2, line 2	<i>Pemphigus napeus</i>	<i>Pemphigus napaeus</i>
Page 264, para 8, line 1	<i>Pemphigua vulgaria</i> <i>Lonicera</i> <i>quingueloenlasis</i> <i>Prociphilus micheliae</i> , Hille Ris Lambers	<i>Pemphigus vulgaris</i> <i>Lonicera</i> <i>quingueloenlasis</i> <i>Prociphilus micheliae</i> Hille Ris Lambers
Page 268, para 3, line 1	<i>Prociphilus oriens</i> , Mordvilko	<i>Prociphilus oriens</i> Mordvilko
Page 303, para 1, line 7	<i>Stagona xylostei</i> Koch	<i>Stagona xylostei</i> Koch
Page 313, para 5, line 2	<i>Thecabius populncus</i>	<i>Thecabius populaeus</i>
Page 326, para 1, line 19	<i>Asephonella</i>	<i>Asiphonella</i>
Pages 328, 329, paras 1, 1, lines 1, last	<i>Smynthuroides betoc</i> <i>Smynthuroides betoe</i>	<i>Smynthuroides betae</i>
Page 333, para 2, line 4 Page 338, paras 1, 2, last, lines 3, (3, 5, 11), last but one	<i>Rhizoctonus ampelonus</i> <i>A. cyanodontii</i>	<i>Reizoctonus ampelinus</i> <i>A. cyanodonti</i>
Page 369, para 6, line 15. Page 370, line 4. Page 370, para 2, line 3. Page 370, para 3, line 5. Page 371, para 1, line 13. Page 371, para 1, last line. Page 386, line 8. Page 386, line 18. Page 394, line 12. Page 395, para 3, line 11. Page 396, line 1. Page 401, para 1, line 11. Page 406, para 6, line 4. Page 416, Ref. srl. No. 9.	<i>Rhizote</i> aparse Rishambers <i>Kaussarii</i> <i>riccoboni</i> <i>basius</i> <i>sguamosa</i> <i>Pemphigitum</i> Subanal Graminaecus <i>Sikkimensis</i> <i>Kaburgia</i> <i>Tychia</i> Gulamullah	<i>Rhizoterus</i> sparse Ris Lambers <i>Kaussari</i> <i>riccobonii</i> <i>Lasius</i> <i>squamosa</i> <i>Pemphigetum</i> subanal <i>Graminaceous</i> <i>sikkimensis</i> <i>Kaburagia</i> <i>Tychea</i> Ghulamulla