

AN ABSTRACT OF THE THESIS OF

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(Name of Students) (Degree)

in ENTOMOLOGY presented on May 19, 1970  
(Major) (Date)

Title: THE NEARCTIC LEAFHOPPERS OF THE SORHOANUS  
COMPLEX (HOMOPTERA: CICADELLIDAE)

Abstract approved: *Redacted for Privacy*  
Dr. Paul W. Oman

The Nearctic leafhoppers placed in the genus Sorhoanus Ribaut by Oman (1949) were found to belong to several genera, some of which are Holarctic in distribution. None is properly placed in Sorhoanus as presently defined. The genera Sorhoanus, Zelenius Emel'yanov, Boreotettix Lindberg, Lebradea Remane, and Acharis Emel'yanov are redefined and their distribution and relationships discussed. A key is presented for the differentiation of the genera from other related elements in the Nearctic fauna.

The characterization of the genera and differentiation of species within the genera are primarily based on the inner genitalia of the male sex and the seventh sternum of the female. Of the 19 species assigned to Sorhoanus by Metcalf (1967), all were studied except acarifer (Lethierry) and fieberi (Metcalf). Twelve of them were placed generically: Sorhoanus contains assimilis (Fallen), schmidtii (Wagner), medius (Mulsant and Rey), and hypochlorus (Fieber).

Deltocephalus abiskoensis Lindberg, type-species of Arctotettix Linnavuori, is a synonym of Rosenus cruciatus (Osborn and Ball); thus Arctotettix is a junior synonym of Rosenus Oman. Zelenius Emel'yanov contains orientalis (De Long and Davidson), uhleri (Oman) and fidus (Knull). Boreotettix Lindberg contains caricis (Gillette and Baker); Acharis Emel'yanov contains ussuriensis (Melichar); and Lebradea Remane contains flavovirens (Gillette and Baker), and helvinus (Van Duzee). Sorhoanus bicornis Linnavuori is a junior synonym of flavovirens Gillette and Baker, bidentatus De Long and Davidson is the synonym of caricis Gillette and Baker. Three species, Deltocephalus debilis Uhler, Thamnotettix lenis Van Duzee, and Deltocephalus spicatus De Long, heretofore placed in Sorhoanus, appear not to be properly placed in any existing genera and remain of uncertain position.

The type-species of Lebradea Remane, calamagrostidis Remane, and three Palearctic Sorhoanus borrowed from Dr. A. F. Emel'yanov; suncharicus Dlabola, tritici (Matsumura), and minutulus Vilbaste, although not occurring in the Nearctic Region are nevertheless discussed in this paper.

One Holarctic distributed species, Deltocephalus xanthoneurus Fieber, originally included by Ribaut (1947) in Sorhoanus, and transferred to Cazenus by Oman (1949), is described and returned to Sorhoanus.

The Nearctic Leafhoppers of the Sorhoanus  
Complex (Homoptera: Cicadellidae)

by

Lucia Chia-yao Tao

A THESIS

submitted to

Oregon State University

in partial fulfillment of  
the requirements for the  
degree of

Master of Science

June 1971

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May 19, 1920

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## ACKNOWLEDGMENTS

I wish to express my sincere gratitude to my major professor, Dr. Paul W. Oman, Oregon State University, who suggested the problem, provided the specimens, and gave constant advice, guidance, and constructive criticism during this study.

I wish to thank Dr. Paul O. Ritcher, Chairman, Department of Entomology, and John A. Kiger, Jr., Minor professor, Department of Biochemistry, for reading the manuscript and for many helpful comments and other assistance.

The following institutions loaned the specimens for this investigation: U. S. National Museum, California Academy of Science and Ohio State University. I am grateful to the authorities of those institutions, and especially to Dr. Paul H. Arnaud, Jr. (California Academy of Science), Dr. Dwight M. De Long (Ohio State University), Dr. A. F. Emel'yanov (Zoological Institute of USSR, Academy of Science), and Dr. James P. Kramer (U. S. Department of Agriculture), and Dr. R. Remane (Zoological Institute of Philipps University), all of whom provided types or other authentically identified specimens, critical comments and much useful information. Without their help there would be many more problems still unresolved.

I also thank Miss Janice Cunningham, for her efficient typing of most of the original draft of this thesis.

This study was supported by Grant GB-7706 "Phylogeny and Distribution of Nearctic and Palearctic Leafhoppers, " from the National Science Foundation to Professor Paul Oman. A part of the literature search was possible through a Grant-in-Aid to Professor Paul Oman from the General Research Fund of the Oregon State University.

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# THE NEARCTIC LEAFHOPPERS OF THE SORHOANUS COMPLEX (HOMOPTERA: CICADELLIDAE)

## INTRODUCTION

This study is concerned primarily with the proper generic placement of the species of Nearctic leafhoppers placed by Oman (1949) in the genus Sorhoanus Ribaut, and with a redefinition of Sorhoanus and certain closely related genera. These steps become necessary if we are to understand the current distribution of Holarctic leafhopper taxa and their probable dispersal routes.

The genus Sorhoanus Ribaut, type-species Cicada assimilis Fallen, 1806, originally contained five Palearctic species. Oman (1949) assigned 14 Nearctic species to the genus, noting at the time that "As here interpreted the genus may contain forms of quite diverse origins." Subsequent authors have further contributed to the uncertainty of the generic limits of Sorhoanus by the removal or addition of species, or by the erection of subgenera within the genus. Metcalf (1967) lists 19 species under Sorhoanus; of these 12 are not placed in any subgenus, five are placed in the typical subgenus, and the remaining two are placed in two recognized subgenera. One species, Deltocephalus xanthoneurus Fieber, originally included by Ribaut in Sorhoanus, was erroneously transferred to Cazen by Oman (1949), while Deltocephalus ussuriensis Melichar was added by Dlabola (1955).



Thus it can be seen that Sorhoanus is comprised of a very heterogeneous assemblage of forms.

Since a heterogeneous assemblage prevents comprehension of relationships and hence of distribution, it is desirable that the classification of the organisms in question be revised so as to reflect their affinities more precisely. It is the objective of this study to redefine Sorhoanus, clarify the generic positions of the species included in or presumed to be related to the genus, and to work out the correct associations between related elements in the Nearctic and Palearctic Regions. In an effort to accomplish these objectives, generic descriptions are given for the genus-group taxa treated, taxonomic conclusions and phylogenetic inferences discussed, and descriptions and keys to the known Nearctic species presented.

A taxonomic work of this sort that attempts to portray the phylogeny of group can seldom be completed satisfactorily within a limited span of time. The fragmentary nature of our knowledge about geographic distribution and almost total lack of fossil evidence of leafhoppers as a group make any generalizations and conclusions regarding dispersal patterns premature and unsatisfactory. In the face of such difficulties taxonomists can only separate organisms by observed differences and associate them by their similarities so as to make probable natural groupings that will serve as bases for tracing their zoogeography.

## LITERATURE REVIEW

The genus Sorhoanus was established by Ribaut (1947), to contain five Palearctic species: assimilis (Fallen) (type species), xanthoneurus (Fieber), medius (Mulsant and Rey), schmidtii (Wagner), and acarifer (Lethierry). Dlabola (1949) erected a new subgenus, Rhoanus with hypochlorus (Fieber) as type species. Oman (1949) assigned 14 Nearctic species to Sorhoanus: bidentatus (De Long and Davidson), debilis (Uhler), caricis (Gillette and Baker), cadyi (Deay), flabellum (De Long), flavovirens (Gillette and Baker), helvinus (Van Duzee), lenis (Van Duzee), lutea (Gillette and Baker), orbiculus (De Long and Sleesman), orientalis (De Long and Davidson), spicatus (De Long), uhleri (Oman), and wilsoni (Oman), all previously placed in either Deltocephalus or Laevicephalus. As interpreted by Oman, the genus contained forms of diverse origins. Oman (1949) also transferred Deltocephalus xanthoneurus Fieber to the genus Cazenius Oman.

Linnavuori (1952) described a new subgenus Arctotettix, type-species Deltocephalus abiskoensis Lindberg, in Sorhoanus.

Emel'yanov (1964) established a new subgenus Cabrellus with type species minutus. In the meanwhile, he also added two new species: mediocris and pratensis to Sorhoanus.

Dlabola (1965) established the new subgenus Emeljanovianus, with medius (Mulsant and Rey) as type-species, added a new species

suncharicus, and transferred Deltocephalus kirtishenkoi Zachvatkin to the genus.

Vilbaste (1965) described a new species minutulus in the genus. Emel'yanov (1966) added another species, kerzhneri, to the genus. Metcalf (1967), reflecting the state of knowledge of the group prior to 1956, recognized 19 species and three subgenera (Sorhoanus, Rhoananus, and Arctotettix), in the genus.

Vilbaste (1965) reported S. (Arctotettix) abiskoensis (Lindberg) (1926) to be synonymous with Rosenus cruciatus (Osborn and Ball) (1899), type species of Rosenus Oman (1949). He also (1968) believed Sorhoanus kerzhneri Emel'yanov (1966) to be a junior synonym of S. tritici (Matsumura) (1902). Subsequently (1969) he found Sorhoanus acarifer (Lethierry) (1888) to be a senior synonym of Deltocephalus cornutus Matsumura (1915).

The genus Lebradea was described by Remane (1959), type-species calamagrostidis Remane (1959). He transferred Laevicephalus flavovirens Gillette and Baker (1985), and Sorhoanus bicornis Linnavuori (1953) to the genus. Dlabola (1967) described Lebradea stylispina. Vilbaste (1968) found that Lebradea karafutonis (Matsumura) (1911) was a senior synonym of stylispina Dlabola (1967). In 1969, Vilbaste found flavovirens Gillette and Baker (1895) is the same as bicornis Linnavuori (1953).

Emel'yanov (1966) removed two species, Laevicephalus

orientalis De Long and Davidson (1935), and Laevicephalus uhleri Oman (1931) from Sorhoanus, to erect a new genus Zelenius, with orientalis as type-species.

The genus Acharis was established by Emel'yanov (1966), with type-species of Deltocephalus ussuriensis Melichar (1902).

Emel'yanov (1966) transferred bidentatus De Long and Davidson (1935) from Sorhoanus to the genus Boreotettix. The genus was established by Lindberg (1952), with one species serricaudus (Knotkanen) (1949). Emel'yanov (1966) assigned a new species ribauti to Boreotettix. Emel'yanov placed debilis Uhler in the genus Rosenus Oman (1949).

In the following check list, and elsewhere in this paper, abbreviated citations are given to original descriptions of species. These citations refer to the Bibliography of the Cicadelloidea (Z. P. Metcalf, 1964. General Catalogue of the Homoptera. Fascicle VI. Agricultural Research Service. United States Department of Agriculture. 349 p.), in which complete literature citations are to be found.

Emel'yanov (1964) established a new subgenus Cabrellus with type-species minutus. In 1965, Vilbaste described a new species minutus in the genus Sorhoanus. In a reprint received from Vilbaste there is a hand written notation indicating minutulus as a replacement name for the preoccupied minutus Vilbaste. In order to avoid confusion with the two species involved, I use minutulus Vilbaste, a manuscript name, in this paper.

CHECK LIST OF TRIVIAL NAMES ASSIGNED TO OR  
AT SOME TIME ASSOCIATED WITH  
SORHOANUS AND RELATED GENERA

abiskoensis Lindberg, 1926b:112 (Deltoccephalus) Rosenus (synonym  
of cruciatus)

acarifer Lethierry, 1888b:253 (Deltoccephalus) Sorhoanus

assimilis Fallen, 1806a:22 (Cicada) Sorhoanus

aurantiacus Fieber, 1869a:218 (Deltoccephalus) Sorhoanus

bicornis Linnavuori, 1953a:116 (Sorhoanus) Lebradea (synonym of  
flavovirens)

bidentatus De Long and Davidson, 1935b:169 (Laeviccephalus) Bore-  
otettix (synonym of caricis)

cadyi Deay, 1927a:55 (Deltoccephalus) genus ? (synonym of debilis)

calamagrostidis Remane, 1959a:386 Lebradea

caricis Gillette and Baker, 1895a:95 (Thamnotettix) Boreotettix

cornutus Matsumura, 1915a:169 (Deltoccephalus) Sorhoanus (synonym  
of acarifer)

cruciatus Osborn and Ball, 1898f:77 (Deltoccephalus) Rosenus

debilis Uhler, 1876a:360 (Deltoccephalus) genus ?

fidus Knull, 1954c:57 (Sorhoanus) Zelenius

fieberi Metcalf, 1967:1459 Sorhoanus (synonym of aurantiacus)

flabellum De Long, 1938b:217 (Laevicephalus) Lebradea (synonym  
of helvinus)

flavovirens Gillette and Baker, 1895a:87 (Deltoccephalus) Lebradea

helvinus Van Duzee, 1917a:300 (Thamnotettix) Lebradea

hypochlorus Fieber, 1869a:215 (Deltoccephalus) Sorhoanus

karafutonis Matsumura, 1914a:210 (Deltoccephalus) Lebradea

kerzhneri Emel'yanov, 1966b:118 Sorhoanus (synonym of tritici)

kiritshenkoi Zachvatkin, 1953:248 (Deltoccephalus) Sorhoanus

lenis Van Duzee, 1925b:423 (Thamnotettix) genus ?

lutea Gillette and Baker, 1895a:106 (Cicadula) Boreotettix (synonym  
of caricis)

mediocris Emel'yanov, 1964f:50 Sorhoanus

medius Mulsant and Rey, 1855a:234 (Deltoccephalus) Sorhoanus

minutulus Vilbaste, 1965 (personal communication) Sorhoanus

minutus Emel'yanov, 1964f:51 (Sorhoanus) Cabrellus

minutus Vilbaste, 1965:60 Sorhoanus (nec minutus Emel'yanov, syno-  
nym of minutulus)

orbiculus De Long and Sleesman, 1929a:103 (Laevicephalus) genus ?  
(synonym of debilis)

orientalis De Long and Davidson, 1935b:167 (Laevicephalus) Zelenius

paratensis Emel'yanov, 1964f:50 Sorhoanus

reiberi Puton, 1877a:xxiv (Deltoccephalus) Sorhoanus (synonym of  
medius)

- ribauti Emel'yanov, 1966b:130 Boreotettix
- schmidti Wagner, 1939a:166 (Deltocephalus) Sorhoanus
- serricaudus Knotkanen, 1949c:41 (Cosmotettix) Boreotettix
- spicatus De Long, 1926d:74 (Deltocephalus) genus ?
- stylispina Dlabola, 1967:31 Lebradea (synonym of karafutonis)
- suncharicus Dlabola, 1965b:126 Sorhoanus
- tritici Matsumura, 1902a:391 (Deltocephalus) Sorhoanus
- uhleri Oman, 1931b:432 (Laeviccephalus) Zelenius
- ussuriensis Melichar, 1902c:144 (Deltocephalus) Acharis
- wilsoni Oman, 1932a:91 (Laeviccephalus) genus ? (synonym of lenis)
- xanthoneurus Fieber, 1869a:219 (Deltocephalus) Sorhoanus

## MATERIALS AND METHODS

This study was based upon specimens borrowed from eight institutions or individuals, and Nearctic specimens collected in Oregon, Idaho, Montana and California. Altogether approximately 1,000 specimens were examined, including representatives of most of the Palearctic and Nearctic species. Some type material (holotypes, allotypes or paratypes) of all Nearctic and Palearctic species listed as Sorhoanus in Metcalf's catalogue (1967), excepting acarifer (Lethierry) and fieberi (Metcalf), were examined.

The types of the North American species of Sorhoanus are located at the U. S. National Museum, California Academy of Science and Ohio State University. Representatives of Palearctic species were borrowed from Dr. R. Remane (Zoological Institute of Philipps University), and Dr. A. F. Emel'yanov (Zoological Institute of USSR Academy of Science).

All measurements were made with a calibrated linear ocular micrometer, and drawings were made with the use of a squared ocular grid in a stereoscopic microscope at 15, 45, or 90 diameters magnification. Body length measurements are from the apex of the head, excluding the antenna, to the posterior part of the abdomen or the tip of the forewings, whichever is greater. The width is the distance between the two lateral limits of the body. All measurements



are given in millimeters.

Descriptions and classifications are based primarily on the male genitalia, and female 7th sternum. To study the male genitalia, it is necessary to remove and macerate the abdomen. The method is as follows: remove the abdomen by means of two tiny dissecting needles, place in a ten percent solution of potassium hydroxide, and heat just short of boiling to dissolve all soft tissues. After this treatment, wash thoroughly with water to eliminate alkali remains, and finally preserve in glycerine in a small plastic vial.

For detailed study and drawing of male genitalia, it is necessary to remove styles, connective and phallus from the capsule. This entire genitalic assemblage is anchored within the capsule at three points. Dissecting needles are used to cut the membranes between the posterior part of phallobase and anal tube, and the tissues connecting the styles to the genital plates.

## CHARACTERS USED IN GENERIC CLASSIFICATION AND SPECIES DIFFERENTIATION

Characters used by early authors for generic differentiation of the Cicadellidae were primarily gross morphology of the head and thorax and venation of the forewing, with coloration no doubt also considered. Although these gross morphological characters appear to be indicators of general relationships, genera defined on such bases are found to contain very diverse elements when the structures of the inner genitalia of the male and seventh sternum of the female are considered. The species considered herein, although quite uniform with respect to external characters, show a diversity of genitalic characters in both sexes. Consequently, characters of the male genitalia and the female seventh sternum are used in the generic classification adopted.

The abdomen of the male is composed of 11 segments, nine of which are usually visible. In this study, only segments eight to ten are considered. The genital capsule (Figure 1) consists of the ninth abdominal segment, to the dorso-caudal aspect of which are attached the tenth segment and the anal tube (11th segment). The tergite of the ninth segment, called pygofer (Figure 3), is deeply incised dorsally for the reception of the tenth segment and appears to consist of two lateral plates. Each side of pygofer may be variously modified to extend as a distal lobe. The shape of pygofer lobes varies widely,

and is useful as a generic character. Ventrally, the genital capsule is differentiated into the basal valve and the paired distal plates. The shape of the distal portion of the plates varies in different species. The tenth segment is simple and collarlike in shape; in a general way, the shape and length of the tenth segment are useful in the definition of species.

The inner parts of the male genitalia are the phallus (Figure 2), the connective and the paired styles. The distal portion of the phallus is free; basally, it is attached to or fused with the connective. The phallus (Figure 2) consists of two parts. The ventral part is the aedeagus, which is a tubular structure, usually sclerotized, and contains the ejaculatory canal. Sometimes it has accessory processes on the apex, and/or small retorse projections (called corniculi) on the surface. These structures are useful in defining species and genera. The dorsal part of the phallus, called the phallobase, is usually shorter than the aedeagus and broader at posterior and anterior parts. The posterior part of the phallobase is attached to the tenth segment by a membrane.

The connective (Figure 2), to which both the styles and aedeagus are attached, is a relatively simple basal plate, lying above the valve. The basic pattern of the connective is an important taxonomic character. The paired styles (Figure 2), which lie on each side of the connective, are highly modified distally. These modifications

usually have specific significance. The distal part of the style terminates in an apical denticle and a subapical denticle (Figure 2). Muscles are attached to the basal end of each style cephalad of its articulation with the connective. Each style is attached to the corresponding genital plate laterally by connective tissue.

The genital structures of male leafhoppers are usually symmetrical, which is considered to be the primitive condition. Asymmetry does occur, however, and appears to have arisen independently in different groups. In the group which I studied, asymmetry involving the aedeagus is found most frequently.

In general, the female seventh sternum is much easier to examine than the genitalia of male, but, in some cases the seventh sternum is not sufficiently different to distinguish between species within a genus. The most useful female character for differentiating species is the contour of the posterior margin of the seventh sternum.

The terminology used in referring to cells of the wings is a modification of the Comstock-Needham system. The anteapical cells (Figure 4) are typically three in number, although the outer one may be absent. The inner anteapically cell is considered to be present even though it remains open basally.

The morphological nomenclature used in this paper follows that of J. R. De La Torre-Bueno (1950) and A. F. Emel'yanov (1967). The

characters in the keys and descriptions are used only for convenience and easy identification; they do not necessarily indicate phylogenetic relationships.

## DISTRIBUTION

The genus Sorhoanus is restricted to the Palearctic Region except for the single Holarctic species xanthoneurus (Fieber). The geographical range extends throughout Korea, central Russia, western Russia, Europe, Middle East and Asia. In Korea, there are two species known: S. assimilis (Fallen), and S. acarifer (Lethierry). In the USSR, there are four recorded species: S. assimilis (Fallen), S. medius (Mulsant and Rey), S. acarifer (Lethierry), and S. hypochlorus (Fieber). These species extend eastward from Siberia to eastern Russia. All the species within the genus are found in Europe; their geographical range covers northern Europe, eastern Europe, central Europe and western Europe. In the middle East, there are two species recorded: medius (Mulsant and Rey), and assimilis (Fallen). In Asia, there is one species recorded: hypochlorus (Fieber). The species xanthoneurus (Fieber) is Holarctic in distribution; the range covers Europe and North America.

The geographical range of the genus Zelenius Emel'yanov is restricted to Nearctic Region, extending southward from Canada into southern United States. The species Z. fidus (Knull) has been found only in Texas.

The species caricis Gillette and Baker of genus Boreotettix Lindberg is found in Rocky Mountain states and Ohio.

The genus Lebradea Remane is found in north Germany and North America. In the north of Germany there is one species recorded: L. calamagrostidis Remane. In the North America, there are two species recorded: L. flavovirens (Gillette and Baker), and L. helvinus (Van Duzee); L. helvinus is restricted to the western United States.

The genus Acharis Emel'yanov, only has one species, ussuriensis(Melichar), recorded only from the USSR.

## TAXONOMIC CONCLUSIONS

Preliminary investigation of taxa available suggested their placement of Nearctic species in Sorhoanus was questionable. The genital structures of specimens representative of Nearctic species are entirely different from that of assimilis (Fallen), the type-species of Sorhoanus. Pictorial comparison of genital structures of Arctotettix Linnavuori with Sorhoanus Ribaut also suggested striking differences, throwing further doubt on the accuracy of the current definition of the genus in North America. Much of the pertinent literature dealing with the taxonomy of Sorhoanus and related genera is in Russian, German, or other foreign languages making it difficult to interpret the views of other workers precisely.

After examining the male genitalia of most species except acarifer (Lethierry) and fieberi (Metcalf) classified by Metcalf (1967), I conclude that four of them: assimilis (Fallen), medius (Mulsant and Rey), schmidti (Wagner), and hypochlorus (Fieber) belong to Sorhoanus. None of the strictly Nearctic species is properly assigned to Sorhoanus. Of the remaining species, some had already been moved to other genera: flavovirens Gillette and Baker to Lebradea Remane (1959), orientalis De Long and Davidson, uhleri Oman to Zelenius Emel'yanov (1966), bidentatus De Long to Boreotettix Lindberg (1966), and ussuriensis Melichar to Acharis Emel'yanov (1966).



Besides the above mentioned species, I think fidus Knull belongs to Zelenius Emel'yanov, because they have general resemblance of male genitalia. Remane also assigned this species to Zelenius (personal communication). The species helvinus has to be placed in Lebradea Remane. It is closely related to the type-species of Lebradea, calamagrostidis Remane, being closer than is flavovirens, but apparently specifically distinct.

I have examined the holotypes of lenis Van Duzee, spicatus De Long, and debilis Uhler, borrowed from the California Academy of Science, Ohio State University, and U.S. National Museum, respectively. I believe each species belongs to a genus of its own; at least they are not Sorhoanus.

Emel'yanov (1966) placed debilis Uhler in Rosenus Oman. It resembles Rosenus species in the retrorse projections on the surface of aedeagus, but the aedeagus of Rosenus is somewhat flat compared to that of debilis Uhler which is round. The shape of aedeagus in lateral view differs also. Because of these differences, debilis should not be assigned to Rosenus.

J. P. Kramer (personal communication), reported that based on a study of the concealed male genitalia, both lutea Gillette and Baker (1895) and caricis Gillette and Baker (1895) are the same as bidentatus De Long and Davidson (1935); caricis has priority.

Thus the only Nearctic Sorhoanus is the Holarctic xanthoneurus (Fieber), which is beyond any doubt congeneric with the

type-species of assimilis (Fallen) (R. Remane and A. F. Emel'yanov, personal communication). Remane considered xanthoneurus generically different from the types of Cazenus Oman, which is in disagreement with Oman's classification in 1949.

Of the four subgenera of Sorhoanus established by previous authors: Rhoananus Dlabola, Arctotettix Linnavuori, Cabrellus Emel'yanov, and Emeljanovianus Dlabola, I retain Rhoananus in the genus, even though the male genitalia of hypochlocus (Fieber) are quite different from typical Sorhoanus; they do have two pairs of apical projections on the aedeagus. I also agree with Dlabola that medius (Mulsant and Rey) and suncharicus Dlabola should have their own subgenus Emeljanovianus Dlabola, because of stout aedeagus and two large pairs of apical projections.

The structure of male genitalia in Arctotettix and Cabrellus is very different. Since the type-species of Arctotettix, abiskoensis (Lindberg) (Figures 34, 35, 36, 37) is already known to be a synonym of Rosenus cruciatus, Arctotettix Linnavuori becomes a junior isogenotypic synonym of Rosenus.

On the basis of a pictorial comparison, the type-species of Cabrellus, minutus Emel'yanov (1966), having only one pair of apical projections of aedeagus, and a median incision of the apex of the aedeagus, ~~these characters~~ does not fit the concept of Sorhoanus. Thus I really doubt that Cabrellus should be retained in Sorhoanus;

rather, it appears to warrant full generic rank\$.

Based on the specimens of minutulus Vilbaste (Figures 26, 28) and Deltocephalus tritici Matsumura (Figures 30, 31) borrowed from Emel'yanov, I believe these two species belong to the genus Sorhoanus. S. minutulus is very close to assimilis (Fallen) and is possibly a subspecies of assimilis; tritici is similar to xanthoneurus (Fieber).

On the basis of a pictorial comparison, I consider mediocris Emel'yanov (1966) to be a Sorhoanus, because it resembles assimilis in general and has two pairs of apical retrorse projections on the aedeagus. The species paratensis Emel'yanov (1966), with only one pair of apical projections of aedeagus, branched distally, has characters not found in Sorhoanus, throwing further doubt on the position of the species. From Vilbaste's illustration (1965), S. acarifer (Lethierry), with one pair of apical projections of aedeagus, seems much closer to Lebradea Remane than to Sorhoanus.

KEY TO SORHOANUS AND RELATED GENERA AND SPECIES

1. Aedeagus asymmetrical ( Figures 85, 86) . . Lemellus Oman
- 1<sup>a</sup> Aedeagus symmetrical . . . . . 2
2. Pygofer lobes extended distally or mesally;  
margins not smooth, with hooked, quadrate  
or irregular projections ( Figures 1, 33, 42) . . . . . 8
- 2<sup>a</sup> Pygofer lobes normal, not extended; distal  
margins smooth . . . . . 3
3. Aedeagus with apical retrorse projections  
( Figures 1, 48) . . . . . 6
- 3<sup>a</sup> Aedeagus without apical retrorse projections  
. . . . . Zelenius Emelyanov 4
4. Aedeagus stout basally in lateral view,  
antero-ventral angle bluntly rounded,  
not pointed ( Figures 62, 63, 64) . . . . . Z. orientalis
- 4<sup>a</sup> Aedeagus in lateral view, with antero-  
ventral angle sharply pointed ( Figures  
69, 70, 72) . . . . . 5
5. Connective with an elongate projection on the  
the posterior margin ( Figure 68) . . . . . Z. uherli
- 5<sup>a</sup> Connective without a posterior projection  
( Figure 71) . . . . . Z. fidus

6. Apex of aedeagus with two pairs of lateral processes . . . . . Cazenus Oman
- 6<sup>a</sup> Apex of aedeagus attenuated, with not more than one pair of small lateral processes (Figures 87, 88) . . . . . Laevicephalus De Long
7. Genital plates bilobed on the outer margin, aedeagus with one pair of elongate and decurved apical process, pygofer lobes extended slightly ventrally to form a small hook (Figures 89, 90) . Verdanus Oman
- 7<sup>a</sup> Genital plates not bilobed on the outer margin . . . . . 8
8. Genital plates broad, abruptly pointed at apex; valve triangular; aedeagus with a basal submembranous hood-like extension for attachment . . . . . Giprus Oman
- 8<sup>a</sup> Genital plates broad basally, gradually tapering apically . . . . . 9
9. Pygofer lobe extended mesally as a quadrate process, sinuated at margin; aedeagus without apical retrorse projections (Figures 39, 42) . . . . . Boreotettix Lindberg,  
B. caricis

- 9<sup>a</sup> Pygofer lobe extended mesally as a hook-like  
or irregular process on each side at cadual  
distal portion, apex of aedeagus with one or  
two pairs of retrorse projections . . . . . 10
10. Aedeagus with paired lateral projections apically  
. . . . . Lebradea Remane 11
- 10<sup>a</sup> Aedeagus with two pairs of retrorse  
projects apically . . . . . Sorhoanus Ribaut 13
11. Length of lateral projection of aedeagus,  
about 1/4 length of aedeagus (Figures 48, 50)  
. . . . . L. flavovirens
- 11<sup>a</sup> Length of lateral projections of aedeagus  
about or less than 1/8 length of aedeagus . . . . . 12
12. Apex of aedeagus rounded, lateral projections  
much less than 1/8 length of aedeagus  
(Figures 53, 54) . . . . . L. helvinus
- 12<sup>a</sup> Apex of aedeagus angled, lateral projections  
about 1/8 length of aedeagus (Figures 43, 44)  
. . . . . L. calamagrostidis
13. Aedeagus short and robust, about the same  
length as connective. Pygofer lobe extended  
irregularly, forming an emargination (Figures  
20, 21, 23) . . subgenus Rohananus Dlabola, S.(R.) hypochlorus

- 13<sup>a</sup> Aedeagus longer than connective,  
pygofer lobes not as above . . . . . 14
14. Pygofer lobes extended mesally as  
a hook on each side . . . . . 15
- 14<sup>a</sup> Pygofer lobes extended mesally as a  
quadrate process, aedeagus robust  
sinuated at lateral edge of subterminal  
projections, gonopore elongate  
(Figures 32, 33) . . . Acharis Emel'yanov, A. ussuriensis
15. Anal tube very long, about three times  
the length of pygofer at mid-dorsal line.  
Phallobase broad anteriorly and posteriorly.. . . . 17
- 15<sup>a</sup> Anal tube broad and short, not longer than  
pygofer at mid-dorsal line. Phallobase  
broad at base and abruptly tapered distally. . . . . 16
16. Aedeagus with terminal retrorse projections  
shorter than the subterminal retrorse  
projections (Figures 24, 27) . . . . . S. suncharicus
- 16<sup>a</sup> Aedeagus with terminal retrorse projections  
broader, and longer than the subterminal  
retrorse projections (Figure 14). . . . . S. medius
17. Apex of aedeagus flat or round . . . . . 19
- 17<sup>a</sup> Aedeagus slender, tapered at apex . . . . . 18

18. Aedeagus pointed apically, phallobase  
about 2/3 length of the aedeagus  
(Figure 11) . . . . . S. xanthoneurus
- 18<sup>a</sup> Aedeagus not distinctly pointed apically,  
phallobase less than half as long as  
aedeagus (Figures 30, 31) . . . . . S. tritici
19. Aedeagus with terminal retrorse  
projections appressed to the sub-  
terminal retrorse projection  
(Figure 8) . . . . . S. schmidtii
- 19<sup>a</sup> Aedeagus with subterminal retrorse  
projections not appressed to the terminal  
retrorse projections . . . . . 20
20. Aedeagus S-shaped in lateral view (Figure 3)  
. . . . . S. assimilis
- 20<sup>a</sup> Aedeagus straight, not curved in lateral  
view (Figure 28) . . . . . S. minutulus



## DESCRIPTIONS OF GENERA AND SPECIES

Sorhoanus Ribaut

Sorhoanus Ribaut, Bull. Soc. Hist. Nat. Toulouse 81-85, 1946. Type-species by original designation, Cicada assimilis Fallen, 1806

Rather slender, yellowish-green leafhoppers, ranging from 3.0 to 4.5 mm. in length, the ratio of length to width nearly constant. Head usually wider than pronotum, anterior margin rounded to the front; crown convex, about one and one-half times as long as medially next the eye. Pronotum small. Forewing long and slender, may or may not cover the abdomen; appendix well developed; inner anteapical cell closed basally.

Male genitalia structures are not uniform in this group. The distally pointed genital plates nearly cover the caudo-ventral opening, extending one-fifth their length beyond the pygofer lobes; usually with a row or tuft of eight to 12 setae on the posterior margins laterally.

Ventral margin of pygofer lobe extended mesally as paired hook-like appendages on each side caudally, highly sclerotized; outer surface of lobes with a cluster of coarse setae along the submargin distally.

Phallus stout, roughly L-shaped in lateral view. Aedeagus with two pairs of retrorse projections near apex; one pair terminal and one pair subterminal, of various shapes. Aedeagus much longer

than phallobase, lacking corniculi. Phallobase widened anteriorly and posteriorly. Gonoduct opens through the gonopore ventrally before the apex.

Style very uniform, lateral margin from base to beyond subapical denticle slightly reflexed to form a fold on each side; the distal inner surface of apical denticle with a row of fine setae; numerous scattered setae between apical denticle and subapical denticle; distal portion of apical denticle pointed, in comparison to the condition in closely related genera.

Connective linear, with or without two projections at posterior margin; a small opening at center, usually observable only with the highly pigmented area of the connective, attached to the aedeagus by membrane.

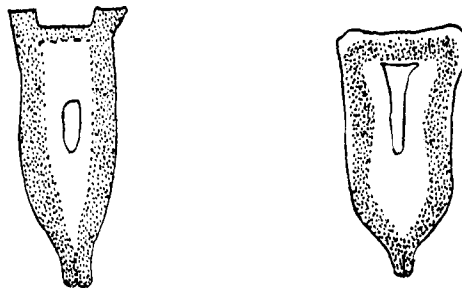


Figure 1. Connective of Sorhoanus Ribaut.

Shape of posterior margin of female seventh sternum variable; margin notched, with or without median incision.

Sorhoanus assimilis (Fallen)  
(Figures 1, 2, 3, 4, 5, 6)

Cicada assimilis    Fallen, 1806 a:22

Body slender, yellowish-green in color, wings transparent without brown spots; shorter in female and not covering tip of abdomen. Size extremely variable but structure uniform. Males 3.5 to 4.0 mm. long; females 3.7 to 4.5 mm.

Size of genitalia variable, pygofer lobes (Figures 1, 3) with two hooks on the distal portion, projecting slightly backward. Anal tube (Figure 3) of male elongate, about three times the length of the pygofer on mid-dorsal line. Plates (Figure 1) pointed at apex, extending about one-fifth of their length beyond pygofer lobes. Aedeagus (Figure 2) rounded and flattened distally, with a very small pair of terminal retrorse projections, about one-eighth as long as the subterminal retrorse projections. Phallobase broadly constricted medially. Style tapering at apical denticle, apex attenuated, not decurved. Connective with two projections on the posterior margin on either arm.

Female seventh sternum (Figure 6) notched posteriorly, with a triangular median incision, shorter laterally, with eighth sternum visible.

Distribution: Widely distributed, geographical range extending

from Korea through Siberia to Eastern USSR, northern, central and eastern Europe.

Sorhoanus schmidtii (Wagner)  
(Figures 7, 8, 9, 10)

Deltocephalus schmidtii Wagner, 1939a:166

Rather slender; male bright green, wings extending beyond the tip of abdomen; female pale green, wings much shorter than the abdomen. Males 4.2 mm. long; females 3 mm. long.

Male genitalia (Figures 8, 10) with anal tube about two times of the length of the pygofer on mid-dorsal line. Hooks of pygofer lobes not well developed, projecting slightly caudad. Male plates rounded distally, extending about one-fifth their length beyond pygofer lobes. Aedeagus stout (Figures 8, 9), the subterminal pair of the retrorse apical projections robust, much longer than the terminal pair. Phallobase, very broad anteriorly, with a narrow constriction before the posterior end. Gonoduct opening subterminally. Styles, decurved at apical denticle, with sinuated margins in the inner apical surface. Connective similar to assimilis (Fallen), with two small projections on the posterior margin.

Female seventh sternum (Figure 7) notched posteriorly with two deep emarginations beside the middle, base rounded; eighth sternum triangular in shape.

Distribution: Only found in eastern USSR, Bavaria and Swabia.

Sorhoanus xanthoneurus (Fieber)  
(Figures 11, 12, 13, 15, 16)

Deltocephalus xanthoneurus Fieber, 1869a:219

Sexual dimorphism evident. Males about 3.5 mm. long, body slender, color bright green, with several brown stripes on crown, pronotum and scutellum; wings mostly green with scattered brown markings along veins. Females robust, about 3.9 mm. long, pale yellow, with two black bends on anterior margin of the crown laterally.

Male genitalia slender, plates pointed distally, extending one-fifth their length beyond pygofer lobes. Hook of pygofer lobe not well developed, extending irregularly toward ventral, to form an emargination, with two small projections on either end (Figures 12, 13). Anal tube very long and slender in comparison with other species in the genus, about two and one-half times the length of pygofer at mid-dorsal line. Aedeagus (Figures 12, 15) pointed at apex, gonopore subterminal, ventral. Phallobase broadly constricted medially. Apical denticle tapering distally, slightly decurved. Connective as in assimilis (Fallen), with two projections on the posterior margin.

Female seventh sternum (Figures 16) notched posteriorly, with a small triangular median incision. Base of the seventh sternum rounded. Pygofer pointed at apex.

Distribution: The only species with a Holarctic distribution; occurring over the whole of Europe and into Asia and North America; occurring from Canada to Mexico.

Sorhoanus (Emeljanovianus) medius (Mulsant and Rey)  
(Figures 14, 17, 19)

Deltocephalus medius Mulsant and Rey, 1855a:234

Sorhoanus (Emeljanovianus) medius Dlabola, 1965b:125

Body robust, pale green in color; and distinguishable from all others by the two black spots on the anterior margin of crown; several brown spots on crown behind the black spots. Wings of the female shorter than the abdomen, not covering tip. Males 3.4 to 3.6 mm. long; females 3.9 to 4.2 mm.

Male genitalia stout, with a large hook on mesal surface on each pygofer lobe, extending past midline. Anal tube (Figure 16) broad and shorter than pygofer on mid-dorsal line. Male plates rounded apically, extending one-fourth their length beyond pygofer lobes. Aedeagus (Figure 14) rounded distally, with a pair of large terminal retrorse projections three times wider and longer than subterminal pair. Gonopore opens on the ventral side subterminally. Phallobase attenuated, broad basally, narrowed distally, in outline bottle-shaped. Style elongate, with short apical denticle, not very tapered at apex, stretch downward. Connective without posterior projections.

Female seventh sternum (Figure 19) emarginate posteriorly, with a medium rounded emargination, and angled at each side.



Distributions: Widely distributed, from central USSR to eastern USSR, central Europe and Middle East.

Sorhoanus (Rhoananus) hypochlorus (Fieber)  
(Figures 18, 20, 21, 22, 23)

Deltocephalus hypochlorus Fieber, 1869a:215

Body medium and slender, yellowish green in color; usually without any markings on crown, pronotum or scutellum; sometimes with two black spots on pronotum; wings transparent, without brown spots, shorter in female and not covering tip of abdomen. Males 3.0 to 3.3 mm. long; females 3.9 to 4.1 mm.

Structure of male genitalia quite different from other Sorhoanus. Each pygofer lobe (Figure 21) bearing a pair of blunt, short projections on the mesal surface; genital plates rounded apically, shorter than pygofer. Anal tube (Figure 20) small, much shorter than the length of pygofer on mid-line. Aedeagus (Figures 22, 23) very robust, with a large apex, about the same length as connective; terminal pair of retrorse projections small, in lateral view terminal pair overlaps the subterminal pair, but these structures not distinguishable as two pairs in ventral view. Gonopore on ventral side subterminally. Phallobase (Figure 23) attenuated, broad basally and gradually tapered distally. Style slender and short, with a truncated apical denticle, distal margin sinuated. Connective without two projections on the posterior margin on either arm.

Female seventh sternum (Figure 18) with a deep median

incision; eighth sternum visible laterally.

Distribution: Widely distributed, the range extending from central USSR to central and southern Europe, and Asia.

Lebradea Remane

Lebradea Remane, Sonderdruck aus "Zoologischer Anzeiger" Bd. 163, Heft 11/12, 385-391, 1959. Type species by original designation, Lebradea calamagrostidis Remane, 1959.

Large and rather slender leafhopper, yellowish-green in color, ranging from 4.75 mm. to 5.2 mm long in female; 4.0 mm. to 4.5 mm. in male. Head wider than pronotum, anterior margin of head more pointed in female than in male; crown convex, about one and one-half times as long as medially next the eye. Pronotum about one-half as long as wide, very small compared to other genera. Forewings long and slender, extending well beyond the tip of abdomen; appendix well developed; inner anteapical cell closed basally.

Male genitalia quite uniform in the genus. Genital plates rounded distally, as long or little longer than pygofer lobes, covering the caudo-ventral opening; lateral posterior margins of plates with a row of eight to ten fine setae.

Ventral margin of pygofer lobe extended mesally as paired hook-like appendages on each side at caudally, highly sclerotized, a cluster of coarse setae distally on the outer surface along laterally submargin.

Phallus, roughly L-shaped in lateral view. Aedeagus slender, much longer than the phallobase, paired lateral projections at apex,

length of the projection variable but useful as a criterion for species differentiation. The gonoduct opens through the gonopore on the ventral side subterminally. Phallobase somewhat bottle-shaped.

Lateral margin of style from base to beyond subapical denticle deeply reflexed. The apical denticles decurved as two hooks on each side, with a cluster of stout setae located between the apical denticle and subapical denticle, numerous fine setae scattered on the inner surface of style distally.

Connective simple as in Boreotettix, but constricted medially; phallus feebly attached to connective.

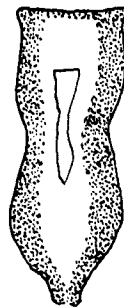


Figure 2. Connective of Lebradea Remane.

Female seventh sternum very large, strongly produced posteriorly to form a large projection, having a median incision. Eighth sternum visible laterally. The seventh and eighth sterna with little variation within the genus; lacking value in species differentiation.

Lebradea calamagrostidis Remane  
(Figures 43, 44, 45, 46, 47)

Lebradea calamagrostidis Remane, 1959a:386

Compared to the other species of the genus, body more slender and brighter green in color. Little difference in the size and color of the two sexes; males 4.0 to 4.2 mm. long; females 4.4 to 4.7 mm. With several brown bands along the anterior edge of crown; some light-brown markings on the crown. Forewing not hyaline, extending beyond the tip of abdomen, outer anteapical and inner anteapical cells present, outer anteapical cell usually very small.

Male genitalia with apically rounded genital plates (Figures 44, 45), about the same length as pygofer lobes. Ventral angles of pygofer lobes terminating in a mesally directed hook-like extensions directed meso-ventral; posterior margins of pygofer (Figure 45) below anal tube produced to form subangular projections. Anal tube longer than the pygofer on the mid-dorsal line. Aedeagus (Figures 43, 44) slender with an angled apex, lateral projections about one-eighth length of aedeagus or a little longer. Gonopore opening on the ventral side subterminally. Phallobase bottle-shaped, broadened at base. Lateral margin of style (Figure 43) from base to beyond subapical denticle reflexed, the apical denticle decurved as a hook, with stout setae between the apical denticle and subapical denticle,

numerous fine setae scattered on the inner surface of distal portion.  
Connective linear being constricted medially.

Female seventh sternum (Figure 47) with a median posterior projection having a small median incision. Eighth sternum visible.

Distribution: Only recorded from North Germany.

Lebradea flavovirens (Gillette and Baker)  
(Figures 48, 49, 50, 51, 52)

Deltocephalus flavovirens Gillette and Baker, 1895a:87

Lebradea flavovirens Remane, 1959a:386

Resembles calamagrostidis Remane in general appearance, rather stout, male green color, ranging from 4.0 to 4.3 mm. in length; female yellowish-green, ranging from 4.8 to 5.2 mm. in length. Crown with brown spots and bands along the anterior margin. Wing hyaline, extending well beyond the tip of abdomen in both sexes. Outer and inner anteapical cells present, outer anteapical cell usually smaller.

Male genitalia with apical subtruncate genital plates (Figure 48), longer than pygofer lobes. Ventral angles of pygofer lobes terminating in mesally directed hook-like extension, posterior margins in profile slightly extended (Figure 49). Anal tube longer than the pygofer on the mid-dorsal line. Aedeagus (Figure 50) slender, with angled apex, and two elongate lateral projections, about one-fourth length of aedeagus. Gonopore opening on the ventral side subterminally. Phallobase as in calamagrostidis; bottle-shaped. Style and connective (Figure 50) almost the same in calamagrostidis, but the apical denticle more decurved in flavovirens.

Female seventh sternum (Figure 52) with a median quadrate



projection in the posterior margin of which there is a small notch;  
very similar to calamagrostidis; eighth sternum visible laterally.

Distribution: Recorded in eastern and western Canada, northern, western and eastern United States.

Lebradea helvinus (Van Duzee)  
(Figures 53, 54, 55, 56, 57)

Thamnotettix helvinus Van Duzee, 1917a:300

Very similar to calamagrostidis Remane, but large and yellowish-green in color not bright. Crown with light brown markings, and bands along the anterior margin. Wing not transparent, extending well beyond the tip of abdomen in both sexes. Outer and inner antepical cells present, outer cell larger than usual in the genus. Males 4.1 to 4.5 mm. long; females 4.9 to 5.2 mm. long.

Male genitalia (Figures 53, 54, 55) with distally subtruncate genital plates, longer than pygofer lobes. Ventral angles of pygofer lobes terminating in paired hook-like processes directed caudad; posterior margins of pygofer smooth, not angularly projected caudally. Anal tube much longer than the pygofer on the mid-dorsal line. Aedagus slender, with a round and slightly flat apex, the two lateral projections very small, much less than one-eighth length of aedeagus. Gonopore opens on the ventral side subterminally. Phallobase, style and connective are the same in flavovirens.

Female seventh sternum (Figure 57) very close to calamagrostidis and indistinguishable from it; eighth sternum visible laterally.

Distribution: Only found in Washington, Oregon, California and Alaska.

Zelenius Emel'yanov

Zelenius Emel'yanov, Entom. Obozr. 45:129-130, 1966. Type species by original designation, Laevicephalus orientalis De Long and Davidson, 1935.

Large leafhoppers, body robust, ranging in length from 3.7 to 4.5 mm. in female, 3.05 to 3.7 mm. in male; ratio of length to width nearly constant, about 2.5 to 1. Color exceedingly variable between sexes, females bright yellowish-green; males yellowish-green, some with hyaline brown spots on the wings. Head is wider than pronotum, anterior margin rounded to the front; crown convex. Forewings long and stout, covering the abdomen; inner anteapical cell either open or closed basally.

Structure of male genitalia various, especially as to size of aedeagus and shape of connective. Plates shorter than pygofer lobes, sharply pointed distally, bearing a row of eight to 12 setae on the posterior margin laterally.

Pygofer lobes not extended ventrally, margins straight without processes, a cluster of coarse setae distally on outer surface of the submargin.

Aedeagus in dorso-ventral view slender, apex sharp; the lateral view stout or pointed basally, tapering rather abruptly to sharply pointed apex, edges serrate. Phallobase rectangular in shape in

dorso-ventral view, slightly broader anteriorly and posteriorly, not constricted medially. Gonoduct opening terminally.

Style very uniform, quite stout, lateral margin from base to beyond subapical denticle deeply reflexed, to form a deep fold on each side. Apical denticle subtruncated at apex and projected slightly laterad; two rows of fine setae scattering located on the inner and outer surface of distal apex.

Connective in dorso-ventral outline varying from an elongate hexagon to a vase-shaped structure, (this refers to the pigmented area of connective, not the total structure), with a small opening on the med-line basally. Connective and phallus articulated firmly.

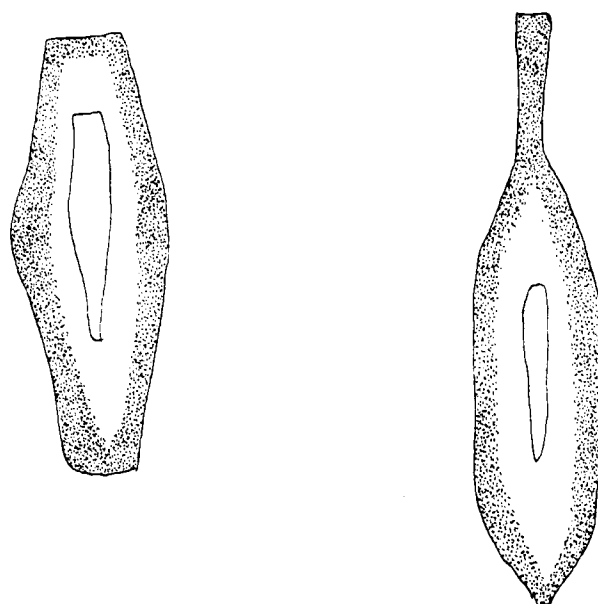


Figure 3. Connective of Zelenius Emel'yanov.

Female seventh sternum very uniform in the genus, and lacking variations of specific significance; posterior margin projecting downward, with a deep median incision.

Zelenius orientalis (De Long and Davidson)  
(Figures 59, 60, 61, 62, 63, 64, 73)

Laevicephalus orientalis De Long and Davidson, 1935b:167

Zelenius orientalis Emel'yanov, 1966b:129

Rather robust leafhoppers, the two sexes with striking differences in size and color. Males much smaller, ranging from 3.0 to 3.5 mm. in length, bright yellowish-green leafhoppers, with dark brown spots on interveins of wing. Females about 4.1 to 4.5 mm. in length, without dark brown spots on wing, forewing extending beyond the tip of abdomen, uniform pale green in color. Outer anteapical cell present, inner anteapical cell sometimes absent in female.

Male genitalia (Figure 58) with distally pointed plates, slightly overlapped, covering the caudo-ventral opening, very short, about half the length of pygofer lobes. Pygofer lobe elongate, about the same length or longer than the anal tube, inner surface straight, not extended mesally; outer surface of distal lobes with a cluster of coarse setae along laterally submargin. Anal tube (Figure 60) very small, shorter than the length of pygofer on mid-dorsal line. Phallus slender, aedeagus (Figures 61, 62, 63, 64) slender and with posterior end sharp in ventral view, stout basally and blade-like in lateral view, tapering rather abruptly to pointed apex, edge of aedeagus serrate. Phallobase broadened posteriorly. Gonopore opens

terminally. Style slightly twisted backward, the apical denticle truncate, with serrate margin and distal inner surface with a row of fine setae; numerous scattering fine setae along the edge of subapical denticle. Connective linear, like an elongate hexagon; with a small opening at center.

Female seventh sternum (Figure 73), posterior margin projected, with a deep median incision.

Distribution: Recorded from Canada, northeastern, southeastern United States, and Oregon.

Zelenius uhleri (Oman)  
(Figures 65, 66, 67, 68, 69, 70)

Laevicephalus uhleri Oman, 1931b:432

Zelenius uhleri Emel'yanov, 1966b:130

Very similar to orientalis (De Long and Davidson). The two species difficult to distinguish by external appearance or internal male genitalia. Specimens examined from different localities showed there is a wide variation within the species (Figures 67, 68). In general, medium sized leafhoppers, with remarkable differences between sexes in size and color. Males from 3.5 to 3.7 mm. long, bright yellowish-green, elytra occasionally black, in part or wholly; females from 4.2 to 4.5 mm. long, pale green in color with smoky white green wings, tip of last dorsal segment of female black. Inner anteapical and outer anteapical cells usually present, inner anteapical cell absent in some specimens.

Structure of male genitalia similar to orientalis except to the aedagus and connective. Aedeagus in lateral view (Figures 69, 70), with antero-ventral angle sharply pointed and tapered posteriorly. Connective (Figures 67, 68) with an elongate projection on the posterior margin, forming a vase-shaped structure. Elongate projection involving the pigmented area; length of projection varying from one specimen to another specimen.



Female seventh sternum indistinguishable from that of  
orientalis.

Distribution: Found in Canada, Northwestern, western, eastern  
and southeastern United States.

Zelenius fidus (Knull)  
(Figures 71, 72)

Sorhoanus fidus Knull, 1954c:57

Resembles orientalis<sup>e</sup> (De Long and Davidson). Early authors placed the species near orientalis, however, the sharply pointed head will distinguish it at once from most members of the genus.

Cream colored, medium leafhoppers; sharp-headed; forewing with short cells, not quite covering the tip of abdomen. Inner anteapical and outer anteapical cells of forewing present. Male about 3.2 mm. long, female about 3.7 mm. long.

Structure of male genitalia similar to orientalis, with normal pygofer lobes, not extending mesally, genital plate pointed distally. Small anal tube, style and connective as in orientalis; but in aedeagus different. Aedeagus in lateral view, fidus (Figure 72) with antero-ventral angle sharply pointed; in orientalis (Figures 62, 63, 64) aedeagus stout basally, antero-ventral angle bluntly rounded; the apex in fidus more blunt than in orientalis.

Females seventh sternum indistinguishable from that of orientalis.

Distribution: Only found in Texas.

Boreotettix Lindberg

Boreotettix Lindberg, Notulae Ent. 32:144, 1952. Type species by original designation, Cosmotettix serricauda Kontkanen, 1949

Medium sized, rather robust leafhoppers, about 4.00 mm. long and 1.5 mm. wide, color varying from straw-green to light brown. Head not much wider than pronotum, anterior margin rounded; crown slightly flat or nearly so. Forewings stout and short, not covering the abdomen; outer anteapical cell absent, inner anteapical cell open basally.

Genital plates of male genitalia as long as pygofer lobes, but not entirely covering the aedeagus, rounded distally, a row of eight to ten fine setae on the posterior margins laterally. Lateral margin of pygofer lobes extended mesally as a quadrate projection having a sinuated margin, highly sclerotized; a cluster of coarse distally on outer submarginal surface.

Phallus in profile shaped roughly like an inverted question mark (?). Aedeagus stout, rod-like in shape, no accessory apical process, broadened at apex, surface of shaft with numerous retrorse corniculi. The gonoduct opens terminally. Phallobase about 2/3 length of aedeagus, constricted medially.

Style very uniform in the genus, lateral margin from base to beyond subapical denticle reflexed, to form a fold on each side.

The apical denticle highly elongate laterally, confirm as a lateral projection. Numerous minute setae scattered between apical denticle and subapical denticle and a row of fine setae on the inner surface of apex distally.

Connective very simple in structure, similar to Sorhoanus, but without anterior projections, a small opening at center, phallus firmly connected with connectives.

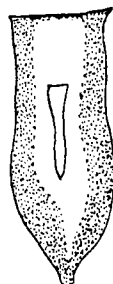


Figure 4. Connective of Boreotettix Lindberg.

Female seventh sternum roughly truncate posteriorly, with a deep median incision, laterally angled.

Boreotettix caricis (Gillette and Baker)

(Figures 38, 39, 40, 41, 42)

Thamnotettix caricis Gillette and Baker, 1895a:95.

Cicadula lutea Gillette and Baker, 1895a:106.

Laevicephalus bidentatus De Long and Davidson, 1935b:169 (new synonymy).

Boreotettix bidentatus Emel'yanov, 1966b:130.

Medium, light brown leafhoppers. Wings transparent without markings, short in female, not covering the tip of abdomen. Crown flat. Males 3.4 to 3.7 mm. long; females 4.2 to 4.4 mm.

Structure of male genitalia (Figures 38, 39, 41, 42) quite unique; pygofer lobes extended mesally forming quadrate processes with irregularly sinuated margin on the caudal portion. Anal tube small, shorter than the pygofer lobes. Plates elongate, about the same length as pygofer lobes, with rounded apex. Aedeagus plain, without any projection, broadened at apex and base. Phallobase elongate, about two-thirds length of aedeagus, abruptly expanded distally as two lateral projections. Gonopore terminal. Style slender, apex foot-shaped, apical denticle extended laterally.

Female seventh sternum (Figure 40) with a deep median incision, angled laterally; eighth sternum visible.

Distribution: Found in Rocky mountain states.

Acharis Emel'yanov

Acharis Emel'yanov, Ent. Obozr. 45(1):125, 1966. Type species by original designation, Deltocephalus ussuriensis Melichar, 1902.

Vertex in male of roughly as long as the pronotum, anterior margin obtuse-angled, with apex not broadly rounded; in female the vertex is slightly longer than the pronotum, anterior margin acute-angled, with a narrowly rounded apex. Male full-winged, female with slightly abbreviated elytra. Males 3.1 to 3.3 mm. long; females 3.6 to 3.8 mm.

Structure of genitalia different from Sorhoanus Ribaut. Extension of pygofer lobe quadrate. Genital plates triangular, with narrowly rounded apex, and slightly concave posterior margins, bearing a marginal row of macrochetae. Anal tube large, length roughly equal to width. Aedeagus stocky and short, with a broad, leaf-like dilatation at the tip. Style small. Connective loop-shaped, with two small posterior projections.

Female seventh sternum, with a posteriorly quadrate emargination.

Acharis ussuriensis (Melichar)  
(Figures 29, 32, 33)

Deltocephalus ussuriensis Melichar, 1902c:144

Acharis ussuriensis Emel'yanov, 1966b:125

Median size leafhoppers, yellowish green, with yellow stripes across crown, pronotum and scutellum; wings with brown spots along the veins. Wings of female shorter than the abdomen. Males 3.1 to 3.3 mm. long; females 3.6 to 3.8 mm.

Pygofer lobe (Figure 33) highly sclerotized, extended mesally as a quadrate process with sinuate margin. Anal tube (Figures 30, 33) broad and short, not longer than pygofer at mid-dorsal line. Male genital plates tapered distally, extending one-fourth their length beyond pygofer lobes. Aedeagus (Figure 33) robust round and slightly flat at apex, lateral surface of subterminal pair of the retorse projections sinuated. Anterior part of phallobase broadened, with a constriction near the posterior end. Gonoduct very wide, comprising two-thirds of the aedeagus, opening before the apex in ventral part, the orifice broad compared to other species. Apical denticles not sharply pointed, stretch downward. Connective with small projections on posterior margin.

Female seventh sternum (Figure 29), sinuate posteriorly, with a quadrate notch; base of the seventh sternum angled.

Distribution: Recorded only from the USSR, distributed from Maritime Territory to Siberia.



## DISCUSSION OF PHYLOGENETIC RELATIONSHIPS

Actually, no organism is generalized or completely specialized. Most organisms are a combination of both, therefore, analyses of taxa based on one structure and its associated characters can place the taxa in different phylogenetic positions depending on the characters chosen. When two or more classifications are developed for the same group of organisms, and when these classifications are based upon different <sup>7</sup> ~~and nonsubstantiated~~ premises, the results are usually contradictory. It may thus seem questionable if evolutionary and phylogenetic speculation contribute significantly to systematic order.

The following analysis of relationships between Sorhoanus and related genera is based on the structure of the male genitalia. The great range of variation in certain structures of the male genitalia indicates a divergent phylogeny; however, these segregates are not named because the evidence available seems insufficient for a suitable interpretation.

So far, there has been no comprehensive comparison of the structure of male genitalia of the generic elements considered in this study, and some previous works emphasizing different morphological characters have not considered the evidence in terms of possible phylogenetic implications. The discussion which follows is not an attempt to set up phylogenetic conclusions but rather to point out

the relationships between each genus and species. In this way it is hoped to contribute to a better understanding of the classification.

There are three distinct evolutionary lines in the genus Sorhoanus. The first group is the subgenus Sorhoanus Ribaut (1949), represented by assimilis (Fallen) and the closely related species schmidti (Wagner), minutulus Vilbaste, xanthoneurus (Fieber), and tritici (Matsumura). They resemble one another in the general structure of male genitalia as follows: anal tube elongate; pygofer lobe with hook-like extension, of moderate size, not enlarged, and twisted slightly backward; aedeagus stout or slender but never broadened laterally, the terminal pair of the retrorse projections much more slender and shorter than the subterminal pair; phallobase broadened anteriorly. Among these five species, assimilis and minutulus (Figures 26, 28) are very closely related. The only morphological difference is that the aedeagus of assimilis is curved in lateral view, with an S shape. They also have same geographical distribution. Because of so much resemblance, it is possible that minutulus is a subspecies of assimilis. S. schmidti seems much closer to assimilis than either is to xanthoneurus. All have a flat rounded apex of aedeagus, but they differ in the shape.

In xanthoneurus and tritici, the aedeagus is slender and pointed apically (Figures 11, 30), the phallobase has a large constriction and the genital plates taper distally. Because of these differences, it

appears that xanthoneurus (Fieber) and tritici (Matsumura) may have separated early from the evolutionary line that produced assimilis (Fallen), minutulus Vilbaste and schmidti (Wagner). The latter three species are considered to be more primitive in the male genitalia structure.

The second group in Sorhoanus is the subgenus Emeljanovianus Dlabola (1965), including the type species medius (Mulsant and Rey), and suncharicus Dlabola (Figures 24, 25, 27). They are notably different from the first group, in having a bottle-shaped phallobase (abruptly constricted at the middle toward the posterior part), and the aedeagus with well developed retrorse projections apically with the terminal pair somewhat bigger and/or longer than the subterminal pair (Figures 14, 24). The aedeagus is also relatively broaden laterally, with apex weakly produced. The pygofer lobes extended mesally, never twisted backward, and are very large compared to the first group. The structure of the aedeagus in the subgenus Emeljanovianus is more evolved than the subgenus Sorhoanus.

The third group, the subgenus Rhoananus Dlabola (1949), contains only the type species hypochlorus (Fieber). The species of hypochlorus (Fieber) differs from the other Sorhoanus in having the anal tube very small, the length about the same as width; pygofer lobe extended irregularly, to form an emargination in lateral view, with two small projections on either end (Figures 20, 21, 23, 24); aedeagus

very robust, about the same length as the connective, with a terminal pair of retrorse projections overlapping the subterminal pair (structure not distinguishable as two pairs in ventral view). The phallobase broadens basally and gradually narrows toward the posterior part.

On the basis of these morphological differences, it is presumed that the S. hypochlorus represents one evolutionary line, from a common stock, and that the subgenera Sorhoanus Ribaut and Emeljanovianus Dlabola represent a second evolutionary line from which these two stocks later evolved. This assumption is illustrated by the following diagram.

Upon examining and comparing the structure of the male genitalia, it appears that there is little relationship between the Sorhoanus as here interpreted and other Nearctic species which were incorrectly assigned to the genus by Oman (1949) and Metcalf (1967).

In Lebradea Remane, the shape of the genital plates and the hook-like extension of the pygofer lobe are the same as in Sorhoanus but the shape of the phallobase and the linear connective without posterior projections are similar to that of Emeljanovianus. Thus these characters suggest that Lebradea has some relationship with Sorhoanus. It is hard to say which genus is more primitive because that determination depends upon what characters are used. Lebradea has only one pair of apical projections on the aedeagus, but two pairs of retrorse projections occur in Sorhoanus; the style in

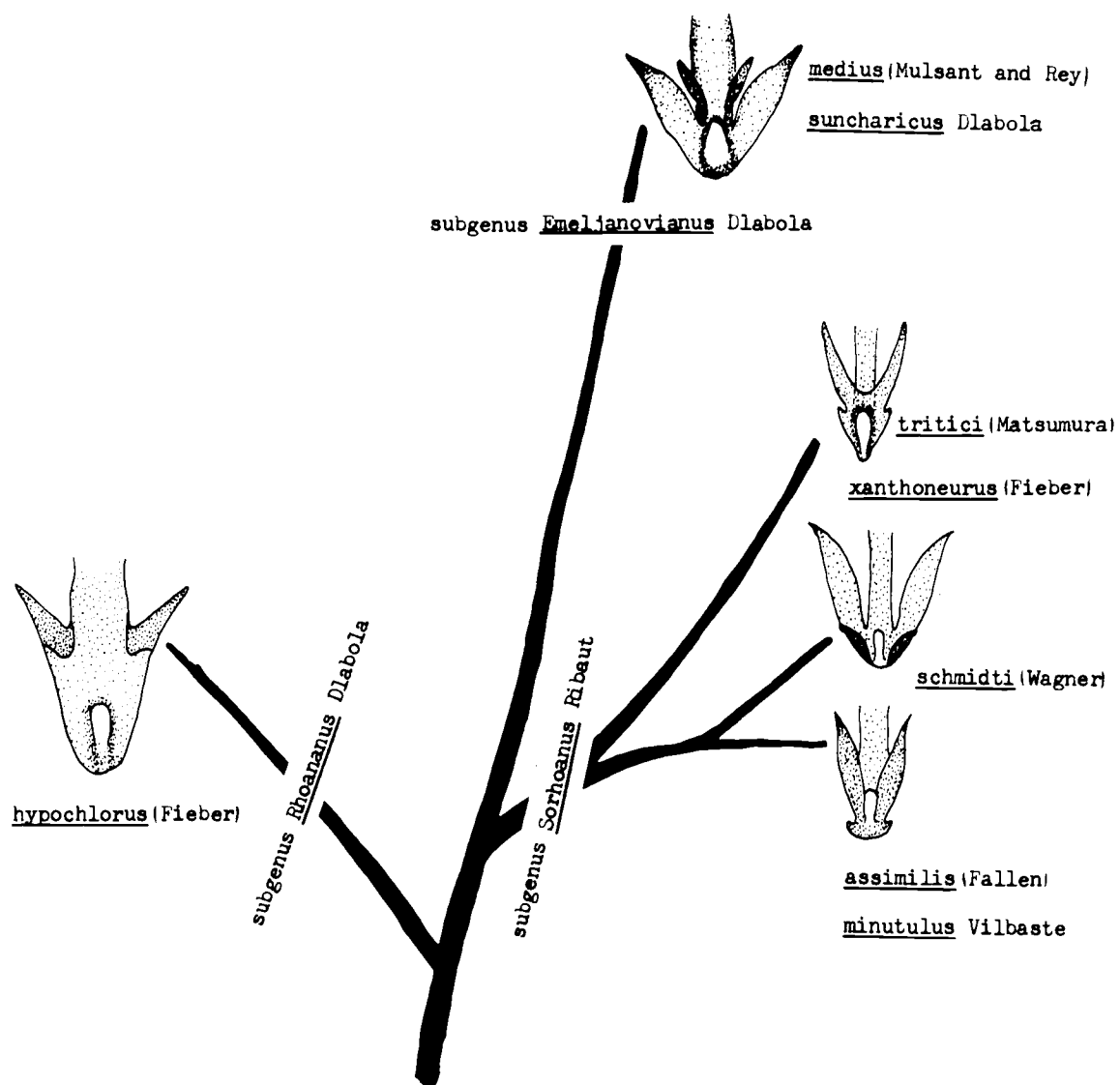


Figure 5. The assumptively evolutionary line of Sorhoanus Ribaut.

Lebradea is well developed and more complex (Figures 43, 50, 54) than is Sorhoanus.

The genus Boreotettix has one character, the quadrate extension of pygofer lobes with sinuated margin, which is like Acharis ussuriensis (Melichar). There is no resemblance between Boreotettix and Sorhoanus.

The structure of the male genitalia in Zelenius is entirely different from Sorhoanus, with no similarities to suggest relationships between these two.

The genus Acharis Emel'yanov, as a whole resembles hypochlorus Fieber but differs in the shape of the extension of pygofer lobes, which are quadrate with sinuated edges. It also differs in the shape of the phallobase (Figures 32, 33) which is bottle-like in hypochlorus (Figure 23), but widened posteriorly with a subapical constriction in ussuriensis.

On the basis of the structure of male genitalia, and general habitus similarities, Oman (1949, p. 110) grouped Giprus Oman, Cazenus Oman, Laevicephalus De Long, Lemellus Oman, Verdanus Oman, and Sorhoanus Ribaut together, members of these genera have linear connectives and the aedeagus articulated with connective. Among the genera, the genus Lemellus is quite singular. It has an asymmetrical aedeagus, and the ventral margin of pygofer lobe strongly extended mesally beyond the midline so as to overlap (Figures 85, 86). The other genera are also distinctively different and suggests that the several genera are of diverse origins.

Giprus has a lobe-like genital plate abruptly tapered distally. The ventral margin of the pygofer lobe slightly extended mesad to form an emargination on each side, and the aedeagus has a basal submembranous hood-like extension for muscular attachment. These characters indicate that the genus is not close to Sorhoanus.

In Laevicephalus, the aedeagus (Figures 87, 88) is attenuated, and the ventral margin of pygofer lobe straight. These conditions are not found in Sorhoanus.

Verdanus (Figures 89, 90) resembles Sorhoanus, but differs in the shape of genital plates (bilobed in Verdanus), phallobase, and aedeagus with only one pair of U-shaped projections at the apex. In general, Verdanus is between Lebradea and Sorhoanus, but more closely related to the former.

## SPECIES OF UNCERTAIN POSITION

Deltocephalus debilis Uhler  
(Figures 74, 75, 76, 77, 78)

Deltocephalus debilis Uhler, 1876a:360.

Laevicephalus debilis De Long and Sleesman, 1929a:93

Laevicephalus orbiculus De Long and Sleesman, 1929a:103

Sorhoanus debilis Oman, 1949a:164

Rosenus debilis Emel'yanov, 1966b:130

Similar in general appearance to Z. uhleri (Oman) but smaller. Sexual differences evident. Male very small, about 2.7 mm. long, pale in color; wing smoky white not hyaline; female robust, about 3.8 to 4.2 mm. long, color yellowish-green, forewing transparent, about the same length as abdomen, but usually not covering the tip of abdomen when at rest. Inner and outer anteapical cells of forewing present.

Structure of genitalia distinctive; pygofer lobe (Figures 74, 75) very large and somewhat rounded, extended slightly mesally, forming a small hook, with a serrate distal edge. Anal tube (Figure 75) short but much broadened basally. Male genital plates (Figure 70) pointed distally, much shorter than the pygofer lobe. Aedeagus (Figure 75) rod-like, slightly broadened at base, with numerous small retrorse projections on the surface; gonopore terminal. Phallobase (Figure 76) rectangular, with a small constriction near



posterior end. Style elongate, apical denticle subtruncated, with sinuate margin, slightly decurved. Connective resembling that of Sorhoanus but without posterior projection.

Female seventh sternum (Figure 78) with a deep median incision, lateral angles projecting posteriorly to form bluntly triangular lobes.

The genitalia of this species is entirely different from that of Sorhoanus Ribaut, Lebradea Remane, Boreotettix Lindberg, or Zelenius Emel'yanov because of its rod-shaped aedeagus with numerous retrorse projections. Superficially D. debilis is close to Rosenus Oman, and Emel'yanov (1966) believed it belonged to Rosenus. Rosenus cruciatus (Osborn and Ball) (type species) (Figures 34, 35, 36, 37) does have some similarities with debilis but cruciatus has a very elongate, hook-like pygofer lobe, and the aedeagus is flat not round. These differences thus raise the question, does debilis belong in Rosenus, or should it have its own genus?

Distribution: Widely distributed, extending from eastern Canada, through northern United States, and down to Tennessee and Texas.

Thamnotettix lenis Van Duzee  
(Figures 79, 80, 81, 82)

Thamnotettix lenis Van Duzee, 1925b:423

Laevicephalus wilsoni Oman, 1932a:91

Gloridonus lenis De Long and Caldwell, 1937c:47

Laevicephalus lenis De Long and Knull, 1946a:39

Sorhoanus lenis Oman, 1949a:164

Large and robust leafhoppers. Female about 5 mm. long, yellowish-green in color, forewing not hyaline, very smoky and extending beyond the tip of abdomen. Male about 4.2 mm. long, bright yellowish-green in color, forewing hyaline, longer than the abdomen. Inner and outer anteapical cells of forewing present.

Structure of male genitalis very different from other species in the Sorhoanus complex of genera. Pygofer lobe (Figure 80) normal, not extending mesally, with a smooth margin. Male plate distally, shorter than the pygofer lobe. Anal tube (Figure 80) very small, less than length of pygofer on mid-dorsal line. Aedeagus (Figures 79, 81) stout, apex projected distally, with two elongate retrorse projections on lateral side, and two small retrorse projections on dorsal and ventral side of apex. Gonopore terminal. Phallobase broadened at either end, with a constriction near posterior end. Connective resembling that of Sorhoanus, with two projections on posterior margin. Style decurved apically, apical denticle subtruncate, with serrate edge; subapical denticle very large, slightly extended

laterally.

Female seventh sternum (Figure 82) sinuate posteriorly, with two emarginations near the middle. Lateral margins rounded, eighth sternum visible.

The four apical projections of the aedeagus in lenis is a unique character and I know of no related species. Remane (personal communication) suggested that lenis should have its own genus.

Distribution: Only found in California and Oregon.

Deltocephalus spicatus De Long

Deltocephalus (Laevicephalus) spicatus De Long, 1926d:74

Laevicephalus spicatus De Long and Slesman, 1929a:93

Sorhoanus spicatus Oman, 1949a:164

Medium sized leafhopper. Male slender, about 3.2 mm. long, yellowish-green in color; wing longer than the abdomen, transparent. Female robust, about 3.5 mm. long, green in color, wing white not transparent, shorter than the abdomen, not covering the tip. Inner anteapical cell of forewing present, outer anteapical cell absent.

Male genitalia (Figure 83) stout. Caudo-dorsal margin of pygofer lobe slightly folded inward, distal portion rounded without a projection. Genital plate tapered apically, about the same length as pygofer lobe. Anal tube elongate about two times as long as pygofer on mid-dorsal line. Phallus stout, aedeagus bottle-like in ventral view, shorter than connective, with numerous retrorse projections on the surface. Gonopore terminal. Phallobase broadened at either end. Connective linear, with a small opening at center, no posterior projection. Style very straight and slender, subapical denticle not obvious; apical denticle subtruncate, margin serrate; numerous scattered setae on the inner surface of distal portion.

Female abdomen lost.

There is hardly any similarity between spicatus and genera of

the Sorhoanus group. It does not belong in Sorhoanus, Zelenius, Boreotettix, Acharis or Lebradea.

Distribution: Known only from Quebec, Ohio, Kansas and Oklahoma.

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## APPENDIX

PLATE 1

Figure

- 1      Ventral view of male genital capsule of Sorhoanus assimilis  
(Fallen).
- 2      Ventral view of male genitalia of Sorhoanus assimilis  
(Fallen).
- 3      Lateral view of male genital capsule of Sorhoanus assimilis  
(Fallen).

## PLATE 1

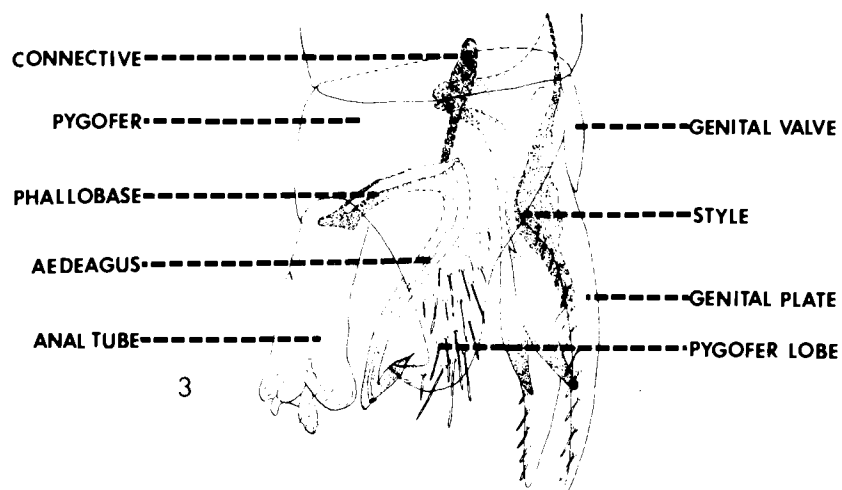
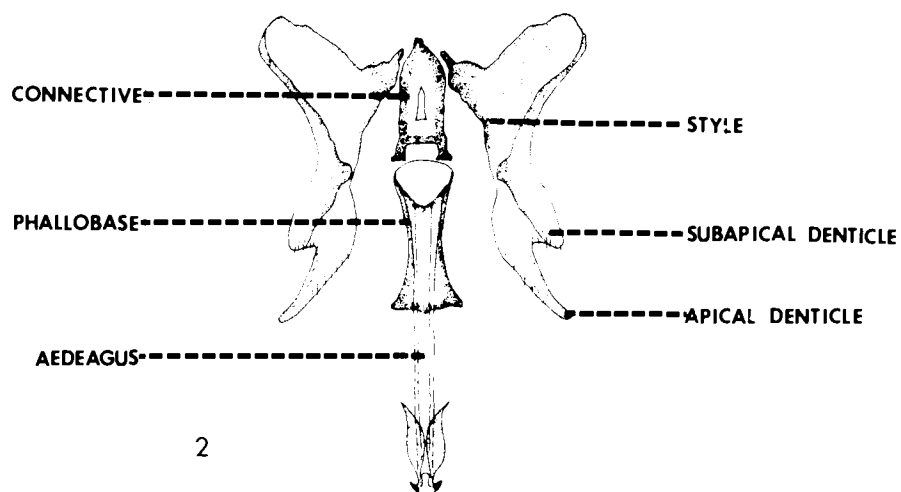
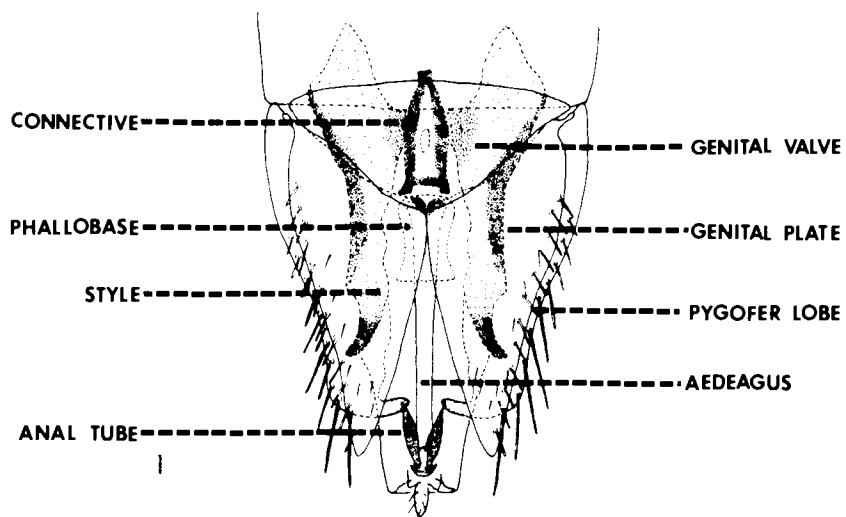
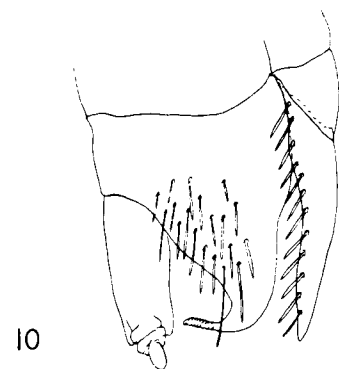
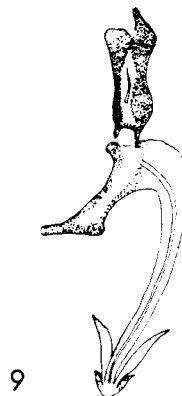
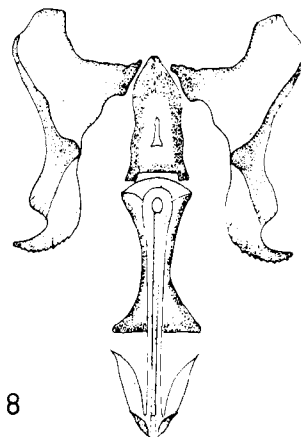
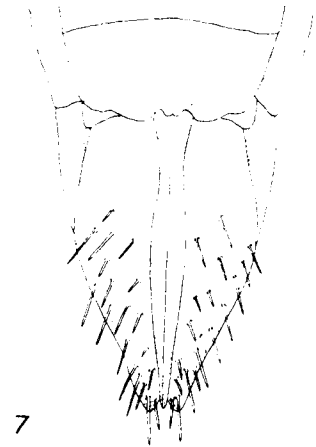
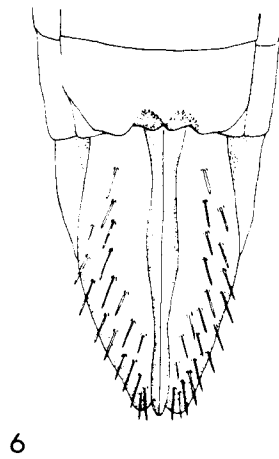
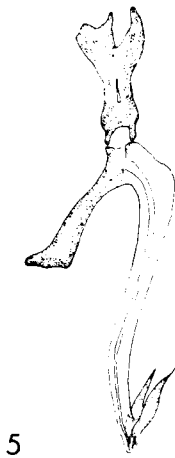
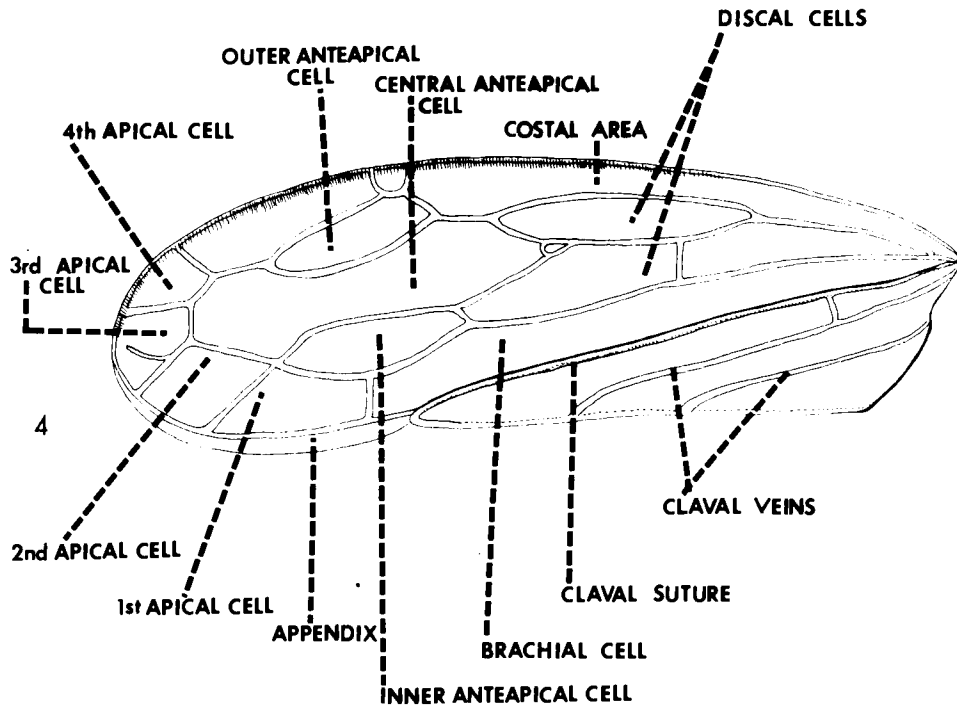


PLATE 2

Figure

- 4 Forewing of Sorhoanus assimilis (Fallen).
- 5 Lateral view of male phallus and connective of Sorhoanus assimilis (Fallen).
- 6 Ventral view of female genitalia of Sorhoanus assimilis (Fallen).
- 7 Ventral view of female genitalia of Sorhoanus schmidti (Wagner).
- 8 Ventral view of male genitalia of Sorhoanus schmidti (Wagner).
- 9 Lateral view of male phallus and connective of Sorhoanus schmidti (Wagner).
- 10 Lateral view of male genital capsule of Sorhoanus schmidti (Wagner).

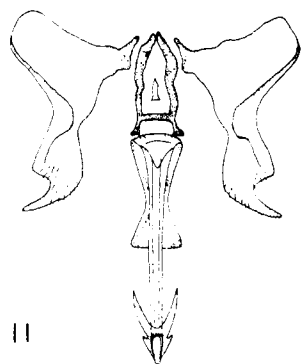


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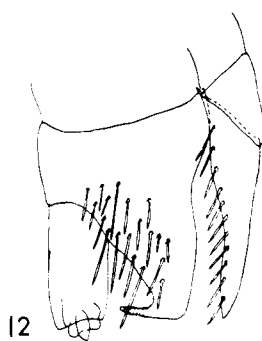
#### Figure

- 11 Ventral view of male genitalia of Sorhoanus xanthoneurus (Fieber).
- 12 Lateral view of male genital capsule of Sorhoanus xanthoneurus (Fieber).
- 13 Ventral view of male genital capsule of Sorhoanus xanthoneurus (Fieber).
- 14 Ventral view of male genital capsule of Sorhoanus medius (Mulsant and Rey).
- 15 Lateral view of male phallus and connective of Sorhoanus xanthoneurus (Fieber).
- 16 Ventral view of female genitalia of Sorhoanus xanthoneurus (Fieber).
- 17 Lateral view of male genital capsule of Sorhoanus medius (Mulsant and Rey).
- 18 Ventral view of female genitalia of Sorhoanus (Rhoananus) hypochlorus (Fieber).
- 19 Ventral view of female genitalia of Sorhoanus medius (Mulsant and Rey).
- 20 Lateral view of male genital capsule of Sorhoanus (Rhoananus) hypochlorus (Fieber).
- 21 Ventral view of male genital capsule of Sorhoanus (Rhoananus) hypochlorus (Fieber).





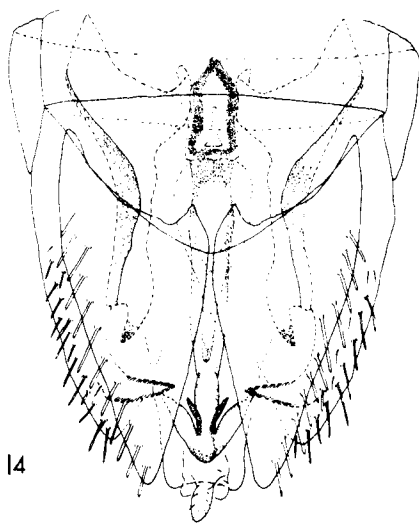
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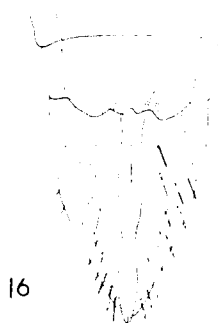
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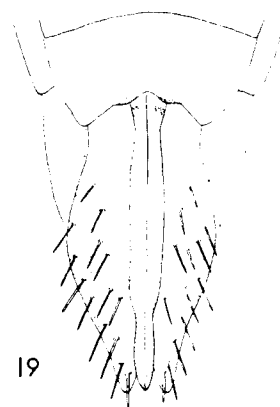
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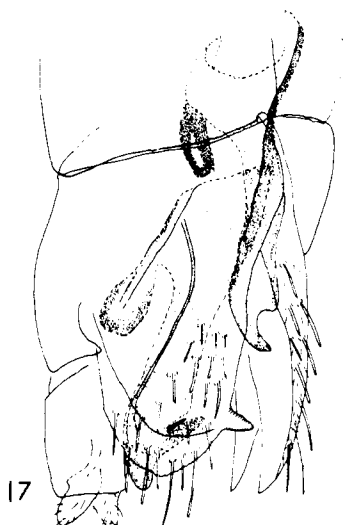
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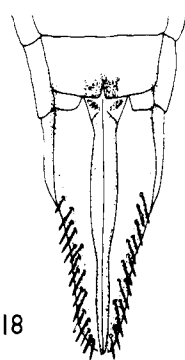
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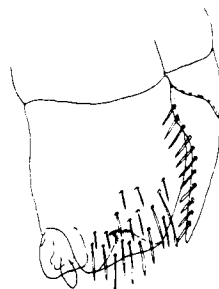
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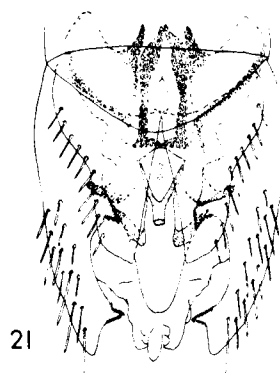
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PLATE 4

Figure

- 22 Lateral view of male phallus and connective of Sorhoanus (Rhoananus) hypochlorus (Feiber).
- 23 Ventral view of male genitalia of Sorhoanus (Rhoananus) hypochlorus (Fieber).
- 24 Ventral view of male genital capsule of Sorhoanus (Emeljanovianus) suncharicus Dlabola.
- 25 Ventral view of female genitalia of Sorhoanus (Emeljanovianus) suncharicus Dlabola.
- 26 Ventral view of male genital capsule of Sorhoanus minutulus Vilbaste.
- 27 Lateral view of male genital capsule of Sorhoanus (Emeljanovianus) suncharicus Dlabola.
- 28 Lateral view of male genital capsule of Sorhoanus minutulus Vilbaste.
- 29 Ventral view of female genitalia of Acharis ussuriensis (Melichar).
- 30 Ventral view of male genital capsule of Sorhoanus tritici (Matsumura).
- 31 Lateral view of male genital capsule of Sorhoanus tritici (Matsumura).

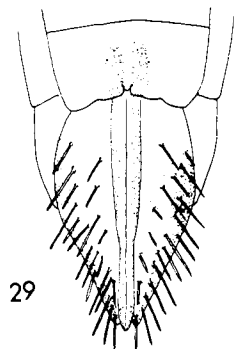
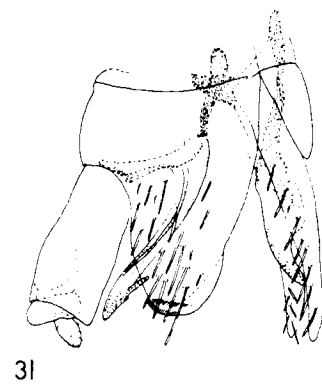
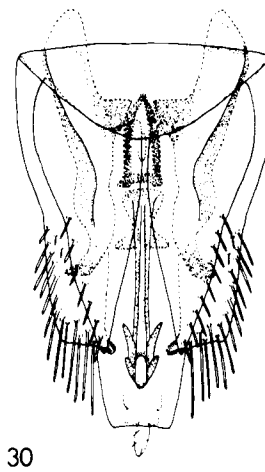
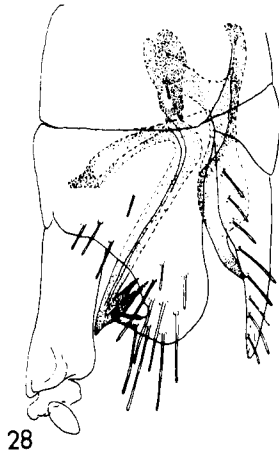
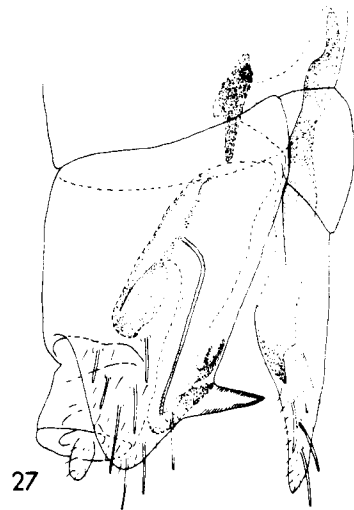
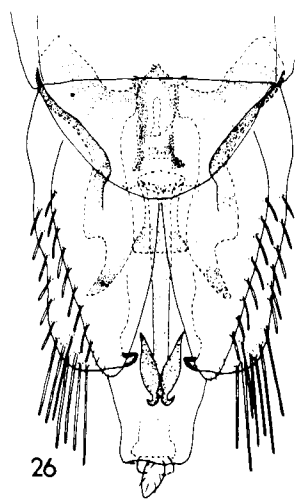
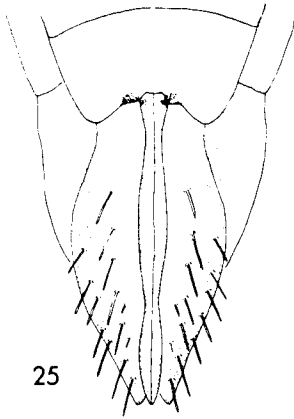
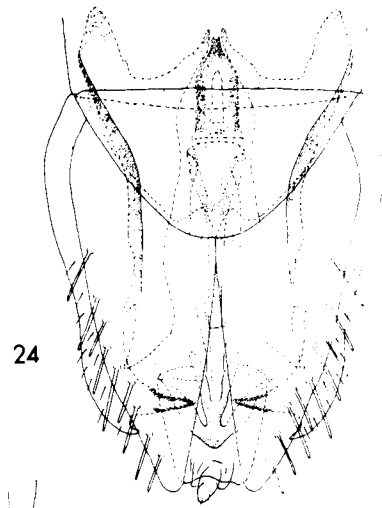
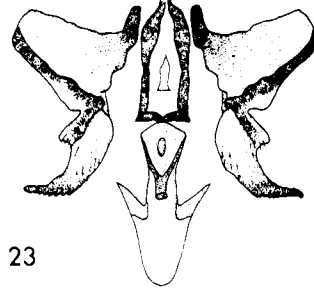


PLATE 5

Figure

- 32 Lateral view of male genital capsule of Acharis ussuriensis (Melichar).
- 33 Ventral view of male genital capsule of Acharis ussuriensis (Melichar).
- 34 Ventral view of male genital capsule of Rosenus cruciatus (Osborn and Ball).
- 35 Lateral view of male genital capsule of Rosenus cruciatus (Osborn and Ball).
- 36 Ventral view of male genitalia of Rosenus cruciatus (Osborn and Ball).
- 37 Ventral view of female genitalia of Rosenus cruciatus (Osborn and Ball).
- 38 Ventral view of male genitalia of Boreotettix caricis (Gillette and Baker).
- 39 Lateral view of male genital capsule of Boreotettix caricis (Gillette and Baker).
- 40 Ventral view of female genitalia of Boreotettix caricis (Gillette and Baker).
- 41 Lateral view of male phallus and connective of Boreotettix caricis (Gillette and Baker).
- 42 Ventral view of male genital capsule of Boreotettix caricis (Gillette and Baker).

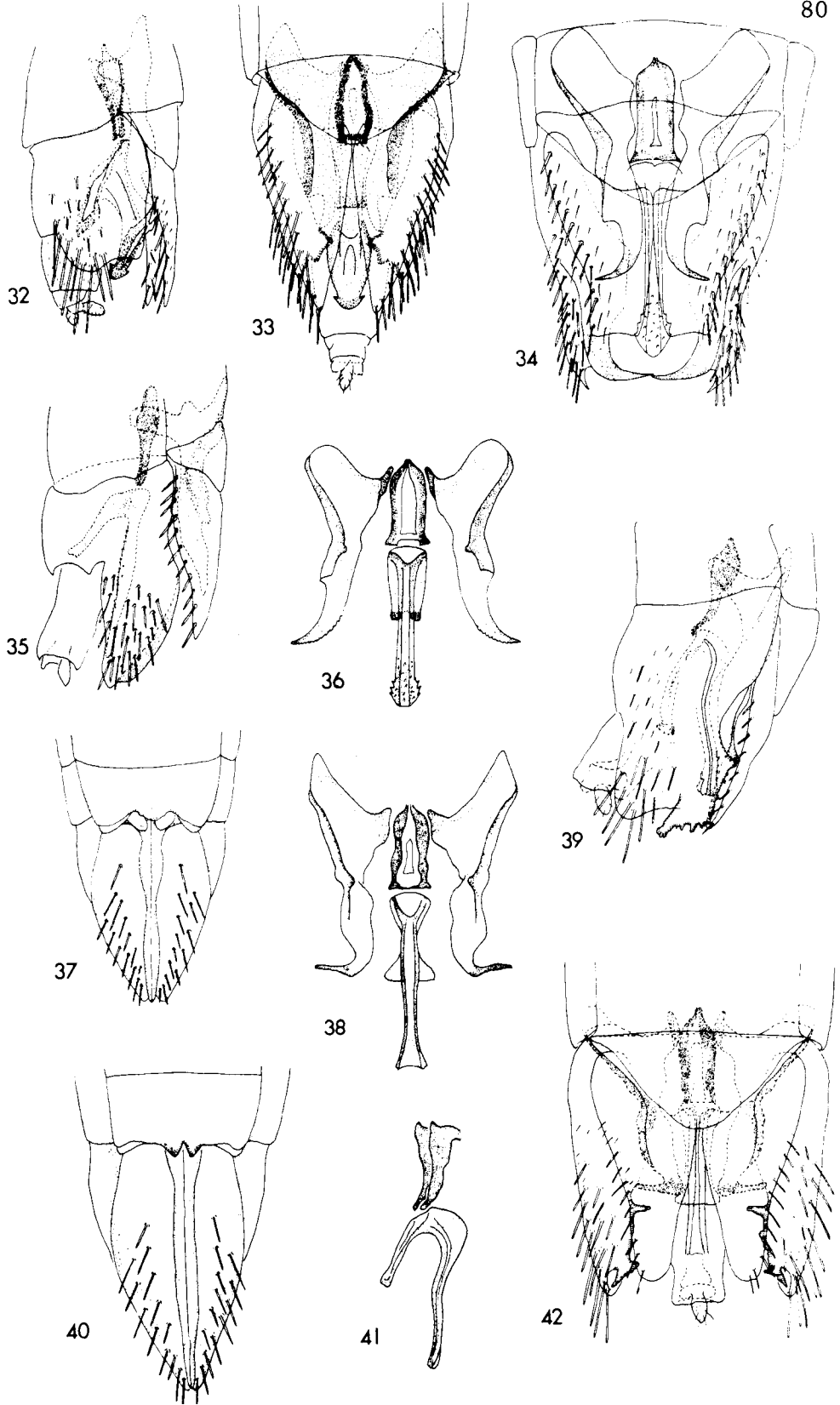
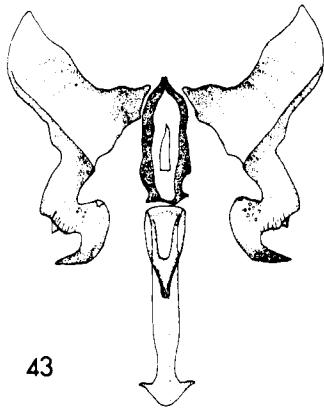


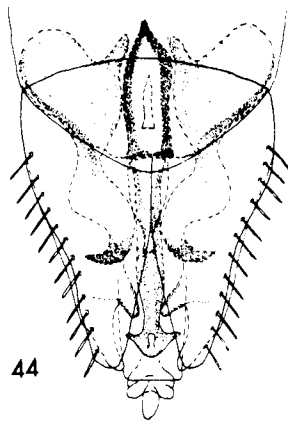
PLATE 6

Figure

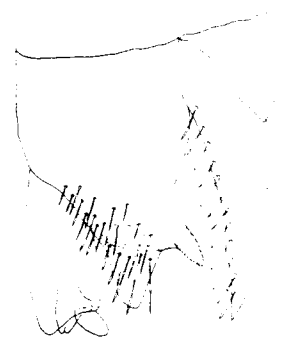
- 43 Ventral view of male genitalia of Lebradea calamagrostidis Remane.
- 44 Ventral view of male genital capsule of Lebradea calamagrostidis Remane.
- 45 Lateral view of male genital capsule of Lebradea calamagrostidis Remane.
- 46 Lateral view of male phallus and connective of Lebradea calamagrostidis Remane.
- 47 Ventral view of female genitalia of Lebradea calamagrostidis Remane.
- 48 Ventral view of male genital capsule of Lebradea flavovirens (Gillette and Baker).
- 49 Lateral view of male genital capsule of Lebradea flavovirens (Gillette and Baker).
- 50 Ventral view of male genitalia of Lebradea flavovirens (Gillette and Baker).
- 51 Lateral view of male phallus and connective of Lebradea flavovirens (Gillette and Baker).
- 52 Ventral view of female genitalia of Lebradea flavovirens (Gillette and Baker).
- 53 Ventral view of male genital capsule of Lebradea helvinus (Van Duzee).
- 54 Ventral view of male genitalia of Lebradea helvinus (Van Duzee).
- 55 Lateral view of male genital capsule of Lebradea helvinus (Van Duzee).
- 56 Lateral view of male phallus and connective of Lebradea helvinus (Van Duzee).
- 57 Ventral view of female genitalia of Lebradea helvinus (Van Duzee).



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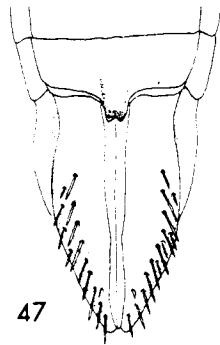
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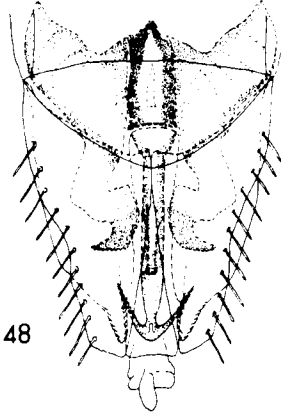
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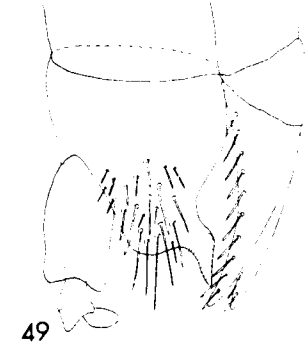
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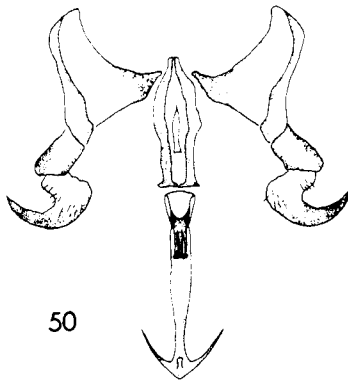
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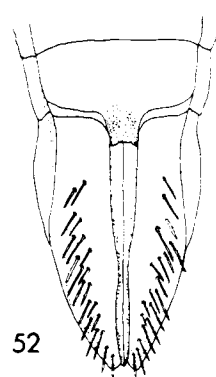
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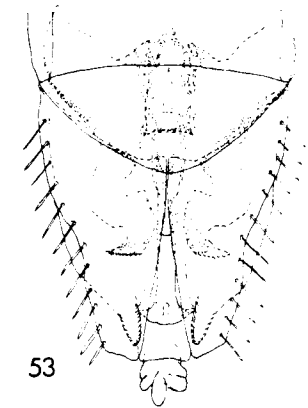
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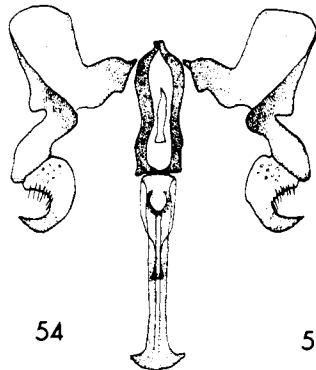
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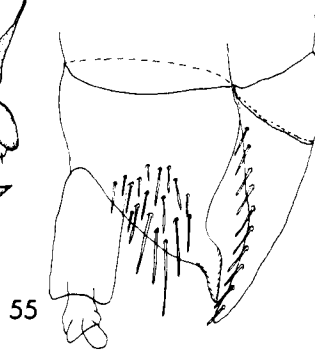
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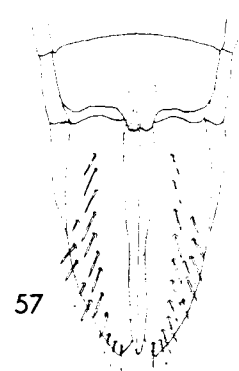
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PLATE 7

Figure

- 58 Ventral view of male genital capsule Zelenius orientalis (De Long and Davidson).
- 59 Ventral view of male genitalia of Zelenius orientalis (De Long and Davidson).
- 60 Lateral view of male genital capsule of Zelenius orientalis (De Long and Davidson).
- 61 Ventral view of male phallus and connective of Zelenius orientalis (De Long and Davidson).
- 62 Lateral view of male phallus and connective of Zelenius orientalis (De Long and Davidson).
- 63 Lateral view of male phallus and connective of Zelenius orientalis (De Long and Davidson).
- 64 Lateral view of male phallus and connective of Zelenius orientalis (De Long and Davidson).
- 65 Ventral view of male genital capsule of Zelenius uhleri (Oman).
- 66 Lateral view of male genital capsule of Zelenius uhleri (Oman).
- 67 Ventral view of male genitalia of Zelenius uhleri (Oman).
- 68 Ventral view of male phallus and connective of Zelenius uhleri (Oman.)
- 69 Lateral view of male phallus and connective of Zelenius uhleri (Oman).
- 70 Lateral view of male phallus and connective of Zelenius uhleri (Oman).
- 71 Ventral view of male genitalia of Zelenius fidus (Knull).
- 72 Lateral view of male phallus and connective of Zelenius fidus (Knull).
- 73 Ventral view of female genitalia of Zelenius orientalis (De Long and Davidson).



## PLATE 7

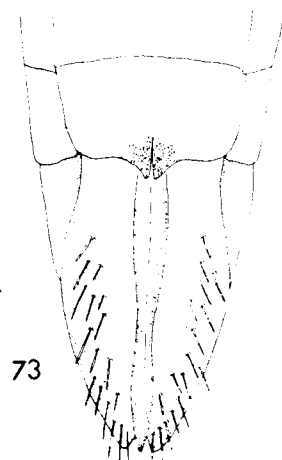
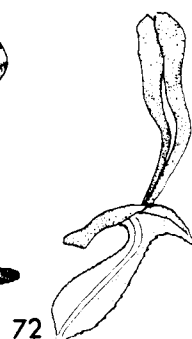
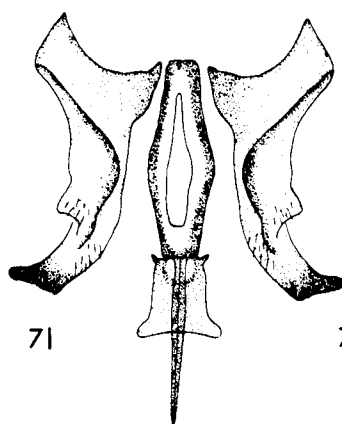
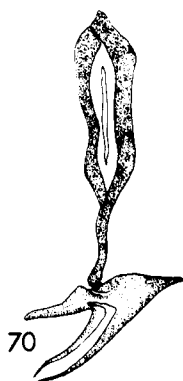
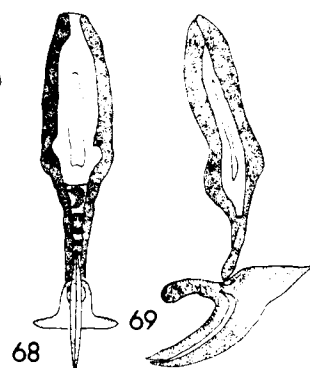
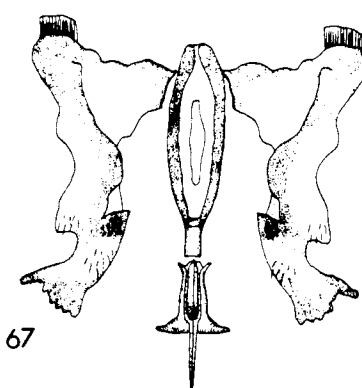
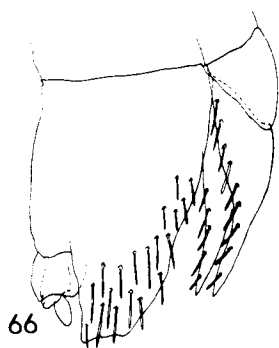
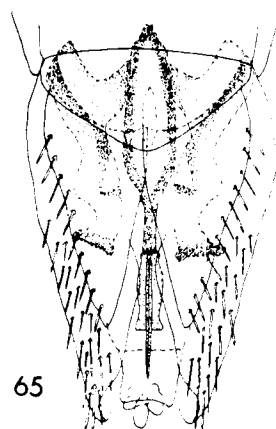
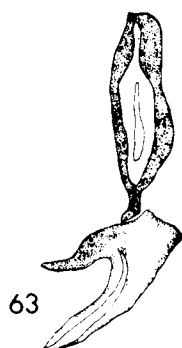
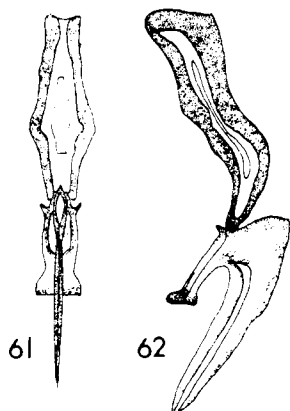
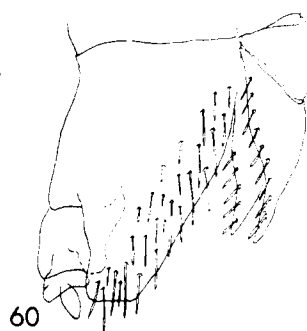
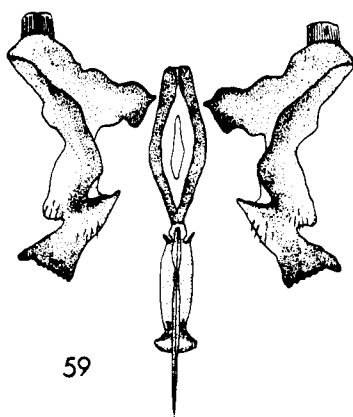
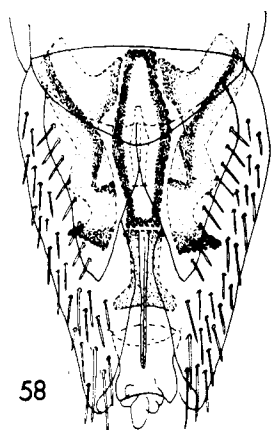


PLATE 8

Figure

- 74 Ventral view of male genital capsule of Deltocephalus debilis Uhler.
- 75 Lateral view of male genital capsule of Deltocephalus debilis Uhler.
- 76 Ventral view of male genitalia of Deltocephalus debilis Uhler.
- 77 Lateral view of male phallus and connective of Deltocephalus debilis Uhler.
- 78 Ventral view of female genitalia of Deltocephalus debilis Uhler.
- 79 Ventral view of male genitalia of Thamnotettix lenis Van Duzee.
- 80 Lateral view of male genital capsule of Thamnotettix lenis Van Duzee.
- 81 Lateral view of male phallus and connective of Thamnotettix lenis Van Duzee.
- 82 Ventral view of female genitalia of Thamnotettix lenis Van Duzee.
- 83 Lateral view of male genital capsule of Deltocephalus spicatus De Long.
- 84 Ventral view of male genitalia of Deltocephalus spicatus De Long.
- 85 Lateral view of male genital capsule of Lemellus bimaculatus (Gillette and Baker).
- 86 Ventral view of male genital capsule of Lemellus bimaculatus (Gillette and Baker).
- 87 Lateral view of male genital capsule of Laevicephalus sylvestris (Osborn and Ball).
- 88 Ventral view of male genital capsule of Laevicephalus sylvestris (Osborn and Ball).
- 89 Ventral view of male genital genitalia of Verdanus abdominalis (Fabricius).
- 90 Lateral view of male phallus and connective of Verdanus abdominalis (Fabricius).

