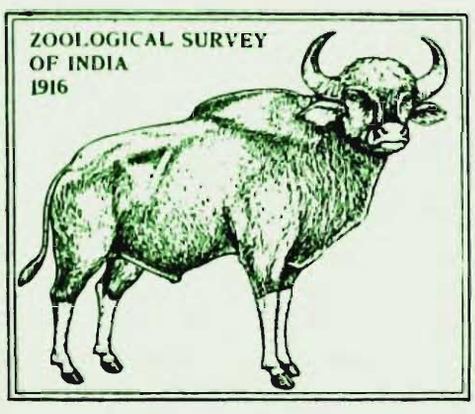
TECHNICAL MONOGRAPH No. 7

# Aphid Parasitoids of India and adjacent countries (Hymenoptera : Aphidiidae)

by

P. STARÝ

A. K. GHOSH

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# FOREWORD

Aphids form one of the most important group of insect pests in the field of agriculture and forestry. In recent years, emphasis has been laid to control these insects by integrated control methods which involve chemical control, agricultural control and biol gical control. For the purpose of biological control, predators, parasitoids and other agents like bacteria, are used. One of the most significant role is played in this field by the Aphidiid parasitoids of Aphids. Many new informations on these bio-control agents have been published in recent years. However, there is no account of Aphidiid parasitoids available for India and its adjacent countries.

In the present monograph, the authors Dr. P. Starý, a world renowned specialist on Aphidiid parasites working with the Institute of Entomology, Czechoslovak Academy of Science and Dr. A. K. Ghosh, an eminent Aphidologist, working with this Survey, have combined their efforts to provide summarising accounts of this important group. It includes basic methods of sampling, rearing, preserving, mounting, and identification of material as well as method for field work. A total of 75 species of parasitoids of 21 genera have been dealt. Information on their original description, hosts, biology and distribution have been provided for individual taxa. The discussion includes zoo-geographical affinities of the fauna of this region. A host parasitoid index include 46 genera and 100 species of Aphids. A seperate subject-index provides extensive coverage of the subjects dealt. The monograph has also been adequately illustrated for easy understanding.

It is hoped, that the amount of valuable informations available in this technical monograph will help the scientists engaged in management and control of Aphid pests which act as the single largest group of insect vectors of plant viruses. In the long run, it is expected that monograph of this nature will render assistance in planning control strategy with minimum utilisation of chemical insecticides.

Calcutta
28th Feb. 1983

B. K. TIKADER
*Director,*
*Zoological Survey of India*

# APHID PARASITOIDS OF INDIA AND ADJACENT COUNTRIES ( HYMENOPTERA : APHIDIIDAE )

P. Starý and A. K. Ghosh

ABSTRACT

The present book is a summarizing account on the aphidiid wasps of India and adjacent countries (Pakistan, Bangladesh, Nepal, Bhutan, etc.). Basic methods of sampling, rearing, preserving, mounting, identification of material as well as of the field work are briefly reviewed. The review of genera and species includes information on the original description, type-material, figures, hosts, biology and distribution of the individual taxa ; both published (up to 1981, part. 1982) and original (incl. cheked) records are included. 21 genera and about 70 species of parasitoids are recorded. The chapter of zoogeography is a preliminary determination of the particular faunal groups and elements represented in the fauna of the target area, as well as their relations to the adjacent zoogeographical areas. Host—parasitoid index is alphabetical in the genus/species system, and brings parasitoid records on 46 genera and about 100 species of aphids., irrespective of taxonomical groups of aphids. Parasitoid index includes all the species/genus names determined in the target area, the synonyms are mentioned only in cases if used in the target area. Subject index is extensive, aiming to bring a brief information from morphology to utilisation of the particular species in biological control. References are divided into three groups, i. e. general papers, references on the target area, and unpublished theses, respectively.

**Taxonomic changes :**

*Lipolexis gracilis* Förster, 1862
=*Lipolexis chinensis* Chen, 1980...N. syn.

*Lysiphlebia mirzai* Shuja-Uddin, 1975
=*Lysiphlebia sacchari* Chen, 1980...N. syn.

(*Pauesia*) *Pauesiella* Starý & Sedlag, 1980
=(*Pauesia*) *Kashmirpauesia* Bhagat, 198....N. syn.

*Trioxys* (*Binodoxys*) *centaureae* (Haliday, 1833)
=*Binodoxys uroleucon* Takada & Rishi, 1980...N. syn.

*Cristicaudus nepalensis* (Takadal, 1970), n. comb.
for *Binodoxys nepalensis* Takada, 1970.

*Trioxys* (*Binodoxys*) *kashmirensis* (Takada & Rishi, 1980), n. comb.
for *Binodoxys kashmirensis* Takada & Rishi, 1980.

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# INTRODUCTION

Aphid pest problems have become worldwide. Doubtlessly, the aphids will still gain importance as the pests. There are many well-known reasons such as their biological peculiarities in combination with the intensification of agriculture and forestry, introduction of new varieties, fertilizers, insecticides (and development of aphid resistant strains), and others. All this has naturally stimulated research on biological control of aphids within the frame of pest management programmes. This attention has been paid to the indigenous fauna of parasitoids, and the ascertained gaps have been covered by introduced species. The degree of research as well as the level of results are different in the particular countries. However, a world analysis of the up-dated situation reveals even a basic lack of information from many, often rather extensive areas of the world. Biological control specialists often have searched merely for the parasitoid complex of a target aphid-pest species and did not pay attention to the whole fauna ; this approach may look economic primarily, and often, owing to time pressure a few days or a part of the season may be thought as enough for the search and exportation of some species but—by far—do not bring complete information. In our opinion, that is perhaps well-documented by long personal experience in the research of the aphidiid parasitoids, just the applied biological control should origin from a complex information in a target area so far as the aphidiid parasitoids are concerned. Faunal composition, distribution, biological peculiarities, etc. of the aphidiids in the particular areas are the basic sources from which many principal features of aphidiid parasitoids as a group may be derived. Important results, however, may be obtained even for the so-called applied research. The knowledge of the host range of a target parasitoid species allows us, for example, to determine the (agro) ecosystem relations and possibly even to join several biological programmes (crop-pest aphid species—parasitoid species) together.

India and adjacent countries (Pakistan, Bangladesh, Nepal, Bhutan, etc.) represent a great part of the Oriental region. Research on aphids is well-known to become rather intensive and it is quite understandable that interest has been also paid to aphid control agents. Doubtlessly, research on parasitoids has been also rather stimulated by the activities and research projects of the world-wide biological control organisations (C.I.B.C., U.S.D,A., etc.) which have utilised the target area as one of the sources to obtain exotic species for introduction, to a lesser degree even for importation of parasitoid species. On the other hand, enthusiastic research undertaken

by individual workers both in and outside of the target area has been also important, partially on "economically unimportant" aphid species and their parasitoids.

Any research in such a geographically heterogeneous area is certainly difficult. There are many different neighbouring areas, with more or less known parasitoids fauna. In a tentative situation in research, in course of the first steps, it is rather difficult even for a skilled specialist to decide the peculiarities, which are the typical features of the target fauna, and which species merely extend into the target area from adjacent areas, and vice versa. An almost detective story on the origin and world distribution of *Aphidius colemani* could be presented as an example.

When analysing the up-dated situation in the research on the aphidiid wasps in the target area, we have concluded that it is necessary to summarize and check the existing information in a comprehensive study from which further research could go ahead. This is a good practice followed in other areas and similar summarizing books have always been appreciated as less informed people do not certainly have both time and research experience or level to get a good orientation in so many scattered contributions, often of rather different scientific value and level.

In the present paper, all available information on the aphidiid wasps of the target area known upto the end of 1981 has been included. However, we have also tried to obtain even the subsequent current information of 1981-1982 as much as possible to keep our paper at the possibly newest information level.

A monographic elaboration of the parasitoids of the target area would be by far premature. Nevertheless, a summarizing account has to work as a tentative partial monograph as well. For this reason, we have included many figures and keys with information where more detailed description may be obtained. We stress rather firmly, however, that species not included in our paper (or unidentifiable according to our keys) may or may not be new to science, and corresponding references on the particular genera and species need to be subsequently used in a more detail. The modern biosystematic approach requires biological information of the species, whereas the descriptive phase has become, more or less, just a hard piece of work or primary step. All the authors who would tend to deal with the group should keep in mind that very often information on the biology, distribution, etc. of the already described species brings much more value than the so-called "hunting for new species". The up-dated research must everywhere be undertaken from a broader viewpoint, hence each specialist working on a partial problem should know and always keep in his mind the whole biological control building, its particular floors and

corridors, and his own position there. Unfortunately (or fortunately), it is impossible to built up a building for all the specialists, hence international collaboration has been the only solution.

ACKNOWLEDGMENTS

It is a pleasure to express our cordial thanks to many specialists who have supported us by material. Sincere gratitude is expressed to the Zoological Survey of India and the Czechoslovak Academy of Science for the general support of our research efforts.

## METHODS

The aphidiid wasps are biologically characterized as parasitoids on the aphids. This is a great advantage for any student on the group. For this reason, any field collection of aphidiid parasitoids should be subsequent to at least a general knowledge of aphid biology. If a complex research is undertaken, it is necessary to collect aphid colonies in all environments which are certainly rather heterogeneous. Both natural ecosystems and agro-ecosystems should be dealt with. Samples should be taken throughout the season as seasonal differences in parasitoid fauna may occur. It is preferable to take extensive samples as greater the quantity of collected material is, the greater information is obtained in various directions (relative abundance of parasitoids, parasitoid spectrum, etc.). It is useful to take many samples of the same aphid species as well as the whole associated parasitoid spectrum which may rarely occur together if more parasitoid species are involved.

As most of the insects, adult parasitoids may be commonly obtained by sweeping. This material, however, may be classified as merely complementary. It is often difficult to determine the isolated specimens to species level : also, the swept material does not bring substantial ecological information except for habitat and seasonal period. For these reasons, sweeping is usually used as a complementary method in field population studies.

Rearing of aphid colonies to obtain parasitoids is much more useful : we obtain the records on the host, its host plant, habitat, season, primary parasitoids, hyperparasitoids, often several species mixed together, and all this is fundamental both for subsequent biosystematic and ecological studies.

Field experience shows that it is preferable to collect aphid colonies irrespective of the presence or absence of mummified aphids ; in most cases, some parasitised aphids are usually present in each larger colony and the 2-3

days of aphid survival within a container is enough for at least a part of parasitoid larvae to complete their development and spin a cocoon within (mummy) or under the empty aphid skin.

Containers for aphid sampling and subsequent parasitoid rearing are determined by the worker. In our field practice, we have used 250 or 500 ccm volume translucent plastic containers covered with a nylon mesh and tied with a rubber or with a plastic cork—in every case, air exchange is necessary. Glass containers can also be used but their disadvantage is in their relative fragility and weight. Smaller plastic or glass tubes (vials) are preferable in case of a long-term trip and restricted space possibilities.

The field collection practice is quite simple. A piece of plant with an aphid colony or its part is transferred into the container, and the latter is tied. Simultaneously, a few aphid adults (alate and apterous, if possible) are taken into a small tube containing alcohol for later identification ; sample number, locality, date, host plant species, notes on the habitat, field identification of the aphid, and various observations are written in a field notebook. The size of the cut-plant piece must be proportionate to the size of the container. The too big pieces of soft leaves produce too much humidity and subsequent growth of various fungi that may spoil whole of the sample. Full containers are carefully kept in a cooler place, at least in shade, as overheating may cause immediate death both of aphids and parasitoids (yet unemerged). In the laboratory, the containers are preserved in a semi-shaded place to keep them at average conditions of temperature and humidity. They have to be checked every 2-3 days to transfer some samples to clean containers in case of fungal infection. The emerged parasitoid adults may be seen after a short time to several days, and may by collected by a suction collector, while running on the nylon mesh ceiling of the container. If the climatic conditions allow this, in combination with time-pressure, the adult parasitoids may be left to die in the containers and the samples are examined at due time later : the dry material of aphids, parasitoid adults, and plant remainders on the bottom must be selected very gently. Mummies are examined as some unemerged mummies may be the diapause mummies that indicate some biological peculiarities and necessitates more detailed approach. Selected dry material of parasitoid adults is transferred and kept in Petri dish before being mounted ; a part of the mummies should be also preserved as they may be useful both for eventual aphid identification and pupation/emergence studies on parasitoids ; sometimes, even the coloration of mummies may be important.

Parasitoid adults are mounted on the standardized paper labels in a style allowing the examination of the face, notal and pleural parts of thorax and abdomen ; hence a droplet of mounting medium is put in the centre of

the first one third of the label and the adult insect is attached by lower-lateral part of thorax. Sample number, and other labels may be restricted to the first specimen in the mounted series. On an average, 10 specimens of each species represented in a sample with the prevalence of females are usually enough for routine examination, and the remaining material is preserved in a small tube which is pinned next to the series in an entomological box. Although many species of parasitoids may be identified in a dry state under a binocular microscope, it is necessary in many cases to make slides for examination of details under an ordinary microscope. Mounting mediums for aphids are generally useful also for the parasitoid adults. After boiling and cleaning of the specimen in 10% KOH it is washed in distilled water, and transferred into a drop of medium on a microscopic slide : within this drop, the specimen is then dissected in such a style that allows to examine the necessary details ; usually, the head, antennae, wings, various parts of thorax (mesonotum, propodeum) and abdomen (tergite 1 and genitalia) have to be selected and isolated. If enongh material is at hand, it is also recommendable to mount a whole specimen in a lateral or dorsal position on a slide ; this may be useful for examining some characters on various body parts in their truly natural position.

The collection of parasitoids is organised alphabetically in a genus/species system. However, even in a parasitoid species, it is recommendable to arrange the series of mounted material in an alphabetic order (host aphids), as such an arrangement is useful both in solving some taxonomic and ecological problems (species, strains).

It is also recommendable to develop a good system of managing the obtained records. This pertains to both the sample, parasitoid-host, and host-parasitoid information.

Rearing of parasitoid cultures in the laboratory is generally rather simple. The rearing room should be air conditioned. Fluorescent light is quite useful for many plant species, but sometimes it is necessary to have parallel host plant cultures (glasshouse or in the open) at hand as they may not survive for long under artifical light conditions. Temperature around 18°C and 60-70 r.h. under 16 hours lightperiod seem to be a good average conditions for the rearings. Rearing cages or isolators have wire skeletons and are covered with nylon mesh. Sprinkling with water once in a day is necessary as well as adding of a few honey droplets on the mesh ceilings as food for parasitoid adults, although the latter feed naturally on aphid honeydew.

Initial studies may perhaps be best undertaken by using various leguminous plants (beans, peas) or cereals, on which a number of aphids may be success fully reared under fluorescent light.

Extensive information on parasitoid rearing in both small and a mass-scale can be obtained from references (see : References, A).

## REVIEW OF GENERA AND SPECIES, AND KEYS (♀ ♀)

*Information* : The review has been adapted according to the research level in the target area and the information is presented at the up-dated levels of biosystematics. For this reason, information on the taxons outside the target area has been omitted as most of the basic records may be found in the summarizing papers (see : References, Section A).

Synonyms are mentioned merely in cases that such names have been used in references on the target area.

Records on original descriptions and type-material are presented if based on the material from the target area.

Genera and species of parasitoids are reviewed in an alphabetic order irrespective of their taxonomic affinities.

*Scheme of records* : In each species, records are differentiated into subsequent paragraphs : Figures (*Figs.*), Synonyms (*Syns.*), Taxonomy (*Tax.*), Hosts (*Hosts*), Biology (*Biol.*), Distribution (*Distr.*), Notes (*Notes*). In case of absence of an information in a certain paragraph, the latter is omitted.

*Abbreviations* : P—Parasitoid. H—Host. (?)...doubtful record. (!)..... obviously erroneous record. [.....] occurrence of the species doubtful, identification apparently erroneous. (+)...following a reference means that we have seen material from the target area and/or host species ; this may or may not be identical with the published record. +...before the parasitoid genus/species name means that we have seen material from the target area.

*Explanations* : Tentorial index is the relative length of the tentorio-ocular line over intertentorial line, see : Fig. 41. Nomenclature of wing-venation, see : Fig. 86.

*Keys* : Many of the keys are preliminary as the number of species presumed to occur in the target area is much higher. For this reason, host range characteristics is also sometimes used as one of the identification characters tending to indicate possible errors if the material to be identified is similar but not identical with the established and keyed species.

*KEY TO THE GENERA*

| | | | |
|---|---|---|---|
| 1. | Median vein developed throughout, separating radial cell 1 from the median cell (Figs. 76, 85): first abscissa of median vein may be more or less subcoloured (Figs. 48, 148, 152). ... | ... | 2 |
| — | Median vein effaced frontally (Figs. 16, 20, 132, 142) or almost entirely (Figs. 103, 120, 124), radial cell 1 and median cell 1 confluent; venation often reduced behind basal vein (Figs. 7, 55, 61, 70, 74, 100, 111, 170, 177). ... | ... | 6 |
| 2 (1) | Both interradial veins developed (Figs. 81, 163) ... | ... | 3 |
| — | Both interradial veins effaced (Figs. 48, 148, 152) | ... | 4 |
| 3 (2) | Ovipositor sheaths straight, almost parallel-sided (Figs. 76, 85). Ovipositor lanceolate at the apex. Antennae 11-segmented. ... | | **EPHEDRUS** |
| — | Ovipositor sheaths curved downwards, rather broadened, deltoid and trifid at extremity. Ovipositor curved downwards, simply acute at the apex (Fig. 161). Antennae with a higher number of segments.... | | **TOXARES** |
| 4 (2) | Propodeum smooth. Ovipositor sheaths with sparse hairs (Figs. 159). ... | ... | 5 |
| — | Propodeum areolated. Ovipositor sheaths pubescent (Fig. 48). ... | | **AREOPRAON** |
| 5 (4) | Intermedian vein distinct (sometimes colourless) (Fig. 152). ... | | **PRAON** |
| — | Intermedian vein effaced (Fig. 148). ... | | **PARAPRAON** |
| 6 (1) | Radial and median cells confluent, distinctly completed by interradial vein 2 on their external margin (Figs. 7, 39, 57, 61, 70, 74, 111, 162 and 177); interradial vein 2 sometimes nearly colourless but distinct (Figs. 100, 120 124,). ... | ... | 7 |
| — | Radial and median cells confluent, open, not completed by interradial vein 2 on their external margin (Figs. 2, 7, 55, 57, 61, 70, 74, 111, 162, 170, 171, 177, 185, 187). ... | ... | 15 |
| 7 (6) | Pterostigmal cell distinctly incomplete (Figs. 7, 57, 61, 70, 74, 111, 162, 177). ... | ... | 8 |
| — | Pterostigmal cell distinctly complete (Fig. 39). ... | | **ARCHAPHIDUS** |
| 8 (7) | Confluent radial and median cells distinctly completed on lower margin by fused intermedian+median vein (Figs. 16, 30, 52, 103, 132, 136, 142, 146). ... | ... | 9 |
| — | Confluent radial+median cells on lower margin distinctly open; fused intermedian+median vein incomplete to a various extent (Figs. 100, 120, 121, 124, 127). ... | ... | 12 |

9 (8) Ovipositor sheaths slightly curved upwards, mostly prolongated oval, or narrowed to the apex (Figs. 15, 18, 22, 28, 105, 106, 133, 139, 140, 144). ... ... 10

— Ovipositor sheaths curved more or less downwards, ploughshare-shaped (Fig. 131). ... **MONOCTONUS**

10 (9) Carinae on propodeum forming large, wide, pentagonal areola ; sometimes poorly distinguishable in their transverse on longitudinal part (Figs. 137, 141, 204). ... **PAUESIA**

— Carinae on propodeum forming a narrow areola (Figs. 17, 23, 45), or only two divergent carinae developed in the lower part of propodeum (Fig. 101). ... ... 11

11 (10) Carinae on propodeum forming a narrow areola (Figs. 17, 23, 45). Ovipositor sheaths with sparse hairs (Figs. 15, 22, 24). ... **APHIDIUS**

— Only two divergent carinae developed in the lower part of propodeum (Fig. 101). Ovipositor sheaths pubescent (Figs. 105, 106). ... **KASHMIRIA**

12 (8) Ovipositor sheaths of oval shape, slightly arcuate, curved upwards (Figs. 118, 129, 130). ... ... 13

— Ovipositor sheaths relatively long and narrow, curved, downwards prolongated, claw-shaped (Fig. 102). ... **INDAPHIDIUS**

13 (12) Propodeum smooth (Figs. 119, 122, 125). ... **LYSIPHLEBUS**

— Propodeum areolated (Fig. 31) or at least with two divergent carinae in the lower portion (Fig. 115). ... ... 14

14 (13) Tergite 1 almost parallel-sided, narrow, only slightly dilated to the apex, with central longitudinal carina in about the two-third (Fig. 37). ... **LYSAPHIDUS**

— Tergite 1 distinctly dilated to the apex, with prominent spiracular, tubercles, without central carina (Fig. 117). ... **LYSIPHLEBIA**

15 (6) Ovipositor sheaths straight or slightly curved upwards, terminal abdominal sternite without prongs (Figs. 1. 68, 156). ... ... 16

— Ovipositor sheaths curved downwards, terminal abdominal sternite sometimes with a pair of prongs (Figs. 107, 114, 169, 174). ... ... 19

16 (15) Notaulices distinct only anteriorly (Fig. 11), or completely effaced (Fig. 66). Ovipositor sheaths with sparse hairs (Figs. 1, 68). ... ... 17

— Notaulices distinct throughout (Fig. 160). Ovipositor sheaths pubescent (Fig. 156). ... **PSEUDOPRAON**

17 (16) Notaulices distinct anteriorly. Propodeum with a narrow central areola (Fig. 64), or with two divergent carinae in the lower portion (Fig. 3), or smooth (Fig. 8). ... ... 18

— Notaulices entirely effaced (Fig. 66). Propodeum with more or less distinct wide central areola, longitudinal carinae less distinct (Fig. 69). ... **DIAERETUS**

18 (17) Propodeum distinctly areolated, with a narrow central areola (Fig. 64). ... **DIAERETIELLA**

— Propodeum smooth, or with two divergent carinae in the lower portion (Figs. 3, 8). ... **ADIALYTUS**

19 (15) Terminal abdominal sternite with 2 prongs (Figs. 168, 169, 174, 178). ... ... 20

— Terminal abdominal sternite without prongs (Figs. 107, 110, 114, 116). ... **LIPOLEXIS**

20 (19) Prongs of various length, straight to strongly curved upwards, with various number of hairs to hairless on the dorsal surface, with various hairs (setae, bristles) to rarely hairless at the apex (Figs. 168, 169, 174, 178). ... **TRIOXYS**

— Prongs with strongly dilated apical portion (Figs. 49, 50, 53), or with strong basal portion (Figs. 62, 63) that bears a crista of long, stout, perpendicular hairs. ... ... 21

21 (20) Prongs with strongly dilated apical portion that bears a crista of long, perpendicular hairs (Figs. 49, 50, 53) ... **BETULOXYS**

— Prongs with stout basal portion that bears a crista of perpendicular hairs, the rest of prongs narrowed to the apex (Figs. 62, 63). ... **CRISTICAUDUS**

## +Genus : **ADIALYTUS** Förester, 1862

*Tax.* : Shuja-Uddin 1978 (notes, Indian spp.).

### +**A. ambiguus** (Haliday, 1834)

*Figs.* : $F_1$, $F_2$ – 5. $F_3$, $F_4$ – 6. Forewing – 2. Propodeum – 3. Tergite 1 – 13. Genitalia – 1. – also : Shuja-Uddin 1978, head, wing, propodeum, tergite 1, genitalia, as "*arvicola*".

*Syns.* : *Lysiphlebus* (or *Adialytus*) *arvicola* Starý, 1961.

*Tax.* : Shuja-Uddin 1978 (re-description).

*Hosts* : *Sipha maydis*—Shuja-Uddin 1978 (Kashmir, Jammu). *Sipha* sp.—(Pakistan) (+).

*Distr.* India (Kashmir, Jammu). Pakistan.

*Notes* : Many earlier references, even some of the recent ones of "*ambiguus* Hal. Auct", it is now established, actually relates to *L. confusus* Trembley and Eady 1978 ; further, re-examination of type has shown that the true "*ambiguus* Haliday" is identical with *L. avirocala* Starý 1961, which has been treated here as a synonym of *ambiguus*.

### +A. salicaphis (Fitch, 1855)

*Figs.* : $F_1$, $F_2$ – 9. $F_3$, $F_4$ – 10. Mesonotum – 11. Wing – 7. Propodeum – 8. Tergite 1 – 12. Genitalia – 4. – also : Shuja-Uddin 1978 : mouthparts, wing, propodeum, tergite 1, genitalia.

*Tax.* : Shuja-Uddin 1978 (re-description).

*Hosts* : *Chaitophorus* sp.—Shuja-Uddin 1978 (Kashmir & Jammu).

*Distr.* : India (Jammu, Kashmir).

*KEY TO SPECIES*

1. Propodeum with two divergent carinae in the lower portion (Fig. 3). $F_1$ three times as long as broad (Fig. 5). Apex of abdomen yellowish, lighter than the middle part. ... **ambiguus**

— Propodeum smooth (Fig. 8). $F_1$ twice as long as broad (Fig. 9). Apex of abdomen brown, concolorous with the middle part. ... **salicaphis**

## + Genus : APHIDIUS Nees, 1819

### + A. absinthii Marshall, 1896

*Syns.* : *Aphidius commodus* Gahan, 1927.

*Hosts* : *Acyrthosiphon pisum*—Hamid, Anwar 1970 (Pakistan) (!). *Aphis craccivora*—Hamid, Shah, Anwar 1977 (Pakistan) (!). Hamid, Anwar 1970 (Pakistan) (!). *Macrosiphoniella pseudoartemisiae*—Dharmadhikari, Ramaseshiah 1970 (India). *Macrosiphoniella sanborni*—Dharmadhikari, Ramaseshiah 1970 (India). *Macrosiphoniella yomogifoliae*—Agarwala *et al.* 1980 (Sikkim) (+). *Undet. aphids*—(Karnataka, Meghalaya) (+).

*Biol* : Percent parasitism, distribution, hyperparasitoids, in Pakistan (Hamid, Shah, Anwar 1977).

*Distr.* : India (Sikkim, Karnataka, Meghalaya). Pakistan.

**A. areolatus** Ashmead, 1906

*Hosts* : Without host records—Rishi, Bhagat 1980 (Kashmir).

*Distr.* : India (Kashmir).

+ **A. cingulatus** Ruthe, 1859

*Figs.* : Wing—16. Genitalia—18.

*Hosts* : *Pterocomma populeum*—Takada, Rishi 1980 (Kashmir).

*Distr.* : India (Kashmir).

+ **A. colemani** Viereck, 1912

*Aphidius colemani* Viereck, 1912, Proc. U. S. Nat. Mus. 42 : 141 (♀ ♂).

*Holotype* ♀ : Bangalore, Karnataka, from *Aphis* sp. on tobacco. Deposition : U. S. Nat. Museum, Washington.

*Figs.* : Wings-20. Propodeum-17. Tergite 1-14, 21. Genitalia-15.—also : Starý 1972, 1975.

*Syns.* : *Aphidius* (or *Lysaphidus*) *platensis* Brèthes, 1913. *Aphidius transcaspicus* Telenga, 1958.

*Tax.* : Subba Rao, Sharma 1964. Starý 1972, 1975.

*Hosts* : *Aphis gossypii*—Starý, Ghosh 1978 (Meghalaya) (+). Greathead, Mohyuddin, 1970 (Pakistan). Starý 1972 (India). Starý 1975 (Pakistan). Mohyuddin, Shah, Anwar 1971 (Pakistan). Mohyuddin, Anwar 1972 (Pakistan). Karnataka (+). *Aphis nerii*—Takada, Rishi 1980 (Kashmir). *Aphis solanella*—Meghalaya (+). *Aphis* sp.—Krishnamurti, Usman 1954 (Karnataka) (+). *Brevicoryne brassicae*—Mohyuddin, Anwar 1972 (Pakistan, lab. tests). *Hyalopterus pruni*—Raychaudhuri, Dutta *et al.* 1979 (Nagaland, Manipur) (+). *Myzus persicae*—Rajagopal, Kareem 1979 (Tamil Nadu), Easwaramoorthy *et al.* 1976 (Tamil Nadu). Subba Rao, Sharma 1964 (India). Starý 1972 (India) (+). Mohyuddin, Anwar 1972 (Pakistan, lab. tests). (Meghalaya), Karnataka (+). *Rhopalosiphum maidis*—Kasi Viswanathan 1972 (Karnataka). *Rhopalosiphum nympheae*—Starý 1972 (India) (+). *Rhopalosiphum padi*—Pakistan (+). *Schizaphis graminum*—Hamid 1978 (Pakistan). Starý 1975 (Pakistan) (+). Mohyuddin, Anwar 1972 (Pakistan, lab. tests). *Sitobion fragariae*—Hamid 1978 (Pakistan).

*Biol.* : Reproductive capacity (Hamid 1978). Host range (Starý 1972, 1975). Parasitoid-Host population systems on *Schizaphis graminum* (Hamid 1978). Percent parasitism (Hamid 1978 ; Mohyuddin, Shah, Anwar 1971 ; Mohyuddin, Anwar 1972). Distribution (Hamid 1978). Glasshouse (Easwaramoorthy *et al.* 1976). Review of introductions : world (Starý 1972, 1975). Shipment

from Pakistan to the United Kingdom (Mohyuddin, Anwar 1973), from Pakistan to U. S. A. (Mohyuddin, Anwar 1972), ; from Africa (Uganda, Tanzania) to Pakistan (Mohyuddin 1970 ; Greathead, Mohyuddin 1970 ; Girling 1971 ; Girling 1973). Effect of insecticides (Rajagopal, Kareem 1979).

*Distr.* : India (Meghalaya, Nagaland, Karnataka, Kashmir, Tamil Nadu, Manipur). Pakistan.

### +**A. ervi** Haliday, 1834

*Figs.* : Tergite 1—19. Genitalia—22.

*Host* : *Acyrthosiphon kondoi*—Pakistan (+).

*Distr.* : Pakistan.

### **A. hortensis** Marshall, 1896

*Figs.* : Wing-27. Propodeum—23. Tergite 1—26. Genitalia—24.

*Hosts* : *Liosomaphis himalayensis*—Takada, Rishi 1980 (Kashmir).

*Distr.* : India (Kashmir).

### +**A. matricariae** Haliday, 1834

*Figs.* : Head—35. $F_1$, $F_2$—34. $F_{10}$—33. Wing—30. Propodeum—32. Tergite 1—25, 29. Genitalia—28.

*Hosts* : *Aphis citricola*—Agarwala *et al.* 1980 (Sikkim). *Aphis craccivora* —Hamid 1977 (Pakistan). *Aphis fabae*—Hamid 1977 (Pakistan). *Aphis gossypii*—Mohyuddin, Anwar 1973 (Pakistan). Hamid 1977 (Pakistan).Agarwala *et al.* 1980 (Sikkim). *Aphis solanella*—Meghalaya (+). *Brachycaudus cardui* —Starý, Bhagat 1978 (Kashmir) (+). *Brachycaudus helichrysi*—Agarwala *et al.* 1980 (Sikkim). Starý, Ghosh 1975 (Meghalaya) (+). *Brachycaudus* sp.—Starý, Bhagat 1978 (Kashmir) (+). *Brevicoryne brassicae*—Starý, Ghosh 1975 (Meghalaya) (+). *Capitophorus hippophaes javanicus*—Alam, Hafiz 1963 (Pakistan). *Capitophorus indicus*—Starý, Ghosh 1978 (Meghalaya) (+). Alam, Hafiz 1963 (Pakistan). *Hyalopterus pruni*—Kazimi, Ahmad, Ghani 1969 (Pakistan). *Lipaphis erysimi*—Kazimi, Ghani 1970 (Pakistan). Starý, Ghosh 1978 (Meghalaya) (+). *Myzus dycei*—Starý, Ghosh 1975 (Meghalaya) (+). Raychaudhuri in litt. (Him. Pradesh) (+). *Myzus ornatus*—Raychaudhuri in litt. (Him. Pradesh) (+). *Myzus persicae*—Alam, Hafiz 1963 (Pakistan) (+). Kazimi, Ahmad, Ghani 1969 (Pakistan). Kazimi, Ghani 1970 (Pakistan). Kazimi, Ghani, Mehr-un-Nisa 1971, 1972 (Pakistan). Mohyuddin, Anwar 1973 (Pakistan). Hamid, 1977 (Pakistan). Starý, Ghosh 1975 (Meghalaya) (+). Agarwala *et al.* 1980 (Sikkim). Takada, Rishi 1980 (Kashmir). *Myzus* sp.— Starý, Ghosh 1978, Meghalaya (+). *Phorodon cannabis*—Kazimi, Ghani 1970

(Pakistan). Starý, Bhagat 1978 (Kashmir) (+). Takada, Rishi, 1980 (Kashmir). Raychaudhuri in litt. (Him. Pradesh) (+). *Phorodon* sp.—Starý, Bhagat 1978 (Kashmir). *Shinjia orientalis*—Starý, Ghosh 1979 (Meghalaya) (+).

*Biol.* : Developmental rate (Kazimi, Ghani 1970 ; Kazimi *et al.* 1971). Emergence (Kazimi, Ghani 1970 ; Kazimi *et al.* 1971). Longevity of adults (Kazimi *et al.* 1971). Reproductive capacity (Kazimi *et al.* 1971). Effect of high temperature on mortality and emergence (Kazimi *et al.* 1969). Sex ratio (Kazimi, Ghani 1970 ; Kazimi *et al.* 1971). Host range (Agarwala *et al.* 1980). Effect of host plants (Kazimi, Ghani 1970 ; Kazimi *et al.* 1971). Host preference (Kazimi *et al.* 1969 ; Kazimi, Ghani 1970 ; Kazimi *et al.* 1971 ; Mohyuddin, Anwar 1973). Seasonal history (Kazimi *et al.* 1969). Percent parasitism (Kazimi *et al.* 1969 ; Kazimi, Ghani 1970). Comparison of Pakistanese and American strains (Kazimi *et al.* 1971). Interspecific relations, x *Diaeretiella rapae* (Kazimi *et al.* 1971). Hyperparasitoids (Kazimi *et al.* 1969, Kazimi, Ghani 1970). Shipping techniques and parasitoid survival (Kazimi *et al.* 1971).

*Distr.* : India (Kashmir, Meghalaya, Sikkim, Him. Pradesh). Pakistan.

**[A. pascuorum** Marshall, 1896]

*Hosts* : *Sitobion fragariae*—Hamid 1978 (Pakistan).

*Biol.* : Percent parasitism (Hamid 1978).

*Distr.* : Pakistan.

*Note* : *A. pascuorum* is a junior synonym of *A. picipes* (Nees, 1811). However, it seems that the Pakistanese material belongs to another species, possibly to *A. uzbekistanicus* Luzh., *A. rhopalosiphi* DeStefani, etc.

**+ A. rosae** Haliday, 1834

*Hosts* : *Macrosiphum rosae*—Raychaudhuri *et al.* 1979 (West Bengal) (Sikkim) (+).

*Distr.* : India (West Bengal, Sikkim).

**A. setiger** Mackauer, 1961

*Hosts* : Without host records—Rishi, Bhagat 1980 (Kashmir).

*Distr.* : India (Kashmir).

**[A. similis** Starý & Carver, 1979]

F-segments, wing, propodeum, tergite 1, genitalia—see : Starý & Carver 1979.

*Tax.* : Agarwala *et al.* 1989. Starý & Carver 1979.

*Hosts* : *Aphis citricola*—Agarwala *et al.* 1980 (Sikkim) (+). *Aphis gossypii*—Agarwala *et al.* 1980 (Sikkim) (+). *Brachycaudus helichrysi*—Agarwala *et al.* 1980 (Sikkim) (+). *Myzus persicae*—Agarwala *et al.* 1980 (Sikkim) (+).

*Biol.* : Host range, seasonal history (Agarwala *et al.* 1980).

*Distr.* : [India—Sikkim, see below—the note.]

*Note* : A species closely related to *A. matricariae*, i. e. *A. similis* was described by Starý & Carver (1979) from Australia, and there were some indications that the species might be also distributed in India, perhaps being even of Indian origin (1. c.). Agarwala *et al.* (1980) have reported the species (as a MS name) from India. However, re-examination with the type-material of *similis* has shown that it belongs to *A. matricariae*, the most apparent differences being in the tentorial index and number of antennal segments, as follows (of. Starý & Carver 1979) : *matricariae* Hal.—Tent. index 0.3-0.4 ; antennae 14-15-segmented ; *similis* Starý & Carver—Tent. index 0.45-06 (0.7) ; antennae 15-16-segmented.—However, it is possible that *similis* will be also found to occur in the target area.

### +A. smithi Sharma & Subba Rao, 1959

*Aphidius* (*Aphidius*) *smithi* Sharma & Subba Rao, (1958) 1959, Indian J. Ent. 20 : 183-187 (♀♂).

*Holotype* ♀ : Kalka, Punjab, ex *Acyrthosiphon* (*Macrosiphum*) *pisi* Kalt. on *Lathyrus odoratus*, 25-3-1957 (Bhatia). Deposition : Indian Agric. Res. Institute, N. Delhi.

*Figs.* : Tergite 1-38. Propodeum—45.—also : Sharma & Subba Rao 1958, head, wing, propodeum, tergite 1, genitalia.

*Tax.* : Starý, González, Hall 1980.

*Hosts* : *Acyrthosiphon pisum*—Sharma, Subba Rao 1959 (Punjab) (+). Rao *et al.* 1969 (U. Pradesh). Rao *et al.* 1970 (U. Pradesh). Hamid, Anwar, 1970 (Pakistan) (+). Hamid, Shah, 1971, 1972 (Pakistan). Rao *et al.* 1971 (India). Him. Pradesh (+). Kashmir (+). Pakistan (+). Hamid *et al.* 1974 (Pakistan). Takada, Rishi 1980 (Kashmir) (+). *Acyrthosiphon* sp.—Pakistan (+). *Sitobion fragariae*—Hamid, Shah, 191, 1972 (Pakistan, as ? *smithi*) (?). Without host records—Muesebeck 1967 (India). Report C. I. B. C. 1968 (India).

*Biol.* : Developmental rate (Hamid *et al.* 1974). Effect of temperature on development (Rao *et al.* 1970 ; Hamid, Anwar 1970 ; Hamid, Shah 1971). Mortality of P in mummies (Hamid *et al.* 1974). Longevity of adults (Rao *et al.* 1969). Reproductive capacity (Rao *et al.* 1969, 1970 ; Hamid, Anwar 1970 ; Hamid *et al.* 1974). Sex ratio (Rao *et al.* 1969). Host range (Hamid *et al.*

1974). Host preference (Rao *et al.* 1970). Effect of P on H (Rao *et al.* 1970). Effect of H instars on P development (Hamid, Shah 1971 ; Hamid *et al.* 1974). P x H behavioural effects (Hamid, Shah 1971 ; Hamid *et al.* 1974). Seasonal history (Hamid *et al.* 1974). Sampling methods (Hamid *et al.* 1974). Percent parasitism (Rao *et al.* 1969, 1970 ; Hamid, Anwar 1970 ; Hamid, Shah 1971 ; (Hamid *et al.* 1974). Dispersal in habitats (Hamid, Anwar 1970). Dispersal (Hamid *et al.* 1974). Distribution in habitats (Hamid *et al.* 1974 ; Hamid, Anwar 1970). Interspecific relations, x *Ephedrus plagiator*, laboratory (Rao *et al.* 1970). Hyperparasitoids (Rao *et al.* 1969 ; Hamid *et al.* 1974). Effect of ant-attendance on P. (Hamid, Shah 1971). Intercropping and ecosystem stability (Hamid *et al.* 1974). Shipment, to U. S. A. and history of introductions (Rao *et al.* 1971).

*Distr.* : India (Punjab, Kashmir, Him. Pradesh, Uttar Pradesh). Pakistan.

### + **A. urticae** Haliday, 1834—group

*Syn.* : *Aphidius lonicerae* Marshall, 1896.

*Hosts* : undet. aphids on Pteris aquilina (West Bengal) (+).

### + **A. uzbekistanicus** Luzhetzki, 1960

*Figs.* : Head—41. Wing—52.

*Hosts* : Rhopalosiphum maidis—Agarwala *et al.* 1980 (Sikkim) (+). *Sitobion ? alopecuri*—Raychaudhuri in litt. (Him. Pradesh) (+). *Sitobion* sp.—Shuja-Uddin 1975, U. Pradesh. Starý, Bhagat 1978 (Kashmir) (+).

*Biol.* : Seasonal, history, percent parasitism and effectiveness (Shuja-Uddin 1975).

*Distr.* : India (Kashmir, Sikkim, Uttar Pradesh, Him. Pradesh).

### + **A.** spp.

*Hosts* : *Acyrthosiphon gossypii*—Hamid. Anwar 1969 (Pakistan). *Acyrthosiphon pisum*—Rao *et al.* 1969 (Karnataka). Hamid, Anwar 1969 (Pakistan). *Aphis citricola*—Starý, Ghosh 1975 (Meghalaya) (+). *Aphis craccivora*—Hamid, Anwar 1969 (Pakistan). *Aphis gossypii*—Raja Rau 1955. Rao *et al.* 1969, 1970 (Karnataka), (Sikkim) (+). *Aphis ruborum longisetosus*—(Meghalaya) (+). *Aphis solanella*—Meghalaya (+). *Aulacorthum* sp.—(Meghalaya) (+). *Brachycaudus helichrysi*—Raychaudhuri *et al.* 1979 (Nagaland) (+). *Chaetosiphon gracilicorne*—Takada, Rishi 1980 (Kashmir). *Hyalopterus pruni*—Raychaudhuri *et al.* 1979, (Nagaland) (+). *Lachnus tropicalis*—Raychaudhuri *et al.* 1979 (Nagaland). *Lipaphis erysimi*—Bakhetia, Sharma, 1979 ; Singh 1980. *Macrosiphum rosae*—Sikkim (+). *Myzus ornatus*—Raychaudhuri in litt. (Him.

Pradesh) (+). *Myzus persicae*—Biol. Control Inf. Bull. 1967 (India). Rao *et al.* 1969, 1970 (Karnataka, Kashmir). Kasimi *et al.* 1969 (Pakistan). West Bengal (+). Bakhetia, Sharma 1979 (Punjab). *Neomyzus circumflexus*—(Sikkim) (+). *Schizaphis graminum*—Hamid *et al.* 1973 (Pakistan). *Schizaphis rotundiventris*—Starý, Ghosh 1978 (Meghalaya) (+). *Sitobion fragariae*—Hamid *et al.* 1973 (Pakistan). *Sitobion rosaeformis*—Starý, Ghosh 1975 (Meghalaya) (+). Him. Pradesh (+). Undet. aphids—Behura 1961.

*Biol.* : Biology (Raja Rau 1955). Life-History (Raja Rau 1955). Effect of temperature on emergence (Hamid *et al.* 1973). Longevity of adults (Hamid *et al.* 1973). Sex ratio (Hamid *et al.* 1973). Host preference (Hamid *et al.* 1973). Seasonal history (Singh, Rawat 1979 ; Rao *et al.* 1979). Percent parasitism (Rao *et al.* 1970 ; Hamid *et al.* 1973). Effect of insecticides in laboratory (Singh, Rawat 1979). Shipment to U. S. A. (Rao *et al.* 1971).

*Distr.* : India (Meghalaya, Nagaland, Kashmir, Karnataka, Him. Pradesh, Madhya Pradesh). Pakistan.

*KEY TO SPECIES*

| | | | |
|---|---|---|---|
| 1. | Anterolateral area of tergite 1 costate (Figs. 14, 21) or costulate (Figs. 25, 29) ... | ... | 2 |
| — | Anterolateral area of tergite 1 rugose (Fig. 19). (Parasitoids of *Acyrthosiphon, Macrosiphum, Sitobion, Myzus*, etc.). ... | | *ervi* |
| 2 (1) | Anterolateral area of tergite 1 costulate (Figs. 25, 29). | ... | 3 |
| — | Anterolateral area of tergite 1 costate (Figs. 14, 21). (Widely specific). ... | | *colemani* |
| 3 (2) | Tentorial index 0.6-0.8 (Parasitoids of *Pterocomma*) ... | | *cingulatus* |
| — | Tentorial index different. ... | ... | 4 |
| 4 (3) | Tentorial index 0.5-0.6. ... | ... | 5 |
| | Tentorial index different. ... | ... | 6 |
| 5 (4) | Antennae 16-17 (15, 18) segmented. Anterolateral area of tergite 1 with 8 costulae in average (variation 5-12). Temple 1/3-1/4 narrower than transverse eye-diameter. (Parasitoids of *Macrosiphoniella* spp.) ... | | *absinthii* |
| — | Antennae 17-18 (16) segmented. Anterolateral area of tergite 1 with 10-12 costulae in average (variation 8-18). Temple 1/6-1/7 narrower than transverse eye-diameter. (Parasitoids of *Macrosiphum rosae* and allied spp.). ... | | *rosae* |
| 6 (4) | Tentorial index 0.4-0.5. ... | ... | 7 |
| — | Tentorial index 0.3-0.4 (widely specific). ... | | *matricariae* |

| | | |
|---|---|---|
| 7 (6) | Antennae 14-15-segmented (Parasitoids of *Liosomaphis*). ... | *hortensis* |
| — | Antennae with a higher number of segments. ... | ... 8 |
| 8 (7) | Antennae 16-17 (15, 18) segmented (Parasitoids of *Metopolophium, Macrosiphum, Sitobion*). ... | *uzbekistanicus* |
| — | Antennae 18-20-segmented in average. ... | ... 9 |
| 9 (8) | Anterolateral area of tergite 1 with 8-10 costulae in average. Antennae 20-21 (17, 18, 19) segmented (Parasitoids of *Macrosiphum, Aulacorthum*, etc.). ... | gr. *urticae* |
| — | Anterolateral area of tergite 1 with 4-6 costulae in average (Fig. 38.) Antennae 19-20-segmented (Parasitoids of *Acyrthosiphon pisum*, possibly even related spp). ... | *smithi* |

*Note* : The expected number of *Aphidius*-species is much higher in the target area. Species not keyed—*A. areolatus*, *A. setiger*.

## +Genus : **ARCHAPHIDUS** Starý & Schlinger, 1967

### + **A. greenideae** Starý & Schlinger, 1967

*Figs.* : Head—46. Mesonotum—43. Wing—39. Propodeum—40. Tergite 1—44. Genitalia—42. —also : Starý & v. Harten (1982).

*Tax.* : Starý, v. Harten (1982, redescription).

*Hosts* : *Greenidea* sp.—Starý v. Harten 1982 (Bangladesh) (+).

*Distr.* : Bangladesh.

*KEY TO SPECIES*

Only *A. greenideae* is known.

## Genus : **AREOPRAON** Mackauer, 1959

*Tax.* : Bhagat (in press).

### **A. lepellepi** (Waterston, 1926)

*Figs.* : Wing—48. Genitalia—47.

*Tox.* : Bhagat (in Press).

*Hosts* : *Eriosoma sp.*—Bhagat (in Press) (Kashmir). without host records : Rishi, Bhagat 1980 (Kashmir).

*Biol.* : Bhagat (in Press).

*Distr.* : India (Kashmir).

### **A.** sp.

*Distr.* : India (Kashmir)—Rishi 1976.

*KEY TO SPECIES*

Only *A. lepelleyi* is known from the target area.

## + Genus : **BETULOXYS** Mackauer, 1959

*Tax.* : Shuja-Uddin 1975 (notes, key). Starý & Raychaudhuri (1978).

*Biol.* : Host range (Starý, Raychaudhuri 1978).

### + **B. assamensis** (Starý, 1975)

*Trioxys (Betuloxys) assamensis* Starý, in Starý & Ghosh, 1975, Orient. Insects 9 : 346-347, 345 (♀♂).

Holotype ♀ : Shillong, Botanical garden, Meghalaya, 14-X-1974, reared from *Betacallis querciphaga* Basu, Ghosh, Raychaudhuri (leg. Ghosh). Deposition : Zoological Survey of India, Calcutta.

*Figs.* : Wing— 55. Propodeum—58. Tergite 1 —51. Genitalia— 49, 50.—also : Starý, Ghosh (1975).

*Tax.* : Starý, Raychaudhuri 1978.

*Hosts* : *Betacallis querciphaga*—Starý, Ghosh 1975 (Meghalaya) (+).

*Distr.* : India (Meghalaya).

### [**B. hortorum** (Starý, 1960)]

*Figs.* : Starý, Ghosh 1975.

*Hosts* : Undet. aphids—Rishi 1976 (Kashmir).

*Distr.* : India (Kashmir).

### **B. intermedius** (Shuja-Uddin, 1975)

*Trioxys (Betuloxys) intermedius* Shuja. Uddin, 1975, Rec. zool. Surv. India 68 : 415- 420 (♀♂).

Holotype ♀ : India, Kashmir ; Sopore, Wadoora, ex green aphids on *Centaurea iberica*, 12-IX-1969 (leg. Shuja-Uddin).

Deposition : Zool. Museum, Aligarh University, Aligarh.

*Figs.* : Wings, propodeum, tergite 1, genitalia—Shuja-Uddin (1975).

*Tax.* : Starý, Raychaudhuri 1978.

*Hosts* : *Capitophorus* sp.—Shuja-Uddin 1975 (Kashmir ; a hand-written note in the reprint indicating a later determination of the material). *Undet. aphids*—Shuja-Uddin 1975 (Kashmir).

*Distr.* : India (Kashmir).

### + B. takecallis (Starý, 1978)

*Trioxys* (*Betuloxys*) *takecallis* Starý, in Starý & Raychaudhuri, 1978, Orient. Insects 12 : 365-367 (♀).

Holotype ♀ : Kalimpong, West Bengal, 1977, 1420 m., reared from *Takecallis arundinariae* (Essig) on *Bambusa* sp. (leg. Dutta). Deposition : Dept. of Zoology, University of Calcutta, Calcutta.

*Figs.* : Wing— 57. Propodeum—56. Tergite 1—54. Genitalia—53. —also : Starý, Raychaudhuri 1978.

*Hosts* : *Takecallis arundinariae*—Starý, Raychaudhuri 1978 (West Bengal) (+). Raychaudhuri et al. 1979 (West Bengal).

*Distr.* : India (West Bengal).

*KEY TO SPECIES*

| | | |
|---|---|---|
| 1. | Prongs separated throughout (Fig. 49). ... ... | 2 |
| — | Prongs fused together till about the half of their length (Fig. 53). ... | *takecallis* |
| 2 (1) | Apical portion of prongs bearing stout perpendicular hairs dilated strongly at the base. Hairs prolongate-oval in shape (Figs. 49, 50). ... | *assamensis* |
| — | Apical portion of prongs bearing stout perpendicular hairs only slightly dilated at the base. Hairs dilated at the base and rather narrowed to the apex. ... ... | 3 |
| 3 (2) | Propodeum with two divergent carinae in the lower portion. ... | *intermedius* |
| — | Propodeum with large, wide, pentagonal areola. ... | [*hortorum*] |

## + Genus : CRISTICAUDUS Starý & Remaudière, 1982

### + C. nepalensis (Takada, 1970), n. comb.

*Binodoxys nepalensis* Takada, 1970, Kontyu 38 : 42-43 (♀ ♂).

Holotype ♀ : Balaju, Kathmandu, Nepal, 1-VII-1968, ex *Aphis* sp. nr. *gossypii* Glov. on and unknown plant similar to *Spirea* (leg. T. Kumata). Deposition : Entomological institute, Hakkaido universitym Sapporo.

*Figs.* : Wing—61. Propodeum—60. Tergite 1—59. Genitalia—62, 63. —also : Starý, Ghosh 1979, and F segments.

*Tax.* : Starý, Ghosh 1979 (re-description).

*Hosts* : *Aphis citricola*—Starý, Ghosh 1979 (Meghalaya) (+). *Aphis* sp. nr. *gossypii*— Takada 1970 (Nepal).

*Biol.* : Host range, seasonal history, interspecific relations, economic significance (Starý, Ghosh 1979).

*Distr.* : India (Meghalaya). Nepal.

*Note* : The generic status of this species needs still to be further dealt with as the other species of the genus are known from Mexico.

*KEY TO SPECIES*

Only *C. nepalensis* is known from the target area.

## + Genus : **DIAERETIELLA** Starý, 1960

### + **D. rapae** (M' Intosh, 1855)

*Diaeretus aphidae* Mukherji & Chatterjee, 1949, Proc. 36 Indian Sci. Congr. 3 : 193 (♀♂). Nomen nudum.

*Diaeretus aphidum* Mukherji & Chatterjee, 1950, Proc. R. ent. Soc. Lond., B, 19 : 4-6 (♀♂).

Holotype ♀ : near Quetta, Baluchistan, Pakistan, ex *Aphis* sp. affecting cabbages. Deposition : Museum New Delhi.

*Figs.* : Wing—70. Propodeum—64. Tergite 1—65. Genitalia—68.

*Tax.* : Starý 1961.

*Hosts* : *Aphis craccivora*—Atwal et al. 1969 (Punjab). *Aphis fabae*—Kazimi et al. (Pakistan). *Aphis gossypii*—Sethumadhavan, Dharmadhikari 1969. (Karnataka). Mohyuddin, Anwar 1973 (Pakistan). *Aphis* sp.—Alam, Hafiz 1963 (Pakistan). *Brevicoryne brassicae*—Sethumadhavan, Dharmadhikari 1969 (India). Habib, Kazimi 1969 (Pakistan). Kazimi, et al. 1969 (Pakistan). Rao et al. 1969 (Kashmir) (+). Kazimi, Ghani 1970 (Pakistan). Rao et al. 1970 (Karnataka, Uttar Pradesh, Kashmir). Kazimi et al. 1971 (Pakistan). Him. Pradesh (+). Batra, Wahdi 1972 (Punjab). Habib 1973 (Pakistan) (+). Starý, Ghosh 1975 (Meghalaya) (+). Hamid 1977 (Pakistan). Takada, Rishi 1980 (Kashmir). *Hayhurstia atriplicis*—Sethumadhavan, Dharmadhikari 1969 (India). *Lipaphis erysimi*—Alam, Hafiz 1963 (Pakistan). Rao et al. 1969 (Karnataka). Atwal et al. 1969, 1971 (Punjab). Kundu et al. 1969 (India). Kazimi et al. 1969 (Pakistan). Kazimi, Ghani 1970 (Pakistan). Rao et al. 1970 (Assam). Kazimi et al. 1971 (Pakistan). Hamid 1977 (Pakistan). Starý, Ghosh 1978 (Meghalaya) (+). Agarwala et al. 1980 (Sikkim) (+). (Him. Pradesh) (+). *Myzus persicae*—Alahm, Hafiz 1963 (Pakistan). Atwal et al. 1969 (Punjab). Sethumadhavan, Dharmadhikari 1969 (India). Kazimi et al. 1969 (Pakistan). Kazimi, Ghani 1970 (Pakistan). Rao et al. 1970 (Kashmir). Kazimi et al. 1971, 1972 (Pakistan). Mohyuddin, Anwar 1973 (Pakistan). Hamid 1977 (Pakistan). *Pterochloroides persicae*—Mukerji, Chatterjee 1950 (Pakistan). *Schizaphis graminum*—Hamid 1958 (Pakistan). Hamid et al. 1973 (Pakistan) (+). *Sipha maydis*—Hamid 1978 (Pakistan) (?). *Sitobion avenae eleusinae*—Atwal et al. 1969 (Punjab). *Undet. aphids*—Mukerji, Chatterjee 1950 (Pakistan). Report C. I. B. C. 1968. Uttar Pradesh (+).

*Biol.* : Bionomics (Habib 1973). Rate of development (Atwal et al. 1969 ; Kazimi, Ghani, 1970 ; Kazimi et al. 1972 ; Habib 1973). Emergence (Kazimi, Ghani 1970 ; Kazimi et al. 1972). Longevity of adults (Sethumadhavan, Dharmadhikari 1969 ; Habib 1973 ; Hamid, Mehr-un-Nisá 1973). Food of adults (Sethumadhavan, Dharmadhikari 1969 ; Hamid, Mehr-un-Nisá 1973). Mating (Sethumadhavan, Dharmadhikari 1969). Reproductive capacity (Habib 1973 ; Hamid 1977, 1978) Kazimi et al. 1970, 1971). Oviposition (Sethumadhavan, Dharmadhikari 1969). Sex ratio (Kazimi, Ghani 1970 ; Kazimi et al. 1972). Host preference (Kazimi, Ghani 1970 ; Rao et al. 1970 ; Kazimi et al. 1970 ; Hamid 1973 ; Mohyuddin, Anwar 1973 ; Hamid 1977, 1978). Effect of H plants (Rao et al. 1970 ; Kazimi, Ghani 1970 ; Kazimi et al. 1972 ; Habib 1973 ; Hamid 1977). Seasonal history (Atwal et al. 1969 ; Sethumadhavan, Dharmadhikari 1969 ; Habib. Kazimi 1969 ; Habib 1973 ; Hamid 1977). Populations H and P (Atwal et al. 1971). Percent parasitism (Atwal et al. 1969 ; Habib, Kazimi, 1969 ; Kazimi Ghani 1970 ; Atwal et al. 1971 ; Hamid, Mehr-un-Nisá 1973 ; Mohyuddin, Anwar 1973 ; Habib 1973 ; Hamid 1977, 1978). Methods, estimating percent parasitism (Habib 1973). Distribution (Rao et al. 1970). Comparison of Pakistanese and American strains (Kazimi et al. 1971, 1972). Interspecific relations, x *Aphelinus* (Habib 1973). Hyperparasitoids (Habib, Kazimi 1969 ; Sethumadhavan, Dharmadhikari 1969 ; Kazimi, Ghani 1970 ; Habib 1973). Effect of insecticides (Hamid 1978). Shipment techniques (Kazimi et al. 1971). Ecosystem relations (Hamid 1977, 1978).

*Distr.* : India (Meghalaya, Sikkim, Kashmir, Punjab, Karnataka, Uttar Pradesh, Assam, Him. Pradesh). Pakistan.

*KEY TO SPECIES*

Only *D. rapae* is known.

## +Genus : **DIAERETUS** Förster, 1862

### +**D. leucopterus** (Haliday, 1834)

*Figs.* Mesonotum—66. Wing—74. Propodeum—69. Tergite 1—67. Genitalia—71.

*Hosts* : *Eulachnus thunbergii*—Starý, Ghosh 1975 (Meghalaya) (+).

*Distr.* : India (Meghalaya).

*KEY TO SPECIES*

Only *D. leucopterus* is known.

## +Genus : **EPHEDRUS** Haliday, 1833

### [E. cerasicola Starý, 1962]

*Hosts* : *Aphis craccivora*—Hamid et al. 1977 (Pakistan). Hamid, Anwar 1970 (Pakistan) (as ? *cerasicola*) (!).

*Biol.* : Percent parasitism, hyperparasitoids (Hamid et al. 1977).

*Distr.* : Pakistan.

### +E. lacertosus (Haliday, 1833)

*Figs.* : $F_1$—73. $F_2$—75. $F_{10,11}$—78. Wing—81. Propodeum—72. Tergite 1—77. Genitalia—76.

*Tax.* : Sharma, Subba Rao 1964.

*Hosts* : *Myzus persicae*—Rao 1969 (?). *Neomyzus circumflexus*—Rao 1969 (?). *Sitobion miscanthi*—Him. Pradesh (+). Without *host records*—Subba Rao, Sharma 1969 (Kashmir).

*Distr.* : India (Him. Pradesh, Kashmir, Meghalaya).

### E. minor Stelfox, 1941

*Figs.* : $F_{1,2}$—80. $F_{10,11}$—79.

*Hosts* : *Cavariella sp.*—Takada, Rishi 1980 (Kashmir).

*Distr.* : India (Kashmir).

### +E. niger Gautier, Bonnamour, Gaumont 1929

*Figs.* : $F_1$—83. $F_2$—84. $F_{10,11}$—82. Wing—86. Genitalia—85.

*Syns.* : *Ephedrus* (*Ephedrus*) *campestris* Starý, 1962.

*Hosts* : *Macrosiphoniella sanborni*—Starý, Ghosh 1975 (Meghalaya) (+). Shuja-Uddin 1978 (Jammu, Kashmir). *Uroleucon pseudotanaceti*—Starý, Ghosh 1975 (Meghalaya) (+). *Uroleucon* sp.—Takada, Rishi 1980 (Kashmir) (+). Undet. aphids—Rishi 1976 (Kashmir).

*Distr.* : India (Jammu, Kashmir, Meghalaya).

### +E. persicae Froggatt, 1904

*Figs.* : Wing—89. Tergite 1 88. Genitalia—87.

*Hosts.* : *Aphis craccivora*—Starý, Bhagat 1978 (Kashmir) (+). *Aphis gossypii*—(Meghalaya) (+). *Aphis ruborum longisetosus*—Meghalaya (+). *Hyperomyzus lactucae*—(Him. Pradesh) (+). *Myzus persicae*—Meghalaya (+). Undet. aphids—Rishi 1976 (Kashmir) (+).

*Distr.* : India (Kashmir, Him. Pradesh, Meghalaya).

### + **E. plagiator** (Nees, 1811)

*Figs.* : $F_{1,2}$—91. $F_{10,11}$—90. Wing—94.

*Hosts* : *Acyrthosiphon pisum*—Agarwala et al. 1980 (Sikkim) (+). *Aphis citricola*—Rao et al. 1969 (West Bengal) (+). Starý, Ghosh, 1978 (Meghalaya) (+). *Aphis fabae*—Him. Pradesh (+). *Aphis gossypii*—Rao et al. 1969 (West Bengal) (+). Starý, Ghosh 1978 (Meghalaya) (+). *Aphis solanella*—(Meghalaya) (+). *Brachycaudus helichrysi*—Starý, Ghosh 1978 (Meghalaya) (+). *Ceratovacuna silvestrii*—Raychaudhuri et al. 1979 (West Bengal) (+). *Hyperomyzus carduellinus*—Him. Pradesh (+). *Macrosiphum rosae*—Raychaudhuri et al. 1978 (West Bengal) (+). Sikkim (+). *Myzus persicae*—Starý, Ghosh 1978 (Meghalaya) (+). Raychaudhuri et al. 1979 (Sikkim). Agarwala et al. 1980 (Sikkim). (West Bengal) (+). *Sitobion rosaeformis*—Agarwala et al. 1980 (Sikkim) (+). Without host records—Alam, Hafiz 1963 (Pakistan) (+). Report C. I. B. C. 1968 (India). Rishi 1976 (Kashmir). Bihar (+). Meghalaya (+). Sikkim (+).

*Biol.* : Seasonal history (Rao et al. 1969). Percent parasitism (Rao et al. 1969). Interspecific relations, x *Aphidius smithi*, laboratory (Rao et al. 1970). Hyperparasitoids (Rao et al. 1969).

*Distr.* : India (West Bengal, Meghalaya, Sikkim, Uttar Pradesh, Bihar). Pakistan.

### + **E. srinagarensis** Starý & Bhagat, 1978

*Ephedrus sinagarensis* Stary & Bhagat, 1978, Acta ent. bohemoslov. 75 : 388-390 (♀).

Holotype ♀ : Srinagar, Kashmir : Zabervan, near Pari Mahal, 23—V 1976, reared from *Myzus* sp. on *Lonicera quinqueocularis*, undergrowth of coniferous forest (leg. Bhagat). Deposition : Zoological Survey of India, Calcutta.

*Figs.* : $F_{1,2}$—97. Wing 96. Propodeum—95. Tergite 1—93. Genitalia —92.—also : Starý, Bhagat 1978.

*Hosts* : *Myzus* sp.—Starý, Bhagat 1978 (Kashmir).

*Distr.* : India (Kashmir).

### + **E.** spp.

*Hosts* : *Aphis citricola*—Starý, Ghosh 1975 (Meghalaya) (+). Raychaudhuri in litt. (Him. Pradesh) (+). *Aphis craccivora*—Hamid, Anwar 1969 (Pakistan). *Aphis ruborum longisetosus*—Starý, Ghosh, 1975 (Meghalaya) (+). *Aphis solanella*—(Meghalaya) (+). *Aulacorthum* sp.—(Meghalaya) (+). *Brevicoryne brassicae*—Hamid 1973 (Pakistan). *Lipaphis erysimi*—(Sikkim) (+). *Myzus dycei*—Starý, Ghosh 1975 (Meghalaya) (+). *Eutrichosiphum flavum* —(Meghalaya) (+). *Rhopalosiphum maidis*—Hamid 1978 (Pakistan). *Rhopalosiphum padi*—Hamid 1978 (Pakistan). *Rhopalosiphum* sp.—Hamid, Shah 1972

(Pakistan). *Schizaphis graminum*—Hamid, Shah, 1972 (Pakistan). Hamid—Mehr-un-Nisá 1974 (Pakistan). *Sitobion fragariae*—Hamid, Shah 1971 (Pakistan). *Toxoptera aurantii*—(Meghalaya) (+). Undet. aphids—(Pakistan) (+). Rishi 1976 (Kashmir).

*Biol.* : Longevity of adults (Hamid, Shah 1972). Reproductive capacity (Hamid, Shah 1972). Percent parasitism (Hamid, Mehr-un-Nisá 1974).

*Distr.* : India (Sikkim, Meghalaya, Him. Pradesh). Pakistan.

*KEY TO SPECIES*

| | | | |
|---|---|---|---|
| 1. | Radial abscissa 2 distinctly shorter to subequal to interradial vein 1 (Fig. 89). Tergite 1 (Fig. 88) almost square. ... | *persicae* | |
| — | Radial abscissa 2 equal (Figs. 81, 86) to distinctly longer than interradial vein 1 (Figs. 94, 96). Tergite 1 (Figs. 77, 93) distinctly longer than wide at spiracles. ... | ... | 2 |
| 2 (1) | Radial abscissa 2 equal to interradial vein 1 (Figs. 81, 86). ... | ... | 3 |
| — | Radial abscissa 2 distinctly longer than interradial vein 1 (Figs. 94, 96). ... | ... | 4 |
| 3 (2) | $F_1$ long and slender, 1/3 longer than $F_2$, brown yellow to yellow (Figs. 73, 75). ... | *lacertosus* | |
| — | $F_1$ stout, about 1/6 longer than $F_2$, black, yellowish at the base (Figs. 83, 84). ... | *niger* | |
| 4 (2) | Antennae distinctly thickened to the apex. Preapical and apical segments thickened, almost fused, forming a club (Figs. 79, 80). ... | *minor* | |
| — | Antennae only slightly thickened to the apex. Praeapical and apical F segments not thickened, distinctly separated from each other (Figs. 90, 91, 97). ... | ... | 5 |
| 5 (4) | $F_1$ about 4 times as long as wide at apex (Fig. 91). $F_2$ subequal to $F_1$ (Fig. 90). $F_1$ brownish at the base, the rest of $F_1$ and $F_2$ brown. Wings subhyaline. ... | *plagiator* | |
| — | $F_1$ and $F_2$ of equal size, a little more than 3.5 times as long as wide. (Fig. 97). $F_1$ yellow with apical fifth infuscated. $F_2$ black with basal third yellow. Wings brown infumated. ... | *srinagarensis* | |

## +Genus : **INDAPHIDIUS** Starý, 1979

*Indaphidius* Starý, 1979, Acta ent. bohemoslov. 76 : 34.

Type-species : *Indaphidius curvicaudatus* Starý, 1979.

### +I. **curvicaudatus** Starý, 1979

*Indaphidius curvicaudatus* Stary', 1979, Acta ent. bohemoslov. 76 : 34-36 (♀).

*Holotype* ♀ : Kalimpong, West Bengal, 1.400 m alt., reared from *Mollitrichosiphum* sp. on *Alnus nepalensis* (leg. Agarwala). Deposition : Dept. of Zoology, University of Calcutta.

*Figs.* : Wing—100. Propodeum.—98. Tergite 1—99. Genitalia—102.—also : Starý 1979, and leg, F segments, head.

*Syns.* : *Indaphidius carvicaudatus* Starý (MS name)—Raychaudhuri et al. 1979 (misspelled).

*Hosts* : *Macrosiphum rosae*—Starý 1979 (West Bengal) (+). *Mollitrichosiphum* sp.—Starý 1979 (West Bengal) (+). Raychaudhuri *et al.* 1979 (West Bengal). *Mollitrichosiphum* (*Metatrichosiphon*) *nandii*—Raychaudhuri *et al.* 1979 (West Bengal, Sikkim).

*Biol.* : Host range (Starý 1979).

*Distr.* : India (Sikkim, West Bengal).

*KEY TO SPECIES*

Only *I. curvicaudatus* is known.

### +Genus : **KASHMIRIA** Starý & Bhagat, 1978

*Kashmiria* Stary' & Bhagat, 1978, Acta ent. bohemoslov. 75 : 391.

Type-species : *Kashmiria aphidis* Starý & Bhagat, 1978.

### + **K. aphidis** Starý & Bhagat, 1978

*Kashmiria aphidis* Stary' & Bhagat, 1978, Acta ent. bohemoslov. 75 : 391-393 (♀).

*Holotype* ♀ : Srinagar, Kashmir : Zabervan, nr. Pari Mahal, 23-V-1976, reared from *Myzus* sp. on *Lonicera quinqueocularis*, undergrowth of coniferous forest (leg. Bhagat). Deposition : Zoological Survey of India, Calcutta.

*Figs.* : Wing—103. Propodeum—101. Tergite 1—108. Genitalia—105, 106.—also : Starý, Bhagat 1978, and F segments.

*Hosts* : *Myzus* sp.—Starý, Bhagat 1978 (Kashmir) (+).

*Distr.* : India (Kashmir).

*KEY TO SPECIES*

Only *K. aphidis* is known.

## + Genus : **LIPOLEXIS** Förster, 1862

### + **L. gracilis** Förster, 1862

*Lipolexis gracilis* Forster, 1862, verti. naturh. ver. preuss. Rhein., 19 : 249.

*Lipolexis chinensis* Chen., 1980, Entomotaxonomia 2 : 169-172 (♀ ♂).

*Syntypes* ♂ ♀ : Boppard Rn., Germany. Deposition. Mus Berlin.

*Holotype* ♀ : Beijing, China, 15-VII-1953. Deposition : Lab. biol. control, Fujian Agric. College. *N. syn.*

*Note* : Judging from the careful original description and figures this species is identical with *L. gracilis* ; the differentiation of a seemingly new species was apparently due to the following of some published information by Chen (1980).

*Figs.* : Wing—111. Propodeum—109. Tergite 1—104. Genitalia—107, 110.—also : Chen 1980, head, antenna wing, legs, tergite 1, genitalia ; as *L. chinensis.*

*Hosts* : *Aphis gossypii*—Mohyuddin, Anwar 1973 (Pakistan) (+). *Liosomaphis himalayensis*—Takada, Rishi 1980 (Kashmir). *Lipaphis erysimi*—Subba Rao, Sharma 1964 (Punjab). *Therioaphis trifolii*—Kashmir (+). Undet. aphids—Subba Rao, Sharma 1964 (Punjab). Rishi 1976 (Kashmir).

*Biol.* : Percent parasitism (Mohyuddin, Anwar 1973).

*Distr.* : India (Kashmir, Punjab). Pakistan.

### + **L. scutellaris** Mackauer, 1962

*Figs.* : Propodeum—113. Tergite 1—112. Genitalia—114, 116.—also : Starý, Schlinger 1967.

*Hosts* : *Aphis citricola*—Biol. Control Inf. Bull. 1967 (India). Rao et al. 1969 (West Bengal). Rao et al. 1970 (West Bengal). Dharmadhikari, Ramaseshiah 1970 (India). Starý, Ghosh 1975 (Meghalaya) (+). Ramaseshiah 1979 (Kerala). *Aphis craccivora*—Dharmadhikari, Ramaseshiah 1970 (India). Starý, Bhagat 1978 (Kashmir) (+). Tripura (+). West Bengal (+). *Aphis fabae*——Agarwala et al. 1980 (Sikkim). *Aphis gossypii*—Biol. Control Inf. Bull. 1967 (India). Dharmadhikari, Ramaseshiah 1970 (India). Starý, Ghosh 1975 (Meghalaya) (+). Rao et al. 1980 (Karnataka). *Aphis nerii*—Dharmadhikari, Ramasehiah 1970 (India). *Aphis ruborum longisetosus*—Starý, Ghosh 1975 (Meghalaya (+). *Aphis solanella*—Rao et al. 1969 (Karnataka) Dharmadhikari, Ramaseshiah 1970 (India). *Aphis sp.*—Dharmadhikari, (Karnataka). Ramaseshiah 1970 (India. Meghalaya (+). *Greenidea formosana*—Dharmadhikari, Ramaseshiah 1970 (India). *Rhopalosiphum maidis*—Dharmadhikari, Ramaseshiah 1970 (India). *Toxoptera aurantii*—Dharmadhikari, Ramaseshiah 1970 (India). *Toxoptera*

*citricidus*—Dharmadhikari, Ramaseshiah 1970 (India). Starý, Ghosh 1975 (Meghalaya (+). *Toxoptera odinae*—Starý, Ghosh 1978 (Meghalaya) (+). Starý, v. Harten 1982 (Bangladesh). *Tuberolachnus salignus*—Starý, Ghosh 1975 (Meghalaya) (+). Without host data—Mackauer, Starý, 1967 (India). Rishi 1976 (Kashmir). Report C.I.B.C 1968. Shuja-Uddin 1971 (U. Pradesh).

*Biol.* : Biology (Shuja-Uddin 1977). Rate of development, longevity of adults, food of adults, reproductive capacity, host-instar preference, laboratory host range, host range, distribution in habitats, abundance, hyperparasitoids (Dharmadhikari, Ramaseshiah 1970). Sensonal history, diapause, description of diapause and non-diapause cocons, emergence (Shuja-Uddin 1977). Seasonal history (Rao et al. 1969 ; Dharmadhikari, Ramaseshiah 1970). Shipment, from India to the West Indies (Ramaseshiah et al. 1970), from India to U. S. A. (Rao et al. 1970).

*Distr.* : India (Tripura, West Bengal, Kashmir, Meghalaya, Kerala, Karnataka, Sikkim, Uttar Pradesh). Bangladesh.

*KEY TO SPECIES*

| | | |
|---|---|---|
| 1. | Tergite 1 with prominent central carina that bifurcates in the middle of the tergite (Fig. 104). Ovipositor sheaths sclerotized in the whole apical part (Figs. 107, 110). ... | *gracilis* |
| — | Tergite 1 with two lateral longitudinal carinae (Fig. 112). Ovipositor sheaths sclerotized only in the dorsal part of the apex (Figs. 114, 116). ... | *scutellaris* |

## + Genus : **LYSAPHIDUS** Smith, 1944

*Tax.* : Shuja-Uddin 1976 (notes, world spp. in relation to Indian fauna).

### [L. **erysimi** Starý, 1960]

*Host* : Undet. aphids—Rishi 1976 (Kashmir).

*Distr.* : Kashmir.

### + **L. qadrii** Shuja-Uddin, 1976

*Lysaphidus qadrii* Shuja-Uddin 1976, J. Bombay Nat. Hist. Soc. 73 : 314-315 (♀).

Holotype ♀ : Uttar Pradesh, Sitapur, 14-III-1973, on leaves of *Artocarpus heterophyllus* L. (leg. Shuja-Uddin). Deposition : Dept. of Zoology, Aligarh University, Aligarh.

*Figs.* : $F_1$—189. $F_2$—190. $F_3$—201. $F_6$—193. Mesonotum—192. Wing—191. Propodeum—31. Tergite 1—37. Genitalia—36. —also : Shuja-Uddin 1976, ocellar triangle, wing, tergite 1, gebitalia.

*Hosts* : *Myzus ornatus*—Raychaudhuri in litt. (Him. Pradesh) (+).

*Distr.* : India (Uttar Pradesh, Him. Pradesh).

**L.** sp.

*Hosts* : *Aphis craccivora*—Dharmadhikari, Ramaseshiah. 1970 (India) *Macrosiphoniella sanborni*—Dharmadhikari, Ramaseshiah 1970 (India).

*Distr.* : India (Punjab, Uttar Pradesh, West Bengal).

*KEY TO SPECIES*

Only one species, *L. qadrii* has been determined from the target area. The occurrence of some other species may be presumed.

+ Genus : **LYSIPHLEBIA** Starý & Schlinger, 1967

+ **L. mirzai** Shuja-Uddin, 1975

*Lysiphlebia mirzai* Shuja-Uddin 1975, Rec. zool. Surv. India 68 : 415-417 (♀ ♂).

*Holotype* ♀ : India, Uttar Pradesh, Meerut, ex. *Longiunguis sacchari* (Zehnt.) on *Saccharum officinarum* L., 25-XI-1968 (leg. Shuja-Uddin). Deposition : Zool. Museum, Aligarh University, Aligarh. *Lysiphlebia sacchari* Chen, 1980, Entomotaxonomia 2 : 141-144 (♀ ♂). *N. syn.*

*Holotype* ♀ : Liaoning (Xifeng), China, 4-VIII-1978. Deposition : Fujian Agric. College.

*Note* : Judging from the careful original description and figures this species is identical with *L. mirzai.*

*Figs.* : Wing—120. Propodeum—115. Tergite 1—117. Genitalia—118.—also : Shuja-Uddin, 1975, wing, propodeum, tergite 1, genitalia.—also : Chen, 1980, head, antennae, wing, propodeum, tergite 1, as *L. sacchari.*

*Hosts* : *Melanaphis sacchari*—Shuja-Uddin 1975 (Utt. Pradesh).

*Distr.* : India (Uttar Pradesh).

*KEY TO SPECIES*

Only one species, *L. mirzai* has benn determined in the target area.

+ Genus **LYSIPHLEBUS** Förster 1862

Subgenus : + **Phlebus** Starý, 1975

All the species recognized in the target area belong to this subgenus.

+ **L. (P.) confusus** Tremblay & Eady, 1978

*Figs.* : Wing—121. Propodeum—119. Tergite 1—123.

*Syns.* : *Lysiphlebus ambiguus* (Haliday, 1834) sensu auct.

[cf. Tremblay & Eady, 1978, see : *Adialytus ambiguus* (Haliday, 1834)].

*Hosts* : *Myzus dycei*—Raychaudhuri in litt. (Him. Pradesh) (+). *Undet. aphids*—Rishi 1976 (Kashmir) (+).

*Distr.* : India (Kashmir, Him. Pradesh).

**L. (P.) delhiensis** (Subba Rao & Sharma, 1960)

*Aphidius* (*Lysiphlebus*) *delhiensis* Subba Rao & Sharma, 1960, Proc. Indian Acad. Sci., B, 51, Suppl. : 82-83 (♀♂).

Holotype ♀ : New Delhi/India, ex *Longiunguis sacchari* (Zehnt.) on sugarcane, Oct.-Nov. 1957 (A. K. Sharma). Deposition : Indian Agric. Res. Institute, New Delhi.

*Figs.* : Subba Rao & Sharma, 1960, wing, genitalia.

*Hosts* : *Melanaphis indosacchari*—Varma *et al.*, 1978 (India). *Melanaphis sacchari*—Subba Rao, Sharma 1960 (Punjab). Ramaseshiah, Menon, 1971 (Assam).

*Biol.* : Seasonal activity and occurrence, percent parasitism, interspecific relations (Singh, Shukla 1966 ; Sandhu *et al.* 1973 ; Varma *et al.* 1978). Shipment, from India to the West Indies (Ramaseshiah *et al.* 1970 ; Bennett, Yaseen 1970).

*Distr.* : India (Punjab, Uttar Pradesh, Assam).

*Note* : The validity of this species need to be examined carafully in the future. Judging from the original description of this species, we do not see basic differences between *L. delhiensis* and *L. confusus* and in that case *L. delhiensis* would have priority in relation to *L. confusus* ; the latter will then be truly a "confused" species (cf. the history of this species, Tremblay & Eady 1978).

+ **L. (P.) fabarum** (Marshall, 1896)

*Figs* . : Wing—124. Propodeum—122. Tergite 1—126.

*Hosts* : *Acyrthosiphon pisum*—Hamid *et al.* 1974 (Pakistan). Hamid, Anwar 1970 (Pakistan). *Aphis craccivora*—Hamid *et al.* 1977 (Pakistan). Hamid, Shah 1972 (Pakistan). Hamid, Anwar 1970 (Pakistan). Undet. aphids—(Pakistan) (+).

*Biol.* : Percent parasitism, hyperparasitoids (Hamid *et al.* 1977).

*Distr.* : Pakistan.

**L. (P.) testaceipes** (Cresson, 1880)

*Figs.* : Wing—127. Propodeum—125. Tergite 1—128. Genitalia—129, 130.

*Hosts* : *Aphis craccivora*—Ramaseshiah *et al.* 1969 (Karnataka-laboratory). *Aphis gossypii*—Mohyuddin, Anwar, 1972, 1973 (Pakistan-laboratory). *Lipaphis erysimi*—Ramaseshiah *et al.* 1969 (Karnataka-laboratory).

*Biol.* : Reproductive capacity, effect of H species, effect of temperature, population relations H×P, percent parasitism (Ramaseshiah *et al.*, 1969 ; Mohyuddin, Anwar 1972). Shipment, from Hawaii to Pakistan (Mohyuddin, Anwar 1973), from U. S. A. to India (Ramaseshiah *et al.* 1969).

*Distr.* : Pakistan (laboratory). India (Karnataka-laboratory).

*Notes* : Results on the field releases and establishment does not seem to have been published. Its occurrence in the field should be verified.

### + L. spp.

*Hosts* : *Aphis craccivora*—Hamid, Shah 1971 (Pakistan). *Aphis gossypii*—Mohyuddin, Anwar, 1972, 1973 (Pakistan) (+). *Melanaphis sacchari*—Singh, Shukla 1966 (India). Undet. aphids—Narayanan *et al.* 1958 (India). (Kashmir) (+).

*Biol.* : Development, oviposition, sex ratio, laboratory cultures (Singh, Shukla 1966). Percent parasitism (Singh, Shukla 1966 ; Hamid, Shah 1971 ; in glasshouse, Mohyuddin, Anwar 1973).

*Distr.* : India (Kashmir, Karnataka). Pakistan.

*KEY TO SPECIES*

| | | |
|---|---|---|
| 1. | Lower and apical margin of forewing with hairs which are longer than these on the surface (Fig. 121). ... ... | 2. |
| — | Lower and apical margin of forewing with hairs which are not longer than those on the surface (Fig. 124). ... | *fabarum* |
| 2 (1) | Metacarpus distinctly longer than pterostigma, reaching the wing apex (Fig. 121). ... | *confusus, delhiensis* |
| — | Metacarpus shorter than pterostigma, not reaching the wing-apex (Fig. 127). ... | *testaceipes* |

## + Genus : **MONOCTONUS** Haliday, 1833

### + M. sp.

*Figs.* : Wing—132. Genitalia—131 (for *M. crepidis* Hal.).

*Hosts* : *Liosomaphis* sp. (Kashmir) (+). *Macrosiphoniella oblonga*—Takada, Rishi, 1980 (Kashmir). Undet. aphids—Rishi, 1976 (Kashmir).

*Distr.* : India (Kashmir).

*KEY TO SPECIES*

Determination of the material to species level is needed.

+ Genus : **PARAPRAON** Starý, 1982

**P. necans** (Mackauer, 1959)

*Praon nymphaeae* Subba Rao, Sarup, Sharma, 1963, Beitr. Ent. 13 : 189-191 (♀ ♂).

*Holotype* ♀ : Hastal village, Delhi/India, ex. *Rhopalosiphum nymphaeae* (Linn.) on *Trapa bispinosa*, March 1962. Deposition : Indian Agric. Res. Institute, New Delhi.

*Figs.* : Head—149. Mesonotum—151. Wing—148. Tergite 1—150.

*Hosts* : *Rhopalosiphum nymphaeae*—Subba Rao, Sarup, Sharma 1963 (Punjab). Without host records—Mackauer, Starý, 1967 (Pakistan).

*Distr.* : India (Punjab). Pakistan.

+ **P. pakistanum** (Kirkland, 1979)

*Praon pakistanum* Kirkland, 1979, J. Kansas ent. Soc. 52 : 309-312 (♀ ♂).

*Holotype* ♀ : Peshawar, Pakistan ; laboratory reared, University of Missouri—Columbia, Missouri, January 10, 1978, reared from *Schizaphis graminum* on *Hordeum vulgare* var. perry. Deposition : U. S. National Museum, Washington.

*Figs.* : General, picture, head, tergite 1, genitalia (Kirkland 1979).

*Hosts* : *Schizaphis graminum*—Kirkland, 1979 (Pakistan) (+).

*Biol.* : Description of cocoon, shipment from Pakistan to U. S. A. (as *Praon* sp.) (Kirkland 1979).

*Distr.* : Pakistan.

*KEY TO SPECIES*

*P. pakistanum* and *P. necans* are apparently closely related species ; their detailed differentiation is needed.

+ Genus : **PAUESIA** Quilis, 1931

Subgenera : + **Paraphidius** Starý, 1958

+ **Pauesia** s. str.

+ **Pauesiella** Sedlag & Starý, 1980

Subgenus : + **Paraphidius** Starý, 1958

*Tax* : Bhagat 1981 (key to subgenera and species in Kashmir).

+ **P. (Paraphidius) antennata** (Mukerji, 1950

*Aphidius antennatus* Mukerji (1948) 1950, Indian J. agric. Sci. 18 : 33-34 (♀).

*Holotype* ♀ : Harnai, Baluchistan/Pakistan, ex. *Pterochlorus persicae*, Deposition : I. A. R. I. New Delhi.

*Figs.* : Wing—136. Propodeum—137. Tergite 1—135. Genitalia—133. —also : Sharma, Subba Rao 1958, wing.

*Tax.* : Sharma, Subba Rao 1959.

*Hosts* : *Pterochloroides persicae*—Mukerji 1950 (Pakistan). Janjua 1955 (Pakistan).

*Biol.* : Host range (Starý 1971).

*Distr.* : Pakistan.

### + **P. (Paraphidius) arcuata** Starý & Raychaudhuri, 1982

*Pauesia* (*Paraphidius*) *arcuata* Stary' & Raychaudhuri, 1982, Orient. Insects 16 :

*Holotype* ♀ : Mashobra, 2.149m (Him. Pradesh), 10-XI-1980, reared from *Cinara abieticola tenuipes* Chakrabarti & Ghosh on *Pinus* sp. (leg. Raychaudhuri). Deposition : Dept. of Zoology, Calcutta University.

*Figs.* : $F_1$—207. $F_2$—212. $F_9$ –209. Preap. F—208. Mesonotum—197. Propodeum—204. Wing—210. Tergite 1—195. Genitalia—202.—also : Starý, Raychaudhuri 1982.

*Hosts* : *Cinara abieticola tenuipes*—Starý, Raychaudhuri 1982 (Him. Pradesh) (+).

*Distr.* : India (Him. Pradesh).

### **P. (Paraphidius) gulmargensis** Bhagat, 1081

*Pauesia* (*Paraphidius*) *gulmargensis* Bhagat, 1981, Orient. Insects 15 : 197-199 (♀).

*Holotype* ♀ : India, Kashmir, Gulmarg, 8. VII. 1977, ex. *Cinara* sp. on *Abies pindrow*, coll. R. C. Bhagat. Deposition : Entomological collection of the Museum of P. G. department of Zoology, Kashmir University, Srinagar.

*Figs.* : Wing, propodeum, tergte 1, genitalia (Bhagat 1981).

*Distr.* : India (Kashmir).

### **P. (Paraphidius) himalayensis** Bhagat, 1981

*Pauesia* (*Paraphidius*) *himalayensis* Bhagat, 1981, Orient. Insects **15** : 199 (♀♂).

*Holotype* ♀ : India, Kashmir, Srinagar, 23. V. 1976, ex. *Lachnus tropicalis* van der Goot on *Pinus excelsa*, coll. R. C. Bhagat. Deposition : Entomological collection of the Museum of P. G. department of Zoology, Kashmir University, Srinagar.

*Figs.* : Wing, propodeum, tergite 1, genitalia (Bhagat 1981).

*Distr.* : India (Kashmir).

### + P. (Paraphidius) indica Starý, 1977

*Pauesia* (*Paraphidius*) *indica* Stary', in Stary' & Raychaudhuri, 1977, Orient. Insects 11 : 233-235 (♀).

*Holotype* ♀ : Churachandpur, Manipur, 22-VI-1976, reared from *Lachnus tropicalis* v. d. G. (leg. Raha). Deposition : Entomology laboratory, Dept. of Zoology, University of Calcutta, Calcatta.

*Figs.* : Head—138. Mesonotum—134. Propodeum—141. Wing—142. Tergite 1—143. Genitalia—139.—also : Starý, Raychaudhuri 1977, and tibia, F segments.

*Hosts* : *Lachnus tropicalis*—Starý, Raychaudhuri 1977 (Manipur) (+). Raychaudhuri *et al.* 1978.

*Distr.* : India (Manipur).

### P. (Paraphidius) pini (Haliday, 1834)

*Hosts* : *Cinara lachnirostris*—Bhagat 1981 (Kashmir). Cinara sp.—Bhagat 1981 (Kashmir). Without host records—Rishi, Bhagat 1980 (Kashmir).

*Distr.* : India (Kashmir).

*KEY TO SPECIES*

| | | |
|---|---|---|
| 1. | Central areola on propodeum with distinct angles between the carinae ; transverse and/or longitudinal carinae developed to a various extent (Figs. 137, 141) ... | 2 |
| — | Central areola on propodeum arcuate in the upper portion ; longitudinal carinae prevalently absent except for the basal part close to spiracles (Eig. 204).... | *arcuata* |
| 2 (1) | Carinae of the central areola on propodeum complete (Fig. 141). ... ... | 4 |
| — | Carinae of the central areola on propodeum incomplete (Fig. 137). ... ... | 3 |
| 3 (2) | Only longitudinal carinae regularly developed, transverse carinae indicated as discontinuous rugosities (Fig. 137). Antennae 22-segmented. Tergite 1 only slightly wider at apex than across spiracles. ... | *antennata* |
| — | Only transverse carinae developed. Antennae 27-segmented. Tergite 1 twice as wide at apex as across spiracles. ... | *himalayensis* |
| 4 (2) | Central areola on propodeum almost smooth ; its carinae regularly developed, well-defined (Note : revision of this group of species is still necessary). ... | *pini, gulmargensis* |
| — | Central areola on propodeum subdivided by less prominent rugosities into smaller more or less defined areolae ; its carinae often irregular owing to lateral rugosities (Fig. 141), ... | *indica* |

*Note* : More species are presumed to occur in the target area.

+ Subgenus : **Pauesia** s. str.

+ **P. (Pauesia) laricis** (Haliday, 1834)

*Figs.* : Wing—146. Genitalia—140.

*Hosts* : *Cinara atrotibialis*—Starý, Ghosh 1975 (Meghalaya) (+).

*Distr.* : India (Meghalaya).

+ **P. (Pauesis) mashobrica** Starý & Raychaudhuri, 1982

*Pauesia* (*Pauesia*) *mashobrica* Stary & Raychaudhuri, 1982, Orient. Insects 16 :

*Holotype* ♀ : Mashobra, 2.149 m (Him. Pradesh), 10-XI-1980, reared from *Cinara abieticola tenuipes* Chakrabarti & Ghosh on *Pinus* sp. (leg. Raychaudhuri). Deposition : Dept. of Zoology, Calcutta University.

*Figs.* : $F_1$—196. $F_2$—198. $F_9$—200. Preap. F—199. Mesonotum—203. Propodeum—211. Wing—206. Tergite—205. Genitalia—194. —also : Starý, Raychaudhuri 1982.

*Hosts* : *Cinara abieticola tenuip*—Starý, Raychaudhuri 1982 (Him. Pradesh) (+).

*Distr.* : India (Him. Pradesh).

*KEY TO SPECIES*

1. Tergite 1.4 times as long as wide across spiracles, with poorly prominent spiracular tubercles, without subsequent lateral impressions, gradually dilating to the apex. Ovipositor sheaths (Fig. 140) with long hairs both in the upper and lower side, their apex arcuate and with short hairs. ... *laricis*

— Tergite 1 (Fig. 205) 2.5 times as long as wide across spiracles ; spiracular tubercles distinct, subsequent lateral impressions distinct ; dilated in the apical third. Ovipositor sheaths (Fig. 194) with a single long hair on the lower side, their apex angular and with several long and short hairs. ... *mashobrica*

Subgenus : **Pauesiella** Sedlag & Starý, 1980

(*Pauesia*) *Kashmirpauesia* Bhagat, 1981, Orient. Insects 15 : 195-196.

*Type-species* : *Pauesia* (*Kashmirpauesia*) *hazratbalensis* Bhagat, 1981 *N. syn.*

*Tax.* : The subgenus *Pauesiella* was described by Sedlag & Starý (1980, Acta ent. bohemoslov. 77 : 383) from the type-species, *P.* (*Pauesiella*) *spatulata* Sedlag & Starý, 1980. The latter species was recognized as a

parasitoid of *Cinara piceicola* Chol. or *C. pilicornis* Htg. on Picea in Central Europe (German Democr. Republic).—A simple comparison of the key-characters of *Pauesiella* and *Kashmirpauesia* shows that both subgenera are identical. Due to priority reasons, *Kashmirpauesia* should be supressed as a new synonym of *Pauesiella*.

**P. (Pauesiella) hazratbalensis** Bhagat, 1981

*Pauesia (Kashmirpauesia) hazratbalensis* Bhagat, 1981, Orient. Insects 15 : 196-197 (♀ ♂).

*Holotype* ♀ : India, Kashmir, Srinagar (Hazratbal), 15. VII. 1979, ex. Lachnus sp. on Biota orientalis, coll. R. C. Bhagat. Deposition : Entomological collection of the Museum of P. G. department of Zoology, Kashmir University, Srinagar.

*Figs.* : Wing, propodeum, tergite 1, genitalia (Bhagat 1981).—for P. spatulata ; Genitalia—144 ; also : Sedlag, Starý 1980, and mesonotum, F-segments, wing, propodeum, tergite 1, genitalia.

*Hosts* : *Lochnus* sp.—Bhagat 1981 (Kashmir).

*Distr.* : India (Kashmir).

*Note* : Judging from the original description and figures, this species seems to differ from the type-species, *P. (P.) spatulata* Sedlag & Starý, 1980, at least in the following points (♀) : Antennae 20-21 segmented. Propodeum with well-developed longitudinal carinae of the central areola. Shape of tergite 1. Host species is *Lachnus* sp.

*KEY TO SPECIES*

Only *P. (P.) hazratbalensis* is known from the target area.

\+ Genus : **PRAON** Haliday, 1833

\+ **P. abjectum** (Haliday, 1833)

*Figs.* : Head—147. Mesonotum—145.

*Hosts* : *Aphis craccivora*—Dharmadhikari, Ramaseshiah 1970 (Karnataka). *Rhopalosiphum nymphaeae*—Starý, Bhagat 1978 (Kashmir) (+).

*Biol.* : Description of mummy, rate of development, life-hi tory (Dharmadhikari, Ramaseshiah 1970).

*Distr.* : India (Kashmir, Karnataka).

**P. aff. absinthii** Bignell, 1894

*Hosts* : *Aphis gossypii*—Dharmadhikari, Ramaseshiah 1970. Uroleucon sp. —Dharmadhikari, Ramaseshiah 1970.

*Distr.* : India.

**P. dorsale** (Haliday, 1833)

*Syns.* : *Praon longicorne* Marshall, 1896.

*Distr.* : India (Kashmir)—Mackauer (1968), Subba Rao, Sharma (1960).

**P. myzophagum** Mackauer, 1959

*Hosts* : *Aphis citricola*—Dharmadhikari, Ramaseshiah 1970 (India). *Aphis gossypii*—Rao *et al.* 1969 (West Bengal). *Myzus persicae*—Dharmadhikari, Ramaseshiah 1970 (Karnataka). Rao *et al.* 1970 (Karnataka).

*Biol.* : Description of mummy, rate of development (Dharmadhikari, Ramaseshiah 1970). Percent parasitism, hyperparasitoids (Rao *et al.* 1970).

*Distr.* : India (West Bengal, Karnataka).

**P. aff. myzophagum** Mackauer, 1959

*Hosts* : *Aphis gossypii*—Rao 1969 (India).

*Distr.* : India.

**P. stagona** Takada & Rishi, 1980

*Praon stagona* Takada & Rishi, 1980, Kontyu 48 : 235-237 (♀ ♂).

*Holotype* ♀ : Pari Mahal (1.750m), Kashmir, 28. VII. 1977, reared from *Stagona* sp. on *Lonicera quinqueocularis* (leg. Rishi). Deposition : Zoological Survey of India, Calcutta.

*Figs.* : Takada, Rishi 1980, wings, tergite 1, genitalia.

*Hosts* : *Stagona* sp.—Takada, Rishi, 1980 (Kashmir).

*Distr.* : India (Kashmir).

+**P. volucre** (Haliday, 1833)

*Figs.* : Head—154. Mesonotum—153. Wing—152. Tergite 1—155. Genitalia—159.

*Hosts* : *Acyrthosiphon pisum*—Hamid, Anwar 1970 (Pakistan). Hamid *et al* 1974 (Pakistan). *Lipaphis erysimi*—Him. Pradesh (+). *Myzus* sp.—Starý, Bhagat 1978 (Kashmir) (+). Without host data—Subba Rao, Sharma, 1961 (Kashmir).

*Biol.* : Percent parasitism, distribution (Hamid, Anwar 1970).

*Distr.* : India (Kashmir, Him. Pradesh). Pakistan.

**P. spp.**

*Hosts* : *Aphis craccivora*—Hamid, Anwar 1969 (Pakistan). Starý, Ghosh 1978 (Meghalaya) (+). *Brachycaudus helichrysi*—Starý, Ghosh 1978 (Megha-

laya) (+). *Macrosiphoniella spinipes*—Starý, Ghosh 1975 (Meghalaya) (+). *Macrosiphoniella* sp.—Starý, Bhagat 1978 (Kashmir) (+). *Macrosiphum pachysiphon*—Starý, Ghosh 1978 (Meghalaya) (+). *Melanaphis sacchari*—Hamid, Mehr-un-Nisá, 1974 (Pakistan). *Myzus ornatus*—(Meghalaya) (+). *Myzus persicae*—Starý, Ghosh 1978 (Meghalaya) (+). *Myzus* sp.—Starý, Ghosh 1978 (Meghalaya) (+). *Rhopalosiphum nymphaeae*—Starý, Ghosh 1978 (Meghalaya) (+). *Schizaphis graminum*—Hamid, 1978 (Pakistan). Hamid, Mehr-un-Nisá, 1973, 1974 (Pakistan). *Sipha maydis*—Hamid, Mehr-un-Nisá, 1974 (Pakistan). *Sitobion rosaeformis*—Starý, Ghosh 1975 (Meghalaya) (+). Undet. aphids——Rishi 1976 (Kashmir).

*Biol.* : Effect of temperature on development, food of adults, longevity of adults, reproductive capacity, seasonal occurrence, percent parasitism (Hamid, Mehr-un-Nisá 1973, Hamid, 1978).

*Distr.* : India. Pakistan.

*KEY TO SPECIES*

Several species are known to be distributed in the target area, but the occurrence of most of them need to be verified. The present key is only an initial orientation.

| | | |
|---|---|---|
| 1. | Lateral lobes of mesonotum with large hairless areas (Fig. 145). ... | *abjectum* |
| — | Lateral lobes of mesonotum almost to completely pubescent (Fig. 153). ... ... | 2 |
| 2 (1) | Ovipositor sheaths prolongatedly oval, apex relatively obtuse (Fig. 159). ... | *volucre* |
| — | Ovipositor sheaths slender, apex relatively acute. ... | *stagona* |

Species not keyed : absinthii, dorsale, myzophagum.

## +Genus : **PSEUDOPRAON** Starý, 1975

### **P. antiquum** (Mackauer, 1967)

*Areopraon antiquum* Mackauer, 1967, Entomophaga 12 : 139-140 (♂).

*Holotype* ♂ : Khanpur, Pakistan, 26.V.1964, reared from *Mindarus* sp. on *Abies pindrow* (leg. Kasimi). Deposition : Mus. Ottawa, Canada.

*Figs.* : Mesonotum-160. Propodeum 158. Wing—162. Tergite 1-157. Genitalia—156 (for *P. mindariphagum* Starý, 1975).

*Host* : *Mindarus* sp. —Mackauer, 1967 (Pakistan).

*Biol.* : Cocoon description (Mackauer 1967).

*Distr.* : Pakistan.

*KEY TO SPECIES*

Only one species, *P. antiquum* (in the male sex) is known from the target area.

## +Genus : **TOXARES** Haliday, 1840

*Syns.* : *Toxares* Westwood, 1840.

*Tax.* : Shuja-Uddin 1976 (key to spp. in India, notes on the authorship).

*Notes* : There was some confusion in the identification of *Toxares* material from the target area. At first, the material was identified as belonging to *deltiger* or *shigai*. However, Shuja-Uddin (1974) keyed 4 species, describing 2 of them as new to science in India. Due to this situation, we have re-classified our Indian material and compared it with the European material of *deltiger*, with the following results :

1. *T. deltiger* is characterized in having 19-20 (18) segmented antennae ; their coloration is somewhat variable : usually the scape, pedicel, $F_1$, $F_2$, and a part of $F_3$ are yellowish, the rest brown ; but the yellow coloration may be distributed even up to the part of $F_5$. However, the most important distinguishing character seems to be in the wing venation : second radial cell is relatively short, second abscissa of median vein is 2.5 times as long as the first abscissa.

2. *T. macrosiphophagum* has 16/17, also 15 segmented antennae according to the original description ; scape, pedicel, $F_1$ and $F_2$ yellow, the latter sometimes wit brownish apex ; wing venation : second radial cell is rather long, second abscissa of median vein is 4 times as long as the first abscissa.

3. Our material determined previously as *deltiger* or *shigai* belongs to *T. macrosiphophagum*. Hence, *T. deltiger* is now considered as not known to occur in India and adjacent areas.

4. The occurrence of *T. shigai* has but remained questionable. Apart of our records (cf. 3, above) Takada & Rishi (1980) reported this species from Kashmir. In our opinion, this material could also belong to *T. macrosiphophagum* as these authors did not include the paper of Shuja-Uddin (1974) in their references ; moreover, the separation of *T. shigai* from the Indian species by Shuja-Uddin (1974, 1. c.) is not quite clear ; it is based on the number of antennal segments (17) and the coloration, which may vary and overlap partially.

### [T. **deltiger** (Haliday, 1833)]

*Tax.* : Shuja-Uddin (1976).

*Hosts* : (all the records are +). *Aphis citricola*—Starý, Ghosh 1978 (Meghalaya). *Aphis solanella*—Meghalaya. *Brachycaudus helichrysi*—Starý,

Ghosh 1978 (Meghalaya). *Brachycaudus* sp.—Starý, Bhagat 1978 (Kashmir). *Capitophorus hippophaes indicus*—Starý, Ghosh 1978 (Meghalaya). *Hyperomyzus* sp.—Starý, Bhagat 1978 (Kashmir). *Lachnus tropicalis*—Meghalaya. *Macrosiphoniella* sp.—Starý, Bhagat 1978 (Kashmir). *Metopolophium euryae*—Starý, Ghosh 1978 (Meghalaya). *Myzus boehmeriae*—(Meghalaya). *Myzus obtusirostris*—(Meghalaya). *Myzus ornatus*—Starý, Ghosh 1978 (Meghalaya). *Myzus persicae*—Starý, Ghosh 1978 (Meghalaya). *Rhopalosiphum maidis*—Pakistan. *Rhopalosiphum nympheae*—Starý, Ghosh 1979 (Meghalaya). *Schizaphis rotundiventris*—Starý, Ghosh 1978 (Maghalaya). *undet. aphids*—(Meghalaya), (West Bengal). Rishi 1976 (Kashmir). Rishi, Bhagat. 1980 (Kashmir).

*Distr.* : India (Meghalaya, West Bengal, Kashmir). Pakistan.

*Notes* : see—introduction, genus *Toxares*.

### + **T. macrosiphophagum** Shuja-Uddin, 1974

*Toxares macrosiphophagum* Shuja-Uddin, 1974, Indian J. Ent. 36 : 269-272 (♀ ♂).

*Holotype* ♀ : Jammu & Kashmir, Srinagar, 20-IX-1969, reared from *Macrosiphoniella sanborni* (Gill.) on *Chrysanthemum* sp. : leg Shuja-Uddin). Deposition : Dept. of Zoology, Aligarh University, Aligarh.

*Figs.* : $F_{1,2,3}$ – 167. Mesonotum—165. Propodeum—166. Wing—163. Tergite 1—164. Genitalia—161.—also : Shuja-Uddin 1974, F segments, mesothorax, propodeum, tergite 1, genitalia.

*Hosts* : (records mostly +). *Aphis citricola*—(Meghalaya). *Aphis solanella*—(Meghalaya). *Brachycaudus helichrysi*—(Meghalaya). *Brachycaudus* sp.—(Kashmir). *Capitophorus hippophaes indicus*—(Meghalaya). *Hyperomyzus* sp.—(Kashmir). *Lachnus tropicalis*—(Meghalaya). *Macrosiphoniella sanborni*—Shuja-Uddin 1974 (Kashmir, Jammu). *Macrosiphoniella* sp.—(Kashmir). *Metopolophium euryae*—(Meghalaya) : *Myzus boehmeriae*—(Meghalaya). *Myzus obtusirostris*—(Meghalaya). *Myzus ornatus*—(Meghalaya). *Myzus persicae*—(Meghalaya). *Rhopalosiphum maidis*—(Pakistan). *Rhopalosiphum nympheae*—(Meghalaya). *Schizaphis rotundiventris*—(Meghalaya). Undet. aphids—(Meghalaya). (West Bengal).

*Biol.* : Pupation, coloration of mummy (Shuja-Uddin 1974).

*Distr.* : India (Kashmir, Meghalaya, West Bengal). Pakistan.

### [**T. shigai** Takada, 1965]

*Tax.* : Shuja-Uddin, 1974.

*Hosts* : *Aphis farinosa*—Takada, Rishi 1980 (Kashmir). *Brachycaudus helichrysi*—Starý, Ghosh 1975 (Meghalaya). *Chaitophorus leucomelas*—Takada,

Rishi 1980 (Kashmir). Macrosiphoniella *sanborni*—Dharmadhikari, Ramaseshiah 1970 (Mysore). *Myzus persicae*—Hamid 1977 (Pakistan). Starý, Ghosh 1975 (Meghalaya). Kazimi *et al.* 1969 (Pakistan). *Rhopalosiphum maidis*—Hamid 1978 (Pakistan). *Rhopalosiphum padi*—Hamid 1978 (Pakistan). *Uroleucon tanaceti*—Takada, Rishi 1980 (Kashmir). Undet. aphids—Dharmadhikari, Ramaseshiah 1970 (Mysore). Rishi 1976 (Kashmir).

*Distr.* : India (Kashmir, Meghalaya, Mysore). Pakistan.

*Note* : see—introduction genus *Toxares*.

### T. zakai Shuja-Uddin, 1974

*Toxares zakai* Shuja-Uddin, 1974, Indian J. Ent. 36 : 272-273 (♀ ♂).

*Holotype* ♀ : Jammu and Kashmir, Sopore, Wadoora, 23-IX-1969, reared from *Myzus persicae* (Sulz.) on *Solanum nigrum* (L.) (leg. Shuja-Uddin). Deposition : Dept. of Zoology, Aligarh University, Aligarh.

*Figs.* : Shuja-Uddin 1974, F segments, mesothorax, wing, propodeum, tergite 1, genitalia.

*Hosts* : *Myzus persicae*—Shuja-Uddin 1974 (Kashmir).

*Biol.* : Pupation, coloration of mummy (Shuja-Uddin 1974).

*Distr.* : India (Kashmir).

*KEY TO SPECIES*

1. $F_1$ and $F_2$ yellow with brown apices. $F_3$ and $F_4$ at least 2.5 times as long as wide (Fig. 167). Tergite 1 with prominent spiracular tubercles (Fig. 164). ... *macrosiphophagum*

— $F_1$ and $F_2$ brown, base of $F_1$ yellowish. $F_3$ and $F_4$ about twice as long as wide. Tergite 1 with poorly distinct spiracular tubercles. ... *zakai*

## + Genus : **TRIOXYS** Haliday, 1833

## Subgenera : + **Binodoxys** Mackauer, 1960

## + **Trioxys** s. str.

*Tax.* : Shuja-Uddin 1973 (notes, key to some Indian spp.).

*KEY TO SUBGENERA*

1. Tergite 1 with primary (=spiracular) tubercles (Fig. 183). ... *Trioxys* s. str.

— Tergite 1 with primary (=spiracular) and secondary tubercles (Figs. 172, 175, 180, 188, 221, 226). ... *Binodoxys*

Subgenus : + **Binodoxys** Mackauer, 1960

+ **T. (Binodoxys) acalephae** (Marshall, 1886)

*Figs.* : Genitalia—169.

*Tax.* : Shuja-Uddin 1974 (key).

*Hosts* : *Aphis gossypii*—Dharmadhikari, Ramaseshiah 1970 (Karnataka). *Phorodon* sp.—Starý, Bhagat 1978 (Kashmir) (+). Without host data—Shuja-Uddin 1974 (India).

*Distr.* : India (Kashmir, Mysore).

**T. (Binodoxys) basicurvus** Shuja-Uddin, 1973

*Trioxys (Binodoxys) basicurvus* Shuja-Uddin, 1973, Indian J. Ent. 35 : 9, 10, 11 (♀♂).

*Holotype* ♀ : India, Kashmir, Sopore (Wadoora), 29-V-1970, ex *Aphis gossypii* Glover on *Rubus* sp. (leg. Shuja-Uddin). Deposition : Dept. of Zoology, Aligarh University, Aligarh.

*Figs.* : Shuja-Uddin 1973, wing, propodeum, tergite 1, genitalia.

*Hosts* : *Aphis gossypii* Glov.—Shuja-Uddin 1973 (Kashmir). According to hand-written notice on the reprint by Shuja-Uddin the original host record has been verified : the aphid is *Aphis ? ruborum* Kalt. (ident. by the Brit. Museum, Nat. Hist., London).

*Distr.* : India (Kashmir).

*Note* : In our opinion, the specific status of *T basicurvus* and *T rubicola* in relation to *T indicus* should be verified. The diagnosis could be easily a matter of variation of the common species, *T indicus* ; the same applies to the type- localities as well as for the host range of both species.

[**T. (Binodoxys) brevicornis** (Haliday, 1833)]

*Tax.* : Shuja-Uddin 1974 (key).

*Hosts* : *Lipaphis erysimi*—Rao *et al.* 1974 (Karnataka) (?). *Myzus persicae*—Subba Rao, Sharma 1964 (Him. Pradesh) (?). Rao *et al.* 1974 (Karnataka) (?).

*Distr.* : India (Him. Pradesh, Mysore).

+**T. (Binodoxys) centaureae** (Haliday, 1833)

*Binodoxys uroleucon* Takada & Rishi, 1980, Kontyu 48 : 239, 235, 236 (♀) ... *N. syn.*

*Holotype* ♀ : Srinagar, Kashmir (1.590m), 2-VII-1977, reared from *Uroleucon* sp. on *Chrysanthemum morifolium* (leg. Rishi). Deposition : Zoological Survey of India, Calcutta.

*Figs.* : Wing—170. Propodeum—173. Tergite 1—172. Genitalia—168.—also : Takada, Rishi 1980, wing, tergite 1, genitalia, as *T. uroleucon*.

*Tax.* : Takada & Rishi (1980) differentiated their *T. uroleucon* from *T. centaureae* "by the stouter shape of the ovipositor sheaths and the structure of the petiole : the distance between first and second lateral tubercles is not as long as that between second tubercles and posterior margin as in *centaureae* (after Mackauer, 1959), but much shorter".—We have examined several series of *T. centaureae* from Europe with the aim to determine the variation range of characters on tergite 1. Our results have shown that the distance between spiracular and secondary tubercles (tops) may be equal to distinctly shorter than the distance between the secondary tubercle and posterior margin. Consequently, the key distinguishing character of *T. uroleucon* falls within the variation range of *T. centaureae*, and the two species thus run to be identical. Owing to priority, *T. uroleucon* is now considered a junior synonym of *T. centaureae*.

*Hosts* : *Macrosiphoniella* sp.—Starý, Bhagat 1978 (Kashmir) (+). *Uroleucon* sp.—Takada, Rishi 1980 (Kashmir).

*Distr.* : India (Kashmir).

### +T. (Binodoxys) eutrichosiphi Starý, 1975

*Trioxys* (*Binodoxys*) *eutrichosiphi* Stary', in Stary' & Ghosh, 1975, Orient. Insects 9 : 347-348 (♀♂).

*Holotype* ♀ : Shillong, Meghalaya, 14-X-1974, reared from *Eutrichosiphum* sp. on *Litsaea* sp. (leg, Ghosh). Deposition : Zoological Survey of India, Calcutta.

*Figs.* : Wing—171. Propodeum—176. Tergite 1—175. Genitalia —174.—also : Starý, Ghosh 1975, and F segments.

*Hosts* : *Eutrichosiphum* sp.—Starý,Ghosh 1975 (Meghalaya) (+).

*Distr.* : India (Meghalaya).

### +T. (Binodoxys) sp.*

*Holotype* ♀ : Dacca,17-II-1981, from *Greenidea* sp. on *Psidium guajava* (leg. A. van Harten). Deposition : Coll. Starý, Czechosl. Acad. of Science.

*Figs.* : $F_1$—216. $F_2$—218. $F_3$—219. preap. F—220. Mesonotum—214. Propodeum. 215. Wing—213, Tergite 1—221. Genitalia—217.—also : Starý, *v.* Harten 1982.

*Hosts* : *Greenidea* sp.—Starý, v. Harten 1982, (Bangladesh).

*Distr.* : Bangladesh.

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*Note : This species will be described as a new species by Stary' and van Harten, in due course.

+. T. **(Binodoxys) indicus** Subba Rao & Sharma, 1959

*Trioxys* (*Trioxys*) *indicus* Subba Rao & Sharma, 1959, Indian J. Ent. **20** : 199-201 (♀ ♂).

*Holotype* ♀ : Delhi, India, ex *Aphis gossypii* Glov. on brinjal plant, 1956 (leg. Sangwan). Deposition : Indian Agric. Res. Institute, New Delhi.

*Figs.* : Wing—177. Propodeum—179. Tergite 1—180. Genitalia—178. —also : Shuja-Uddin 1973, head, wing, propodeum, tergite 1, genitalia. Sharma, Subba Rao 1973.

*Tax.* : Shuja-Uddin 1974 (re-description).

*Hosts* : *Aphis citricola*—Starý, Ghosh 1975 (Meghalaya) (+). (Sikkim) (+). *Aphis craccivora*—Starý, Ghosh 1975 (Meghalaya) (+). Starý, Bhagat 1978 (Kashmir) (+). Raychaudhuri *et al.* 1978 (Manipur). Singh, Sinha 1979, 1980 (U. Pradesh). Singha *et al.* 1979 (U. Pradesh). Sinha, Singh 1979 (U. Pradesh)—Sinha, Singh 1980 (U. Pradesh). (West Brngal) (+). (Him. Pradesh) (+). *Aphis gossypii*—Narayanan *et al.* 1958 (India) Subba Rao, Sharma 1959 (Punjab). Subba Rao, Sharma 1962 (Punjab). Sharma, Farooqi 1963 (India). Rao *et al.* 1969 (West Bengal). Rao *et al.* 1970 (Karnataka). Ramaseshiah 1972 (Karnataka). Shuja-Uddin 1974 (U. Pradesh). Starý, Bhagat 1978 (Kashmir) (+). Raychaudhuri *et al.* 1978 (Manipur). Agarwala *et al.* 1980 (Sikkim). Him. Pradesh (+). *Aphis nasturtii*—(Kashmir) (+). *Aphis nerii*—Shuja-Uddin 1974 (U. Pradesh). *Aphis ruborum longisetosus*—Starý, Ghosh 1975 (Meghalaya) (+). *Aphis solanella*—Starý, Ghosh 1975 (Meghalaya) (+). *Aphis* sp.—(Meghalaya) (+). (West Bengal) (+). *Aulacorthum magnoliae*—Agarwala *et al.* 1980 (Sikkim). *Aulacorthum* sp.—(Sikkim) (+). *Brachycaudus helichrysi*—Starý, Ghosh 1978 (Meghalaya) (+). *Hysteroneura setariae*—Starý, v. Harten 1982 (Bangladesh) (+). *Lipaphis erysimi*—Rao *et al.* 1969 (Karnataka). *Myzus persicae*—Starý, Ghosh 1975 (Meghalaya) (+). Rao *et al.* 1969 (Karnataka). Starý, v. Harten 1982 (Bangladesh) (+). *Sinomegoura citricola*—Starý, Ghosh 1975 (Meghalaya) (+). *Sitobion miscanthi*—(Him. Pradesh) (+). *Toxoptera aurantii*—Starý, Ghosh 1975 (Meghalaya) (+). *Toxoptera citricidus*—Starý, Ghosh 1975 (Meghalaya) (+). *Toxoptera odinae*—Starý, v. Harten 1982 (Bangladesh) (+). Undet. aphids—(Him. Pradesh) (+). (West Bengal) (+). (Sikkim) (+). (Kashmir) (+). Mackauer, Starý 1967 (Pakistan). Rishi, Bhagat, 1980 (Kashmir).

*Biol.* : Morphology, adult, larva (Subba Rao, Sharma 1962). Development (Subba Rao, Sharma 1962). Developmental rate (Subba Rao, Sharma 1962). Mummy, field populations (Singh. Sinha 1980). Emergence, field (Singh, Sinha, 1980). Longevity of adults (Subba Rao, Sharma, 1962). Behaviour (Subba Rao, Sharma 1962 ; Sinha, Singh 1979). Searching capacity, models (Singh *et al.* 1979, 1980). Mating (Subba Rao, Sharma 1962). Oviposition (Subba Rao, Sharma 1962 ; Sinha, Singh 1979), effects of ♀ on

host mortality (Sinha, Singh 1980). Reproductive capacity (Subba Rao, Sharma 1962). Sex ratio, efffects on host population density (Sinha, Singh 1979), in field populations (Singh, Sinha 1980). Host preference (Subba Rao, Sharma 1962). Host instar preference (Subba Rao, Sharma 1962). Host range (Rishi 1976). Population dynamics (Sharma, Farroqi 1963). Populations, density effects, numerical interactions (Singh *et al.* 1979, 1980). Parasitism, field (Rao *et al.* 1969, 1970 ; Subba Rao, Sharma 1962), determination of percent (Subba Rao, Sharma 1962). Dispersal (Sinha, Singh 1980). Diapause (Singh, Sinha 1980). Distribution (Rishi 1976). Superparasitism (Subba Rao, Sharma 1962 ; Sinha, Singh 1980). Intraspecific competition (Sinha, Singh 1980). Interspecific relations (Subba Rao, Sharma 1962 ; Sinha, Singh 1980). Hyperparasitoids (Narayanana *et al.* 1958 ; Singh, Sinha 1979, 1980 ; Rao *et al.* 1969), effect of temperature, effect of host density diapause, effect of host effectiveness on hyperparasitoids (Singh, Sinha 1980). Effectiveness, factors (Sinha, Singh 1980). Rearing methods (Singh *et al.* 1979 ; Subba Rao, Sharma 1962). Release numbers (Sinha, Singh 1979). Shipment, from India to U. S. A. (Rao *et al.* 1970, 1971 ; Ramaseshiah 1972). Role in biological control (Singh, Sinha 1980).

*Distr.* : India (Meghalaya, Sikkim, Kashmir, West Bengal, Mysore, Manipur, Uttar Pradesh, Him. Pradesh, Punjab). Pakistan. Bangladesh.

### T. (**Binodoxys**) **kashmirensis** (Takada & Rishi, 1880) *n. comb.*

*Binodoxys kashmirensis* Takada & Rishi, 1980, Kontyu 48 : 238-239, 235, 236 (♀♂).

*Holotype* ♀ : Harwan, Kashmir, 1.656m, 12-V-1977, reared from *Macrosiphum* sp. on *Rosa bruiana*. Deposition : Zoological Survey of India, Calcutta.

*Figs.* : Takada, Rishi 1980 : wing, tergite 1, genitalia.

*Hosts* : *Mocrosiphum* sp.—Takada, Rishi 1980 (Kashmir).

*Distr.* : India (Kashmir).

### + T. (**Binodoxys**) **kumaonensis** Starý & Raychaudhuri, 1982

*Trioxys* (*Binodoxys*) *kumaonensis* Stary' & Raychaudhuri, 1982, Orient. Insects. 16 : .....(♀♂).

*Holotype* ♀ : Mashobra, 2.149m (Him. Pradesh), 10-XI-1980, reared from *Greenidea kumaoni* on *Berberis* sp. (leg. Raychaudhuri). Deposition : Dept. of Zoology, Calcutta University.

*Figs.* : $F_1$—222. $F_2$—227. Middle F—228. Preap. F—229. Mesonotum—230. Propodeum—224. Wing—223, Tergite 1—226, Genitalia—225.—also : Starý, Raychaudhuri 1982.

*Hosts* : *Greenidea* sp.—Starý, Raychaudhuri 1982 (Him. Pradesh) (+).

*Distr.* : India (Him. Pradesh).

### T. (Binodoxys) rubicola Shuja-Uddin, 1973

*Trioxys* (*Binodoxys*) *rubicola* Shuja-Uddin, 1973, Indian J. Ent. 35 : 10-12 (♀ ♂).

*Holotype* ♀ : India, Kashmir, Sopore (Wadoora) ; 29-V-1970, ex *Aphis gossypii* Glover on *Rubus* sp. (coll. Shuja-Uddin). Deposition : Dept. of Zoology, Aligarh University, Aligarh.

*Figs.* : Shuja-Uddin 1973 : wing, propodeum, tergite 1, genitalia.

*Hosts* : *Aphis gossypii*—Shuja-Uddin 1973 (Kashmir).

*Distr.* : India (Kashmir).

*Note* : see--*T* (*B.*) *basicurvus*.

### +T. (Binodoxys) shillongensis Starý, 1978

*Trioxys* (*Binodoxys*) *shillongensis* Stary' in Stary' & Ghosh, 1978, Orient. Insects 12 : 78-79 (♀).

*Holotype* ♀ : Meghalaya, Shillong, 1-IX-1976, reared from *Sinomegoura pyri* Ghosh and Raychaudhuri : (leg. Jyrwa). Deposition : Zoological Survey of India, Calcutta.

*Figs.* : Wing—187. Propodeum—186. Tergite 1—188. Genitalia—184.—also : Starý, Ghosh 1978.

*Hosts* : *Eutrichosiphum pyri*—Starý, Ghosh 1978 (Meghalaya) (+).

*Distr.* : India (Meghalaya).

### [T. (Binodoxys) sinensis Mackauer, 1962]

*Hosts* : *Aphis craccivora*—Rao 1969. Hamid, Anwar, 1970 (Pakistan). Mohyudddin *et al.* 1971 (Pakistan). Mohyuddin, Anwar 1972, 1973 (Pakistan). Hamid *et al.* 1977 (Pakistan, as ? sinensis). *Aphis gossypii*—Anwar 1974 (Pakistan). Mohyuddin, Anwar 1972, 1973 (Pakistan). Mohyuddin *et al.* 1971 (Pakistan). Rao 1969. *Rhopalosiphum* sp.—Mohyuddin *et al.* 1971 (Pakistan).

*Biol.* : Behaviour (Mohyuddin, Anwar 1973). Host range (Hamid, Anwar 1970 ; Mohyuddin, Anwar 1972). Host preference (Mohyuddin, Anwar 1972, 1973). Percent parasitism (Mohyuddin, Anwar 1973 ; Mohyuddin *et al.* 1973). Effect of H plant on P (Mohyuddin, Anwar 1973). Populations (Mohyuddin, Anwar 1972). Utilisation in biological control, glasshouse (Mohyuddin *et al.* 1971). Shipment, from Pakistan to U. S. A. and United Kingdom (Mohyuddin, Anwar 1972), from Pakistan to United Kingdom (Anwar 1974 ; Mohyuddin, Anwar 1972, 1973).

*Distr.* : Pakistan.

*Note* : At least, we have seen laboratory reared material originating from Pakistan (sent kindly by Glasshouse Crops Res. Institute, Littlehamilton, U. K.) which belongs to *T.* (*B*) *indicus*.—Most probably, all the records should be referred to *T.* (*B.*) *indicus* as well.

### *KEY TO SPECIES OF* BINODOXYS

| | | |
|---|---|---|
| 1. | Distance between primary (=spiracular) and secondary tubercles subequal to distinctly longer than the width across spiracles (Figs. 172, 175, 180, 226, 188). ... | ... 3 |
| — | Distance between primary (=spiracular) and secondary tubercles distinctly shorter than the widthacross spiracles (Figs. 169, 221). ... | ... 2 |
| 2 (1) | Prongs slightly arcuate, with 4-5 long, slender hairs on the dorsale surface ; the hairs on the ventral surface distinctly shorter than these on the dorsal surface (Fig. 169). ... | *acalephae* |
| — | Prongs straight, with 7 stout, basally dilated and relatively short hairs on the dorsal surface ; the hairs on the ventral surface distinctly longer than these on the dorsal surface (Fig. 217). ... | *greenideae* |
| 3 (1) | Prongs with 7-8 long, stout hairs on the dorsal surface (Fig. 168). ... | *centaureae* |
| — | Prongs with less number of hairs on the dorsal surface (Figs. 225, 174. 178, 184). ... | ... 4 |
| 4 (3) | Propodeum with central areola (Figs. 176, 179, 186). Basal segments of flagellum with the hairs distinctly shorter than segment diameter. ... | ... 5 |
| — | Propodeum with two divergent carinae in the lower portion (Fig. 224). Basal segments of flagellum with the hairs distinctly longer than segment diameter (Figs. 222, 227). ... | *kumaonensis* |
| 5 (4) | Prongs with several long hairs on the dorsal surface and ventral surface (Figs. 184, 178). ... | .... 6 |
| — | Prongs with 1 long hairs on the dorsal and ventral surface, respectively, beside the preapical hairs on each side (Fig. 174). ... | *eutrichosiphi* |
| 6 (5) | Prongs slender, slightly arcuate, with 2 simple short apical bristles (Fig. 178). ... | *indicus* (see : note) |
| — | Prongs relatively strong, arcuate, with one long apical bristle (Fig. 184). ... | *shillongensis* |

Species not keyed : *drevicornis*, *sinensis*.—For the differentiation of the reportedly different and closely related species to *indicus*, i.e., *basicurvus*, *rubicola* and *kashmirensis*, see : the original descriptions and diagnoses.

Subgenus : + **Trioxys** s. str.

**T. (Trioxys) auctus** (Haliday, 1833)

*Host* : *Rhopalosiphum maidis*—Dharmadhikari, Ramaseshiah 1970.

*Distr.* : India (Assam).

**T. (Trioxys) pallidus** (Haliday, 1833)

*Host* : *Undet. aphids*—Rishi 1976 (Kashmir).

*Distr.* : India (Kashmir).

**+ T. (Trioxys) rishii** Starý & Bhagat, 1978

*Trioxys* (*Trioxys*) *rishii* Stary' & Bhagat, 1978, Acta ent. bohemoslov. **75** ; 390-391, 389 (♀ ♂).

*Holotype* ♀ : Srinagar, Kashmir, Shankradharya hill lock, 16-IX-1975, reared from *Brachycaudus* sp. on *Carduus edelbergii*, foothill, mixed forest (leg. Bhagat). Depostition : Zoological Survey of India, Calcutta.

*Figs.* : Wing—185. Propodeum—182. Tergite 1—183. Genitalia—181. also : Starý, Bhagat 1978, and F segments.

*Hosts* : *Brachycaudus* sp.—Starý, Bhagat 1978 (Kashmir). Without host records.—Rishi, Bhagat 1980 (Kashmir).

*Distr.* : India (Kashmir).

**T.** ssp.

*Hosts* : *Aphis citricola*—(Meghalaya) (+). *Aphis craccivora*—Hamid, Anwar 1969 (Pakistan). (Meghalaya) (+). *Aphis* sp.—(Him. Pradesh (+). *Brachycaudus* sp.—Starý, Bhagat 1978 (Kashmir) (+). *Macrosiphoniella spinipes*—Starý, Ghosh 1975 (Meghalaya) (+). *Melanaphis donacis*—Raychaudhuri in litt. (Him. Pradesh) (+). *Mollitrichosiphum tenuicorpus*—Starý, Ghosh 1978 (Meghalaya) (+). *Sipha maydis*—Hamid, Shah 1971 (Pakistan). *Therioaphis trifolii*—Hamid, Shah 1971 (Pakistan). *Toxoptera aurantii*—Rau 1936. *Toxoptera citricidus*—(Meghalaya) (+). *Tuberculatus indicus*—Starý, Ghosh 1978 (Meghalaya) (+). Undet. aphids—Behura 1961. Dharmadhikari, Ramaseshiah 1970. Rishi 1976. (Kashmir) (+).

*Biol.* : Percent parasitism (Hamid, Shah 1971).

*Distr.* : India (Meghalaya, Kashmir, Him. Pradesh). Pakistan.

*KEY TO SPECIES OF* **TRIOXYS**

1. Tergite 1 striate in the fore part. Apex of prongs with 2 simple bristles. ... *auctus*

— Tergite 1 smooth in the fore part (Fig. 183). Apex of prongs with 2 basally dilated bristles at the apex (Fig. 181). ... *rishii*

Species not keyed : *pallidus*.

## ZOOGEOGRAPHY

Our knowledge of the parasitoid fauna of the target area is doubtlessly too scanty to determine the particular faunal complexes and peculiarities. For this reason, the parasitoid species known from this area are divided into several groups in accordance with their distribution range. Information on the range has been obtained from the general papers (see : References, A), except where otherwise stated. The original or verified records on the particular parasitoid species have been principally used.

A great part of the established species belong to various faunal complexes of the Palearctic region which apparently extend into the target area as well. The key-position and significance in this respect, has the Himalayan range and its submountains, that belong zoogeographically to the Himalayan province of the Eastern Palearctic sub-region of the Palearctic. The parasitoid species involved, however, may exhibit somewhat different host range patterns in detail, in that they parasitize indigenous aphid species.

Holarctic forest tundra faunal complex.—*Adialytus salicaphis*, *Aphidius cingulatus* ; their host aphids are associated with *Populus*, *Salix*, etc., hence the parasitoids are rather trans-zonal both in the horizontal and vertical scales, they follow the rivers, brooks and associated vegetation on the banks. *Parapraon necans* is associated with moors, marshes, and various aquatic and semi-aquatic habitats, mainly through its parasitization on *Rhopalosiphum nympheae* ; this parasitoid species is also widely transzonal.

Eurasian coniferous forest faunal complex.—*Pauesia laricis*, *Diaeretus leucopterus*. Distributed in the coniferous and mixed forests of the Himalayan range and its submountains.

European deciduous forest faunal complex.—*Aphidius hortensis*, *Aphidius rosae*, *Aphidius urticae*, *Areopraon lepelleyi*, *Ephedrus lacertosus*, *Ephedrus persicae*, *Ephedrus plagiator*, *Praon abjectum*. They are represented mainly in the submountains and mountains of the Himalayan range, but some elements penetrate also far into the plains.

Eurasian steppes faunal complex.—*Adialytus ambiguus*, *Aphidius absinthii*, *Aphidius ervi*, *Aphidius matricariae*, *Aphidius uzbekistanicus*, *Diaeretiella rapae*, *Ephedrus niger*, *Lipolexis gracilis*, *Lysiphlebus confusus*, *Lysiphlebus fabarum*, *Praon volucre*, *Trioxys acalephae*, *Trioxys auctus*, *Trioxys centaureae*. These species are distributed mainly in the northwestern submountains of the Himalayan range, but some of them penetrate far into the other areas.

The oriental faunal groups are as follows :

*Aphidius colemani*, *Lipolexis scutellaris*, *Lysiphlebia mirzai*, *Trioxys indicus* are widely distributed species apparently over most of the Oriental region.

*Pauesia arcuata*, *Pauesia mashobrica* and other *Pauesia* species associated with conifer aphids and *Pseudopraons antiquum* are typical representatives of the coniferous forests of the Himalayan range.

*Betuloxys assamensis*, *Betuloxys takecallis*, *Cristicaudus nepalensis*, *Ephedrus srinagarensis*, *Indaphidius curvicaudatus*, *Kashmiria aphidis*, *Lysaphidus qadrii*, *Pauesia antennata*, *Pauesia*, *indica*, *Toxares macrosiphophagum*, *Toxares zakai*, *Trioxys kashmirensis*, *Trioxys rishii* seem to be representatives of deciduous forest complexes ; some of these species appear to penetrate far into other areas, being associated mainly with cultivated plants and habitats (pest aphids).

Parasitoids associated with the Greenidid aphids have a peculiar position, representing the true tropical representatives in many cases, e. g., *Archaphidus greenideae* (extends to Taiwan), *Trioxys eutrichosiphi* (extends to Japan, c f. Takada & Yamauchi 1979), *Trioxys greenideae*, *Trioxys kumaonensis*, *Trioxys shillongensis*, *Indaphidius curvicaudatus* (ex parte) ; some of the widely distributed and specific parasitoids are also partially involved (*Lipolexis scutellaris*).

*Aphidius smithi*, *Praon pakistanum* seem to be associated with the steppe—cultivated steppe in the submountains and plains.

It should be stressed that the palearctic and oriental parasitoid species often occur together in the same area ; this seems to be the main feature of the submountains and mountains of the Himalayan range (*e. g.*, Kashmir & Jammu).

# HOST—PARASITOID CATALOGUE

The aphid genera and species are listed in an alphabetic order irrespective of their taxonomic classification (families, subfamilies, etc.).

In aphid nomenclature, Eastop and Hille Ris Lambers (1976) have been generally followed.

*Abbreviations* :

(!) obviously erroneous record.

(?) doubtful host record.

[ ] occurrence of the parasitoid species doubtful in the target area.

*ACYRTHOSIPHON* Mordvilko, 1914
*gossypii* (Mordvilko, 1914)
*Aphidius* sp.
*kondoi* Shinji, 1938
*Aphidius ervi*
*pisum* (Harris, 1776)
*Aphidius absinthii* (!)
*Aphidius smithi*
*Aphidius* sp.
*Ephedrus plagiator*
*Lysiphlebus fabarum*
*Praon volucre*

*APHIS* Linnaeus, 1758
*citricola* v. d. Goot, 1912
*Aphidius matricariae*
[*Aphidius similis*]
*Aphidius* sp.
*Cristicaudus nepalensis*
*Ephedrus plagiator*
*Ephedrus* sp.
*Lipolexis scutellaris*
*Praon myzophagum* (?)
[*Toxares deltiger*]
*Toxares macrosiphophagum*
*Trioxys indicus*
*Trioxys* sp.
*craccivora Koch*, 1854
*Aphidius absinthii* (!)
*Aphidius matricariae*
*Aphidius* sp.
*Diaeretiella rapae*
[*Ephedrus cerasicola* (!)]
*Ephedrus persicae*
*Ephedrus* sp.
*Lipolexis scutellaris*
*Lysaphidus* sp.
*Lysiphlebus fabarum*
*Lysiphlebus testaceipes*
*Lysiphlebus* sp.
*Praon abjectum*
*Praon* sp.
*Trioxys indicus*
[*Trioxys sinensis*]
*Trioxys* sp.

*fabae* Scopoli, 1763
*Aphidius matricariae*
*Diaeretiella rapae*
*Ephedrus plagiator*
*Lipolexis scutellaris*

*farinosa* Gmelin, 1790
[*Toxares shigai*]
*gossypii* Glover, 1877
*Aphidius colemani*
*Aphidius matricariae*
[*Aphidius similis*]
*Aphidius* sp.
*Cristicaudus nepalensis*
*Diaeretiella rapae*
*Ephedrus persicae*
*Ephedrus plagiator*
*Lipolexis gracilis*
*Lipolexis scutellaris*
*Lysiphlebus testaceipes*
*Lysiphlebus* sp.
*Praon absinthii* (?)
*Praon myzophagum* (?)
*Trioxys acalephae*
*Trioxys basicurvus*

*Trioxys indicus*
*Trioxys rubicola*
[*Trioxys sinensis*]
*nasturtii* Kaltenbach, 1843
*Trioxys indicus*
*nerii* Boyer de Fonscolombe, 1841
*Aphidius colemani*
*Lipolexis scutellaris*
*Trioxys indicus*
*ruborum longisetosus* Basu, 1969
*Aphidius* sp.
*Ephedrus persicae*
*Ephedrus* sp.
*Lipolexis scutellaris*
*Trioxys indicus*
*solanella* Theobald, 1914
*Aphidius colemani*
*Aphidius matricariae*
*Aphidius* sp.
*Ephedrus plagiator*
*Ephedrus* sp.
*Lipolexis scutellaris*
[*Toxares deltiger*]
*Toxares macrosiphophagum*
*Trioxys indicus*
*sp.*
*Aphidius colemani*
*Diaeretiella rapae*
*Lipolexis scutellari*
*Trioxys indicus*
*Trioxys* sp.

*AULACORTHUM* Mordvilko, 1914

*magnoliae* (Essig & Kuwana, 1918)
*Trioxys indicus*
*sp.*
*Aphidius* sp.
*Ephedrus* sp.
*Trioxys indicus*

*BETACALLIS* Matsumura, 1919

*querciphaga* Basu, Ghosh, Raychaudhuri, 1974
*Betuloxys assamensis*

*BRACHYCAUDUS* v. d. Goot, 1913

*cardui* (Linnaeus, 1758)
*Aphidius matricariae*
*helichrysi* (Kal tenbach, 1843)
*Aphidius matricariae*
[*Aphidius similis*]
*Aphidius* sp.
*Ephedrus plagiator*
*Praon* sp.
[*Toxares deltiger*]
*Toxares macrosiphophagum*
[*Toxares shigai*]
*Trioxys indicus*
*sp.*
*Aphidius matricariae*
[*Toxares deltiger*]
*Toxares macrosiphophagum*
*Trioxys rishii*
*Trioxys* sp.

*BREVICORYNE* v. d. Goot, 1915

*brassicae* (Linnaeus, 1758)
*Aphidius colemani*
*Aphidius matricariae*
*Diaeretiella rapae*
*Ephedrus* sp.

*CAPITOPHORUS* v. d. Goot, 1913

*hippophaes javanicus Hille Ris* Lambers, 1953
*Aphidius matricariae*

*indicus* Ghosh & Raychaudhuri, 1968
*Aphidius matricariae*
[*Toxares deltiger*]
*Toxares macrosiphophagum*
*sp.*
*Betuloxys intermedius*

*CAVARIELLA* del Guercio, 1911

*sp.*
*Ephedrus minor*

*CERATOVACUNA* Zehntner, 1897

*silvestrii* (Takahashi, 1927)
*Ephedrus plagiator*

*CHAETOSIPHON* Mordvilko, 1914

*gracilicorne* David, Rajasing, Narayanan, 1971
*Aphidius* sp.

*CHAITOPHORUS* Koch, 1854

*leucomelas* Koch, 1854
[*Toxares shigai*]
*sp.*
*Adialytus salicaphis*

*CINARA* Curtis, 1835

*abieticola tenuipes* Chakrabarti & Ghosh, 1974

*Pauesia arcuata*
*Pauesia mashobrica*

*atrotibialis* David & Rajasing, 1968

*Pauesia laricis*

*lachnirostris* Hille Ris Lambers

*Pauesia pini*

*sp.*

*Pauesia gulmargensis*
*Pauesia pini*

*EULACHNUS* del Guercio, 1909

*thunbergii* (Wilson, 1919)

*Diaeretus leucopterus*

*EUTRICHOSIPHUM* Essig & Kuwana, 1918

*flavum* (Takahashi, 1941)

*Ephedrus* sp.

*pyri* Chakrabarti, Ghosh, Raychaudhuri, 1972

*Trioxys shillongensis*

*sp.*

*Trioxys eutrichosiphi*

*GREENIDEA* Schouteden, 1905

*formosana* (Maki, 1917)

*Lipolexis scutellaris*

*kumaoni* Chakrabarti & Raychaudhuri (1978)

*Trioxys kumaonensis*

*sp.*

*Archaphidus greenideae*
*Trioxys greenideae*

*HAYHURSTIA* del Guercio, 1917

*atriplicis* (Linnaeus, 1761)

*Diaeretiella rapae*

*HYALOPTERUS* Koch, 1854

*pruni* (Geoffroy, 1762)

*Aphidius colemani*
*Aphidius matricariae*
*Aphidius* sp.

*HYPEROMYZUS* Börner, 1933

*carduellinus* (Theobald, 1915)

*Ephedrus plagiator*

*lactucae* (Linnaeus, 1758)

*Ephedrus persicae*

*sp.*

[*Toxares delliger*]
*Toxares macrosiphophagum*

*HYSTERONEURA* Davis, 1919

*setariae* (Thomas, 1878)

*Trioxys indicus*

*LACHNUS* Burmeister, 1835

*tropicalis* (v. d. Goot, 1916)

*Aphidius* sp.
*Pauesia himalayensis*
*Pauesia indica*
[*Toxares deltiger*]
*Toxares macrosiphophagum*

*sp.*

*Pauesia hazratbalensis*

*LIOSOMAPHIS* Walker, 1868

*himalayensis* Basu, 1964

*Aphidius hortensis*
*Lipolexis gracilis*

*sp.*

*Monoctonus* sp.

*LIPAPHIS* Mordvilko, 1928

*erysimi* (Kaltenbach, 1843)

*Aphidius matricariae*
*Aphidius* sp.
*Diaeretiella rapae*
*Ephedrus* sp.
*Lipolexis gracilis*
*Lysiphlebus testaceipes*
*Praon volucre*
*Trioxys brevicornis* (?)
*Trioxys indicus*

*MACROSIPHONIELLA* del Guercio, 1911

*oblonga* (Mordvilko, 1901)

*Monoctonus* sp.

*pseudoartemisiae* Shinji, 1933

*Aphidius absinthii*

*sanborni* (Gillette, 1908)

*Aphidius absinthii*
*Ephedrus niger*
*Toxares macrosiphophagum*
[*Toxares shigai*]

*spinipes* Basu, 1968

*Praon* sp.
*Trioxys* sp.

*yomogifoliae* (Shinji, 1924)

*Aphidius absinthii*

*sp.*

*Praon* sp.
[*Toxares deltiger*]
*Toxares macrosiphophagum*
*Trioxys centaureae*

*MACROSIPHUM* Passerini, 1860
*pachysiphon* Hille Ris Lambers, 1966

*Praon* sp.

*rosae* (Linnaeus, 1758)

*Aphidius rosae*
*Aphidius* sp.
*Ephedrus plagiator*
*Indaphidius curvicaudatus*

*sp.*

*Trioxys kashmirensis*

*MELANAPHIS* v. d. Goot, 1917
*donacis* (Passerini, 1862)

*Trioxys* sp.

*indosacchari* (David, 1956)

*Lysiphlebus delhiensis*

*sacchari* (Zehntner, 1897)

*Lysiphlebia mirzai*
*Lysiphlebus delhiensis*
*Lysiphlebus* sp.
*Praon* sp.

*METOPOLOPHIUM* Mordvilko, 1914

*euryae* Takahashi, 1937

[*Toxares deltiger*]
*Toxares macrosiphophagum*

*MINDARUS* Koch, 1857

*sp.*

*Pseudopraon antiquum*

*MOLLITRICHOSIPHUM* Suenaga, 1934
*nandii* Basu, 1964

*Indaphidius curvicaudatus*

*tenuicorpus* (Okajima, 1908)

*Trioxys* sp.

*sp.*

*Indaphidius curvicaudatus*

*MYZUS* Passerini, 1860

*boehmeriae* Takahashi, 1922

[*Toxares deltiger*]
*Toxares macrosiphophagum*

*dycei* Carver, 1961

*Aphidius matricariae*
*Ephedrus* sp.
*Lysiphlebus confusus*

*obtusirostris* David, Narayanan, Rajasingh, 1971

[*Toxares deltiger*]
*Toxares macrosiphophagum*

*ornatus* Laing, 1932

*Aphidius matricariae*
*Aphidius* sp.
*Lysaphidus qadrii*
*Praon* sp.
[*Toxares deltiger*]
*Toxares macrosiphophagum*

*persicae* (Sulzer, 1776)

*Aphidius colemani*
*Aphidius matricariae*
[*Aphidius similis*]
*Aphidius* sp.
*Diaeretiella rapae*
*Ephedrus lacertosus* (?)
*Ephedrus persicae*
*Ephedrus plagiator*
*Praon myzophagum*
*Praon* sp.
[*Toxares deltiger*]
*Toxares macrosiphophagum*
[*Toxares shigai*]
*Toxares zakai*
*Trioxys brevicornis* (?)
*Trioxys indicus*

*sp.*

*Aphidius matricariae*
*Ephedrus srinagarensis*
*Kashmiria aphidis*
*Praon volucre*
*Praon* sp.

*NEOMYZUS* v. d. Goot, 1917

*circumflexus* (Buckton, 1876)

*Aphidius* sp.
*Ephedrus lacertosus* (?)

*PHORODON* Passerini, 1860

*cannabis* Passerini, 1860

*Aphidius matricariae*

*sp.*

*Aphidius matricariae*
*Trioxys acalephae*

*PTEROCHLOROIDES* Mordvilko, 1914

*persicae* (Cholodkovsky, 1899)

*Diaeretiella rapae*
*Paucsia antennata*

*PTEROCOMMA* Buckton, 1879

*populeum* (Kaltenbach, 1843)

*Aphidius cingulatus*

*RHOPALOSIPHUM* Koch, 1854

*maidis* (Fitch, 1856)

*Aphidius colemani*
*Aphidius uzbekistanicus*
*Ephedrus* sp.
*Lipolexis scutellaris*
[*Toxares deltiger*]
*Toxares macrosiphophagum*
[*Toxares shigai*]

*nympheae* (Linnaeus, 1761)

*Aphidius colemani*
*Parapraon necans*
*Praon abjectum*
*Praon* sp.
[*Toxares deltiger*]
*Toxares macrosiphophagum*

*padi* (Linnaeus, 1758)

*Aphidius colemani*
*Ephedrus* sp.
[*Toxares shigai*]

*sp.*

*Ephedrus* sp.
[*Trioxys sinensis*]

*SCHIZAPHIS* Börner, 1931

*graminum* (Rondani, 1847)

*Aphidius colemani*
*Aphidius* sp.
*Diaeretiella rapae*
*Ephedrus* sp.
*Parapraon pakistanum*
*Praon* sp.

*rotundivenstris* (Signoret, 1860)

*Aphidius* sp.
[*Toxares deltiger*]
*Toxares macrosiphophagum*

*SHINJIA* Takahashi, 1938

*orientalis* (Mordvilko, 1929)

*Aphidius matricariae*

*SINOMEGOURA* Takahashi, 1960

*citricola* (v. d. Goot, 1917)

*Trioxys indicus*

*SIPHA* Passerini, 1860

*maydis* Passerini, 1860

*Adialytus ambiguus*
*Diaeretiella rapae* (?)
*Praon* sp.
*Trioxys* sp.

*sp.*

*Adialytus ambiguus*

*SITOBION* Mordvilko, 1914

*alopecuri* Takahashi, 1921

*Aphidius uzbekistanicus*

*avenae eleusinae*.....

*Diaeretiella rapae*

*fragariae* (Walker, 1848)

*Aphidius colemani*
[*Aphidius pascuorum*]
*Aphidius smithi* (?)
*Aphidius* sp.
*Ephedrus* sp.

*miscanthi* (Takahashi, 1921)

*Ephedrus lacertosus*
*Trioxys indicus*

*rosaeformis* (Das, 1918)

*Aphidius* sp.
*Ephedrus plagiator*
*Praon* sp.

*sp.*

*Aphidius uzbekistanicus*

*STAGONA* Koch, 1857

*sp.*

*Praon stagona*

*TAKECALLIS* Matsumura, 1917

*arundinariae* (Essig, 1917)

*Betuloxys takecallis*

*THERIOAPHIS* Walker, 1870

*trifolii* (Mobell, 1882)

*Lipolexis gracilis*

*Trioxys* sp.

*TOXOPTERA* Koch, 1856

*aurantii* (Boyer de Fonscolombe, 1841)

*Ephedrus* sp.

*Lipolexis scutellaris*

*Trioxys indicus*

*Trioxys* sp.

*citricidus* (Kirkaldy, 1907)

*Lipolexis scutellaris*

*Trioxys indicus*

*Trioxys* sp.

*odinae* (v. d. Goot, 1917)

*Lipolexis scutellaris*

*Trioxys indicus*

*TUBERCULATUS* Mordvilko, 1894

*indicus* Ghosh, 1972

*Trioxys* sp.

*TUBEROLACHNUS* Mirdvilko, 1909

*salignus* (Gmelin, (1790)

*Lipolexis scutellaris*

*UROLEUCON* Mordvilko, 1914

*tanaceti* (Linnaeus, 1758)

[*Toxares shigai*]

*pseudotanaceti* (Verma, 1969)

*Ephedrus niger*

*sp.*

*Ephedrus niger*

*Praon absinthii* (?)

*Trioxys centaureae*

*UNDETERMINED APHIDS*

*Aphidius absinthii*
*Aphidius smithi*
*Aphidius urticae*
*Aphidius* sp.
*Areopraon* sp.
*Betuloxys hortorum*
*Betuloxys intermedius*
*Diaeretiella rapae*
*Ephedrus lacertosus*
*Ephedrus niger*
*Ephedrus persicae*
*Ephedrus plagiator*
*Ephedrus* sp.
*Lipolexis gracilis*
*Lipolexis scutellaris*
*Lysaphidus erysimi*
*Lysiphlebus confusus*
*Lysiphlebus fabarum*
*Lysiphlebus* sp.
*Monoctonus* sp.
*Parapraon necans*
*Praon volucre*
*Praon* sp.
[*Toxares deltiger*]
*Toxares macrosiphophagum*
[*Toxares shigai*]
*Trioxys acalephae*
*Trioxys auctus*
*Trioxys indicus*
*Trioxys pallidus*
*Trioxys* sp.

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**Valid names in Roman types. Synonyms in italics.**


abjectum (Haliday, 1833), Praon
absinthii Marshall, 1986, Aphidius
absinthii Bignell, 1894, Praon ..
acalephae (Marshall, 1896), Trioxys
ADIALYTUS Förster, 1862
ambiguus (Haliday, 1834), Adialytus
*ambiguus* (Haliday, 1834) auct., Lysiphlebus
antennata (Mukerji, 1950), Pauesia
antiquum (Mackauer, 1967), Pseudopraon
*aphidae* Mukerji & Chatterjee, 1949, Diaeretus
aphidis Stary' & Bhagat, 1978, Kashmiria
APHIDIUS Nees, 1819
*aphidum* Mukerji & Chatterjee, 1950, Diaeretus
ARCHAPHIDUS Stary' & Schlinger, 1967
arcuata Stary' & Raychaudhuri, 1982, Pauesia
AREOPRAON Mackauer, 1959
areolatus Ashmead, 1906, Aphidius
*arvicola* Stary', 1961, Lysiphlebus
assamensis (Stary', 1975), Betuloxys
auctus (Haliday, 1833), Trioxys
basicurvus Shuja-Uddin, 1973, Trioxys
BETULOXYS Mackauer, 1960
Binodoxys Mackauer, 1960
brevicornis (Haliday, 1833), Trioxys
*campestris* Stary', 1962, Ephedrus
centaureae (Haliday, 1833), Trioxys
cerasicola Stary', 1962, Ephedrus
*chinensis* Chen, 1980, Lipolexis
cingulatus Ruthe, 1859, Aphidius
colemani Viereck, 1912, Aphidius
*commodus* Gahan, 1927, Aphidius
confusus Tremblay & Eady, 1978, Aphidius
CRISTICAUDUS Stary', & Remaudière, 1982
curvicaudatus Stary', 1979, Indaphidius
delhiensis (Subba Rao & Sharma, 1960), Lysiphlebus
deltiger (Haliday, 1833), Toxares
DIAERETIELLA Stary', 1960
DIAERETUS Förster, 1862
dorsale (Haliday, 1833), Praon
EPHEDRUS Haliday, 1833
ervi Haliday, 1834, Aphidius
erysimi Stary', 1960, Lysaphidus
eutrichosiphi Stary', 1975, Trioxys
fabarum (Marshall, 1896), Lysiphlebus
gracilis Förster, 1862, Lipolexis
greenideae Stary' & Schlinger, 1967, Archaphidus
gulmargensis Bhagat, 1981, Pauesia
hazratbalensis, Bhagat, 1981, Pauesia
himalayensis Bhagat, 1981, Pauesia
hortensis Marshall, 1896, Aphidius
hortorum (Stary', 1960), Betuloxys
INDAPHIDIUS Stary', 1979
indica Stary', 1977, Pauesia
indicus Subba Rao & Sharma, 1959, Trioxys
intermedius (Shuja-Uddin, 1975), Betuloxys
kashmirensis Takada & Rishi, 1980, Trioxys
KASHMIRIA Stary' & Bhagat, 1978
Kashmirpauesia Bhagat, 1981
kumaonensis Stary' & Raychaudhuri, 1982, Trioxys
lacertosus (Haliday, 1833), Ephedrus
laricis (Haliday, 1834), Pauesia
leucopterus (Haliday, 1834), Diaeretus
LIPOLEXIS Förster, 1862
*longicorne* Marshall, 1896, Praon
*lonicerae* Marshall, 1896, Aphidius
LYSAPHIDUS Smith, 1944
LYSIPHLEBIA Stary' & Schlinger, 1967
LYSIPHLEBUS Förster, 1862
macrosiphophagum Shuja-Uddin, 1974, Toxares
mashobrica Stary' & Raychaudhuri, 1982, Pauesia
matricariae Haliday, 1834, Aphidius
minor Stelfox, 1941, Ephedrus
mirzai Shuja-Uddin, 1975, Lysiphlebia
MONOCTONUS Haliday, 1833
myzophagum Mackauer, 1959, Praon

necans (Maclkauer, 1959), Parapraon
nepalensis (Takada, 1970), Cristicaudus
niger Gautier, Bonnamour, Gaumont, 1929, Ephedrus
*nympheae* Subba Rao, Sarup, Sharma 1963, Praon
pakistanum (Kirkland, 1979), Parapraon.
pallidus (Haliday, 1833), Trioxys
Paraphidius Stary', 1958
PARAPRAON Stary', 1982
*pascuorum* Marshall, 1896, Aphidius
PAUESIA Quilis, 1931
Pauesia s. str.
Pauesiella Sedlag & Stary', 1980
persicae Froggatt, 1904, Ephedrus
Phlebus Stary', 1975
picipes (Nees, 1811), Aphidius
pini (Haliday, 1834), Pauesia
plagiator (Nees, 1811), Ephedrus
*platensis* Brèthes, 1913, Aphidius
PRAON Haliday, 1833
PSEUDOPRAON Stary', 1975
qadrii Shuja-Uddin, 1976, Lysaphidus
*rapae* (Curtis, 1855), Diaeretus
rapae (M'Intosh, 1855), Diaeretiella
rhopalosiphi DeStefani, 1902, Aphidius
rishii Stary', & Bhagat, 1978, Trioxys
rosae Haliday, 1834, Aphidius
rubicola Shuja-Uddin, 1973, Trioxys
*sacchari* Chen, 1980, Lysiphlebia
salicaphis (Fitch, 1855), Adialytus
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setiger Mackauer, 1961, Aphidius
shigai Takada, 1965, Toxares
shillongensis Stary', 1978, Trioxys
similis Stary' & Carver, 1979, Aphidius
sinensis Mackauer, 1962, Trioxys
smithi Sharma & Subba Rao, 1959, Aphidius
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Ephedrus
Lysaphidus
Lysiphlebus
Monoctonus
Pauesia
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takecallis (Stary', 1978), Betuloxys
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TOXARES Haliday, 1840
TOXARES Westwood, 1840
*transcaspicus* Telenga, 1958, Aphidius
TRIOXYS Haliday, 1833
Trioxys s. str.
*uroleucon* (Takada & Rishi, 1980), Trioxys
urticae Haliday, 1834, Aphidius
uzbekistanicus Luzhetzki, 1960, Aphidius
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## C. THESES ON APHID PARASITOIDS

(unpublished, not included in the review)

All the Theses mentioned below bring a lot of information. There are also descriptions of new taxa, but they have remained invalid until being described in printed papers.

BHAGAT R. C., 1979-1780 : Parasitoid-complex of aphids of Kashmir with special reference to Aphidiidae (Hymenoptera). Thesis, Univ. of Kashmir, Srinagar.

AAMID S., 1980 : Some biological, ecological and behavioural studies on the natural balance of graminaceous aphids in Pakistan. 132 pp. Thesis, Quaid-i-Azam University, Islamabad.

RAMASESHIAH G., 1975 : Natural enemy complex of aphids of e conomic importance with special reference to aphidiids and aphelinids in India. Thesis, Univ. of Mysore, 226 pp.

## D. OTHERS SOURCES OF INFORMATION

A great amount of informasion is also included in the Annual Reports (C. I, B. C.) for the internal use of the Institute. However most of this information seems to become also published in the "Reports" or Tech. Communications on the particular topics by the individual authors.

## FIGURES

In the organisations of the figures the alphabetical order of the genera (species) has been, in principle, followed.

All figures were drawn from female specimens mounted as slides.

In some cases, figures were drawn from species not known to occur in the target area (such records mentioned in brackets).

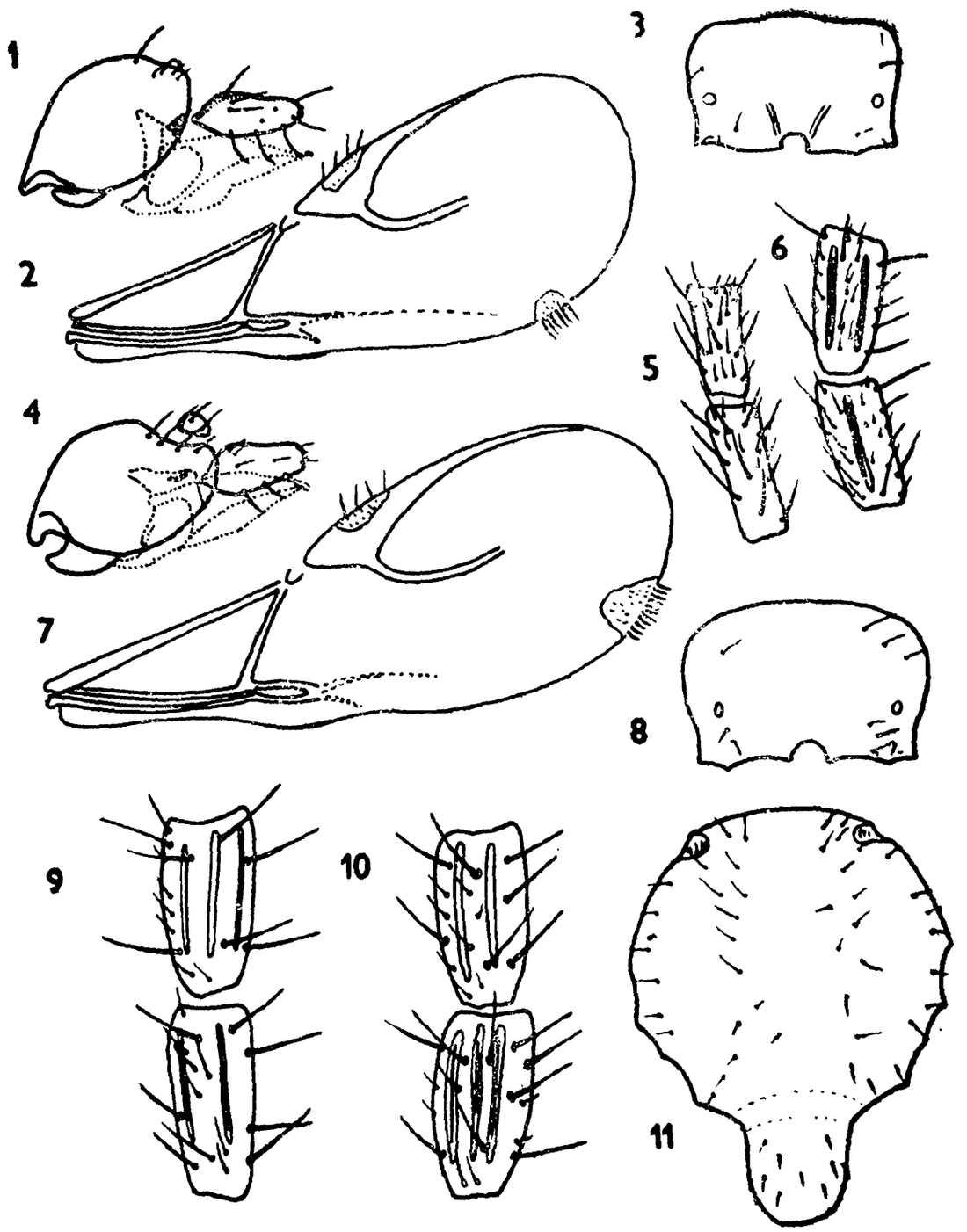
In principle, the size of the same body part is relative in all the figures. Some exceptions exist in the wings where the size had to be reduced owing to their dimmensions.

### Explanation of Abbreviations :

Nomenclature of wing-venation : Fig. 86.

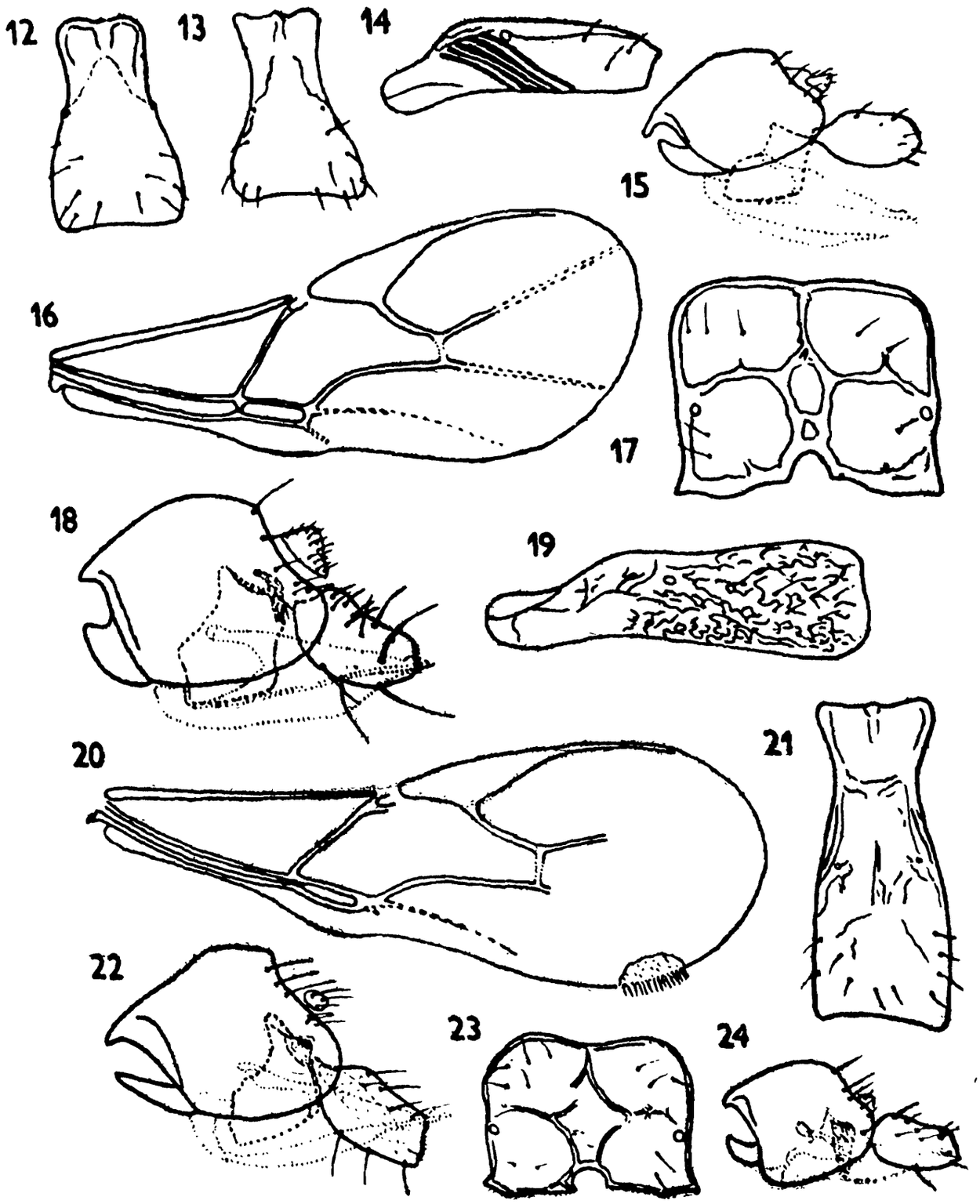
Tentorial index : Fig. 41.

F—Flagellar segment.



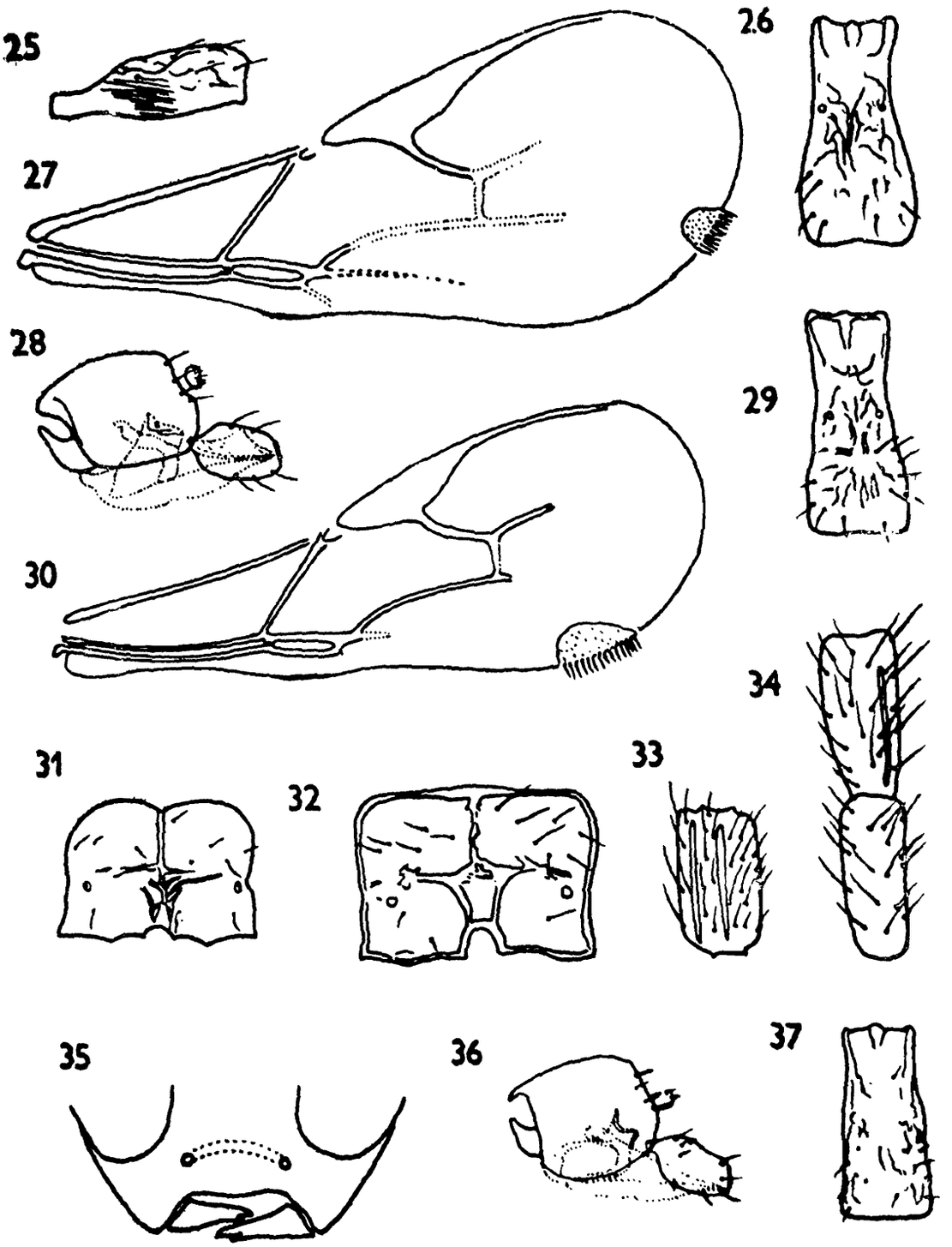

Figs. 1—11

1. *Adialytus ambiguus*, genitalia. 2. *A. ambiguus*, forewing. 3. *A. ambiguus*, propodeum. 4. *Adialytus salicaphis*, genitalia. 5. *A. ambiguus*, $F_1$ and $F_2$. 6. *A. ambiguus*, $F_3$ and $F_4$. 7. *A. salicaphis*, forewing. 8. *A. salicaphis*, propodeum. 9. *A. salicaphis*, $F_1$ and $F_2$. 10. *A. salicaphis*, $F_3$ and $F_4$. 11. *A. salicaphis*, mesonotum.



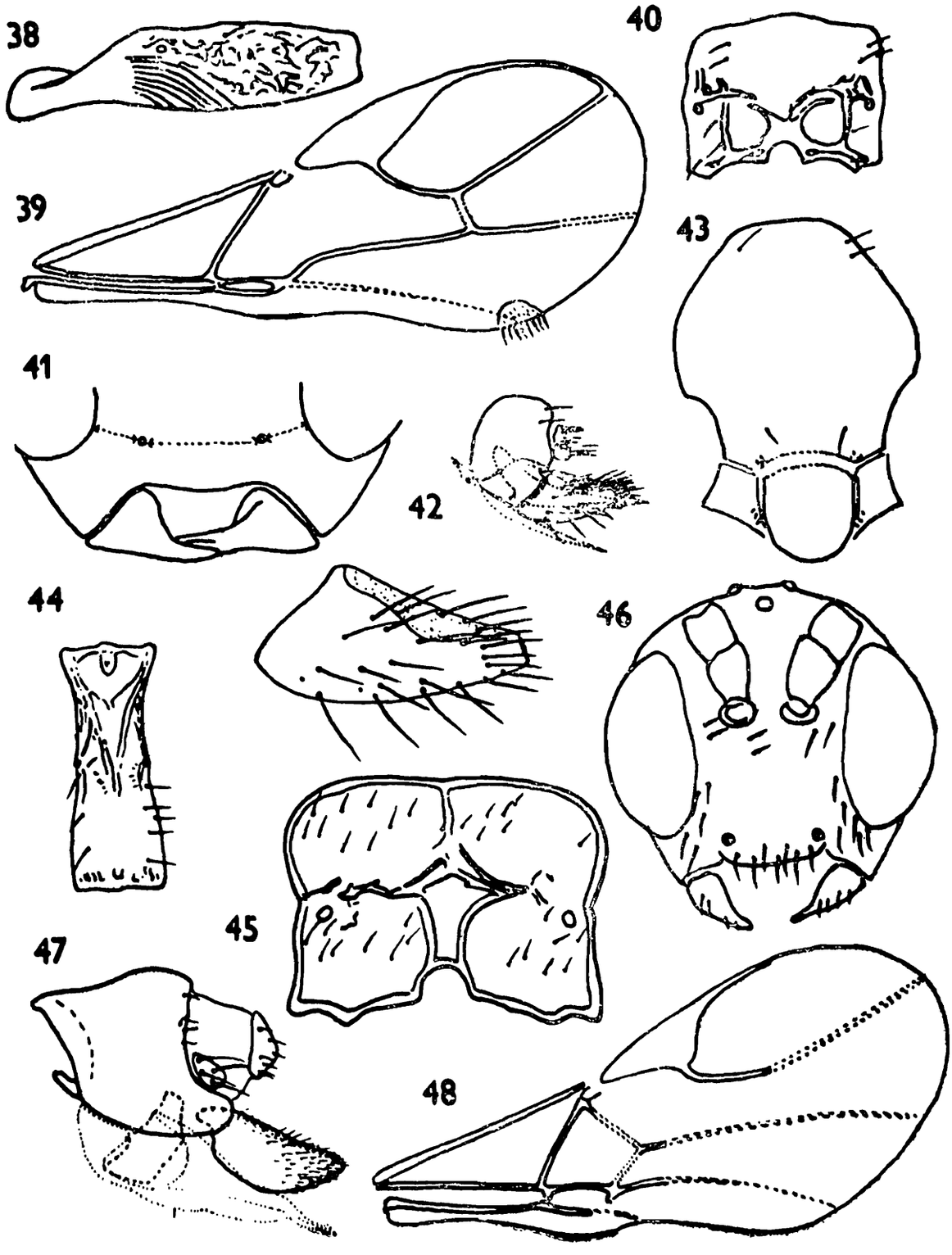

Figs. 12—24

12. *Adialytus salicaphis*, tergite 1. 13. *Adialytus ambiguus*, tergite 1. 14. *Aphidius colemani*, tergite 1. 15. *A. colemani*, genitalia. 16. *Aphidius cingulatus*, forewing. 17. *A. colemani*, propodeum. 18. *A. cingulatus*, genitalia. 19. *Aphidius ervi*, anterolateral area, tergite 1. 20. *A. colemani*, forewing. 21. *A. colemani*, tergite 1. 22. *A. ervi*, genitalia. 23. *Aphidius hortensis*, propodeum. 24. *A. hortensis*, genitalia.



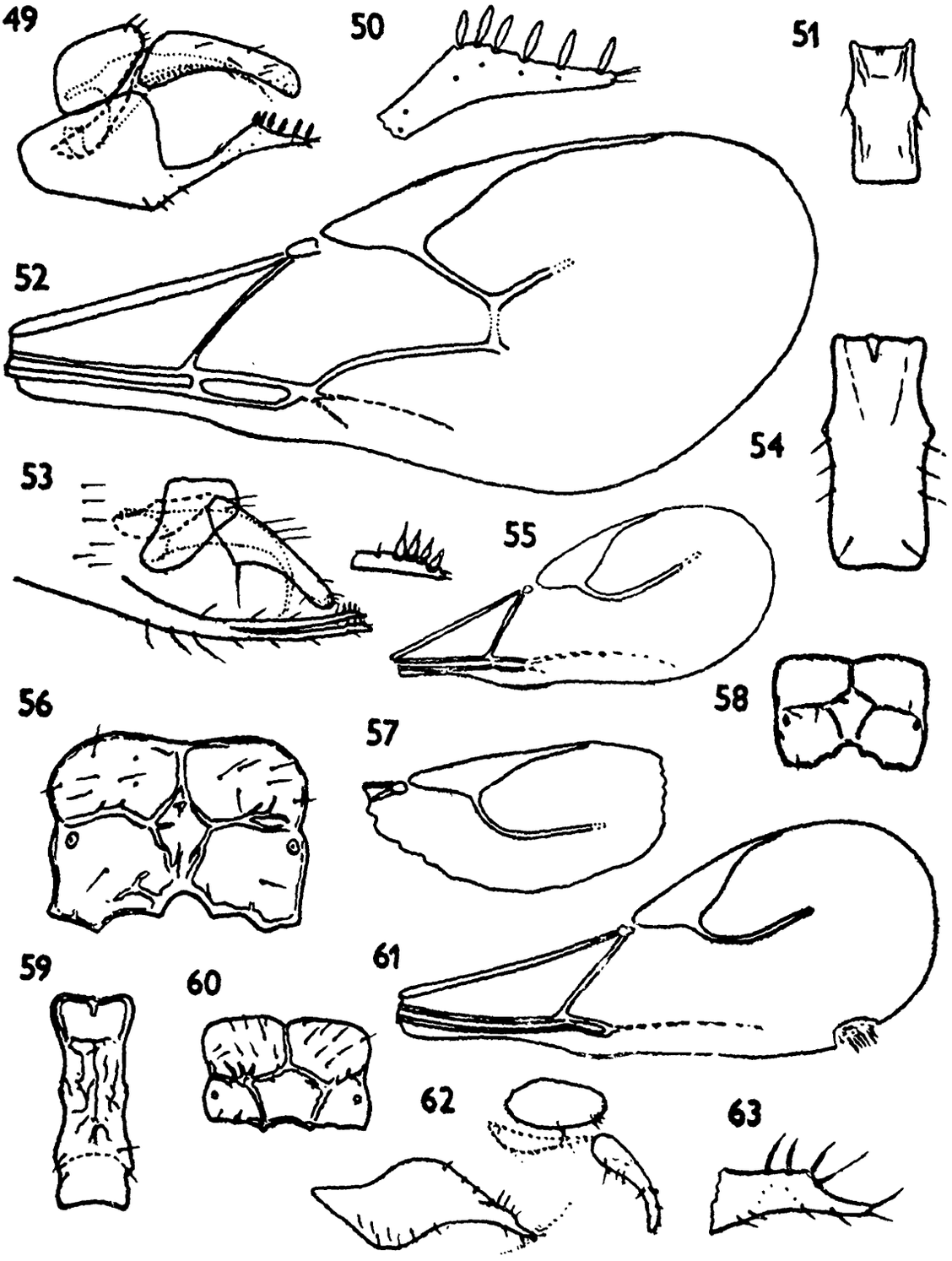

Figs. 25—37

25. *Aphidius matricariae*, anterolateral area. tergite 1. 26. *Aphidius hortensis*, tergite 1. 27. *A. shortensis*, forewing. 28. *A. matricariae*, genitalia. 29. *A. matricariae*, tergite 1. 30. *A. matricariae*, forewing. 31. *Lysaphidus qadrii*, propodeum. 32. *A. matricariae*, propodeum. 33. *A. matricariae*, $F_{10}$. 34. *A. matricariae*, $F_1$, $F_2$. 35. *A. matricariae*, head, frontal view, tentorial index. 36. *L. qadrii*, genitalia. 37. *L. qadrii*, tergite 1.



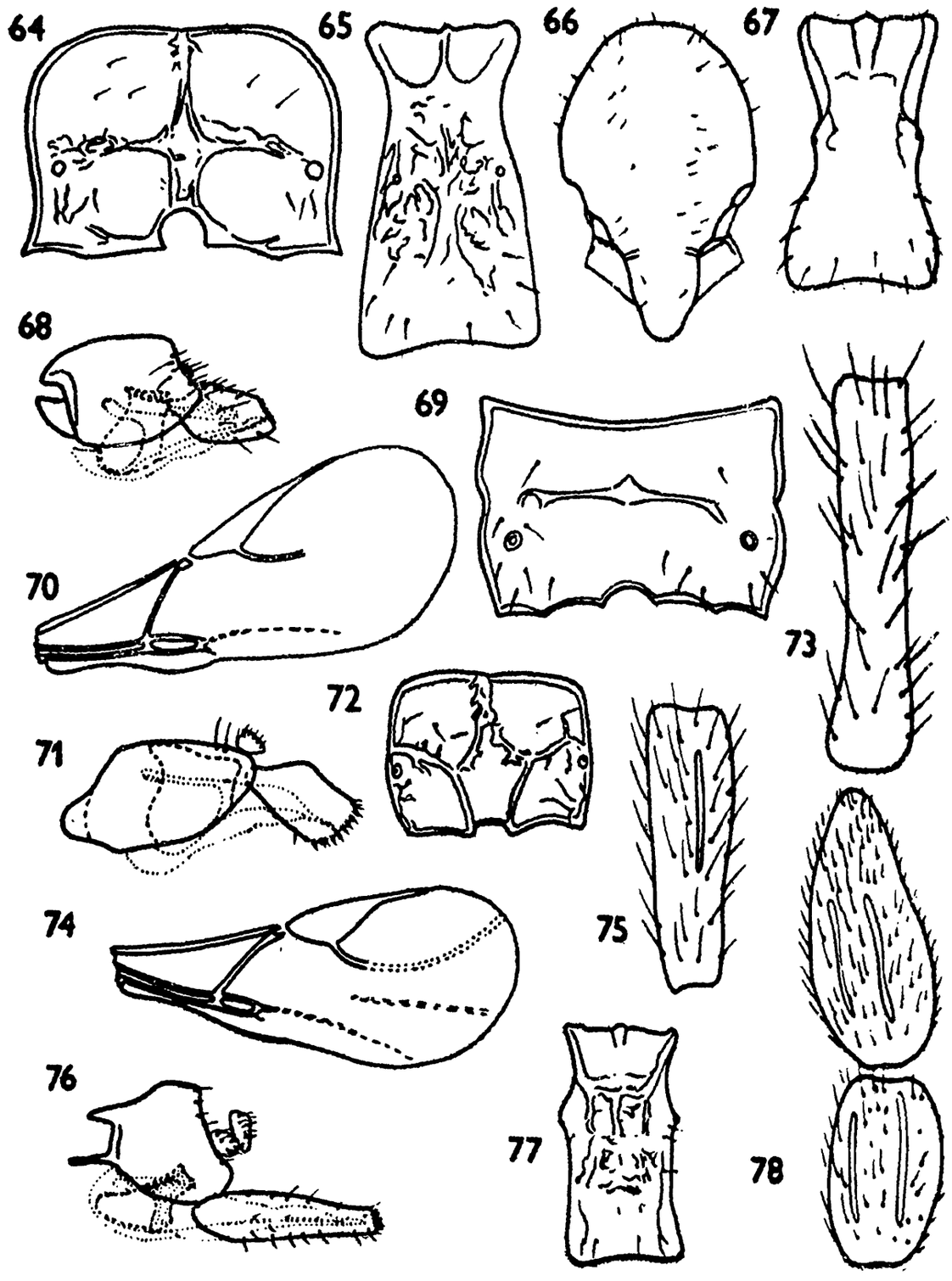

Figs. 38—48

38. *Aphidius smithi*, anterolateral area, tergite 1. 39. *Archaphidus greenideae*, forewing. 40. *A. greenideae*, propodeum. 41. *Aphidius uzbekistanicus*, head, frontal view, tentorial index. tl—tentorio-ocular line, itl—intertentorial line. 42. *A. greenideae*, genitalia, detail. 43. *A. greenideae*, mesonotum. 44. *A. greenideae*, tergite 1. 45. *A. smithi*, propodeum. 46. *A. greenideae*, head, frontal view. 47. *Areopraon lepelleyi*, genitalia. 48. *A. lepelleyi*, forewing.



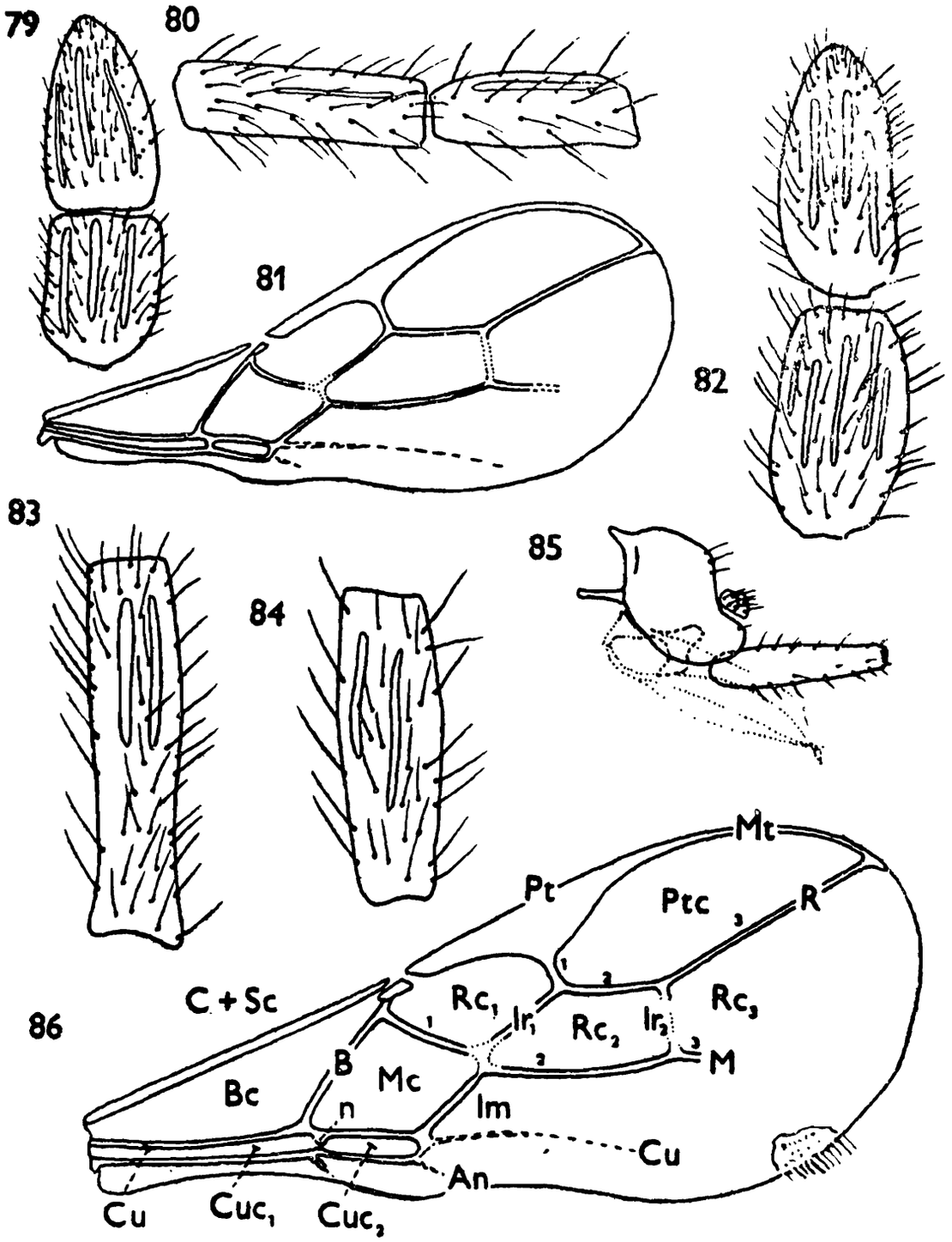

Figs. 49—63

49. *Betuloxys assamensis*, genitalia. 50. *B. assamensis*, apex of prongs. 51. *B. assamensis*, tergite 1. 52. *Aphidius uzbekistanicus*, forewing. 53. *Betuloxys takecallis*, genitalia a, b—apex of prongs, detail. 54. *B. takecallis*, tergite 1. 55. *B. assamensis*, forewing. 56. *B. takecallis*, propodeum. 57. *B. takecallis*, forewing. 58. *B. assamensis*, propodeum. 59. *Cristicaudus nepalensis*, tergite 1. 60. *C. nepalensis* propodeum. 61. *C. nepalensis*, forewing. 62. *C. nepalensis*, genitalia. 63. *C. nepalensis*. apex of prongs.




Figs. 64—78

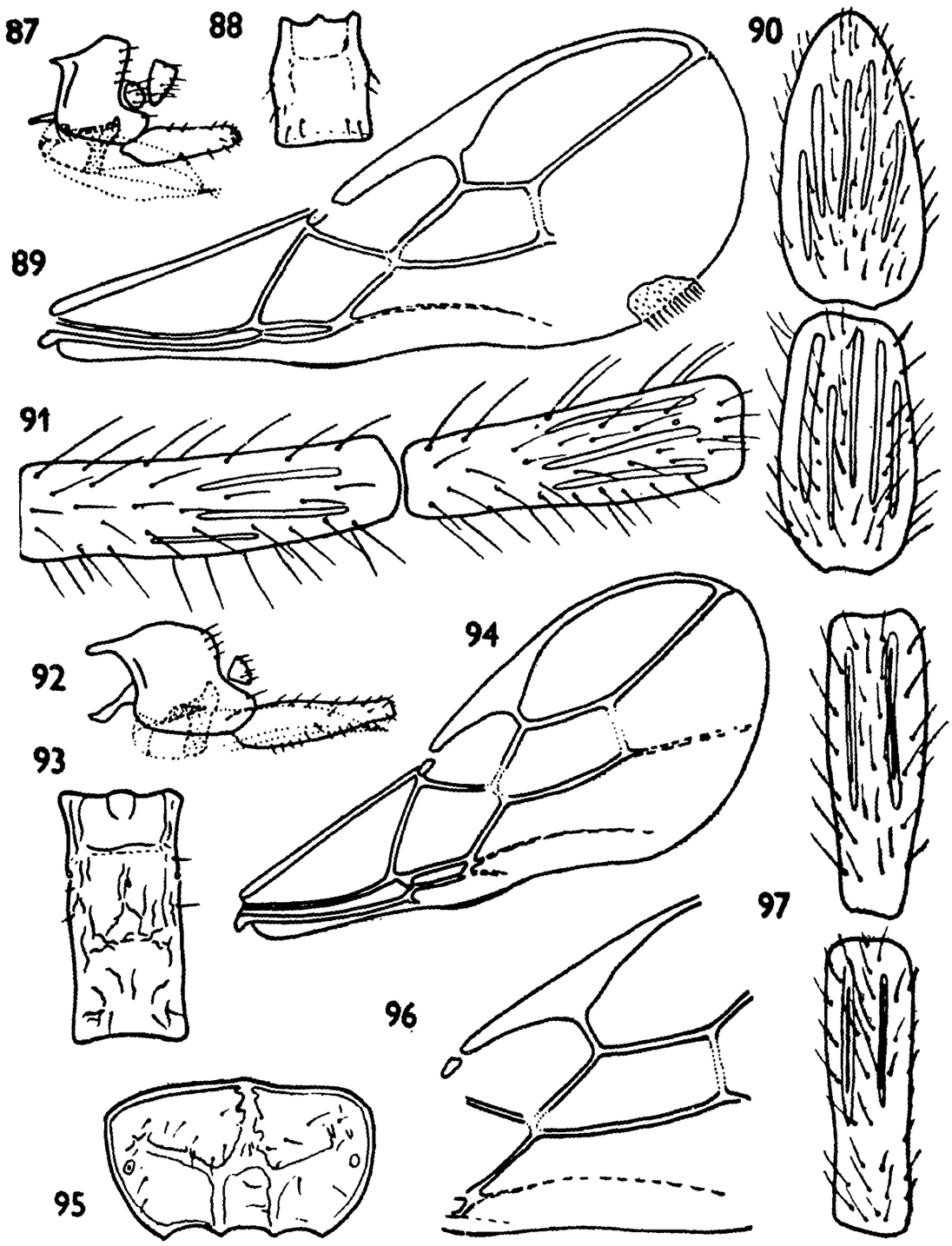
64. *Diaeretiella rapae*, propodeum. 65. *D. rapae*, tergite 1. 66. *Diaeretus leucopterus*, mesonotum. 67. *D. leucopterus*, tergite 1. 68. *D. rapae*, genitalia. 69. *D. leucopterus*, propodeum. 70. *D. rapae*, forewing. 71. *D. leucopterus*, genitalia. 72. *Ephedrus lacertosus*, propodeum. 73. *E. lacertosus*, $F_1$. 74. *D. leucopterus*, forewing. 75, *E. lacertosus*. $F_2$. 76. *E. lacertosus*, genitalia. 77. *E. lacertosus*, tergite 1. 78. *E. lacertosus*, $F_{10}$ and $F_{11}$.




Figs. 79—86

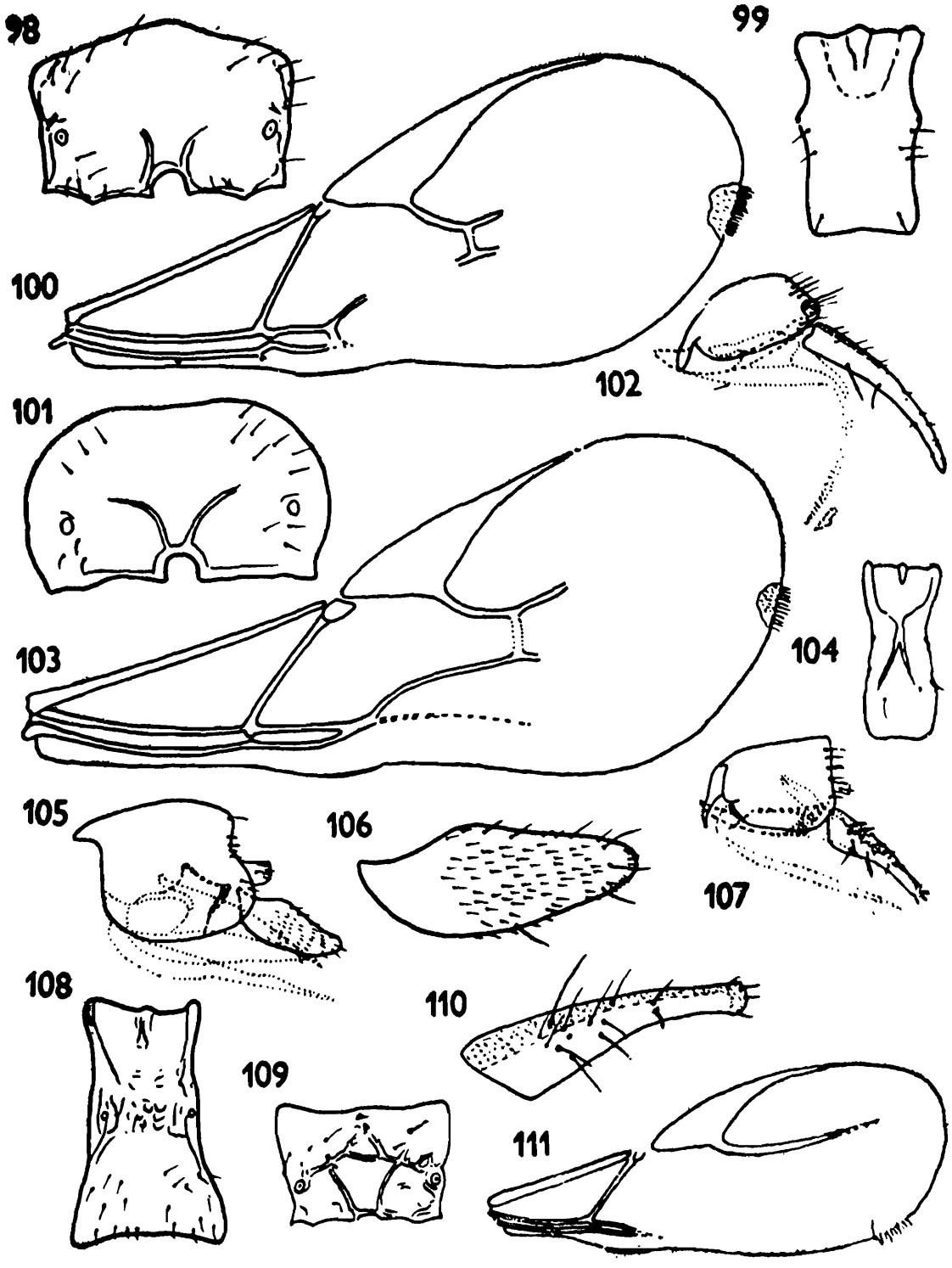
79. *Ephedrus minor*, $F_{10}$ and $F_{11}$. 80. *E. minor*, $F_1$ and $F_2$. 81. *Ephedrus lacertosus*, forewing. 82. *Ephedrus niger*, $F_{10}$ and $F_{11}$. 83. *E. niger*, $F_1$. 84. *E. niger*, $F_2$. 85. *E. niger*, genitalia. 86. *E. niger*, forewing.

*Nomenclature of wing-venation* : C—Costal vein. Sc—Subcostal vein. Mt—Metacarpus. Pt—Ptersotigma. Ptc—Pterostigmal cell. Rc—Radial cell (1,2,3). Ir—Interradial vein (1,2). R—Radial vein (abscissa 1, 2, 3). M—Median vein (abscissa 1, 2, 3). Mc—Median cell. Im—Intermedian vein. Bc—Basal cell. B—Basal vein. Cu—Cubital vein. An—Anal vein. Cuc—Cubital cell (1, 2). n—nervulus.



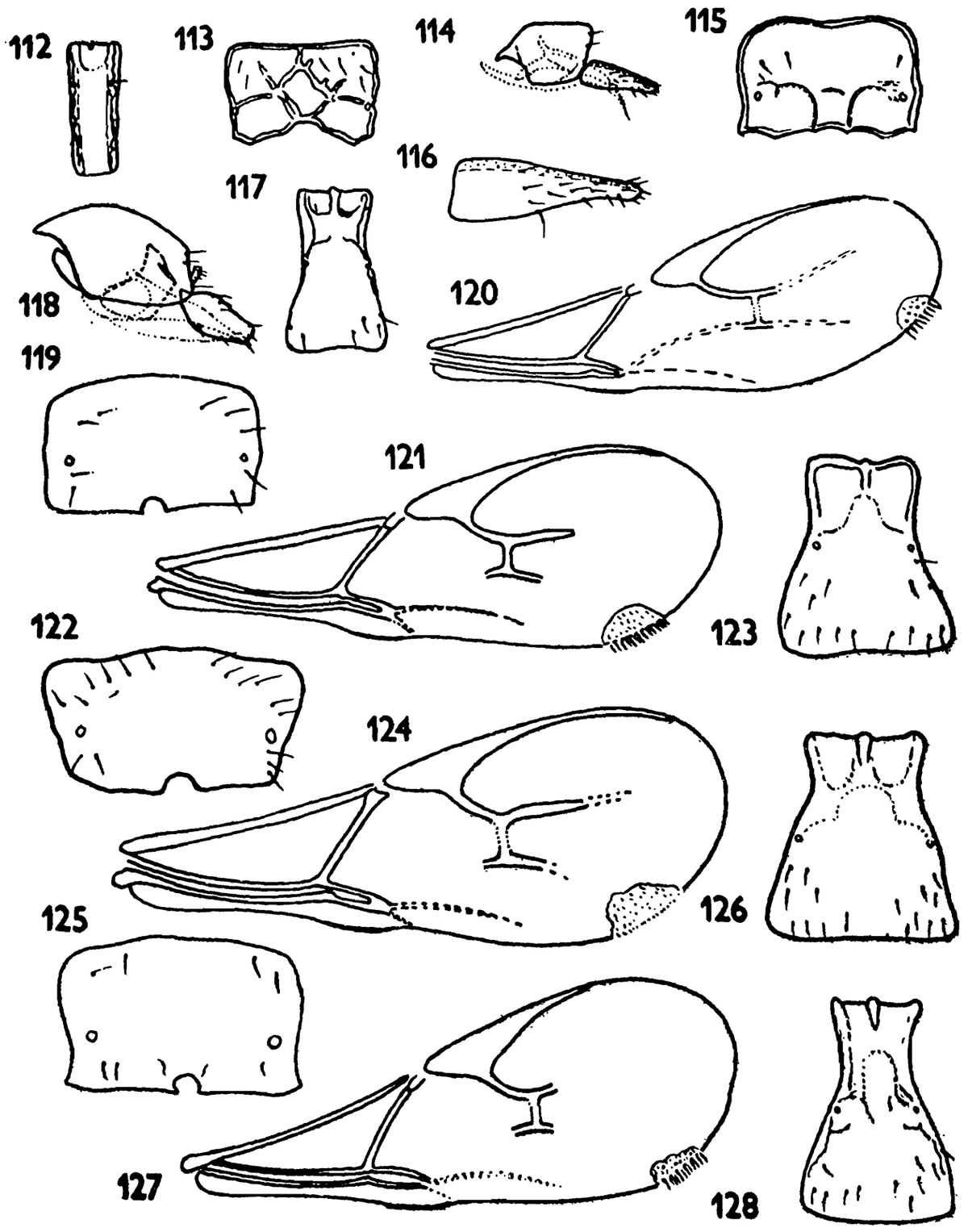

Figs. 87—97

87. *Ephedrus persicae*, genitalia. 88. *E. persicae*, tergite 1. 89. *E. persicae*, forewing. 90. *E. plagiator*, $F_{10}$ and $F_{11}$. 91. *E. plagiator*, $F_1$ and $F_2$. 92. *Ephedrus srinagarensis*, genitalia. 93. *E. srinagarensis*, tergite 1. 94. *E. plagiator*, forewing. 95. *E. srinagarensis*, propodeum. 96. *E. srinagarensis*, part of forewing. 97. *E. srinagarensis*. $F_1$ and $F_2$.



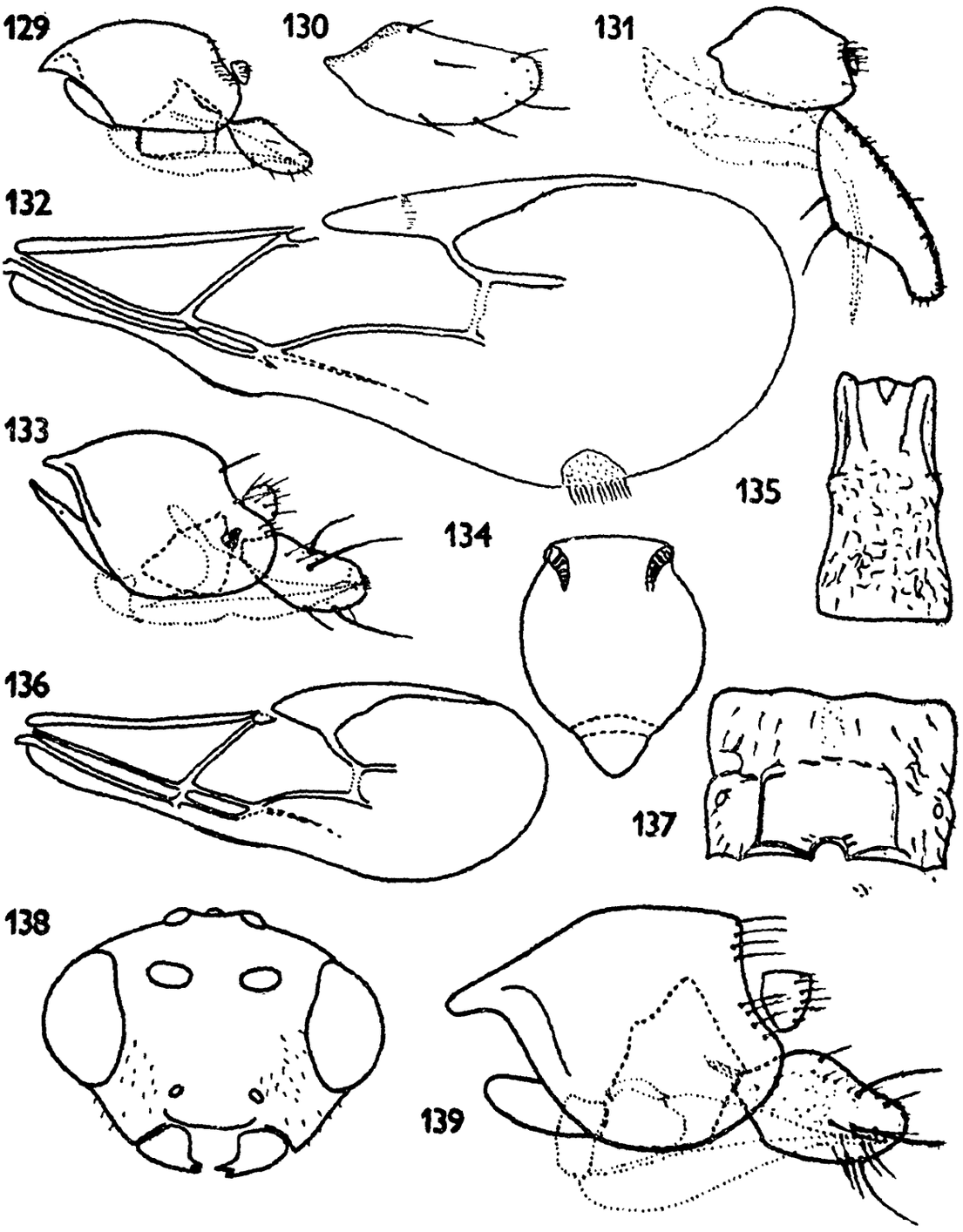

Figs. 98—111

98. *Indaphidius curvicaudatus*, propodeum. 99. *I. curvicaudatus*, tergite 1. 100. *I. curvicaudatus*, forewing. 101. *Kashmiria aphidis*, propodeum. 102. *I. curvicaudatus*. genitalia. 103. *K. aphidis*, forewing. 104. *Lipolexis gracilis*, tergite 1. 105. *K. aphidis*, genitalia. 106. *K. aphidis*, genitalia, ovipositor sheath. 107. *L. gracilis*, genitalia. 108. *K. aphidis*, tergite 1. 109. *L. gracilis*, propodeum. 110. *L. gracilis*, genitalia, ov. sheath. 111. *L. gracilis*, forewing.



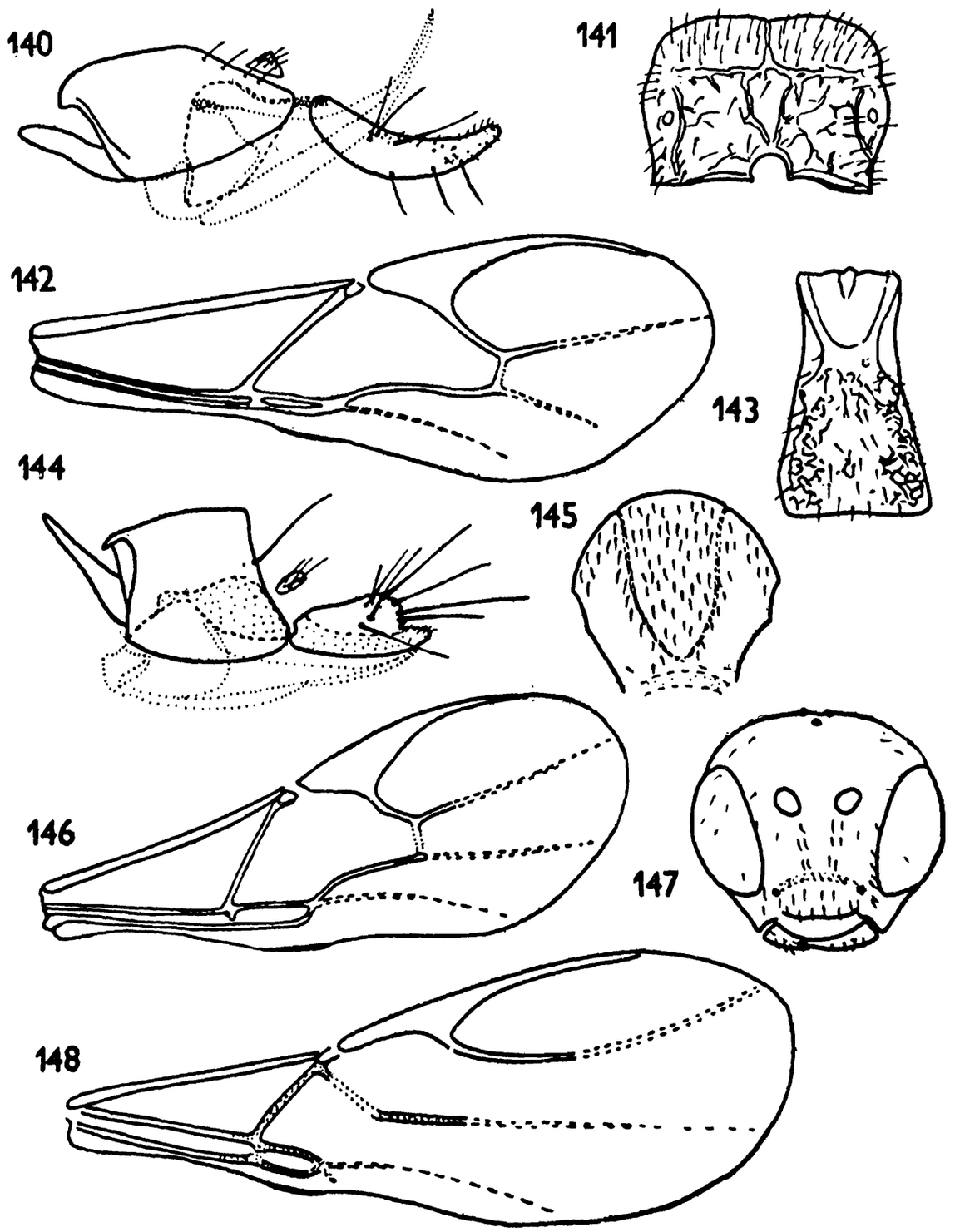

Figs. 112—128

112. *Lipolexis scutellaris*, tergite 1. 113. *L. scutellaris*, propodeum. 114. *L. scutellaris*, genitalia. 115. *Lysiphlebia mirzai*, propodeum. 116. *L. scutellaris*, genitalia, ovipositor sheath. 117. *L. mirzai*, tergite 1. 118. *L. mirzai*, genitalia. 119. *Lysiphlebus confusus* propodeum. 120. *L. mirzai*, forewing. 121. *L. confusus*, forewing. 122. *Lysiphlebus fabarum*, propodeum. 123. *L. confusus*, tergite 1. 124. *L. fabarum*, forewing. 125. *Lysiphlebus testaceipes*, propodeum. 126. *L. fabarum*, tergite 1. 127. *L. testaceipes*, forewing. 128. *L. testaceipes*, tergite 1.



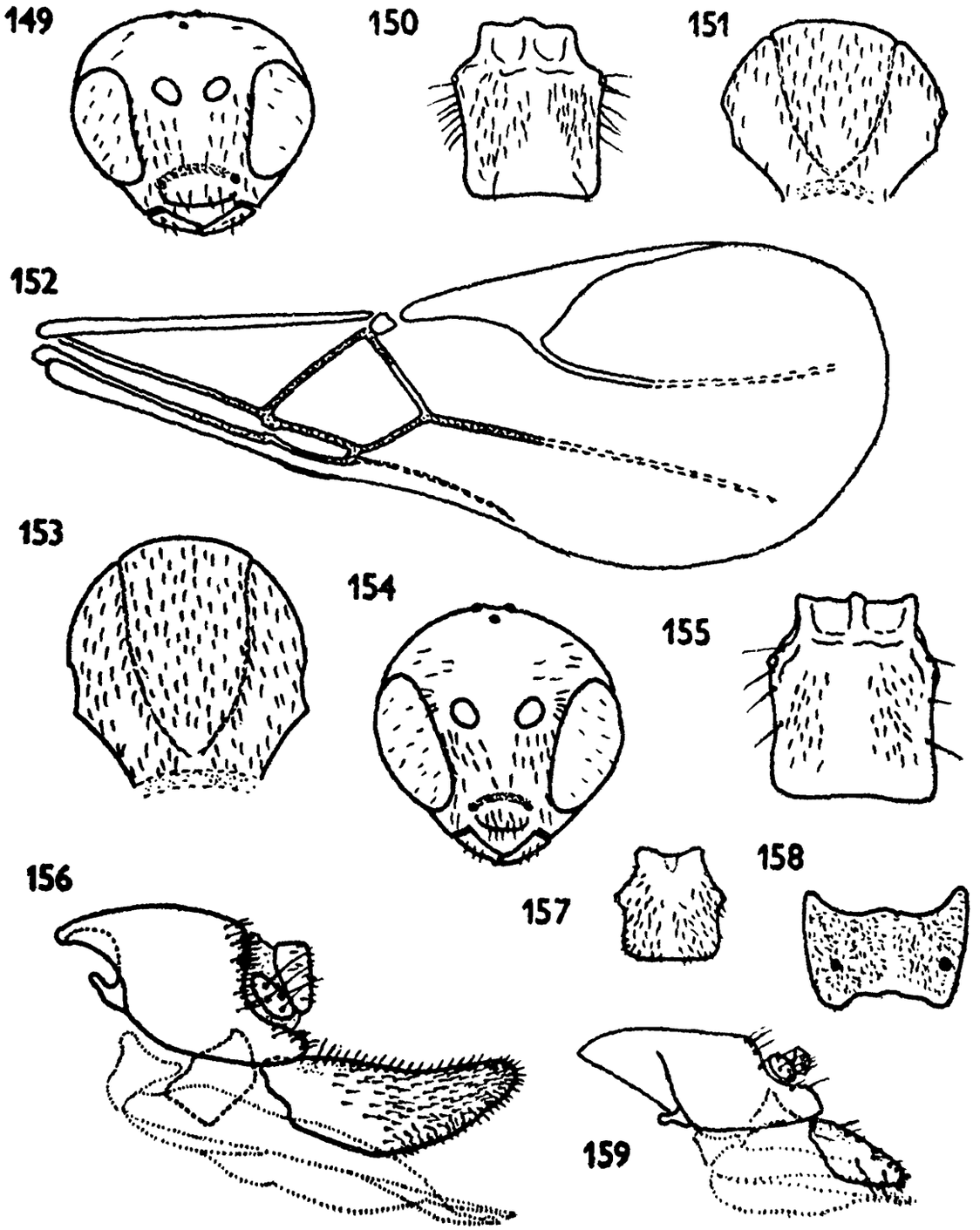

Figs. 129—139

129. *Lysiphlebus testaceipes*, genitalia. 130. *L. testaceipes*, genitalia, ovipositor sheath. 131. *Monoctonus crepidis* Hal., genitalia (unknown from the target area). 132. *M. crepidis*, forewing. 133. *Pauesia antennata*, genitalia. 134. *Pauesia indica*, mesonotum. 135. *P. antennata*, tergite 1. 136. *P. antennata*, forewing. 137. *P. antennata*, propodeum. 138. *P. indica*, head. 139. *P. indica*, genitalia.



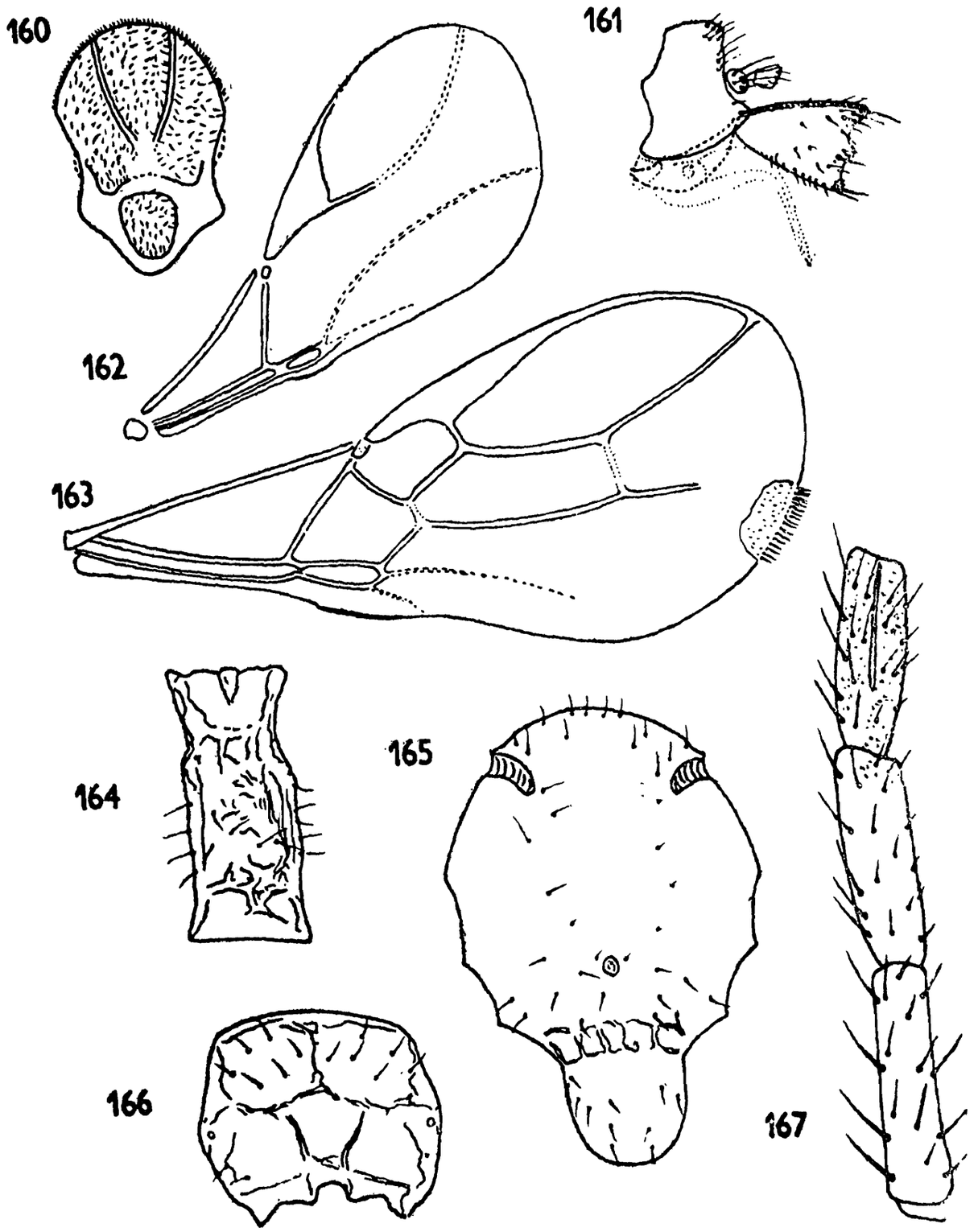

Figs. 140—148

140. *Pauesia laricis*, genitalia. 141. *Pauesia indica*, propodeum. 142. *P. indica*, forewing. 143. *P. indica*, tergite 1. 144. *Pauesia spatulata* Sedlag & Stary', genitalia (unknown from the target area). 145. *Praon abjectum*, mesonotum. 146. *P. laricis*, forewing. 147. *P. abjectum*, head. 148. *Parapraon necans*, forewing.




Figs. 149—159

146. *Parapraon necans*, head. 150. *P. necans*, tergite 1. 151. *P. necans*, mesonotum. 152. *Praon volucre*, forewing. 153. *P. volucre*, mesonotum. 154. *P. volucre*, head. 155. *P. volucre*, tergite 1. 156. *Pseudopraon mindariphagum* Stary', genitalia (unknown from the target area). 157. *P. mindariphagum*, tergite 1. 158. *P. mindariphagum*, propodeum. 159. *P. volucre*, genitalia.




Figs. 160—167

160. *Pseudopraon mindariphagum*, mesonotum. 161. *Toxares macrosiphophagum*, genitalia. 162. *P. mindariphagum*, forewing. 163. *T. macrosiphophagum*, forewing. 164. *T. macrosiphophagum*, tergite 1. 165. *T. macrosiphophagum*, mesonotum. 166. *T. macrosiphophagum*, propodeum. 167. *T. macrosiphophagum*, $F_1$, $F_2$, $F_3$.

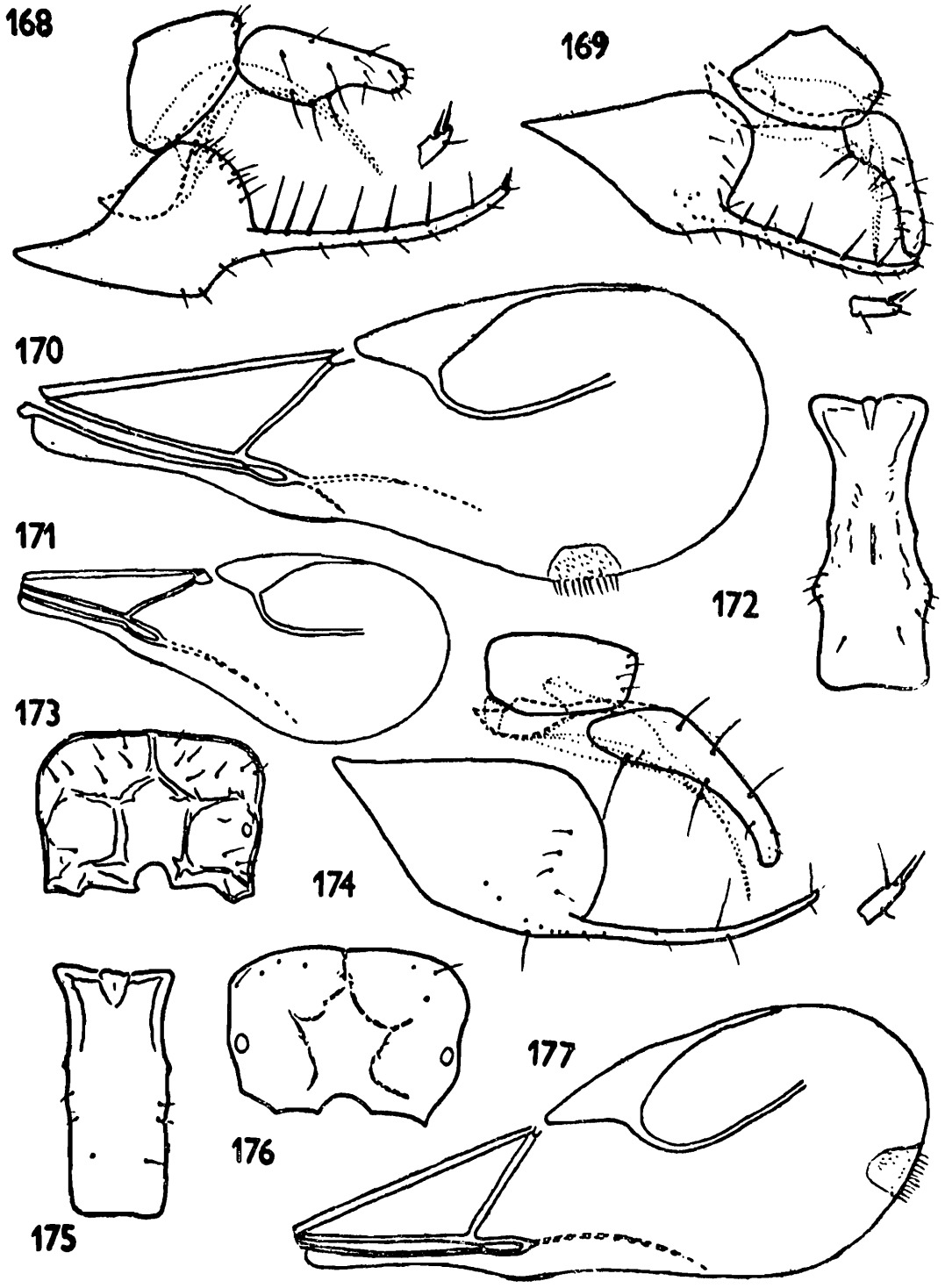
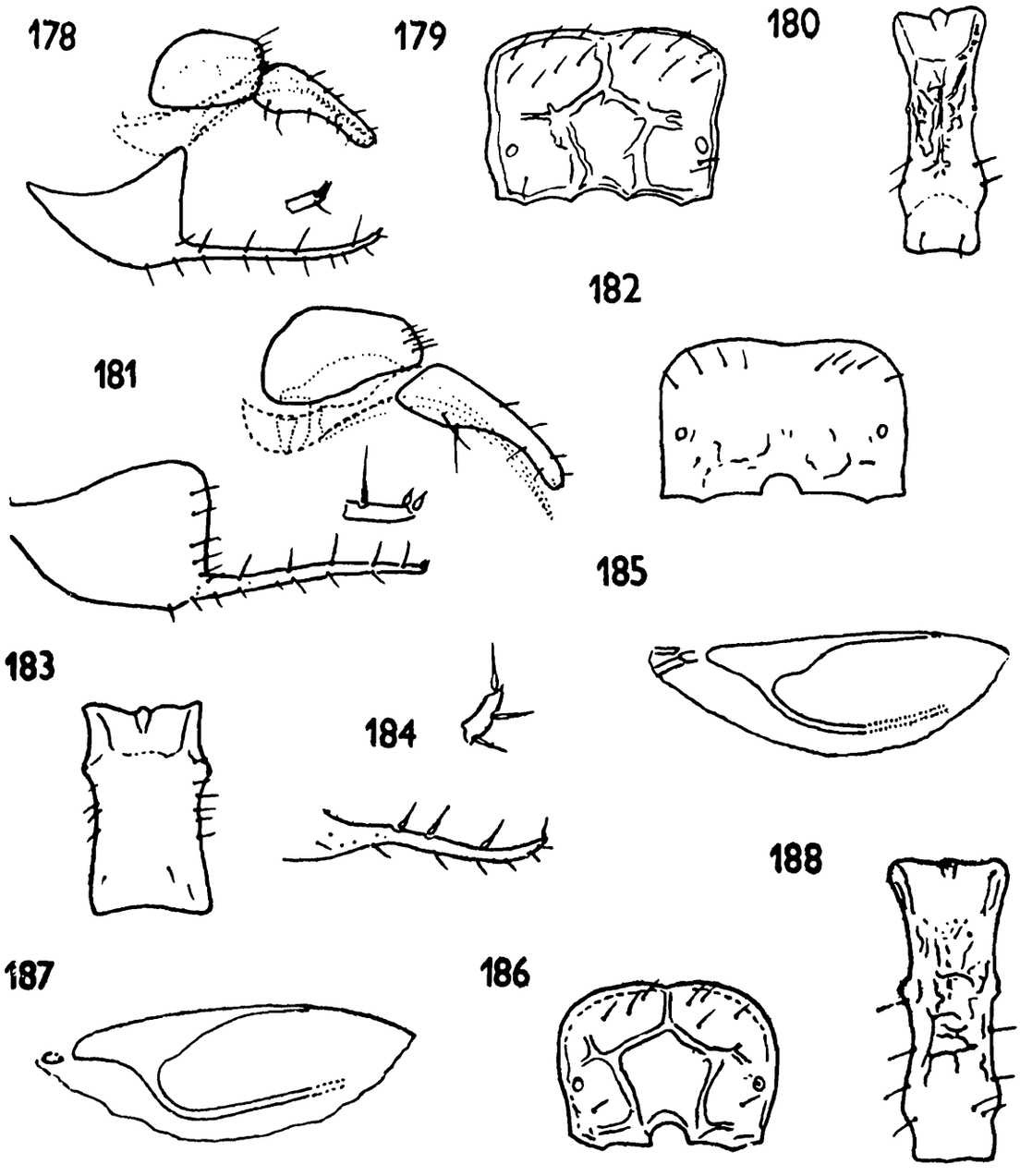


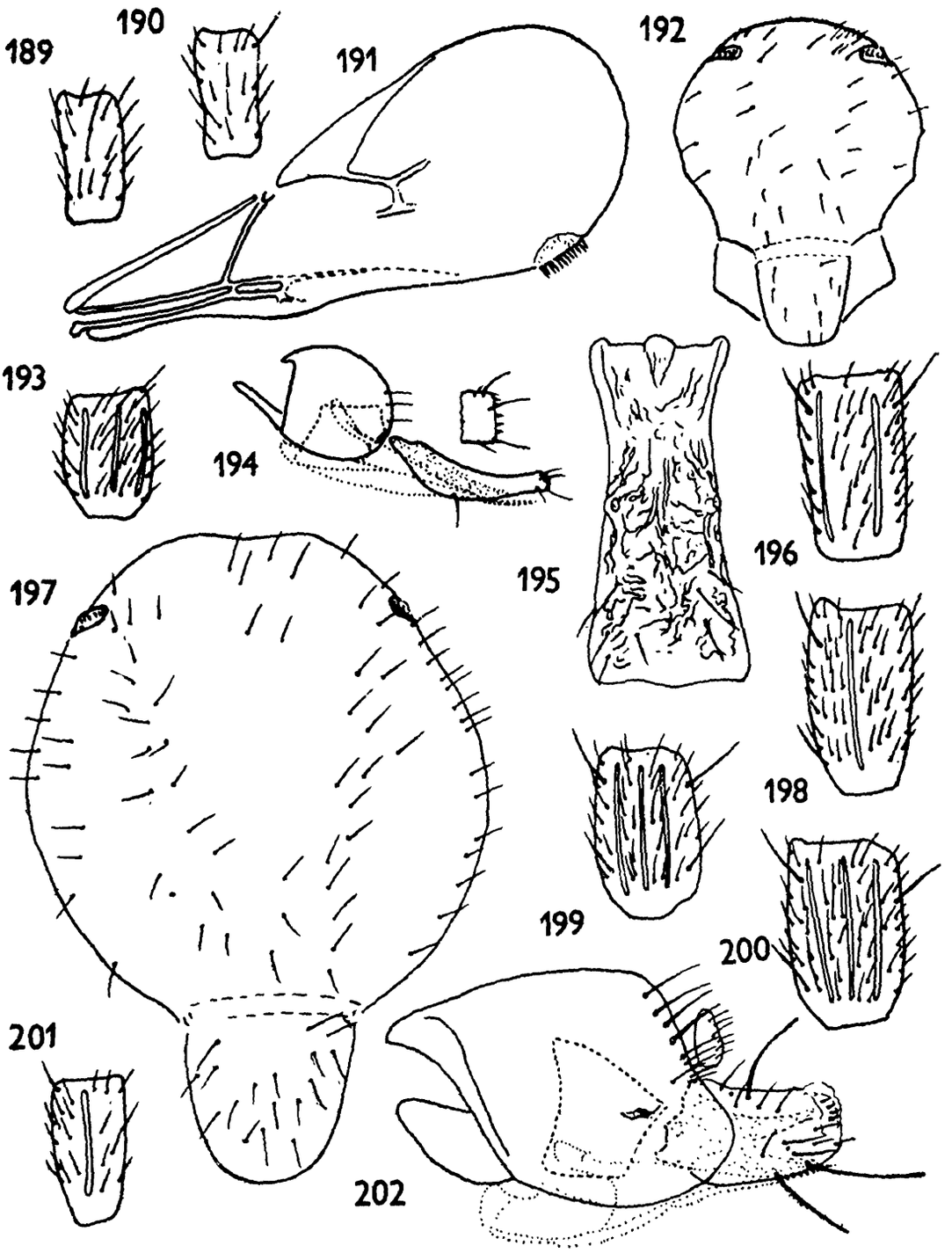

Fig. 168—177

168. *Trioxys centaureae*, genitalia. 169. *Trioxys acalephae*, genitalia. 170. *T. centaureae*, forewing. 171. *Trioxys eutrichosiphi*, forewing. 172. *T. centaureae*, tergite 1. 173. *T. centaureae*, propodeum. 174. *T. eutrichosiphi*, genitalia. 175. *T. eutrichosiphi*, tergite 1. 176. *T. eutrichosiphi*, propodeum. 177. *Trioxys indicus*, forewing.



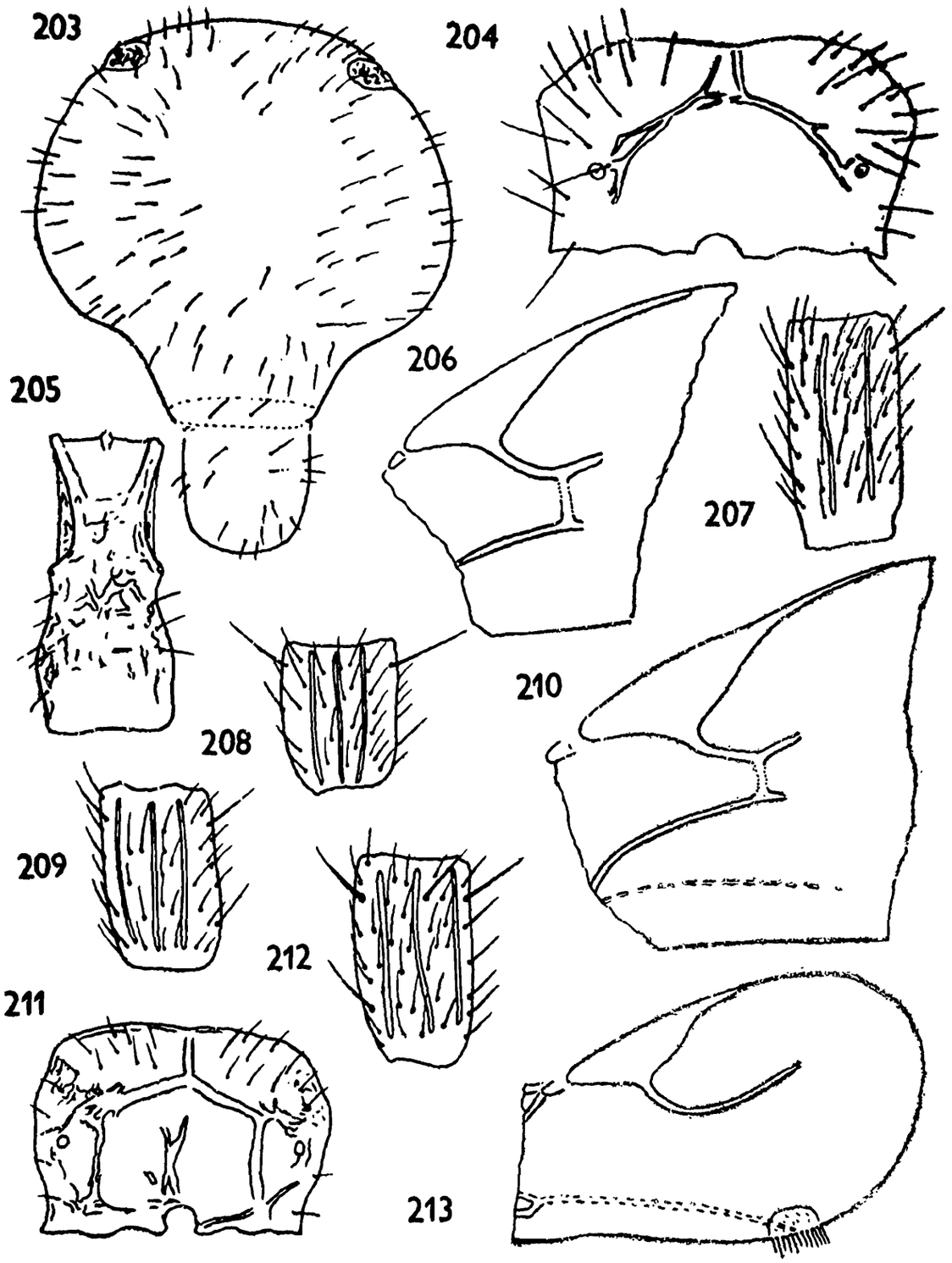

Figs. 178—188

178. *Trioxys indicus*, genitalia. 179. *T. indicus*, propodeum. 180. *T. indicus*, tergite 1. 181. *Trioxys rishii*, genitalia. 182. *T. rishii*, propodeum. 183. *T. rishii*, tergite 1. 184. *Trioxys shillongensis*, genitalia, prongs. 185. *T. rishii*, forewing. 186. *T. shillongensis*, propodeum. 187. *T. shillongensis*, forewing. 188. *T. shillongensis*, tergite 1.



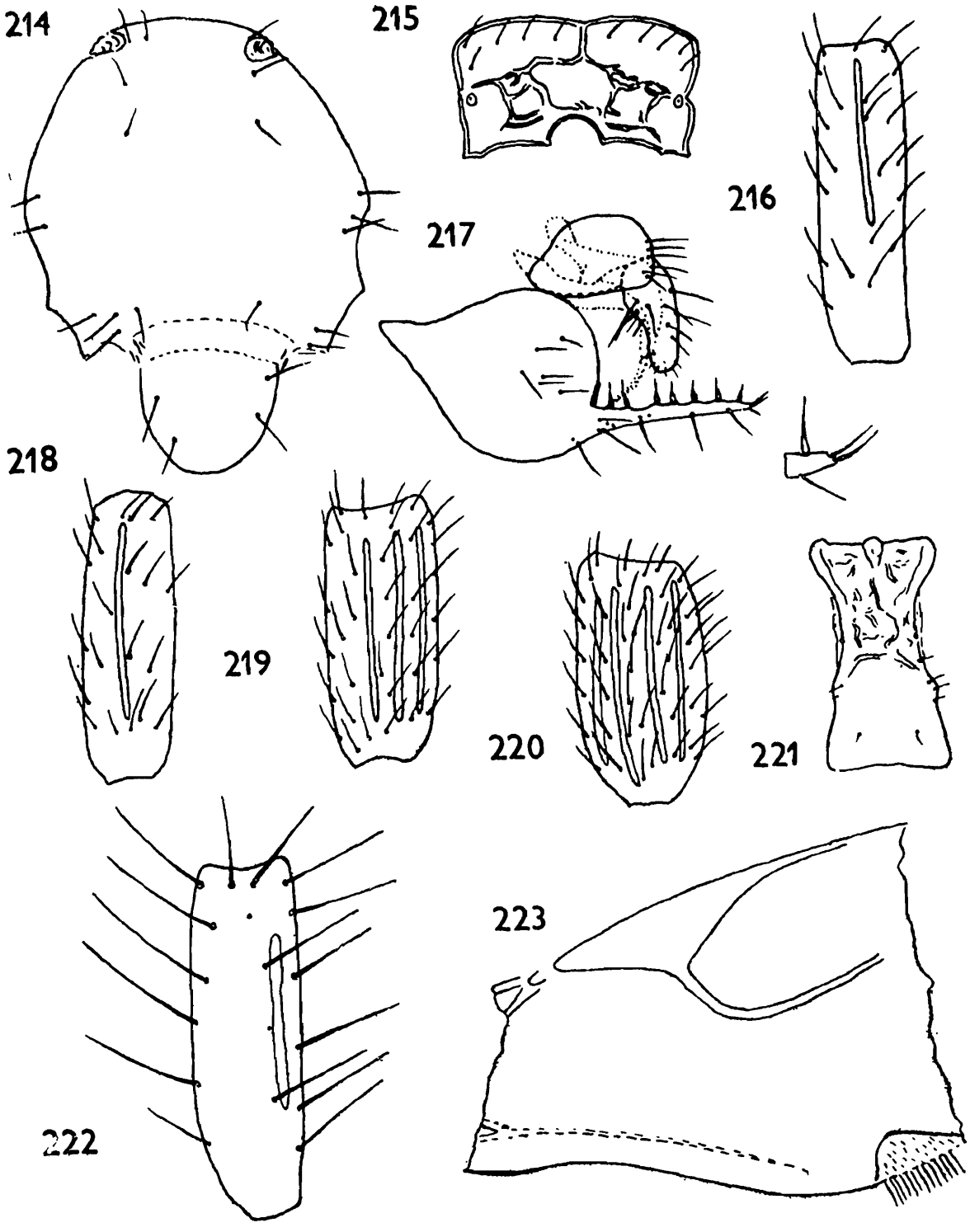

Figs. 189—202

189. *Lysaphidus qadrii*, $F_1$. 190. *L. qadrii*, $F_2$. 191. *L. qadrii*, forewing. 192. *L. qadrii*, mesonotum. 193. *L. qadrii*, $F_6$. 194. *Pauesia mashobrica*, genitalia. 195. *Pauesia arcuata*, tergite 1. 196. *P. mashobrica*, $F_1$. 197. *P. arcuata*, mesonotum. 198. *P. mashobrica*, $F_2$. 199. *P. mashobrica*, preapical F. 200. *P. mashobrica*, $F_3$. 201. *L. qadrii*, $F_3$. 202. *P. arcuata*, genitalia.



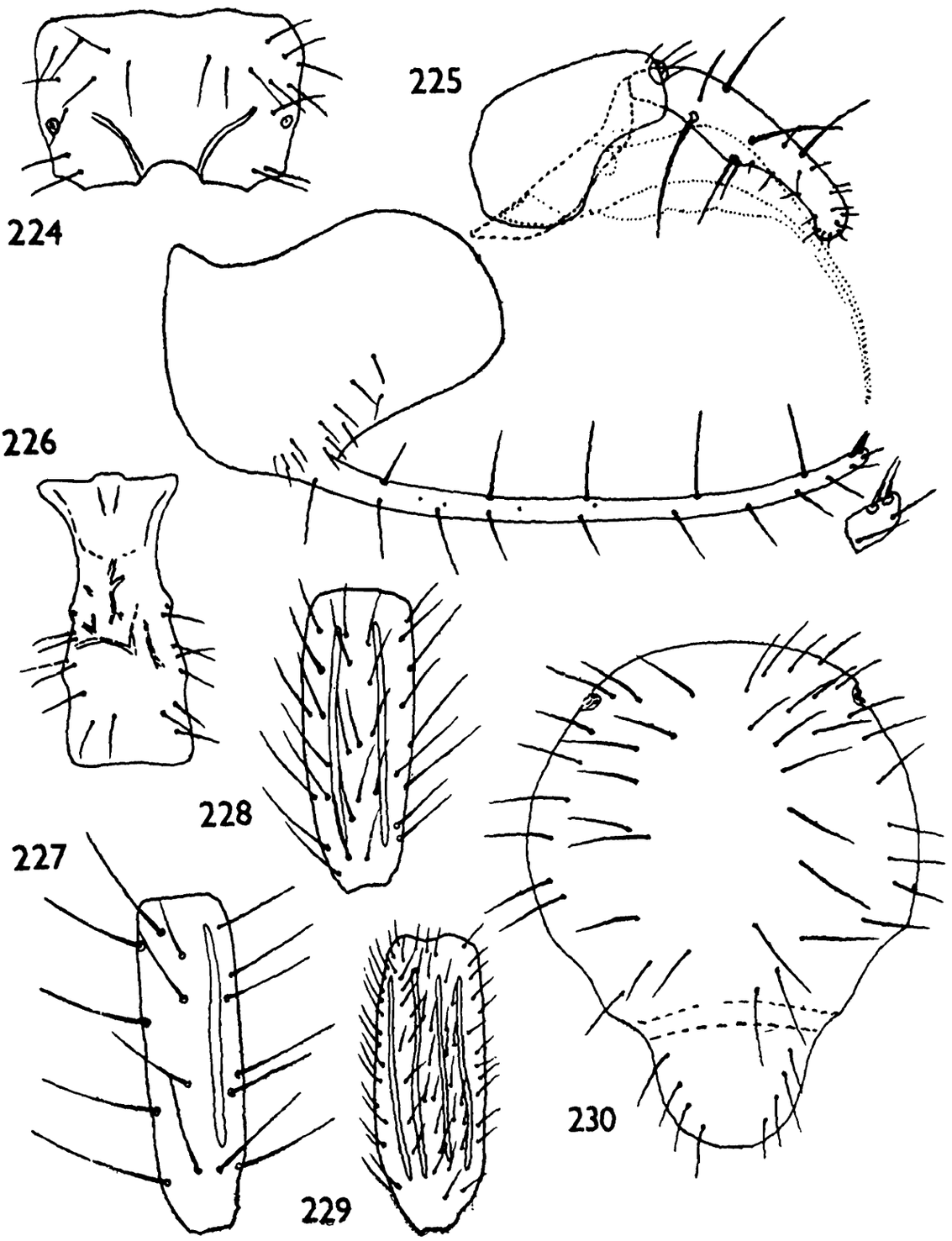

Figs. 203—213

203. *Pauesia mashobrica*, mesonotum. 204. *Pauesia arcuata*, propodeum. 205. *P. mashobrica*, tergite 1. 206. *P. mashobrica*, a part of forewing. 207. *P. arcuata*, $F_1$. 208. *P. arcuata*, preapical F. 209. *P. arcuata*, $F_0$. 210. *P. arcuata*, a part of forewing. 211. *P. mashobrica*, propodeum. 212. *P. arcuata*, $F_2$. 213. *Trioxys greenideae*, a part of forewing.




Figs. 214—223

214. *Trioxys greenideae*, mesonotum. 215. *T. greenideae*, propodeum. 216. *T. greenideae*, $F_1$. 217. *T. greenideae*, genitalia. 218. *T. greenideae*, $F_2$. 219. *T. greenideae*, $F_3$. 220. *T. greenideae*, preapical F. 221. *T. greenideae*, tergite 1. 222. *T. kumaonensis*, $F_1$. 223. *T. kumaonensis*, a part of forewing.




Figs. 224—230

224. *Trioxys kumaonensis*, propodeum. 225. *T. kumaonensis*, genitalia. 226. *T. kumaonensis*, tergite 1. 227. *T. kumaonensis*, $F_2$. 228. *T. kumaonensis*, middle F. 229. *T. kumaonensis*, preapical F. 230. *T. kumaonensis*, mesonotum.