

## A REVISION OF THE HECALINAE (Homoptera: Cicadellidae) OF THE ORIENTAL REGION<sup>1,2</sup>

By William P. Morrison<sup>3</sup>

*Abstract*: This study is the first attempt to revise the Hecalinae (Homoptera: Cicadellidae) of the Oriental region. Most of the species have previously been known only from their original descriptions and were often represented by single female holotypes. The genitalia of many of the species are described and illustrated for the first time. The Oriental region is considered to include India, Ceylon, southern China, Formosa, Philippine Islands, Southeast Asia and the Malay archipelago.

Keys to the 2 tribes, 4 genera and the species in which the males are known are included. The distribution, parasites, probable phylogeny and location of types are discussed to the extent to which they are known. Lectotypes have been designated where appropriate in Distant's and Matsumura's collections.

Field studies were conducted in Thailand to determine the host plants and importance of these leafhoppers to rice. They were found to occur most often on grasses around rice paddies. The host plants of all species of Hecalinae for which data are available are discussed.

The Paradorydiini have previously been represented by 2 species in *Bumizana* Distant, and *B. ashlocki* n. sp. (Thailand) is added. One new genus in this tribe, *Sectoculus*, type sp. *carinatus* n. sp. (Laos) is also added.

The Hecalini are represented by 2 genera, *Glossocratus* Fieber, 1866 and *Hecalus* Stål, 1864. The taxonomic history and problems of these genera are discussed and both type-species are illustrated.

Fourteen species are considered valid in *Glossocratus*, with the following new combinations: *capitatus* (Distant), *orientalis* (Ishihara), *dilatatus* (Bierman), *elliptus* (Jacobi), *formosanus* (Matsumura), *parvus* (Walker), *platalea* (Noualhier) and *sulcatus* (Fieber) from *Hecalus*; *chinensis* (Signoret) from *Ectomops*; *cultratus* (Walker), *greeni* (Distant), and *spatulatus* (Distant) from *Ledrotypa*. *G. breviceps* (India) and *G. bakeri* (Philippines) are new spp. New synonymies are: *Ledrotypa* Distant, 1912, and *Ectomops* Signoret, 1880; and *E. rubescens* Noualhier, 1896 of *G. platalea* (Noualhier), 1896, which is new to Thailand. The ♀ of *orientalis* is described for the first time.

Twenty species are considered valid in *Hecalus*, with the following new combinations: *apicalis* (Matsumura) (reinstated), *gressitti* (Linnavuori), *lutescens* (Distant), *nitobei* (Matsumura), *prasinus* (Matsumura) from *Parabolocratus* Fieber; *arcuatus* (Motschulsky), and *porrectus* (Walker) from *Linnavuoriella* Evans; and *misranus* (Distant) from *Ledrotypa* Distant. *H. fuscovittatus* (Laos), *bicornus* (Amboina, Philippines), *furcatus* (China), *thailandensis* (Thailand) and *multilineatus* (Laos) are new spp. New synonymies are: *Linna-*

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*vuoriella* Evans, 1966, and *P. concentricus* Matsumura, 1940 of *arcuatus* (Motschulsky), 1859; *P. rusticus* Distant, 1918 and *P. merinoi* Capco, 1959 of *porrectus* Walker, 1858, *P. dubiatus* Bierman, 1910 of *prasinus* (Matsumura), 1905; *P. antipolanus* Capco, 1959 of *thomsoni* Stål, 1870; *H. flori* Stål, 1870, *H. gramineus* Merino, 1936, *P. minutus* Bierman, 1910, *P. taiwanus* Matsumura, 1912 and *P. mandlensis* Singh-Pruthi, 1930 of *wallengreni* Stål, 1870. New locality and host records are: Sri Lanka and India for *apicalis*; Taiwan, Laos, Okinawa, Penang, Macao and Thailand on *Heteropogon* sp. and *Themeda* sp. for *arcuatus*; Laos, Malaysia, Amboina, Singapore and Philippines on *Setaria palmifolia* and *Imperata cylindrica* for *gressitti*; Laos, China and Thailand on *Eleusine indica* and *Panicum repens* for *porrectus*; Java, Laos, Philippines, and Thailand on *Imperata cylindrica* for *prasinus*; and Java, Taiwan, Laos and Thailand on *Chrysopogon aciculatus* for *wallengreni*.

Lectotypes are designated for *B. elongata* Distant, 1918, *E. rubescens* Noualhier, 1896, *H. platalea* Noualhier, 1896, *H. fascialis* Distant, 1918, *H. lefroyi* Distant, 1908, *P. prasinus* Matsumura, 1905, *P. lutescens* Distant, 1918, *P. rusticus* Distant, 1918, *P. apicalis* Matsumura, 1912 and *Thomsoniella albomaculata* Distant, 1908.

## INTRODUCTION

This study represents the first attempt to revise the leafhoppers of the subfamily Hecalinae that occur in the Oriental region. The Hecalinae are cosmopolitan in distribution. Their host plants are most often grasses; in the Orient they are known to occur around, and occasionally in, rice paddies (Misra 1920a, Grist & Lever 1969). A better understanding of these leafhoppers is desirable in light of their association with grass and rice ecosystems.

Studies of the genus *Parabolocratrus* by Ishihara (1959) for Japan and by Capco (1959) for the Philippine Islands are the only previous revisionary works. The literature otherwise consists of scattered new species descriptions. Prior to this study, there had been considerable taxonomic confusion in this group primarily because (1) several types of genera had not been reexamined since their early descriptions, (2) the genitalia of many of the species had never been described or illustrated, and (3) the strong sexual dimorphism characteristic of most of the species was not recognized by early workers.

The Oriental region in this study is considered to be the zoogeographic region defined by Wallace ([1876] 1962). This area includes Ceylon and the Indo-Pakistan subcontinent east across southern China to and including Formosa, then south through the Philippine Islands, including the Malay archipelago and all of Southeast Asia. Four genera and 40 species are reported here as occurring in this region.

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For the identification of host plants in Thailand I thank Mr Jaray Sadagorn of the Thailand Department of Agriculture, Bangkok, Thailand.

Finally, I wish to express my profound gratitude to my wife Kay for her support and patience throughout this study.

#### HOST PLANTS AND ECONOMIC IMPORTANCE

The host plants of hecaline leafhoppers are most often grasses, although some species have been reported to feed on rushes and trees of the genera *Casuarina* and *Melaleuca* (Metcalf, 1963). At least one species, *Hecalus porrectus*, is known to cause damage to rice (Grist and Lever, 1969). In Thailand, *H. wallengreni* and *H. porrectus* were found to occur occasionally on rice although they were never collected in abundance. Continual sampling of leafhopper populations in rice paddies in northeast Thailand during the rainy season of 1971 indicated that the Hecalinae occur primarily on grasses around the rice paddies. Rice is apparently not a preferred host plant for these leafhoppers.

*H. wallengreni* was most commonly collected in Thailand on *Chrysopogon aciculatus* and *Cynodon dactylon*. In India this species has been collected on mixed *C. dactylon* and *Sorghum halepense*. Near Poo Wieng, Thailand, *H. wallengreni* and *H. arcuatus* were collected together in an area of mixed *Echinochloa colonum* and *C. aciculatus*. *H. arcuatus* was found to occur in Thailand on *Themeda* sp. and *Heteropogon* sp. This

species was successfully reared on *Themeda* sp. from a population occurring near Chaiphum. Capco (1959) reports collecting this species "among grasses along river banks and side roads" in the Philippine Islands.

*H. porrectus* is a common species on grass near water in the Philippine Islands (Capco, 1959). In Thailand it was collected on *Panicum repens* and *Eleusine indica* being successfully reared in the laboratory on the latter. Data on male specimens from Punjab, India, show this species occurring in a "big fruit garden (of "lokat", "anar", apricot and peaches)".

*H. prasinus* was collected in Thailand at three widespread locations (Ubon, Kalasin and Chumpae), always on the same host plant, *Imperata cylindrica*. *H. gressitti* females have also been collected on this plant at Albay, Philippine Islands, and males from the same locality have been collected on *Setaria palmifolia* and "Corocanding". Matsumura (1912) reports *H. taiwanus* as occurring on "Theapflantzen" in his original description of the species.

Only one host plant record is known for the genus *Glossocratus* Fieber in the Oriental region. This record comes from a male and female *G. orientalis* occurring on *Paspalum* sp. in Simpang Lima, Malaya. No host plant records are known for any of the species of *Bumizana* Distant and *Sectoculus*. It is probable, however, that they occur on grasses as related species of *Paradorydiini* have been collected in "grass sweepings" in South Africa (Naudé, 1926).

In general, all Oriental hecalines for which host plant records are known occur on grasses, particularly around water. They seldom occur on cultivated plants and are of only minor economic importance. These leafhoppers are not known to be vectors of plant diseases.

#### PARASITES

The Hecalinae are parasitized by three orders of insects—Hymenoptera (Dryinidae), Diptera (Pipunculidae) and Strepsiptera (Halictophagidae). These parasites, particularly strepsipterans, sometimes cause a modification of the genitalia which can lead to confusion and misidentification. Among the Hecalinae, for example, Oman (1949) found the holotypes of *Parabolocratus terminus* DeLong and *P. inflatus* DeLong to contain female Strepsiptera which had altered the genitalia. These species are now considered synonyms of *P. viridis* (Uhler) and *P. continuus* DeLong, respectively.

The first to report a parasite of an Oriental hecaline was Pierce (1918), who found *H. arcuatus* (Motschulsky) parasitized by *Halictophagus paradeniya* Pierce in Ceylon. In Thailand specimens of *H. wallengreni* Stål containing strepsipterans were collected. One male paratype of *H. thailandensis* n. sp. was parasitized by four Strepsiptera, the largest number of parasites encountered in a single specimen in this study. Dryinids were found in specimens of *H. arcuatus* and *H. prasinus* (Matsumura). Perkins (1905) illustrates a *Hecalus* sp. from Australia parasitized by a pipunculid. However, none of these parasites were found in dissections of Oriental specimens.

No parasites were found in the approximately 200 *Glossocratus* specimens examined. Similarly, parasites have not been found in Oriental *Paradorydiini*.

## MATERIALS AND METHODS

*Materials:* About 1,200 specimens were examined during the course of this study. Many of them were borrowed from museums, including all of the unidentified Oriental hecalines in the U. S. National Museum, American Museum of Natural History and the British Museum (Natural History). Only the unidentified hecaline material from Laos and Thailand was borrowed from the Bernice Bishop Museum. In addition, some 500 specimens were collected by the author in Thailand, and about 200 were borrowed from various Thai institutions.

The following is a list of museums and individuals from whom material was received on loan, together with the abbreviations used throughout the text.

AMNH - American Museum of Natural History, New York ; Dr J. G. Rozen, Jr.

AMS - Zoologisch Museum, Amsterdam ; Dr J. P. Duffels.

BER - Zoologisches Museum an der Humboldt-Universität zu Berlin, Berlin ; Dr U. Göllner-Scheiding.

BISHOP - Bernice P. Bishop Mueum, Honolulu, Hawaii ; Dr J. L. Gressitt.

BMNH - British Museum (Natural History), London ; Dr W. J. Knight.

BON - Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn ; Dr H. F. Klockenhoff.

BPI - Bureau of Plant Industry, Manila, Philippines ; Dr S. A. Estocapio.

EHIU - Ehime University, Matsuyama, Japan ; Dr T. Ishihara.

GEN - Muséum d'Histoire Naturelle, Geneva ; Dr B. Hauser.

HOKU - Hokkaido University, Sapporo, Japan ; Dr S. Tagaki.

KASU - Kasetsart University, Bangkok, Thailand ; Dr S. Areekul.

LEI - Rijksmuseum van Natuurlijke Historie, Lieden ; Dr P. H. van Doesburg.

MOS - Zoological Museum, Moscow State University, Moscow.

PAR - Muséum National d'Histoire, Paris ; Dr M. Boulard.

RPRC - Rice Protection Research Center, Bangkok, Thailand ; Dr K. Kovitvadhi.

STK - Naturhistoriska Riksmuseet, Stockholm ; Dr P. I. Persson.

TDA - Thailand Department of Agriculture, Bangkok, Thailand ; Dr A. Wattana-  
pongsiri.

UKY - University of Kentucky, Lexington, Kentucky ; Dr P. H. Freytag.

USNM - United States National Museum, Smithsonian Institution, Washington, D.  
C. ; Dr J. P. Kramer.

WEI - Naturhistorisches Museum, Vienna ; Dr A. Kaltenbach.

ZSI - Zoological Survey of India, Calcutta ; Dr K. S. Pradhan.

*Methods:* Methods used in this study for the examination of the male genitalia are similar to those described by Oman (1949) and Knight (1965). For removal of the abdomen the specimen was first supported, ventral side up, on a platform. This was achieved by using either a clay block provided with an inverted flat-bottomed vial or by using a pill box. The abdomen was removed by inserting a sharp pin between the abdomen

and thorax and gently prizing the pin.

For removal of the unsclerotized tissue, the abdomen was placed in a microbeaker containing a 10 % KOH solution. After remaining in the cold solution 2-4 hours the unsclerotized material was removed by gently prodding the abdomen with the head of a pin. Some workers heat the KOH solution until convection currents are observed, allowing the clearing procedure to take only a few minutes. Because heating sometimes causes distortion of the genitalia, this procedure was not followed.

After most of the unsclerotized tissue had been removed in the KOH treatment, the abdomen was transferred to water where it was thoroughly rinsed. It was often convenient to separate the genital capsule from the abdomen at this time to facilitate complete removal of any remaining tissue. The abdomen was then stored in glycerine ready for study.

It was often necessary to dissect the genitalic structures out of the capsule for more detailed examination. This was accomplished by breaking the point of articulation between the styles and plates. The internal structures were then removed by use of a hooked pin.

Wings were prepared for illustration by mounting on slides. Suspending the wings in a drop of water on the slide after carefully removing them facilitated positioning and spreading of the hindwing. The excess water was removed with tissue paper prior to adding the cover slip. The cover slip was held in place by a small amount of balsam on the margin. It was often necessary to place a light weight on the cover slip for several days to prevent curling of the wings.

Illustrations were made in the laboratory by using a Wild M5 stereomicroscope equipped with a camera lucida. A compound microscope with a crosshatch micrometer reticle was used while visiting museums.

#### MORPHOLOGY AND TERMINOLOGY

The following discussion pertains to the Hecalinae of the Oriental region. For general treatments of leafhopper morphology the reader is referred to the more comprehensive works by Evans (1946), Oman (1949) and Tuxen (1956).

Hecaline leafhoppers have heads which are subangularly produced to foliaceous. The dorsal region of the head is termed the vertex or crown (Fig. 1). The vertex length as used in this work is the distance from the mid-anterior margin to the pronotum. The interocular width is the transverse distance on the vertex between the compound eyes. The face (Fig. 6) is divided by sutures into the anteclypeus (clypellus), postclypeus (clypeus), lora and genae. The lateral clypeal sutures extend dorsad beyond the antennal pits to the vertex margin anterior to the ocelli. The lateral margin of the gena is strongly sinuate below the eye, a characteristic of the subfamily. Antennal pits are vestigial or lacking and the antennae are of moderate length. The ocelli are located on the lateral margin of the vertex, usually adjacent or close to the compound eye. In *Sectoculus* the vertex margin partially bisects the compound eye.

The scutellum is laterally carinate and finely striate. Pronotal length, as used in this work, is the medial longitudinal distance from the anterior to the posterior margin. The scutellum is triangular and usually pointed posteriorly. The texture of the head and

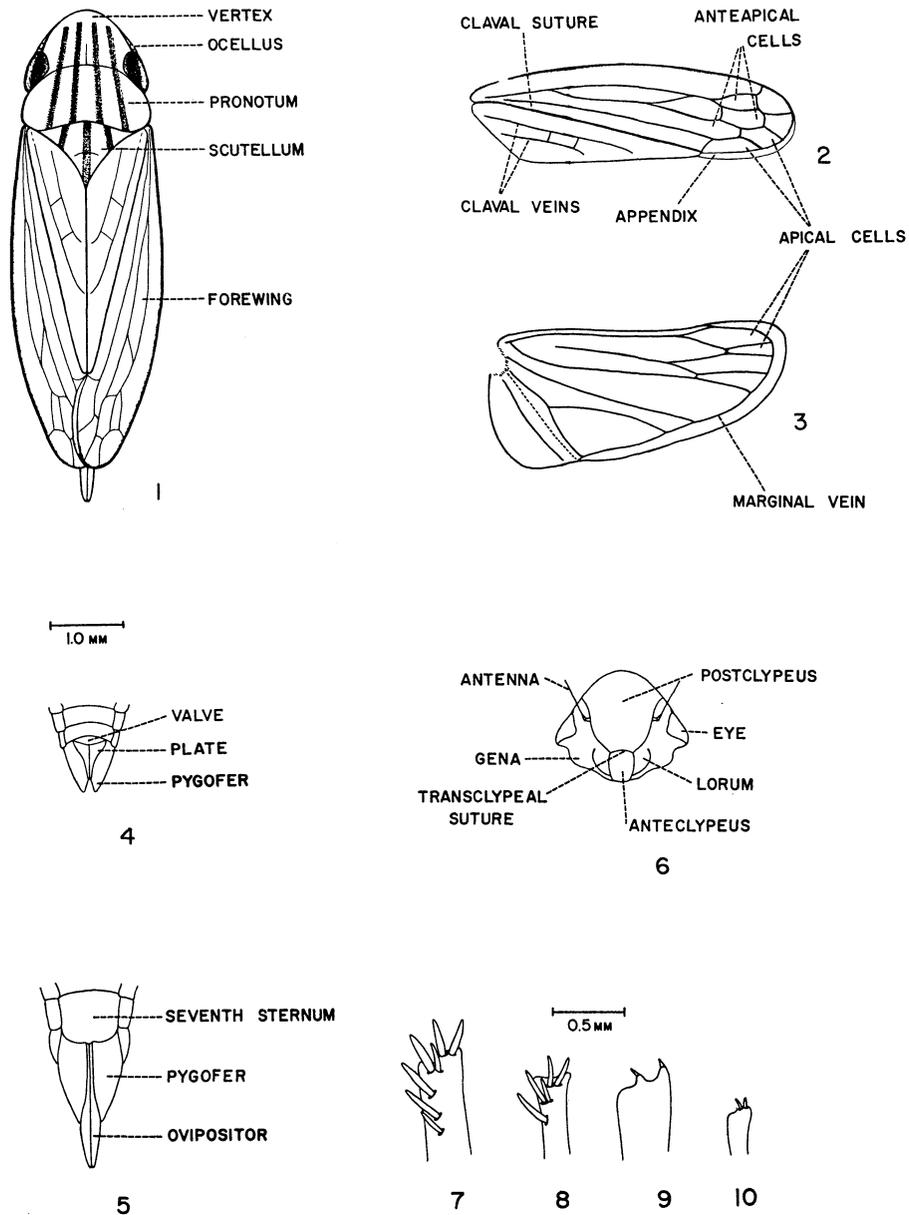


Fig. 1-10. 1-6, *Hecalus porrectus* (Walker): 1, habitus of ♀; 2, right forewing of ♀; 3, right hindwing of ♀; 4, ventral view of ♂ genitalia; 5, ventral view of ♀ genitalia; 6, ventral view of ♀ head. 7, hind femoral setal formula of *Glossocratus orientalis*. 8, hind femoral setal formula of *Hecalus porrectus*. 9, hind femoral setal formula of *Sectoculus carinatus*. 10, hind femoral setal formula of *Bumizana ashlocki*.

thorax ranges from punctate in *Bumizana* to smooth in *Hecalus*.

The hind femoral setal formula has been found to be of diagnostic importance in separating members of this subfamily. *Glossocratus* has a formula of 2-2-1-1-1 (Fig. 7), *Hecalus* 2-2-1 (Fig. 8) and the Paradorydiini 2-0-0 (Fig. 9 and 10). It should be mentioned that these setae are easily broken and the femora should always be examined carefully.

The forewings (Fig. 2) have two claval veins and occasionally one or more claval crossveins. The wings are subacutely pointed in the Paradorydiini (Fig. 32 and 51) but rounded in the Hecalini (Fig. 2 and 88). *Sectoculus* has many supernumerary crossveins to the costal margin, whereas in the other genera there are few or none.

The hindwings range from hyaline to smokey brown in color. The apical cells are closed in the hindwings (Fig. 3) of all the genera except *Bumizana*, which has the unusual character of open apical cells (Fig. 33). Brachyptery is a common characteristic of the females.

The male genitalia provide a number of characters useful in separating species of this group. The ninth abdominal segment, or pygofer, is heavily setose in the Hecalini whereas it is bare in the Paradorydiini. The pygofer may be posteriorly hooked, rounded or subacutely pointed. The genital valve, considered the sternum of the ninth abdominal segment by Tuxen (1956), is usually distinct and broadly triangular. Extending posteriorly from the genital valve are two elongate structures—the plates. These structures assume various shapes and often possess setae. The above-mentioned characters comprise the genital capsule.

The internal genitalia are located within the genital capsule and consist of the aedeagus, connective and styles. The styles, or parameres, are paired structures articulating laterally with the connective and midventrally with the plates. The connective, shaped like an inverted Y, is an intermediate structure between the styles and aedeagus. It articulates laterally with the styles and posteriorly with the aedeagus. This structure is sometimes referred to as the phallobase.

The aedeagus articulates basally with the connective and serves as the intromittent organ. The shaft may be tubular, dorso-ventrally flattened or laterally compressed. The aedeagus usually has processes of various shapes and sizes, although in *Bumizana* it is styliform. The gonopore may be apical or subapical. A dorsal apodeme, which may be reduced, is present.

The shape of the posterior margin of the seventh sternum of the female is a useful character. In the Hecalinae this sternum may be laterally notched with a medial projection, deeply cleft, with a simple medial projection or straight. The ovipositor is composed of a pair of valvifers and an ovipositor sheath. The extension of this structure beyond the pygofer, relative to its width, is also used as a taxonomic character. This character varies from species in which the ovipositor does not extend beyond the pygofer to those in which it extends three times its own width beyond the pygofer.

#### TAXONOMIC PROBLEMS

Sexual dimorphism is a characteristic of all the genera except *Bumizana*. The failure

of some early workers to recognize this has caused considerable taxonomic problems both at the generic and specific levels. For example, the genus *Ectomops* contained two species based on males and the genus *Ledrotypa* four species based on females. Both of these genera are designated new synonyms of *Glossocratus* in this study. Probably the most common error at the species level is found in *H. porrectus*. The males of this species are often labelled *H. albomaculatus* and the females *H. porrectus*. Capco (1959) was the first to point out this synonymy.

Another problem encountered in studying the Oriental Hecalinae is that many of the species consist only of single female holotypes, a number of which have the abdomen missing. For example, of the 14 species of *Glossocratus* considered in this work, eight are single female specimens (excluding the type of *sulcatus* which could not be found). Four of these specimens have the abdomen missing.

Most of the early work on Oriental hecalines was conducted by Distant and Matsumura. Matsumura worked with the fauna of Japan and Formosa and Distant with that of India. Species described from the area in between consists primarily of specimens collected on early expeditions. There are currently no published illustrations or descriptions of the genitalia of many of the species as most were described before the importance of these structures was realized.

All of Distant's types in the British Museum (Natural History) have been studied. Although many of his holotypes are single females, lectotypes have been designated in his syntypic series where appropriate. Some of the taxonomic problems associated with Distant's work on Indian leafhoppers have been discussed by Mahmood (1967).

Matsumura's types and his collection were studied at Hokkaido University, Sapporo, Japan. Most of his types can be distinguished by labels in his handwriting, usually of the form "*P. centralis* n. sp. Mats." or "*Parabolocratus ikumae* n. sp." Occasionally there is an additional red, printed "Type Matsumura" label which was not attached by Matsumura himself. Specimens so labelled were checked carefully before being considered holotypes. Although most of his types are in Sapporo, some were apparently taken to Formosa, Sakhalin and Peking and have not been returned owing to Japan's losses during the war (Dr Tagaki, personal communication). This might be the fate of *P. concentricus*, for example, which could not be found in Sapporo.

A single species of the tribe Eupelicini, *Eupelix flavescens* Guérin-Méneville (1834), has been described from the Oriental region. However, this tribe is generally considered Palearctic in distribution and, owing to the antiquity of the description, this species is probably misplaced. The original description is based on a female from Java 10 mm in length, considerably longer than any known eupelicine. The type of this species has not been located.

The genus *Clavena* Melichar is also considered as occurring in the Oriental region. Two species are ascribed to the genus in Metcalf's catalogue (1963): *C. sulcata* Melichar from China and *C. thomsoni* (Stål) from the Philippine Islands. The type of *C. thomsoni* has been examined and clearly belongs to *Hecalus*. The type of *C. sulcata* has not been located but, judging from the original description (Melichar, 1902), it is not certain whether this species is a hecaline or ledrine as the ocelli are located "im Nacken." The description is based on a female 3 3/4 mm long, which would make this the smallest hecaline in the Oriental region.

## DISTRIBUTION

The Hecalinae are found in all major zoogeographic regions of the world. In the Oriental region four genera and two tribes are represented: *Bumizana* and *Sectoculus* in the Paradorydiini and *Glossocratus* and *Hecalus* in the Hecalini.

Only two species of *Bumizana* have been previously described, both from India. The occurrence of *B. thailandensis* in northern Thailand represents a considerable range extension for this genus. *Sectoculus* is currently known only from the type-locality near Vientianne, Laos, but probably also occurs in Thailand.

The genus *Glossocratus*, so far as is known, is restricted to the Ethiopian, Palearctic and Oriental regions. It appears to be widely distributed in the Oriental region but, as it is rarely collected, species records are few and scattered. Specifically, specimens have been examined from India, China, Formosa, Philippine Islands, Tonkin, Laos, Viet Nam, Thailand, Malaysia, Singapore, Cambodia and Sumatra. Males of *G. orientalis* and *G. platalea* have both been collected at Nakon nayok, Thailand, which is the only record of two species of this genus occurring at the same locality.

Members of the genus *Hecalus* have been recorded from all major zoogeographic regions except South America. *H. porrectus*, *H. arcuatus* and *H. wallengreni* are known to be widely distributed in the Oriental region. *H. gressitti* has previously been recorded only from the Western Caroline Islands, but the range of this species is herein extended West through the Philippine Islands to Laos and Malaysia. *H. apicalis* likewise has been known only from the type-locality in Formosa but additional specimens from Lappa Island, Ceylon and India were found. Several species, however, are still known only from their type-localities.

## PHYLOGENY

This discussion is intended to present only a broad, general overview of the phylogeny of Oriental Hecalinae. More concise statements cannot be made until more material has been collected and made available for study, particularly from the Sunda Islands and the Burma-East India area. This discussion is based only on those species for which the male genitalia are known.

The Oriental genera of Hecalinae can be distinguished from other leafhoppers by a combination of the following characters: (1) ocelli on the vertex margin close to the compound eye, (2) vertex subangularly produced to foliaceous, (3) pronotum laterally carinate, and (4) the strong sinuation of the gena below the eye. Two tribes of Hecalinae are represented in the Oriental region. These are: (1) Paradorydiini (*Bumizana* and *Sectoculus*), which have a vertex at least four times the width of the pronotum, forewings pointed apically and a 2-0-0 hind femoral setal formula and (2) Hecalini (*Glossocratus* and *Hecalus*), which have a vertex length of not more than three times the width of the pronotum, forewings rounded apically and a hind femoral setal formula of 2-2-1-1-1 or 2-2-1. These two tribes, although sharing a number of common characters, do not appear to be closely related.

Within the Paradorydiini, *Bumizana* has open apical cells in the hindwing, a vertex length of about four times the width of the pronotum and the compound eye not bisected by the vertex margin. The three species of this genus—*elongata*, *ruberosa* and *ashlocki*

— form a natural group. They are all similar externally and genitally, differing primarily in the shape of the plate. The monospecific genus *Sectoculus* may be distinguished by having closed apical cells in the hindwing, a vertex length of at least six times the width of the pronotum and the compound eye bisected by the vertex margin.

The two genera within the Hecalini appear to be more closely related than the two genera of Paradoriini. *Glossocratus* species have a hind femoral setal formula of 2-2-1-1-1, the female ovipositor not extending beyond the pygofer and the male pygofer with 2-3 rows of short, stout spines on the posterior margins. The five described males in this genus also form a natural group. These species — *breviceps*, *orientalis*, *platalea*, *chinensis* and *bakeri* — all have two pairs of terminal aedeagal processes. The length of the ventral pair is reduced in *breviceps*, the dorsal pair reduced in *platalea*, and the other three species have both pairs subequal in length.

*Hecalus*, which is the most common Oriental genus, may be distinguished by its hind femoral setal formula of 2-2-1, the female ovipositor extending beyond the pygofer and the male pygofer without any rows of short, stout spines on the posterior margins. Most of the *Hecalus* spp. examined in this study fall into two main groups. The first, the *porrectus* group, consists of six species all characterized by a reduced aedeagal apodeme, orange fasciae on the head and the male forewing darkened in the apical third with white spots in the apical and antiapical cells. The widespread *porrectus*, with two aedeagal processes, is considered the common ancestor. The other species in the group — *gressitti*, *apicalis*, *multilineatus*, *bicornus* and *furcatus* — each have two additional aedeagal processes which exhibit a progressive lengthening and modification.

The second major group, the *wallengreni* group, consists of five species — *prasinus*, *wallengreni*, *thailandensis*, *fuscovittatus* and *lutescens*. All of these species have an elongate aedeagal apodeme, one pair of aedeagal processes and are green or brown in color without orange fasciae.

One common species, *H. arcuatus*, does not fit well into either of the above-mentioned groups. It has two pair of aedeagal processes, a unique parabolic arrangement of orange fasciae on the head and pronotum, a relatively long aedeagal apodeme and a broad, dorso-ventrally flattened aedeagal shaft. It is considered in a group by itself although this initial position might be changed when additional material is available for study.

#### KEY TO THE GENERA OF ORIENTAL HECALINAE

1. Vertex length at least  $3 \times$  interocular width (Fig. 29); forewings pointed apically (Fig. 32); hind femoral setal formula 2-0-0 (Fig. 9 and 10) (Paradoriini) ..... 2
- Vertex length not more than  $2 \times$  interocular width (Fig. 92); forewings rounded apically (Fig. 2); hind femoral setal formula 2-2-1 (Fig. 8) or 2-2-1-1-1 (Fig. 7) (Hecalini) ..... 3
- 2 (1). Vertex length about  $3 \times$  interocular width, dorso-ventrally flattened (Fig. 29); compound eye not bisected by vertex margin; hindwing with apical cells open (Fig. 33) ..... **Bumizana** Distant
- Vertex length at least  $6 \times$  interocular width, forming a deep V in cross section (Fig. 47); compound eye bisected  $1/2$  its length by vertex margin; hindwing with apical cells closed ..... **Sectoculus** n. gen.

- 3 (1). Hind femoral setal formula 2-2-1-1-1; ♀ ovipositor not extending beyond pygofer (Fig. 97); ♂ pygofer with 2-3 rows of short, stout setae on posterior margins (Fig. 63) ..... **Glossocratus** Fieber  
 Hind femoral setal formula 2-2-1; ♀ ovipositor extending beyond pygofer (Fig. 189); ♂ pygofer without 2-3 rows of short, stout setae on posterior margins (Fig. 111)..... **Hecalus** Stål

### Genus **Bumizana** Distant

*Bumizana* Distant 1918: 32. Type-species *B. elongata* Distant, by original designation and monotypy.

*Length*: 7-10 mm.

*Description*: Vertex elongated, length about  $3 \times$  interocular width. Prominent mid-dorsal longitudinal carina extending length of vertex and pronotum. Head including eyes, as wide as pronotum. Ocelli on vertex margin anterior to compound eye by width of an eye. Strong longitudinal mid-ventral carina on vertex, gradually expanding posteriorly. Anteclypeus rectangular. Gena laterally notched under compound eye. Transclypeal suture complete. Frontal sutures extending through antennal pits to vertex margin just anterior to ocelli. Face and entire dorsal surface punctate. Pronotum collar-like, convex anteriorly, concave posteriorly. Scutellum almost as long as pronotum. Forewings tectiform, pointed apically; appendix small. Hindwings with apical cells open. Hind femoral setal formula 2-0-0. Color reddish brown to light brown.

♂. Plates dorso-ventrally flattened, broader basally and variously shaped apically. Pygofer pointed postero-ventrally. Anal tube elongate, pronounced. Connective in shape of inverted Y. Styles triangular, poorly sclerotized. Aedeagus styliform and recurved, without processes; dorsal apodeme present.

♀. Ovipositor extending beyond pygofer. 7th sternum deeply cleft, sometimes separated into two halves.

*Remarks*: This genus is presently known only from Thailand and India. Singh-Pruthi (1930) is of the opinion that *Bumizana* should be considered a synonym of *Dorydium* Burmeister (*Dorydium* is considered a synonym of *Paradorydium* Kirkaldy by some workers). His reasons are given as (1) both lack a mid-dorsal carina on the vertex and have ocelli, separating this group from *Cephaleus* Percheron and (2) both have very similar ♀ genitalia and forewing venation when compared with the illustrations of Naudé (1926) for South African species of *Dorydium*. However, it appears best to reserve *Bumizana* for the Oriental species until the hindwing and internal ♂ genitalia of *Dorydium* have been better characterized.

### KEY TO THE SPECIES OF BUMIZANA

1. Males ..... 2  
 Females ..... 4
- 2 (1). Vertex without pronounced notch in margin anterior to ocelli (Fig. 29); plates apically foot-shaped with lateral projection  $2 \times$  as long as wide (Fig. 27); Thailand ..... **ashlocki** n. sp.  
 Vertex with pronounced notch in margin anterior to ocelli (Fig. 35); plates not as above; India..... 3
- 3 (2). Plates more than  $2 \times$  as long as width at base, slender, finger-like (Fig. 21); vertex rapidly narrowing to interocular width slightly beyond ocelli (Fig. 35) .....

- ..... *ruberosa* Singh-Pruthi  
 Plates less than  $2 \times$  as long as width at base, robust, truncate apically (Fig. 15);  
 vertex gradually narrowing to interocular width in apical 1/3 (Fig. 39) .....
- ..... *elongata* Distant
- 4 (1). Vertex without pronounced notch in margin anterior to ocelli (Fig. 29); Thailand...  
 ..... *ashlocki* n. sp.  
 Vertex with pronounced notch in margin anterior to ocelli (Fig. 35); India .....
- 5 (4). Vertex rapidly narrowing to interocular width slightly beyond ocelli (Fig. 35).....  
 ..... *ruberosa* Singh-Pruthi  
 Vertex gradually narrowing to interocular width in apical 1/3 (Fig. 39) .....
- ..... *elongata* Distant

***Bumizana elongata* Distant** Fig. 11-16, 39-43.

*Bumizana elongata* Distant 1918: 32.—Singh-Pruthi 1930: 20; 1934: 80.—Evans 1947: 145.—Metcalf 1963: 116.

*Length*: ♂ 8.9-9.0 mm; ♀ 9.2-9.3 mm.

*Structure*: Vertex gradually narrowing to interocular width in apical 1/3; only slightly upturned apically. Lateral clypeal suture extending to vertex margin just anterior to ocelli, terminating in pronounced lateral vertex notch.

*Coloration*: Light brown with dark brown punctations. Dorso-medial carina cream colored; margin of ventral carina black. Midlateral vertex margin with two dark fuscous spots ventrally, sometimes present dorsally.

♂ *genitalia*: Plates slightly tapering apically with blunt, rounded laterad projection. Pygofer prominently pointed postero-ventrally. Connective in shape of inverted Y; stems rounded. Styles triangular, poorly sclerotized. Aedeagus tubular, recurved; gonopore apical; dorsal apodeme stout.

♀ *genitalia*: Ovipositor extending beyond pygofer one and  $1/2 \times$  its width. 7th sternum divided into two halves.

*Types*: 10 specimens are in the type series in the BMNH. A lectotype is herein designated is a ♀ with the data "Type, *Bumizana elongata* type Dist. (in Distant's handwriting), Kodai Kanal, S. India, 489, T. V. Campbell, S. India, E. A. Butler, 1915-60." The lectotype is on the same pin with 2 additional ♂♂, which are pointed separately.

*Distribution*: This species is known only from the type-locality.

*Remarks*: The genitalia of this species have not been previously described. There is one specimen from the type-locality in the USNM in addition to the type series. The lectotype is the same specimen illustrated by Distant in his original description and can be distinguished by the broken tip of the vertex.

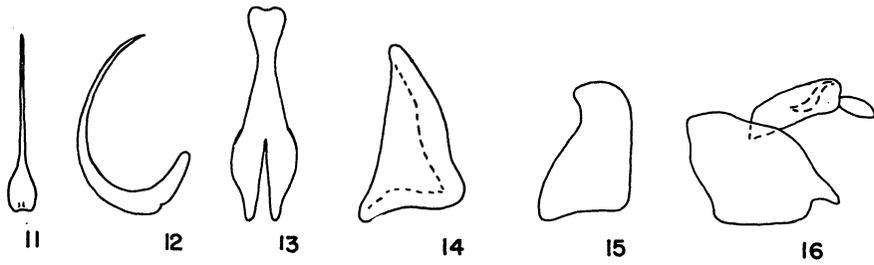
Distant originally reported a length of  $8\frac{1}{2}$ -9 mm "incl. teg." for this species. However, my measurements of the types show them to be somewhat longer.

***Bumizana ruberosa* Singh-Pruthi** Fig. 17-22, 35-38.

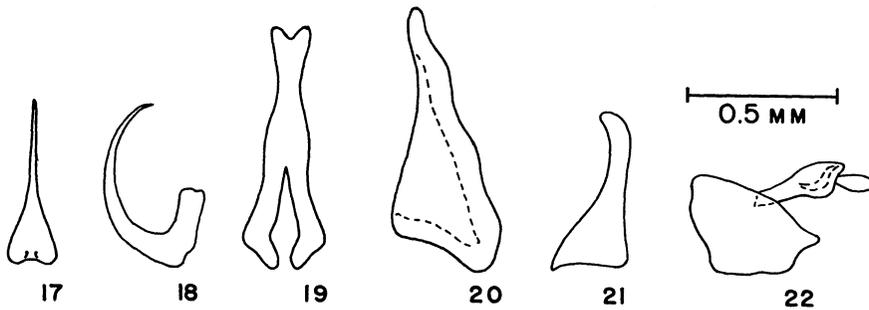
*Bumizana ruberosa* Singh-Pruthi 1930: 20; 1934. 80. — Metcalf 1963: 116.

*Length*: ♂ 7.3-8.3 mm; ♀ 9.0 mm.

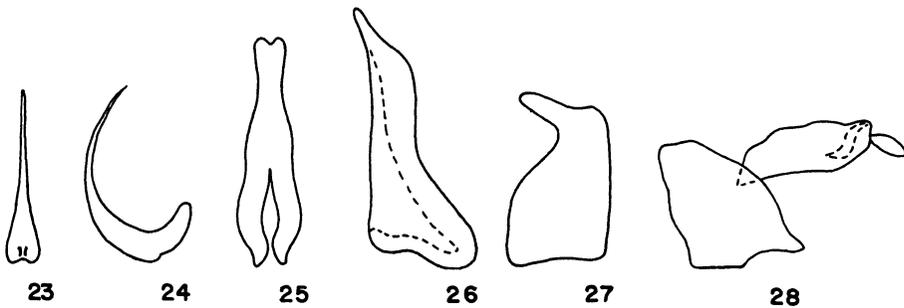
*Structure*: Vertex rapidly narrowing to interocular width slightly beyond ocelli; upturned



## ELONGATA



## RUBEROSA



## ASHLOCKI

Fig. 11-28. 11-16, *Bumizana elongata* Distant: 11, ventral view of aedeagus; 12, lateral view of aedeagus; 13, ventral view of connective; 14, ventral view of style; 15, ventral view of plate; 16, lateral view of pygofer. 17-22, *B. ruberosa* Singh-Pruthi: 17, ventral view of aedeagus; 18, lateral view of aedeagus; 19, ventral view of connective; 20, ventral view of style; 21, ventral view of plate; 22, lateral view of pygofer. 23-28, *B. ashlocki* n. sp.: 23, ventral view of aedeagus; 24, lateral view of aedeagus; 25, ventral view of connective; 26, ventral view of style; 27, ventral view of plate; 28, lateral view of pygofer.

apically. Lateral clypeal suture extending to vertex margin just anterior to ocelli; terminating in pronounced lateral vertex notch.

*Coloration*: Reddish brown. Dorsal medial carina light brown. Ventral medial carina fuscous. Anterior 2/3 of vertex mottled with dark brown. Veins of forewing reddish.

♂ *genitalia*: Plates more than 2× as long as width at base; tapering apically. Pygofer short, tapering postero-ventrally. Connective in shape of inverted Y; stems foot-shaped. Styles triangular, poorly sclerotized. Aedeagus tubular, recurved; gonopore apical; dorsal apodeme stout.

♀ *genitalia*: Ovipositor extending beyond pygofer about 1.5× its width. 7th sternum divided into two halves.

*Type*: Holotype ♂: Labelled "Chitteri, 3,000 ft., Chitteri Hills, Salem Dist., S. India, (forests at sides of plateau), Eastern Ghats Survey, Sta. 28, 20-22/VI/29, H. S. Pruthi, Holotype, *Bumizana ruberosa* Pruthi, 585/H7", deposited in ZSI.

*Distribution*: Central and South India.

*Remarks*: The holotype ♂ and 1 ♀ from the type series have been examined. The aedeagus of the only ♂ in Singh-Pruthi's material was partially mutilated and consequently not included in his original illustrations. The aedeagus illustrated herein is from a ♂ from Dhimban, S. India (BMNH).

*Other material examined*: 1 ♂, INDIA: Dhimban, Biligirirangan, Hills, S. India, 28. IV.1937, B. M. - C. M. Expdn. to South India, April-May 1937 (BMNH).

***Bumizana ashlocki* Morrison, new species** Fig. 23-34.

*Length*: ♂ 8.6 mm, ♀ 9.2 mm.

*Structure*: Vertex rapidly narrowing to interocular width slightly beyond ocelli; strongly upturned apically and spoon-like. Lateral clypeal suture extending to vertex margin just anterior to ocelli; lateral vertex margin at this point evenly rounded and not notched.

*Coloration*: Cinnamon brown with fuscous punctations. Dorsal medial carina light brown; margin of ventral carina black. Lateral posterior margins of abdominal segments often orange. Small reddish-orange band surrounding compound eye.

♂ *genitalia*: Plates with basal half broad, foot-shaped apically with lateral projection 2× as long as wide. Pygofer short, tapering postero-ventrally. Connective in shape of inverted Y; stems foot-shaped. Styles triangular, poorly sclerotized. Aedeagus tubular, recurved; gonopore apical; dorsal apodeme stout.

♀ *genitalia*: Ovipositor short, extending beyond pygofer its width. Pygofer with ventral margins somewhat scollaped. 7th sternum divided into two halves.

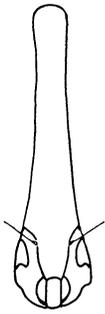
*Types*: Holotype ♂ (BISHOP 10095): THAILAND: Chiangmai Prov., Doi Suthep, 1300 m, 8.VI.1965, P. D. Ashlock, U. S. - Japan Coop. Sci. Program. Allotype ♀: Same data as holotype. Paratypes: 4 ♂♂ 6 ♀♀ same data as holotype.

*Distribution*: This species is known only from the type-locality.

*Remarks*: This species somewhat resembles *B. ruberosa* but may be distinguished from it by the absence of a lateral notch on the vertex margin anterior to the ocelli and by its distinct ♂ plates. This genus was previously recorded only from India and the occurrence of this species in Thailand represents a considerable range extension.



29



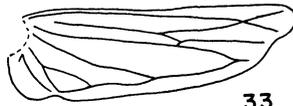
30



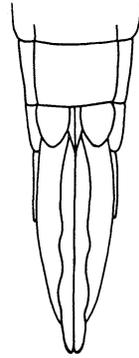
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32

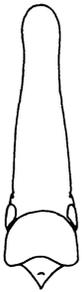


33

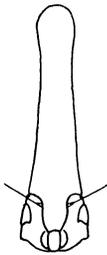


34

ASHLOCKI



35



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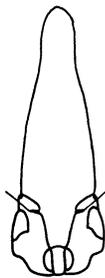


38

RUBEROSA



39



40

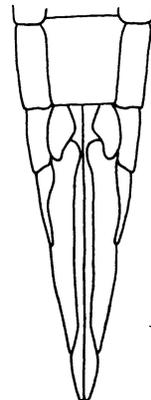


41



42

ELONGATA



43

Genus *Sectoculus* new genus

Type-species: *Sectoculus carinatus* n. sp.

*Length*: ♂ 22.9 mm, ♀ 31.2 mm.

*Structure*: Large, elongated leafhoppers. Vertex over  $6 \times$  interocular width; strong ventral longitudinal carina; forming a deep V in cross section. Head including eyes narrower than pronotum. Ocelli on vertex margin anterior to compound eye by width of eye. Margin of vertex partially bisecting compound eye. Anteclypeus rectangular. Gena laterally notched under eye. Transclypeal suture incomplete. Posterior margin of pronotum mesially indented; anterior margin straight. Forewing pointed apically with many antepical supernumerary veins to costa; appendix small. Hindwing with apical cells closed. Hind femoral setal pattern 2-0-0. Color yellow-brown to dark brown.

♂ valve present. Plates dorso-ventrally flattened, stout, blunted apically. Pygofer with posterior processes. Connective in shape of inverted Y. Style with anterior process directed laterad. Aedeagus short, with bulbous base.

♀ ovipositor extending beyond pygofer. 7th sternum with median projection.

*Remarks*: The leafhoppers of this genus are among the largest known. This genus somewhat resembles *Bumizana* Distant and *Paradorydium* Kirkaldy but may be distinguished from them by its strongly keeled, greatly elongated head and partial bisection of the compound eye by the vertex margin.

***Sectoculus carinatus* Morrison, new species**      Fig. 44-57.

*Length*: ♂ 22.9 mm, ♀ 31.2 mm.

*Structure*: Sexually dimorphic. ♂ vertex  $7 \times$  longer than pronotum, expanding apically to greater than its basal width, strongly reflexed. Vertex of ♀  $8 \times$  longer than pronotum, gradually tapering apically to  $1/2$  its basal width, only slightly upturned. Ocelli on vertex margin anterior to compound eye by width of eye. Compound eye bisected  $1/2$  its length by vertex margin. Transclypeal suture incomplete. Pronotum with transverse striae and faint lateral carina. Scutellum slightly shorter than pronotum.

*Coloration*: ♂ dark brown with fine granular fuscous spots on body. Sparse dark mottling on apical  $1/3$  to vertex. Lateral margins of vertex with 2 light halfmoon shaped areas in reflexed portion. ♀ yellow-brown with fine granular fuscous spots on body. Occasionally larger fuscous patches on body and wings.

♂ *genitalia*: Valve broadly triangular. Plates with row of fine teeth on medial and lateral margins; dorsal and ventral rounded knobs apically; sparsely setose. Pygofer with a pair of strong, finger-like processes curving ventrally on posterior margin. Connective in shape of inverted Y; stems forming foot-like processes. Style with anterior process directed laterad. Aedeagus stout, bifurcate apically, base bulbous; gonopore apical.

♀ *genitalia*: Ovipositor extending beyond pygofer by  $3 \times$  its width. Pygofer with lateral margins indented on posterior  $1/2$ . 7th sternum with a triangular median projection.

Fig. 29-43. 29-34, *Bumizana ashlocki* n. sp.: 29, dorsal view of head; 30, ventral view of head; 31, lateral view of head; 32, right forewing; 33, right hindwing; 34, ventral view of ♀ genitalia. 35-38, *B. ruberosa* Singh-Pruthi: 35, dorsal view of head; 36, ventral view of head; 37, lateral view of head; 38, right forewing. 39-43, *B. elongata* Distant: 39, dorsal view of head; 40, ventral view of head; 41, lateral view of head; 42, right forewing; 43, ventral view of ♀ genitalia.

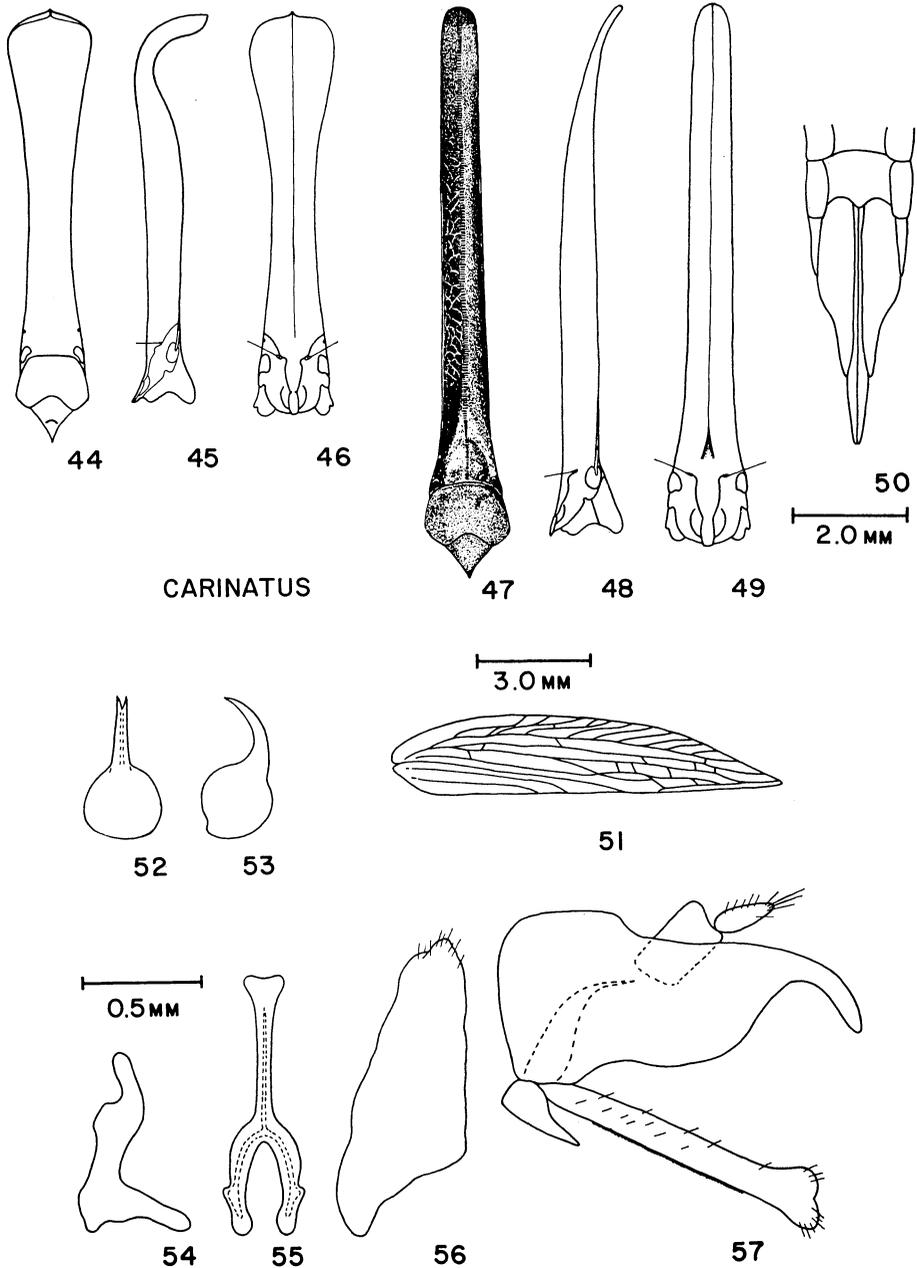


Fig. 44-57. *Sectoculus carinatus*: 44, dorsal view of ♂ head; 45, lateral view of ♂ head; 46, ventral view of ♂ head; 47, dorsal view of ♀ head; 48, lateral view of ♀ head; 49, ventral view of ♀ head; 50, ventral view of ♀ genitalia; 51, right forewing of ♀; 52, ventral view of aedeagus; 53, lateral view of aedeagus; 54, ventral view of style; 55, ventral view of connective; 56, ventral view of plate; 57, lateral view of pygofer.

**Types:** Holotype ♂ (BISHOP 10096) : LAOS : Vientiane Prov., Ban Van Eue, 15.XII. 1966, Native Collector, Rondon-Bishop Mus. Collection, Malaise trap. Allotype ♀ : LAOS : 800 m, Phou-kow-kuei, 15.IV.1965, J. L. Gressitt.

**Distribution:** This species is known only from Laos.

**Remarks:** The ledrine *Ledromorpha planirostris* (Donovan) from Australia, whose females range from 23–28 mm (Evans, 1966), is the closest in size to these unusually large leafhoppers.

### Genus *Glossocratus* Fieber

*Glossocratus* Fieber 1866 : 502. Type-species *G. foveolatus* Fieber, by subsequent designation of Evans 1947 : 141.

*Ectomops* Signoret 1880 : 49. Type-species *E. chinensis* Signoret, by monotypy. **New synonym.**

*Ledrotypa* Distant 1912 : 442. Type-species *L. spatulata* Distant, by subsequent designation of Evans 1947 : 141. **New synonym.**

**Length:** ♂ 7.0–8.6 mm; ♀ 8.0–14.0 mm to tip of wing, 9.5–12.5 mm to tip of ovipositor.

**Description:** Sexually dimorphic; ♂ vertex subangularly produced, about as long as pronotum, ♀ vertex foliaceous, about 2 × length of pronotum. Ocelli on margin next to compound eye in ♂; anterior to compound eye in ♀ by at least 3 × its own diameter. Margin of gena below eye strongly sinuate. Transclypeal suture complete. Lateral clypeal suture extending through antennal pit to vertex margin anterior to ocelli. Pronotum 2 × as long as wide; concave posteriorly; laterally carinate. ♀ brachypterous or macropterous. Wings often with claval crossveins present. Hind femoral setal formula 2-2-1-1-1. Light to dark brown in color.

♂ valve present. Plates finger-like, dorso-ventrally flattened; lateral setae. Posterior half of pygofer heavily setose; 2-3 rows of short, stout setae on posterior margins. Connective in shape of inverted Y. Style triangular with dorso-posterior thumb-like projection. Aedeagus with terminal processes; gonopore apical; dorsal apodeme present.

♀ ovipositor not extending beyond tip of pygofer. 7th sternum with medial projection.

**Remarks:** This genus is closely related to *Hecalus* Stål but differs in (1) having a 2-2-1-1-1 hind femoral setal formula, (2) the ♀ ovipositor not extending beyond the pygofer and (3) the ♂ having 2-3 rows of short, stout setae on the posterior margins of the pygofer.

Two species were ascribed to *Glossocratus* in Fieber's original description of the genus : *G. foveolatus* Fieber from Russia and *G. sulcatus* Fieber from the East Indies. Evans (1947) subsequently designated *G. foveolatus* as the type of the genus. The type specimen is a single ♀ deposited in the Muséum d'Histoire Naturelle, Geneva, Switzerland. The type was not in Fieber's collections, but rather in the Frey-Gessner collection, and apparently has been overlooked for decades. The genitalia of this type, which have not been previously described, are illustrated in Fig. 104.

In 1879 Signoret erroneously stated that *Glossocratus* was a synonym of *Hecalus*. He was soon followed by others (Atkinson 1885; Puton 1886; Van Duzee 1894; Oshanin 1906; Distant 1908b; etc.) who perpetuated this error until it was commonly accepted. From examination of the types of genera, however, it is evident that they are not synonyms and that *Glossocratus* is a valid name. Linnavuori (1961) was the first to recognize this and reinstated *Glossocratus* although he indicated that "unfortunately the generotype *G. foveolatus* is unknown to me."

The genera *Ectomops* Signoret and *Ledrotypa* Distant were found to be new synonyms

of *Glossocratus*. The holotypes of all species currently ascribed to these genera have been examined. *E. chinensis* Signoret and *E. rubescens* Noualhier are both ♂♂ and early workers, not recognizing the sexual dimorphism of *Glossocratus* spp., placed them in a separate genus. *Glossocratus* was described on a ♀, making such errors difficult to avoid. All holotypes of *Ledrotypa* spp. are ♀ from India and Ceylon. Several of these species might well be synonyms owing to the variable nature of the foliaceous head of *Glossocratus* ♀♀. However, the names are retained until more ♂♂ from India and Ceylon are available for study.

#### KEY TO THE ♂♂ OF ORIENTAL GLOSSOCRATUS

1. Aedeagus with 2 pairs of terminal processes subequal in length (Fig. 58).....2  
 Aedeagus with 2 pairs of terminal processes, one pair about 1/2 as long as other pair (Fig. 64)..... 4
- 2 (1). Aedeagal shaft basally tubular, gradually expanding and dorso-ventrally flattened in apical 2/3, stout, with 2 dorsal subapical flares prominent in ventral view (Fig. 70); China ..... **chinensis** (Signoret)  
 Aedeagal shaft slender, tubular throughout length with 2 dorsal flares not visible in ventral view ..... 3
- 3 (2). Aedeagal shaft with pair of large medial dorsal flares extending at least half the length of the shaft (Fig. 58); SE Asia..... **orientalis** (Ishihara)  
 Aedeagal shaft with pair of small dorsal subapical flares (Fig. 76); Philippines .....  
 ..... **bakeri** n. sp.
- 4 (1). Ventral pair of aedeagal terminal processes 2 × as long as dorsal pair (Fig. 64); shaft tubular; Southeast Asia..... **platalea** (Noualhier)  
 Dorsal pair of aedeagal terminal processes 2 × as long as ventral pair (Fig. 82); shaft laterally compressed with strong dorsal and ventral keel; India... **breviceps** n. sp.

***Glossocratus orientalis* (Ishihara), new combination**      Fig. 58-63, 88, 89, 97.

*Hecalus orientalis* Ishihara 1961: 236.

*Length*: ♂ 7.0-8.1 mm; ♀ 9.6-10.9 mm to tip of wing, 10.2-11.2 to tip of ovipositor.

*Structure*: ♂ vertex slightly upturned apically. Vertex length: interocular width ratio of ♂♂ 3.3: 5.0; ♀♀ 7.5: 6.5. Pronotum about as long as ♂ vertex. Fine hairs on ♀ body ventrally.

*Coloration*: Light to dark brown. Vertex with 2 longitudinal dark lines on each side of midline; usually medial dark spot on posterior margin and 2 faint brown patches in lateral region of interocular area. Scattered small granular black spots on body; usually more pronounced on ♀ and forming a reticulated pattern on vertex dorsally. ♂ with row of 4 black spots forming semicircle across scutellum; may be faint or lacking in ♀. 6-8 oblique piceous lines on face, sometimes faint. ♂ with fuscous spot anterior to compound eye ventrally; lacking or faint in ♀. Meso- and metapleural areas with dark band. ♂ abdomen dorsally with 1 medial and 2 lateral longitudinal stripes. Body and forewings sparsely mottled with dark patches of varying intensity.

♂ *genitalia*: Valve broadly triangular. Plates dorsoventrally flattened, tapering apically; lateral setae. Pygofer heavily setose in posterior half. Connective in shape of inverted Y. Style triangular with dorso-posterior thumb-like projection. Aedeagus with 2 pairs of terminal processes subequal in length, curving posteriorly; shaft tubular with pair of dorsal triangular flares extending at least 1/2 its length; gonopore apical; dorsal apodeme finger-like.

♀ *genitalia*: Ovipositor not extending beyond pygofer. 7th sternum with medial projection, somewhat truncate. Pygofer with many fine hairs.

*Types*: Holotype ♂: CAMBODIA, Sisophon, 8.XII.1957, T. Umesao leg. Paratypes: 1 ♂, sama data as holotype. All types deposited at EHIU.

*Distribution*: SE Asia.

*Remarks*: Ishihara described this species on 2 ♂ specimens. Both sexes were collected in Thailand by the author, and the ♀ is described here for the first time. The host plant record of a ♂ and ♀ from Malaya reared on *Paspalum* sp. represents the only host plant data for *Glossocratus* in the Oriental region.

This species closely resembles *G. platalea* externally but may be distinguished from it by the two pairs of aedeagal processes being subequal in length. The ♀♀ of these 2 species, however, cannot be separated at this time. *G. orientalis* has been collected with *G. platalea* in light trap collections from Nakon nayok, Thailand.

*Other material examined*: THAILAND: 2 ♂♂, 3 ♀♀, Tha Phra, Khon Kaen, VIII-XI.1971, W. P. Morrison (UKY); 1 ♂, 1 ♀, Tha Phra, Khon Kaen, V.1968, Fred W. Knapp (UKY); 4 ♂♂, Surin, I-V.1965 (RPRC); 1 ♂, Khaophappa Khaochang, Trang Prov., 200-400 m, 31.XII.1963 (BISHOP); 4 ♂♂, Khaophappa, Khaochang, Trang. Prov., 200-400 m, 11.I.1964 (BISHOP); 1 ♂, Nakou nayok, No. 1966 (RPRC); 2 ♂♂, Chiangmai, VIII-XII.1966 (RPRC); 1 ♂, Huntra, VII.1966 (RPRC); 3 ♂♂, 4 ♀♀, Pimai, VII.1964-V.1966 (RPRC). SINGAPORE: 1 ♂, Coll. Baker (USNM). VIETNAM: 1 ♂, Tonkin, reg. de Hoa-Binh, A. de Cooman, 1926 (PAR); 1 ♂, Bihn Thuy, Mekong Delta, 13.I.1972, H. J. Harlan (UKY). MALAYSIA: 1 ♂, Sungkei, 21.VI.1902, Siamese Malay States, B. M. 1903-127 (BMNH); 1 ♂, 1 ♀, Simpang Lima, P. Bunter, on *Paspalum* sp., emerged 8.VI.1930, adult 30.VII.1930, H. T. Pagden (BMNH). LAOS: 1 ♂, 3 ♀♀, Phon Tiou, Khammouane Prov., 11/13.VI.1966, J. A. Rondon Coll. (BISHOP); 3 ♀♀, Phon Tiou, Khammouane Prov., 10.VI.1965, N. Wilson (BISHOP).

***Glossocratus bakeri* Morrison, new species** Fig. 76-81, 99.

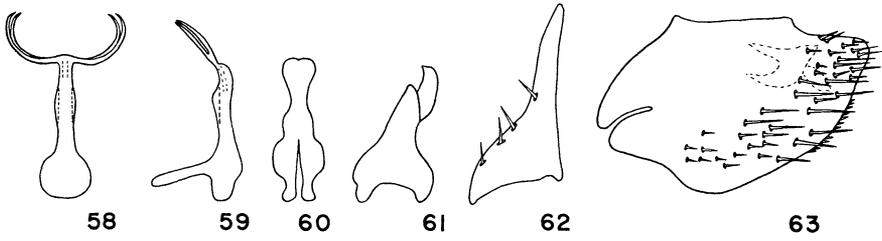
*Hecalus capitatus*: Merino 1936: 354 (Misidentified—not *H. capitatus* Distant).

*Length*: ♂ 8.2 mm, ♀ 9.9-10.2 mm to tip of wings, 10.2-10.5 mm to tip of ovipositor.

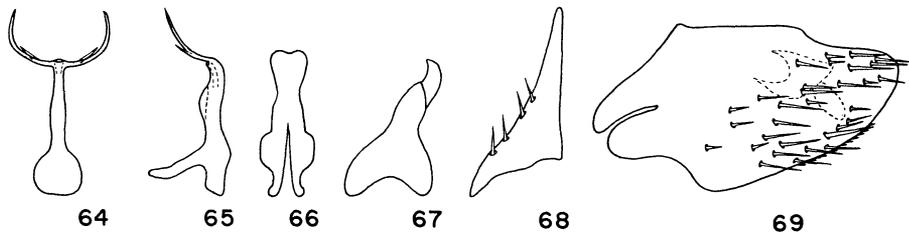
*Structure*: ♂ vertex slightly upturned apically. Vertex length: interocular width ratio of ♂♂ 3.5: 5.0; ♀♀ 8.0: 6.3. Pronotum about as long as ♂ vertex. Fine hairs on ♀ body ventrally.

*Coloration*: Light to dark brown. Vertex with two longitudinal light lines on each side of midline; usually medial dark spot on posterior margin. Scattered small granular black spots on body, usually more pronounced on ♀ and often forming a reticulated pattern on vertex dorsally. ♂ with row of 4 black spots forming semicircle across scutellum; may be faint or lacking in ♀. 6-8 oblique piceous lines on face, sometimes faint. ♂ with fuscous spot anterior to compound eye ventrally; faint or lacking in ♀. Meso- and metapleural areas with dark band. ♂ abdomen dorsally with 1 medial and 2 lateral longitudinal dark stripes. Body and forewings sparsely mottled with dark patches of varying intensity.

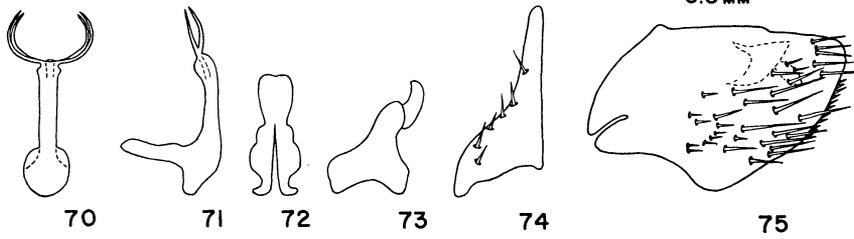
♂ *genitalia*: Valve broadly triangular. Plates dorso-ventrally flattened, tapering apically; lateral setae. Posterior 1/2 of pygofer heavily setose. Connective in shape of inverted Y. Style triangular with dorso-posterior thumb-like projection. Aedeagus with 2 pairs of terminal



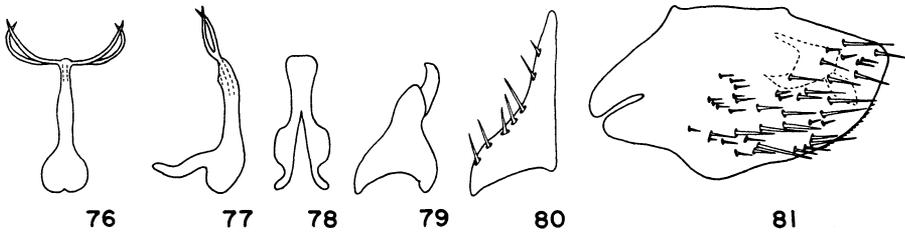
ORIENTALIS



PLATALEA



CHINENSIS



BAKERI

processes subequal in length; shaft tubular with 2 small, dorsal subapical flares; gonopore apical; dorsal apodeme finger-like.

♀ *genitalia*: Ovipositor not extending beyond pygofer. 7th sternum with medial projection rounded and slightly emarginated. Pygofer with many fine hairs.

*Types*: Holotype ♂: PHILIPPINES: Mt. Makling, Luzon, Baker, 20617 (USNM). Allotype ♀: Mt. Makling, Luzon, Baker (USNM), Paratypes: 1 ♀, Bacoar, P. I., P. L. Stangl; 1 ♀, Los Baños, P. I., Baker; 1 ♀, light, Victorias Occ. Negros, 10-7-27, HH 128, all in USNM; 1 ♀, Acc. No. 4669, Lot, Govt. Lab. Coll., C. S. Banks, 1908-228, in BMNH.

*Distribution*: Philippine Islands.

*Remarks*: This species is closely related to *G. orientalis* but may be separated from it by the subapical position and small size of the dorsal flare on the aedeagal shaft of the ♂. This is probably the species Merino (1936) referred to *Hecalus capitatus* in his discussion of Philippine Cicadellidae.

***Glossocratus chinensis* (Signoret), new combination**      Fig. 70-75, 91.

*Ectomops chinensis* Signoret 1880: 50. — Noualhier 1896: 259. — Noualhier & Martin 1904: 185. — Evans 1947: 140. — Metcalf 1963: 50.

*Length*: ♂ 8.5 mm.

*Structure*: Vertex of ♂ slightly upturned apically. Vertex length: interocular width ratio of ♂♂ 3.2: 4.5. Pronotum about as long as ♂ vertex.

*Coloration*: Reddish brown to light brown. Vertex with 2 longitudinal dark lines on each side of midline; dark spot medially on posterior margin. Small, scattered granular dark spots on body forming reticulated pattern on vertex dorsally. ♂ with row of 4 black spots forming semicircle across scutellum. 6-8 oblique dark lines on face. ♂ with fuscous spot anterior to compound eye ventrally. Meso- and metapleural areas with dark band. ♂ abdomen dorsally with 1 medial and 2 lateral longitudinal stripes. Body and forewings sparsely mottled with dark patches of varying intensity.

♂ *genitalia*: Valve broadly triangular. Plates dorso-ventrally flattened, tapering apically; lateral setae. Posterior 1/2 of pygofer heavily setose. Connective in shape of inverted Y. Style triangular with dorso-posterior thumb-like projection. Aedeagus with 2 pairs of terminal processes subequal in length; shaft tubular basally gradually expanding apically and dorso-ventrally flattened; stout; 2 subapical dorsal flares prominent in ventral view; gonopore apical; dorsal apodeme finger-like.

♀ *genitalia*: Unknown.

Fig. 58-81. 58-63, *Glossocratus orientalis* (Ishihara): 58, ventral view of aedeagus; 59, lateral view of aedeagus; 60, ventral view of connective; 61, ventral view of style; 62, ventral view of plate; 63, lateral view of pygofer. 64-69, *G. platalea* (Noualhier): 64, ventral view of aedeagus; 65, lateral view of aedeagus; 66, ventral view of connective; 67, ventral view of style; 68, ventral view of plate; 69, lateral view of pygofer. 70-75, *G. chinensis* (Signoret): 70, ventral view of aedeagus; 71, lateral view of aedeagus; 72, ventral view of connective; 73, ventral view of style; 74, ventral view of plate; 75, lateral view of pygofer. 76-81, *G. bakeri* n. sp.: 76, ventral view of aedeagus; 77, lateral view of aedeagus; 78, ventral view of connective; 79, ventral view of style; 80, ventral view of plate; 81, lateral view of pygofer.

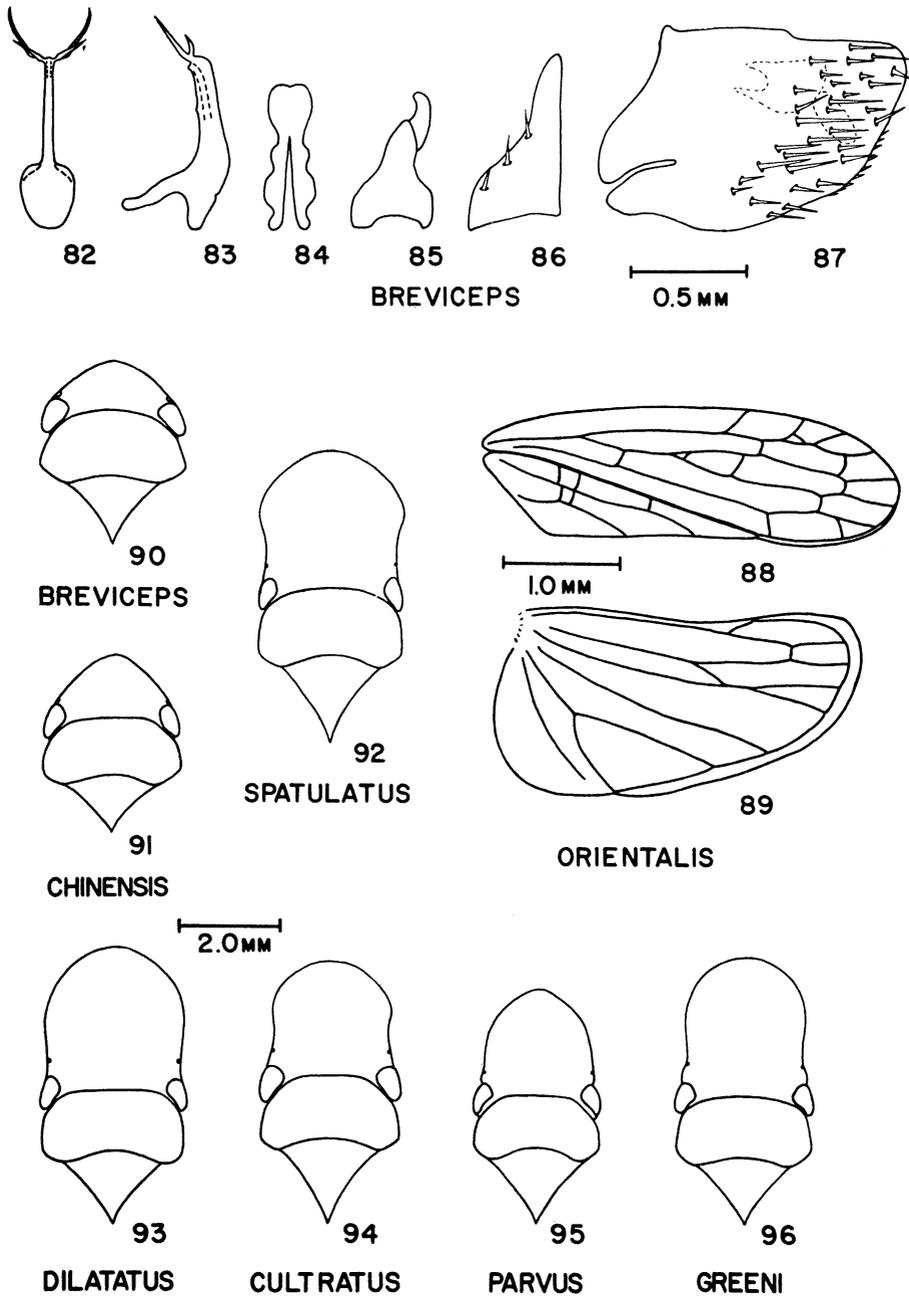


Fig. 82-96. 82-87, *Glossocratus breviceps* n. sp.: 82, ventral view of aedeagus; 83, lateral view of aedeagus; 84, ventral view of connective; 85, ventral view of style; 86, ventral view of plate; 87, lateral view of pygofer. 88, right forewing of *G. orientalis* ♀. 89, right hindwing of *G. orientalis* ♀. 90-96, dorsal view of head: 90, *G. breviceps* n. sp.; 91, *G. chinensis*; 92, *G. spatulatus* (Distant); 93, *G. dilatatus*; 94, *G. cultratus*; 95, *G. parvus*; 96, *G. greeni*.

*Distribution*: China

*Types*: Holotype ♂: labelled "China, coll. Signoret, *chinensis*. det. Signoret." Left pair of wings mounted separately with same data. Deposited in WEI.

*Remarks*: The abdomen is missing from the type and the ♂ genitalia of this species have not been previously described. The type, known only from "China", is very similar to 2 ♂♂ examined from Foochow, China, and the genitalia of the latter are described and considered to be *C. chinensis*. This species may be distinguished by its stout aedeagal shaft expanding subapically with two subapical dorsal flares prominent in ventral view.

*Other material examined*: 2 ♂♂, China, Foochow, 1935-36, M. S. Yang (BMNH).

**Glossocratus platalea** (Noualhier), new combination      Fig. 64-69, 98.

*Hecalus platalea* Noualhier 1896: 259. — Noualhier & Martin 1904: 184. — Metcalf 1963: 21.

*Ectomops rubescens* Noualhier 1896: 259. — Noualhier & Martin 1904: 185. — Metcalf 1963: 50.

**New synonym.**

*Length*: ♂ 8.0-8.6 mm, ♀ 10.2-11.2 mm to tip of wing, 10.7-12.5 mm to tip of abdomen.

*Structure*: ♂ vertex slightly upturned apically. Vertex length: interocular width ratio of ♂♂ 3.5: 5.0; ♀♀ 8.5: 7.0. Pronotum about as long as ♂ vertex. ♀ with fine hairs on body ventrally.

*Coloration*: Reddish brown to light brown. Vertex with 2 longitudinal dark lines on each side of midline; usually medial dark spot on posterior margin. Scattered small granular black spots on body, usually more pronounced on ♀ and forming a reticulated pattern on vertex dorsally. ♂ with row of 4 black spots forming semicircle across scutellum; may be faint or lacking in ♀. 6-8 oblique piceous lines on face, sometimes faint. ♂ with fuscous spot anterior to compound eye ventrally; faint or lacking in ♀. Meso- and metapleural areas with dark band. ♂ abdomen dorsally with 1 medial and 2 lateral longitudinal strips. Body and forewings sparsely mottled with dark patches of varying intensity.

♂ *genitalia*: Valve broadly triangular. Plates dorso-ventrally flattened, tapering apically; lateral setae. Pygofer heavily setose in posterior 1/2. Connective in shape of inverted Y. Style triangular with dorso-posterior thumb-like projection. Aedeagus with 2 pairs of terminal processes curving posteriorly, ventral pair about 2 × as long as dorsal pair; shaft tubular, 2 mid-dorsal triangular flares extending more than 1/2 the length of shaft; gonopore apical; dorsal apodeme finger-like.

♀ *genitalia*: Ovipositor not extending beyond pygofer. 7th sternum with medial projection, somewhat truncate. Pygofer with many fine hairs.

*Types*: 2 ♀♀ are in the type series in the Paris Museum. A lectotype is herein designated as ♀ with data "Type, Museum Paris, Siam, Chantaboun A Battambang, A. Pavie, 1886, 1839, 86, *Hecalus platalea* Type Nlh., Bull. Mus. H. Nat. Paris 1866". Paralectotype: 1 ♀, same data as lectotype except "*H. platalea* Type Nlh., B. M. H. N. P. 1896". All types in PAR.

*Distribution*: SE Asia.

*Remarks*: The 3 syntypic ♂♂ of *E. rubescens* Noualhier are part of Noualhier's original series of *G. platalea*. He apparently failed to recognize the sexual dimorphism of *Glossocratus* sp. and mistakenly described a new species, *E. rubescens*, on the ♂♂ in the series. *E. rubescens* is therefore considered a new synonym. This species closely re-

sembles *G. orientalis* externally but may be separated from it by the 2 pairs of terminal aedeagal processes being of unequal length. The ♀♀ of these 2 species are too close to separate. *G. platalea* has been collected with *G. orientalis* in light trap collections from Nakon nayok, Thailand.

*Other material examined*: 3 ♂♂ syntypes of *Ectomops rubescens* Noulhier, a lectotype of which is herein designated as the ♂ with abdomen in a capsule attached to pin and data "Type, Museum Paris, Siam, Chantaboun A Battambang, A. Pavie, 1886, 1839, 86, *E. rubescens*, Type Nlh., B. M. H. N. P. 1896" (PAR); THAILAND: 3 ♂♂, 3 ♀♀, Rungsit, VIII.1966-III.1967 (RPRC); 4 ♂♂, 2 ♀♀, Klonglaung, I.1965-III. 1967 (RPRC); 1 ♂, 1 ♀, Bangkok, 14.XII.1936 (TDA); 1 ♂, Bangkok, 8.II.1971 (RPRC); 1 ♂, Nakon nayok, XII. 1966 (RPRC); COCHINCHINE: 1 ♂, Julien, 1875 (PAR); 1 ♂, 1 ♀, Cambodge (PAR).

***Glossocratus breviceps* Morrison, new species**      Fig. 82-87, 90.

*Length*: ♂ 7.8 mm.

*Structure*: Vertex slightly upturned apically; 2 short, longitudinal furrows dorsally. ♂ vertex length: interocular width ratio 2.5: 4.5. Pronotum longer than ♂ vertex (3.0: 2.2).

*Coloration*: Light brown. Vertex with small black spot on mid-posterior margin. Pronotum and scutellum with scattered, small granular black spots. Scutellum with lateral piceous spot. Face with 6-8 oblique dark lines. Fuscous spot anterior to compound eye ventrally. Meso- and metapleural area with dark band. Abdomen dorsally with 1 medial and 2 lateral longitudinal dark stripes. Femora piceous distally. Body sparsely mottled with dark patches; veins dark brown.

♂ *genitalia*: Valve broadly triangular. Plates dorsoventrally flattened, tapering apically; some lateral setae. Posterior 1/2 of pygofer heavily setose. Connective in shape of inverted Y. Style triangular with dorsoposterior thumb-like projection. Aedeagus with 2 pairs of terminal processes; dorsal pair about 2 × as long as ventral pair; shaft laterally compressed; strongly keeled dorsally and ventrally; gonopore apical; dorsal apodeme finger-like.

♀ *genitalia*: Unknown

*Types*: Holotype ♂: INDIA: Ind. Mus., Kierpur, Purneah dist., Bihar, 9-12.X.1915, C. Paiva. Paratypes: 1 ♂, same data as holotype. Both in USNM.

*Distribution*: Known only from type material.

*Remarks*: This species differs from the other known ♂♂ of *Glossocratus* by having the vertex considerably shorter than the pronotum, the strong dorsal and ventral keel of the aedeagal shaft and the dorsal pair of aedeagal terminal processes being 2 × as long as the ventral pair. It is possible this is the ♂ of one of the several species occurring in northern India known only from single ♀ holotypes.

***Glossocratus capitatus* (Distant), new combination**      Fig. 103.

*Hecalus capitatus* Distant 1918: 30.—Metcalf 1963: 14.

*Length*: ♀ "incl. tegm. 10 1/2 millim."

*Structure*: Vertex broadly rounded anteriorly. Vertex length: interocular width ratio 6.5: 6.3.

*Coloration*: Tan brown. Vertex with longitudinal dark lines on each side of midline, ex-

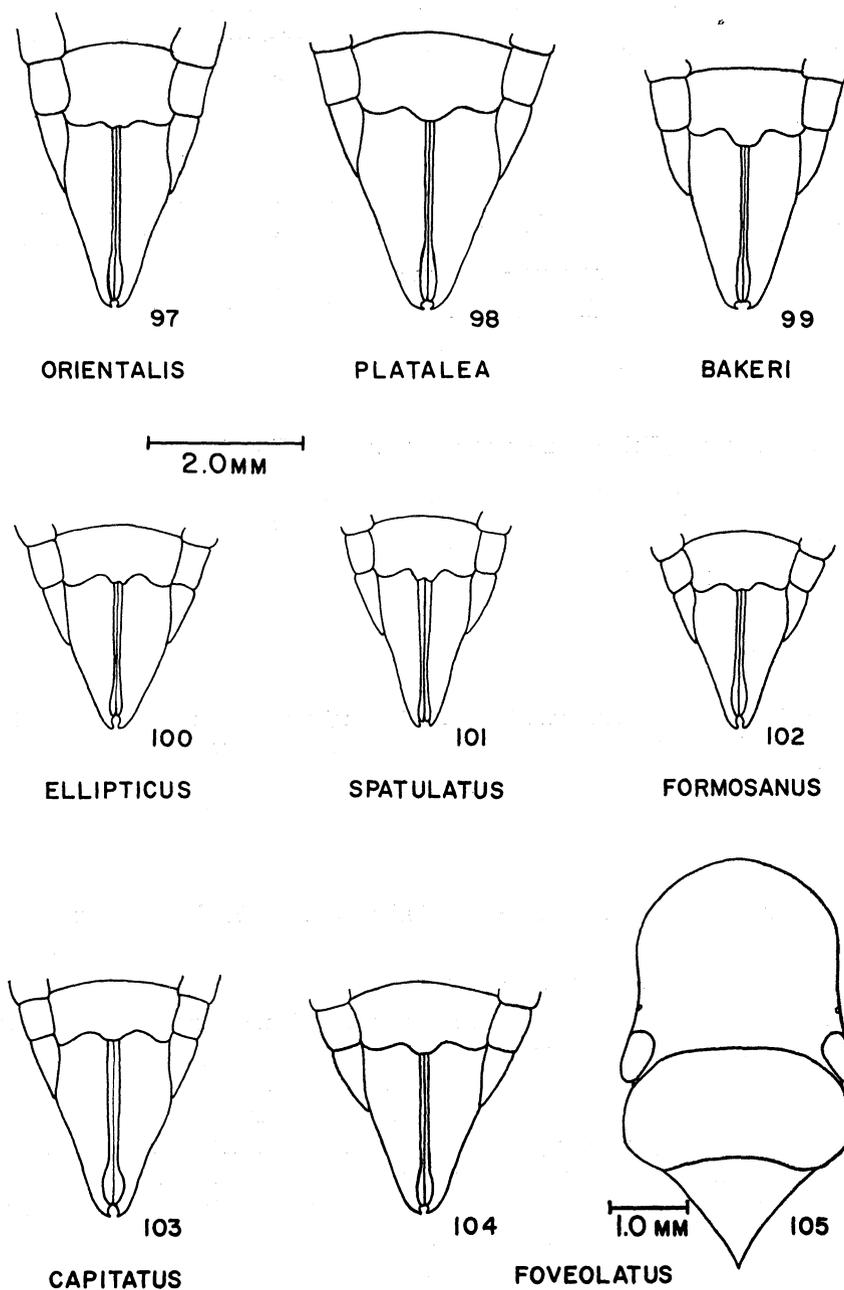


Fig. 97-105. 97-104, ventral view of ♀ genitalia: 97, *Glossocratus orientalis*; 98, *G. platalea*; 99, *G. bakeri*; 100, *G. ellipticus*; 101, *G. spatulatus*; 102, *G. formosanus*; 103, *G. capitatus*; 104, *G. foveolatus*. 105, dorsal view of head of ♀ *G. foveolatus*.

tending to anterior margin; 1 medial and 2 lateral fuscous spots on posterior margin. Scutellum with 2 rounded black spots on lateral margins. Scattered, small granular black spots on vertex and pronotum. Forewings with scattered brownish speckles.

♂ *genitalia*: Unknown.

♀ *genitalia*: Ovipositor not extending beyond pygofer. 7th sternum with broad, short medial projection.

*Types*: Holotype ♀: labelled "Type H. T., *Hecalus capitatus* Type Dist. (in Distant's handwriting), North Bengal, Distant's Coll., 1911-383" deposited in the BMNH.

*Distribution*: Known only from type specimen.

*Remarks*: The genitalia of this species have not been previously described. Merino (1936) recorded *G. capitatus* as occurring in the Philippines, but he was discussing *G. bakeri* n. sp. rather this species.

**Glossocratus cultratus** (Walker), new combination      Fig. 94.

*Ledra culobata* Walker 1851; 827. — Dohrn 1859: 93.

*Ledra cultrata* Walker 1852; 1159. Nom. nov. pro. *Ledra culobata* Walker.

*Selenocephalus cultratus*: Stål 1862; 494. — Atkinson 1885: 106.

*Ledrotypa cultrata*: Distant 1916: 223. — Metcalf 1963: 7.

*Length*: ♀ "excl. tegm. 10; exp. tegm. 16 millim."

*Structure*: Vertex length; interocular width ratio of ♀ 8.3: 7.0. 2 pronounced longitudinal grooves in apical 2/3 of vertex.

*Coloration*: Tan brown. Vertex with 2 longitudinal light lines on each side of midline; dark spot on mid-posterior margin. Scattered, small granular black dots on vertex and pronotum, forming reticulated pattern on vertex dorsally. 2 dark fuscous spots on lateral margins of scutellum. "The abdomen above is marked with five longitudinal piceous fasciae, one central and two on each lateral area."

♂ ♀ *genitalia*: Unknown.

*Types*: Holotype ♀: Labelled "Type, 39, *Ledra cultrata*, E. Ind., 43, *culturata*." Deposited in BMNH.

*Distribution*: Known only from type specimen.

*Remarks*: The type is in poor condition with the abdomen and hind wings missing. The genitalia have never been described. Walker originally described this species as *L. culobata* but subsequently changed it to *L. cultrata*. Distant (1916) suggests the first name was "probably a misprint." Quotations of the length and abdominal coloration are from Distant's (1916) redescription of the species. Walker's original recorded length of "exp. tegm. 16 millim." would make this the longest ♀ in the genus. However, the remains of the type do not appear abnormally large, and it is likely 16 mm is too long, although this statement is impossible to refute because of the missing abdomen.

**Glossocratus dilatatus** (Bierman), new combination      Fig. 93.

*Hecalus dilatatus* Bierman 1910: 65.— Metcalf 1963: 14.

*Length*: "Female 12 mm."

*Structure*: Vertex length: interocular width ratio of ♀ 8.7: 7.0. Vertex with 2 medial longitudinal grooves. Pronotum narrower than head; with 4 longitudinal grooves. Probably brachypterous.

*Coloration*: Brown. Vertex with light brown medial longitudinal line; lateral margins of lines darker. Scattered small granular black dots on vertex and pronotum, forming reticulated pattern on vertex dorsally. 2 small black spots on posterior margin of pronotum and scutellum. Meso- and metapleural areas with dark band. Forewings entirely brown, without dark mottling.

♂ ♀ *genitalia*: Unknown.

*Types*: Holotype ♀: labelled "*Hecalus dilatatus*, Type Bierman, Soernel, 4. 78., type" in LEI.

*Distribution*: Known only from type specimen (Soeroelangoen, Sumatra).

*Remarks*: The abdomen is missing from the type and the *genitalia* have never been described. The wings of the type are short and the ♀♀ of this species are probably brachypterous.

***Glossocratus ellipticus* (Jacobi), new combination Fig. 100.**

*Hecalus ellipticus* Jacobi 1944: 53. — Metcalf 1963: 15.

*Length*: ♀ 10.7 mm to tip of wing, 10.9 mm to tip of ovipositor.

*Structure*: Vertex length: interocular width ratio of ♀ 8.0: 6.55. Vertex with 2 longitudinal furrows on each side of midline; faint on pronotum. Dorsal depressions on vertex anterior to compound eye. Slightly brachypterous.

*Coloration*: Light brown. Vertex with 2 longitudinal dark lines on each side of midline; small medial fuscous spot on posterior margin. Scattered small granular piceous spots on body forming reticulated pattern on vertex dorsally. Scutellum with 2 fuscous spots on lateral margins. Forewings with small scattered dark markings along vein borders; fuscous spot at tip of clavus. Several oblique dark lines on face. Meso- and metapleural areas with dark band. Abdomen ventrally with dark brown lateral margins.

♂ *genitalia*: Unknown.

♀ *genitalia*: Ovipositor not extending beyond pygofer. 7th sternum with slightly emarginated medial projection. Pygofer with many fine hairs.

*Type*: Holotype ♀: labelled "Shaowu-Fukien, (500 m), J. Klapperich, 8-8-1937, Typus, Coll. Jacobi Ankauf, 1947, Staatl. Museum fur Tierkunde, Dresden, 145, *Hecalus ellipticus* Jacobi Holotypus, Mannheims det. 1965, Holotypus", deposited in BON.

*Distribution*: Known only from type specimen.

*Remarks*: The *genitalia* of this species have not been previously described. This species, known only from a ♀, might be a synonym of *G. chinensis*, known only from ♂♂. Both species are from the province of Fukien, China. However, the name is retained until additional material from this region is available for study.

***Glossocratus formosanus* (Matsumura), new combination Fig. 102.**

*Hecalus formosanus* Matsumura 1912: 283. — Schumacher 1915a: 98. — Easki & Ito 1954: 76. — Metcalf 1963: 15.

*Length*: ♀ 8.3 mm to tip of wing, 9.9 mm to tip of ovipositor.

*Structure*: Vertex length: interocular width ratio of ♀ 7.2: 6.0. Vertex and pronotum with 2 faint longitudinal furrows on each side of midline. Brachypterous.

*Coloration*: Light brown. Vertex with 2 longitudinal dark lines on each side of midline; medial fuscous line on posterior margin. Scattered small granular piceous spots on body forming reticulated pattern on vertex dorsally. Pronotum with 2 fuscous spots on latero-posterior margin. Forewings with small scattered dark marking along veins, fuscous spot at tip of clavus; veins with numerous white hairs. Body mottled ventrally. Meso- and metapleural area with dark band. Tip of ovipositor and pygofer black. Femora darkened distally.

♂ *genitalia*: Unknown.

♀ *genitalia*: Ovipositor not extending beyond pygofer. 7th sternum with slightly emarginated medial projection. Pygofer with many fine hairs.

*Type*: Holotype ♀: labelled "31-VII-1906, Shirin, *Hecalus* n. sp. det. Matsumura, Type Matsumura", deposited in HOKU.

*Distribution*: Known only from type specimen.

*Remarks*: The *genitalia* of this species have not been previously illustrated. This single ♀ is considerably brachypterous. Unfortunately, no additional specimens of *Glossocratus* from Formosa have been studied.

***Glossocratus greeni* (Distant), new combination** Fig. 96.

*Ledrotypa greeni* Distant 1912: 442; 1916: 224. — Metcalf 1963: 7.

*Length*: ♀ "incl. tegm. 11 mm."

*Structure*: Vertex length: interocular width ratio of ♀ 9.5: 7.5. 2 pronounced longitudinal grooves on each side of midventral line extending length of vertex and pronotum, with midventral rounded ridge and two lateral ridges.

*Coloration*: Body dark brown, forewings tan brown. Scattered small granular black spots on vertex and pronotum, forming reticulated pattern on vertex dorsally. Costal area with dark brown longitudinal streak in cells; several additional streaks in antepical cells varying in intensity between left and right forewings.

♂ ♀ *genitalia*: Unknown.

*Type*: Holotype ♀: labelled "Type, *Ledrotypa greeni* Type Dist. (in Distant's handwriting), Ceylon (Green), Distant's Coll. 1911-383." deposited in BMNH.

*Distribution*: Known only from type.

*Remarks*: The abdomen is missing from the type, and the *genitalia* have never been described. Distant states in his original description that the abdomen was "mutilated," so it was either partially or completely missing at that time. The wings of the type are short and the ♀♀ of this species are probably brachypterous.

***Glossocratus parvus* (Walker), new combination** Fig. 95.

*Ledra parva* Walker 1851: 828. — Dohrn 1859: 93. — Signoret 1879b: 270.

*Selenocephalus parvus*: Stål 1862: 494. — Melichar 1902: 124.

*Selenocephalus parva*: Signoret 1880: 63.

*Hecalus parva*: Signoret 1879b: 272. — Atkinson 1885: 103.

*Hecalus parvus*: Distant 1908a : 145. — Wu 1935 : 80. — Metcalf 1963 : 20.

*Length*: ♀ "body 4 1/2 lines (9.5 mm); of the wings 7 lines (14.7 mm)."

*Structure*: Vertex length: interocular width ratio of ♀ 8.2 : 7.0. Vertex foliaceous, somewhat pointed.

*Coloration*: Brown. Vertex with 2 longitudinal dark lines on each side of midline extending almost entire length; medial dark spot on posterior margin. Scattered small granular black beads on body forming reticulated pattern on vertex dorsally. Scutellum with 1 medial piceous spot on anterior margin; row of 4 dark spots forming transverse semicircle; 1 medial piceous spot on anterior margin. Wings light brown with dark spot at tip of clavus.

♂ ♀ *genitalia*: Unknown.

*Types*: Holotype ♀ : labelled "Type, 41, *Ledra parva*, Hong Kong", deposited in BMNH.

*Distribution*: Known only from type.

*Remarks*: The abdomen is missing and the genitalia have never been illustrated. The head of this species is somewhat pointed anteriorly; not broadly rounded as is typical of other *Glossocratus* ♀♀.

***Glossocratus spatulatus* (Distant), new combination** Fig. 92, 101.

*Ledrotypa spatulata* Distant 1912 : 442; 1916 : 223. — Evans 1947 : 141. — Metcalf 1963 : 8.

*Length*: ♀ "incl. tegm., 11 mm"

*Structure*: Vertex strongly spatulate. Vertex length: interocular width ratio 10.0 : 6.5. Pronotum with 4 longitudinal grooves. Brachypterous.

*Coloration*: Brown. Scattered small granular black beads on body forming reticulated pattern on vertex dorsally. Vertex with medial dark spot on posterior margin. Meso- and metapleural region with dark band. Forewings light brown, veins somewhat darker.

♂ *genitalia*: Unknown.

♀ *genitalia*: Ovipositor not extending beyond pygofer. 7th sternum with emarginate medial projection.

*Types*: Holotype ♀ : labelled "Type, *spatulata* Type Dist. (in Distant's handwriting), Himalaya, Sharp Coll. 1905-313," deposited in BMNH.

*Distribution*: Known only from type.

*Remarks*: The genitalia of this species have not been previously described. There should be additional syntypes in the BMNH and Indian Museum (Calcutta) from Bho-ganon, Purneah Distr., North Bengal. However, they are not present in the BMNH nor could any be found in the Indian Museum (K. S. Pradhan, Zoological Survey of India, personal communication).

***Glossocratus sulcatus* Fieber**

*Glossocratus sulcatus* Fieber 1866 : 513; Dallas 1867 : 574.

*Hecalus sulcatus*: Signoret 1879b : 272. — Atkinson 1885 : 103. — Distant 1908b : 274. — Bierman 1910 : 66. — Metcalf 1963 : 22.

*Length*: ♀ "5 lines" (10.5 mm).

*Structure*: "Sordid yellow; vertex parallel, parabolic in front, angles very obtusely rounded; pronotum with 4 elongated cavities in front, finely transversely striated behind; tegmina transparent, as long as the abdomen, veins strong, yellowish, not margined, a blackish dot at the point of the clavus; abdomen above with 2 bands of small brown patches, 2 at the base of each segment; legs entirely sordid yellow, unicolorous; ventral segments parallel, medial lobe obtusely salient, sides sinuated" (translation of Distant, 1908b).

♂ ♀ *genitalia*: Unknown.

*Types*: Holotype ♀: from East India, repository unknown.

*Distribution*: Known only from type.

*Remarks*: Very little is known about this species. Correspondence with major European museums, including those containing Fieber's collections, has failed to locate the holotype. It is possible that one of Distant's species from East India is a synonym of *G. sulcatus*.

### Genus *Hecalus* Stål

*Hecalus* Stål 1864: 65. Type-species *H. paykulli* Stål, by subsequent designation of Distant 1908b: 273.

*Parabolocratas* Fieber 1866: 502. Type-species *P. glaucescens* Fieber, by monotypy.

*Thomsoniella* Signoret 1880: 52. Type-species *T. kirschbaumi* (Stål), by monotypy.

*Columbanus* Distant 1916: 222. Type-species *C. misranus* Distant, by monotypy.

*Linnavuoriella* Evans 1966: 134. Type-species *L. arcuatus* (Motschulsky), by original designation. New synonym.

*Length*: ♂ 3.6-7.1 mm; ♀ 4.5-9.4 mm.

*Description*: Vertex subangularly acute to foliaceous; anterior margin usually with a dorsal ridge; broadly triangular to rounded in dorsal view. Ocelli on margin next to compound eye. Margin of eye below gena strongly sinuate. Transclypeal suture complete. Lateral clypeal suture extending through antennal pit to vertex margin anterior to ocelli. Pronotum as wide or wider than head; laterally carinate; concave posteriorly. ♀♀ brachypterous or macropterous. Wings sometimes with claval crossveins. Hind femoral setal formula 2-2-1. Brown to green in color.

♂ valve present. Plates finger-like, dorso-ventrally flattened; lateral setae. Posterior half of pygofer heavily setose. Connective in shape of inverted Y. Style triangular with dorso-posterior thumb-like projection. Aedeagus with terminal processes; gonopore apical or subapical; dorsal apodeme present.

♀ ovipositor extending beyond pygofer at least 1× its width. 7th sternum with or without medial projection and notches.

*Distribution*: Reported from all zoogeographical regions except the Neotropical.

*Remarks*: 2 species were ascribed to *Hecalus* in Stål's original description of the genus; *H. paykulli* Stål from Senegal and *H. pallescens* Stål from Australia. Distant (1908b) designated *H. paykulli* as the type of the genus. The type ♀ is deposited in the Naturhistoriska Riksmuseet, Stockholm.

In 1866 Fieber described the genus *Parabolocratas* on a ♀ specimen from Malaga. The type, *P. glaucescens* Fieber, was found in the Muséum d'Histoire Naturelle, Geneva, Switzerland.

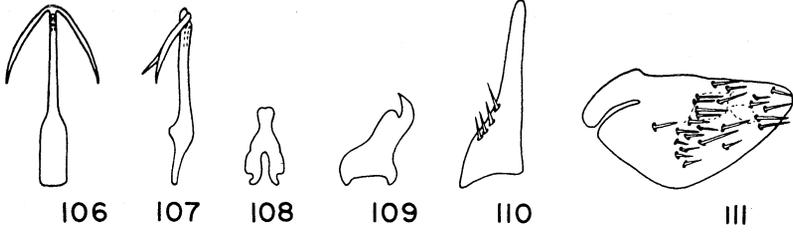
Four years after Fieber described *Parabolocratius*, Stål (1870) stated that this genus was a synonym of his *Hecalus*. After examination of the type-species of both genera I am of the opinion that Stål was correct. However, Stål was ignored and this is the last mention of the synonymy until 1961 when Linnavuori found that "the generotype of the genus *Hecalus* (*H. paykulli* Stål) is congeneric with species of the genus *Parabolocratius* Fieber."

After Linnavuori established the synonymy of *Parabolocratius* with *Hecalus*, Evans (1966) described the genus *Linnavuoriella* to accommodate those species previously ascribed to *Parabolocratius* which did not have a spatulate head. However, I am of the opinion that *Linnavuoriella* should be considered a synonym of *Hecalus* because (1) *Hecalus* specimens at hand have heads which range from angulate to spatulate with intermediate forms not clearly one or the other, and (2) in all other features, including genitalia, the species are very similar. There is no geographical separation as both types have been collected together in Thailand.

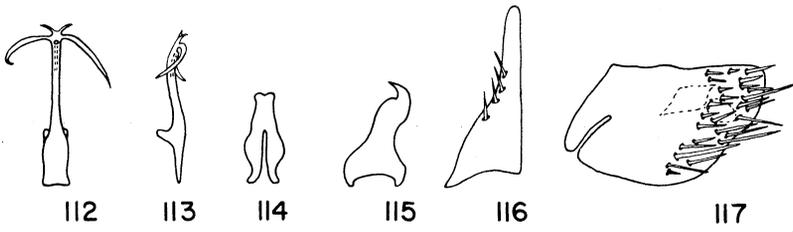
Signoret described the genus *Thomsoniella* in 1880 (originally called *Thomsonia* by Signoret in 1879, he changed it because the name was not sufficiently different from the existing crustacean genus *Thompsonia*). He placed a single species, *kirschbaumi* (Stål), 1870, in the genus because it has "6 discoidal cells instead of 5 or 4." He did not recognize that this character is variable in the Hecalini. Metcalf ascribed 5 species to this genus in his catalogue of the Euscelinae (1967) and considered *kirschbaumi* a synonym of *porrectus* (Walker), 1858. Of these 5 species the types of *porrecta* and *concentralis* (Matsumura) have been examined and illustrations of the types of *arcuatus* (Motsch.) and *lineolatus* (Motsch.) have been provided by Dr J. Vilbaste. From examination of the holotypes of *Thomsoniella* spp. it is apparent that this genus is a synonym of *Hecalus*. The fragmentary remains of the fifth species, *rubrolineolata* (Motsch.), have also been examined by Dr Vilbaste, and he is of the opinion that this species is not a hecaline, but rather the eusceline *Stymphalus rubrolineolatus* (Stål) (personal communication).

#### KEY TO THE ♂♂ OF ORIENTAL HECALUS

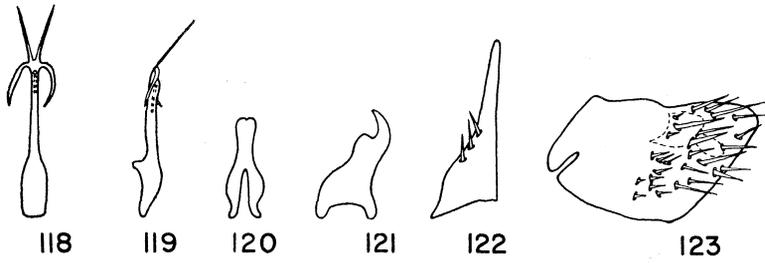
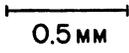
1. Thorax and face brown to piceous.....2  
 Thorax and face green to yellow-green ..... 3
- 2 (1). Aedeagal shaft with mid-dorsal lateral flares; gonopore small (Fig. 142); India ...  
 .....*lutescens* (Distant)  
 Aedeagal shaft straight, without flares; gonopore large (Fig. 160); Laos.....  
 .....*fuscovittatus* n. sp.
- 3 (1). Concentric parabolic orange fasciae on head and pronotum (Fig. 184). Australia &  
 Oriental region on *Heteropogon* & *Themeda* ..... *arcuatus* (Motschulsky)  
 Without concentric parabolic orange fasciae on head and pronotum ..... 4
- 4 (3). One pair of aedeagal processes, not branched or forked..... 5  
 Two pair of aedeagal processes or one pair branched or forked.....8
- 5 (4). Longitudinal orange lines on head, pronotum and scutellum (Fig. 1); forewings  
 brown in apical 1/3 with white spots in apical and anteapical cells. Indo-Australian  
 Region on *Panicum* ..... *porrectus* (Walker)
5. Without longitudinal orange lines; head, pronotum, scutellum and forewings en-  
 tirely green to yellow-green ..... 6
- 6 (5). Subapical spine on each aedeagal process, process curving anteriorly; gonopore  
 subapical by length of process (Fig. 166). Thailand ..... *thailandensis* n. sp.



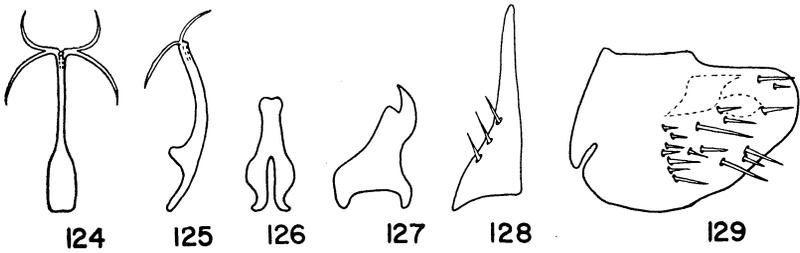
**PORRECTUS**



**GRESSITTI**



**APICALIS**



**BICORNUS**

- Aedeagal processes without spines, processes curving posteriorly; gonopore near apex ..... 7
- 7 (6). Aedeagal shaft constricted medially, expanding distally into a dorsal diamond-shaped flare (Fig. 148); 4.5-5.3 mm. Philippines, Java, India, Taiwan, Laos, Thailand, on *Chrysopogon aciculatus* ..... **wallengreni** Stål
- Aedeagal shaft straight throughout, laterally compressed, (Fig. 154); 5.7-6.7 mm. Java, Thailand, Philippines, Laos, on *Imperata cylindrica* ..... **prasinus** (Matsumura)
- 8 (4). Aedeagal shaft strongly grooved ventrally (Fig. 136): without orange lines on head. China ..... **furcatus** n. sp.
- Aedeagal shaft tubular throughout, without ventral groove orange lines present on head ..... 9
- 9 (8). Apical pair of aedeagal processes only about 1/5 length of other pair (Fig. 112). W. Carolines, Amboina, Singapore, Laos, Malaysia, Philippines on *Setaria palmifolia* & *Imperata cylindrica* ..... **gressitti** (Linnavuori)
- Both pair of aedeagal processes about equal in length ..... 10
- 10 (9). Apical pair of aedeagal processes slender, needle-like (Fig. 118). Taiwan, India, Lappa Is., Ceylon ..... **apicalis** (Matsumura)
- Both pair of aedeagal processes of about same diameter, not needle-like ..... 11
- 11 (10). Pronotum with 7 longitudinal orange lines (Fig. 178); apical pair of aedeagal processes not separated by more than width of shaft (Fig. 130). Laos ..... **multilineatus** n. sp.
- Pronotum with 4 longitudinal orange lines; apical pair of aedeagal processes separated by at least 6 × width of shaft (Fig. 124). Amboina, Philippines ..... **bicornus** n. sp.

**Hecalus wallengreni** Stål      Fig. 148-153, 179-181, 203.

*Hecalus wallengrenii* Stål 1870: 736. — Merino 1936: 354.

*Parabolocratius wallengrenii*: Signoret 1879b: 280; 1880: 53. — Metcalf 1963: 48.

*Thomsoniella wallengrenii*: Atkinson 1885: 105.

*Parabolocratius wallengreni*: Lethierry 1892: 209. — Osborn 1934: 174.

*Hecalus florii* Stål 1870: 737. — Signoret 1879b: 270 (58). — Merino 1936: 394. **New synonym.**

*Parabolocratius florii*: Signoret 1879b: 270 (58). — Metcalf 1963: 35.

*Parabolocratius minutus* Bierman 1910: 63. — Metcalf 1963: 40. **New synonym.**

*Parabolocratius taiwanus* Matsumura 1912: 286. — Schumacher 1915a: 98; 1915b: 123. — Esaki & Ito 1954: 79. — Metcalf 1963: 43. **New synonym.**

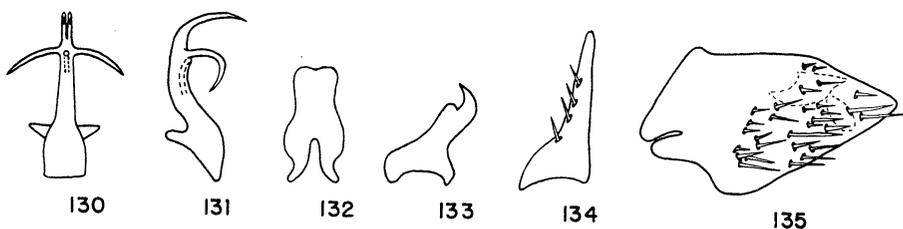
*Parabolocratius mandlensis* Singh-Pruthi 1930: 20. — Metcalf 1963: 40. **New synonym.**

*Hecalus gramineus* Merino 1936: 353. — Metcalf 1963: 16. **New synonym.**

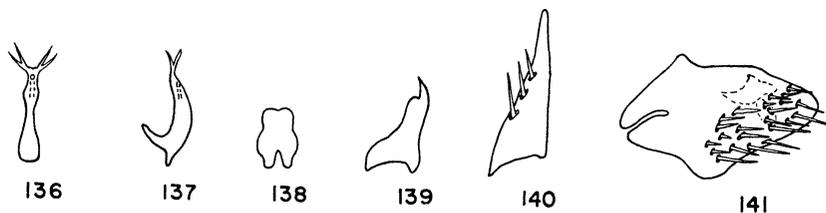
*Length*: ♂♂ 4.5-5.3 mm, ♀♀ 5.1-6.4 mm to tip of wings, 5.3-6.9 mm to tip of ovipositor.

*Structure*: vertex subangularly produced; broadly triangular in ♂♂, somewhat more rounded

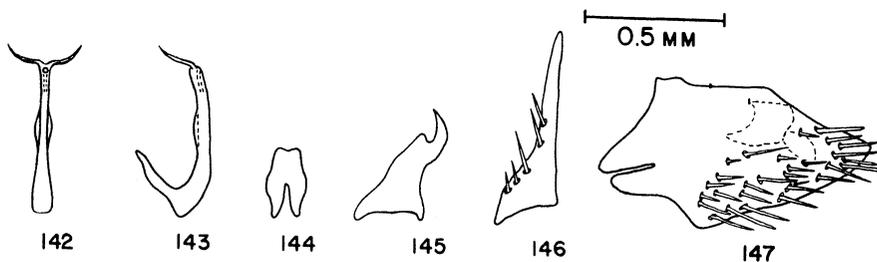
Fig. 106-129. 106-111, *Hecalus porrectus* (Walker): 106, ventral view of aedeagus; 107, lateral view of aedeagus; 108, ventral view of connective; 109, ventral view of style; 110, ventral view of plate; 111, lateral view of pygofer. 112-117, *H. gressitti* (Linnavuori): 112, ventral view of aedeagus; 113, lateral view of aedeagus; 114, ventral view of connective; 115, ventral view of style; 116, ventral view of plate; 117, lateral view of pygofer. 118-123, *H. apicalis* (Matsumura): 118, ventral view of aedeagus; 119, lateral view of aedeagus; 120, ventral view of connective; 121, ventral view of style; 122, ventral view of plate; 123, lateral view of pygofer. 124-129, *H. bicornus* n. sp: 124, ventral view of aedeagus; 125, lateral view of aedeagus; 126, ventral view of connective; 127, ventral view of style; 128, ventral view of plate; 129, lateral view of pygofer.



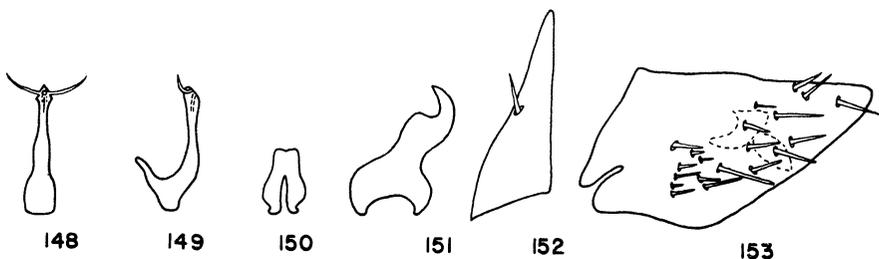
## MULTILINEATUS



## FURCATUS



## LUTESCENS



## WALLENGRENI

Fig. 130-153. 130-135, *Hecalus multilineatus* n. sp.: 130, ventral view of aedeagus; 131, lateral view of aedeagus; 132, ventral view of connective; 133, ventral view of style; 134, ventral view of plate; 135, lateral view of pygofer. 136-141, *H. furcatus* n. sp.: 136, ventral view of aedeagus; 137, lateral view of aedeagus; 138, ventral view of connective; 139, ventral view of style; 140, ventral view of plate; 141, lateral view of pygofer. 142-147, *H. lutescens* (Distant): 142, ventral view of aedeagus; 143, lateral view of aedeagus; 144, ventral view of connective; 145, ventral view of style; 146, ventral view of plate; 147, lateral view of pygofer. 148-153, *H. wallengreni* Stål: 148, ventral view of aedeagus; 149, lateral view of aedeagus; 150, ventral view of connective; 151, ventral view of style; 152, ventral view of plate; 153, lateral view of pygofer.

in ♀♀. Vertex length : interocular width ratio of ♂♂ 3.5 : 5.2; ♀♀ 4.5 : 6.2. Vertex length : pronotal length ratio of ♂♂ 3.5 : 4.0; ♀♀ 4.5 : 4.5. Pronotum as wide as head; laterally carinate.

*Coloration* : Yellow-green to green. Vertex margin anteriorly with transverse submarginal ventral fuscous line. Eyes often red with 2 medial longitudinal whitish lines. Forewings light green to subhyaline; black spot at end of clavus. Hindwings hyaline.

♂ *genitalia* : Valve broadly triangular. Plates dorso-ventrally flattened, tapering apically; lateral setae. Pygofer heavily setose in posterior 1/2, subacutely pointed apically. Connective in shape of inverted Y. Style triangular with dorso-posterior thumb-like projection. Aedeagus with 1 pair of terminal processes, curving posteriorly; aedeagal shaft constricted medially, apical dorsal diamond-shaped flare, keeled subapically ventrally; gonopore subapical; dorsal apodeme finger-like.

♀ *genitalia* : Ovipositor extending beyond pygofer about 2 × its width. 7th sternum with rounded medial projection, sometimes slightly truncate.

*Type* : Holotype ♀ : labelled "*Hecalus wallengrenii* Stål, Ins., Philipp., Semper., Typus," deposited in STK.

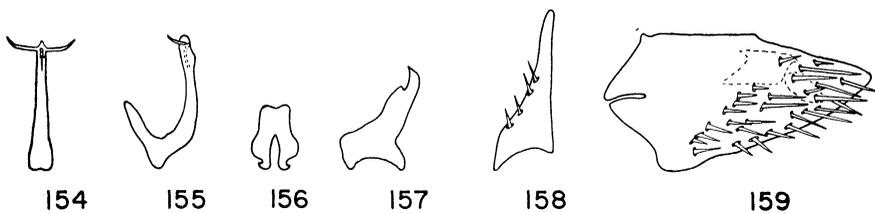
*Distribution* : Widely distributed in the Oriental region.

*Remarks* : This species is one of the most common Hecalinae in the Oriental region. It is similar to *H. prasinus* but may be distinguished by being smaller in size and having the ♂ aedeagal shaft expanding distally into a dorsal, diamond-shaped flare.

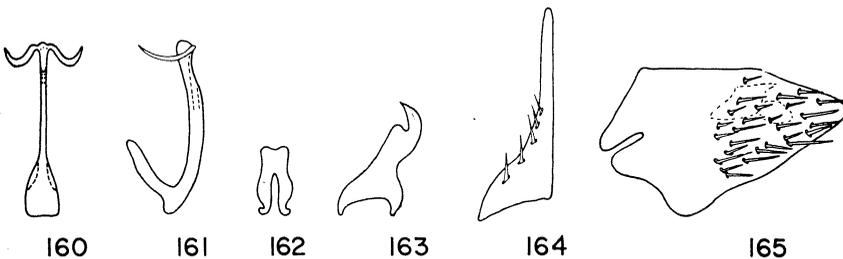
The holotype, a ♀, has the abdomen missing. In addition, the types of the following species have been examined: *H. florii* Stål, a ♀ labelled "*Hecalus florii* Stål, Ins. Philipp., Semper., Typus," deposited in STK; *P. minutus* Bierman, a ♂ labelled "*Parabolocratus minutus*, Type, Bierman, Coll. Dr. D. MacGillavry, E. Jacobson, Semarang, Java, Type," deposited in AMS; *P. mandlensis*, a ♂ and ♀ labelled "*Parabolocratus mandlensis*, Norbudda Survey, Dindori, Mandla dist., Central Provinces, 9.VI.1927, H. S. Pruthi, Holotype, 1167/H7 (♂) and 1168/H7 (♀)," deposited in ZSI; *P. taiwanus*, 2 ♀♀ mounted together labelled "*P. taiwanus* n. sp. det. Matsumura, Formosa, Matsumura," deposited in HOKU. Males in the syntypic series of *P. taiwanus*, labelled "Formosa, Matsumura," have also been examined.

The type of *H. gramineus* Merino is probably no longer in existence because Dr. Merino's property was destroyed during world war II (Dr C. R. Baltazar, National Institute of Science and Technology, Manila, P. I., per. comm.). Based on the original description of apparently a single ♀, this species is considered a synonym of *H. wallengreni*.

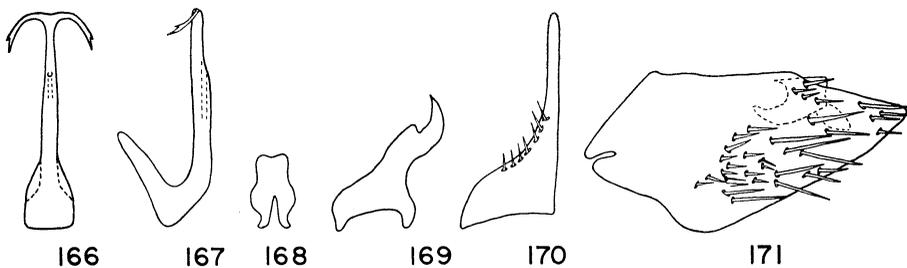
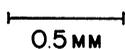
*Other material examined* : LAOS : 4 ♂♂, 3 ♀♀, Vientiane, 8-28.V.1965, P. D. Ashlock (BISHOP). PHILLIPINES : 1 ♂, Cuernos Mts., Negros, Baker (USNM); 1 ♂, Malinao, Tyabas, Baker (USNM); 2 ♂♂, 1 ♀, Dapitan, Mindanao, Baker (USNM); 1 ♂, Baguio, Benguet, Baker (USNM); 1 ♂, Mt. Limay, Luzon, Baker (USNM); 7 ♂♂, 2 ♀♀, Los Banos, P. I., Baker (USNM); 2 ♂♂, Mt. Banahao, P. I., Baker (USNM); 6 ♂♂, 2 ♀♀, Mt. Makling, Luzon, Baker (USNM); 2 ♂♂, 2 ♀♀, Luzon, Isabela Prov., San Mariano, IV-20.V.1915, 1961, P. I. Nat'l. Mus. & Am. Mus. Nat. Hist. Expedition (AMNH). THAILAND : 7 ♂♂, 3 ♀♀, Manchakiri, VIII.27.1971, W. P. Morrison, on *Chrysopogon aciculatus* (UKY); numerous specimens from Thailand (UKY, KASU, RPRC). MALAYA : 3 ♂♂, 1 ♀, Island of Penang, Baker (USNM).



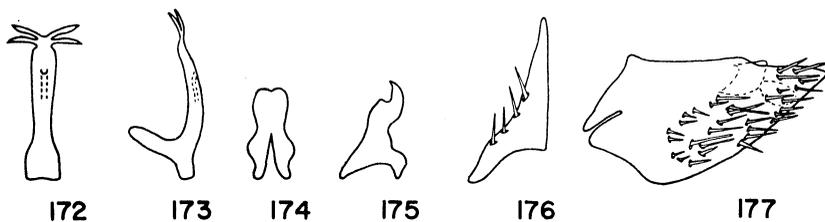
PRASINUS



FUSCOVITTATUS



THAILANDENSIS



ARCUATUS

**Hecalus prasinus** (Matsumura), new combination      Fig. 154-159, 186, 187, 204.

*Parabolocrates prasinus* Matsumura 1905; 48; 1930: 29. — Tanaka 1932: 577.

*Parabolocratus prasinus*: Matsumura 1912: 285; 1931: 1260; 1932: 69.—Esaki & Hashimoto 1931: 40; 1932: 38. — Esaki 1932a: 4; 1932b: 1751; 1950: 290. — Kato 1933: pl. 28, fig. 1. — Watanabe 1937: 113, 248. — Esaki, Hori & Yasumatsu 1938: 74. — Higashi 1939: 30.—Ishihara 1953: 35; 1961: 237. — Esaki & Ito 1954; 78. — Metcalf 1963; 42.

*Parabolocratus prasinus*: Ma 1933: 628.

*Parabolocratus dubiatus* Bierman 1910: 64. — Metcalf 1963: 32. **New synonym.**

*Length*: ♂♂ 5.7-6.7 mm, ♀♀ 7.5-8.5 mm to tip of wing, 7.7-9.4 mm to tip of ovipositor.

*Structure*: Vertex of ♂♂ broadly triangular in dorsal view, ♀♀ rounded. Vertex length; interocular width ratio of ♂♂ 2.5; 3.5; ♀♀ 4.5; 5.0. Vertex length: pronotal width of ♂♂ 2.5; 2.5; ♀♀ 4.5; 3.3. Pronotum as wide as head, laterally carinate.

*Coloration*: Yellow-green. Vertex margin usually with transverse submarginal ventral fuscous line. Forewings light green, veins darker; black spot at tip of clavus. Hindwings hyaline.

♂ *genitalia*: Valve broadly triangular. Plates dorso-ventrally flattened, tapering apically; lateral setae. Pygofer heavily setose in posterior 1/2, subacutely pointed apically. Connective in shape of inverted Y. Style triangular with dorso-posterior thumb-like projection. Aedeagus with 1 pair of terminal processes, curving posteriorly; shaft laterally compressed, keeled ventrally; gonopore subapical; dorsal apodeme finger-like.

♀ *genitalia*: Ovipositor extending beyond pygofer 2 × its width. 7th sternum with broadly rounded medial projection.

*Type*: A lectotype is herein designated is a ♀ labelled "*prasinus*, Type Matsumura, 7/19," deposited in HOKU.

*Distribution*: Widely distributed in the Oriental region.

*Remarks*: This species closely resembles *H. wallengreni* but may be distinguished by (1) being larger and (2) the aedeagal shaft is straight, without a dorsal subapical diamond-shaped flare.

The holotype of *P. dubiatus* Bierman has been examined. This is a ♂ labelled "*Parabolocratus dubiatus*, Type Bierman, coll. Dr D. MacGillavry, E. Jacobson, Semarang, Java, Type," deposited in AMS.

*Other material examined*: THAILAND: 5 ♂♂, 3 ♀♀, Cholburi Prov., Sriracha Dist., 22. X.1966, sweeping vegetation, J. S. Burton (BISHOP); 1 ♀, Chiangmai, Ban-tin-doi, 350 m, 13.XI.1957, J. L. Gressitt (BISHOP); 1 ♀, Rayong, 24.IV.1963, (KASU); 1 ♀, Phu Kae, 5.III.1963, (KASU); 1 ♂, 1 ♀, Bangkok, I.1971, (RPRC); 1 ♀, Klonglaung, VII. 1966, (RPRC); 1 ♀, Chainat, III.1966, (RPRC); 1 ♀, Chainat, 12.I.1965 (RPRC); 1 ♀,

Fig. 154-177. 154-159, *Hecalus prasinus* (Matsumura): 154, ventral view of aedeagus; 155, lateral view of aedeagus; 156, ventral view of connective; 157, ventral view of style; 158, ventral view of plate; 159, lateral view of pygofer. 160-165, *H. fuscovittatus* n. sp.: 160, ventral view of aedeagus; 161, lateral view of aedeagus; 162, ventral view of connective; 163, ventral view of style; 164, ventral view of plate; 165, lateral view of pygofer. 166-171, *H. thailandensis*, n. sp.: 166, ventral view of aedeagus; 167, lateral view of aedeagus; 168, ventral view of connective; 169, ventral view of style; 170, ventral view of plate; 171, lateral view of pygofer. 172-177, *H. arcuatus* (Motschulsky): 172, ventral view of aedeagus; 173, lateral view of aedeagus; 174, ventral view of connective; 175, ventral view of style; 176, ventral view of plate; 177, lateral view of pygofer.

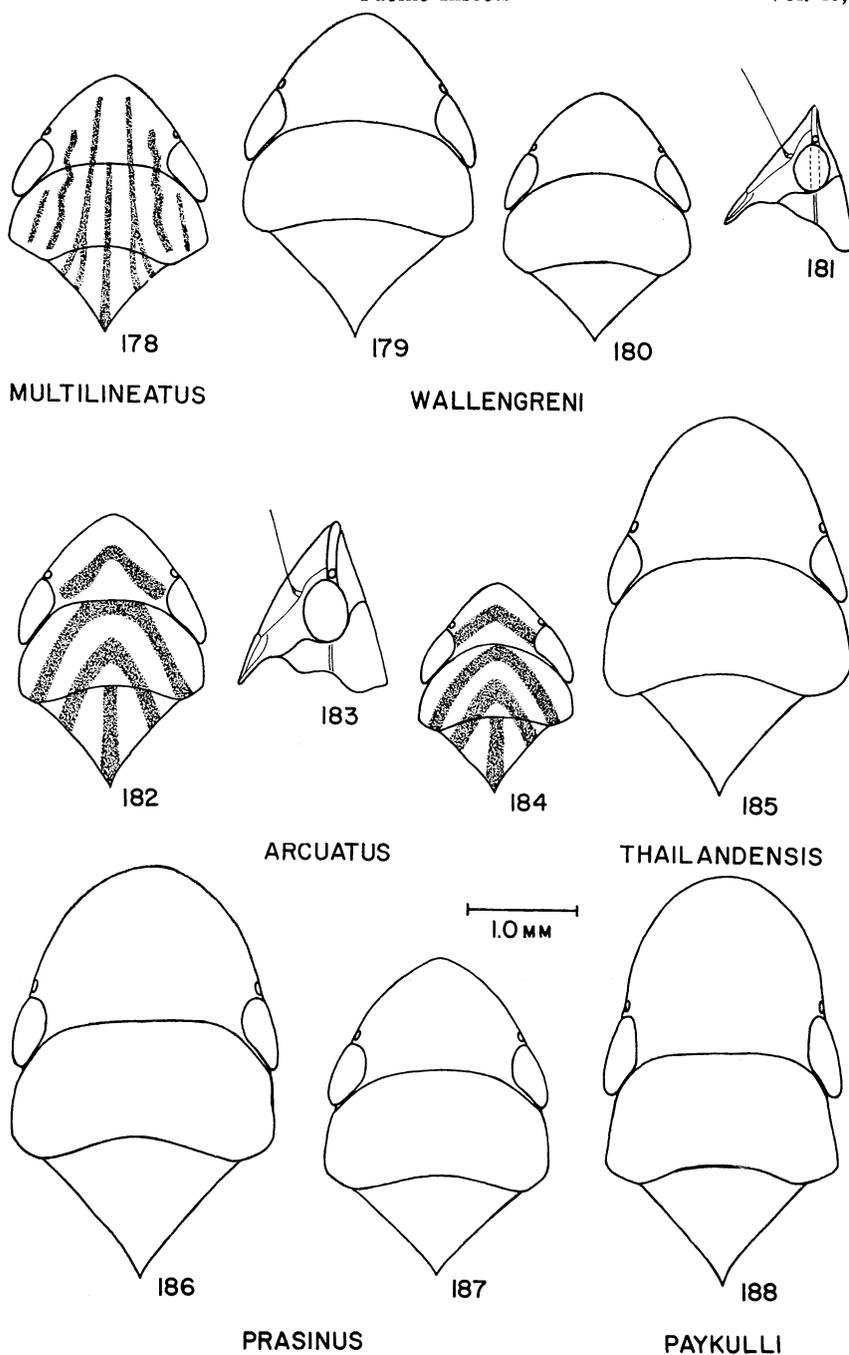


Fig. 178-188. Heads of *Hecalus* spp.: 178, dorsal view of *H. multilineatus* ♂; 179, dorsal view of *H. wallengreni* ♀; 180, dorsal view of *H. wallengreni* ♂; 181, lateral view of *H. wallengreni* ♂; 182, dorsal view of *H. arcuatus* ♀; 183, lateral view of *H. arcuatus* ♀; 184, dorsal view of *H. arcuatus* ♂; 185, dorsal view of *H. thailandensis* ♂; 186, dorsal view of *H. prasinus* ♀; 187, dorsal view of *H. prasinus* ♂; 188, dorsal view of *H. paykulli*.

Koksumrung, 15.VI.1965 (RPRC); 12 ♂♂, 7 ♀♀, 8 nymphs, Ubon, 7.IX.1971, W. P. Morrison, on *Imperata cylindrica* (UKY); 6 ♂♂, 4 ♀♀, 4 nymphs, Kalasin, VIII-11/25 and X-28, 1971, W. P. Morrison, on *Imperata cylindrica*, (UKY); 2 ♂♂, 3 ♀♀, Tha Phra, Khon Kaen, 1968-1971, Fred W. Knapp, (UKY). PHILIPPINES: 1 ♀, Luzon, Isabela Prov., San Mariano, 15-20.V.1961, P. I. Natl. Mus. & Am. Mus. Nat. Hist. Expedition (AMNH); 1 ♂, Tangcolan, Bukidnon, Baker (USNM); Baguio, Benguet, Baker (USNM): 1 ♀, 3 ♂♂, Mt. Makling, Luzon, Baker (USNM); 1 ♂; Malinao, Tayabas, Baker (USNM): JAVA: 1 ♀, Pekalongan, F. Muir (USNM); 1 ♂, Amboina, F. Muir (USNM); LAOS: 2 ♂♂, 1 ♀ Vientiane, 8.V.1965, P. D. Ashlock (BISHOP); 2 ♀♀, 100 m, Pakkad- ing, Borikhane Prov., 22.IV.1965, J. A. Rondon Collection (BISHOP).

***Hecalus thailandensis* Morrison, new species**      Fig. 166-171, 185.

*Length*: ♂♂ 7.0-7.1 mm.

*Structure*: Vertex subangularly produced; slightly upturned apically. Vertex length: interocular width ratio of ♂♂ 5.7: 8.0. Vertex length: pronotal length ratio of ♂♂ 5.7: 6.0. Ocelli on vertex margin distant from compound eye by its own diameter. Pronotum slightly wider than head; laterally carinate.

*Coloration*: Yellow-green. Vertex margin anteriorly with transverse submarginal ventral fuscous line. Forewings yellow-green, veins slightly darker; black spot at end of clavus. Hindwings hyaline.

*♂ genitalia*: Valve broadly triangular. Plates dorso-ventrally flattened, tapering apically; lateral setae. Pygofer heavily setose in posterior half; pointed apically. Connective in shape of inverted Y. Style triangular with sharp dorso-posterior thumb-like projection. Aedeagus with 1 pair of terminal processes, curving posteriorly, flattened, with small subapical dorsal spine; shaft laterally compressed, dorsally keeled, pronounced ventral groove; gonopore subapical by length of process; dorsal apodeme finger-like.

*Types*: Holotype ♂ (BISHOP 10097): THAILAND (N.): Pangmakampon (Pankampawng) nr. Fang, 450 m, 15.XI.1957, J. L. Gressitt. Paratype ♂: same data as holotype except 15-16.XI.1957. All types deposited in BISHOP.

*Distribution*: Only known from type material.

*Remarks*: The ♂♂ of this species are the largest among the known Oriental *Hecalus* spp. This species resembles *H. prasinus* but may be distinguished from it by (1) being larger in size, (2) having a small subapical spine on each aedeagal process, and (3) the gonopore being subapical by the length of the aedeagal processes.

***Hecalus lutescens* (Distant), new combination**      Fig. 142-147.

*Parabolocratus lutescens* Distant 1918: 31. — Metcalf 1963: 39.

*Length*: ♂♂ 5.4-5.5 mm.

*Structure*: Head produced, subfoliaceous; vertex slightly upturned apically. Vertex length: interocular width ratio 3.5: 6.5. Vertex length: pronotal length ratio 3.5: 4.5. Pronotum as wide as head, laterally carinate.

*Coloration*: Head and thorax pale yellow dorsally. Vertex anteriorly dorsal and with ventral transverse. Submarginal fuscous line. Face and thorax dark brown ventrally fading to yellow in sutures and marginal areas. Abdomen entirely dark brown except yellow lateral

margins and genital capsule. Forewings pale yellow; black spot at end of clavus. Hindwings hyaline.

♂ *genitalia*: Valve broadly triangular, brown. Plates dorso-ventrally flattened, tapering apically; lateral setae. Pygofer brownish, heavily setose in posterior half; pointed apically. Connective in shape of inverted Y. Style triangular with dorso-posterior sharp thumb-like projection. Aedeagus with pair of terminal processes curving dorsally; shaft laterally compressed, ventrally keeled with 4 fine teeth; short subapical dorsal keel; mid-dorsal lateral expansions; gonopore apical; dorsal apodeme finger-like, with medial bulge.

♀ *genitalia*: Unknown.

*Types*: The lectotype is herein designated as the ♂ labelled "Type H. T., *Parabolocratus lutescens* Type Dist. (in Distant's handwriting), Sovedala, Nilgiri Hills, S. India, 7200 ft, T. B. Campbell, 946, S. India, E. A. Butler, 1915-60." The lectotype is on the same pin with an additional ♂ and may be distinguished by the red mark on the point. 7 additional paralectotypes same data as lectotype. All types in BMNH.

*Distribution*: India.

*Remarks*: The genitalia of this species have not been previously described. The syntypes are all ♂♂ and the ♀ is unknown. This species can be distinguished by a combination of its dark brown ventral surface and the aedeagal shaft with mid-dorsal lateral flares.

***Hecalus fuscovittatus* Morrison, new species** Fig. 160-165, 205.

*Length*: ♂♂ 5.4 mm; ♀ 6.0 mm.

*Structure*: Vertex angularly produced. Vertex length: interocular width of ♂♂ 2.0: 3.0; ♀♀ 3.5: 4.5. Vertex length: pronotal length ratio of ♂♂ 2.0: 2.3; ♀♀ 3.5: 3.3. Pronotum as wide as head; laterally carinate.

*Coloration*: Brown. 2 prominent medial longitudinal dark brown lines on vertex, pronotum and scutellum. Longitudinal dark brown lines as follows: vertex 6, pronotum 10, scutellum 4. 2 medial lines most prominent in both sexes, lateral lines more faint in ♀. Incomplete anterior submarginal dark line on vertex dorsally. Anterior 1/2 of face piceous ventrally. Pleural region of thorax piceous. ♂ abdomen with 4 longitudinal brown lines. Forewings light brown, veins bordered with dark brown. Hindwing hyaline, veins brown.

♂ *genitalia*: Valve brown, triangular. Plates brown, dorso-ventrally flattened, tapering apically; lateral setae. Pygofer with 4 longitudinal brown lines; heavily setose in posterior 1/2, subangularly produced apically. Connective in shape of inverted Y. Style triangular with dorso-posterior thumb-like projection. Aedeagus with 1 pair of terminal processes, curving dorsally; shaft laterally compressed with 5 small teeth ventrally; gonopore large, subapical; dorsal apodeme elongate.

♀ *genitalia*: Ovipositor extending beyond pygofer  $1\frac{1}{2}$  × its width. 7th sternum with broadly rounded medial projection.

*Types*: Holotype ♂ (BISHOP 10098): LAOS: Ban Theuong, 18 km NW of Xieng Khuang, 1035 m, 2/6.VIII.1960, sweeping grasses, R. E. Leech. Allotype ♂: Bolouens Plateau, 16 km S of Thateng, 1020 m, 22/24.VIII.1960, at light, R. E. Leech. Paratype: 1 ♂, same data as holotype except 10/17.VIII.1960. All types in BISHOP.

*Distribution*: Only known from type material.

*Remarks*: This species resembles *H. lutescens* from India in having the thorax and face

brown, but may be distinguished from it by having the veins of the forewing bordered with brown and the aedeagal shaft being straight, without lateral flares.

**Hecalus porrectus** (Walker), new combination      Fig. 1-6, 106-111, 198.

- Acocephalus porrectus* Walker 1858: 232. — Motschulsky 1863: 96. — Signoret 1879a: 87; Kirby 1891: 172.
- Thomsoniella porrecta*: Melichar 1903: 172. — Distant 1908b: 278. — Bierman 1910: 61. — Melichar 1914: 131. — Schumacher 1915a: 99. — Misra 1920a: 229. — Richter 1928: 193, 200. — Dammerman 1929: 111. — Merino 1936: 355. — Metcalf 1967: 1722.
- Thomsoniella porrecta*: Steinhaus 1946: 374.
- Thomsoniella perrecta*: Muller 1949: 356.
- Thomsonia porrecta*: Esaki & Ito 1954: 80.
- Parabolocratus porrectus*: Distant 1918: 31. — Singh-Pruthi 1930: 20; 1934: 16. — Jacobi 1941: 307. — Mathur 1953: 164. — Nuorteva 1954: 79. — Capco 1959: 327.
- Linnavuoriella porrecta*: Evans 1966: 134.
- Platymetopius lineolatus* Motschulsky 1859: 114; 1863: 100. — Melichar 1903: 173. — Distant 1908b: 228. — Schumacher 1915a: 99. — Baker 1923: 532. — Merino 1936: 355, 394. — Esaki & Ito 1954: 80.
- Platymetopus lineolatus*: Kirby 1891: 173.
- Thomsonia lineolatus*: Kirkaldy 1906: 316. — Schumacher 1915a: 99.
- Thomsonia lineolata*: Distant 1908b: 278. — Merino 1936: 355.
- Thomsonia lineolatus*: Esaki & Ito 1954: 80.
- Thomsoniella lineolata*: Metcalf 1967: 1721.
- Hecalus kirschbaumii* Stål 1870: 737. — Evans 1947: 240.
- Thomsoniella kirschbaumii*: Signoret 1879b: 280 (68). — Atkinson 1885: 104 (31). — Kirkaldy 1900: 294. — Melichar 1903: 171.
- Thomsoniella kirchbaumii*: Signoret 1880: 52.
- Thomsonia kirschbaumii*: Kirkaldy 1906: 316; 1907: 40.
- Thomsoniella viridis* Distant 1908b: 280. **New synonym.**
- Parabolocratus rusticus*: Distant 1918: 31, nom. nov. pro. *Thomsoniella viridis* Distant (preoc., Uhler, 1877). — Dammerman 1948: 472. — Mathur 1953: 164. — Capco 1959: 332. — Metcalf 1963: 43.
- Thomsoniella albomaculata* Distant 1908b: 280. — Misra 1920a: 229; 1920b: 442. — Merino 1936: 335.
- Parabolocratus albomaculatus*: Distant 1918: 32. — Jacobi 1941: 307. — Dammerman 1948: 472. — Mathur 1953: 164. — Evans 1955: 6. — Metcalf 1963: 29.
- Parabolocratus albomaculata*: Singh-Pruthi 1934: 17. — Ishihara 1961: 237.
- Parabolocratus merinoi* Capco 1959: 333. **New synonym.**

*Length*: ♂♂ 4.5-5.3 mm; ♀♀ 5.3-6.0 mm to tip of wings, 5.5-6.2 mm to tip of ovipositor.

*Structure*: Vertex subfoliaceous, slightly upturned apically. Vertex length: interocular width ratio of ♂♂ 3.2: 5.0; ♀♀ 4.7: 6.4. Vertex length: pronotal length ratio of ♂♂ 3.2: 4.0; ♀♀ 4.7: 5.0. Pronotum slightly wider than head, laterally carinate.

*Coloration*: Green. 4 longitudinal orange lines on vertex and pronotum, 3 on scutellum. Vertex margin anteriorly with transverse submarginal ventral fuscous line. ♂ abdomen dark brown dorsally and midventrally, yellow-green laterally; pygofer with anterior transverse brown band. ♂ forewings green with apical 1/3 brown, white spots in apical and antepical cells; brown spot at end of clavus; usually 3 additional brown spots on apical margin. ♀ forewings entirely light green, dark spot at end of clavus; usually 2 additional brown spots on apical margin. Hindwings hyaline.

♂ *genitalia*: Valve broadly triangular. Plates dorso-ventrally flattened, tapering apically; lat-

eral setae. Pygofer heavily setose in posterior 1/2, somewhat rounded; transverse brown band dorsally. Connective in shape of inverted Y. Style triangular with dorso-posterior thumb-like projection. Aedeagus with 1 pair of terminal processes, subequal in length, tapering apically; gonopore subapical; dorsal apodeme reduced.

♀ *genitalia*: Ovipositor extending beyond pygofer about  $2 \times$  its width. 7th sternum with medial projection, notched on each side.

*Type*: Holotype ♀: labelled "Type, *Acocephalus porrectus*, Ceylon, 52, 62," deposited in BMNH.

*Distribution*: Widely distributed in the Oriental region; also occurring in Australia (Evans 1966).

*Remarks*: In addition to examining the holotype, the types of all synonyms have been studied. The holotype of *H. kirschbaumii* is a ♀ labelled "*Hecalus kirschbaumii* Stål, Philipp. Ins., Typus," and is deposited in STK. The type of *P. rusticus* has been examined, and a lectotype is herein designated as a ♀ labelled "Type, H. T., *viridis* Type Dist. (in Distant's handwriting), Calcutta, 21-1-07, Distant's Coll. 1911-383" deposited in BMNH.

The syntypic series of *T. albomaculata* consists of 7 ♂♂ from Pusa, E. Bengal, Calcutta, India and Pundalu-yoa, Ceylon. A lectotype is herein designated as the ♂ labelled "Type, H. T., *Thomsoniella albomaculata* Type Distant (in Distant's handwriting), H. M. Lefroy, E. Bengal, Pusa, 173, Distant Coll. 1911-383." The series is mixed and the 2 ♂♂ from Pundalu-oya, Ceylon are *H. apicalis*. All types of *T. albomaculata* are in the BMNH.

A ♂ and ♀ paratype of *P. merinoi* from Trinidad, P. I., were studied. I consider this species a synonym of *H. porrectus* based on examination of these paratypes plus Capco's (1959) description of the ♂ and ♀ *genitalia* and external color pattern. It should be noted that the ♂ *genitalia* which he illustrates for this species does not fit his description and appear to be in error. The terminal genitalic processes are directed posteriorly rather than anteriorly and are very similar to *H. wallengreni*. In addition, he states that the ♂♂ of *P. merinoi* are "similar to *porrectus* in color and external appearance," i. e., "body fasciated with orange-red," but yet he places *P. merinoi* in the key with the group having the "body not fasciated with orange-red."

Illustrations of the type of *P. lineolatus* Motschulsky were provided by Dr J. Vilbaste. 2 syntypic ♀♀, one badly damaged, are deposited in MOS.

There has been much confusion with this species owing to its sexual dimorphism. In most collections studied by the author the ♀♀ were labelled *porrectus* and the ♂♂ *albomaculatus*. This species is relatively abundant in Thailand where I have collected it on *Eleusine indica* (L.) Gaerth. and *Panicum repens* L.

*Other material examined*: CHINA: 1 ♂, 1 ♀, Foochow, 1937-38, M. S. Yang (BMNH). PHILIPPINES: 1 ♂, 10 ♀♀, Bacoor, P. L. Spangl (USNM); 5 ♂♂, 6 ♀♀, Los Banos, Baker (USNM); 1 ♂, 1 ♀, P. Princess, Palawan, Baker (USNM); 3 ♂♂, 4 ♀♀, Dapitan, Mindanao, Baker (USNM); 2 ♀♀, Mt, Makling, Luzon, Baker (USNM); 4 ♂♂, Island Samar, Baker (USNM). FORMOSA: 1 ♂, M. Kato (BMNH); CEYLON: Deniyaya, 4. XI.1953, J. W. S. Pringle, BM 1953-75 (BMNH), LAOS: 1 ♂, 1 ♀, Sedone Prov., Pakse, 23.V.1965, P. D. Ashlock (BISHOP); 1 ♂, 11 ♀♀, Muong Sing, NW of Luang Prabang, 650 m, 6/10.VI.1960; 2 ♀♀, Vientiane, 31.V/3.VI.1960, S. & L. Quate (BISHOP);

2 ♂♂, Vientiane, 8.V.1965, P. D. Ashlock (BISHOP). THAILAND: 1 ♂, 7 ♀♀, Chiangmai Prov., Fang, 500 m, 13.VI.1965, P. D. Ashlock, U. S. - Japan Sci. Coop. Program (BISHOP); 1 ♂, Prakanong Madi Rd, 4.XII.1951, R. E. Elbel (USNM); 38 ♂♂, 101 ♀♀, Tha Phra, Khon Kaen, 13/24.X.1971, W. P. Morrison, on *Panicum repens* (UKY); numerous males and females from Thailand (UKY, KASU, RPRC). JAVA: 7 ♂♂, 11 ♀♀, Pekalongan, F. Muir (USNM). BURMA: 1 ♂, 4 ♀♀, ca 200 m, Washaung, 20 km East of Myitkyina, 14.VII.1934, Malaise (STK). INDIA: 7 ♂♂, 7 ♀♀, Delhi, 1.X.1961, P. W. Oman (USNM); 2 ♂♂, 2 ♀♀, Chabua, Assam, June-Jan., 1943, D. E. Hardy (USNM); 4 ♂♂, 1 ♀, 6-10 mi. N of Tinsukia, Assam, 6/15.III.1944, D. E. Hardy (USNM); 6 ♂♂, Big fruit garden (of "Lokat", "anar", apricot and peaches) near rest house, Choa Saida Shan, Salt Range, Punjab, Sta. 5, 30.VI.1931, Zool. Surv. Ind. (USNM); 11 ♂♂, 45 ♀♀, New Delhi, 9.X.1967 K. E. Gibson (USNM).

**Hecalus gressitti** (Linnavuori), new combination      Fig. 112-117, 199.

*Parabolocratulus gressitti* Linnavuori 1960: 272.

*Length*: ♂♂ 4.8-5.4 mm, ♀♀ 5.1-6.0 mm to tip of wings, 5.6-6.7 mm to tip of ovipositor.

*Structure*: Vertex angularly produced. Vertex length: interocular width ratio of ♂♂ 4.0: 5.8; ♀♀ 5.0: 7.0. Vertex length: pronotal length ratio of ♂♂ 4.0: 4.2; ♀♀ 5.0: 5.2. Pronotum slightly wider than head, laterally carinate.

*Coloration*: Yellow-green. 4 longitudinal orange lines on vertex and pronotum, 3 on scutellum. Vertex margin anteriorly with transverse submarginal ventral fuscous line. ♂ abdomen dark brown dorsally, often with ventral medial brown stripe; lateral margins yellow; pygofer with anterior transverse brown band. ♂ forewings green with apical 1/3 brown; white spots in apical and anteapical cells. ♀ forewings entirely yellow-green; dark spot at end of clavus, usually one additional brown spot on apical margin. Hindwings hyaline.

♂ *genitalia*: Valve broadly triangular. Plates dorsoventrally flattened, tapering apically; lateral setae. Pygofer heavily setose in posterior 1/2; rounded apically. Connective in shape of inverted Y. Style triangular with dorso-posterior thumb-like projection. Aedeagus with 2 pairs of terminal processes; apical pair short, projecting posteriorly; subapical pair about 1/2 as long as shaft, usually 1 curving dorsally and 1 ventrally; gonopore subapical; dorsal apodeme reduced.

♀ *genitalia*: Ovipositor extending beyond pygofer more than 2 × its width. Posterior margin of 7th sternum with short medial projection and 2 lateral notches.

*Types*: Holotype ♂: (US 63384), Palau, Babelthuap, Ulimang, 16-25.XII.1947, Dybas, deposited in USNM.

*Distribution*: W. Caroline Islands, Philippines, Amboina, Singapore, Penang and Laos.

*Remarks*: This species closely resembles *H. porrectus* and *H. apicalis* externally. It may be distinguished by having the terminal pair of aedeagal processes short; only about 1/6 the size of the subapical pair. This species has been previously reported only from the Western Caroline Islands.

*Other material examined*: PHILIPPINES: 4 ♂♂, Mt. Makling, Luzon, Baker (USNM); 2 ♂♂, Ligao, Albay, 21.I.1952, Corocanding, Calica and Pableo (USNM); 1 ♂, Guinobatan, Albay, P. I., 5.XII.1952, *Setaria palmifolia*, Calica (USNM); 1 ♂, Guinobatan, Albay, P. I., 23.II.1953, *Setaria palmifolia*, Opena (USNM); 5 ♀♀, Guinobatan, Albay,

23.II.1953, *Imperata cylindrica*, Pableo (USNM); 1 ♂, Cuernos Mts., Negros, Baker (USNM); 1 ♂, 2 ♀♀, Surigao, Mindanao, Baker (USNM). LAOS: 3 ♂♂, Borikhane Prov., Paksane, 9.IX-22.XII.1965, native collector (BISHOP); 1 ♂, 1 ♀, Sedone Prov. Pakse, 23.V.1965, P. D. Ashlock (BISHOP); 1 ♂, Sedone Prov., Paksong, 18.V.1955, Ashlock (BISHOP); 1 ♂, Sedone Prov., Paksong-Paksong, 20.IX.1965, native collector (BISHOP); 2 ♂♂, 1 ♀, Vientiane Prov., Tha Ngone, 21.VIII.1965, 2.II.1966, 1 ♂, Nongtevada, 21.VII.1965, native collector, (BISHOP). SINGAPORE: 5 ♂♂, 17 ♀♀, Coll. Baker, (USNM). AMBOINA: 3 ♂♂, 3 ♀♀, F. Muir (USNM); 1 ♂, Island of Penang, Baker (USNM).

**Hecalus apicalis** (Matsumura), new combination (reinstated) Fig. 118-123, 201.

*Parabolocatus apicalis* Matsumura 1912: 287; 1915: 171. — Schumacher 1915a: 99. — Esaki & Ito 1954: 80.

*Thomsoniella porrecta*: Metcalf 1967: 1723 (Incorrect synonymy).

*Length*: ♂♂ 4.3-4.5 mm; ♀♀ 4.8-5.4 mm to tip of wings, 5.3-5.6 mm to tip of ovipositor.

*Structure*: Vertex angularly produced; rounded in dorsal view. Vertex length: interocular width ratio of ♂♂ 3.0: 5.2; ♀♀ 3.8: 6.2. Vertex length: pronotal length ratio of ♂♂ 3.0: 3.8; ♀♀ 3.8: 4.2. Pronotum as wide as vertex, laterally carinate.

*Coloration*: Yellow-green. 4 longitudinal orange lines on vertex and pronotum; 3 on scutellum. Vertex margin anteriorly with submarginal ventral fuscous line. ♂ forewings green with apical 1/3 brown; apical and subapical cells with white spots; black spot at end of clavus; 3 additional dark lines in apical margin. ♀ forewings entirely green; dark spots at end of clavus and wing margin as in ♂ but more faint. ♂ abdomen brown dorsally, pygofer with anterior transverse brown band. Hindwings hyaline.

♂ *genitalia*: Valve broadly triangular. Plates dorso-ventrally flattened, tapering apically; lateral setae. Pygofer heavily setose in posterior 1/2; rounded apically. Connective in shape of inverted Y. Style triangular with dorso-posterior thumb-like projection. Aedeagus with 2 pairs of terminal processes; terminal pair subequal in length, needle-like, extending posteriorly; subapical pair subequal in length, curving anteriorly, as long as or somewhat longer than terminal processes; gonopore subapical; dorsal apodeme reduced.

♀ *genitalia*: Ovipositor extending beyond pygofer  $1\frac{1}{2} \times$  its width. 7th sternum with slight medial indentation with small rounded projection.

*Types*: A lectotype is herein designated as the ♂ with data "Formosa, Matsumura, 31/VII/1906 Shirin" Paralectotypes: 1 ♂, same pin as lectotype; 6 ♀♀, same data as lectotype, all on same pin. All types deposited in HOKU.

*Remarks*: The genitalia of this species have not been previously described. This species resembles *H. gressitti* but may be distinguished from it by the relatively long, needle-like pair of terminal aedeagal processes. The lateral aedeagal processes in the India and Ceylon specimens are somewhat longer than those in the Formosa and Lappa Island specimens.

*Other material examined*: INDIA: 2 ♂♂, 1 ♀, Raipur, III.1969, J. A. Lowe (UKY). LAPPAL IS.: 1 ♂, (USNM); CEYLON: 1 ♂, Green Coll., 90-115 (BMNH); 1 ♂, Peradeniya, 6-09, 2407. Distant Coll., 1911-383 (BMNH); 2 ♂♂, Pundalu-eya, 3-03, 1626, Distant Coll., 1911-383 in the mixed syntypic series of *T. albomaculata* Distant (BMNH).

**Hecalus bicornus** Morrison, new species      Fig. 124-129.

*Length*: ♂♂ 5.4-5.5 mm.

*Structure*: Vertex subfoliaceous, short, rounded; slightly upturned apically. Vertex length: interocular width ratio ♂♂ 3.5: 5.6. Vertex length: pronotal length ♂♂ 3.5: 5.0 mm. Pronotum slightly wider than head, laterally carinate.

*Coloration*: Yellow-green. 4 longitudinal orange lines on vertex and pronotum; 3 on scutellum. Vertex margin anteriorly with transverse submarginal ventral fuscous line. ♂ abdomen with mid-dorsal brown longitudinal stripe extending to anal tube, sometimes faint in anterior 1/2. ♂ forewings light yellow with veins slightly darker; brown spot at end of clavus and at wing margin at 1st and 4th apical veins. Hindwings hyaline.

♂ *genitalia*: Valve broadly triangular. Plates dorso-ventrally flattened, tapering apically; lateral setae. Pygofer heavily setose in posterior half; rounded apically. Connective in shape of inverted Y. Style triangular with dorso-posterior thumb-like projection. Aedeagus with a pair of branched terminal processes; ventral branch somewhat shorter, directed laterad; dorsal branch about 2/3 length of shaft, directed dorsad; gonopore apical; dorsal apodeme reduced.

♀ *genitalia*: Unknown.

*Types*: Holotype ♂ (USNM): AMBOINA. F. Muir. Paratypes: 4 ♂♂, same data as holotype; 1 ♂, PHILIPPINES: Mt. Makling, Luzon, Baker. All types deposited in USNM.

*Distribution*: Only known from type material (Amboina and Luzon, P. I.).

*Remarks*: This species resembles *H. lineatus* (Horváth) but differs in the size and direction of the aedeagal processes. The aedeagal processes of *H. lineatus* are subequal in length, 1/3 the length of the shaft in size and directed dorsad and posteriorly. *H. lineatus* appears to be more northerly in distribution, being known from Japan, Korea and the Soviet Maritime Territories.

**Hecalus multilineatus** Morrison, new species      Fig. 130-135, 178.

*Length*: ♂♂ 5.3 mm.

*Structure*: Vertex angularly produced. Vertex length: interocular width ♂♂ 4.5: 6.0. Vertex length: pronotal length ♂♂ 4.5: 4.3. Pronotum wider than head, laterally carinate.

*Coloration*: Head, pronotum and scutellum yellow. Orange longitudinal lines dorsally as follows: head 4, pronotum 7, scutellum 5. Vertex margin anteriorly with transverse submarginal ventral fuscous line. Thorax black ventrally; abdomen black. ♂ forewings green with apical 1/3 brown; white spots in apical and anteapical cells; black spot at end of clavus; 3 additional black spots on apical margin. Hindwings smoky brown.

♂ *genitalia*: Valve broadly triangular, brown. Plates dorso-ventrally flattened, tapering apically; lateral setae. Pygofer heavily setose in posterior 1/2; pointed apically; dark brown dorsally. Connective in shape of inverted Y. Style triangular with dorso-posterior thumb-like projection. Apical 1/3 of aedeagus bifurcate, curving dorsally; 2 lateral processes and gonopore at base of bifurcation; shaft rounded, bulbous basally; dorsal apodeme short, broadly expanded triangularly,

♀ *genitalia*: Unknown.

*Type*: Holotype ♂ (BISHOP 10099): LAOS: Sedone Prov., Paksong, 18.V.1965, P. D. Ashlock, Bishop Mus.

*Distribution:* Only known from type material.

*Remarks:* This species is related to *H. apicalis* from which it differs by (1) having the vertex longer than the pronotum, (2) the number and position of the longitudinal orange lines on the head, pronotum and scutellum, and (3) the terminal aedeagal processes being robust, not needle-like.

**Hecalus furcatus** Morrison, new species      Fig. 136-141, 202.

*Length:* ♂♂ 3.6 mm; ♀♀ 4.5 mm to tip of wings, 5.2 mm to tip of ovipositor.

*Structure:* Vertex angularly produced. Vertex length: interocular width ratio of ♂♂ 3.0: 4.0; ♀♀ 4.2: 5.3. Vertex length: pronotal length ratio of ♂♂ 3.0: 3.1; ♀♀ 4.2: 4.0. ♀ brachypterous, last abdominal segment exposed.

*Coloration:* ♂ yellow-green; ♀ green. Vertex margin anteriorly with transverse submarginal ventral fuscous line. ♂ forewings green with apical 1/3 light brown; white spots in apical and anteapical cells; apical margin with 3 pronounced brown spots. ♀ forewing green; 2 faint brown spots on apical margin. Hindwings hyaline.

♂ *genitalia:* Valve broadly triangular. Plates dorso-ventrally flattened, tapering apically; lateral setae. Pygofer light brown, heavily setose in posterior 1/2; rounded apically. Connective in shape of inverted Y. Style triangular with dorso-posterior sharp thumb-like projection. Aedeagus with 1 pair of terminal forked processes; ventral fork slightly longer and larger; shaft laterally compressed with pair of strong ventral lateral ridges expanding subapically; gonopore subapical in ventral groove; dorsal apodeme short, rectangular.

♀ *genitalia:* Ovipositor extending beyond pygofer about 2 × its width. 7th sternum with strong rounded medial projection.

*Types:* Holotype ♂ (BMNH): CHINA: Nanking, Shaolingwei, 9.VIII.1937, Miss Hurford, BM 1938-426, Sweeping along creek bank. Allotype ♀: Same data as holotype. All types deposited in BMNH.

*Distribution:* Only known from type material.

*Remarks:* This species is similar in size to *H. tripunctatus* (Matsumura), the smallest hecaline known to occur in the Oriental region. It differs by having expanded ventral ridges on the aedeagal shaft and by the forked processes of the aedeagus being of approximately equal length.

**Hecalus arcuatus** (Motschulsky), new combination      Fig. 172-177, 182-184, 206.

*Platymetopius arcuatus* de Motschulsky 1859: 115; 1863: 100.

*Platymetopus arcuatus:* Kirby 1891: 173.

*Thomsoniella arcuata:* Melichar 1903: 172. — Distant 1908b: 280. — Melichar 1914: 131. — Metcalf 1967: 1720.

*Thomsoniella arcuata* Pierce 1918: 474. — Bohart 1943: 354.

*Thomsonia arcuata:* Kirkaldy 1905: 267; 1906: 316, *arcuatus*

*Parabolocratus arcuatus:* Distant 1918: 32. — Jacobi 1941: 307. — Mathur 1953: 164. — Capco 1959: 330.

*Linnavuoriella arcuata:* Evans 1966: 134.

*Teitonia (Diedrocephala) kalidasa* Kirkaldy 1900: 294.

*Parabolocratus centralis* Matsumura 1912: 288. — Esaki & Ito 1954: 77. — Ishihara 1961: 237; 1959: 80.

*Thomsoniella concentralis*: Schumacher 1915: 99. — Metcalf 1967: 1721.

*Parabolocratus concentricus* Matsumura 1940: 36. — Metcalf 1963: 31. **New synonym**

*Parabolocratus citrinus* Evans 1941: 36; 1966: 134.

*Length*: ♂♂ 3.5-5.3 mm; ♀♀ 5.1-6.0 mm to tip of wings, 5.1-6.1 to tip of ovipositor.

*Structure*: Vertex subangularly produced. Vertex length: interocular width ratio of ♂♂ 3.6: 5.0; ♀♀ 4.2: 6.0. Vertex length: pronotal length ratio of ♂♂ 3.6: 4.2; ♀♀ 4.2: 4.8. Pronotum slightly wider than head, laterally carinate.

*Coloration*: Yellow-green. Orange lines dorsally forming inverted V on vertex, 2 concentric parabolic lines on pronotum, 3 longitudinal lines on scutellum. Vertex margin anteriorly with transverse submarginal ventral fuscous line. ♂ abdomen brown dorsally. ♂ forewings yellow-green; apical 1/3 light brown with faint white spots in apical and anteapical cells; dark spot at tip of clavus, 2 dark spots on apical margin; claval vein, claval suture and usually 3 veins partially orange. ♀ forewing yellow-green; apical 1/3 only slightly darkened with obscure white spots; orange veins as in ♂ but usually faint. Hindwings hyaline.

♂ *genitalia*: Valve broadly triangular. Plates dorso-ventrally flattened, tapering apically; lateral setae. Pygofer heavily setose in posterior 1/2; pointed apically. Connective in shape of inverted Y. Style triangular with dorso-posterior, sharp thumb-like projection. Aedeagus with 2 pairs of petal-like terminal processes subequal in length; gonopore subapical; dorsal apodeme finger-like.

♀ *genitalia*: Ovipositor extending beyond pygofer about  $1\frac{1}{2}$  × its width. 7th sternum with slight medial projection.

*Types*: 1 ♂, 1 ♀ syntype from Ceylon deposited in MOS.

*Distribution*: Widely distributed in the Oriental region; also occurring in Australia (Evans, 1966).

*Remarks*: Illustrations of the types were provided by Dr J. Vilbaste, Academy of Sciences of the Estonian S. S. R., Tartu, U. S. S. R. The ♀ syntype has the abdomen and the tips of the forewings missing. The types of *Parabolocratus concentralis* Matsumura, a ♂ and ♀ mounted together labelled "*P. concentralis* n. sp. Mats., Formosa, Matsumura" and deposited in HOKU, have been examined. The type of *P. concentricus*, however, could not be found in Matsumura's collection at Hokkaido University and might be lost (Dr S. Tagaki, personal communication). Although this species has never been illustrated it is apparent from the original description that it is a synonym of *H. arcuatus*. The types of *T. kalidasa* Kirkaldy and *P. citrinus* Evans have not been examined.

This species was collected in Thailand on *Themeda* sp. and *Heteropogon* sp. It was successfully reared in the laboratory on *Themeda* sp. Capco (1959) reports collecting this species "among grasses along river banks and side roads" in the Philippines.

The distinct color pattern of this species readily distinguishes it from all other species occurring in the Oriental region.

*Material examined*: VIETNAM: 4 ♂♂, Reg. de Hoa-Binh, Tonkin, 1928, A. de Cooman (PAR). LAOS: 2 ♀♀, Vientiane, 8.V.1965, P. D. Ashlock (BISHOP); 1 ♂, Luang Prabang, 300 m, 4/5.VI.1960, S. and L. Quate (BISHOP); 3 ♂♂, 3 ♀♀, Ban Thenong, 18 km NW of Xieng Khouang, 1035 m, 10/17 and 2/6.VIII.1960, R. E. Leech (BISHOP). CEYLON: 1 ♂, 2 ♀♀ (USNM). FORMOSA, 1 ♂, Matsumura (USNM). PHILLIPINES: 1 ♂, Dapitan, Mindanao, Baker (USNM); 2 ♂♂, Davao, Mindanao, Baker (USNM); 1 ♂, Tangcolan, Bukidnon, Baker (USNM); 1 ♀, Diklon, Bukidnon, Mindanao, 3-10-32

(USNM). OKINAWA I.: 4 ♂♂, 19 ♀♀, 7.X.1945, W. D. Field (USNM). ISLAND OF PENANG: 4 ♂♂, 1 ♀, Baker (USNM). MACAO: 2 ♀♀, F. Muir (USNM); 1 ♀, Larat, 12-07 (USNM). THAILAND: 49 ♂♂, ♀♀ and nymphs, Chaiyaphum, 14.IX.1971, on *Themeda* sp., W. P. Morrison (UKY); numerous ♂♂ and ♀♀ from Thailand (UKY, KASU, RPRC).

***Hecalus facialis* Distant** Fig. 191.

*Hecalus facialis* Distant 1918: 29. — Metcalf 1963: 15.

*Length*: ♀♀ "7-8 millim. incl. tegm."

*Structure*: Vertex broadly rounded. Vertex length: interocular width 4.5: 5.0. Vertex length: pronotal length 4.5: 3.5.

*Coloration*: Dull yellow. Wings concolorous; black spot at end of clavus. ♀ ovipositor with 2 medial and 2 lateral longitudinal brownish bands.

♂ *genitalia*: Unknown.

♀ *genitalia*: Ovipositor extending beyond pygofer about  $1/2 \times$  its width. 7th sternum with broadly rounded medial projection.

*Type*: A lectotype is herein designated as the ♀ labelled "Type, H. T., *Hecalus facialis* Type Dist. (in Distant's handwriting), Khargpur, Bengal, 17/30-VI-11, R. Hodgart, Distant's Coll. 1911-383," deposited in BMNH.

*Distribution*: India.

*Remarks*: The genitalia of this species have not been previously described. Distant states in his original description that this species "is allied to *H. lefroyi* Dist., but with the vertex of the head shorter and less narrowed anteriorly, the distinct markings to face, which is narrower and more oblong, etc."

5 additional ♀♀ from India are in the syntypic series.

***Hecalus godavariensis* Distant** Fig. 197.

*Hecalus godavariensis* Distant 1918: 30. — Metcalf 1963: 16.

*Length*: ♀ "8 millim. incl. tegm."

*Structure*: Vertex subangularly produced; broadly rounded in dorsal view. Vertex length: interocular width ♀♀ 3.5: 5.0. Vertex length: pronotal length 3.5: 3.5.

*Coloration*: Light brown. Vertex with 2 lateral faint dark spots in posterior region. Wings concolorous; black spot at end of clavus.

♂ ♀ *genitalia*: Unknown.

*Type*: Holotype ♀: labelled "Type H. T., *Hecalus godavariensis* Type Dist. (in Distant's handwriting), Godavari Dt, Samalkot, 21/24-Sept, 12, T. V. R. Coll., presented by Agricultural College, Coimbatore, 1915-322," deposited in BMNH.

*Distribution*: Known only from type.

*Remarks*: The genitalia of this species have never been described and the ♀ holotype now has the abdomen missing.

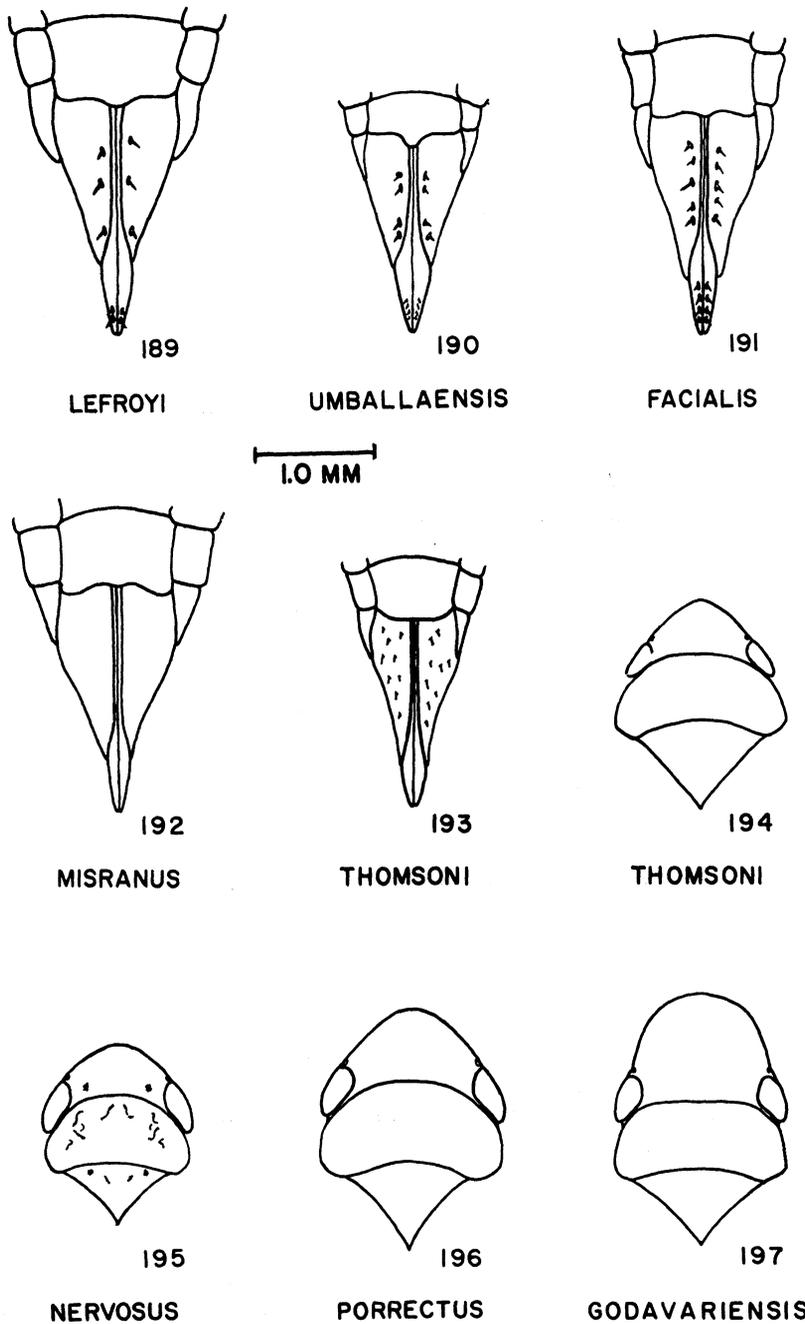


Fig. 189-197. 189-193, ventral view of ♀ genitalia of *Hecalus* spp.: 189, *Hecalus lefroyi*; 190, *H. umballaensis*; 191, *H. facialis*; 192, *H. misranus*; 193, *H. thomsoni*. 194-197, dorsal view of heads of *Hecalus* spp.: 194, *H. thomsoni*; 195, *H. nervosus*; 196, *H. porrectus*; 197, *H. godavariensis*.

**Hecalus lefroyi** Distant      Fig. 189.

*Hecalus lefroyi* Distant 1908b : 275 ; 1918 : 30. — Miwa 1943 : 75. — Box 1953 : 47. — Mathur 1953 : 163. — Esaki & Ito 1954 : 76. — Metcalf 1963 : 17.

*Hecalus lebroyi* : Kato 1933 : Plate 28, fig. 2.

*Hecalus leufroyi* : Jacobi 1944 : 53.

*Length* : ♀♀ "excl. tegm. 10, exp. tegm. 14 millim."

*Structure* : Vertex broadly rounded. Vertex length : interocular width ♀♀ 8.5 : 6.5. Vertex length : pronotal length ♀♀ 8.5 : 4.5.

*Coloration* : Pale green. Vertex margin anteriorly with transverse submarginal ventral fuscous line. Wings pale green with black spot at end of clavus.

♂ *genitalia* : Unknown.

♀ *genitalia* : Ovipositor extending beyond pygofer about  $2 \times$  its width. 7th sternum with broadly rounded medial projection.

*Type* : A lectotype is herein designated as the ♀ labelled "Type H. T., *Hecalus lefroyi* Type Dist. (in Distant's handwriting), Pusa, Lefroy, Distant Coll. 1911-383," deposited in BMNH.

*Distribution* : Asia.

*Remarks* : The genitalia of this species have not been previously described. The head is now missing from the lectotype, although the specimen was complete when illustrated by Distant in his original description. The specimen can be distinguished by having both pairs of wings spread. One additional ♀ from Pusa, Bengal, is in the syntypic series.

This species has also been recorded from Japan, Formosa and China. These distribution records, however, cannot be verified.

**Hecalus misranus** (Distant), new combination      Fig. 192.

*Columbanus misranus* Distant 1916 : 224.

*Ledrotypa misrana* : Evans 1947 : 140. — Metcalf 1963 : 7.

*Length* : ♀ "incl. tegm. 10 millim."

*Structure* : Vertex bluntly rounded. Interocular width : vertex length ♀♀ 5.4 : 5.4. Pronotum slightly wider than head. "The broadly sulcate face is a strongly characteristic feature."

*Coloration* : Brown. Vertex dorsally with 2 dark lines in shape of inverted V on anterior margin. Anterior and lateral areas of vertex pale brown. Scattered, small granular beaded spots on body.

♂ *genitalia* : Unknown.

♀ *genitalia* : Ovipositor extending beyond pygofer about  $1/2 \times$  its width. 7th sternum slightly concave posteriorly with small, broadly rounded medial projection.

*Type* : Holotype ♀ : labelled "Type, *Columbanus misranus*, Type Dist. (in Distant's handwriting), on grass, Pusa, Bengal, 25-IX-06, C. S. M., Pusa Coll., Pusa Collection, 1915-164," deposited in BMNH.

*Distribution* : Known only from type.

*Remarks* : The genitalia of this species have not been previously described. This spe-

cies, based on a single ♀, is the only species of *Hecalus* which does not have the characteristic 2-2-1 hind femoral setal formula. Dr W. J. Knight of the British Museum (Nat. Hist.) has examined the type and states that the specimen has a 2-2-1 on one femur and 2-2-1-1 on the other.

This species, the type-species of *Columbanus*, was previously transferred to *Ledrotypa* by Evans (1947). However, because the ovipositor extends well beyond the pygofer, it is considered to be properly placed in *Hecalus*.

***Hecalus umballaensis* Distant** Fig. 190.

*Hecalus umballaensis* Distant 1908b : 274. — Metcalf 1963 : 22.

*Length* : ♀ "incl. anal segment 6½ millim."

*Structure* : Vertex broadly rounded. Vertex length : interocular width ♀♀ 4.5 : 5.0. Vertex length : pronotal length 4.5 : 3.0. Pronotum slightly wider than head.

*Coloration* : Light brown. Vertex, pronotum and scutellum with 4 pronounced longitudinal dark brown lines. Vertex with 2, pronotum with 4 additional faint longitudinal lines laterad. Wings pale brown, veins darker ; black spot at end of clavus.

♂ *genitalia* : Unknown.

♀ *genitalia* : Ovipositor extending beyond pygofer about 1.5 × its width. 7th sternum with pronounced medial rounded projection.

*Type* : Holotype ♀ : labelled "Type H. T., *Hecalus umballaensis* Type Dist. (in Distant's handwriting), Umballa, 2-VII-5, Distant Coll. 1911-383," deposited in BMNH.

*Distribution* : Known only from type.

*Remarks* : The genitalia of this species have not been previously described. This species may be distinguished by the number of brown longitudinal lines on the vertex, pronotum and scutellum.

***Hecalus nervosus* Melichar** Fig. 195.

*Hecalus nervosus* Melichar 1903 : 173. — Distant 1908b : 277. — Metcalf 1963 : 20.

*Length* : ♀♀ 6.7 mm to tip of wing.

*Structure* : Vertex subangularly produced. Vertex length : interocular width ♀♀ 2.0 : 4.0. Vertex length : pronotal length ♀♀ 2.0 : 3.0. Pronotum as wide as head.

*Coloration* : Light brown. Vertex dorsally with incomplete fuscous submarginal line ; medial longitudinal brown line with 2 comma-shaped markings on each side ; 2 lateral fuscous spots near posterior margin. Pronotum with several fuscous markings in anterior 1/2 ; 6 faint longitudinal brown lines. Scutellum with 1 medial and 2 lateral longitudinal brown lines ; 2 medial comma-shaped fuscous spots. Vertex ventrally with wide submarginal transverse piceous band ; 8 oblique brown lines on postclypeus. Pro- and mesopleural region with brown band. Forewings brown, veins bordered with dark brown ; costal margin yellowish. Hindwings hyaline ; veins brown.

♂ ♀ *genitalia* : Unknown.

*Type* : Holotype ♀ : labelled "*Hecalus nervosus* Melichar, *nervosus* sp. det. Melichar, *Hecalus*, 7053, Type, Ceylon, Nictnes," deposited in BER.

*Distribution*: Only known from type.

*Remarks*: The genitalia of this species have never been described, and the abdomen is missing from the type. It may be distinguished, however, by a combination of the color pattern and pronounced dark brown border of the forewing veins.

***Hecalus nitobei* (Matsumura), new combination** Fig. 200.

*Parabolocratus nitobei* Matsumura 1912: 286. — Schumacher 1915a: 98. — Esaki & Ito 1954: 78. — Metcalf 1963: 41.

*Length*: ♀♀ 6.4 mm to tip of ovipositor, 7.0 mm to tip of wing.

*Structure*: Vertex subangularly produced. Vertex length: interocular width ratio of ♀♀ 4.5: 7.0. Vertex length: pronotal length ratio of ♀♀ 4.5: 5.0. Macropterous. Pronotum as wide as head, laterally carinate.

*Coloration*: Yellow-green. Vertex with ventral submarginal dark line. Forewings light green, hindwings hyaline.

♂ *genitalia*: Unknown.

♀ *genitalia*: Ovipositor extending beyond pygofer  $2 \times$  its width. 7th sternum with medial finger-like projection, strongly notched on each side.

*Type*: Holotype ♀: labelled "*P. nitobei* n. sp., det. Matsumura, Type Matsumura, Toran, Coll. Nitobe," deposited in HOKU.

*Distribution*: Only known from type (Toran, Formosa).

*Remarks*: The genitalia of this species have not been previously described. In the original species description, Matsumura states that he had 2 specimens, 1 from Toran and 1 from Tansui. However, only the specimen from Toran is present in Matsumura's collection in Sapporo, Japan.

The ♀ genitalia closely resembles *H. apicalis*, differing in the medial projection being longer and the lateral notches more pronounced.

***Hecalus thomsoni* Stål** Fig. 193, 194.

*Hecalus thomsonii* Stål 1870: 737. — Merino 1936: 354.

*Parabolocratus thomsonii*: Signoret 1879b: 267; 1880: 41.

*Clavena thomsonii*: Melichar 1902: 127. — Metcalf 1963: 67.

*Parabolocratus antipolanus* Capco 1959: 329. **New synonym.**

*Length*: ♂♂ 6.4 mm; ♀ 8.0 mm to tip of wing, 8.5 mm to tip of ovipositor.

*Structure*: Vertex subangularly produced, upturned apically, triangular in dorsal view. Vertex length: interocular width ratio of ♀♀ 4.5: 7.0. Vertex length: pronotal length ratio of ♀♀ 4.5: 5.3. Pronotum wider than head; laterally carinate.

*Coloration*: Green to yellow green. 4 longitudinal orange lines on vertex, 6 on pronotum. Lateral margins of pronotum and costal margins of forewings whitish. Forewings green; dark spot at tip of clavus sometimes faint; veins orange. Hindwing whitish.

♂ *genitalia*: "Male internal genitalia, with style, long, erect, slightly curved and pointed at apex; connective long and Y-shaped; aedeagus at dorsal view enlarged near base and slender towards apex, a pair of terminal processes curved posteriorly, and narrower near pointed tips, at side view, with a long perpendicular extension dorsally near base, wider posteriorly, terminal

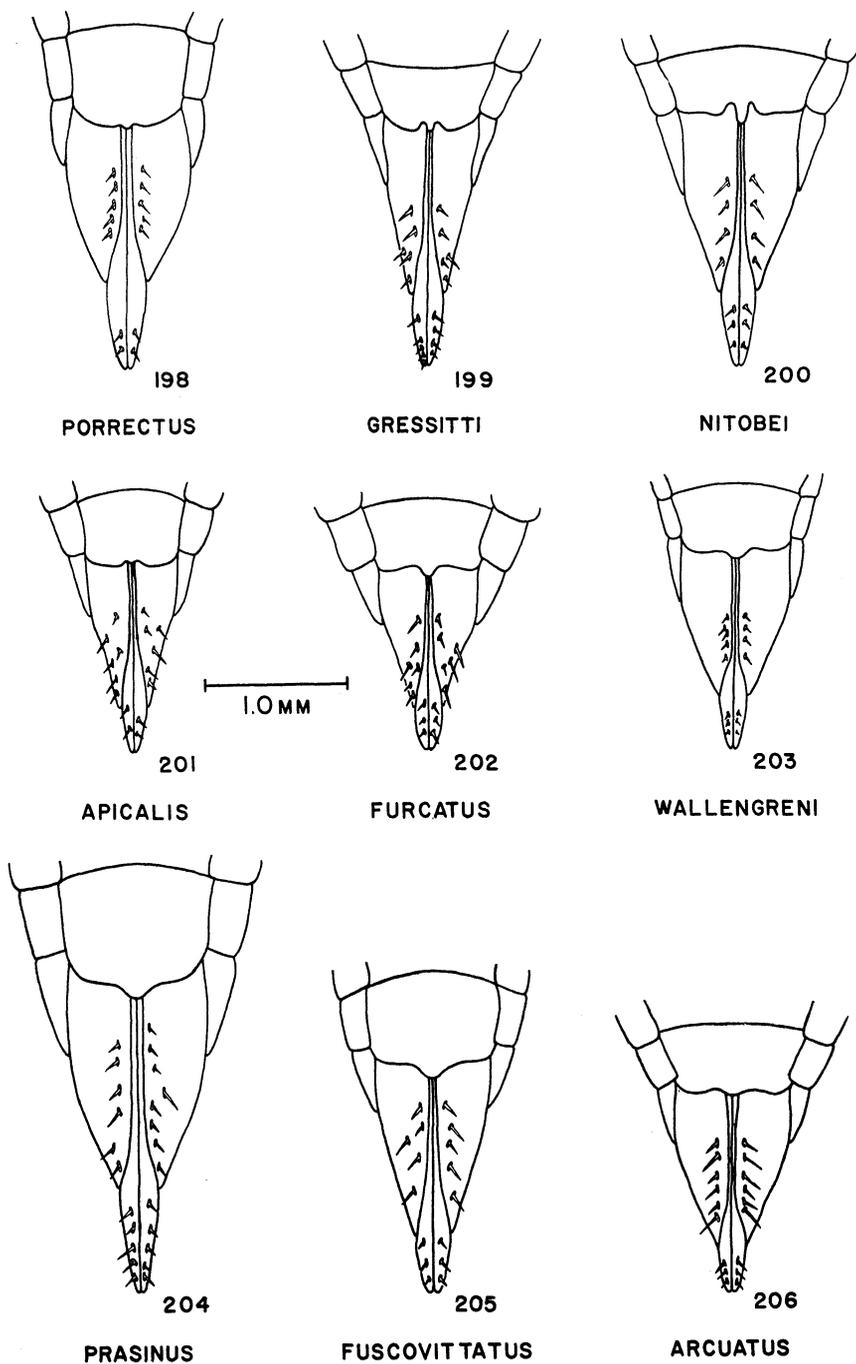


Fig. 198-206. Ventral view of ♀ genitalia of *Hecalus* spp.: 198, *H. porrectus*; 199, *H. gressitti*; 200, *H. nitobei*; 201, *H. apicalis*; 202, *H. furcatus*; 203, *H. wallengreni*; 204, *H. prasinus*; 205, *H. fuscovittatus*; 206, *H. arcuatus*.

processes scythe-like" (after Capco, 1959).

♀ *genitalia*: Ovipositor extending beyond pygofer  $1\frac{1}{2} \times$  its width. 7th sternum with posterior margin nearly straight.

*Type*: Holotype ♀: labelled "*Hecalus Thomsonii* Stål, Typus, Semper, Ins. Philipp.," deposited in STK.

*Distribution*: Philippine Islands.

*Remarks*: In addition to studying the holotype, 2 ♀ paratypes of *P. antipolanus* deposited in BPI have also been examined. The ♂ *genitalia* have been described and illustrated by Capco (1959).

This species may be distinguished externally by a combination of the following characters: (1) the pronotum being considerably wider than the head (Fig. 194) and whitish laterally and (2) the orange veins of the forewings.

In Rizal, Philippine Islands, this species is reported by Capco (1959) as being found on *Schizostachyum humampao*.

*Other material examined*: PHILIPPINES: 1 ♀, Baguio, Benguet, Baker (USNM); 1 ♀, Leyte, Dagami, 14 mi. SW. Tacloban, 11.VIII.1961, P. I. Nat'l. Mus. and Am. Mus. Nat. Hist. Expedition (AMNH).

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## LITERATURE CITED

- Atkinson, E. T. 1885. Notes on Indian Rhynchota, No. 3. *Asiatic Soc. Bengal J.* 54: 76-117.
- Baker, C. F. 1923. Comparison of Neotropical and Palaeotropical insect faunae. *Philippine J. Sci.* 23: 531-32.
- Bierman, C. J. H. 1910. Homopteren aus Niederländisch Ost-Indien. II. Herausgegeben von D. MacGillavry und K. W. Dammerman. *Leyden Mus. Notes* 33: 1-68
- Bohart, R. M. 1943. New species of *Halictophagus* with a key to the genus in North America (Strepsiptera: Halictophagidae). *Entomol. Soc. Amer. Ann.* 36: 341-59.
- Box, H. E. 1953. List of sugar-cane insects. A synoptic catalogue of the sugarcane insects and mites of the world, and of their insect parasites and predators, arranged systematically. Commonw. Inst. Entomol. 101 p.
- Capco, S. R. 1959. The Phillipine species of *Parabolocratus* (Cicadellidae, Homoptera). *Phillippine J. Sci.* 88: 325-34.
- Dallas, W. S. 1867. Insecta. *Zool. Rec.* 3: 65-75.
- Dammerman, K. W. 1929. Krakatau. Part III. Krakatau's new fauna. *Pacific Sci. Congr. Proc.* 4: 83-118.
1948. The fauna of Krakatau 1883-1933. K. Nederland. *Akad. Wetensch. afd. Naturk. Verh.* 44: 1-594.
- Distant, W. L. 1908a. Rhynchota Malayana. Part I. *Indian Mus. Rec.* 2: 127-51.
- 1908b. Rhynchota; Homoptera. The Fauna of British India including Ceylon and Burma. 4: 1-501.
1912. Descriptions of some new Homoptera. *Ann. Mag. Nat. Hist. ser 8*, 10: 438-46.
1916. Rhynchota, Homoptera. Appendix. The fauna of British India, including Ceylon and Burma. 6: 1-248.
1918. Rhynchota, Homoptera: Appendix. Heteroptera: Addenda. The fauna of British India, including Ceylon and Burma. 7: 1-210.

- Dohrn, F. A.** 1859. Homoptera. Catalogue Hemipterorum. Entomol. Ver. Stettin. 1-102.
- Esaki, T.** 1932a. A lecture on the leafhoppers injurious to the rice plant. [in Japanese] 38 p.
- 1932b. Homoptera. Nippon Konchu Zukan (Iconographia Insectorum Japonicorum). 2241 p.
1950. Homoptera, Auchenorrhyncha. *Iconographia Insectorum Japonicorum*, 2 Ed. 271-324.
- Esaki, T. & S. Hashimoto.** 1931. Report on the leafhoppers injurious to the rice plant and their natural enemies (for the year 1930). *Kyushu Imp. Univ., Ent. Lab. Pub.* **2**: 1-59.
1932. Do. (for the year 1931). *Kyushu Imp. Univ., Ent. Lab. Pub.* **3**: 1-42.
- Esaki, T. & S. Ito.** 1954. A tentative catalogue of Jassoidea of Japan and her adjacent territories. Japan Society for the Promotion of Science, Tokyo, 315 p.
- Esaki, T., H. Hori & K. Yasumatsu.** 1938. Insectorum Japonicorum illustratio iconographia coloribus ad natura depicta. Sanseido, Tokyo, 1-426 p.
- Evans, J. W.** 1941. New Australian leafhoppers. *Roy. Soc. So. Australia, Trans.* **65**: 36-41.
1946. A natural classification of leafhoppers (Jassoidea, Homoptera). Part I. External morphology and systematic position. *Entomol. Soc. Lond. Trans.* **97**: 39-54.
1947. A natural classification of leafhoppers (Jassoidea, Homoptera). *Entomol. Soc. Lond. Trans.* **98**: 105-271.
1955. Cicadellidae (Hemiptera, Homoptera). *Exploration du Parc Nat. Albert* **84**: 3-23.
1966. The Leafhoppers and Froghoppers of Australia and New Zealand. (Homoptera: Cicadelloidea and Cercopoidea). *Australian Mus. Mem.* **12**: 1-347.
- Fieber, F. X.** 1866. Neue Gattungen und Arten in Homoptern (*Cicadina* Bur.) *Zool.-Bot. Gesell. Wien. Verh.* **16**: 497-516.
- Guérin-Méneville, F. E.** 1834. Voyage aux Indes-Orientales. ... 1825-1829, Bélanger, Zoologie. Insectes, 445-80.
- Grist, D. H. & R. J. A. W. Lever.** 1969. Pests of Rice. Longmans, Green Co., Ltd., London and Harlow. 520 p.
- Higashi, M.** 1939. The insect-fauna of the Tottori Sand-Dune. *Kansai Entomol. Soc. Trans.* **8**: 25-46.
- Ishihara, T.** 1953. A tentative checklist of the superfamily Cicadelloidea of Japan (Homoptera). *Matsuyama Agr. Coll. Sci. Rep.* **11**: 1-72.
1959. The genus *Parabolocratus* of Japan (Hemiptera). *Kontyû* **27**: 77-80.
1961. Homoptera of Southeast Asia collected by the Osaka City University Biological Expedition to Southeast Asia 1957-58. *Nature and Life in Southeast Asia* **1**: 225-57.
- Jacobi, A.** 1941. Die Zikadenfauna der Kleinen Sundainseln. Nach der Expeditions ausbeute von B. Reusch. *Zool. Jahrb., Syst. Okol.* **74**: 277-322.
1944. Die Zikadenfauna der Provinz Fukien in Südchina and ihre tiergeographischen Beziehungen. *München. Ent. Gesell. Mitt.* **34**: 5-66.
- Kato, M.** 1933. Homoptera. Three-color illustrated insects of Japan **4**: 1-9.
- Kirby, W. F.** 1891. Catalogue of the described Hemiptera, Heteroptera, and Homoptera of Ceylon, based on the collection formed (chiefly at Pundaloya) by Mr. E. Ernest Green. *Linn. Soc. Lond. Zool.* **24**: 72-176.
- Kirkaldy, G. W.** 1900. Notes on some Sinhalese Rhynchota. *Entomologist* **33**: 293-95.
1905. Neue und weing bekannte Hemiptera. *Wien. Ent. Ztg* **24**: 266-68.
1906. Leafhoppers and their natural enemies. Pt. IX, Leafhoppers. Hemiptera. *Hawaii Sugar Pl. Assoc., Div. Entomol. Bul.* **1**: 271-479.
1907. Leafhoppers supplement. (Hemiptera). *Hawaii Sugar Pl. Assoc., Div. Entomol. Bul.* **3**: 1-186.
- Knight, W. J.** 1965. Techniques for use in the identification of leafhoppers (Homoptera: Cicadellidae). *Entomol. Gaz.* **16**: 129-36.
- Lethierry, L. F.** 1892. Liste d'Hémiptères récoltés à Mahé (Inde) par M. Em. Deschamps. *Soc. Zool. de France Bul.* **1892**: 207-10.
- Linnavuori, R.** 1960. Homoptera: Cicadellidae. *Insects Micronesia.* **6** (5): 231-344.

1961. Hemiptera (Homoptera) Cicadellidae. *South African Animal Life* **8** : 452-86.
- Ma, T. (T. C. Maa)** 1933. The parasites of rice Fulgorids and Cicadellids. [In Chinese]. *Entomol. and Phytopath.* **1** : 627-29.
- Mahmood, S. H.** 1967. A study of the Typhlocybinae genera of the Oriental Region (Thailand, the Philippines and adjoining areas). *Pacif. Ins. Monogr.* **12**.
- Mathur, R. N.** 1953. A systematic catalogue of the main identified entomological collection at the Forest Research Institute, Dehra Dun. Part 21. Order Hemiptera. *Indian Forest Leaflet (Entomol.)* **121** : 138-87.
- Matsumura, S.** 1905. [1000 insects of Japan]. **2** : 42-70.
1912. Die Acocephalinen und Bythoscopininen Japans. *Sapporo Coll. Agri. J.* **4** (7) : 279-325.
1915. Neue Cicadinen Koreas. *Sapporo Nat. Hist. Soc. Trans.* **5** : 154-84.
1930. Rhynchota. The Illustrated Thousand Insects of Japan. **1** : 1-198.
1931. [Homoptera.] 6000 illustrated insects of the Japan Empire. 1496 p.
1932. Hymenoptera-Diptera-Rhynchota. Illustrated Common Insects of Japan. **4** : 1-145.
1940. Homopterous insects collected at Kotosho (Botel Tabago) Formosa by Mr. Tadao Kano. *Insecta Matsumurana* **15** : 34-51.
- Melichar, L.** 1902. Homopteren aus West China, Persien, und dem Süd-Ussuri-Gebiete. *St. Petersburg Mus. Zool. Ann.* **7** : 76-146.
1903. Homopteren-Fauna von Ceylon. Verlag von Felix L. Damer. Berlin. 248 p.
1914. Homopteren von Java, gesammelt von Herrn. Edw. Jacobson. *Leyden Mus. Notes* **36** : 91-147.
- Merino, G.** 1936. Philippine Cicadellidae (Homoptera). *Philippine J. Sci.* **61** : 307-400.
- Metcalf, Z. P.** 1963. General catalogue of the Homoptera. Fascicle VI, Cicadelloidea, Part 9. Hecalinae. Agr. Res. Serv., U. S. Dep. Agr. 123 p.
1967. General catalogue of the Homoptera. Fascicle VI, Cicadelloidea, Part 10. Euscelidae. Agr. Res. Serv., U. S. Dep. Agr. 2695 p.
- Misra, C. S.** 1920a. The rice Leafhoppers (*Nephotettix bipunctatus* and *Nephotettix apicalis* Motsch.) *India Dep. Agr. Mem., Entomol. Ser.* **5** : 207-39.
- 1920b. The rice leafhoppers. *Pusa Entomol. Meeting Rep.* **3** : 433-43.
- [**Miwa, Yusaburo**] 1943. [A handlist of pest insects in Formosa] [*Formosa Agr. Soc. Pub.*] **16** : 1-242.
- Motschulsky, V. I. de** 1859. Homoptères. In *Insectes des Indes Orientales, et de Contrées Analogues. Étud. Entomol.* **8** : 25-118.
1863. Essai d'un catalogue des insectes de l'île Ceylan. *Soc. Nat. Moscow Bull.* **36** : 1-153.
- Müller, H. J.** 1949. Über Systematik und Phylogenie der Zikaden-Endosymbiosen. *Biol. Centbl.* **68** : 343-68.
- Naudè, T. J.** 1926. Cicadellidae of South Africa, a taxonomic and faunistic study. *Union So. Africa Dep. Agr. and Forestry, Entomol. Mem.* **4** : 1-106.
- Noualhier, J. M.** 1896. Note sur les Hémiptères récoltés en Indo-Chine et offerts au Museum par M. Pavie. *Paris Mus. d'Hist. Nat. Bull.* **10** : 251-59.
- Noualhier, J. M. & J. Martin.** 1904. Hémiptères recueillis par M. A. Pavie. Mission Pavie Indo-Chine 1879-1895. Etudes Diverses. *Recherches sur l'Histoire Naturelle de l'Indo-Chine Orientale* **3** : 167-85.
- Nuorteva, P.** 1954. On the significance of proteases and amylases in the life of *Empoasca flavescens* (F.) (Hom., Typhlocybidae) *Ann. Entomol. Fenn.* **20** : 76-79.
- Oman, P. W.** 1949. The Nearctic leafhoppers (Homoptera : Cicadellidae). A generic classification and check list. *Wash. Entomol. Soc. Mem.* **3** : 1-253.
- Osborn, H.** 1934. Hemiptera. Cicadellidae (Jassidae). Part II. *Insects of Samoa and other Samoan terrestrial Arthropoda* **4** : 163-92.
- Oshanin, V. T.** 1906. Verzeichnis der palaearktischen Hemipteren mit besonderer Berücksichtigung ihrer Verteilung im Russischen Reiche. II. Band. Homoptera. I. Lieferung. *Mus. Zool.*

- St. Petersburg Ann.* **11**: 1-192.
- Perkins, R. C. L.** 1905. Leafhoppers and their natural enemies (Pt. VI. Pipunculidae). *Hawaii Sugar Pl. Assoc., Div. Entomol. Bull.* **1** (4): 123-57.
- Pierce, W. D.** 1918. The comparative morphology of the order Strepsiptera together with records and descriptions of insects. *U. S. Natl. Mus. Proc.* **54**: 391-501.
- Puton, A.** 1886. Homoptera Ann. Serv. (Gulaerostria Zett. Fieb.) Sect. 1. Auchenorrhyncha Dumér. Cicadina Burm. Catalogue dos Hémiptères (Heteropteres, Cicadines et Psyllides) de la faune Paléarctique. 3rd ed. 3-100.
- Ritcher, G.** 1928. Untersuchungen an Homopterensymbionten. 2. Die Symbionten einiger exotischer Zikaden. *Zs. Morph. Ökol. Tiere.* **10**: 174-206.
- Schumacher, F.** 1915a. Der gegenwärtige Stand unserer Kenntnis von der Homopteren-fauna der Insel Formosa unter besonderer Berücksichtigung von Sauter'schem Material. *Berlin Zool. Mus. Mitt.* **8**: 73-134.
- 1915b. Homoptera. In H. Sauter's Formosa-Ausbeute. *Suppl. Entomol.* **4**: 108-42.
- Signoret, V.** 1879a. Essai sur les Jassides Stål, Fie. et plus particulièrement sur les Acocéphalides Puton. 1<sup>re</sup> partie. *Soc. Entomol. de France Ann.* **9**: 47-92.
- 1879b. Do. l. c., 259-80.
1880. Do. op. cit. **10**: 41-70.
- Singh-Pruthi, H.** 1930. Studies on Indian Jassidae (Homoptera). Part I. Introduction and description of some new genera and species. *Indian Mus. Mem.* **11**: 1-68.
1934. Entomological investigations on the spike disease of sandal (14). Jassidae (Homopt.). *Indian Forest Rec., Entomol. Ser.* **19** (4): 1-30.
- Stål, C.** 1862. Synonymiska och systematiska anteckningar öfver Hemiptera. *Svenska Vetensk.-Akad. Öfv. Förh.* **19**: 479-504.
1864. Hemiptera nonnula nova vel minus cognita. *Soc. Entomol. France Ann.* **4**: 47-68.
1870. Hemiptera insularum Philippinarum. Bidrag till Philippinska öarnes Hemipter-fauna. *Svenska Vetensk.-Akad. Öfv. Förh.* **27**: 607-776.
- Steinhaus, E. A.** 1946. Insect Microbiology. Comstock Publishing Co., Inc., Ithaca, New York. 763 p.
- [**Tanaka, Kenso**] 1932. [A list of Japanese citrus insects] *J. Plant Protect.* **19**: 570-85.
- Tuxen, S. L.** 1956. Taxonomists' glossary of genitalia in insects. Munksgaard, Copenhagen: 284 p.
- Van Duzee, E. P.** 1894. A catalogue of the described Jassoidea of North America. *Amer. Entomol. Soc. Trans.* **21**: 245-317.
- Walker, F.** 1851. List of the specimens of Homopterous insects in the collection of the British Museum **3**: 637-907.
1852. Supplement. List of the specimens of Homopterous insects in the collection of the British Museum **4**: 1119-88.
1858. Supplement. List of the specimens of Homopterous insects in the collection of the British Museum. 307 p.
- Wallace, A. R.** 1962. The Geographical Distribution of Animals. Vol. 1. Hafner, New York. 503 p. [First published 1876].
- Watanabe, F.** 1937. [Insect pests of trees in Japan] 1-487, 1-38, 1-34, 1-27, 1-10, 1-15.
- Wu, C. F.** 1935. Order XV. Homoptera. *Catalogus Insectorum Sinensium* **2**: 1-252.