A SYNOPSIS OF THE

CANADIAN THYSANOPTERA

by

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ABSTRACT

The present state of knowledge of the order Thysanoptera in Canada is reviewed. The order has been sorely neglected since Provancher submitted a list of 35 eastern Canadian species in 1890. In contrast to the latest previous estimate of 102 species (Heming, 1979), the number of species found in this study is 174 (143 described and 31 undescribed species). One new genus and five new species are reported as well as the European species *Odontothrips biuncus* which has been found for the first time in North America. Descriptions, illustrations and a dichotomous key to the Canadian genera of the Thysanoptera are given for the first time. Also included are lists of the species hitherto found in Canada along with their localities and habitats. In addition, an alternative computer-compatible key is presented for the suborder Tubulifera. The distribution and study of the order in Canada are discussed and notes on collection, classification, biology and economic importance are given.

RESUME

Ce travail revise l'état de nos connaissances sur l'ordre des Thysanoptères au Canada. Ce groupe a fait l'objet de peu d'études depuis la publication de Provancher (1890), qui énumérait 35 espèces pour l'est du Canada. Dans la présente étude, nous rapportons 174 espèces (143 espèces décrites, 31 espèces non décrites) alors qu'Heming (1979) n'en citait que 102 espèces pour ce pays.

On y crée un nouveau genre et 5 nouvelles espèces, en plus de récolter pour la première fois l'espèce européenne, *Odonthrips biuncus* en Amérique du Nord. L'auteur décrit et illustre pour la première fois les genres de Thysanoptères représentés dans la faune canadienne. De plus, on y trouve une liste des espèces présentes au Canada, accompagnée de notes sur leur répartition géographique et leur habitat. On y inclut un tableau dichotomique conventionnel ainsi qu'un tableau de détermination adapté à l'ordinateur, pour le sous-ordre des Tubulifères. Ce travail fournit également, pour les Thysanoptères du Canada, une discussion sur leur répartition géographique et des renseignements sur leur récolte et classification, leur biologie et importance économique.

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INTRODUCTION

The Thysanoptera or 'thrips' as an order, comprise the smallest pterygote insects showing affinities in structure to the Hemiptera, the order in which they were originally placed. These insects are characterised as follows: minute insects (0.4-5mm in length), usually two to three times longer than wide, of various shades and combinations of brown or yellow, and sometimes black or dark purple; antennae four- to nine-segmented, usually short; mouth parts asymmetrical, used for piercing, rasping and sucking; maxillary and labial palps present; prothorax well developed and well separated from the head and mesothorax; legs of moderate size, the tarsi usually two-segmented, sometimes unsegmented, each with a vesicle-like projection at its apex and often armed with teeth; wings, when present, narrow with very reduced or virtually no venation and long setae on their margins; abdomen with ten full segments and a vestigial eleventh in both sexes. Metamorphosis is intermediate between holometabolous and hemimetabolous types.

Thrips are known by their abundance rather than by their appearance. They can be collected in almost every terrestrial habitat, in almost all parts of the world, even in the high arctic. They display a wide variety of feeding habits, and several species are serious economic pests of cultivated plants either directly by feeding or by the transmission of viral diseases.

Research on these insects, called *'Thrips'* by Linnaeus meaning 'woodworm', has been relatively limited; this has been so for several reasons. Their small size has certainly been a detriment in their popularity; most species measure between 1 to 3 mm in length. This presents many drawbacks for the collection, the observation, identification and rearing of these insects. Apart from a revision of a single genus by O'Neill and Bigelow (1964) detailed study of Canadian Thysanoptera has been undertaken by only two authors, R.C. Treherne and B.S. Heming. Treherne investigated thrips associated with the orchards of British Columbia and published, amongst other articles, a list and descriptions of 30 species of Thysanoptera known to occur in Canada (1924). Heming specialized in the morphology and embryology of the group, as well as its systematics. His latest published estimate of the number of Canadian species stands at 102 (Heming, 1979).

The present study attempts to bring our knowledge of the Canadian Thysanoptera fauna up to date. Species from Alaska and Greenland are also included since these areas are geographically related to Canada. Species from regions south of the Canadian border are dealt with separately (Appendix 3). An account of the distribution and habitats of the known species is presented. This project was achieved through the examination of museum and personal collections, a thorough search of the literature for published records and extensive field collection. Since the whole of Canada could not be covered by collection, four main areas from northeastern

Ontario and from Quebec were selected; these areas had not previously been searched for thrips. Close to 2000 specimens were examined and, of these, 1500 were slide-mounted. From this work, the list of recorded Canadian species was raised to 174 of which 31 are apparently undescribed (Appendix 1). A new estimate of the total thrips fauna in Canada is also included in Table 1.

Dichotomous keys to the genera found in Canada are provided, including a computerized key to the genera of the suborder Tubulifera. These keys are supported by full descriptions and illustrations of each genus. The work concludes with an account of the present Canadian distribution of the order, with a discussion of the classification of some groups and an indication of taxonomic problems existing for certain genera.

With the above information, along with notes on the collection and the biology of these fascinating insects, it is hoped that this research will provide a sound basis for future work on this little studied order in Canada.

LITERATURE REVIEW AND GENERAL DESCRIPTION OF THE ORDER THYSANOPTERA

Historical Development of the Classification of the Thysanoptera

The literature is relatively limited in studies of North American Thysanoptera. Only a half dozen specialists have worked significantly on this group of insects since Asa Fitch described the first American species (Fitch, 1855). Most of these thysanopterists collected and described the thrips fauna only south of the Canadian border, but attention must nevertheless be paid here to their work since information on Canadian thrips has always been sparse.

Uzel published the first monograph of the Thysanoptera of the world in 1895 in which he recorded 160 species. At that time, Canadian records consisted of 2 species (Brodie and White, 1885). A few years later, Provancher (1890) increased this number to 35 species mainly from the province of Quebec. In the United States, Alice Beach presented a list of 17 species found in Iowa (Beach, 1895). Her article was followed by J.B. Smith's paper (1899), which listed 12 species for the state of New Jersey. Hinds (1902) later increased this number of species to 39 for the whole of North America giving full descriptions of each species and genus with information on life history and economic importance. His work dealt with

eastern American material. In that paper, two Canadian records were mentioned. Following these contributions, several entomologists became interested in thrips and soon obtained reputations as prominent thysanopterists. They included R.S. Bagnall, J.D. Hood, H.H. Karny, D. Moulton, H. Priesner and J.R. Watson. These men, half of whom were Europeans, did the bulk of the work presently available on the order. Their large personal collections contributed to the establishment of the main diagnostic features, the description of several hundred species and the present method of classification.

Although Priesner (1926-28, 1949, 1964a) published a key to the known genera of the world, only Hood, Moulton and Watson studied North American species in depth. Moulton (1907) published his 'A Contribution to our Knowledge of the Thysanoptera of California' and (1911) his 'Synopsis, Catalogue and Bibliography of North American Thysanoptera', in which 115 species are recognized. Hood (1908a) described five genera and fifteen species from Illinois and Morgan (1913, 1925) 3 genera and 25 species, one collected in British Columbia, *Franklinella cephalica*. Jones (1912) added 11 species to the fauna of California. A major paper was published by Watson (1924a) which included 335 North American species. In a series of many smaller papers, over a period of years, Hood (1908 - 1955), Moulton (1907 - 1936), Watson (1913 - 1933) along with J.C. Crawford (1938), Bailey (1932-1966), described most of the North American species we presently know. During this time, Canadian species were studied by Cameron *et al.* (1916), Cameron and Treherne (1918) and by

Treherne (1918,1919,1922,1924); these were the first articles published exclusively on Canadian species. Treherne's (1924) list of Canadian thrips includes 30 species.

In more recent times, major works on thrips include Cott's (1956) treatment of Californian Tubulifera, and Bailey's (1957) study of the Terebrantia of California. Some genera have been dealt with individually, such as *Thrips* (Speyer, 1934; Gentile and Bailey, 1968), *Aeolothrips* (Bailey, 1951), *Franklinella* (Sakimura and O'Neill, 1976), *Scirtothrips* (Bailey, 1964), *Heterothrips* (Bailey and Cott, 1954) and *Chirothrips* (Andre, 1939); some species were also given special attention such as *Thrips simplex*, the gladiolus thrips (Herr, 1934), *Thrips tabaci* (Ghabn, 1948), the onion thrips and *Caliothrips fasciatus*, the bean thrips (Bailey, 1933b). These studies described a total of 182 species. Stannard (1957) published an in depth study of the genera of North American Tubulifera, and later (Stannard, 1968) a complete treatise of the thrips of Illinois. This last paper covers 225 species including some not found in, but bordering on, Illinois. Canadian records are mentioned in both of these accounts; 7 in the former and 12 in the latter. The North Dakota thrips fauna has also been recorded. Thomasson and Post (1966) published a key to and descriptions of the Tubuliferan species of that state, and Huntsinger, Post and Balsbaugh (1982) produced a similar handbook to the Terebrantian species based on the former author's master's thesis (Huntsinger, 1971). Post (1961) also dealt with the Oregon fauna.

Records of Canadian species are also included in Jacot-Guillarmod's 'Catalogue of the Thysanoptera of the World' (1970-1978). In this series, the Terebrantia are dealt with completely, but only the subfamily Idolothripinae of the single family Phlaeothripidae of the Tubulifera was completed. After Treherne and Cameron's publications, information on the Canadian fauna was limited to agricultural bulletins (with records of pest species), until O'Neill and Bigelow's (1964) treatment of the Canadian *Taeniothrips*. O'Neill (1967) and O'Neill and Langille (1971) also described the genus *Catinathrips* based on Canadian specimens found on blueberry bushes (Wood, 1956; 1960). O'Neill's contributions to the knowledge of North American thrips cannot be overlooked here. Through several small publications (1960-1973), she described 2 genera and three species and synonimized several others. Heming (1970, 1972, 1979) has also published several small articles listing and describing Canadian thrips, and several major works on the morphological development of two Canadian species *Haplothrips verbasci* and *Frankliniella fusca* (Heming 1970, 1973, 1975, 1979, 1980).

Information from European studies has been valuable since many introduced North American species originate from Europe. Publications such as Morison's 'Thysanoptera of the London Area' (1947-1949), and his 'Review of British Glasshouse Thysanoptera' (1957), Priesner's 'Ordnung Thysanoptera'(1964a), Mound *et al.*'s 'Handbook for the Identification of British Insects: Thysanoptera' (1976), Scheilphake and Klimt's 'Thysanoptera, Fransenflugler' (1979),

include many descriptions of species also found in Canada. Very recently, Mound and Palmer (1983) published what is now known about the world genera of the subfamily Idolothripinae. The classification of the Thysanoptera has recently been analysed phylogenetically along Hennig's principles of classification (Mound *et al.*, 1980). The last world review of the order was published by Ananthakrishnan (1979), unless one counts the brief account of the order given by Stannard (1982).

Since the geographical relationship between Canada and arctic regions such as Greenland and Alaska is very close, records from these areas were included in this study. Henriksen and Lundbeck 's (1917) and Henriksen's (1939) review of Greenland insects lists six species which incorporate typically northern species which are also found in northern Canada with one exception. Weber's (1949) study of Alaskan fauna also includes northern grass-inhabiting fauna.

Morphology

General but thorough descriptions of the anatomical features of thrips have been published several times within the past century. Willaume (1925) gave excellent descriptions of the main features of the adult thrips and of their embryonic and postembryonic development. Throughout his major works, Priesner (1926-1928, 1949, 1964a, b) gave detailed descriptions of European and world species. Snodgrass (1934) described the anatomical features of thrips in relation to

other orders. Doeksen's (1941) doctoral thesis was a careful study of the comparative morphology of thrips. Pesson (1951) treated the morphological and developmental characters of the group as part of the exaustive French 'Traite de Zoologie. Anatomie, Systematique, Biologie'. The structure of the mouthparts and the process of embryonic development are very well explained; the illustrations are not, however, of species found in Canada. Recently, Bournier (1983) presented morphological descriptions of agronomically important thrips of Europe, some of which do occur in North America.

As a group, the Thysanoptera are the smallest of the winged insects, with lengths ranging from 0.5 mm to an exceptional 14 mm (0.5 mm to 5 mm. in Canada) (Lewis, 1973). They are recognized by their distinct head, relatively large prothorax and long abdomen and by four narrow, membranous wings surrounded by long fringe cilia. When at rest, the wings are kept folded flat along the back of the abdomen and are seen as silvery strips shining in the light.

The head bears a pair of four- to nine-segmented antennae, inserted between large, and often prominent compound eyes. Heming (1975) studied the metamorphosis of the antennae of one terebrantian and one tubuliferan species. Differences in antennal structure and development was related to the habitat of the two unrelated species. What distinguishes the Thysanoptera from all other orders are their asymmetric mouthparts. The right mandible is vestigial and therefore only the left is functionnal. The mouthparts of thrips have been studied closely for information on the origin of their

asymmetry (Garman, 1890; Peterson, 1915; Anathakrishnan, 1951; Jones, 1954; Risler, 1957; Davies, 1958; Grinfel'd, 1959; Heming, 1978a, 1980) or for their close relationship with the economic importance of the group (Borden, 1915; Lewis, 1973). A new look at their functional morphology has recently been taken by Chisholm and Lewis (1984).

The legs are usually slender but sometimes characteristically stout, either smooth or with tubercles or hooks, depending on the species' habitat. The unsegmented or two-segmented tarsi have a terminal vesicle-like tip which is used for clinging to smooth surfaces. This structure is regulated by the contraction and dilation of the pretarsal depressor muscle and by changes in blood pressure (Heming, 1971). Hooks or claws on the tarsi also aid in the adherence to surfaces.

Thrips can either be apterous, brachypterous or macropterous. These conditions vary from species to species or within a species depending on sex, habitat, and environmental conditions; the expression of this feature is not genetically determined (Hood, 1940; Mound, 1976; Bournier, 1983). When wing development differs within a species, the winged form is usually smaller, has ocelli and large eyes and greater number of body setae; the brachypterous form is larger, with no ocelli, reduced eyes and a lesser number of setae (Hood, 1940). Cooler temperatures often favour brachypterism over macropterism, e.g. *Thrips angusticeps, Hoplothrips cottei* (Bournier, 1983); this fact was also observed with a species of *Anaphothrips* found in Ellesmere Island (Downes and

Chiasson, unp. res.).

The genital apparatus of the Terebrantia is easier to distinguish than in the Tubulifera. The large protrusive saw-like ovipositor of the female Terebrantia is used to tear a slit through the epidermis of the plant tissue where the egg is then laid. Males of the Terebrantia are smaller and often lighter in colour than females, with a bluntly rounded abdomen, while the females have a more gradually tapering tip. Some males have claspers or spines on the ventral side of the last abdominal segments. The tubuliferan female does not have an external ovipositor and her genital area is reduced to a short, chitinous rod, the fustis, situated internally at the base of the terminal, abdominal tube. Male Tubulifera possess difficult to see glandular areas on the middle abdominal segments. The development of the reproductive systems of a terebrantian and of a tubuliferan species was studied in detail by Heming (1970). De Gryse and Treherne (1924) looked at male genitalia as valuable taxonomic characters. Other studies of the external reproductive organs were done by Doekson (1941), Jones (1954) and Priesner (1964b). Internal morphology of the Thysanoptera has been considered by Hood and Hook (1932), Sharga (1933) and by Heming (1970a,b). Heming (1970a,b, 1973, 1975, 1979, 1980) has given in depth descriptions, and minutely detailed illustrations of the morphological development of thrips in his embryological studies of *Haplothrips verbasci* and *Frankliniella fusca*. Heming has also described and illustrated the different larval stages of approximately 30 species of thrips

(Heming, unpubl.).

Aberrations in the morphological structures of thrips have been noticed in the antennae (Mound and Walker, 1982) and in the genital organs (Morison, 1949).

Biology, Ecology and Host Plant Relationships

This subject was treated in an excellent manner by Lewis (1973). Lewis gives a very thorough review of thrips biology and ecology, and also adds valuable information on laboratory methods used to study thrips and the economic importance of the group. This work is based on over 700 references including 19 of the author's own work. Lewis's work on thrips continues to the present; Chisholm and Lewis (1984) recently studied the feeding behaviour.

Ananthakrishnan (1973) published a somewhat similar book to that of Lewis', but much less involved with, and pertinent to, Canadian species as it deals mainly with the Oriental fauna.

Certain publications on thrips ecology (Andrewartha, 1934,1935; Davidson and Andrewartha, 1948a,1948b) have provided fundamental information on insect ecology (Andrewartha and Birch, 1954). Thrips are an interesting group for ecological studies because of their presence in almost all terrestrial habitats and the migratory habits of several species. The following is a generalized description of the bionomics of the Thysanoptera. It seems pertinent to include it here for a proper understanding of the main body of this thesis.

Reproduction and mating

Although males are often present in a population of thrips, females usually predominate. In some species, males are rare or even unknown e.g. in *Heliothrips haemorrhoidalis* (Mound, *et al*, 1976), *Aptinothrips rufus* (Ananthakrishnan, 1973), *Haplothrips subtilissimus* (Putman, 1942). O'Neill (1960) noticed that introduced species are mainly female because parthenogenic females become established in other regions more easily than do sexually reproducing species or males, which remain restricted to their country of origin. This can also explain why only females are found in extreme northern regions of the world (Lewis, 1973; Chiasson unpub. res.)

Reproduction in thrips is of two types. Like many species of the Hymenoptera, reproduction is by arrhenotoky, whereby females are diploid and males are haploid. This means that males develop only from unfertilized eggs. This type of reproduction usually favours the production of females over males, which again accounts for a greater abundance of females in a population. Where males are not present, reproduction is by thelotoky where females are produced parthenogenically without fertilization. Jordan (1888 cited by Shull, 1914) first suggested that thrips follow a cycle of reproduction similar to that adopted by aphids, i.e., a series of parthenogenic generations during the summer followed by a generation of males and sexual females in the latter part of the summer or in the fall. Shull (1914) accumulated data indicating seasonal variation in the abundance of males. Since

change of temperature was found to influence the sex ratio, i.e., males were present in greater numbers during cooler periods and in lesser numbers when temperatures were warmer, the change from thelotoky to arrhenotoky is very probable (Lewis, 1973). Another form of development, deuterotoky, has been observed by Heeger (1852) in the case of *Parthenothrips dracaenae*. In this species, unfertilized females produce females, but, under certain conditions, they may also produce males.

Mating can occur within hours of adult emergence from the last pupal stage. The male holds the dorsal part of the female abdomen with its legs and twists the end of his abdomen into the female genital aperture (Bournier, 1983). Copulation lasts from one to several minutes depending on the species. Males of Thripidae possess abdominal glandular areas which secrete sex pheromones used in attracting the female (Pelikan, 1951).

Development

The terebrantian female lays her eggs in tender plant tissue with the help of her ovipositor which cuts and opens a slit in the epidermis of the plant. Once the ovipositor is under the epidermis, an egg passes down the organ and is inserted into the plant tissue. A female can lay 2-5 eggs per day and 60-100 eggs in her lifetime. Females of the Tubulifera, which are devoid of an ovipositor, deposit their eggs on the surface of a plant, usually choosing an area which has a pilous or textured surface. The mucilagenous chorion of the egg can then

easily adhere to this substrate.

Most species are oviparous but ovoviviparity has been observed in two species of Megathripini; at the moment of laying, the egg contains a first-instar larva (Bournier, 1983).

The life stadia consist of egg, two larval instars, one (Terebrantia) or two (Tubulifera) prepupal instars, one pupal instar and the adult stage (Stannard, 1968). Since metamorphosis is intermediate between the 'complete' and 'incomplete' forms, the immature stages have been called either nymphs (Loan and Holdaway, 1955; Cott, 1956; Bailey, 1957) or larvae (Stannard, 1968). The two larval instars are feeding stages where all food necessary for adult development is ingested. The prepupal and pupal stages are non-feeding and quiescent, however, pupae can walk if disturbed. Pupation occurs on the plant (most Aeolothripidae, Heterothripidae and Phlaeothripidae) or in the soil (most Thripidae). Some members of the Aeolothripidae are cocoon-spinners (Bailey, 1940a). Upon pupation, 'silk' is produced by the larval Malphigian tubules and comes out through the anus, forming a cocoon in response to the twisting and curling action of the abdomen.

Information on hibernation is limited. Thrips have mainly been reported to pass the winter as adults in the soil, in leaf litter or plant debris, under the bark of trees, or in the hollow stems of dead herbs. Overwintering in the larval or pupal stages has also been reported (Loan and Holdaway, 1955; Stannard, 1968). A period of aestivation, i.e., summer quiescence, is also possible in some species of thrips, as in

the case of *Limothrips cerealium* (Stannard, 1968) and *Haplothrips tritici* (Bournier and Bernaux, 1971).

Locomotion and Dispersal

Predacious species are generally much more active than phytophagous species. When walking they flick their antennae which act as sensors to the immediate environment. Certain species are capable of jumping, and this behaviour is specialized by a more developed furca in members of the Dendrothripini of the Thripidae (Mound *et al.*, 1976). Jumping is often preliminary to flight. Flight is undertaken quite readily by some species but very relunctantly by most (Chiasson, unpub. res.; Stannard, 1968).

Since the membranous part of their wings is quite narrow, thrips are not strong fliers. They are known to cross great distances when in search of suitable host plants or of a hibernation site. This long-distance displacement is, however, a direct result of a high wind velocity and is not directed flight (Lewis, 1959a, 1964, 1969, 1970; Johnson, 1969). Lewis and Navas (1962) have made in-depth studies of the movement of thrips from wintering quarters to food and breeding plants. Lewis (1969, 1970) and Lewis and Dibley (1970) also looked at the effects of windbreaks on the distribution of thrips in an adjoining wheat field. Vertical displacement was also studied intensively by Lewis (1973).

Mass flights of certain species of thrips are highly correlated with weather conditions. Hot (over 20° C), dry, sunny and settled weather with slight convection offers

the necessary conditions for take-off of cereal feeding thrips (Lewis, 1964). Other species studied, including two predatory species, needed only warm temperatures, whether humid or dry, to migrate. In species that have been studied, thunderstorms did not influence flight as previously and widely believed (thrips *per se*, were traditionally known as 'thunderflies' or 'stormflies') (Lewis, 1964). Other conditions for dispersal, such as sexual differences, ovarian development, and quality of food have been treated by Lewis (1973).

Habitats

Thrips are terrestrial and occupy a diversity of habitats. Some of the phytophagous species are host-specific, others can live on several hundred different host-plant species. Most are, however, found on a few closely related plants (Ananthakrishnan, 1979).

Thrips, in general, feed on all parts of a plant except the roots, but prefer young, tender tissue. A few species will infest the whole plant at one time. *Thrips simplex* will attack the flowers, leaves and corm of the gladiolus plant (Crossley and Arrowsmith, 1972). Thrips usually seek narrow and sheltered areas, e.g. crevices of flowers and leaves and often are not immediately seen by the casual observer; the insect feels its site with its antennae and body setae and chooses a site that it fits closely because of its thigmnotactic reflex. To the polyphagous feeders, ease of concealment, coloration and odour are important conditions of acceptance (Lewis, 1973; Bournier, 1983). Several

flower-inhabiting members of the Terebrantia feed on pollen (Loan and Holdaway, 1955; Grinfel'd, 1959; Putman, 1965). Grinfel'd believes that, in thrips, pollen feeding is as ancient as predation, as both modes of feeding are used by the most primitive family, the Aeolothripidae. Pollen feeding, however, according to Grinfel'd, most likely determined the course of evolution of the mouthparts by causing atrophy of one mandible. Since pollen grains are so small, only one stylet can be used to pierce them. Favouring the use of the left mandible over the right resulted in a diminishing in importance and subsequently in size of the latter.

Predatory species are mainly found in the family Aeolothripidae (Treherne, 1920) along with a few species from the Phlaeothripidae. *Haplothrips faurei, Leptothrips mali* and *Aeolothrips melaleucus* were closely investigated as possible biological control agents of orchard mites and of eggs of codling moth, *Laspeyresia pomonella* and of the Oriental fruit moth *Grapholitha molesta* in North American orchards. (Putman, 1942, 1965; MacPhee, 1953). Thrips also attack several other soft-bodied insects including aphid nymphs, psocids, scales and other thrips. *Aeolothrips fasciatus* attacks larvae and adults of the oats, onion, gladiolus and bean thrips (Lewis, 1973).

Most members of the Phlaeothripidae are leaf-litter or bark dwellers (Mound and O'Neill, 1972). The subfamily Idolothripinae have specialized maxillary stylets for ingesting fungal spores (Mound and Palmer, 1983). Pielou (1966), Pielou and Matthewman (1966) and Pielou and Verma

(1968) have found six species associated with the bracket fungi, *Fomes fomentaius* and *Polyporous betulinus* in Gatineau Park, Quebec. Of the six, five are Phlaeothripidae; the other is a member of the Thripidae. Hood and Welch (1980) identified two species of thrips from nests of the red-winged blackbird in Delta, Manitoba. One of them *Bolothrips dentipes*, a marsh inhabitant, was found in greater numbers than the other *Frankliniella tritici*, a flower dweller; the presence of the latter species was probably incidental. *Limothrips denticornis*, a grass inhabitant was also found in a bird's nest in up-state New York (Herrick, 1924). Thrips are well known gall-formers (Ananthakrishnan, 1978), although only one or possibly two species form galls in Canada (Landry and Shorthouse, pers. comm.). Other species are associated with galls but are not gall-formers, e.g., *Megalothrips spinosus* (Hood, 1927a)

Unusual activities of thrips were observed by Bailey (1936) and Evans (1932) who gave accounts in which *Thrips tabaci* and *T. imaginis* have molested man by puncturing the skin, bloodsucking or seeking moist facial areas such as the eyes, nose and mouth.

Economic Importance

Information on the economic importance of North American thrips has been spread throughout several short articles and governmental reports. Lewis' major work (1973) encompassed most of the knowledge so far acquired on pest and beneficial

species of thrips of the world. Examples of the impact of thrips' presence on different crops were given, indicating the injury caused by phytophagous thrips, and describing their role as possible vectors of bacterial, fungal and viral diseases. Their beneficial effect as predators of other pest species was also discussed. Kono and Papp (1977) present a comprehensive key to pest species found in California along with excellent illustrations. Several of the thrips species treated by the French agronomist Bournier (1983) are found in Canada as well as in Europe.

Information of pests species of thrips in Canada date back to Hewitt's (1912) report on the grass thrips *Anaphothrips obscurus*, affecting oats. Then Cameron and Treherne (1918), and Cameron *et al.* (1916) followed the northern migration of the pear thrips *Taeniothrips inconsequens*, from California to the orchards of Vancouver Island. This European species had been causing enormous losses in the plum orchards of California and in the states of New York, Pennsylvania and Maryland. The spread northwards into eastern Canada the pear thrips from New York State was very slow since it was not found on Quebec fruit trees until 1969 (Paradis, 1969) and numbers at this time were well below economic injury levels. The Western Flower thrips, *Frankliniella occidentalis* was also reported in British Columbia orchards but did not cause extensive damage (MacNay, 1957; Madsen *et al.*, 1975).

The action of the mouthparts of the pear thrips on its host is characteristic of all plant feeding Thysanoptera. The adults scrape and rasp tender plant tissue. The maxillary

stylets are inserted into the wound and pierce cell walls. The stylets then suck the liquid contents of the cells (Lewis, 1973; Stannard, 1968). Feeding causes a silvering, scarring and distortion of the leaves and fruit. Further damage can occur due to excrement left on plant tissue favouring the growth of moulds. Besides orchard fruit, thrips attack small fruits such as blueberry (Phipps, 1930; Wood, 1956, 1969; Fox, 1974) and have attained severe levels in Nova Scotia plantings. The species responsible for this damage are *Catinathrips kainos, C. vaccinophilus* and *Frankliniella vaccinii*.

Thrips also infest flowers, their feeding early in the bud stage preventing blooming, and fruit and seed set (Carlson, 1964; Kelleher, 1979). Ornamental plants such as chysanthemum can be severely affected by *Heliothrips haemorrhoidalis* (Beirne, 1972). Gladiolus is attacked by *Thrips simplex* (Dustan, 1933; Herr, 1934; Crossley and Arrowsmith, 1972) and several other flowering plants by *Parthenothrips dracaenae, Hercinothrips femoralis, Frankliniella occidentalis* and *Frankliniella tritici* (Steiner and Elliott, 1983).

Thrips damage to vegetable crops is also important in Canada. *Thrips tabaci*, a major pest of onions is a cosmopolitan species found in all parts of the world (Lewis, 1973; Ananthakrishnan, 1973). Damage to onions results from continuous feeding on leaves, which retards the growth of the bulb (Armand, 1951). *T. tabaci* is still causing important yield reduction from 25-50% in onions in Canada and has developed resistance to certain insecticides (Beirne, 1972).

For this reason, selection for onion cultivars resistant to thrips attack is being investigated (Jones *et al.*, 1954; Coudriet *et al.*, 1979). Resistance of the plant to puncturing has been attributed to hardness, thickness or toughness of the epidermis or other tissues (Callan, 1943) or to the shape of the leaves. Rounded leaves are less attractive than flatter ones to *T. tabaci*, as they do not offer many crevices and hiding places when pressed together as the flatter ones do when pressed together especially near the bulb. *T. tabaci* also infests cabbage (MacNay, 1957; Hudon and Martel, 1973, 1975; Kelleher, 1979), asparagus, (Banham, 1968), cucurbits, beans (MacNay, 1957), turnip, carrot, potato, corn, alfalfa and clovers (Beirne, 1972). Its presence on greenhouse cucumbers and peppers has initiated a great deal of investigation into its control in the Netherlands (Ramakers, 1976, 1978, 1980; Samson, *et al.*, 1979; Ramakers and Van Lieburg, 1982); and elsewhere in Europe (Carl, 1975; Gould 1970, 1971; Macleod *et al.*, 1976; Binns *et al.*, 1982). Results of their studies are now being put into effect in Canadian greenhouses (Steiner and Elliott, 1983). Gentile and Bailey (1968) describe in detail the economic importance of the genus *Thrips* as pests of cultivated plants and as vectors of plant diseases.

Cereal and forage crops such as oats, barley, wheat, timothy and clovers are damaged when young thrips feed on developing flowers that are still protected by sheath (Fernald and Hind, 1900; Pettit, 1908; MacNay, 1957; Beirne, 1972; Kelleher, 1979). Flowers turn white and do not produce seeds. Species

associated with grains in Canada are *Anaphothrips obscurus, Haplothrips leucanthemi, H. niger* and *Limothrips denticornis*.

Chemical controls at the beginning of the present century consisted mainly of the application of nicotine sulphate or of other nicotine preparations combined with kerosene emulsion or soap or of a distillate oil emulsion combined with nicotine (Chittenden, 1919; Phipps, 1921). Richardson (1934) tested rotenone, soaps, hellebore, pyrethrin and Paris green as means of controlling *Thrips simplex*. Later, when hydrochloride compounds were produced as insecticides, control was achieved with dieldrin, DDT, BHC and chlordane (Armand, 1951; Rogoff, 1952; Ananthakrishnan, 1973). When organochlorines were replaced by organophosphorus compounds, products such as parathion, dimethoate and diazinon were used, and diazinon is still being used to a great extent, especially against *Thrips tabaci* (Lewis, 1973). Fumigants are used for greenhouse crops and for gladiolus corms. Presently, insecticidal soap, a non-persistant and relatively non-toxic insecticide has been shown to be effective on greenhouse thrips (Moore *et al.*, 1979).

Cultural controls have been used since the recognition of thrips as pest insects. Good sanitary practices have been encouraged and these include spring burning of fields which had previously harboured an infestation (Fernald and Hinds, 1900; Armand, 1951; Bournier, 1983), intercropping of vegetables highly susceptible to thrips attack with non-susceptible vegetables (Chittenden, 1919; Armand, 1951),

fall plowing and disking of fields to disturb dormant stages (Chittenden, 1919; Bailey, 1934), and improvement of plant quality (Chittenden, 1919).

Weather directly affects thrips abundance. Long periods of continuous rain can destroy a population of plant dwellers (Bailey, 1934). On the other hand, extreme dry conditions can lower survival rate of pupae in the soil since these cannot compete with soil for the limited available moisture (Andrewartha, 1934; Bailey, 1934; Davidson and Andrewartha, 1948a, a1948b).

Certain biological control programs against greenhouse thrips have proved successful. Various kinds of entomophagous organisms were studied initially, such as the fungus *Entomophthora thripidum* (Carl, 1975; MacLeod *et al.*, 1976; Ramakers, 1976, 1978; Samson *et al.*, 1979) and predators like *Orius minutus*, an Anthocorid bug (Ramakers, 1978). The most promising biological agents are two predatory species of phytoseid mites, *Amblyseuis mckenzeii* and *A. cucumeris* (Ramakers, 1978, 1980, 1984). Commercial mass-production of these mites has been achieved (Ramakers and van Lieberg, 1982) and they are currently available to Dutch and Canadian greenhouse growers (Ramakers and van Lieberg, 1982; Reeves, pers. comm.).

Letourneau and Altieri (1983) have investigated the possibility of biological control of the injurious western flower thrips *Frankliniella occidentalis*, by its predator, *Orius tristicolor* (Anthocoridae). These authors compared the number of both prey and predator in polycultures and

monocultures and found that the bug had appreciably repressed thrips numbers. Tanigoshi *et al.* (1984) found that the phytoseiid mite *Euseius hibisci* could maintain populations of *Scirtothrips citri*, the citrus thrips at near zero densities through and beyond the critical period of fruit injury in orange groves. Other attempts at biological control of thrips attacking field crops have been unsuccessful so far (Lewis, 1973; Bournier, 1983).

On the positive side, thrips have been recognized for their beneficial influence rather than their injurious nature. Orchard entomologists (Putman, 1942; MacPhee, 1953; Lord, 1972; Parent, 1973; Parella *et al.*, 1982) have studied the possiblility of using the predator species, *Aeolothips melaleceus*, *Haplothrips subtilissimus* and *Leptothrips mali* as biological control agents against the European red mite, *Panonychus ulmi* and the Oriental fruit moth, *Grapholitha molesta*. The tubuliferan *Amynothrips andersoni* has been imported from South America to the U.S. for the control of alligatorweed, an aquatic pest plant (O'Neill, 1968b). Due to the host specificity of *Liothrips mikaniae*, this species of thrips is now recommended for introduction against the noxious weed *Mikania micrantha* in South-East Asia (Cock, 1982).

Thrips have also been considered effective pollinators (Annand 1926; Lewis, 1973). Free (1970) reports cases of pollen transport by thrips but does not give an indication of their impact on pollination.

COLLECTION, PRESERVATION AND MOUNTING OF THYSANOPTERA

Methods used for the collection of thrips vary according to the habitat of the species sought. In this study, flower-dwelling species were collected by means of a very fine meshed sweep net. The active thrips were then easily picked up with a moistened camel's hair brush and placed in vials of 75% alcohol. A great number of specimens was also gathered when whole plant parts were placed in plastic bags (one plant species per bag) and then brought to the laboratory for examination. Often, thrips which cannot be seen on the plants in the field are visible in the laboratory since they leave the crevices and fissures of the plants once these have been picked. In addition, the coloration of certain species of thrips makes it difficult to detect these insects outdoors. This method which was also used by Uzel (1895) and Hinds (1902) gives information on host plants. Another advantage is that thrips can be observed live at the laboratory for behavioural reflexes such as combing of the fringe wing cilia with body setae, upturning of the abdomen in response to touch and so forth. Even so, thrips were not seen to fly in the laboratory after receiving various types of stimuli.

Tree-inhabiting species were collected by means of a beating sheet held underneath the tree while the branches were shaken. As with the sweep net, specimens were then picked up with a brush and placed into vials of alcohol. The beating sheet

measured approximately one meter square.

The forest has a rich thrips fauna. To collect this, detritus is gathered in bags and then shaken over a sieve to remove twigs, leaves and other large particles. The residue is placed in a Tullgren funnel to extract the insects. A wide variety of species, mainly of the family Phlaeothripidae, can be obtained in this way. Species which inhabit bark, forest litter, mosses and fungi are the least known in Canada (as elsewhere) because of the difficulty in locating them. Most of such species live in aggregations interspersed throughout the forest habitat. Enormous amounts of forest detritus and bark may be processed before a single specimen is obtained. This was the experience of the author for most of the collection period. Information about the association with certain species of trees and forest plants has proven beneficial in finding the insects. Nevertheless, since this was not always helpful, it is possible that their presence is not only related to the types of trees in a given area but also to soil conditons. The author, however, has found that a greater number of thrips could be obtained when the top layer of litter (loose dry leaves and twigs) had been removed and the lower, moist, section retained along with a scraping of the top-soil. Whether the search is for flower-, tree- or litter-dwellers, a hand lens of 10- to 20-power magnification is an indispensable tool for field observations. Equally valuable is a list of possible finding-places for each species; Appendix 1 has been divised for this purpose.

Thrips are usually obtained when the host plant is fully

developed. Most flowers and grasses are abundant in late June, July and August, so that this is the ideal time for capturing such species. Since many flower- and grass-dwellers migrate to the forest and back to the field in the fall and in the spring respectively, it is challenging for the collector to intercept them in their flight. This can easily be done by means of interception traps, such as the Malaise trap. A modified Malaise trap made of white fabric was used in this work.

Water traps placed in the vegetation were also used in this study. The trap, measuring approximately 30cm X 18 cm X 7 cm was sunk into the soil so that the edges were level with the soil line. Litter was brought to the sides to reproduce the natural setting. Many grass- and flower-dwelling species were found by this method, but, surprisingly, no litter-dweller was so obtained, even when the trap was placed in the forest.

Thrips are best killed and preserved temporarily by means of a solution (AGA) made of eight parts of 95% alcohol, five parts of water, one part of glycerol and one part of glacial acetic acid. This fluid relaxes the insects, thus preparing them for mounting. For long-term storage the specimens are removed from AGA and placed in vials containg 70% alcohol. The author also added a drop of glycerol to each vial in order to prevent specimens from becoming brittle.

Since identification of thrips requires the use of a high-powered compound microscope (in the present work, using phase contrast and interference microscopy), thrips must be mounted on slides. The best medium in which to mount thrips is with Canada Balsam, since this product assures the permanency

of the slides. For Canada Balsam mounts, the author followed the steps enumerated by Heming (1969). Another method which also produces excellent results, is given by Mound and Pitkin (1972). For this study, polyvinyl lactophenol was also used. The use of this fluid, which acts as both a clearing and a mounting agent, does not involve the numerous steps necessary for the Balsam mounts. A drop of polyvinyl lactophenol is put on the slide, the insect is placed on the drop and spread out. The coverslip is placed on the insect and the slide is allowed to clear and dry for 5-7 days. For a longer lasting slide, it is recommended to ring the coverslip with Glyptal (a waterproofing paint used as a sealant). This method is one currently used for the mounting of mites (Krantz, 1978).

CLASSIFICATION

Thrips were recognized as constituting a separate order of insects by Haliday (1836) and named by him Thysanoptera (from *thusanos*=fringe, *pteron*=wing) from the long cilia arising from the margins of the wings. The names Physopoda, Physapoda or Vesitarses also used previously and subsequently for this group, referred to the bladder-like structure (empodium) at the tip of each tarsus. Priesner (1958) finally established that this structure is not actually a vesicle, and he therefore attempted to discredit all ordinal names referring to it.

Three major characters are employed in the definition of the order Thysanoptera: the strongly asymmetrical mouthparts (fig. 3), the bladder-like tarsi (figs 15, 51), and the fringe cilia along the wing margins (figs 1, 2, 18, 19, 20, 46, 84, 88, 103). Of these, straplike wings bordered by long hairs are not diagnostic as they are also to be found in certain groups of Hymenoptera, Coleoptera and Lepidoptera. Nevertheless, in Thysanoptera, this character is universal (where wings are present), whereas this is not the case in the other groups mentioned which have independently developed this type of wing as a solution to a common problem in the aerodynamics of very small insects (Cott, 1956). The Thysanoptera comprise, indeed, many apterous forms (figs 35, 87, 104).

Other characters distinguishing the order but of secondary

importance are the small size of virtually all of its members (body under 5 mm long, only exceptionally reaching 10-12 mm in length), the five- to nine-segmented antenna and the large prothorax. The last is one of the characters used to justify the former inclusion of the Thysanoptera among the orthopteroid orders (e.g. by Handlirsch).

The order is divided into two suborders, customarily known as the Terebrantia[1] (fig. 1) and the Tubulifera[2] (fig. 2). The characters separating these two groups are clearly defined and even the fossil record has not yet revealed species with characters intermediate between the two (Cott, 1956). Two characters are of primary importance in separating the suborders: the presence of a saw-like ovipositor (figs 7, 8) and of veins on the wings (figs 14, 18, 19, 20, 46, 58) of the Terebrantia, and the absence of both of these features in the Tubulifera (figs 10, 62, 84, 88, 103). A third character is also often used: the shape of the tenth abdominal segment. In the Terebrantia, this segment is broad and more or less conical (fig. 1), whereas, in the Tubulifera, it is tube-like, its sides being parallel to each other (fig. 2). In some genera, however, this character does not

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[1]Haliday, 1836; junior homonym of Terebrantia Latreille, 1817, from *terebrantes* (Hymenoptera) Latreille (1802).

[2]Haliday, 1836; junior homonym of Tubulifera (Hymenoptera) Latreille, 1809.

adequately conform to this distinction, the tubuliferan *Pygothrips*, for example, has a rounded terminal segment, while in some species of the terebrantian genus *Taeniothrips*, the same structure may be tube-like.

There has been much controversy regarding the classification at, and below, superfamily level. General classification has been treated by Karny (1921), Bagnall (1912), Hood (1955b) and Priesner (1949, 1960). A recent review by Schleiphake (1975) has classified the order according to Henning's theory of phylogenetic systematics.

The system accepted here is basically that of Stannard (1968) and of Jacot-Guillarmord (1970-1978) for the Terebrantia, although, for reasons of priority, Stannard's subfamily names Heliothripinae has been changed to Panchaetothripinae (Wilson, 1975) and Megathripinae to Idolothripinae (Mound, 1974).

The SUBORDER TEREBRANTIA is divided into three superfamilies. Of these, the Aeolothripoidea feature nine-segmented antennae (fig. 12, 13) , relatively broad wings (fig. 14) with rounded apices, a cylindrical body, a pronotum without dorsal sutures (fig. 16), a well developed, upturned ovipositor (fig. 8), and a mainly predatory feeding behaviour. Of this superfamily, only the family Aeolothripidae remains in the world fauna today. The other families have been described only from fossils. The family Aeolothripidae is well represented in Canada.

The superfamily Merothripoidea is distinguished by having

eight- to nine-segmented antennae, narrow wings with pointed ends and not covered with microtrichia, a pronotum with dorsal sutures, a weakly developed, upturned ovipositor, a depressed body, enlarged fore and hind femora, and a propensity to inhabit leaf litter and recently-dead wood. This superfamily comprises only one family, the Merothripidae which has representatives throughout the world including the United States. Since one species, *Merothrips morgani* Hood, is known from as close to Canada as the states of New York and New Jersey, it probably also occurs on the Canadian side of the border.

The third superfamily of the suborder, the Thripoidea, is the largest of the three. It includes species that occur mainly in grasses and flowers and on bushes. Its members are characterized by their six- to nine-segmented antennae (figs 17, 28-31, 40, 48, 49, 59, 60) narrow wings with acute apices (figs 18, 19, 20, 46, 58), a more or less flattened body, a pronotum without dorsal sutures (figs 21, 22, 23, 24, 25, 26, 32, 35, 36, 37, 39, 41, 42, 43, 44, 56, 57), and a well developed, downturned ovipositor (fig. 7). Two families are recognized in this superfamily; the larger, the Thripidae, containing most of the economically important Thysanoptera, and the smaller, the Heterothripidae, in which species are often host-specific. The Thripidae are well represented in Canada but only one species of Heterothripidae (*Heterothrips arisaemae* Hood) has been found thus far. It is possible that several other species of this family also occur in Canada as they are present in the New England and Great Lakes areas of

the United States and their host plants are to be found in Canada. The Thripidae are subdivided into three subfamilies, the Uzelothripinae, the Thripinae and the Panchaetothripinae. Only the latter two subfamilies are represented in Canada.

According to most authors, the SUBORDER TUBULIFERA comprises only one superfamily, the Phlaeothripoidea, represented by the single family, Phlaeothripidae. Its members usually have two-segmented maxillary palps, usually eight-segmented (figs 73, 82, 83), rarely four- to seven-segmented (fig. 105) antennae, sensory trichomes often present on segments III-VIII of the antennae (figs 82, 83), and abdominal terminal setae seldom longer than the terminal tube (fig. 62). The Phlaeothripidae are well represented in Canada, with 57 species recorded thus far. Members of this family have a wide range of habitats and hosts. The litter-dwelling Idolothripinae feed on fungal spores, while the Phlaeothripinae are either predatory, or flower- and leaf-dwelling, feeding on pollen (Grinfel'd, 1959) or on plant juices.

Bagnall (1908) had formally placed tubuliferan thrips with four- to seven-segmented antennae, the hind pair of coxae further apart than the other pairs and a distinct surface sculpturation, in a separate family, the Urothripidae. Hood (1912) further acknowledged the species having these characters by giving them the status of superfamily, i.e. the Urothripoidea. However, Hood (1929), while retaining this superfamily, gives less importance to the above-mentioned

diagnostic characteristics.

The genera originally placed in the Urothripidae which include *Trachythrips* (the only Canadian genus of the group) are now generally regarded as being part of the single family Phlaeothripidae. Compared with all Tubulifera, *Trachythrips* is quite distinct (see descriptions of genera herein), so that contrary to the classification of Stannard (1957, 1968), I have placed this genus in a separate subfamily, the Urothripinae, as did Priesner (1964). The classification of the subfamily Phlaeothripinae is drawn from Priesner (1964) and the classification of the subfamily Idolothripinae is based on Mound and Palmer's (1983) excellent review.

MORPHOLOGICAL CHARACTERS USED IN IDENTIFICATION

Coloration

Colours of thrips vary from almost white to dark brown, either unicolorous or in a combination of colours and shades. Some specimens have white markings on their bodies, while others have subhypodermal red or orange pigment. Furthermore, colour is of two basic types: opaque, visible by incident light, and transparent, visible by transmitted light.

Coloration can, in some instances, be used as a distinguishing character at the specific or subspecific level. However, because of the amount of variation in depth of colour one may find within a species, it should not be relied upon exclusively for the separation of species. Cott (1956) mentions that such variation can be determined by the type and amount of food available to the immature stages. Colour may also vary with sex within a species (Cott, 1956). In any event, the character is limited in its usefulness to certain groups which have been well studied and for which generalizations can be made, e.g., in Panchaetothripinae.

Surface Sculpturation and Microtrichia

This character is used at both generic and specific levels. Sculpturation may be of various forms, from weak, transverse striae to deep, anastomosing striations or strong, hexagonal reticulation. It may be restricted to a small area or it may

extend over almost the entire body. The heavy hexagonal reticulation of the Panchaetothripinae (fig. 21) alone readily distinguishes this group from other Terebrantia.

The body surface may or may not be covered with microtrichia (fig. 27) and this may be of taxonomic importance.

Setae

The presence, position, form and length of the setae are all useful in classification at and below the generic level. In Tubulifera, the apices of the setae can be sharply pointed (fig. 1), blunt (figs 75, 97), club-shaped (fig. 2) or dilated (figs 87, 75). In Terebrantia, nearly all bristles have pointed tips. In both suborders, setae can be very stout to very thin and range from being minute to very long. Many setae are named according to the area of the body upon which they are found; the respective names of the most important ones are mentioned in the sections below.

Antennae

The antennae can be from four- to nine-segmented however they are usually either seven- or eight-segmented. The type, shape and position of sensoria are diagnostic in the suborder Terebrantia (figs 12, 13, 17, 40, 48, 49, 59, 60). The type of sensoria (e.g. bands, cones or circumpolar areas) is characteristic of a family while the shape and position is of taxonomic importance at the generic and species level. In the Tubulifera the four- to six- segmented antenna distinguishes the subfamily Urothripinae (fig. 105) from the subfamily

Phlaeothripinae which have members with seven- to eight-segmented antennae (figs 73, 82, 83, 87).

Head

The compound eyes are usually many-facetted, although compared with most insects, the maximum number of facets is small. Relative to the size of the head the eyes are large, occupying from one quarter to one half of the head surface and usually they are more extensive on the dorsum than on the ventral side of the head. Sometimes they are reduced to less than ten facets (fig. 87), and they may occasionally be more extensive ventrally than dorsally (fig. 91).

There are three ocelli (at least in winged forms) which form a triangle between the compound eyes; the size and position of the ocellar setae are often distinguishing characters. Mound *et al.* (1976) have designated as "ocellar setae pair I" those anterior to the median ocellus, as "pair II" those placed lateral to the ocellar triangle, and as "pair III" those within the triangle or lateral to the posterior ocelli (figs 42, 44, 47, 50).

The position and size of the postocular setae are also important at the specific level as is the presence or absence of stout setae or tubercles on the cheeks (fig. 23). The margins of cheeks are usually parallel, but they may be diagnostically constricted in some genera (e.g., in *Heliothrips* fig. 21).

Maxillary stylets

In the Terebrantia the stylets are confined within the mouth cone and are difficult to see without painstaking dissection, but in the Tubulifera, they provide an important character at all levels of classification. For example, the members of the subfamily Idolothripinae have broad stylets (more than 5 microns in basal thickness, i.e., twice as wide as the bases of the postocular setae), adapted to ingestion of fungal spores (Mound *et al.*,1976), (figs 63, 65, 67, 69). On the other hand, members of the subfamily Phlaeothripinae have characteristically very slender stylets (2-3 microns in basal thickness, i.e., only about as wide as the bases of the postocular setae) (figs 75, 76, 77, 79, 85, 90, 96, 101, 102). The shape and position of the stylets are also characteristic at the generic and subgeneric level.

Prothorax

The main taxonomic feature of the prothorax in both suborders is the number, size and position of the pronotal setae (fig. 5). In the Terebrantia, pronotal setae vary between genera; the principal pairs of setae are the anteromarginals, the anteroangulars, the midlaterals, the epimerals, the posteroangulars, and the posteromarginals. These setae are reduced in numbers in the Tubulifera, in which the posteroangulars are more evident and often of taxonomic importance.

The prosternum bears two pairs of median sclerites, the praepectal plates or praepectus and the probasisterna (fig.

6). The praepectus is unique to the Phlaeothripidae. There is also another unpaired sternal sclerite posterior to the probasisterna, called the prospinasternum (fig. 6). It is generally small in the Phlaeothripidae but very large and broad in the Terebrantia.

Pterothorax

The pterothorax (mesothorax and the metathorax together) in thrips forms virtually a single unit. Its shape varies, depending particularly upon the presence or absence of wings. Its sculpturation is sometimes used as a taxonomic character. Some members of the Thripidae have a well developed endoskeletal furca, an endoskeletal apodeme. Such members of the group can jump actively.

The mesopraesternum is a sternal sclerite lying anterior to the principal sclerite of the mesosternum (fig. 6). It is absent in Terebrantia.

On the other hand, the mesospinasternum, a sclerite lying in the middle of the pterosternum, is present in Terebrantia but not in Tubulifera.

Wings

Wings may be fully, partially or not developed in the adults, i.e., macropterous (figs 1, 2, 46), brachypterous, micropterous, or apterous (figs 35, 87, 104). This is often of major taxonomic importance. Wing development can, however, sometimes be related to ecological factors within a species e.g. in *Hoplothrips germanae* (Bournier, 1961). In the

Terebrantia, colour, setae and venation of the fore wing are important in classification (figs 14, 18, 19, 20, 58). Members of the Phlaeothripidae virtually lack wing venation; the fore wing can be constricted medially with duplicated or accessory setae on the distal posterior margin (fig.88).

Legs

The legs of thrips are short, the tarsus being either unsegmented or having two segments. There is always, also, a well developed pretarsal apparatus, (or so-called "bladder" or "vesicle") (figs 15, 51) used for adherence to smooth surfaces. The fore tarsus and fore femur often bear denticulations and, in a few Thripidae, the pretarsal "bladder" bears a terminal tooth (fig.87). The posterior tibia bears on the apical half, a series of needle-like spines used by the insects for combing the wing setae and, where applicable, for grasping the substrate prior to jumping.

Abdomen

The abdomen is attached by a broad base to the pterothorax and tapers towards the posterior end. It is ten-segmented with the eleventh segment reduced to a minute sclerite (fig. 45). The tenth segment is in the form of a tube in the Phaleothripidae (fig. 2), and more or less bluntly rounded in the Terebrantia (fig. 1). Since tergites and sclerites completely cover the terga and sterna respectively (except for the tergite on abdominal segment I of the Tubulifera), authors use the terms tergite and sternite interchangeably with tergum

and sternum respectively.

Abdominal terga - In the Phlaeothripidae, the sclerite on tergum I is reduced to a shield-like plate called the pelta (figs 64, 68, 70, 72, 74, 78, 80, 81, 86, 89, 94, 95, 99, 100). On terga II to VII, there is a pair of sigmoid setae which hold the wings at rest (fig. 2). In the family Thripidae, the posterior margin of tergum VIII often bears a comb of ciliate or dentate setae or microtrichia (figs 45, 46, 54). Grass-feeding species of this family have the posterior margins of terga and sterna extended into a flange or craspeda (figs. 33). The number of setae on the lateral margins of tergum II separates certain species of the genus *Thrips* from each other.

Abdominal sterna - Marginal setae are sometimes set in front of the posterior margin of a sternum and an extra row of setae (accessory sternal setae) may lie in a transverse median row on the middle sterna (fig. 55).

The ovipositor of the Terebrantia is external and varies in orientation and curvature (figs 7, 8), while in the Phlaeothripidae, it is internal and females of this family can be distinguished by a rod-shaped structure, the fustis, situated at the base of the tubular abdominal apex (figs 10, 62).

Glandular areas vary in number and shape on the middle abdominal sterna of male Terebrantia (figs 9, 53). The glandular area in male Phlaeothripids is usually limited to sternite VIII; male Tubulifera also have the anterior sternal margin of the apical tube incised (fig. 11).

KEY TO THE CANADIAN GENERA OF THE ORDER THYSANOPTERA

This section includes a dichotomous key to the genera of the Thysanoptera. In addition, an alternative computer-compatible key for the suborder Tubulifera is given in Appendix 2. This latter key is intended for the non-specialist as well as the specialist for the quick preliminary identification of this difficult group.

Before presenting a key to genera, a synoptic diagnostic table of higher taxa of Thysanoptera, as they occur in Canada (Alaska and Greenland included), is given.

Diagnosis of Suborders, Superfamilies and Families of THYSANOPTERA.

Suborder Terebrantia

Last abdominal segment (X) usually conical in female, bluntly rounded in male, rarely tubelike, always divided ventrally, and frequently with a dorsal longitudinal slit (figs 1, 45); female always with sawlike ovipositor (figs 7, 8); major anal setae arising from subapical region of abdominal segment X, never from separate terminal platelets; wings covered with microscopic setae (figs 1, 18, 19, 20, 58); fore wings with longitudinal veins and sometimes cross-veins and with a distinct chaetotaxy.

Superfamily Aeolothripidae

Ovipositor well developed, curved upwards when retracted (fig. 8); pronotum without dorsal sutures (fig. 16); wings broad, rounded at apices (fig. 14), covered with microtrichia; body cylindrical; antennae nine-segmented (figs 12, 13); fore and hind femora not enlarged; feeding behaviour mainly predatory (a single family is now present in the world as all others are from fossils records).

Family Aeolothripidae

Antennae nine-segmented with longitudinal sensoria on segments III and IV (figs 12, 13); maxillary palps three-segmented; labial palps four-segmented; base of fore tarsus armed with cocoon breaking hooks (fig. 15); larvae predacious.

Superfamily Merothripoidea

Ovipositor weakly developed, turned upwards when retracted; pronotum with dorsal sutures; wings narrow with pointed apices and not coated with microtrichia; body depressed, not cylindrical; antennae eight- to nine-segmented; fore and hind femora enlarged; inhabit leaf litter and dead wood, feeding on decaying matter; a single family is involved, the Merothripidae.

Family Merothripidae

Antennae eight-segmented, with large circular sensoria on segments III and IV; unsegmented style; fore tarsi unarmed basally; larvae usually mycophagous; not presently known from Canada but occur in bordering regions of the United States of America[1].

Superfamily Thripoidea

Ovipositor well developed, curved downward, when retracted (fig.7); pronotum without dorsal sutures (figs 1, 21, 22, 23, 24, 25, 26, 32, 35, 36, 37, 39, 41, 42, 43, 44, 56, 57); wings narrow, with pointed apices and covered with microtrichia (figs 1, 18, 19, 20, 46, 58); body often depressed, rarely cylindrical; antennae six to eight (figs 17, 28, 29, 30, 31, 40, 48, 49, 59, 60) and sometimes nine segmented; mainly phytophagous, found on grasses and flowers. Two families are involved, The Thripidae and the Heterothripidae.

Family Thripidae

Antennae six- to eight- sometimes nine-segmented; usually with two-, three- or unsegmented terminal style; antennal segments III and IV each usually with a sense cone (figs 40, 48, 49, 59, 60); fore tarsi unarmed; larvae usually phytophagous.

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[1]Therefore not included in key to genera.

Family Heterothripidae

Antennae nine-segmented; with circumpolar sensory areas at apex of antennal segment III and IV, sensoria featuring numerous dots (fig. 17); fore tarsi with cocoon-breaking spurs; larvae usually phytophagous; only one species, *Heterothrips arisaemae* is found in Canada[2].

Suborder Tubulifera

Last abdominal segment (X) in both sexes usually tubelike, undivided longitudinally, ventrally or dorsally; female without sawlike ovipositor; major anal setae arising from platelets attached to end of tube (figs 10, 11, 62); wings without microscopic setae (figs 2, 84, 88, 103); fore wings virtually without longitudinal veins and without a distinct chaetotaxy; a single superfamily and one family only are involved.

Superfamily Phlaeothripoidea

Maxillary palps usually two-segmented; antennae eight- and rarely four- to seven-segmented, with sense cones on segments III-VII; setae on posterior margin of tube seldom longer than

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[2]The circumpolar sensory areas on antennal segments III and IV can readily identify this genus, therefore *Heterothrips* was not added to the key to genera.

this segment.

Family Phlaeothripidae

Antennae four- to eight-segmented; usually with an unsegmented style; sensoria, when present setae-like on intermediate segments; fore tarsi unsegmented, each mid and hind pair unsegmented or two-segmented; fore tarsi unarmed basally but can bear teeth near apex.

Key to the Subfamilies and Genera of the TEREBRANTIA

Superfamily Aeolothripoidea

Family Aeolothripidae

Subfamily Aeolothripinae

1-All segments of antennae freely movable and diminishing in size gradually toward the tip; maxillary palps with seven segments; wings with bands .....*Orothrips*

Last four segments of antennae closely united and together shorter or a little longer than the fifth; maxillary palps with three segments; wings with or without bands ..2

2-Pronotum with a pair of elongate posteroangular setae; antennal segments VII-IX closely united .....

..... *Rhipidothrips*

Pronotum without prominent posteroangular setae; antennal segments V-IX closely united .....*Aeolothrips*

Superfamily Thripoidea

Family Thripidae

1-Fore vein, as indicated by setae, of forewing fused to costa in apical two-thirds (figs 18, 19, 20); antennal segments III and IV usually strongly vasiform and terminal segment of style extremely long; macropterous; head with distinct reticulations (fig. 21, 22) .....
.....2 (Subfamily Panchaetothripinae)

Fore vein of fore wing not fused to costa (fig. 58), or wings reduced to pads or wingless; intermediate antennal segments not usually strongly vasiform, terminal segment of style not extremely long; head smooth, weak to strongly striated .....5 (Subfamily Thripinae)

2-Fore wing with three complete rows of stout setae (fig. 19); tarsi two-segmented; internal furca of metathorax large and Y-shaped ..... *Hercinothrips*

Fore wing with only a few setae on first vein, or setae very reduced in size; tarsi unsegmented; internal furca of metathorax small, not extending to meso-metathoracic suture 3

3-Antennae seven-segmented; fore wings unusually broad; wing membrane with reticulate pattern; cilia absent on costa (fig. 18) ..... *Parthenothrips*

Antennae eight-segmented; fore wings slender; cilia present on costa (fig. 20) 4

4-Fore wing with fringe cilia predominantly wavy .....*Caliothrips*

Fore wing with fringe cilia straight (fig. 20)

.....*Heliothrips*

5-Internal furca of metathorax lyre-shaped extending to mesothoracic furca; abdominal terga with a pair of major setae close together medially; leaf feeding species mainly on trees and shrubs or in glasshouses; tarsi unsegmented; fore wing fringe cilia straight (tribe Dendrothripini) 6

Metathoracic furca not lyre-shaped, small, rarely extending to mesothoracic furca, then only as a slender spinula; abdominal terga rarely with a pair of major setae close together medially 7

6-General colour brown; prothorax without well-developed posterior setae (fig. 23) .....*Dendrothrips*

General colour pale to nearly white; prothorax with well-developed posterior setae .....*Leucothrips*

7-Surface of abdomen with numerous microsetae (at least 2/3 of terga covered with about 8 rows of microtrichia .....8 (tribe Sericothripini)

Abdomen without numerous microtrichia or microtrichia extremely short .....10 (Tribe Thripini)

8-Sense cones on antennal segments III and IV simple .....*Echinothrips*

Sense cones on antennal segments III and IV forked 9

9-Both sexes dark brown; fore vein or fore wing regularly set with setae; macropterous and micropterous; microtrichia covering entire terga (fig. 27); on Leguminosae ....*Sericothrips*

Pale thrips; fore vein of fore wing with interrupted row of setae; always macropterous; microtrichia only on lateral sides of terga; in glasshouses in Canada .....
.....*Scirtothrips*

10-Either both sexes with pronotum trapezoidal, much wider posteriorly than anteriorly, with small head (fig. 26); or female with a pair of stout thorn-like setae on tergum X and male with a pair of stout setae basally on tergum IX (fig. 34); antennal segments II or III greatly or slightly produced at outer apex (figs 28, 29, 30); on grasses
.....11

Neither sex with pronotum trapezoidal nor female with a pair of stout thorn-like setae on tergum X, nor male with stout setae basally on tergum IX; antennal segments II or III never prolonged at outer apex 12

11-Prothorax trapezoidal with two pairs of major posteroangular setae (fig. 26); head small; fore femur stocky; antennal segment II produced at outer apex; female without thorn-like setae on abdominal tergum X .....*Chirothrips*

Prothorax not trapezoidal with one pair of major posteroangular setae; head as large as pronotum; tergum X of female with a pair of stout thorn-like setae; male apterous with a pair of stout setae on large quadrate bases medially on tergum X (fig. 34) .....*Limothrips*

12-Prothorax with all major setae extremely long, including the midlateral pair .....*Scolothrips*

Prothorax with shorter major setae; if long, the midlateral pair is always short 13

13-Antennae six-segmented .....*Aptinothrips* (in part)

Antennae seven-, eight- or nine-segmented 14

14-Antennae seven-segmented 15

Antennae eight- or nine-segmented 17

15-Maxillary palps each two-segmented .....*Baliothrips*

Maxillary palps each three segmented 16

16-Head oval-shaped; male without ocelli and apterous

..... *Toxonothrips*

Head square-shaped; male macropterous or micropterous with ocelli present .....*Thrips* (in part)

17-Antennae each nine-segmented or partially nine-segmented (i.e. segment VI having a partial suture) 18

Antennae each eight-segmented 19

18-Pronotum with one pair of well developed epimeral setae (figs 37); abdominal tergum VIII without posterior comb of setae ..... *Oxythrips*

Pronotum without well developed setae; abdominal tergum VIII with complete posterior comb of setae .....

..... *Anaphothrips* (in part)

19-Fore tibia with 1 or 2 claws at apex (fig. 51) .....

.....*Odontothrips*

Fore tibia without claws at apex 20

20-Abdomen with strong hexagonal reticulation (fig. 46)

.....*Ctenothrips*

Abdomen without strong hexagonal reticulation 21

21-Pronotum without any long setae 22

Pronotum with well developed setae, either the posteroangular setae long or both these and the

anteromarginal setae long 25

22-Always apterous 23

Macropterous, brachypterous or apterous 24

23-Dark brown abdomen wider than thorax, head wider than long; terga and sterna with a marginal row of teeth (fig. 33); on grasses .....*Apterothrips*

Usually yellow; elongate, slender abdomen scarcely wider than thorax, head longer than wide; terga and sterna without row of teeth marginally; various hosts ..*Aptinothrips*

24-Antennal segments VII and VIII more than three quarters times as long as segment VI; always macropterous; on *Galium* ....*Belothrips*

Antennal segments VII and VIII less than half as long as segment VI (fig. 31); sometimes apterous; various hosts ..... *Anaphothrips* (in part)

25-Antennal segment IV with simple sense cones .....

.....*Iridothrips*

Antennal segment IV with forked sense cones 26

26-Pronotum with anteromarginal and posterioangular setae (fig. 44) .....*Franklinella*

Pronotum with only the posteroangular setae well developed 27

27-Pronotum with one pair of posteroangular setae well developed 28

Pronotum with two pairs of posteroangular setae well developed 30

28-Mouth cone stout and long (fig. 36) ....*Chilothrips*

Mouth shorter 29

29-Ocellar setae pair I present i.e. three pairs of ocellar setae developed (fig. 37); body light brown; abdominal setae slender; both sexes macropterous ...*Oxythrips* (in part)
Ocellar setae pair I absent, i.e. only 2 pairs of ocellar setae developed (fig. 39); cheeks rounded and swollen; abdomen dark and broad, terminal setae on tergum IX stout; male and frequently female, micropterous; on grasses .....*Tmetothrips*

30-Head with two pairs of ocellar setae (figs 41, 56, 57) 31
Head with three pairs of ocellar setae (figs 42, 47) 34

31-Abdominal tergum VIII without posterior comb of setae; veins of fore wings with few setae, fringe cilia weakly wavy or not at all .....*Catinathrips*
Abdominal tergum VIII with posterior comb of setae; veins of fore wings with many setae, at least on hind vein; fringe cilia always distinctly wavy 32

32-Ctenidia or comb-like setae laterally on abdominal terga V-VIII, on tergum VIII passing close to the spiracle; sterna with or without accessory setae (fig. 55); ocellar setae pair III (figs 56, 57) and comb of cilia on terga VIII short ..... *Thrips* (in part)
Ctenidia absent on lateral portions of terga except for an irregular group of setae near the spiracles on abdominal terga VIII; sterna without accessory setae; ocellar setae pair III much longer than distance between two ocelli; comb on terga VIII very long (fig. 54) 33

33-Males with large, circular and oval glandular areas on abdominal sterna .....*Taeniothrips*

Males with abdominal sterna each with numerous small circular glandular areas (fig. 53) .....*Pezothrips*

34-Pronotum with two pairs of posteromarginal setae; tergum VIII with complete row of microsetae on posterior margin; terga III-VII with microsetae on posterior lateral margin; metathoracic furca with an apical prolongation .....*Mycterothrips*

Pronotum with more than two pairs of posteromarginal setae; tergum VIII with row of microsetae absent or interrupted medially; terga III-VII without microsetae on lateral portion of posterior margin; metathoracic furca without an apical prolongation .....*Ceratothrips*

Key to the Subfamilies and Genera of the TUBULIFERA

Superfamily Phlaeothripoidea

Family Phlaeothripidae

1-Maxillary stylets broad and band-like, more than 5 microns wide throughout their length, i.e. stylets twice as wide as bases of postocular setae (figs 63, 65, 67, 69); males with lateral pair of posterior setae on abdominal tergum IX as long as in females; species feeding on fungal spores .....2 (subfamily Idolothripinae)

Maxillary stylets slender, 2-3 microns wide, i.e. about as

wide as the bases of postocular setae (figs 75, 76, 77, 79, 85, 90, 91, 96, 101, 102, (the stylets should not be confused with the maxillary pillars which are sometimes stout, fig. 4); males with lateral pair of posterior setae on abdominal tergum IX short and spinelike (fig. 11) 7

2-Eyes posteriorly prolonged on to ventral surface of head (fig. 63) 3

Eyes normal, without ventral prolongation 4

3-Ant-like in appearance; pterothorax narrowest portion of body (fig. 66); metanotum raised, generally with striae arranged as concentric, anastomosing rings (fig. 66); dorsal surface of first abdominal segment chalky white; maxillary stylets parallel within head ..... *Compsothrips*

Not ant-like in appearance; pterothorax nearly as wide or wider than abdomen; metanotum not noticeably raised, with striae usually linear or hexagonal in form; first abdominal segment concolorous with abdominal segment II; maxillary stylets wide apart and arranged in a V-shaped (fig. 63) .....*Bolothrips*

4-Tube (abdominal segment X) hairy, epimeral sutures incomplete (fig. 69) 5

Tube smooth, epimeral sutures complete (figs 65, 67) 6

5-Anterolateral setae of pronotum displaced away from anterior margin toward the midlateral setae; maxillary stylets widely

spaced in centre of head .....*Megathrips*

Anterolateral setae close to anterior margin; maxillary stylets touching, or nearly touching, in centre of head .....*Megalothrips*

6-Maxillary stylets retracted far into head, usually touching, or nearly touching, in its center (fig 65) .....

.....*Cryptothrips*

Maxillary stylets retracted about halfway into head, forming a V within it (fig. 67) .....*Elaphrothrips*

7-Always apterous; hind coxae farther apart than are the middle coxae; antennae five- or six-segmented (fig. 105) (subfamily Urothripinae) .....*Trachythrips*

Macropterous to apterous; hind coxae closer together than are middle coxae; antennae seven- or eight-segmented (subfamily Phlaeothripinae) 8

8-Macropterous or micropterous; mouth cone pointed, exceptionally long and slender, extending posteriorly to mesosternum (fig. 102); pronotum and margins of head and abdomen with chalky white markings; on dead tree branches .....*Poecilothrips*

Macropterous to apterous; mouth cone frequently rounded at apex, when pointed, not extending to beyond two-thirds of length of prosternum; body without chalky white markings 9

9-Usually macropterous, fore wings constricted medially, with duplicated cilia present on distal posterior margin; fore legs with two inner subapical femoral spurs and one inner subbasal tibial spur 10

Commonly apterous or micropterous or macropterous; fore wings not constricted medially but broad and parallel-sided (fig.88), duplicated cilia often absent; fore legs with femora unarmed 13

10-Antennal segment III without or with 1 or 2 sense cones; prosternal praepectus present; maxillary bridge present (figs 79, 85), maxillary stylets not usually close together in middle of head; fore femur without tubercles; (mainly in flowers, sometimes on leaves of trees or on dead wood) 11

Antennal segment III with 3 sense cones (fig. 73) prosternal praepectus absent; maxillary bridge absent, maxillary stylets close together or touching in middle of head (fig. 75); fore femur frequently with 1 or 2 tubercles near apex (not found on flowers, sometimes on leaves of trees, on dead wood and other decaying material) 12

11-Eyes prolonged posteriorly on ventral surface of head more than on dorsal surface (fig. 91); metanotum strongly longitudinally striated (fig. 93) .....*Leptothrips*

Eyes not prolonged posteriorly more on ventral surface than on dorsal surface of head (figs 79, 85); metanotum weakly sculptured to smooth .....*Haplothrips*

12-Antennal segments III and IV with constricted apical "necks" (fig. 73); fore femur with a stout tooth near inner apex; basal pair of cheek setae not proportionately stouter than others .....*Acanthothrips*

Antennal segments III and IV lacking apical "necks"; fore femura with two inner subapical femoral spurs; basal pair of

cheek setae often stouter than others .....
.....*Hoplandrothrips* (in part)

13-Antennal segment III extremely small, decidedly smaller than either segment II or IV .....*Lissothrips*

Antennal segment III only slightly smaller (nearly equal to) or longer than segment IV 14

14- Eyes prolonged ventrally more than dorsally .....
.....*Cephalothrips*

Eyes not prolonged ventrally more than dorsally ...15

15-Wings fully formed, fore wings with distinct hexagonal reticulation on upper surface (fig. 103) .*Stictothrips*

Wings sometimes reduced, if fully formed, fore wings without hexagonal reticulation, occasionally marked with short linelike sculpture but this not forming geometric designs
.....16

16-Antennal segment III without sense cones ..*Lispothrips*

Antennal segment III with at least one sense cone
.....17

17-Antennal segment III with 1 sense cone, (feeding on living tissues of Angiosperms, some forming galls) 18

Antennal segment III with 2 or 3 sense cones, (feeding on fungal hyphae on dead wood) 20

18-Sculpture complex and well developed over entire pronotum, forming oval spots posteriorly; only epimeral setae more than twice as long as discal setae; head with hexagonal reticulations and epimeral suture incomplete
.....*Gynaikothrips*

Pronotal sculpture weak medially, all 5 pairs of major setae

elongate; head with transverse striations; epimeral sutures complete 19

19-Fore wings, when fully developed, long, five times length of head, with accessory fringe cilia; head about as long as wide; forms with reduced wings with short wing stubs .....*Liothrips*

Fore wings, when fully developed, no more than two and a half times length of head, without accessory fringe cilia; head longer than wide; forms with more greatly reduced wings, micropterous, with wing stubs barely as long as length of head .....*Gnophothrips*

20-Always apterous; antennal segment III with 2 sense cones; head much longer than wide, major posterior setae on abdominal tergum IX blunt ...*Hoplandrothrips tumiceps*

Macropterous to apterous; antennal segment III with 3 sense cones; head about as long as wide; major posterior setae on abdominal tergum IX pointed .....*Hoplothrips*

DESCRIPTIONS OF THE GENERA OF CANADIAN THYSANOPTERA

Suborder Terebrantia

Superfamily Aeolothripoidea

Family Aeolothripidae

Subfamily Aeolothripinae

Orothrips Moulton

Orothrips Moulton, 1907:45.

Type species: *Orothrips kelloggii* Moulton, 1907:45.

Head wider than long; ocelli present in both sexes; antennae nine-segmented, segments all freely movable and diminishing in size gradually to a pointed tip, segments III and IV each with two circular to linear sensory areas (fig. 12); maxillary palps seven-segmented; labial palps five-segmented.

Prothorax about one third wider than long with strong posterior setae; legs long and slender except for fore femur which is enlarged, all tibiae armed; wings with dark cross bands, broader in distal third, narrower near base, veins set with stout setae.

Abdomen spindle shaped, tapering abruptly from segment V to tip; abdominal tergum X without longitudinal split; ovipositor upturned; male smaller than female; male with abdomen slender, first segment much longer than second; male terminal segments

without claspers or thornlike bristles.

Aeolothrips Haliday

Aeolothrips Haliday, 1836:451

Type species: *Aeolothrips albicincta* Haliday, 1836:451, by monotypy.

Head as wide as or wider than long; eyes with ventral prolongation; ocelli present; antennae eight-segmented, terminal segments closely united, segments III and IV usually longer than others, segments longer in male than in female, antennal sensoria oval to linear on segments III and IV (fig. 13); maxillary palps three-segmented; labial palps four-segmented.

Pronotum with all setae short; mesospinasternum separated from metascutum by a complete suture; tarsi two-segmented, fore tarsi with cocoon-breaking hooks (fig. 15); macropterous or brachypterous; fore wings broad, with two complete longitudinal veins and several crossveins (fig. 14); fringe cilia straight.

Abdomen constricted at anterior end; abdominal terga with median pair of setae spaced far apart; sterna with a few accessory setae laterally; tergum VIII without a posterior comb of setae; females with a well developed upturned ovipositor (fig. 8); males with two longitudinal ridges on tergum I, without sternal glandular areas, with or without genital claspers; males smaller than females; females about 2 mm in length.

Aeolothrips occupy a variety of habitats: on deciduous and coniferous trees, on flowering plants, in grasses; species, both as larvae and adults, are primarily predacious on other insects such as thrips, aphids, mites.

Rhipidothrips Uzel

Rhipidothrips Uzel, 1895:66.

Type species: *Rhipidothrips gratiosa* Uzel, 1895:67, by monotypy.

Head slightly longer than wide (fig. 16); eyes prolonged ventrally; ocelli present; antennae nine segmented, with lens-shaped sensoria at ventral apex of antennal segment III and IV at times completely circling the segment, terminal antennal segments fused; maxillary palps three-segmented; labial palps four-segmented.

Prothorax wider than long, with a lateral ridge from the anterior to the posterior end of the pronotum (fig. 16); one pair of major posteroangular setae; fore wings with two longitudinal veins set with regularly spaced setae and without cross bands.

Abdomen broadly joined to thorax, tapering sharply at posterior end; upturned ovipositor; male, smaller than female, terminal segments of male without claspers, heavy spines or chitinized projections.

Superfamily Thripoidea

Family Heterothripidae Bagnall

Heterothrips Hood

Heterothrips Hood, 1908a:361.

Type species: *Heterothrips arisaemae* Hood, 1908:362, by monotypy.

Head wider than long; fore ocellus smaller than other two; antennae nine-segmented, segment III with two white subbasal rings giving the appearance of a two-jointed petiole, segments III and IV with a band of circular sensoria encircling apex (fig. 17), segments V-VIII each with one or two slender sense cones; maxillary palps three-segmented; labial palps two-segmented.

Prothorax with only short setae; mesospinasternum separated from metasternum by a broad suture; metascutum with ring-like striations; tarsi two-segmented, fore tarsi each with cocoon-breaking hooks, fore femora large; fore wings broad basally, narrow in apical three fourths, with setae unifromly set on two longitudinal veins and costa set with stout spines; fringe cilia usually straight, rarely wavy.

Abdomen covered almost entirely with minute setae and without distinct pleural plates; many setae on posterior margin of the segments, which sometimes fuse at base into plates on intermediate segments; median pair of tergal setae placed close together on the intermediate segments; females with well developed downturned ovipositor; males usually with

sternal glandular areas and sometimes with long and thin projections on tergum X.

This genus is intermediate in structure between the primitive Aeolothripidae and the more advanced Thripidae. It has nine-segmented antennae and cocoon-breaking hooks like the Aeolothripidae and the reduced narrow wings and downturned ovipositor of the Thripidae. Furthermore, Heterothrips is phytophagous rather than predaceous; many species of this genus are host specific.

Family Thripidae

Subfamily Panchaetothripinae Bagnall

Caliothrips Daniel

Caliothrips Daniel, 1904:296.

Type-species: *Caliothrips woodworthi* Daniel, 1904:297, by monotypy.

Head, much broader than long, vertex slightly prolonged in front of eyes (fig. 22), without a deep constriction basally; ocelli on raised area betwee eyes; antennae eight-segmented, segment III globular, segment VIII two to two and one half times as long as segment VII, segments III and IV with forked sense cones; maxillary palps two-segmented, with segments II and III partly fused.

Prothorax hexagonally reticulate, without particularly long

posteroangular setae (fig. 7); metathorax smooth; mesospinasternum partly fused to metasternum; tarsi unsegmented; hind coxae closely spaced; fore wings with pointed tip with a row of stout setae and a row of slender setae along the leading edge.

Abdomen with fused comblike plates on the lateral posterior margin of each tergum; males with glandular areas medially on sterna III-VII and with stout bristles on terminal terga; body black or dark brown with reticulation.

Caliothrips fasciatus, the bean thrips is found frequently in the western part of North America and only occasionally in the eastern regions.

Heliothrips Haliday

Heliothrips Haliday, 1836:443.

Type species: *Heliothrips adonidum* Haliday, 1836:443.

Head with hexagonal reticulations, constricted at base (fig. 21); eyes large; ocelli on slightly raised vertex; antennae eight-segmented, segment III elongate, VIII four times as long as VII, both of them forming the style, sense cones on segments III and IV simple; mouth cone broad; maxillary palps two-segmented.

Prothorax, wider than long, reticulate like the head, with no long setae; metathorax with reticulations forming a distinct V-shaped area; mesospinasternum fused to metasternum; tarsi unsegmented; always macropterous, fore wings pale, broad at base, with irregularly set minute setae, fore vein fused to costa in apical two-thirds (fig. 20), leading edge without setae; fringe cilia straight.

Abdominal terga mainly reticulate laterally; median pair of setae close together; sterna without accessory setae, marginal setae placed forward of posterior margin; tergum VIII with a complete comb of setae; females with well developed downturned ovipositor, tergum X split longitudinally; males with transversely elongate glandular areas, one on each sternum III-VII and with four thornlike setae on tergum IX.

This genus comprises only two species, one found only in South Africa, the other spread throughout the world and highly polyphagous; this latter species, *H. haemorrhoidalis*, occurs in glasshouses in temperate regions.

Hercinothrips Bagnall

Hercinothrips Bagnall, 1932:506.

Type species: *Heliothrips bicinctus* Bagnall, 1932:506.

Head wider than long, constricted at neck, with hexagonal reticulation on dorsum; ocelli on raised portion of vertex; antennae eight-segmented, segment III elongate, segment VIII three times as long as VII, forming a long pointed two segmented style; sensoria on segments III and IV forked; maxillary palps two-segmented.

Pronotum shorter than head, and with hexagonal reticulation; reticulation on metathorax not forming V-shaped area, with internal furca large and Y-shaped; tarsi two-segmented; metaspinasternum fused to the metasternum; fore wing almost pointed at tip, with a row of stout setae on leading edge, and stout setae regularly set on two longitudinal veins (fig. 19);

fringe cilia predominantly wavy.

Abdomen with fine hexagonal reticulation; female with well developed downturned ovipositor; males with three pairs of strong setae on tergum IX; male smaller than female.

One species is found in Canada, *H. femoralis*; this dark coloured species is found only in glasshouses.

Parthenothrips Uzel

Parthenothrips Uzel, 1895:170.

Type species: *Heliothrips dracaenae* Heeger, 1854:365, by monotypy.

Head square-shaped, with a pronounced constriction at base, and with strong hexagonal reticulation on dorsum; eyes large, protruding; antennae seven-segmented, III-VII thin and long, VII needle-like, sense cones on II and IV simple; mouth cone broad; maxillary palps two-segmented.

Prothorax hexagonally reticulate with broad explanate setae, anteromarginal and posterolateral pairs the longest; meso- and metascutum reticulate, metascutum with a raised V-shaped area; mesospinasternum fused to metasternum; tarsi unsegmented; macropterous; fore wings broad, indented close to the middle, reticulate, setae on veins broad, without cilia on costa, leading edge with minute or no setae (fig. 18); fringe cilia wavy on hind margin.

Abdominal tergum I with a deep median line, possibly a precursor of the pelta of the Tubulifera; terga with weak hexagonal reticulation on the anteromedian and lateral

regions; tergum VIII with a lamellate posterior border, without comb of setae; female with tergum X split; males with a round to oval glandular area on each of sterna IV-VII.

This genus comprises one dark coloured species, *P. dracaenae*, found in glasshouses in temperate regions.

Subfamily Thripinae

Dendrothrips Uzel

Dendrothrips Uzel, 1895:159.

Type species: *Dendrothrips ornatus* Jablonowski, 1894:94.

Head much wider than long; eyes proportionately large; ocelli widely spaced (fig. 23); antennae eight- or nine-segmented depending on a partial or complete suture of segment VI; segment III and IV with simple sense cones, sense cone on VI near middle of segment; maxillary and labial palps two-segmented.

Prothorax with transverse striations and no major setae (fig. 23); mesospinasternum fused to metasternum; metathoracic furcae lyre shaped, extending to mesothoracic furca; tarsi unsegmented; fore wing with anterior margin curved downward at apex to join posterior margin, and with cilia arising below anterior margin; fringe cilia straight.

Abdominal terga with hexagonal reticulation laterally, with median setae set close together on intermediate terga; pleural plates present; tergum VIII with a posterior comb of setae; female with a well developed downturned ovipositor; males

without glandular areas and without major setae on terminal terga; female brown, pale yellow or white, with brown markings, male smaller than female and pale.

This genus is represented by phytophagous species on, e.g. *Ligustrum* sp., *Fraxinus* sp., *Tilia* sp..

Leucothrips O.M. Reuter

Leucothrips O.M. Reuter, 1904:107.

Type species: *Leucothrips nigripennis* O.M. Reuter, 1904:107, by monotypy.

Head much wider than long (fig. 24); eyes bulging; ocelli present; antennae seven-segmented, segment III and IV with simple sense cones; maxillary palps two-segmented; labial palps two-segmented.

Pronotum expanded submedially into a transverse ridge (fig. 24); posterior pronotal setae well developed; mesospinasternum fused to metasternum; metafurcae enlarged; tarsi unsegmented; fore femora small; fore wings narrow with a few setae set basally and apically on one longitudinal vein; fringe cilia straight.

Abdomen without microsetae except on terminal segments; pleural plates difficult to see; abdominal sterna without accessory setae; females with a downturned ovipositor; males without abdominal projections other than setae.

Sericothrips Haliday, 1836:444.

Type species: *Sericothrips staphyinus* Haliday, 1836:444.

Name *staphyinus* corrected to *staphylinus* by Burmeister, 1838.

Head wider than long (fig. 25); eyes bulged; ocelli on slightly raised vertex; interocellar setae short; antennae eight segmented, III and IV with forked sense cones, segment VI with or without a pedicel; mouth cone pointed and brown at tip; maxillary palps three-segmented.

Prothorax wider than long, one pair of long posteroangular setae (fig. 14); pronotum with transverse striations or with hexagonal reticulation; mesospinasternum separated from metasternum by suture; tarsi two-segmented; fore wings narrow with regularly set setae on fore vein and with several or no setae at apex of hind vein; fringe cilia wavy.

Abdominal segments I-VIII with dense microsetae laterally (fig. 27); terga VII, VIII and sometimes IX with a comb of setae on posterior margin; sterna without accessory setae except for microsetae, terga with median pair of setae close together; females with well developed downturned ovipositor; males with small, round glandular areas, on sterna IV-VII, V-VII, or VII only, or absent, without stout setae on tergum IX.

Scirtothrips Shull

Scirtothrips Shull, 1909:222.

Type species: *Scirtothrips ruthveni* Shull, 1909:222, by monotypy.

Head wider than long, not prolonged in front of eyes; ocelli

present; head setae short; antennae eight-segmented, segments III and IV with forked sense cones; mouth cone of moderate size; maxillary palps three-segmented.

Pronotum with transverse striae and blotched regions, with one pair of long posteroangular setae; mesispinasternum separated from metasternum by suture; tarsi two segmented; fore wings narrow with two longitudinal veins, interrupted setae on fore vein, only apical setae on hind vein; fringe cilia wavy.

Abdominal segments I-VIII covered with many microsetae laterally; abdominal sterna II-VII with major setae along posterior margin, but without accessory setae besides microsetae; abdominal terga with median pair of setae closely spaced together; tergum VIII with a complete comb of posterior setae; female with well developed ovipositor; males apparently with glandular areas absent on abdominal sterna and without thornlike setae on abdominal sterna and without thornlike setae on abdominal tergum IX.

Chirothrips Haliday

Thrips subgenus *Chirothrips* Haliday, 1836:444.

Type species: *Thrips (Chirothrips) manicata* Haliday, 1836:444. Raised to generic rank by Amyot and Audinet Serville, 1843.

Head longer than wide, prolonged slightly to considerably beyond eyes, eyes large (fig. 26); ocelli on posterior half of head in females, absent in males; antennae with eight

segments, segment I greatly enlarged in some species, segment II with a projection on outer apex (fig. 28), sense cones on segments II and III forked or simple, two-segmented style; maxillary palps three segmented; labial palps two-segmented.

Prothorax trapezoidal (fig. 26), with posteroangular setae well developed; mesospinasternum separated from metascutum by a wide suture; fore legs swollen; tarsi two-segmented; females macropterous, males apterous or brachypterous; fore wings with two veins, set irregularly with setae; fringe cilia wavy.

Abdomen with pleural plates; terga and sterna bare; terga without posterior combs of setae, abdominal sterna without accessory setae besides the regular posterior marginal ones; middle pair of setae far apart on the intermediate abdominal terga; complete longitudinal split on tergum X of female; males with or without sternal glandular areas.

Members of this genus can be easily distinguished by their small head, trapezoidal prothorax, the produced apex of antennal segment II and the enlarged fore legs.

Chirothrips is a grass-inhabiting genus of more than 50 species; some of the species have a wide range, i.e. *mexicanus* which is found from Guadalajara, Mexico to Canada, as well as down to South America, Hawaii and the Philippines, and *falsus* which occurs from Mexico to Canada.

Limothrips Haliday

Thrips subgenus *Limothrips* Haliday, 1836:444.

Type species: *Thrips (Limothrips) cerealium* Haliday, 1836:445. Raised to full generic rank by Amyot and Audinet Serville, 1843.

Head longer than wide prolonged in front of eyes in a triangular projection; ocelli present in macropterous forms, absent in apterous forms; antennae eight-segmented, segment III sometimes slightly or greatly produced at outer apex (fig. 29-30), sense cones on antennal segments III and IV simple or forked; maxillary palps two-segmented.

Prothorax with one pair of well developed setae on posterior angles; mesospinasternum separated from metasternum by a wide suture; tarsi two-segmented; females macropterous, males apterous; setae on fore vein interrupted, regularly set on posterior vein; fringe cilia wavy.

Abdominal terga with median setae far part; sterna with accessory setae; tergum VIII without a posterior comb of setae; female with a well-developed ovipositor, with a pair of thornlike setae on tergum X; males with or without small, circular, glandular areas on abdominal sternums III-VII, setae on terga IX, small but thornlike (fig. 34) and segments IX and X forming a large semicircular unit; male is smaller than female.

There are five species in genus found only on grasses; it is distinguished from closely related species by the paired thornlike setae on abdominal tergum X found in the female; two

species occur in Canada, *consimils* and *denticornis*.

Anaphothrips Uzel

Anaphothrips Uzel, 1895:142.

Type species: *Anaphothrips virgo* Uzel, 1895:142.

Head nearly as long as wide (fig. 32); ocelli present in macropterous and brachypterous forms, absent in apterous forms; antennae eight- (fig. 31) or nine-segmented, depending on a partial or total split of segment VI, segment III with a forked or single sense cone, segment IV always with a forked sense cone; maxillary palps three-segmented.

Prothorax smooth, without long setae (fig. 32); mesospinasternum separated from metasternum by wide suture; metascutum with hexagonal reticulation; tarsi two-segmented; macropterous, brachypterous, or apterous; fore wings with both veins bearing short weak setae, setae irregularly spaced on fore vein; fringe cilia wavy.

Abdomen with pleural plates; terga and sterna devoid of dense microsetae; abdominal sterna without accessory setae, only posterior marginal setae present; median pair of setae placed closer together than their length on the intermediate terga; tergum VIII with a complete posterior comb of setae; females with median setae placed forward of margin of sternum VIII; males with this pair of setae on hind margin of sternum VIII; males with U-shaped glandular areas on sterna III-VII and with four thorn-like setae on tergum IX; males are smaller

than females.

Species from this genus are found mainly on various grasses, shrubs and trees. The Canadian species are found in the subgenera, *Anaphothrips* and *Neophysopus*. A new species of *Anaphothrips* has been found in Ellesmere Island on *Poa* spp.

Apterothrips Bagnall

Apterothrips Bagnall, 1908:185.

Type species: *Apterothrips subreticulata* Bagnall, 1908:185, monobasic.

Head wider than long; antennae eight-segmented, sense cones on antennal segment III and IV simple; cheeks with a row of sharp thorn-like teeth on each side.

Pronotum with no major setae at posterior angles; apterous.

Abdomen wider than thorax; terga and sterna deeply lobed or indented at posterior margin (fig. 33)

This genus of dark brown species is found in cold temperate parts of the world; species feed and breed in grasses.

Aptinothrips Haliday

Thrips subgenus *Aptinothrips* Haliday, 1836:445, raised to full generic rank by Lindeman, 1887.

Type species: *Thrips rufa* Gmelin, 1788:2224.

Head much longer than wide with a slight prolongation in front of eyes; ocelli absent; antennae six- or

eight-segmented, the former condition having no style while the latter having a two-segmented style, segments III and IV each with simple sense cones; maxillary palps three-segmented.

Prothorax without major setae on margins (fig. 35); mesothorax separated from metathorax by an incomplete suture; mesospinasternum completely separate from metasternum by a suture; legs stout; tarsi one- or two-segmented; always apterous.

Abdomen narrow and cylindrical (fig. 35); terga with many scattered minute setae, with median pores far apart near posterior margin; tergum VIII without posterior comb of setae; sterna with accessory setae; segment X with deep longitudinal furrows; females with well developed downturned ovipositor; males without glandular areas on sterna and with two pairs of stout setae medially on tergum X.

Members of this genus are found in grasses and sod; they can be mistaken for the larval form of other species because of their pale colour and wingless condition.

Belothrips Haliday

Belothrips Haliday, 1836:444.

Type species: *Thrips (Belothrips) acuminata* Haliday, 1836:450, by monotypy.

Head about as long as wide; antennae eight-segmented, segments VII and VIII nearly as long as segment VI.

Pronotum with one pair of long posteroangular setae; brachypterous, micropterous of macropterous, wings, when

present with two longitudinal veins.

Abdomen slender; terga without a pair of median setae; segment X twice as long as broad at widest, tubelike.

Chilothrips Hood

Chilothrips Hood, 1916b:119.

Type species: *Chilothrips pini* Hood, 1916b:120, by original designation.

Head much broader than long; eyes relatively small; antennae eight-segmented, with forked sense cones on segments III and IV; mouth cone wide, extended beyond the posterior margin of the prothorax (fig. 36); maxillary palps three-segmented; labial palps two-segmented.

Prothorax long with one pair of well developed posteroangular setae; mesospinasternum divided from metasternum by a suture; tarsi two-segmented; fore wings with the setae on fore vein interrupted and regularly spaced on hind vein; fringe cilia wavy.

Abdomen with pleural plates; median pair of setae far apart on intermediate terga; tergum VIII without a comb of setae on posterior margin; males unknown.

Only one species is found in this genus *Chilothrips pini*. It closely resembles members of the genus *Oxythrips* except for the enlarged mouth cone.

Hemianaphothrips Priesner

Hemianaphothrips Priesner, 1925b:5

Type species: *Anaphothrips articulosis* Priesner, 1925b:5, by monotypy.

Head about as wide as long; ocelli present; antennae nine-segmented, with a three-segmented style.

Pronotum without any strong bristles; fore tibia in both sexes not strongly developed; macropterous with two longitudinal veins.

Abdominal segments about as long as broad.

Oxythrips Uzel

Oxythrips Uzel, 1895:133.

Type species: *Oxythrips ajugae* Uzel, 1895:136.

Head wider than long to longer than wide; ocelli present with three pairs of ocellar setae (fig. 37); antennae eight-segmented, sometimes with a partial split near the apex of segment VI, sensoria forked on segments II and IV; mouth cone small; maxillary palps three-segmented; labial palps two-segmented.

Prothorax with one pair of well developed posteroangular setae (fig. 37); mesospinasternum separated from metasternum by suture; tarsi two-segmented; macropterous, fore wings with interrupted setae on fore vein and evenly spaced setae on hind vein; fringe cilia wavy.

Abdomen with pleural plates; median pair of setae far apart

on intermediate terga; tergum VIII without posterior comb of setae; segment X often long and with a pointed tip; females with well developed downturned ovipositor; males with glandular areas on sterna and with two pairs of stout setae on tergum IX (fig. 38).

Taetothrips Amyot et Audinet Serville

Taetothrips Amyot et Audinet Serville, 1843:645.

Type species: *Thrips subaptera* Haliday, 1836:450.

Head about as long as wide; cheeks well rounded; ocellar setae pair I absent, i.e. only two pairs of well developed ocellar setae (fig. 39); antennae eight-segmented, with forked sense cones on antennal segments III and IV; maxillary palps three-segmented.

Pronotum with one pair of well developed posteroangular setae (fig. 39); females macropterous, but frequently micropterous, males micropterous.

Abdomen broad and dark; terga without ctenidia (deeply-lobed comb) laterally; tergum VIII without a posterior comb of setae; sterna without accessory setae; stout setae on tergum IX; dark coloured body.

Genus comprises one species, found in *Galium* sp. and *Stellaria* sp., with a structure intermediate in form between the Anaphothripina and the Thripina.

Baliothrips Uzel

Baliothrips Uzel, 1895: 204.

Type species: *Thrips dispar* Haliday, 1836:449, by monotypy.

Head slightly wider than long; anterior margin between eyes, slightly rounded; interocellar and postocular setae small; antennae seven-segmented, segments III and IV each with a forked sense cone (fig. 40); mouth cone slightly pointed at tip; maxillary palps two-segmented.

Prothorax with well developed posteroangular setae, and with three pairs of setae along posterior margin of prothorax between these major setae; mesospinasternum separated from metasternum by a suture; metascutum with longitudinal striations; tarsi two-segmented; fore wings with fore vein with setae interrupted, and hind vein evenly set with setae; fringe cilia wavy.

Abdominal sterna without accessory setae, with posterior pair of setae forward of margin of most sterna; median pair of setae far apart on intermediate terga; female with well developed downturned ovipositor and with partial split on tergum X; males with glandular area on sterna III-VII and without thornlike setae on tergum IX.

This genus closely resembles the genus *Thrips*. *Baliothrips* has two-segmented maxillary palps and the median pair of setae of the abdominal sterna are placed

forward of posterior margin. On the other hand, *Thrips* bears three-segmented maxillary palps and, except for abdominal sternum VIII, the median pair of posterior setae are placed on the posterior margins of the sterna. *Baliothrips* feeds on grasses; one species is recorded from Canada, *B. dispar*. A genus closely ressembling *Baliothrips* (simple instead of forked sense cones on antennal segment III) was found on Ellesmere Island.

Catinathrips O'Neill

Catinathrips O'Neill, 1967:854.

Type species: *Catinathrips kainos* O'Neill, 1967:856.

Head small (fig. 41); eyes slightly bulging, longer dorsally,than half the length of the head; ocellar setae short, pair I absent, pair II near eyes, pair III between posterior ocelli; ocular setae small; antennae eight-segmented, VIII sometimes joined to VII, III and IV with forked sense cones, VIII distinctly longer than VII; maxillary palps two-segmented; distal segment much longer than basal one.

Pronotum (fig. 41) slightly wider than long, with two pairs of long posteroangular setae, and only one pair of posteromarginal setae between major setae; tarsi two-segmented; wings short, less than half length of body; fore margin slightly concave, with few setae on two longitudinal veins; fringe cilia weakly wavy or not at all.

Abdomen slightly broader than pterothorax, spindle-shaped;

most segments with posterior marginal scalloped plates, more pronounced dorsally than ventrally; tergum I with distinct discal setae; tergum III with three pairs of lateral setae, tergum V with six pairs of setae, tergum VIII with median pair of pores just foreward of posterior margin; tergum X partially split; sterna without accessory setae.

This genus comprises two species, *C. kainos* and *C. vaccinophilus*; both infest *Vaccinium* species, along with *Franklinothrips vaccinii*. These species are small (1mm long) and possibly form galls on the host (Shorthouse and Landry, pers. comm.).

Ceratothrips O.M. Reuter

Ceratothrips O.M. Reuter, 1899:65.

Type species: *Ceratothrips ericae*, Haliday, 1836:448.

Head with ocelli present and three pairs of ocellar setae (fig. 42); antennae eight-segmented, segments III and IV with forked sense cones; maxillary palps three-segmented.

Pronotum with more than two pairs of posteromarginal setae (fig. 42); metathoracic furca with an elongate spinula medially; macropterous, fore wing with irregular set setae on fore vein.

Abdomen with terga III-VII without microtrichia on posterior lateral margin; tergum VIII with comb absent or widely interrupted medially.

Ctenothrips Franklin

Ctenothrips Franklin, 1907:247.

Type species: *Ctenothrips bridwelli* Franklin, 1907:248, by monotypy.

Head slightly longer than wide, greatly bulged medially; ocelli large; interocellar and postocular setae moderately developed; antennae eight-segmented, III and IV with forked sense cones; maxillary palps three-segmented, labial palps two-segmented.

Prothorax with weak striations (fig. 46); posterolateral pairs of setae the longest; mesospinasternum not fused to metasternum; metascutum with hexagonal reticulation; tarsi two-segmented; macropterous, rarely micropterous, fore wings with curved hind margin and with both longitudinal veins regularly set with numerous setae; fringe cilia wavy.

Abdominal terga and sterna with strong hexagonal reticulation (fig. 46); terga without pair of closely set median setae; sterna without accessory setae; tergum VIII with complete comb of posterior marginal setae; segment X stout, tubelike, with a complete split on dorsum; females with well developed downturned ovipositor; males with wide glandular areas on each of sterna III-VIII, without thornlike setae on tergum IX.

This genus comprises two species only; one of them occurs in Canada, *C. bridwelli*.

Echinothrips Moulton

Echinothrips Moulton, 1911:37.

Type species: *Echinothrips mexicanus* Moulton, 1911:37, by monotypy.

Head about as long as wide, with strong reticulation or striations (fig. 43); eyes large; ocelli present on slightly raised vertex; antennae eight-segmented, segment III constricted subbasally, segment VI and style elongated and nonpedicellate; sense cones on segments III and IV simple; maxillary palps and labial palps two-segmented.

Prothorax with strong reticulation, with an angular structure at sides and with two major pairs of posteroangular setae (fig. 43); mesospinasternum fused to metasternum; metascutum with hexagonal reticulation; femora with a large clublike seta at base on dorsum; tarsi two-segmented; always macropterous; fore wings strong, widest at base, narrowing to a pointed tip, with two rows of heavy, stout spines; fringe cilia wavy.

Abdominal terga with or without microsetae laterally, with a median pair of closely spaced setae on most terga; tergum VIII with a complete comb of setae; sterna without accessory setae; female with well developed downturned ovipositor; males with sternal glands, and without thornlike setae on tergum IX.

Franklinella Karny

Franklinella Karny, 1910:46.

Type species: *Thrips intonsa* Trybom, 1895:188, by subsequent designation by Hood, 1914.

Head wider than long to slightly longer than wide (fig. 44); ocelli placed farther apart than closely related *Thrips*, sometimes reduced or absent in brachypterous forms, ocellar setae pair III forward of anterior margins of posterior ocelli; interocellar and postocular setae well developed; antennae eight-segmented, segments III and IV with a forked sense cone, segments VII and VIII forming a short style; maxillary palps three-segmented.

Pronotum wider than long, with well developed setae on both the anterior and posterior angles, and with five pairs of small setae between inner posteroangular pair (fig. 44); mesospinasternum separated from the metasternum by a suture; tarsi two-segmented; macropterous or brachypterous; fore wings with regularly set setae on both veins; fringe cilia wavy.

Abdomen with a ctenidium laterally on terga V-VIII and sometimes terga II-IV and sometimes only on tergum VIII (brachypterous form); abdominal tergum VIII with or without posterior comb of setae; female with well developed downturned ovipositor, tergum X split (fig. 45); males with glandular areas on sternum III-VII; males often yellow and smaller than female.

This genus is very difficult to identify to species because of the little variation between the species.

Iridothrips Priesner

Iridothrips Priesner, 1940:403.

Type species: *Bregmatothrips iridis* Watson, 1924c:253, by original designation.

Head with a bulging vertex (fig. 50); antennae eight-segmented, segments III and IV with simple sense cones; maxillary palps three-segmented; labial palps two-segmented.

Prothorax with anterolateral and two pairs of posteroangular setae long with the midanterior and midposterior pair slightly shorter and with lateral setae much smaller; mesospinasternum with a suture separating it from the metasternum; metaspinasternum truncate; large fore legs; tarsi two-segmented; macropterous or brachypterous; fore wings with regularly set setae on both veins; fringe cilia wavy.

Abdomen with pleural plates; median pairs of setae far apart on intermediate terga; sterna without accessory setae; males with glandular areas on sterna III-VII in the form of ellipses.

This genus is represented in Canada by one species *I. iridis*. This species is placed in the genus *Franklinielliae* by Mound *et al.*, 1976. I have not done so since this species has simple sense cones on antennal segments III and IV while members of *Franklinielli*a have forked sense cones; this is a distinguishing character at the generic level.

Mycterothrips Trybom

Mycterothrips Trybom, 1910:158.

Type species: *Mycterothrips laticauda* Trybom, 1910:158, by original description and monobasic.

Head wider than long; ocelli present, ocellar pair I present, pair III long, within ocellar triangle (fig. 47); antennae eight-segmented, segments III and IV with forked sense cones, antennae of male similar to that of female or totally different (figs 48-49).

Pronotum with two pairs of well developed posteroangular setae and two pairs of posteromarginal setae between inner pair of posteroangular setae; metathoracic furca with an elongate spinula; fore wing with only two distal setae on fore vein.

Abdomen with terga III-VII with small comb of microtrichia on lateral posterior margin; tergum VII with complete comb of setae; abdominal sterna with none to many accessory setae, sometimes in one sex only; male without sternal glandular areas.

Species of this genus feed on the leaves of shrubs and trees, e.g. *Salix* sp. and *Betula* sp.

Odontothrips Amyot and Audinet Serville

Odontothrips Amyot and Audinet Serville, 1843:642.

Type species: *Thrips phalerata* Haliday, 1836:447.

Head wider than long; ocelli present; antennae eight-segmented, with a two-segmented style, with forked sense cones on III and IV and with a clear elongated and pointed sensoria area on segment VI, extending from the apex to middle of segment (fig. 52); maxillary palps three-segmented; labial palps two-segmented.

Prothorax wider than long, with two pairs of well developed posteroangular setae; mesospinasternum separated from metascutum by wide suture; fore tibiae each with one or two distal claws (fig. 51); tarsi two-segmented; always macropterous; fore wings with interrupted bristlelike setae on fore vein, but with evenly spaced setae on hind vein.

Abdomen with pleural plates; tergum VIII with a weak and incomplete comb of setae; sterna without accessory setae; female with partial split on tergum X; males without glandular areas, and with or without a pair of bristle-like setae on tergum IX.

These dark coloured thrips are found in fields of mixed vegetation and seem to breed in flowers of Leguminosae (Mound, 1976). Members of *Odontothrips* are similar to species of *Taeniothrips* but are distinct because of their tibial claws and the enlarged sense cone on antennal segment VI. Two species had previously been reported in Canada and United States, i.e. *pictipennis* and *loti*; in this study the European species, *biuncus* John is being recorded for the first time in North America.

Pezothrips Karny

Pezothrips Karny, 1907:45.

Type species: *Physopus frontalis* Uzel, 1895:34.

Head about as long as wide; ocelli present with three pairs of ocellar setae, ocellar setae pair III much longer than the other two pairs; antennae eight-segmented, segments III and IV each with a forked sense cone, segments VII and VIII forming a small style; maxillary palps three-segmented.

Pronotum with two pairs of long posteroangular setae, with small setae at anterior margin; legs unarmed; wings macropterous or micropterous; when fully developed, fore wing with interrupted setae at the middle of fore vein and regularly set setae on hind vein.

Abdomen without accessory setae on abdominal sterna; tergum VIII with comb of long setae on posterior margin; terminal abdominal segments narrow, almost tube-like; tergum IX with two pairs of pores; male with many small circular glandular areas (fig. 53).

Scolothrips Hinds

Scolothrips Hinds, 1902:157.

Type species: *Thrips sexmaculata* Pergande, 1895:539.

Head wider than long, with prolongation in front of eyes; ocelli on raised portion of vertex, with interocellar setae extremely long; antennae eight-segmented, with a two-segmented style and with forked sense cones on segments III and IV;

maxillary palps three-segmented.

Pronotum with all major setae, including midlateral pair, well developed; mesospinasternum separated from metasternum by a suture; tarsi two-segmented; legs unarmed; macropterous; fore wings broad, pointed, set with long setae; fringe cilia wavy.

Abdomen without comb of setae on tergum VIII; abdominal terga with median setae set far apart; abdominal sterna without accessory setae, posterior marginal setae long; female with well developed ovipositor; males with transverse sensory areas enlarged at ends on abdominal sterna III-VIII; male smaller than female.

Taeniothrips Amyot and Audinet Serville

Taeniothrips Amyot and Audinet Serville, 1843:644.

Type species: *Thrips primulae* Haliday, 1836:449

Head wider than long to as long as wide; cheeks bulged slightly to greatly; ocellar pair I absent, pair III much longer than distance between two ocelli; antennae eight-segmented, with a two-segmented style, and with forked sense cones on segments III and IV; maxillary palps three-segmented; labial palps two-segmented.

Prothorax wider than long, with well developed posteroangular setae; mesospinasternum separated from metasternum by a suture; tarsi two-segmented; macropterous, brachypterous, or apterous; fore wings with setae often irregularly set on fore vein, regularly set on hind vein;

fringe cilia wavy.

Abdomen with pleural plates, without microsetae; median pair of setae placed far apart on the intermediate terga; sterna with or without accessory setae; tergum VIII with complete comb of setae on posterior margin (fig. 54); females with well developed downturned ovipositor; males usually with sternal glandular areas.

This genus comprises large, yellow to brown flower-dwelling species. Several species originally placed in *Taeniothrips* are now in *Ceratothrips*, *Mycterothrips*, *Pezothrips* and Thrips.

Thrips Linnaeus

Thrips Linnaeus, 1758:457.

Type species: *Thrips physapus* Linnaeus, 1758:457.

Head wider than long (figs 56-57) to as long as wide occasionally prolonged in front of eyes, but only slightly; postocular setae in a continuous row; antennae seven- and eight-segmented (figs 59-60) , segments III and IV each with a forked sense cone, segment VI sometimes enlarged in males; maxillary palps three-segmented.

Prothorax wider than long (figs 56-57), with two pairs of well developed posteroangular setae and all other setae minute and with two, three, or four pairs of posteromarginal setae between two major pairs; mesospinasternum separated from metasternum by a wide suture; metascutum with longitudinal to hexagonal striations; fore legs bare; tarsi two-segmented;

macropterous, micropterous, or brachypterous; fore wings with irregularly set setae on fore vein, evenly spaced setae on hind vein (fig. 58); fringe cilia wavy.

Abdomen with distinct pleural plates; tergum I with weak or strong striations; tergum II with three or four setae on lateral margins; median pair of setae placed far apart on the intermediate terga; terga sometimes with scalloped margins; sterna often with medial accessory setae (fig. 55); segment VIII often with a posterior comb of setae; females with a well developed downturned ovipositor, with tergum X partially split; males with sternal glandular areas and without stout setae on tergum IX.

Seventeen species of *Thrips* are recorded from Canada. Many are host specific while a few are cosmopolitan e.g. *Thrips tabaci*, *T. fuscipennis*.

Toxonothrips Moulton

Toxonothrips Moulton, 1927b:30.

Type species: *Toxonothrips graminae* Moulton, 1927b:30, by original designation.

Head about as wide as long, broadly rounded in front, cheeks rounded; ocelli fully developed in female, absent in male; antennae seven-segmented, style unsegmented, with forked sense cones on segments III and IV, segment III with pedicel; maxillary palps three-segmented.

Prothorax wider than long, with two pairs of well developed posteroangular setae, reduced setae on anterior angles; tarsi

unarmed; wings fully developed in female, absent in males; fore wings, when present with longitudinal veins, hind vein regularly set with setae.

Abdomen with comb of setae on tergum VIII; male smaller than female and with oval glandular areas on sterna III and IV, without claspers on terminal abdominal segments (fig. 61). General appearance similar to *Anaphothrips* (Bailey and Kono, 1966).

Suborder Tubulifera

Superfamily Phlaeothripidae

Family Phlaeothripidae

Subfamily Idolothripinae

Bolothrips Priesner

Bolothrips Priesner, 1926:90.

Type species: *Phloeothrips bicolor* Heeger, 1852:477, by original designation.

Head more or less oval to oblong, longer than broad, sometimes slightly protruding in front of eyes (fig. 63); cheeks smooth; eyes slightly swollen, often prolonged ventrally more than dorsally; ocelli, when present, usually greatly reduced even in macropterous form; antennae eight-segmented, segment VIII, with a distinct pedicel, well separated from segment VII; mouth cone short and broadly rounded; maxillary stylets forming a V-shape within the head.

Prothorax with all major setae well developed, anteromarginals often reduced; epimeral sutures complete; praepectus well developed; fore legs unarmed in female, often armed in male; female either macropterous or apterous, known males only apterous; fore wing broad, with about ten accessory fringe cilia.

Abdomen smooth or with weak sculpturation; pelta broad with a more or less pointed anterior tip (fig. 64), with weak striations on posterior half; abdominal segment IX in female with three pairs of moderately long, pointed posterior setae (fig. 62); male, in addition, with a long pair of ventral setae; tube longer than head.

Compsothrips O.M. Reuter

Compsothrips O.M. Reuter, 1901:214.

Type species: *Phloeothrips albosignata* O.M.Reuter 1901:214, by monotypy.

Head longer than wide, round with a constricted base; eyes small, prolonged ventrally more than dorsally; ocelli absent; postocular setae well developed; antennae eight-segmented, segments V and VI prolonged ventrally at apex; mouth-cone broadly rounded; maxillary stylets when retracted into the head, far apart and V-shaped.

Prothorax unusually small (fig. 66), about two thirds as long as wide, with all major setae well developed; pterothorax exceptionally small relative to the head and abdomen, giving an ant-like appearance; metanotum produced

dorsally with concentric striations (fig. 66); praepectus present; mesopraesternum well developed, extremely narrow; pterothorax, greatly reduced, about as long as broad and about as wide as head; fore tarsi armed in both sexes; apterous in North America.

Abdomen broad, heavy; pelta broad; usually with white spots on lateral margins of one to several segments; tergum II long, often deeply sculptured; tube about half as long as head.

This genus is distinct from all others because of its large head and narrow pterothorax which gives an ant-like appearance.

Cryptothrips Uzel

Cryptothrips Uzel, 1895:228.

Type species: *Cryptothrips lata* Uzel, 1895:228.

Head rectangular (fig. 65), longer than wide, with weak hexagonal reticulation on lateral and posterior margins; eyes small, less than one-quarter length of head; ocellar setae sometimes long; antennae eight-segmented, segments IV-VII produced ventrally at apex, segment VIII slightly pedicellate; mouth cone short and broadly rounded; maxillary stylets, broad and band-like and when retracted, touching within the center of the head.

Prothorax with all major setae well developed (fig. 65), although anterior pairs shorter than posterior pairs, setae pointed to blunt; pelta broad with tapering anterior tip (fig. 68); epimeral sutures complete; praepectus often small; fore

legs unarmed in female, armed in male; macropterous or brachypterous; fore wings, when fully developed, broad and with accessory fringe cilia.

Abdomen large; pelta broad, with pointed anterior tip, usually with hexagonal reticulation; tube without long lateral setae.

Species of this blackish brown thrips may be found under the bark of dead branches where they feed on fungus spores.

Elaphrothrips Buffa

Elaphrothrips Buffa, 1909:162.

Type species: *Idolothrips coniferarum* Pergande, 1896:63.

Head much longer than wide, prolonged in front of eyes (fig. 67) with weak striations on dorsum; eyes, sometimes produced ventrally more than dorsally; fore ocellus often far forward, ocellar setae often prominent; cheeks often with stout spines; antennae eight-segmented, intermediate segments elongate, segment VIII usually with constricted base and with a slight pedicel; mouth cone short, broadly rounded; maxillary stylets broad, forming V-shape within head.

Prothorax short, with all major setae well developed, although anterior pairs shorter than posterior pairs, setae pointed to blunt (fig. 67); epimeral sutures complete; praepectus present; mesonotum with small hexagonal reticulations; fore legs usually armed, in addition, in males, fore femora with curved and stout apical setae, hind legs often with well developed basal and apical setae;

macropterous, micropterous or brachypterous; fore wing broad with 20-40 accessory fringe cilia.

Pelta broad, with lateral extensions and with hexagonal reticulation; terga II-IX with transverse to hexagonal striations; segment IX in females with three pairs of long, pointed posterior setae; in males additional shorter pair of ventral setae; tube long.

Megalothrips Uzel

Megalothrips Uzel, 1895:224.

Type species: *Megalothrips bonannii* Uzel, 1895:224.

Head much longer than wide (fig. 69), narrow and arched dorsally, with transverse striae, area between eyes prolonged slightly forward; eyes small, compared to head size; ocellar and postocular setae well developed; cheeks with several pairs of stout spines; antennae eight-segmented, VI and VII ventrally produced at apex and VIII lanceolate; mouth cone broadly rounded; maxillary stylets long, broad, and when at rest, retracted far into head, close together in middle.

Prothorax small, about three times wider than long, with all major setae present (fig. 71); epimeral sutures incomplete; praepectus present; fore tarsus unarmed or armed with a minute tooth; macropterous, fore wing broad with accessory fringe cilia.

Abdomen large; pelta with characteristic lateral lobes (fig. 70); terga with anterior halves with hexagonal reticulation, posterior halves with transverse striations; tergum VI in male

with a pair of long, tubelike structures laterally; tube long, and hairy, longer in female than in male.

Megathrips Targioni-Tozzetti

Megathrips Targioni-Tozzetti, 1881:120.

Type species: *Megathrips piccioli* Targioni-Tozzetti, 1881:120, by monotypy.

Head elongate, two and a half times as long as wide not arched, but with transverse striations; area bearing antennae slightly prolonged in front of eyes; interocellar, postocellar, postocular, and middorsal setae well developed; cheeks with several pairs of capitate spines; antennae eight-segmented, III elongate, VIII lanceolate; mouth cone broad; maxillary stylets long, spaced wide apart in middle of head.

Prothorax not as short as in *Megalothrips*, all major setae well developed, posterior pairs being the longest, anterolaterals placed farther away from the anterior margin of the prothorax than from the mid lateral setae; epimeral sutures incomplete in brachypterous forms, complete or nearly complete in macropterous forms; praepectus present; fore tarsi unarmed in females, sometimes with a tiny tooth in males; macropterous or brachypterous; fore wing pale and broad, with accessory fringe cilia.

Abdomen large, pelta with lateral lobes (fig. 72); tergum VI

in male with long, tubelike structures; tergum VIII in male with lateral stout setae on raised areas; terga IX-X with short major posterior setae, less than one-third as long as tube; tube hairy and constricted near the middle in male; large and dark coloured thrips.

Subfamily Urothripinae

Trachythrips Hood

Trachythrips Hood, 1929: 317.

Type species: *Trachythrips watsoni* Hood, 1929:371, by original designation.

Head longer than wide, marked entirely by warts (fig. 104); eyes with a few large facets in two short rows dorsally; ocelli absent; postocular setae minute; antennae five- or six-segmented; mouth cone short and broad; maxillary stylets parallel within the head.

Prothorax with warts, with all setae minute (fig. 104); epimeral sutures incomplete; praepectus present; meso- and metanotum degenerate; meso- and metasternum fused; tarsi unsegmented; hind coxae farther apart than are middle coxae; always apterous.

Abdomen with pelta undifferentiated, forming a continuous dorsal band over the entire tergum; wing-holding setae undifferentiated; lateral setae stout and blunt; segment IX cylindrical, fustis extending entire length of segment in female; tube long, with six very long anal setae.

Subfamily Phlaeothripinae

Acanthothrips Uzel

Acanthothrips Uzel, 1895:259.

Type-species: *Phloeothrips nodicornis* O.M. Reuter, 1885:16, by monotypy.

Head longer than wide (fig. 75), cheeks slightly swollen, often with prominent warts; eyes large and bean-shaped; antenna eight-segmented, intermediate segments prolonged and constricted beyond sense cone insertions (fig. 73); postocular setae well developed; mouth cone long and pointed; maxillary stylets slender, usually touching within center of the head.

Pronotum with granules or hexagonal reticulation (fig. 75); one or two well developed epimeral setae; praepectus absent; macropterous, fore wings sometimes indented in middle, with accessory fringe cilia.

Abdomen with small, bell-shaped pelta (fig. 74); terga with two or three pairs of wing-holding setae; anal setae less than twice as long as tube.

This genus is characterized by its white stripes or dots along the dorsolateral margins of the body, ranging from the tip of the head to the tube or restricted to a few segments of the abdomen.

Cephalothrips Uzel

Cephalothrips Uzel, 1895:244.

Type species: *Phloeothrips monilicornis* O.M. Reuter, 1885:21, by monotypy.

Head longer than wide (fig. 76), longer than prothorax, with weak transverse striations along lateral and posterior margins; eyes sometimes prolonged ventrally more than dorsally; ocelli present in macropterous forms, absent in apterous form; antennae eight-segmented (fig. 82), VII and VIII each with a broad pedicel; mouth cone broadly rounded; maxillary stylets, placed close together but not touching within the center of the head.

Prothorax with only posteroangular setae well developed (fig. 76), these setae dilated at tip; praepectus absent; metanotum with weak longitudinal striations laterally; fore legs each armed with a small tooth; macropterous or apterous; fore wing without accessory setae.

Abdomen with sides nearly parallel; pelta triangular and faintly reticulate; tube with terminal setae shorter than tube; male unknown in North America.

Gnophothrips Hood and Williams

Gnophothrips Hood and Williams, 1915:133.

Type species: *Gnophothrips megaceps* Hood and Williams,

1915:133, by original designation.

Head longer than wide with a slight arch, and with transverse striations (fig. 77); cheeks straight and smooth; area between eyes slightly prolonged anteriorly; postocular setae blunt; antennae eight-segmented, III and IV with short sense cones, VIII nonpedicellate; mouth cone broadly rounded; maxillary stylets, when at rest, extended far into the head close to the eyes.

Prothorax shorter than head (fig. 77), with weak lateral transverse striae; major pairs of setae present, blunt to dilated; epimeral sutures complete; praepectus absent; fore legs unarmed; macropterous or micropterous; fore wings short, only about two and one half as long as head, without accessory fringe cilia; wings in micropterous form nearly equal in length to head.

Abdomen with weak transverse striae; pelta more or less triangular, blunt anteriorly; terga II-VII each with two pairs of wing-holding setae; sternum VIII of male without glandular area; tergum IX with major posterior setae shorter than tube and pointed; lateral pair in male short and stout; tube half as long as head, anal setae somewhat shorter than tube.

Gynaikothrips Zimmerman

Gynaikothrips Zimmerman,1900:13.

Type species: *Mesothrips uzeli* Zimmerman, 1900:13, by original designation.

Head elongate; eyes large; ocelli on raised portion of head;

antennae eight-segmented, III with one sense cone, IV with three sense cones, VI not truncate at apex; postocular setae from large to small, but never minute; mouth cone broadly rounded; maxillary stylets slender retracted only halfway into head, placed far apart within center of head.

Prothorax with pronounced irregular and twisted sculpturation, with only epimeral setae well developed; epimeral sutures often incomplete; praepectus absent; metanotum with transverse to hexagonal markings; fore wings broad and parallel sided.

Abdomen with triangular pelta, with occasionally two additional lateral lobes (fig. 78).

This leaf-feeding thrips is to be found only indoors in temperate regions of the world. It has been introduced from the tropics on house plants such as *Ficus* species.

as *Ficus* species.

Haplothrips Amyot and Audinet Serville

Haplothrips Amyot and Audinet Serville, 1843:640.

Type species: *Phloeothrips albipennis* Burmeister, 1838:410, by monotypy.

This genus is divided into three subgenera, *Haplothrips s.str.*, *Xylaplothrips* Priesner and *Neoheegeria* Schmutz. Stannard (1968) and Thomasson and Post (1966) regard *Leptothrips* Hood as a subgenus of *Haplothrips*, but this author prefers to follow Mound's (pers. comm.) decision to accord it full generic status because of its striated

metanotum, which is not found in *Haplothrips* as have been understood.

Subgenus *Haplothrips* Amyot and Audinet Serville *s.str.*

References and type-species as given under generic name.

Head about as long as wide to longer than wide, with weak transverse striae (figs 79, 85); eyes never prolonged ventrally more than dorsally; ocelli present, fore ocellus often protruding in front of eyes; cheeks smooth; antennae eight-segmented, III usually asymmetrical, generally smaller than IV, with none, one, or two apical sense cones, IV with four apical sense cones, VIII usually nonpedicellate, broadly attached to VII; mouth cone short and broad to longer and pointed or nearly pointed; maxillary stylets often far apart within center of head, with conspicuous, and usually wide maxillary bridge.

Thorax large; prothorax weakly striated, with anterior and lateral pairs of major setae much shorter than posterior pairs, setae pointed to blunt; epimeral sutures complete; praepectus present; metanotum very weakly striated; fore tarsus with an inner tooth; macropterous, fore wing slightly constricted in the middle, with or without accessory setae.

Abdomen with pelta triangular often with deep sculpturation (figs 80, 81); wing holding setae sigmoidal; major setae on posterior margin of tergum IX pointed, in males the lateral pair being much smaller; males without an apparent glandular area on sternum VIII; females with small to large fustis in

segment IX.

Members of this subgenus are distinct from those of the subgenus *Xylaplothrips* by being larger and stouter and in having pointed or blunt-ended, and not dilated setae. ***Neoheegeria***, on the other hand, has much longer setae on head and pronotum than in the typical subgenus ***Haplothrips***.

Subgenus ***Neoheegeria*** Schmutz

Neoheegeria Schmutz, 1909:344.

Type species: ***Neoheegeria dalmatica*** Schmutz, 1909:344, by monotypy, subordinated to ***Haplothrips*** by Stannard, 1957.

This subgenus differs from the others by a combination of characters and not by one or a few structural features alone.

In ***Neoheegeria***, the head and prothoracic setae are extremely long and in the Old World, some species have apically expanded fore wings. Only a single introduced species, ***Haplothrips (Neoheegeria) verbasci*** is found in Canada.

Subgenus *Xylaplothrips* Priesner

Xylaplothrips Priesner, 1925a:151.

Type species: *Xylaplothrips fuliginosus* Schille, 1910:7, subordinated by Stannard, 1957.

This subgenus differs form the nominate form in the following characteristics:

Antennal segment III symmetrical; antennal segment IV with one or two sensory trichomes; mouth cone broadly rounded, very short, reaching one third across posternum; fore tarsus armed with tooth; found in leaf litter, feeding on decaying matter.

Only one species is found in Canada, *Haplothrips (Xylaplothrips) subterraneus* Crawford.

Hoplandrothrips Hood

Phloeothrips subgenus *Hoplandrothrips* Hood, 1912:145.

Type species: *Phloeothrips (Hoplandrothrips) xanthopus* Hood, 1912:145, by original designation. Raised to full generic rank by Hood, 1915c.

Head moderate in size to elongate, sometimes arched dorsally, surface weakly striated; eyes bean shaped, more or less length of antennal segments I and II; postocular setae well developed, however longer in males than in females and often dilated at tips; cheeks usually wide, bearing a prominent posterior pair of setae; antennae eight-segmented, III often asymmetrical, with one inner, and one or two outer, slender sense cones, VIII pedicellate or nonpedicellate; mouth cone more or less pointed; maxillary stylets touching within center of the head.

Prothorax smooth to weakly sculptured, with well developed

setae, usually dilated at tips; anteromarginals longer, and anteromarginals shorter in male than in female; epimeral sutures complete; praepectus absent; metanotum with deep hexagonal reticulation or longitudinal striations; fore legs usually armed with tarsal tooth, with two inner subapical fore femoral spurs and one inner subbasal fore tibial spur, all structures present in most males and some females and when present usually larger in male than in female; macropterous or brachypterous, fore wings often with slight constriction in middle and with a small bulge on the surface at middle, always with several accessory fringe cilia.

Abdomen with bell shaped to triangular pelta, often hexagonally reticulate (fig. 86); wing holding setae sigmoidal; major terminal setae on tergum IX either pointed, blunt or dilated, lateral pair in males reduced and always pointed; male with weak usually small, sometimes broad, circular glandular area on sternum VIII.

Hoplandrothrips is distinguished from other genera by a complex of characters rather than by one single feature. Many characters are shared in various degrees by closely related genera, such as *Acanthothrips, Malacothrips* and *Phlaeothrips*. Because of these close relationships, this genus is difficult to work with.

Hoplothrips Amyot and Audinet Serville

Hoplothrips Amyot and Audinet Serville, 1843:640.

Type species: *Thrips corticis* DeGeer, 1773:11.

Head as wide as long to longer than wide (fig. 90), sometimes with a slight dorsal arch; surface of head smooth to weakly reticulate; eyes usually not longer than length of antennal segment I, sometimes reduced to a few dorsal facets (fig. 87); ocelli present in macropterous forms, present, reduced, or absent in brachypterous forms, absent in apterous forms; postocular setae dilated to pointed; cheeks with prominent basal setae; antennae eight-segmented (fig. 83), III longer than II, with one inner and one or two outer sense cones, IV with two to four sense cones; VIII pedicellate, often lanceolate, or without pedicel and closely joined to segment VII; mouth cone broadly rounded to pointed; maxillary stylets nearly touching within center of head.

Prothorax smooth to weakly sculptured, with major setae pointed or dilated (fig. 87), anteromarginals minute and anterolaterals longer in major forms than in minor forms; epimeral sutures complete (fig. 90); praepectus usually absent; metanotum smooth; fore legs very large in major forms, with or without fore tarsal teeth, sometimes with projections on fore tibia and femur in major males; macropterous, brachypterous, or apterous; fore wings not constricted in middle, with accessory fringe cilia (fig. 88).

Abdomen with pelta small and broad (fig. 89), especially in winged forms, sometimes large in apterous forms; wing holding setae often absent in apterous forms; lateral abdominal setae pointed or dilated; major terminal setae on tergite IX usually pointed, lateral pair in males reduced; males with oval to wide glandular area on sternum VIII.

As with *Hoplandrothrips*, this genus is difficult to define because of its wide range of forms and, as with that genus, the extreme forms of the genus *Hoplothrips* tend to grade into closely related genera.

In general, species of *Hoplothrips* lack strong sculpture, especially on the metanotum, they lack a maxillary bridge and have slender maxillary stylets.

Leptothrips Hood

Leptothrips Hood, 1909:249.

Type species: *Cryptothrips aspersus* Hinds, 1902:205, by original designation.

Generally dark purple; head long, narrow (fig. 91), almost twice as long as broad, constricted at base; eyes bulging; in female, eyes prolonged on ventral surface more than on dorsal surface; vertex raised in front of antennae insertion; antennae eight-segmented with small weak sense cones; maxillary stylets placed far apart within head.

Prothorax about half as long as head, with lateral setae minute, midlaterals absent and with only one pair of posteroangulars well developed; metanotum with deep longitudinal striations (fig. 93), as long as width of head; legs slender, fore tarsus unarmed in both sexes; fore wings distinctly narrowed at middle, with accessory fringe cilia.

Abdomen with triangular pelta (fig. 92); abdominal terminal segment (tube) short, half as long as head, with terminal hairs about as long as tube; abdomen smaller in male than in

female; segment IX of female with small fustis.

Liothrips Uzel

Liothrips Uzel, 1895:261.

Type species: *Phloeothrips setinodis* O.M. Reuter, 1880:310.

Head longer than (fig. 96), or about as long as, wide with transverse striations on dorsum; eyes about one third length of head; fore ocellus sometimes reduced in brachypterous forms; postocular setae dilated, blunt or pointed; antennae eight-segmented, III with only one outer sense cone, IV elongate with one inner and one or two outer sense cones, VIII usually nonpedicellate; mouth cone usually long, pointed to broadly rounded; maxillary stylets nearly touching in center of head.

Prothorax smooth to weakly sculptured, with major anterior setae smaller than major posterior pairs, pointed, blunt or dilated; epimeral sutures complete (fig. 96); praepectus absent; metanotum with longitudinal striations or hexagonal reticulation (fig. 98); fore tibia unarmed; macropterous or brachypterous; fore wings with parallel sides with accessory fringe cilia, sometimes coloured with brown in basal half.

Abdomen with broad to triangular pelta (figs 94, 95); wing holding setae minute in brachypterous forms; major terminal setae on tergum IX pointed to blunt, lateral pair smaller in males and pointed; males with wide glandular area on sternum VIII; tube conical or narrow.

Members of this genus are often host specific (Cock, 1982).

Lispothrips O.M. Reuter

Lispothrips O.M. Reuter, 1899:17.

Type species: *Lispothrips wasastjernae* O.M. Reuter, 1899:17, by monotypy.

Head somewhat longer than wide, with transverse anastomosing striae; cheeks with deep lines and many stout setae (fig. 97); antennae eight-segmented, III small, smaller than IV, without sense cones, IV with at least one inner and one outer sense cone, VIII long, slender and nonpedicellate; mouth cone long, blunt, to pointed; maxillary stylets slender and when at rest, close or moderately apart within the head; maxillary bridge weak or well developed.

Prothoracic setae small and blunt; epimeral sutures incomplete to complete; praepectus absent; winged forms rare, usually brachypterous; when macropterous, fore wings without accessory cilia.

Abdomen with pelta broad with flattened anterior margin (fig. 99), larger in wingless forms than in winged forms; wing holding setae weak in winged forms, absent in brachypterous forms; lateral abdominal setae short, pointed to dilated; tergum IX with terminal setae short, lateral pair reduced in male; tube nearly equal to head.

This genus is represented in Canada by three species of very dark thrips, *L. birdii, L. brevicruralis. L. populi.*

Lissothrips Hood

Lissothrips Hood, 1908:365.

Type species: *Lissothrips muscorum* Hood, 1908:365, by monotypy.

Head wider than long (fig. 101), to longer than wide, with a smooth surface narrowed posteriorly; eyes small; postocular setae well developed, pointed to dilated; antennae eight-segmented, segment III smaller than II or IV with one or no sense cones, IV with one inner and one or two outer sense cones, VIII from lanceolate to nonpedicellate and closely joined to VII; mouth cone pointed and long; maxillary stylets placed far apart within the head.

Prothorax with all major setae well developed (fig. 101), with epimeral setae the longest, and dilated to pointed; epimeral sutures often incomplete; praepectus present; macropterous, brachypterous or apterous; fore wing parallel-sided, with or without accessory setae fringe cilia.

Abdomen with pelta broad with flattened anterior margin (fig. 100); wing holding setae well developed only in winged forms; lateral abdominal setae long; tergum IX with terminal setae long, pointed, lateral pair weaker in male; sternum VIII with or without glandular area in male.

This genus comprises only one species in Canada, *Lissothrips muscorum*, a greenish-coloured thrips which feeds on mosses. Other species in this genus are neotropical, having been recorded in Florida, Texas, Mexico, the West Indies and Brazil.

Poecilothrips Uzel

Poecilothrips Uzel, 1895:264.

Type species: *Poecilothrips albopicta* Uzel, 1895:264, by monotypy.

Head longer than wide, with weak transverse striations and many small setae; ocelli present with fore ocellus behind anterior eye margin; postocular setae minute; antennae eight-segmented, III with two sense cones, IV with four sense cones, VIII lanceolate; mouth cone pointed, extremely long, extending posteriorly beyond the prothorax (102); maxillary stylets slender, touching in middle of head.

Pronotum shorter than head, with all major setae well developed, stout, dilated and one pair only of epimeral setae; epimeral sutures complete; praepectus absent; metanotum with longitudinal striations; mesosternum broken into tiny platelets; macropterous or brachypterous; fore wings parallel sided, with accessory fringe cilia.

Abdomen with pelta triangular; terga II-VII with well developed wing holding setae; tube shorter than head with anal setae somewhat longer than tube.

At present, this genus has only one representative in North America, *Poecilothrips albopictus*. This species is characterized as being dark brown with chalky white markings laterally.

Stictothrips Hood

Stictothrips Hood, 1924b:295.

Type species: *Phloeothrips maculatus* Hood, 1909:250.

Head about as long as wide, constricted at base; cheeks with several long funnel shaped bristles; fore ocellus in a depression on vertex; eyes large, rounded and closely facetted; antennae eight-segmented, with VIII subpedicellate, and with one sense cone on antennal segment III and two sense cones on IV; maxillary stylets close together but not touching within head.

Prothorax with fore tarsus armed in both sexes; fore wing broad at base, abruptly constricted at basal two fifths, apical three fifths narrow, with hexagonal reticulations (fig. 103).

Abdomen with a broad dorsal furrow for the reception of the wings; major setae fan shaped; anal setae shorter than tube and pointed.

Stictothrips maculatus is the only species recorded from Canada and it is found on dead branches.

DISCUSSION

The order Thysanoptera is represented in all zoogeographical regions of the world (excluding the Antarctic). Most genera are found in the tropics, whereas some are restricted to temperate or even cold regions of the earth; e.g. the genus *Apterothrips* is only found in the northernmost part of the Northern Hemisphere. The distribution of the Thysanoptera in Canada can be defined for certain groups, but there is a lack of information about many genera and from several regions of the country.

Study of the fauna of southern British Columbia began at the turn of the century with R.C. Treherne's (1924) list of thrips known to occur in Canada; this work was based mainly on his findings in the fruit-growing regions of the Vancouver area and of the Okanagan Valley. Species were either feeders on fruit trees and small fruit or predators of these herbivores. After his report, collections were occasonally made by entomological research centres such as those now known as the Biosystematics Research Institute in Ottawa and the Lyman Entomological Museum in Montreal. Only O'Neill and Bigelow (1964) published specifically on Canadian thrips and then only their findings on the single genus *Taeniothrips*.

Interest in thrips in Canada was renewed in the 1960-70's by B.S. Heming who took a special interest in their embryological and development and morphological peculiarities.

Heming also collected in British Columbia but more intensively in the province of Alberta. These efforts combined with references from museum collections, permitted Heming (1979) to raise the number of known Canadian thrips species recorded to 102. Unlike Treherne, Heming collected from all areas and habitats of the province, which increased the variety of thrips found. Many litter-dwelling species of the family Phlaeothripidae, as well as those associated with native grasses were added to the list.

The present study differs from others in that it was concentrated in eastern Canada and that a great part of it was done away from areas where collection had been previously undertaken. The regions which were chosen were the northern Ontario community of Kapuskasing (49°25'N 82°26'W), and, in Quebec, the Lower St Lawrence area near the town of Rimouski, the countryside surrounding the Laurentian towns of Oka and St Jerome, and the southeastern town of Bromont. Kapuskasing lies in an area of subarctic boreal forest; Rimouski is just beyond the easternmost limit of the agricultural lands of the St Lawrence, with forests of broad-leaved deciduous and coniferous trees; further south, these forests also surround Oka, St-Jerome and Bromont. Oka, however, is also an area renowned for its apple orchards. St Jerome lies within the Laurentian highlands and Bromont within an area regarded as the best agricultural land in Quebec, yielding a large variety of crops.

Museum collections added to the study many additional species of various groups and material from areas which could

not otherwise be covered in the project.

Even though many regions and habitats have yet to be studied, one can make certain general statements about the distribution of the order in Canada. These observations will first be made for species native to North America then for introduced species, and finally some comments will be made on certain taxonomic problems.

Species native to North America. Species which have evolved in the eastern and western regions of North America are isolated from each other in Canada as they are in the United States. Fore example, *Frankliniella occidentalis, Aeolothrips duvali, A. nasturtii, Orothrips* sp. are confined to the west in both countries because of natural barriers of mountains and prairie, while *Heterothrips arisaemae, Dendrothrips ornatus* and *Frankliniella tritici* (most western records of this species given in Appendix 1 probably refer to the closely related *F. occidentalis*) are restricted to the east. Manitoba is possibly the transition zone between eastern and western fauna, as North Dakota has proved to be south of the international border (Huntsinger, 1971). Some species, e.g., *Taeniothrips orionis* are found only at high altitudes and have not been found beyond the western mountain ranges.

The prairie provinces abound with grass-inhabiting native species, e.g., *Chirothrips* spp. and *Anaphothrips* spp. B.S. Heming (unpubl.) has collected from Alberta nine species of the genus *Chirothrips*, eight of which have so far been

found only in this prairie province. It is quite possible that these species will also be found in Saskatchewan and in Manitoba. With the exception of *Chirothrips manicatus*, all species of *Chirothrips* are, most likely, concentrated in the prairie provinces.

Species like *Ctenothrips bridwelli* and many *Frankliniella* and *Thrips* species can survive on many different kinds of hosts and this adaptation has favoured their movement to other regions of the country. On the other hand, species with a limited number of host plants, often have very narrow geographical ranges. Examples of such species are *Chilothrips pini, Taeniothrips pini, Thrips anemonensis Mycterothrips betulae, M. aureus, Ceratothrips* spp. *Catinatothrips* spp., *Frankliniella vaccinii*, and many species of *Haplothrips*.

Several native detritus-feeding species of Tubulifera have been collected, but there are few locality records for each species. The litter fauna has either been insufficiently sampled or the species involved have a very limited range. Both assumptions may be correct.
Mound (1976) states that the majority of species from this group is limited to the area east of longitude 95°W in the United States; this difference in fauna which is reflected in differing soil conditions probably occurs also in Canada.

Introduced species. Most of these species have spread throughout the country following the distribution of their host plants or preferred habitat. The Palaearctic species

Anaphothrips obscurus as well as *Apterothrips secticornis*, *Aptinothrips rufus* and *A. stylifer* have invaded all areas of the cool latitudes which support grasses. *Aptinothrips rufus*, has been found at Hazen Camp on Ellesmere Island associated with its hosts *Poa* spp. Another example of a widely distributed grass-inhabitant is *Limothrips denticornis* which, like most introduced species, has met little competition in an area of abundant host plants. *L. denticornis* occurs in such great numbers in the province of Saskatchewan that it is economically injurious to cereal crops.

The association of introduced species with their hosts is especially noticeable in the coastal areas, which are, by their nature, areas of introduction. Natural barriers such as the Rocky Mountains in the west and the boreal forest of Ontario has prevented the inland spread of non-native species. Orchard-dwelling species such as the pear thrips, *Taeniothrips inconsequens*, is found only associated with the fruit-growing areas of British Columbia, Ontario and southwestern Quebec. In North America, this insect was first introduced into California and later on the eastern seaboard of the United States of America. From these two areas, the pear thrips migrated northwards to British Columbia and to Quebec in the west and east respectively. Some species, e.g., *Thrips tabaci, Frankliniella tritici* and *Aeolothrips fasciatus*, however, have invaded the entire country where suitable host plants and ecological conditions are to be found. *A. fasciatus*, however, has several close relatives

that are indigenous to the western parts of North America and, in addition, the European *A. fasciatus* appears to constitute a species-complex rather than a single species. One may therefore say that this group, both native and introduced forms, is a complicated one involving many unsolved taxonomic and distributional problems.

Most of those species originally from the tropics, e.g., *Heliothrips haemorrhoidalis, Hercinothrips femoralis, Parthenothrips dracaenae* and *Scirtothrips longipennis*, have been seen only in greenhouses. Nevertheless, two species, *Thrips simplex*, from tropical Africa and *Thrips tabaci*, from southern Europe and North Africa, have adapted themselves to the cooler climate to the extent of overwintering outdoors in Canada.

All of the species so far mentioned have been present in Canada for many years (possibly all of them since before the turn of the century). Some species, however, have been more recently introduced. *Limothrips consimilis* was first found in the late 1960's (Huntsinger, 1971). Species such as *Belothrips morio, Oxithrips ajugae*, and *Tmetothrips subapterus* were first collected in North America by B.S. Heming in the 1960-70's (Heming, unpubl.) and so they may be very recent introductions. The present study presents the first Canadian record of the European *Odontothrips biuncus*. It is questionable whether or not this introduction is recent since the specimens were collected in relatively little-travelled areas (Northern Ontario and the Quebec Gaspe peninsula).

Hitherto, only introduced species of the suborder Terebrantia have been mentioned. Two members of the tubuliferan genus *Gynaikothrips ficorum* are restricted to greenhouse tropical plants. On the other hand, *Haplothrips leucanthemi* has followed its host, *Chrysanthemum leucanthemum*, and like it, has become generally distributed throughout the North American continent. The European *Bolothrips bicolor*, found on native as well as naturalized grasses, has also spread quickly over a wide area since its introduction into the eastern United States about the year 1913 (Hood, 1914).

All other introduced species of the family Phlaeothripidae live either on fungi or on decaying matter. Such habitats do not seem to encourage movement of the inhabitants, so that the spread of these species has been much slower than that of the flower-dwellers. *Bolothrips dentipes* is found only in marshy areas and its spread has therefore been limited. Curiously, more locality records exist for the species *Hoplothrips japonicus* and *H. corticis* than for the other remaining species of introduced saprophytic Phlaeothripidae. Both of these species have been found associated with fungi growing on trees, so that they may indeed have become more widely and rapidly distributed than the others because of their meeting with air currents. On the other hand, it many merely be that this habitat is an easier one for the collector to study than that of the forest litter, and this could give a false impression of relative abundance.

Taxonomic problems

With further collection, especially in areas such as southern Ontario and Quebec, many new species would undoubtedly be found. The Canadian fauna will not approach the North American totals (980 species in 149 genera and 5 families) because of the cooler climate and less diversified vegetation. The climate prevents many species of thrips from overwintering in Canada. The abundant species, *Frankliniella tritici* has not been found overwintering north of the southern boundaries of Illinois (Stannard, 1968); this species apparently migrates north every spring and many other species most likely follow a similar pattern. Further collection will nevertheless produce new records since many species which have not yet been found in Canada are known to be present in bordering areas of this country (Appendix 3).

Genera such as *Frankliniella, Taeniothrips* and *Thrips* of the Terebrantia are difficult to separate from each other. Thysanopterists such as L.A. Mound, J.M. Palmer, S. Nakahara, K. O'Neill and S. Sakimura, have redefined or are presently attempting to redefine them. *Frankliniella* grades into *Taeniothrips* and *Taeniothrips* into *Thrips* with very subtle differences between 'intermediate' species. In Canada, the *Frankliniella* fauna does not contain such species, so that members of this genus can be distinguished from the others by the eight-segmented antennae, the long anteroangular pair of prothoracic setae, the short midlateral prothoracic setae and by the fore wings (when present) having two longitudinal veins bearing two rows of

evenly set setae.

The genus *Taeniothrips* has been reduced considerably to include only large brown flower-dwelling species which lack accessory abdominal sternal setae and the pair of ocellar setae (Mound *et al.* 1976). Several species which used to be member of this group are now placed in *Ceratothrips*, *Mycterothrips* and *Thrips*.

The genus *Thrips* once comprised species with seven-segmented antennae, and this character was formerly considered to be important in separating members of this genus from *Taeniothrips*. Recently, however, this feature has come to be regarded as unsatisfactory as a distinguishing character. Consequently, species with eight-segmented antennae such as *Taeniothrips atratus, T. simplex, T. vulgatissimus* are now placed in the genus *Thrips*. The main feature which now separates the two genera is the presence of the paired ctenidia (or comb of dentate projections) placed laterally on abodominal terga V-VIII in *Thrips* but absent in *Taeniothrips*.

In the suborder Tubulifera, *Hoplothrips* and *Hoplandrothrips* are presently large and ill-defined groups (Mound *et al.*,1976; Stannard, 1968). It is also difficult to distinguish between members of these two genera and those of the genus *Phlaeothrips* (not yet found in Canada but present in the bordering United States of America) (Appendix 3). The relative uniformity and extent of the habitat and the low vagility of these groups produce localized populations in which there is very little gene flow. Hitherto, most nominal

species have been based on but one sample or sometimes on a single specimen, and this has resulted in a large number of 'species' with very subtle differences in characters (Mound, 1976). There is, therefore, a great need for further study of the litter-dwelling thrips fauna in order to obtain a better understanding of the relationship between so-called species and between genera.

CONCLUSION

This project has provided much information about the thrips of Canada. The number of species now actually recorded approaches the numbers projected as being likely to occur (considering the greater number of species present in the bordering United States of America). The new list of species, the descriptions and illustrations of each genus found in Canada, in addition to comprehensive keys to these genera should make the study of these tiny insects more accessible. It is intended that this information along with notes on localities, habitats, distribution, host plants, predator-parasite relationships; economic importance will stimulate research on this group. Work is now needed on thrips of the forest habitat, of regions presently uncollected i.e. the maritimes, the arctic and subarctic regions, on their overwintering tactics in this country and on their association with fungus, galls and predators and parasites.

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TABLE I

Recorded and estimated numbers of genera and species of Thysanoptera present in Canada

	No. of spp. recorded from Canada	No. of undescribed spp. found in Canada	No. of genera recorded from Canada	Estimated[1] no. of Canadian spp. unrecorded
Suborder Terebrantia				
Aeolothripidae	16 (13[2])	2	3	4
Heterothripidae	1 (0)	0	1	6
Merothripidae	0 (0)	0	0	1
Thripidae	81 (59)	17	33 (1 undescribed)	39
Suborder Tubulifera				
Phlaeothripidae	45 (30)	12	20	21
TOTALS	143 (102)	31	57	71

[1]Based on records from the bordering U.S.A. (Appendix 3)

[2]Figures from Heming (1979)

PLATE I

Thysanoptera- Terebrantia

Abbrevations: a-*antenna*; ios-*interocellar seta*; *h-head*; pn-*pronotum*; msn-*mesonotum*; mtn-*metanotum*; *f-femora*; ti-*tibia*; ta-*tarsus*; ab-*abdomen*; ds-*dorsal slit*.

Figure: 1- *Limothrips denticornis* sp. total view, dorsal aspect (adapted from Huntsinger *et al.*, 1982)

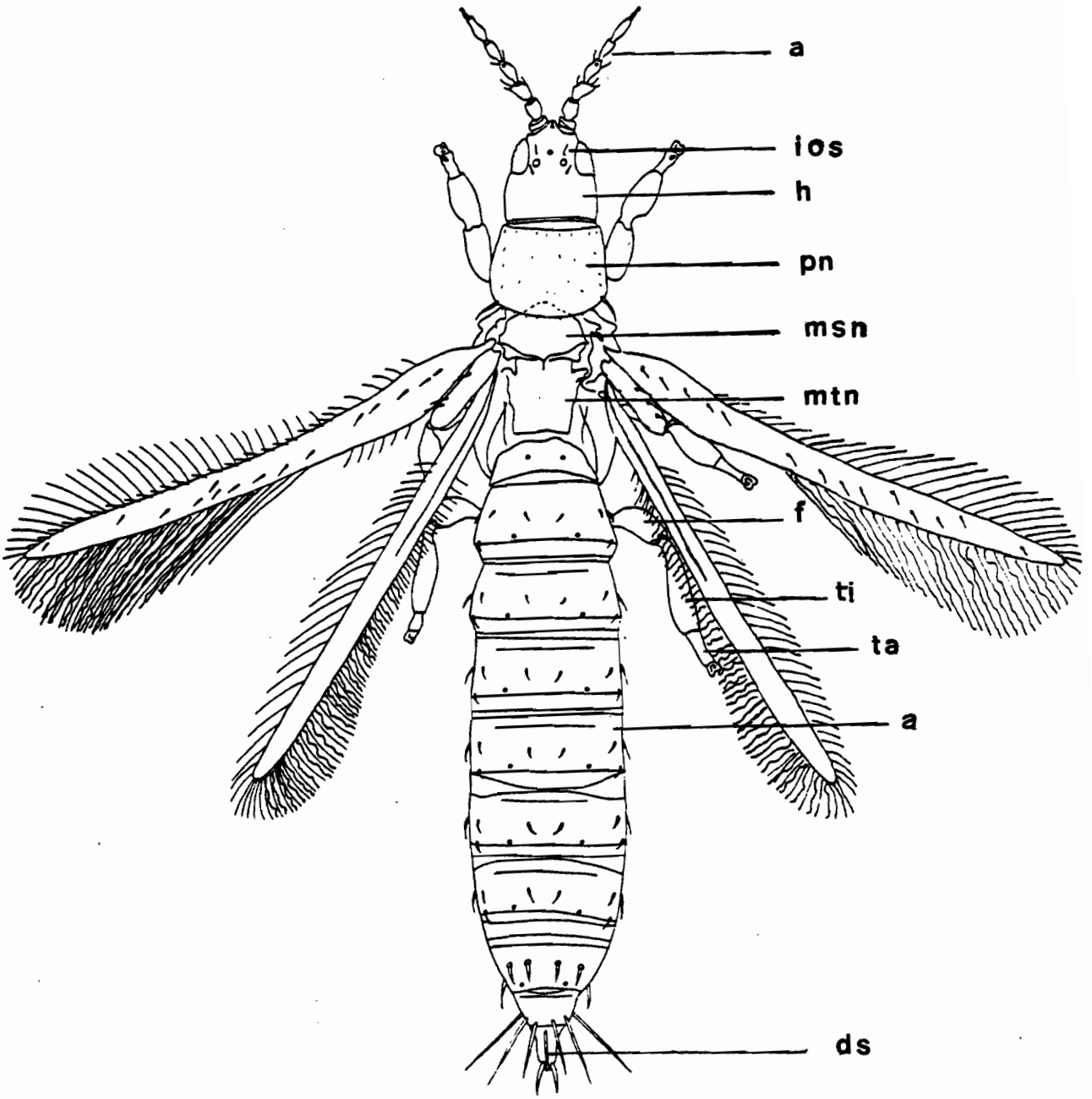

a
ios
h
pn
msn
mtn
f
ti
ta
a
ds

PLATE II

Thysanoptera - Tubulifera

Abbrevations: a-*antenna*; afc-*accessory fringe cilia*; pn-*pronotum*; msn-*mesonotum*; mtn-*metanotum*; p-*pelta*; whs-*wing-holding seta*; as-*anal seta*; t-*tube*.

Figure: 2- *Hoplandrothrips* sp. total view, dorsal aspect (from Thomasson and Post, 1966)

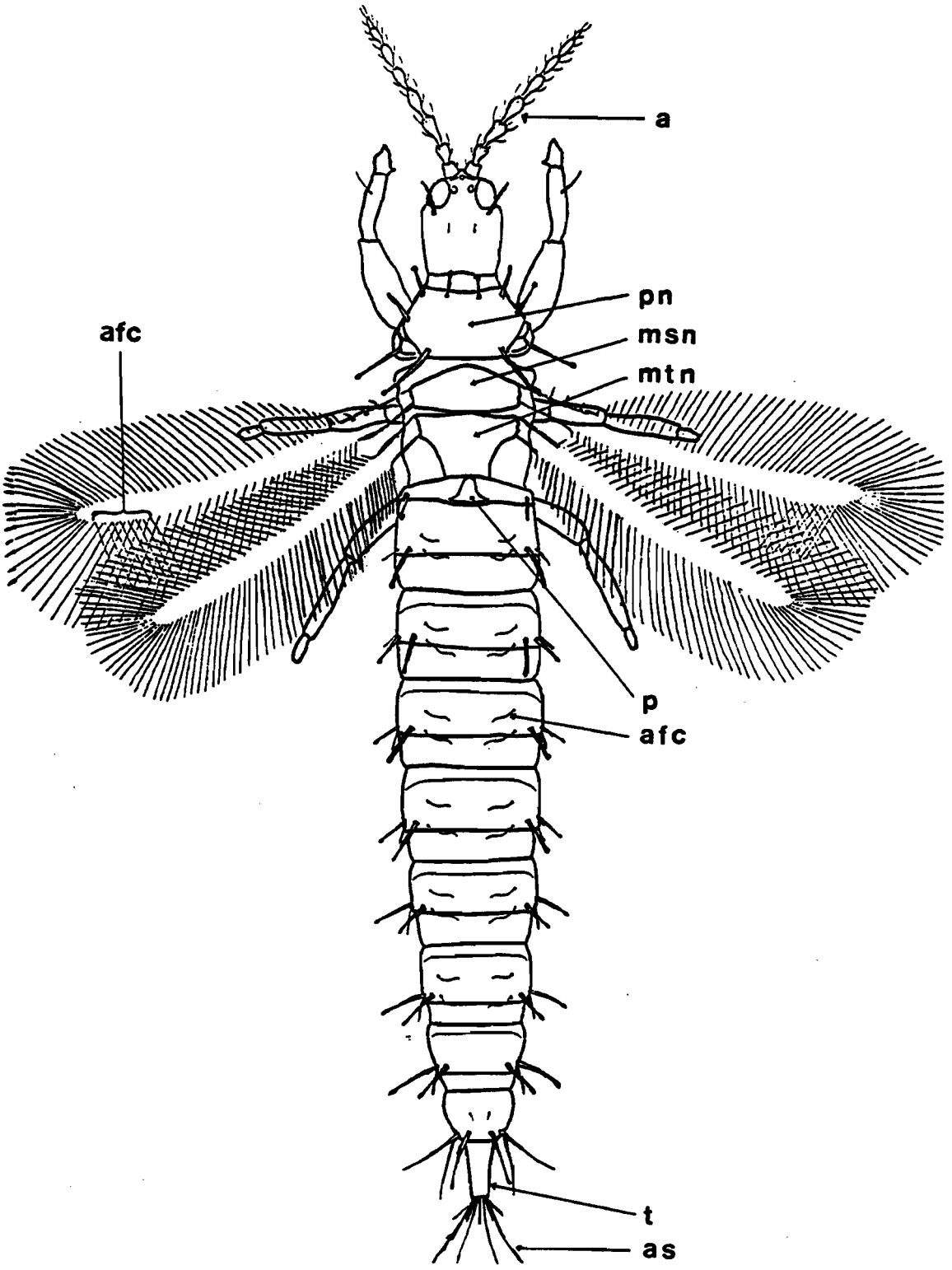

a
pn
msn
mtn
afc
p
afc
t
as

PLATE III

Thysanoptera general

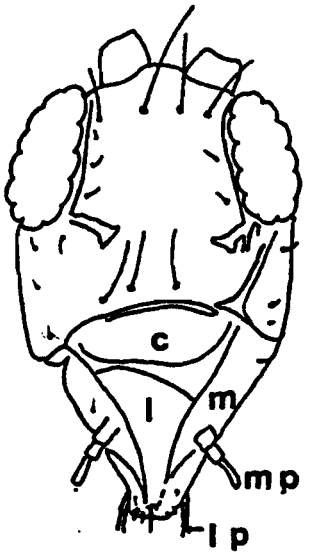
Abbrevations: c-*clypeus*; l-*labrum*; m-*maxilla*; mp-*maxillary palp*; lp-*labial palp*; mpr-*maxillary pillar*; mg-*maxillary guide*; s-*maxillary stylet*; am-*anteromarginal seta*; aa-*anteroangular seta*; es-*epimeral suture*; e se-*epimeral seta*; pa-*posteroangular seta*; pm-*posteromarginal seta*; pp-*praepectus*; bs-*basisternum*; sp-*prospinasternum*; mps-*mesopraesternum*.

Figures: 3- *Thrips* sp. head, frontal aspect (adapted from Bournier, 1983)

4- maxillary stylets and accessory structures (diagrammatic sketch from Stannard, 1957)

5- *Haplothrips faurei* pronotum, dorsal aspect (adapted from Thomasson and Post, 1966)

6- *Bolothrips bicolor* pro- and mesosterna, ventral aspect (from Thomasson and Post, 1966)



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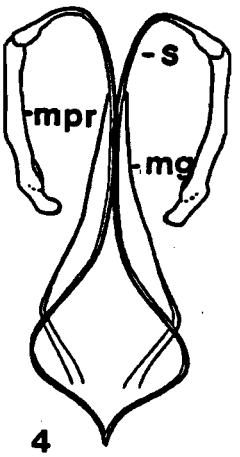

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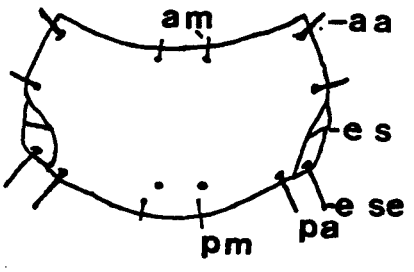

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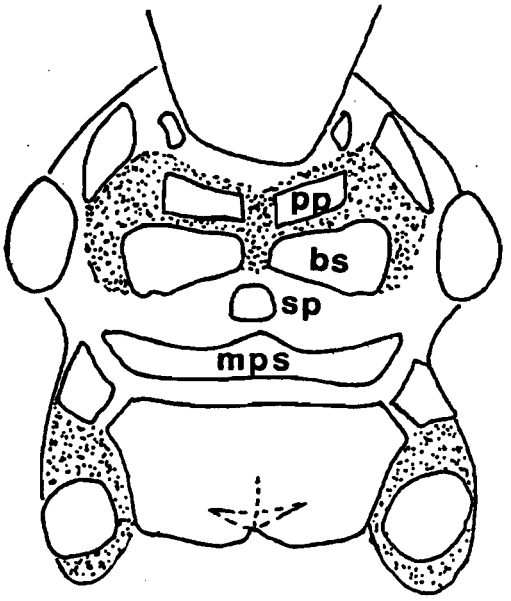

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PLATE IV

Thysanoptera - general

Abbrevation: f- *fustis*

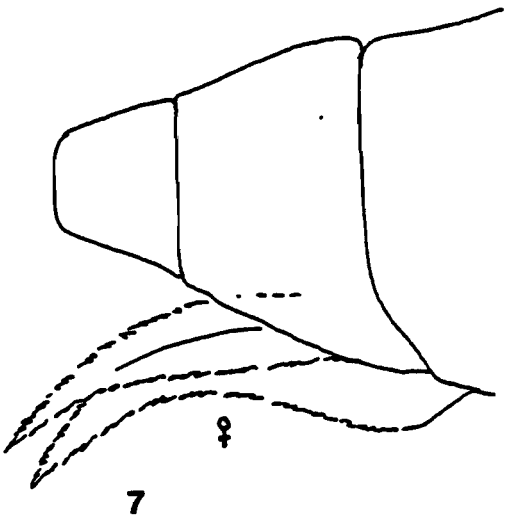
Figures: 7- Thripoidea ovipositor

8- Aeolothripoidea ovipositor

9- *Ceratothrips ericae* male abdominal sterna III-IX/X (from O'Neill and Bigelow, 1964)

10- *Hoplothrips pergandei* female abdominal sterna IX-X (from Stannard, 1968)

11- *H. pergandei* male abdominal sterna IX-X (from Stannard, 1968)



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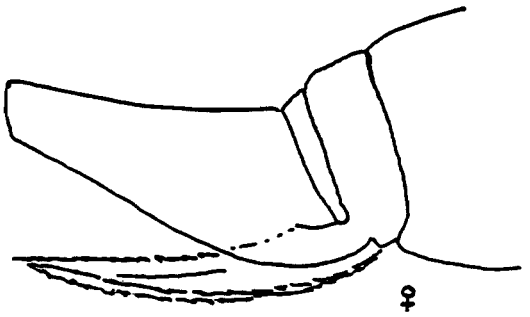

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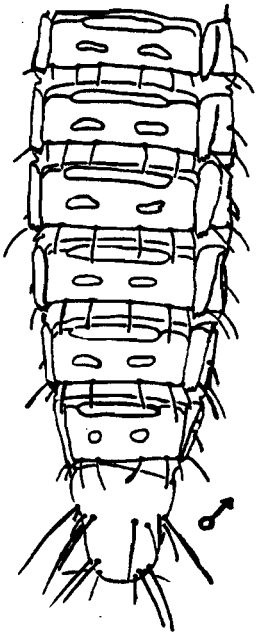

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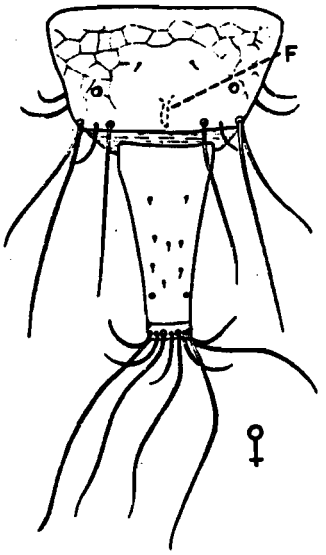

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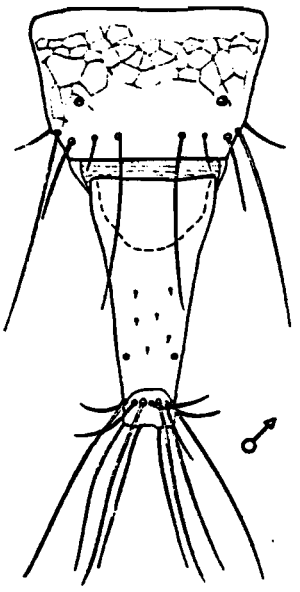

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PLATE V

Terebrantia

Abbrevations: sn-*sensoria*; cb-*cocoon-breaking hooks*

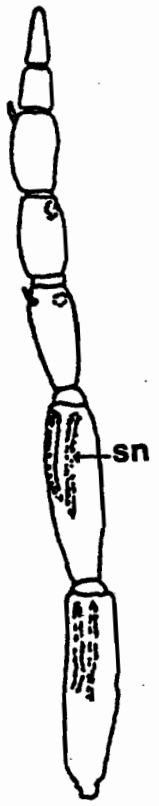
Figures: 12- *Orothrips kelloggi* antennal segments III-IX (adapted from Bailey, 1957)

13- *Aeolothrips nasturtii* antenna

14- *A. fasciatus* fore wing

15- *A. melaleucus* right fore leg

16- *Rhipidothrips gratiosus* head and pronotum, dorsal aspect



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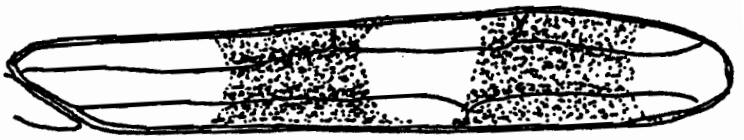

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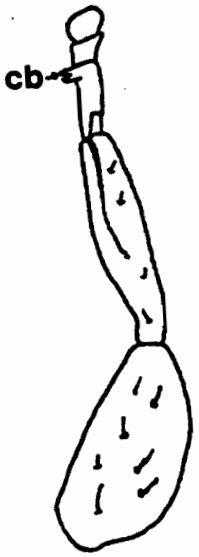

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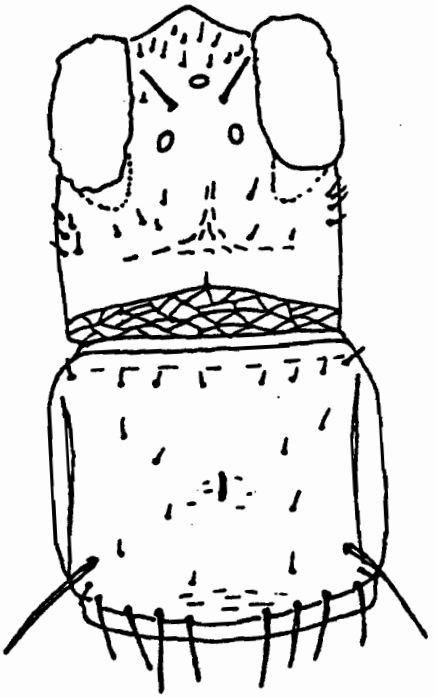

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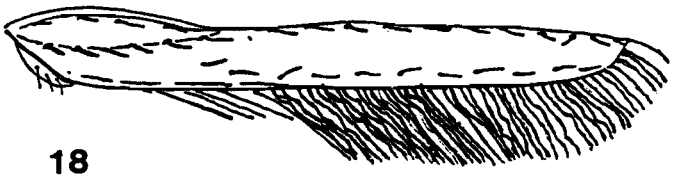
PLATE VI

Terebrantia

Figures 17- *Heterothrips arisaemae* antenna
18- *Parthenothrips dracaenae* fore wing
19- *Hercinothrips femoralis* fore wing
20- *Heliothrips haemorrhoidalis* fore wing
21- *H. haemorrhoidalis* head and pronotum dorsal aspect
22- *Caliothrips fasciatus*, head and pronotum, dorsal aspect

17



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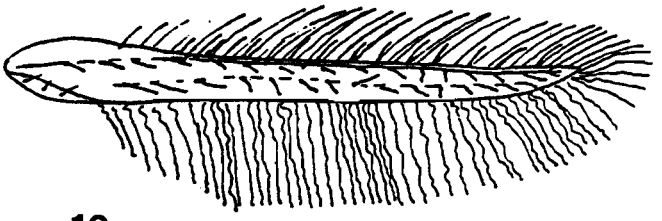

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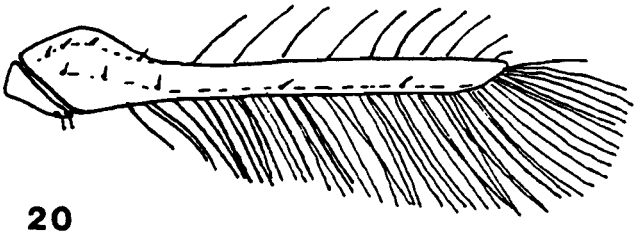

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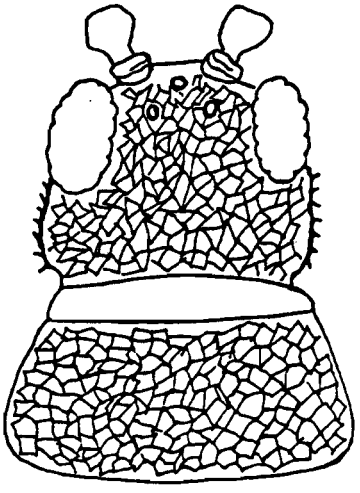

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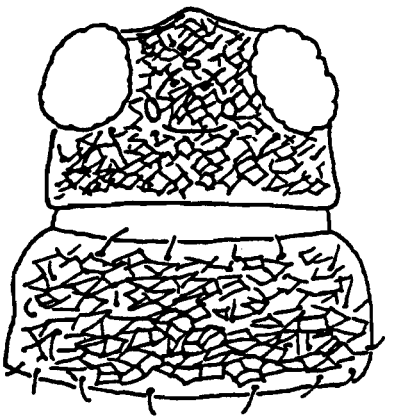

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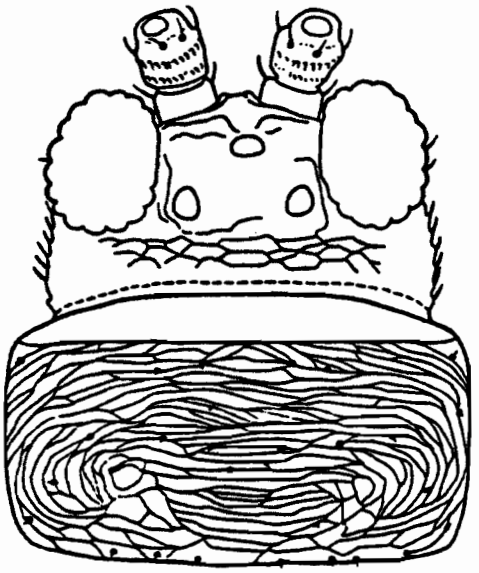
PLATE VII

Terebrantia

Figures: 23- *Dendrothrips ornatus* head and pronotum, dorsal aspect (from Stannard, 1968)
24- *Leucothrips pierci* head and pronotum, dorsal aspect (from Stannard, 1968).
25- *Sericothrips sambuci* head and pronotum, dorsal aspect.
26- *Chirothrips alexanderae* head and pronotum, dorsal aspect
27- *Sericothrips* sp. tergite III



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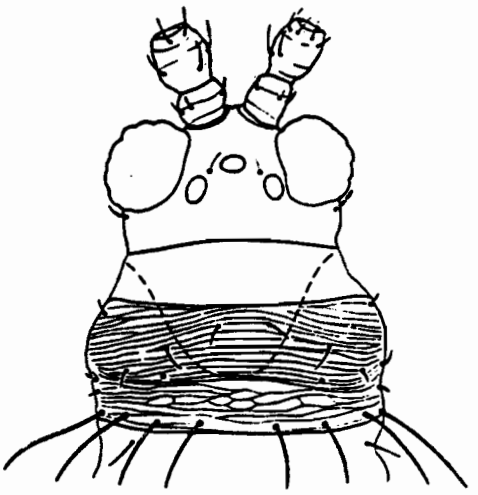

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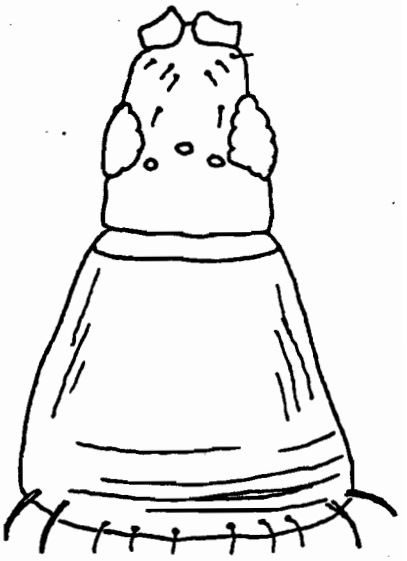

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PLATE VIII

Terebrantia

Figures: 28- *Chirothrips patruelis* antenna
29- *Limothrips consimilis* antenna
30- *L. denticornis* antenna
31- *Anaphothrips* sp. antenna
32- *A. obscurus* head and pronotum, dorsal aspect.
33- *Apterothrips secticornis* female sternite IV (adapted from Mound *et al.*, 1976)
34- *Limothrips consimilis* male tip of abdomen

28

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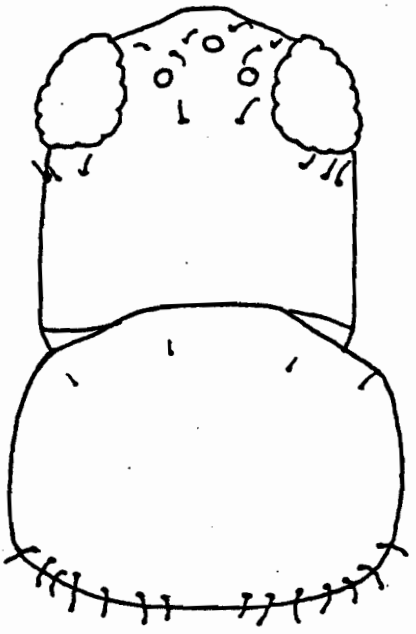

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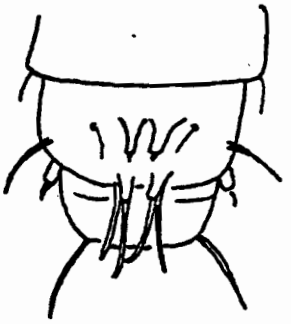

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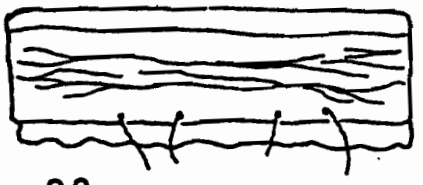

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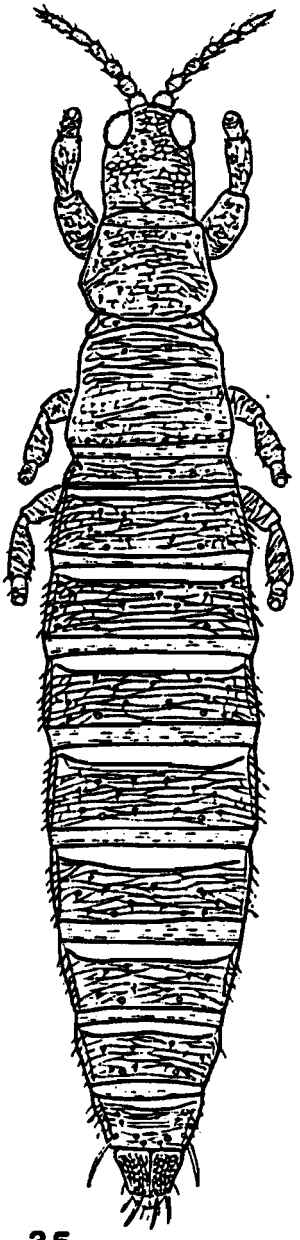
PLATE IX

Terebrantia

Figures: 35- *Aptinothrips rufus* nominate form, total view, dorsal aspect (from Stannard, 1968)
36- *Chilothrips pini* head and pronotum, dorsal aspect (from Stannard, 1968)
37- *Oxythrips ajugae* head and pronotum, dorsal aspect
38- *Oxythrips ajugae* male tip of abdomen



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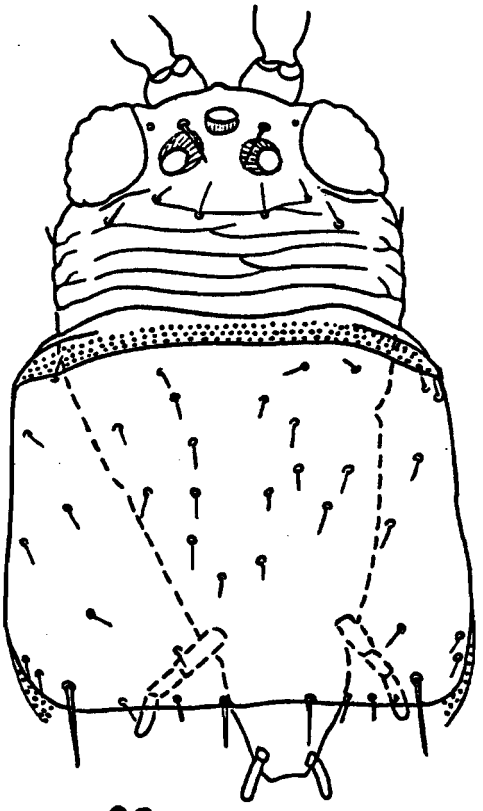

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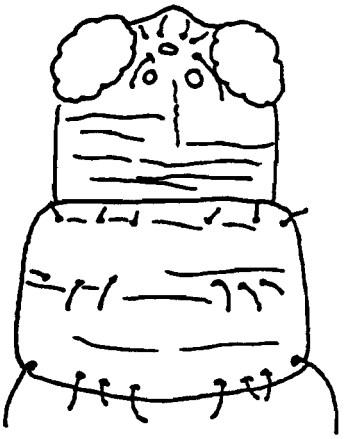

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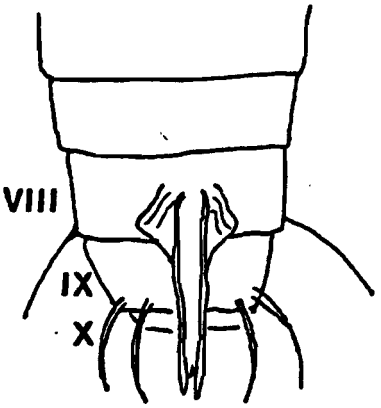

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PLATE X

Terebrantia

Figures: 39- *Tmetothrips subapterus* head and pronotum, dorsal aspect (from Mound *et al.*, 1976)
40- *Baliothrips dispar*, antenna
41- *Catinathrips kainos* head and pronotum, dorsal aspect
42- *Ceratothrips frici* head and pronotum, dorsal aspect (from O'Neill and Bigelow, 1964)
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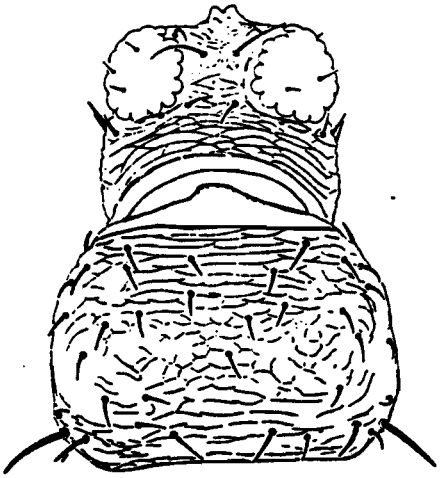
44- *Frankliniella vaccinii* head and pronotum, dorsal aspect
45- *F. tritici* female abdominal segments VII-X, dorsal aspect



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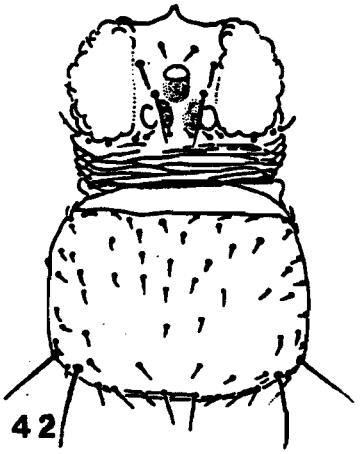

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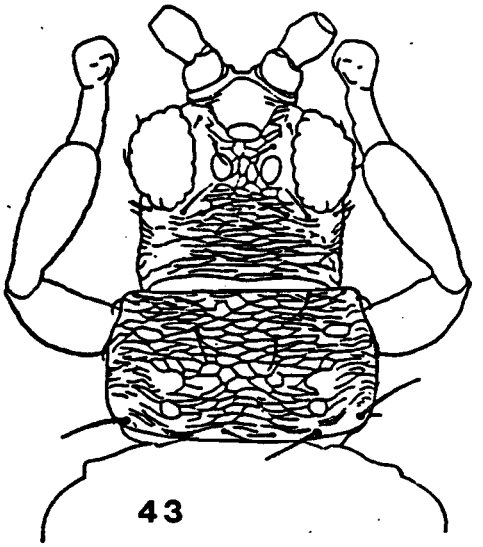

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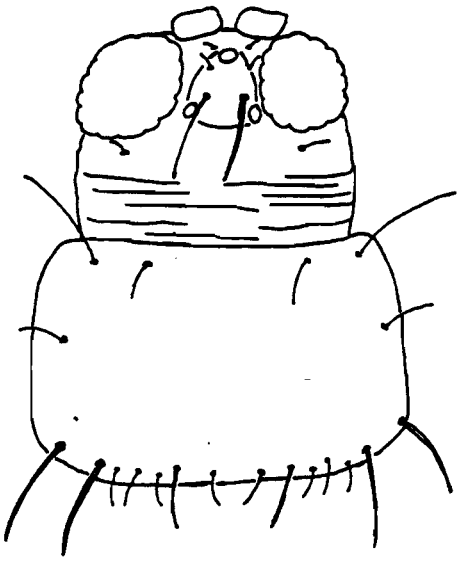

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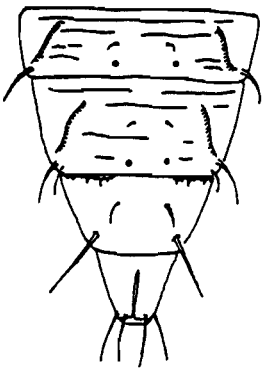

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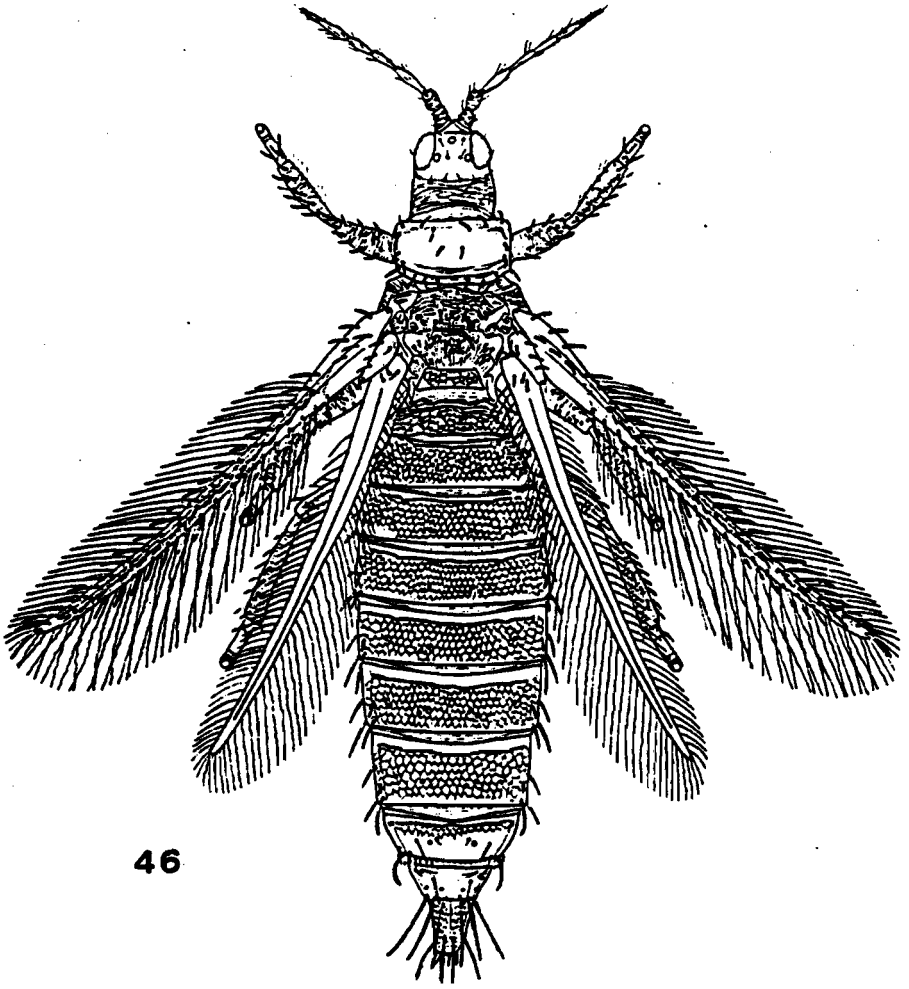
PLATE XI

Terebrantia

Figures: 46- *Ctenothrips bridwelli* total view, dorsal aspect (from Stannard, 1968)
47- *Mycterothrips salicis* head, dorsal aspect
48- *M. albus* male antenna (adapted from O'Neill, 1972b)
49- *M. albus* female antenna (from O'Neill, 1972b)



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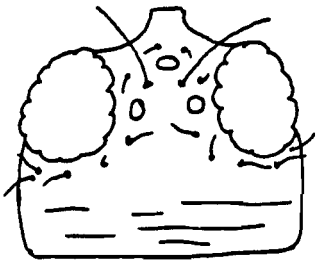

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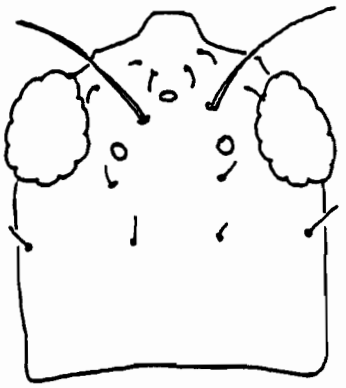
PLATE XII

Terebrantia

Figures: 50- *Iridothrips iridis* head, dorsal aspect
51- *Odontothrips biuncus* right fore tarsus
52- *O. loti* antennal segments VI-VIII
53- *Pezothrips dianthi* male abdominal sterna III-X (from O'Neill and Bigelow, 1964)
54- *Taeniothrips orinonis* abdominal tergum VIII
55- *Thrips vulgatissimus* abdominal sternum VI



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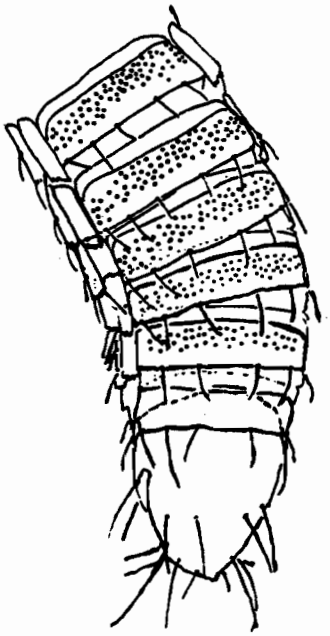

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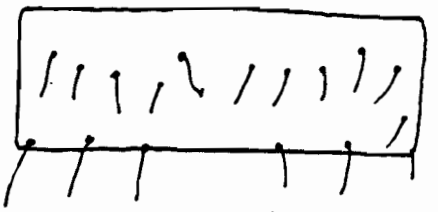

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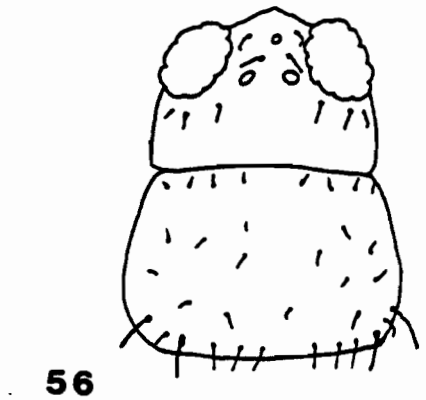
PLATE XIII

Terebrantia

Figures: 56- *Thrips tabaci* head and pronotum, dorsal aspect
57- *T. monotropae* head and pronotum, dorsal aspect
58- *T. vulgatissimus* fore wing
59- *T. dilatatus* antenna
60- *T. atratus* antenna
61- *Toxonothrips gramineae* male abdominal terga VI-IX/X (adapted from Bailey and Kono, 1966)



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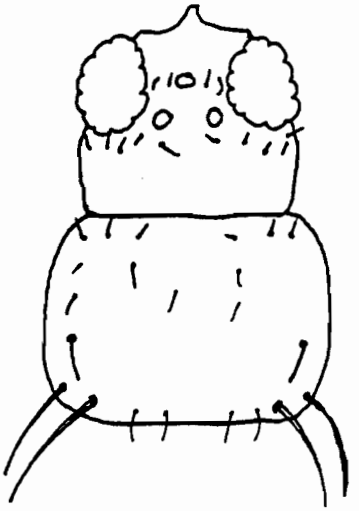

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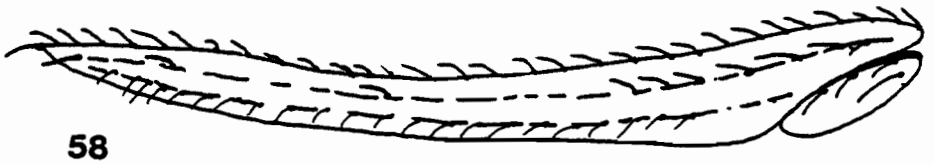

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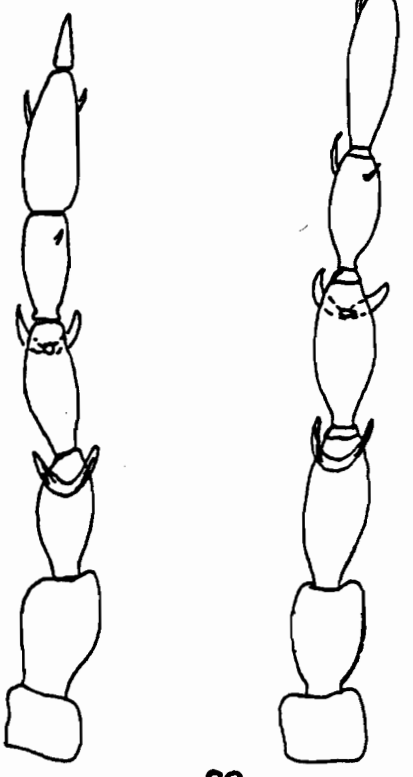

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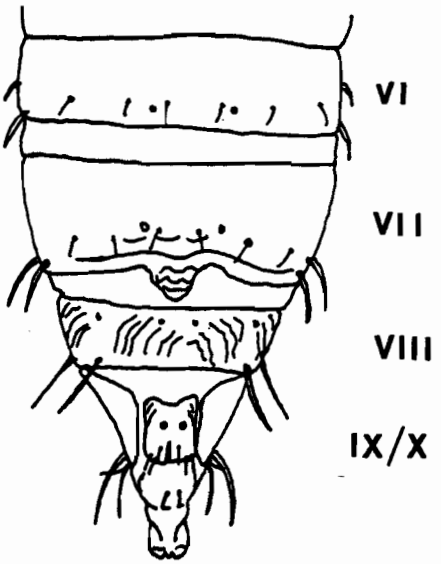

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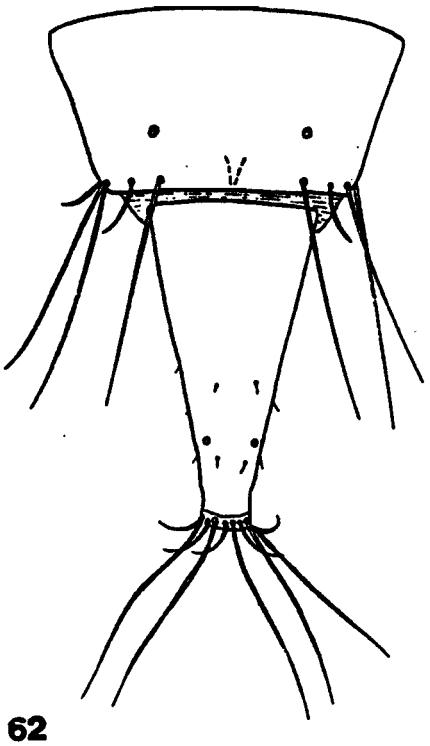
PLATE XIV

Tubulifera

Figures: 62- *Bolothrips bicolor* female abdominal terga IX-X (from Stannard, 1968)
63- *Bolothrips bicolor* head and pronotum, dorsal aspect (from Stannard, 1968)
64- *B. schaferi* pelta
65- *Cryptothrips rectangularis* head and pronotum, dorsal aspect
66- *Compsothrips yosemitae* thorax



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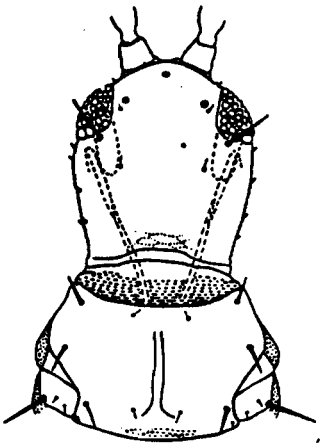

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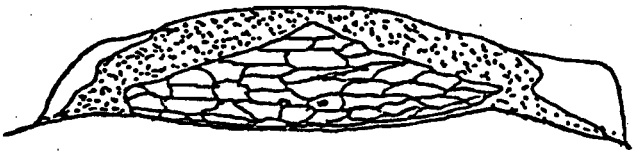

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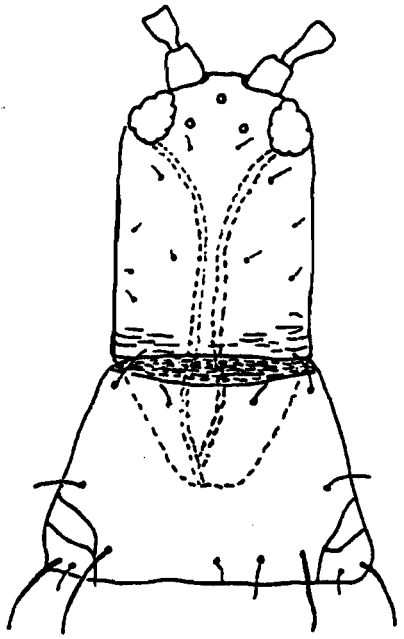

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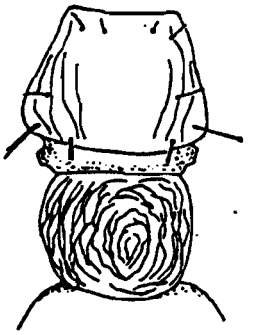

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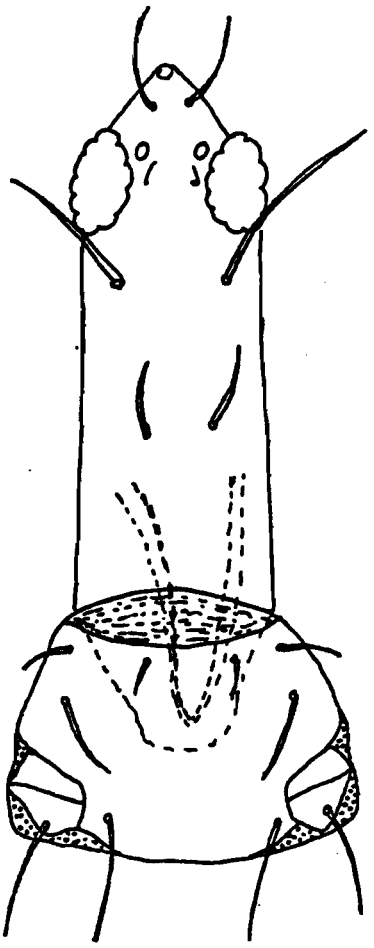
PLATE XV

Tubulifera

Figures: 67- *Elaphrothrips armatus* head and prnotum (Stannard, 1968)
68- *Cryptothrips rectangularis* pelta (Stannard, 1957)
69- *Megalothrips spinosus* head and pronotum (Stannard, 1968)
70- *M. spinosus* pelta (Stannard, 1968)
71- *M. spinosus* thorax
72- *Megathrips lativentris* pelta (Stannard, 1968)



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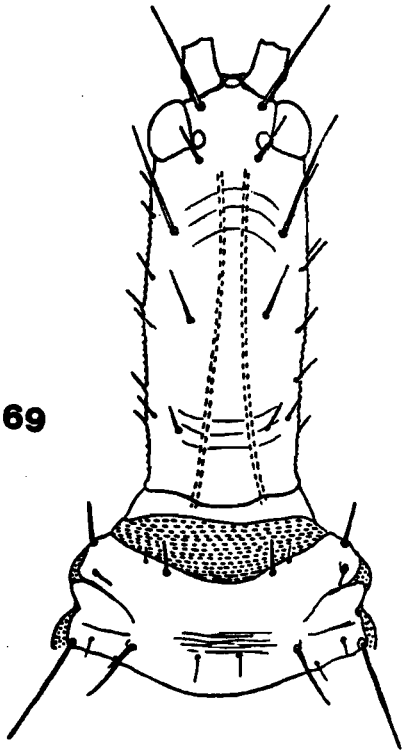

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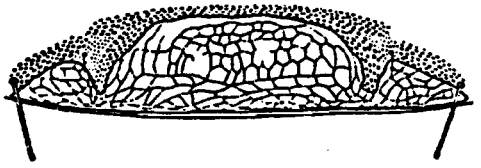

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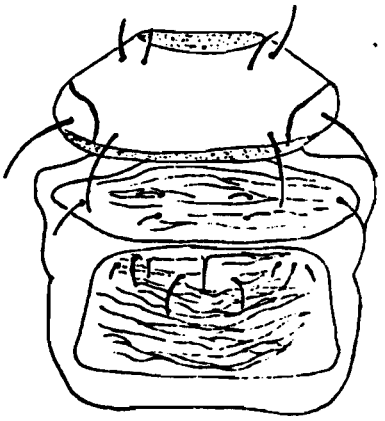

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PLATE XVI

Tubulifera

Figures: 73- *Acanthothrips* sp. antenna (Stannard, 1968)
74- *Acanthothrips* sp. pelta (Stannard, 1957)
75- *Acanthothrips nodicornis* head and pronotum (Stannard, 1968)
76- *Cephalothrips monilicornis* head and pronotum
77- *Gnophothrips fuscus* head and pronotum
78- *Gynaikothrips* sp. pelta (Stannard, 1957)

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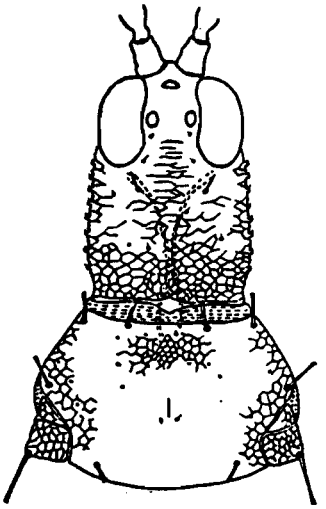

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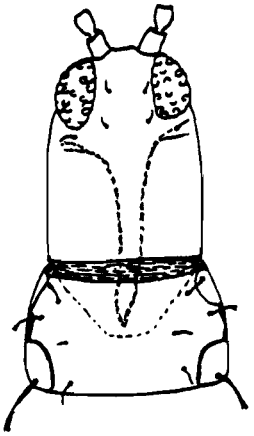

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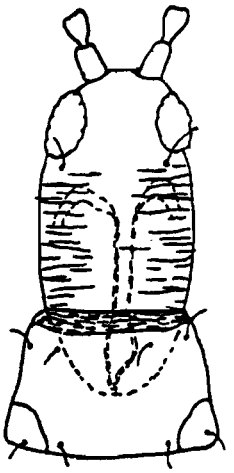

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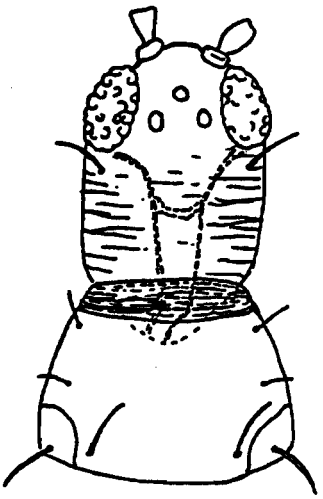
PLATE XVII

Tubulifera

Figures: 79- *Haplothrips faurei* head and pronotum
80- *Haplothrips distalis* pelta
81- *H. statices* pelta
82- *Cephalothrips monilocornis* antenna (from Cott, 1956)
83- *Hoplothrips* sp. antenna (from Cott, 1956)
84- *Haplothrips* sp. right fore wing (from Cott, 1956)



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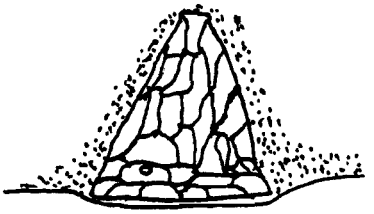

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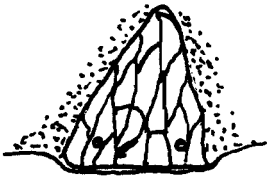

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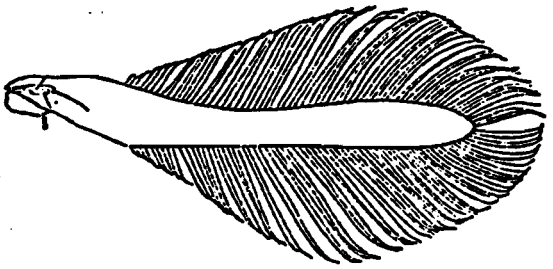

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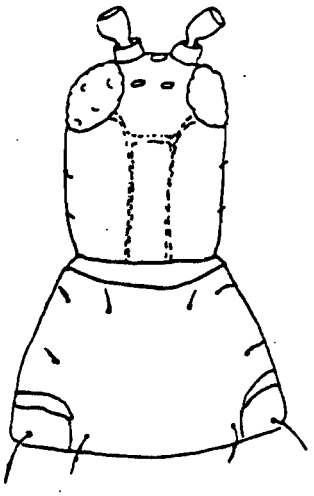
PLATE XVIII

Tubulifera

Figures: 85- *Haplothrips leucanthemi* head and pronotum
86- *Hoplandrothrips pergandei* pelta (Stannard, 1968)
87- *Hoplothrips pergandei* total view, dorsal aspect (Stannard, 1968)
88- *Hoplothrips* sp. right fore wing (from Cott, 1956)
89- *H. pergandei* pelta



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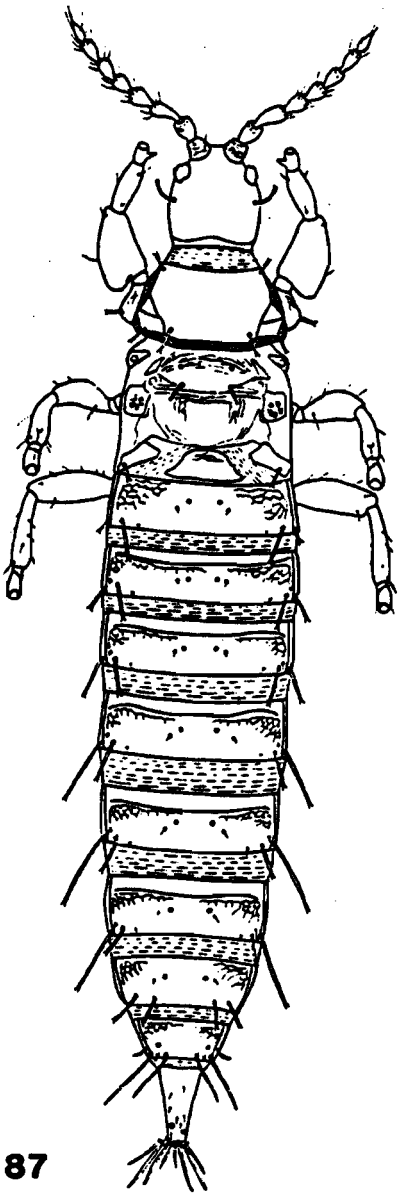

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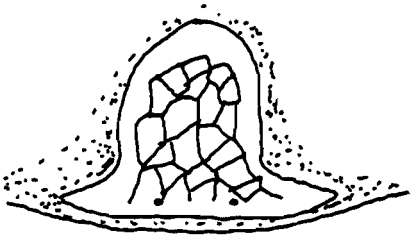

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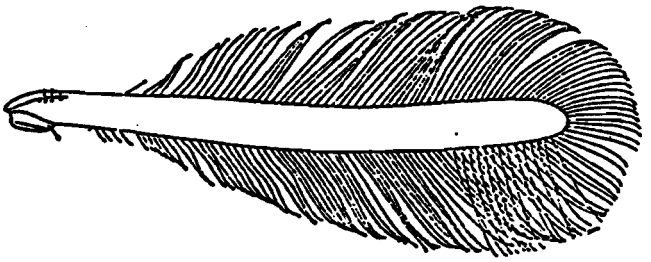

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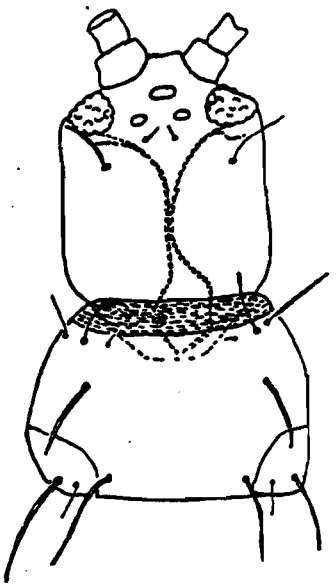
PLATE XIX

Tubulifera

Figures: 90- *Hoplothrips corticis* head and pronotum
91- *Leptothrips mali* nead and pronotum
92- *Leptothrips mali* pelta (from Stannard, 1968)
93- *Leptothrips mali* thorax and abdominal segment I
94- *Liothrips russelli* pelta
95- *L. citricornis* pelta (from Stannard. 1968)



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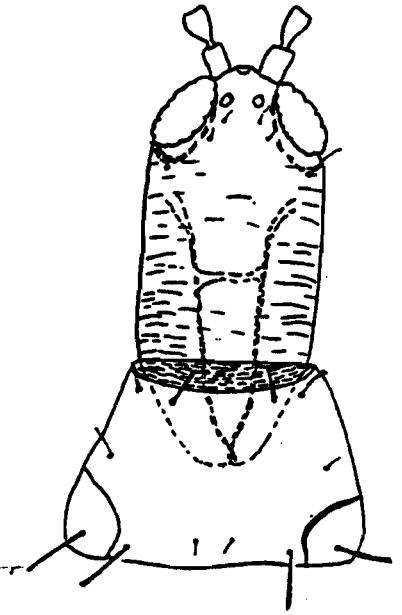

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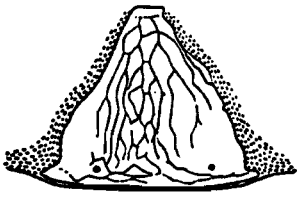

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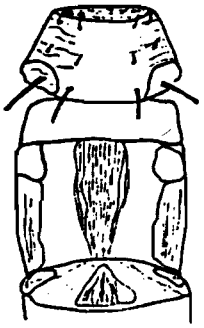

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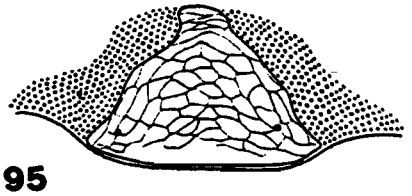

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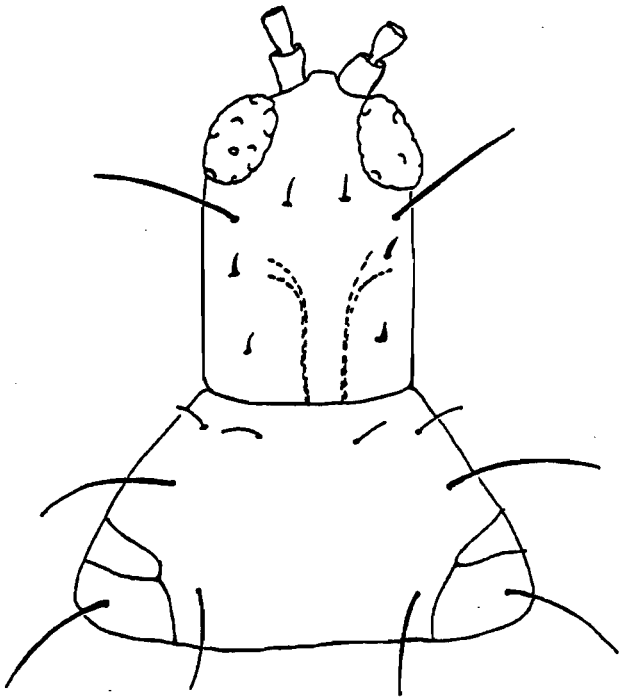
PLATE XX

Tubulifera

Figures: 96- *Liothrips citricornis* head and pronotum, dorsal aspect
97- *Lispothrips brevicruralis* head and pronotum, dorsal aspect
98- *Liothrips russelli* thorax and abdominal segment I, dorsal aspect
99- *Lispothrips* sp. pelta (from Stannard, 1957)
100- *Lissothrips muscorum* pelta (from Stannard, 1968)
101- *Lissothrips muscorum* head and pronotum, dorsal aspect
102- *Poecilothrips albopictus* head, frontal aspect (from Stannard, 1968)



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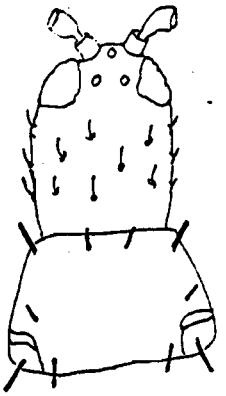

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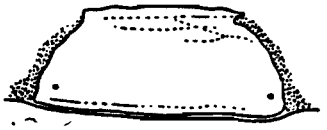

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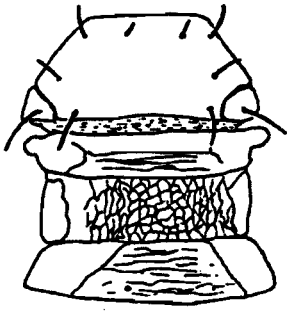

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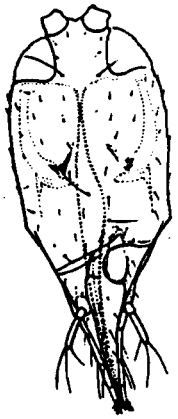

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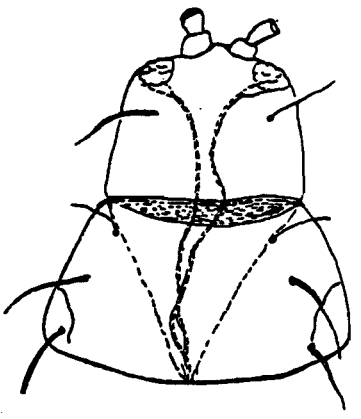

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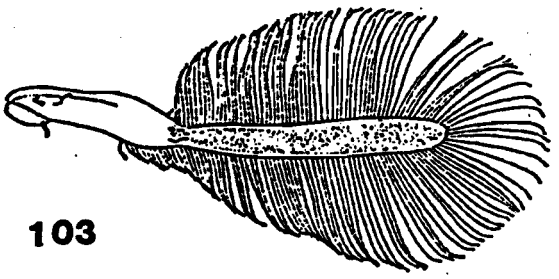
PLATE XXI

Tubulifera

Figures: 103- *Stictothrips maculatus* right fore wing (from Cott, 1956)
104- *Trachythrips watsoni* total view, dorsal aspect (from Stannard, 1968)
105- *Trachythrips watsoni* antenna (from Stannard, 1968)



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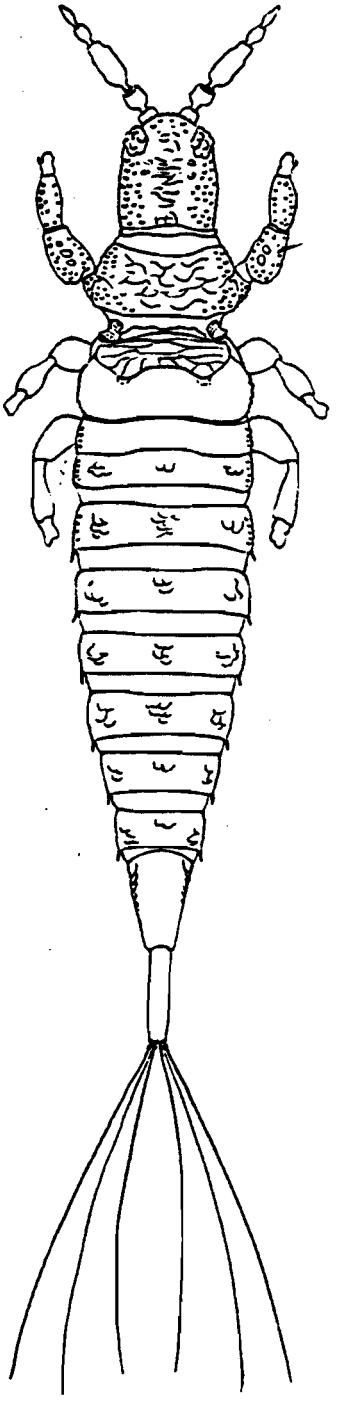

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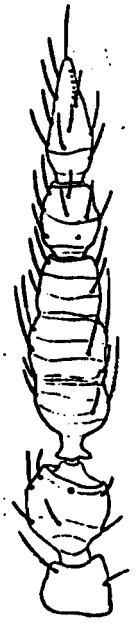

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APPENDIX 1

LIST OF THYSANOPTERA KNOWN TO OCCUR IN CANADA

The following is the compiled list of Thysanoptera recorded from Canada, Alaska and Greenland, along with information on locality and habitat. Alaska and Greenland were included in this list since these areas are geographically related to Canada if not politically. Records from regions south of the Canadian border are enumerated in Appendix 3. In this text, the term 'finding place' is used instead of 'habitat', as in Morison (1947), to indicate the place where the thrips have been collected. This is a general term which encompasses all possible answers, e.g. pantrap, sweep net, indoors, as well as those describing particular habitats.

Superorder Thysanopteroidea Weber, 1933

Order Thysanoptera Haliday, 1836

Suborder Terebrantia Haliday, 1836

Superfamily Aeolothripoidea (Uzel, 1895) Hood, 1915

Family Aeolothripidae Uzel, 1895

Subfamily Aeolothripinae (Uzel,1895) Bagnall, 1913

Tribe Orothripini (Bagnall, 1913) Priesner, 1939

1-*Orothrips* Moulton, 1907

1-*kelloggi* Moulton,1907 F

Locality: Malahat, Vancouver Island, B.C.; Salt Spring Island, B.C.

Finding place: fruit trees, madrone, arbutus flowers

2-*yosemitei* Moulton, 1911 F

Locality: Mt. McLean, Lillooet, B.C.

Finding place: fruit trees, oak, grasses, *Amelanchier* sp.

Tribe Aeolothripini (Uzel, 1895) Priesner, 1939

II-*Aeolothrips* Haliday, 1836

3-*albicinctus* Haliday, 1836 F

Locality: Cochrane, Cochrane Co., Ont.; Harrington Lake, Que.; Nova Scotia

Finding place: pantrap in field; sedges; grasses; apple trees

4-*auricestus* Treherne, 1919 F

Locality: Vernon, B.C.; Kelowna, B.C.

Finding place: *Elymus* sp., rye grass, grasses

5-*duvali* Moulton, 1927 F

Locality: Alberta

Finding place: unknown

6-*fasciatus* (Linnaeus, 1758) F

Locality: Ste Anne de Bellevue, Que.; St-Mathieu, Rimouski Co., Que.; Burlington, Halton Co., Ont.; Oro, Simcoe Co., Ont.; Kapuskasing, Cochrane Co., Ont.; Grimsby, Ont.; Vernon, B.C.; Lillooet, B.C.; Midday Valley, B.C.;

Agassiz, B.C.; Vernon, B.C.; Victoria, B.C.; Waterton Lake, Alb.; Lethbridge, Alb.; Treesbank, Man.

Finding place: *Taraxacum officinale, Trifolium repens, Lotus corniculatus, Elymus* sp., *Prunus* sp., *Solidago* sp., Brassicaceae, sweeping lawn, wild rose, *Lithospermum* sp., cherry, *Amelanchier* sp., *Crataegus* sp., dahlia, strawberry, peach

7-*hartleyi* Moulton, 1927 F

Locality: Alberta

Finding place: unknown

8-*intermedius* Bagnall, 1934 F

Locality: Alberta

Finding place: unknown

9-*kuwanaii* Moulton, 1907 F

Locality: British Columbia

Finding place: fruit trees, predacious on mites and thrips e.g. *Scirtothrips citri*

10-*melaleucus* (Haliday, 1852) F M

Locality: Nova Scotia; Pinery Provincial Park, Lambton Co., Ont.; St Davids, Ont.; Rougemont, Que.; Kootenay, B.C.; Vernon, B.C.; Kelowna, B.C.; Victoria, B.C.; Steveston, B.C.; Royal Oak, B.C.; Vaseaux Lake, B.C.; Alberta

Finding place: *Acer* sp., *Ribes* sp., *Sambucus racemosa, Viburnum sterilis, Ulex europaeus, Lithospermum* sp., *Amelanchier* sp., apple, alder, cherry, potato flower, through sweeping general vegetation; predacious on thrips and mites

11-*montanus* Bailey, 1951 F

Locality: Alberta

Finding place: unknown

12-*nasturtii* Jones, 1912 F

Locality: Vernon, B.C.; Penticton, B.C.; Vineland Station, Ont.; Alberta

Finding place: wild rye grass, *Gaillardia aristata*, gladioli, flowers of many herbaceous plants

13-*oregonus* Hood, 1935 F

Locality: Alberta

Finding place: unknown

14-*vittatus* Haliday, 1836 F

Locality: Sault Ste Marie, Ont.

Finding place: Scots pine; on tree leaves, probably feeds on aphids

15-*vittipennis* Moulton, 1929 F

Locality: Alberta

Finding place: unknown

16-sp. near *fasciatus* F

Locality: Alaska Hwy, km 1713, Yukon

Finding place: *Dryas* sp.

17-sp. F

Locality: Toronto, Ont.

Finding place: indoors

III-*Rhipidothrips* Uzel, 1895

18-*gratiosus* Uzel, 1895 F

Locality: near Huff's Island, Edward Co., Ont.

Finding place: *Avena sativa*

Superfamily Thripoidea (Stephens, 1829) Karny, 1907

Family Heterothripidae Bagnall, 1912

Tribe Heterothripini (Bagnall, 1912)

IV-*Heterothrips* Hood, 1908

19-*arisaemae* Hood, 1908 F M

Locality: Ste Anne de Bellevue, Que.

Finding place: *Arisaema triphyllum*

Family Thripidae Stephens, 1829

Subfamily Panchaetothripinae Bagnall, 1912

V-*Caliothrips* Daniel, 1904

20-*fasciatus* (Pergande, 1895) F

Locality: Milner, B.C.

Finding place: potato

VI-*Heliothrips* Haliday, 1836

21-*haemorrhoidalis* (Bouche, 1833) F

Locality: Lachine, Que.; Montreal, Que.; Saskatoon, Sask.; Calgary, Alb.

Finding place: pest of numerous greenhouse or indoor plants, e.g. azalea, holy fern, philodendron, Easter lily

VII-*Hercinothrips* Bagnall, 1932

22-*femoralis* (O.M.Reuter, 1891) F

Locality: Vineland, Ont.; Grimsby, Ont.; Saskatoon, Sask.; Alberta

Finding place: pest of numerous greenhouse or indoor plants, e.g. *Cinerarias* sp., Easter lily, tomato

VIII-*Parthenothrips* Uzel, 1895

23-*dracaenae* (Heeger, 1854) F

Locality: Vancouver, B.C.; Fredericton, N.B.

Finding place: pest of numerous greenhouse and indoor plants, e.g. *Ficus elastica*, palm, Liliaceae

Subfamily Thripinae (Stephens, 1829) Karny, 1921

Tribe Dendrothripini Priesner, 1925

IX-*Dendrothrips* Uzel, 1895

24-*ornatus* (Jablonowski, 1894) F

Locality: Ontario

Finding place: *Ligustrum* sp.

X-*Leucothrips* O.M. Reuter, 1904

25-sp. F

Locality: N.W.T. pipeline, Yukon

Finding place: unknown

Tribe Sericothripini (Karny, 1921) Priesner, 1926

Subtribe Sericothripina (Karny, 1921) Priesner, 1926

XI-*Sericothrips* Haliday, 1836

26-*cingulatus* Hinds, 1902 F

Locality: Birtle, Man.; Fort Whyte, Man.

Finding place: various grasses; under snow on prairie

27-*sambuci* Hood, 1924 F

Locality: Ontario

Finding place: *Sambucus canadensis*, dead leaves, mosses

28-*variabilis* (Beach, 1896) F

Locality: Lillooet, B.C.

Finding place: wide variety of plants, e.g. *Amelanchier* sp., predator of red spider mite

29-near *apicalis* Hood, 1927 F

Locality: Alberta

Finding place: unknown

30-sp. F

Locality: Alberta

Finding place: unknown

31-sp. F M

Locality: Alberta

Finding place: *Shepherdia canadensis*

Subtribe Scirtothripina Priesner, 1957

XII-*Scirtothrips* Shull, 1909

32-*longipennis* Bagnall, 1909 F

Locality: British Columbia

Finding place: in greenhouse on tropical plants, e.g.

begonia, ferns, *Imponoea* sp.,*Pharbitis* sp.

Tribe Chirothripini Priesner, 1957

XIII-*Chirothrips* Haliday, 1836

33-*alexanderae* Stannard, 1959 F

Locality: Hanna, Alb.; Dinosaur Provincial Park, Alb.; Ashcroft, Alb.

Finding place: grass under sage brush

34-*crassus* F

Locality: St-Mathieu, Co. Rimouski, Que.

Finding place: *Lotus corniculatus*

35-*crenulatus* Hood, 1927 F M

Locality: Dinosaur Provincial Park, Alb.; E. of Bellevue, Alb.

Finding place: grasses

36-*cuneuiceps* Hood, 1940 F

Locality: Alsike, Alb.; Rollyy View, Alb.

Finding place: willow; sweep from sedges in seepage area

37-*falsus* Priesner, 1925 F

Locality: Alberta; Saskatoon, Sask.

Finding place: various grasses, e.g. *Bromus* sp.

38-*hamatus* Trybom, 1895 F M

Locality: R.B. Miller Biol. Sta., Alb.

Finding place: sedges

39-*manicatus* (Haliday, 1836) F M

Locality: Bromont, Brome Co., Que.; Harrington Lake, Que.; Katevale, Stanstead Co., Que.; Ste Anne de Bellevue, Que.;

Kentville, N.S.; Vineland, Ont.; Chatham, Ont.; Beamsville, Ont.; Kapuskasing, Ont.; North West Territories; Alberta; Vernon, B.C.

Finding place: *Alopecurus pratensis*, wheat, pear, peach, apple orchards, roadside grasses

40-*patruelis* Hood, 1940 F M

Locality: Sandy Lake, Alb.

Finding place: grasses, wheat, alfalfa

41-*simplex* Hood, 1927 F

Locality: Dinosaur Provincial Park, Alb.

Finding place: sweeping grass

42-near *manicatus* (Haliday, 1836) F

Locality: Nestow, Alb.

Finding place: sweeping beside railroad track in bog

43-near *molestus* Priesner, 1926 F

Locality: Alberta

Finding place: unknown

44-sp. F

Locality: Pinery Provincial Park, Lambton Co., Ont.

Finding place: *Calamovilfa longifolia*

45-sp. F

Locality: Hamilton, Ont.

Finding place: *Quercus* sp.

XIV-*Limothrips* Haliday, 1836

46-*consimilis* Priesner, 1926 F

Locality: Saskatoon, Sask.; Winnipeg, Man.

Finding place: *Bromus inermis*

47-*denticornis* (Haliday, 1836) F M

Locality: Rougemont, Que.; Ste Anne de Bellevue, Que.; Chatham, Que.; Ourigne, Sask.; Bjorkdale, Sask.; Elrose, Sask.; Altmont, Man.; Alberta

Finding place: barley, grass, apple tree

Tribe Thripini (Stephens, 1829) Priesner, 1957

Subtribe Aptinothripina (Karny, 1921)

XV-*Anaphothrips* Uzel, 1895

Subgenus *Anaphothrips* Uzel, 1895

48-*cameroni* (Bagnall, 1919) F M

Locality: Semans, Sask.; Keewatin, Ont.; Alberta; Alaska

Finding place: wheat stems, grasses, prairie grass

49-*lundbecki* Richter, 1928 F

Locality: Qagssiarssuk, Igaliko-Fjord, West Greenland

Finding place: unknown

50-*obscurus* (Muller, 1776) F

Locality: Burnt Creek, Que.; Ste Anne de Bellevue, Que.; Burlington, Ont.; Vineland, Ont.; Chatham, Ont.; Niagara-on-the-Lake, Ont.; Strathroy, Ont.; Wodford, Alb.; Nova Scotia to British Columbia

Finding place: various grasses, e.g. *Sesbania* sp., *Phleum pratense, Poa* sp., cereals, e.g. wheat, rye, barley, corn; peach, *Avena sativa, Bromus* sp.

51-*stanfordii* (Moulton, 1907) F

Locality: Victoria, British Columbia

Finding place: wild oats, various weeds

52-sp. F

Locality: Hazen Camp, Ellesmere Island 81°49·N, 71°18·W

Finding place: *Arctagrostis latifolia, Agropyron latiglume, Alopecurua alpinus, Poa glauca, Pleuropogon sabinei*

XVI-*Apterothrips* Bagnall, 1908

53-*secticornis* (Trybom, 1896) F

Locality: Lillooet, B.C.; Hebron, Labrador; Indian House Lake, Que.; Masset, Queen Charlotte Islands, B.C.; Qagssiarssuk, West Greenland

Finding place: grasses, wild oats, *Lupinus arcticus, Hordeum jubatum, Taraxacum officinale*

XVII-*Aptinothrips* Haliday, 1836

54-*rufus* (Goeze, 1778) F M

Locality: Hazen Camp, Ellesmere Island 81°49·N, 71°18·W; Qagssiarssuk, Igaliko-Fjord, West Greenland; St Mathieu, Rimouski Co., Que.; Birtle, Man.; Lethbridge, Alb.; Skiff, Alb.

Finding place: *Poa glauca*, *Poa* sp., *Bromus inermis*, wheat, timothy grass, predominantly grasses; under snow on prairie

55-*stylifer* Trybom, 1894 F

Locality: St Mathieu, Rimouski Co., Que.; Ste Anne de Bellevue, Que.; Alsike, Alb.

Finding place: *Medicago sativa*, sedge

XVIII-*Belothrips* Haliday, 1836

56-*morio* O.M. Reuter, 1899 F M

Locality: Alberta

Finding place: unknown

XIX-*Chilothrips* Hood, 1916

57-*pini* Hood, 1916 F M

Locality: Thessalon, Ont.; Alberta

Finding place: white spruce, pine

XX-*Heminanaphothrips* Richter, 1928

58-*postumus* Richter, 1928 F

Locality: Kr-Iraab, Qagssiarssuk, Christiansshaab, West Greenland

Finding place: unknown

XXI-*Oxythrips* Uzel, 1895

Subgenus *Oxythrips* Uzel, 1895

59-*ajugae* Uzel, 1895 F

Locality: Alberta

Finding place: unknown

XXII-*Taetothrips* Amyot et Audinet Serville, 1843

60-*subapterus* (Haliday, 1836) F M

Locality: Edmonton, Alb.

Finding place: unknown

Subtribe Thripina (Stephens, 1829) Priesner, 1957

XXIII-*Baliothrips* Uzel, 1895

61-*dispar* (Haliday, 1836) F M

Locality: Alberta

Finding place: grasses

XXIV-*Catinathrips* O'Neill, 1967

62-*kainos* O'Neill, 1967 F M

Locality: Sudbury, Ont.; New Brunswick, Nova Scotia

Finding place: *Vaccinium* sp.

63-*vaccinophilus* (Hood, 1936) F

Locality: Fredericton, N.B.; Nova Scotia

Finding place: *Vaccinium* sp.

XXV-*Ceratothrips* Reuter, 1899

64-*ericae* (Haliday, 1836) F

Locality: British Columbia

Finding place: *Erica* spp., *Calluna* spp.

65-*frici* (Uzel, 1895) F M

Locality: British Columbia

Finding place: dandelion and other plants

XXVI-*Ctenothrips* Franklin, 1907

66-*bridwelli* Franklin, 1907 F M

Locality: Ste Anne de Bellevue, Que.; Harrington Lake, Que.; Lac Tremblant, Que.; Eardley, Hopkins Hole Bog, Gatineau Park, Que.; Alfred Bog, Prescott Co., Ont.; Mer

Bleu Bog, Carleton Co., Ont.; South March, Carleton Co., Ont.; Deloraine, Man.; Alberta; Vernon, B.C.

Finding place: *Lyschiton ramtschatcense*, bog, sphagnum, under black spruce, litter under white beech and poplar, *Trillium* sp., leaves, forest flowers

XXVII-*Echinothrips* Moulton, 1911

67-*americanus* Morgan, 1913 F

Locality: Quebec

Finding place: jewelweed (*Impatiens* sp.)

68-*subflavus* Hood, 1927 F

Locality: Quebec

Finding place: hemlock

XXVIII-*Franklinella* Karny, 1910

69-*acheta* Hood, 1925 F M

Locality: Indian Head, Sask.; E. Hearle, Sask.; Bellevue, Alb.

Finding place: *Arnica cordifolia*, yarrow, sweeping dry prairie

70-*cephalica* (D.L. Crawford, 1910) F

Locality: Naramata, B.C.; Penticton, B.C.; Vernon, B.C.

Finding place: buckwheat, clover bloom, yarrow, chicory

71-*exigua* Hood, 1925 F

Locality: Aylsham, Sask.

Finding place: rape field

72-*fusca* (Hinds, 1902) F

Locality: Marten River, Temiscamingue Co., Ont.; Alberta

Finding place: large variety of plants including grass, *Trifoloium pratense*; a pest on tobacco and peanuts

73-*intonsa* (Trybom, 1985) F

Locality: Vernon, B.C.

Finding place: *Prunella vulgaris*

74-*minuta* (Moulton, 1907) F

locality: Canada

Finding place: a number of flowering plants

75-*nubila* Treherne, 1924 F M

Locality: Mt. McLean, Lillooet, B.C.; Alberta

Finding place: *Cassiope* sp., moss heather

76-*occidentalis* (Pergande, 1895) F

Locality: Mission, B.C.; Naramata, B.C.; Vernon, B.C.; Agassiz, B.C.; Treesbank, Man.; Vermilion, Alb.; Lethbridge, Alb.; Whitehorse, Yukon

Finding place: broad beans, alfalfa, wild flowers, apple *Rosa acularis*; from a large number of plants, both wild and cultivated

77-*stylosa* Hood, 1912 F M

Locality: Saskatoon, Sask.

Finding place: *Pulsatilla* sp.

78-*tenuicornis* (Uzel, 1895) F M

Locality: Ottawa, Ont.; Oro, Simcoe Co., Ont.

Finding place: cereals, e.g. wheat and oats; a number of grasses and flowers

79-*tritici* (Fitch, 1855) F M

Locality: St Charles des Grondines, Portneuf Co., Que.; Oka, Deux Montagnes Co., Que.; St Jerome, Terrebonne Co.,

Que.; Pierrefonds, Que.; Ste Anne de Bellevue, Que.; Ile Perrot, Que.; Strathroy, Ont.; Stonecliffe, Ont.; Mattice, Cochrane Co., Ont.; Nobleton, York Co., Ont.; Hamilton, Ont.; Straton, Man.; Delta Man.; Semans, Sask,; Lethbridge, Alb.; Okanagan Valley, B. C.; Agassia, B.C.; Vancouver, B.C.; Lillooet, B.c.

Finding place: *Alopecurus pratensis, Taraxacum officinale, Trifolium repens, Amaranthus* sp.,*Philadelphus coronarius, Chrysanthemum leucanthemum, Rhus typhina, Tragopogon pratensis, Lythrum salicaria, Petalostemon purpureum, Rubus idaeus, Lotus acorniculatus, Aster lucidulus, Catalpa bignonioides, Oenothera grandiflora Thlapsi arvense, Sonchus arvensis; Spiraea* sp., wild rose, lilac, rhubarb flower, Cucurbitaceae, day lily, cultivated strawberries, apple tree, peony, blueberry; an extremely large number of plants; bird's nest

80-*vaccinii* Morgan, 1930 F

Locality: Sudbury, Ont.; Charlotte, N.B; Cumberland Co., N.S.

Finding place: *Vaccinium* sp., blueberry

XXIX-*Iridothrips* Priesner, 1940

81-*iridis* (Watson, 1924) F

Locality: Montreal, Que.

Finding place: a pest species on *Iris* sp.

XXX-*Mycterothrips* Trybom, 1910

82-*albus* (Moulton, 1911) F M

Locality: Kelowna, B. C.; Alberta

Finding place: *Amelanchier* sp., peach foliage, forest litter, maple, *Salix* sp., *Bromus* sp.; various plants, trees and flowers

83-*aureus* (Moulton, 1946) F

Locality: Alberta

Finding place: unknown

84-*betulae* (J.C. Crawford, 1939) F M

Locality: Quebec; Alberta

Finding place: *Betula populifolia*, *Salix* spp.

85-*salicis* (O.M. Reuter, 1879) F

Locality: Eardley, Hopkins Hole Bog, Gatineau Park, Que.

Finding place: bog; willows and other trees

86-sp. F

Locality: Caribou Mts, Alberta

Finding place: sedge

XXXI-*Odontothrips* Amyot et Audinet Serville, 1843

87-*biuncus* John, 1921 F

Locality: St Mathieu, Rimouski Co., Que.; Oka, Terrebonne Co., Que.; Kapuskasing, Cochrane Co., Ont.

Finding place: *Vicia cracca*, peony, pantrap in field

88-*loti* (Haliday, 1852) F M

Locality: Kentville, N.S.; St Mathieu, Rimouski Co., Que.; Abbotsford, Que.; Fort Chimo, Que.; Arthabasca, Que.; Cypress Hills, Alt.; Kelowna, B.C.; Malahat, B.C.; Kootenay Bay, B.C.

Finding place: *Lotus corniculatus*

Salix sp.; rye grass, vetch, cherry, *Lupinus* sp., apple

XXXII-*Pezothrips* Karny, 1907 F

89-*dianthi* (Priesner, 1921)

Locality: British Columbia

Finding place: *Dianthus* spp.

XXXIII-*Scolothrips* Hinds, 1902

90-*sexmaculatus* (Pergande, 1890) F

Locality: Chatterton, Ont.

Finding place: predator of red spider mite

XXXIV-*Taeniothrips* Amyot et Audinet Serville, 1843

Subgenus *Taeniothrips* Amyot et Audinet Serville, 1843

91-*inconsequens* (Uzel, 1895) F

Locality: southern Quebec; Beamsville, Ont.; Vineland, Ont.; Stouffville, York Co., Ont.; Royal Oak, B.C.; Keating, B.C.; Gorden Head, B.C.; Agassiz, B.C.; Duncan, B.C.

Finding place: pitfall trap in forest, peaches, plums, cherries, pears, apples, maple, *Acer macrophyllum*, *Taraxacum officinale*

92-*orionis* Treherne, 1924 F M

Locality: Mt. McLean, Lillooet, B.C.; Kenai, Alaska

Finding place: various flowers at high altitude, injuring cabbage, lettuce and potatoes

93-*pini* (Uzel, 1895) F

Locality: Kirkwood Twp., Ont.; shore of Lake Superior, Ont.; Alberta

Finding place: *Pinus* spp., *Picea* spp.; casually on all conifers

XXXV-*Thrips* (Linneaus, 1758)

Subgenus *Thrips* Linneaus, 1758

94-*anemonensis* Moulton, 1936 F

Locality: Birtle, Manitoba

Finding place: *Anemone patens*

95-*atratus* (Haliday, 1836 F M

Locality: Ontario; Mission City, B.C.; Huntingdon, B.C.

Finding place: numerous flowers, especially Caryophyllaceae, Labiatae and Compositae, loganberry

96-*calcaratus* Uzel, 1895 F

Locality: Vineland, Ont.; Stouffville, York Co., Ont.; Ste Anne de Bellevue, Que.

Finding place: pantrap and pitfall trap in forest; *Tilia* sp.; apple

97-*dilatatus* Uzel, 1895 F

Locality: Perkins, Que.; Bells Corners, Ont.

Finding place: Berlese sample in moss, under bark

98-*frostis* Moulton, 1936 F

Locality: Eardley, Hopkins Hole Bog, Gatineau Park, Que.; St Mathieu, Rimouski Co., Que.; Quetico Provincial Park, Ont.

99-*fuscipennis* Haliday, 1836 F

Locality: Klondike Hwy., km 562, Yukon; Ste Anne de Bellevue, Que.; Fort Chimo, Que.; Treesbank, Man.; Vancouver, B.C.; Vaseaux Lake, B.C.; Huntingdon, B.C.; Agassiz, B.C.; North West Territories

Finding place: *Populus* sp., pantrap in hedgerow, rosebuds, blackberry, loganberry, *Acer* sp., flowers of wild plants, soybeans, apple and plum

100-*madroni* Moulton, 1907 F

Locality: Vancouver, B. C.

Finding place: *Rubus parviflorus*, wild rose, wide range of flowering plants

101-*magnus* Moulton, 1911 F

Locality: Alberta

Finding place: unknown

102-*major* Uzel, 1895 F M

Locality: Alberta

Finding place: unknown

103-*monotropae* Hood, 1927 F

Locality: Chelsea, Que.

Finding place: *Monotropa* sp.

104-*nigropilosus* Uzel, 1895 F

Locality: British Columbia

Finding place: chrysanthemum

105-*physapus* Linneaus, 1758 F

Locality: Vernon, B.C.; Kelowna, B.C.; Victoria, B.C.

Finding place: *Taraxacum officinale*, *Rubus parviflorus*

106-*simplex* (Morison, 1930) F M

Locality: Vineland Station, Ont.

Finding place: a major pest of cultivated gladioli; other iridaceous plants

107-*tabaci* Lindeman, 1889 F M

Locality: Ste Anne de Bellevue, Que.; St Mathieu, Rimouski Co., Que.; Bromont, Brome Co., Ont.; St Remi, Napierville Co., Que.; Truro, N.S.; Strathroy, Ont.; Toronto, Ont.; Leamington, Ont.; Barrie, Ont.; Toronto, Ont.; Aylsam, Sask.; Moosejaw, Sask.; Aberta; Vernon, B.C.; Okanagan Valley, B.C.; Agassiz, B.C.; Victoria, B.C.; Kelowna, B.C.; Huntingdon, B.C.; Westbank, B.C.; Milner, B.C.; Vancouver, B.C.

Finding place: *Taraxacum officinale, Trifolium repens, Chrysanthemum* sp., *Lotus corniculatus, Solidago graminifolia*, loganberry, houseplants, squash, English cucumber in greenhouse, onion, rape field, potato, ragweed; transmits tomato spotted wilt virus and other viruses

108-*trehernei* Priesner, 1927 F M

Locality: Berwick, N.S.; St Fabien-sur-mer, Rimouski Co., Que.; Ste Anne de Bellevue, Que.; Dorval, Que.; Lanark, Ont.; Burlington, Ont.; Fork River, Man.; Elbow, Sask.; Midday Valley, B.C.; Alaska Hwy, km 1800, Yukon

Finding place: *Tagetes patula, Sonchus arvense, Rhododendron* sp., *Oenothera* sp., squash, sweeping lawn, various flowers, especially Compositae

109-*vulgatissimus* (Haliday, 1836) F M

Locality: Nova Scotia; Taylor's Brook, Newfoundland; Ste

Anne de Bellevue, Que.; St Mathieu, Rimouski Co., Que.; Toronto, Ont.; Treesbank, Man.; Haney, B.C.; Mission, B.C.; Vernon, B.C.; Lillooet, B.C.; Klondike Hwy., km 562, Yukon; Alaska Hwy, km 1706, Yukon; Dempster Hwy., km 68, Yukon; Musartut, Arsuk, Ivigtu, Kagiarsuk, Igahko-Fjord, West Greenland; Taagefjord, Gaase Fjord, Gaase Land, Rode, East Greenland

Finding place: pear, apple buds, rhubarb, *Taraxacum officinale, Rosa* sp., *Dryas* sp.; *Medicago sativa, Acer macrophyllum, Nuttalia cerasiformis, Picea* sp., forest, subalpine meadow; black spruce conelets; from a large number of plants

110-near *fuscipennis* F M

Locality: Ste Anne de Bellevue, Que.; Kapusaksing, Cochrane Co., Ont.; Klondike Hwy., km 562, Yukon

Finding place: *Populus* sp.,*Anaphalis margaritacea* pantrap in hedgerow

111-near *gracilis* F

Locality: Aweme, Man.; Alberta

Finding place: *Lathyrus venosus*

112-near *validus* Uzel, 1895 F M

Locality: Alberta

Finding place: unknown

113-near *urticae* Fabricius, 1781 F

Locality: Alberta

Finding place: unknown

114-sp. F M

Locality: St Mathieu, Rimouski Co., Que.

Finding place: *Malva* sp.

115-sp. F

Locality: Anaktuvuk, Alaska; Point Barrow, Alaska

Finding place: on galls of *Salix* sp.; tundra at base of *Salix*, tundra

XXXVI-*Toxonothrips* Moulton, 1927

116-*gramineae* Moulton, 1927 F M

Locality: Alaska

Finding place: grass, *Carex* sp., *Calamagrostis* sp., *Rumex* sp.

XXXVII- near *Baliothrips* Uzel, 1895

117-sp. F

Locality: Hazen Camp, Ellesmere Island 81°49·N, 71°18·W

Finding place: *Arctagrostis* sp., sedge

Suborder Tubulifera Haliday, 1836

Superfamily Phlaeothripoidea (Uzel, 1895) Karny, 1907

Family Phlaeothripidae Uzel, 1895

Subfamily Idolothripinae Bagnall, 1908

Tribe Pygothripini Mound and Palmer, 1983

Subtribe Compsothripina Karny, 1921

XXXVIII-*Bolothrips* Priesner, 1926

118-*bicolor* (Heeger, 1852) F

Locality: Kentville, N.S.; Knowlton, Que.; Harrington Lake, Que.; Stouffville, York Co., Ont.; Vernon, B.C.

Finding place: pitfall trap in forest, grass, deciduous litter, leaf mould

119-*dentipes* (O.M. Reuter, 1880) F

Locality: Delta, Man.

Finding place: nest of redwing blackbird

120-*schafferi* (Thomasson and Post, 1966) F M

Locality: Alberta

Finding place: unknown

XXXIX-*Compsothrips* O.M. Reuter, 1901

121-*yosemitae* (Moulton, 1929) F M

Locality: Alberta

Finding place: unknown

122-near *baileyi* Hood, 1941 M

Locality: Alberta

Finding place: unknown

123-near *dampfi* Priesner, 1926 F

Locality: Alberta

Finding place: unknown

124-near *jacksoni* Hood, 1925 F

Locality: Alberta

Finding place: unknown

125-near *tristis* Cott, 1956 F

Locality: Alberta

Finding place: unknown

Subtribe Pygothripina Hood, 1915

XL-*Cryptothrips* Uzel, 1895

126-*rectangularis* Hood, 1908 F M

Locality: Gatineau Park, Quebec; St Catherines, Ont.; Vineland, Ont.; Wasagamis, Man.; Alberta

Finding place: under bark of various dead tree branches and insect burrows, peach bark, chokecherry bark

127-sp. F

Locality: Gatineau Park, Quebec

Finding place: *Fomes fomentarius*

Tribe Idolothripini

Subtribe Elaphrothripina (Priesner, 1961)

XLI-*Elaphrothrips* Buffa, 1909

128-*armatus* (Hood, 1908) F

Locality: Dunn Twp. Ont.

Finding place: *Eurosta solidaginis* galls

Subtribe Idolothripina (Priesner, 1961)

XLII-*Megalothrips* Uzel, 1895

129-*spinosus* Hood, 1908 F

Locality: East Hereford, Que.; Dunn Twp., Ont.; Guelph, Ont.; Alberta

Finding place: in Cecidomyiid gall on *Salix* sp.; *Eurosta solidaginis* galls on *Solidago canadensis*

130-*schuhi* J.C. Crawford, 1947 F

Locality: Alaska

Finding place: unknown

XLIII-*Megathrips* Targioni-Tozzetti, 1881

131-*lativentris* (Heeger, 1852) F

Locality: Ontario; eastern Canada

Finding place: plant detritus

Subfamily Urothripinae Priesner, 1960

XLIV-*Trachythrips* Hood, 1929

132-*watsoni* Hood, 1929

Locality: Canada

Finding place: unknown

Subfamily Phlaeothripinae Karny, 1921 *sensu* Priesner, 1928

Tribe Haplothripini Priesner, 1928

XLV-*Haplothrips* Amyot et Audinet Serville, 1843

Subgenus *Haplothrips* Amyot et Audinet Serville, 1843

133-*distalis* Hood, 1925 F

Locality: Alberta

Finding place: unknown

134-*faurei* Hood, 1914 F

Locality: E. Eaton, N.S.; Arthabaska, Que.; St Davids, Ont.; Vineland, Ont.; Ste Catherines, Ont.; Toronto, Ont.; Kapuskasing, Cochrane Co., Ont.; Manitoba

Finding place: *Rosa* sp., *Anaphalis margaritacea*, apple tree, old mullein plant, fallen leaves, peach, plum

135-*halophilous* Hood, 1915 F M

Locality: Alberta

Finding place: unknown

136-*leucanthemi* (Schrank, 1781) F

Locality: Sable Island, N.S.; Ste Anne de Bellevue, Que.; St Mathieu, Rimouski Co., Que.; Aylmer, Que.; St Jerome, Terrebonne Co., Que.; Arnprior, Ont.; Nobleton, York Co., Ont.; Vineland, Ont.; Kapusaksing, Cochrane Co., Ont.; Exshaw, Alberta; Victoria, B.C.

Finding place: *Trifolium repens, Sambucus canadensis, Chrysanthemum leucanthemum, Medicago sativa, Lotus corniculatus, Aster* spp., *Tragopogon pratensis, Cornus stolonifera, Quercus* sp., peach, rhubarb flowers

137-*minutus* (Uzel, 1895) F

Locality: Nova Scotia

Finding place: unknown

138-*niger* (Osborn, 1883) F M

Locality: Nova Scotia; Aylmer, Que.; Ottawa, Ont.; Welland, Ont.; Vineland, Ont.; Belleville, Ont.; Agassiz, B.C.; Penticton, B.C.; Royal Oak, B.C.; Vernon, B.C.

Finding place: red clover, *Chrysanthemum leucanthemum*, rose in bloom, yarrow, apple

139-*shacklefordae* Moulton, 1927 F M

Locality: Alberta

Finding place: unknown

140-*statices* (Haliday, 1836) F

Locality: Alberta; Royal Oak, B.C.; Penticton, B.C.; Vernon, B.C.; Vineland, Ont.

Finding place: clover and apple bloom, chrysanthemum

141-*subtilissimus* Haliday, 1852 F

Locality: Meaford, Ont.; South March, Carleton Co., Ont.; Alberta

Finding place: on apple, small bog

142-near *aculeatus* (Fabricius, 1803) F

Locality: Alberta

Finding place: unknown

143-sp. F

Locality: Alberta

Finding place: unknown

144-sp. F M

Locality: Alberta

Finding place: unknown

subgenus *Neoheegeria* Schmutz, 1909

145-*verbasci* (Osborn, 1986) F M

Locality: Lac Tremblant, Que.; Carp, Ont.; Strathroy, Ont.; Vineland Station, Ont.; Alberta

Finding place: *Verbascum thapsus*; dead branches, litter under white birch

subgenus *Xylaplothrips* Priesner, 1925

146-*subterraneus* J.C. Crawford, 1938 F

Locality: Toronto, Ont.

Finding place: lily bulb

XLVI-*Leptothrips* Hood, 1909

147-*mali* (Fitch, 1856) F

Locality: Nova Scotia, St Damase, Que.; Beauceville, Que.; Winona, Ont.; Vineland, Ont.; Vernon, B.C.; Summerland, B.C.; Penticton, B.C.; Vaseaux Lake, B.C.; Okanagan Falls, B.C.; Victoria, B.C.; Thetis, B.C.; Kootenay Bay, B.C.

Finding place: plum, cherry, alder, apple, grape, peach, maple (*Acer glabrum*), *Amelanchier* sp., *Quercus* sp.

148-sp. F M

Locality: Alberta

Finding place: unknown

Tribe Phlaeothripini Priesner, 1928

Subtribe Phlaeothripina Priesner, 1960

XLVII-*Acanthothrips* Uzel, 1895 F M

149-*nodicornis* (O.M. Reuter, 1880)

Locality: Alberta

Finding place: unknown

XLVIII-*Hoplandrothrips* Hood, 1912

150-*chapmani* (Hood, 1927) F

Locality: Vineland, Ont.; Ste Catherines, Ont.; Okanagan Falls, B.C.; Penticton, B.C.

Finding place: peach, off moss on rocks

151-*tumiceps* Hood, 1925 F

Locality: Quetico Provincial Park, Ont.

Finding place: detritus

152-near *pergandei* (Hinds, 1902) F

Locality: Alberta

Finding place: unknown

153-near *chapmani* (Hood, 1927) F

Locality: Alberta

Finding place: unknown

154-sp. F M

Locality: Alberta

Finding place: unknown

XLIX-*Poecilothrips* Uzel, 1895

155-*alpopictus* Uzel, 1895 F

Locality: Stoney Creek, Wentworth Co., Ont.

Finding place: under bark of dead beech tree

Subtribe Stictothripina Priesner, 1960

L-*Stictothrips* Hood, 1924

156-*maculatus* Hood, 1924 F

Locality: Alberta

Finding place: unknown

157-near *maculatus* Hood, 1924 F

Locality: Osayoos, B.c.

Finding place: *Artemisia tridentata*

Tribe Hoplothripini Priesner, 1928

Subtribe Lispothripina Priesner, 1960

LI-*Lispothrips* O.M. Reuter, 1899

158-*birdii* Moulton, 1929 F

Locality: Birtle, Man.

Finding place: *Salix longifolia*

159-*brevicruralis* (Schull, 1909) F

Locality: Alberta

Finding place: unknown

160-*populi* Moulton, 1929 F

Locality: Thessalon, Ont.; British Columbia

Finding place: *Populus tremuloides*, black poplar

Subtribe Cephalothripina Priesner, 1960

LII-*Cephalothrips* Uzel, 1895

161-*monilicornis* (O.M.Reuter, 1880) F

Locality: Vernon, B.C.; Hanna, Alb.

Finding place: tall rye grass, grasses

LIII-*Lissothrips*[1] Hood, 1908

162-*muscorum* Hood, 1908 F

Locality: Alfred Bog, Prescott Co., Ont.; Turkey Point, Norfolk Co., Ont.; Brucedale Cons. Park, Bruce Co., Ont.

Finding place: sphagnum under black spruce, moss litter

Subtribe Hoplothripina Priesner, 1960

LIV-*Liothrips* Uzel, 1895

163-*citricornis* (Hood, 1908) F M

Locality: Alexandria, Ont.; Alberta

Finding place: basswood

164-*montanus* Hood 1913 F

Locality: Ottawa, Ont.

Finding place: red currant

165-*russelli* (Hood, 1925) F M

Locality: Alberta

Finding place: unknown

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[1]In the absence of a reference, the author has placed the genus *Lissothrips* in the Cephalothripina since Hood (1908a), when describing *Lissothrips* mentions close relationship with *Cephalothrips*.

166-*umbripennis* Hood, 1909 F

Locality: Westport, Leeds Co., Ont.

Finding place: *Quercus alba*

167-*vaneekei* Priesner, 1920 F

Locality: Toronto, Ont.

Finding place: lily

LV-*Gnophothrips*[2] Hood and Williams, 1915

168-*fuscus* Morgan, 1913 F

Locality: Pembroke, Ont.; Sault Ste Marie, Ont.; North Bay, Ont.; Kearney, Ont.

Finding place: Scots pine, red pine, black pine, jackpine

LVI-*Gynaikothrips* Zimmermann, 1900

169-*ficorum* Marchal, 1908 F M

Locality: Alberta

Finding place: tropical plant

170-sp. F M

Locality: Medicine Hat, Alb.

Finding place: *Ficus benjamina*

LVII-*Hoplothrips* Amyot et Audinet Serville, 1843

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[2]In the absence of a reference, the author has placed the genus *Gnophothrips* in the subtribe Hoplothripina since Stannard (1957) refers to *Gnophothrips* as being closely related to *Liothrips* also of the Hoplothripina.

171-*angusticeps* (Hood, 1908) F

Locality: South Mountain, Dundas Co., Ont.

Finding place: bracket fungus on *Ulmus* sp.

172-*corticis* (De Geer, 1773) F

Locality: Etienne Brule Park, Toronto, Ont.; Toronto, Ont.

Finding place: in wooden fence, fungus growing on tree

173-*japonicus* Karny, F M

Locality: Etienne Brule Park, Toronto, Ont.; Hope, B.C.; Wolfe Twp. Terrebonne Co., Que.

Finding place: fungus growing on tree; *Pleurotus* sp.

174-*pergandei* (Hinds, 1902) F

Locality: upper Rock Lake Bog, Frontenac Co., Ont.

Finding place: sphagnum

F = female (when records did not indicate the sex of the specimen, I assumed that it was female, since females are the more common)

M = male

APPENDIX 2

ELIMINATOR KEY TO THE ADULTS OF THE CANADIAN GENERA OF THE TUBULIFERA (THYSANOPTERA)

A note on computer compatible keys

William and Lauck (1982) have given the term 'computer compatible key' to all keys with the following characteristics:

1-They have the capacity to be multidirectional;

2-They use multiple characters or multiple states of a character;

3-They can incorporate overlapping and integrading characters;

4-Characters can be randomly selected.

When a key is programmed into a computer, identification is achieved quickly and efficiently. The computer can rapidly scan characters or different states of characters while giving continuous feedback information. Computers are however expensive and therefore often unavailable. On the other hand, computer compatible keys offer several advantages over completely computerized keys since:

1-They can be used with or without a computer;

2-They can be written in a book format;

3-They are easier and faster to use than the dichotomous key and still retain their accuracy.

4-They bridge the gap between the unidirectional dichotomous key and the computerized key. Until computers are more

convenient or the purchase of one is warranted, a bank of computer compatible keys can be developed.

The Eliminator Key

William and Lauck describe three types of computer compatible keys. The one used here to the genera of Canadian Tubulifera is called the eliminator key since it operates through the process of elimination. It is an adaptation of a key produced by S.E. Stein and further modified by William and Lauck. The eliminator key displays the characteristics of computer compatible keys. In addition, it can identify a large number of taxa. Twenty taxa can be used with ease - to treat a much larger number, the taxa would first need to be subdivided into subgroups.

The eliminator key to the Canadian genera of the Tubulifera uses characters which are considered diagnostic at the generic level as well as other characters which show overlap or intergration among the different genera. This key therefore does not group genera along an established taxonomic hierarchy.

The key starts with an introduction and brief description of the suborder Tubulifera of the order Thysanoptera[1]. A section on morphological terms used in identification follows[1]. An explanation on how the key works is given and then the key as such begins.

To each genus a letter is assigned; these letters represent

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[1] In this case, refer to text.

the genera in the key and all illustrations are identified by these letters. Ten sets of characters or states of a character are presented and are then followed by verification sheets[1] which are complete descriptions of the genera used in the key.

How to use this key

1. Start with Set 1. After obtaining the correct shape of pelta, record the letters given for that particular pelta. (Remember that if your specimen has a pelta with a shape intermediate between two forms shown in the set, write down the letters shown under both forms.)
   Example: pelta triangular = GKLPS

2. Continue to any other set and select the correct state. Cross out all letters that do not appear in both sets.
   Example: Set 2, 4th state, i.e. 8-segmented antenna with two sense cones on segment III = BCEFLMNS.

G K L P S

3. Continue to another set eliminating some of the remaining letters as outlined in 2.

4. Continue to additional sets until only one letter remains or as an option proceed to the verification sheets when only two or three letters remain, and compare the characters of the remaining genera with the specimen.

5. When only a few genera are left, scanning for their letters in the answers for states can help make valid choices quicker.

6. Once an answer is obtained this answer can be verified by using additional sets or the verification sheets.

List of the Canadian Genera of the Tubulifera

A-*Bolothrips*
B-*Compsothrips*
C-*Cryptothrips*
D-*Elaphrothrips*
E-*Megalothrips*
F-*Megathrips*
G-*Acantothrips*
H-*Trachythrips*
I-*Cephalothrips*
J-*Gnophothrips*
K-*Gynaikothrips*
L-*Haplothrips*
M-*Hoplandrothrips*
N-*Hoplothrips*
O-*Leptothrips*
P-*Liothrips*
Q-*Lispothrips*
R-*Lissothrips*
S-*Poecilothrips*
T-*Stictothrips*

List of illustrations

Plate I -Morphological characters - adapted from fig. 1, Thomasson and Post, 1966.

Set 1 a-*Haplothrips verbasci*, pelta

b-*Hoplandrothrips pergandei*, pelta, fig. 234, Stannard, 1968

c-*Trachythrips watsoni*, pelta, fig. 108, Stannard, 1957

d-*Lispothrips brevicruralis*, pelta

e-*Bolothrips schaferi*, pelta, fig. 67, Thomasson and Post, 1966

f-*Megathrips lativentris*, pelta, fig. 298, Stannard, 1968

g-*Neurothrips magnafemoralis*, pelta, fig. 135, Stannard, 1957; this figure was used because of the lack of specimens and of figures from the literature. Stannard, 1957 says that *Stictothrips was Neurothrips*-like except for the hexagonal reticulations on the fore wings, therefore, I assumed that the pelta of the two genera would be the same.

Set 2 a-*Trachythrips watsoni*, right antenna, fig. 158, Stannard, 1968

b-*Lissothrips muscorum*, right antenna

c-*Cephalothrips monilicornis*, left antenna

d-*Hoplothrips baileyi*, left antenna

e-*Acantothrips albivittatus*, right antenna

Set 3 a-*Trachythrips watsoni*, right antenna, fig. 158, Stannard, 1968

b-*Hoplandrothrips jennei*, right antenna

c-*Lissothrips muscorum*, right antenna

d-*Acantothrips albivittatus*, right antenna

e-*Liothrips umbripennis*, right antenna

Set 5 a-*Hoplothrips baileyi*, right forewing, Pl. 1c, Cott, 1956

b-*Haplothrips malifloris*, right forewing, Pl. 1e, Cott, 1956

c-*Stictothrips maculatus*, right forewing, Pl. 1a, Cott, 1956

Set 6 a-*Bolothrips bicolor*, head and prothorax, fig. 301,
Stannard, 1968

b-*Cryptothrips rectangularis*, head and prothorax

c-*Hoplothrips corticis*, head and prothorax

d-*Cephalothrips monilicornis*, head and prothorax

e-*Haplothrips faurei*, head and prothorax

Set 7 a-*Hoplothrips corticis*, head and prothorax

b-*Cryptothrips rectangularis*, head and prothorax

c-*Cephalothrips monilicornis*, head and prothorax

d-*Gnophothips fuscus*, head and prothorax

Set 8 a-*Haplothrips leucanthemi*, head and porthorax

b-*Liothrips citricornis*, head and prothorax

c-*Acanthothrips nodicornis*. head and prothorax, fig. 205,
Stannard, 1968

Lispothrips brevicruralis, head and prothorax

Set 9 a-*Haplothrips faurei, head and prothorax*

b-Cephalothrips monilicornis, head and prothorax

c-*Lissothrips muscorum*, head and prothorax

Set 10a-*Leptothrips mali*, thorax

b-*Lispothrips brevicruralis*, thorax

c-*Liothrips russelli*, thorax

d-*Compsothrips yosemitae*, thorax

e-*Megalothrips apinosus*, thorax

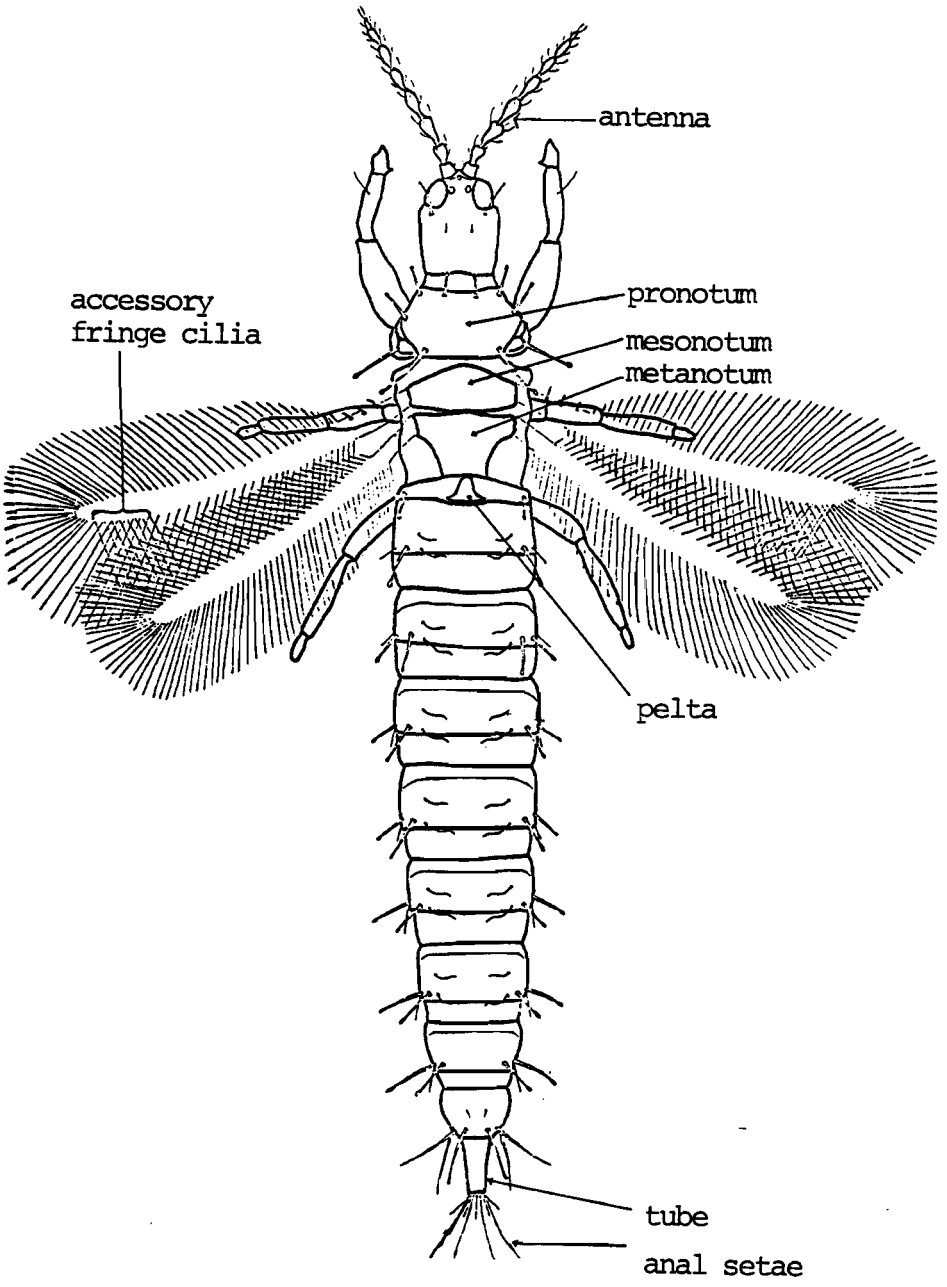

antenna
accessory
fringe cilia
pronotum
mesonotum
metanotum
pelta
tube
anal setae

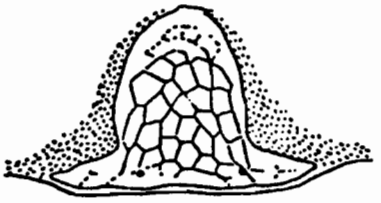
PLATE I

Set 1 - Size and shape of pelta

a -Pelta triangular - base often shorter than other sides

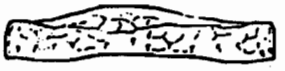
G K L O P S

b -Pelta bell-shaped - broadly rounded at the top, with constriction above the base



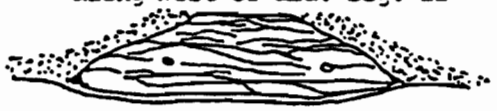
G I M

c -Pelta rectangular - takes the shape of abdominal segment I



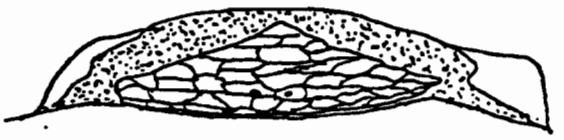
H

d -Pelta broad with squared or flattened top - base extends along most of abd. seg. II



B I J N P Q R

e -Pelta broad with tapered tip or pointed tip - base extends along most of margin of abd. seg. II

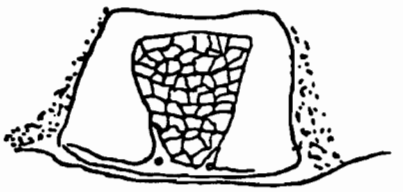


A C I

f -Pelta with lateral flanges joined to main part even though this joint may be very thin

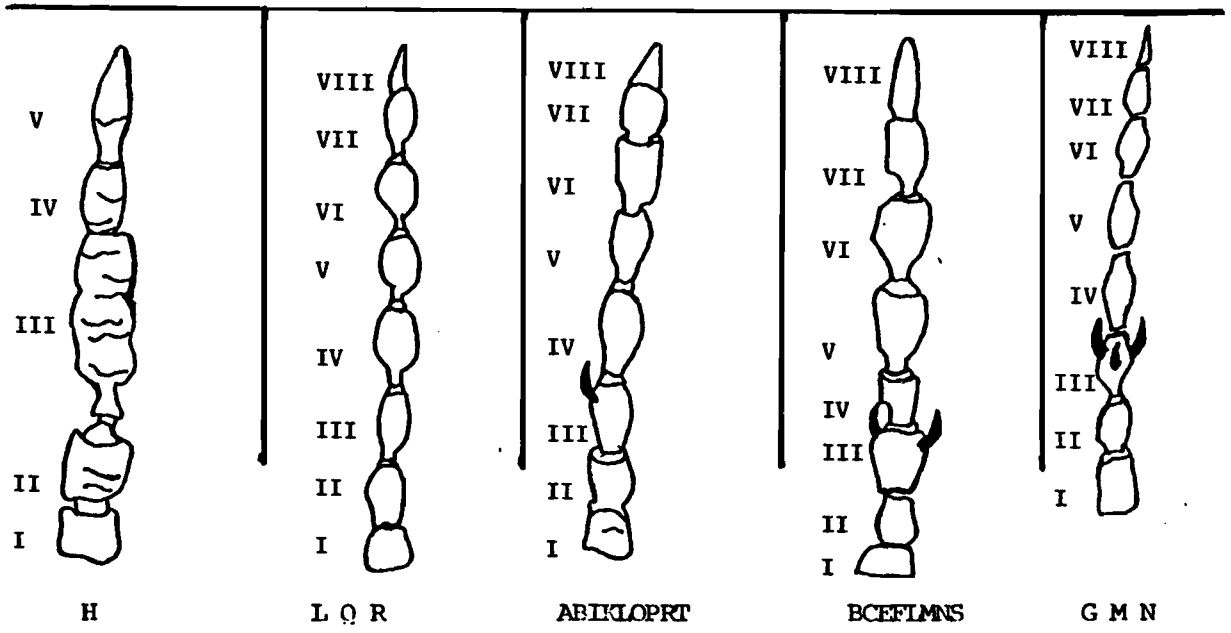
D E F

g-Pelta square - base slightly longer than other sides



T

Set 2 - Antennae - no. of segments and no. of sense cones on seg. III



a- 5 segments

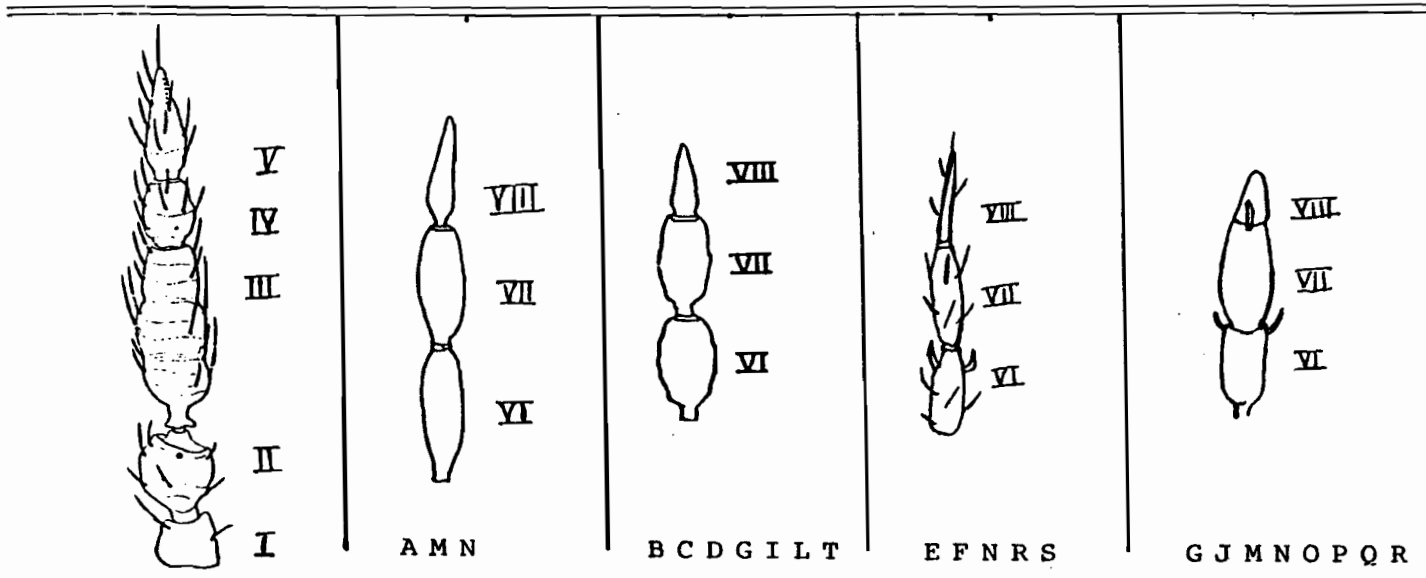
b- 8 segments - no sense cones ant. seg. III

c- 8 segments - 1 sense cone ant. seg. III

d- 8 segments - 2 sense cones ant. seg. III

e- 8 segments - 3 sense cones ant. seg. III

Set 3 - Antennae - no. of segments and degree of union of terminal seg.



H

a- 5 segments

b- 8 segments - segment VIII well separated from seg. VII, pedicel thin

c- 8 segments - segment VIII slightly pedicellate, pedicel broad

d- 8 segments - segment VIII lanceolate

e- 8 segments - segment VIII non-pedicellate

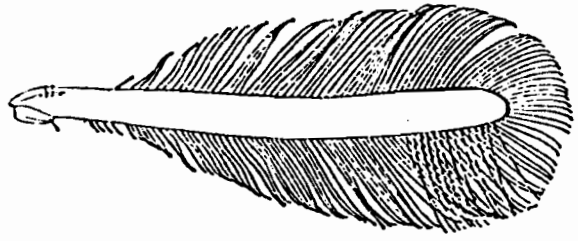
Set 4 - Hosts and habitats

on dead trees in leaf litter - feed on decaying matter	on foliage of living trees, shrubs - feed on living plant tissue	on grasses - feed on plant tissues	on pines - introduced as well as native	in flowers	moss feeders	indoors, on Ficus sp. usually - leaf-feeding on trees and shrubs in the tropics - gall forming
A B C D F F G H I M N S T	L P Q	I B	J	L O	P	K

dead matter - beetle burrows and old galls ---- E

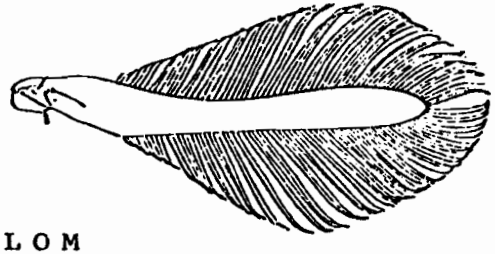
Set 5 - Wing shape or without wings (wing length 5X length of head)

a - entire wing straplike, membranous part parallel-sided throughout, with or without accessory fringe cilia



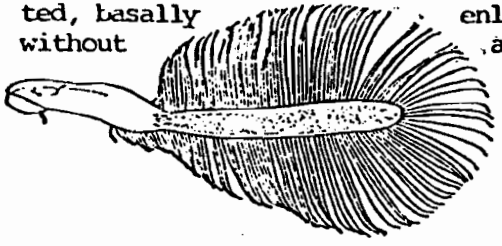
A C D E F G K N P S

b - entire wing sole-shaped, membranous part medially constricted, basally enlarged, with or without accessory fringe cilia



G L O M

c - bent wing, membranous part medially constricted, basally enlarged, without accessory fringe cilia



T

d - forewing short, 2 1/2 times length of head

J

e - brachypterous

C D F M N

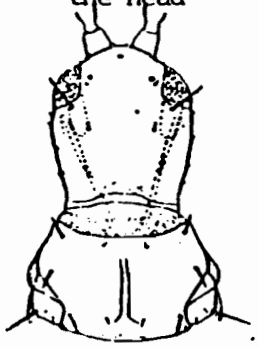
P Q R

f - apterous

A B H N R

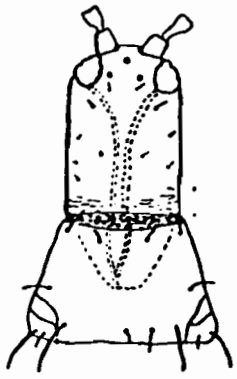
Set 6 - Width and position of the maxillary stylets

a-Broad (at least twice as wide as base of postocular setae), places V-shaped within the head



A B D F

b-Broad, touching or nearly touching in center of head

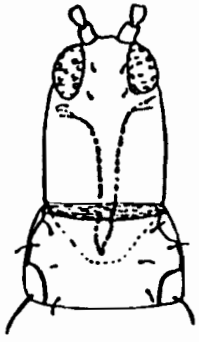


C E

c-Slender (about as wide as bases of postocular setae), touching or nearly touching in center of head

G J K L M N P

d-Slender, far apart or moderately far apart, parallel within head



H I N P Q R

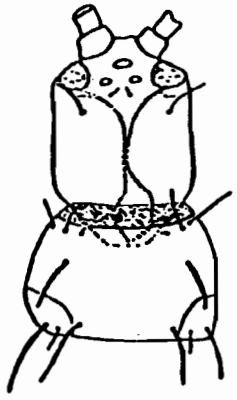
e-Slender, widely spread out with maxillary bridge

L O Q

Q S T

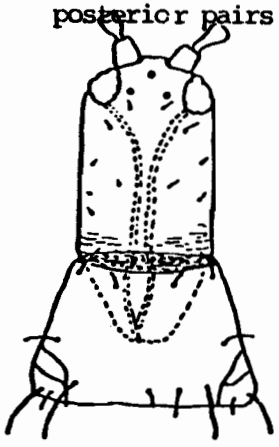
Set 7 - Setae on prothorax

a - All major setae well-developed



MNQRS

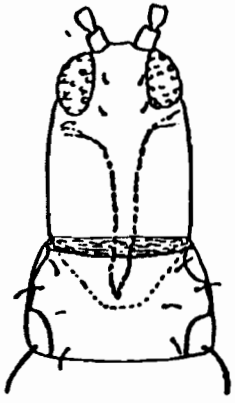
b -Major setae well developed, anterior pairs smaller than posterior pairs



A B C D E F L O

P R

c-Only one pair of prominent pronotal setae



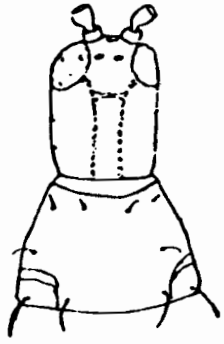
G I K T

d-All major setae present but small to minute

H J Q

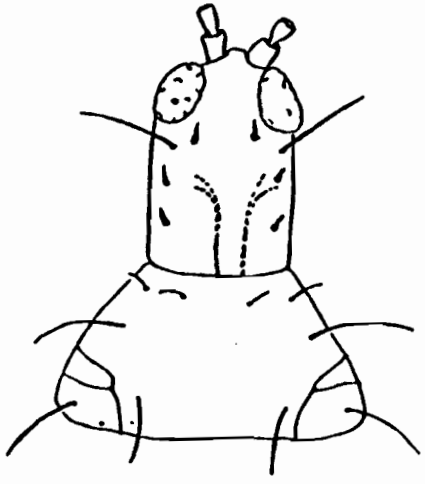
Set 8 - Presence or absence of setae and/or bristle-bearing warts on cheeks

a -Cheeks without strong setae or warts



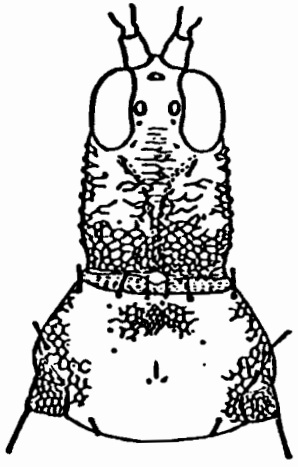
A I J L P R

b -Cheeks with a few stout setae



B I K L N P

c -Cheeks covered by warts and setae



G H

d -Cheeks with several pairs of stout setae throughout no warts

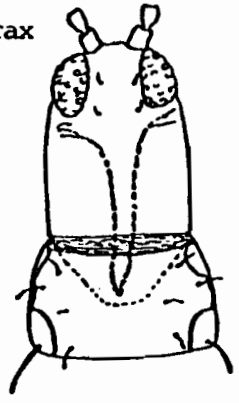
D E F M Q S T

Set 9 - Types of mouth cones

a - Short and pointed (not extending to posterior margin of prothorax

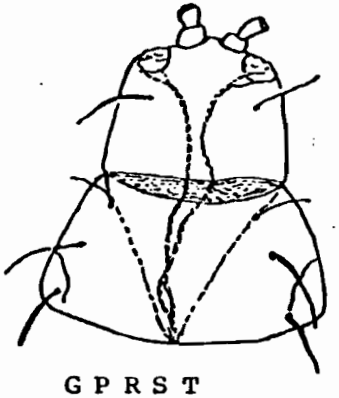
L M N O

b - Short, broadly rounded or moderately rounded



A B C D E F H I J
L N P Q

c - Long and pointed (extending at least to posterior margin of prothorax)



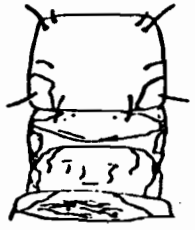
G P R S T

Set 10 - Striae on metanotum

a -Distinct and longitudinal

J M O P S

b -Smooth to weakly sculptured



A C F H I N P Q R

c -Distinct and hexagonally reticulate

D G M P

d -With concentric striations

B

e -Transversely striate

E

APPENDIX 3

Check List of Bordering U.S.A. Thrips

The following is a partial list of thrips species found in the states immediately south of the Canadian border (but not yet collected in Canada). Records are included for the following states: (from west to east) Washington, Idaho, Montana, North Dakota, Minnesota, Wisconsin, Michigan, Ohio, Pennsylvania, New York, Vermont, New Hampshire, Maine.

Order Thysanoptera

Suborder Terebrantia

Family Aeolothripidae

Subfamily Melanthripidae

1-*Ankothrips aequalis* D.L.Crawford, 1909: Washington

Subfamily Aeolothripidae

2-*Aeolothrips bicolor* Hinds, 1902: Minnesota, Maine, New York, Pennsylvania

3-*A. hartleyi* Moulton, 1927: New York

4-*A. nitidus* Moulton, 1946: Idaho

5-*A. pallidicornis* Hood, 1938: New York

Family Merothripidae

Subfamily Merothripinae

6-*Merothrips morgani* Hood, 1912: New York, Ohio

Family Heterothripidae

7-*Heterothrips azaleae* Hood, 1916: New York

8-*H. limbatus* Hood, 1925: New York

9-*H. lyoniae* Hood, 1916: New York

10-*H. quercicola* J.C. Crawford, 1942: New York

11-*H. salicis* Shull, 1902: Michigan

12-*H. vitis* Hood, 1916: Michigan

Family Thripidae

Subfamily Thripinae

13-*Asprothrips antennatus* (Moulton, 1937): New York

14-*Leucothrips nigripennis* Reuter, 1904: Michigan

14-*L. pierci* (Morgan, 1913): New York

15-*Sericothrips annulipes* Hood, 1927: New York

16-*S. baptisiae* Hood, 1916: New York

17-*S. fraxinicola* Hood, 1940: New York

18-*S. langei* Moulton, 1929: Michigan

19-*S. pubescens* Hood, 1957: New York

20-*S. tiliae* Hood, 1931: New York

21-*S. zebra* Hood, 1940: New York

22-*Drepanothrips reuteri* Uzel, 1895: New York

23-*Scirtothrips ruthveni* Shull, 1909: Michigan

24-*Sericopsothrips palloris* Hood, 1936: New York

25-*Chirothrips aculeatus* Bagnall, 1927: Washington

26-*C. productus* Hood, 1927: Idaho

27-*Limothrips cerealium* (Haliday, 1836): Pennsylvania, North Dakota

28-*Anaphothrips nanus* Hood, 1941: New York

29-*Chaetanaphothrips orchidii* (Moulton, 1907): New York

30-*Psilothrips pardalotus* Hood, 1927: Idaho

31-*Dorcadothrips walteri* (J.C. Crawford, 1941): New York

32-*Echinothrips subflavus* Hood, 1927: New York

33-*Frankliniella davidsoni* (Moulton, 1936): Idaho

34-*F. grandis* Moulton, 1936: North Dakota

35-*F. hemerocallis* J.C. Crawford, 1948: New York

36-*F. runneri* (Morgan, 1913): Minnesota

37-*F. williamsi* Hood, 1915: New York

38-*Microcephalothrips abdominalis* (D.L. Crawford, 1910): Washington, New York

39-*Odontothrips pictipennis* Hood, 1916: New York

40-*Rhaphidothrips longistylosus* Uzel, 1895: New York

41-*Scolothrips hoodi* Priesner, 1950: New York

42-*S. pallidus* (Beach, 1896): New York

43-*Thrips discolor* Haliday, 1836: New York

44-*T. flavus* Schrank, 1776: New York

45-*T. herricki* Bagnall, 1926: New York

46-*T. impar* Hood, 1915: New York, Ohio

47-*T. quinciensis* Morgan, 1913: Michigan, Wisconsin

48-*T. tripartitus* Hood, 1940: New York

49-*T. validus* Uzel, 1895: Idaho

Suborder Tubulifera

Family Phlaeothripidae

Subfamily Idolothripinae

50-*Allothrips megacephalus* Hood, 1908: Michigan, North Dakota

51-*Bolothrips icarus* (Uzel, 1985): Michigan

52-*Elaphrothrips tuberculatus* (Hood, 1908): New York

Subfamily Phlaeothripinae

53-*Acanthothrips albivittatus* Hood, 1908: North Dakota

54-*A. vittatus* (Hood, 1912): New York, North Dakota

55-*Adelothrips junctus* (Hood, 1912): Michigan, North Dakota

56-*A. lativenticis* (Post, 1961): Washington

57-*Aleurodothrips fasciapennis* (Franklin, 1908): New York

58-*Bagnalliella glaucae* Hood, 1927: North Dakota

59-*Brachythrips debilis* (Hood, 1925): New York

60-*B. russelli* (Hood, 1925): North Dakota

61-*B. usitatus* (Hood, 1927): New York

62-*Eurythrips ampliventralis* Hinds, 1902: North Dakota

63-*E. hindsi* Morgan, 1913: North Dakota

64-*E. tarsalis* Hood, 1925: North Dakota

65-*Glyptothrips arkansanus* Hood, 1957: North Dakota

66-*Haplothrips americanus* (Hood, 1912): North Dakota

67-*Neurothrips magnafemoralis* (Hinds, 1902): North Dakota

68-*Phlaeothrips ambitus* (Hinds, 1902): North Dakota

69-*P. karnyi* (Hood, 1914): North Dakota