THE CICADAS (HOMOPTERA: CICADIDAE) AND TREEHOPPERS (HOMOPTERA: MEMBRACIDAE) OF CANADA

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The purposes of this review are to enable adults of the known Canadian species of cicadas and treehoppers to be identified and to provide summaries of known information on their life-histories, habits, and distributions.

Work on this was started while the author was on the staff of what is now the Entomology Research Institute, Ottawa, Ontario, but was completed, in 1959, at the Entomology Research Institute for Biological Control, Belleville, Ontario. The study was mainly based on material in the Canadian National Collection, Ottawa.

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Introduction

Cicadas and treehoppers are sucking insects found on various plants but mostly on deciduous trees and shrubs. A few species are of economic importance but none is normally a major pest. Many are conspicuous in form, colour, or size, or because of the sounds they produce. The life-histories, habits, and host-relations often are not known in any detail. Adults may be collected and preserved as described by Beirne (1955). Most species can be identified on a basis of external characters but in a few genera, which include some economically-significant species, reliable identification requires examination of the internal male genitalia.

These insects comprise two of the five major taxonomic groups of what are commonly termed the auchenorhynchous Homoptera. The five groups may be separated by the following key:-

1. With three ocelli arranged in a triangle..... ..... Family Cicadidae (cicadas)
   With two or no ocelli..... 2

2. Antennae arising below the eyes..... ..... Superfamily Fulgoroidea (fulgorids)
   Antennae arising between the eyes..... 3

3. Pronotum greatly enlarged, prolonged backward over abdomen, and with anterior surface vertical.Family Membracidae (treehoppers)
   Pronotum not greatly enlarged, not prolonged backward over abdomen, and with no part of it vertical..... 4

4. Hind tibiae with two rows of numerous stout setae ..... Family Cicadellidae (leafhoppers)
   Hind tibiae without setae, with a few stout spurs ..... Family Cercopidae (froghoppers)

The Cicadidae and Membracidae are discussed here. The then known Canadian species of leafhoppers (Cicadellidae) were covered in an earlier work (Beirne, 1956). There are as yet no comprehensive keys to the Canadian Fulgoroidea or Cercopidae.

Family CICADIDAE

Cicadas are conspicuous insects because of their large size and of the sounds made by the males. Two kinds of sounds are produced: the song, by organs near the base of the underside of the abdomen, and a clicking or rattling, apparently by movements of the wings.

These insects mostly occur among woody plants. The adults tend to stay high up, where they are difficult to see and even more difficult to capture. Females are captured more easily than males because they descend to the ground for egg-laying, but they are often difficult to identify reliably: the males show the best specific characters.

The eggs are laid in slits in twigs, and this sometimes causes economic damage to fruit trees. The newly-hatched nymphs drop to the ground and bury themselves in the soil where they feed by piercing and sucking plant roots. The length of the life-cycle varies with the species, and sometimes perhaps also with the environment, from two or three up to 17 years. Though cicadas can be reared (see Beamer, 1928), this is obviously tedious and difficult. Because of this, the life-histories and immature stages of many of the species are still undescribed. The chief control agents probably are physical, though the eggs are attacked by parasitic Hymenoptera and the adults by birds and predatory Hymenoptera and Diptera.

The number of species of cicadas found in Canada depends on what is regarded as a species. Simon (1954), Davis (see Metcalf, 1942) and others who studied the taxonomy believed that a large number of closely-related species exist, especially in such genera as Okanagana and Platypedia. For reasons explained later, it is more probable that there is in fact a relatively fewer number of highly variable species. Because of this, a number of the so-called species that have been found in Canada are treated here as subspecies, varieties, or forms. On this basis seven species, and a large number of lower taxonomic entities, inhabit this country.

The following keys and descriptions apply to preserved specimens, and ephemeral morphological characters are usually omitted. Newly-emerged, living specimens are coated with a pruinosity to a greater or lesser extent, but this, and the fine hairs on the body, tends to wear off with age.

Key to Genera of Cicadidae

1. Head wider than fore margin of pronotum..... 2
   Head narrower than fore margin of pronotum..... 2. Okanagana

2. Node of forewing at middle of costa; larger species, over 40 mm. in length; east of Rockies..... 3
   Node of forewing on costa two-thirds from base; smaller species, 30 mm. or less in length; in and west of Rockies..... 1. Platypedia

3. Pronotum with lateral flanges..... 3. Tibicen
   Pronotum without lateral flanges, the sides rounding into the dorsal surface (genus not yet positively recorded from Canada)..... 4. Magicicada

Genus 1. Platypedia Uhl.

Only one species has been found in Canada. It is probable that, as with Okanagana, there may be unrecognized synonymy among the North American species. Most of the known North American species were dealt with by Simon (1954), and earlier by Davis (1920).

Platypedia areolata (Uhl.) (Figs. 1, 19). Length 26-30 mm. Black with the pale markings light yellow and the body, in fresh specimens, with many whitish hairs. The male genitalia provide the best characters to distinguish this from other, non-Canadian, species. So-called species that resemble this in genitalic characters, e. g. putnami (Uhl.), which was recorded as damaging apple trees in the Okanagan Valley, B. C. (Downes, 1918), may be forms of it. The call is described (Davis, 1920) as consisting of a few clicks.

Widely distributed, common, and sometimes abundant locally, throughout most of southern British Columbia.

Genus 2. Okanagana Dav.

There is a large number of described species of this genus. Specific distinctions often are based on relatively minor characters of size, form, colour, and markings that are variable in species of auchenorhynchous Homoptera as a whole, including some other genera of cicadas such as Tibicen. Reliable distinctions between many of the species have not been found in the male genitalia or other structures that normally exhibit such distinctions in those Homoptera, including some other genera of cicadas. Many of the species intergrade in specific characters: specimens from any one population tend to be of the one form, but some often are of other forms or are intermediates; and some populations are predominantly intermediate in characters between two species. It is therefore probable that many

of these so-called species are subspecies, varieties, or local forms: that there is in fact a relatively small number of variable species rather than a large number of closely-related species.

The habits favour the independent development of populations. These insects tend to occur as geographically or ecologically isolated populations, especially in the West where the largest number of so-called species are found. Each population is further divided on a time basis: the long life-cycles mean that broods that comprise a population largely reach maturity in different years and are thus more or less effectively reproductively isolated from one another. Populations thus not only tend to be isolated geographically but also by lack of overlap of broods. Isolation in these ways, combined with the relatively small number of individuals that must comprise many populations, is likely to favour the independent development of each population and brood. Moreover, the wide range of habitats in conjunction with the long life-cycles mean that the immature stages of different populations and broods may develop under widely differing conditions of food, soil, and other environmental factors that commonly affect the size, colour, markings, and form of the adult insects.

For these reasons, this genus is regarded here as consisting of a relatively small number of species, each exhibiting local variation, often annual environmental variation, and perhaps commonly variation between the different broods of any one population. On this basis, three species are known to occur in Canada. Specimens agreeing with descriptions of other species that have been recorded from Canada were not available for study. Consequently their status, as valid species or as forms of others, is not clear. They include fratercula Dav. and luteobasalis Dav., both recorded from southern Alberta (Davis, 1927, 1935), probably feeding on sagebrush, and perhaps forms of schaefferi Dav. The same applies to certain so-called species that have been recorded from Washington State, and that consequently might be found in southern British Columbia; examples are utahensis Dav., tristis Van D., lurida Dav., yakimaensis Dav., and gibbera Dav. The then known North American species of the genus were revised by Davis (1919), but a number were described subsequently.

Key to Species of Okanagana

1. Length under 28 mm. (or, wing-expanse under 58 mm., usually under 52 mm.); western..... 2
   Length over 30 mm. (or, wing-expanse over 58 mm.); transcontinental..... 1. rimosa

2. Scutellum with large, pale yellow markings; veins of forewing light yellow except those bordering apical cells which are blackish-brown; western prairie and foothills regions..... 3. synodica
Scutellum black; veins of forewing pale only in basal region and on costa; British Columbia..... 2. oregona

1. Okanagana rimosa (Say) (occidentalis Walk., canadensis Prov., novaeboracensis Emms., ornata Van D., bella Dav., and probably other Western forms not yet found in Canada). (Figs. 4, 5, 22-26). Black, with the pale markings ochreous, yellow, orange-yellow, or fulvous, and variable in extent. There is also variation in the male genitalia (Figs. 22-26) and there are sometimes extra crossveins in the forewing. The song, which is produced throughout the day, is loud, rather low-pitched, and continues for several minutes (Beamer, 1930) and is said to resemble that of some long-horned grasshoppers (Davis, 1926). The species (form bella) is also said to produce a noise consisting of a number of clicks close together and continuing for a long while (Davis, 1921).

The dominant forms of Eastern Canada are rimosa and canadensis. They have relatively slender forewings: the forewing usually is more than three times as long as its greatest width whereas in other forms the forewing usually is less than three times as long as its greatest width. Rimosa has the posterior margins of the abdominal tergites fulvous whereas canadensis usually has the dorsal surface of the abdomen wholly black; the pale markings of the head and thorax often are more extensive in rimosa than in canadensis and tend to be fulvous rather than yellowish; and canadensis tends to have the veins of the forewing thicker than in rimosa. Rimosa appears to be dominant in Nova Scotia, New Brunswick, and Prince Edward Island but is relatively less frequent in southern Ontario and southern Quebec where canadensis is the dominant form. Novaeboracensis is a rare, perhaps abnormal, form that may not occur in Canada.

Rimosa appears to be frequent in the southern parts of the Prairie Provinces, especially in southern Manitoba, but the dominant form (perhaps var. ohioensis Dav.) of the Prairie Provinces is similar to canadensis but tends to be slightly larger, on the average, and to have the pale markings of the head and thorax ochreous rather than yellow. There is variation in the shape of its forewing, even within the one population: in some specimens the forewing is more than three times as long as broad, as in typical canadensis, whereas in others it is as long as or less than three times as long as broad, as in the dominant forms of British Columbia. This western form of canadensis appears to occur chiefly in northern and hill districts and has been found in the Northwest Territories,

at Fort Wrigley. Specimens of typical canadensis and of occidentalis and bella have also been found in Prairie Provinces.

Three main forms appear to be dominant in British Columbia. As stated above, it is possible that additional forms occur there. Ornata is, when typical, the most distinctive. The main veins toward the base of the forewing are bright orange, instead of ochreous or blackish-brown as in other forms, and the hind margin of the pronotum is usually black, instead of fulvous or ochreous. This appears to be the most local of the three forms, but seems to be dominant in the Lilloet region. Occidentalis and bella differ from the eastern forms primarily in their proportionately broader forewings. Typically, occidentalis tends to have many long hairs on the ventral surface of the abdomen whereas bella has fewer and shorter hairs; bella tends to be more distinctly blue-black in colour than occidentalis; and the male valvae are black in bella but are frequently wholly or partly pale in occidentalis (they are usually wholly pale in ornata). Bella and occidentalis, and their intergrades, are collectively common and widely distributed throughout southern British Columbia up to altitudes of 5,000 feet. The Prairie Province form that is similar to canadensis occurs occasionally in British Columbia, apparently especially in the mountains (6,000 feet), and specimens of form rimosa have been found occasionally.

As the above indicates, this is the most widely distributed of the Canadian species of cicadas. It appears to be less common and widely distributed in the Prairie Provinces than in the East and in British Columbia. It occurs among trees, and there are indications that the nymphs may feed at roots of a variety species of trees and shrubs. For example, it was found mainly among aspen on Manitoulin Island, Ont. (Davis, 1930) but mainly among pine at Ironsides, Que. (Davis, 1919), and has been found in British Columbia among juniper, willow, and other trees. It normally rests at the extremities of the highest branches.

2. Okanagana oregona Dav. (Figs. 3, 21). Length 25-28 mm. Black, with the pale markings of the head and thorax ochreous and those of the abdomen ochreous or fulvous; basal membranes of hindwing orange. There is variation in the size of the pale areas, which sometimes are more extensive, particularly on the thorax, than as shown in Fig. 3. It is possible that this may be a form of rimosa but it is treated here as a valid species because intergrades between it and forms of rimosa were not seen.

Southern British Columbia, in dry areas of the interior.

3. Okanagana synodica (Say) (Figs. 2, 20). Length 21-24 mm. Black with the pale areas, which are extensive, light honey-yellow. A distinctive species in form and colour. The largely pale venation of the forewings is noteworthy. The call is said to be a continuous note that sometimes lasts for only a short while (Davis, 1921).

Southern Alberta, mainly in the foothills region; perhaps on grasses.

Genus 3. Tibicen Latr.

The largest of the Canadian cicadas. Four species have been found in the East; one of them occurs in the Prairie Provinces; none has been found in British Columbia. They occur among deciduous trees. Specific characters are in the size and markings, the genitalia and opercula (the coverings of the sound-producing organs) of the males, and the songs. Life-histories and habits of a number of the North American species were discussed by Beamer (1928).

Key to Species of Tibicen

1. Undersurface of abdomen wholly pale..... 1. chloromera
   Undersurface of abdomen with a black median band..... 2

2. Hind region of pronotum (collar) black or blackish.. 2. lyricen
   Hind region of pronotum green or greenish (sometimes yellowish in preserved specimens)..... 3

3. Opercula rounded; costal margin of forewing usually evenly curved..... 3. pruinosa
   Opercula bluntly pointed; costal margin of forewing usually distinctly angled near middle..... 4. linnei

1. Tibicen chloromera (Walk.) (sayi Smith & Gross.). (Figs. 11, 15, 18). Length 47-51 mm. Blackish with the markings greenish (yellowish or light brownish in some preserved specimens); veins of forewing greenish in basal region, otherwise brownish. There is much variation in the extent of the pale markings. Distinctive features are: the pale undersurface of the abdomen, under the often heavy pruinosity; the opercula, which are longer than those of any

other Canadian species (Fig. 15); the form of the aedoeagus (Fig. 18); and the song, which starts quite low, rises to a rapid zzz and then gradually subsides (Davis, 1922, 1926), and which begins early in the morning, before those of other species, and apparently normally ceases before noon.

Southern Ontario, among deciduous trees; apparently rare.

2. Tibicen lyricen (DeG.) (fulvula Osb.) (Figs. 10, 14, 17). Length 46-50 mm. Blackish with the markings brownish-yellow and the veins of the basal region of the forewing greenish. There is much variation in the extent of the pale markings; var. englehardti Dav. (Fig. 10) has the pale areas greatly reduced and is the most frequent form in Canada. This species can be distinguished from chloromera by the blackish median band, beneath the pruinosity, on the undersurface of the abdomen, and from the following two species by the dark 'collar' of the pronotum. The song is a rather monotonous, even-toned zzz, generally of rather short duration (Davis, 1918, 1926).

Southern Ontario (Niagara region), among large deciduous trees; apparently locally common.

3. Tibicen pruinosa (Say) (canicularis Harr.) (dog-day cicada or harvestman) (Figs. 6, 8, 12, 16). Length 41-45 mm. Black with the pale markings dull greenish, yellowish-green, or (in some preserved specimens) brownish-yellow. There is individual variation in the extent of the pale areas. This species is closely related to linnei; the two have similar male genitalia, and pruinosa occasionally has the costa of the forewing angled as in linnei. The song is distinctive: it is high-pitched, rather shrill, not very long, rising and falling, consisting of a continuous zzz with a loud zape at pulsating intervals, and rendered as z-zape, z-zape, z-zape, or za-wie, za-wie, za-wie (Davis, 1910; Beamer, 1928). The species normally sings in the late afternoon and early evening.

Prince Edward Island, Nova Scotia, and the southern regions of Quebec, Ontario, Manitoba, and Saskatchewan, generally distributed among deciduous trees and often locally abundant.

4. Tibicen linnei Smith & Gross. (tibicen auctt. nec L.) (Figs. 7, 13). Length 42-46 mm. Black, with the markings dull greenish, yellowish-green, or (in some preserved specimens) brownish-yellow. The most reliable character to distinguish this species from pruinosa is the shape of the opercula (Fig. 13). Other

distinguishing characters, of lesser reliability, are: the costal margin of the forewing is distinctly angled (Fig. 7), instead of evenly curved as is usual in pruinosa; the whitish basal abdominal spots of the male, and the whole insect, tend to be slightly larger than in pruinosa. There appear to be no reliable differences between the male genitalia of the two species. The song of linnei is distinctive, and consists of rather even-toned zeeger, zeeger, zeeger of short duration (Davis, 1922, 1926).

Southern Ontario (Lake Erie region); apparently local, among deciduous trees, especially in moist localities.

Genus 4. Magicicada Dav.

Magicicada septemdecim (L.) (periodical cicada, 17-year locust, or red-eyed cicada) (Fig. 9). Length 37-42 mm. Blackish, with the eyes often reddish, the legs and sometimes the sides of the pronotum brownish-yellow, and the veins of the basal half of the forewing reddish-orange or brownish-yellow.

This species has not been reliably recorded from Canada, though there is an unconfirmed record from Almaville-en-Haut, Quebec. There is a possibility that it might occur in southern Ontario, as broods of its 17-year race inhabit a number of localities in the Lake Ontario region of New York, the Lake Erie region of Ohio, and northern Michigan. The species is of some economic significance in the United States where two main races occur, one with a 17-year life-cycle and the other, which is more southerly in distribution, with a 13-year life-cycle.

Family MEMBRACIDAE

These often conspicuous insects feed on deciduous trees and shrubs and on herbaceous plants. The adults tend to be relatively sedentary, except in still, warm weather. A few species fly at night and are attracted by lights, and members of the tribe Telamonini are strong, active fliers that are thus often difficult to capture. In general, membracids are not of great economic significance in Canada, as most species do not attack crop plants and populations are normally relatively low. A few species, notably of the tribe Ceresini, damage fruit trees by scarring the shoots when egg-laying, and occasionally damage alfalfa, clover, and fruit trees by feeding. No species is known to be a vector of virus diseases of any crop plant in Canada.

The life-cycle of most species takes a year, with the winter passed in the egg stage, except with members of the tribe Polyglyptini which hibernate as adults. The eggs are laid in plant tissues, often in woody plants in which case the nymphs drop to complete their development in herbaceous plants and the adults return to the woody plants to feed and oviposit. The adults of most species are to be found from about mid-July to September. The nymphs of most species are present in the spring and early summer and the adults later in the summer and in the early fall. Though membracids are not difficult to rear, little is known of the habits, morphology, and taxonomy of the immature stages. Many of the species are host-specific to particular plants. The nymphs excrete honeydew and are thus attractive to ants, and some have been found in the nests of ants. Though various stages are attacked by parasitic and predatory insects, mainly Hymenoptera, the chief natural control factors are physical. Unfavourable weather, especially windstorms and heavy rains, can cause heavy mortality, and there is often severe mortality to the eggs when they are crushed either by the growth of the plant tissues in which they are laid or by the twigs shrinking after they are killed by the egg-laying activities.

About 70 species and a species-group of perhaps an additional six are recognized here as inhabitants of Canada. Most of these are confined to the southern parts of the country; about four-fifths inhabit eastern Canada but only about one-fifth have been found in or west of the Rockies. The taxonomic characters chiefly used for identifications are the shape, colour, and markings of the pronotum. This usually has a median, longitudinal ridge or crest or a dorsal horn or process, and sometimes a lateral, humeral, process behind each eye. In general, reliable specific characters have not been found in the genitalia, except in the tribe Ceresini which includes the species of most economic significance. There is often much variation in external morphological characters. Because of this it is sometimes impossible to name single specimens with confidence, as in the tribe Telamoni: a series of specimens from the one

population must be available for a species to be named reliably. The genus Cyrtolobus remains a taxonomic problem; it is not clear whether it consists of a larger number of closely-related species or a smaller number of highly variable species.

Publications on membracids up to 1942 were listed by Metcalf (1942) and the synonymy by Funkhouser (1927). Provincial lists are by Brittain (1918) for Nova Scotia, Downes (1927, 1935) for British Columbia, Moore (1950) for Quebec, and Strickland (1955) for Alberta. State lists, with keys, are by Lawson (1922) for Kansas, Funkhouser (1923) for Connecticut, Osborn (1940) for Ohio, and Dennis (1952) for Wisconsin. Species that damage fruit trees were discussed by Brittain (1917) and Yothers (1934), and habits and food-plants of Ontario species were described by Brimley (1961).

Key to Subfamilies of Membracidae

1. Pronotum greatly enlarged, covering scutellum and dorsal surface of abdomen..... 2
   Pronotum not greatly enlarged, but part of scutellum and most of dorsal surface of abdomen visible..... ..... 2. Centrotinae (p. 13)

2. Tarsi of hind legs short, shorter than those of front and middle legs..... 3. Hoplophorinae (p. 14)
   Tarsi of hind legs as long as or longer than those of front and middle legs..... 3

3. Tibiae of front and middle legs broadened and flattened ..... 1. Membracinae (p. 11)
   Tibiae of all three pairs of legs simple.. 4. Smiliinae (p. 15)

Subfamily 1. Membracinae

Small insects with the front and middle tibiae expanded and flattened and with the pronotum produced anteriorly as a median horn.

Key to Genera of Membracinae

Clypeus longer than wide, rounded below; pronotum with yellowish markings..... Euchenopa
Clypeus not longer than wide, truncate below; pronotum without yellowish markings..... Campylenchia

Genus Campylenchia Stal

Campylenchia latipes (Say) (antonia Walk., venosa Walk., bimacula Walk., frigida Walk., curvata Stal, rectidorsum Buck.) (Figs. 27, 28). Length 5-8 mm., its variation depending mainly on variations in the length of the horn. Pronotum brown, varying from light brown to blackish; forewings brownish. In dark specimens the posterior region of the pronotum tends to be paler than the remainder. The variation in the length of the horn is both between individuals and between populations; specimens from the Prairie Provinces tend to have the horn relatively short whereas specimens with the longest horn are most frequent in the East. According to Brimley (1961), who described the life-history, the colour of the nymphs varies depending on the foodplant.

Southern parts of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, and Quebec, and in New Brunswick and Nova Scotia, widely distributed and often common; on a variety of herbaceous plants but most frequently on alfalfa (Medicago spp.) and other legumes. Nymphs were found in nests of the ant Formica subnitens Creighton in British Columbia, but the adults are eaten by this ant (Ayre, 1958); and in Ontario the honeydew attracts Formica fusca L. and Lasium alienus americanus Em. (Brimley, 1961).

Genus Euchenopa Am. & Serv.

Key to Species of Euchenopa

Horn large and long; forewing uniformly brown; pale markings of pronotum restricted to two median elongate areas... binotata
Horn short; forewing ochreous with brown or blackish areas; pronotum usually with additional or other pale areas..... permutata

Euchenopa binotata (Say) (brevis Walk., porrecta Buck.) (Fig. 29). Length 5-8 mm., its variation depending mainly on variations in the length of the horn. Dark brown, sometimes almost black, sometimes lighter brown; pale areas of pronotum yellowish; forewings brown. There is some variation in the shape of the horn as well as in its length.

Southern Manitoba, local, southern Ontario, widely distributed and locally common, and southern Quebec and Nova Scotia, local. In

wooded districts, on various shrubs and small trees and sometimes on herbaceous plants.

Euchenopa permutata Van D. (Fig. 30). Length 4-5 mm. Pronotum and forewings ochreous with the markings dark brown or blackish. There is much variation in the extent of the dark areas. Some specimens are almost wholly ochreous with the markings light brown; at the other extreme the pronotum and the forewing, except its apical one-third, are black; most specimens are more or less intermediate, as shown in the figure.

Southern Alberta, local; on Sarcobatus sp.

Subfamily 2. Centrotinae

Members of this subfamily may be readily recognized by the relatively small pronotum that does not entirely cover the scutellum and that is extended backward as a median, spine-like process.

Key to Genera of Centrotinae

Pronotum produced backward as a median process that is somewhat sinuate in lateral view, and with a wide, pointed process at each side of the median process; Ontario.... Microcentrus
Pronotum produced backward as a single median, process that is straight and spine-like; British Columbia... Gargara

Genus Microcentrus Stal

Microcentrus caryae (Fitch) (Fig. 31). Length 6-9 mm. Dull greyish-brown or greyish-fuscous, the cells at apex of forewing paler. Forewing sometimes darkened at base and before middle as ill-defined transverse bands. There is some variation in the shape and height of the pronotum in lateral view, though its general form is always distinctive.

Southern Ontario, local; on hickory (Carya spp.), and perhaps also on ironwood (Ostrya sp.).

Genus Gargara Am. & Serv.

Gargara genistae Fab. (Fig. 32). Length 5 mm. Pronotum black, closely covered with silvery-white pubescence; forewing fuscous-tinged.

Southwestern British Columbia, local, probably introduced from Europe; on broom (Cytisus sp.) and probably other shrubs.

Subfamily 3. Hoplophorinae

Members of this subfamily are distinguished by the relatively short hind tarsi. One genus and two species have been found in Canada.

Genus Platycotis Stal

Key to Species of Platycotis

On birch; pronotum with a median, anteriorly-directed horn, or with the rudiment of a horn; if horn absent then mid-line not heavily marked with black; larger species, length 9-12 mm.; eastern and western Canada..... vittata

On western hemlock; pronotum with no trace of a horn; anterior half of mid-line heavily marked black; smaller species, length 7-9 mm.; western only..... maritimus

Platycotis vittata (Fab.) (humilis Walk., guttifera Walk., lineosa But.) (Figs. 33, 34). Length, including horn, 9-12 mm. There are two forms that intergrade and that frequently occur together. The typical form is dull brownish or ochreous-brown with darker punctures, usually with irregular blackish or fuscous areas, especially in the frontal region, and with these areas sometimes forming irregular bands, and is sometimes spotted with red to varying degrees. Var. quadrivittata Say (quadrilineata Germ., lineata Fairm., rubrivittata Walk., viridescens Walk., porrecta Dohrn) is ochreous or straw-coloured with bright red bands, and the bands are sometimes largely black, or partly black and partly black-margined. There is much variation in the length of the pronotal horn; it is frequently longer in quadrivittata than in the typical form in which it is often relatively short, especially in the male; it is often intermediate, especially in the typical form; and it is occasionally virtually absent.

Southwestern British Columbia, locally common, and southern Ontario, local; on birch (Betula spp.), but quadrivittata on oak (Quercus sp.) in British Columbia.

Platycotis maritimus Van D. (minax God., asodalis God.) (Fig. 35). Length 7-9 mm. Dull ochreous or brownish with irregular darker brown mottlings; sometimes with blackish areas anteriorly; sometimes bright green, brownish anteriorly; mid-line heavily marked with black from front to middle.

Southwestern British Columbia, apparently local; on western hemlock (Tsuga heterophylla (Raf.) Sarg.).

Subfamily 4. Smiliinae

This subfamily includes the majority of the Canadian species of Membracidae. There is great variation between species in form, colour, and size, and in some genera there is intergrading that makes specific identifications difficult. Specific characters are found primarily in the shape, colour, and markings of the pronotum, and, in the tribe Ceresini, in the genitalia.

Key to Tribes of Smiliinae

1. Clavus of forewing never largely or entirely covered by pronotum; species usually moderate-sized, usually unicolorous greenish or ochreous, usually with humeral angles produced as prominent horns, and pronotum without a median horn ..... 4. Ceresini
   Most or all of clavus of forewing and often part or all of corium covered by pronotum..... 2

2. Terminal cell at apex of hindwing not an equilateral triangle, but either with its base truncated or, rarely, an elongate triangle; species usually moderate to large in size, usually some shade of brown with distinct markings, usually with a pronounced dorsal horn or crest ..... 3. Telamonini
   Terminal cell at apex of hindwing an equilateral triangle; species usually small..... 3

3. Basal region of corium with three longitudinal veins ..... 2. Smiliini
   Basal region of corium with only two longitudinal veins..... 1. Polyglyptini

Tribe 1. Polyglyptini

Key to Genera of Polyglyptini

1. Cell at apex of forewing elongate, not triangular; pronotum in lateral view not with elevations; small, distinctly hairy insects..... 1. Vanduzea
   Cell at apex of forewing triangular; pronotum in lateral view elevated before and behind a median depression..... 2

2. Pronotum in lateral view with two strong elevations separated by a deep median notch..... 3. Entylia
   Pronotum in lateral view only slightly, though distinctly, elevated before and behind a shallow median depression..... 2. Publilia

Genus 1. Vanduzea God.

Key to Species of Vanduzea

Length over 5.5 mm. Eastern..... arquata
Length under 5.0 mm. Prairie Provinces..... triguttata

Vanduzea arquata (Say) (apicalis Walk.) (Fig. 37). Length 5.5-6.0 mm. Female dark brown with the bands ochreous or whitish and broadly bordered with blackish. Male black with the markings whitish.

Southern Ontario; on honey locust (Gleditsia sp.), cottonwood (Populus spp.), and oak (Quercus spp.).

Vanduzea triguttata (Burm.) (tripunctata Fairm., annexus Towns., vestita God.) (Fig. 36). Length 4-5 mm. Female brown with the bands ochreous and broadly bordered with dark brown. Male very dark brown, virtually black, with the markings whitish.

Southern Manitoba.

Genus 2. Publilia Stal

Key to Species of Publilia

Pronotum with strong, raised longitudinal ridges or reticulations; mainly Eastern..... concava
Pronotum without strong ridges or reticulations; Prairie Provinces..... modesta

Publilia concava (Say) (extensa Walk., nigridorsum God., grisea Buck., vittata Buck., reticulata Van D.) (Fig. 38). Length 4-5 mm. Variable in colour and markings. Pronotum usually brown to fuscous with ill-defined, ochreous, transverse bands before middle and apex and with the ridges often mottled with ochreous; sometimes wholly dark brown or black; sometimes ochreous or reddish-ochreous with the frontal and apical regions, and sometimes the median, black; occasionally greyish-brown, with or without darker markings as described above. There is also variation in the raised ridges, which are usually longitudinal and more or less straight, but are sometimes irregular and tend to form reticulations. The reticulated form has been regarded as a distinct species, reticulata, but it appears to intergrade with other forms. The most distinctly reticulated specimens are from southern Manitoba.

Widely distributed and common throughout southern Ontario, widely distributed in southern Quebec, and found in New Brunswick, Nova Scotia, and the southern regions of Manitoba and Alberta; on oak (Quercus spp.) and various herbaceous plants, but apparently most frequent on ragweed (Ambrosia sp.). Adults hibernate under leaves. Ants associated with this species include Formica fusca L., Camponotus noveboracensis (Fitch), Crematogaster (Acrocoelia) lineolata (Say), Lasium alienus americanus Em., and Myrmica brevispinosa discontinua Web. (Brimley, 1961).

Publilia modesta Uhl. (bicinctura God.) (Fig. 39). Length 4-5 mm. Variable in colour and markings. Usually light greenish or ochreous with light or darker brown markings that form indefinite diagonal transverse bands; sometimes mottled with dark brown; sometimes with the frontal region black, bordered with whitish, and the remainder of pronotum dull ochreous; sometimes dark brown, with or without an ochreous posterior transverse band and with or without the frontal region black.

Widely distributed and locally common in the southern regions of Manitoba, Saskatchewan, and Alberta; on various herbaceous plants but apparently most frequently on ragweed (Ambrosia sp.). Adults and nymphs were found in nests of an unidentified species of ant.

Genus 3. Entylia Germ.

Entylia carinata (Forst.) (sinuata Fab., emarginata Fab., bactriana Germ., accisa Walk., indecisa Walk., reducta Walk., torva Fitch, impedita Walk., mira But., inaequalis Fowl., vittata Buck., oedipus Buck.) (Figs. 40, 41). Length 5 mm. Highly variable in colour and markings, from ochreous through various shades of brown to fuscous, usually with darker markings in the frontal region and either as a median saddle or as ill-defined lines or bands; dark brown or blackish specimens usually have either an ochreous transverse band near apex or the apical region ochreous. There is also variation in the shapes of the elevations of the pronotum, which, especially in the female, sometimes are lower than as shown in the figures, and the anterior elevation sometimes is rounded rather than truncate.

Common throughout most of southern Ontario, southern Quebec, and Nova Scotia; on various herbaceous plants and shrubs but apparently most frequently on thistles (Cirsium spp.). Adults hibernate under dead leaves. Ants associated with this species include Camponotus pennsylvanica (DeG.), Formica fusca L., F. sanguinea subnuda Emery, Crematogaster lineolata (Say), and Tapinoma sessile (Say) (Brimley, 1961).

Tribe 2. Smiliini

Oak-feeding insects, usually relatively small in size. There is often much individual and local variation and a number of so-called species intergrade on a basis of known taxonomic characters. The status of these, as species or as varieties, is a matter of individual opinion. It would seem probable that, as in the cicadid genus Okanagana, there is in fact a smaller number of species that exhibit much individual, environmental, and geographical variation rather than a larger number of closely-related, less variable species. Detailed studies of the life histories and ecology, and rearing experiments, may be necessary to reveal the true species-limits.

Key to Genera of Smiliini

1. Corium of forewing without a crossvein connecting the two inner longitudinal veins..... 3. Smilia
   Corium of forewing with a crossvein connecting the two inner longitudinal veins..... 2

2. Dorsal surface of pronotum rounded in front view, without a longitudinal median elevation, ridge, or crest ..... 2. Ophioderma
   Dorsal surface of pronotum in front view with a moderate or strong median longitudinal elevation, ridge, or crest..... 1. Cyrtolobus

Genus 1. Cyrtolobus God.

The known species of this genus (including the subgenera Atymna Stal and Xantholobus Van D.) were described, discussed, and mostly figured, but without keys, by Woodruff (1924). He recognized about 45 species and Funkhouser (1927) listed 52, eight of them from Canada; Osborn (1940) recorded 28 from Ohio and Dennis (1952) 20 from Wisconsin. The impression gained from a study of Canadian specimens and of the literature is that the species are probably both fewer in number and more highly variable than generally recognized.

This genus therefore presents a taxonomic problem that awaits solution, perhaps only by rearing experiments and ecological studies. There is much variation in the taxonomic characters that are commonly regarded as indicating specific distinctions: the shape, colour, and markings of the pronotum. The species are all found on oaks and many of them intergrade. Any one population may be predominantly of one identifiable form but often includes specimens of other forms and of intermediates; it may be predominantly of intermediates that usually cannot be named with confidence; or it may be predominantly of two or more named forms, usually with intermediates between them or between one or more of them and other forms. Though some forms are apparently valid species that do not intergrade with others, the true specific limits of other forms cannot be defined reliably on a basis of known taxonomic characters. The situation is further complicated by the existence of more or less strong sexual dimorphism. In general the females can be named more readily than the males.

The apparently valid Canadian species and some recognizable forms that were available for study in adequate series are discussed below. Additional species and forms occur in Canada but were not available in sufficient numbers for the status of each to be judged; consequently the following key and descriptions must be regarded as very incomplete.

Partial Key to Species and Forms of *Cyrtolobus*

1. Ridge of pronotum continued forward nearly to head; pronotum of female green, without darker or paler markings except on crest; pronotum of male either uniform light brown or dark brown with bright yellow markings (subgenus *Atymna*)..... 2
   Ridge of pronotum usually obsolete anteriorly; pronotum of female usually with definite dark or pale markings, if unicolorous then not green; pronotum of male not coloured as above..... 4

2. Pronotum of female strongly arched above humeri in lateral view; pronotum of male light brown..... 1. *inornata*
   Pronotum of female evenly curved in lateral view, not strongly arched above humeri; pronotum of male dark brown with bright yellow markings..... 3

3. Pronotum of female with the ridge bordered on each side by a creamy band; anterior region of male pronotum usually largely yellowish..... 2. *helena*
   Pronotum of female with the ridge not pale-bordered; anterior region of male pronotum usually largely brown..... 3. *querci*

4. Robust species; pronotum in lateral view with its highest point behind middle; pronotum with a bulbous inflation at each side before and behind a mid-dorsal bilateral compression; male genitalia with small projection on anterior margin of connective (subgenus *Xantholobus*) ..... 4. *muticus*
   Less robust species; pronotum without bulbous inflations, or if these are present than with its highest point before middle; connective without projection from anterior margin (subgenus *Cyrtolobus*)..... 5

5. Apex of pronotum reaching apex of forewing..... 6
   Forewing extending beyond apex of pronotum..... 7

6. Pronotum high, strongly arched, mainly ochreous or pale brown, often with a pinkish tinge, without a mid-dorsal pale spot..... 6. *fuliginosus*
   Pronotum not strongly arched, dark reddish brown with a pale, quadrate, mid-dorsal blotch..... 7. *fenestratus*

7. Large species, length 8-9 mm.; pronotum strongly arched, with bulbous expansions, its highest at or before middle (see couplet 4)..... 6. *tuberosus*
   Smaller species, length 7 mm. or less..... 8. *vau* group

1. Cyrtolobus inornata (Say) (Figs. 42, 43). Length 5.5-7.0 mm. Female green with the edge of the median ridge narrowly black; forewing tinged with brownish at base and apex. Male light brown with the edge of the ridge narrowly dark brown, and the forewing suffused with dark brown on basal half and with fuscous in apical region. The shape of the pronotum in lateral view distinguishes the female from those of related species, and the colour and the lack of markings of the male are distinctive.

Southwestern Ontario, apparently local; on oak (Quercus spp.).

2. Cyrtolobus helena Woodr. (Figs. 44, 45). Length 6-7 mm. Female green, often irrorated with yellow, with the ridge creamy and its edge often narrowly marked with black or dark brown. Male yellow, often with a greenish tinge, and dark brown; forewing suffused with fuscous at base and apex. The distinctive features are indicated in the key. The female is more distinctly green than is that of querci.

Southern Manitoba, widely distributed and locally common; on oak (Quercus spp.).

3. Cyrtolobus querci (Fitch) (Figs. 46, 47). Length 5.5-7.0 mm. Female yellowish, mottled with green to give a general pale green or pale yellowish-green appearance that becomes ochreous in old specimens; ridge narrowly dark brown or blackish; forewing sometimes slightly darkened at apex. Male bright yellow and dark brown or blackish-brown with the forewing fuscous-tinged in basal and apical regions. There is some variation in the relative proportions of the dark and pale areas in the male. The distinctive features of the species are indicated in the key.

Southern Ontario, generally distributed and locally common; on oaks (Quercus spp.), possibly mainly burr oak.

4. Cyrtolobus muticus (Fab.) (trilineata Say) (Fig. 48). Length 6.5-7.5 mm. Female variable, ochreous to brown, irrorated anteriorly with darker brown or fuscous, and with ochreous or whitish bands and brown to fuscous markings. Male very variable, brown to black, or brown and black, with the markings whitish. A more robust insect than other Canadian species of this genus. It might be confused with tuberosus, also a relatively large insect with bulbous inflations on the pronotum, but can be distinguished by the shape of the pronotum in lateral view.

Widely distributed in southern Ontario and southern Manitoba

and found in southern Quebec; on oak (Quercus spp.), possibly mainly white oak.

5. Cyrtolobus tuberosus (Fairm.) (semifascia Walk.) (Figs. 49, 50). Length 8-9 mm. Female brownish, tinged greenish, especially anteriorly, with the pale spots hyaline and the dark areas dark brown. Male mottled with dark brown on an ochreous background to give a general dark brown appearance; the pale markings whitish, hyaline on crest. There is some variation in the relative sizes of the markings in both sexes. Forewing tinged with dark brown or fuscous in apical region. This species may be distinguished from muticus primarily by the shape of the pronotum in lateral view.

Southern Ontario, apparently local; on oak (Quercus spp.).

6. Cyrtolobus fuliginosus (Emm.) (Figs. 52, 53). Length 6-7 mm. Female ochreous or pale brown, often tinged with pinkish, with the bands paler ochreous and margined with darker brown. Male brown with the bands ochreous. There is much variation in the colour and markings; in pale specimens the dark and pale markings are sometimes almost obsolete, whereas strongly-marked specimens are more distinctly marked than as shown in the figure. The forewing tends to have a darkened median transverse band in strongly-marked specimens. There is an almost entirely black form of the female, which apparently has not been found in Canada. The strongly arched pronotum, which is as long as the forewings, is distinctive.

Southern Ontario, widely distributed; on oak (Quercus spp.).

7. Cyrtolobus fenestratus (Fitch) (Fig. 54). Length 6 mm. Female dark reddish-brown, becoming blackish on the crest and anteriorly, with the pale markings ochreous and the forewing suffused with fuscous at base and apex. The underside of the body is green in life but this fades after death. A slender insect with the pronotum as long as the forewings.

Southern Ontario and southern Quebec, apparently not common; on oak (Quercus spp.), possibly black oak.

8. Cyrtolobus vau (Say) group. (Figs. 55-63). This is a group of so-called species, based on characters of shape, colour, and markings, that intergrade with one another. They are small insects that average about 5.5 mm. in length. The female is

usually ochreous, greyish-ochreous, or brown, with light to dark brown or fuscous markings. The male is usually ochreous or whitish with extensive dark brown or fuscous markings. The group is generally distributed and locally common throughout southern Ontario and southern Manitoba and in parts of southern Quebec, on oaks (Quercus spp.) of various kinds.

The identity of vau Say is doubtful, and the type has been lost. The original description indicates that it is marked as in Figs. 61-63. There is much colour variation in such forms, a number of which have been described as species. A weakly-marked form with a large, usually divided, blackish blotch on the front of the pronotum (Fig. 55) agrees with the description of maculifrontis (Emm.). A form similar in pronotal markings to "vau" but with a median dark band on the forewing is pallidifrontis (Emm.) (ornata Prov.) (Figs. 56, 57). A frequent form is marked as in Fig. 58; when it has a median band on the forewing it agrees with the description of rufulus Woodr. A more or less uniform brown form agrees with the description of intermedius (Emm.) (Fig. 59), which may occur mainly on red oak; and a form with dark, sinuate, longitudinal bands agrees with the description of discoidalis (Emm.) (Fig. 51) and might be a valid species distinct from the vau group.

Genus 2. Ophioderma Fairm.

This genus was revised by Gibson and Wells (1917) and Woodruff (1919, 1920) and consists of oak-feeding species that have been found only in the East. There is often strong sexual dimorphism, and males of some species are sometimes difficult to identify reliably in the absence of associated females.

Key to Species of Ophioderma

1. Pronotum largely or wholly green..... 2
   Pronotum not green..... 3

2. Pronotum reddish-tinged posteriorly; hook on side of thorax at base of forewing (pre-elytral hook) stout, blunt, and not strongly curved..... 3. female flava
   Pronotum not reddish-tinged; hook on side of thorax at base of forewing, more slender, more distinctly pointed, strongly curved..... 2. female evelyna

3. Pronotum with a broad, yellow marginal band from behind eye to middle, sometimes with an apical transverse band, otherwise without definite markings..... 1. male flavicephala
Pronotum not marked as above, with side margins dark, and with different or additional markings..... 4

4. Forewing with dark band across middle..... 5
Forewing without dark band across middle..... 6

5. Larger species, length 7 mm. or more; strongly hairy ..... 4. salamandra
Smaller species, length 6 mm. or less; weakly hairy ..... 6. definita

6. Females..... 7
Males..... 8

7. Pronotum not reddish-tinged; pale markings usually obscure; smaller species, length under 7 mm. ..... 5. pubescens
Pronotum partly reddish-tinged; pale markings usually distinct; larger species, length 7 mm. or more. 4. salamandra

8. Pale markings of pronotum pale yellow; larger species, length about 7 mm.; weakly hairy..... 3. flava
Pale markings of pronotum whitish; smaller species, length about 6 mm.; strongly hairy..... 5. pubescens

1. Ophioderma flavicephala God. (Fig. 64). Length 5-6 mm. Male brown or dark brown with the lateral areas of the pronotum pale yellow, and with a distinct or indefinite whitish or yellowish transverse band before apex; forewing tinged brown at base and apex. A rather hairy insect. Female said to be similar to the male. There is a slight possibility that this species may be the male of the following. The colour and markings are distinctive.

Southern Ontario, apparently local; on oak (Quercus spp.).

2. Ophioderma evelyna Woodr. (Fig. 65). Length 7 mm. Female mottled with green on a yellow background to give a general green appearance; head and front of pronotum yellow; forewing tinged with light brown at base and apex. The absence of a reddish tinge on the pronotum and forewings and the shape of the pre-elytral hook distinguish the female from that of flava.

Southern Ontario, apparently local; on oak (Quercus spp.).

3. Ophioderma flava God. (fraterna Gibs. and Wells) (Figs. 66, 67). Length 7 mm. Pronotum of female green, with the posterior half suffused with brownish-red, and often with a small yellow spot at the middle of each side margin; head yellowish; basal third of forewing suffused with brownish-red, and a brownish suffusion at apex. The reddish suffusions and the shape of the pre-elytral hook distinguish the female from that of evelyna. Male dark brown or black with the markings, which vary somewhat in size, pale bright yellow; forewing tinged with fuscous at base and apex. The yellow markings tend to be distinctive. A weakly hairy species.

Southern Ontario and southern Quebec, widely distributed and locally common; on various oaks (Quercus spp.).

4. Ophioderma salamandra Fairm. (Figs. 68, 69). Length 7-8 mm. Female brown to dark brown, usually partly tinged with reddish-brown, with the markings dirty white or brownish-white; forewing suffused with fuscous at base and apex, and frequently with a median fuscous band. There is variation in the size and the degree of distinctness of the pale markings of the pronotum, which tend to be relatively distinct in specimens that have the median band on the forewing. It is possible that what is at present treated as salamandra may be a complex of two or more species. Male dark brown to blackish with the markings dirty whitish; forewing tinged with fuscous at base and apex.

Southern Ontario, southern Quebec, New Brunswick, and Nova Scotia, widely distributed; on oak (Quercus spp.).

5. Ophioderma pubescens (Emm.) (flaviguttula God.) (Fig. 70, 71). Length 6-6.5 mm. Female rather uniform greyish-brown with the markings, when present, whitish; forewing suffused with fuscous at base and apex. There is some variation in the size and degree of distinctness of the pale markings of the pronotum. Male brown or dark brown with the markings white; forewing suffused with fuscous at base and apex. A hairy insect.

Southern Ontario and southern Quebec, widely distributed; on oaks (Quercus spp.).

6. Ophioderma definita Woodr. (Fig. 72). Length 5-6 mm. Female brown or dark brown, distinctly fulvous-tinged; markings brownish-white or dirty white. Male black with the markings dirty white and somewhat variable in size. Forewing in both sexes suffused with fuscous at base, middle, and apex. The median band of the forewing combined with the small size are distinctive. O. grisea Woodr., which has not been found in Canada but which might

occur in southern Ontario, also has these characters but its female is distinctly grey in colour.

Southern Ontario and southern Quebec, widely distributed; on oak (Quercus spp.).

Genus 3. Smilia Germ.

Smilia camelus (Fab.) (vittata Am. and Serv., zimmermanni Fairm., guttata Fitch, betulae God., compressa Buck.) (Figs. 73, 74). Length, male 7-8 mm., female 9-10 mm. Female ochreous to black, usually light brown with the diagonal band yellow and the spots translucent whitish. The band is commonly reduced to a spot in the crest and is often obsolete; sometimes it is broadened to become confluent with the median spot; occasionally all pale markings are absent. Male brown to black, with the band lemon-yellow, the spots translucent whitish, and the frontal region irrorated with yellow. The band is sometimes reduced in size, but in general the variation is less than in the female. There is some variation in the shape and height of the pronotum in lateral view in both sexes.

Generally distributed and locally frequent in southern Ontario and southern Quebec; on oak (Quercus spp.), possibly mainly red oak.

Tribe 3. Telamonini

Large, active, robust, usually dark-coloured insects that usually occur on deciduous trees and shrubs and tend to be host-specific. The North American species were revised by Ball (1931). Despite the conspicuous appearance of these insects, much remains to be discovered about their life-histories and habits, which may be important from the taxonomic viewpoint. There is frequently variation in the shape, colour, and markings, and this is often such as to cause intergrading between so-called species. It seems not improbable that the actual number of species may be smaller than is at present supposed, and that some species have several races or subspecies each perhaps associated with a different foodplant.

Key to Genera of Telamonini

1. Pronotum with a horn or crest..... 2
   Pronotum without a horn or crest, in front view either very high and thin or low and evenly rounded..... 4

2. Pronotum with a dorsal horn that arises above or in front of the humeral angles..... 3
Pronotum with a crest the major portion of which is behind the humeral angles..... 3. Telamona

3. Horn pointing forward, and less compressed..... 5. Thelia
Horn pointing upward, not or only slightly directed forward, and much compressed bilaterally..... 4. Glossonotus

4. Pronotum very high and strongly compressed..... 1. Archasia
Dorsal surface of pronotum rounded in front view... 2. Carynota

Genus 1. Archasia Stal

Key to Species of Archasia

Pronotum very high, projecting forward beyond head in front, with the median ridge usually not strongly darkened; larger species, length 10-11 mm. ..... galeata
Pronotum lower and not projecting beyond head in front, with the median ridge black or dark brown from above head to apex; smaller species, length 8-9 mm. ..... belfragei

Archasia belfragei Stal (canadensis Prov.) (Fig. 75). Length 8-9 mm. Green with a smoky tinge, darker than galeata when alive; median ridge of pronotum black or dark brown from above head to apex; forewing largely dark fuscous.

Southern Ontario and southern Quebec, scarce; on oak (Quercus spp.).

Archasia galeata (Fab.) (auriculata Fitch) (Fig. 76). Length 10-11 mm. Bright green when alive, becoming greenish-ochreous after death; median ridge of pronotum sometimes with a narrow, interrupted, dark line; forewing tinged with fuscous at base and apex.

Southern Ontario, scarce; on oak (Quercus spp.).

Genus 2. Carynota Fitch

Key to Species of Carynota

1. Greyish-brown with an oblique dark band at each side just behind middle..... 3. mera
   Mahogany with creamy irrorations and not with a distinct dark band..... 2

2. Pronotum in side view low, evenly sloped from highest point to apex..... 1. stupida
   Pronotum in side view relatively high, with a distinct hump behind middle..... 2. marmorata

1. Carynota stupida (Walk.) (muskokensis God., vera God., albopicta Buck.) (Fig. 77). Length 7-9 mm. Female reddish-brown or mahogany, male mahogany to almost black; both sexes polished, with creamy irrorations, the median ridge black in at least the anterior region, and sometimes a creamy median strip behind middle. There is also some variation in the number of irrorations, which tend to be most numerous in specimens from the Prairie Provinces.

Southern parts of Saskatchewan, Manitoba, Ontario, and Quebec, and in New Brunswick and Nova Scotia, widely distributed and locally common; on birch (Betula spp.).

2. Carynota marmorata (Say) (porphyrea Fairm., picta Prov.) (Fig. 78). Length 7-8 mm. Mahogany or reddish with the pale markings creamy. There is much variation in the number of creamy irrorations, which sometimes are reduced to a few on the frontal region and sides, often are numerous and more or less confluent on the anterior half, and occasionally cover the entire pronotum except its apex. The dark areas are sometimes black-margined in the male.

Southern Quebec, widely distributed; southern Manitoba, southern Ontario, Nova Scotia, and New Brunswick, local; on alder (Alnus spp.). Recorded foodplants are hazel (Corylus spp.), birch (Betula spp.), and oak (Quercus spp.).

3. Carynota mera (Say) (tripartita Walk., majus Eurm.) (Fig. 79). Length 8-10 mm. Greyish-brown with the apical region dark brown or blackish. The dark band occasionally is indefinite, sometimes is extended forward in the costal region as a blackish suffusion, and

sometimes is extended forward as a dark band on either side of the pale mid-line to the frontal region of the pronotum.

Southern Ontario, widely distributed but local; on hickory (Carya spp.). The nymphs are attended by the ant Formica fusca L.

Genus 3. Telamona Fitch (Heliria Stal, Palonica Ball)

Species of Telamona, Heliria, and Palonica are treated here as of a single genus because members of each are so closely related and because the differences in the characters used, based on adult morphology alone, are so slight. Ball (1931) indicated that certain nymphal characters might be used for generic divisions, but further information is necessary before the taxonomic status of these can be evaluated.

Large, robust, active, usually brown or blackish insects that feed on deciduous trees. Specific characters are mainly the shape of the crest, which is sometimes difficult to describe clearly but which can be seen from the figures. The host plant often indicates the identity of a species, and colour and markings are frequently useful. Because of the variation in shape and markings, single specimens that lack host-plant data sometimes cannot be named reliably. No doubt some species additional to those discussed below inhabit Canada, particularly southern Ontario.

Key to Species of Telamona

1. Crest with a posterior step or projection, or with upper margin distinctly concave..... 2
   Crest without a step or projection, and with upper margin straight or convex..... 8

2. Crest long, low, quadrangular, with its anterior peak no higher than the posterior, and with its posterior margin vertical..... 13. molaris
   Crest high, more or less pyramidal, with its anterior region higher than the posterior projection or step..... 3

3. Crest with anterior region broadly rounded, with a prominent pyramidal posterior projection, and with posterior margin vertical below this projection..... 4
   Crest not with this combination of characters..... 5

4. Dark brown without a distinct pattern..... 14. scalaris
Whitish with a distinct dark brown or blackish pattern
..... 15. concava

5. Upper margin of crest distinctly and evenly concave between two low, blunt points..... 6
Crest with upper margin broadly rounded, and with a posterior step..... 7

6. General colour greenish or dull yellowish-brown, without extensive black areas; on cottonwood..... 9. viridia
General colour dark greyish-brown, consisting of heavy black mottlings on a brown background; on aspen.10. tremulata

7. Posterior margin of crest below step vertical; pattern on crest and sides more definite..... 12. gemma
Posterior margin of crest below step not vertical, sloping; pattern on crest and sides obscure, ill-defined..... 11. pyramidata

8. Crest very low, long, its posterior angle rounded or almost absent..... 1. westcotti
Crest high..... 9

9. Crest pyramidal, horn-like, acutely rounded at apex
..... 11. pyramidata
Crest broad, with a distinct straight or convex upper margin..... 10

10. Crest very large, quadrangular, with its anterior margin vertical or overhanging..... 11
Crest smaller, placed well back, with its anterior margin sloping backwards..... 13

11. Humeral angles each longer than its basal width, acute; a black spot on middle of lower margin of pronotum which is otherwise pale without well-defined dark markings
..... 3. maculata
Humeral angles shorter, each not longer than its basal width; crest with a distinct dark band, and pronotum usually with well-defined dark markings and sometimes largely dark..... 12

12. Smaller species, length 8-9 mm.; on hazel and ironwood
..... 2. tristis
Larger species, length 9-11 mm. 13

13. Pronotum with a wavy dark line from front of crest to lower margin; on Virginia creeper..... 4. ampelopsidis
Pronotum not marked as above; on hickory, black walnut and butternut..... 14

14. Pronotum wholly pale, without darker and lighter areas or distinct dark markings..... 5. unicolor
Pronotum with darker and lighter areas or with distinct dark markings..... 15

15. Pronotum light or darker brownish or greenish-brown, usually with a creamy median band behind crest, and without definite dark markings..... 6. monticola
Pronotum with definite but variable dark brown or blackish markings..... 16

16. On basswood; fresh specimens tinged with greenish; crest more distinctly tapering..... 7. tiliae
On oak; not tinged with greenish; crest more distinctly quadrangular..... 8. spreta

1. Telamona westcotti God. (obsoleta Ball, jugata Osb.) (Fig. 80). Length 8-10 mm. Dull ochreous with blackish dots forming an ill-defined pattern, to give a general brownish-grey appearance. There is some variation in the extent of the dark areas. The shape of the pronotum in side view is distinctive.

Southern Manitoba and southern Ontario, local; on white and burr oaks (Quercus spp.). The ant Formica fusca L. associated with the nymphs.

2. Telamona tristis Fitch (coryli Fitch) (Fig. 81). Length 8-9 mm. Whitish or light yellowish-brown with the markings dark brown. There is much variation in the markings: var. coryli is shown in Fig. 81; var. tristis has additional dark mottlings on the crest and sides; var. jucunda Ball is more or less uniform yellowish-brown or tawny, with or without indications of the darker markings. These varieties intergrade. There is also variation in the shape of the crest, particularly in the slope of its front margin. The smaller size and often the dark markings distinguish this species from others with which it might be confused. The var. coryli tends to predominate in the middle of the summer, the typical form later.

Southern regions of Manitoba, Ontario, and Quebec, widely distributed and locally common, and in New Brunswick; on hazel (Corylus spp.), blue beech (Carpinus sp.), and ironwood (Ostrya spp.).

3. Telamona maculata Van D. (Fig. 82). Length 10-11 mm. Light or medium brown, sometimes tinged with greenish, with a dark brown or blackish spot at the middle of side margin, below which the forewing is darkened, and with other darkened areas, when present, darker brown. The relative lack of well-defined dark markings on the crest in conjunction with the black spot on the side margin and the very long humeral angles distinguish this species.

Southern Ontario, local.

4. Telamona ampelopsidis (Harr.) (cyrtops Fairm., diffusa Walk.) (Fig. 83). Length 9-11 mm. Ochreous to brown with the markings dark brown to blackish. There is much variation in the extent of the dark markings: pale specimens have only the margins of the bands and the frontal region of the pronotum darkened, whereas dark specimens, which are usually males, are almost wholly dark brown or blackish. There is also some variation in the shape of the crest.

Southern Ontario, widely distributed and locally common, and southern Manitoba, southern Quebec, and Nova Scotia, more local; on Virginia creeper (Ampelopsis spp.).

5. Telamona unicolor Fitch (fasciata Fitch) (Figs. 84, 85). Length 9-12 mm. There is sexual dimorphism: female green, with the crest narrowly dark-bordered, fading to yellowish-brown with age; male ochreous, often with a pinkish tinge, with the markings dark brown.

Southern Ontario and southern Quebec, widely distributed but local; on hickory (Carya spp.) and perhaps also black locust (Robinia spp.).

6. Telamona monticola (Fab.) (querci Fitch, brunneipennis Buck.), (Fig. 86). Length 8-10 mm. Light to darker brown, frequently tinged with greenish and fresh specimens sometimes mottled with green to give a generally greenish appearance; creamy irrorations sometimes present on frontal region of pronotum and occasionally on sides; frequently a creamy median band from behind crest; sometimes almost fuscous, with or without the median creamy band. As this description indicates, there is much colour variation. The shape of the pronotum, the colour, and the absence of definite dark markings are distinctive. The shape and position of the crest distinguishes the species from Glossonotus univittatus which it sometimes resembles superficially in colour.

Southern regions of Saskatchewan, Manitoba, Ontario, and Quebec, widely distributed and locally common; on oak (Quercus spp.), especially burr oak. The ants Crematogaster (Acrocoelia) lineolata (Say) and Formica fusca L. associate with the first and second instar nymphs (Brimley, 1961).

7. Telamona tiliae Ball (Fig. 87). Length 9-10 mm. Ochreous or light brown, tinged with greenish in fresh specimens, and sometimes with a pinkish tinge; with dark brown or blackish markings and numerous dark brown or blackish punctures on the pale areas. There is much variation in the extent and intensity of the dark markings, which are usually more clearly defined in the male than in the female.

Southern Ontario and southern Quebec, widely distributed and locally common; on basswood (Tilia spp.). The egg-scars on the branches are conspicuous. The nymphs are attended by workers of the ant Formica fusca L.

8. Telamona spreta God. (lugubris Ball) (Fig. 88). Length 8-10 mm. Dull ochreous closely dotted with black and with black areas on sides of crest and forming bands on sides of pronotum, to give a general dark greyish-brown or blackish-brown appearance. There is much variation in the extent and hue of the dark markings.

Southern regions of Alberta, Saskatchewan, and Manitoba, widely distributed and common and apparently locally abundant; on oak (Quercus spp.). Individual specimens examined from several localities in southern Ontario may be of this species.

9. Telamona viridia Ball (Figs. 89, 90). Length 9-11 mm. Female green, fading to dull light brown or yellowish; male green to dull yellowish-brown; both sexes with black or dark brown dots that form indefinite bands which are most distinct in the male.

Southern Alberta and southern Manitoba, local but widely distributed; on cottonwood (Populus spp.).

10. Telamona tremulata (Ball) (Fig. 91). Length 8-10 mm. Light brown heavily mottled with black to give a general dark greyish-brown appearance, with a blackish band from crest to costa and usually with a pale median band behind the crest. There is much variation in the extent and intensity of the dark markings. The shape of the crest in conjunction with the foodplant is distinctive.

The most widely distributed species of the genus. Southern regions of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, and Quebec, and in New Brunswick and Nova Scotia, apparently common in the Prairie Provinces, more local elsewhere; on aspen (Populus spp.).

11. Telamona pyramidata Uhl. (Figs. 92-94). Length 8-10 mm. Ochreous or light brown, with numerous black or dark brown punctures that sometimes form indefinite bands, and usually with a pale median band behind the crest; the general hue is dull dark brown. The high, pyramidal crest of the typical form (Fig. 92) is distinctive. Var. declivata Van D. (Fig. 93) is similar to var. pyramidata in size and colour but has a distinct step on the posterior margin of the crest. What may be var. ampliata Ball (Fig. 94), or possibly a distinct species, also has a step on the posterior margin of the crest but is dark greyish-brown with whitish markings, a distinct, subapical white band, and a broader crest. The shape of the crests distinguish the various forms of this species from other species.

This is also a relatively widely-distributed species. British Columbia and Northwest Territories (Norman Wells), apparently local, southern regions of Alberta, Saskatchewan, Manitoba, Ontario, and Quebec, widely distributed and locally common; on willows (Salix spp.), but the form treated here as var. ampliata on birch (Betula spp.).

12. Telamona gemma (Ball) (Fig. 95). Length 9-11 mm. Ochreous with brown mottlings and bands, the latter bordered with black. The colour and markings and the broader crest, which is set well back, distinguish this species from the varieties of the preceding that have the crest stepped.

Southern Ontario, local.

13. Telamona molaris But. (irrorata God., dubiosa Van D.) (Fig. 96). Length 10-11 mm. Ochreous, closely dotted and mottled with black to give a general dark greyish-brown, mottled appearance. The dark markings sometimes form irregular, ill-defined bands.

Southern Manitoba, local, on aspen (Populus spp.), and southern Ontario, local, on oak (Quercus spp.). It is possible that there are two species, on different foodplants; in this event the oak-feeding species is the true molaris.

14. Telamona scalaris (Fairm.) (fagi Emm., praealta Fowl., turritella Buck., rubidella Ball) (Fig. 97). Length 8-10 mm. Dark brown or mahogany, often with creamy irrorations especially on the frontal region of the pronotum. There is much variation in the shape of the crest. These variations intergrade and sometimes occur in the same population, and it is for these reasons that this group of forms is treated here as a single species rather than as several. Typical scalaris has the anterior lobe of the crest large and strongly overhanging in front. The specimen figured (Fig. 97) has this lobe higher and less strongly overhanging and agrees with the description of var. clivulata Ball. The variety, or species, praealta has the anterior lobe narrow, with its front margin vertical or sloped backward; extreme forms approach T. pyramidata var. declivata in shape.

Southern regions of Alberta, Saskatchewan, Manitoba, Ontario, and Quebec, and in New Brunswick and Nova Scotia, widely distributed and locally common; on wild and cultivated apple (Malus spp.) and plum and apricot (Prunus spp.). Some Saskatchewan specimens were collected on wolf willow (Salix spp.), and the typical scalaris, which has apparently not been found in Canada, is said to feed on hawthorn (Crataegus spp.).

15. Telamona concava Fitch (ornata Emm.) (Fig. 98). Length 10 mm. Whitish with the markings dark brown or black. There is much variation in the extent of the dark markings, which often are more extensive than in the specimen figured.

Southern Ontario, local.

Genus 4. Glossonotus Butl.

Key to Species of Glossonotus

1. Horn in lateral view flattened and enlarged at apex and distinctly constricted near base; sides of pronotum with definite markings; no pale median band behind horn..... 2
   Horn usually broadest at base, usually not constricted, or sides of pronotum without definite markings, or, usually, both; a pale median band behind horn..... 3

2. Pronotum with distinct pattern, creamy and reddish-brown or blackish; on hawthorn..... 1. crataegi
Pronotal pattern often indistinct, greyish-ochreous and brownish or blackish; on oak..... 2. acuminatus

3. Horn relatively low, nearly as broad as high, but variable..... 3. univittatus
Horn obviously much higher than broad..... 4. turriculatus

1. Glossonotus crataegi (Fitch) (pyramidoides God.) (Fig. 99). Length 7-8 mm. Creamy with the dark areas reddish-brown bordered with black; the dark areas sometimes blackish, especially on the horn where they may include brown irrorations. Though variable, the markings and their colours are distinctive.

Southern Ontario, southern Quebec, and Nova Scotia; widely distributed but local; on hawthorn (Crataegus spp.).

2. Glossonotus acuminatus (Fab.) (Fig. 100). Length 10 mm. Greyish-ochreous with numerous black punctures that form an indefinite, blackish-brown pattern similar to that of crataegi.

Southern Ontario, local.

3. Glossonotus univittatus (Harr.) (godingi Van D., dorsalis Buck.) (Fig. 101). Length 7-9 mm. Ochreous, dotted with dark brown to give a general dull, darkish brown appearance, with the median band creamy. There is variation in the general colour, and in the shape of the horn from more slender or broader than figured; the apical region of the horn is sometimes distinctly expanded.

Southern Saskatchewan, and widely distributed and locally common in the southern regions of Manitoba, Ontario, and Quebec; on oaks (Quercus spp.), especially burr oak. It is the most common species of the genus.

4. Glossonotus turriculatus (Emm.) (Fig. 102). Length 7-8 mm. Ochreous, dotted with dark brown or black to give a general greyish-brown appearance; apical region of horn usually blackish; median band whitish.

Southern Manitoba, local.

Genus 5. Thelia Am. & Serv.

Key to Species of Thelia

Female largely greyish; male blackish with yellow markings; horn in side view usually distinctly tapered from a broad base and usually slightly curved upward..... bimaculata

Both sexes dark brown or fuscous, without distinct pale markings; horn in side view almost parallel-margined, usually straight..... uhleri

Thelia bimaculata (Fab.) (unanimus Walk.) (Figs. 103, 104). Length, including horn, 10-13 mm. Female greyish or brownish-grey with a narrow brownish line on the median ridge of pronotum. Male dark blackish-brown, becoming brownish on frontal region of pronotum, with the face and the region immediately above it yellowish and the broad band on each side of the pronotum bright yellow. There is some variation in the colour and in the shape of the horn, but in general these are distinctive.

Southern Ontario and southern Quebec, widely distributed and locally common; on black locust (Robinia pseudoacacia). The nymphs are attended by the ant Formica fusca L.

Thelia uhleri (Stal) (Fig. 105). Length, including horn, 12 mm. Dark brown to fuscous, often tinged with reddish toward ridge of pronotum and especially in apical region of horn.

Southern Manitoba and southern Ontario, local; on wild plum (Prunus spp.) and apple (Malus spp.).

Tribe 4. Ceresini

This tribe was revised by Caldwell (1949) on a basis of characters of the internal male genitalia. The genus Tortostilus Cald. is included here as a synonym of Stictocephala because the differences do not appear to warrant generic status. It is possible that in the present paper, as in other papers on the tribe, some of the specific names may be incorrectly assigned, as the original descriptions of certain species are inadequate and the types apparently have been lost.

The triangular shape of many of the species make these among the most familiar of the Canadian membracids. Most of the species

are some shade of green when fresh, but become yellowish or brownish with age and from effects of some killing agents. A few species can be reliably, and the majority tentatively, identified on a basis of external characters, but the internal male genitalia must be examined for reliable identifications of the majority. The best characters are in the shapes and relative positions of the upper margins of the openings on the anterior and posterior surfaces of the aedoeagus, the shape of the posterior arm of the aedoeagus, the form of the style, and the form of the stout process that arises from the middle of each pygofer.

Most of the species apparently are generalized feeders in both the adult and nymphal stages, as they occur on a variety of kinds of herbaceous plants and shrubs. Some occur on fruit trees and at least one, S. bubalus, is often of some economic significance. Life-histories, habits, and immature stages of economic species were described by Yothers (1934).

Key to Genera of Ceresini

1. Length 4 to 5 mm.; pronotum low in front, pale yellow with well-defined black areas; basal region of forewing with three longitudinal veins..... 2
   Length 6 to 9 mm.; pronotum elevated in front, not coloured as above; basal region of forewing with two longitudinal veins that are fused at the base..... 3

2. Forewing with five apical cells and with the veins distinct and usually dark..... 1. Acutalis
   Forewing with four apical cells and with the veins indistinct and pale..... 2. Micrutalis

3. Posterior arm of aedoeagus tubular, expanded at apex, with the opening posterio-dorsally at apex..... 3. Spissistilus
   Posterior arm of aedoeagus tapering to a sharp or blunt point at apex, with a longitudinal opening on posterior surface..... 4. Stictocephala

Genus 1. Acutalis Fairm.

Acutalis tartarea (Say) (Fig. 106). Length 4-5 mm. Ochreous or pale yellowish with the dark areas black or very dark brown, shining; veins of forewings usually fuscous, sometimes brown or

yellowish; pronotum sometimes largely black, except for an ochreous line parallel to each side margin.

Southern Ontario and southern Quebec, widely distributed, especially in and near damp situations; on ragweeds (Ambrosia spp.).

Genus 2. Micrutalis Fowl.

Micrutalis calva (Say) (melanogramma Perty, flavipennis Germ.) (Fig. 107). Length 4-5 mm. Pale yellow and shining black.

Southern Ontario and southern Quebec, local. Associated with a variety of plants, but apparently most frequently with honey locust (Gleditsia spp.) and ironweed (Veronia spp.).

Genus 3. Spissistilus Cald.

Caldwell (1949) and Dennis (1952) included borealis Fairm. (referred to by Caldwell as constans Walk.) in this genus. The male genitalia indicate that this species is more closely related to Sticticephala, and it is included here in that genus.

Spissistilus franciscanus (Stal) (nigricans Van D.) (Figs. 108, 124). Length 6 mm. Greenish-ochreous, probably greenish in fresh specimens. The male genitalia are distinctive. Externally the species resembles certain of the species of Stictocephala that lack the suprahumeral horns.

Southwestern British Columbia, apparently local.

Genus 4. Stictocephala Stal (Tortostilus Cald.)

The internal male genitalia must be examined for reliable specific identifications. Structures of the male genitalia of the North American species were figured by Caldwell (1949) and those of the Wisconsin species, in more detail, by Dennis (1952) who also figured parts of the ovipositor that may show specific characters. S. borealis Fairm. (constans Walk. of Caldwell) is included here in this genus, though it may be of a distinct, unnamed, genus. No Canadian specimens of albosparsa Stal or pacifica Van D. were available for examination; both have been recorded from British Columbia

but it is possible that the records may be based on misidentifications; those for pacifica almost certainly refer to inermis.

Key to Species of Stictocephala

1. Without suprahumeral horns..... 2
   With distinct suprahumeral horns..... 6

2. Aedoeagus tubular, with opening at apex; British Columbia ..... Spissistilus franciscanus
   Aedoeagus tapering, with elongate opening on posterior surface..... 3

3. Style pointed with apex..... 4
   Style with a straight, serrated apical margin..... 5

4. Apex of style strongly curved; western Canada..... 3. wickhami
   Apex of style weakly curved; eastern Canada..... 4. lutea

5. Length 8 to 9 mm.; pronotum high, strongly arched; posterior arm of aedoeagus evenly tapered in lateral view; apical region of style curved and apical margin not produced below to a sharp point; eastern Canada and Prairie Provinces..... 2. inermis
   Length 7 to 8 mm.; pronotum moderately arched; posterior arm of aedoeagus not evenly tapered in lateral view; apical region of style not curved, with straight, serrated apical margin produced below as a pointed process; Prairie Provinces..... 1. minutus

6. Pronotum with a broad, dark brown, well-defined transverse band behind middle, and with other dark brown areas; forewings tinged with fuscous.....7
   Pronotum not marked as above, usually without well-defined dark areas; forewings usually clear..... 8

7. Sides of pronotum with well-defined dark brown areas that are usually not confluent with the posterior band; length 8 to 10 mm., usually distinctly hairy; posterior opening of aedoeagus not extended to near apex; style not serrated near apex; top of pygofer process not curved downward; transcontinental..... 5. diceros
   Sides of pronotum with ill-defined dark areas that are usually more or less confluent with the posterior band; length 7 to 8 mm., not distinctly hairy; posterior opening of aedoeagus extended almost to apex; style minutely serrated near apex; tip of pygofer process curved downward; eastern Canada and Prairie Provinces..... 6. albescens

8. Undersurface of abdomen largely or wholly black, and usually entire abdomen and undersurface of head and thorax black; pronotum often suffused with fuscous; forewing usually with fuscous spot at apex of clavus; rather hairy species; transcontinental..... 12. basalis
Undersurface of abdomen wholly pale; pronotum not with fuscous markings; forewing not with fuscous spot at apex of clavus; usually not distinctly hairy species..... 9

9. Suprahumeral horns well-defined, produced; legs and undersurface of thorax pale..... 10
Suprahumeral horns not well-defined, but as short processes; coxae, femora, and often part of undersurface of thorax marked with black; Prairie Provinces and eastern Canada..... 11. brevicornis

10. Posterior arm of aedoeagus in lateral view broad at base, with a blunt, upwardly-directed, median, posterior process, and a pair of thorn-like lateral processes near base; distinctly hairy species; eastern Canada. 14. borealis
Posterior arm of aedoeagus tapered from base to apex in lateral view, not with posterior process or lateral processes; species not distinctly hairy..... 11

11. Style with minutely serrated apical margin..... 9. taurina
Style sharply pointed at apex, without serrations at or near apex..... 12

12. Large, robust species; front of pronotum virtually straight between tips of suprahumeral horns; pronotum usually darkened only at apex and at tips of horns; style evenly curved; transcontinental..... 13. bubalus
Usually smaller, less robust, species; front of pronotum not straight between tips of suprahumeral horns but produced at middle, or horns curved backward, or both; style not evenly curved; eastern Canada..... 13

13. Pronotum usually darkened along crests; suprahumeral horns distinctly curved backward; upper margin of anterior opening of aedoeagus situated near base or apex; spine of pygofer not evenly tapered to a sharp point..... 14
Pronotum not darkened along crests; suprahumeral horns not distinctly curved backward; upper margin of anterior opening of aedoeagus situated at middle; process of pygofer evenly tapered to a sharp point..... 10. constans

14. Style straight; upper margin of anterior opening of aedoeagus situated near apex; posterior arm of aedoeagus not evenly tapered from base to apex in lateral view; process of pygofer bluntly angled below apex7. tauraniformis

Style sinuate; upper margin of anterior opening of aedoeagus situated near base; posterior arm of aedoeagus evenly tapered from base to apex in lateral view; process of pygofer tapered to a bluntly-rounded apex..... 8. palmeri

1. Stictocephala minutus (Cald.) (Figs. 109, 125). Length 6-7 mm. Green, fading to yellowish with age. The aedoeagus and the apical region of the style are distinctive.

Southern Manitoba, apparently rare.

2. Stictocephala inermis (Fab.) (goniophora Say). The green clover treehopper. (Figs. 110, 126). Length 7-8 mm. Dull greenish or straw-coloured, usually slightly paler along the crests. The pronotum is more strongly arched, in lateral view, than in the other species of the genus that lack suprahumeral horns. The apical region of the style is distinctive, though variable.

Widely distributed and locally common in the southern parts of Alberta, Saskatchewan, Manitoba, and Ontario; on a variety of herbaceous plants, including clover and alfalfa (Medicago spp.), and, less frequently, on trees and shrubs, including apple (Malus spp.). It sometimes causes economic injury to young fruit trees from the punctures it makes when egg-laying in young twigs, and its feeding activities sometimes give stems of alfalfa a girdled appearance.

3. Stictocephala wickhami Van D. (Figs. 111, 127). Length 7-8 mm. Greenish or yellowish-green, usually paler along the crests. The apical region of the style is distinctive, though variable. There is also some variation in the thickness of the aedoeagus in posterior view.

Widely distributed and locally common throughout southern British Columbia and in the hill and mountain districts of Alberta; apparently on a variety of herbaceous plants.

4. Stictocephala lutea (Walk.) (pectoralis Emms., festina Prov., sanguino-apicalis God.) (Figs. 112, 128). Length 7 mm. Dull greenish, dull light greenish-yellow or yellowish-brown, or fulvous. The median crest is sometimes dark brown in dark specimens. The coxae, femora, and undersurfaces of the head and thorax usually are black. The style is distinctive.

Widely distributed and locally common in the southern regions of Ontario and Quebec; on shrubs and herbaceous plants.

5. Stictocephala diceros (Say) (postfasciata Am. and Serv.) (Figs. 113, 129). Length 8-10 mm. Ochreous with the markings dark brown and the forewings fuscous-tinged. There is variation in the extent of the dark areas, and some specimens have the anterior region of the pronotum variably maculated. The colour of the dark areas ranges from black to, in some Prairie specimens, reddish-brown. There is some variation in size and in length, thickness, and degree of curvature of the suprahumeral horns. A distinctly hairy insect. The markings are distinctive; the only species with which it might be confused is albescens, from which it may be distinguished by the characters described below.

Southern British Columbia, apparently local, widely distributed and locally common in the southern regions of Alberta, Saskatchewan, Manitoba, Ontario, and Quebec, and in New Brunswick and Nova Scotia; in wooded areas, where it has been found on various trees, shrubs, and herbaceous plants, but apparently mainly on hazel (Corylus spp.); nymphs were reared to maturity on wild raspberry (Rubus sp.) (Brimley, 1961).

6. Stictocephala albescens (Van D.) (Figs. 114, 130). Length 7-8 mm. Ochreous with the markings dark reddish-brown or chocolate brown, with paler irrorations, and with the forewings fuscous-tinged. There is variation in the extent of the dark markings and in the length and degree of curvature of the horns. Compared with diceros this tends to be a smaller insect, not distinctly hairy, with the suprahumeral horns more slender, more sharply pointed, and usually distinctly curved backward, and with the dark areas of the anterior half of the pronotum usually paler than the posterior transverse band. The male genitalia provide the most reliable distinctions.

Southern Manitoba and southern Ontario, apparently local; in wooded districts on various shrubs and trees but especially ironwood (Ostrya sp.) and blue beech (Carpinus sp.).

7. Stictocephala tauraniformis Cald. (Figs. 115, 131). Length 8 mm. Dark areas brown, with paler irrorations at each side of the median crest; sides of pronotum ochreous or greenish-ochreous. The suprahumeral horns are relatively long, and are more strongly curved than in other species. This species most closely resembles palmeri, which also has darkened crests and curved horns, but may be readily recognized by the genitalic characters described in the key.

Southern Ontario, local, in wooded areas.

8. Stictocephala palmeri (Van D.) (Figs. 116, 132). Length 7-8 mm. Greenish-ochreous or pale fulvous with the crests reddish-yellow or reddish-brown, with the tips of the suprahumeral horns,

and the median ridge posteriorly, black, and with the sides of the pronotum often irrorated with whitish or ochreous. The horns are relatively long and are distinctly curved backward. Often superficially resembles tauraniformis (see above).

Southern Ontario and southern Quebec, widely distributed, in wooded districts, often on hickory and sugar maple.

9. Stictocephala taurina (Harr.) (illinoiensis God.) (Figs. 117, 118, 133). Length 8-9 mm. Green, variably irrorated with whitish or ochreous to give a general dull greenish appearance; front usually largely ochreous. Often ochreous, brownish-yellow, or dull light brown. The suprahumeral horns are slightly but distinctly curved backward. A variable species in colour and form that sometimes intergrades in external characters with others. It may be reliably distinguished from basalis by the pale undersurface of the abdomen, from bubalus by the form of the apical region of the style, and from brevicornis and other species by genitalic characters.

Southern parts of Manitoba, Ontario, and Quebec, and in Nova Scotia, widely distributed and locally common, especially in wooded areas; on a large variety of herbaceous plants, shrubs, and trees. Attacked by nymphs of the pentatomid Podisus maculiventris Say (Brimley, 1961).

10. Stictocephala constans (Walk.) (Figs. 119, 134). Length 7 mm. Dull reddish-brown with the forewings fuscous-tinged; or straw-coloured mottled with green to give a general greenish-stramineous appearance, with the forewing fuscous-tinged at apex. The front of the pronotum is usually distinctly produced at middle in dorsal view. The shape of the pygofer process in conjunction with that of the style are distinctive.

Southern Ontario and southern Quebec, local, in wooded districts; on various plants but perhaps most frequently associated with basswood (Tilia spp.).

11. Stictocephala brevicornis (Fitch) (Figs. 120, 135). Length 7-8 mm. Straw-coloured tinged with light greenish, sometimes orange-tinged or fulvous; front more distinctly yellowish; crest sometimes orange-tinged; median crest sometimes mottled with dark brown toward apex. The suprahumeral horns are shorter than those of other species, and the pronotum tends to be more strongly arched in lateral view. Specimens from Ontario tend to have the horns more distinctly produced than specimens from the Prairie Provinces, and may be distinguished from taurina primarily by the relative positions of the upper margins of the openings of the aedoeagus. This and basalis are the only horned species that are marked with black on the

undersurface of the body. In basalis the abdomen is marked with black, and the undersurface is usually wholly black, whereas in brevicornis the black is restricted to the coxae, femora, and adjacent parts of the thoracic region. The two species also may be distinguished from each other by the genitalic characters.

Southern districts of Alberta, Saskatchewan, and Manitoba, widely distributed and locally abundant, and southern Ontario, local; apparently on herbaceous plants and perhaps most frequent in moist situations.

12. Stictocephala basalis (Walk.) (brevicornis Prov., semicremna Prov., turbida God., melanogaster Osb., semibrunnea Buck.) (Figs. 121, 136). Length 7-9 mm. Ochreous, greenish-ochreous, light or darker fulvous, straw-coloured, or brownish; often dark brown or blackish along the crests, or with sides of pronotum suffused with fuscous or black; pronotum sometimes almost entirely black; undersurface, including abdomen, largely or wholly black, and dorsal surface of abdomen frequently partly or wholly black. Darker specimens tend to have the forewings brownish-tinged. A rather hairy species. Distinctive features are the black marks on the forewing at the apex of the clavus, and the shape of the pygofer process in conjunction with that of the style. This is perhaps the most variable species of the genus in colour and markings; there is also some variation in the shape of the style. The variation is both individual and between populations.

Northwest Territories (Fort Simpson), generally distributed and locally common in the southern parts of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, and Quebec, and widely distributed in New Brunswick, Nova Scotia, and Prince Edward Island. The most widely distributed of the Canadian membracids, it occurs on a variety of herbaceous plants, including alfalfa and clover (Medicago spp.), and is possibly most frequent in moist localities. It also attacks fruit trees.

13. Stictocephala bubalus (Fab.), the buffalo treehopper. (Figs. 122, 137). Length 8-10 mm. Greenish, usually irrorated paler, or ochreous, stramineous, or light brownish; usually slightly paler along the crests but brownish at apex. The large size, the virtually straight front between the tips of the suprahumeral horns in dorsal view, and the relatively uniform colour of the pronotum as a whole, except the darkened apex, are distinctive. This species is sometimes difficult to distinguish from taurina on a basis of external characters, but can be readily distinguished by the genitalic characters, notably the apical region of the style. There is much variation, both individual and between populations. Specimens from the Prairie Provinces tend to be smaller than those from the East.

Southern regions of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, and Quebec, and in New Brunswick and Nova Scotia, widely distributed and locally common; on a large variety of herbaceous plants, shrubs, and trees, and is perhaps most frequent on alfalfa (Medicago spp.). It sometimes causes economic damage to apple (Malus spp.) by its egg scars on the twigs.

14. Stictocephala borealis (Fairm.) (Figs. 123, 138). Length 7-8 mm. Pale dull greenish, yellowish-green, or yellowish-brown, with whitish irrorations and the crests whitish; sometimes ochreous with the crests reddish-brown. A relatively very hairy insect. The genitalic characters, notably the aedoeagus, are distinctive and indicate that this species may be of a genus distinct from Stictocephala.

Southern Ontario and southern Quebec, widely distributed but local; on a variety of herbaceous and woody plants, perhaps especially in moist wooded situations.

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CHECK LIST

Family I. CICADIDAE
- Genus 1. Platypedia Uhl.
  - 1. areolata (Uhl.)
- Genus 2. Okanagana Dav.
  - 1. rimosa (Say)
  - 2. oregona Dav.
  - 3. synodica (Say)
- Genus 3. Tibicen Latr.
  - 1. chloromera (Walk.)
  - 2. lyricen (DeG.)
  - 3. pruinosa (Say)
  - 4. linnei Smith & Gross.
- Genus 4. Magicicada Dav.
  - 1. septemdecim (L.)

Family II. MEMBRACIDAE
- Subfamily 1. Membracinae
  - Genus 1. Campylenchia Stal
    - 1. latipes (Say)
  - Genus 2. Euchenopa Am. & Serv.
    - 1. binotata (Say)
    - 2. permutata Van D.
- Subfamily 2. Centrotinae
  - Genus 1. Microcentrus Stal
    - 1. caryae (Fitch)
  - Genus 2. Gargara Am. & Serv.
    - 1. genistae Fab.
- Subfamily 3. Hoplophorinae
  - Genus 1. Platycotis Stal
    - 1. vittata (Fab.)
    - 2. maritimus Van D.
- Subfamily 4. Smiliinae
  - Tribe 1. Polyglyptini
    - Genus 1. Vanduzea God.
      - 1. arquata (Say)
      - 2. triguttata (Burm.)
    - Genus 2. Publilia Stal
      - 1. concava (Say)
      - 2. modesta Uhl.
    - Genus 3. Entylia Germ.
      - 1. carinata (Forst.)
  - Tribe 2. Smiliini
    - Genus 1. Cyrtolobus God.
      - 1. inornata (Say)
      - 2. helena Woodr.
      - 3. querci (Fitch)
      - 4. muticus (Fab.)
      - 5. tuberosus (Fairm.)
      - 6. fuliginosus (Emm.)
      - 7. fenestratus (Fitch)
      - 8. vau (Say) group
    - Genus 2. Ophioderma Fairm.
      - 1. flavicephala God.
      - 2. evelyna Woodr.
      - 3. flava God.
      - 4. salamandra Fairm.
      - 5. pubescens (Emm.)
      - 6. definita Woodr.
    - Genus 3. Smilia Germ.
      - 1. camelus (Fab.)
  - Tribe 3. Telamonini
    - Genus 1. Archasia Stal
      - 1. belfragei Stal
      - 2. galeata (Fab.)
    - Genus 2. Carynota Fitch
      - 1. stupida (Walk.)
      - 2. marmorata (Say)
      - 3. mera (Say)
    - Genus 3. Telamona Fitch
      - 1. westcotti God.
      - 2. tristis Fitch
      - 3. maculata Van D.
      - 4. ampelopsidis (Harr.)
      - 5. unicolor Fitch
      - 6. monticola (Fab.)
      - 7. tiliae Ball
      - 8. spreta God.
      - 9. viridia Ball
      - 10. tremulata (Ball)
      - 11. pyramidata Uhl.
      - 12. gemma (Ball)
      - 13. molaris But.
      - 14. scalaris Fairm.
      - 15. concava Fitch
    - Genus 4. Glossonotus Butl.
      - 1. crataegi (Fitch)
      - 2. acuminatus (Fab.)
      - 3. univittatus (Harr.)
      - 4. turriculatus (Emm.)
    - Genus 5. Thelia Am. & Serv.
      - 1. bimaculata Fab.
      - 2. uhleri (Stal)
  - Tribe 4. Ceresini
    - Genus 1. Acutalis Fairm.
      - 1. tartarea (Say)
    - Genus 2. Micrutalis Fowl.
      - 1. calva (Say)
    - Genus 3. Spissistilus Cald.
      - 1. franciscanus (Stal)
    - Genus 4. Stictocephala Stal
      - 1. minutus (Cald.)
      - 2. inermis (Fab.)
      - 3. wickhami Van D.
      - 4. lutea (Walk.)
      - 5. diceros (Say)
      - 6. albescens (Van D.)
      - 7. tauraniformis Cald.
      - 8. palmeri (Van D.)
      - 9. taurina (Harr.)
      - 10. constans (Walk.)
      - 11. brevicornis (Fitch)
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Captions for Figures

Figs. 1-7. 1, Platypedia sp.; 3-5, Okanagana spp.; 6, 7, Tibicen spp. (Figs. 6 and 7 on smaller scale than the remainder).

Figs. 8-11. 8, 10, 11, Tibicen spp.; 9, Magicicada spp.

Figs. 12-26. 12-15, opercula of Tibicen spp.; 16-18, apical region of male genitalia in lateral view and aedoeagus in posterior (dorsal) view of Tibicen spp.; 19, dorsal and lateral views of aedoeagus of Platypedia sp.; 22-26, dorsal and lateral views of aedoeagus of Okanagana spp. Specimen in Fig. 22 is from Nova Scotia, 23 Ontario, 24 Manitoba, 25 British Columbia (ornata and bella), and 26 British Columbia (occidentalis).

Figs. 27-51. Lateral views of adults. 27, 28, Campylenchia sp.; 29, 30, Euchenopa spp.; 31, Microcentrus sp.; 32, Gargara sp.; 33-35, Platycotis spp.; 36, 37, Vanduzea sp.; 38, 39, Publilia spp.; 40, 41, Entylia spp.; 42-51, Cyrtolobus spp.

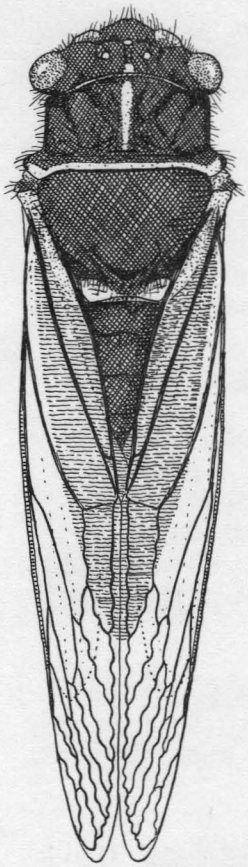
Figs. 52-78. Lateral views of adults. 52-63, Cyrtolobus spp.; 64-72, Ophioderma spp.; 73, 74, Smilia sp.; 75, 76, Archasia spp.; 77, 78, Carynota spp.

Figs. 79-96. Lateral views of adults. 79, Carynota sp.; 80-96, Telamona spp.

Figs. 97-111. 97-105, lateral, and 106-111, lateral and dorsal views of adults. 97, 98, Telamona spp.; 99-102, Glossonotus spp.; 103-105, Thelia spp.; 106, Acutalis sp.; 107, Micrutalis sp.; 108, Spissistilus sp.; 109-111, Stictocephala spp.

Figs. 112-123. Lateral and dorsal views of adults, Stictocephala spp.

Figs. 124-138. Structures of the male genitalia: lateral and posterior views of aedoeagus, one or more views of style, and (133-138), process of pygofer. 124, Spissistilus sp.; 125-138, Stictocephala spp.



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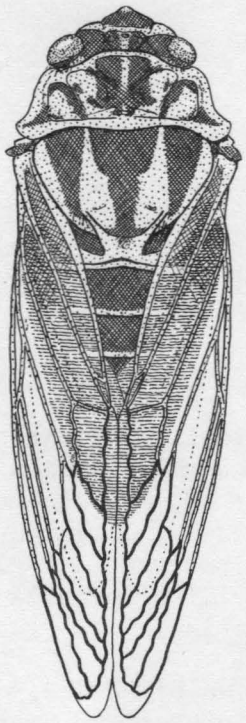

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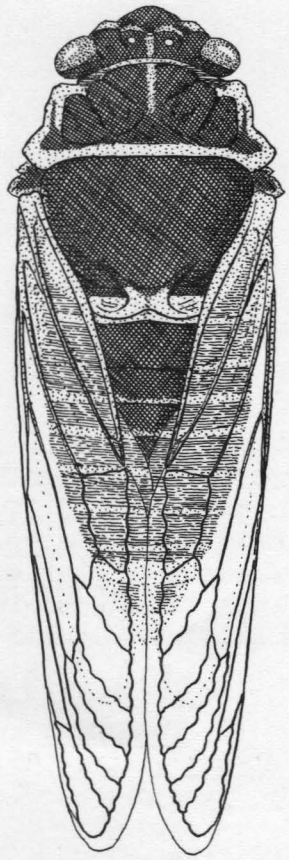

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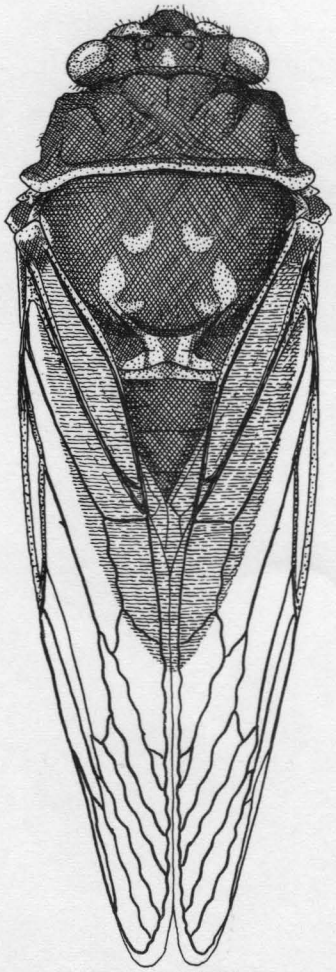

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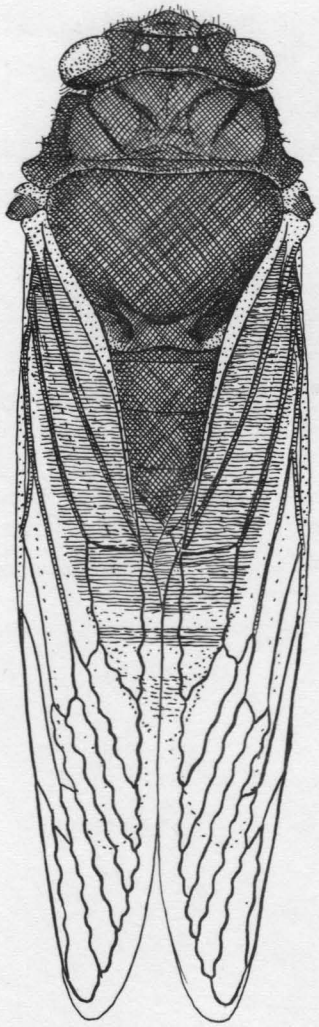

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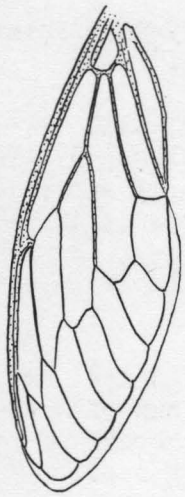

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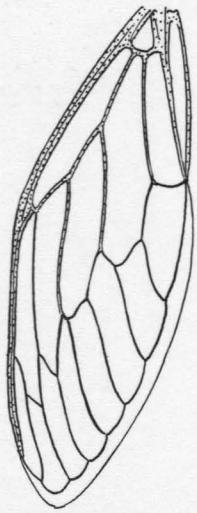

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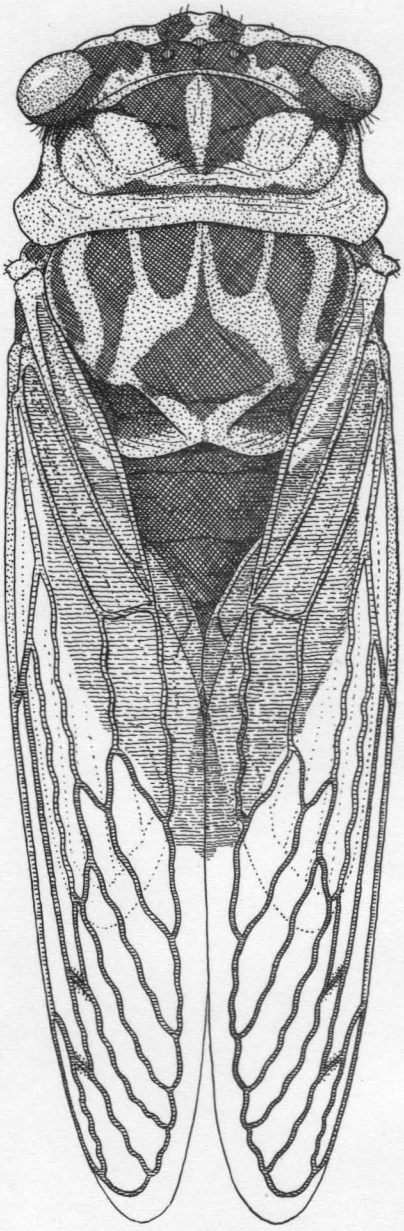

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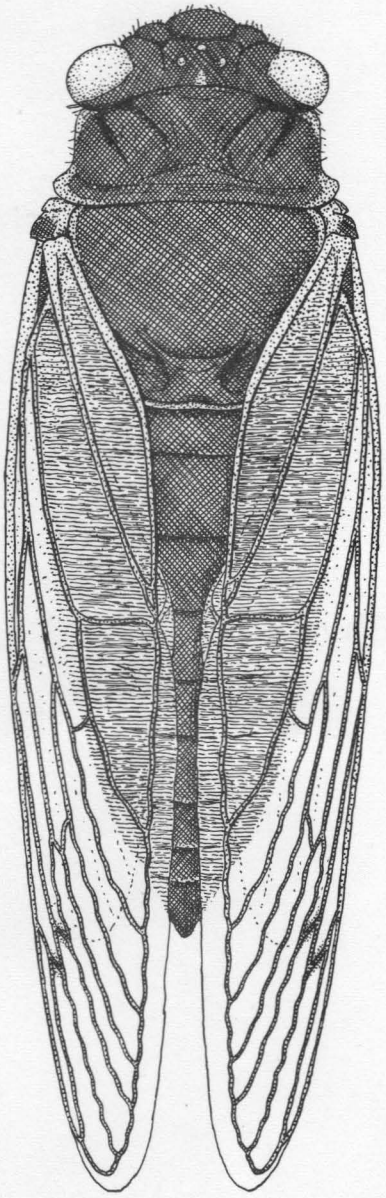

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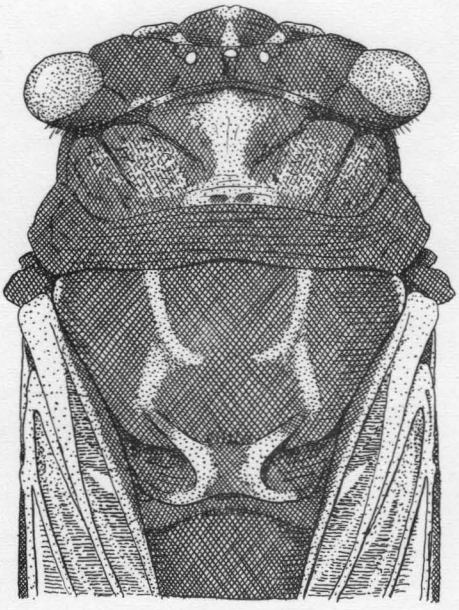

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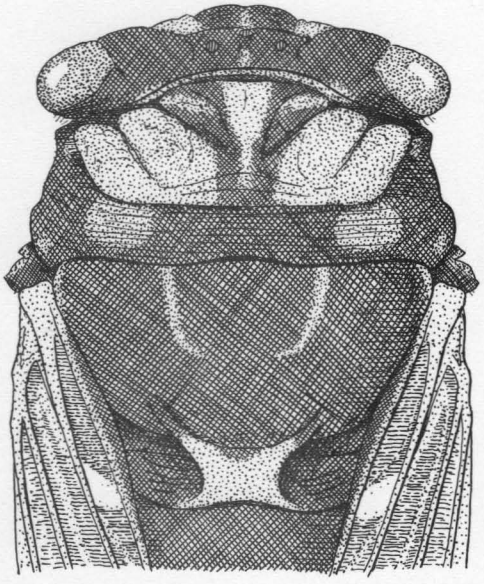

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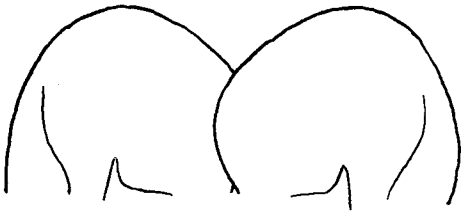

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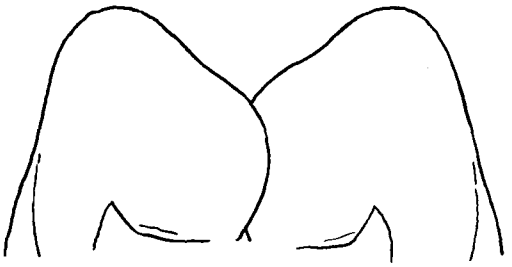

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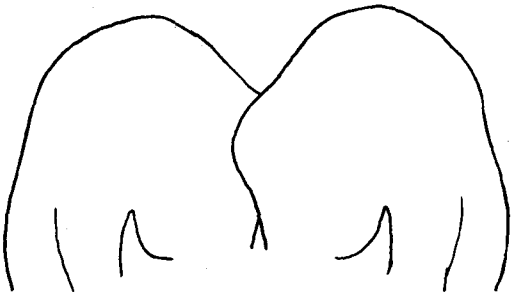

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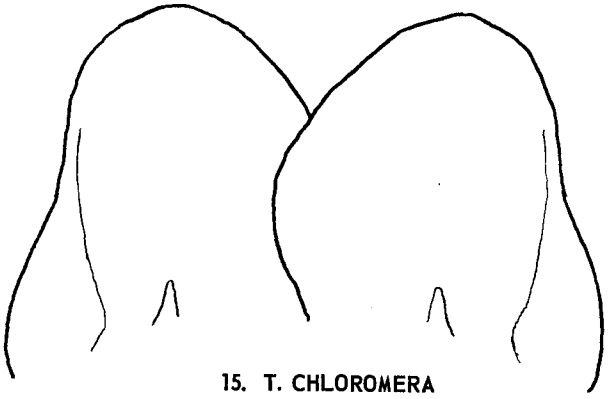

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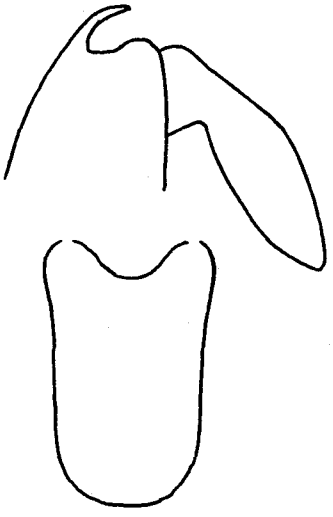

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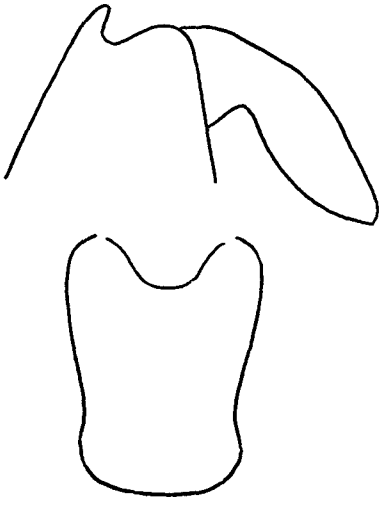
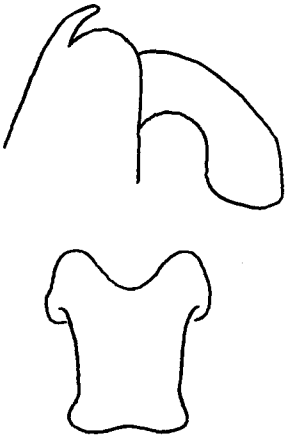
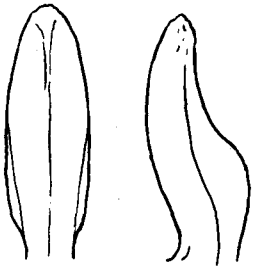


17. T. LYRICEN



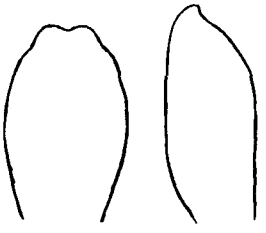
18. T. CHLOROMERA



19. P. AREOLATA

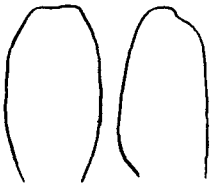
20. O. SYNODICA

21. O. OREGONA



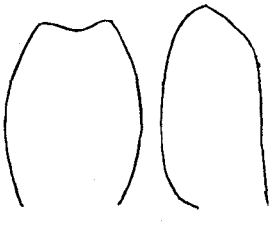
22. O. RIMOSA

23. O. RIMOSA



24. O. RIMOSA

25. O. RIMOSA



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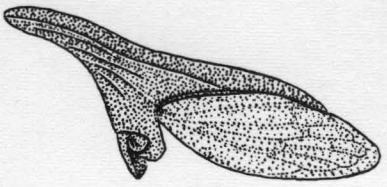
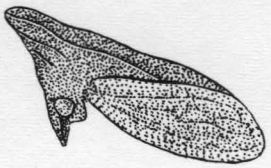
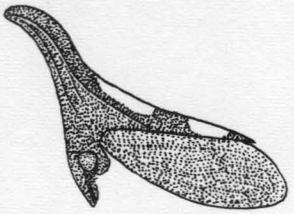


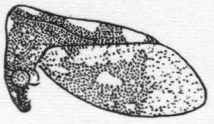
27. C. LATIPES



28. C. LATIPES



29. E. BINOTATA



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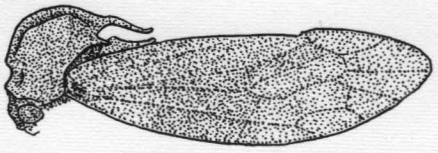
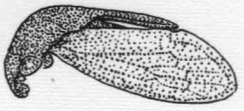
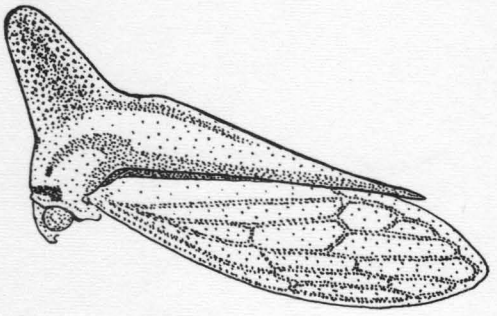


31. M. CARYAE



32. G. GENISTAE



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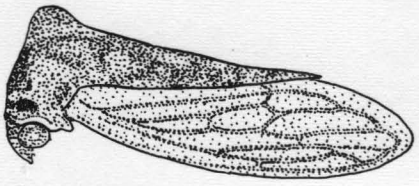

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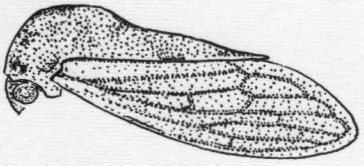
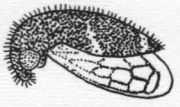
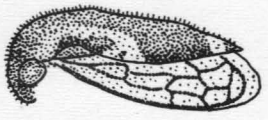


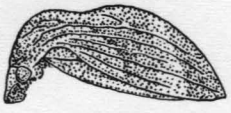
35. P. MARITIMUS



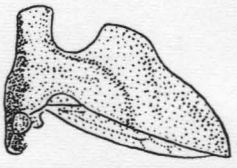
36. V. TRIGUTTATA



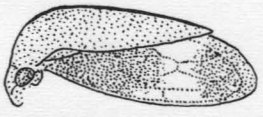
37. V. ARQUATA



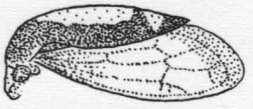
38. P. CONCAVA



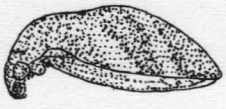
40. E. CARINATA



42. C. INORNATA ♂



44. C. HELENA ♂



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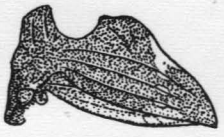

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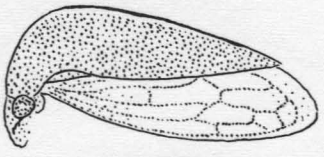
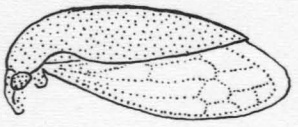
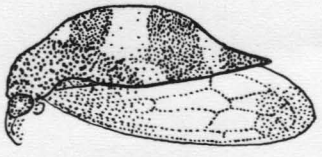


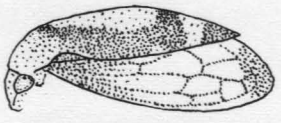
43. C. INORNATA ♀



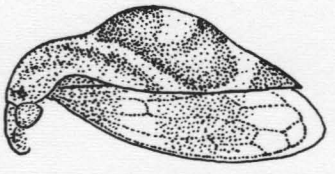
45. C. HELENA ♀



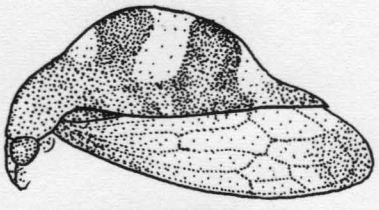
46. C. QUERCI ♂



48. C. MUTICUS



50. C. TUBEROSUS ♀



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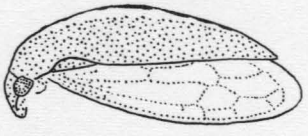
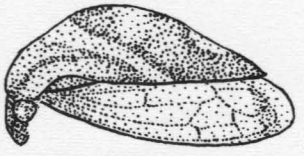
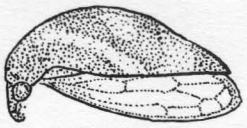


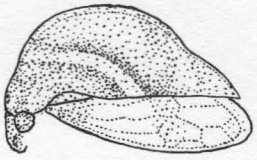
49. C. TUBEROSUS ♂



51. C. DISCOIDALIS ♂



52. C. FULIGINOSUS ♂



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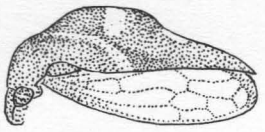
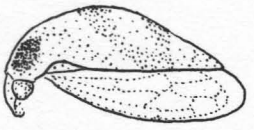
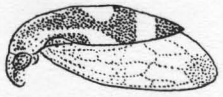


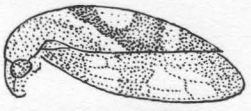
54. C. FENESTRATUS ♀



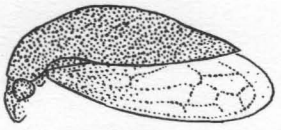
55. C. VAU GROUP (MACULIFRONTIS ♀)



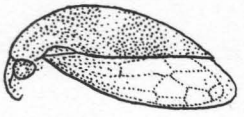
56. C. VAU GROUP (PALLIDIFRONTIS ♂)



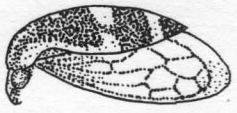
57. C. VAU GROUP (PALLIDIFRONTIS ♀)



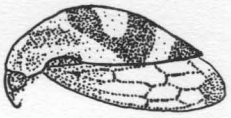
58. C. VAU GROUP ♂



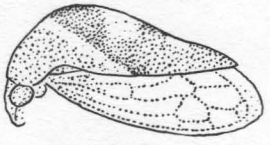
59. C. VAU GROUP (INTERMEDIUS ♀)



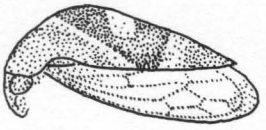
60. C. VAU GROUP ♂



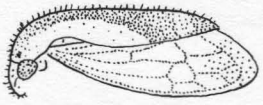
61. C. VAU GROUP ♂



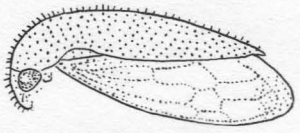
62. C. VAU GROUP ♀



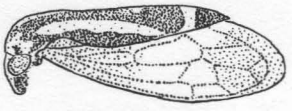
63. C. VAU GROUP ♀



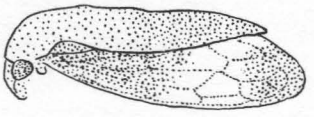
64. O. FLAVICEPHALA ♂



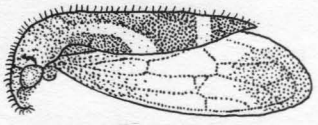
65. O. EVELYNA ♀



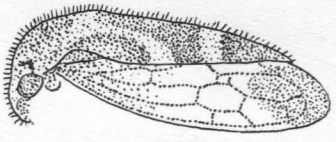
66. O. FLAVA ♂



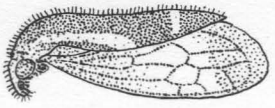
67. O. FLAVA ♀



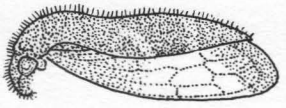
68. O. SALAMANDRA ♂



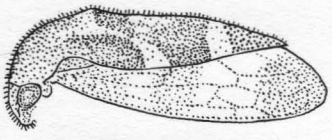
69. O. SALAMANDRA ♀



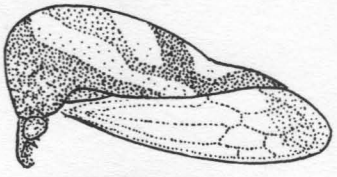
70. O. PUBLESCENS ♂



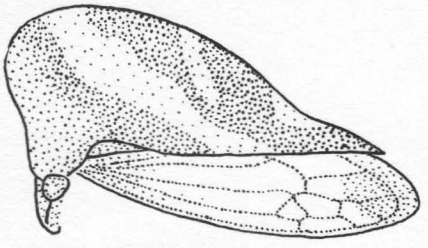
71. O. PUBESCENS ♀



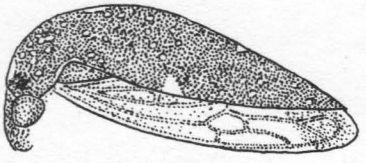
72. O. DEFINITA ♀



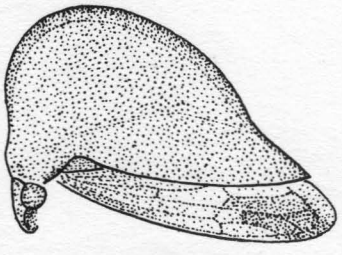
73. S. CAMELUS ♂



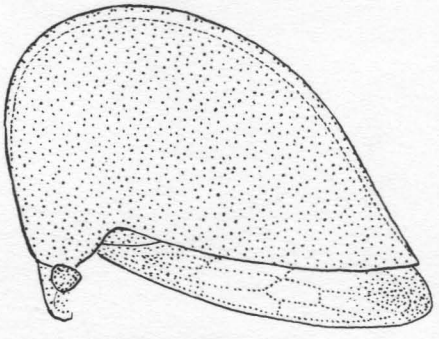
74. S. CAMELUS ♀



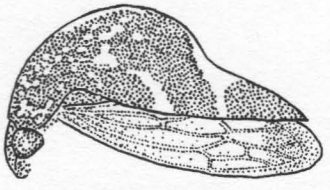
77. C. STUPIDA



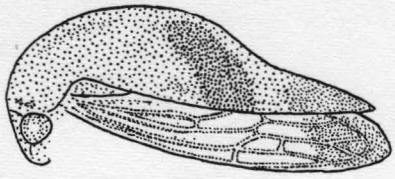
75. A. BELFRAGEI



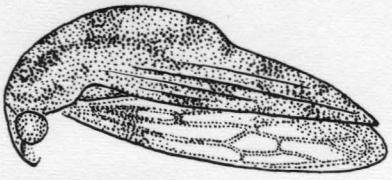
76. A. GALEATA



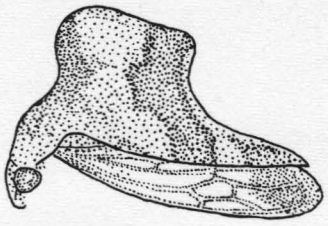
78. C. MARMORATA



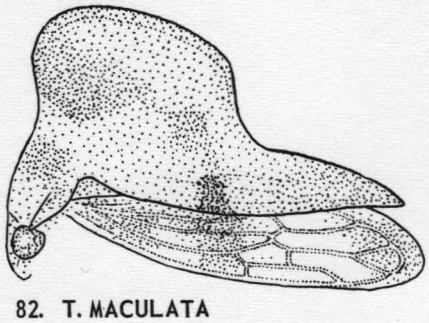
79. C. MERA



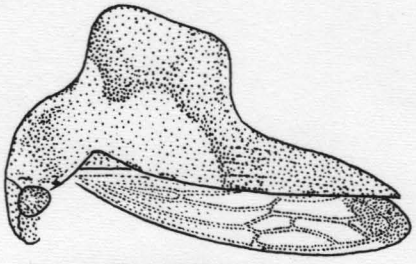
80. T. WESTCOTTI



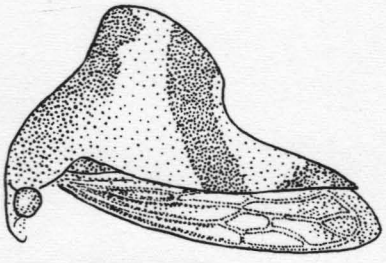
81. T. TRISTIS



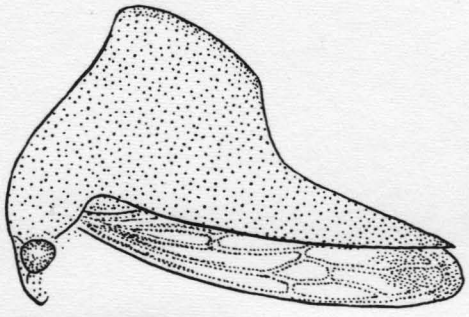
82. T. MACULATA



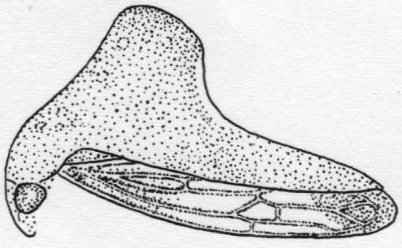
83. T. AMPELOPSIDIS



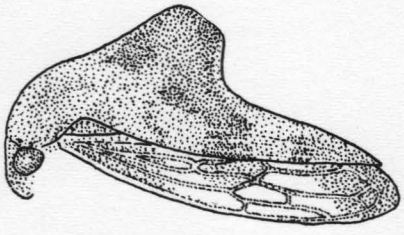
84. T. UNICOLOR ♂



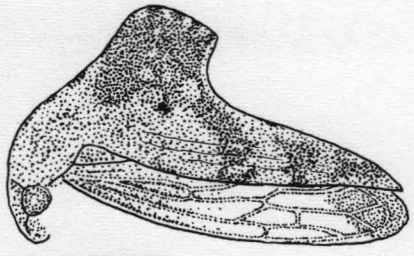
85. T. UNICOLOR ♀



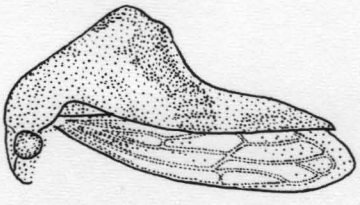
86. T. MONTICOLA



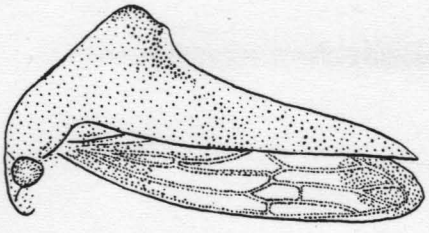
87. T. TILINE



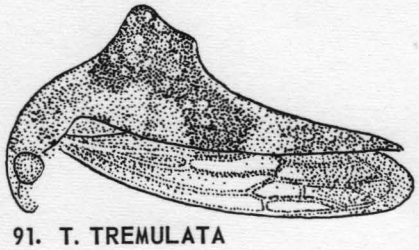
88. T. SPRETA



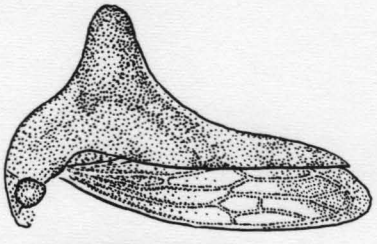
89. T. VIRIDIA ♂



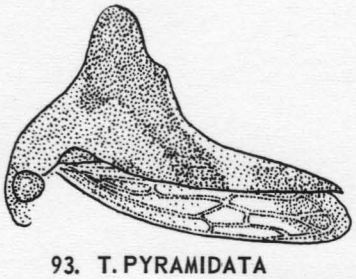
90. T. VIRIDIA ♀



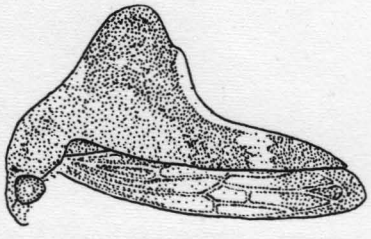
91. T. TREMULATA



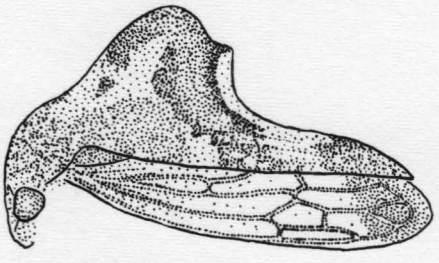
92. T. PYRAMIDATA



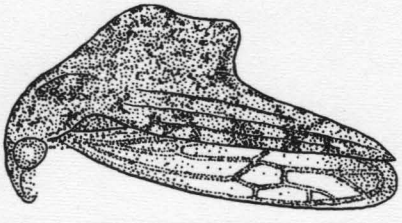
93. T. PYRAMIDATA VAR. DECLIVATA



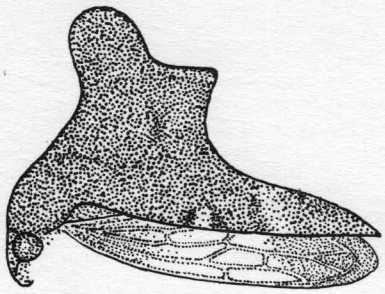
94. T. PYRAMIDATA VAR. AMPLIATA



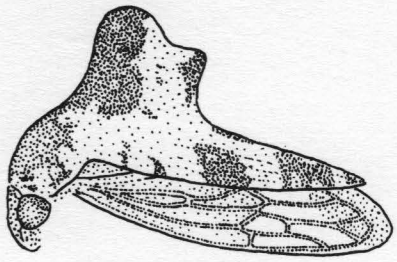
95. T. GEMMA



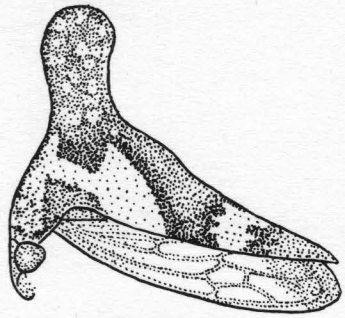
96. T. MOLARIS



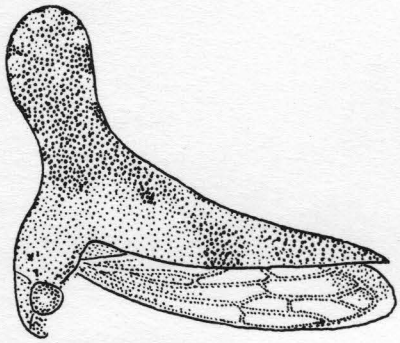
97. T. SCALARIS



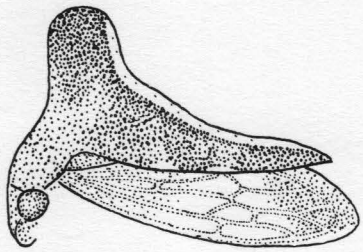
98. T. CONCAVA



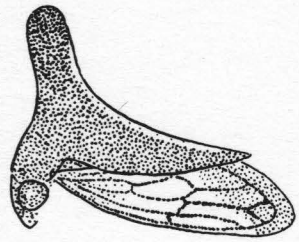
99. G. CRATAEGI



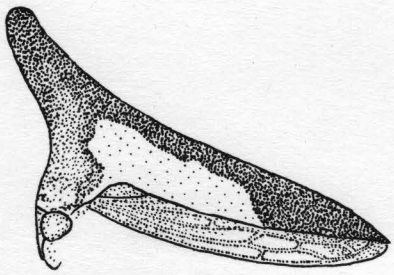
100. G. ACUMINATUS



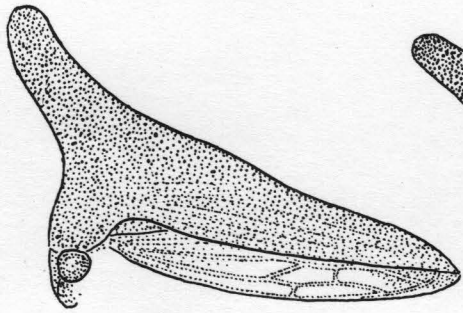
101. G. UNIVITTATUS



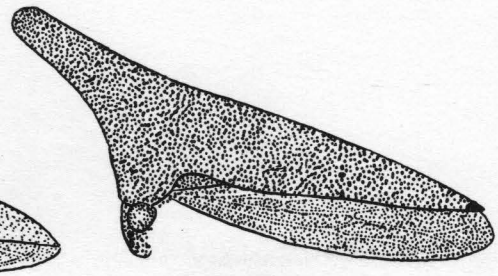
102. G. TURRICULATUS



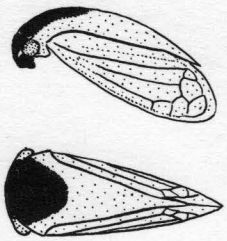
103. T. BIMACULATA ♂



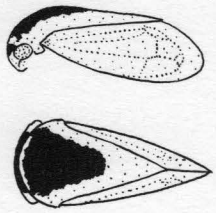
104. T. BIMACULATA ♂



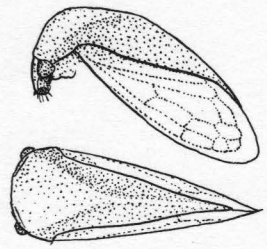
105. T. UHLERI



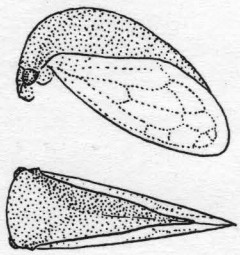
106. A. TARTAREA



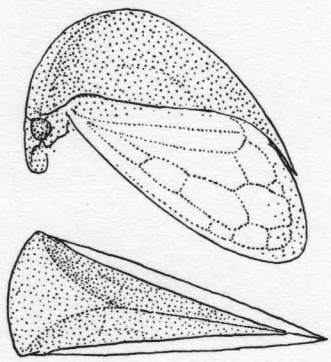
107. M. CALVA



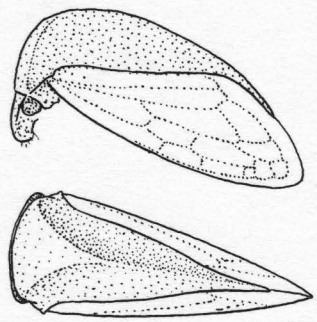
108. S. FRANCISCANUS



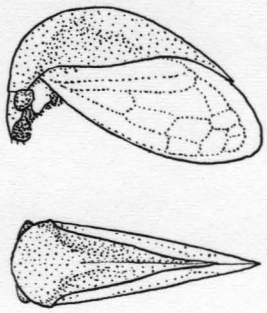
109. S. MINUTUS



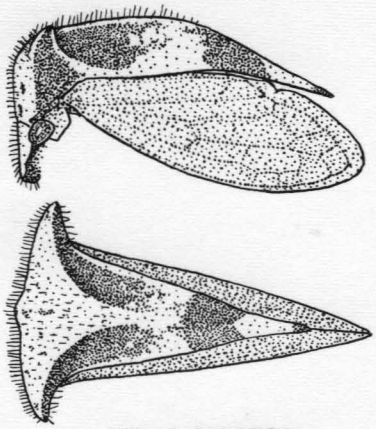
110. S. INERMIS



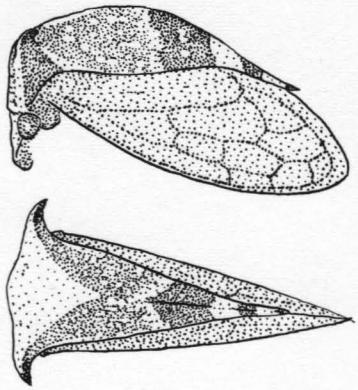
111. S. WICKHAMI



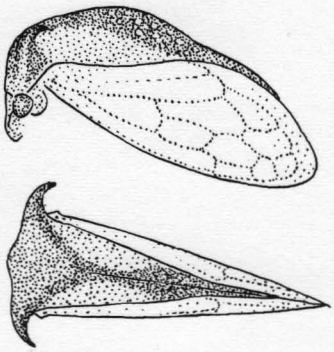
112. S. LUTEA



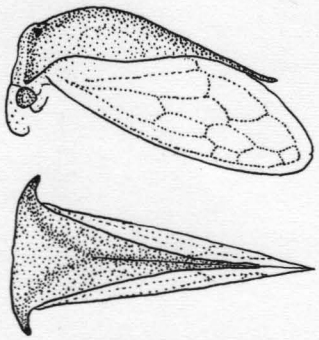
113. S. DICEROS



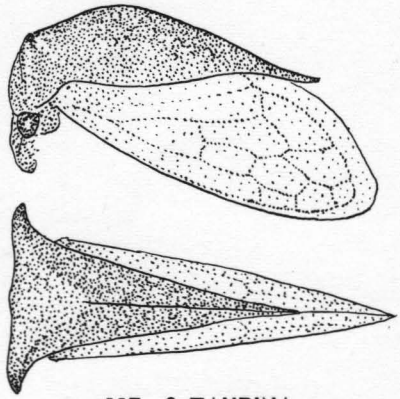
114. S. ALBESCENS



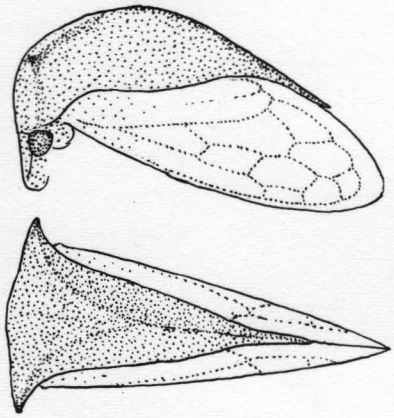
115. S. TAURANIFORMIS



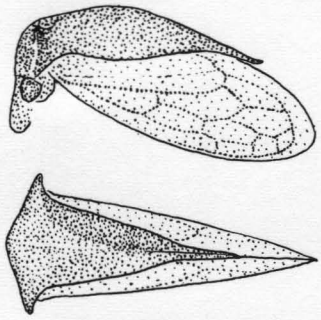
116. S. PALMERI



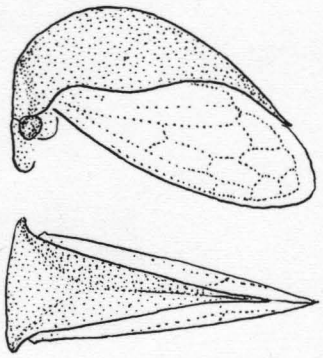
117. S. TAURINA



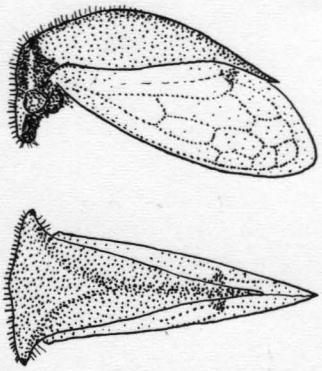
118. S. TAURINA



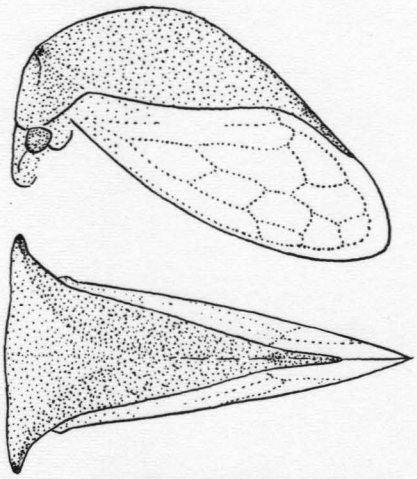
119. S. CONSTANS



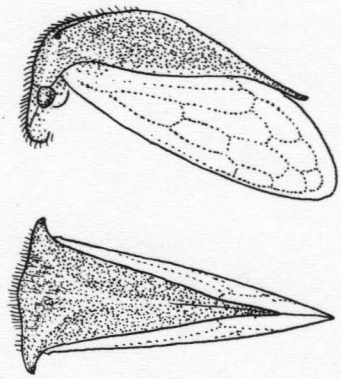
120. S. BREVICORNIS



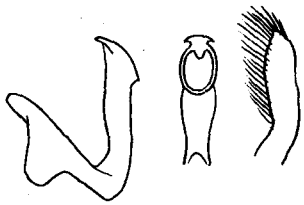
121. S. BASALIS



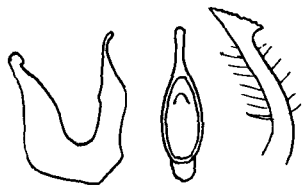
122. S. BUBALUS



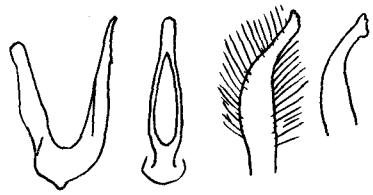
123. S. BOREALIS



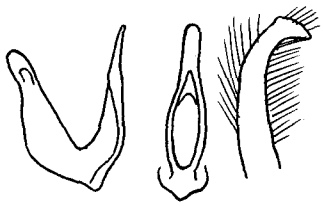
124. S. FRANCISCANUS



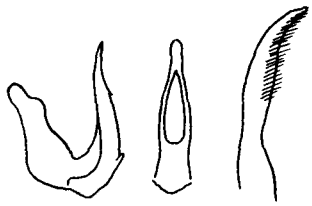
125. S. MINUTUS



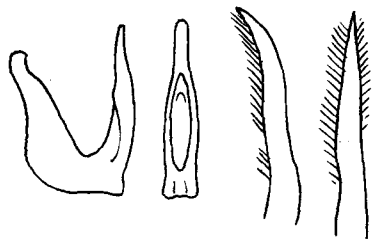
126. S. INERMIS



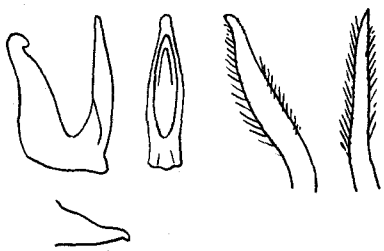
127. S. WICKLAMI



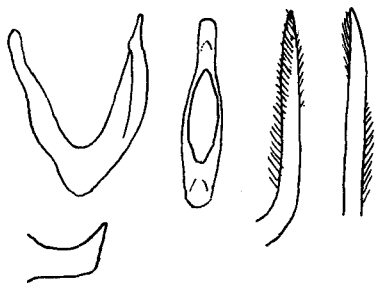
128. S. LUTEA



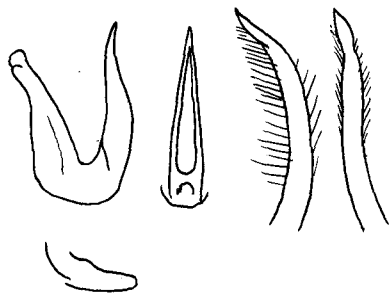
129. S. DICEROS



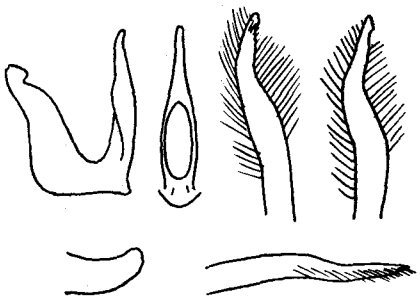
130. S. ALBESCENS



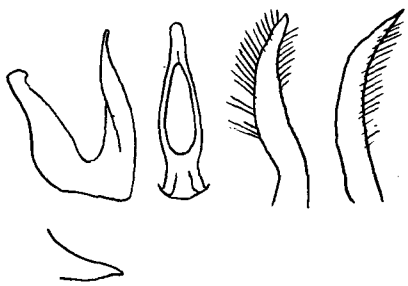
131. S. TAURANIFORMIS



132. S. PALMERI

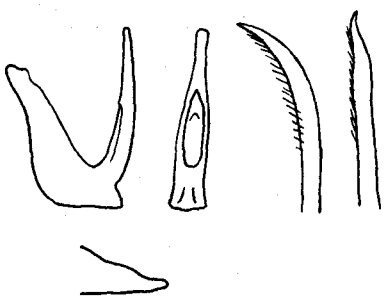


133. S. TAURINA

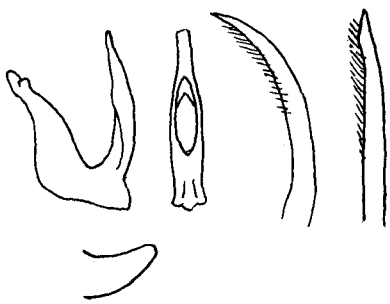


134. S. CONSTANS

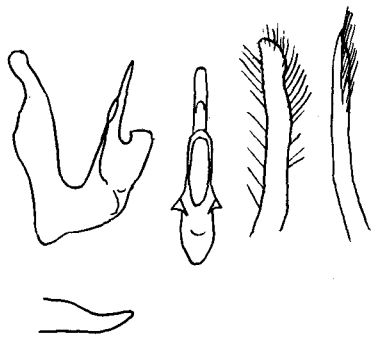
135. S. BREVICORNIS



136. S. BASALIS



137. S. BUBALUS



138. S. BOREALIS