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Chalcidoidea
(Insecta: Hymenoptera)
– introduction, and review of genera in smaller families*

J. S. Noyes
Entomology Department
British Museum (Natural History)
Cromwell Road, London SW7 5BD, England
&
E. W. Valentine[1]
Entomology Division
Department of Scientific and Industrial Research
Mt Albert Research Centre
Private Bag, Auckland, New Zealand

*Families not well represented in New Zealand – Agaonidae, Aphelinidae, Chalcididae, Elasmidae, Eupelmidae, Eurytomidae, Perilampidae, Rotoitidae, Signiphoridae, Torymidae, and Trichogrammatidae; also Mymarommatoidea: Mymarommatidae

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[1]Present address: Sunset Valley Road, R.D. 1, Upper Moutere, Nelson, New Zealand

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Front cover. The insects depicted are *Rotoita basalis*, female (above) and *Palaeomymar insulare*, female (below).

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ABSTRACT

A key is presented to the fifteen families of Chalcidoidea and the one of Mymarommatoidea known from New Zealand. Each family is characterised by a brief diagnosis. Where necessary, the known New Zealand genera of twelve families – viz Agaonidae, Aphelinidae, Chalcididae, Elasmidae, Eupelmidae, Eurytomidae, Perilampidae, Rotoitidae, Signiphoridae, Torymidae, Trichogrammatidae, and Mymarommatidae – are keyed. Each genus is diagnosed, and illustrated with a line drawing of at least one representative species. Notes are provided on distribution and hosts, and the known host associations of the New Zealand chalcidoid fauna are summarised in appendix tables. Species are placed in forty-three established genera and in a new genus proposed in the Trichogrammatidae. *Bardylis* Howard and *Dahmsiella* Hayat are synonymised with *Pteroptrix* Westwood (Aphelinidae).

CHECKLIST OF TAXA

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INTRODUCTION

The superfamily Chalcidoidea is a very large group of parasitic Hymenoptera including world-wide nearly 20 000 described species (Noyes 1978). They are well represented in nearly all parts of the world, but most groups within the superfamily appear to be most diverse in the tropics. The majority of chalcids are small or very small, and many have strongly sculptured integuments giving a strongly metallic blue, green, bronze, or purple sheen. Their coloration, sculpture, and great morphological diversity make them one of the most varied and attractive groups of Hymenoptera.

The superfamily is here considered to comprise twenty families, the Mymarommatidae being treated as a separate superfamily, the Mymarommatoidea (see p. 48). However, the limits of several of these families are poorly defined, different workers recognising different numbers of families; e.g., Rick (1970) recognised only nine families, and Nikol'skaya (1952) recognised as many as twenty-four families.

Chalcids probably exhibit a greater range of biological diversity than any other superfamily of Hymenoptera Parasitica. Most species are parasitoids, but groups of species in several families are phytophagous. Agaonidae develop only in figs, and phytophagous species also occur in the Eulophidae, Eurytomidae, Pteromalidae, Tanaostigmatidae, and Torymidae.

Parasitoid biology attains its most elaborate expression in the Chalcidoidea. There are solitary and gregarious species; ectoparasitoids and endoparasitoids; primary, secondary, and tertiary parasitoids; polyembryonic species; and species with planidial larvae. Some species are extremely polyphagous, whereas others appear to be very host-specific. All immature stages of hosts are attacked, from the egg (which may be parasitised by species of Mymaridae, Trichogrammatidae, Eulophidae, Encyrtidae, or Aphelinidae) to the pupa (attacked by several groups of Pteromalidae in particular). Chalcids attack an extremely broad range of hosts, including virtually all endopterygote orders, many exopterygotes, and some arachnids.

Chalcids are one of the most important groups in applied biological control (see Noyes 1985), and have been widely used as such in New Zealand (see below). Many species introduced for this purpose have become established as effective parasitoids of insect pests of agriculture and horticulture (see below). Several exotic species have become established accidentally, probably after being imported with plant material. These chalcids may now be associated with modified environments such as gardens, or with exotic plants, and may play an important part in limiting the development of potentially damaging insects. Some chalcids are pests because of their phytophagous habit. For example, some Eurytomidae develop in the seeds of red clover, lucerne, and acacia, and others damage the stems of grasses.

Given their importance to agriculture and horticulture in New Zealand, it is surprising that so little has been published on the New Zealand chalcid fauna. Except for a few descriptions of new genera and species – by Walker (1839), Kirby (1883a), Ashmead (1900, 1904), Cameron (1910), Timberlake (1916, 1929), Gahan (1922, 1927), Gourlay (1928), Hincks (1961), Kerrich (1964), Kerrich & Yoshimoto (1964), Tachikawa & Valentine (1969a,b, 1971), and Valentine (1966, 1971a) – our knowledge has been limited to a few papers published by Gourlay (1930a,b), Miller (1935), Cumber (1959), and Valentine (1963, 1967, 1970, 1971b) which are largely concerned with the introduced fauna. In all, up until 1984, published information on the New Zealand fauna deals with only 75 genera and 92 species (see Appendix Table 2).

The present study is based almost entirely on material which has accumulated in the New Zealand Arthropod Collection (NZAC), held by DSIR's Entomology Division in Auckland, and from an extensive Malaise trap and sweep-net survey in both the North and South islands during 1980 and 1981. Although we believe that this material is a representative sample of the chalcids to be found in New Zealand, some large areas remain comparatively poorly surveyed. For example, very little material has been seen from the Mount Egmont area (TK) or from the eastern and central North Island.

This contribution reviews to generic level the eleven families of Chalcidoidea and Mymarommatoidea which are represented in New Zealand by eleven or fewer genera. Keys to the genera of the remaining families occurring in the New Zealand subregion are included either in separate contributions to the 'Fauna of New Zealand' series (Encyrtidae – Noyes 1988; Mymaridae – Noyes & Valentine 1989) or in a review of the Australasian genera of chalcids, excluding Elasmidae, Encyrtidae, Aphelinidae, Signiphoridae, Mymaridae, and Trichogrammatidae, by Dr Z. Boucek (1988).

Table 1 Numbers of species (Spp) and genera (Gen) of Chalcidoidea and Mymarommatoidea in New Zealand, from information published up to 1984 and from examination of material in the New Zealand Arthropod Collection.

	Totals from published records		Totals from NZAC material	
	Spp.	Gen.	Spp.	Gen.
Agaonidae	1	1	2	2
Aphelinidae	19	10	67	11
Chalcididae	2	1	5	3
Elasmidae	–	–	2	1
Encyrtidae	19	16	70	37
Eulophidae	15	13	123	37
Eupelmidae	5	4	6	4
Eurytomidae	4	4	8	4
Mymaridae	4	5	163	42
Perilampidae	–	–	3	1
Pteromalidae	15	13	126	39
Rotoitidae	–	–	3	1
Signiphoridae	2	1	3	2
Torymidae	5	5	12	6
Trichogrammatidae	1	1	37	11
Mymarommatidae	1	1	6	1
	93	**75**	**636**	**202**

ZOOGEOGRAPHIC RELATIONSHIPS

The numbers of genera and species of Chalcidoidea known in New Zealand are shown in Table 1. A striking feature of the chalcid fauna is the unusally high number of species of Mymaridae, i.e., about 25% of the total. In contrast, the family Mymaridae contains about 7% of the known chalcid species in the world (Noyes 1978) or about 6% of chalcid species known in the United Kingdom (Fitton *et al.* 1978). Many mymarid species in New Zealand live on or near the ground, and are associated with habitats such as leaf litter and native grasses rather than arboreal habitats. In these species there has been a tendency towards wing reduction or loss; this is also true of the Trichogrammatidae. Some New Zealand mymarids are probably among the largest and most spectacular in the world. Two species placed in *Australomymar* Girault exceed 4 mm in length, excluding the ovipositor. These and many other unusual species are discussed more fully in Noyes & Valentine (1989).

Other notable features of the chalcid fauna are the large number of species of *Pteroptrix* (Aphelinidae), possibly over 30; the large number of elachertine species (Eulophidae); and the fairly large endemic genus *Adelencyrtoides* (Encyrtidae), which contains 14 species. Some families such as Agaonidae, Chalcididae, Elasmidae, Eurytomidae, and Signiphoridae are poorly represented, and probably have few endemic species.

Table 2 Summary of zoogeographic relationships of genera of Chalcidoidea known from New Zealand. Column categories defined in footnote.

Category:	1	2	3	4	5	6	7	8	9
Agaonidae	–	–	–	–	–	–	2	–	–
Aphelinidae	–	–	2	–	8	4	1	2	2
Chalcididae	–	–	2	–	–	1	1	–	–
Elasmidae	–	–	–	–	1	–	–	–	–
Encyrtidae	7	1	–	–	6	15	7	10	1
Eulophidae	8	3	2	1	17	4	3	5	1
Eupelmidae	–	–	1	–	2	1	–	1	–
Eurytomidae	–	1	–	–	1	3	1	3	–
Mymaridae	20	4	3	2	13	3	2	1	–
Perilampidae	–	1	–	–	–	–	–	–	–
Pteromalidae	6	8	3	3	7	11	–	8	2
Rotoitidae	1	–	–	–	–	–	–	–	–
Signiphoridae	–	–	–	–	1	1	–	–	–
Torymidae	–	–	–	–	4	3	1	2	–
Trichogrammatidae	1	2	–	–	6	1	–	–	?1
	43	**20**	**13**	**6**	**66**	**47**	**18**	**32**	**?7**

COLUMN CATEGORIES:
1 – genera known from New Zealand only;
2 – genera known from New Zealand and Australia;
3 – genera known from New Zealand and Australasia;
4 – genera known from New Zealand, Australasia, and South America and / or southern Africa;
5 – cosmopolitan or widely distributed genera, with some species probably endemic / indigenous to New Zealand;
6 – cosmopolitan or widely distributed genera, with some species introduced into New Zealand;
7 – genera containing at least one species introduced from Australia;
8 – genera containing at least one species introduced from Europe;
9 – genera containing at least one species introduced from North America.
N.B. Some genera may appear in more then one column, e.g., those which have both introduced and endemic / indigenous elements.

Table 2 summarises the zoogeographic relationships of the New Zealand chalcid fauna, and clearly demonstrates a high level of endemicity, more than 25% of the genera known from New Zealand having been recorded from nowhere else (Category 1). These genera contain at least 109 species, or 17% of the known fauna. This figure excludes endemic species which represent more widely distributed genera (about 33% of the known New Zealand genera), and it is possible that future work will show perhaps as many as half of the species to be endemic to New Zealand. The numbers of genera which indicate a possible earlier southern distribution (Category 4) are few, these belonging to the Eulophidae, Mymaridae, and Pteromal-

idae. About 50 genera contain species known to have been introduced from Australia, Europe, or North America (Categories 6–9), either purposefully for biological control purposes or accidentally with exotic plants, e.g., *Ficus*, *Acacia*, *Eucalyptus*.

BIOLOGICAL CONTROL IN NEW ZEALAND

Many of the chalcids encountered in modified environments in New Zealand are exotic, and it is probable that a high proportion of these arrived, along with their hosts, in the early days of European settlement, on plants, in animal fodder and other foodstuffs, in seeds, timber, etc. The presence of these parasitoids in the new agricultural and horticultural environments undoubtedly served to limit the populations of potential pest insects. Some pests, however, may not have been accompanied by their natural parasitoids, or these failed to establish, requiring the importation of appropriate parasitoids (or other natural enemies) in order to establish some degree of natural control. About 100 exotic species of chalcid now well established in New Zealand are known to have been purposefully introduced.

The first published record of the deliberate introduction of a chalcid is that of the eulophid *Pediobius epigonus* (Walker) for the control of hessian fly, *Phytophaga destructor* (Say) in wheat (Kirk 1894). In the early years of this century, during the period when biological control was being developed, introductions of most natural enemies were of predators, particularly coccinellid beetles, for the control of aphids and various coccoids. As activity expanded, parasitic Hymenoptera (including Chalcidoidea) were also imported for the attempted suppression of some pest insects. Notable among these were *Aphelinus mali* (Haldeman) (Aphelinidae), a parasitoid of the woolly aphid, *Eriosoma lanigerum* (Hausman) (Tillyard 1921–26); and *Anaphes nitens* (Girault) (Mymaridae), an egg parasitoid of the eucalyptus weevil, *Gonipterus scutellatus* (Gyllenhal) (Clark 1931).

Successful establishment of such species, and spectacular reductions in pest infestations, gave further impetus to applied biological control as a practical method of insect pest suppression. Various Chalcidoidea were imported subsequently to meet particular problems, with varying degrees of success in establishment and control. The introduction of *Habrolepis dalmanni* Westwood (Gourlay 1935) (Encyrtidae) resulted in the virtual elimination of golden oak scale, *Asterodiaspis variolosum* (Ratzeburg), which was threatening to decimate the English oak (*Quercus robur*) in New Zealand. This scale is now very rarely seen. *Achrysocharoides latreillii* (Curtis) (=*Enaysma splendens* of authors) (Eulophidae), in combination with other parasitoids, plays an important part in the control of the oak-leaf miner, *Phyllonorycter messaniella* (Zeller) (Given 1959, Swan 1973).

A more recent example of outstandingly rapid establishment and spread is offered by *Copidosoma floridanum* (Ashmead) (Encyrtidae), a polyembryonic parasitoid of green looper caterpillars, *Chrysodeixis eriosoma* (Doubleday) (Roberts 1979, 1983; as *Litomastix* sp. and *Litomastix maculata*). It is now one of the most common chalcids collected in modified, agricultural, and horticultural environments, at least in much of the North Island.

Other introduced chalcids which have become familiar to New Zealand entomologists as valuable biological control agents include *Pteromalus puparum* Linnaeus (Pteromalidae), a gregarious internal parasitoid of the pupae of the white butterfly, *Pieris rapae* Linnaeus; *Encarsia formosa* Gahan (Aphelinidae), attacking larvae and pupae of the greenhouse whitefly, *Trialeurodes vaporariorum* (Westwood); and *Coccophagus gurneyi* Compere, a common parasitoid of immature long-tailed mealybugs, *Pseudococcus longispinus* Targioni Tozzetti.

The foregoing examples are of Chalcidoidea which were purposefully introduced to overcome the lack of natural control of pests, but by far the greater proportion of species known to parasitise exotic insects in New Zealand are probably accidental introductions. The activities of these species serve to suppress the increase of insects which might otherwise be damaging pests. Few of the exotic parasitoids are known to have adapted to native vegetation, or to native hosts, but some endemic chalcids – e.g., some trichogrammatid parasitoids of the eggs of Tortricidae and Noctuidae – have followed their natural hosts to exotic plants in modified environments. Most of the native species are confined to native forest, scrubland, tussock grassland, and alpine environments where their natural hosts occur. In these situations Chalcidoidea, through their parasitism of phytophagous and xylophagous insects, may play an important role in the natural or biological control of potentially destructive species.

COLLECTING AND PRESERVATION

Perhaps the main difficulty in the study of chalcids is their relative unpopularity with collectors of insects because of their small size. Therefore a common complaint of the serious student of this group (indeed, of any microhymenoptera) is that there is not adequate material available for study. The following methods are the most rewarding for collecting chalcids. For greater detail on collection and preservation, see Noyes (1982).

Collecting methods

SWEEPING. Sweep-net collection is by far the best method, since a large number of species may be collected in a short time. The insects should be removed from the net using an aspirator, and killed by placing a plug of paper tissue or cotton wool soaked in ethyl acetate in the entry tube of the aspirator. Before any insects are sucked into the aspirator it is advisable to place in it a crumpled sheet of soft tissue to prevent insects from sticking to the sides of the tube. It is important to keep the specimens as dry as possible.

The sweep-net is most efficient if the handle is about 1.2 m long and the head triangular, with the handle joining the head in the middle of one side of the triangle. The triangular head allows the net to used most efficiently on grassland, i.e., more of the net will be in contact with the ground during sweeping. The relatively long handle allows the net to be held as far away from the body as possible, so that insects are not forewarned by footfalls, etc. It also allows for greater reach when collecting in forest habitats. The best material for the frame is aluminium, since this is sufficiently rigid, yet light enough in use. The net bag should be of a material which is strong and durable, yet allows easy passage of air. For this latter reason it should not be made of canvas.

When sweeping grassland it is very important to sweep in long arcs, keeping the head of the net in contact with the ground for the entire arc by pressing down on the handle.

REARING. Rearing is the most rewarding method of obtaining specimens, since much can be learned about their biology. A limitation is that much effort has to be put into locating possible hosts and rearing parasitoids from them. Hosts should be kept in a container appropriate to the size of the sample, and should be examined regularly for the emergence of parasitoids. If possible they should be placed in a darkened emergence box with a glass vial attached to collect emerging parasitoids, which are attracted towards the light. Care should be taken to ensure that the correct host is recorded; it is very easy to collect an aphid mummy on a very small piece of leaf and assume that a parasitoid found wandering around or dead in the tube comes from the aphid, whereas in fact it may have emerged from some other host, such as an agromyzid pupa, which may have been overlooked. Rearing from individually isolated hosts can overcome this problem.

MALAISE TRAPPING. A design for an efficient trap for collecting chalcids has been described by Townes (1972). The advantage of a Malaise trap is that it can be set up and serviced by someone who is not a chalcid specialist. The trap can be emptied relatively infrequently – at fortnightly intervals if ethyl alcohol is used as a killing and preserving agent. However, the use of ethyl alcohol is disadvantageous because material is collected wet (see Preservation, below), and the subsequent sorting of required specimens from the catch takes considerable time. It is possible to collect dry using fumigants such as Vapona®, but the catch is greatly reduced, and the chalcid material is often covered with moth scales and damaged by dying insects. A Malaise trap has the added advantage that it often takes species of small size that are rarely collected by other means, e.g., the minute mymarid *Alaptus*.

YELLOW PAN TRAPPING. Pan trapping is a good method of catching small Hymenoptera. The trap consists of a tray about 30 cm square and 5–8 cm deep, painted yellow on the inside. Insects are attracted to the yellow colour and drown in the collecting medium contained in the pan. The collecting medium may be water with a few drops of detergent to break the surface tension, or water plus ethylene glycol (1:1), or a dilute solution of picric acid or a saturated solution of common salt. If water is used the trap must be emptied at least once a day or the material will deteriorate very badly. With other media the trap can be emptied weekly (weather permitting). Specimens must be rinsed well in clean water before transferring to 70% ethanol. Ethylene glycol is not recommended because subsequent slide-preparation of material may be difficult; the specimens tend to collapse badly on transfer to balsam. Picric acid causes the gaster to distend (although this is not often important taxonomically).

Pan-trapping is ideal for collecting from among trees and in forest where there is little undergrowth.

SUCTION TRAPPING. The suction trap has a single advantage over a Malaise trap, in that it actively sucks in small, flying insects. It has many disadvantages, e.g., it needs an electric power source, is much more expensive, and fails to catch flightless insects. Even so, catches from a suction trap should not be overlooked since they may contain many interesting species.

PITFALL TRAPPING. Pitfall trapping is a fairly good method for windy habitats such as mountains. Collecting media are as for yellow pan traps.

EXTRACTING FROM LEAF LITTER AND MOSS. Insects can be collected from leaf litter or moss using a Berlese funnel or an emergence box. This is a good method for some Mymaridae which are rarely collected by other methods.

Preservation

Material collected dry should be kept dry. Specimens that are not mounted within 2 hours of killing in ethyl acetate

vapour should be relaxed before mounting, or layered between sheets of cellulose wadding (or even a couple of layers of soft toilet paper), and stored in a strong, dry, airtight box. A crystal or two of thymol should be added to inhibit the growth of mould. Material collected into alcohol, e.g., in Malaise traps or yellow pan traps, should be dried as soon as possible. This can be done by air-drying the material on absorbent card (see below, 'Mounting material'). Unfortunately, air-dried specimens usually collapse or shrivel upon drying. This can be prevented by dehydrating specimens using a critical-point drier (see Gordh & Hall 1979). Dried specimens can be stored between sheets of tissue paper or in gelatin capsules, held in place with finely teased cotton wool. Specimens which have been kept in alcohol for a long time (5 years or more for specimens less than 1 mm long) are normally unsuitable for making slides.

MOUNTING MATERIAL. Chalcids are best mounted on rectangular cards using a water-soluble glue. The specimens should be mounted with the vertical axis through the thorax at about 45° to the plane of the card, preferably with the wings, legs, and antennae displayed, and the wings and head free of glue – see Noyes (1982) for details. This method requires a good deal of practice, but has advantages over card-point mounting in that specimens are well protected, and the various parts are much easier to see against the white background of the card.

Specimens from alcohol should be dried out on a piece of moderately absorbent card, for instance library record cards or even Bristol board; the latter is best for smaller chalcids such as Mymaridae and Trichogrammatidae. The insect should be placed in a drop of alcohol on the card with its wings flat against the card. As soon as it is dry, in 5–25 seconds, it should be removed and mounted.

RELAXING SPECIMENS. Specimens that have been dry for some time become extremely brittle, and should be softened to prevent breakage of appendages. This is best done by placing them on a piece of tissue on a glass dish inside a plastic box. Put in a few drops of water or glacial acetic acid (not more than 1.5 ml per 750 ml of box) and leave for 8–24 hours. If material is layered, put it in the box still in layers, otherwise it may be damaged when removing the top layer. If the material was killed in ethyl acetate vapour it should be sufficiently relaxed to be mounted without any damage whatsoever.

SLIDE MOUNTING. To examine smaller chalcids it is usually necessary to make good slides.

(a) Temporary slides. These usually entail mounting whole specimens in a water-soluble medium such as Hoyer's or Berlese. This method is not recommended, and should be used only if there is an abundance of material of the one species available. Its main (and probably only) advantage is that slides are relatively quickly and easily made.

(b) Permanent slides. It is essential that slides be made using Canada balsam if material is of taxonomic value, or if only a limited amount of material is available. This method is laborious and time-consuming, and a good deal of practice is required to master it. Preferably, body parts should be mounted (after clearing in 10% potassium hydroxide solution) under four or five separate 6 mm coverslips. For a detailed description of the method, see Noyes (1982).

Briefly, the method is as follows:

- Remove the wings and placed them in balsam.
- Clear the specimen in 10% KOH at 20°C for 24–48 hours (if it has never been in alcohol), or at 20°C for 72 hours, or at 20°C for 24 hours followed by 40°C for 24 hours (if it has been in alcohol).
- Next, neutralise the preparation in glacial acetic acid for 10 minutes, followed by distilled water, then dehydrate through 35%, 70%, and 95% alcohols (each for 10 minutes), and finally clear in clove oil (or terpineol warmed under a bench light) for 10 minutes. Position the body parts in individual drops of balsam on a slide and keep in an oven at 40°C for 4 weeks; this fixes them in position.
- Finally, add the requisite amount of balsam to each part (smallest amount possible for wings and antennae, and largest for thorax and gaster), and place a coverslip over each part of the preparation.

NOTE. The balsam should be relatively thick, i.e., if a pin is put in it and pulled out the balsam should form 'strings'. If the balsam is thinner it will be difficult to position the coverslip flat; also, the balsam will contract as it dries, crushing the part that it covers.

DATA LABELS. All material should be labelled adequately with at least collection locality, date and host data (if reared). Never use code numbers alone and keep the data separate; the data may be lost or mislaid.

DIAGNOSTIC CHARACTERS AND MORPHOLOGY

The Chalcidoidea can be separated from all other groups of Hymenoptera by their small size (generally less than 4 mm in length), frequently highly lustrous or metallic blue, green, or purple colouring, elongate scape, giving the antenna an elbowed appearance, flagellum usually differentiated into a well defined funicle and clava, and wings with reduced venation and no enclosed cells. From other groups of similar size and wing venation (Proctotrupoidea

and Ceraphronoidea) they can be separated by the pronotum not extending back as far as the tegulae, by the presence of longitudinal sensilla ('rhinaria') on the antennal funicle, and by the presence of the prepectus, which may be reduced to a narrow strip, especially in the Mymaridae. The Proctotrupoidea and Ceraphronoidea always have the pronotum extending back to the tegulae and lack a prepectus and longitudinal sensilla on the antennae.

Gibson (1986a) has shown that the Mymarommatidae are probably the sister-group to the Chalcidoidea, and they are therefore treated here as a separate superfamily. The Mymarommatoidea can be distinguished from chalcids, proctotrupids, and ceraphronids by the characters given under the section dealing with this superfamily (p. 48).

Keys to the families of the Chalcidoidea can be found in Peck *et al.* (1964), Graham (1969), Prinsloo (1980), Yoshimoto (1984), and Boucek (1988).

Morphology and terminology

HEAD (Fig. 1, 2, 7, 8)

Antenna (Fig. 7, 8) – composed of scape, pedicel, and a flagellum subdivisible into three parts, as follows.

(a) Anelli (or ring segments) – when present, situated between the pedicel and funicle; most often there are one or two, but sometimes as many as four. They are distinguishable from the funicle segments by normally being strongly transverse or abruptly smaller, and by their lack of longitudinal sensilla. True anelli are usually absent from smaller species, i.e., Encyrtidae, Aphelinidae, Trichogrammatidae, and Mymaridae.

(b) Funicle – composed of one or more (normally not more than six) well separated segments which are often subequal. In families other than the four mentioned above each segment normally bears longitudinal sensilla.

(c) Clava – the apical flagellar segment(s), comprising from one to three segments (exceptionally more), separated from each other by a septum only.

Malar space (Fig. 1) – the minimum distance between eye and mouth margin.

Malar sulcus (Fig. 1) – the sulcus joining the lower margin of the eye and the mouth margin; sometimes absent, but usually indicated by a slight change of sculpture.

OOL (Fig. 2) – minimum distance between the eye margin and the nearest posterior ocellus.

POL (Fig. 2) – minimum distance between the posterior ocelli.

THORAX, or mesosoma of some authors (Fig. 3–6)

Here treated as being composed of four parts, as follows.

(a) Prothorax – consists largely of a dorsal sclerite, the pronotum, of varied shape and an important character for distinguishing families of chalcids.

(b) Mesothorax – divided dorsally into anterior and posterior parts separated by sutures. The anterior mesoscutum is often divided longitudinally by furrows, the notauli, to form a middle lobe and lateral lobes. The degree of development of notauli is an important feature for identification in certain families. The posterior part of the mesonotum comprises a central scutellum and lateral sclerites, the axillae, the form and position of which are major diagnostic features. The sides of the mesothorax comprise the mesopleuron, which is normally divided into an anterior episternum and a posterior epimeron, although in some families – e.g., Encyrtidae, some Eupelmidae – this is represented by a large, undivided sclerite, the mesopleural shield or acropleuron, which is an enlargement of the subalar area of the mesopleuron (Gibson 1986b).

(c) Metathorax – the metanotum is represented dorsally by a very narrow, broadly U-shaped strip immediately behind the scutellum and connecting the bases of the hindwings. The metapleuron is reduced to a relatively narrow strip, sometimes almost completely hidden by the mesopleuron, connecting the hindwing base to the hind coxae.

(d) Propodeum – posterior to the metanotum, and lying above the hind coxae. This is the true first abdominal segment, but is fused to the metathorax. For the purpose of this study it is treated as part of the thorax.

Prepectus (or postspiracular sclerite of some authors) – usually has the appearance of a triangular sclerite between the posterolateral margin of the pronotum and the anterior margin of the mesopleuron; often reduced to a very narrow strip, especially in some Mymaridae.

Wings (Fig. 5, 6) – forewing with reduced venation consisting of an elongate submarginal vein, a short to elongate marginal vein, a short to elongate postmarginal vein, and a relatively short stigmal vein. The forewing has the following additional diagnostic features.

Basal cell (Fig. 5) – the basal area delimited by the submarginal vein, the basal vein, which is usually coincident with the proximal margin of the speculum, and the cubital vein, which if present is represented by the nearest line of setae to the hind margin of the wing.

Linea calva – the oblique, naked line across the wing from the stigmal and marginal veins (found only in the Encyrtidae, some Aphelinidae, and some Eupelmidae).

Parastigma – a very slight to strong swelling of the apical one-third or so of the submarginal vein.

Speculum – distinct from the linea calva, and defined as the naked area immediately distad of the basal cell, below the parastigma and the junction of the submarginal and marginal veins; not usually extending to the stigmal vein.

The hindwing is shorter and narrower than the forewing, with vein reduction even more marked.

GASTER (Fig. 9–11)

For the purposes of this study the second abdominal segment is referred to as the petiole, and is not counted as part of the gaster. The first visible tergite of the gaster is abdominal tergite III, and the first visible sternite is abdominal sternite III. Thus, the hypopygium is gastral sternite V. The last visible tergite is normally fused tergites VII + VIII, and is termed the epipygium or syntergum.

Cerci. Subdivided into the cercal plate and cercal bristles. These are usually fairly inconspicuous and situated very near the apex of the gaster. In most genera of Encyrtidae the cerci are placed in the anterior half of the gaster and the bristles are very long and conspicuous (Fig. 9).

Ovipositor. Usually hidden, but often well exserted. The length of the exserted part is measured from the apex of the last visible gastral tergite.

KEY TO CHALCIDOID FAMILIES KNOWN FROM NEW ZEALAND

1 Abdominal petiole long, 2-segmented (Fig. 126); forewing (when present) pedunculate, varying in shape but commonly spatulate with a long marginal fringe (Fig. 126), disc reticulately alveolate (Fig. 126), and venation reduced and indistinct; pronotum reaching tegulae, without an intervening prepectus. Minute, less than 0.75 mm long (Mymarommatoidea) ... (p. 48) .. **MYMAROMMATIDAE**

—Abdominal petiole 1-segmented, often indistinct or more or less completely invisible; forewing not as above, if pedunculate then not reticulate; pronotum not reaching tegulae, separated from them by a prepectus (Fig. 4). Normally longer than 0.75 mm, but occasionally much shorter (Chalcidoidea) ... **2**

2(1) Tarsi 3-segmented; antennae short, the funicle with no more than 2 segments (Fig. 85, 86, 88, 89, 92, 93, etc). Minute to very small insects, not more than 1.2 mm long ... (p. 42) .. **TRICHOGRAMMATIDAE**

—Tarsi 4- or 5-segmented. Minute to moderate-sized insects varying from 0.2 mm to more than 10 mm long, the majority exceeding 1.2 mm ... **3**

3(2) Antennal toruli situated much closer to eyes than to each other; frons with a straight, transverse suture a little above toruli which connects with vertical sutures adjacent to each orbit, thus forming an H (Fig. 66, 68); the macropterous species almost always with membrane of hindwing not extending to base, thus giving hindwing a stalked appearance (Fig. 69) [exception: *Anagroidea* spp. (Fig. 67)] ... (p. 34) .. **MYMARIDAE**

—Antennal toruli situated as close to or closer to each other than to eyes or very nearly so; frons occasionally with a transverse suture, which may be straight or V-shaped, but never with vertical sutures running adjacent to inner orbits; the macropterous species with membrane of hindwing always extending to base ... **4**

4(3) Either macropterous, with stigmal vein of forewing long and forming an angle of about 90° with marginal vein (Fig. 12, 13), or completely apterous (males only), with eyes minute, less than half as long as distance between them (Fig. 14). Males with fore and hind femora very stout, contrasting with relatively slender middle femora (Fig. 14). [Associated with fig fruits] ... (p. 15) .. **AGAONIDAE**

—Without the foregoing combination of characters ... **5**

5(4) Hind leg with femur swollen and tibia curved; body black, without metallic colouring ... (p. 24) .. **CHALCIDIDAE**

—Either hind leg with femur not swollen and tibia straight, or head and thorax metallic green ... **6**

6(5) Hind coxa elongate, at least about twice as long as forecoxa (Fig. 83); forewings fully developed, with stigmal vein short and uncus hardly separated from the well developed postmarginal vein (Fig. 81–83); ovipositor often well exserted ... (p. 39) .. **TORYMIDAE** (TORYMINAE, MONODONTOMERINAE)

—Hind coxa not so enlarged, not or hardly longer than forecoxa; forewing, if fully developed, usually with stigmal vein longer and uncus well separated from postmarginal vein, or postmarginal vein absent; ovipositor normally hardly exserted ... **7**

7(6) Antenna with a very long, unsegmented clava and funicle composed of 2–4 indistinct, strongly transverse segments (Fig. 73, 76); body shining black or yellow; gaster sessile; axillae not distinctly marked off from scutellum, the two together forming a strongly transverse band about 3x as broad as long; propodeum with a large, shiny, central triangular area (Fig. 75) ... (p. 37) .. **SIGNIPHORIDAE**

—Antenna not as above; occasionally clava long and unsegmented, but then funicle composed of only 2 strongly transverse segments, and body metallic green; scutellum shield-shaped, about as long as broad or slightly transverse, usually with axillae distinctly marked off; propodeum without a distinct triangular central area ... **8**

8(7) All tarsi 4-segmented ... **9**

—At least hind tarsi 5-segmented ... **13**

9(8) Forewing marginal vein indistinct, more or less punctiform (Fig. 52) ... (p. 26) .. **ENCYRTIDAE**
—Forewing marginal vein distinct, several times longer than broad ... **10**

10(9) Antenna 14-segmented; funicle and clava each composed of 6 segments (Fig. 71)
... (p. 37) .. **ROTOITIDAE**
—Antenna with not more than 12 segments; funicle composed of not more than 5 segments, and clava never with more than 3 segments ... **11**

11(10) Hindleg with coxa strongly expanded, disc-shaped (Fig. 50) and tibia on outer surface with coarse, dark bristles arranged in longitudinal rows or diamond-shaped patterns; gaster in cross-section more or less triangular
... (p. 26) .. **ELASMIDAE**
—Hindleg with coxa subcylindrical, not compressed, and hind tibia without darker bristles arranged in a conspicuous pattern; gaster not triangular in cross-section ... **12**

12(11) Gaster distinctly constricted at junction with propodeum; forewing in macropterous forms with postmarginal and stigmal veins frequently long and distinct; body almost always at least partly metallic; notaular lines, if complete, almost always curved
... (p. 27) .. **EULOPHIDAE**
—Gaster at base about as broad as propodeum, not distinctly constricted; forewing in macropterous forms with postmarginal vein absent, or almost so, and stigmal vein very short (Fig. 15, 19, 22, 23, 26, etc.); body non-metallic, usually brown or black; notaular lines complete, straight (Fig. 22, 23, 25, etc.) ... (p. 17) .. **APHELINIDAE**

13(8) Either mesopleuron undivided, relatively large and shield-shaped (Fig. 39, 54, 57) or gaster broadly sessile (Fig. 9, 22, 23, 27, etc.); middle tibia usually with a strong apical spur (Fig. 22, 23, 30, 40–42, 54, 56) ... **14**
—Mesopleuron divided into mesepisternum and mesepimeron (Fig. 4), the 2 parts often with distinctly different sculpture; gaster never broadly sessile, at least with a distinct constriction at junction with propodeum, often petiolate; middle tibia with spur of normal proportions (Fig. 58, 61, 64, 81–83, etc.) ... **16**

14(13) Thorax in profile with middle coxa inserted about level with middle of mesopleural shield (Fig. 53) or even slightly anterior to this; forewing, if fully developed, with marginal vein short, usually not more than 3–4x as long as broad ... (p. 26) .. **ENCYRTIDAE**
—Thorax in profile with middle coxa inserted about level with posterior margin of mesopleural shield (Fig. 39, 54, 57); forewing, if fully developed, with marginal vein always at least 6–7x as long as broad ... **15**

15(14) Antenna with flagellum not more than 7-segmented; gaster sessile, broadly attached to propodeum (Fig. 22, 23, 27, 30, 40, 41, etc.); mesoscutum at least slightly convex, with notauli always present and straight (Fig. 22, 23, 25, etc.); length not more than 1.5 mm
... (p. 17) .. **APHELINIDAE**
—Antenna with flagellum 8- or 9-segmented; gaster distinctly constricted at junction with propodeum, or petiolate (Fig. 55, 56); mesoscutum either impressed or convex, with notauli very inconspicuous; length almost always greater than 1.5 mm ... (p. 28) .. **EUPELMIDAE**

16(13) Pronotal collar large, subrectangular, at least about two-thirds as long as mesoscutum (Fig. 58, 64); antenna with not more than 6 funicle segments; head and dorsum of thorax with numerous conspicuous, piliferous punctures which often give rise to very coarse sculpture; gena sharply margined posteriorly ... (p. 31) .. **EURYTOMIDAE**
—Pronotal collar not large and subrectangular, shorter than half length of mesoscutum, or if longer then antenna with 7 funicle segments, or sculpture of head and thorax shallow, or gena not with a sharp edge ... **17**

17(16) Forewing with apex of stigmal vein much enlarged, deeper than long, and apex of uncus very close to postmarginal vein (Fig. 79); pronotum elongate, subconical; female with ovipositor strongly exserted
... (p. 39) .. **TORYMIDAE**
(MEGASTIGMINAE)
—Forewing with apex of stigmal vein not or hardly enlarged, or if as above then pronotum transverse and not well developed; female rarely with ovipositor strongly exserted
... **18**

18(17) Wings fully developed; forewing marginal vein at least 3.5x as long as stigmal vein (Fig. 70); gastral petiole at least 1.5x as long as broad; antennae inserted above lowest eye margins, without a crest or tubercle between them ... (p. 35) .. **PERILAMPIDAE**
—If wings fully developed, then forewing marginal vein less than 3.5x as long as stigmal vein, or if relatively longer then either gastral petiole not longer than broad, or antenna inserted well below lowest margin of eye, or a sharp crest or tubercle present between antennal toruli ... **19**

19(18) Mesopleuron divided by a very weak, inconspicuous depression; notaular grooves complete; forewing marginal vein always more than twice as long as stigmal vein; antenna with 7 funicle segments and a single small

anellus; scutellum conspicuously hairy. Males only ... (p. 28) .. **EUPELMIDAE**

—Mesopleuron distinctly divided into episternum and epimeron; notaular grooves sometimes incomplete; marginal vein mostly less than twice as long as stigmal vein; antenna usually with 6 or fewer funicle segments, often with as many as 3 anelli; scutellum usually without conspicuous pilosity. Males and females ... (p. 36) .. **PTEROMALIDAE**

—ଌ—

DESCRIPTIONS

Superfamily CHALCIDOIDEA

Family AGAONIDAE

Figures 12–14

Diagnosis. General habitus fairly elongate, often distinctly dorsoventrally flattened. Integument smooth, shiny, non-metallic (except in Sycophaginae, species of which are generally metallic green). Length (excluding ovipositor) 1.0–4.0 mm. Sexual dimorphism very marked (except in Epichrysomallinae); females fully winged and of normal chalcid appearance; males (except in Epichrysomallinae) specialised, with the head disproportionately large, wings reduced to stumps, and gaster relatively small. Head varying from oval to strongly rectangular and elongate, from hypognathous to strongly prognathous. Eyes often extremely small, especially in specialised males, in which they may be placed near front of head. Mandible of female often elongate (Agaoninae), with a transversely ridged proximal appendage, that of males often relatively very large and used for fighting. Antenna of female 9–13-segmented, that of male 3–10-segmented; scape in female often very large, swollen, subrectangular.

Thorax dorsally usually quite flat, with pronotum fairly elongate. Forewing most often with the long stigmal vein at a very characteristic 90° angle to anterior wing margin; marginal vein varying from only a little longer than broad to several times longer than broad; postmarginal vein often quite long. Females often and males usually with fore and hind femora strongly developed, swollen, contrasting with weakly developed, slender middle femora. Tarsi of female 5-segmented, of male 1–5-segmented.

Gaster of female not petiolate, with ovipositor generally at least slightly exserted, but usually very strongly so; last tergite sometimes very elongate, almost filamentous, much longer than remainder of gaster; gaster of male normally deflexed downwards.

Biology. Species of Agaonidae are always associated with figs; many act as pollinators of various *Ficus* spp. (species of Agaoninae; Agaonidae in the sense of Wiebes and of authors), whereas others are probably parasitoids of the pollinators.

Figs and their associated species of agaonine pollinators are totally dependent on one another, since fig flowers can only be pollinated by the appropriate species of wasp, and no wasp can produce progeny outside the appropriate fig (Wiebes 1982a). The relationship is therefore very close, both groups probably being descendants of a common ancestor-fig and its pollinator-wasp (Wiebes 1982a,b).

Female agaonine fig-wasps normally enter the fig via the narrow ostiole, in the process losing their wings and often also parts of their antennae and legs (Wiebes 1982a, Valentine & Walker 1983). These females carry pollen from other figs, thus pollinating the flowers within the fig they enter and in which they are now doomed to die. Pollen is transported in pollen 'pockets' on the thorax, in 'corbicula' on each foreleg, or in folds of the intersegmental membrane of the gaster. The female wasps oviposit in female fig flowers. The larvae of the pollinator wasp develop and pupate within the endosperm of these flowers. The wingless males emerge first and mate with the females while still inside the galled flowers. These males normally bore a hole in the wall of the fig which allows the female wasps to emerge from the galled flowers. A few species of Agaoninae lay eggs without pollinating the fig flowers, and act as cuckoos (Wiebes 1979).

The immature stages have been described in detail only for *Blastophaga psenes* (Linnaeus) (Agaoninae) (Grandi 1929, Buscalioni & Grandi 1938). The deposited egg is oval with a long filament at one end. The first-instar larva is simple, translucent, and thirteen-segmented. The mature larva is strongly curved, and the meso- and metathoracic segments each have a pair of slightly raised, rounded, ventrolateral protuberances.

Blastophaga psenes is probably the best known of all the fig-wasps since it is the sole pollinating agent of the edible fig, *Ficus carica*. This species of fig is gynodioecious, i.e., the female flowers occur on one plant and the male and gall-flowers (non-reproductive female flowers with a relatively short style) on another. Wasps that emerge from a fig may fly to either a male or a female plant. The well known commercial edible seed-fig will be produced only if the wasps entering a female fig have emerged from a male fig, thus pollinating the flowers within the female fig (see Buscalioni & Grandi 1938). The use of *Blastophaga psenes* in producing figs commercially in North America has been summarised by Sisson (1970).

At least some species of the subfamily Epichrysomallinae also gall the flowers of figs, and in some instances may

act as pollinators (Z. Boucek, pers. comm.).

Species belonging to subfamilies other than the Agaoninae and Epichrysomallinae are probably all parasitoids or hyperparasitoids of the gall-formers. Adult females of the parasitic species oviposit inside galled flowers which contain the immature gall-former. The resulting larva eats the gall tissue, eventually starving the pollinator larva to death, or it may kill the immature gall-former. Ovipositing females may or may not enter the fig. Those that do not enter oviposit from outside, and have a long ovipositor with which they pierce the wall of the fig. Species of the groups that enter the fig have a relatively short ovipositor. These enter the fig through the ostiole, at the same time as their agaonine host (Wiebes 1982a).

Remarks. The family Agaonidae, as understood here, contains about 600 species in 70 or so genera. It comprises several subfamilies, of which only the Agaoninae and Epichrysomallinae are represented in New Zealand. Two genera, each containing a single species, are found in New Zealand.

KEY TO GENERA OF AGAONIDAE FOUND IN NEW ZEALAND

1 Notaular lines well marked, reaching, or very nearly reaching, posterior margin of mesoscutum; head more or less hypognathous (Fig. 12)
... (p. 16) .. **Epichrysomallinae: *Herodotia***

—Notaular lines absent; head prognathous (Fig. 13, 14)
... (p. 16) .. **Agaoninae: *Pleistodontes***

Genus *Herodotia* Girault

Figure 12

Herodotia Girault, 1931: 1. Type species *Herodotia procopii* Girault, 1931; Australia.

Diagnosis. Female. Length about 2.5–3.0 mm. Head and thorax shining orange-brown, covered with sparse brown bristles; gaster dark brown. Head about one-third broader than long; eyes moderately large, separated by a little more than their own length; antenna situated about level with lower eye margins, 13-segmented, including a single anellus. Pronotum elongate, about half as long as mesoscutum, parallel-sided; notaular lines complete; propodeum very steep, forming a right angle with scutellum. Forewing with a distinct marginal fringe; marginal vein a little longer than stigmal vein, postmarginal much shorter than stigmal. Tarsi 5-segmented. Gaster about as long as thorax; petiole very transverse, indistinct; cercal bristles situated on a raised tubercle; ovipositor hardly exserted.

Male. Length about 2.5–3.0 mm. Similar in appearance to female but gaster concolorous or only slightly darker than thorax and slightly deflexed downwards. Antenna 10-segmented; mandibles moderately large. Fore and hind legs with femora conspicuously swollen and tibiae stout; middle legs of more normal proportions, comparatively slender.

Biology. The single New Zealand species has been reared from the fruits of *Ficus rubiginosa* Desfontain in association with *Pleistodontes imperialis*.

Remarks. World status: two species; Australia, New Zealand.

New Zealand: one species, *Herodotia subatriventris* (Girault).

Genus *Pleistodontes* Saunders

Figures 13, 14

Pleistodontes Saunders, 1883: 8 Type species *Pleistodontes imperialis* Saunders, 1883; Australia.

Diagnosis. Female. Length (excluding ovipositor) about 1.5–3.5 mm. Head elongate, rectangular in dorsal view, about 2–3× as long as broad; a single groove connecting anterior ocellus to antennal sockets; eyes very much smaller than the distance between them, situated near back of head; antenna not distinctly hairy, 10- or 11-segmented; scape flattened, subrectangular to suboval, other segments subcylindrical, including the 2 anelliform segments; mandible with several transverse ridges and, including its appendage, only a little shorter than head. Mesoscutum, scutellum, and propodeum subequal in length. Forewing about twice as long as broad; postmarginal vein about as long as stigmal vein or longer. Tarsi 5-segmented. Hypopygium reaching or exceeding apex of gaster; ovipositor varying from a little shorter than gaster to twice as long.

Male. Length about 1.0–1.6 mm. Body generally yellow to orange. Head subcubical, with mouth opening as wide as head; eyes very small to minute, situated on anterior part of head; antennae 5- or 6-segmented, accommodated in deep recesses at front of head, separated by a sharp flange; flagellum very short. Apterous. Fore and hind legs with femora strongly swollen, tibiae very short and stout; middle leg with femur and tibia relatively slender. Gaster normally reflexed beneath thorax.

Biology. Species of *Pleistodontes* act as pollinators of various *Ficus* species. Eggs are laid in developing flower buds within the unripe fig after the female has gained access

through the ostiole. Mating of the resulting offspring takes place after emergence, in the receptacle of the ripe fig. Mated females emerge from the fig, carrying pollen grains which adhere to their bodies, and locate an unripe fig. In gaining access to this they introduce pollen from the original ripe fig. Males die within the ripened fruit (see Valentine & Walker 1983).

The single New Zealand species has been reared from the fruit of *Ficus rubiginosa* Desfontain (see Valentine & Walker 1983). It has been reared in association with *Herodotia subatriventris* (Girault).

Remarks. Taxonomy: Wiebes (1963, 1968, 1977).

World status: eighteen species; Australasia.

New Zealand: one species only, *Pleistodontes imperialis* Saunders.

Family APHELINIDAE

Figures 8, 15–46

Diagnosis. Generally small and robust or flattened, rarely elongate; length about 0.4–1.8 mm. Body varying in colour from pale yellow to dark brown, very rarely metallic and never strongly so. Antenna 5–9-segmented (excluding anellus, if present); funicle in both sexes 2–4-segmented, but male funicle sometimes with an additional segment. Mesoscutum with deep, straight notauli; mesopleuron varying from normal-sized and divided into mesepisternum and mesepimeron to relatively large, shield-shaped, and undivided. Fully winged or brachypterous; fully winged forms with marginal vein elongate, stigmal vein short, and postmarginal absent (in the Myocneminae, not yet found in New Zealand, the stigmal vein is elongate and the postmarginal vein is distinct); forewing often with a linea calva or speculum. Middle coxae inserted well behind middle of mesopleuron; middle tibial spur fairly elongate and stout; tarsi 4- or 5-segmented. Gaster sessile; ovipositor usually not or hardly exserted, although occasionally strongly exserted.

Biology. Aphelinids are generally internal parasitoids or hyperparasitoids of Homoptera (notably Coccoidea and Aphididae), or ectoparasitoids of diaspid scales (Homoptera: Diaspididae), or predators of their eggs. Some species are internal parasitoids of eggs of other insects, notably Homoptera and occasionally Orthoptera and Lepidoptera, and a few develop on larvae or pupae of Dryinidae (Hymenoptera), Cecidomyiidae, or Chamaemyiidae (Diptera) (Viggiani 1984). Many species are of interest because of the different ontogenies of the sexes (see below).

Adult aphelinids may feed on the honeydew exuded by their hosts or on secretions issuing from the oviposition site. A species of *Coccophagus* has even been observed to stroke its coccid host to induce it to secrete honeydew (Cendana 1937). Aphelinid eggs are often stalked. The larvae of ectoparasitic species (*Aphytis* spp.) have a functional tracheal system and spiracles (Rosen & DeBach 1979), but the endoparasitoids (e.g., *Coccophagus*) have neither (Cendana 1937). Pupation may take place inside or outside the host. Some species pupate within the living host, inside a pupation chamber which becomes filled with air. There is some evidence that air inside this chamber is derived from the host's tracheal system, as in the Encyrtidae (Clausen 1940). Parasitoids of scales and aphids generally emerge by cutting a hole through the integument of the host mummy, but if the scale has a delicate covering the adults push their way out from beneath it; such adults may even lack functional mandibles (Viggiani 1984).

Some species of Aphelinidae are very unusual in that the sexes have different host relationships. The females of these species develop as primary endoparasitoids of homopterous hosts (usually coccids). Males of the same species may be primary ectoparasitoids of Homoptera, hyperparasitoids of other chalcidoid species within their homopterous hosts, primary endoparasitoids of lepidopteran eggs, or even hyperparasitoids of males or females of their own species (see Valentine 1964; see also a review of the phenomenon by Walter 1983).

There is marked sexual dimorphism in the immature stages of some species of Aphelinidae. Several species (e.g., of *Coccophagus*) have sexually dimorphic eggs (Flanders 1937, Viggiani & Mazzone 1978, Mazzone & Viggiani 1984), and the larvae of many taxa are unusually sexually dimorphic. For example, the first-instar male larva of *Coccophagus* may be clothed in long setae and have a spine-like tail, whereas the female larva has no long setae and has a more normal tail (Flanders 1937). The pupae of some species (e.g., *Encarsia* spp.) also exhibit sexual dimorphism (Viggiani & Mazzone 1978).

Worldwide, many species of aphelinid have been used successfully in the biological control of insect pests. Perhaps the best known of these is *Encarsia formosa*, which is sold commercially to control the greenhouse whitefly, *Trialeurodes vaporariorum*, a potentially serious pest of greenhouse plants. *Aphytis* contains many species which have been employed in programmes to control diaspid scale pests of orchard and other crops (see Rosen & DeBach 1979).

Remarks. The family Aphelinidae is of moderate size, containing about 900 species in 45 genera. About 67 species in 11 genera are known from New Zealand.

KEY TO GENERA OF APHELINIDAE KNOWN FROM NEW ZEALAND

1 Females ... **2**
—Males ... **14**

Females

2(1) Tarsi 4-segmented; forewing in macropterous forms almost always with a single seta on submarginal vein basad of parastigma, this seta clearly longer than maximum width of costal cell (Fig. 23, 42); funicle with not more than 3 segments ... **3**
—At least hind tarsi 5-segmented; forewing submarginal vein with more than 1 seta, these setae rarely longer than maximum width of costal cell or, if only 1 seta present, then funicle clearly 4-segmented ... **4**

3(2) Clava solid, or flagellum 4-segmented (Fig. 23) ... (p. 21) .. ***Cales***
—Clava 3-segmented, or flagellum 5-segmented (Fig. 42, 44–46) ... (p. 23) .. ***Pteroptrix***

4(2) Forewing short, not reaching apex of gaster ... **5**
—Forewing at least reaching apex of gaster ... **6**

5(4) At least head and thorax dark brown and shiny; apex of clava rounded, not produced downwards (Fig. 18) ... (p. 20) .. ***Aphelinus***
—Body completely yellowish; apex of clava slightly produced downwards (Fig. 27, 28) ... (p. 21) .. ***Centrodora***

6(4) Forewing with an oblique, naked stripe (linea calva) extending basad from vicinity of stigmal vein (Fig. 6, 19, 21, 26, 36); funicle 3-segmented ... **7**
—Forewing without such a stripe, and with discal setae more or less evenly distributed (Fig. 23, 30, 32, 33, 41), or if basal half of forewing nearly naked (Fig. 15) then funicle 4-segmented (Fig. 16) ... **10**

7(6) Body rather narrow and elongate, with gaster distinctly longer than head plus thorax (Fig. 25); forewing narrow, at least about 2.5–3.0x as long as broad (Fig. 26); clava usually slightly produced downwards at apex (Fig. 27, 28); ovipositor about 3x as long as middle tibia; body yellowish ... (p. 21) .. ***Centrodora***
—Body relatively broad, with gaster not longer than head plus thorax, or hardly so (Fig. 22); forewing slightly more than twice as long as broad; clava rounded or obliquely truncate at apex (Fig. 18, 22, 37); ovipositor at most about twice as long as middle tibia; body often darkened ... **8**

8(7) Axillae not projecting anterior to scutellum, their anterior margins forming a straight line with anterior margin of scutellum (Fig. 38)... (p. 23) .. ***Eutrichosomella***
—Axillae projecting anterior to scutellum, their anterior margins not forming a straight line with that of scutellum (Fig. 22) ... **9**

9(8) Forewing marginal vein relatively short, usually not longer than submarginal vein (Fig. 19), or if slightly longer then thorax dark brown and shiny; hypopygium reaching apex of gaster (Fig. 20); body usually robust; thorax dorsally rather convex ... (p. 20) .. ***Aphelinus***
—Forewing marginal vein distinctly longer than submarginal vein (Fig. 22); thorax never dark brown and shiny, usually yellow or at least pale, occasionally with some darker markings; hypopygium not reaching apex of gaster (Fig. 21); body usually at least slightly flattened dorsoventrally; dorsum of thorax quite flat ... (p. 20) .. ***Aphytis***

10(6) Flagellum 5-segmented; funicle 4-segmented, the 3rd segment distinctly shorter than the others (Fig. 16); forewing more or less evenly infumate brownish, with basal half almost naked and costal cell naked (Fig. 15) ... (p. 19) .. ***Ablerus***
—Flagellum 6-segmented; funicle not as above; forewing with at least base and apex hyaline, the basal half with moderately dense setae and usually some setae in costal cell ... **11**

11(10) Flagellum not clearly differentiated into funicle and clava, gradually tapering towards apex (Fig. 29) ... (p. 21) .. ***Coccophagoides***
—Flagellum clearly differentiated into funicle and at least a 2-segmented clava, the clava at least as broad as 1st funicle segment and usually distinctly broader ... **12**

12(11) Forewing submarginal vein basad of parastigma with at most 4 setae dorsally; marginal fringe often at least half as long as maximum width of forewing, sometimes with a distinct naked area at apex of stigmal vein (Fig. 32); longitudinal sensilla on flagellum few, not clearly visible in card-mounted material ... (p. 22) .. ***Encarsia***
—Forewing submarginal vein basad of parastigma with at least 6 setae dorsally, and usually many more; marginal fringe short, much less than one-quarter of maximum wing width, never with a naked area at apex of stigmal vein; longitudinal sensilla on flagellum often dense, clearly visible in card-mounted material ... **13**

13(12) Funicle 3-segmented; body usually with some brown areas; scutellum with only 6 setae (Fig. 30), or if with more then thorax mostly brown ... (p. 22) .. ***Coccophagus***

—Funicle 4-segmented (in dry-mounted material sometimes apparently 3-segmented); body yellow; scutellum with at least 12 setae; longitudinal sensilla on flagellum not prominent (Fig. 41) ... (p. 23) .. ***Euxanthellus***

Males

14(1) Forewing submarginal vein basad of parastigma with only a single seta dorsally, or if 2 present then flagellum not differentiated into funicle and clava ... **15**
—Forewing submarginal vein basad of parastigma with at least 3 setae dorsally, or if only 2 present then flagellum clearly differentiated into a 4-segmented funicle and 2-segmented clava ... **17**

15(14) Tarsi 5-segmented; flagellum 5-segmented, the 3rd segment much the shortest ... (p. 19) .. ***Ablerus***
—Tarsi 4-segmented; flagellum not 5 segmented (in at least 1 extralimital species flagellum 5-segmented, but all segments subequal in length) ... **16**

16(15) Flagellum (including the very small anellus) 3-segmented, clothed in whorls of dark setae several times as long as the diameter of segments of origin (Fig. 24) ... (p. 21) .. ***Cales***
—Flagellum 6-segmented, clothed with setae shorter than the diameter of segments of origin (Fig. 43) ... (p. 23) .. ***Pteroptrix***

17(14) Forewing with an oblique, bare stripe (linea calva) extending basad from vicinity of stigmal vein (as in Fig. 6, 19, 21, 26, 36) ... **18**
—Forewing with no such stripe (as in Fig. 23, 28, 32, 33, 41) ... **20**

18(17) Forewing relatively narrow, at least about 2.5–3.0x as long as broad; body yellowish ... (p. 21) .. ***Centrodora***
—Forewing relatively broad, at most only slightly longer than twice its width; body frequently dark brown, occasionally yellow or pale with darker markings ... **19**

19(18) Forewing marginal vein at most about as long as submarginal vein, or if longer then thorax dark brown and shiny; body usually robust; dorsum of thorax rather convex ... (p. 20) .. ***Aphelinus***
—Forewing marginal vein distinctly longer than submarginal vein; thorax never dark brown and shiny, usually yellow or at least pale, occasionally with some darker markings; body at least slightly flattened dorsoventrally; dorsum of thorax flat ... (p. 20) .. ***Aphytis***

20(17) Forewing submarginal vein basad of parastigma dorsally with at most 4 setae; flagellum either not clearly differentiated into funicle and clava, or with a 4-segmented funicle and a 2-segmented clava; longitudinal sensilla on flagellum not prominent ... **21**
—Forewing submarginal vein basad of parastigma dorsally with at least 6 setae; flagellum usually consisting of a 3-segmented funicle and a 3-segmented clava, although occasionally funicle and clava not clearly differentiated; longitudinal sensilla prominent ... **22**

21(20) Flagellum consisting of 6 similar segments; scutellum, excluding axillae, marked with dark brown; forewing submarginal vein basad of parastigma usually with 4 setae (occasionally 3) dorsally; marginal fringe less than one-quarter as long as maximum wing width, with no naked area at stigmal vein ... (p. 21) .. ***Coccophagoides***
—Flagellum consisting of a 2-segmented clava and a 4-segmented funicle (Fig. 34); scutellum, excluding axillae, entirely orange or yellow; forewing submarginal vein basad of parastigma usually with only 2 setae dorsally, occasionally with 3 or 4; marginal fringe often at least half as long as maximum wing width, often with a naked area at stigmal vein (as in Fig. 32) ... (p. 22) .. ***Encarsia***

22(20) Scutellum and mesoscutum brown or black; axillae and extreme sides of mesoscutum occasionally orange; scutellum most often with only 6 setae, but occasionally with more than 12 ... (p. 22) .. ***Coccophagus***
—Scutellum and mesoscutum yellow; axillae and a central wedge-shaped mark on mesoscutum brown; scutellum with at least 12 setae (Fig. 40) ... (p. 23) .. ***Euxanthellus***

Genus *Ablerus* Howard

Figures 15, 16

Ablerus Howard, 1894: 7. Type species *Centrodora clisiocampe* Ashmead, 1894; U.S.A., Florida.

Diagnosis. Female. Length about 0.50–0.80 mm. Antenna 7-segmented (excluding anellus, if present); funicle 4-segmented, the 3rd segment shortest. Pronotum entire; mesoscutum with 1 or 2 pairs of setae; propodeum distinctly longer than metanotum. Forewing with parastigma not conspicuously enlarged; stigmal vein long, its apex varying from not to fairly swollen; postmarginal vein absent; disc sparsely and uniformly setose, or almost bare; submarginal vein with 1 seta. Tarsi 5-segmented. Gaster with tergites VII + VIII separated; ovipositor usually exserted; hypopygium reaching apex of gaster.

Male (not known for New Zealand species). Length about 0.50–0.80 mm. Generally similar to female; forewing often paler, but similarly marked.

Biology. Unknown; elsewhere recorded as parasitoids of eggs of Homoptera (Cumber 1967) and Lepidoptera (Darling & Johnson 1984).

Remarks. We follow the opinions of Hayat (1983) and Darling & Johnson (1984) in maintaining *Ablerus* and *Azotus* as distinct genera, although some characters used for separating the genera do not hold for the New Zealand species. In particular, the swollen apex of the stigmal vein is regarded as a character typical of *Azotus*, but on balance other characters, such as the squat habitus and forewing setation, place the New Zealand species in *Ablerus*. It is possible that a detailed study of the two genera will confirm the synonymy proposed by Shafee & Rizvi (1985).

Taxonomy: De Santis (1948), Annecke & Insley (1970), Darling & Johnson (1984).

World status: 53 species; cosmopolitan, but predominantly Australian.

New Zealand: a single undetermined species from the North Island (AK).

Genus *Aphelinus* Dalman

Figures 17–20

Aphelinus Dalman, 1820: 181. Type species *Entedon (Aphelinus) abdominalis* Dalman, 1820; Sweden.

Diagnosis. Female. Length 0.70–1.35 mm. Usually body quite robust. Antenna 6-segmented (excluding anellus, if present) with a 3-segmented funicle. Distance between posterior pair of scutellar setae equal to or greater than distance between anterior pair; mesopleuron divided into epimeron and episternum. Forewing occasionally shortened and not reaching apex of gaster, but if fully developed then marginal vein not longer than costal cell; postmarginal vein absent; a well defined linea calva present. Tarsi 5-segmented; claws equal in length; middle tibial spur densely hairy. Hypopygium reaching apex of gaster; ovipositor not or hardly exserted.

Male. Length 0.50–1.15 mm. Very similar to female, differing only slightly in antennal structure, and in genitalia.

Biology. Species of *Aphelinus* are primary endoparasitoids of aphids (Homoptera: Aphididae); also recorded from whitefly (Homoptera: Aleyrodidae). Known host associations of species in New Zealand are:

• *A. abdominalis* Dalman – from *Macrosiphum euphorbiae* (Thomas) and *Acyrthosiphon kondoi* Shinji;

• *A. asychis* Walker – from *Macrosiphum euphorbiae*;

• *A. gossypii* Timberlake – from *Aphis nerii* Fonscolom, *Capitophorus eleagni* (Del Guercio), *Toxoptera aurantii* (Fonscolom), *Toxoptera citricidus* Kirkaldy; also from *Trialeurodes vaporariorum* (Westwood);

• *A. mali* (Haldeman) – from *Eriosoma lanigerum* (Hausman);

• *A. subflavescens* (Westwood) – from *Tuberculoides annulatus* (Hartig).

Remarks. For extralimital host records, see Kalina & Stary (1976).

Taxonomy: Ferrière (1965), Graham (1976).

World status: sixty-three species, many of them possibly misplaced in this genus; cosmopolitan.

New Zealand: seven species – the five listed above, *A. humilis* Mercet, and one undetermined.

Genus *Aphytis* Howard

Figures 6, 21, 22

Aphytis Howard, 1900: 168. Type species *Aphytis chilensis* Howard, 1900; Chile.

Diagnosis. Female. Length 0.60–1.40 mm. Body yellow or whitish, often with darker markings. Antenna 6-segmented (excluding anellus, if present) with 3 funicle segments, or rarely 5-segmented with only 2 funicle segments; clava with not more than 15 longitudinal sensilla. Pronotum membranous medially, relatively short, less than one-quarter as long as mesoscutum; mesopleuron divided into episternum and epimeron, occasionally appearing undivided; propodeum with posterior crenulae. Forewing hyaline or sometimes with an infuscate pattern; linea calva present; marginal vein longer than costal cell; postmarginal vein absent. Tarsi 5-segmented. Gaster with hypopygium not reaching apex; ovipositor not or hardly exserted.

Male. Length 0.50–1.10 mm. Apart from genitalia and slightly smaller size, generally similar to female.

Biology. Species of *Aphytis* are external parasites of diaspidid scales (Homoptera: Diaspididae). Normally they are solitary in habit, but in some species up to six individuals may develop on a single host. Known host associations of New Zealand species are:

• *A. chilensis* Howard – a wide host range, including *Aonidiella aurantii* (Maskell), *Aspidiotus hederae* (Vallot), *Hemiberlesia rapax* (Comstock), *Parlatoria pittospori* Maskell, and *Leucaspis* spp.;

• *A. chrysomphali* Mercet – probably specific to *Aonidiella aurantii* (Maskell);

• *A. diaspidis* Howard – known only from *Quadraspidiotus perniciosus* (Comstock);

• *A. ignotus* Compere – a gregarious species with up to six

larvae developing on a single *Lindingaspis rossi* Maskell; • *A. mytilaspidis* (Le Baron) – from *Lepidosaphes ulmi* (Linnaeus), *Quadraspidiotus ostreaeformis* (Curtis), and *Q. perniciosus* (Comstock).

Remarks. *Aphytis* species are extensively used in biological control of pest diaspidid scales, particularly on orchard crops. *Aphytis diaspidis* was introduced into New Zealand in 1960 as a parasitoid of the San José scale, but was possibly already established.

Taxonomy: Rosen & De Bach (1980).

World status: ninety-six species; cosmopolitan.

New Zealand: seven species, comprising the five listed above and two undetermined.

Genus *Cales* Howard

Figures 23, 24

Cales Howard, 1907: 82. Type species *Cales noacki* Howard, 1907; Brazil.

Diagnosis. Female. Length about 0.40–0.80 mm. Body yellowish or brownish. Antenna (including the distinct anellus) 6-segmented; funicle 2-segmented; clava transversely truncate at apex. Pronotum longitudinally divided. Forewing marginal fringe at least half as long as width of wing; linea calva absent; submarginal vein with a single seta; postmarginal vein absent. Foretibial spur almost straight; tarsi 4-segmented. Gaster with hypopygium not reaching apex.

Male. Length about 0.35–0.80 mm. Generally similar to female, but antenna (including anellus) 5-segmented, and flagellum clothed in whorls of long setae.

Biology. The single New Zealand species has been reared from *Asterochiton pittospori* Dumbleton (Homoptera: Aleyrodidae) on *Pittosporum eugenioides* Cunningham.

Remarks. The type species, *C. noacki*, has been introduced in recent years into Central America and Europe in an attempt to control the woolly whitefly, *Aleurocanthus woglumi* Ashby.

World status: two described species; South America, Europe (introduced), and Australia.

New Zealand: one undescribed species; North Island only (AK).

Genus *Centrodora* Förster

Figures 25–28

Centrodora Förster, 1878: 66. Type species *Centrodora amoena* Förster, 1878; Germany.

Diagnosis. Female. Length (excluding ovipositor) 0.60–1.20 mm. Colour generally yellow or yellowish often with a dusky brown pattern on thorax; legs never with dark bands or spots. Antenna (excluding anellus, if present) 6-segmented; funicle 3-segmented; clava usually with apex pointed and slightly down-curved. Mesoscutum with not more than 12 setae; mesopleuron usually divided into episternum and epimeron, occasionally appearing undivided. Wings sometimes strongly reduced; fully developed forewing long, narrow, about 2.5–3.0x as long as broad; marginal vein at most as long as costal cell; linea calva present or absent. Tarsi 5-segmented. Gaster usually longer than head and thorax combined; ovipositor frequently well exserted, the exserted part up to half as long as gaster; hypopygium not extending to apex of gaster.

Male. Length about 0.30–0.95 mm. Apart from genitalia and slightly smaller size, similar in appearance to female.

Biology. Hosts recorded in New Zealand are as follows: • *C. scolypopae* Valentine – from eggs of the passion vine hopper, *Scolypopa australis* Walker (Homoptera: Ricaniidae);
• *C. xiphidii* Perkins – from eggs of the grasshopper *Conocephalus semivittatum* (Walker) (Orthoptera: Acrididae). Extralimital host records are all from insect eggs.

Remarks. Taxonomy: Hayat (1974, 1983), Valentine (1966).

World status: twenty-eight species; cosmopolitan.

New Zealand: four species, those listed above and two undetermined.

Genus *Coccophagoides* Girault

Figure 29

Coccophagoides Girault, 1915a: 58. Type species *Coccophagus abnormicornis* Girault, 1915; Australia.

Diagnosis. Female. Length about 0.50–0.95 mm. Antenna (excluding anellus, if present) 8-segmented; flagellum spindle-shaped, not clearly differentiated into funicle and clava, its apical segment conical with a pointed apex; flagellum clothed with very short hairs, appearing naked in dry-mounted material. Pronotum membranous medially; axillae small, longer than wide, separated by more than their own length. Forewing with 3 or more setae on submarginal vein; marginal vein shorter than costal cell; stigmal vein with an enlarged apex; postmarginal vein absent; linea calva absent; marginal fringe short, hardly longer than stigmal vein. Tarsi 5-segmented, occasionally foretarsi 4-segmented. Gaster with hypopygium reaching or nearly reaching apex.

Male. Length about 0.50–0.95 mm. Very similar to female, but flagellum not as markedly spindle-shaped and clothed in relatively coarse setae.

Biology. The New Zealand species has been reared from *Hemiberlesia rapax* (Comstock) (Homoptera: Diaspididae). Elsewhere, females of the genus are primary endoparasitoids of diaspidid scales (Homoptera: Diaspididae), and the males are obligate secondary ectoparasitoids of the prepupae and pupae of their females.

Remarks. Taxonomy: Doutt (1966).
World status: twelve species; cosmopolitan.
New Zealand: one undetermined species.

Genus *Coccophagus* Westwood

Figures 30, 31

Coccophagus Westwood, 1833b: 344. Type species *Entedon scutellaris* Dalman, 1825; Sweden.

Diagnosis. Female. Length 0.60–1.80 mm. Body colour varying from almost completely yellow to completely black. Antenna (excluding anellus, if present) 8-segmented with a 3-segmented clava, or rarely 7-segmented with a 2-segmented clava; scape subcylindrical, not flattened or expanded; rhinaria prominent, giving segments a striate appearance in card-mounted specimens. Pronotum entire; scutellum not extending over base of gaster, with 6 or more setae; axillae separated medially by about the length of an axilla. Forewing with 5 or more, usually at least 12, setae on submarginal vein; postmarginal vein very short or absent; stigmal vein very short; linea calva absent; marginal fringe generally short, not or hardly longer than stigmal vein. Tarsi 5-segmented. Gaster with hypopygium not reaching apex.

Male. Length 0.50–1.50 mm. General appearance similar to that of female, but often much darker; antenna usually with flagellar segments longer and broader, sometimes differentiated into a 3-segmented funicle and 3-segmented clava but usually a 5-segmented funicle and 1-segmented clava.

Biology. Species of *Coccophagus* are all parasitoids of either Coccidae or Pseudococcidae. The named New Zealand species have the following host associations:
• *C. gurneyi* Compere – reared from *Pseudococcus longispinus* Targioni Tozetti;
• *C. ochraceus* Howard – from *Ceroplastes sinensis* Del Guercio, *Saissetia coffeae* Walker, and *S. oleae* (Bern);
• *C. scutellaris* (Dalman) – from *Coccus hesperidum* Linnaeus and *Pulvinaria* sp.

All unidentified New Zealand species that have been reared were recorded from Pseudococcidae.

Remarks. Taxonomy: Compere (1931), Ferrière (1964), Annecke & Insley (1974), Hayat (1971).
World status: 174 species; cosmopolitan.
New Zealand: about ten species, three of them identified (see below), the remainder probably endemic.

Genus *Encarsia* Förster

Figures 32–35

Encarsia Förster, 1878: 65–66. Type species *Encarsia tricolor* Förster, 1878; Germany.

Diagnosis. Female. Length about 0.35–0.75 mm. Antenna (excluding anellus, if present) 8-segmented; funicle 3–5-segmented; longitudinal sensilla on flagellum indistinct, hence not giving a striate appearance in card-mounted specimens. Scutellum with 2 pairs of setae; axillae relatively small, separated by more than their own length. Forewing with fewer than 4 setae on submarginal vein; postmarginal vein absent; stigmal vein short; a naked patch sometimes present at apex of venation; marginal fringe varying from less than one-sixth to more than half of wing width; linea calva absent. Tarsi 5-segmented; occasionally middle tarsus 4-segmented. Gaster with hypopygium not reaching apex.

Male. Length about 0.35–0.60 mm. Usually darker than female; antenna 7-segmented; flagellar segments subequal in length, not differentiated into funicle and clava; longitudinal sensilla on flagellum indistinct.

Biology. *Encarsia* species are parasitoids of diaspidid scales and aleyrodid larvae and pupae (Homoptera: Diaspididae, Aleyrodidae), and rarely are parasitoids of the immature stages of Coccidae. The females are primary endoparasitoids, and the males are obligate secondary parasitoids developing on the prepupae or pupae of females of their own species or other suitable hymenopterous prepupae in appropriate hosts. Species known from New Zealand have the following host associations:
• *E. citrina* (Howard) – a common and widespread parasitoid of many Diaspididae (12 host species recorded in New Zealand) and immature stages of some Coccidae, viz. *Ceroplastes sinensis* Del Guercio and *Coccus hesperidum* (Linnaeus);
• *E. formosa* Gahan – from *Trialeurodes vaporariorum* Westwood and *Pealius azaleae* (Baker & Moles) (Aleyrodidae);
• *E. koebelei* (Howard) – a parasitoid of *Lindingaspis rossi* Maskell (Diaspididae);

• *E. pergandiella* Howard – a parasitoid of *Trialeurodes vaporariorum* Westwood;
• *E. perniciosi* (Tower) – a parasitoid of *Aonidiella aurantii* Maskell and *Quadraspidiotus perniciosus* (Comstock) (Diaspididae).

Remarks. World status: over 150 species; cosmopolitan.
New Zealand: about ten species, only five of them identified (see above).

Genus *Eutrichosomella* Girault

Figures 36–39

Eutrichosomella Girault, 1915a: 40. Type species *Eutrichosomella albiclava* Girault, 1915; Australia.

Diagnosis. Female. Length about 1.00–1.30 mm. Antenna (excluding anellus, if present) 6-segmented; funicle 3-segmented; scape slightly to markedly broadened and flattened. Pronotum undivided; axillae separated by about their own length; anterior margins of axillae and scutellum in a straight line; scutellum almost as wide as long; mesopleuron large, undivided. Forewing often infuscate; linea calva present; marginal vein longer than costal cell; postmarginal vein absent; stigmal vein short. Legs without any darker spots or bands; tarsi 5-segmented.
Male. Unknown.

Biology. Unknown.

Remarks. The large, undivided mesopleuron and the straight posterior margin of the mesoscutum are so suggestive of the Encyrtidae that *Eutrichosomella* was earlier placed in that family (Timberlake 1941). However, after studying described species Hayat (1983) placed it correctly in the Aphelinidae.
Taxonomy: Timberlake (1941), Hayat (1983).
World status: seven species; Australasian, Oriental.
New Zealand: one undetermined species; North Island only (AK).

Genus *Euxanthellus* Silvestri

Figures 40, 41

Euxanthellus Silvestri, 1915: 320. Type species *Euxanthellus philippiae* Silvestri, 1915; Ethiopia.

Diagnosis. Female. Length about 0.8–1.3 mm. Body generally yellow. Antenna (excluding annellus if present) 9-segmented; funicle 4-segmented; rhinaria prominent in card-mounted specimens, giving segments a striate appearance. Axillae separated by about their own length; scutellum with more than 12 setae, not extending over base of gaster. Forewing with more than 5 setae on submarginal vein; postmarginal vein absent; linea calva absent; marginal fringe short, not or hardly longer than stigmal vein. Tarsi 5-segmented. Gaster with hypopygium not reaching apex.
Male. Length about 0.70–0.90 mm. Generally similar to female, but with a bold, contrasting yellow and dark brown pattern on mesoscutum and scutellum; flagellar segments relatively longer and stouter; and antenna with a 3-segmented funicle and 3-segmented clava.

Biology. The single New Zealand species, *E. philippiae* Silvestri, has females which are primary parasitoids of Coccidae and males which are hyperparasitoids on their own females or on other encyrtid and aphelinid primary parasitoids of Coccidae, Pseudococcidae, and Aleyrodidae. Females have been reared, as primary parasitoids, from species of *Ceroplastes*, *Coccus*, *Ctenochiton*, *Parthenolecanium*, *Pulvinaria*, and *Saissetia*. Males have been reared as hyperparasitoids of these same hosts via females of *E. philippiae*, and from the following:
• *Parthenolecanium* sp. (Coccidae), via *Metaphycus timberlakei* Ishii (Encyrtidae);
• *Ctenochiton perforatus* Maskell (Coccidae), via *Pteroptrix* sp. (Aphelinidae);
• *Nipaecoccus aurilanatus* (Maskell) (Pseudococcidae), via *Tetracnemoidea* sp. (Encyrtidae);
• unidentified species of Aleyrodidae, via *Encarsia* sp. (Aphelinidae).

Remarks. Taxonomy: Annecke & Prinsloo (1976).
World status: three species; Afrotropical, Australasian.
New Zealand: one species (see above).

Genus *Pteroptrix* Westwood

Figures 42–46

Pteroptrix Westwood, 1833b: 344. Type species *Pteroptrix dimidiatus* Westwood, 1833; England.
=*Bardylis* Howard, 1907: 84. Type species *Bardylis australiensis* Howard, 1907; Australia. **New synonymy.**
=*Dahmsiella* Hayat, 1979: 123. Type species *Neocasca shillingsworthi* Girault, 1920; Australia. **New synonymy.**

Diagnosis. Female. Length about 0.50–1.00 mm. Colour varying from completely whitish, through yellow, to completely brown; paler specimens sometimes with dark brown bands or stripes. Antenna (excluding anellus, if present) 7-segmented; funicle 2- or 4-segmented. Pronotum divided medially. Wings usually fully developed, although

some brachypterous New Zealand species are known; submarginal vein with only a single seta dorsally. Tarsi 4-segmented. Ovipositor sometimes strongly exserted; hypopygium varying from nearly reaching apex to reaching apex of gaster.

Male. Length about 0.4–0.9 mm. Generally similar to female, but antenna (excluding anellus, if present) 7- or 8-segmented, with funicle 4- or 5-segmented.

Biology. Generally parasitoids of Diaspididae, although some of the New Zealand species have been reared from Coccidae and Eriococcidae.

Remarks. We have examined the syntypes of *Bardylis australiensis* Howard (USNM, BMNH, NZAC). They are uncleared, and are mounted on several slides. A lectotype is not designated here, since this would best be done when some specimens have been remounted. There is very little difference between *australiensis* and those species generally regarded as belonging to *Pteroptrix*, except that the middle tibial spur is shorter in relation to the basitarsus, and the antenna of the males has a six-segmented flagellum, whereas in *Pteroptrix* (where known) it is five-segmented. In a review of the world aphelinid genera, Hayat (1983) retained the two genera as distinct on the basis of these characters, also noting that the seventh and eighth gastral tergites are apparently separate in *australiensis*, but fused in the known species of *Pteroptrix*. We feel that these differences are not generic, but probably only reflect possible species-groups, since in other respects the type species are morphologically very similar.

Hayat (1979) proposed the genus *Dahmsiella* for *Neocasca shillingsworthi*, separating it from other tetramerous aphelinids by the spindle-shaped flagellum and prominent hypopygium. However, the New Zealand species vary from being very close morphologically to *P. dimidiata* Westwood [*Pteroptrix* takes a feminine ending] to perhaps even more extreme than the type species of *Dahmsiella* (many are superficially similar to species of *Coccophagoides*). We do not believe that retaining the two genera as distinct is realistic, and here regard them as synonymous.

Pteroptrix can be distinguished from the other tetramerous aphelinid genera by the combination of seven-segmented antenna in the female and the presence of only a single seta on the forewing submarginal vein.

Pteroptrix maskelli Ashmead, described from New Zealand, was transferred to *Ophelimus* (Eulophidae) by Boucek (1988).

Taxonomy: Hayat (1983).

World status: seventeen species; cosmopolitan.

New Zealand: at least twenty-five species, most if not all endemic and undescribed.

Family CHALCIDIDAE

Figures 47–49

Diagnosis. Body robust to elongate, strongly sculptured; length (excluding ovipositor) about 2.5–9.0 mm. Colour blackish often marked with white, yellow, or red, particularly on legs. Antenna in both sexes 11–13-segmented, inserted about midway between mouth margin and anterior ocellus, or much closer to mouth; clava 1–3-segmented; occasionally 1st flagellar segment of male very thin, anelliform, hidden by pedicel. Tegula suboval; prepectus small, hardly visible between pronotum and mesopleuron. Forewing marginal vein varying from very short to quite long; stigmal vein short; postmarginal vein varying from absent to moderately long. Hind femur characteristically swollen, often with several teeth on inner margin; tibia markedly curved; tarsi 5-segmented. Gaster varying from subsessile to distinctly petiolate.

Biology. Chalcidids are mainly solitary, primary endoparasitoids of the mature larvae or young pupae of Diptera or Lepidoptera, although a few species are known to be ectoparasitoids or gregarious. Some species attack Hymenoptera, Coleoptera, or Neuroptera. A number of species (including some tropical species of *Spilochalcis*) may be hyperparasitic. Some species of *Chalcis* oviposit into eggs of Stratiomyidae (Diptera) laid in clusters on waterside vegetation (Cowan 1979). Upon hatching, the stratiomyid larvae quickly enter the water, in which they undergo larval development. During this period the chalcidid larvae remain almost dormant inside them. When the stratiomyid larvae are ready to pupate they migrate to mud banks or other similar sites above the waterline. The *Chalcis* larvae quickly complete their development, and their adults emerge through round holes that they cut in the calcified cuticle of the stratiomyid (Burks 1979). At least one species of *Chalcis* oviposits directly into submerged stratiomyid larvae (Schremmer 1960).

Female chalcidids may lay up to two hundred eggs, which are elongate-oval and may sometimes have a very short petiole. The first-instar larva may be simple, or it may have a tail; it may have spiracles or not, but has well developed cuticular spines. Pupation takes place inside the host pupa.

Some chalcidids are of interest as parasitoids of insect pests. For example, *Brachymeria intermedia* (Nees) is a parasitoid of *Lymantria dispar*, an introduced pest of a variety of trees in North America, but it has proved to be of little use for biological control purposes. Species of the predominantly tropical genus *Dirhinus* may be of some economic importance as parasitoids of synanthropic Diptera and fruit-flies (Boucek & Narendran 1981).

Remarks. This moderately large, cosmopolitan family is most diverse in the tropics. Worldwide, it contains about 1500 species placed in five subfamilies, two of which are found in New Zealand, viz Chalcidinae and Haltichellinae. Five species in three genera are represented in New Zealand.

KEY TO GENERA OF CHALCIDIDAE KNOWN FROM NEW ZEALAND

1 Hind tibia obliquely truncate at apex; hind femur with a line of coarse teeth (Fig. 48) ... (p. 25) .. ***Brachymeria***
—Hind tibia more or less transversely truncate at apex; hind femur with a ventral comb of fine teeth ... 2

2(1) Forewing postmarginal vein slightly longer than marginal vein, which is confluent with anterior wing margin (Fig. 47); posterior margin of scutellum produced into 2 short lobes; legs reddish ... (p. 25) .. ***Antrocephalus***
—Forewing lacking postmarginal vein; marginal vein narrowly separated from anterior wing margin (Fig. 49); posterior margin of scutellum rounded; legs black ... (p. 25) .. ***Proconura***

Genus *Antrocephalus* Kirby

Figure 47

Antrocephalus Kirby, 1833b: 63. Type species *Halticella fascicornis* Walker, 1871; India.

Diagnosis. Female. Length about 3–7 mm. Body black, often with legs paler, yellow, orange, or reddish. Head and thorax usually with relatively fine, umbilicate punctures. Face with a horseshoe-shaped carina running from above anterior ocellus and along inner margin of eyes to genal sutures. Pronotal collar margined laterally, only narrowly interrupted medially; scutellum with or without a median longitudinal furrow, its apex with 2 short lobes. Forewing with a marginal vein on anterior margin of wing; postmarginal vein elongate. Hind femur with a ventral comb of fine teeth on 1–3 lobes; hind tibia with apex truncate at right angles, with 2 spurs and sometimes an external carina. Petiole distinct; 1st gastral tergite often with a pair of basal carinae.

Male. Length about 3–5 mm. Smaller but generally similar in appearance to female.

Biology. Species of *Antrocephalus* generally parasitise lepidopterous pupae, the single New Zealand species being no exception. It has been reared from pupae of the kowhai moth, *Uresiphita polygonalis maorialis* (Felder) (Geometridae).

Remarks. Taxonomy: Steffan (1953), Habu (1960, 1962), Narendran (1977), Husain & Agarwal (1982).

World status: fifty-nine species; Old World.

New Zealand: one undetermined species.

Genus *Brachymeria* Westwood

Figure 48

Brachymeria Westwood, 1832: 127. Type species *Vespa minuta* Linnaeus, 1767; Europe.

Diagnosis. Female. Length about 3–7 mm. Head, thorax, and gaster black with white, yellow, orange, or reddish markings on tegulae or legs. Head and thorax with coarse, deep, umbilicate punctures. Frons not produced into a pair of horns. Forewing with a long marginal vein running along anterior margin, and a long postmarginal vein. Hind femur with a line of coarse teeth; hind tibia with apex obliquely truncate and with only a single spur. Gaster subsessile, without a distinct petiole; ovipositor not or hardly exserted.

Male. Length about 3–7 mm. Generally similar in appearance to female.

Biology. Species of *Brachymeria* are pupal parasitoids of various Lepidoptera and Diptera. Two species, *B. phya* (Walker) and *B. tenta* (Walker) (=*rubripes* Girault), have been introduced into New Zealand from Australia and are possibly established as parasitoids of tortricid pupae. A third species, *B. rubrifemur* (Girault), has been recorded by Boucek (1988).

Remarks. Taxonomy: Habu (1960, 1962), Joseph *et al.* (1973).

World status: about 250 species; cosmopolitan.

New Zealand: possibly four species, three of them identified (see above).

Genus *Proconura* Dodd

Figure 49

Proconura Dodd *in* Girault, 1915b: 343. Type species *Proconura politiventris* Dodd & Girault, 1915; Australia.

Diagnosis. Female. Length about 2.5–4.0 mm. Body shining, black. Sculpture of head and thorax fairly shallow and smooth. Frons not produced into a pair of horns. Scutellum apically rounded. Forewing marginal vein narrowly separated from wing margin; postmarginal vein absent. Hind femur with a ventral comb of teeth and 1 lobe;

hind tibia transversely truncate at apex. Gaster with a pair of basal carinae on 1st tergite.

Male. Length about 1.5–3.5 mm. Similar in general appearance to female, but usually a litle smaller.

Biology. Unknown; elsewhere parasitising Lepidoptera pupae.

Remarks. Taxonomy: Steffan (1976; as *Euchalcidia* misident.).

World status: twenty-two species; Old World.

New Zealand: one undetermined species.

Family ELASMIDAE

Figures 50, 51

Diagnosis. Small species with a fairly elongate body about 1.5–3.1 mm long. Body never metallic, usually black with pale markings, although occasionally entirely yellowish. Antenna inserted nearer to mouth margin than to anterior ocellus, in female 9-segmented (including an anellus); male antenna 10-segmented with a very small anellus, 4-segmented funicle, and 3-segmented clava; occasionally divisions of clava obscure, the clava appearing to be entire or only 2-segmented; in male, 3 basal funicle segments branched. Mesoscutum about as long as broad. Forewing characteristically wedge-shaped, with anterior and posterior margins straight; marginal vein very long, about 3–4x as long as submarginal vein; stigmal and postmarginal veins extremely short. Hind coxa very enlarged, flattened, disc-like; hind tibia almost always with conspicuous setae arranged in a diamond-shaped pattern; middle and hind femora broadened, flattened; tarsi 4-segmented. Gaster subsessile, more or less triangular in cross-section; ovipositor not or hardly exserted.

Biology. Elasmids are mostly gregarious primary external parasitoids of larvae or pupae of Lepidoptera living protected by cases, spun leaves, or webs, or of other insects in webs, larval cases, or cocoons. Some species are hyperparasitoids of such hosts, mostly via cocooned braconids and ichneumonids (Askew 1968).

The female elasmid paralyses the host caterpillar by stinging it with her ovipositor, and then deposits eggs – the number varying with the size of the host – on its surface or near its body. The eggs are elongate-oval (Parker 1924), or elongate and slightly curved with both ends smoothly rounded (Taylor 1937). The first-instar elasmid larva is simple, distinctly segmented, and may have median pseudopodia situated intersegmentally from the second and third segments posteriorly. These pseudopodia are thought to aid locomotion (Taylor 1937). The young larva normally has four pairs of spiracles (Parker 1924). The mature larva has nine pairs of spiracles.

Remarks. The family Elasmidae, containing about 200 species in a single genus, is most diverse in the Old World tropics.

Genus *Elasmus* Westwood

Figures 50, 51

Elasmus Westwood, 1833: 343. Type species *Eulophus flabellatus* Fonscolombe, 1832; France.

Diagnosis. **Female.** Length about 1.20–3.10 mm. Body colour varying from almost completely yellow, orange, or reddish to dark brown; other characters as for family diagnosis.

Male. Length about 0. 90–2.10 mm. Generally similar to female except for the genitalia, branched antennae, smaller size, and often darker coloration.

Biology. One of the New Zealand species has been reared from larvae of *Cosmiotes archaeonoma* (Meyrick) (Lepidoptera: Elachistidae) mining in leaves of the grass *Holcus lanatus*. Outside New Zealand, species of *Elasmus* have been recorded as primary or secondary parasitoids of Lepidoptera larvae or pupae.

Remarks. Taxonomy: Ferrière (1947), Riek (1967).

World status: about 225 species; cosmopolitan.

New Zealand: two undetermined species.

Family ENCYRTIDAE

Figures 9, 52, 53

Diagnosis. Generally very robust species, but occasionally elongate or flattened, about 0.5–3.5 mm long. Body variously metallic or from yellow to orange, red, brown, or black. Antenna inserted variously from near mouth margin to about midway between mouth margin and anterior ocellus, 5–13-segmented in female, 5–10-segmented in male; occasionally female flagellum very broadened and flattened; male antenna often with branched segments. Mesoscutum transverse, normally without notauli, but if present these very shallow and linear; mesopleuron consisting almost entirely of an enlarged, convex, shield-shaped acropleuron. Wings often shortened; fully developed forewing with marginal vein short, postmarginal and stigmal veins relatively short and often subequal in length. Middle coxae in profile about level with middle of meso-

pleuron; middle tibial spur relatively long and stout; tarsi 5-segmented, very rarely 4-segmented. Gaster usually broadly sessile; cercal plates advanced, often situated in anterior half of gaster; ovipositor varying from hidden to well exserted.

Biology. Most species of Encyrtidae are associated with Coccoidea (Homoptera) as endoparasitoids of immature stages, or less commonly of adults. A few species have been recorded as predators of coccid eggs (Sugonjaev 1984). Almost all species of the Tetracneminae are parasitoids of Pseudococcidae; species of Encyrtinae are known to be parasitoids of a variety of coccoids (including Pseudococcidae) and other insects, mites, ticks, and spiders. One species has been recorded as a parasitoid of adult psyllids (Robinson 1961). Many species of encyrtid – e.g., *Copidosoma* spp. – are polyembryonic parasitoids of lepidopterous larvae. Several are hyperparasitoids of various insects via other chalcidoids, Braconidae, Ichneumonidae, Dryinidae, etc.

The morphology of the egg and first-instar larva has been summarised by Maple (1947). The egg is characteristically dumbell-shaped and is laid inside the host. In many instances the stalk of the egg may remain protruding throught the body wall of the host, thus enabling the larva, when it hatches, to utilise atmospheric oxygen. The first-instar larva is generally simple, although it may have a tail, which may be bifurcate. These larvae vary from 10- to 14-segmented, and may or may not have functioning spiracles. Some may be vesiculate, in that they have a caudal vesicle; they may also have a ring of fleshy protuberances around each of the first twelve segments. Some larvae are encyrtiform, i.e., they have at least one pair of functioning spiracles and remain attached to the egg after eclosion. They are generally 10- or 11-segmented and utilise atmospheric oxygen, which they obtain through the protruding remains of the egg-shell. Other immature larvae with no functional spiracles absorb oxygen directly through the cuticle. Later larvae are more uniform in structure, and are sometimes enclosed in a sheath which has anastomosed with the tracheal system of the host, e. g., *Encyrtus* spp. and *Metaphycus* spp. (Embleton 1904; Alam 1957, 1959). Pupation normally takes place within the body of the host. In some species the host does not die until after the adult encyrtid emerges. In these species the mature larva makes a pupation chamber in the form of a membranous envelope which becomes confluent with the tracheal system of the host. The envelope becomes filled with air, thus enabling the pupa to respire (Embleton 1904, Thorpe 1936).

Some encyrtids (e.g., *Copidosoma* spp.) are of particular interest because they are polyembryonic parasitoids. Some species that attack large lepidopterous hosts may produce up to 2000 individuals from a single egg. In many species - e.g., *Copidosoma floridanum* (Ashmead), *Copidosomopsis tanytmemus* Caltagirone – there are two morphs of larvae (Silvestri 1906; Cruz 1981, 1986a,b). One morph develops normally; the other 'guard' morph emerges from the embryonic envelope first but fails to ecdyse, and eventually disintegrates. Polyembryonic species often cause their hosts to become grotesquely deformed and twisted when they are killed as prepupae (see Silvestri 1906).

As with the Aphelinidae, many species of encyrtid have been used successfully in the control of insect pests. On a worldwide basis, using encyrtids as the main agent, total economic control of a pest species has been achieved in more than thirty instances. Within New Zealand, three introduced species have proved very effective in controlling target pest species. These are *Habrolepis dalmanni* (Westwood), controlling *Asterodiaspis variolosum* (Ratzeburg) (Homoptera: Asterolecaniidae), a pest of oak; *Copidosoma floridanum* (Ashmead) controlling *Chrysodeixis eriosoma* (Doubleday) (Lepidoptera: Noctuidae), a pest of horticulture; and *Microterys flavus* (Howard), controlling *Coccus hesperidum* Linnaeus (Homoptera: Coccidae). Outside New Zealand a recent notable success in the use of encyrtids to control pest species is *Epidinocarsis lopezi* (De Santis), introduced from South America to west and central Africa against *Phenacoccus manihoti* Matile-Ferrero (Homoptera: Pseudoccidae), a serious pest of cassava (Neuenschwander & Madojemu 1986).

Remarks. The Encyrtidae are one of the largest families of chalcidoids, containing over 3000 described species in 450 or so genera. They are generally divided into two subfamilies, the Tetracneminae and the Encyrtinae. In New Zealand thirty-five genera containing about seventy species have been recorded, representing both subfamilies; a complete revision has been published as 'Fauna of New Zealand' no. 13 (Noyes 1988).

Family EULOPHIDAE

Not figured

Diagnosis. About 0.4–6.0 mm in length, varying from squat to very elongate, often very robust or distinctly flattened dorsoventrally. Colour varying from yellowish to brownish with darker markings, these sometimes metallic or body entirely metallic. Antenna usually inserted at about level of lower eye margin or below, 7–12-segmented (including anelli), at most with 4 funicle segments; funicle of male sometimes branched. Mesoscutum usually with well marked notauli; scutellum often with submedian longitudinal grooves. Forewing marginal vein long; postmarginal

and stigmal veins normally not long, occasionally very short. Tarsi 4-segmented. Gaster clearly constricted at junction with propodeum, from subsessile to distinctly petiolate; ovipositor varying from hidden to well exserted.

Biology. The majority of eulophids are primary parasitoids of concealed larvae, especially those inhabiting leaf mines. These species mostly parasitise larvae of Lepidoptera and agromyzid Diptera, although other insects living in concealed situations may be attacked, e.g., heterarthrine Tenthredinidae and Curculionidae; others attack various gall-forming species of insects and mites (see Boucek & Askew 1968). A few species develop on insect eggs. Amongst these is the European species *Mestocharis bimacularis* (Dalman), attacking dytiscid beetle eggs when they are exposed by fluctuating water levels (Jackson 1964). One European species, *Entedon ergias* Walker, is known to be an egg / larval parasitoid of scolytid beetles (Beaver 1966). Some species of Tetrastichinae may act as predators of delphacid (Homoptera) eggs or cecidomyiid (Diptera) larvae (Rothschild 1966, Parnell 1963). Some species of eulophid may be solitary or gregarious ectoparasitoids of lepidopterous larvae (mostly Eulophinae and Euderinae), while others are endoparasitoids of the larvae of Lepidoptera (mostly Tetrastichinae and Entedontinae). In some species of *Achrysocharoides* the male develops as a solitary endoparasitoid, while the female is a gregarious endoparasitoid (Viggiani 1964, Askew & Ruse 1974, Bryan 1983). A few species have been recorded as facultative hyperparasitoids, e.g., *Cirrospilus* spp. Some species of eulophid are phytophagous. Two of these form galls on *Eucalyptus globulus* Labill in New Zealand (Valentine 1970b), one in the seed capsules (*Quadrastichodella* sp.; in Valentine as *Flockiella*), and the other on the stems or leaves (*Ophelimus* sp.; in Valentine as *Rhicnopeltella*).

The egg is normally elongate-oval or kidney-shaped (Cameron 1939, Clancy 1946, Askew & Ruse 1974), or occasionally with a long anterior filament (Viggiani 1971) which probably serves to anchor it to the integument of the host (Silvestri 1911). There are from three to five larval instars. The first-instar larva is simple, thirteen-segmented, and occasionally with fleshy tubercles or rows of spines on its body. The mature larva is generally not hairy (Askew 1968). In some species (e.g., of *Diglyphus*, *Chrysocharis*) the larvae construct a circle of faecal pillars about themselves (Viggiani 1964), pupating within this circle; the pillars prevent the mine from collapsing as the plant tissue dries out. The pupae of *Euplectrus bicolor* (Swederus) are enclosed in flimsy cocoons (Swezey 1924) made of silk secreted by the Malpighian tubules.

The mating behaviour of some eulophids is very complex, and has been described in detail for *Melittobia* spp. (Assem *et al.* 1975, 1978, 1982). Mating behaviour can be used to separate closely related species (Assem & Maeta 1980, Dahms 1984), and the evolution of different patterns of behaviour may help in understanding systematic relationships (Bosch & Assem 1986).

An interesting phenomenon has been reported for *Melittobia acasta* (Walker) (Balfour-Browne 1922, Assem 1975). Unmated females remain with their developing (male) progeny. If the developing males are accessible, the female may stroke them with her antennae, and this behaviour is accentuated when they pupate. The unmated female will mate with one of her emerging progeny. If the males are inside a dipterous puparium the female will even gnaw her way in to gain access.

Several species of eulophid are important in biocontrol programmes thoughout the world. Two species have been introduced into New Zealand for this purpose: *Pediobius epigonus* (Walker), against the hessian fly *Phytophaga destructor* (Say) in wheat (Kirk 1894); and *Achrysocharoides latreillii* (Curtis), against the oak leaf miner, *Phyllonorycter messaniella* (Zeller) (Given 1959, Swan 1973). The latter species plays an important part in the control of its host. Notable examples of the use of eulophids in the control of pests outside New Zealand are: *Chrysocharis laricinellae* (Ratzeburg), a European species partially responsible for the control of *Coleophora laricella* (Hübner) (Lepidoptera: Coleophoridae), a pest of larch in North America (Peck 1963); and *Dahlbominus fuscipennis* (Zetterstedt), a European species partially responsible for the control of diprionid sawfly pests of pines in North America (Bobb 1965).

Remarks. The family Eulophidae, one of the largest in the Chalcidoidea, contains well over 3000 species placed in 330 genera. It is generally divided into four subfamilies, viz Eulophinae, Entedontinae, Euderinae, and Tetrastichinae, all represented in New Zealand.

About 120 species in 40 or so genera have been found in New Zealand. A review of these genera is included in an account of the Australasian Eulophidae by Boucek (1988).

Family EUPELMIDAE

Figures 10, 54–57

Diagnosis. Species varying from robust to extremely elongate; length (excluding ovipositor) about 1.3–7.5 mm. Body normally highly metallic, but sometimes yellow or orange. Antenna inserted variously from near mouth margin to near middle of face, in female 9–13-segmented (including 1 anellus), in male 10–12-segmented, with 7

funicle segments; male funicle occasionally with branched segments. Pronotum sometimes very triangular and elongate; mesoscutum conspicuously impressed centrally, or convex with indistinct notauli; in most species, female mesopleuron consisting mainly of a convexly expanded, undivided acropleuron; mesopleuron of male normally divided into a mesepimeron and mesepisternum. Wings fully developed or shortened; fully developed wings with marginal vein fairly long, stigmal and postmarginal veins moderately long. Middle leg with an elongate tibial spur, which is stout in female; tarsi 5-segmented. Gaster subsessile, without a distinct, elongate petiole; ovipositor varying from hidden to well exserted.

NOTE. Males of the Eupelminae are often mistaken for cleonymine pteromalids, but the New Zealand species can be recognised by the relatively long mesoscutum (as long as the scutellum or longer) with moderately impressed, complete notaular lines, and by the pronotum being medially shallowly concave from anterior to posterior margin in lateral view.

Biology. Eupelmids are mostly primary or facultative secondary parasitoids of the immature stages of various insects, notably Diptera, Orthoptera, Coleoptera, Lepidoptera, and Hemiptera. Some species (e.g., of *Eupelmus*, *Macroneura*) may develop either as primary ectoparasitoids or as ectoparasitoids of a great range of other primary ectoparasitoids (Morris 1938, Askew 1961a). A small number of species are predators on the eggs or larvae of various insects, or on the eggs of spiders. A few are solitary, primary endoparasitoids of the eggs of Lepidoptera, Orthoptera, and Hemiptera. Some species are gregarious parasitoids, although the vast majority are solitary. Most are ectoparasitoids, but a few may be endoparasitoids of coccids or gregarious parasitoids of dipterous pupae. Species of Calosotinae are mostly parasitic on the larvae and pupae of xylophagous beetles.

The eupelmid egg is ellipsoidal and usually bears a stalk at one end. This stalk may be very long and used to attach the egg to a substrate or to the cuticle of the host (Morris 1938, Clancy 1946, Askew 1961a). Ectoparasitoid species may simply place their egg in the vicinity of the host rather than on to it; some species may cover the egg with a fibrous network (Phillips & Poos 1921, Taylor 1937). The first-instar larva is elongate, thirteen-segmented, and usually has a bifurcate tail and a ventral row of spines (Clausen 1927). In some species the spines may be missing from the abdominal segments, or there may be a pair of longer spines on each segment (Morris 1938, Askew 1961a). The integument may be enclosed in minute setae (Clancy 1946). The final-instar larva is robust and may be very hairy (Morris 1938).

Species of the subfamily Eupelminae are of interest because of the unique adaptation of the sclerites and muscles of the mesothorax of the female for jumping. This mechanism was first noticed by Walsh & Riley (1869) when they published a description of what was later termed the 'back-rolling wonder' by Clausen (1927). Jumping is achieved by the contraction of large muscles which pull on a large block of resilin, which stores the resulting energy. When this is triggered the energy is released, pulling the thorax in such a way that it becomes shorter; the mesonotum arches upwards at the scuto-scutellar suture, which in turn pulls the middle coxae inwards (via a tendon-like muscle), resulting in a sudden kick of the middle legs and hence an explosive jump (Gibson 1986b). Because of these modifications to the thorax, eupelmines often die in a characteristic contorted state with the head and gaster reflexed upwards, sometimes nearly meeting over the thorax.

Remarks. The family Eupelmidae contains about 750 species placed in 60 genera. The family is usually divided into two subfamilies, both represented in New Zealand, the Eupelminae and Calosotinae. Six species in four genera are known from New Zealand.

KEY TO GENERA OF EUPELMIDAE KNOWN FROM NEW ZEALAND

1 Brachypterous, forewing abruptly bent at right angles at about midlength (Fig. 56). Females only ... (p. 30) .. ***Macroneura***

—Wings fully developed, not abruptly bent upwards at middle. Males and females ... **2**

2(1) Mesoscutum relatively broad, the anterolateral angles protruding as shoulders behind the distinctly narrower pronotum, which has a separate, narrow collar near posterior margin (Fig. 55); antennae relatively long, longer than thorax, very slender, gradually tapering towards apex; female with ovipositor not or hardly exserted past apex of last gastral tergite, which is long and acutely pointed at apex ... (p. 30) .. ***Eusandalum***

—Mesoscutum only slightly wider than pronotum, the anterolateral angles gradually rounded and tapered; pronotum without a collar medially; antennae relatively short, not longer than thorax and of more normal dimensions, gradually widening towards apex, semiclavate; female with exserted part of ovipositor at least half as long as middle tibia; last gastral tergite short, apically blunt ... **3**

3(2) Anterior quarter of mesopleuron clothed in conspicuous, dense, white hairs (Fig. 57); hind tibia brown, its outer margin laminately expanded and coloured contrast-

ing white and orange. Males unknown in New Zealand ... (p. 31) .. ***Tineobius***

—Mesopleuron without conspicuous white hairs (Fig. 54); hind tibia unicolorous dark brown to testaceous, or with only the apex a different colour, not expanded. Males and females ... (p. 30) .. ***Eupelmus***

Genus *Eupelmus* Dalman

Figure 54

Eupelmus Dalman, 1820: 377. Type species *Eupelmus memnonius* Dalman, 1820; Sweden.

Neosolindenia Gourlay, 1928: 370. Type species *Neosolindenia cyanea* Gourlay, 1928; New Zealand.

Diagnosis. Female. Length (excluding ovipositor) about 2.0–5.0 mm. Head and thorax clothed in brown setae. Maxillary palp with apical segment not abnormally enlarged; antennal scrobes distinct; eyes not conspicuously convergent dorsally; antenna with funicle 7-segmented, clava 3-segmented. Mesoscutum impressed, longer than broad; notaular lines not meeting posteriorly; metanotum shorter than propodeum medially; mesopleuron anteriorly without a patch of silvery setae or with only sparse setae. Wings fully developed; forewing hyaline or infuscate, with or without linea calva; marginal vein at least about two-thirds as long as submarginal. Middle tibia with spur not or hardly longer than basal segment of tarsus; hind tibia not flattened. Ovipositor exserted, the exserted part usually shorter than the gaster; at least basal tergite of gaster excised medially.

Male. Length about 2.0–3.5 mm. Similar to male of *Anastatoidea*, but forewing with a speculum, and mesopleuron without an anterior patch of silvery setae.

Biology. The host associations of the New Zealand species are as follows:

- *E. antipoda* Ashmead – an internal parasitoid of the eggs of *Orthodera ministralis* Fabricius (Mantidae).
- *E. cyaneus* (Gourlay) – a hyperparasitoid of *Morova subfasciata* Walker (Lepidoptera: Thyrididae) via pupae of its ichneumonid parasitoid, *Diadegma muelleri* White & Butler; a primary parasitoid of the larvae of *Oreocalus hebe* Marshall (Coleoptera: Curculionidae) in galls on *Hebe divaricata*; also a hyperparasitoid of this weevil via prepupae and pupae of its (unidentified) braconid parasitoid.

Outside New Zealand, the hosts and mode of parasitism of species in this genus are extremely diverse. Species may be primary parasitoids or hyperparasitoids of Hymenoptera, Diptera, Coccoidea, Lepidoptera, and Coleoptera.

Remarks. Taxonomy: Ruschka (1921).

World status: approximately 300 species; cosmopolitan.

New Zealand: two species (see above).

Genus *Eusandalum* Ratzeburg

Fig. 10, 55

Eusandalum Ratzeburg, 1852: 199. Type species *Eusandalum abbreviatum* Ratzeburg, 1852; Germany.

Diagnosis. Female. Length about 2.3–9.0 mm. Antenna characteristically very long and slender; funicle 7-segmented; clava entire, very short. Mesoscutum broader than long or nearly so, with anterolateral corners protruding as shoulders behind pronotum, posteriorly impressed; notaular lines meeting anteriorly, indistinct posteriorly; metanotum short, medially more or less hidden by scutellum and propodeum. Forewing infuscate or hyaline, with a speculum but no linea calva. Gaster elongate, longer than head and thorax together; last tergite relatively long, usually with a median carina; ovipositor hardly exserted.

Male. Length 2.0–5.0 mm. Generally similar to female, but basal funicle segments often slightly swollen [in some Australian species the males have branched antennae].

Biology. The single New Zealand species, *E. barteli* (Gourlay), has been reared as a parasitoid of the larvae of *Poecilippe medialis* Sharp (Coleoptera: Cerambycidae). Elsewhere also reared as parasitoids of xylophagous beetle larvae.

Remarks. Taxonomy: Boucek (1967), Hedqvist (1970; as *Polymoria*).

World status: fifty-three species; cosmopolitan.

New Zealand: one species (see above).

Genus *Macroneura* Walker

Figure 56

Macroneura Walker, 1837: 353. Type species *Macroneura maculipes* Walker, 1837; Europe.

Diagnosis. Female. Length (excluding ovipositor) about 2.0-4.5 mm. Antenna with funicle 7-segmented, clava 3-segmented. Mesoscutum longer than broad, impressed, with lateral margins of middle lobe usually carinate; neck of pronotum with numerous long, dark bristles (lost in some specimens); metanotum medially longer than propodeum; mesopleuron without an anterior patch of silvery setae. Wings shortened; forewing bent upwards at about middle, or very reduced, often infuscate. Ovipositor at least slightly exserted.

Male. Length about 1.5–2.5 mm. Clava 1- or 3-segmented. Propodeum medially longer than metanotum; mesopleuron anteriorly with a patch of sparse, translucent setae. Wings fully developed, hyaline; forewing with or without a speculum. Otherwise similar to *Anastatoidea*.

Biology. *M. vesicularis* has been reared as a hyperparasitoid of *Coleophora ?alcyonipennella* Kollar (Lepidoptera: Coelophoridae) via *Bracon variegator* (Nees) (Hymenoptera: Braconidae), and as a primary parasitoid of *Phanacis hyperochoeridis* (Kieffer) (Hymenoptera: Cynipidae).

Remarks. Taxonomy: Ferrière (1954); Kalina (1981).
World status: twenty-seven species; cosmopolitan.
New Zealand: one species, *Macroneura vesicularis* (Retzius) (=*messene* Walker).

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Genus *Tineobius* Ashmead

Figure 57

Tineobius Ashmead, 1896: 7, 14–15. Type species *Tineobius citri* Ashmead, 1896; Australia.

Diagnosis. Female. Length (excluding ovipositor) about 3.0–5.0 mm. Frontovertex relatively narrow, several times narrower than an eye; eyes dorsally convergent; antennal scrobes distinct, carinate above; antenna with a 7-segmented funicle and 3-segmented clava. Mesoscutum impressed, longer than broad; notaular lines Y-shaped, joining in posterior half of mesoscutum; metanotum shorter than propodeum medially; mesopleuron anteriorly with a patch of white setae. Wings fully developed; forewing infuscate, without linea calva or speculum; basal cell more or less naked. Hind tibia with a thin lamella or with a whitish dorsal margin. Ovipositor clearly exserted, the exserted part at least about half length of gaster.

Male. Length about 3.0–4.5 mm. Clava 2-segmented. Notaular lines reaching hind margin of mesoscutum but not meeting posteriorly; mesopleuron with an anterior patch of whitish hairs. Forewing hyaline; basal cell hairy. Hind tibia without a whitish dorsal margin.

Biology. Unknown; elsewhere reared as parasitoids or hyperparasitoids of Lepidoptera.

Remarks. Taxonomy: Ferrière (1938; as *Anastatoidea*).
World status: twenty-one species; Old World tropics.
New Zealand: one undetermined species.

Family EURYTOMIDAE

Figures 58–65

Diagnosis. Body robust to elongate, often strongly sculptured; length about 1.4–6.0 mm. Colour usually black, at most only very slightly metallic. Antenna inserted about midway between mouth margin and anterior ocellus, with 13 or fewer segments, in male with whorls of long setae. Pronotum, viewed from above, with sides more or less parallel and forming a subrectangular collar; mesoscutum with notauli deep, complete. Wings almost always fully developed; forewing marginal vein generally longer than stigmal, which may be quite short; postmarginal vein often quite short. Tarsi 5-segmented. Gaster usually smooth, shining, never broadly joined to propodeum, in female usually subsessile, in male usually with a long petiole; ovipositor usually hidden, not prominent.

Biology. The Eurytomidae exhibit a wide range of biologies, but the majority seem to be endophytic, either as phytophages or as parasitoids of phytophagous insects. The phytophagous eurytomids may develop on the endosperm of seeds or in plant stems, especially the stems of grasses. The seed-feeding group is represented by two taxa in New Zealand: *Systole*, species of which feed in the seeds of Apiaceae; and *Bruchophagus*, species of which develop in leguminous seeds, and may even assume pest status (see Valentine 1970b; also Claridge 1959b). The stem-mining group is represented in New Zealand by *Tetramesa*. Claridge (1961) reviewed the biology of a number of British species. Several develop in the central cavity of grass stems, feeding above the nodes. They may be solitary or gregarious, but there is no external sign of their presence, and their effect on the flowering head is usually slight. Other species produce obvious stem galls, and these often result in stunting of the flower head. In North America several species of *Tetramesa* are pests of cereal crops.

Most of the entomophagous species are solitary ectoparasitoids of insect larvae feeding within plant tissue, although a few are known to complete their development feeding on plant tissue (Varley 1937). Hosts attacked include Coleoptera, gall-forming Hymenoptera (mostly Cynipinae), Diptera (especially Tephritidae), and Lepidoptera (Claridge 1959a, Claridge & Askew 1960). Some species may develop either as a primary parasitoid or as a facultative hyperparasitoid, e.g., *Eurytoma curculionum* Mayr, a primary parasitoid of *Apion* sp. (Coleoptera: Curculionidae) or a hyperparasitoid of *Apion* via *Chlorocytus* sp. (Hymenoptera: Pteromalidae) (Fisher 1970). *Eurytoma rosae* Nees, a European species, is predaceous in the multichambered galls of *Diplolepis* sp. (Hymenoptera: Cynipidae) on rose. The eurytomid chews its way from cell

to cell, consuming several cynipid larvae in succession (Blair 1944). Considerable polyphagy is shown by another European eurytomid which inhabits cynipid galls: *Eurytoma brunniventris* Ratzeburg may parasitise a cynipid gall-maker, or its *Synergus* (Hymenoptera: Cynipidae) inquiline, or other chalcid parasitoids, or even feed on the gall tissue (Askew 1961a). A few eurytomids that attack gall-forming insects are endoparasitic, e.g., *Sycophila biguttata* (Swederus), which develops as an endoparasitoid of a cynipid larva forming oak galls in Britain (Askew 1985).

A few species of *Eurytoma* have been recorded as gregarious ectoparasitoids of Lepidoptera. One Oriental species is of particular interest as it is an obligate multiparasitoid. It can only oviposit on its host, a mature lepidopterous larva in a thick cocoon, if a chrysidid first bites an oviposition hole in the cocoon. The eurytomid oviposits through the plugged chrysidid hole (Piel 1933).

One New Zealand genus, *Axanthosoma*, has been recorded as an internal parasitoid of cicada eggs (Harford 1958). A few eurytomids have also been recorded as predators of eggs of other insects (Clausen 1940); many of these are in the Rileyinae, a subfamily not occurring in New Zealand.

The eurytomid egg is very characteristic, with a short process at the micropylar end and a long, flattened, filamentous process at the opposite end. Many that are deposited externally are clothed with short spines, the form of which has been useful in separating sibling species (Claridge & Askew 1960, Fisher 1965). The first-instar larva is simple, oval to elongate, and its segments may each have sensory setae. There are usually at least five pairs of spiracles. The mature larva of endoparasitic species may vary from quite slender to fairly robust (Askew 1971, Roskam 1982).

Remarks. The Eurytomidae comprise nearly 1200 species in about 80 genera worldwide. The family is currently divided into three subfamilies, of which only the Eurytominae are represented in New Zealand. Seven species in four genera are known from New Zealand.

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KEY TO GENERA OF EURYTOMIDAE KNOWN FROM NEW ZEALAND

1 Antenna with short, appressed hairs (Fig. 63). Females ... **2**

—Antenna with whorls of long setae (Fig. 59, 62, 65). Males ... **5**

Females

2(1) Gaster very elongate, over twice as long as thorax; epipygium rather long, more than twice as long as preceding tergite, apically very acute, on top of the ovipositor, which is exserted; funicle 6-segmented (Fig. 58) ... (p. 33) .. ***Axanthosoma***

—Gaster less elongate, at most slightly less than twice as long as thorax (Fig. 61, 64); epipygium very short, often much shorter than preceding tergite, in dorsal view hardly as long as visible part of ovipositor; funicle 5- or 6-segmented ... **3**

3(2) First funicle segment nearly bare and smooth, with no longitudinal sensilla, and with at least proximal third to half without setae and distinctly narrower than remainder (Fig. 63); thorax with more or less regular, shallow, reticulate-alutaceous sculpture lacking any coarse punctures ... (p. 33) .. ***Systole***

—First funicle segment with longitudinal sensilla (which may be indistinct), and with setae in basal one-third to half; thorax irregularly sculptured, with at least a few coarse punctures ... **4**

4(3) Propodeum relatively steep, forming an angle of nearly 90° with plane of scutellum (Fig. 61) ... (p. 33) .. ***Bruchophagus***

—Propodeum less steep, forming an angle of about 45° with plane of scutellum ... (p. 34) .. ***Tetramesa***

Males

5(1) Forewing proximad of marginal vein naked dorsally (Fig. 60); funicle 5-segmented (Fig. 59) ... (p. 33) .. ***Axanthosoma***

—Forewing proximad of marginal vein setose, and usually completely setose basally; funicle 4-segmented or 6-segmented (possibly 5-segmented in unknown males of *Tetramesa*) ... **6**

6(5) Propodeum less steep, forming an angle of at most about 45° with plane of scutellum; funicle (Fig. 65) never 4-segmented ... (p. 34) .. ***Tetramesa***

—Propodeum relatively steep, forming an angle of nearly 90° with plane of scutellum (as in Fig. 61); funicle 4- or 6-segmented ... **7**

7(6) Dorsum of thorax with irregular sculpture, and with at least a few coarse punctures; funicle 4- or 6-segmented ... (p. 33) .. ***Bruchophagus***

—Dorsum of thorax with more or less regular, shallow reticulate-alutaceous sculpture lacking any coarse punctures; funicle 4-segmented (Fig. 62) ... (p. 33) .. ***Systole***

Genus *Axanthosoma* Girault

Figure 58–60

Axanthosoma Girault, 1913a: 81. Type species *Axanthosoma nigra* Girault, 1913; Australia.

Diagnosis. **Female.** Body generally slender; length about 3.5–5.0 mm. Colour black, non-metallic. Cheeks not margined laterally with a carina; ventral part of head not overlapping bases of anterior coxae; anterior ocellus situated above scrobes; antenna with 10 or 11 subequal segments, the funicle 5-segmented, the clava 2- or 3-segmented. Dorsum of thorax with fairly smooth sculpture, not with coarse umbilicate punctures; posterior margin of scutellum rounded. Forewing hyaline; marginal vein slender. Gaster very elongate, laterally compressed; petiole indistinct, much wider than long; last tergite produced into an elongate process at least nearly half as long as remaining gastral tergites together; ovipositor long, extending well past apex of hypopygium.

Male. Length about 2.5–4.5 mm. Similar in general appearance to female, but gaster a little shorter than thorax, with petiole about 3–4x as long as broad; clava 2-segmented; funicle segments each with 2 whorls of long setae, except the 1st, which has several whorls.

Biology. The New Zealand species has been reared from eggs of *Amphipsalta cingulata* (Fabricius) (Homoptera: Cicadidae) (Harford 1958, as "unrecorded hymenopterous parasite").

Remarks. Taxonomy: Subba Rao (1974).
World status: four species; Australia.
New Zealand: one species, possibly *A. io* Girault.

Genus *Bruchophagus* Ashmead

Figure 61

Bruchophagus Ashmead, 1888a: 42. Type species *Bruchophagus borealis* Ashmead, 1894; Canada.

Diagnosis. **Female.** Body robust; length about 1.5–6.0 mm. Colour normally black, non-metallic. Head with gena and lower part of temple well delimited posteriorly; anterior ocellus situated above scrobes; antennae inserted slightly above ventral eye margin, the funicle 5-segmented, the clava 3-segmented; funicle segments all with distinct longitudinal sensilla. Thorax with shallow to fairly deep umbilicate-punctate sculpture; posterior margin of scutellum more or less rounded; propodeum steep, forming an angle of about 90° with plane of scutellum. Forewing with marginal, stigmal, and postmarginal veins subequal in length, relatively slender. Gaster about as long as head and thorax combined; petiole very short, wider than long; last tergite not elongate.

Male. Length about 1.2–5.0 mm. Similar in habitus to female, but funicle 4-segmented, each segment with 2 whorls of long setae; petiole distinct, longer than wide.

Biology. The three New Zealand species are phytophagous, the larvae feeding on the endosperm of seeds, as follows:
- *B. gibbus* (Boheman) – in seeds of red clover (*Trifolium repens* Linnaeus);
- *B. roddi* Gussakovskii – in seeds of lucerne (*Medicago sativa* Linnaeus).
- *B. acaciae* (Cameron) – in seeds of *Acacia mearnsii* De Wild.

Several extralimital species of *Bruchophagus* are parasitic in habit, although the majority are phytophagous in the seeds of various plants. *B. gibbus* and *B. roddi* may become a minor pest of clover and lucerne, although not as serious in New Zealand as in some parts of central Europe.

Remarks. *Bruchophagus* has commonly been treated as a synonym of *Eurytoma*, but we follow Boucek (1988) in maintaining it as a distinct genus.
Taxonomy: Ferrière (1950); Szelenyi (1976).
World status: about 150–200 species; cosmopolitan.
New Zealand: three species (see above).

Genus *Systole* Walker

Figures 62, 63

Systole Walker, 1832: 13 and 22. Type species *Systole albipennis* Walker, 1832; England.

Diagnosis. **Female.** Length about 1.5–2.5 mm. Body dark brown or black, non-metallic. Cheeks not carinate; anterior ocellus above antennal scrobes; antenna inserted well above ventral level of eye, with funicle 5-segmented and clava 3-segmented; 1st funicle segment elongate, almost bare and smooth, without any longitudinal sensilla. Dorsum of thorax with fairly smooth sculpture, never coarsly umbilicate; posterior margin of scutellum more or less rounded; propodeum fairly steeply angled, at about 80–90° with plane of scutellum. Forewing with marginal, postmarginal, and stigmal veins subequal in length. Gaster about as long as head and thorax together; petiole very short, indistinct; last tergite not elongate.

Male. Length about 1.0–2.0 mm. Generally similar to female; antennal funicle 4-segmented, each segment with 2 whorls of long setae; gaster with a distinct petiole at least about as long as wide.

Biology. The New Zealand species, *S. foeniculi* Otten (=*geniculata* in the sense of Gourlay 1930b, Valentine 1967, 1970b), has been reared from seeds of fennel (*Foeniculum officinale*) and hemlock (*Conium maculatum*). All known extralimital species are phytophagous in seeds of various Apiaceae.

Remarks. Taxonomy: Claridge (1959b); Szelenyi (1971).
World status: nineteen species.
New Zealand: one species (see above).

Genus *Tetramesa* Walker

Figures 64, 65

Tetramesa Walker, 1848: 54 and 154. Type species *Tetramesa iarbas* Walker, 1848 (England).

Diagnosis. Female. Body relatively elongate and slender; length about 1.5–6.5 mm. Colour black or dark brown. Pronotum almost always with anterolateral angles paler than remainder of thorax. Antenna inserted well above ventral margin of eye; anterior ocellus situated at about dorsal margin of antennal scrobes; cheeks without a posterior carina; antenna (including anellus) 10- or 11-segmented, the funicle 6-segmented with a 2-segmented clava, or 5-segmented with a 2-segmented clava, or 4-segmented with a 3-segmented clava. Dorsum of thorax usually with fairly smooth sculpture, but sometimes with semi-umbilicate puncturation; propodeum forming a relatively shallow angle of about 30–60° with plane of scutellum. Forewing with stigmal and postmarginal veins usually both shorter than marginal vein. Gaster longer than head and thorax combined; petiole short, usually indistinct; last tergite not elongate.

Male. Length about 1.5–6.0 mm. Similar in general appearance to female; gastral petiole distinct, at least a little longer than broad; funicle 4- or 5-segmented, the segments with 2 whorls of long setae except the 1st, which has several such whorls; clava solid.

Biology. One New Zealand species, probably *T. linearis* (Walker), has been reared from couch grass (*Agropyron repens*). Elsewhere phytophagous in the central cavity of the flowering stem of grasses, or gall-formers in the flowering stem, its surrounding leaf sheath, or the flower itself (Claridge 1961).

Remarks. Taxonomy: Claridge (1961).
World status: over 300 species; cosmopolitan.
New Zealand: at least three species, including *T. linearis* (see Boucek 1988).

Family MYMARIDAE

Figures 66–69

Diagnosis. Minute to moderate-sized insects, generally fragile in appearance; length 0.35–5.0 mm. Colour usually yellow to dark brown with paler or darker markings, only very rarely metallic. Head with a transverse, membranous suture (sometimes called a trabecula or carina) below anterior ocellus and along inner eye margins, and occasionally further sutures visible behind ocelli; antennal toruli situated far apart, much closer to eye margin than to each other, normally situated quite high on head, about midway between mouth margin and vertex; antenna 6–13-segmented, that of male usually long and filamentous, that of female with a distinct apical clava which may be solid or 2- or 3-segmented. Scutellum normally divided transversely into anterior and posterior parts; propodeum usually moderately long, with few exceptions having only a single seta posterior to each spiracle. Wings often reduced, occasionally more or less absent; fully developed forewing normally with a short marginal vein, very short stigmal vein, and no postmarginal vein; in New Zealand species the marginal and postmarginal veins are often very long [and in one Australian species the postmarginal vein is extremely long, nearly reaching the wing apex]; hindwing almost always petiolate, with membrane of disc not extending to base. Tarsi 4- or 5-segmented. Gaster varying from distinctly petiolate to broadly sessile; ovipositor varying from hidden to strongly exserted.

Biology. Mymaridae are internal, solitary (rarely gregarious) parasitoids of eggs of other insects, notably Coleoptera, Lepidoptera, Hemiptera, and Psocoptera. Mymarids most commonly parasitise eggs laid in concealed situations, such as those embedded in plant stems, placed under bracts, or hidden in the ground, and seem to prefer eggs that have not undergone much development. After oviposition further development of the host egg normally ceases, but it is not known whether mymarids inject an arrestment venom during oviposition, as do many other egg parasitoids (Strand 1986).

The egg is elongate-oval with a short pedicel at one end (Jackson 1961). The number of larval instars is difficult to ascertain, but from two to four have been recorded (Balduf 1928, Bakkendorf 1934, Sahad 1982). The first-instar larva is generally either sacciform (a simple sac with few processes and no hairs) or mymariform (body curved, with a cephalic process, long caudal appendage, and long cuticular hairs). The second larval instar of some species with a sacciform first-instar larva is very distinctive, and is known as a histriobdellid larva. It is cylindrical and divided into six segments, the first and last largest, and often

bearing paired fleshy processes (see Dumbleton 1934, Jackson 1961). The second larval instar of other species is often without segmentation and lacks spines or setae. There appear to be no functional tracheal system or spiracles in any larval instar. Pupation normally takes place within the host egg-shell.

Several Holarctic species are known to parasitise the submerged eggs of aquatic insects, and have been observed to swim under water using their wings as paddles, e.g., *Caraphractus* spp. (Matheson & Cosby 1912, Jackson 1966). Females need not exit from the water immediately after emergence, and mating may also take place under water. Individuals are capable of remaining under water for 15 consecutive days (Rimsky-Korsakov 1933).

Remarks. The family Mymaridae is moderately large, comprising nearly 1300 species in about 95 genera. A little over 160 species in about 40 genera are known from New Zealand. A review of the genera of Mymaridae occurring in New Zealand has been published as 'Fauna of New Zealand' no. 17 (Noyes & Valentine 1989).

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Family PERILAMPIDAE

Figure 70

Diagnosis. Moderately large, robust species with thorax often strongly sculptured; length about 1.3–5.5 mm. Colour black, green, or blue, often strongly metallic. Antenna (including anellus) 13-segmented. Thorax deep and, in profile, dorsally convex; pronotum in dorsal view with sides more or less parallel, medially clearly visible behind head; prepectus often fused with pronotum and in same plane; notauli deep, straight. Wings fully developed; forewing marginal vein moderately long; postmarginal vein varying from short to long; stigmal vein short. Tarsi 5-segmented. Gaster often distinctly petiolate, sometimes with 1st tergite partially fused to 2nd, these often completely covering the gaster dorsally; ovipositor not or hardly exserted.

Biology. Perilampids are mostly hyperparasitoids of the pupae of Hymenoptera, Diptera, and Lepidoptera, being ectoparasitic on their tachinid and ichneumonid parasitoids. Some species are primary external parasitoids of larvae of Hymenoptera (Diprionidae, Tenthredinidae), Neuroptera (Chrysopidae), and Coleoptera (Nitidulidae). At least one species has been recorded as a hyperparasitoid of Orthoptera nymphs via Sarcophagidae (Diptera) (Tripp 1962).

Perilampids are most frequently encountered feeding on flowers, but some feed on aphid honeydew. Female Perilampinae, a subfamily not found in New Zealand, lay up to 500 eggs in the vicinity of the primary host. These eggs, which are suboval in profile and have a short peduncle at one end, may be lightly attached to foliage or partially embedded in an incision made by the female in a leaf. From this egg emerges the planidial first instar. This larva has sclerotised bands on the first twelve segments, a pair of strong caudal cerci on the twelfth segment, and the thirteenth segment expanded to form a caudal sucker. The sclerotised segmental bands may have sharp teeth along their posterior margins which aid locomotion. The larva also has functional spiracles (Heraty & Darling 1984). The first-instar larva waits for the arrival of a primary host, to which it attaches itself and then enters. No further development occurs until its host pupates, and then the planidial larva exits its host to feed externally. There are three or four larval instars. The second instar completely lacks the specialised characters of the first, and the final instar is very robust, often having a pair of lateral tubercles on each thoracic segment. Pupation takes place in the host cocoon or puparium.

The New Zealand species of Perilampidae belong to the subfamily Chrysolampinae. Very little is known about their biology except for the British species *Chrysolampus thenae* (Walker), which has been studied by Askew (1980). This develops as an ectoparasitoid of nitidulid larva (Coleoptera). Several parasitoid larvae are usually positioned on the ventral side of the host. They remain minute until after the fully fed host larva constructs a pupation chamber in the soil. The host is killed before it pupates, and only one chrysolampine larva develops to maturity on each host.

Remarks. The small, cosmopolitan family Perilampidae comprises about 200 species in 26 genera. There are two subfamilies, but only the Chrysolampinae are represented in New Zealand, by a single genus.

Genus *Austrotoxeuma* Girault

Figure 70

Austrotoxeuma Girault, 1929: 2. Type species *Austrotoxeuma coerulea* Girault, 1929; Australia.

Diagnosis. **Female.** Length about 3–4 mm. Head with scrobes fairly shallow, V-shaped; antennae with scape subcylindrical, inserted about level with or slightly higher than lowest eye margin; flagellum relatively short, shorter than width of frontovertex plus eye; eye a little shorter than width of frontovertex. Pronotum a little shorter than meso-

scutum but with neck elongate, about half as long as pronotum; pronotal collar not margined anteriorly by a carina; prepectus not fused with pronotum and not lying in same plane laterally. Forewing marginal vein about 4–5x as long as stigmal, and about as long as postmarginal. Gaster with at least 3 tergites visible dorsally, but with 1st tergite covering about half; petiole about 1.5–3.0x as long as broad.

Male. Length 3–4 mm. Similar to female, but scape sometimes distinctly swollen and much less than twice as long as broad.

Biology. Unknown.

Remarks. There is some debate with regard to the correct family placement of the Chrysolampinae, some authors (e.g., Graham 1969) having included this subfamily in the Pteromalidae. Following the opinion of Dr Z. Boucek and Dr D.C. Darling (pers. comm.), the chrysolampines are here placed in the Perilampidae, where they are characterised by the free prepectus – i.e., not fused with the pronotum – and petiolate gaster.

World status: one described species; Australian.

New Zealand: *A. kuscheli* Boucek, plus two undescribed species.

Family PTEROMALIDAE

Figures 1–3, 5, 7

Diagnosis. Slender to quite robust insects; length about 1.2–2.7 mm. Body usually green and metallic, often strongly so, although many orange, reddish, or black species are known. Head varying in shape from subrectangular to oval; antenna variably positioned, from mouth margin to just below anterior ocellus, 7–13-segmented (including up to 4 anelli). Pronotum from very short to quite long and subrectangular, often with a conspicuous collar; mesoscutum with or without complete notauli; propodeum usually with well developed sculpture medially. Wings almost always fully developed; forewing marginal vein at least several times longer than broad; postmarginal vein and stigmal vein well developed, rarely quite short; speculum distinct. Tarsi 5-segmented, or occasionally middle tarsi 4-segmented. Gaster subpetiolate to distinctly petiolate; ovipositor varying from completely hidden to well exserted.

Biology. The majority of species are solitary or gregarious ectoparasitoids of larvae or pupae of Lepidoptera, Coleoptera, Diptera, and Hymenoptera. Some pteromalids develop as endoparasitoids. The best known of these is *Pteromalus puparum* (Linnaeus) (Pteromalinae), a common parasitoid of the pupae of various butterflies, especially Papilionidae, Pieridae, and Nymphalidae. A number of species develop as predators rather than parasitoids. Species of Eunotinae may be predators of the eggs of insects, notably Coccoidea, while species of *Systasis* (Miscogasterinae) have been observed to feed on a succession of small cecidomyiid larvae (Ahmad & Mani 1939, Parnell 1963). Some species are hyperparasitoids, attacking aphelinids and braconids parasitising aphids. Many pteromalids are associated with galls, feeding on gall tissue or on the larvae, pupae, or even adults of the gall-maker. Species of *Bairamlia* (Asaphinae) are of particular interest because on at least one occasion they have been reared from the cocoons of fleas (Waterston 1929). Females of this genus of parasitoid appear to bite off their own wings in order to facilitate their movement within the nest of the host of the flea (Graham 1969). Also of interest are species of *Tomicobia* (Pteromalinae), which develop as endoparasitoids of adult Coleoptera (Boucek 1977).

The fecundity of pteromalids varies, but a female may lay up to 700 eggs, placed on or inside the host. The egg may be elongate with rounded ends (Varley 1937); arched and broadened anteriorly, with a narrow nipple, and tapered posteriorly (Cameron 1939, Askew 1961b); clothed in minute spicules (Noble 1932); or hirsute and having a pitted appearance (Hussey 1955). The first-instar larva is simple, thirteen-segmented, and in some ectophagous or predatory species is relatively slender in appearance. The last segment may be bilobed and the head is often very enlarged; occasionally the mandibles are large. Some species may have strong spines on each segment. The first-instar larva of ectophagous species has an open tracheal system, whilst that of endophagous species is closed or completely lacking (Varley 1937, Cameron 1939, Hussey 1955, Askew 1961b). Pupation may take place within or in the vicinity of the dead host.

Pteromalus puparum (Linnaeus) is of particular interest in New Zealand. Introduced from Europe in the early 1930s against the white butterfly, *Pieris rapae* Linnaeus, it has proved an important agent in the control of this agricultural pest (Muggeridge 1943; Todd 1957, 1958, 1959).

Remarks. The family Pteromalidae is one of the largest in the chalcidoids, comprising about 3100 species placed in 600 or so genera. It is at present divided into more than twenty subfamilies, only nine of which are known from New Zealand: Spalangiinae, Eunotinae, Celonyminae, Cerocephalinae, Macromesinae, Diparinae, Asaphinae, Miscogasterinae, and Pteromalinae. Some 130 species in about 40 genera are known from New Zealand. An account of these genera is included in a review of the Australasian Pteromalidae by Boucek (1988).

Family ROTOITIDAE

Figure 71

Diagnosis. Known from the female only. Antenna 14-segmented with a 6-segmented clava; radicle short, quadrate; longitudinal sensilla with apical half free, present on funicle segments and clava; hypostomal bridge well developed, about twice as long as diameter of occipital foramen. Mesothoracic spiracle situated at exposed lateral edge of mesoscutum, about level with tegula; notaular lines absent; axillae strongly advanced; scutellum transverse; prepectus apparently absent; mesopleuron undivided, but with an oblique depression housing the middle femur. Forewing lacking a speculum; costal cell short, about one-quarter as long as forewing; postmarginal vein extremely long, much longer than marginal vein, nearly reaching wing apex; position of basal vein indicated by a dark line across wing. Hindwing with membrane of disc extending to base. Tarsi 4-segmented. Gaster with petiole very transverse; ovipositor with outer plates remaining attached to abdominal tergite X.

Remarks. The structure of the ovipositor, placement of the mesothoracic spiracle, presence of longitudinal sensilla on the antenna, and reduced venation place the Rotoitidae within the Chalcidoidea. The combination of six-segmented clava, advanced and widely separated axillae, peculiar wing venation, and strongly transverse scutellum immediately separates them from all other chalcidoid families. Their systematic placement is somewhat uncertain, although the four-segmented tarsi, six-segmented funicle, petiolate gaster, and ovipositor structure indicate that they may be closest to the Tetracampidae, Eulophidae, or perhaps even the Mymaridae. The apparent absence of the prepectus is somewhat puzzling, but it is likely that this is a secondary loss, as is demonstrated by some genera of Pteromalidae and Mymaridae.

A single genus is known; New Zealand only. (A second genus has recently been reported from Chile – G. Gibson & J. Huber, pers. comm.).

Genus *Rotoita* Boucek & Noyes

Figure 71

Rotoita Boucek & Noyes, 1987: 407. Type species *Rotoita basalis* Boucek & Noyes, 1987: 408; New Zealand.

Diagnosis. Female. Length about 0.80–1.10 mm. General habitus quite squat, very similar to some species of *Anaphes* (Mymaridae). Body colour dark shining brown. Head with both mandibles bidentate; maxillary palpi 3-segmented; labial palpi 1-segmented; frontovertex about two-thirds of head width; eyes relatively small; antennal toruli situated about midway between lowest eye margin and mouth margin; scape subcylindrical, distinctly shorter than width of frontovertex; longitudinal sensilla present on funicle segments 4 and 5 and on clava. Pronotum membranous medially, very short, less than one-tenth as long as mesoscutum; scutellum slightly more than twice as broad as long, about twice as long as metanotum and a little shorter than propodeum; propodeal spiracle touching anterior margin of propodeum; phragma reaching posterior margin of propodeum. Middle and hind coxae inserted in a more or less straight line; foretibial spur apically bifurcate; middle tibial spur very short and straight; hind tibial spur about twice the size of middle tibial spur. Forewing with discal setae more or less evenly distributed from base to apex; marginal fringe up to about one-third as long as wing width; costal cell a little more than one-quarter as long as wing; marginal vein slightly shorter than costal cell; stigmal vein about one-quarter as long as marginal; postmarginal vein extremely long, about one-half longer than marginal. Hindwing about three-quarters as long as forewing, apically pointed; marginal fringe a little longer than maximum width of wing. Gaster about as long as thorax or a little longer, with petiole strongly transverse, a little less than one-third as wide as propodeum at its posterior margin; hypopygium reaching or very nearly reaching apex of gaster; tergites I–VI subequal in length; ovipositor slightly more than one-half longer than middle tibia, hidden or very slightly exserted; gonostyli about one-third as long as ovipositor.

Male. Unknown.

Biology. Unknown.

Remarks. World status: New Zealand only.

New Zealand: three species, *basalis* and two undescribed; North and South islands.

Family SIGNIPHORIDAE

Figures 72–77

Diagnosis. Generally very small, squat, robust species about 0.7–1.0 mm long. Body colour normally completely black, but occasionally with orange or yellow areas. Antenna inserted at or above mouth margin, 5–7-segmented; funicle segments ring-like; club long, unsegmented. Scutellum strongly transverse, with anterior and posterior margins subparallel; axillae not distinctly marked off from scutellum, the two together forming a transverse band; propodeum with a characteristic large, triangular median area.

Wings fully developed, usually with a relatively long marginal fringe; marginal vein quite long, about as long as submarginal; postmarginal and stigmal veins not developed or extremely short; hindwing usually more or less devoid of discal setae. Legs often with distinct spines on tibiae; tarsi 5-segmented. Gaster sessile; ovipositor usually hidden.

Biology. All but a few species of signiphorid are endoparasitoids of immature stages of Homoptera (Coccoidea, Aleyrodidae, Psyllidae) and the pupae of Diptera. Most species are known to be hyperparasitic via other chalcids, though some are gregarious hyperparasitoids through encyrtids.

The egg is relatively large, oval, and slightly curved, and may have a distinct peduncle at the anterior end. The first-instar larva is simple, with four pairs of spiracles, one on the mesothoracic segment and one on each of the first three abdominal segments (Quezada *et al.* 1973). Pupation takes place inside the host remains or (scale parasitoids) outside the host but under the scale covering.

Remarks. The small, cosmopolitan family Signiphoridae contains about seventy-five species in six genera, most diverse in the Neotropical region. They are represented in New Zealand by three species placed in two genera.

KEY TO GENERA OF SIGNIPHORIDAE KNOWN FROM NEW ZEALAND

1 Hindwing in distal half not parallel-sided and with a single discal cilium (Fig. 72); marginal fringe shorter than maximum wing width; funicle in female 4-segmented (Fig. 73) ... (p. 38) .. ***Chartocerus***

—Hindwing in distal half more or less parallel-sided and without a discal cilium (Fig. 75); marginal fringe longer than maximum wing width; funicle in female 3-segmented (Fig. 76) ... (p. 38) .. ***Signiphora***

Genus *Chartocerus* Motschulsky

Figures 72–74

Chartocerus Motschulsky, 1859: 171. Type species *Chartocerus musciformis* Motschulsky, 1859; Sri Lanka.

Diagnosis. Female. Body dorsally quite flat; length about 0.6–1.2 mm. Colour usually shining black, occasionally with a slight green sheen. Head hypognathous; occipital margin more or less sharp; mandibles bidentate; antennal scrobes distinct, generally an inverted V-shape; antenna with 4 funicle segments and no anellus or with 3 funicle segments and 1 anellus; clava unsegmented. Pronotum transverse, much wider than long. Wings hyaline or infuscate; forewing stigmal vein more or less indistinct from marginal vein. Hindwing with a single discal cilium, not parallel-sided in distal half; marginal fringe a little shorter than width of wing. Middle tibial spur with at least 7–12 teeth, forming a comb (Fig. 74).

Male. Length about 0.5–1.0 mm. Similar in general appearance to female; antenna with a 2–4-segmented flagellum, with a single anellus and clava only or additionally with a 2-segmented funicle; clava generally relatively longer than that of female, with longitudinal sensilla so arranged as to give a striate appearance.

Biology. The New Zealand species has been reared from *Nipaecoccus aurilanatus* (Maskell) on *Araucaria excelsa*. Elsewhere reared from various Homoptera and Diptera.

Remarks. Taxonomy: Rozanov (1965), Hayat (1970, 1976).

World status: fifteen species; probably cosmopolitan, but apparently not yet recorded from Africa.

New Zealand: one undetermined species.

Genus *Signiphora* Ashmead

Figures 75–77

Signiphora Ashmead, 1880: 19-30. Type species *Signiphora flavopalliata* Ashmead, 1880; U. S. A.

Diagnosis. Female. Body dorsally quite flat; length about 0.4–0.7 mm. Colour varying from entirely yellow to entirely black. Head hypognathous; occipital margin more or less sharp; mandible bidentate; antennal scrobes distinct, but usually not deeply impressed; antennal flagellum 4-segmented, with 3 anelli and a 1-segmented clava or with a single anellus, 2-segmented funicle, and 1-segmented clava. Pronotum much wider than long. Wings hyaline or infuscate. Forewing stigmal vein distinct from marginal vein. Hindwing without a discal cilium, parallel-sided in distal half; marginal fringe usually as long as wing width or longer. Middle tibial spur with 4 teeth (Fig. 77).

Male. Length about 0.4–0.7 mm. Similar in general appearance to female; flagellum 4-segmented, with either 3 anelli or 1 anellus plus 2 funicle segments and a long, unsegmented clava about as long as that in female.

Biology. The New Zealand species are associated with diaspidid scales (Homoptera: Diaspididae), as follows:

• *S. flavopalliata* Ashmead – reared from *Aonidiella aurantii* (Maskell);

• *S. merceti* Malenotti – reared from *Hemiberlesia rapax* (Comstock).
Elsewhere associated with Aleyrodidae, Diaspididae, Coccidae, and Pseudococcidae.

Remarks. Taxonomy: Rozanov (1965), Quezada *et al.* (1973).
World status: forty-three species; cosmopolitan.
New Zealand: two species (see above).

—⊛—

Family TORYMIDAE

Fig. 4, 11, 78–83

Diagnosis. Generally elongate species, usually quite smooth and not strongly sculptured; length about 1.1–7.5 mm (excluding ovipositor). Colour often blue or green, highly metallic. Antenna 13-segmented, usually with 1 anellus, rarely with 2 or 3. Mesoscutum with notauli complete, deeply impressed; prepectus large, clearly visible as a triangular sclerite between pronotum and mesopleuron. Wings fully developed; forewing almost always with a long marginal vein and short stigmal and postmarginal veins; uncus of stigmal vein nearly touching postmarginal vein. Hind coxa elongate (except in Megastigminae), at least about twice as long as forecoxa; hind femur sometimes strongly expanded, with ventral teeth; tarsi 5-segmented. Gaster never broadly attached to propodeum, occasionally distinctly petiolate; ovipositor with very few exceptions clearly exserted, often very strongly so.

Biology. Torymids are either phytophagous or parasitic in habit. The phytophages develop in the endosperm of seeds of various plants; e.g., species of *Megastigmus* Swederus (see Hussey 1955, 1957). Most species of Toryminae, many Monodontomerinae, and a few Megastigminae are primary ectoparasitoids of the immature stages of gall-inhabiting insects. Some species of *Torymus* that oviposit into cynipid galls do not develop as parasitoids, but develop on the gall tissue (Askew 1961a, 1965). Not all parasitic torymids attack the inhabitants of galls. A few torymid species may be ectophagous hyperparasitoids of beetle larvae via a chalcid primary parasitoid (Parnell 1964), while others may be ectoparasitoids of the larvae of aculeate Hymenoptera (Eves 1970, Danks 1971). Species of the tribe Podagrionini are primary parasitoids in mantid oothecae. Females of at least one species of this tribe have been noted clinging to the hindwings of the adult female mantid. This ensures that they reach the deposited eggs of the mantid before the froth hardens (Bordage 1913). A few species are known to be hyperparasitoids of the pupae of Lepidoptera via tachinids or ichneumonids.

Torymids lay kidney-shaped to very elongate ovoid eggs in, on, or near to the food source (Askew 1966, Skrzypczynska 1978). The eggs of *Monodontomerus* bear numerous minute recurved spines. The larvae are simple, and their cuticle bears setae which are most conspicuous in parasitic species (Varley 1937, Danks 1971, Askew & Ruse 1974) but inconspicuous in phytophagous species (Hussey 1955, Askew 1966). The female pupa has the ovipositor externally visible and bent over its dorsum (Skrzypczynska 1978).

Remarks. The family Torymidae comprises about 1500 species placed in about 110 genera. Three subfamilies are recognised, all of which – Toryminae, Monodontomerinae, and Megastigminae – occur in New Zealand. About twelve species in six genera are represented in New Zealand.

KEY TO GENERA OF TORYMIDAE KNOWN FROM NEW ZEALAND

1 Forewing stigmal vein noticeably enlarged, much deeper than width of stigmaticus (Fig. 79); body not metallic but yellow with brown markings
... (p. 40) .. **Megastigminae:** ***Megastigmus***
—Forewing with stigmaticus of more normal proportions, only slightly deeper than width of stigmal vein itself; body metallic green, blue, or purple ... 2

2(1) Mesepimeron with posterior margin distinctly incised (Fig. 4) ... (p. 41) .. **Toryminae:** ***Torymus***
—Mesepimeron with posterior margin more or less straight, not incised ... **Monodontomerinae** .. 3

3(2) Hind femur distinctly swollen, with a row of teeth ventrally (Fig. 81) ... **Podagrionini** .. 4
—Hind femur not distinctly swollen, with at most only 1 tooth ventrally (Fig. 72) ... **Monodontomerini** .. 5

4(3) Antenna with 1st flagellar segment at least about as long as wide (Fig. 80) ... (p. 40) .. ***Pachytomoides***
—Antenna with 1st flagellar segment anelliform (Fig. 81)
... (p. 41) .. ***Podagrion***

5(3) Forewing marginal vein at most about half as long as costal cell (Fig. 81); occiput without a horseshoe-like carina above foramen ... (p. 40) .. ***Liodontomerus***
—Forewing marginal vein at least nearly as long as costal cell (Fig. 82); occiput with a horseshoe-like carina above foramen ... (p. 41) .. ***Torymoides***

Genus *Liodontomerus* Gahan

Figure 78

Liodontomerus Gahan, 1914: 159. Type species *Liodontomerus perplexus* Gahan, 1914; U.S.A.

Diagnosis. **Female.** Length (excluding ovipositor) about 1.0–3.5 mm. Head and thorax shining metallic green, bronze-green, or blue-green, occasionally velvety, never marked with yellow in part. Occipital margin with or without a horseshoe-shaped carina above foramen; antenna usually with 2 anelli; clava without a hyaline apical process. Scutellum without a cross-furrow posteriorly; hind margin of mesepimeron straight. Forewing marginal vein about half as long as costal cell (Fig. 77, cf. Fig. 72); hind femur not swollen or toothed. Gaster with 1st tergite usually excised medially; ovipositor about as long as gaster.

Male. Length about 1.0–2.0 mm. Generally very similar to female except for structure of gaster.

Biology. The New Zealand species, *L. longfellowi* Girault, has been reared as a parasitoid of *Bruchophagus gibbus* feeding in seeds of red clover (*Trifolium repens*). Elsewhere known as parasitoids of various *Bruchophagus* species phytophagous in fruit seeds.

Remarks. Taxonomy: Szelenyi (1959).

World status: thirty-two species; cosmopolitan.

New Zealand: one species (see above).

Genus *Megastigmus* Dalman

Figure 79

Megastigmus Dalman, 1820: 178. Type species *Pteromalus bipunctatus* Swederus, 1795; Sweden.

Diagnosis. **Female.** Length (excluding ovipositor) about 1.5–7.00 mm. Body characteristically hunched in dead individuals, with the head nearly touching the forecoxae. Coloration normally yellowish with brown markings, not metallic, but species with a partly metallic head or thorax are known. Occiput with a horseshoe-shaped carina above foramen; antenna with only a single anellus. Forewing stigmal vein conspicuously enlarged at apex (Fig. 79). Hind coxa only slightly longer than forecoxa; hind femur not enlarged, without teeth. Exserted part of ovipositor varying from much shorter than gaster to considerably longer.

Male. Length 1.5–6.0 mm. Generally of similar appearance to female except for structure of gaster.

Biology. The New Zealand species have the following host associations:

- *M. aculeatus* Swederus – developing in seeds of briar rose (*Rosa rubiginosa*);
- *M. spermotrophus* Wachtl – developing in seeds of douglas fir (*Pseudotsuga menziesii*);
- *M.* sp. indet. – a parasitoid of the pupa of *Procecidochares utilis* Stone (Diptera: Trypetidae) inside galls on Mexican devil weed (*Eupatorium adenophorum*).

Elsewhere mainly phytophagous in the endosperm of various seeds, especially of conifers and Rosaceae.

Remarks. Taxonomy: Boucek (1970).

World status: 115 species; cosmopolitan.

New Zealand: three species, one undetermined and two identified (see above).

Genus *Pachytomoides* Girault

Figure 80

Pachytomoides Girault, 1913b: 143. Type species *Pachytomoides mirus* Girault, 1913; Australia.

Diagnosis. **Female.** Length (excluding ovipositor) about 3–5 mm. Body generally dark metallic green. Antenna with the single anellus about as long as wide; clava large, at least about as long as the 4 preceding segments combined, 1-segmented, or 3-segmented with the septa incomplete. Groove between mesopleuron and metapleuron virtually straight; metasternum with 2, sometimes interrupted, submedian carinae. Forewing marginal vein much longer than stigmal; hind coxa longer than hind femur. Hind-coxal cavities separated at narrowest point by a smooth, darkly sclerotised area less than the diameter of a cavity; hind femur distinctly swollen, with a ventral row of strong teeth; apex of hind tibia produced into a distinct, triangular spine. Gaster narrow at attachment with propodeum; ovipositor usually as long as body or longer.

Male. Length about 3–4 mm. Generally similar to female except in structure of gaster.

Biology. The New Zealand species has been reared from oothecae of *Orthodera ministralis* Fabricius (Phasmida: Mantidae). So far as is known, all species are parasitoids of mantid eggs.

Remarks. Taxonomy: Habu (1962); Grissell & Goodpasture (1981).

World status: eighteen species; circumtropical.

New Zealand: one undetermined species.

Genus *Podagrion* Spinola

Figure 81

Podagrion Spinola, 1811: 147. Type species *Podagrion splendens* Spinola, 1811; Central Europe.

Diagnosis. **Female.** Length (excluding ovipositor) about 2–4 mm. Body generally dark metallic green. Antenna with the single anellus strongly transverse; clava often as long as or longer than the 4 preceding segments combined, but sometimes shorter, varying from relatively slender to large and broad, 1- or 3-segmented, sometimes with sutures incomplete. Groove between mesopleuron and metapleuron virtually straight; metasternum with a single submedian carina. Forewing marginal vein much longer than stigmal vein. Hindcoxal cavities separated at narrowest point by a reticulate, darkly sclerotised area subequal to the diameter of a cavity; hind coxa longer than hind femur; femur distinctly swollen, with a ventral row of strong teeth; apex of hind tibia produced into a distinct, triangular spine. Gaster narrow at attachment with propodeum; ovipositor usually as long as body or longer, sometimes shorter.

Male. Length about 1.7–4.0 mm. Generally similar to female, except for structure of gaster.

Biology. The New Zealand species has been reared from oothecae of *Orthodera ministralis* Fabricius (Phasmida: Mantidae). Elsewhere known only as parasitoids of mantid eggs. At least one species is phoretic on the adult female mantid, clinging to its hind wings in order to gain access to recently deposited oothecae before the case hardens (Bordage 1913).

Remarks. Taxonomy: Habu (1962), Grissell & Goodpasture (1981).

World status: a little over 100 described species; cosmopolitan.

New Zealand: one undetermined species (see above).

Genus *Torymoides* Walker

Figure 82

Torymoides Walker, 1871: 37-38. Type species *Torymoides amabilis* Walker, 1871; Sri Lanka.

Diagnosis. **Female.** Length (excluding ovipositor) about 1.5–3.0 mm. Head and thorax metallic green or blue. Occiput with a horseshoe-like carina above foramen; antenna with 2 transverse anelli, the 2nd often larger than the 1st. Notaular lines complete, reaching hind margin of mesoscutum; scutellum without a cross-furrow posteriorly; posterior margin of mesepimeron straight (Fig. 82); propodeum with at most only 1 median longitudinal carina, usually more or less smooth. Forewing marginal vein about as long as costal cell; stigmal vein extremely short, with uncus not enlarged. Hind femur not swollen, without teeth. Gaster not petiolate; hind margin of 1st tergite medially incised; exserted part of ovipositor usually at least as long as gaster.

Male. Length 1.5–2.0 mm. Generally similar to female except for structure of gaster and slightly stouter antennae.

Biology. One species, *T. antipoda* (Kirby), is a parasitoid of the larvae of an unidentified gall-forming cecidomyiid (Diptera: Cecidomyiidae) on *Carmichaelia* sp. Other, as yet unidentified and probably endemic, New Zealand species have been reared from cecidomyiid galls on the shoot tips and buds of a number of native plants, including *Hebe*, *Carpodetus*, *Carmichaelia*, *Podocarpus*, and *Coprosma*. Elsewhere known as parasitoids of gall-forming cecidomyiids.

Remarks. World status: over thirty species; cosmopolitan.

New Zealand: probably at least five species, but only one identified (see above).

Genus *Torymus* Dalman

Figures 4, 11, 83

Torymus Dalman, 1820: 135. Type species *Ichneumon bedeguaris* Linnaeus, 1758; Sweden.

Diagnosis. **Female.** Length (excluding ovipositor) 2.0–6.0 mm. Body generally metallic blue, green, or purple. Occiput with a horseshoe-shaped carina above foramen; antenna usually with only a single anellus, but occasionally with 2. Posterior margin of mesepisternum distinctly incised. Apex of stigmal vein not conspicuously swollen. Hind femur not swollen, without ventral teeth. Gaster not petiolate; ovipositor usually at least as long as gaster.

Male. Length 1.5–4.5 mm. Generally as for female except for structure of gaster.

Biology. The single New Zealand species, *T. varians* (Walker), a native of Europe, develops on the endosperm of seeds of *Crataegus oxyacantha* (hawthorn), *C. crusgalli*, and *C. monogyna*. Elsewhere largely parasitoids of gall-forming Hymenoptera and Diptera.

Remarks. Taxonomy: Askew (1961c), Grissell (1976).

World status: about 500 species; cosmopolitan.

New Zealand: one non-native species (see above).

Family TRICHOGRAMMATIDAE

Figures 84–121

Diagnosis. Minute to very small, squat to elongate insects; excluding ovipositor about 0.2–1.2 mm long, including ovipositor up to 1.8 mm. Body colour varying from yellow or orange to dark brown, never metallic. Antenna 5–9-segmented, including 1 or 2 anelli; funicle with not more than 2 segments, often ring-like; clava 1–5-segmented; female antenna normally with short setae; male antenna usually with whorls of long setae. Thorax with pronotum very short, in dorsal view hardly visible behind head; notauli complete. Wings usually fully developed; fully developed forewing with marginal vein varying from almost absent to quite elongate, sometimes enormously swollen; stigmal vein varying from elongate to short and sessile; postmarginal vein absent; discal setae frequently arranged in distinct radiating rows. Tarsi 3-segmented. Gaster sessile; ovipositor varying from hidden to well exserted.

Biology. Trichogrammatids are primary, solitary or gregarious endoparasitoids of the eggs of other insects, notably Thysanoptera, Hemiptera, Lepidoptera, Coleoptera, Hymenoptera, and Diptera.

Many species of trichogrammatid oviposit directly into more or less exposed host eggs, and some may even attempt to oviposit into anything the same size and shape as an egg, e.g., dried globules of sap. A few trichogrammatids parasitise the eggs of aquatic insects, such as Dytiscidae (Coleoptera), Notonectidae (Hemiptera), or Odonata, while the egg is beneath the surface of the water. These aquatic species – e.g., *Prestwichia aquatica* Lubbock and *Hydrophilita aquivolans* (Matheson & Crosby) – search for hosts by swimming under water (Lubbock 1864, Matheson & Crosby 1912, Henriksen 1922). A number of other trichogrammatids are phoretic. For example, in some species the adults attach themselves to adult tettigoniids (Orthoptera) to gain access to freshly laid eggs (Ferrière 1926).

The egg is at least slightly elongate, and is sometimes expanded centrally with both ends smoothly rounded (Flanders 1937), or there may be a peduncle at one end (Silvestri 1916, Bakkendorf 1934). The first-instar larva is usually either sacciform (e.g., *Chaetostricha*, *Trichogramma*) or mymariform (e.g., *Popopoea*) (for explanation of terms, see under Mymaridae, p. 35). Some species have an additional curved, pre-apical, spine-like process (e.g., *Ophioneurus*). The mature larva is generally robust, distinctly segmented and without integumental spines or setae. There is apparently no tracheal system. Pupation takes place within the remains of the host egg, the adult parasitoid emerging by biting a hole in the chorion.

Several species of *Trichogramma* and other genera are frequently used in the biological control of lepidopterous insect pests in areas such as China, Russia, India, and Central and North America. Most species utilised are mass-reared, to be released in huge numbers early in the season in an effort to control the pest species before its numbers build up to a level at which damage becomes of economic significance.

Remarks. Trichogrammatids are a cosmopolitan family comprising over 500 species in 74 genera. Most genera are keyed by Doutt & Viggiani (1968). The family is normally divided into the subfamilies Trichogrammatinae and Lathromerinae; both occur in New Zealand, being represented by thirty-six species in eleven genera.

KEY TO GENERA OF TRICHOGRAMMATIDAE KNOWN FROM NEW ZEALAND

1 Females ... **2**
—Males ... **14**

Females

2(1) Apterous or brachypterous, wings not reaching apex of gaster ... **3**
—Wings normally developed, reaching or exceeding apex of gaster ... **4**

3(2) Antennal funicle 1-segmented, clava 3-segmented (Fig. 98) ... (p. 45) .. ***Oligosita***
—Antennal funicle 2-segmented with a 'connate segment', clava 1-segmented (Fig. 105, 111)
... (p. 45) .. ***Trichogramma***

4(2) Forewing narrow, at least 7x as long as its greatest width; marginal fringe more than 4x as wide as disc; disc bare (Fig. 94) or with a single row of setae extending from stigmal vein (Fig. 96). Minute species not exceeding 0.25 mm in length ... (p. 45) .. ***Megaphragma***
—Forewing not more than 3x as long as its greatest width; marginal fringe less than 4x as wide as disc; discal setae relatively dense, sometimes arranged in radiating lines. Species longer than 0.25 mm ... **5**

5(4) Flagellum not divided into funicle and clava ... **6**
—Flagellum clearly divided into funicle and clava ... **7**

6(5) Flagellum 2-segmented or obscurely 3-segmented, preceded by a single anellus and a 'connate segment' (Fig. 86); forewing venation reaching only one-third along wing (Fig. 84); hypopygium not extended
... (p. 44) .. ***Aphelinoidea***

—Flagellum 5-segmented, preceded by 2 anelli, the 2nd closely appressed to base of flagellum (Fig. 92); forewing venation extending halfway along wing (Fig. 91); hypopygium distinctly extended ... (p. 44) .. ***Lathromeris***

7(5) Funicle 1-segmented ... **8**
—Funicle 2-segmented ... **9**

8(7) Antenna with 1 anellus; clava 3-segmented (Fig. 98) ... (p. 45) .. ***Oligosita***
—Antenna with 2 anelli; clava obscurely 2-segmented (Fig. 122) ... (p. 47) .. ***Zelogramma***

9(7) Clava 3-segmented, sometimes obscurely so ... **10**
—Clava 1- or 2-segmented ... **11**

10(9) Thorax with a distinct median, dorsal sulcus (Fig. 90); clava obscurely 3-segmented and well separated from funicle by a narrow stalk (Fig. 88); forewing venation relatively short, hardly reaching more than one-third along wing (Fig. 87); stigmal vein clearly shorter than marginal vein, sessile ... (p. 44) .. ***Brachyia***
—Thorax without a median dorsal sulcus; clava distinctly 3-segmented, less clearly separated from funicle (Fig. 120); forewing venation nearly reaching halfway along wing (Fig. 118); stigmal vein relatively long and slender, about as long as marginal vein ... (p. 47) .. ***Ufens***

11(9) Clava 2-segmented (Fig. 116) ... (p. 46) .. ***Trichogrammatomyia***
—Clava 1-segmented ... **12**

12(11) Forewing marginal and stigmal veins not forming a smooth, sigmoidal curve; apex of marginal vein square (Fig. 101) ... (p. 45) .. ***Pseudogrammina***
—Forewing marginal and stigmal veins forming a more or less smooth, sigmoidal curve; apex of marginal vein indistinct, oblique (Fig. 110, 113) ... **13**

13(12) Vein track RS1, from stigmal vein, present (Fig. 110) ... (p. 45) .. ***Trichogramma***
—Vein track RS1 absent (Fig. 113) ... (p. 46) .. ***Trichogrammatoidea***

Males

14(1) Apterous or brachypterous, wings not reaching apex of gaster ... **15**
—Wings normal, exceeding apex of gaster ... **16**

15(14) Flagellum 4-segmented with a 1-segmented funicle and 3-segmented clava ... (p. 45) .. ***Oligosita***
—Flagellum 1-segmented [with 'connate segment'] ... (p. 45) .. ***Trichogramma***

16(14) Forewing narrow, at least 7x as long as its greatest width; marginal fringe more than 4x as long as width of wing (as in Fig. 88, 90) ... (p. 45) .. ***Megaphragma***
—Forewing not more than 4x as long as its greatest width; marginal fringe not longer than width of wing ... **17**

17(16) Forewing at least a little more than 3x as long as its greatest width; discal setae sparse, never distinctly arranged in radiating lines or vein tracks; marginal fringe about as long as width of wing (as in Fig. 99); antenna with a 1-segmented funicle and 3-segmented clava ... (p. 45) .. ***Oligosita***
—Forewing at most 3x as long as its greatest width; discal setae relatively dense, often arranged in radiating lines or vein tracks; marginal fringe less than half as long as maximum wing width; combinations of flagellar segments not as in alternate ... **18**

18(17) Forewing stigmal vein relatively short and sessile; apex of venation hardly reaching more than one-third along wing ... **19**
—Forewing stigmal vein relatively long and petiolate; apex of venation at least reaching nearly halfway along wing ... **20**

19(18) Forewing about 3x as long as wide, apically rounded (as in Fig. 78); thorax dorsally without a median sulcus ... (p. 44) .. ***Aphelinoidea***
—Forewing about twice as long as wide, apically more or less truncate (as in Fig. 98); thorax dorsally with a median sulcus (as in Fig. 90) ... (p. 44) .. ***Brachyia***

20(18) Forewing with parastigma not conspicuously enlarged, hardly wider than submarginal vein (as in Fig. 101, 104, 110) ... **21**
—Forewing with parastigma conspicuously enlarged, triangular, clearly much broader than submarginal vein (as in Fig. 117, 118, 121) ... **23**

21(20) Forewing marginal and stigmal veins not forming a smooth, sigmoidal curve; apex of marginal vein square (as in Fig. 101) ... (p. 45) .. ***Pseudogrammina***
—Forewing marginal and stigmal veins forming a more or less smooth, sigmoidal curve; apex of marginal vein indistinct or oblique (as in Fig. 104, 110) ... **22**

22(21) Setae of vein track RS1 as in Fig. 98; marginal setae about one-sixth as long as width of disc; antennal flagellum segmentation varied – either clearly (Fig. 106,

107, 112) or obscurely (Fig. 108) 3-segmented, or not segmented (Fig. 109) ... (p. 45) .. ***Trichogramma***

—No setae on vein track RS1 (Fig. 110); marginal setae nearly one-third as long as width of disc; antennal flagellum differentiated into 2-segmented funicle and 3-segmented clava (Fig. 115) ... (p. 46) .. ***Trichogrammatoidea***

23(21) Flagellum, in addition to normal setae, bearing several long spines each longer than entire flagellum (Fig. 124) ... (p. 47) .. ***Zelogramma***

—Flagellum bearing no long spines but only setae of varying length, though all clearly much shorter than flagellum (Fig. 113) ... **24**

24(23) Clava 3-segmented; forewing with apex of marginal vein square (as in Fig. 117) ... (p. 46) .. ***Trichogrammatomyia***

—Clava with a very small, terminal 4th segment; forewing with apex of marginal vein oblique (Fig. 119) ... (p. 47) .. ***Ufens***

Genus *Aphelinoidea* Girault

Figures 84–86

Aphelinoidea Girault, 1911: 2–4. Type species *Aphelinoidea semifuscipennis* Girault, 1911; U.S.A.

Diagnosis. Female. Length (excluding ovipositor) 0.4–0.9 mm. Antenna with 1 or 2 anelli; funicle absent; clava elongate, 2- or 3-segmented. Forewing usually hyaline but occasionally with an infuscate pattern, about 3x as long as wide; venation short, reaching to about one-third along wing; marginal vein reaching anterior wing margin; stigmal vein very short, sessile; discal setae relatively dense, not arranged in distinct lines; no distinct clusters or tufts of setae beneath venation; disc without an oblique, bare area from stigmal vein towards base of wing; marginal fringe varying from very short to a little over one-third as long as width of wing. Gaster sometimes elongate, with an exserted ovipositor.

Male. Length about 0.4–0.7 mm. Except for genitalia and slightly smaller size, generally very similar in appearance to female.

Biology. Unknown; elsewhere recorded as parasitoids of the eggs of Cicadellidae.

Remarks. Taxonomy: Girault (1918), Doutt & Viggiani (1968).

World status: thirty species; probably cosmopolitan, although not yet recorded from Africa.

New Zealand: five species, all undetermined.

Genus *Brachyia* Strand

Figures 87–90

Brachyia Strand, 1926: 52. Type species *Brachygramma biclavatum* Girault, 1912; Australia.

Diagnosis. Female. Length about 0.7–0.8 mm. Antennal flagellum with a single anellus, 2 transverse, closely appressed funicle segments, and a 3-segmented clava; connection between funicle and clava stalk-like. Dorsum of thorax with a well defined median sulcus. Forewing not more than twice as long as broad, its apex sometimes truncate; marginal vein reaching anterior wing margin; stigmal vein relatively short and broad; setae on disc arranged along vein tracks; marginal fringe very short. Ovipositor relatively short, not exserted.

Male. Length about 0.7–0.8 mm. Generally similar in appearance to female, but flagellum clothed in setae about as long as width of segments, and funicle segments well separated.

Biology. Not known.

Remarks. Taxonomy: Doutt & Viggiani (1968).

World status: two species; Australia.

New Zealand: one undescribed species.

Genus *Lathromeris* Förster

Figures 91–93

Lathromeris Förster, 1856: 87. Type species *Lathromeris scutellaris* Förster, 1856; Europe.

Diagnosis. Female. Length about 0.6–1.1 mm. Antennal scape subcylindrical; flagellum with 2 anelli but no funicle; clava 5-segmented, sometimes with an apical, rod-like spicule. Forewing about twice as long as broad; marginal vein about as long as costal cell, with apex truncate; vein track RS1 absent. Ovipositor varying from hardly exserted to exserted about one-third along gaster, often enclosed in hypopygium, which is extended into pale-coloured lobes.

Male. Length 0.4–0.9 mm. Generally similar in appearance to female, but smaller, and lacking apical spicule of clava.

Biology. Unknown; elsewhere recorded as parasitoids of the eggs of Lepidoptera.

Remarks. Taxonomy: Doutt & Viggiani (1968).
World status: twenty-one species; cosmopolitan.
New Zealand: two undetermined species.

Genus *Megaphragma* Timberlake

Figures 94–97

Megaphragma Timberlake, 1924: 412. Type species *Megaphragma mymaripenne* Timberlake, 1923; Hawaii.

Diagnosis. Female. Length about 0.20–0.25 mm. Antenna with 1 anellus, 1 funicle segment, and a 2-segmented clava terminating in 2 or more apical processes. Forewing hyaline or basally infuscate, long, narrow, at least about 7x as long as broad; marginal fringe very long, at least 4x as long as maximum wing width; disc with at most a single line of setae distad of stigmal vein. Hind coxa placed slightly anterior to middle coxa.

Male. Length about 0.20–0.25 mm. Apart from genitalia, generally similar in appearance to female.

Biology. Unknown; elsewhere recorded as parasitoids of the eggs of thrips (Thysanoptera).

Remarks. Taxonomy: Ghesquière (1939), Subba Rao (1969).
World status: four species; cosmopolitan.
New Zealand: two undescribed species.

Genus *Oligosita* Walker

Figures 98, 99

Oligosita Walker, 1851: 212. Type species *Oligosita collina* Walker, 1851; Northern Ireland.

Diagnosis. Female. Body relatively elongate; length about 0.35–1.1 mm. Antenna with a single anellus, 1-segmented funicle, and 2- or 3-segmented clava often terminating in a rod-like projection. Wings sometimes shortened; fully developed forewing usually relatively long and narrow, at least about 3x as long as broad, only occasionally broader; marginal vein relatively long and straight, longer than costal cell, touching anterior margin of wing, usually about 4x as long as stigmal vein; setae sparse in disc, absent basally.

Male. Length about 0.35–0.8 mm. Apart from genitalia, generally very similar to female, but usually smaller and with gaster darker.

Biology. Unknown; elsewhere reared from eggs of hispid beetles, cicadellids, mirids (Homoptera), and tettigoniids (Orthoptera). Also recorded from pupae of Cecidomyiidae and Chloropidae (Diptera).

Remarks. Taxonomy: Doutt & Viggiani (1968), Viggiani (1976, 1981).
World status: about 100 species; cosmopolitan.
New Zealand: three undetermined species.

Genus *Pseudogrammina* Ghesquière

Figures 100–103

Pseudogrammina Ghesquière, 1946: 371. Type species *Pseudogramma fasciatipenne* Girault, 1912; Australia.

Diagnosis. Female. Body short, compact; length about 0.30–0.50 mm. Antenna with a single anellus lacking a dorsal spine, a 2-segmented funicle, and a solid clava. Scutellum with or without a median sulcus. Forewing about twice as long as broad, beneath venation infuscate and of leathery appearance; parastigma hardly swollen; marginal vein much shorter than costal cell, touching anterior wing margin, squarely truncate at apex and bearing a pair of very long setae; setae on disc not very dense in distal half of wing, but sometimes arranged in distinct lines; vein track RS1 absent; marginal fringe longer than one-quarter of wing width.

Male. Length about 0.3–0.5 mm. Generally similar in appearance to female, but antenna clothed in relatively long setae, and clava 3-segmented.

Biology. Unknown.

Remarks. The New Zealand species differ from the type species in lacking the median sulcus on the scutellum (see Doutt & Viggiani 1968, pp. 485, 533). However, they agree with all other characters of the genus, and therefore we place them in *Pseudogrammina*. The New Zealand species can be separated, in both sexes, by the extent of the forewing infuscation, relative density of setae in the forewing disc, and coloration of the thorax, as well as genital characters.
World status: one described species; Australian.
New Zealand: three undescribed species.

Genus *Trichogramma* Westwood

Figures 104–112

Trichogramma Westwood, 1833a: 444. Type species *Trichogramma evanescens* Westwood, 1833; England.

Diagnosis. Female. Body short, compact; length about

0.4–0.7 mm. Antenna with a single anellus lacking a dorsal spine, a 2-segmented funicle, and a solid clava. Wings sometimes shortened; macropterous forms with forewing about twice as long as broad, hyaline or infuscate, with submarginal, marginal, and stigmal vein forming a smooth, sigmoid curve; submarginal vein without an enlarged parastigma; marginal vein touching anterior wing margin, relatively short, much shorter than costal cell; discal setae relatively dense in distal half of wing, arranged in conspicuous lines; vein track RS1 present; marginal fringe normally not longer than one-eighth of wing width.

Male. Length about 0.3–0.7 mm. Generally similar in appearance to female, but usually noticeably darker, and often with wings poorly developed; antenna clothed in relatively long setae, and with variable segmentation, usually with a solid clava and no funicle, but endemic New Zealand species may have a 2-segmented funicle and solid clava (as in *T. funiculatum* Carver, Fig. 109).

Biology. *T. funiculatum* Carver is common, and has been reared from *Epiphyas postvittana* (Walker), *Cydia pomonella* (Linnaeus), *Planotortrix excessana* (Walker), and *Ctenopseustis obliquana* (Walker) (all Tortricidae). The undetermined New Zealand species have been reared from eggs of various tortricids, noctuids, and oecophorids.

Extralimital species are all parasitoids of the eggs of Lepidoptera, although a few have been recorded from eggs of Cicadellidae (Homoptera), Cimbicidae (Hymenoptera), and various Coleoptera and Diptera. Several species are of importance in the attempted control of lepidopterous pests of graminaceous and other crops in several countries, e.g., U.S.S.R., China, India, Mexico.

Remarks. Taxonomy: Doutt & Viggiani (1968), Nagarkatti & Nagaraja (1971), Nagaraja & Nagarkatti (1973), Nagaraja (1973), Oatman *et al.* (1982), Voegele & Pintureau (1982).

World status: about 100 species; cosmopolitan.

New Zealand: *T. funiculatum*, plus at least fifteen undetermined, mostly probably undescribed species.

Genus *Trichogrammatoidea* Girault

Figures 113–115

Trichogrammatoidea Girault, 1911: 13. Type species *Chaetosticha nana* Zehntner, 1896; Java.

Diagnosis. Female. Body short, compact; length about 0.4–0.6 mm. Antenna with a single anellus lacking a dorsal spine, a 2-segmented funicle, and a solid clava. Wings fully developed; forewing at least lightly infuscate basally, about twice as long as broad; submarginal, marginal, and stigmal veins forming a smooth, sigmoid curve; submarginal vein without an enlarged parastigma; marginal vein touching anterior wing margin, relatively short, much shorter than costal cell; discal setae relatively dense in distal half of wing, arranged in conspicuous lines; vein track RS1 absent; marginal fringe normally longer than one-fifth of wing width.

Male. Length about 0.15–0.5 mm. Generally similar in appearance to female, but usually noticeably darker, and wings often poorly developed or more or less absent; antenna clothed with relatively long setae; funicle 2-segmented; clava 3-segmented, but occasionally segmentation indistinct.

Biology. In New Zealand, *T. bactrae* has been reared from eggs of *Epiphyas postvittana* (Walker) (Tortricidae). Other, unidentified material has been reared from eggs of *Chrysodeixis eriosoma* (Doubleday) (Noctuidae), *Helicoverpa armigera* (Hübner) (Noctuidae), *Sceliodes cordalis* (Douleday) (Pyralidae), and *Planotortrix excessana* (Walker) (Tortricidae).

Remarks. Taxonomy: Doutt & Viggiani (1968), Nagaraja (1979).

World status: twenty species; cosmopolitan.

New Zealand: two species, one determined as *T. bactrae* Nagaraja (see above).

Genus *Trichogrammatomyia* Girault

Figures 116, 117

Trichogrammatomyia Girault, 1916: 268. Type species *Trichogrammatomyia tortricis* Girault, 1916; Canada.

Diagnosis. Female. Length about 0.5–0.6 mm. Antenna with a single anellus, a 2-segmented funicle, and a 2-segmented clava. Forewing hyaline or basally infuscate; parastigma swollen; marginal vein shorter than costal cell, touching anterior wing margin, its apex obliquely truncate; discal setae distad of apex of venation relatively sparse, some of them arranged more or less in lines. Ovipositor relatively short, not or hardly exserted.

Male (not yet known in New Zealand). Length about 0.5 mm. Similar in appearance to female, but antenna clothed in relatively long setae and with clava 3-segmented.

Biology. Unknown; *T. tortricis* Girault has been reared from the eggs of Tortricidae (Lepidoptera) in Canada.

Remarks. Taxonomy: Doutt & Viggiani (1968).

World status: one species; Nearctic.
New Zealand: one undescribed species.

Genus *Ufens* Girault

Figures 118–120

Ufens Girault, 1911: 32. Type species *Trichogramma nigrum* Ashmead, 1888b; U.S.A.

Diagnosis. Female. Length (excluding ovipositor) about 0.5–0.9 mm. Maxillary palpi 1-segmented. Antenna with 1 or 2 anelli, 2 transverse or subquadrate funicle segments broadly joined with an oblique division, and a 3-segmented clava. Forewing hyaline, not more than about twice as long as broad, mostly almost squarely truncate apically; parastigma swollen; marginal vein shorter than costal cell, touching anterior wing margin, its apex squarely truncate; discal setae moderately dense, arranged along vein tracks distad of apex of venation. Gaster varying from short to quite elongate; ovipositor sometimes slightly exserted.

Male. Length about 0.5–0.7 mm. Similar in appearance to female, but antenna clothed in whorls of long setae, and clava with a small, obscure, terminal 4th segment.

Biology. Unknown; elsewhere recorded as parasitoids of the eggs of Cicadellidae (Homoptera).

Remarks. Taxonomy: Girault (1918), Nowicki (1935), Doutt & Viggiani (1968).
World status: sixteen species; cosmopolitan.
New Zealand: two undetermined species.

Zelogramma new genus

Figures 121–125

Type species *Zelogramma maculatum* new species.

Female. Body fairly short and compact.

Head. Mandibles with 3 acute teeth, the lowest slightly the longest. Maxillary palpi 2-segmented. Antenna with 1 anellus, 2 anelliform funicle segments, 1 elongate funicle segment, and a 2-segmented clava with a short apical projection; suture separating segments of clava strongly invaginate on outer surface; longitudinal sensilla prominent on clava and 3rd funicle segment.

Thorax. Scutellum about as long as broad, without a median sulcus but with 2 pairs of subequal setae. Forewing about twice as long as broad, infuscate in basal half or so; marginal vein touching anterior wing margin, about one-third as long as costal cell; parastigma strongly expanded; costal cell with a line of setae dorsally in distal half; marginal vein apically truncate; stigmal vein forming an angle of very nearly 90°; discal setae moderately dense, some arranged in lines along vein tracks; vein track RS1 more or less indicated; marginal fringe less than one-eighth as long as wing width. Hindwing about 5x as long as broad; marginal fringe a little shorter than maximum wing width.

Gaster about as long as thorax. Ovipositor long, more or less extending to base of gaster, exserted, the exserted part nearly half as long as gaster or about half as long as middle tibia.

Male. Essentially similar to female, differing only as follows. Antenna interpreted here as consisting of scape, pedicel, a single anellus, and a 5-segmented clava of which the 1st segment is more or less anelliform; clava supporting several elongate, spine-like structures apparently derived from grossly elongate longitudinal sensilla. Forewing setation relatively sparse; marginal fringe a little longer. Genitalia similar to those of other trichogrammatid males, with fairly elongate digiti and parameres; digiti a little longer than parameres, each with a pair of apical teeth.

Remarks. *Zelogramma* appears to be closest to *Parachaetostricha* Lin, but differs in the structure of the antenna (*Parachaetostricha*: female with two subquadrate funicle segments and a three-segmented clava; male with a six-segmented flagellum and normal longitudinal sensilla) and forewing (*Parachaetostricha*: stigmal vein forming an angle of not more than 45° with anterior wing margin; vein track RS1 absent).

Only a single species is known.

Zelogramma maculatum new species

Figures 121–125

Female. Length range (excluding ovipositor) 0.46–0.63 mm (n=21); holotype about 0.54 mm. Generally very dark brown, almost black, with slight bluish reflections; antennae dark brown; forewing infuscate in basal half (Fig. 121), hindwing lightly infuscate in basal half; legs concolorous with body, but basal tarsal segments testaceous yellow; ovipositor sheaths concolorous with body.

Head. Frontovertex about half of head width, with shallow, transversely elongate, shagreened sculpture becoming more or less longitudinally elongate on lower parts of face and on genae. Antennal toruli with upper margin more or less level with lower eye margin, separated from each other and from mouth margin by about their own length; scape about three-quarters as long as width of frontovertex; proportions of antennal segments as in Fig. 122.

THORAX. Mesoscutum with very shallow, reticulate sculpture, posteriorly becoming more elongate and similar to that of scutellum, which is reticulate-striate; setae on disc of mesoscutum and scutellum subequal in length; setae on axillae nearly as long as those on scutellum; placoid sensillae situated in anterior third of scutellum. Forewing, Fig. 121.

GASTER. Exserted part of ovipositor about one-third as long as middle tibia. Relative lengths (holotype): ovipositor 75, gonostylus 20 [middle tibia 45].

Male. Length about 0.38 mm (n=1). Generally similar to female, but smaller. Antenna, Fig. 124. Genitalia, Fig. 125. Forewing marginal fringe about one-fifth of wing width; hindwing about 6x as long as broad, hardly infuscate. Relative lengths: middle tibia 65, aedeagus 70.

Type data. **Holotype:** female, AK, Birkenhead, Malaise trap in second growth bush, November 1980, J.F. Longworth (NZAC).

Paratypes (20 females, 1 male) from the following localities: ND – Waipoua State Forest; AK – Birkenhead, Huia, Lynfield; MC – Banks Peninsula (Price's Valley).

Material examined. Type series only (New Zealand Arthropod Collection, DSIR, Auckland; British Museum (Natural History), London; United States National Museum of Natural History, Washington D.C.; University of California at Riverside; Australian National Insect Collection, CSIRO, Canberra; Istituto di Entomologia Agraria, Portici, Italy).

ND, AK / MC.

Habitats noted: bush; edge of native bush; along stream; forest clearing.

Adults collected January–April, November, December.

Biology. Unknown.

Superfamily MYMAROMMATOIDEA

Gibson (1986b) has demonstrated that the Mymarommatidae are very probably the sister-group of the Chalcidoidea, and we prefer to treat them as a separate superfamily.

Characters separating mymarommatids from chalcids are: petiole two-segmented (one-segmented in Chalcidoidea); membrane of forewing reticulate or cellulate (cf. never so); pronotum touching tegulae (cf. normally well separated); prepectus absent (cf. present, although sometimes very reduced in some Mymaridae); longitudinal sensilla absent from flagellar segments (cf. always some present); presence of a membranous hyperoccipital region (cf. absent); and concealed mesothoracic spiracle (cf. exposed).

Family MYMAROMMATIDAE

Figure 126

Very small – 0.4–0.7 mm long. Similar in appearance to Mymaridae. Head lenticular, consisting of 2 sclerites separated by a hyperoccipital membranous region, without other sutures or carinae. Mouth cavity as wide as head, with large mandibles not meeting at midline. Antennal toruli close together, inserted high on head, level with dorsal margins of eyes. Eyes consisting of a small number of large ommatidia. Female antenna 10- or 11-segmented, without longitudinal sensilla; male antenna 13-segmented. Pronotum greatly reduced, hardly visible from above, but propleura large; prepectus absent; mesopleuron large; metapleuron larger, fused with propodeum. Forewing pedunculate, reticulate, the wide disc usually margined with long cilia arising from within membrane. Hindwing reduced to a vein plus a vestige of membrane, or to vein alone, terminating in wing-coupling hooks. Forewing size, shape, and ciliation varied; one New Zealand species is brachypterous, another is apparently apterous. Petiole 2-segmented.

Represented worldwide by a single genus.

Genus *Palaeomymar* Meunier

Figure 126

Palaeomymar Meunier, 1901: 288. Type species *Mymar duisbergi* Stein, 1877; Europe.

Diagnosis. Characterised by the features of the family, as above.

Biology. Unknown, but in New Zealand apparently associated with leaf litter.

Remarks. *Palaeomymar* is easily recognised by the two-segmented petiole, lenticular head with wide-set mandibles, and antennae arising close together high on the head.

Taxonomy: Debauche (1948), Doutt (1973), Yoshimoto (1975, 1984), Valentine (1971a), Kozlov & Rasnitsyn (1979).

World status: twelve species, including three fossil species from the Upper Cretaceous.

New Zealand: *P. insulare* Valentine, described from the Auckland and Antipodes islands, plus five undescribed species.

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Appendix Table 1 Plant hosts of Chalcidoidea – associations mentioned in Introduction and under families reviewed. The original published sources of these associations are Valentine (1970b) and Valentine & Walker (1983); other information is taken from the authors' unpublished notes.

Graminaceae	*Agropyron repens*	*Tetramesa* sp.	Eurytomidae
Moraceae	*Ficus rubiginosa*	*Herodotia subatriventris*	Agaonidae
		Pleistodontes imperialis	Agaonidae
Papilionaceae	*Acacia mearnsii*	*Bruchophagus acaciae*	Eurytomidae
	Medicago sativa	*Bruchophagus roddi*	Eurytomidae
	Trifolium repens	*Bruchophagus gibbus*	Eurytomidae
Pinaceae	*Pseudotsuga menziesii*	*Megastigmus spermotrophus*	Torymidae
Rosaceae	*Crataegus crus-galli*	*Torymus varians*	Torymidae
	Crataegus monogyna	*Torymus varians*	Torymidae
	Crataegus oxyacantha	*Torymus varians*	Torymidae
	Rosa rubiginosa	*Megastigmus aculeatus*	Torymidae
Apiaceae	*Conium maculatum*	*Systole foeniculi*	Eurytomidae
	Foeniculum officinale	*Systole foeniculi*	Eurytomidae

Appendix Table 2 Host associations of some New Zealand Chalcidoidea. A list including chalcid species not appearing in the text is given by Valentine (1967, 1975). These publications, and also Valentine (1970b), are the source of most of the records appearing here; others are taken from the unpublished records of E.W. Valentine.

Chalcid species	Host species	Host family
AGAONIDAE		
Herodotia subatriventris	*Ficus rubiginosa*	Moraceae
Pleistodontes imperialis	*Ficus rubiginosa*	Moraceae
APHELINIDAE		
Ablerus sp.	not known	Diaspididae
Aphelinus abdominalis	*Acyrthosiphon kondoi*	Aphididae
	Macrosiphum euphorbiae	Aphididae
Aphelinus asychis	*Macrosiphum euphorbiae*	Aphididae
Aphelinus gossypii	*Aphis nerii*	Aphididae
	Capitophorus eleagni	Aphididae
	Toxoptera aurantii	Aphididae
	Toxoptera citricidus	Aphididae
	Trialeurodes vaporariorum	Aleyrodidae
Aphelinus mali	*Eriosoma lanigerum*	Aphididae
Aphelinus subflavescens	*Tuberculoides annulatus*	Aphididae
Aphytis chilensis	*Aonidiella aurantii*	Diaspididae
	Aspidiotus hederae	Diaspididae
	Hemiberlesia rapax	Diaspididae
	Parlatoria pittospori	Diaspididae
	Leucaspis spp.	Diaspididae
Aphytis chrysomphali	*Aonidiella aurantii*	Diaspididae
Aphytis diaspidis	*Quadraspidiotus perniciosus*	Diaspididae
Aphytis ignotus	*Lindingaspis rossi*	Diaspididae
Aphytis mytilaspidis	*Lepidosaphes ulmi*	Diaspididae
	Quadraspidiotus ostreaeformis	Diaspididae
	Quadraspidiotus perniciosus	Diaspididae
Cales sp.	*Asterochiton pittospori*	Aleyrodidae
Centrodora scolypopae	*Scolypopa australis*	Ricaniidae
Centrodora xiphidii	*Conocephalus semivittatum*	Tettigoniidae
Coccophagoides sp.	*Hemiberlesia rapax*	Diaspididae
Coccophagus gurneyi	*Pseudococcus longispinus*	Pseudococcidae
Coccophagus ochraceus	*Ceroplastes sinensis*	Coccidae
	Saissetia coffeae	Coccidae
	Saissetia oleae	Cocidae
Coccophagus scutellaris	*Coccus hesperidum*	Coccidae
	Pulvinaria sp.	Coccidae
Encarsia citrina	*Aonidiella aurantii*	Diaspididae
	Aspidiotus hederae	Diaspididae
	Aulacaspis rosae	Diaspididae
	Lepidosaphes ulmi	Diaspididae
	Leucaspis stricta	Diaspididae
	Leucaspis spp.	Diaspididae
	Lindingaspis rossi	Diaspididae
	Parlatoria fulleri	Diaspididae
	Phenacaspis eugeniae	Diaspididae
	Quadraspidiotus ostreaeformis	Diaspididae
	Quadraspidiotus perniciosus	Diaspididae
	Ceroplastes sinensis (imm.)	Coccidae
	Coccus hesperidum (imm.)	Coccidae
Encarsia formosa	*Pealius azaleae*	Aleyrodidae
	Trialeurodes vaporariorum	Aleyrodidae
Encarsia koebelei	*Lindingaspis rossi*	Diaspididae
Encarsia pergandiella	*Trialeurodes vaporariorum*	Aleyrodidae
Encarsia perniciosi	*Aonidiella aurantii*	Diaspididae
	Quadraspidiotus perniciosus	Diaspididae
Euxanthellus philippiae	*Ceroplastes sinensis*	Coccidae
(females)	*Coccus hesperidum*	Coccidae
	Ceroplastes longulus	Coccidae
	Ctenochiton perforatus	Coccidae
	Parthenolecanium persicae	Coccidae
	Pulvinaria sp.	Coccidae
	Saissetia coffeae	Coccidae
	Saissetia oleae	Coccidae
Euxanthellus philippiae	*Encarsia* sp. in aleyrodid	Aphelinidae
(males)	*E. philippiae* female	Aphelinidae
	Pteroptrix sp.	Aphelinidae
	(in *Ctenochiton perforatus*)	Coccidae
	Metaphycus timberlakei	Encyrtidae
	(in *Parthenolecanium persicae*)	Coccidae
	Tetracnemoidea sp.	Encyrtidae
	(in *Nipaecoccus aurilanatus*)	Pseudococcidae
Pteroptrix spp.	not known	Diaspididae
	Ctenochiton perforatus	Coccidae
	not known	Eriococcidae

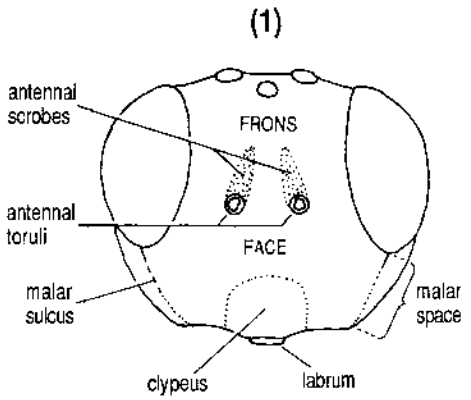
Chalcid species	Host species	Host family
CHALCIDIDAE		
Antrocephalus sp.	*Uresiphita polygonalis maorialis*	Geometridae
Brachymeria phya	? *Epiphyas postvittana*	Tortricidae
Brachymeria rubripes	? *Epiphyas postvittana*	Tortricidae
ELASMIDAE		
Elasmus sp.	*Cosmiotes archaeonoma*	Elachistidae
ENCYRTIDAE		
Copidosoma floridanum	*Chrysodeixis eriosoma*	Noctuidae
Habrolepis dalmanni	*Asterodiaspis variolosum*	Asterolecaniidae
Microterys flavus	*Coccus hesperidum*	Coccidae
	Saissetia oleae	Coccidae
EULOPHIDAE		
Pediobius epigonus	*Mayetiola destructor*	Cecidomyiidae
Achrysocharoides latreillii	*Phyllonorycter messaniella*	Gracilariidae
EUPELMIDAE		
Tineobius sp.	"Lepidoptera"	
Eupelmus antipoda	*Orthodera ministralis*	Mantidae
Eupelmus cyaneus	*Diadegma muelleri*	Ichneumonidae
Eusandalum barteli	*Poecilippe medialis*	Cerambycidae
Macroneura vesicularis	*Bracon variegator*	Braconidae
	Phanacis hyperochoeridis	Cynipidae
EURYTOMIDAE		
Axanthosoma sp.	*Amphipsalta cingulata*	Cicadidae
Bruchophagus acaciae	*Acacia mearnsii*	Papilionaceae
Bruchophagus gibbus	*Trifolium repens*	Papilionaceae
Bruchophagus roddi	*Medicago sativa*	Papilionaceae
Systole foeniculi	*Conium maculatum*	Apiaceae
	Foeniculum officinale	Apiaceae
Tetramesa sp.	*Agropyron repens*	Graminaceae
MYMARIDAE		
Anaphes nitens	*Gonipterus scutellatus*	Curculionidae

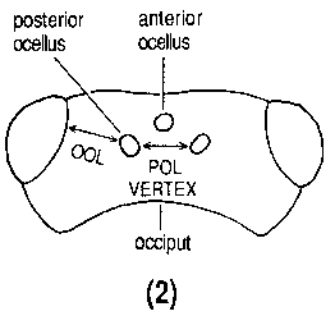
Chalcid species	Host species	Host family
PTEROMALIDAE		
Pteromalus puparum	*Pieris rapae*	Pieridae
SIGNIPHORIDAE		
Chartocerus sp.	*Nipaecocccus aurilanatus*	Pseudococcidae
Signiphora flavopalliata	*Aonidiella aurantii*	Diaspididae
Signiphora merceti	*Hemiberlesia rapax*	Diaspididae
TORYMIDAE		
Torymoides antipoda	galls on *Carmichelia*	Cecidomyiidae
Torymoides spp.	galls on *Hebe, Carpodetus, Coprosma, Rosa, Carmichaelia, Podocarpus*	Cecidomyiidae
Liodontomerus longfellowi	*Bruchophagus gibbus*	Eurytomidae
Megastigmus aculeatus	*Rosa rubiginosa*	Rosaceae
Megastigmus spermotrophus	*Pseudotsuga menziesii*	Pinaceae
Megastigmus sp.	*Procecidochares utilis*	Trypetidae
Pachytomoides sp.	*Orthodera ministralis*	Mantidae
Podagrion sp.	*Orthodera ministralis*	Mantidae
Torymus varians	*Crataegus crusgalli*	Rosaceae
	Crataegus monogyna	Rosaceae
	Crataegus oxyacantha	Rosaceae
TRICHOGRAMMATIDAE		
Aphelinoidea sp.	unknown	Cicadellidae
Lathromeris sp.	"Lepidoptera"	
Megaphragma sp.	"Thysanoptera"	
Oligosita sp.	unknown Cicadellidae	
Trichogramma funiculatum	*Ctenopseustis obliquana*	Tortricidae
	Cydia pomonella	Tortricidae
	Epiphyas postvittana	Tortricidae
	Planotortrix excessana	Tortricidae
Trichogrammatoidea bactrae	*Epiphyas postvittana*	Tortricidae
Trichogrammatoidea spp.	*Chrysodeixis eriosoma*	Noctuidae
	Helicoverpa armigera	Noctuidae
	Sceliodes cordalis	Pyralidae
	Planotortrix excessana	Tortricidae
Trichogrammatomyia sp.	unknown	? Tortricidae
Ufens sp.	unknown	Cicadellidae

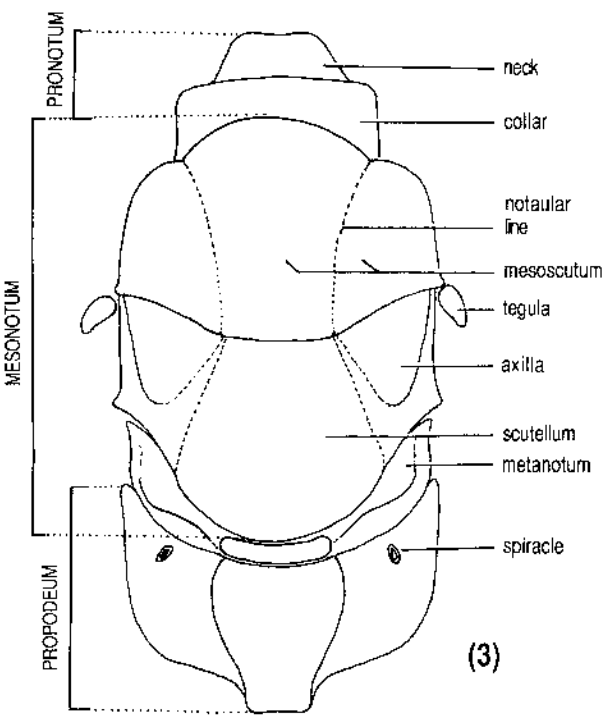
Appendix Table 3 Insect hosts of Chalcidoidea – associations mentioned in the Introduction and under families reviewed; where specific identities of either hosts or parasitoids are not known, group names are given. A list including chalcid species not appearing in the text is given by Valentine (1967, 1975). These publications are the source of most of the records appearing here; others are taken from the unpublished records of E.W. Valentine.

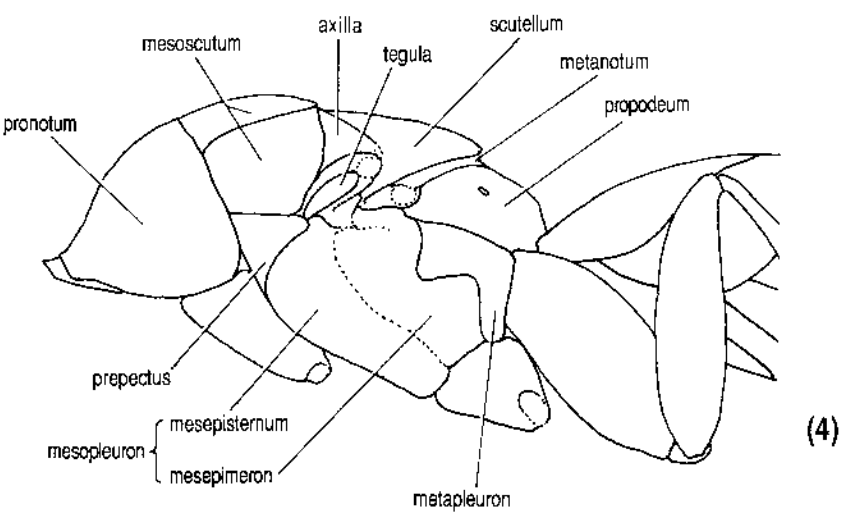
Host	Parasitoid	Parasitoid family
COLEOPTERA		
CERAMBYCIDAE		
Poecilippe medialis	*Eusandalum barteli*	Eupelmidae
Curculionidae		
Gonipterus scutellatus	*Anaphes nitens*	Mymaridae
DIPTERA		
CECIDOMYIIDAE		
Mayetiola destructor	*Pediobius epigonus*	Eulophidae
HEMIPTERA		
ALEYRODIDAE		
Asterochiton pittospori	*Cales* sp.	Aphelinidae
Pealius azaleaea	*Encarsia formosa*	Aphelinidae
Trialeurodes vaporariorum	*Aphelinus gossypii*	Aphelinidae
	Encarsia formosa	Aphelinidae
	Encarsia pergandiella	Aphelinidae
APHIDIDAE		
Acyrthosiphon kondoi	*Aphelinus asychis*	Aphelinidae
	Aphelinus abdominalis	Aphelinidae
Aphis nerii	*Aphelinus gossypii*	Aphelinidae
Capitophorus eleagni	*Aphelinus gossypii*	Aphelinidae
Eriosoma lanigerum	*Aphelinus mali*	Aphelinidae
Macrosiphum euphorbiae	*Aphelinus abdominalis*	Aphelinidae
	Aphelinus asychis	Aphelinidae
Toxoptera aurantii	*Aphelinus gossypii*	Aphelinidae
Toxoptera citricidus	*Aphelinus gossypii*	Aphelinidae
Tuberculoides annulatus	*Aphelinus subflavescens*	Aphelinidae
ASTEROLECANIIDAE		
Asterodiaspis variolosum	*Habrolepis dalmanni*	Encyrtidae
CICADELLIDAE		
unknown	*Aphelinoides* sp.	Trichogrammatidae
	Oligosita sp.	Trichogrammatidae
	Ufens sp.	Trichogrammatidae
CICADIDAE		
Amphipsalta cingulata	*Xanthosoma* sp.	Eurytomidae
COCCIDAE		
Ceroplastes longulus	*Euxanthellus philippiae*	Aphelinidae
Ceroplastes sinensis	*Coccophagus ochraceus*	Aphelinidae
	Coccophagus scutellaris	Aphelinidae
	Encarsia citrina	Aphelinidae
	Euxanthellus philippiae	Aphelinidae
Coccus hesperidum	*Microterys flavus*	Encyrtidae
	Coccophagus scutellaris	Aphelinidae
	Encarsia citrina	Aphelinidae
	Euxanthellus philippiae	Aphelinidae
Ctenochiton perforatus	*Pteroptrix* sp.	Aphelinidae
	Euxanthellus philippiae	Aphelinidae
Parthenolecanium persicae	*Euxanthellus philippiae*	Aphelinidae
Pulvinaria ?hydrangeae	*Coccophagus scutellaris*	Aphelinidae
	Euxanthellus philippiae	Aphelinidae
Pulvinaria sp.	*Euxanthellus philippiae*	Aphelinidae
Saissetia coffeae	*Coccophagus ochraceus*	Aphelinidae
	Euxanthellus philippiae	Aphelinidae
Saissetia oleae	*Coccophagus ochraceus*	Aphelinidae
	Euxanthellus philippiae	Aphelinidae
	Microterys flavus	Encyrtidae
DIASPIDIDAE		
Aonidiella aurantii	*Aphytis chilensis*	Aphelinidae
	Aphytis chrysomphali	Aphelinidae
	Encarsia citrina	Aphelinidae
	Encarsia perniciosi	Aphelinidae
	Signiphora flavopalliata	Signiphoridae
	Signiphora merceti	Signiphoridae
Aspidiotus hederae	*Aphytis chilensis*	Aphelinidae
	Encarsia citrina	Aphelinidae
Aulacaspis rosae	*Encarsia citrina*	Aphelinidae
Unknown	*Ablerus* sp.	Aphelinidae
	Pteroptrix sp.	Aphelinidae
Hemiberlesia rapax	*Aphytis* sp.	Aphelinidae
	Aphytis chilensis	Aphelinidae
	Coccophagoides sp.	Aphelinidae
	Signiphora flavopalliata	Signiphoridae
	Signiphora merceti	Signiphoridae

Lepidosaphes ulmi	*Aphytis mytilaspidis*	Aphelinidae
	Encarsia citrina	Aphelinidae
Leucaspis spp.	*Encarsia citrina*	Aphelinidae
	Pteroptrix spp.	Aphelinidae
Leucaspis stricta	*Encarsia citrina*	Aphelinidae
	Pteroptrix spp.	Aphelinidae
Lindingaspis rossi	*Aphytis ignotus*	Aphelinidae
	Encarsia citrina	Aphelinidae
	Encarsia koebelei	Aphelinidae
Parlatoria fulleri	*Encarsia citrina*	Aphelinidae
Parlatoria pittospori	*Aphytis chilensis*	Aphelinidae
	Encarsia citrina	Aphelinidae
Phenacaspis eugeniae	*Encarsia citrina*	Aphelinidae
Quadraspidiotus ostreaeformis	*Aphytis mytilaspidis*	Aphelinidae
	Encarsia citrina	Aphelinidae
Quadraspidiotus perniciosus	*Aphytis mytilaspidis*	Aphelinidae
	Aphytis diaspidis	Aphelinidae
	Encarsia citrina	Aphelinidae
	Encarsia perniciosi	Aphelinidae
ERIOCOCCIDAE		
Unknown	*Pteroptrix* sp.	Aphelinidae
PSEUDOCOCCIDAE		
Nipaecococcus aurilanatus	*Chartocerus* sp.	Signiphoridae
Pseudococcus longispinus	*Coccophagus gurneyi*	Aphelinidae
RICANIIDAE		
Scolypopa australis	*Centrodora scolypopae*	Aphelinidae
HYMENOPTERA		
APHELINIDAE		
Encarsia perniciosi (f)	*Encarsia perniciosi* (m)	Aphelinidae
Encarsia spp. (f)	*Encarsia* spp. (m)	Aphelinidae
Encarsia sp.	*Euxanthellus philippiae* (m)	Aphelinidae
Euxanthellus philippiae (f)	*Euxanthellus philippiae* (m)	Aphelinidae
Pteroptrix sp.	*Euxanthellus philippiae* (m)	Aphelinidae
Pteroptrix spp. (f)	*Pteroptrix* spp. (m)	Aphelinidae
	Encarsia spp. (m)	Aphelinidae
	Euxanthellus philippiae (m)	Aphelinidae
BRACONIDAE		
Unknown	*Eupelmus* sp.	Eupelmidae
CYNIPIDAE		
Phenacis hypochoeridis	*Macroneura vesicularis*	Eupelmidae
ENCYRTIDAE		
Metaphycus timberlakei	*Euxanthellus philippiae* (m)	Aphelinidae
Tetracnemoidea sp.	*Euxanthellus philippiae* (m)	Aphelinidae
ICHNEUMONIDAE		
Diadegma muelleri	*Eupelmus cyaneus*	Eupelmidae
LEPIDOPTERA		
ELACHISTIDAE		
Cosmiotes archeonoma	*Elasmus* sp.	Elasmidae
GEOMETRIDAE		
Uresiphita polygonalis	*Antrocephalus* sp.	Chalcididae
GRACILLARIIDAE		
Phyllonorycter messaniella	*Achrysocharoides latreillii*	Eulophidae
NOCTUIDAE		
Chrysodeixis eriosoma	*Copidosoma floridanum*	Encyrtidae
	Trichogrammatoidea sp.	Trichogrammatidae
Helicoverpa armigera	*Trichogrammatoidea* sp.	Trichogrammatidae
Thysanoplusia orichalcea	*Copidosoma floridanum*	Encyrtidae
PIERIDAE		
Pieris rapae	*Pteromalus puparum*	Pteromalidae
PYRALIDAE		
Sceliodes cordalis	*Trichogrammatoidea* sp.	Trichogrammatidae
TORTRICIDAE		
Ctenopseustisobliquana	*Trichogramma funiculatum*	Trichogrammatidae
	Trichogramma spp.	Trichogrammatidae
Cydia pomonella	*Trichogramma funiculatum*	Trichogrammatidae
Epiphyas postvittana	*Brachymeria phya*	Chalcididae
	Brachymeria teuta	Chalcididae
	Trichogramma funiculatum	Trichogrammatidae
	Trichogramma spp.	Trichogrammatidae
	Trichogrammatoidea bactrae	Trichogrammatidae
Planotortrix excessana	*Trichogramma funiculatum*	Trichogrammatidae
	Trichogrammatoidea sp.	Trichogrammatidae
PHASMIDA		
MANTIDAE		
Orthodera ministralis	*Eupelmus antipoda*	Eupelmidae
	Pachytomoides sp.	Torymidae
	Podagrion sp.	Torymidae
ORTHOPTERA		
TETTIGONIIDAE		
Conocephalus semivittatum	*Centrodora xiphidii*	Aphelinidae
THYSANOPTERA		
THRIPIDAE		
Unknown	*Megaphragma* spp.	Trichogrammatidae

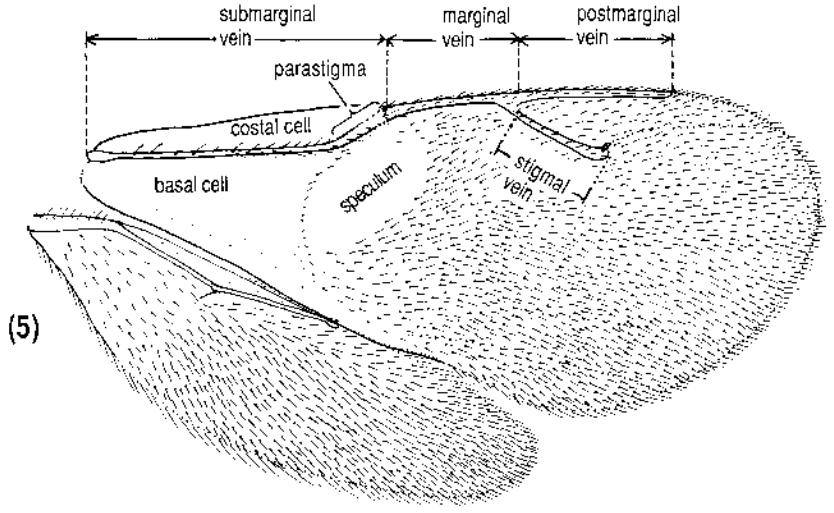




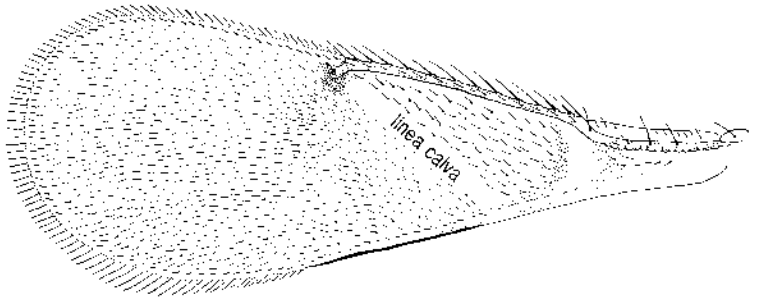




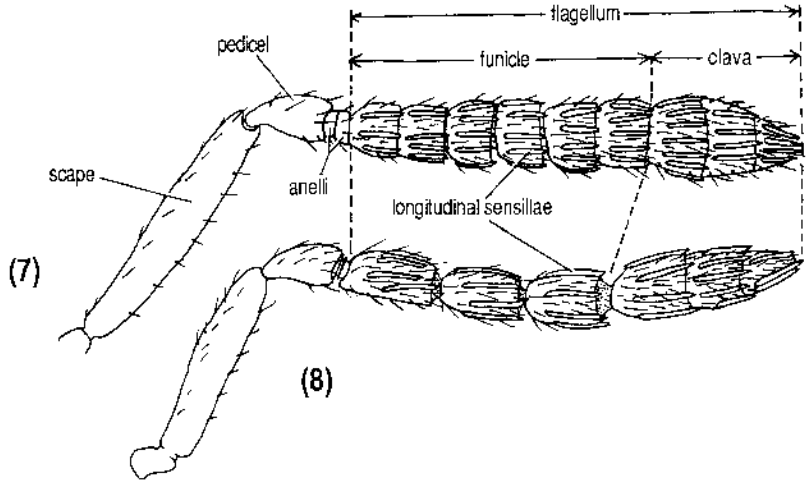
Figures 1–11 Morphological terms and measurements used in descriptions of Chalcidoidea.
1,2 head, generalised, facial and dorsal aspects (Pteromalidae); **3** thorax, generalised, dorsal aspect (Pteromalidae); **4** thorax, left side, *Torymus varians* (Torymidae); *(continued overleaf)*


submarginal vein
marginal vein
postmarginal vein
parastigma
costal cell
basal cell
speculum
stigmal vein

(5)

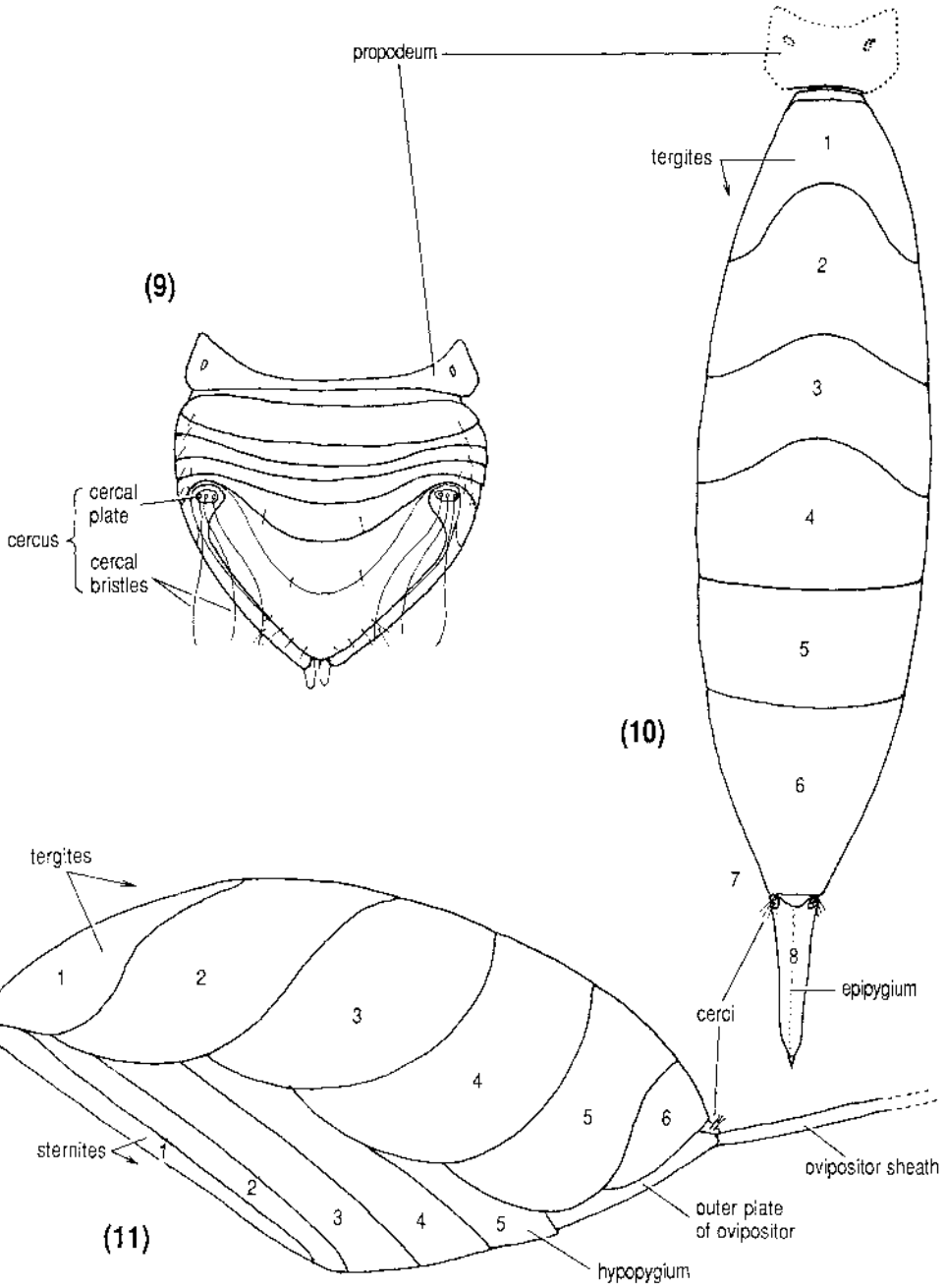

linea calva

(6)

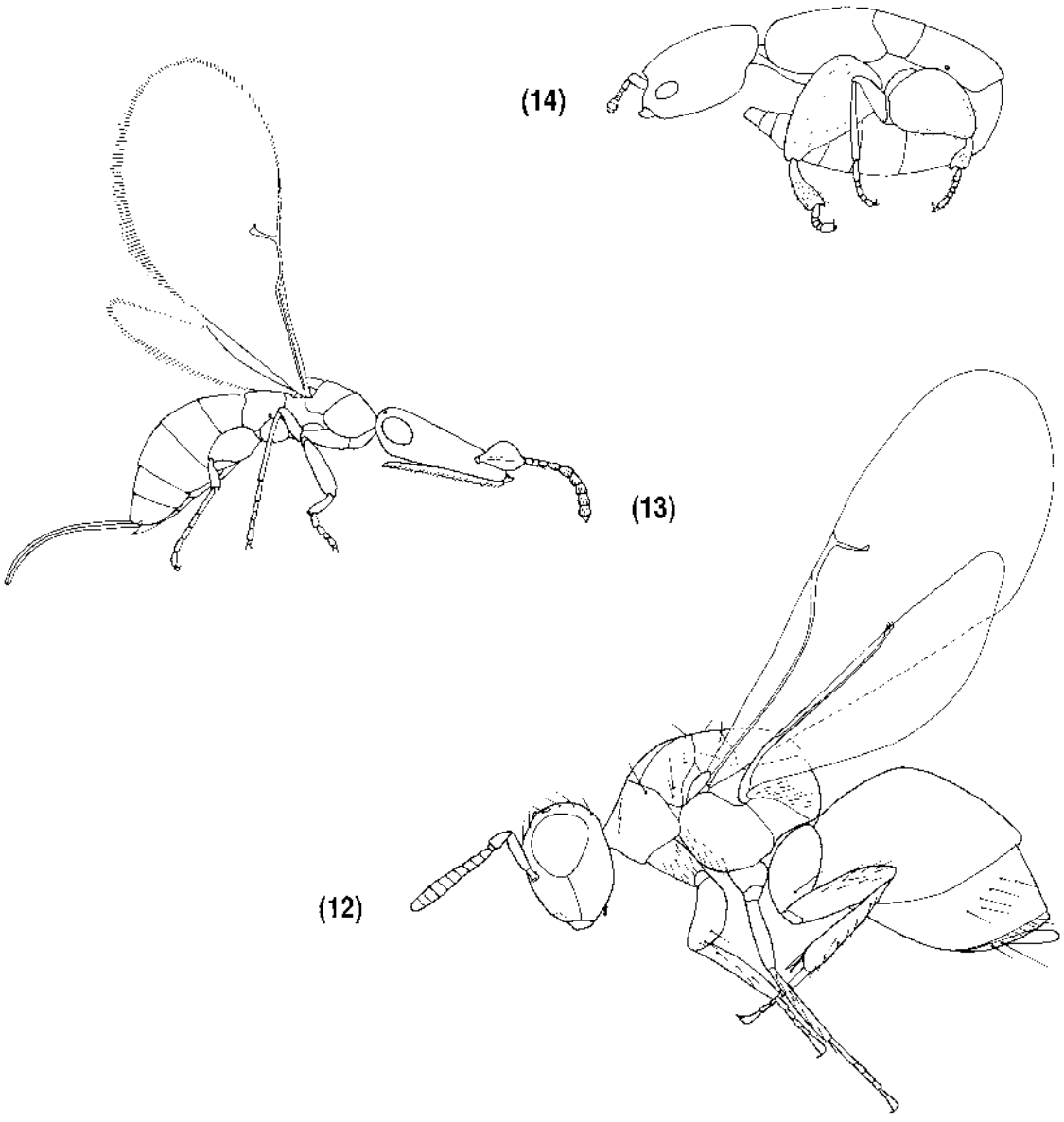

flagellum
pedicel
funicle
clava
scape
anelli
longitudinal sensillae

(7)

(8)

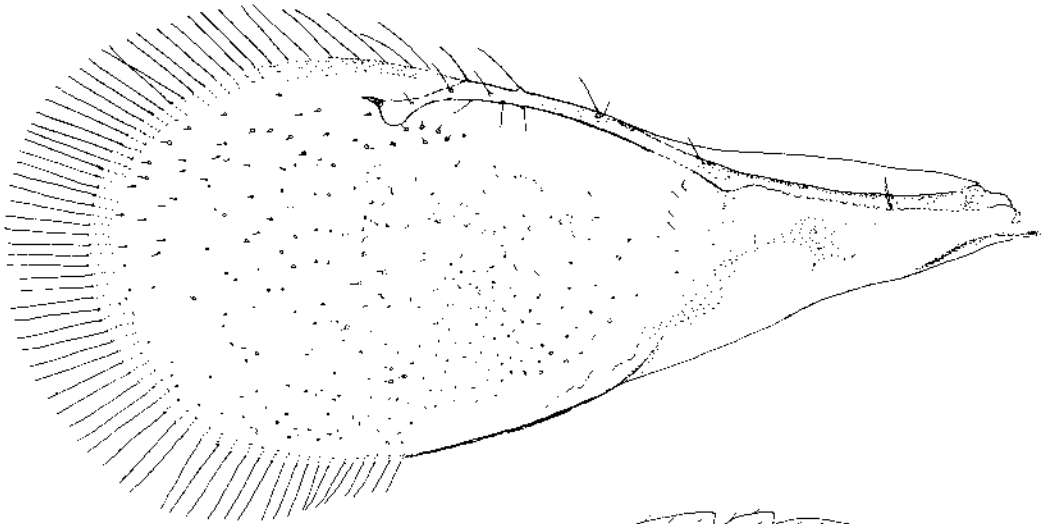


(continued from previous page) **5** wings, right pair, *Pteromalus puparum* (Pteromalidae); **6** right forewing, *Aphytis chilensis* (Aphelinidae); **7,8** antennae, *Trichomalopsis* sp. (Pteromalidae) and *Coccophagus gurneyi* (Aphelinidae); **9,10** gaster, dorsal aspect, female, *Arrhenophagus chionaspidis* (Encyrtidae) and *Eusandalum barteli* (Eupelmidae); **11** gaster, left side, female, *Torymus varians* (Torymidae).



Figures 12–126 Illustrations of diagnostic features from representatives of chalcidoid families.

Agaonidae: **12** *Herodotia subatriventris*, female, habitus, left side; **13** *Pleistodontes imperialis*, female, habitus, right side; **14** *P. imperialis*, male, habitus, left side.
Aphelinidae: **15** *Ablerus* sp., left forewing, female; **16** *Ablerus* sp., antenna, female; **17,18** *Aphelinus mali*, antennae, male and female; **19** *A. mali*, base of right forewing, female.



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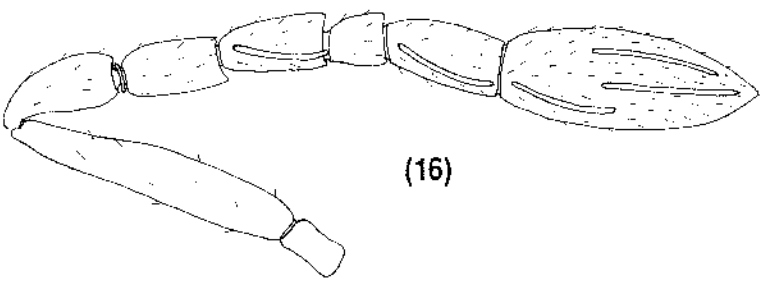

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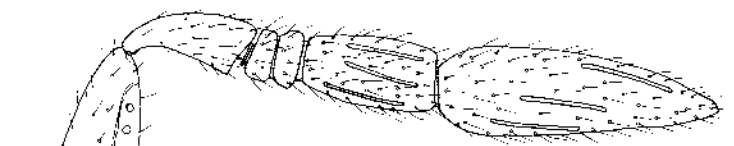

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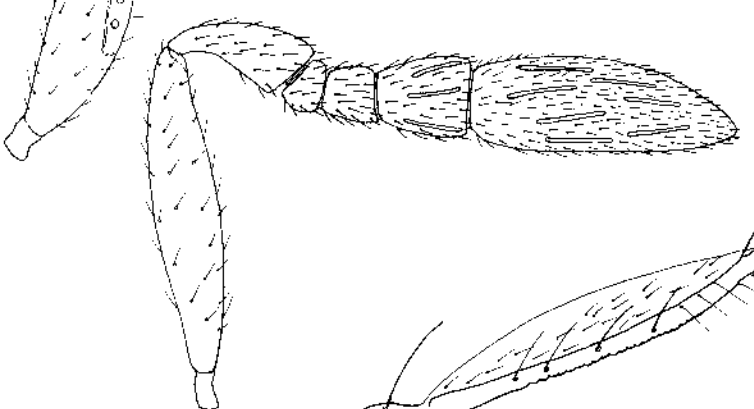

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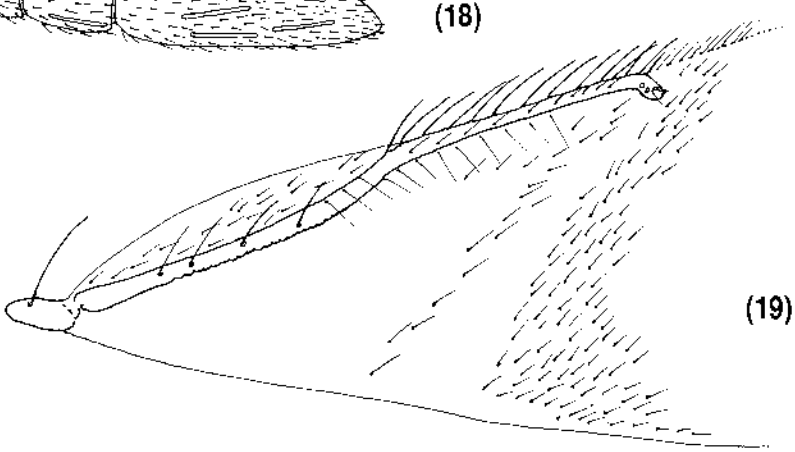

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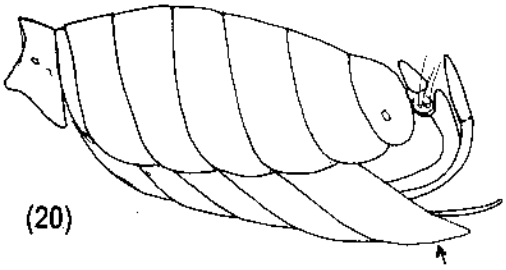

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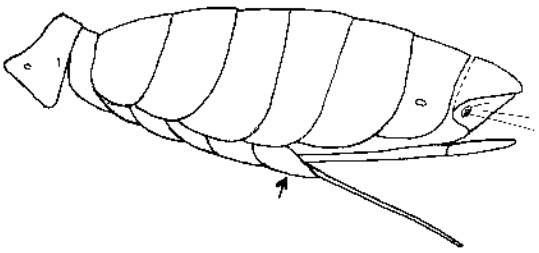
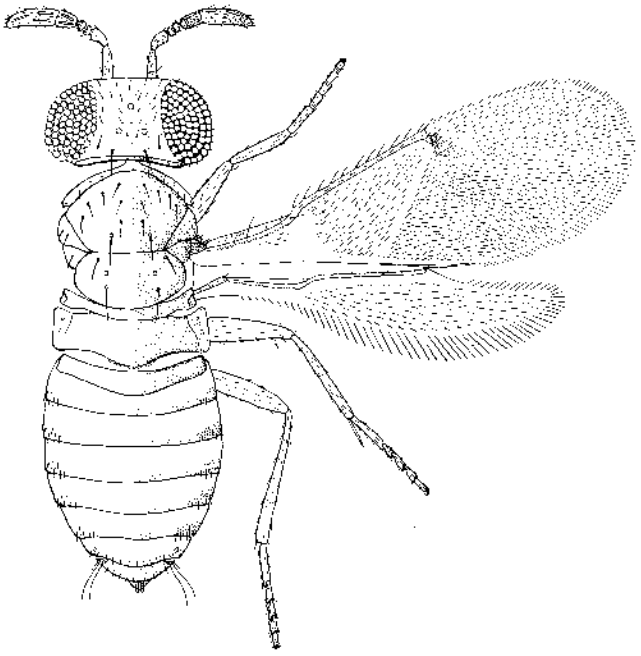
(21)





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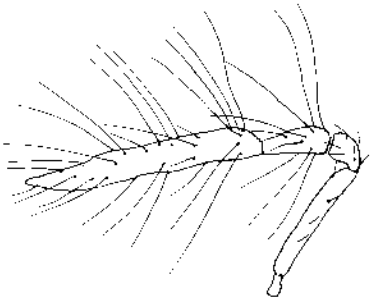

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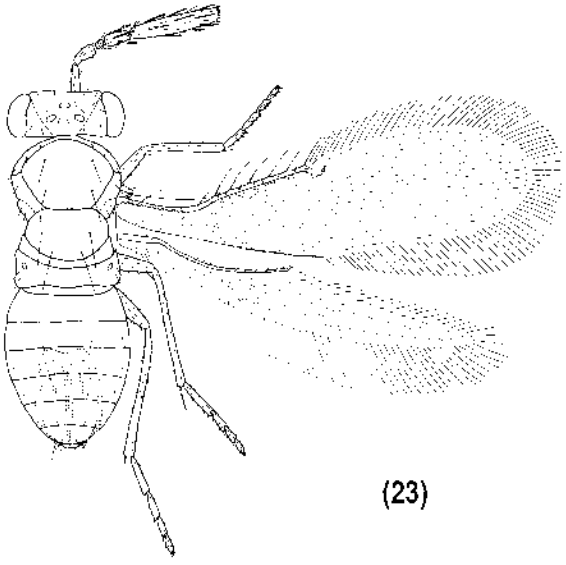
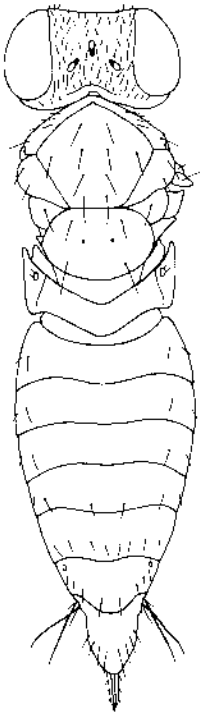


(23)

Aphelinidae: **20** *Aphelinus* sp., gaster, left side, female (→, hypopygium); **21** *Aphytis* sp., same; **22** *A. diaspidis*, habitus, dorsal, female; **23** *Cales* sp., same; **24** *Cales* sp., antenna, male; **25** *Centrodora scolypopae*, habitus, dorsal, female; **26** *C. scolypopae*, right forewing, female; **27** *C. scolypopae*, antenna, female; **28** *C. xiphidii*, same; **29** *Coccophagoides* sp., same; **30** *Coccophagus ochraceus*, habitus, dorsal, female; **31** *C. ochraceus*, antenna, male.



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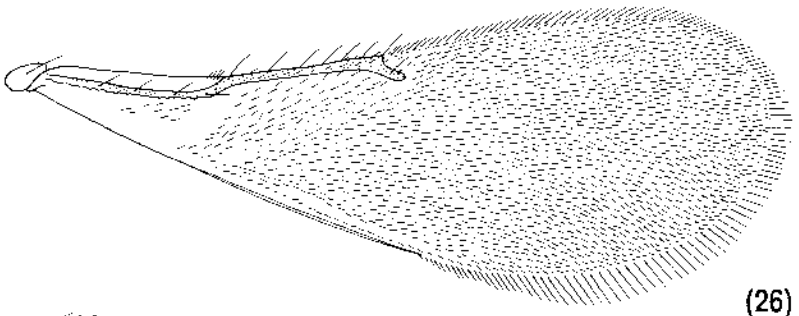

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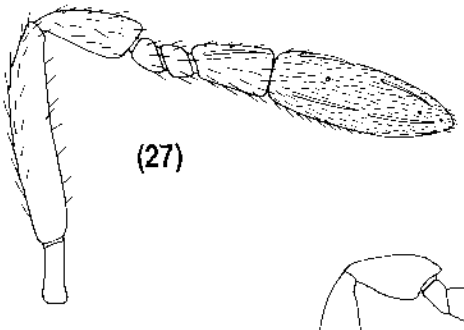

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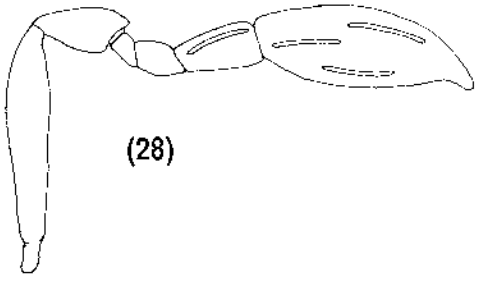

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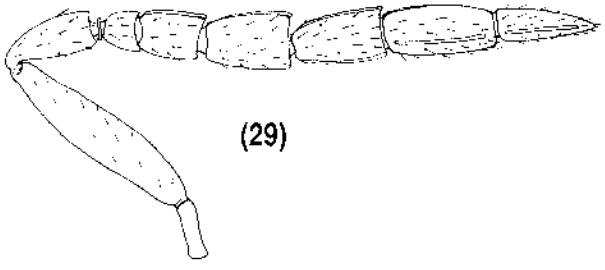

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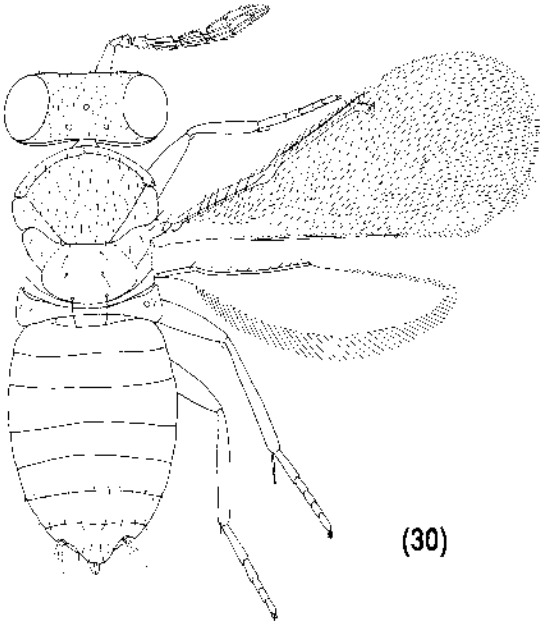

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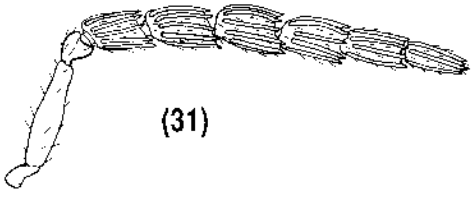

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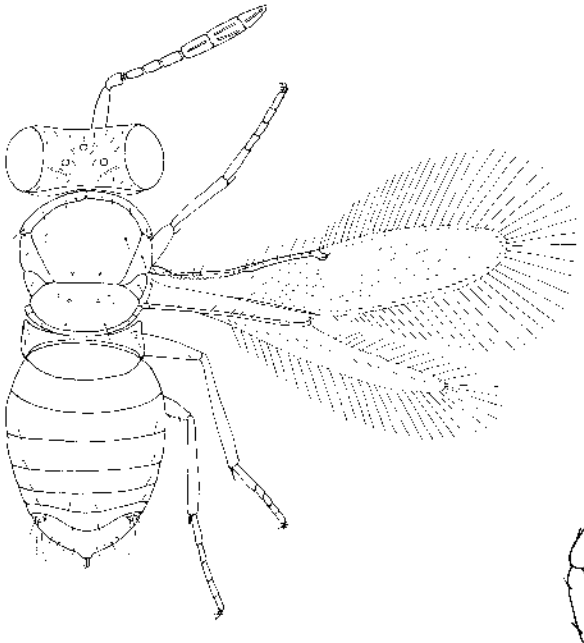

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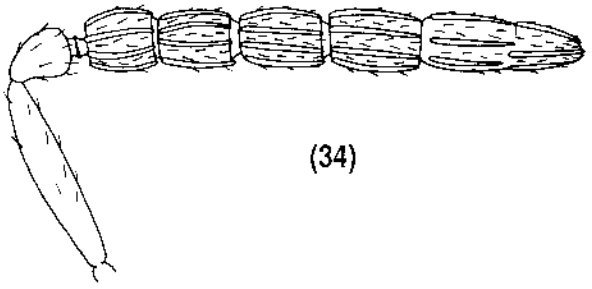

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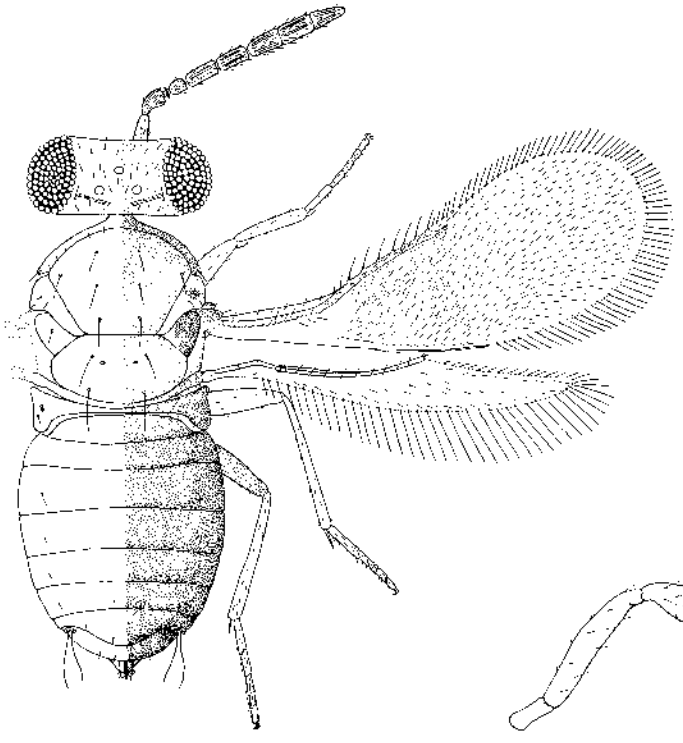

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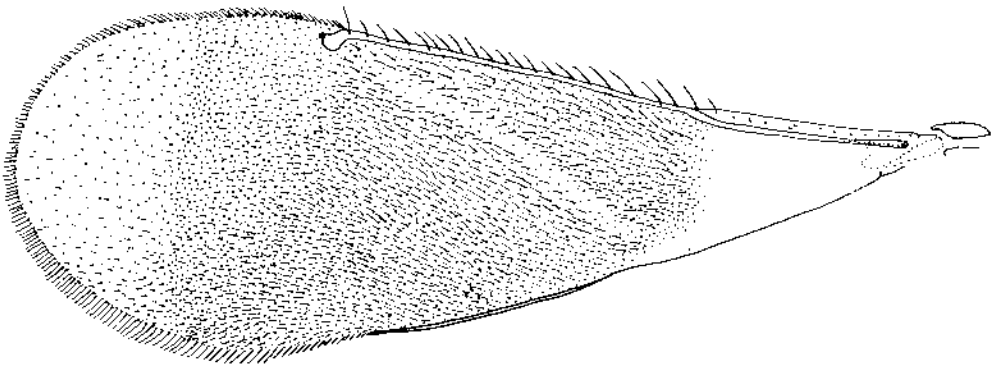

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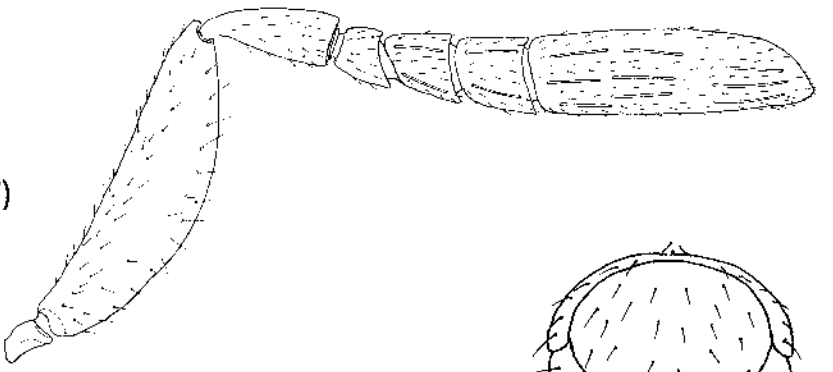

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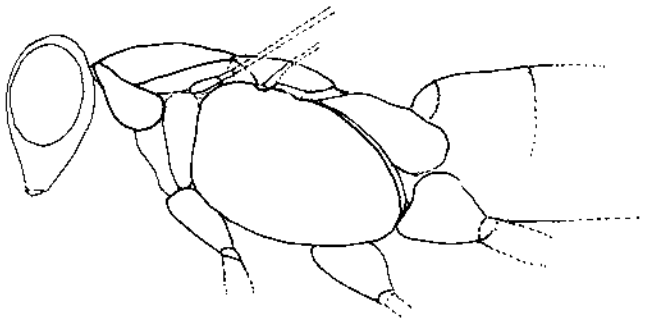

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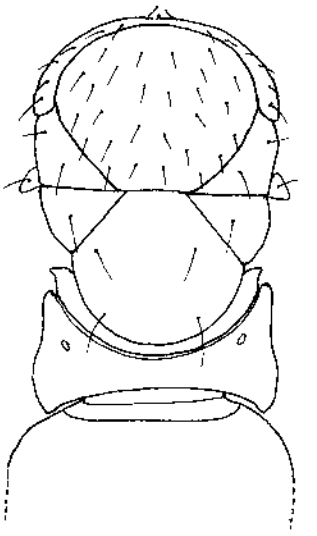
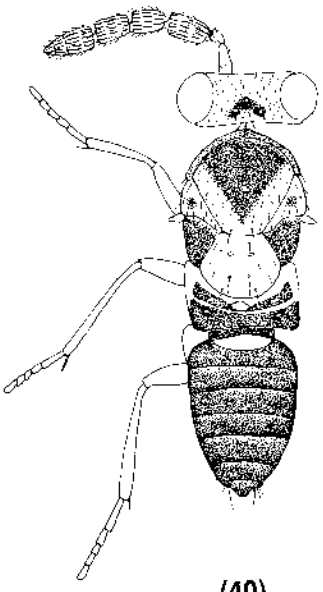


(38)

Aphelinidae: **32** *Encarsia citrina*, habitus, dorsal, female; **33** *E. perniciosi*, same; **34** *E. perniciosi*, antenna, male; **35** *Encarsia* sp., antenna, female; **36** *Eutrichosomella* sp., left forewing, female; **37** *Eutrichosomella* sp., antenna, female; **38** *Eutrichosomella* sp., thorax, dorsal, female; **39** *Eutrichosomella* sp., head and thorax, left side, female.



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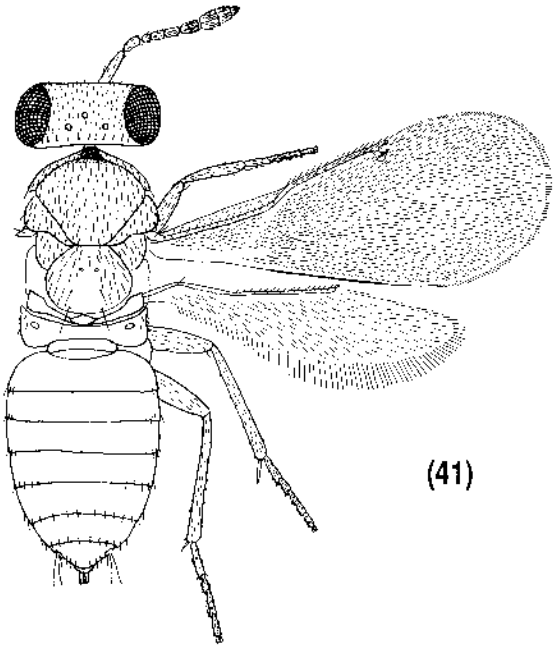

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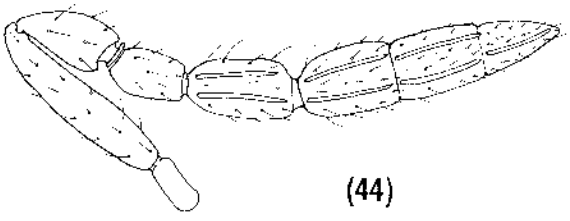

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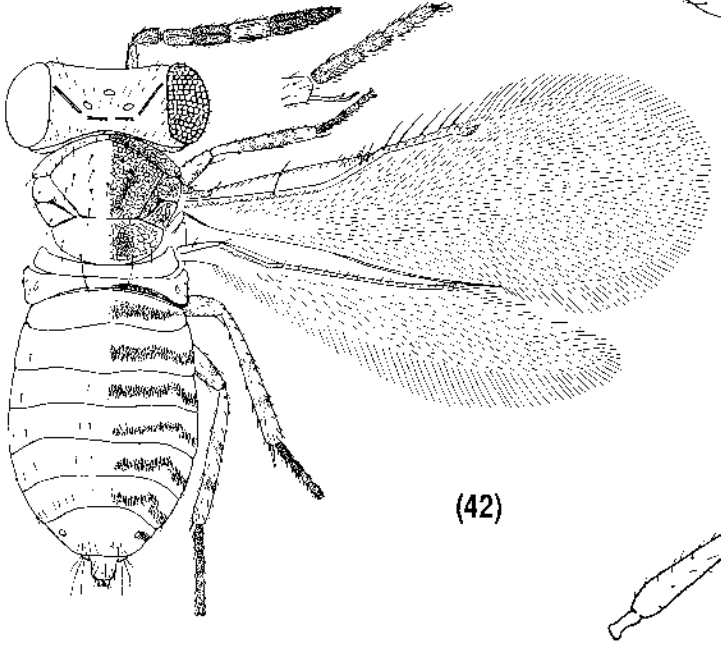

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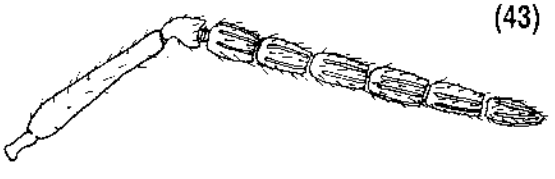

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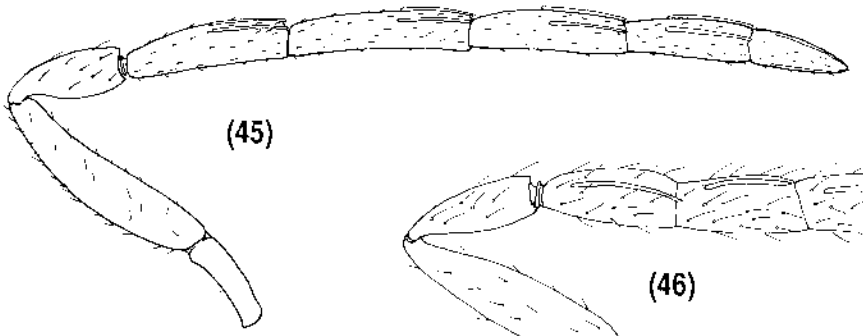
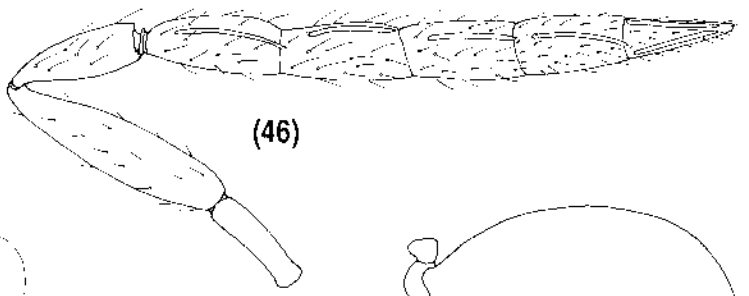
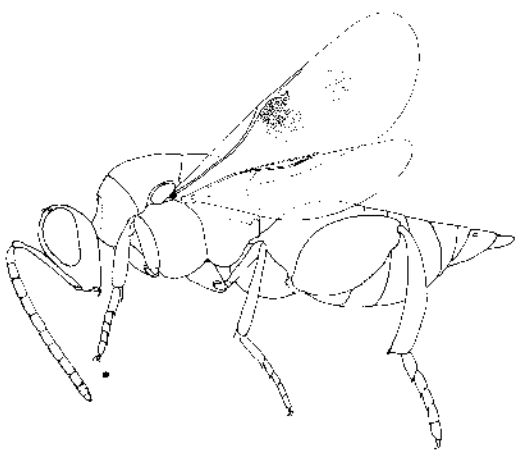
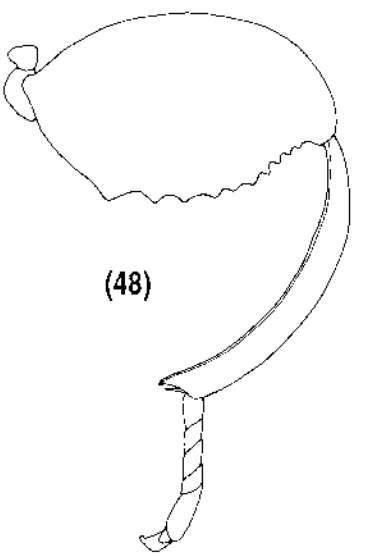
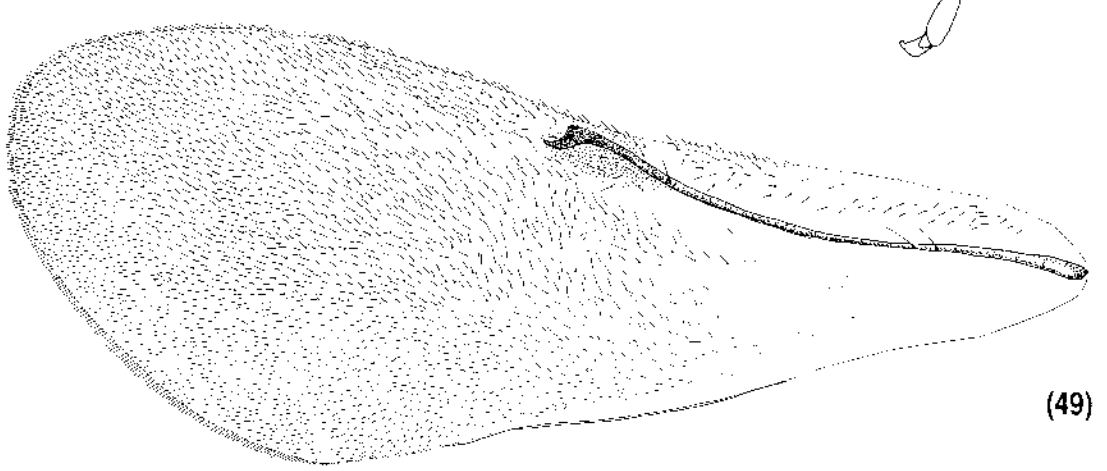


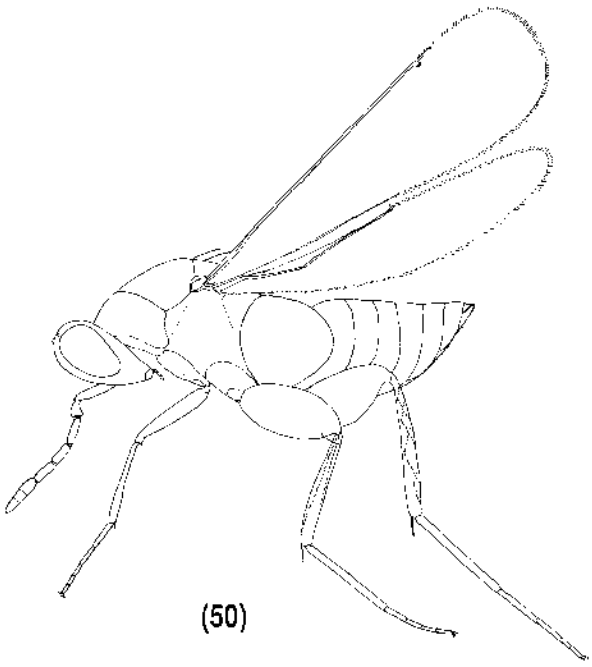








Aphelinidae: **40,41** *Euxanthellus philippiae*, habitus, dorsal, male and female; **42** *Pteroptrix* sp., habitus, dorsal, female; **43–46** *Pteroptrix* sp., antenna, male and 3 variants of female.
Chalcididae: **47** *Antrocephalus* sp., habitus, left side; **48** *Brachymeria phya*, hind leg, female; **49** *Proconura* sp., left forewing, female.



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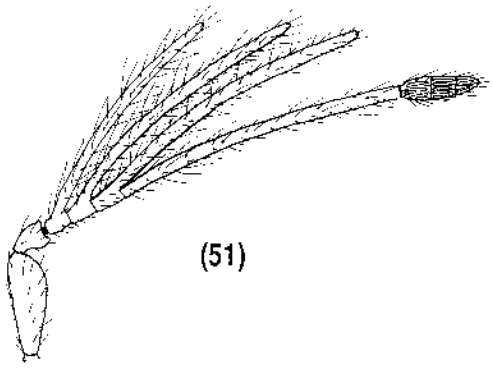

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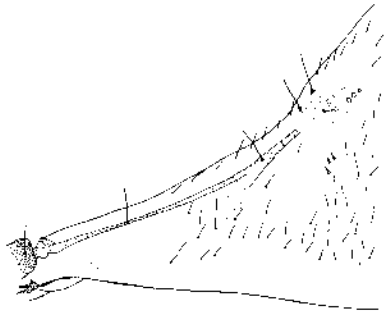

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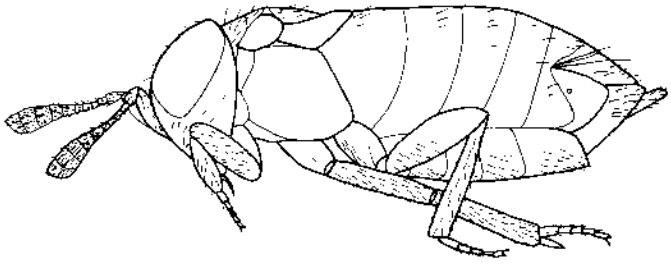
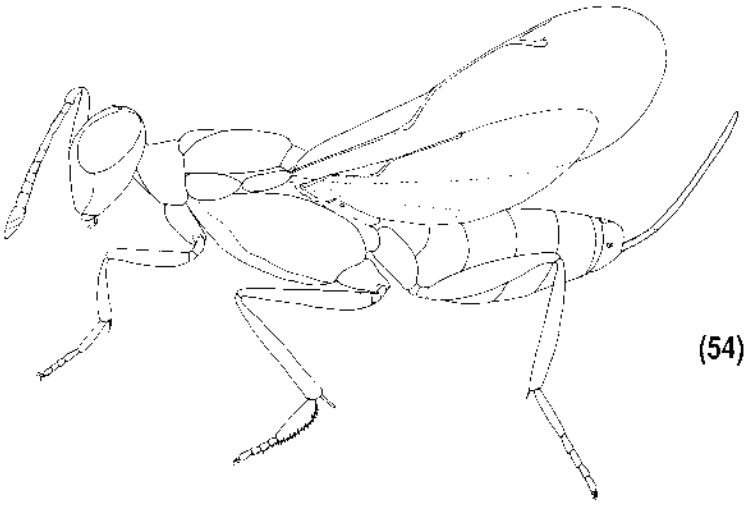


(53)

Elasmidae: **50** *Elasmus* sp., habitus, left side, female; **51** *Elasmus* sp., antenna, male.
Encyrtidae: **52** *Arrhenophagus chionaspidis*, right forewing, female; **53** *Austrochoreia* sp., habitus, left side, female.
Eupelmidae: **54** *Eupelmus antipoda*, habitus, left side; **55** *Eusandalum barteli*, habitus, dorsal, female; **56** *Macroneura vesicularis*, habitus, dorsal, female; **57** *Tineobius* sp., thorax, left side, female.



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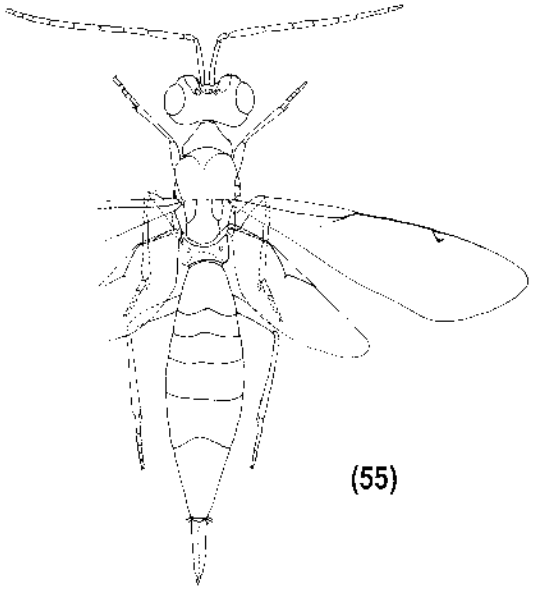
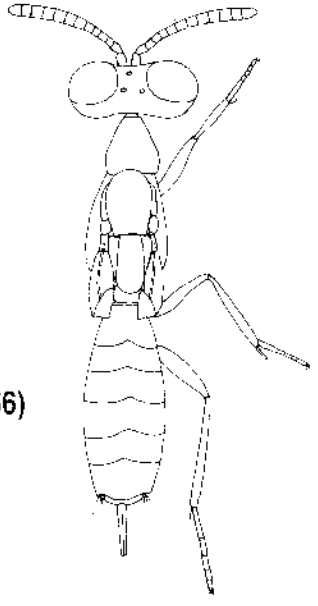


(55)



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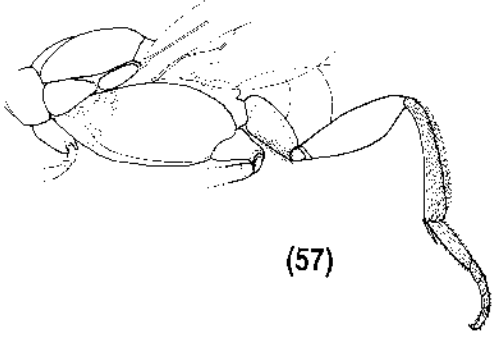

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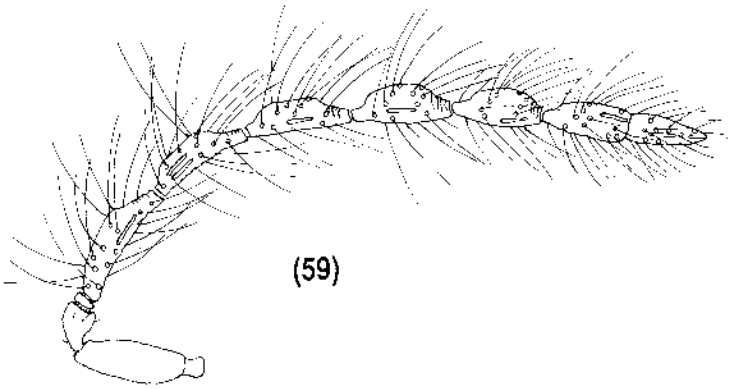

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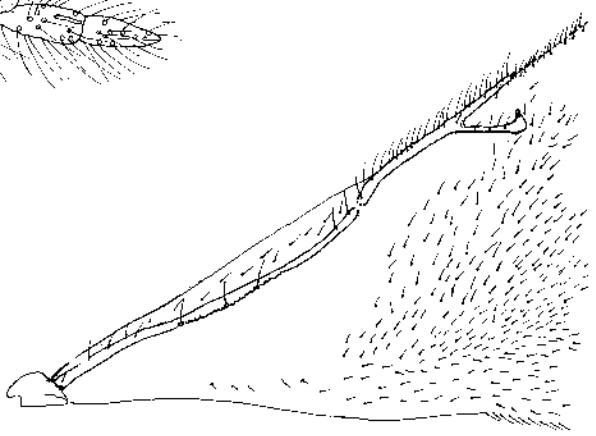

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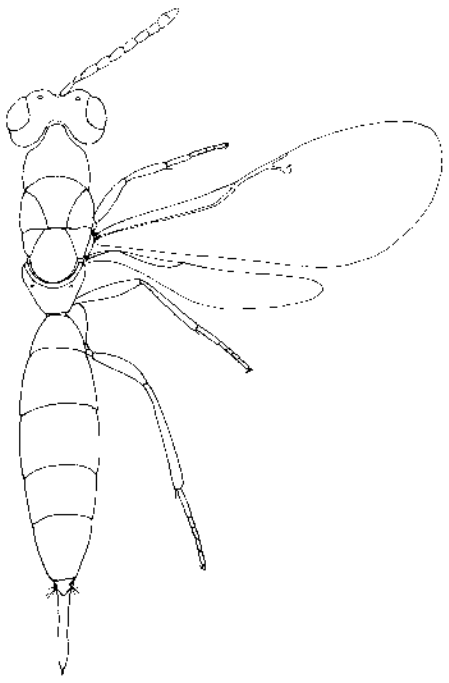

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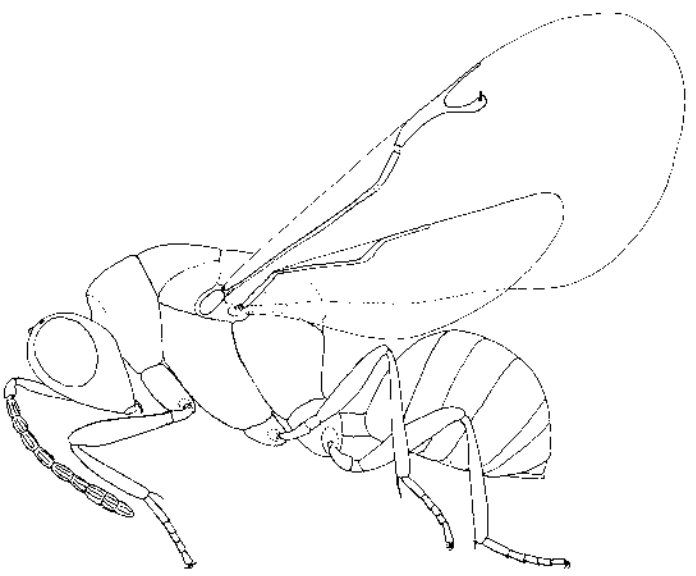
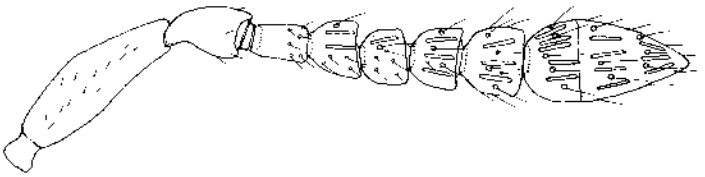
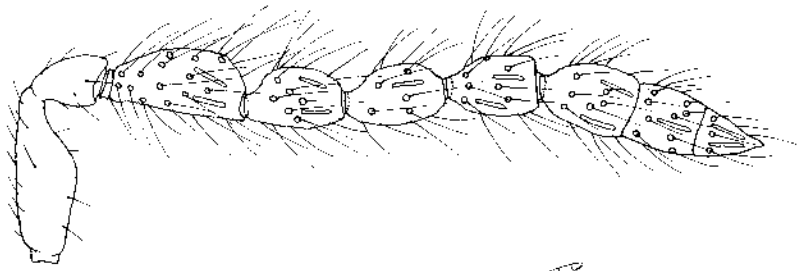


(61)

Eurytomidae: **58** *Axanthosoma* sp., habitus, dorsal, female; **59** *Axanthosoma* sp., antenna, male; **60** *Axanthosoma* sp., right forewing base, male; **61** *Bruchophagus acaciae*, habitus, left side, female; **62,63** *Systole foeniculi*, antennae, male and female; **64** *Tetramesa* sp., habitus, dorsal, female; **65** *Tetramesa* sp., antenna, male.

(63)





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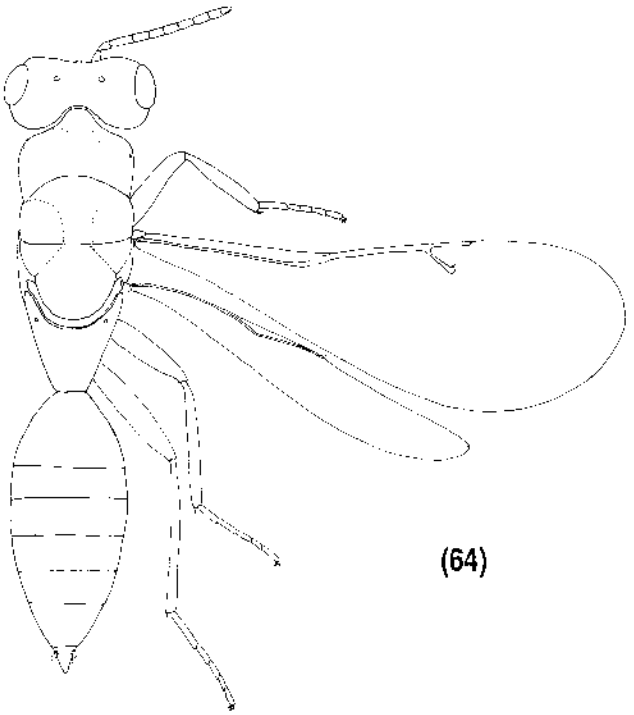

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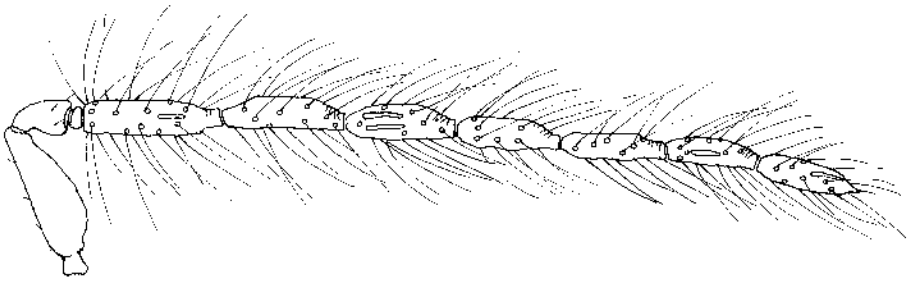

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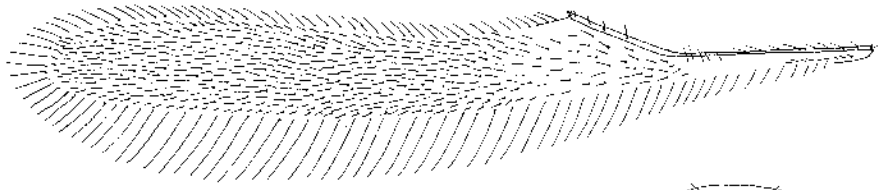

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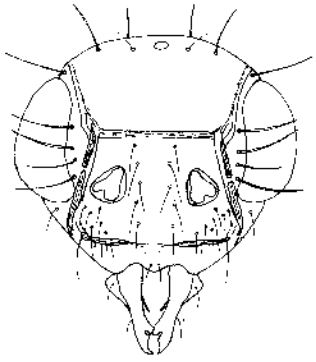

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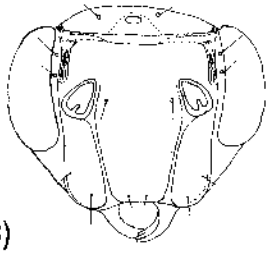

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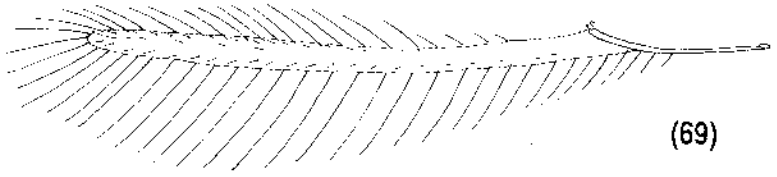

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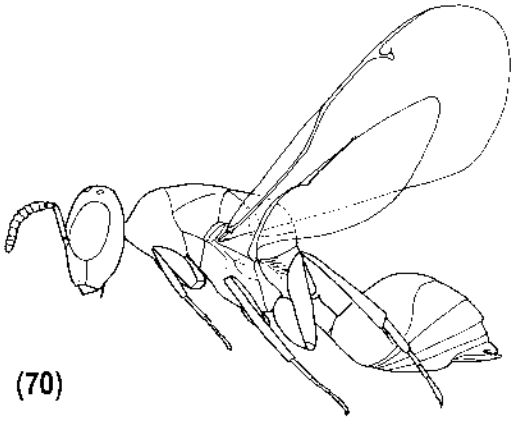

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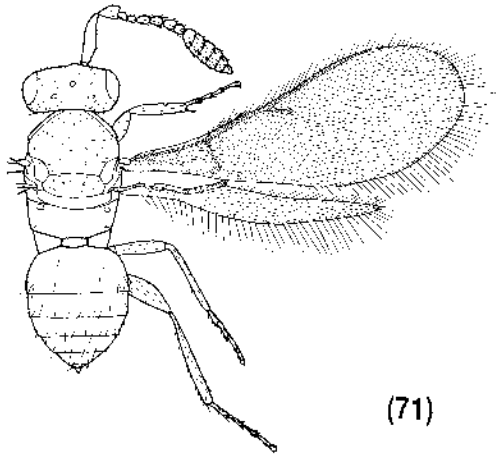
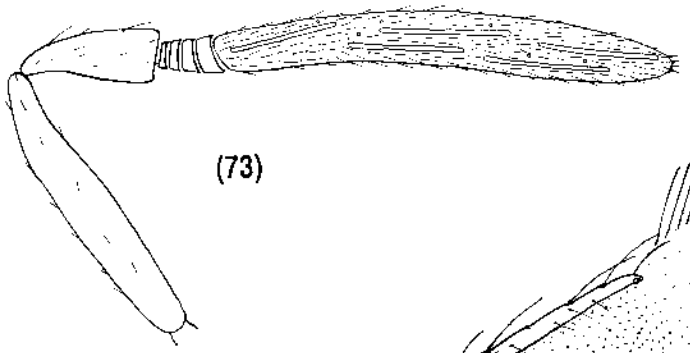


(71)

Mymaridae: **66** *Anagroidea* sp., head, facial aspect, female; **67** *Anagroidea* sp., left hindwing, female; **68** *Stethynium* sp., head, facial aspect, female; **69** *Stethynium* sp., left hindwing, female.
Perilampidae: **70** *Austrotoxeuma* sp., habitus, left side, female.
Rotoitidae: **71** *Rotoita basalis*, habitus, dorsal, female.
Signiphoridae: **72** *Chartocerus* sp., right pair of wings, female; **73** *Chartocerus* sp., antenna, female; **74** *Chartocerus* sp., middle leg, female; **75** *Signiphora merceti*, habitus, dorsal, female.



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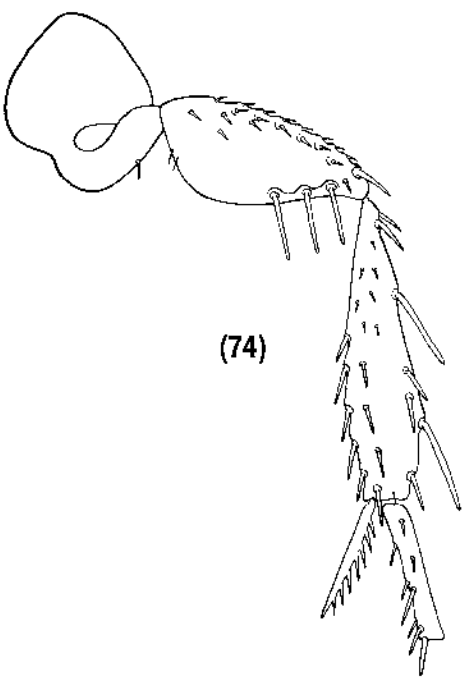

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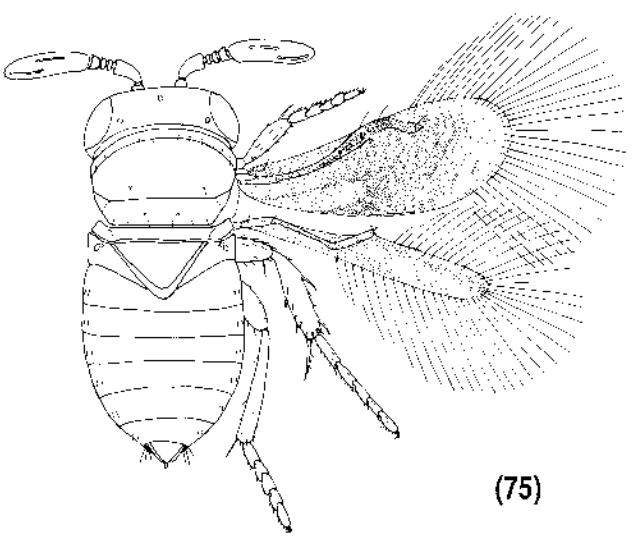

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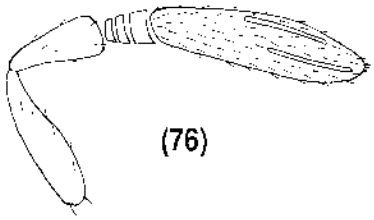

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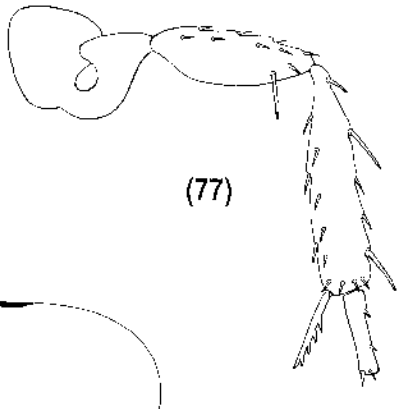

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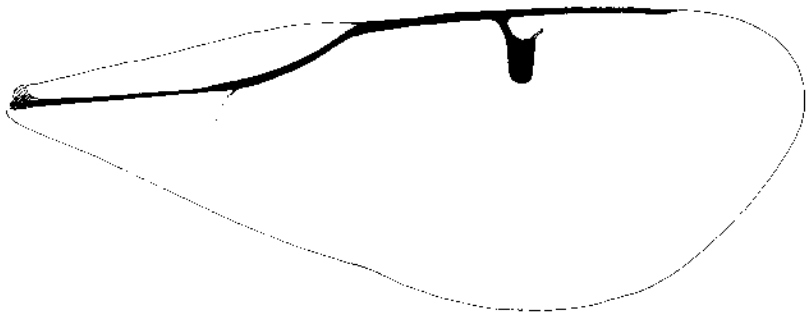

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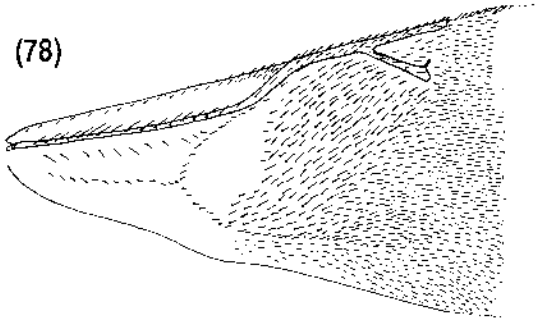
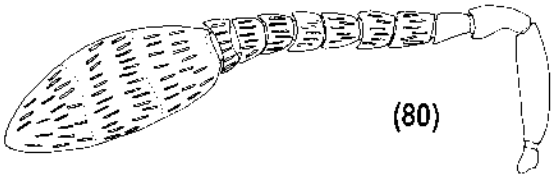
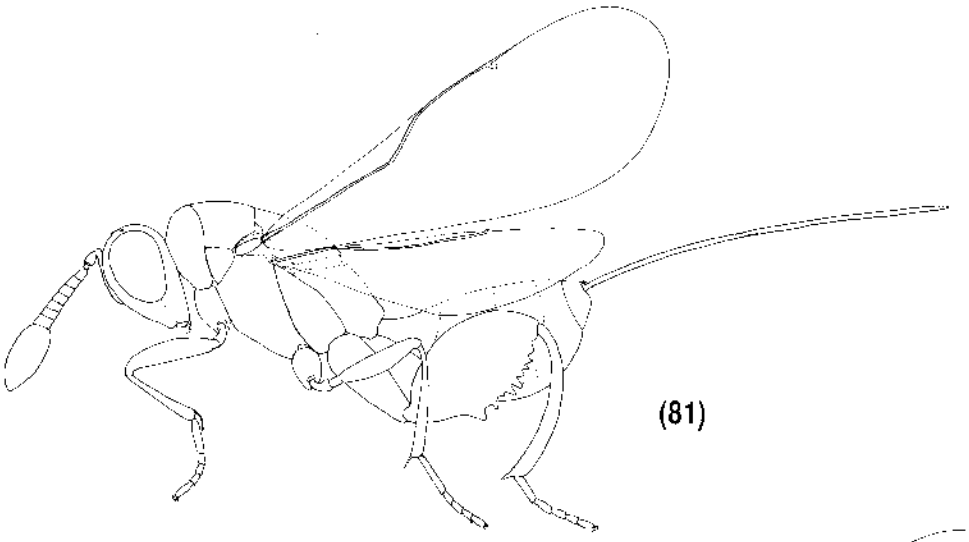




(80)

Signiphoridae: **76** *Signiphora merceti*, antenna, female; **77** *S. merceti*, middle leg, female.
Torymidae: **78** *Liodontomerus longfellowi*, right forewing base, female; **79** *Megastigmus aculeatus*, right forewing, female; **80** *Pachytomoides* sp., antenna, female; **81** *Podagrion* sp., habitus, left side, female; **82** *Torymoides* sp., same; **83** *Torymus varians*, same.



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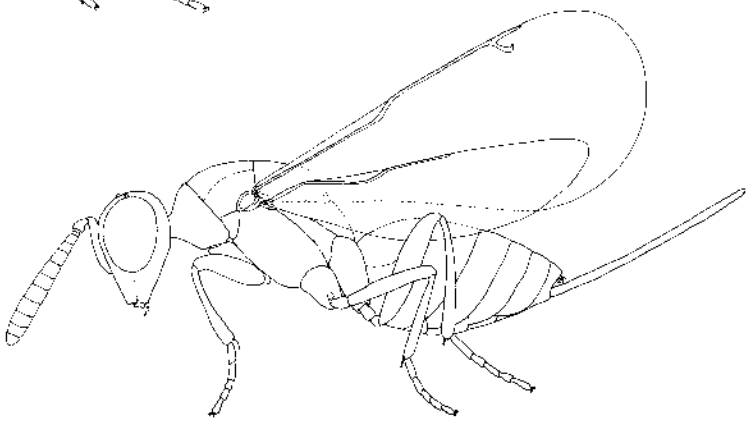

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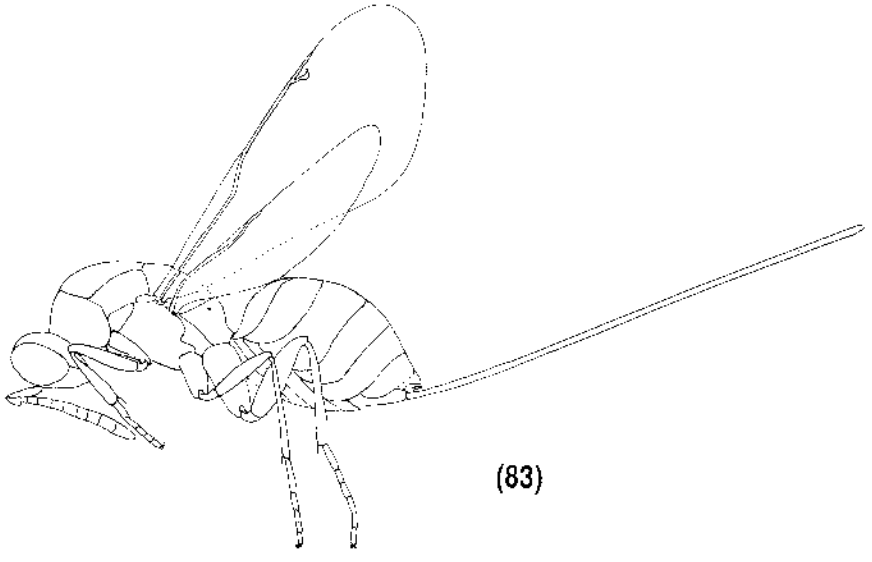

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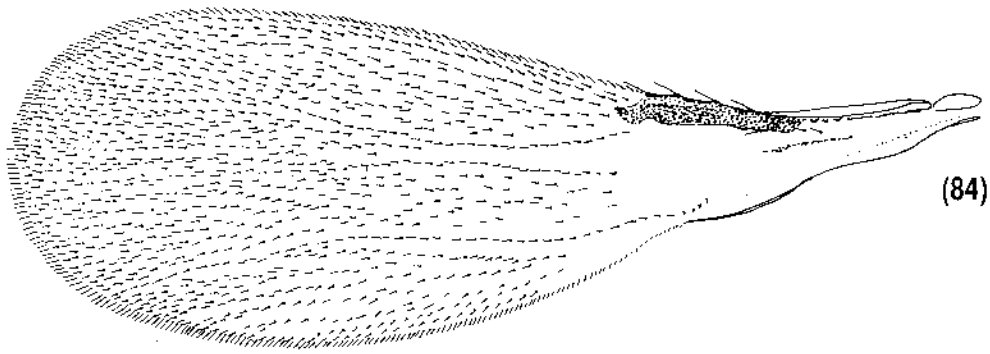
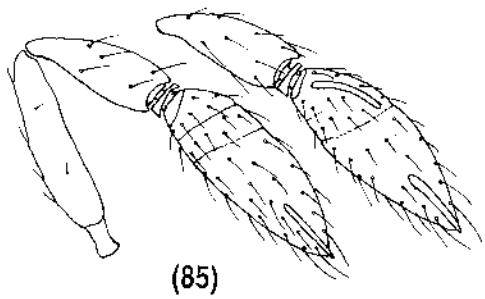
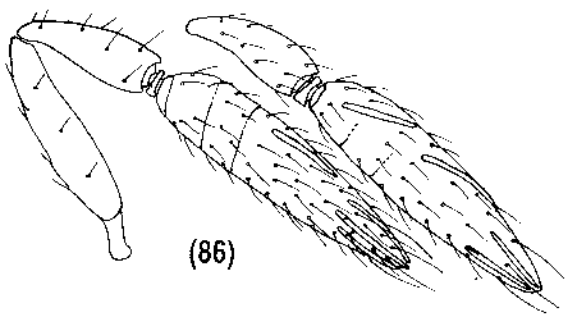
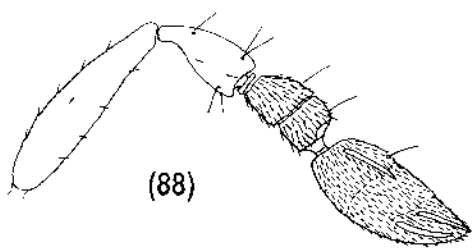
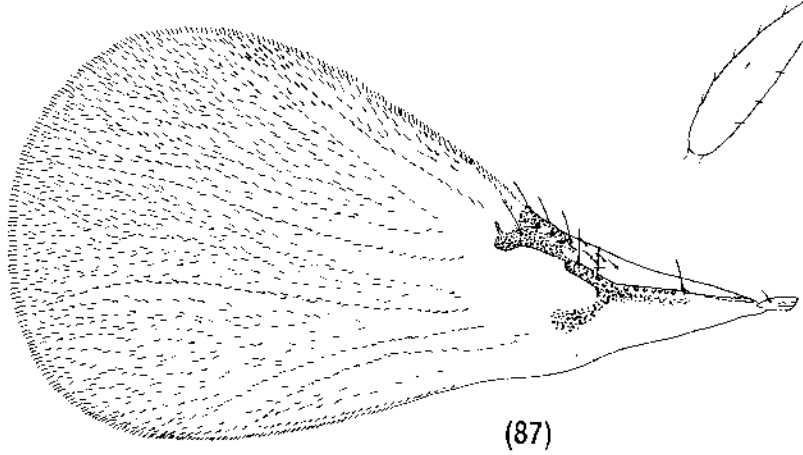


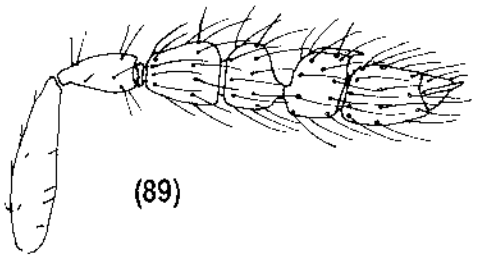








Trichogrammatidae: **84** *Aphelinoidea* sp., left forewing, female; **85,86** *Aphelinoidea* sp., antenna, inner and outer aspects, male and female; **87** *Brachyia* sp., left forewing, female; **88,89** *Brachyia* sp., antenna, female and male; **90** *Brachyia* sp., thorax, dorsal, female, showing median sulcus; **91** *Lathromeris* sp., right forewing, female; **92,93** *Lathromeris* sp., antenna, female and male; **94** *Megaphragma* sp. A, left pair of wings, female; **95** *Megaphragma* sp. A, antenna, female.



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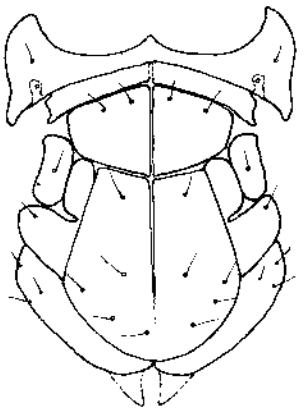
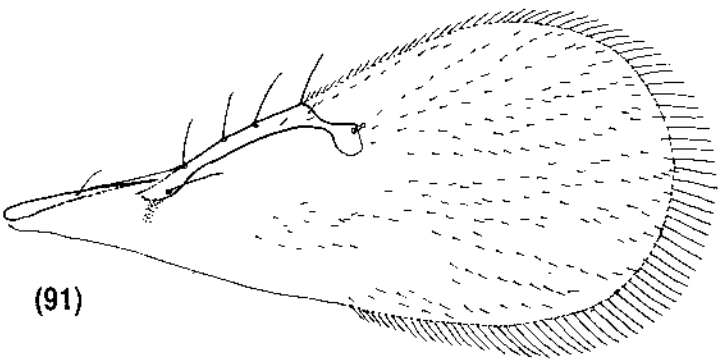
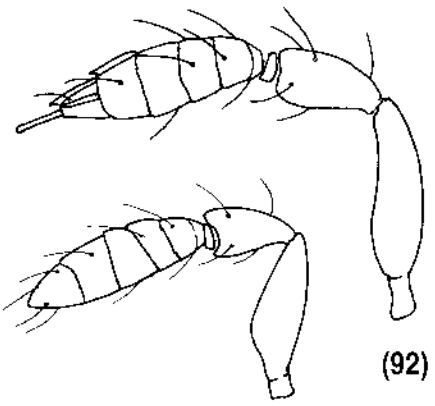


(90)



(91)



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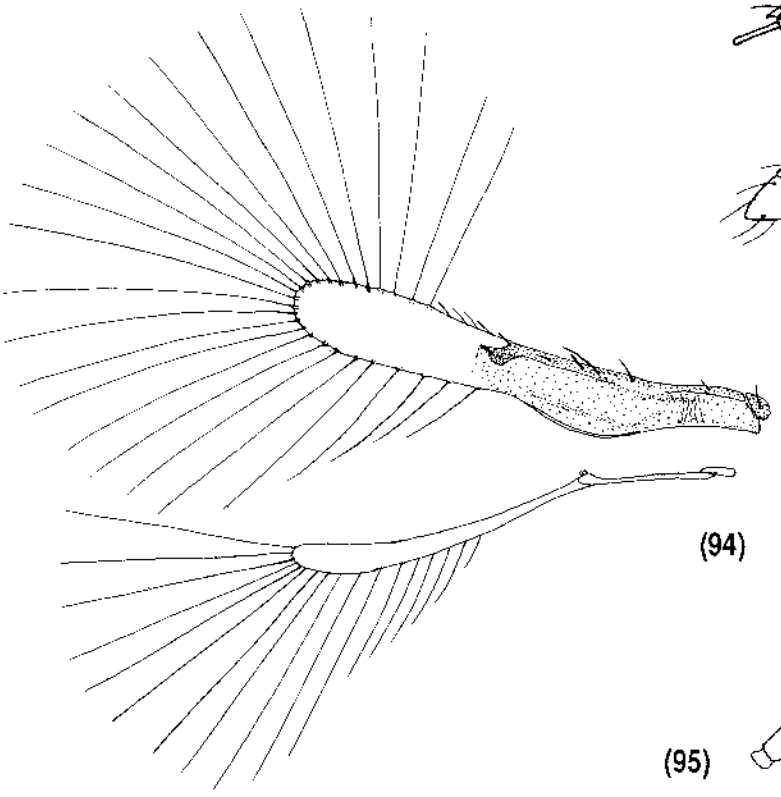

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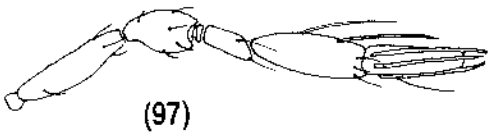

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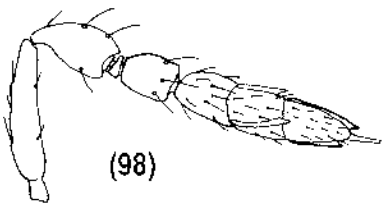

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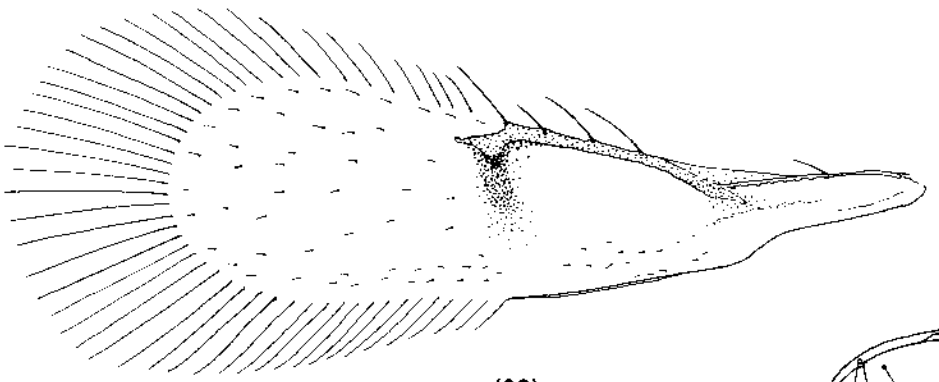

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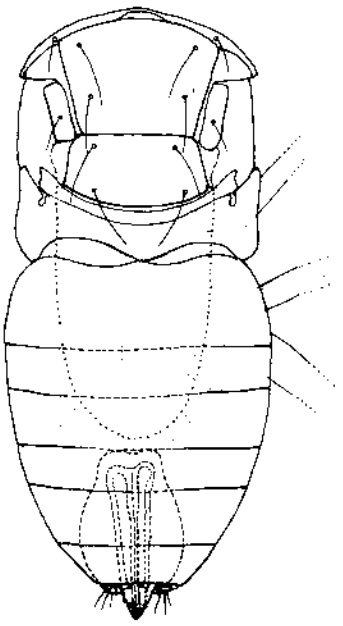
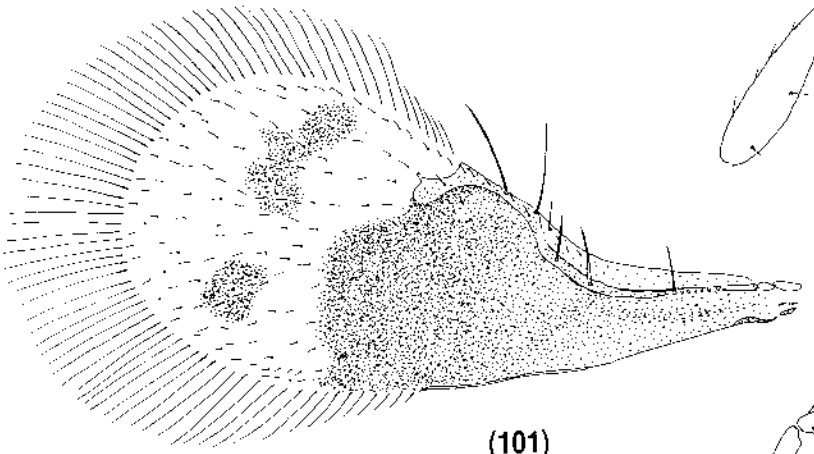


(100)

Trichogrammatidae: **96** *Megaphragma* sp. B, right forewing, female; **97** *Megaphragma* sp. B, antenna, female; **98** *Oligosita* sp., same; **99** *Oligosita* sp., left forewing, female; **100** *Pseudogrammina* sp., thorax and gaster, dorsal, female; **101** *Pseudogrammina* sp., left forewing, female; **102,103** *Pseudogrammina* sp., antenna, female and male; **104** *Trichogramma* sp., left forewing, female (vein track RS1 bracketed); **105** *Trichogramma* sp., antenna, female; **106–109** *Trichogramma* spp., antennae, male.



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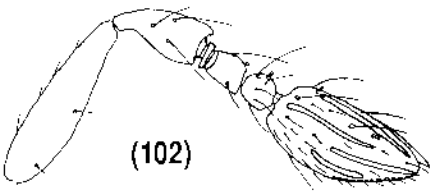

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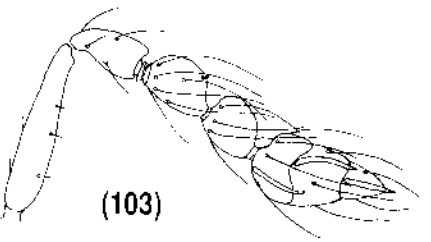

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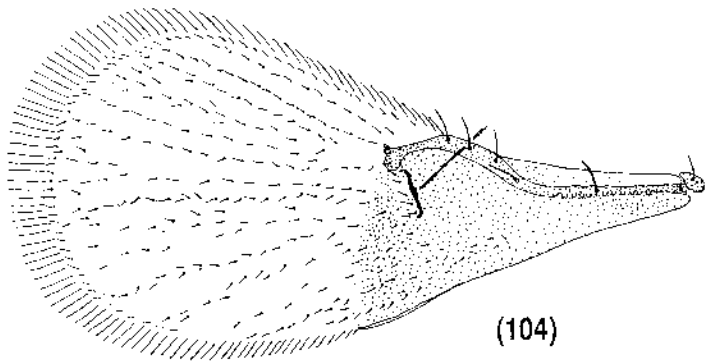

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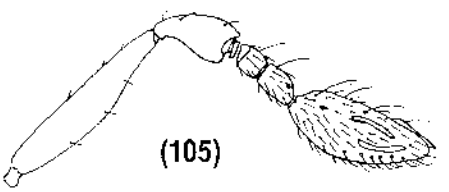

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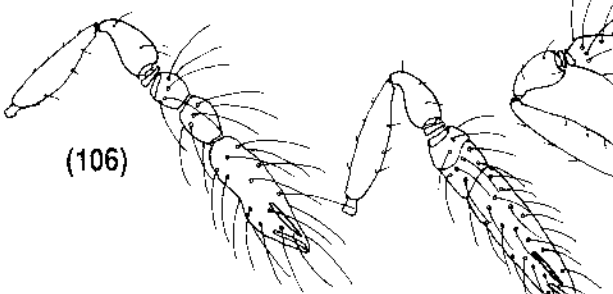

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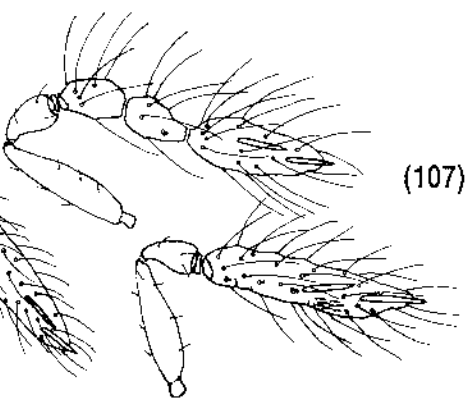

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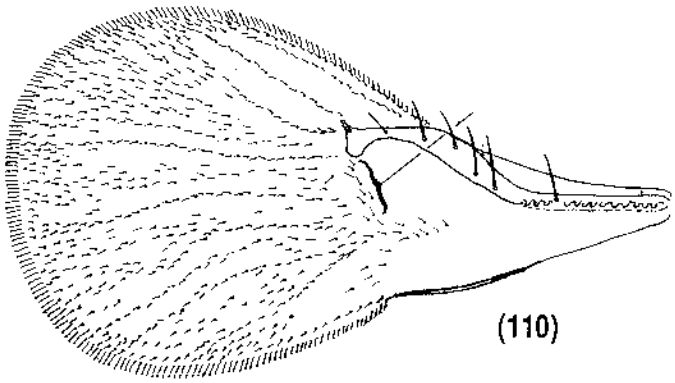

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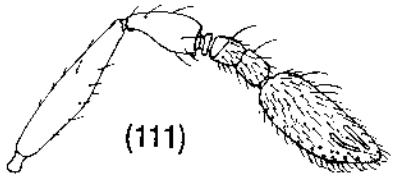

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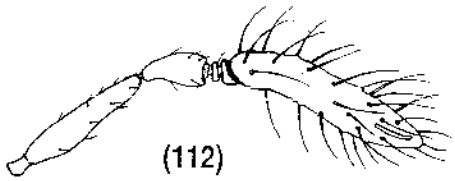

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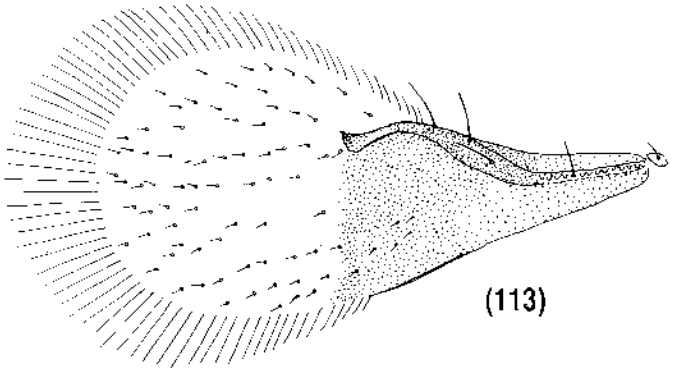

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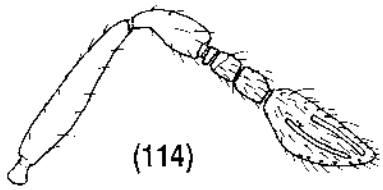

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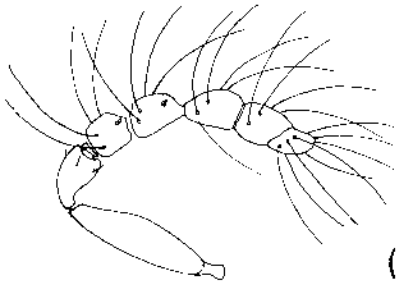
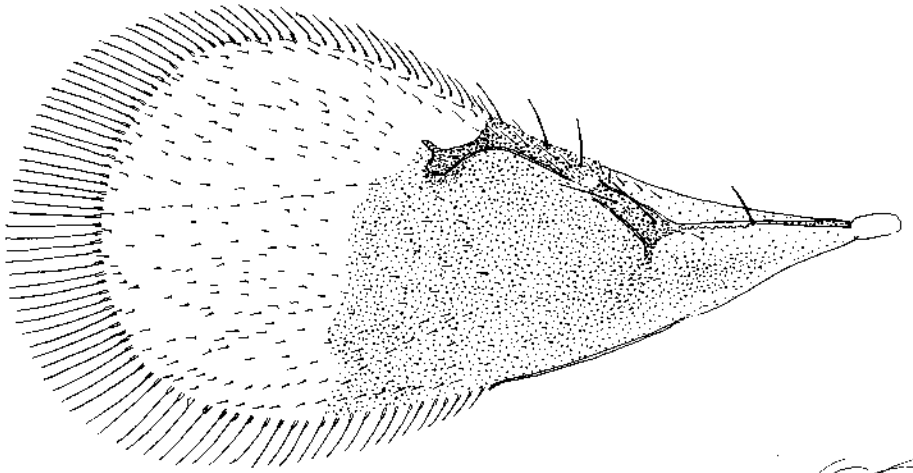


(115)

(116)

Trichogrammatidae: **110** *Trichogramma* sp., left forewing, female (vein track RS1 bracketed); **111,112** *Trichogramma* sp., antenna, female and male; **113** *Trichogrammatoidea* sp., left forewing, female; **114,115** *Trichogrammatoidea* sp., antenna, female and male; **116** *Trichogrammatomyia* sp., antenna, female; **117** *Trichogrammatomyia* sp., left forewing, female; **118** *Ufens* sp., left forewing, female; **119,120** *Ufens* sp., antenna, male and female; **121** *Zelogramma maculatum*, left forewing, female.



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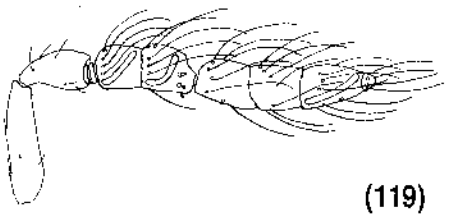

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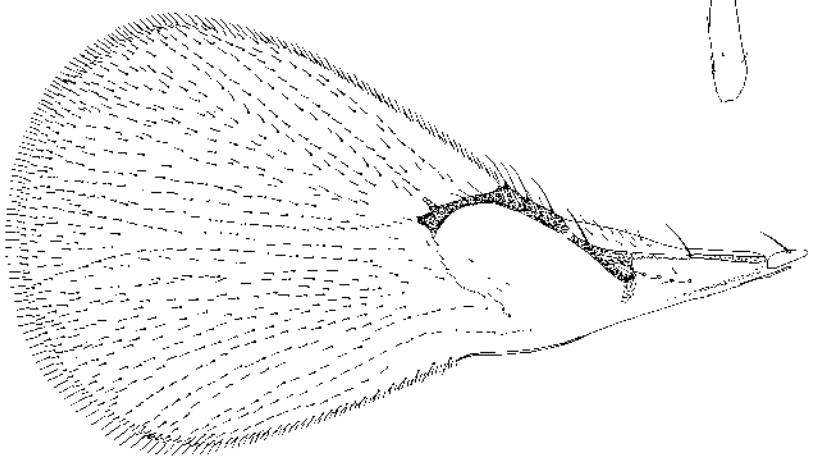

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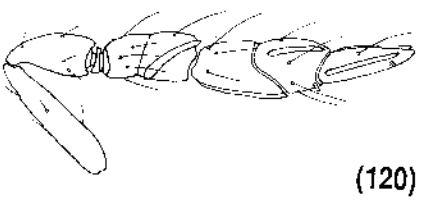

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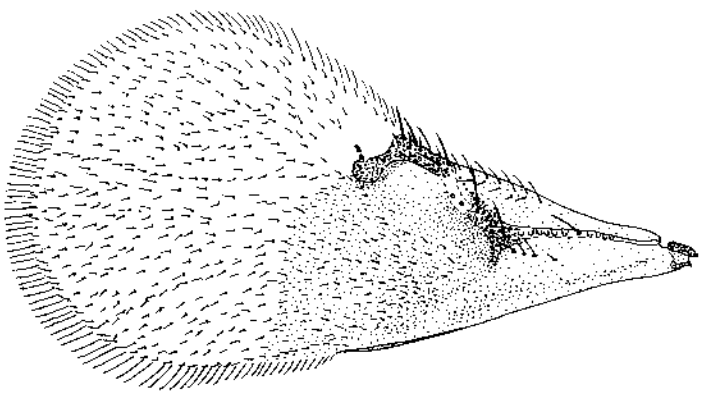

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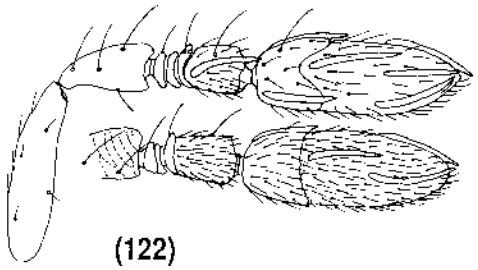

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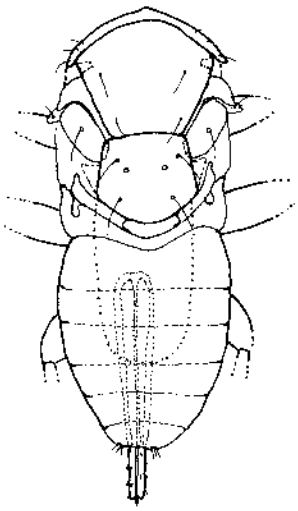

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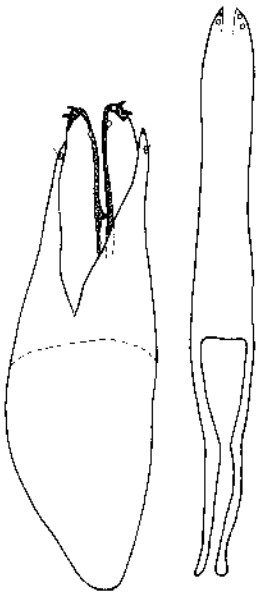

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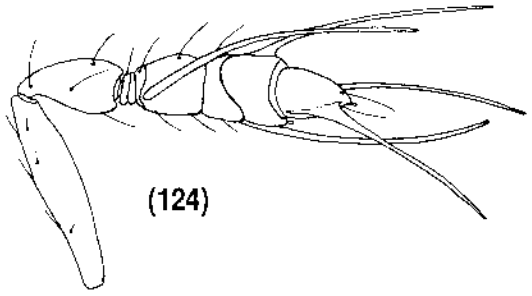

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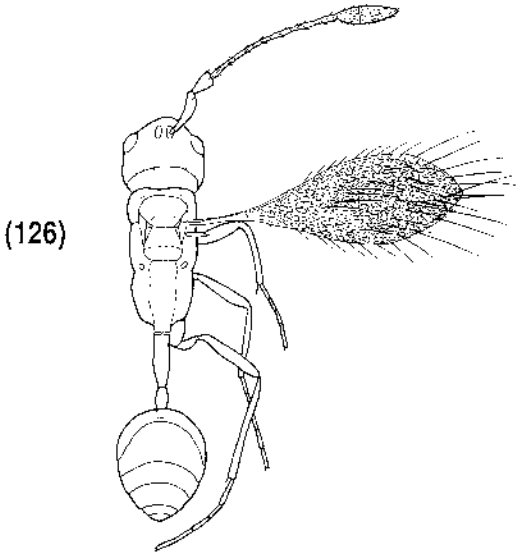


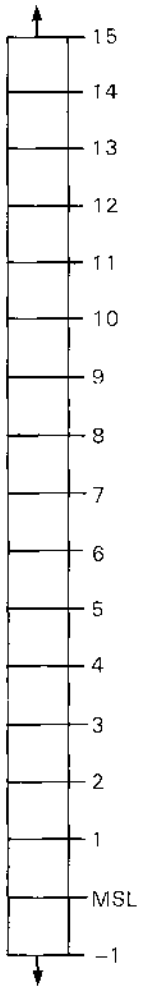
(126)

Trichogrammatidae: **122** *Zelogramma maculatum*, antenna, inner and outer aspects, female; **123** *Z. maculatum*, thorax and gaster, dorsal aspect, female; **124** *Z. maculatum*, antenna, male; **125** *Z. maculatum*, male genitalia, phallobase and aedeagus.
Mymarommatidae: **126** *Palaeomymar insulare*, habitus, dorsal, female (composite drawing from Valentine 1971).

TAXONOMIC INDEX

All nominal taxa covered in the text are indexed, including host taxa, and regardless of their status in taxonomy. Page numbers with the suffix 'k' are those on which a taxon is keyed out. Page numbers in bold type indicate the start of major descriptive sections. Numbers in italic type indicate pages on which a taxon is figured.

TAXON :



ALTITUDINAL DISTRIBUTION

(MSL, mean sea level) The range of altitude for each scale division may be set according to need, but should be in metric units.

OFFSHORE ISLANDS

- Kermadecs ☐
- Three Kings ☐
- Chathams ☐
- Snares ☐
- Bounty ☐
- Antipodes ☐
- Aucklands ☐
- Campbell ☐

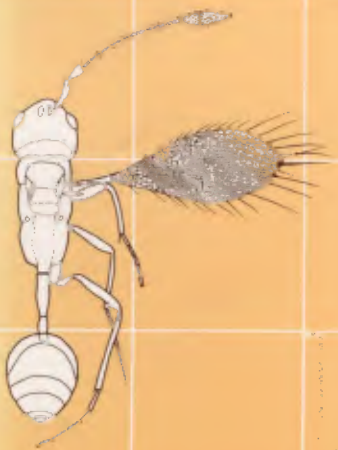
This base–map is used in the *Fauna of N.Z.* for recording the distribution of collection localities. The small grid divisions are 10 minutes of arc by latitude and longitude.

DISTRIBUTION IN TIME

Suggested subdivisions: (A, adult; E, egg; J, juvenile; L,larva; P, pupa)

or

Fauna of New Zealand



Number 18

Chalcidoidea (Insecta: Hymenoptera) – introduction, and review of genera in smaller families

J. S. Noyes &
E. W. Valentine

Fauna of New Zealand

This series of refereed occasional publications has been established with two major objectives: to encourage those with expert knowledge of elements in the New Zealand fauna to publish concise yet comprehensive accounts; and to provide a means of identification accessible to the non-specialist. It will deal with non-marine invertebrates only, since the vertebrates are well documented, and marine forms are covered by the series 'Marine Fauna of New Zealand'.

Contributors should discuss their intentions with an appropriate member of the Fauna Advisory Group or with the Series Editor before commencing work (for names and addresses, see page ii). All necessary guidance will be given.

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INTRODUCTION

KEY TO TAXA

DESCRIPTIONS

HOST RECORDS

ILLUSTRATIONS

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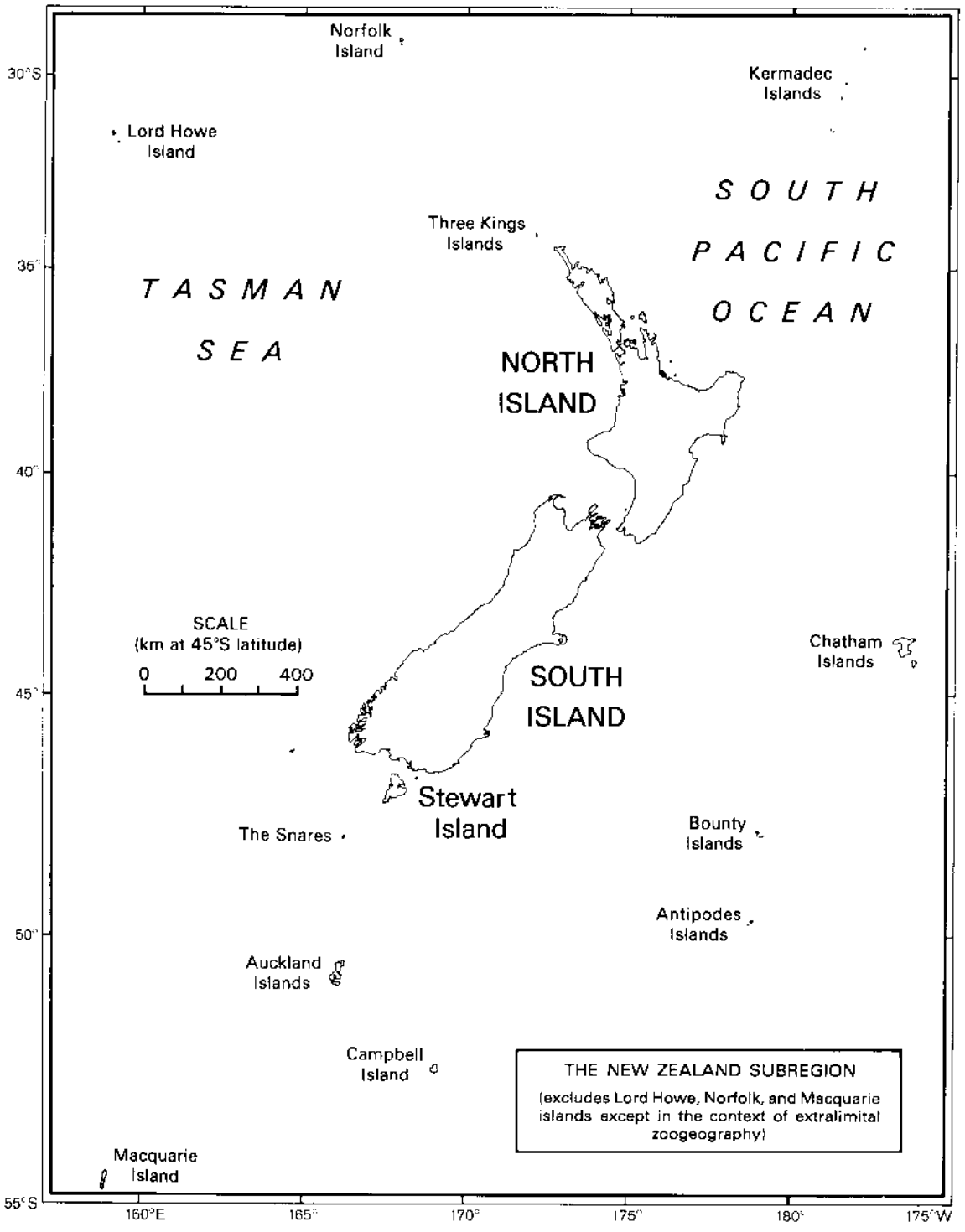
No. 18 Chalcidoidea (Insecta: Hymenoptera) – introduction, and review of genera in smaller families, by J.S. Noyes & E.W. Valentine. Publication date to be announced. 92 p. Price $24.95.*

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, WELLINGTON, NEW ZEALAND


Norfolk Island
Kermadec Islands
Lord Howe Island
SOUTH PACIFIC OCEAN
Three Kings Islands
TASMAN SEA
NORTH ISLAND
SCALE (km at 45°S latitude)
0 200 400
SOUTH ISLAND
Chatham Islands
Stewart Island
The Snares
Bounty Islands
Antipodes Islands
Auckland Islands
Campbell Island
THE NEW ZEALAND SUBREGION
(excludes Lord Howe, Norfolk, and Macquarie islands except in the context of extralimital zoogeography)
Macquarie Island
30°S
35°
40°
45°
50°
55°S
160°E
165°
170°
175°
180°
175°W

North Island

AK – Auckland

BP – Bay of Plenty

CL – Coromandel

GB – Gisborne

HB – Hawkes Bay

ND – Northland

RI – Rangitikei

TK – Taranaki

TO – Taupo

WA – Wairarapa

WI – Wanganui

WN – Wellington

WO – Waikato

South Island

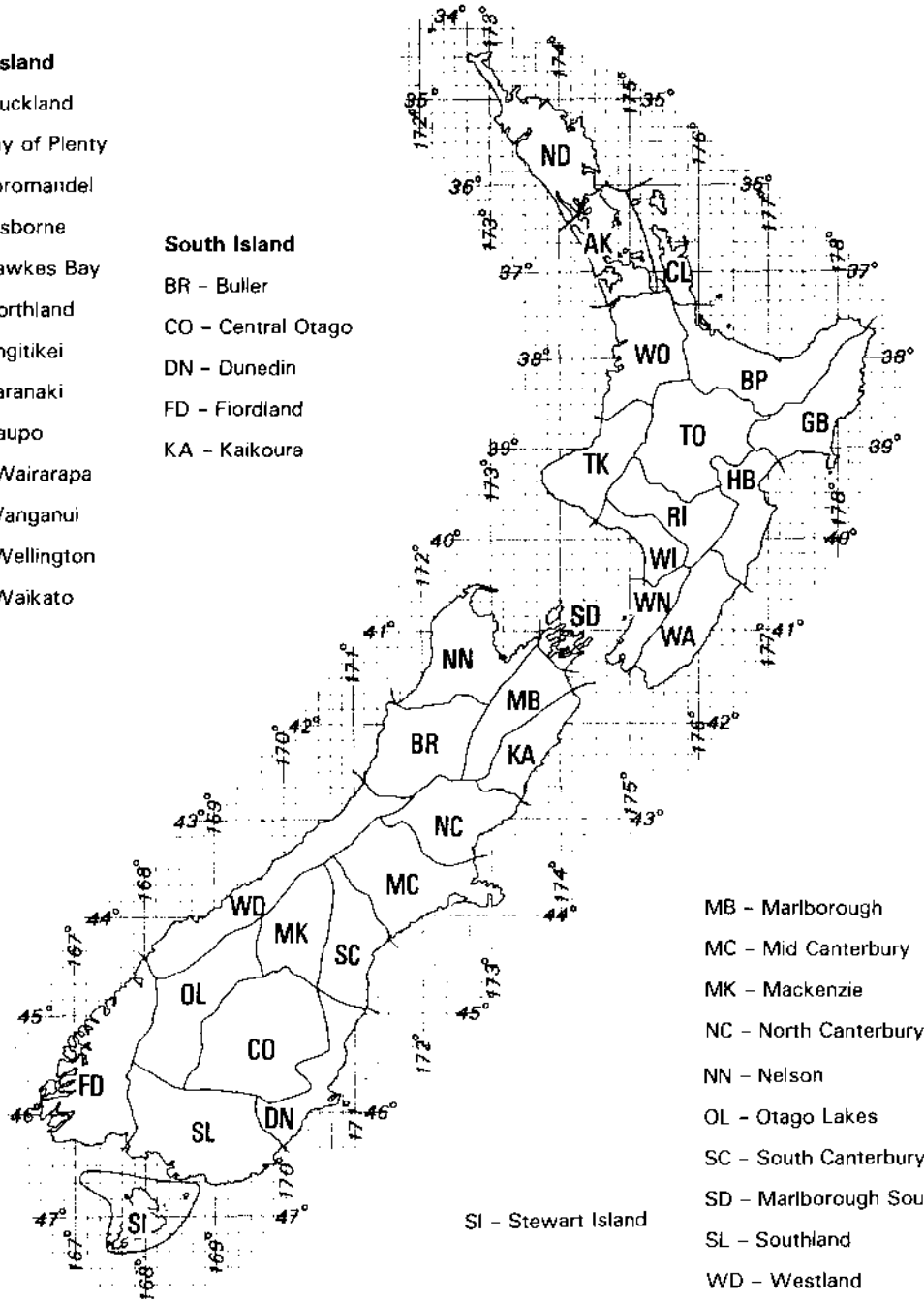
BR – Buller

CO – Central Otago

DN – Dunedin

FD – Fiordland

KA – Kaikoura



MB – Marlborough

MC – Mid Canterbury

MK – Mackenzie

NC – North Canterbury

NN – Nelson

OL – Otago Lakes

SC – South Canterbury

SD – Marlborough Sounds

SL – Southland

WD – Westland

SI – Stewart Island

Area codes and boundaries proposed by Crosby *et al.* (1976) for use with specimen locality data

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www.LandcareResearch.co.nz

Noyes, J. S.; Valentine, E. W. 1989: Chalcidoidea (Insecta: Hymenoptera) – introduction, and review of genera in smaller families. *Fauna of New Zealand 18,* 96 pp.

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