Guide to the Aquatic Insects of New Zealand

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Larvae of the oeconesid caddisfly *Zelandopsyche ingens* inhabit South Island beech forest streams where they feed on leaf and wood detritus. Some of this shredded material becomes available to fine particle browsers such as the mayfly *Deleatidium*, one of the commonest inhabitants of our stony steams.

Contents

Preface

The need for a comprehensive guide to the New Zealand freshwater insects has been apparent for many years. A questionnaire which Rob Ogilvie and I circulated following discussions among stream biologists at the 1976 meeting of the New Zealand Limnological Society confirmed this need, and ultimately resulted in the production of this set of keys. My thanks to those people who replied enthusiastically to this initial circular, particularly Geoff Fish, George Gibbs, Ceri Hopkins, and Ian McLellan who sent unpublished keys and information on texts used for aquatic insect identification in the course of their work. Subsequently, Brendon Hicks, Chris Fowles, and others through judicious prodding ensured that this project did not die, and I am relieved to say that it is now complete. I only hope that the end product justifies the effort that has been put into it.

It is a great pleasure to acknowledge the assistance of Brent Cowie, Trevor Crosby, Peter Johns, Rob Ogilvie, Richard Rowe, John Stark, and Dave Towns whose contributions have been invaluable. John Stark's key to chironomid midge larvae represents the first comprehensive treatment of the family in New Zealand and to a large extent is the product of his own painstaking research. He acknowledges the help of Jacques Boubee, Don Forsyth, John Leader, and Jon Martin who provided material, information, and constructive criticism.

I am especially indebted to my co-author, the talented Kate Gregson, who patiently drew most of the figures appearing in this work. Her contribution has been considerable and I am sure her illustrations greatly enhance the utility of the guide.

Finally, I acknowledge the University of Canterbury and the Department of Labour who supported the project through research assistant grants and the Student Community Service Programme and Trevor Crosby for editing the work with enthusiasm and skill.

MICHAEL J. WINTERBOURN
July 1980

Abstract

Illustrated keys are provided to the 11 orders of aquatic and water-associated insects inhabiting the three main islands of New Zealand. The life history stages covered are those found in or on water bodies. Where possible insects are identified to genera and species, but sometimes identification is possible only to the family level (many Diptera and Coleoptera). Annotated notes on distribution, habitat, and taxonomic problems are incorporated in the keys, and references to the main taxonomic and biological studies on New Zealand aquatic insects are given. The section on chironomid larvae is the first comprehensive guide to New Zealand taxa of this family.

Keywords: New Zealand, Insecta, Coleoptera, Diptera, Ephemeroptera, Hemiptera, Lepidoptera, Mecoptera, Megaloptera, Neuroptera, Odonata, Plecoptera, Trichoptera, aquatic, water-associated, keys, identification.

Introduction

The need for an identification guide to the aquatic insects of New Zealand has grown in recent years with the increasing demand for river surveys and water quality studies by a variety of agencies and personnel. No comprehensive guide has been produced prior to this, although Wise (**142**) produced a valuable annotated checklist to the aquatic and water-associated insects, and general introductory accounts of the fauna have been written by Marples (**79**) and Pendergrast & Cowley (**96**). These latter works are of only limited use as identification guides, but provide readable accounts of the biology of some common species.

Few overseas keys to orders and families of aquatic insects can be applied to the New Zealand fauna — for example, keys to orders provided by Lehmkuhl (**63**) do not work — which includes a large number of endemic or southern families but contains no or few representatives of several common northern hemisphere groups. Nevertheless, overseas keys are useful for identification of families in some orders, e.g., Diptera, Coleoptera, and Hemiptera which are largely cosmopolitan, and several major works (**39, 85, 97, 122**) include valuable information on the biology of aquatic insects which has general application to New Zealand. Most strongly recommended in this regard is Usinger's "Aquatic Insects of California" (**122**), while the more recent work by Merritt & Cummins (**85**) is well illustrated and possesses an invaluable aquatic insect bibliography.

Information in this book and its set-out

Most published keys deal primarily with late instar larvae and inevitably this also is a limitation of the keys which follow. The reason for this is that few early instar larvae have been described, and it has been found that young stages of closely related species are difficult or impossible to tell apart. Where possible, we have used obvious, morphological features to characterise species, but sometimes biological and distributional information is used in the keys. In some cases, species discrimination requires dissection or use of high magnification, e.g., Chironomidae, but where possible we have tried to avoid recourse to such methods.

An important aspect of this guide, which encompasses the aquatic insects inhabiting the three main islands of New Zealand, is the provision of a large number of illustrations showing representative members of most families and many genera. We hope that these will help readers to become familiar with our aquatic insects more easily and quickly than would be the case if only drawings of taxonomically important parts were provided as in many specialist works. Although the purpose of the keys is to provide a means of positively identifying larvae, it is still good practice to rear adult insects from larvae in order to confirm identifications (which are based on the adult forms) whenever possible.

In addition to the keys, notes on distribution and habitat as well as comments on problems likely to be encountered in identification are provided. Pertinent taxonomic, biological, and ecological works are noted following the annotations. References are numbered in alphabetical order of authors and in most instances only the numbers are given in the text.

A glossary of terms used in the keys is provided on p. 74-75. Figs 1 and 2 illustrate the main structural features of insect larvae.

Finally, it is inevitable that parts of this guide will become outdated as increasing knowledge of our aquatic insects is accumulated. In the near future, further taxonomic advances can be expected with respect to the leptophlebiid mayflies, hydraenid beetles, and at least two families of Diptera, the Chironomidae and Tipulidae. If the shortcomings of this volume stimulate still more taxonomic work, so much the better.

Notes on the collection, preservation, and curation of specimens

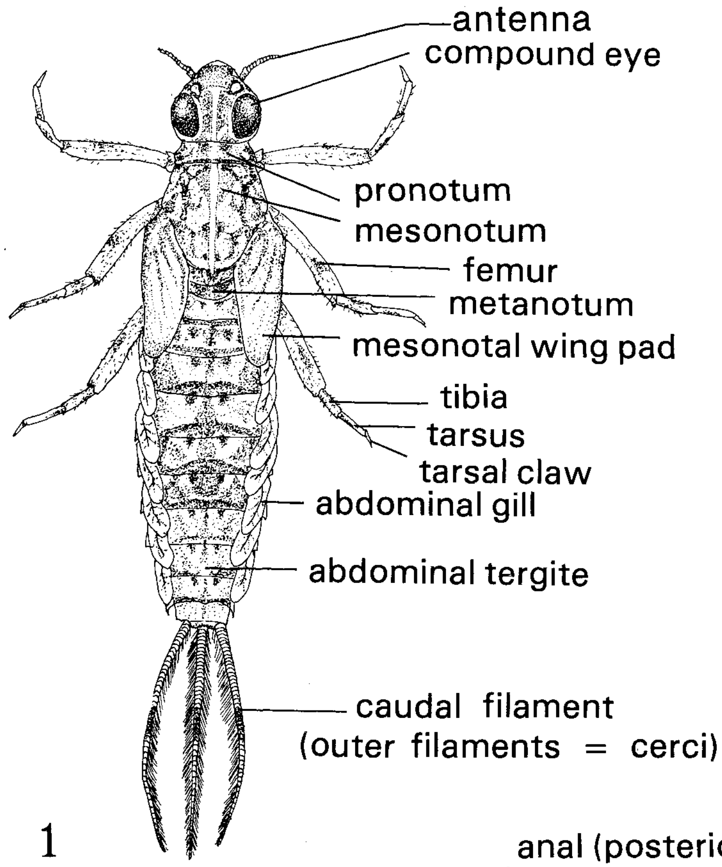
Collection

Aquatic insects can be collected with nets, grabs, and similar devices, or picked from surfaces with forceps or a fine brush. Details of collecting methods are outside the scope of this work, and the reader is referred to appropriate chapters of Usinger (**122**), Wiggins (**124**) and Williams (**125**) who have provided comprehensive, practical accounts. Local works which outline collecting techniques are the books on New Zealand insects and our freshwater insects by Child (**16**) and Pendergrast and Cowley (**96**) respectively.

Care should be taken when collecting and transporting aquatic insects as many are quite fragile and therefore easily damaged. It is good practice either to carry living insects from the field in a minimum of water and with a substrate for them to cling to, or to carry them in a very large volume of water, e.g., a bucket. Plastic bags, plastic pottles, and glass vials make suitable small sample containers, while if insects are wanted alive in the laboratory they are likely to travel best if kept cool, for example, in a commercial "chilly bin" containing freezer pads.

Preservation and sorting

Insects can be preserved in the field immediately following collection, but this may result in loss of appendages or gills of delicate insects such as mayfly larvae, contraction of body segments, or regurgitation of gut contents. Rapid immersion in hot water or



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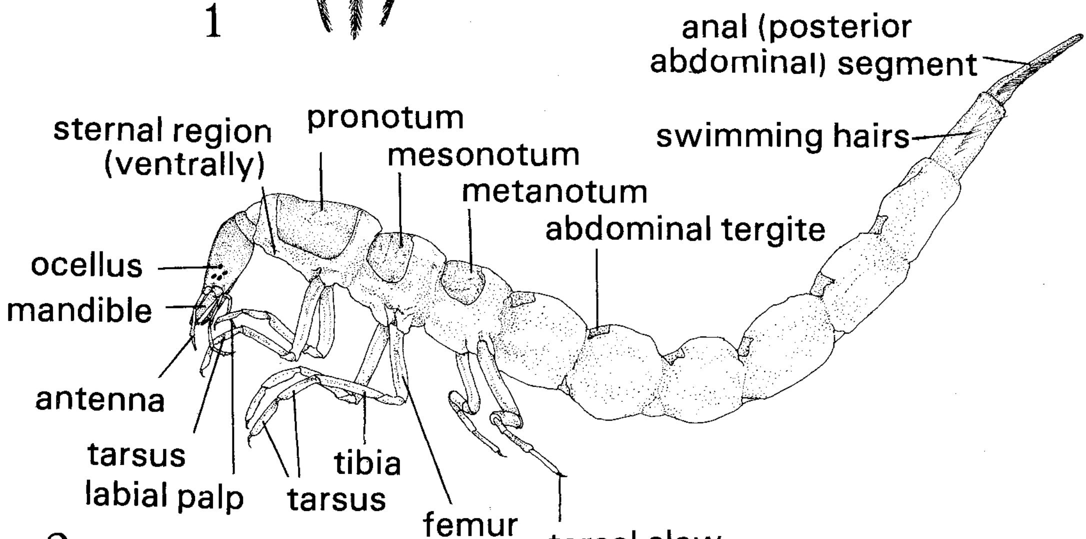


2

Figs 1, 2. Basic structural features of aquatic insect larvae: **1**, mayfly, an exopterygote, hemimetabolous larva; **2**, beetle, an endopterygote, holometabolous larva.

gradual heating of surrounding water will result in many larvae dying in a more relaxed state upon which preservative should be added. An alternative technique which effectively prevents regurgitation of gut contents is to anaesthetise larvae in soda water or by bubbling carbon dioxide into the collecting jar before killing with alcohol or formalin.

Sorting of samples is most easily accomplished in well illuminated, white trays using forceps, a fine paint brush, or dropper to remove the insects. Initial sieving to remove the fine sediment will clear the sample considerably and improve the efficiency of sorting: however, small animals may be lost through the mesh. Floatation techniques also may be useful since debris is separated from animals which rise to the water surface. Sucrose (dissolve 360 g of granulated sugar per litre of water) and calcium chloride solutions of specific gravity 1.12 are the most successful floatation media to which unsorted samples are added and stirred repeatedly until no further animals come to the surface. Most species respond to this treatment although cased caddisflies (and molluscs) cannot be separated in this way. Although a sucrose solution is most convenient to make, it is much messier than calcium chloride which is just as efficient in our experience. Both solutions can be reused several times. A further aid in separation is the stain Rose Bengal, which stains animal but not plant material. It should be made up to a concentration of 200 mg per litre in water, and the solution added to a preserved sample at the rate of 150 ml per 200 ml of 70 percent ethanol (ethyl alcohol) or 4 percent formalin. For the stain to develop adequately, the sample should be left 24 hours, and following removal the animals can be destained by placing them in 95 percent ethanol.

As a general rule, aquatic insects are best preserved in fluid and stored in well-stoppered vials. The most commonly used fluids are 70 percent ethanol (70 ml of 95 percent ethanol diluted to 95 ml with water) and 40 percent isopropyl alcohol (40 ml of concentrated alcohol diluted to 100 ml with water) although they have the disadvantage that material tends to lose its colour with time. Alternatives which reduce this problem are 4-10 percent formalin (good if gut contents are to be examined at a later date, but unpleasant to use), ethylene glycol (following formalin fixation), and Kahle's Fluid. The latter can be strongly recommended as larvae maintain their colours well and remain pliable and therefore easy to manipulate. Kahle's Fluid is made up of ethanol, formalin, glacial acetic acid, and distilled water (15:6:1:30 by volume), and because of its penetrating odour should be kept in a well-stoppered bottle, Alcohol, vials, and other supplies can be obtained from a range of suppliers (see reference **123**) and should be obtainable from your local chemist.

Labelling

All insect collections should be provided with labels placed inside the vial or other container, and these should state at least the location, habitat, collector's name, and date of collection, preferably in the format specified by Walker and Crosby (**123**). We recommend that the standard New Zealand area codes devised by Crosby et al. (**27**) be used on labels to indicate the geographic area of the locality. Field labels often are written in pencil (not ink which runs when wetted), but permanent labels are best made with a waterproof, black, drawing ink.

Voucher specimens

Workers are encouraged to deposit voucher specimens of species listed in reports and papers with an organisation which keeps and curates a research collection of insects. Obvious choices are the major museums and the New Zealand Arthropod Collection housed at Entomology Division, DSIR, Auckland.

Key to orders

1 Insects with chewing mouthparts; forewings represented by hard elytra meeting along the midline of the body when at rest (they may cover the entire abdomen or be variably reduced in length); beetles .... **COLEOPTERA** (adults), p.39
—Without elytra; hemelytra sometimes present but if so mouthparts are of the piercing and/or sucking type and form a pointed cone **2**

2 Mouthparts form a short, pointed beak or a long, narrow, piercing proboscis . . **3**
—Mouthparts not forming a beak or elongate proboscis **4**

3 Mouthparts form a short, often conical, segmented beak; with or without wing buds, or wings which may be hemelytra .... **HEMIPTERA**, p.37
—Black insects with elongate, piercing stylets forming a needle-like proboscis; body with prominent, sparsely distributed projecting hairs; semi-aquatic .... **NEUROPTERA**, p.10

4 Labium prominent, extendable, forming a food capturing structure longer than the head .... **ODONATA**, p.10
—Without a prominent, extendable labium **5**

5 Abdomen terminating in 3 multisegmented processes which may be long and thin or with prominent fringes of hairs (note: the median process may be much shorter than the others); mesonotal wing pads prominent in older larvae .... **EPHEMEROPTERA**, p.14
—Without 3 posterior processes **6**

6 Abdomen terminating in 2 multisegmented processes (cerci); older larvae with prominent mesonotal and metanotal wing pads .... **PLECOPTERA**, p.18
—Without long cerci and never with external wing pads **7**

7 With 3 pairs of jointed, thoracic legs, OR if legs absent, with prominent spine-like spiracles on abdominal segments **8**
—Without jointed, thoracic legs although non-segmented prothoracic and post-abdominal prolegs may be present; with or without a well developed head capsule .... **DIPTERA**, p.47

8 Abdomen with 5 pairs of non-segmented prolegs bearing rows of fine hooks; numerous, prominent filamentous gills on thorax and abdomen; often in a roughly constructed, portable case .... **LEPIDOPTERA**, p.10
—Without 5 pairs of abdominal prolegs **9**

9 With 8 pairs of 2-segmented, finger-like abdominal gills; abdomen with a pair of posterior prolegs each with 2 prominent claws .... **MEGALOPTERA**, p.10
—Either, without paired lateral, abdominal gills, or, if such gills are present, without posterior prolegs bearing prominent claws **10**

10 Abdomen with a pair of short or long posterior prolegs bearing claws with subsidiary hooks; sometimes in a portable case .... **TRICHOPTERA**, p.23
—Abdomen lacking posterior prolegs with hooked claws; never with a case **11**

11 Body very narrow and worm-like with a translucent, regularly repeated pattern dorsally on thorax and abdomen; posterior abdominal segment conical with a pair of terminal hooks and 2 retractile, anal papillae .... **MECOPTERA**, p.10
—Body not worm-like and lacking translucent, dorsal markings; with or without paired lateral abdominal gills and anal hooks; without finger-like anal papillae .... **COLEOPTERA** (larvae), p.43

Orders with few representatives

Neuroptera (lacewings)

There are no truly aquatic neuropterans in New Zealand although the family Osmylidae contains 3 species of *Kempynus* (Fig. 3) and 1 of *Euosmylus* whose larvae inhabit the margins of streams. They are frequently seen in the spray zone alongside waterfalls or on the undersides of stones immediately above the stream surface. Larvae of individual species have not been described or distinguished but the family appears to have a broad distribution within the country. **15**

Lepidoptera (moths)

Only *Nymphula nitens* (Butler) (Fig. 4), a species of Pyralidae, has an aquatic larva in New Zealand. Caterpillars are common amongst macrophytes in ponds and lakes throughout the country but especially in the north. They usually occupy portable shelters which are roughly constructed from plant fragments. **96**

Megaloptera (dobsonflies)

Only the family Corydalidae is represented in the New Zealand fauna and this contains the single species, *Archichauliodes diversus* (Walker) (Fig. 5). Dobsonfly larvae are common throughout the country in stony streams where they are important predators on other insect larvae. They are some of our largest aquatic insects. **32, 51**

Mecoptera (scorpionflies)

Most scorpionflies have terrestrial larvae but one family the Nannochoristidae has representatives with aquatic immature stages. One species, *Microchorista philpotti* (Tillyard) (Fig. 6), occurs in New Zealand. It is known only from the South Island, principally in small, forested streams. The larval habitat is fine organic deposits out of the current, particularly in backwater regions or along the margins of streams. **104**

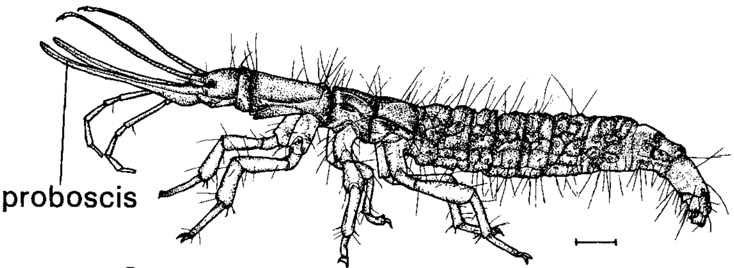
Odonata (damselflies and dragonflies)

Key to larvae

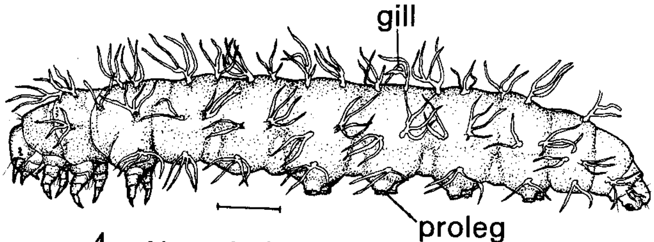
R. J. Rowe

Thirteen species of Odonata comprising 3 damselflies (Zygoptera) and 10 true dragonflies (Anisoptera) have been recorded from New Zealand. Several are cosmopolitan insects or occur elsewhere in the Pacific region and 2, *Pantala flavescens* and *Tramea transmarina,* do not seem to have established breeding populations in this country.

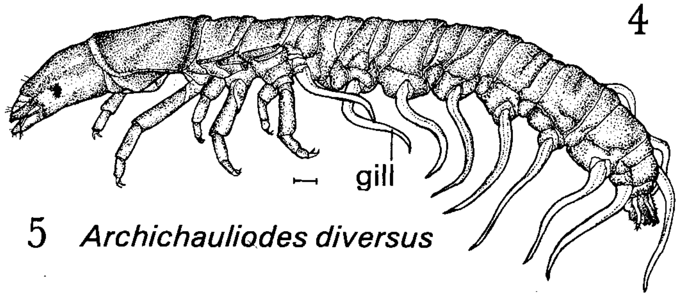
Of the New Zealand species, the only adequate, formal, larval description is for *Antipodochlora braueri* (Selys) (**126**) although a workable key to larvae was written by Penniket (**101**). Identification of early instars to species is difficult or impossible in some cases, and the following points should be borne in mind when attempting to identify younger than final instar material using the key which follows: a) couplets 1 and 4 hold for all instars after the first (or pronymphal stage); b) couplets 2, 5, 6, 7, 8, 9, 10, and 11 can be used once the wing pads have grown to cover the 1st abdominal segment; c) couplets 3 and 12 require care and are best restricted to final instar larvae in which the wing pads reach at least to abdominal segment 5.



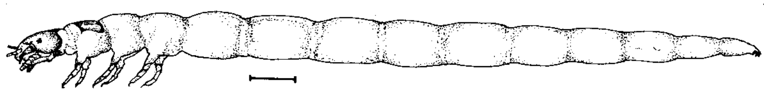
3 *Kempynus* sp.



4 *Nymphula nitens*



5 *Archichauliodes diversus*



6 *Microchorista philpotti*

Figs 3-6. Larvae of orders with few representatives. **3**, *Kempynus* sp. (Neuroptera). **4**, *Nymphula nitens* (Lepidoptera). **5**, *Archichauliodes diversus* (Megaloptera). **6**, *Microchorista philpotti* (Mecoptera). Scale bar = 1 mm.

1 Caudal lamellae (gills) present .... **ZYGOPTERA, 2**
—Caudal lamellae absent .... **ANISOPTERA, 4**

2 Lamellae long with rounded tips and 2 or 3 dark, transverse stripes (Figs 7, 8) .. **Austrolestes colensonis** (White)

Widely distributed in still waters generally in association with rushes and reeds. Swims actively with legs trailing the body. **28, 29, 30**

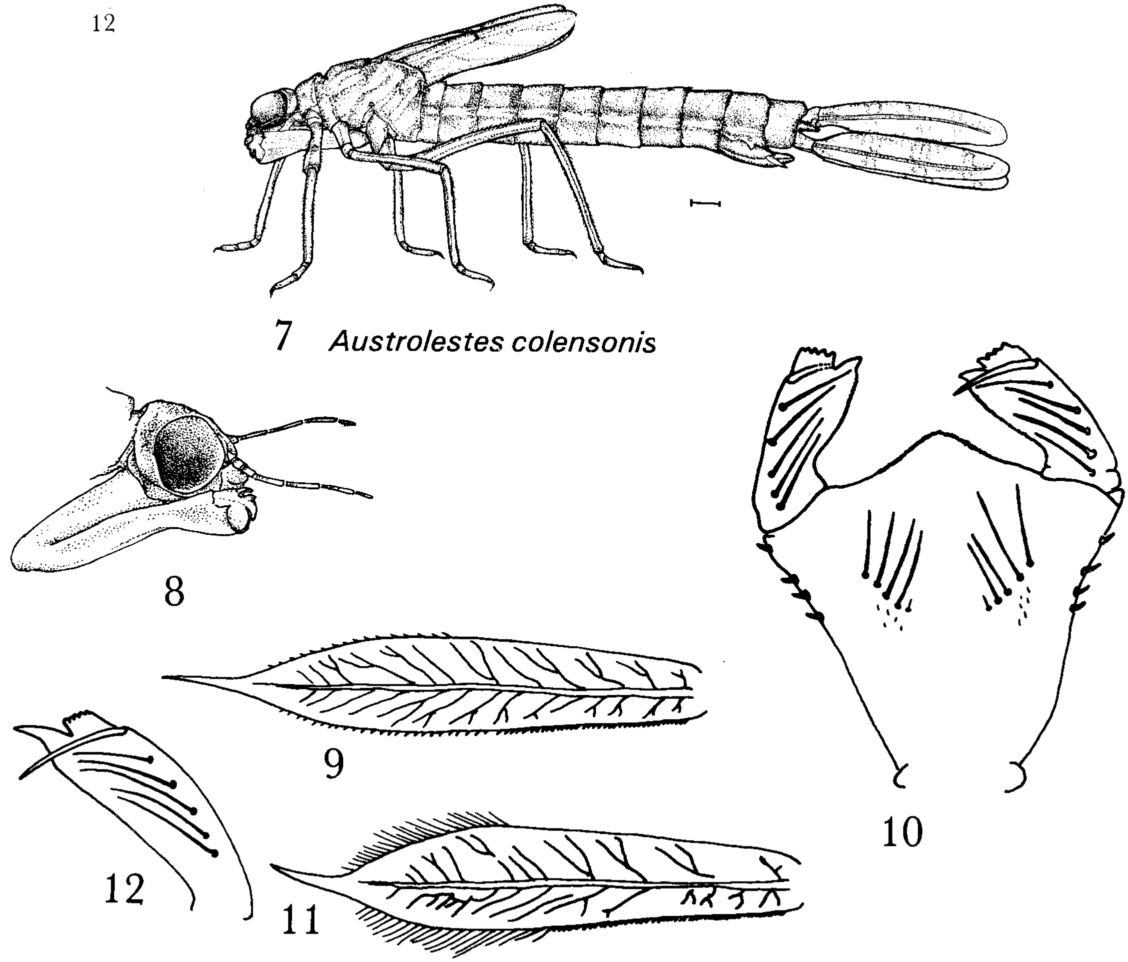
—Lamellae with pointed tips **3**

3 Lamellae with contiguous, small ventral spines to less than half the length; distal setae of the lamellae spiniform and separated by about their own length (Fig. 9); labial palp as in Fig. 10 .... **Ischnura aurora** (Brauer)

In New Zealand known only from the North Island amongst littoral vegetation of standing waters. A recent immigrant, widespread through the Indo-Pacific region. **110**

—Lamellae with contiguous, small ventral spines to beyond half the length, distal setae of the lamellae very long and separated by much less than their own length (Fig. 11); labial palp as in Fig. 12 .... **Xanthocnemis zealandica** (McLachlan)

Found throughout New Zealand in littoral vegetation of lakes, ponds, and sometimes rivers. Larvae like those of *I. aurora* swim with a laborious wagging motion, the legs being held out in front of the body. **28, 29, 30, 112**



Figs 7-12. Odonata (Zygoptera). **7, 8,** *Austrolestes colensonis*: 7, larva; 8, head, lateral view. **9, 10,** *Ischnura aurora*: 9, caudal lamella; 10, labial palp. **11, 12,** *Xanthocnemis zealandica:* 11, caudal lamella; 12, labial palp. Scale bar = 1 mm.

4 Labium flat, lying below the head at rest **5**
—Labium cupped at rest; labial palps cover face to base of antennae **7**

5 Body form bulky, not torpedo-like; abdomen and legs hairy; inhabit tunnels adjacent to seepages . . . . **Uropetala carovei** (White)

2 subspecies, *carovei carovei* and *carovei chiltoni* Tillyard, are recognised although their status needs reviewing. The larvae leave their tunnels at night to feed. **29, 127, 146**

—Body torpedo-shaped; not noticeably hairy; aquatic **6**

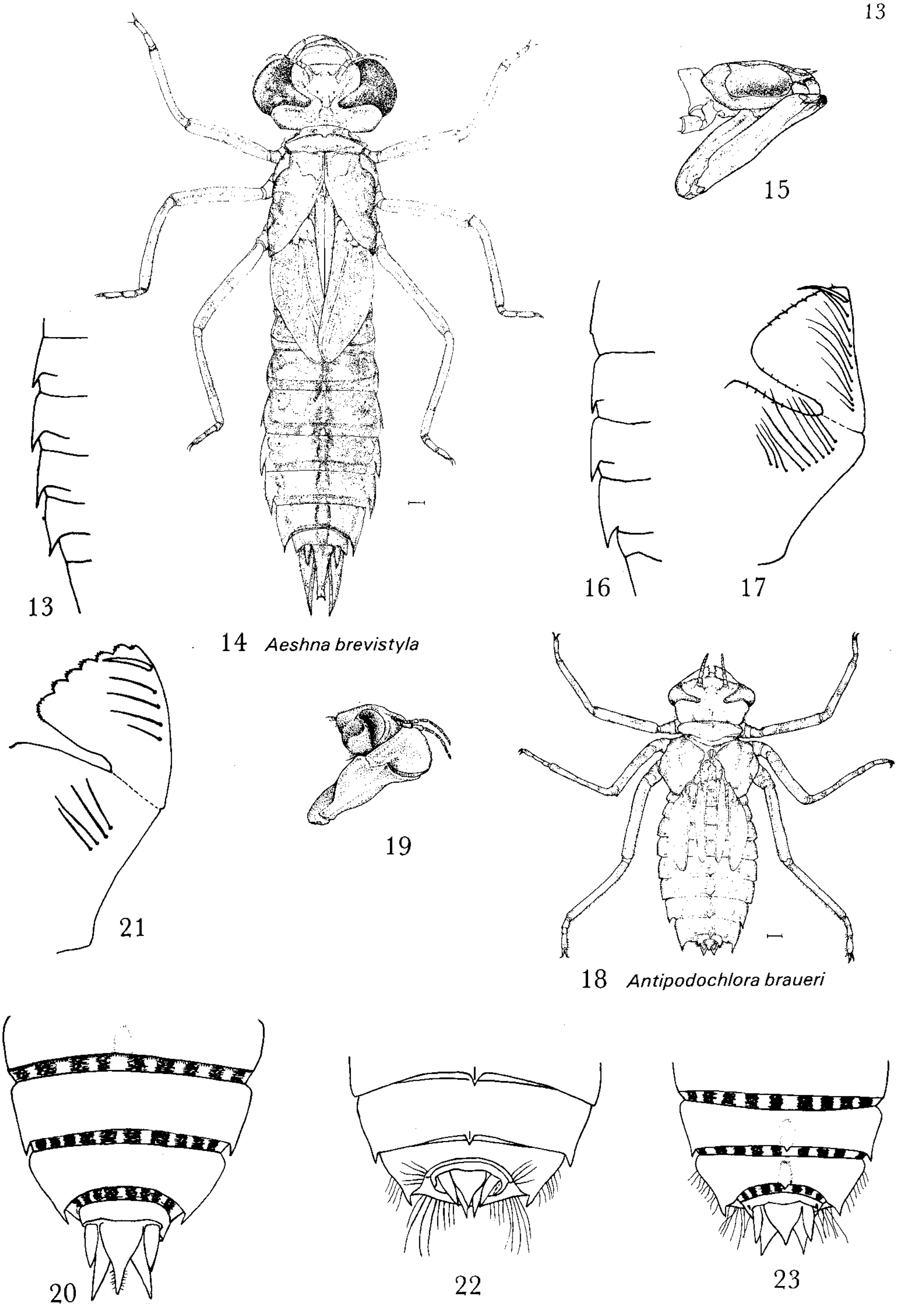
6 Abdominal segments 6-9 with lateral spines (Figs 13, 14, 15) . . . . **Aeshna brevistyla** Rambur

A brown larva found amongst vegetation, especially raupo in backwaters and swamps. The body of early instar larvae is drop-shaped. **107**

—Abdominal segments 7-9 with lateral spines (Fig. 16) . . . . **Hemianax papuensis** (Burmeister)

A green or "dazzle-striped" cylindrical larva found amongst green vegetation usually in ponds. A recent immigrant from Australia, recorded only from the North Island.

7 Distal margin of labial palps with small undulations (almost smooth) (Fig. 17) . **8**
—Distal margin of labial palps with distinct crenulations or teeth (Fig. 21) **9**



Figs 13-23. Odonata (Anisoptera). **13-15,** *Aeshna brevistyla*: 13, abdominal segments; 14, larva; 15, head, lateral view. **16,** *Hemianax papuensis*, abdominal segments. **17,** *Diplacodes bipunctata*, labial palp. **18, 19,** *Antipodochlora braueri:* 18, larva; 19, head, lateral view. **20, 21,** *Procordulia grayi:* 20, abdominal segments; 21, labial palp. **22,** *Hemicordulia australiae*, abdominal segments. **23,** *Procordulia smithii*, abdominal segments. Scale bar = 1 mm.

8 Abdominal segments 8 and 9 with very long lateral spines .... **Tramea transmarina** (Brauer)

This species is widely distributed throughout the Pacific Ocean, is resident on the Kermadec Islands, and might be expected to reach New Zealand at least occasionally.

—Abdominal segments 8 and 9 without noticeable spines .... **Diplacodes bipunctata** (Brauer)

Probably breeds in shallow ponds and marshes; locally common in the northern North Island; occasionally collected in the South Island. **29**

9 Abdominal segments 8 and 9 with very long lateral spines .... **Pantala flavescens** (Fabricius)

Recorded only as a rare immigrant to New Zealand. There are no breeding records. **17**

—Abdominal segments without long lateral spines **10**

10 Dorsal midline of abdomen with large, curved spines (Figs 18, 19) .... **Antipodochlora braueri** (Selys)

Known only from the North Island where larvae inhabit thick vegetation, leaf trash, or stones in heavily shaded forest streams. **126**

—Dorsal midline of abdomen with small spines, bumps, or smooth **11**

11 Prementum with 4 setae on each side; labial palps with 4-5 setae; tip of abdomen appears pointed (Figs 20, 21) .... **Procordulia grayi** (Selys)

Occurs in lakes where the most probable habitats are submerged weed beds, trash, and stones. Larvae are active at night and near to emergence can be found close to the lakeshore. **29**

—Prementum with more than 6 setae on each side; tip of abdomen not pointed . **12**

12 10th (terminal) abdominal segment reduced dorsally giving the abdomen a truncate appearance (Fig. 22); dorsum of abdomen lacking a crest .... **Hemicordulia australiae** (Rambur)

Most common in the North Island but also known from the South Island including Westland. Larvae occur in lakes, swamps, and streams in similar habitats to *Procordulia* species. **2, 107**

—10th abdominal segment not reduced dorsally; abdominal tip rounded (Fig. 23); dorsum of abdomen with a low crest of ''embossed'' hairy bumps .... **Procordulia smithii** (White)

Found in raupo trash in swamps and at lake margins, and also in streams. **29**

Ephemeroptera (mayflies)

Key to larvae

(in collaboration with D. R. Towns)

No major revision of the New Zealand Ephemeroptera has been made since the work of Phillips (**103**) although several species have been described subsequently and the large family Leptophlebiidae is in the process of revision by Towns and Peters (**118, 119, 120, 121** and in preparation). The higher classification of McCafferty and Edmunds (**64**) is followed in the following key, which means that the subfamily Coloburiscinae (genus *Coloburiscus*) is placed in Oligoneuriidae, and the family Siphlaenigmatidae of Penniket is reduced to subfamilial level within the Baetidae.

Larvae of all genera (but not necessarily species) in all families of New Zealand Ephemeroptera are easily recognised, except in Leptophlebiidae where morphological differences between some genera are very small. Making identifications is difficult in this family.

1 With 6 pairs of bifid, plumose gills held over the abdomen; mandibles tusk-like, extending well in front of head; burrowers .... **EPHEMERIDAE**

A single genus, *Ichthybotus* (Figs 24, 31), with 2 described species, *I. hudsoni* (McLachlan) and *I. bicolor* Tillyard. The larva of the former has been described; it inhabits soft stream sediments. **103**

—Without plumose gills and tusk-like mandibles **2**

2 Gills bifid, spiny, held erect over abdomen; fore and middle legs with thick fringes of hairs; central caudal filament very short .... **OLIGONEURIIDAE**

A single genus *Coloburiscus* with 2 described species, *C. humeralis* (Walker) (Figs 25, 32) and *C. tonnoiri* Lestage. The latter is known only from the originally described specimens and possibly is a synonym of *humeralis*. Habitat: stony streams. **69, 70, 103, 143, 144**

—Gills not spiny and rigid; all 3 caudal filaments of a similar length **3**

3 Larvae dorsoventrally flattened with caudal filaments longer than body and lacking fringes of long hairs .... **LEPTOPHLEBIIDAE, 9**

—Larvae flattened or fish-like with fringed caudal filaments that are shorter than the body **4**

4 Swimming larvae with 20 + segmented antennae approximately the length of the abdomen; gills leaf-like, over twice as long as wide and without serrated margins .... **BAETIDAE**

A single species, *Siphlaenigma janae* Penniket (Fig. 37), the only known member of the subfamily Siphlaenigmatinae. Inhabits low flow areas of stable, forest streams where fringing vegetation hangs in the water. **100, 115**

—Antennae approximately the length of the head and of less than 20 segments; gills leaf-like and nearly as broad as long OR consisting of 2 lamellae, the ventral lamella tufted .... **SIPHLONURIDAE, 5**

5 Body not dorsoventrally flattened **6**

—Body dorsoventrally flattened **7**

6 Gills single leaf-like lamellae; antennae with 10-20 segments (Figs 26, 35) ...... **Nesameletus**

2 species, *N. ornatus* (Eaton) and *N. flavitinctus* (Tillyard), are described but their larvae cannot be distinguished with confidence. Widely distributed in stony, particularly forested, streams. **69, 103, 115**

—Gills with double lamellae, the dorsal lamella leaf-like, the ventral one tufted; antennae with less than 10 segments (Figs 27, 34) .... **Rallidens**

1 described species, *R. mcfarlanei* Penniket, inhabits stony streams but is poorly known. **69, 70, 102, 115**

7 Head large and skull-like, much broader than prothorax; gills extend laterally from abdomen (Fig. 36); caudal filaments about equally fringed on each side ... **Ameletopsis**

1 described species, *A. perscitus* (Eaton), which is widely distributed in stony streams but never common. **103.**

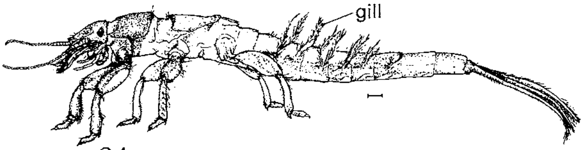
—Head narrower than thorax; gills held flat over dorsal surface of abdomen; caudal filaments fringed on inner side only .... **Oniscigaster, 8**

8 10th tergite smoothly rounded posteriorly; clypeus projecting forward as a definite "beak" when seen in lateral view; caudal filaments with a dark, median band (Figs 28, 33) .... **Oniscigaster wakefieldi** McLachlan

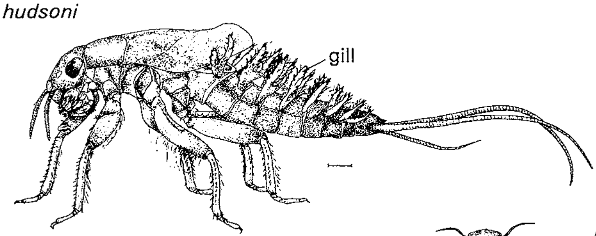
O. intermedius Eaton is probably a synonym of *wakefieldi*. Larvae are widely distributed in forest streams with little silt and are most common in gravel-bottomed pools. **71, 99, 103**

—10th tergite with distinct, posterior-lateral projections; clypeus smoothly rounded; caudal filaments uniformly coloured .... **Oniscigaster distans** Eaton

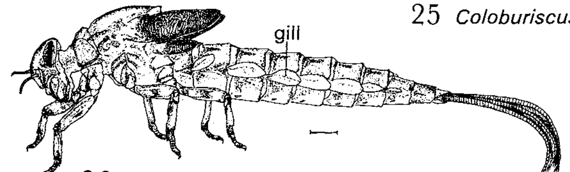
Habitat as for *wakefieldi*. Probably widely distributed. **71, 99**



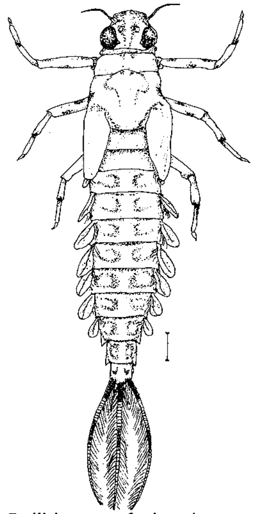
24 *Ichthybotus hudsoni*



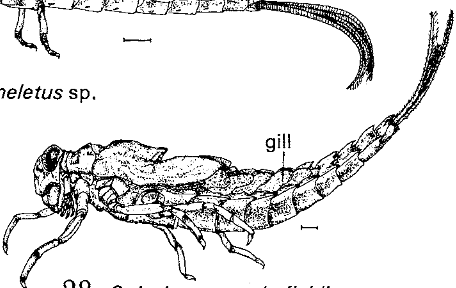
25 *Coloburiscus humeralis*



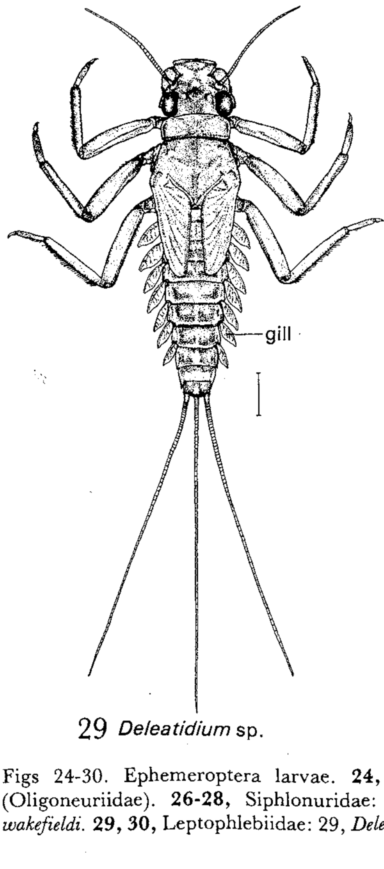
26 *Nesameletus* sp.



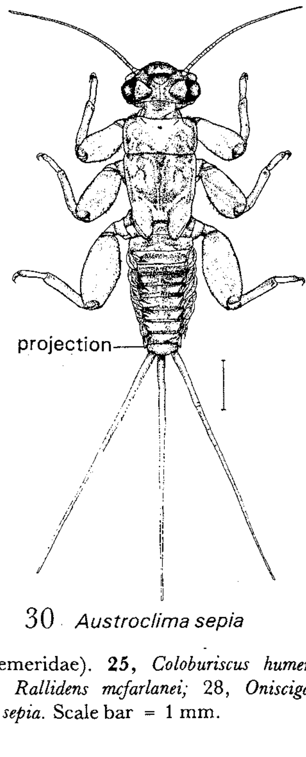
27 *Rallidens mcfarlanei*



28 *Oniscigaster wakefieldi*

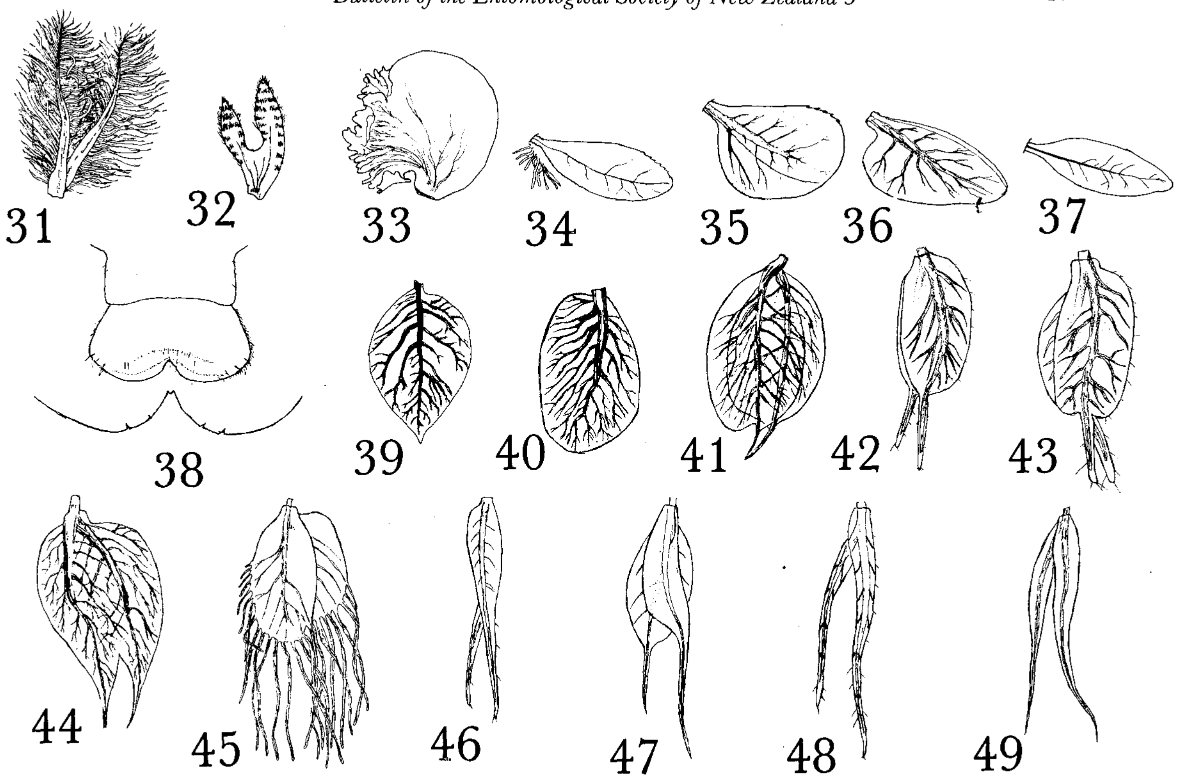


29 *Deleatidium* sp.



30 *Austroclima sepia*

Figs 24-30. Ephemeroptera larvae. **24,** *Ichthybotus hudsoni* (Ephemeridae). **25,** *Coloburiscus humeralis* (Oligoneuriidae). **26-28,** Siphlonuridae: 26, *Nesameletus* sp.; 27, *Rallidens mcfarlanei;* 28, *Oniscigaster wakefieldi.* **29, 30,** Leptophlebiidae: 29, *Deleatidium* sp.; 30, *Austroclima sepia.* Scale bar = 1 mm.



Figs 31-49. Ephemeroptera. **31-37,** gills of non-leptophlebiid mayflies: 31, *Ichthybotus hudsoni;* 32, *Coloburiscus humeralis;* 33, *Oniscigaster wakefieldi;* 34, *Rallidens mcfarlanei;* 35, *Nesameletus* sp.; 36, *Ameletopsis perscitus;* 37, *Siphlaenigma janae.* **38,** *Mauiulus luma,* labrum. **39-49,** gills of leptophlebiid mayflies: 39, *Deleatidium lillii;* 40, *Deleatidium myzobranchia;* 41, *Zephlebia versicolor;* 42, 43, *Austroclima sepia;* 44, *Zephlebia cruentata;* 45, *Isothraulus abditus;* 46, *Atalophlebioides cromwelli;* 47, *Arachnocolus phillipsi;* 48, *Mauiulus luma*; 49, *Zephlebia nodularis.*

9 Gills with a single lamella (Fig. 29) .... **Deleatidium**

Probably the commonest mayfly genus in New Zealand. Species names cannot be assigned to larvae at present but informal *lillii*-group and *myzobranchia*-group designations have been used (**137**) for larvae with apically rounded (Fig. 40) and pointed-tipped (Fig. 39) gills respectively. **69, 103, 117, 135, 137**

—Gills with double lamellae **10**

10 Gills oval with prominent fringes (Fig. 45) .... **Isothraulus**

1 described species, *I. abditus* Towns & Peters, which is known only from the Auckland area, mainly in pools on vegetation or amongst debris. **120**

—Gills without marginal fringes **11**

11 At least some abdominal segments with spines at the posterior-lateral angles . **14**

—Abdominal segments 8 and 9 with blunt projections at the posterior-lateral angles **12**

12 Gills plate-like, with slender apical filament and branched tracheae, outer margins of mandibles angular .... **Austroclima, 13**

—Gills slender, smoothly tapered to apex, tracheae unbranched, outer margins of mandibles smoothly curved (Figs 38, 48) .... **Mauiulus**

1 described species, *M. luma* Towns & Peters, which occurs in a wide range of habitats in forested rivers and streams. **119**

13 Gills pale (hyaline) (Figs 42, 43); dorsal surface of abdomen brown usually with pale patches on segments 3-7 (Fig. 30) . . . . **Austroclima sepia** (Phillips)

Found commonly in small, forest streams, often among mosses on small falls. **119**

—Gills dark except for paler lateral margins; dorsal surface of abdomen dark brown and lacking pale patches . . . . **Austroclima jollyae** Towns & Peters

Known habitat as for *A. sepia.* **119**

14 7th gill greatly reduced, either a single lamella or very small filaments **17**

—7th gill with both lamellae present and only slightly smaller than 6th gill **15**

15 Head roughly rectangular; labrum shallow and broader than apex of clypeus (Fig. 46) . . . . **Atalophlebioides**

1 known species, *A. cromwelli* (Phillips), which occurs on rocky substrates in slow-flow areas of moderately large rivers and small streams. **118**

—Head roughly shield-shaped; labrum deep, apex of clypeus broader than or equal to width of labrum **16**

16 General colour yellow to bright orange-red; gills ovate-acuminate, tapering smoothly to the tip (Fig. 44) . . . . **Zephlebia cruentata** (Hudson)

Although currently placed in *Zephlebia,* a new genus is likely to be erected to accommodate this species. Often common in gently flowing, forested, stony streams in the North Island. **69, 70, 103**

—Dorsal surface of abdomen dark brown; gills very narrow with thick, unbranched tracheae (Fig. 49) . . . . **Zephlebia (Neozephlebia)**

This subgenus includes *Z. nodularis* (Eaton) which may or may not be a synonym for *Z. scita* (Walker). Habitats include stony streams, especially slower forested streams. **69, 70, 98, 103**

17 All femora very long and thin; labrum with anterior margin almost straight and with very small anteromedian denticles (Fig. 47) . . . . **Arachnocolus**

1 described species *A. phillipsi* Towns & Peters, known only from the North Island in slow-flowing streams, especially on trailing vegetation. **120**

—Fore femora roughly oval, in some species also broadly expanded and with prominent spines; labrum with anterior margin concave and with well developed denticles (Fig. 41) . . . . **Zephlebia** s.s.

Z. dentata (Eaton) and *Z. versicolor* (Eaton) belong here and perhaps up to 7 undescribed species. **69, 98, 103**

Plecoptera (stoneflies)

Key to larvae

The stonefly fauna of mainland New Zealand and Stewart Island is well known and consists of 40 described species in 18 genera, as well as several yet to be described species. Species of *Vesicaperla, Apteryoperla, Holcoperla* and *Rakiuraperla* possess terrestrial larvae and are not included in the following key. For their identification, reference should be made to McLellan (**77**). Names used here follow McLellan (**75, 76, 77**) and Zwick (**150**).

1 Green or yellow larvae with 5 pairs of segmented, lateral abdominal gills . . . . **EUSTHENIIDAE, 2**

—Larvae without lateral abdominal gills **3**

2 Fringes of hairs present on the distal cercal segments (Fig. 50) . . . . **Stenoperla prasina** (Newman)

A widespread and common species throughout New Zealand from sealevel to high altitudes. **32, 53, 54, 135, 150**

—Hair fringes absent on distal cercal segments, only apical setae .... **Stenoperla maclellani** Zwick

Probably widely distributed but at present best known from the South Island. **150**

3 With 3 tubular anal gills arising between the cerci (Fig. 62) .. **AUSTROPERLIDAE**

1 described species, *Austroperla cyrene* (Newman) (Fig. 51), whose larvae often occur on wood in streams. **18, 19, 128, 137**

—Without tubular anal gills **4**

4 With a rosette of filamentous anal gills between the bases of the cerci (Fig. 58) .. **GRIPOPTERYGIDAE, 5**

—Without visible gills (Fig. 61); segments of cerci knob-like (cerci frequently broken near their bases) .... **NOTONEMOURIDAE, 17**

5 Each subanal lobe produced posteriorly in a spinose process (Fig. 58); gill rosette pulsatory .... **Megaleptoperla, 6**

—Subanal lobes roughly triangular (Fig. 59) or tongue-shaped (Fig. 60), without a posterior spine; gills nonretractile **7**

6 Gena (side of face) with a distinct anteriorly projecting spur; cerci robust; body length up to 18 mm .... **Megaleptoperla grandis** (Hudson)

Larvae occur on stones in streams but are rarely abundant. *72, 77*, **128**

—Gena without a spur; cerci thread-like; body length about 10 mm (Fig. 52) ..... **Megaleptoperla diminuta** Kimmins

Most common on vegetation in slow-flowing water. *77*

7 Femora strongly dorsoventrally flattened; all leg segments with a well developed fringe of hairs on the posterior margin (Figs 53, 59) .... **Zelandoperla, 8**

Accurate identification of *Zelandoperla* species, except *denticulata* McLellan, is difficult even for an experienced person. Where possible some adults should be reared from larvae or the developing wings can be dissected from mature larvae and their patterns examined (see **73**, *77*)

—Femora not strongly flattened; legs lacking a well developed fringe of hairs ... **11**

8 Pronotum with anterior angles produced into forward-directed spines; anterior margins of femora and lateral margins of pronotum and mesonotum serrated ... **Zelandoperla denticulata** McLellan

Known only from stony streams and rivers in Westland where it can be common. **73**, *77*

—Anterior angles of pronotum not produced; legs and thoracic plates lacking serrated margins **9**

9 Cerci with thick fringes of hairs on the inner margins; cerci and antennae about as long as body; hind margin of mesonotum convex; short, dark, approximately transverse marks on abdominal terga .... **Zelandoperla decorata** Tillyard

This is *Z. maculata* (Hare) of Winterbourn (**128, 129**) and is common in fast-flowing waters including unstable rivers. *72*, **73**, *77*, **129**

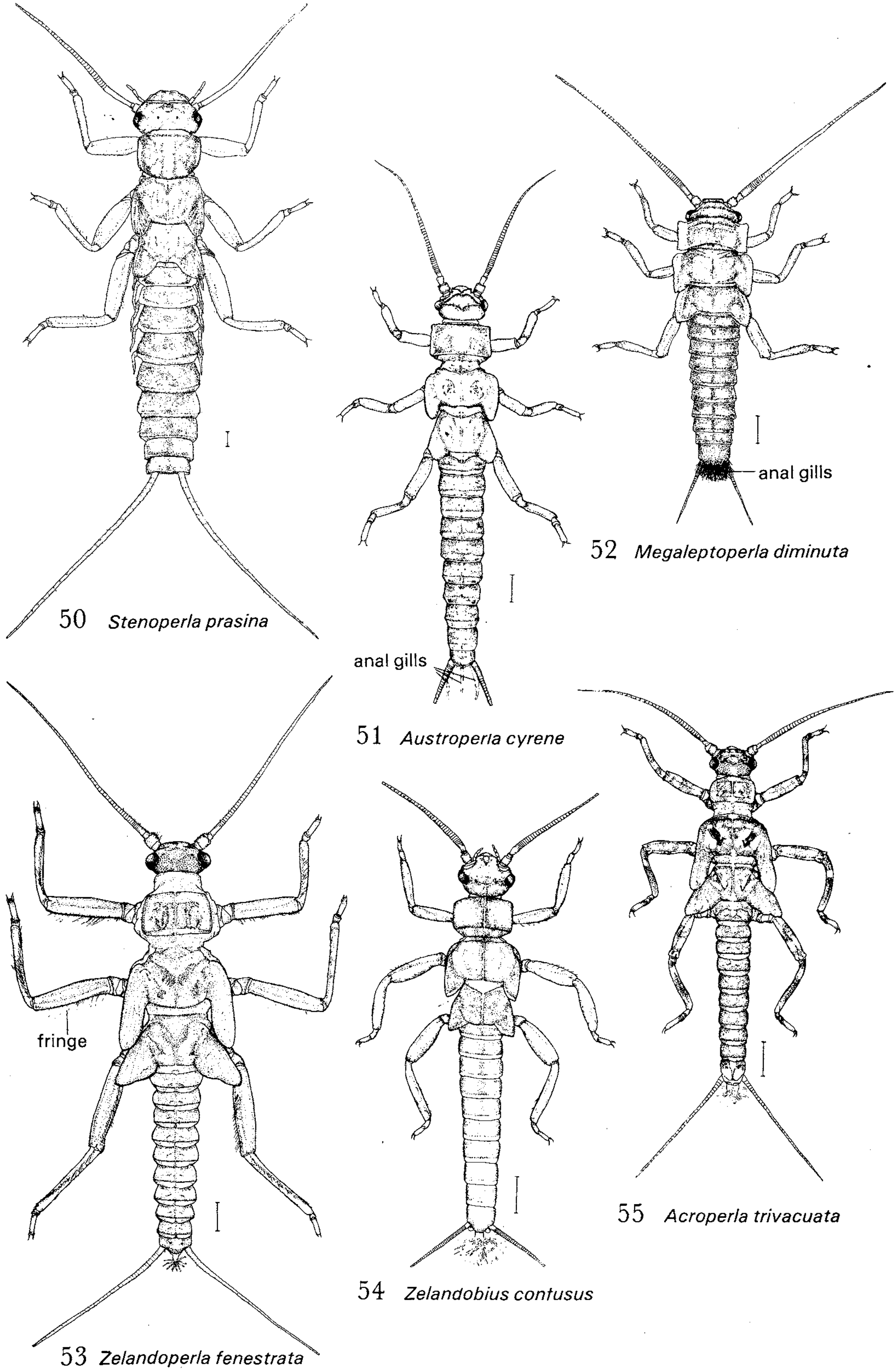
—Cerci without thick fringes of hairs; antennae and cerci always shorter than body **10**

10 Mesonotum with straight hind margin; no dark marks on abdominal terga ..... **Zelandoperla agnetis** McLellan

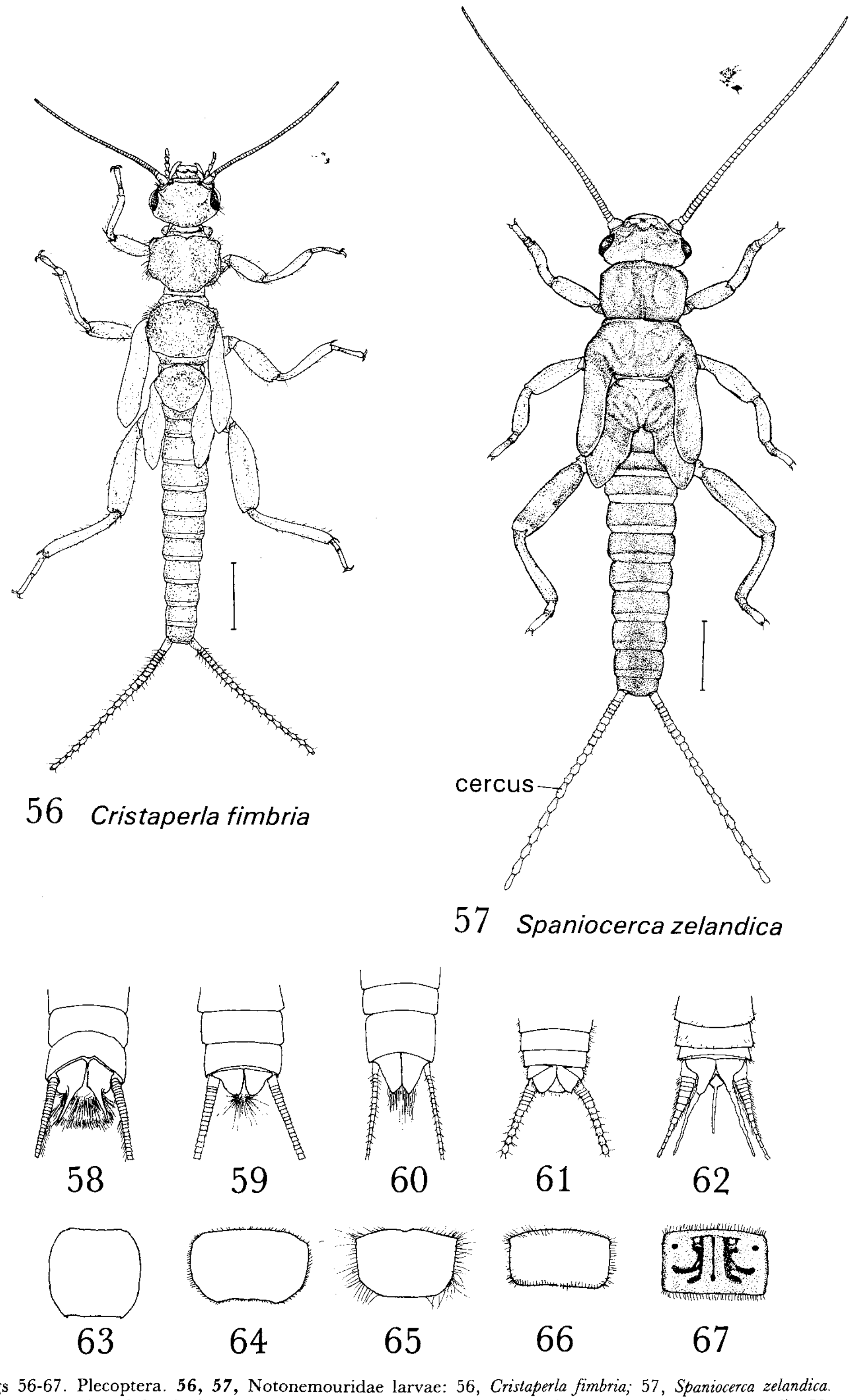
This is *Z. decorata* Tillyard of Winterbourn (**128**), and is a widely distributed species in stony streams. *72*, **73**, *77*

—Mesonotum with convex hind margin; rows of narrow marks present on abdominal terga (Fig. 53) .... **Zelandoperla fenestrata** Tillyard

Widely distributed in stony streams especially in the mountains. Sometimes associated with moss. **19**, *72*, **73**, *77*.



Figs 50-55. Plecoptera larvae. **50,** *Stenoperla prasina* (Eustheniidae). **51,** *Austroperla cyrene* (Austroperlidae). **52-55,** Gripopterygidae: 52, *Megaleptoperla diminuta;* 53, *Zelandoperla fenestrata;* 54, *Zelandobius confusus;* 55, *Acroperla trivacuata.* Scale bar = 1 mm.



Figs 56-67. Plecoptera. **56, 57,** Notonemouridae larvae: 56, *Cristaperla fimbria;* 57, *Spaniocerca zelandica.* **58-62,** posterior abdominal segments of plecopteran larvae, ventral view: 58, *Megaleptoperla grandis;* 59, *Zelandoperla fenestrata;* 60, *Zelandobius furcillatus;* 61, *Spaniocerca zelandica;* 62, *Austroperla cyrene.* **63-67,** pronota of Notonemouridae: 63, *Spaniocercoides hudsoni;* 64, *Halticoperla viridans;* 65, *Cristaperla fimbria;* 66, *Spaniocerca zelandica;* 67, *Notonemoura latipennis.* Scale bar = 1 mm.

11 Body including legs uniformly coloured, brown or grey-brown; subanal lobes tongue-shaped (Fig. 60); abdomen swings from side to side when the living larva is at rest . . . . **Zelandobius, 12**

5 described species, of which *Z. brevicauda* McLellan is known only from apterous, adult females. **77**

—Larvae not uniformly coloured but with light bars on femora and tibiae, and patterned thoracic nota and abdominal terga; subanal lobes triangular; abdomen not swung from side to side at rest **15**

12 Lateral margins of pronotum and mesonotum with rows of spines; abdominal and thoracic segments with serrated posterior margins and dorsal projections . . . **Zelandobius illiesi** McLellan

Known only from small forested streams in Westland. **75**

—Margins of thoracic segments without spines or serrations **13**

13 Pronotum almost square, slightly wider than long; abdominal segments without a median dorsal ridge; 10th abdominal tergum as broad as long (Fig. 54) . . . . . . **Zelandobius confusus** (Hare)

Abdominal setation varies considerably in extent as does the size attained by larvae in different localities. It is possible that more than one species is represented here. **18, 72, 75, 137**

—Pronotum broader than long, roughly resembling a playing card; abdominal terga ridged (at least slightly) in the midline; 10th tergum longer than broad . **14**

14 Abdominal terga 1-8 with short, dark hairs and a weak median ridge; longitudinal tracheal vessels usually clearly visible through the abdomen wall; colour light grey-brown . . . . **Zelandobius furcillatus** Tillyard

Widely distributed in stony streams and rivers, among marginal stream fringe vegetation, and on stony lake shores. **75, 128, 137**

—Abdomen with strongly developed dorsal ridge and terga lacking short, dark hairs; tracheal vessels not visible through wall; colour golden-brown . . . . **Zelandobius unicolor** Tillyard

Probably most common in South Island forest streams. The early instars in particular are easily confused with those of *Z. furcillatus*. **75**

15 With a pale inverted triangle medially on each abdominal tergite (Fig. 55) . . . . . **Acroperla, 16**

3 described species, of which *A. samueli* McLellan from north Westland is not known as a larva. **77**

—With a pale, oblique bar on either side of each abdominal tergite . . . . **Nesoperla**

1 described species from mainland New Zealand, *N. fulvescens* (Hare). Most late instar larvae seem to occur out of water in cool, damp conditions in river beds. Known only from Westland. **72, 77**

16 Pronotum with posterior angles produced as spines; mesonota and metanota with dorsally projecting spinous processes . . . . **Acroperla spiniger** (Tillyard)

Widely distributed in stony streams. Larvae leave the water at night to feed. **72, 77, 128, 137**

—Thoracic segments without spines or projections (Fig. 55) . . . . **Acroperla trivacuata** (Tillyard)

Most common in North Island streams where late larvae may be semi-terrestrial. **72, 77, 128, 129**

17 Pronotum roughly square, without hairy marginal fringes and without a pattern of dark markings (Fig. 63) . . . . **Spaniocercoides**

2 known species, *S. hudsoni* (Kimmins) and *S. cowleyi* (Winterbourn). Larvae of the former have been described, but those of *cowleyi* which are known from larger Westland forest streams, where they may be mainly hyporheic, have not. No way of discriminating between larvae of the 2 species has been found. *S. hudsoni* larvae are known from seepage areas in

alpine and subalpine herb fields, and from weedy streams and amongst detritus in small forest streams. **76**

—Pronotum with a distinct hairy fringe on at least 2 margins **18**

18 Pronotum rectangular with a pattern of dark markings and fringes of hairs on the anterior and posterior margins only (Fig. 67) .... **Notonemoura, 19**

—Fringes of hairs on lateral and at least some of the anterior and posterior margins of pronotum **20**

19 General colour brown; inhabiting alpine or subalpine seepage, bog pools, or bog outflow streams .... **Notonemoura latipennis** Tillyard

2 subspecies have been described; *latipennis latipennis* being fully winged, and *latipennis paludis* McLellan being brachypterous. **74, 76**

—General colour brown with greenish legs and light patches. Larvae inhabit vertical films of seepage water in forest .... **Notonemoura alisteri** McLellan

Note that the green colouration may fade in preservative. Known distribution, north Westland and Arthurs Pass region. **74, 76**

20 Pronotum fringed with long, pale hairs on lateral and parts of anterior and posterior margins; legs clothed in long light hairs (Figs 56, 65) ....
Cristaperla fimbria (Winterbourn)

Note that McLellan's (**76**) description of the larval prothorax based on an exuviae is incorrect. Most larvae have been collected from soft sediments in pools and backwaters of small, South Island, forest streams. **76, 137**

—Short hairy fringe extends around entire pronotum **21**

21 Lateral margins of pronotum strongly rounded; hind femora much enlarged, about twice width of fore femora and having setae with prominent sockets distally; living larvae with obvious green pigmentation (Fig. 64) ...... **Halticoperla**

1 described species, *H. viridans* McLellan & Winterbourn, which inhabits shallow films of water in streams. Larvae exhibit unusual leaping behaviour. **76, 78**

—Lateral margins of pronotum not strongly convex (Fig. 66); posterior margin of mesonotum with a rather inconspicuous row of short setae (absent in all other notonemourids); hind femora less than twice as broad as fore femora, their setae without prominent sockets; general colour grey-brown ...... **Spaniocerca, 22**

22 Pronotum a uniform brown or with a large pale area in each half (Fig. 57) ......
Spaniocerca zelandica Tillyard

One of the commonest and most widely distributed New Zealand stoneflies. Note that the shape of the pronotum is somewhat variable and that the key character used by McLellan (**76**) to differentiate *Spaniocerca* from other genera, i.e., the presence of a fringe of hairs on the posterior margin of the mesonotum, may be difficult to see even with a good microscope. **76, 130, 137**

—Pronotum with 5-6 pale spots in each half ....
Spaniocerca longicauda McLellan

Known only from Fiordland. **77**

Trichoptera (caddisflies)

Key to larvae

The Trichoptera is a large order represented in New Zealand by 15 families containing 45 genera and over 140 described species, many of which are not known as larvae. In addition, several species are known, but have yet to be described (A. G. McFarlane pers. comm.). The major works on our caddisfly larvae are the recently published paper by Cowley (**22**) which considers 46 species in 14 families and two papers by

McFarlane dealing with Hydropsychidae (**68**) and Rhyacophilidae (**65**). These papers represent the principal source of information on which the following keys are based. John Stark contributed the key to Hydroptilidae which is based largely on his own research.

In 1977, Neboiss (**89**) published the results of a major systematic study of the Tasmanian Trichoptera and made a number of important nomenclatural changes which have implications in this country. Unfortunately, these were not incorporated in Cowley's papers (**21, 22**) but are accepted here. This means that the Ecnomidae and Conoesucidae are given family status rather than being considered subfamilies of Psychomyiidae and Sericostomatidae respectively, Pycnocentrellidae is considered to be a synonym of Calocidae, and *Hydrobiosella*, formerly a subgenus of *Dolophilodes* (Philopotamidae), is given generic status. Note also that Philanisidae (as in Wise **142**) is a synonym of Chathamiidae, and the Oeconesidae (formerly a tribe of Sericostomatidae) are considered a family (**22, 88**).

Further discussion of taxonomic problems is given in appropriate parts of the keys. It will be apparent that positive identification of larvae is difficult in a number of families, and whenever there is doubt, every attempt should be made to associate larvae with adults. This can be done by rearing material or by using field-collected late male pupae in which the external genitalia (primary identificatory characters) are developed. Sclerotised exoskeletal plates of the final instar larva conveniently are retained within the pupal case enabling larvae and adults to be positively associated.

Key to families

1 Larvae with a portable case **7**
—Larvae without a portable case, but sometimes occupying a fixed shelter **2**

2 Dorsum of each thoracic segment largely covered by a sclerotised plate **3**
—Metanotum and sometimes mesonotum entirely membranous or largely so, but with several pairs of small sclerites and hairs **5**

3 Abdomen with branched ventral gill tufts on 6 or 7 segments; anal prolegs long, each with a conspicuous brush of long hairs inserted near the base of the anal claw (Fig. 70) .... **HYDROPSYCHIDAE**, p.25
—Ventral abdominal gill tufts absent **4**

4 Minute larvae (less than 2 mm long) with numerous extremely long setae, especially posteriorly .... early instar **HYDROPTILIDAE**, p.26
—Small larvae (less than 5 mm long) without extremely long setae; superficially resembling non-chelate rhyacophilids (Fig. 77) .... **ECNOMIDAE**, p.28

5 Forelegs chelate, i.e., with an apical "pincer"; freeliving, with no net or shelter (Figs 79, 80) .... **RHYACOPHILIDAE**, p.28
—Forelegs not chelate **6**

6 Abdomen characteristically pale pink to pale purple with brown pigmentation dorsally; prothoracic trochantin projecting forward as an obvious long, sharp prong; head capsule pale yellow with prominent but small, brown spots (Fig. 90) .... **POLYCENTROPODIDAE**, p.30
—Abdomen cream-white; labrum soft and membranous, roughly T-shaped; prothoracic trochantin not produced into a prong; head capsule yellow-orange; posterior margin of pronotum shining black .... **PHILOPOTAMIDAE**, p.30

7 Small larvae (less than 4 mm long) in a transparent, purse-like case; abdomen distinctly swollen (Fig. 71) .... final instar **HYDROPTILIDAE**, p.26
—Not in a transparent, purse-like case **8**

8 Marine; case primarily of algal fragments; sides of abdominal segment 8 with several rows of fine spicules (Fig. 92) .... **CHATHAMIIDAE**, p.32

—In fresh water (or occasionally weakly brackish water) **9**

9 Case spirally coiled, resembling a snail shell; anal claw with a comb of teeth beyond the primary barb (Figs 93, 94) .... **HELICOPSYCHIDAE**, p.32

—Case not spirally coiled; anal claw with a single accessory barb **10**

10 Lateral line (a longitudinal fringe of hairs) present on most abdominal segments **11**

—Lateral line absent **14**

11 Mesonotum and metanotum each with 3 pairs of reduced, sclerotised plates; top of head almost circular, shallowly convex with a definite marginal carina; case straight, cylindrical, gradually tapering, of plant and/or mineral fragments (Figs 95-99) .... **OECONESIDAE**, p.32

—Mesonotum a sclerotised shield; head not carinate **12**

12 Hind legs approximately 3 times as long as forelegs; mid and hind femora in 2 parts (Figs 101, 104) .... **LEPTOCERIDAE**, p.33

—Hind legs less than twice length of forelegs; fore and middle legs at least partially raptorial, the tibia (or tibiotarsus) curved to a degree **13**

13 Fore and middle legs with tibia and tarsus fused, hind legs with many strong spines; mesonota and metanota lightly sclerotised shields with ill-defined margins; sand grain case straight, elliptical in cross-section with anterior, posterior, and lateral flanges formed mainly of larger particles (Fig. 106) .... **KOKIRIIDAE**, p.33

—Tibia and tarsus of middle legs only fused (Fig. 109); hind legs without strong spines; metanotum consisting of 3 pairs of plates; case slightly curved and tapered, of irregularly arranged sand grains (Fig. 107)..................... **PHILORHEITHRIDAE**, p.36

14 Terminal claw of anal proleg with a single auxiliary barb almost as large as the primary one; concave anterior margin of pronotum with a row of very short, black setae best developed close to the anterolateral angles; case curved and tapered, of fine sand grains (Fig. 110) .... **CALOCIDAE**, p.36

—Accessory barb of anal claw much smaller than primary barb **15**

15 Metanotum with a pair of small, transversely elongate, anterior patches each with several hairs; case curved, tapered, of sand grains and/or pieces of liverwort or moss, its posterior aperture in a secreted region beneath a dorsal overhang (Fig. 112) .... **HELICOPHIDAE**, p.36

—Metanotum with at most 2 pairs of small, anterior patches without hairs arising from them; case curved, slightly tapering, highly variable in construction and appearance (Figs 116-121) .... **CONOESUCIDAE**, p.36

Hydropsychidae

1 Trochantin of foreleg a single spine; 5 anal gills (which may be withdrawn); abdominal segments 1-7 with gill tufts .... **Diplectrona**

D. zealandensis Mosely is found in the South Island and southern North Island, typically in shaded rivers and streams. Retreats are loose structures of gravel and plant fragments. The larva of a second species, *D. bulla* Wise, is unknown. **22, 68**

—Trochantin forked; 4 anal gills **2**

2 Gill tufts on abdominal segments 1-6; abdominal setation principally of erect, somewhat globular elements (Fig. 68) .... **Orthopsyche**, **3**

—Gill tufts on abdominal segments 1-7; abdominal setation dominated by fine adpressed setae interspersed with fewer short, blunt, blackish elements (Figs 69, 70) . . . . **Aoteapsyche**

Larvae of 6 species are keyed out by McFarlane (**68**) and 3 are described by Cowley (**22**). Nevertheless, all species are not easy to distinguish, and McFarlane's key and head capsule figures are likely to cause confusion. *A. colonica* (McLachlan) and *A. raruraru* (McFarlane) are easiest to identify, the former by the convex anterior margin of the frontoclypeus and the latter by its distinctive bicoloured head and thorax (some other species are light around the eyes only). *A. colonica* is common and widespread in stony streams and rivers especially in the open throughout New Zealand. Its retreat is a loose, irregular structure of gravel and plant fragments; the capture net lacks supports. *A. raruraru* is more common in shaded streams and rivers. It has a tightly constructed gravel retreat and the net has side supports. **22, 25, 67, 68, 117.**

3 Anterior margin of frontoclypeus with a shallow concavity on the left side; head longer than wide . . . . **Orthopsyche fimbriata** (McLachlan)

Inhabits small stony streams. Retreat a compact structure mainly of mineral particles. **22, 68, 117.**

—Anterior margin of frontoclypeus straight; dorsal surface of head almost round . . . . **Orthopsyche thomasi** (Wise)

Best known from small, forest streams in the northern half of the North Island. Retreat a loose structure made of fine gravel. **22, 68.**

Hydroptilidae (J. D. STARK)

Six species have been described from New Zealand, 1 in the widespread genus *Oxyethira* and 5 in the endemic genus *Paroxyethira*. Larvae of 2 species were described by Cowley (**22**) and the larva of a 3rd (*P. tillyardi* Mosely) has now been positively identified.

1 With a case **2**

—Without a case; either instars 1-4 of all species, or 5th instar larvae which have lost their cases **5**

2 Case the shape of a flask or axehead (Fig. 71) **Oxyethira albiceps** (McLachlan)

Widely distributed in freshwaters from sea level to about 900 m. All life history stages exhibit considerable variation in size and may be found throughout the year. **22.**

—Case approximately rectangular . . . . **Paroxyethira, 3**

3 Case with spine-like projections which interrupt its otherwise smooth outline . **4**

—Case without projections (Fig. 72) . . . . **Paroxyethira eatoni** Mosely

. . . . **Paroxyethira kimminsi** Leader

. . . . **Paroxyethira hintoni** Leader

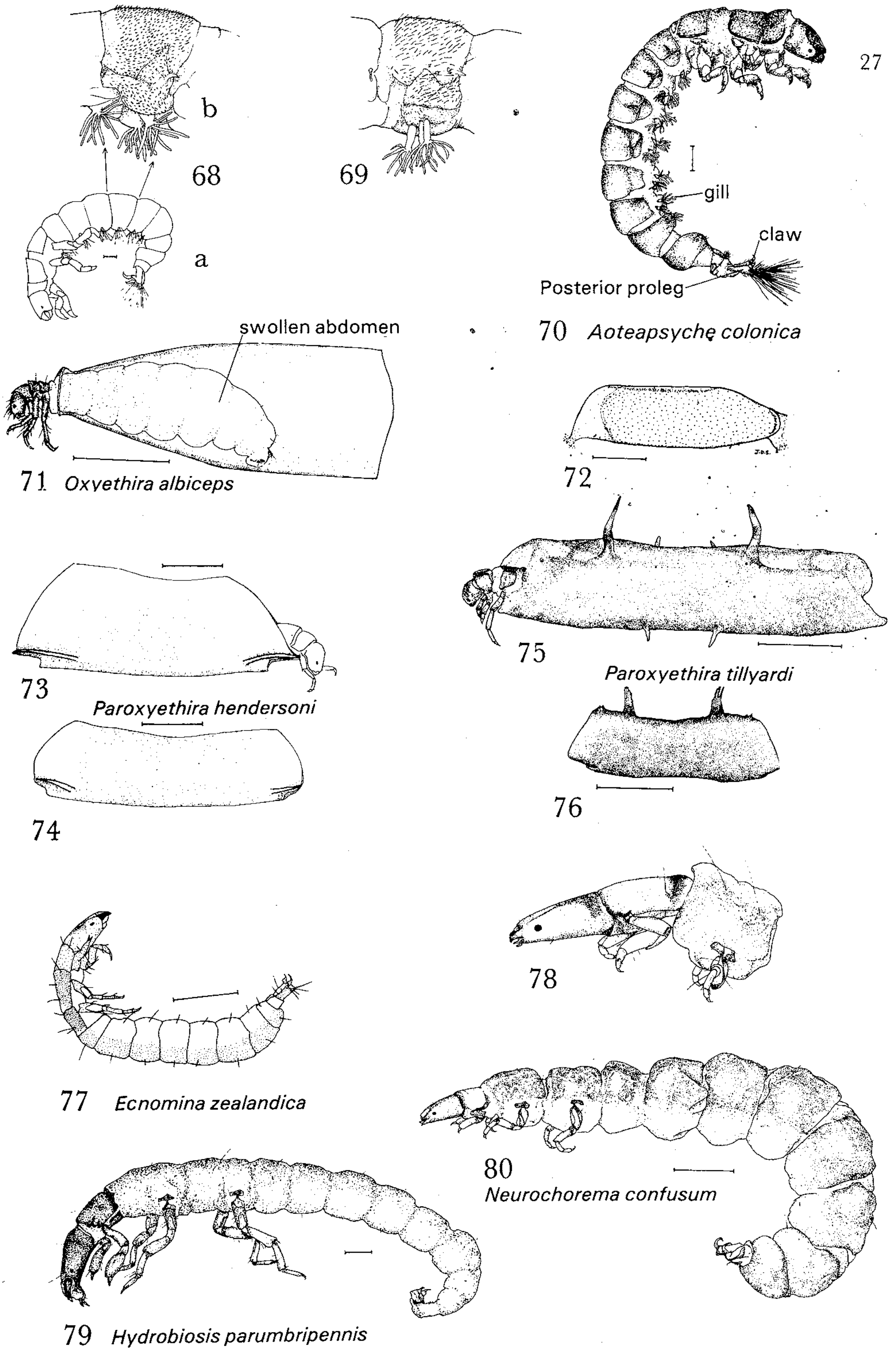
These 3 species are not well known and as yet their larvae cannot be told apart. *P. eatoni* inhabits small ponds, seeps, tarns, and the quieter stretches of streams and often is associated with filamentous algae and diatoms. *P. kimminsi* is known only from quieter parts of streams in the Waitakere Ranges near Auckland. *P. hintoni* is known from mountain streams above 600 m. **60.**

4 Case with 2 horizontal projections at each end (Figs 73, 74) . . . . **Paroxyethira hendersoni** Mosely

Larvae occur widely in a variety of freshwater habitats from sea level to at least 1320 m. Case shape and size can be highly variable. **22, 59, 60, 96**

—Case with up to 4 lateral and 2 dorsal projections; often darkly pigmented, sometimes black (Figs 75, 76) . . . . **Paroxyethira tillyardi** Mosely

Known only from lakes where larvae are found on algal coated macrophytes and stones. Larval cases vary considerably in shape and in numbers and development of spines.



Figs 68-80. Trichoptera. **68-70,** Hydropsychidae: 68, *Orthopsyche:* a, larva; b, abdominal segment; 69, *Aoteapsyche,* abdominal segment; 70, *Aoteapsyche colonica,* larva. **71-76,** Hydroptilidae: 71, *Oxyethira albiceps,* larva; 72, *Paroxyethira eatoni,* pupal case; 73, 74, *Paroxyethira hendersoni,* cases; 75, 76, *Paroxyethira tillyardi,* cases. **77,** *Ecnomina zealandica* (Ecnomidae), larva (after Cowley (22)). **78-80** Rhyacophilidae: 78, *Psilochorema* sp., head and pronotum; 79, *Hydrobiosis parumbripennis,* larva; 80, *Neurochorema confusum,* larva. Scale bar = 1 mm.

5 Prothorax narrower than head; abdomen tapering gradually posteriorly and possessing long setae; anal appendages long and slender .... **Instars 1-4, all species**

At present it is not possible to separate early instars of the 6 species. **59.**

—Prothorax as broad as or broader than head; abdomen large and swollen, usually laterally flattened .... **Final instar larvae**

P. hendersoni and *P. tillyardi* possess a complex spine on the inside of the ventral prolongation of the protarsus, but *O. albiceps* lacks this spine. In addition, the tarsal claw of the hind limb of *P. hendersoni* is about 20 times as long as its basal width whereas it is only 10 times as long in *P. tillyardi*. The condition pertaining in the other *Paroxyethira* species is not known.

Ecnomidae

Considered a subfamily of Psychomyiidae by Cowley (**22**), the ecnomids are given family status by most authors (**89**). There is 1 New Zealand species, *Ecnomina zealandica* Wise (Fig. 77), whose larva has been found only recently. **22, 116.**

The larva of our only species of Psychomyiidae (Psychomyiinae), *Zelandoptila moselyi* Tillyard, has not been described but according to A. G. McFarlane (pers. comm.) it is very similar to that of *E. zealandica*. Both species have a large, forward-projecting foretrochantin with 2 apical spines.

Rhyacophilidae

Fifty-seven species of rhyacophilid have been described from New Zealand but larvae have been associated with only 22 species in 7 genera. Larvae of *Atrachorema* and *Synchorema* are unknown. Because so many larvae are unknown and because differences between larvae of many known species are small, e.g., in *Psilochorema, Costachorema,* and *Hydrobiosis,* positive associations with adults should be made whenever possible. This can be done by rearing larvae or by examining mature male pupae which occur in stone shelters attached firmly to stones in the larval habitat. Since the larval sclerites are retained within the pupal case, positive associations between stages can be made.

1 Prosternum with 1 sclerite **2**

—Prosternum with 3 or more sclerites **7**

2 Prosternal sclerite longer than wide, shield-like, the posterior margin black and with thick black lines extending forward near the lateral margins; abdomen green (Figs 78, 83) .... **Psilochorema**

Larvae of 5 of the 10 known species are described by McFarlane (**65**). Shape of the prosternum and minor differences in pigmentation of the head and pronotum are used in species identification. However, differences are small and McFarlane's descriptions and figures can be misleading. Species are easily recognised from the adult male genitalia which are developed in late pupae. The larva attributed to *P. mimicum* McLachlan by McFarlane (**65**) is *P. tautoru* McFarlane. Habitat — forested and open, stony streams. **65, 136.**

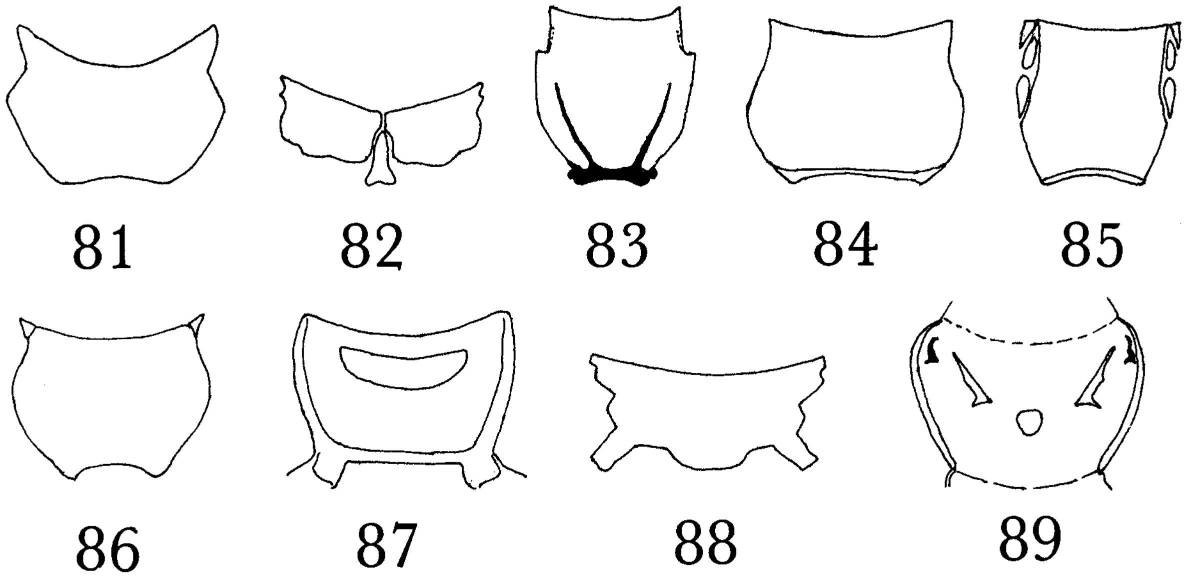
—Prosternal sclerite not longer than wide **3**

3 Prosternal sclerite more than twice as broad as long **4**

—Prosternal sclerite nearly square.. **5**

4 Prosternal sclerite a simple, almost crescentic, band; chela very rudimentary (Fig. 87) .... **Tiphobiosis**

Of 6 described species, only *T. montana* Tillyard is known as a larva. It inhabits small mountain streamlets and seepages. **65**



Figs 81-89. Trichoptera. Rhyacophilidae, prosternal plates (after McFarlane (65)): 81, *Hydrobiosis umbripennis;* 82, *Hydrobiosis clavigera;* 83, *Psilochorema bidens;* 84, *Edpercivalia maxima;* 85, *Hydrochorema crassicaudatum;* 86, *Neurochorema confusum;* 87, *Tiphobiosis montana;* 88, *Costachorema xanthoptera;* 89, *Costachorema callista.*

—Prosternal sclerite roughly rectangular, its anterior margin shallowly concave, and its posterior margin irregular in outline; chela massive (Fig. 88) .... **Costachorema** (in part)

Larvae of 4 of the 5 known species have been described of which only *C. xanthoptera* McFarlane keys out here. Habitat includes cold seepage streams with vegetation. **65.**

5 Posterior margin of prosternal sclerite straight, thickened and heavily pigmented, the pigmentation projecting forward as a "knob" in the midline; head and thoracic sclerites brown with little patterning (Fig. 84) .... **Edpercivalia**

These characters identify *E. maxima* (McFarlane), the only 1 of 8 species whose larva is described. Habitat — forested mountain streams. **65.**

—Posterior margin of prosternum convex or concave and without a median pigment projection **6**

6 Posterior margin of prosternal sclerite not thickened, and ranging in shape from roughly convex to shallowly concave (Fig. 81) .... **Hydrobiosis** (in part)

Larvae of 8 of the 18 known species are described and of these 6 have the prosternum consisting of a single plate. Species differ mainly in pigmentation patterns of the head and pronotum, and are well described and figured by McFarlane. The best known and probably most widely distributed species is *H. parumbripennis* McFarlane (Fig. 79) which is commonly found in fairly open, stony streams. **25, 65, 136.**

—Posterior margin of prosternal sclerite dark, concave; abdomen dark green with a dorsolateral row of diffuse spots (Fig. 86) .... **Neurochorema**

Of 4 species only the larva of the common and widely distributed *N. confusum* (McLachlan) (Fig. 80) is described. Habitat — open stony streams. **65, 136.**

7 Prosternum consisting of 3 sclerites **8**

—Prosternum with a large sclerite and 3 small sclerites at each side; head long and narrow, reddish-brown; abdomen white (Fig. 85) .... **Hydrochorema, 9**

8 Prosternum with 2 sclerites partly separated by a small, triangular plate (Fig. 82) .... **Hydrobiosis** (in part)

2 species, *H. silvicola* McFarlane and *H. clavigera* McFarlane, are known to have this form of prosternum. **65**.

—Prosternal sclerites consisting of a central disc and 2 narrow, triangular lateral plates (Fig. 89) .... **Costachorema** (in part)

3 species, *C. psaroptera* McFarlane, *C. callista* McFarlane, and *C. brachyptera* McFarlane, belong here. They are difficult to tell apart as larvae, more so than McFarlane's (**65**) descriptions and figures suggest, and all inhabit swift, mountain streams.

9 Length up to 23 mm; prosternum almost twice as long as broad ....
Hydrochorema tenuicaudatum Tillyard

Inhabits heavily shaded shingle-bedded streams in mountainous areas. **65**.

—Length up to 11 mm; prosternum almost square ....
Hydrochorema crassicaudatum Tillyard

Widely distributed in fast flowing, stony, forest streams. **65**.

Polycentropodidae

The New Zealand fauna consists of 5 species of *Polyplectropus* (Fig. 90) and 1 species of *Plectrocnemia* (*P. maclachlani* Mosely). The genera are very difficult to tell apart as larvae, and the attempt made by Cowley (**22**) using small differences in body proportions and colour is not entirely convincing. Since *P. puerilis* (McLachlan) is the only species of *Polyplectropus* with a described larva, the range of characters within the genus is unknown and no generic key is given here. Using a recent North American key (**124**), *P. puerilis* larvae key out to *Polycentropus*, not *Polyplectropus*, suggesting that the generic placements of our species may need to be reviewed. New Zealand polycentropodids inhabit large rivers and small streams, and occupy untidy nets and galleries. **22, 136.**

Philopotamidae

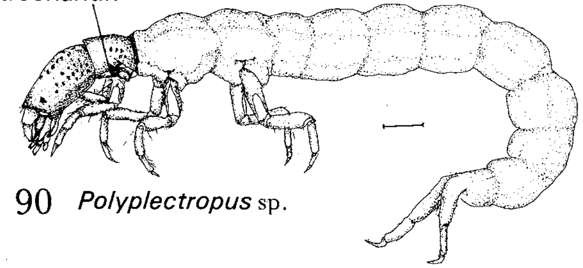
The New Zealand fauna comprises *Neobiosella irrorata* Wise whose larva is unknown, and 3 species of *Hydrobiosella*, 2 with described larvae and 1, *H. tonela* (Mosely), without. *Hydrobiosella* is accepted as a genus following Neboiss (**89**) rather than as a subgenus of *Dolophilodes* as used by Wise (**142**) and Cowley (**20, 22**).

1 Pronotum with 4 hairs on lower half of mid-lateral region, 2 close to the margin; fore femur 3 times as long as wide .... **Hydrobiosella mixta** (Cowley)

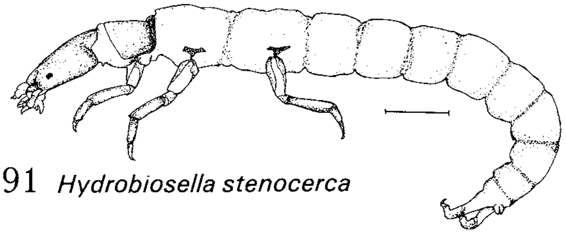
Common in the North Island in small forest streams. Larvae occupy tubular stocking-like nets. **20, 22**

—Pronotum with 2 hairs on lower half of mid-lateral region, 1 close to the margin; fore femur less than 3 times as long as wide (Fig. 91) ....
Hydrobiosella stenocerca Tillyard

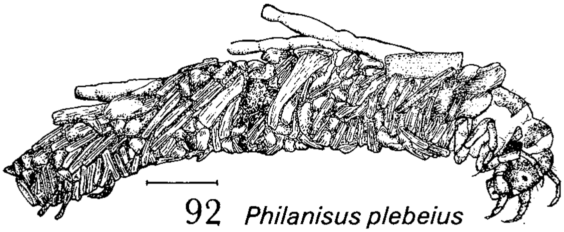
Common in small, South Island forest streams. Like *H. mixta,* larvae occupy very fine-meshed tubular nets. **22, 137.**



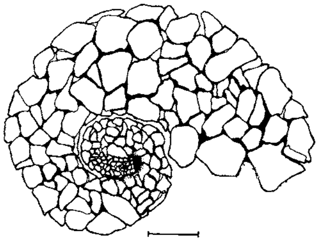
90 *Polyplectropus* sp.



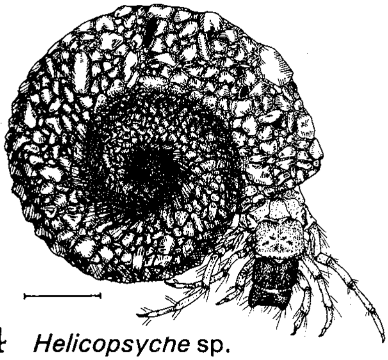
91 *Hydrobiosella stenocerca*



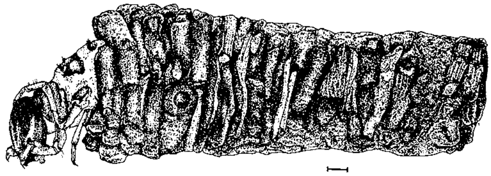
92 *Philanisus plebeius*



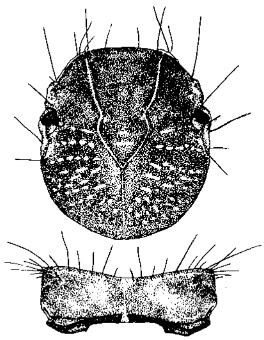
93 *Rakiura vernale*



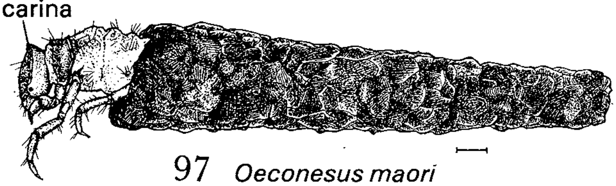
94 *Helicopsyche* sp.



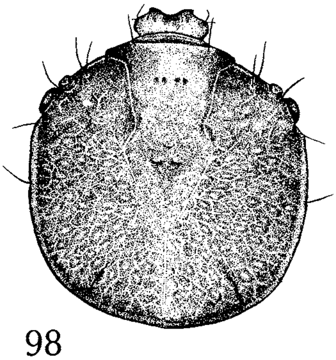
95 *Zelandopsyche ingens*



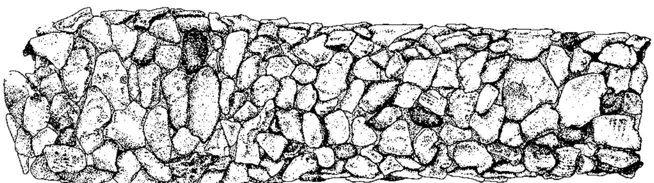
96



97 *Oeconesus maori*



98



99 *?Pseudoeconesus* sp.

Figs 90-99. Trichoptera larvae. **90,** *Polyplectropus* sp. (Polycentropodidae). **91,** *Hydrobiosella stenocerca* (Philopotamidae). **92,** *Philanisus plebeius* (Chathamiidae). **93, 94,** Helicopsychidae: 93, *Rakiura vernale* (after Michaelis (86)); 94, *Helicopsyche* sp. **95-99,** Oeconesidae: 95, 96, *Zelandopsyche ingens:* 95, larva; 96, head and pronotum; 97, *Oeconesus maori*; 98, 99, *?Pseudoeconesus* sp.: 98, head; 99, case. Scale bar = 1 mm.

Chathamiidae

1 Legs including tarsi unicolorous (Fig. 92) .... **Philanisus plebeius** Walker

Common around much of the New Zealand coast in the rocky, intertidal zone. Larval cases constructed of irregular algal fragments. **22, 109, 138.**

—All tarsi with a prominent, broad, dark band .. **Chathamia integripennis** Riek

Common, at least north of Auckland in the intertidal zone where it has almost certainly been confused with *P. plebeius* (60a, 61). The key characters used by Riek (109) to distinguish *Chathamia* from *Philanisus* (arrangement of spicules laterally on abdominal segment 8; setation of pronotum) are based on the Chatham Islands species, *C. brevipennis* Tillyard and will not separate *C. integripennis* from *P. plebeius*.

Helicopsychidae

1 Top of head almost circular, strongly carinate; anterior margin of pronotum strongly concave and with anterior angles projecting forward .... **Rakiura**

1 species, *R. vernale* McFarlane (Fig. 93), known only from a few localities in the South Island and Stewart Island. It should be noted that the form of the case changes markedly with age from a straight tube in instar 1 to a curved tube (instar 2), a spiral case (instars 3 & 4), and finally a spiral case with a tubular projection. **22, 86.**

—Top of head longer than broad, usually with 2 weakly developed carinae; anterior margin of pronotum straight or weakly convex without forwardly projecting angles (Fig. 94) .... **Helicopsyche, 2**

4 species have been described but 1 of these, *H. howesi* Tillyard, is of dubious validity.

2 Ventral edge of fore femur without short spines .... **Helicopsyche poutini** McFarlane

Known from the central North Island and northwest Nelson where it inhabits rock crevices in streams. **22.**

—Ventral edge of fore femur with 12 or more short spines **3**

3 Head broad and evenly rounded across the upper part of the capsule .... **Helicopsyche albescens** Tillyard

Widely distributed in the South Island and known from the central North Island. Occurs in crevices and under stones in streams. The key character is not definite enough to guarantee that this species will always be correctly identified. **22.**

—Head sloping away laterally from the top of the capsule (i.e., less evenly rounded than above). .... **Helicopsyche zealandica** Hudson

The commonest New Zealand species which occurs throughout the North Island and in the north and west of the South Island. Larvae occur in the same habitats as those of *H. albescens* with which they are easily confused. **22.**

Oeconesidae

The family contains 14 named species in 5 genera but few larvae have been described. Those of *Tarapsyche* and *Zepsyche* are unknown. Genera with described larvae are discussed below.

Zelandopsyche: 1 described species, *Z. ingens* Tillyard (Figs 95, 96), and a 2nd species yet to be described, known from Westland. Head capsule shiny, lacking a coating of short hairs; anal claws with 3 small secondary claws; posterior and lateral mesonotal plates with broad, black posterior margins; cases of plant fragments, transversely laid twig sections in final instar *Z. ingens.* **22, 88, 137, 139.**

Oeconesus: 4 species have been described but all may not be valid. Larvae of *O. maori* McLachlan (Fig. 97) and *O. similis* Mosely have been described by Cowley (**22**) but are more difficult to distinguish than his key suggests. Head capsule with a coating of short hairs giving it a dull appearance; anal claws with 2 small secondary claws; cases tubular, made from a mixture of plant and mineral particles. **22, 88.**

Pseudoeconesus: 7 described species but again it is unclear how many of these are valid. No larvae have been described, but larvae suspected to belong to this genus (probably *P. stramineus* McLachlan) are known (Figs 98, 99). Head capsule shiny with a distinct pattern of light spots; anal claw with 2 small secondary claws; cases as for *Oeconesus*.

Oeconesid larvae typically occur in forested streams containing large quantities of plant debris. *O. maori* is probably widely distributed but *Z. ingens* may be confined to the central and northern South Island.

Leptoceridae

1 Sickle-shaped, 3-toothed mandibles extending beyond the front of the head; metanotum without definite plates . . . . **Oecetis, 2**

—Mandibles short and triangular; metanotum with 2 or 3 pairs of plates 3

2 Middle and hind pretarsal claws distinctly curved and with a basal spine . . . . **Oecetis iti** McFarlane

A poorly known species inhabiting lakes and sluggish streams. **22.**

—Middle and hind pretarsal claws faintly curved and without a basal spine (Fig. 100). . . . . **Oecetis unicolor** (McLachlan)

Occurs in lakes and on sandy substrata in rivers. **22.**

3 Hind tibia a single, unbroken segment . . . . **Hudsonema, 4**

—Hind tibia with a median "false joint" (Fig. 104) 5

4 Tibia and femur striped; case made mainly of coarse sand grains (Fig. 101) . . . . **Hudsonema amabilis** (McLachlan)

The most widespread New Zealand leptocerid; an inhabitant of rivers, streams, and lakes. Note that the yellow and black striped head pattern is much more pronounced in larvae from the North than South Island. **22**

—Legs unicolorous pale brown; case of spirally arranged, longitudinally placed, plant fragments (Fig. 102) . . . . **Hudsonema aliena** (McLachlan)

Occurs widely in rivers and streams containing vegetation. **22**

5 Anal claw with 2 secondary barbs . . . . **Triplectidina**

1 known species, *T. oreolimnetes* (Tillyard), which occurs in small pools including tarns. Case of sand grains or small plant fragments. **22.**

—Anal claw with 1 secondary barb . . . . **Triplectides, 6**

6 Frontoclypeus with 3 pale patches; anterior margin of pronotum with blunt, rounded teeth (Fig. 103) . . . . **Triplectides cephalotes** (Walker)

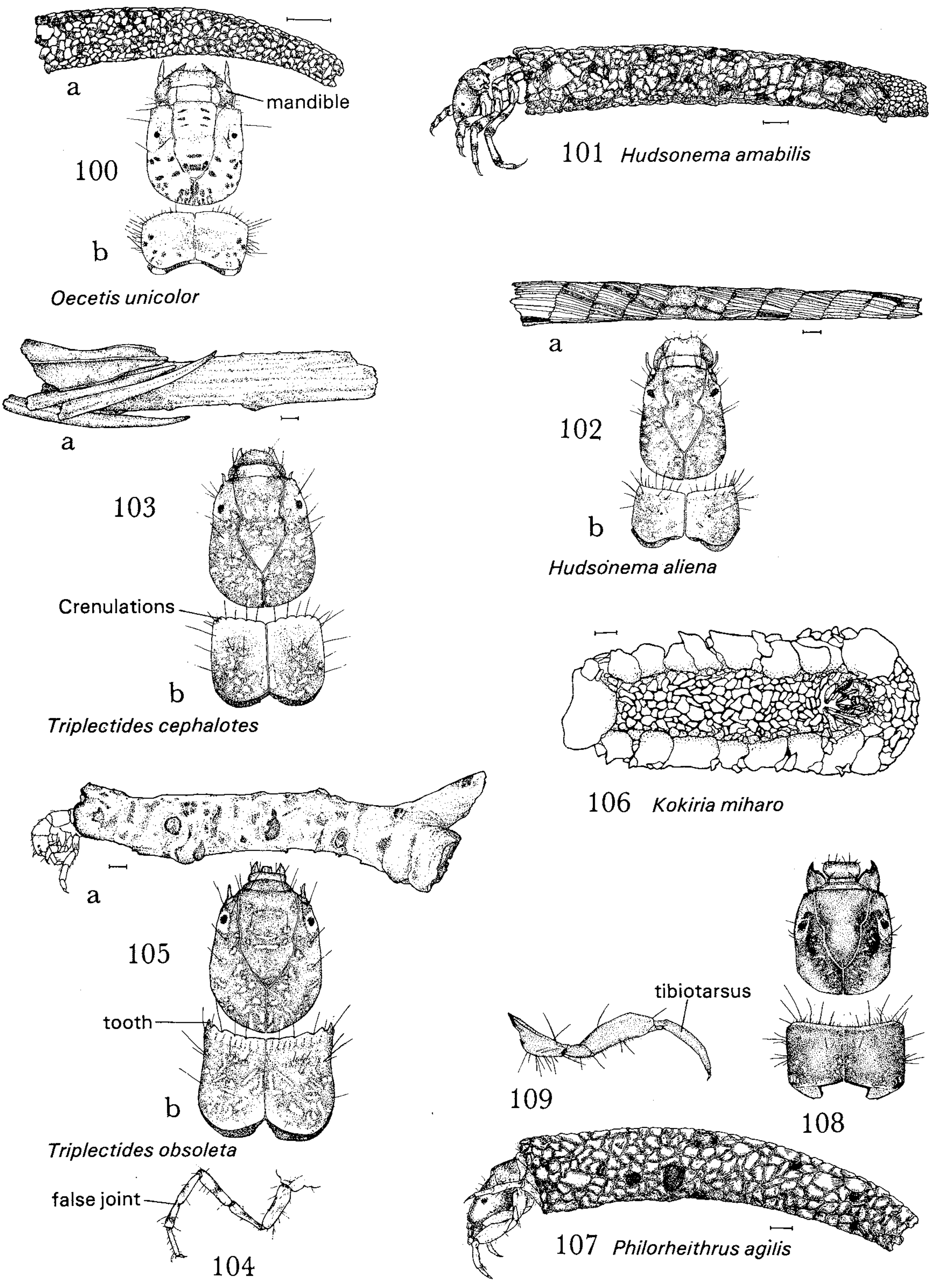
Widely distributed in lakes and other still waters. Case usually of plant fragments. **22, 96.**

—Frontoclypeus without pale patches; anterior margin of pronotum with prominent, pointed teeth laterally (Fig. 105) . . . . **Triplectides obsoleta** (McLachlan)

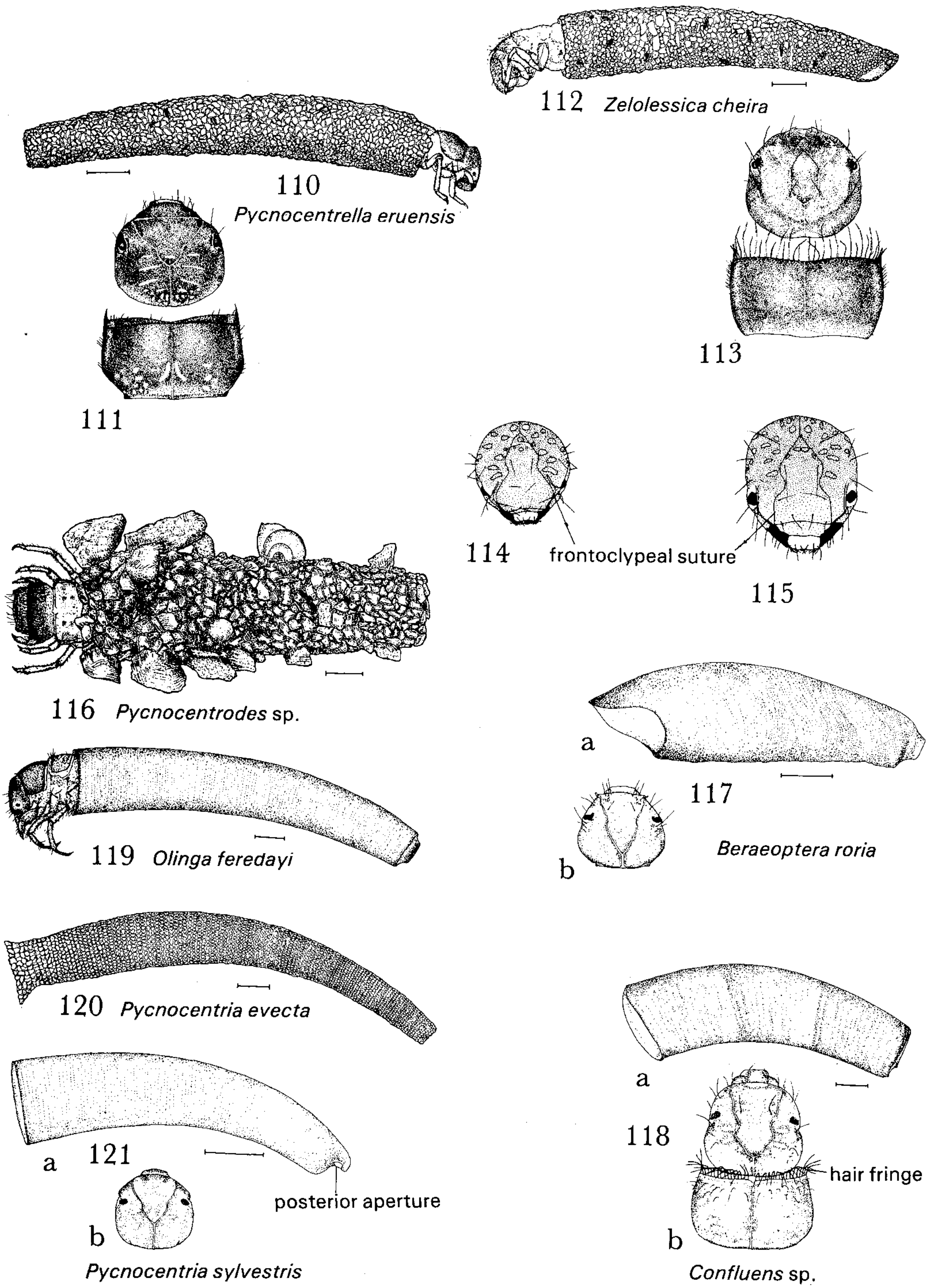
Common in streams and rivers. Case variable in form, constructed from hollow sticks, or pieces of leaf, stick, bark, etc. **22.**

Kokiriidae

A single species, *Kokiria miharo* McFarlane (Fig. 106), known only from two localities in north Westland—northwest Nelson. Cowley (**22**) found larvae were abundant on stable sand banks in a gently flowing stream. **22, 87.**



Figs 100-109. Trichoptera. **100-105,** Leptoceridae: 100, *Oecetis unicolor:* a, head and pronotum; b, case; 101, *Hudsonema amabilis,* larva in case; 102, *Hudsonema aliena*: a, case; b, head and pronotum; 103, *Triplectides cephalotes:* a, case; b, head and pronotum; 104, 105, *Triplectides obsoleta:* 104, hind leg; 105, a, case; b, head and pronotum. **106,** *Kokiria miharo* (Kokiriidae), larva in case (after Cowley (22)). **107-109,** *Philorheithrus agilis* (Philorheithridae): 107, larva; 108, head and pronotum; 109, middle leg. Scale bar = 1 mm.



Figs 110-121. Trichoptera. **110, 111,** *Pycnocentrella eruensis* (Calocidae): 110, larva; 111, head and pronotum. **112-115,** Helicophidae: 112, 113, *Zelolessica cheira:* 112, larva; 113, head and pronotum; 114, *Zelolessica* head (after Cowley (22)); 115, *Alloecentrella* head (after Cowley (22)). **116-121,** Conoesucidae: 116, *Pycnocentrodes* sp., larva; 117, *Beraeoptera roria:* a, case; b, head; 118, *Confluens* sp.: a, case; b, head and pronotum; 119, *Olinga feredayi,* larva; 120, *Pycnocentria evecta,* pupal case; 121, *Pycnocentria sylvestris:* a, case; b, head. Scale bar = 1 mm.

Philorheithridae

Two species have been described; *Philorheithrus agilis* (Hudson) (Figs 107-109) and *P. lacustris* Tillyard. However, the latter should probably be synonymised with *agilis*. Larvae are common in beech and some other forest streams in the South Island and lower North Island. **22, 137.**

Calocidae

This family has been referred to in the New Zealand literature as Pycnocentrellidae, a synonym of Calocidae (**89**). One New Zealand species, *Pycnocentrella eruensis* Mosely (Figs 110, 111), is known from forested streams in the central North Island, Wellington, Nelson, and Westland, where it may be abundant. **22.**

Helicophidae

1 Frontoclypeal suture of head bulging out and then in to the front of the face (Fig. 114); posterior aperture of case broader than long . . . . **Zelolessica**

1 described species, *Z. cheira* McFarlane (Figs 112-114), and the larva of a second undescribed species are known. Cowley (**22**) misassociated the larvae of these 2 species which are usually found in association with liverworts and mosses in swift, stable, rocky streams. **19, 22.**

— Frontoclypeal suture bulging out and then running parallel to the long axis of the head to its anterior margin (Fig. 115); posterior aperture of case longer than broad . . . . **Alloecentrella**

1 species, *A. magnicornis* Wise, which is probably widely distributed in similar habitats to *Zelolessica*. **22.**

Conoesucidae

Until now, all New Zealand members of this family have been referred to Sericostomatidae. Neboiss (**89**) included the New Zealand genera *Pycnocentria*, *Olinga* and *Conuxia* in subfamily Conoesucinae which he raised to family level but left the remainder in Sericostomatidae. Subsequently, Cowley (**22**) concluded that "all New Zealand species are conoesucines" an assessment which is accepted here.

1 Roof of head capsule almost flat and marked off from the rest of the head by distinct carinae; abdomen cream to green (sometimes yellow-orange); coarse sand grain case sometimes with larger stones attached to the sides (Fig. 116) . . . . **Pycnocentrodes**

The genus contains 3 apparently valid species whose larvae are extremely difficult to tell apart. The pronotal characters used by Cowley (**22**) to distinguish the species have yet to be tested adequately. *P. aeris* Wise and *P. aureola* (McLachlan) are widely distributed and often are common, especially in large lowland steams where they may occur together. *P. aureola* also inhabits the littoral zone of lakes, but is not known north of Lake Waikaremoana. *P. modesta* Cowley is known only from the northern half of the North Island where it occurs mainly in smaller forested streams, often with *P. aeris*. **20, 22, 106, 117.**

— Head capsule not strongly carinate but more or less rounded **2**

2 Case completely of secreted material (or with very few sand grains incorporated), its anterior aperture markedly oblique; abdomen pale cream and green (Fig. 117) . . . . **Beraeoptera**

1 species, *B. roria* Mosely, widely distributed in a range of stony streams with moderate flow. Especially common in the central North Island. **22, 117**

— Case secreted, or completely or partly covered in sand grains; anterior aperture straight or only slightly oblique **3**

3 Secreted case; pronotum with a prominent fringe of long, black hairs on the anterior margin; abdomen green (Fig. 118) .... **Confluens**

2 described species, *C. hamiltoni* (Tillyard) and *C. olingoides* (Tillyard), of which only the former has a described larva. *C. hamiltoni* apparently occurs only in the North Island where it is usually found associated with moss, liverwort, or algae in swiftly flowing streams. *C. olingoides* is known only from the South Island. Larvae from Banks Peninsula (Fig. 118) resemble those of *hamiltoni* and occur in the conditions described above. **22**

—Case secreted or sand grain covered; pronotum without a prominent anterior fringe of hairs **4**

4 Case having a mixture of secreted and fine, sand grain covered areas; abdomen green; associated with mosses and liverworts in swift, clean water .... **Conuxia**

1 widely distributed species, *C. gunni* (McFarlane) **22**

—Abdomen cream-white; not usually associated with mosses or liverworts **5**

5 Entirely secreted case with a straight anterior aperture (Fig. 119) ...... **Olinga**

3 species have been described from New Zealand, but *O. jeanae* McFarlane and *O. fumosa* Wise differ only in colour and size from *O. feredayi* (McLachlan) and should probably be referred to that species. Differences between larvae of *feredayi* and *jeanae* described by Cowley (**22**) are not consistent in our experience (**137**). No larva has been described for *fumosa*. *O. feredayi* is one of our commonest caddisflies and occurs most frequently in stony steams of low or moderate flow. The 1st instar larva has a sand grain case. **22, 117, 137.**

—Case entirely or largely composed of sand grains, or, if these are lacking, with the posterior aperture ventrally placed .... **Pycnocentria**

5 described species, including *P. hawdonia* McFarlane and *P. forcipata* Mosely without described larvae. Characteristics of larvae of the other 3 species are given below.

P. evecta McLachlan: Case long and tapered, of secreted material covered with small, even sand grains laid down in a neat, continuous spiral (Fig. 120). Head and pronotum golden brown. This is the commonest and most widely distributed species of *Pycnocentria*, often found on vegetation or stony substrates in moderately slow flowing streams. **22.**

P. sylvestris McFarlane: Case short and curved, of secreted material variably or not at all covered in small, but irregular sized, sand grains; posterior aperture in a ventral notch (Fig. 121). Head and pronotum with distinctive golden-brown mottling on a dark brown, granular background. Known from the central North Island and northern and central South Island, usually associated with wood in forest streams. **22, 67.**

P. funerea McLachlan: Case short and curved, of secreted material completely covered in small, but irregular sized sand grains; posterior aperture terminal not ventral. Head and pronotum medium-dark brown, sometimes pale patches around the eyes. Known from the North and South Islands on stones in quiet parts of forest streams. Particularly common in the central North Island. **22.**

Hemiptera (water bugs)

New Zealand possesses a small fauna of aquatic Hemiptera with only 6 families having truly aquatic or water associated members. The only major systematic work on the group is Young's (**147**) revision of the Corixidae and Notonectidae (waterboatmen and backswimmers).

1 Antennae shorter than head, inserted beneath the eyes and not plainly visible from above; aquatic or semi-aquatic (i.e., at the water's edge) 2

—Antennae larger than the head, inserted in front of the eyes and plainly visible from above; water surface dwellers or semi-aquatic 5

2 Body dorsoventrally flattened; beak (labium) triangular, very short, unsegmented; foreleg about ½ length of middle leg, its tarsus a single scoop-like segment without a claw; waterboatmen, swim dorsal side up . . . **CORIXIDAE, 3**

—Body laterally compressed; beak several times as long as broad, segmented; foreleg little shorter than middle leg, its tarsus not scoop-like and with a pair of terminal claws; backswimmers, swim ventral side up . . . . . **NOTONECTIDAE, 4**

3 Head with 2 prominent ocelli (Fig. 122) . . . . **Diaprepocoris**

1 described species, *D. zealandiae* Hale, found most commonly in weedy, lentic habitats. **147**

—Head without ocelli (Fig. 123) . . . . **Sigara**

5 species are described but only the males can be identified with certainty; juveniles cannot be separated. Identification is based on small diferences in size and shape of the pala, strigil, and right clasper, and the reader is referred to Young (**147**) for details. The commonest species is *S. arguta* (White) which occurs in most still waters. **96, 147, 148.**

4 Claws of foreleg ½ as long as tarsal segment in male, equal to distal tarsal segment in female; with a prominent facial tubercle (projection immediately above the labrum) (Fig. 124) . . . . **Anisops wakefieldi** White

See notes about *A. assimilis* below.

—Claws of foreleg about ¼ as long as tarsal segment in male, ½ as long as distal tarsal segment in female; without a facial tubercle . . . . **Anisops assimilis** White

Both species have variable pigmentation; thoracic size and shape dependent on flight muscle development. Both are widely distributed in ponds and other vegetated waters, slow streams, and at lake margins. Although key characters appear straightforward, in practice it is not always easy to identify notonectids with confidence. **96, 147, 148.**

5 Body long and slender; head nearly 3 times as long as broad; eyes not at base of head . . . . **HYDROMETRIDAE**

1 described species, *Hydrometra risbeci* Hungerford (Figs 125, 126), a yellowish-brown to dark brown insect which occurs in winged and wingless forms. Note that the specific name has been misspelt *ribesci* in most recent literature. **96.**

—Body not elongated; head short and broad with eyes at its base 6

6 Membrane of wing with 4 or 5 distinct and similar cells clearly visible when the insect is at rest; semi-aquatic at the edges of lakes, etc. . . . . **SALDIDAE**

Little is known about the distribution or biology of saldids in New Zealand. 7 species of *Saldula* are listed by Wise (**142**); *S. stoneri* Drake & Hoberlandt is water-associated in North Island thermal areas, and *S. parvula* Cobben occurs on estuary shores. **82, 131.**

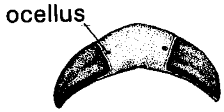
—Winged or wingless insects less than 3 mm long without 4 or 5 distinct cells in the wing membrane; surface film dwellers or in damp, semi-aquatic sites 7

7 Claws inserted well before apex of last tarsal segment . . . . **VELIIDAE**

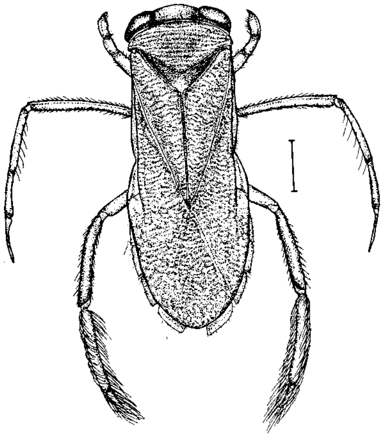
1 genus, *Microvelia* (Fig. 127), but the number of species in New Zealand is unclear; 2 have been recorded, *M. macgregori* (Kirkaldy) (common and widespread) and *M. halei* Esaki (= *M. oceanica* Distant), but Don (**33**) indicates that in fact there may be only one species here. On the other hand, Pendergrast and Cowley (**96**) suggest there may be more than two. Surface-film dwellers on still water. **33, 96.**

Claws apical . . . . **MESOVELIIDAE**

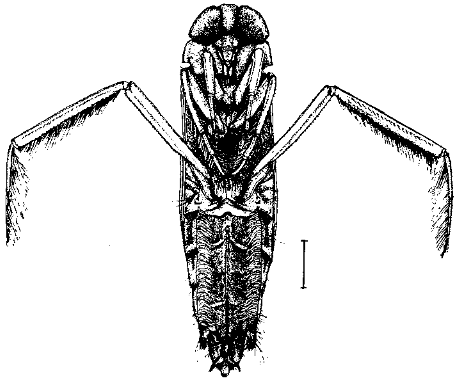
No members of the family have been identified or described from New Zealand although they have been recorded from ponds and streams in Northland and Auckland. Research in progress (J. T. Polhemus, pers. comm.) **95, 116.**



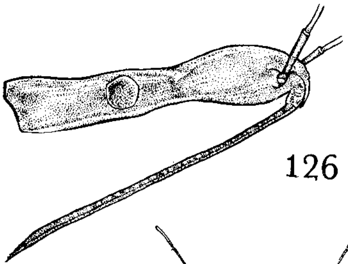
122



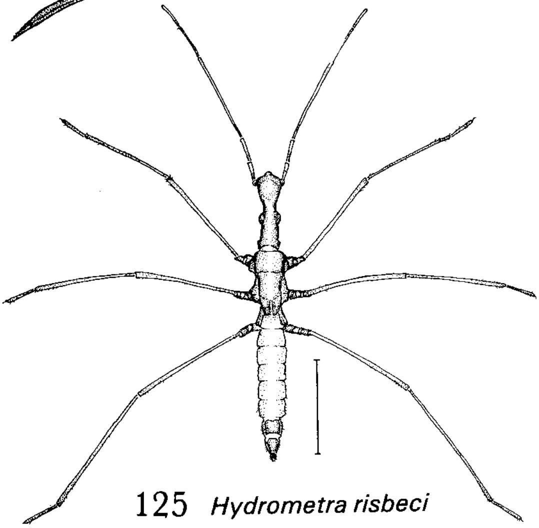
123 *Sigara* sp.



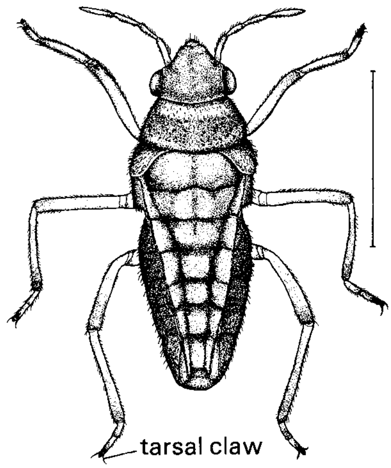
124 *Anisops* sp.



126



125 *Hydrometra risbeci*



127 *Microvelia macgregori*

Figs 122-127. Hemiptera **122-123**, Corixidae: 122, *Diaprepocoris zealandiae,* head; 123, *Sigara* sp., adult. **124,** *Anisops* sp. (Notonectidae), adult. **125, 126,** *Hydrometra risbeci* (Hydrometridae): 125, adult; 126, head, lateral view. **127,** *Microvelia macgregori* (Veliidae), adult. Scale bar = 1 mm.

Coleoptera (beetles)

Key to adults

1 With subdivided (apparently 4) compound eyes (Fig. 128); streamlined body form; mid and hind legs modified as flat paddles . . . . **GYRINIDAE**

1 species only, *Gyrinus convexiusculus* Mcleay (Figs 129, 130), an Australian immigrant known to occur in the Waikato Valley.

—With 2 compound eyes **2**

2 Antennae simple without a terminal club (Fig. 135) **3**

—Antennae with a club of 3-5 segments (Fig. 133) **5**

3 Body oval, evenly rounded; antennae 11-segmented; hind coxae extend posteriorly over 1st abdominal segment .... **DYTISCIDAE**, p.40

The common water beetles of lakes and ponds; our best known aquatic family.

—Body more elongated, not streamlined for fast swimming; hind coxae not extending over the 1st abdominal segment **4**

4 Elytra truncate (shortened), exposing at least 2 entire abdominal segments; body elongate, narrow .... **STAPHYLINIDAE**

Several species may be water-associated if not fully aquatic, but none have been identified beyond family level to date. **116.**

—Elytra covering the entire abdomen or exposing only part of 1 abdominal segment; body not excessively narrow or elongate (Fig. 131) .... **ELMIDAE**

This family has been variously referred to in the literature as Helmidae, Helminthidae, and Elminthidae, and in New Zealand members have been attributed erroneously to Parnidae and Dryopidae. The most common New Zealand genus is probably *Hydora* (Fig. 131) which has 6 described species. Elmids are widely distributed in stony streams and rivers and on some stony lake shores. **10, 116, 117.**

5 Antennae extending posterolaterally beneath the head and with a 3-segmented club (Fig. 133); maxillary palps often longer than antennae; abdomen with 5 visible sternites .... **HYDROPHILIDAE**, p. 42

—Antennal club of 5 segments; abdomen with 6-7 visible sternites; minute beetles less than 3 mm long (Fig. 134) .... **HYDRAENIDAE**

The New Zealand fauna is poorly known, and although members of the family are fairly common in forested mountain streams only 2 species of *Orchymontia* have been described. The family is currently under study. **116, 149.**

Dytiscidae (based on the keys of Ordish **91, 92, 93**)

1 Beetles less than 5 mm long; scutellum not visible **2**

—Beetles over 5 mm long; scutellum visible **9**

2 With prominent compound eyes but without long, erect setae on pronotum and elytra **4**

—Eyes absent; long erect setae present on pronotum and elytra; colour uniform brown; subterranean habitat **3**

3 Head evenly rounded anteriorly; pronotum constricted posteriorly; length 2.2-2.5 mm. .... **Phreatodessus hades** Ordish

Known from wells near Nelson in the South Island. **93**

—Head straight anteriorly; pronotum not constricted posteriorly; length 1.5-1.6 mm .... **Kuschelydrus phreaticus** Ordish

Known only from wells near Nelson. **93.**

4 Length 2.5-3.0 mm; conspicuous grooves present on pronotum and bases of elytra **5**

—Length 4-5 mm; pronotum and elytra without grooves **7**

5 Ventral surface sparsely punctured .... **Liodessus, 6**

—Dorsal and ventral surfaces uniformly punctured .... **Huxelhydrus**

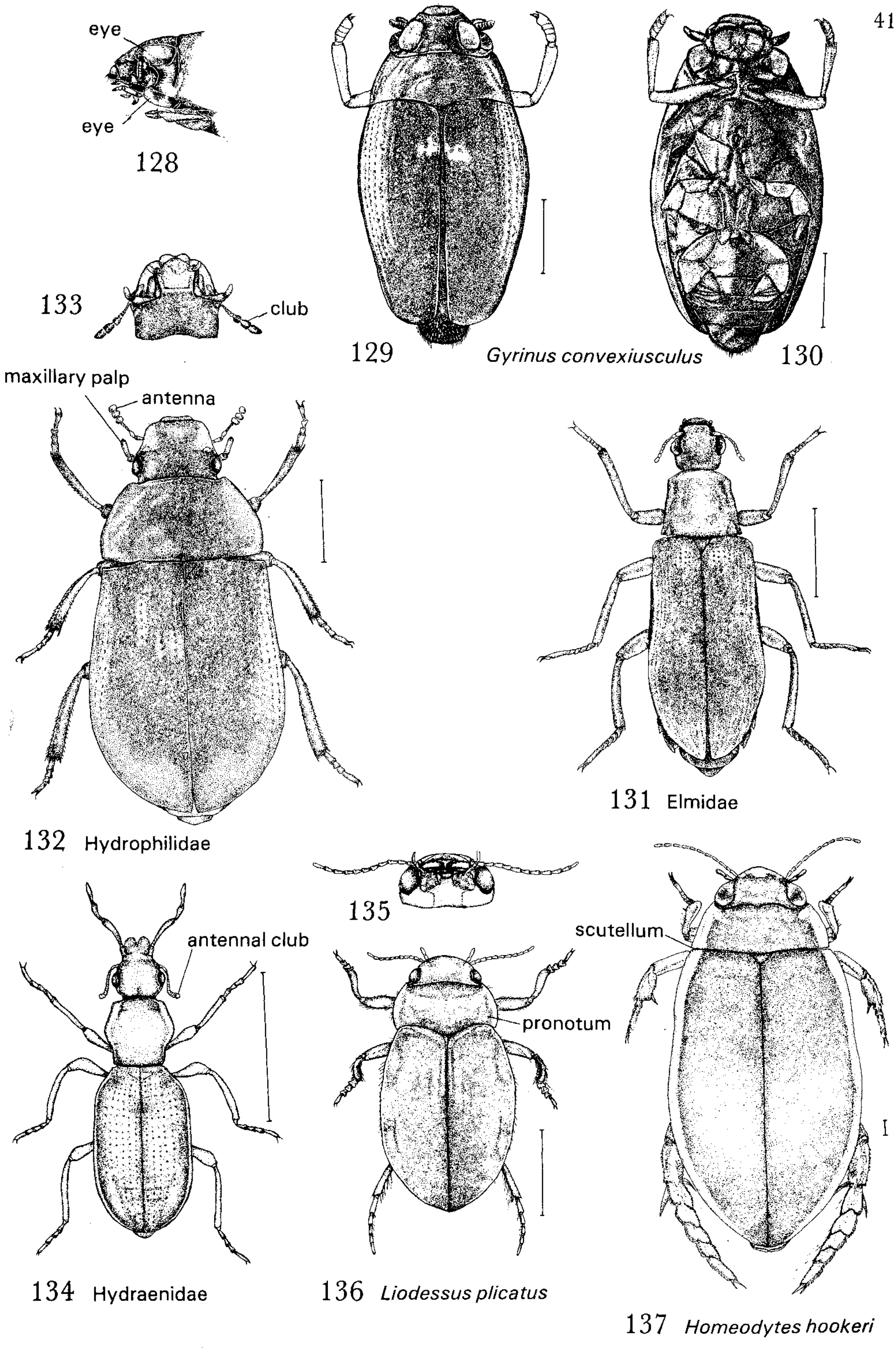
1 species, *H. syntheticus* Sharp, which is found mainly at the margins of larger rivers particularly in shingle pools. **91, 92**

6 Dark brown except for lighter anterior of pronotum; margin of eye not breaking curvature of head when viewed from above ...... **Liodessus deflectus** Ordish

Inhabits ponds and stream backwaters in many parts of New Zealand. **91.**

—Body colour not uniform; margin of eye breaking curvature of head when viewed from above (Fig. 136) .... **Liodessus plicatus** (Sharp)

One of the commonest dytiscids throughout the country. Occurs mainly in ponds, including alpine tarns and thermal pools, as well as stream backwaters. **91.**



Figs 128-137. Coleoptera, adults. **128-130,** *Gyrinus convexiusculus* (Gyrinidae): 128, head, lateral view; 129, adult, dorsal view; 130, adult, ventral view. **131,** Elmidae (*?Hydora*). **132,** Hydrophilidae (*Cylomissus*). **133,** Hydrophilidae, head, ventral view. **134,** Hydraenidae. **135-137,** Dytiscidae: 135, head, ventral view; 136, *Liodessus plicatus;* 137, *Homeodytes hookeri*. Scale bar = 1 mm.

7 4th segment of fore tarsus much shorter than the 3rd . . . . **Hyphydrus**

1 species, *H. elegans* (Montrouzier), known only from the north and southwest of the North Island in still water. **91.**

—4th segment of fore tarsus at least as long as the 3rd . . . . **Antiporus, 8**

8 Elytra not uniformly coloured, usually partly striped; anterior tarsal claw of male without a tooth at its midpoint; length about 5.0 mm . . . . **Antiporus strigosulus** (Broun)

A moderately common, widely distributed species which inhabits temporary pools, permanent ponds, and streams. **91, 116.**

—Elytra uniformly dark brown or with lighter lateral patches; anterior tarsal claw of male with a tooth at its midpoint; length about 4.2 mm . . . . **Antiporus wakefieldi** (Sharp)

Widely distributed, but apparently less common than *A. strigosulus*. Probably mainly a pond species. **91.**

9 Length less than 12 mm **10**

—Length greater than 12 mm **13**

10 Length 5-6 mm; elytra with reticulate microsculpture and fine longitudinal grooves; reddish brown . . . . **Copelatus**

1 species, *C. australis* (Clark), whose habitat has yet to be defined. Known from northern North Island. **91.**

—Length greater than 8 mm; elytra smooth **11**

11 Elytra with yellow and black longitudinal stripes and truncate apices . **Lancetes**

1 species, *L. lanceolatus* (Clark), which is probably widely distributed in lowland ponds and streams. **91.**

—Elytra uniformly coloured (brown or black) and rounded distally . **Rhantus, 12**

12 Length 12 mm; inner fore tarsal claw of male longer and less curved than outer claw . . . . **Rhantus pulverosus** (Stevens)

Widespread and often abundant in upland and lowland ponds as well as stream backwaters. **91, 96.**

—Length 10 mm; inner fore tarsal claw of male shorter than outer claw . . . . **Rhantus plantaris** Sharp

Known only from the holotype; there is some doubt whether this is even a New Zealand species.

13 Posterior femur elongate; a yellow or brown triangular mark between the eyes . . . . **Dytiscus**

1 species, the cosmopolitan *D. semisulcatus* Muller, recorded once only from New Zealand.

—Posterior femur short; front of head uniformly coloured . . . . **Homeodytes, 14**

14 Scutellum black with greenish reflections; under surface black (Fig. 137) . . . . **Homeodytes hookeri** (White)

The largest New Zealand dytiscid. Primarily a pond species, best known from the North Island, but also from Nelson province. **91, 92.**

—Scutellum reddish brown at least in the centre; under surface yellowish-brown . . **Homeodytes scutellaris** (Germar)

An Australian species, recorded only once from New Zealand.

Hydrophilidae

Seven genera are listed by Wise (**142**) and at least 1 other genus is known to occur. Because little work has been done on the family in New Zealand the following key to adults should be regarded as tentative.

1 Antennae 7-segmented; mid and hind tibiae with long swimming hairs; elytra and pronotum punctate; metasternum with a short backwardly directed process . . . . **Berosus**

2 species, *B. mergus* Broun and *B. pallidipennis* (Sharp), are described but the former may be a synonym of the latter. Habitat — stony streams. **10.**

—Antennae with other than 7 segments **2**

2 Hind tibiae curved; fringes of swimming hairs on mid and hind tibiae . . . . **Laccobius**

2 species, *L. arrowi* d'Orchymont and *L. mineralis* Winterbourn, are described. The latter inhabits thermal waters (27-38°C) in both main islands. **133.**

—Hind tibiae straight **3**

3 Maxillary palps much longer than antennae, segment 2 longest and curved, the convexity facing forward; tibiae and tarsi of all legs with some swimming hairs . . . . **Enochrus**

Species in this genus are probably the most common hydrophilids in New Zealand. They occur in ponds, ditches, and other still waters and *E. tritus* (Broun), the only described species, has been found in thermal waters (28-45°C). **133.**

—Maxillary palps about as long as antennae or shorter; swimming hairs not present on legs (Fig. 132) . . . . **several genera**

A complex of poorly defined genera including species referred to *Anacaena, Paracymus, Stygnohydrus,* and *Limnoxenus* key out here. Included are *Anacaena tepida* Winterbourn which occurs in thermal outflow channels (34-44°C) in the Rotorua region (**133, 134**); *Paracymus pygmaeus* (Macleay) which recently has been redescribed (**1**) but is known in this country only from the Auckland region; an undescribed *Paracymus* which occurs in North Island thermal waters (**133**); *Stygnohydrus femoralis* Broun whose habitat and distribution are unknown (**10**); and *Limnoxenus zealandicus* (Broun), a large beetle (length 9 mm) which inhabits weed-choked ponds and is well described by Broun (**10**). Other beetles referable to *Cylomissus* Broun (D. Miller, pers. comm.) (Fig. 132) have been taken from rotten wood in forested South Island streams.

Key to larvae

1 With jointed thoracic legs **2**

—Thoracic legs absent . . . . **CURCULIONIDAE**

The larva of a weevil, *Desiantha ascita* (Pascoe), inhabits mud among roots of swamp plants. It is cylindrical, up to 15 mm long with a red-brown head and white body. Characteristic pale-brown, spine-like spiracles occur laterally on abdominal segments 1-8. **84**

2 Tarsi with 2 movable claws **3**

—Tarsi each with a single claw **4**

3 With elongated, lateral abdominal gills; 2 pairs of stout, terminal hooks on abdominal segment 10 (Fig. 138) . . . . **GYRINIDAE**

Larvae of *Gyrinus convexiusculus* recently have been recorded in the Waikato valley. Note that Fig. 138 is not of this species but is a *Dineutes* larva from Fiji.

—Without lateral abdominal gills or terminal hooks . . . . **DYTISCIDAE**, p.44

4 Antennae multisegmented (12 + segments) and much longer than the head; body form slater-like or with an anterodorsal carapace-like extension (Figs 139, 140) . . . . **HELODIDAE**

No larvae have been positively associated with adult beetles which are not aquatic. Some larvae possess a dorsal "carapace" and superficially resemble water pennies (Psephenidae). Helodid larvae may be common in forested streams. **9, 116, 137.**

—Antennae with 2-4 segments **5**

5 Body somewhat dorsoventrally flattened: abdomen soft, 8-segmented, the posterior cloacal chamber if present without an operculum; mandibles sickle-like, prominent; lateral abdominal gills sometimes present . **HYDROPHILIDAE**, p.46

—Body rounded in cross-section; abdomen well sclerotised, 9-segmented, without lateral gills; mandibles small 6

6 9th abdominal segment with a flat, hair-fringed plate dorsally and a pair of clawed appendages ventrally (Figs 141-143) . . . . **PTILODACTYLIDAE**

Larvae of New Zealand species have not been associated with named adults. Larvae occur in forested streams, especially where detritus has accumulated. **116.**

—9th abdominal segment without a flat dorsal plate but with a ventral chamber containing retractile hooks, gills, and an operculum (Figs 144-146) . . **ELMIDAE**

A number of species have aquatic larvae of which the commonest appears to be *Hydora nitida* Broun. Since larvae and adults of other species have not been associated the discriminatory features of *nitida* are unknown. Frequently common in open and forested stony streams. **116, 117**

Dytiscidae

1 Head with a frontal projection (Fig. 147); body without lateral fringes of swimming hairs; maxillary palps 3-segmented . . . . **HYDROPORINAE, 2**

—Head without a frontal projection (Fig. 148); body with or without lateral fringes of swimming hairs; maxillary palps with 4 or more segments 5

2 Frontal projection a round-tipped cone lacking lateral notches or projections; mandibles not visible from above; caudal respiratory horn very short (about ½ length of posterior abdominal segment); length about 4 mm . . . . **Liodessus**

Features distinguishing larvae of the 2 mainland species *L. plicatus* and *L. deflectus* have not been determined, and the larva of neither species has been described formally. Common in ponds throughout the country. The larva of *Huxelhydrus syntheticus* is not known but may also key out here. **141.**

—Frontal projection spatulate, with or without lateral projections; mandibles visible from above 3

3 Frontal projection without lateral barbs; caudal respiratory horn almost as long as cerci; length about 8 mm . . . . **Hyphydrus**

The larva of the only known species, *H. elegans,* was described by Wise (**141**). Larvae are unusual in being able to move about on land.

—Frontal projection with lateral barbs 4

4 Blunt anterior projection bearing a pair of spinose, bifid, lateral projections and anterolateral spines; length 2.2 mm . . . . **Phreatodessus hades**

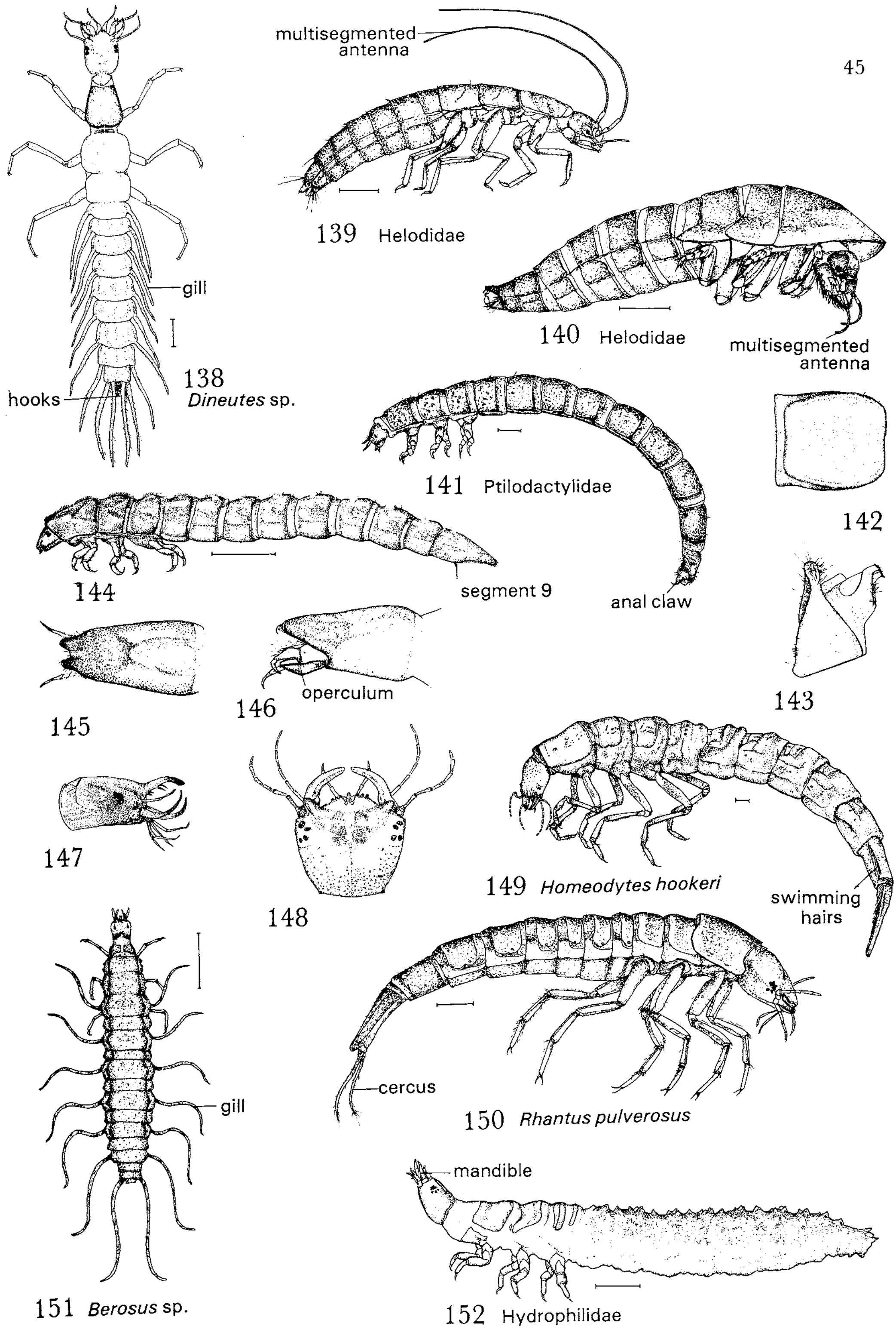
Known only as 3rd instar larvae obtained from a Nelson well. **93.**

—Frontal projection with a pair of lateral barbs near mid length and a pair of small ventral projections near the base; caudal respiratory horn absent; length about 10 mm (Fig. 147) . . . . **Antiporus**

The larva of *A. wakefieldi* has been described but that of *A. strigosulus* has not. *Antiporus* larvae are primarily benthic and slow-moving and occur in ponds throughout New Zealand. **116, 141.**

5 Abdominal segments 7 and/or 8 without lateral fringes of swimming hairs . . . . . . **COLYMBETINAE, 6**

—Abdominal segments 7 and 8 with lateral fringes of swimming hairs . . . . **DYTISCINAE, 8**



Figs 138-152. Coleoptera, larvae. **138,** *Dineutes* sp. (Gyrinidae) (from Fiji). **139, 140,** Helodidae (see reference 137): 139, type A; 140, type B. **141-143,** Ptilodactylidae: 141, larva; 142, 143, posterior abdominal segment: 142, dorsal view, 143, lateral view. **144-146,** Elmidae: 144, larva; 145, 146, posterior abdominal segment: 145, dorsal view, 146, lateral view. **147-150,** Dytiscidae: 147, *Antiporus* sp., head, lateral; 148, 149, *Homeodytes hookeri:* 148, head dorsal; 149, larva; 150, *Rhantus pulverosus.* 151, 152, Hydrophilidae: 151, *Berosus* sp.; 152, unknown species. Scale bar = 1 mm.

6 Mandibles with teeth on the inner margin; cerci shorter than last abdominal segment . . . . **Copelatus**

The larva of *C. australis* has not been described. The presence of toothed mandibles is probably correlated with the fact that *Copelatus* larvae swallow their food rather than suck digested contents from prey as is usual in dytiscids. **62, 123a.**

—Mandibles without teeth on the inner margin; cerci not shorter than last abdominal segment **7**

7 Cerci about the same length as the last abdominal segment . . . . **Rhantus**

Larvae of *R. pulverosus* (Fig. 150) are commonly found along with adult beetles in weeded ponds throughout New Zealand. They are highly active, voracious predators. **92, 93, 123a.**

—Cerci more than twice length of the last abdominal segment . . . . **Lancetes**

L. lanceolatus larvae attain a length of 15-16 mm and have been described from Australia by Watts (**123a**).

8 Anterior margin of head lacking dentation; cerci with lateral fringes of hairs . . . . **Dytiscus**

Larvae of the 1 recorded species, *D. semisulcatus*, have not been reported in New Zealand. **122.**

—Anterior margin of head dentate; cerci absent; length about 50 mm . . . . **Homeodytes**

Larvae of *H. hookeri* (Figs 148, 149) are open water predators in ponds but are infrequently seen. They have not been described formally. The larva of *H. scutellaris* has been described by Watts (**123a**).

Hydrophilidae

Larvae belonging to 4 genera have been positively associated with adults and several others are known. Even though most New Zealand Hydrophilidae belong to cosmopolitan genera, larvae have been found which cannot be identified to genus using available keys, e.g., **3, 62, 108.**

1 With elongate, lateral abdominal gills (Fig. 151) . . . . **Berosus**

Found widely in streams, lakes and ponds.

—Without lateral abdominal gills (Fig. 152) **2**

2 With 5 pairs of short but obvious abdominal prolegs; clypeal edge serrate, slanting forward on the right; ligula present; mandibles asymmetrical; length about 9 mm . . . . **Enochrus**

Habitat as for adults. **131, 133.**

—Without abdominal prolegs **3**

3 Clypeal edge with a projecting, toothed median lobe; left epistoma expanded anteriorly and with about 12 spines; ligula absent; mandibles asymmetrical . . . . **Laccobius**

The larva of *L. mineralis* occurs in the same habitat as the adult. **133.**

—Left epistoma not expanded anteriorly; ligula present or absent **4**

4 Clypeal edge not slanting to either side but with several prominent teeth; ligula present; mandibles identical; a row of conspicuous stout setae on anterior margin of pronotum . . . . **Anacaena**

Larvae of *A. tepida* occur at the margins of thermal spring effluent channels. **134**

—Not as above . . . . **Unidentified larvae**

Diptera (two-winged flies)
Key to larvae

Key to families

1 Mandibles move against each other in a horizontal plane; head capsule complete and fully exposed, or retractile and variably reduced .... **NEMATOCERA, 2**

—Mandibles replaced by mouthhooks which move parallel to each other in a vertical plane; head capsule variably reduced posteriorly and at least partly retracted within the thorax **11**

2 Head capsule variably reduced and retracted into thorax; abdomen terminating in a spiracular disc with associated lobes and/or hairs (Figs 167-173) .... **TIPULIDAE**, p.48

—Head capsule complete and not retracted into thorax **3**

3 Body dorsoventrally flattened with 6 median suctorial discs ventrally (Figs 174, 175) .... **BLEPHARICERIDAE**, p.51

—Ventral suctorial discs absent **4**

4 Thoracic segments fused into a broad, flattened "segment" distinctly wider than abdomen (Fig. 176) .... **CULICIDAE** , p.52

—Thoracic segments individually distinguishable and not wider than abdomen . **5**

5 Paired, crotchet-bearing prolegs on 1st and/or 1st and 2nd abdominal segments; 2 flat, setose lobes posteriorly; body U-shaped in living larvae at rest (Fig. 178) . **DIXIDAE**, p.54

—Without abdominal prolegs or flat posterior setose lobes; not U-shaped at rest **6**

6 Prothorax with 1 or 2 prolegs ventrally **7**

—Prothorax without prolegs **9**

7 Abdominal segments 5-8 swollen, the posterior segment with a circlet of minute hooks; head with conspicuous dorsolateral fans of setae (Fig. 179) **SIMULIIDAE**, p.55

—Without anal circlet of hooks or head fans; abdomen not swollen **8**

8 Prothoracic and anal prolegs unpaired .... **THAUMALEIDAE**

The solitary midges are represented in New Zealand by a single genus, *Austrothaumalea*, with 2 species whose larvae are not described. Habitat shallow seepages.

—Prothoracic and anal prolegs paired .... **CHIRONOMIDAE**, p.60

9 Last 2 abdominal segments with long, filamentous processes and a pair of elongate prolegs extending posteriorly (Fig. 153) .... **TANYDERIDAE**

In New Zealand, this family of primitive crane flies contains 1 genus, *Mischoderus*, with aquatic larvae which have not been described. Uncommon but apparently widely distributed in stony and soft-bottomed streams.

—Posterior abdominal segments without long, filamentous processes **10**

10 All body segments secondarily divided into 2 or 3 subdivisions, at least some of which bear dorsal, sclerotised plates (Fig. 154) .... **PSYCHODIDAE**

Although 43 species of moth fly have been described from New Zealand, little is known about their larvae or habitats. Larvae of 4 species of *Psychoda* occurring in the Dunedin area have been described and figured by Goldson (**50**). They occur along stream margins in mud, and amongst decaying leaves.

—Narrow, worm-like larvae without secondarily divided segments; a rosette of fine hairs at the tip of the abdomen (Fig. 155) .... **CERATOPOGONIDAE**

Nothing is known about the aquatic stages of this family of biting midges in New Zealand although they are frequently seen in still or slowly flowing water. **116**

11 Head capsule well developed, at least partly sclerotised dorsally, often retractile; antennae well developed and situated on a sclerotised plate **12**

—Head nonsclerotised, permanently retracted into prothorax; antennae absent or poorly developed and situated on a membranous surface **14**

12 Head not retractile; body somewhat flattened and leathery with a posterior rosette of pale hairs (Fig. 156) .... **STRATIOMYIDAE**

No larval stratiomyids have been identified or described from New Zealand although species keying to *Odontomyia* and *Eulalia* in overseas works are known to occur. Often common in shallow still water among vegetation, e.g. at the margin of lakes. **131**

—Head capsule retractile; body not flattened or leathery **13**

13 Body cylindrical, the first 7 abdominal segments ringed by fleshy pseudopods; dorsal surface of head capsule a well developed plate (Fig. 157) .... **TABANIDAE**

Nothing is known about horse fly larvae in New Zealand although they are found sporadically in stony streams.

—Without encircling pseudopods on first 7 abdominal segments; dorsal surface of head capsule represented by a pair of slender, longitudinal rods (Fig. 158) ...... **EMPIDIDAE**

No aquatic dance fly larvae have been identified in this country. The family is widely distributed and larvae may be common amongst aquatic vegetation or plant debris in open and forested streams. If aquatic larvae belonging to species of Dolichopodidae occur in New Zealand they probably will key out here. **19.**

14 Terminal abdominal segment with a spiracular disc surrounded by several short lobes (Fig. 159) .... **SCIOMYZIDAE**, p.68

—Posterior spiracles not surrounded by lobes but on short or long respiratory tubes **15**

15 Posterior spiracle at the tip of a long tube approximately the length of the body; mouth hooks absent .... **SYRPHIDAE**

Rat-tailed maggots of at least 1 species, the introduced *Eristalis tenax* (Linnaeus), can occur in heavily polluted or dirty shallow waters in New Zealand. Larvae of *Helophilus* may also be represented. **96**

—Respiratory tube much shorter than body; mouth hooks present **16**

16 Posterior abdominal segment somewhat tapered; body usually covered in prominent, but short, setae or spinules (Figs 220, 221) .... **EPHYDRIDAE**, p.68

—Posterior abdominal segment rather truncate; body with setae only on intersegmental areas (Fig. 160) .... **MUSCIDAE**

No muscid larvae have been described from New Zealand freshwaters although larvae resembling *Limnophora* from elsewhere (**140**) are often found in stony streams.

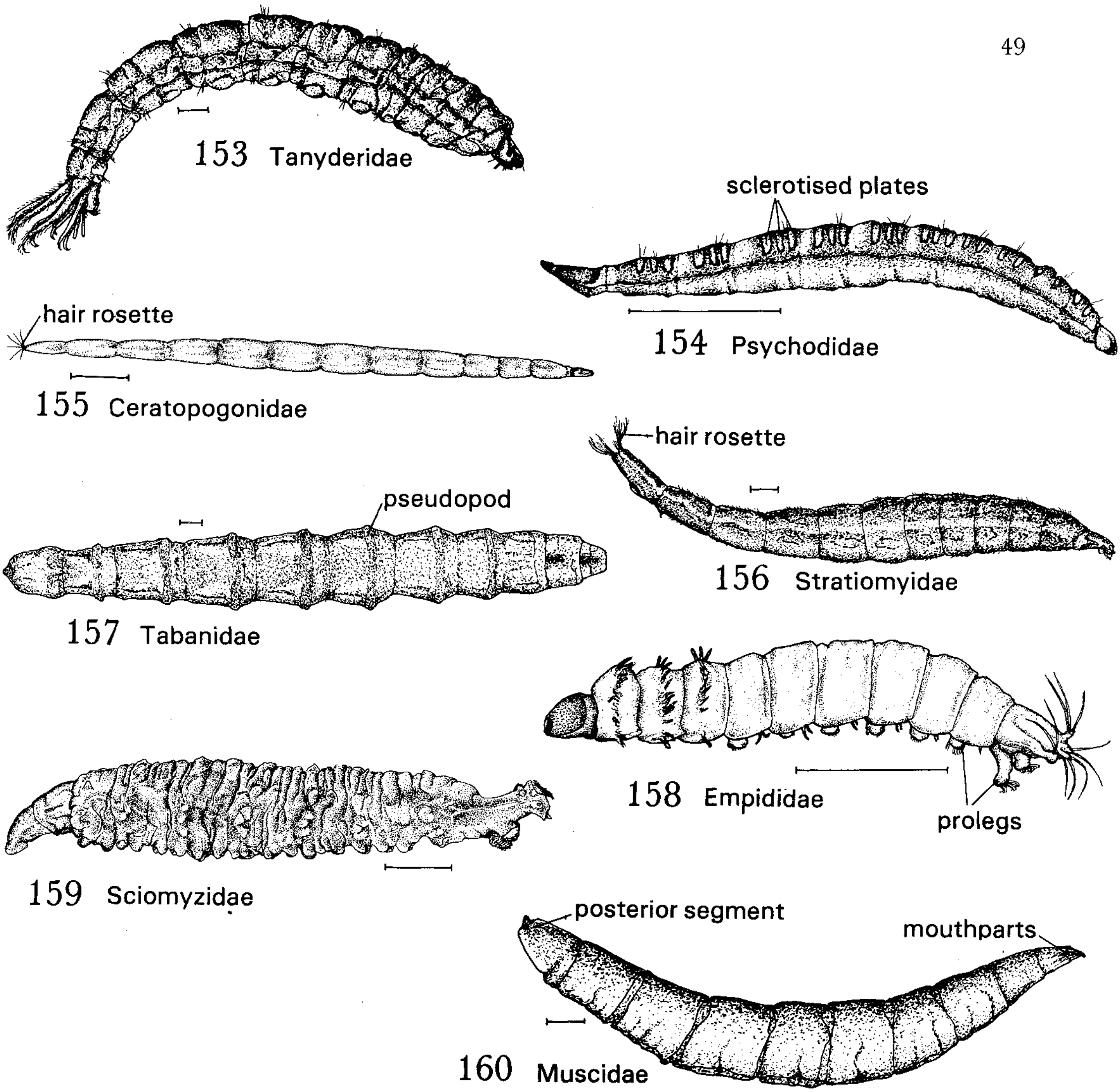
Tipulidae (crane flies)

Few New Zealand aquatic tipulid larvae have been associated with adult flies. Nevertheless, most if not all larvae likely to be encountered in streams can be identified at the tribal or generic level. If material does not fit the key provided, the reader should refer to the excellent key by Byers (**14**) which includes numerous genera found in this country. Comments on the New Zealand fauna have been made by Johns (**57**).

1 Spiracular disc surrounded by 6 finger-like lobes (Fig. 167); integument leathery; creeping welts absent .... **TIPULINAE**

The subfamily is represented by 6 species of *Zelandotipula* (Fig. 161) whose large larvae (length up to 40 mm) typically inhabit seepages.

—Spiracular disc with 5 or fewer lobes (Figs 168-173) .... **LIMONIINAE, 2**



Figs 153-160. Diptera larvae. 153, *Mischoderus* sp. (Tanyderidae). 154, Psychodidae. 155, Ceratopogonidae. 156, Stratiomyidae. 157, Tabanidae. 158, Empididae. 159, *Neolimnia sigma* (Sciomyzidae). 160, Muscidae. Scale bar = 1 mm.

2 Prominent creeping welts and transverse dorsal "scars" present on abdominal segments **3**

—Creeping welts and scars absent; integument shiny, golden-brown **4**

3 Spiracular disc small with 5 blunt, densely fringed, triangular lobes, the median dorsal lobe much smaller than the others (Figs 162, 168) . . . . **Limonia**

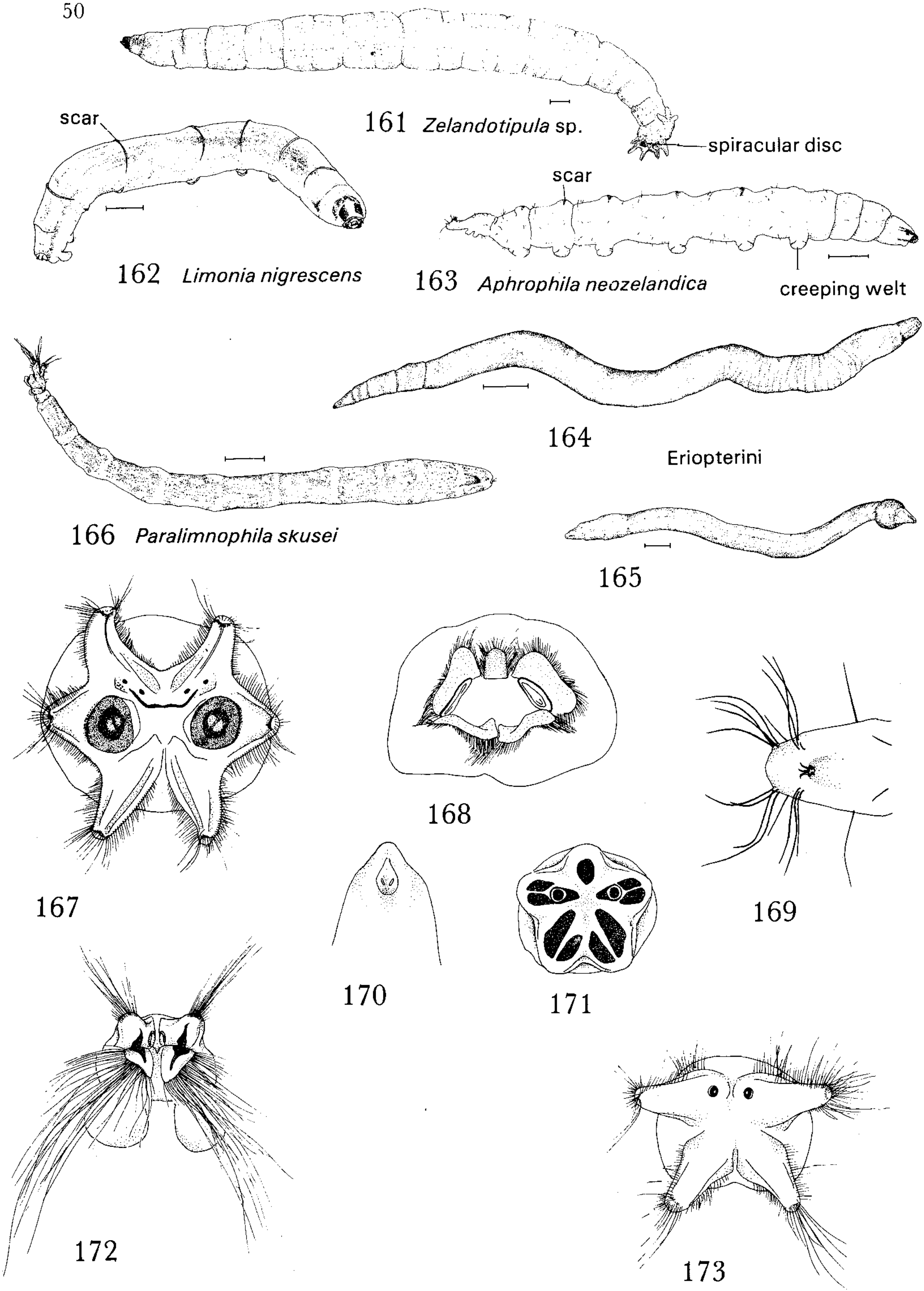
Larvae of *L. nigrescens* (Hutton) inhabit decaying logs in and alongside streams. Several other species almost certainly inhabit freshwaters whereas others have marine, intertidal larvae.

—Abdomen tapering posteriorly to a rounded tip with several prominent, stiff setae and 3 tiny hooks in the dorsal midline (Figs 163, 169) . . . . **Aphrophila**

A. neozelandica (Edwards) is common in stony streams throughout New Zealand.

4 Spiracular disc with 4 posteriorly directed, hair-fringed, finger-like lobes . . . . . . **Hexatomini** (in part), **6**

—Spiracular disc either with 5 short, rounded lobes, or roughly wedge-shaped and apparently lacking lobes **5**



Figs 161-173. Diptera (Tipulidae). **161-166,** larvae: 161, *Zelandotipula* sp.; 162, *Limonia nigrescens;* 163, *Aphrophila neozelandica;* 164, Eriopterini species; 165, Eriopterini showing bulbous posterior segments; 166, *Paralimnophila skusei.* **167-173,** spiracular discs: 167, *Zealandotipula* sp.; 168, *Limonia nigrescens;* 169, *Aphrophila neozelandica;* 170, Eriopterini sp.; 171, ?*Molophilus* sp.; 172, *Paralimnophila skusei,* 173, Hexatomini species. Scale bar = 1 mm.

5 Spiracular disc wedge-shaped; posterior segments may be bulbous in living and preserved specimens (Figs 164, 165, 170) .... **ERIOPTERINI** (in part)

There worm-like larvae are often common in clear, fast-flowing, stony streams and may belong to *Rhabdomastix* or a closely related genus. The larva figured by Towns (**116**, Fig. 26) as a Hexatomini species belongs here. The swollen 7th abdominal segment possibly aids locomotion or anchorage. **13, 14.**

—Spiracular disc with 5 short, rounded lobes and extensive blackening (Fig. 171) . **Eriopterini sp.**

North American larvae with medially divided black spots on the dorsoventral and ventral lobes and an entire dorsal spot as in the New Zealand species figured belong to the genus *Molophilus* **13, 14**

6 Spiracular lobes elongate with prominent apical tufts of pale hairs, those of the ventral lobes about as long as 2 abdominal segments; integument covered with long, adpressed, golden hairs (Figs 166, 172) .. **Paralimnophila skusei** Hutton

Widely distributed in stony streams but rarely abundant. The larva attributed to this species by Towns (**116**, Fig. 27) is a tanyderid.

—Spiracular lobes fairly short and narrow with well developed fringes of short pale hairs; integument lacking hair cover (Fig. 173) .... **HEXATOMINI** (in part)

Larvae occur in a variety of streams but cannot be identified beyond tribal level.

Blephariceridae (net-wing midges) (based on Craig 23)

Revisions dealing with most species have been made by Craig (**23**) and a little earlier by Dumbleton (**34**). These are the only important sources of information on the larvae, their distribution, and ecology.

1 Dorsoventrally flattened; prolegs not extending beyond lateral margins which have no marginal armature .... **Nothohoraia**

1 species, *N. micrognathia* Craig, known only from the Buller Gorge. **23.**

—Body convex; prolegs extend beyond lateral margins; marginal armature of scales and spines **2**

2 Marginal armature of scales ....**Neocurupira, 3**

—Marginal armature of irregular, dark, pointed spines .... **Peritheates, 6**

3 Prolegs pointed apically **4**

—Prolegs rounded apically **5**

4 Dorsal surface covered with large, black spines (Fig. 174) .... **Neocurupira chiltoni** (Campbell)

Found only on Banks Peninsula in stony streams from sealevel to 350 m.

—Dorsal surface without large black spines ... **Neocurupira tonnoiri** Dumbleton

Known from the West Coast, South Island, in steep, forest streams and deep, swift, open rivers. Altitudinal range 150-800 m.

5 Posterior margin of body with a row of about 30 hairs (Fig. 175) .... **Neocurupira hudsoni** — complex

This complex includes larvae of *N. hudsoni* Lamb, *N. rotalapisculus* Craig, and several southern forms of uncertain taxonomic status. *N. hudsoni* is our most widely distributed species and occurs mainly in open stable streams and rivers with good flow. Altitudinal range sealevel to 1500 m.

—Posterior margin of body with 6-8 black hairs .... **Neocurupira campbelli** Dumbleton

Occurs in the South Island mountains from 400-1400 m in large, open fast-flowing streams. Larvae often are densely aggregated on boulders.

6 Posterior margin of body crenulate with 6-8 hairs medially . . . . **Peritheates harrisi** (Campbell)

Found only in the North Island where it may be widespread in mountainous areas. Habitat little known.

—Posterior margin of body not crenulate and bearing 2 widely separated hairs . . . . **Peritheates turrifer** Lamb

Known from the southern North Island, Nelson, and the Arthur's Pass regions, mainly in torrential forest streams but also large, open, stable rivers. Altitudinal range 60-1000 m.

Culicidae (mosquitoes) (based on Dumbleton **35**)

Revisions by Belkin (**7, 8**) and a key by Dumbleton (**35**) give most of what is known about all species. Only other references are noted in the annotations to individual species to avoid repetition.

1 Siphon (Fig. 177) as wide as long, its terminal valves fused and as long as siphon; antennae twice length of head . . . . **Coquillettidia**

2 species, *C. iracunda* (Walker) and *C. tenuipalpis* (Edwards), neither with described larvae. Habitat probably ground pools or swamps.

—Siphon longer than wide, terminal valves separate and small; antennae shorter than head **2**

2 Anal gills (Fig. 177) scarcely visible, not longer than wide **3**

—Anal gills prominent, longer than wide **4**

3 Pecten (a comb of teeth near the siphon base) with 2 or 3 teeth; in brackish or saline, coastal pools . . . . **Opifex**

Only *O. fuscus* Hutton, which is widely distributed around the New Zealand coast.

—Pecten with many teeth in a definite row . . . . **Aedes** (in part)

1 species, *A. australis* (Erichson), which inhabits brackish or saline coastal rock pools in the southern South Island and Stewart Island.

4 Siphon with 1 pair of ventrolateral hairs . . . . **Aedes** (in part), **5**

—Siphon with more than 1 pair of ventrolateral hairs, or several short, median-ventral hairs **7**

5 Siphon index (length:width at mid-length) 2; dorsal gill longer than ventral gill . **Aedes notoscriptus** (Skuse)

Known from the northern North Island and Nelson district, inhabiting tree holes and containers.

—Siphon index 3; all gills approximately the same length **6**

6 Pecten teeth extend as a continuous series to the mid-length of siphon . . . . **Aedes antipodeus** (Edwards)

Found throughout New Zealand in freshwater ground pools.

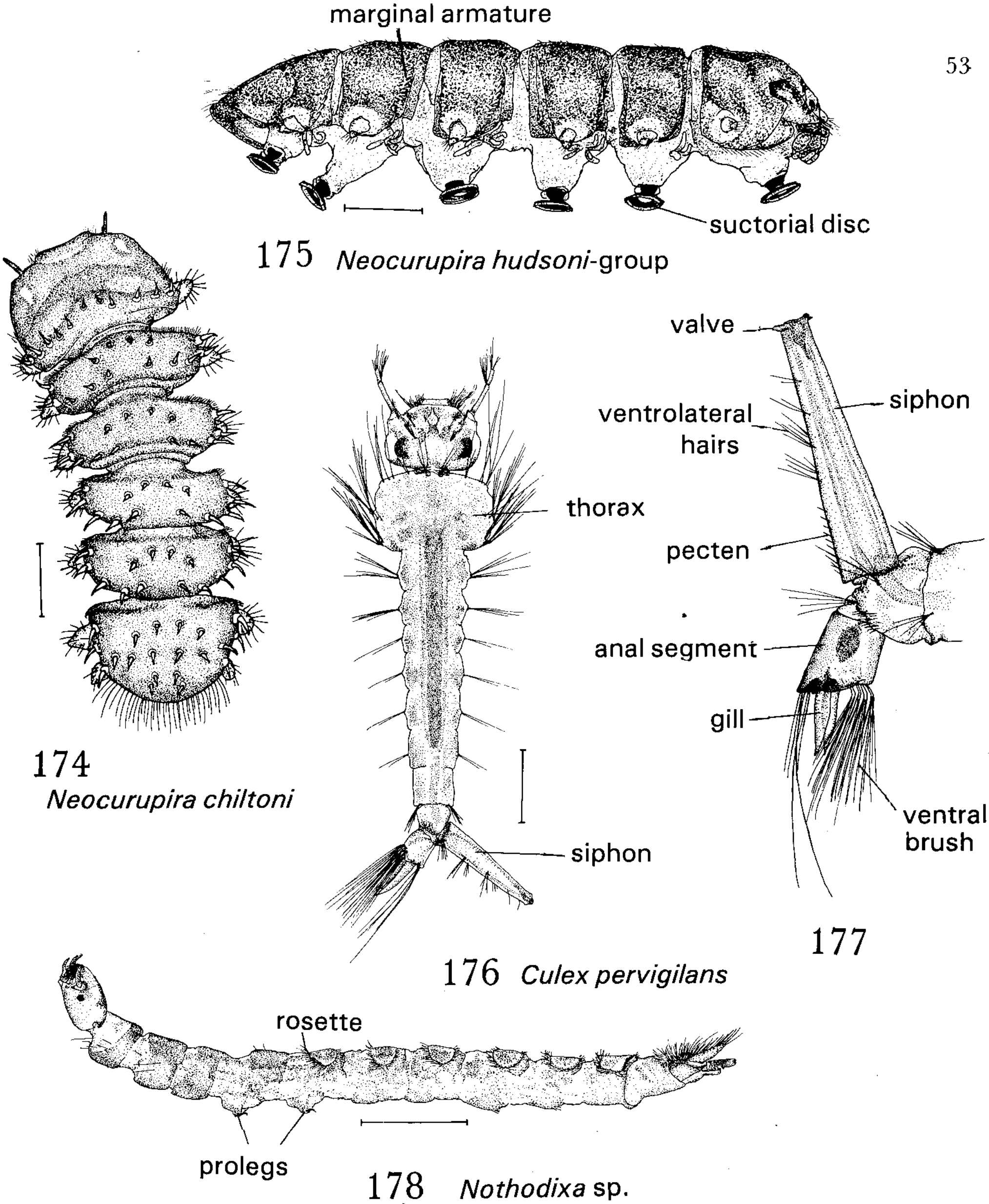
—Pecten teeth in a continuous series for ⅓ siphon length, and with 1 or 2 more isolated teeth beyond them . . . . **Aedes subalbirostris** Klein & Marks

Known from the east coast of Otago and Southland and Stewart Island in freshwater ditches and ponds.

7 Siphon with more than 6 pairs of long, ventrolateral *and* dorsolateral hairs; anal gills rounded apically . . . . **Maorigoeldia**

1 species, *M. argyropus* (Walker), which inhabits tree holes, tanks, and containers throughout New Zealand.

—Siphon with not more than 6 pairs of ventrolateral hairs; dorsolateral hairs if present very short; anal gills pointed apically **8**



Figs 174-178. Diptera larvae. **174, 175,** Blephariceridae: 174, *Neocurupira chiltoni;* 175, *Neocurupira hudsoni*-group. **176, 177,** Culicidae, *Culex pervigilans:* 176, larva; 177, posterior abdomen. **178,** Dixidae, *Nothodixa* sp. Scale bar = 1 mm.

8 Lateral comb of abdominal segment 8 (the segment from which the siphon arises) with scales in a single row .... **Culiseta, 9**

—Scales of lateral comb in several rows making up a subtriangular pattern .... **Culex, 10**

9 Lateral comb with 18-20 scales; anal gills with sub-basal constrictions .... **Culiseta tonnoiri** (Edwards)

Known from the northern North Island and western South Island in forest ground pools.

—Lateral comb with 25-29 scales; anal gills without sub-basal constrictions ...... **Culiseta novaezealandiae** Pillai

Known only from ground pools and coastal flax swamps in southeast Otago. **105**

10 Siphon index 5 or less **11**
—Siphon index 6.5 or more **12**

11 Anal gills approximately equal in length, shorter than anal segment . . . . **Culex rotoruae** Belkin

Inhabits mineralised, sometimes warm, water in North Island thermal areas.

—Dorsal anal gills longer than ventral . . . . **Culex quinquefasciatus** Say

A cosmopolitan species recorded from dirty water in the Auckland province.

12 Siphon index 6.5-7 (Figs 176, 177) . . . . **Culex pervigilans** Bergroth

The most common New Zealand mosquito. It breeds in ground pools, containers, and at stream margins, and has been found in South Island thermal waters.

—Siphon index 8.5-10 . . . . **Culex asteliae** Belkin

An endemic species known from islands of the Hauraki Gulf, Coromandel, Auckland City, and North Auckland. Larvae have been found in water-holding leaf bases of epiphytic or terrestrial *Collospermum* species.

Dixidae (dixid midges) (adapted from Belkin **8**)

The family has been reviewed by Belkin (**7, 8**) and reference should be made to his papers for information on biology and distribution. Three genera are found in New Zealand, but larvae of *Neodixa* are unknown. This genus is represented by 1 species, *N. minuta* (Tonnoir), known from a unique adult male collected at Nelson.

1 Dorsal surface of abdominal segments with conspicuous ovoid rosettes of plumose spinules; no prothoracic hairs reach the anterior margin of head capsule (Fig. 178) . . . . **Nothodixa**

There are 4 described species, but larvae of *N. philpotti* (Tonnoir) and *N. otagensis* (Alexander) are unknown. *N. campbelli* (Alexander) seems to be the most common and only widespread species. Larvae possess distinctive, strong spicules on the dorsum of the thorax, and have 15-30 hooks arranged in transverse arcs on prolegs 1 and 2. They inhabit quiet pools and backwaters of very small steep streams. *N. septentrionalis* (Tonnoir) is known only from south Auckland and the Gisborne region where larvae occur at the margins of small hill or mountain streams with moderate-strong current. Minute, fine spicules are present on the larval thorax while hooks are arranged in a longitudinal arc on proleg 1 and in a transverse arc on proleg 2.

—Dorsal surface of abdomen without rosettes of plumose spinules; some prothoracic hairs project well beyond the anterior border of head capsule . . . . **Paradixa, 2**

Larvae of the 4 species are very similar to one another and can be differentiated only using minor morphological features.

2 Pecten plate of abdominal segment 9 with 3-5 very large black, basally-fused teeth ventrally . . . . **Paradixa harrisi** (Tonnoir)

Known from pools and margins of small, shaded, North Island streams.

—Pecten plate with separate teeth approximately equal in size to those elsewhere on the plate **3**

3 Dorsal surface of thorax without spicules visible at 100 ×; antennae much darker than head capsule . . . . **Paradixa fuscinervis** (Tonnoir)

The most widely distributed New Zealand dixid occurring on hills, mountains, plains, in coastal areas, and cities. Larvae inhabit streams, seepages, pools, ponds, lakes, and swamps.

—Dorsal surface of thorax with spicules distinctly visible at 100 ×; antennae the same colour as, or lighter than, head capsule **4**

4 Basal, posterior pecten spines very large and dark ....
Paradixa neozelandica (Tonnoir)

Occurs in a similarly wide range of habitats as *P. fuscinervis* but is less common, especially in the mountains.

—Basal, posterior pecten spines very small and light coloured ....
Paradixa tonnoiri Belkin

Known from partially shaded, slow moving, or still water in the South Island.

Simuliidae (blackflies or sandflies) (T. K. Crosby)

Austrosimulium is the only genus found in New Zealand. There are 11 described species forming 2 species-groups: the *australense*-group and the *ungulatum*-group. In addition, 2 further species belonging to the *ungulatum*-group occur on subantarctic islands: *A. vexans* (Mik) on the Auckland Islands and *A. campbellense* Dumbleton on Campbell Island. The main taxonomic papers with illustrations of species are those by Tonnoir (**114**), Dumbleton (**38**), and Crosby (**24, 26**) while Tonnoir and Dumbleton also provide biological information on some species. The work of Dumbleton (**38**) has provided the basis for the keys presented below.

The pupa is the most reliable stage to use to identify species and for this reason, and because they are frequently found, keys to pupae as well as larvae are provided. Mature final-instar larvae in which the respiratory histoblasts (≑ respiratory gill of the developing pupa) are fully formed can be positively identified but younger instars can be determined less reliably. Earlier instars can be separated into the 2 species-groups but seldom can be identified to species.

When identifying material, larvae should be slide-mounted so that structures such as the hypostomium and antennae can be examined or measured at high magnification. Since some intraspecific variation in taxonomic characters is found, specimens obtained from localities other than those mentioned by Dumbleton (**38**) may cause problems.

Adult flies can be sexed easily with the naked eye; in males the whole head appears to be one conspicuous, bright orange eye (i.e., the eyes are holoptic), whereas in females there are two dullish-orange distinct eyes making up less than half the head (i.e., the eyes are dichoptic). This character can also be used to sex pupae.

Males have been collected in the field only on rare occasions and nearly always by light-trapping; those described in publications have been reared from pupae.

Females caught while biting humans are most likely to be *Austrosimulium australense* (Schiner) which is found throughout New Zealand, or *A. ungulatum* Tonnoir which occurs in the South Island and Stewart Island. If the halteres are yellowish brown the species is most likely to be *A. australense*, if white then it is almost certainly *A. ungulatum*. Females of other species can be a nuisance when they hover around, land, and crawl over the body; however, they seldom bite.

Keys to species-groups

Larvae

1 Suboesophageal ganglion (Fig. 179) pigmented; nerve cord pigmented; semicircular sclerite (Fig. 181) forked or expanded at dorsal ends ....
australense-group, p.56

Full expression of semicircular sclerite character only shows in the final few instars. This is the group most likely to be collected.

—Suboesophageal ganglion (Fig. 179) not pigmented, or only faintly pigmented; nerve cord faintly pigmented to well pigmented; semicircular sclerite (Fig. 181) not forked or expanded at dorsal ends, or only slightly expanded ....
ungulatum-group, p.56

PUPAE

Cocoon with anterior process or processes (Fig. 188); pupa with eye spine (Fig. 183) .... **ungulatum**-group, p.58

—Cocoon without anterior dorsal processes (Fig. 187); pupa without eye spine (Fig. 183) .... **australense**-group, p.59

The group most likely to be collected.

FEMALES

Tarsal claw with a large (Fig. 189) or small basal tooth ..... **ungulatum**-group

—Tarsal claw without a basal tooth (Fig. 190) .... **australense**-group

It is difficult to key adults to species. Dumbleton (**38**) has a key to females, but there is no key to males.

Key to larvae

A **ungulatum**-group

[Note that *A. dumbletoni* Crosby from South Westland is unknown as a larva.]

1 Respiratory histoblast (Fig. 179) with a horn (Fig. 184); semicircular sclerite (Fig. 181) slender, evenly tapering to a point; length of 2nd antennal segment (Fig. 180) more than twice the width **2**

—Respiratory histoblast without a horn; semicircular sclerite slightly expanded near its ends; length of 2nd antennal segment less than twice the width .... **ungulatum** Tonnoir

This is the species in this group most likely to be collected. Larvae are usually found in smaller streams within forests, in fast-flowing parts, on stones and leaves. Normally these streams are well shaded, and you are aware that your eyes need to adjust to the deep shade when collecting. The semicircular sclerite expansion is slight and can be difficult to detect unless viewed at right angles to the central point of the sclerite end. Occurs in the South Island and Stewart Island.

2 Horn of respiratory histoblast 5 times longer than wide; 2nd antennal segment ⅓ the length of the 1st .... **bicorne** Dumbleton

Occurs in the Main Divide area of the South Island south of Temple Basin.

—Horn of respiratory histoblast 3 times longer than wide; 2nd antennal segment nearly as long as 1st .... **unicorne** Dumbleton

Occurs in the Main Divide area of Canterbury in the South Island.

B **australense**-group

1 Respiratory histoblast (Fig. 179) with black horn (Fig. 184) **3**

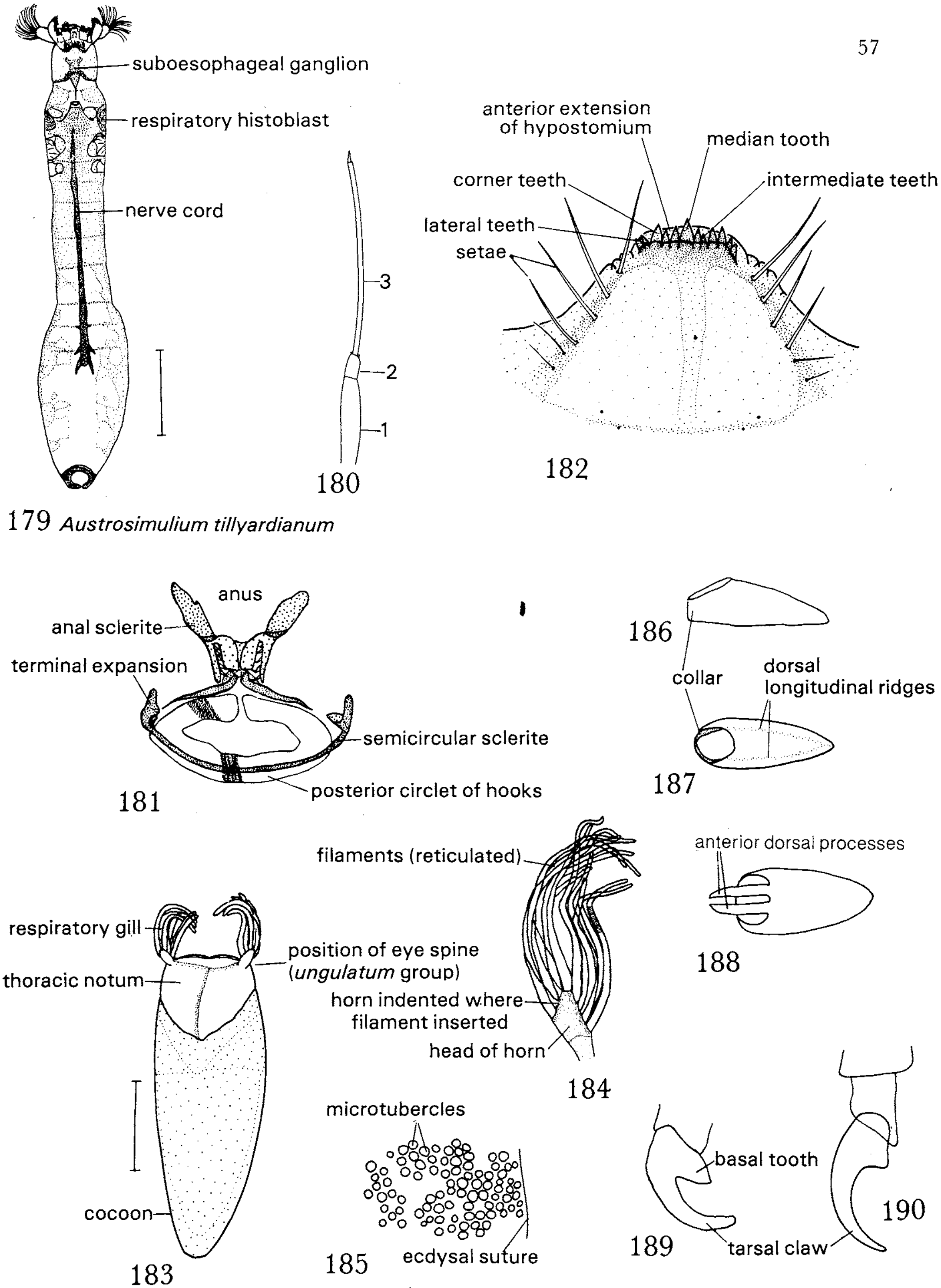
—Respiratory histoblast without black horn, or horn apparently absent **2**

2 Horn of respiratory histoblast small and easily overlooked, pale brown, wider than long; 5-6 thin respiratory filaments; hypostomial teeth (Fig. 182) prominent .... **longicorne** Tonnoir

Larvae normally in mature streams in lowland and open areas, on vegetation. Known from the Three Kings and North Island and less commonly in the South Island.

—Horn of respiratory histoblast obvious and brown, longer than wide (Fig. 184); usually 8-12 thick respiratory filaments (Fig. 184); hypostomial teeth (Fig. 182) not prominent .... **tillyardianum** Dumbleton

Larvae normally in open lowland streams and larger rivers, on stones. Found in the North and South Islands although less commonly in the North.



Figs 179-190. Diptera (Simuliidae). **179-187,** *Austrosimulium australense*-group (*tillyardianum*): 179-182, larva: 179, ventral view, 180, antenna, 181, semicircular sclerite region, dorsal view, 182, hypostomium; 183-185, pupa: 183, dorsal view, 184, respiratory gill showing horn and filaments, 185, thoracic notum microtubercles; 186, 187, cocoon; 186, lateral view, 187, dorsal view. **188, 189,** *Austrosimulium ungulatum*-group (*ungulatum*): 188, cocoon, dorsal view, 189, female, tarsal claw; **190,** *Austrosimulium australense*-group, female, tarsal claw. Scale bar = 1 mm.

3 Horn of respiratory histoblast comparatively broad, of large area, with fine respiratory filaments that are coiled on its surface 4

—Horn of respiratory histoblast narrower, of smaller area, with stout respiratory filaments that are not coiled on its surface 5

4 Horn of respiratory histoblast almost parallel-sided, with pale head; 2nd antennal segment less than 1/5 length of 1st . . . . **australense** (Schiner)

Larvae occur on vegetation normally in lowland and open mature streams with constant flow and emergent vegetation or where there is overhanging vegetation. Present throughout New Zealand.

—Horn of respiratory histoblast broadened and rounded near apical end, with dark head; 2nd antennal segment ⅓ length of 1st . . . . **laticorne** Tonnoir

2 subspecies are recognised, **laticorne laticorne** Tonnoir in the northern, western, and southern South Island, and **laticorne alveolatum** Dumbleton which occurs in the Canterbury foothills near Porters Pass. The 2 subspecies are not distinguishable as larvae which normally are found on stones in open lowland streams and larger rivers.

5 2nd antennal segment almost ½ length of 1st; median hypostomial tooth distinctly longer than other major teeth . . . . **albovelatum** Dumbleton

Known from the Canterbury foothills near the Ashburton River.

—2nd antennal segment 1/5-1/3 length of 1st; median hypostomial tooth not longer than other major teeth 6

6 2nd antennal segment ¼ - ⅓ length of 1st . . . . **multicorne** Tonnoir

2 subspecies are recognised, **multicorne multicorne** Tonnoir in the central North Island and South Island except Fiordland, and **multicorne fiordense** Dumbleton in Fiordland. The subspecies cannot be distinguished as larvae which are normally found in cold streams either in forest or less commonly in the open, on stones or leaves.

—2nd antennal segment 1/5 length of 1st . . . . **stewartense** Dumbleton

Known from the southern South Island and Stewart Island. Larvae occur on vegetation or leaves in small muddy, lowland streams especially in peaty or forested areas.

Key to pupae

[Note that pupae occupy identical habitats to larvae; notes on distribution are given in the larval key.]

A **ungulatum**-group

[Note that *A. dumbletoni* Crosby from South Westland is unknown as a pupa.]

1 Cocoon fabric thin and brown; cocoon with 2 thin, parallel-sided anterior dorsal processes (Fig. 188); respiratory gill (Fig. 184) without a horn, and with 6-13 strongly tapered, rigid respiratory filaments . . . . **ungulatum** Tonnoir

This is the most likely species of this group to be collected.

—Cocoon fabric thick and white; cocoon with 1 or 2 stout, thick, anterior dorsal processes; respiratory gill with a black horn, and with 30-40 scarcely tapered, slender, flexible respiratory filaments 2

2 Cocoon with 2 anterior dorsal processes which are parallel-sided; dorsal surface of cocoon with 2 thickened longitudinal ridges (Fig. 187); horn of respiratory gill about 5 times longer than wide; respiratory filaments 2-3 times longer than horn . . . . **bicorne** Dumbleton

—Cocoon with 1 anterior dorsal process which is bent downwards and has an expanded, rounded end; dorsal surface of cocoon with 1 thickened median longitudinal ridge; horn of respiratory gill about 3 times longer than wide; respiratory filaments about 10 times longer than horn . . . **unicorne** Dumbleton

B **australense**-group

1 Horn of respiratory gill (Fig. 184) black; cocoon usually not close-fitting and nearly circular and flattened; or, cocoon fabric sometimes white, or cocoon with reticulated pattern 3

—Horn of respiratory gill brown or chestnut-coloured; cocoon usually close-fitting and oval (Fig. 183); or, cocoon fabric not white, nor with reticulated pattern . 2

2 Horn of respiratory gill distinct, longer than wide (Fig. 184); brown or chestnut-coloured, with no common stem for respiratory filaments; respiratory filaments wide, long, stiff, with reticulated pattern (Fig. 184); cocoon with high collar (Fig. 186) and 2 faint dorsal longitudinal ridges (Fig. 187). Usually on stones . . . . **tillyardianum** Dumbleton

—Horn of respiratory gill scarcely visible, wider than long, pale brown, but with a short common stem for respiratory filaments; respiratory filaments wide at base, very long, tapering, stiff, some bifurcating, without reticulated pattern; cocoon with low collar (Fig. 186) and no dorsal longitudinal ridges (Fig. 187). Usually on leaves . . . . **longicorne** Tonnoir

3 Horn of respiratory gill large and obvious because respiratory filaments are short and slender; respiratory filaments flexible, with little taper; horn not indented where respiratory filaments inserted; horn almost parallel-sided, or club-shaped 4

—Horn of respiratory gill small and relatively inconspicuous because respiratory filaments are long and thick; respiratory filaments quite stiff and tapered; horn indented where respiratory filaments are inserted (Fig. 184); horn spindle-shaped, diamond-shaped, rod-like, or with gradual taper 5

4 Horn of respiratory gill almost parallel-sided, 2½ times longer than wide, and bent downwards and approaching lateral margin of pupal head; 35-45 respiratory filaments, not regularly arranged; cocoon not close-fitting, oval to nearly circular; cocoon fabric texture smooth. Usually on leaves . . . . **australense** (Schiner)

—Horn of respiratory gill club-shaped; about 40 respiratory filaments, often in pairs or groups of pairs directed forward at a low angle from the longitudinal axis of the horn; cocoon oval, close-fitting (Fig. 183), with a relatively high collar (Fig. 186); cocoon fabric usually with reticulated pattern, but sometimes non-reticulated . . . . **laticorne laticorne** Tonnoir

5 Horn of respiratory gill spindle-shaped or diamond-shaped 6

—Horn of respiratory gill rod-like or with gradual taper 8

6 Integument of thoracic notum (Fig. 185) with microtubercles. [Cocoon not close-fitting, usually nearly circular and flattened.] . **multicorne multicorne** Tonnoir

—Integument of thoracic notum without microtubercles 7

7 Cocoon not close-fitting, usually nearly circular and flattened . . . . **multicorne fiordense** Dumbleton

—Cocoon close-fitting, oval (Fig. 183). [Cocoon fabric thick, with deep honeycomb-like cells] . . . . **laticorne alveolatum** Dumbleton

8 Horn of respiratory gill 8 times longer than wide; gill with about 20 respiratory filaments; cocoon white, orifice not circular, margins gathered round base of gills; cocoon with 2 dorsal longitudinal ridges (Fig. 187) . . . . **albovelatum** Dumbleton

—Horn of respiratory gill 3 times longer than wide; gill with about 30 respiratory filaments. [Cocoon not close-fitting, ovoid; cocoon fabric thin, non-fibrous, transparent] . . . . **stewartense** Dumbleton

Chironomidae (nonbiting midges) (J. D. STARK)

The identification of chironomid larvae is not easy since taxonomic knowledge of larvae lags behind that of adults. Therefore, it is often necessary to establish the link between adult and larval stages of a species to enable specific identification. The importance of life history information (in the broadest sense, the ecology of a species) in this regard should not be underestimated. Behavioural features, microhabitat preferences, and data on abundance can all be useful in associating life-history stages.

Often a clue to larval identity can be obtained by association with adults collected in the region of the larval habitat although there is always the danger of misassociation. Pupae can be especially useful because they develop adult characteristics, e.g., genitalia, and it may then be possible to associate adults, pupae, and larvae through field collections. The best method, and the one least subject to misinterpretation, is that of rearing individually isolated larvae, through the pupal stage, to emergence as the adult. One then has larval head capsules, pupal exuviae, and adults for examination. If due care is taken to duplicate environmental conditions (especially temperature, current speed, substrate, and food supply) rearing is not too difficult for many species, e.g., several species reared by Forsyth (**42**) took 12-25 days at 20-25°C to grow from egg to adult.

Identification of chironomid larvae relies on features of both the head and body and usually requires the mounting of specimens on slides. The following procedure is recommended: colours of specimens should be noted before they are killed and stored in 70% alcohol. To mount a larva on a slide, the body should be separated from the head and mounted on its side whereas the head should be placed ventral side up. It is often best to boil the head in 5-10% KOH (10 min or less) to digest away muscle tissue prior to mounting on the slide. A good mounting medium is lactophenol-PVA. Sometimes, temporary mounts in water are useful for examination of the fine structures of mouthparts. The nature of the taxonomic characters used in the keys will become evident on referring to the figures; anatomical terminology used follows Mason (**83**).

I would like to emphasise that the keys must be used with caution as our fauna is relatively poorly known. Especially within the subfamily Orthocladiinae there are many undescribed species, a number of which are extremely similar as adults and, as yet, indistinguishable as larvae. Overseas keys (**12, 83, 90**) also may be useful for identifying larvae at the generic level.

Nomenclature used below is that employed by most contemporary European workers, e.g., **11, 41**. As such, it is in line with recent work in Australia (J. Martin, pers. comm.) and current trends in North America (**52, 111**). The European classification employs smaller generic groups than those traditionally used by most North American taxonomists and past New Zealand workers (**42, 48**).

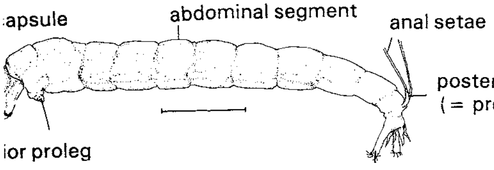
As the distributions and habitat requirements of most species are poorly known, few annotated notes on biology are appended.

Key to subfamilies

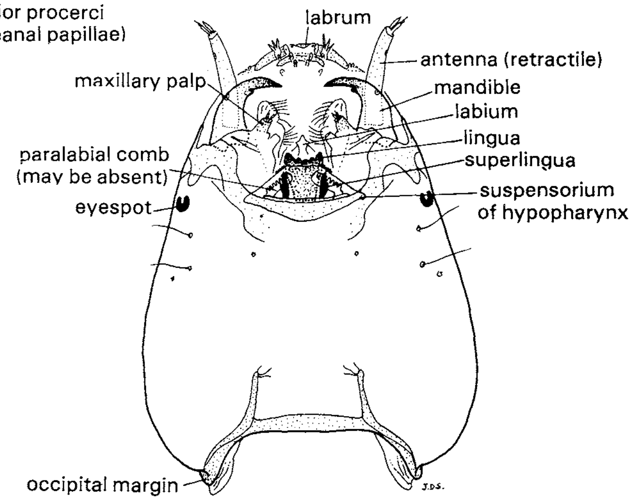
[Subfamilies or tribes marked with an asterisk (*) have not been recorded from New Zealand. Orthocladiinae, Clunioninae, and Telmatogetoninae are poorly known in this country as larvae and are not keyed further.]

1 Head capsule with fork-shaped lingua; antennae retractile into sheaths embedded in head (Figs 191, 193) .... **TANYPODINAE,** p.62
—No fork-shaped lingua; antennae not retractile 2

2 Premandibles absent 3
—Premandibles present (Fig. 194) 4



191 Tanypodinae



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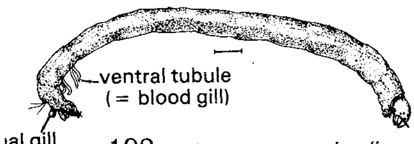
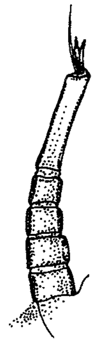


192 *Chironomus zealandicus*



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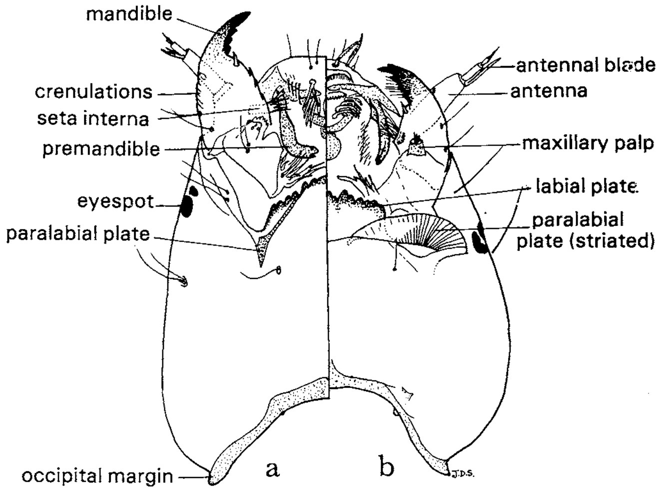

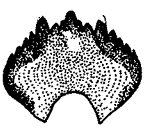

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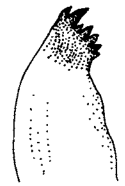

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Figs 191-197. Diptera (Chironomidae). 191, Tanypodinae, larva. 192, *Chironomus zealandicus,* larva. 193, 194, head capsules, ventral view: 193, Tanypodinae; 194a, Orthocladiinae; 194b, Chironominae. 195, *Ablabesmyia mala,* maxillary palp. 196, 197, *Parochlus* sp.: 196, labial plate; 197, mandible, distal end. Scale bar = 1 mm.

3 Posterior procerci (= preanal papillae) 5-10 times as long as wide; antennae 4- or 5-segmented, 3rd segment may be annulated; hypopharynx with ventral lamellae projecting forward .... **PODONOMINAE**, p.63

—Posterior procerci lacking; antennae 3-segmented, not annulated; labial plate without teeth, anterior margin nearly straight; body heterogeneously sclerotised, partly covered with plates of differing forms and bearing strongly developed setae .... **APHROTENIINAE***

4 Paralabial plates with striations (Fig. 194b) (exception: *Harrisius pallidus*, paralabial plates indistinct) (Fig. 192) . . . . **CHIRONOMINAE**, p.64
—Paralabial plates, if present, without striations (Fig. 194a) **5**

5 3rd antennal segment with annulations, OR head in dorsal or ventral view tapering towards the front (i.e., tending toward trapezoid shape), occipital margin with distinct, deep-black neck (Fig. 198), head colour either dark reddish-brown or light yellow, head capsule often with numerous long setae . . . . **DIAMESINAE**, p.63
—Not as above; 3rd antennal segment never annulated **6**

6 Freshwater species (some terrestrial or semiterrestrial); labial plate variable, usually convex anteriorly, its central ¾ always with teeth (Fig. 194a) . . . . **ORTHOCLADIINAE**, p.67
—Generally marine (intertidal) . . . . . **CLUNIONINAE and TELMATOGETONINAE**

TANYPODINAE

1 Paralabial combs (Fig. 193) absent; abdominal segments slender, without hair fringe; anal gills slender . . . . **PENTANEURINI**, **2**
—Paralabial combs, or a row of free chitin points present; abdominal segments broad, usually with hair fringe **3**

2 Maxillary palp with more than 1 basal segment (Fig. 195); lingua with 5 teeth . . . . **Ablabesmyia mala** (Hutton)

Found in lakes, ponds and streams. **48, 56, 113.**

—Maxillary palp with a single basal segment; lingua with 5 teeth . . . . other **PENTANEURINI**

1 described species, *Pentaneura harrisi* Freeman, and at least 1 undescribed species. There is some doubt concerning the generic placement of Australasian *Pentaneura* (J. Martin pers. comm.). Found in streams and lakes. **42, 48**

3 Antennae at least ½ as long as head; a row of free chitin points present in place of paralabial comb; lingua with 6-7 teeth . . . . **COELOTANYPODINI***
—Antennae at most ⅓ as long as head; paralabial combs present **4**

4 Mandible with thick, bulging basal portion; 6 anal gills . . . . **TANYPODINI***
—Mandible not as above (Fig. 193); 4 anal gills **5**

5 Lingua with 4 yellow teeth of equal length, OR lingua with 5 black teeth; superlingua scale-like with toothed edge . . . . **MACROPELOPIINI** (in part)*
—Lingua with 5 reddish-yellow or brownish-black teeth; superlingua 2-pointed . **6**

6 Mandible with large 2-pointed tooth; labial plate with long pustule-like appendages latero-basally; paralabial combs each with 13 teeth **ANATOPYNIINI***
—Mandible with 2 small teeth close together; no pustule-like appendages; paralabial combs each with, at most 9 teeth; toothed margin of lingua concave or straight . . . . **MACROPELOPIINI** (in part)

Larvae keying here belong to the genera *Macropelopia, Apsectrotanypus,* or *Gressittius.* 10 species have been described as adults from New Zealand: *Gressittius antarcticus* (Hudson), *Macropelopia apicincta* (Freeman), *M. languidus* (Freeman), *M. debilis* (Hutton). *M. quinquepunctata* (Freeman), *M. flavipes* (Freeman), *M. apicinella* (Freeman), *M. umbrosa* (Freeman), and the species *quadricincta* Freeman and *cana* Freeman which may belong in *Apsectrotanypus* (J. Martin pers. comm.). Larvae of few of the above species have been recognised and genera and species are separated easily only as adults. Members of the tribe occur in many freshwater habitats. **42, 48, 56, 113.**

PODONOMINAE

[The diagnoses of New Zealand podonomid larvae leave much to be desired. Tentative larval identifications should be checked by examination of pupae or adult males.]

1 Posterior procerci (= preanal papillae) uniformly pigmented .... **PODONOMINI, 2**

—Posterior procerci black basally, hyaline (= transparent) distally .... Tribe **BOREOCHLINI***

2 Antennae comparatively short and stout, 3rd segment annulated in most New Zealand species; middle tooth of labial plate considerably broader and longer than the first of 7 laterals (Fig. 196); mandible with an apical group of 7 dark teeth (Fig. 197) .... **Parochlus**

10 species have been described: *P. conjungens* Brundin, *P. aotearoae* Brundin, *P. spinosus* Brundin, *P. maorii* Brundin, *P. ohakunensis* (Freeman), *P. carinatus* Brundin, *P. pauperatus* Brundin, *P. novaezelandiae* Brundin, *P. longicornis* Brundin, and *P. glacialis* Brundin. Specific determination is possible only by examination of pupal material although *P. conjungens* and *P. glacialis* can be identified as adult males. Common in mountain streams. **11**

—Antennae short and stout, 3rd segment never annulated; middle tooth of labial plate small, hardly broader or longer than the first of 7 or 8 laterals; head often broad and triangular but may be slender and parallel-sided ...... **Podonomus**

3 species have been described; *P. parochloides* Brundin, *P. waikukupae* Brundin, and *P. pygmaeus* Brundin. Adult males are preferred for specific determination. Found in mountain streams. **11.**

The larva of *Zelandochlus latipalpis* Brundin (recorded from Franz Josef and Fox Glaciers) was described by Dumbleton (**37**); however, insufficient detail was given for this species to be included in the key.

Larvae of *Podochlus* spp. are not known. 4 species have been described; *P. grandis* Brundin, *P. stouti* Brundin, *P. cockaynei* Brundin, and *P. knoxi* Brundin. Specific identification is possible by examination of pupae or adult males. *Podochlus* larvae probably inhabit mountain streams. **11, 37.**

DIAMESINAE

1 3rd antennal segment annulated **2**

—3rd antennal segment not annulated **3**

2 Dorsal surface of head with numerous large protuberances .... **BOREOHEPTAGYINI***

—Dorsal surface of head without such protuberances .... **DIAMESINI***

3 Paralabial plates well developed, extending beyond the labial plate by at least ½ the width of the labial plate; paralabials with distinct beard of large, black hairs or, hairs absent and central portion of labial plate with narrow concavity between 2 median teeth .... **PRODIAMESINI***

—Paralabials not developed as above **4**

4 Anterior margin of labial plate virtually straight, middle ⅓ of plate (at least) without teeth; premandibles not well developed and ending in a single blade .... **PROTANYPINI***

—Labial plate distinctly convex (Figs 199, 200); premandibles well developed and ending in more than 1 blade **5**

5 Antennae 4-segmented, basal segment more than twice the length of segments 2, 3, and 4 together; head yellow and body light green; long posterior prolegs; labial plate light yellow, median tooth nearly ½ plate width and smoothly rounded, flanked by 7 darker laterals (Fig. 200) .... **LOBODIAMESINI**

This tribe is monotypic, containing 1 species (*Lobodiamesa campbelli* Pagast) which is found characteristically in small, slow-flowing mountain streams. **11, 94**

—Antennae 5-segmented .... **HEPTAGYINI**

5 species of *Maoridiamesa* belong in this tribe. They have very dark, conspicuously triangular heads with black occipital margins produced into pronounced necks with 2 ventral, posteriorly directed, projections and dorsolateral incisions (Fig. 198); labial plate with 15 teeth, median tooth broad, 2nd laterals small, 3rd laterals very large (Fig. 199). Larvae of the 5 species, *M. harrisi* Pagast, *M. intermedia* Brundin, *M. stouti* Brundin, *M. glacialis* Brundin, and *M. insularis* Brundin (Campbell Island) inhabit mountain streams and some lowland rivers, but only adult males or pupae can be identified easily. **11, 94**

CHIRONOMINAE

[The larvae of *Tanytarsus albanyensis* Forsyth and *Ophryophorus ramiferus* Freeman are not known.]

1 Antennae arise from prominent tubercles (prominences), as long as wide or longer; 1st antennal segment long and curved; striated paralabial plates often nearly 4 times as wide as long and nearly touching in the midline (Fig. 215) .... **TANYTARSINI, 3**

—Antennal tubercles much wider than long, 1st segment not long and curved; striated paralabial plates usually (but not always) more fan-shaped (Fig. 208) . **2**

2 Paralabial plates nearly touching in the midline, about 4 times wider than long .... **PSEUDOCHIRONOMINI**

1 species, *Riethia zeylandica* Freeman, has been described from New Zealand. The larva is unknown. **48.**

—Paralabial plates distinctly separated (plates indistinct in *Harrisius* (Fig. 206)) ... **CHIRONOMINI, 7**

3 Labial plate with 11, 13, or 15 teeth; mandibles with obvious teeth **4**

—Labial plate with 3 teeth (may appear like 5) (Fig. 212); mandibles without obvious teeth (Fig. 213) .... **Corynocera**

Undescribed larvae of this genus have been recorded from several lakes in New Zealand.

4 Labial plate with 11 or 15 teeth **5**

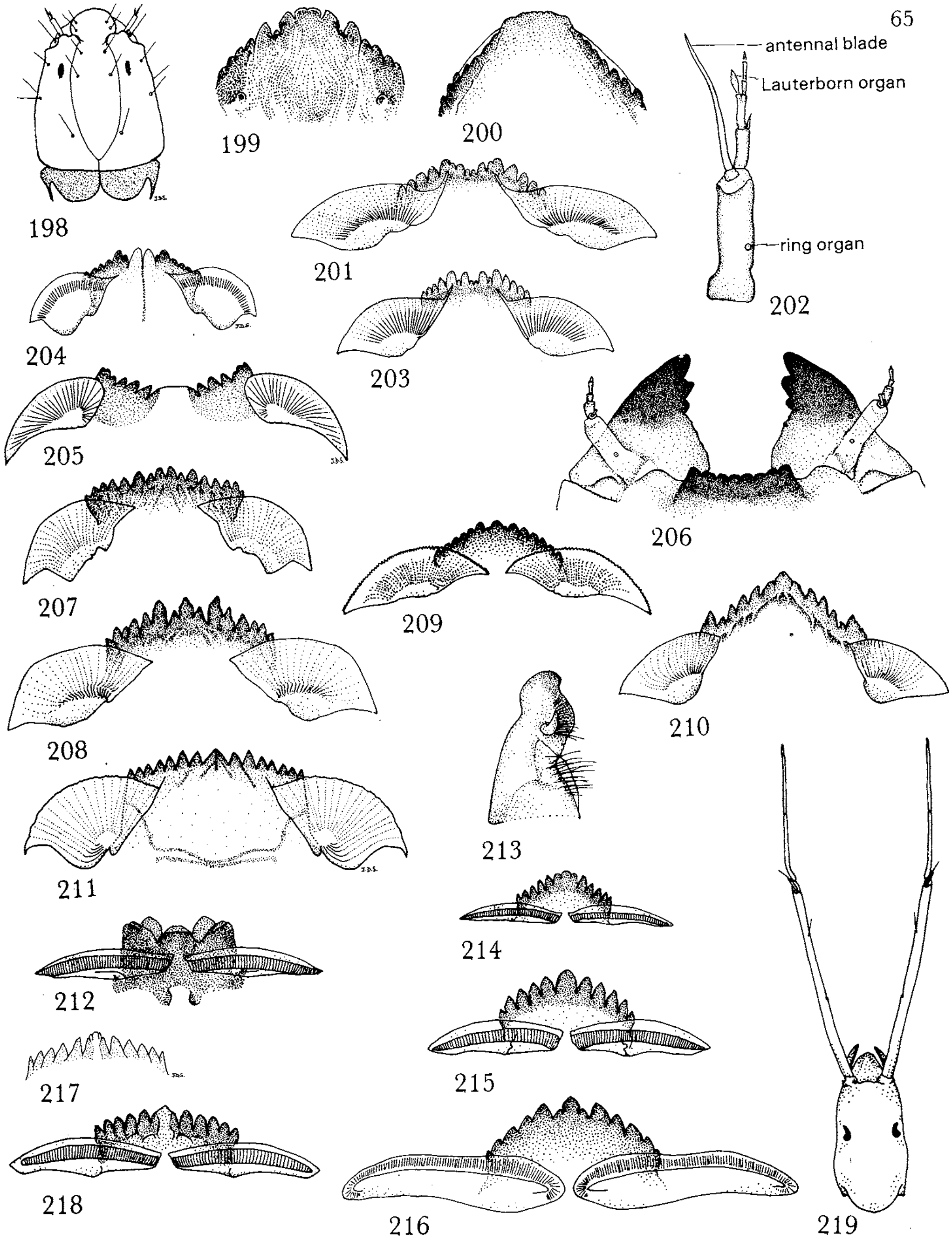
—Labial plate with 13 distinct, unicolorous teeth (or 11 if the median tooth is considered trifid) (Fig. 214) .... **Calopsectra** sp.

All life history stages of this species, collected from the Hurunui River hot springs, await description.

5 Anterior margin of labial plate strongly convex and with 11 teeth, median tooth rounded and unicolorous with no sign of notching (Fig. 215) .... **Tanytarsus vespertinus** Hutton

This species has been recorded from lakes and rivers in lowland and upland areas. **48, 56.**

—Median tooth of labial plate not unicolorous and/or not uniformly rounded ... **6**



Figs 198-219. Diptera (Chironomidae). **198,** *Maoridiamesa* sp., head capsule, dorsal (after Brundin (11)). **199, 200,** labial plates (after Brundin (11)): 199, *Maoridiamesa stouti;* 200, *Lobodiamesa campbelli.* **201, 202,** *Paucispinigera approximata:* 201, labial and paralabial plates; 202, antenna. **203-205,** labial and paralabial plates: 203, *Paucispinigera* sp. a; 204, *?Microtendipes/Paralauterborniella* sp. (after Mason (83)); 205, *Cryptochironomus* sp. **206,** *Harrisius pallidus,* labial plate, antennae, and mandibles. **207-212,** labial and paralabial plates: 207, *Polypedilum* sp.; 208, *Chironomus zealandicus, C. analis,* and *C.* sp. a; 209, *Kiefferulus opalensis* (after Forsyth (42)); 210, *Cladopelma curtivalva;* 211, *Parachironomus cylindricus;* 212, *Corynocera* sp. **213,** *Corynocera* sp., mandible. **214-219,** labial and paralabial plates: 214, *Calopsectra* sp.; 215, *Tanytarsus vespertinus;* 216, *Paratanytarsus agameta* (after Forsyth (42)); 217, *Calopsectra funebris,* newly moulted larva showing details of middle "tooth" (after Sublette & Wirth (113)); 218, *Calopsectra funebris.* 219, *Corynoneura* sp., head capsule, dorsal.

6 Median tooth of labial plate with basal, lateral notches (i.e., trifid); labial plate unicolorous and strongly convex (Fig. 216) .... **Paratanytarsus agameta** (Forsyth)

This species has been recorded from shallow ponds and some lakes in the northern third of the North Island. **42, 58.**

—Median tooth of labial plate not unicolorous and with slight lateral notching (Fig. 218), which may make it appear to comprise 5 teeth in newly moulted larvae (Fig. 217); labial plate only slightly convex .... **Calopsectra funebris** (Freeman)

This species can be found in rivers, lakes, ponds, swamps, and some oxidation ponds. **42, 48, 113.**

7 Antennae 6-segmented (Fig. 202) **8**

—Antennae 5-segmented **9**

8 Paired median teeth of labial plate smaller than 1st laterals, 2nd laterals small and on the side of 3rd laterals, 16 teeth (Figs 201, 203) (early instars *may* have 15 teeth, i.e., only *1* small median tooth) .... **Paucispinigera** spp.

1 described species, *P. approximata* Freeman, and 1 undescribed species. The larva of the latter species (known from Lakes Gault and Matheson) has minute middle and 2nd lateral teeth on the labial plate (Fig. 203). *P. approximata* inhabits beech forest streams and some lakes, especially those with beech-derived organic substrates. **48**

—Paired median teeth of labial plate lighter than laterals and larger than 1st laterals which are on the sides of 2nd laterals (Fig. 204) .... **?Microtendipes** sp.

Known from a single larva collected in Blue Lake, Tongariro.

9 Labial plate concave anteriorly, the middle tooth wide and light, flanked by oblique rows of darker laterals (Fig. 205). Maxillary palps prominent .... **Cryptochironomus** sp.

Recorded from Waitomo Stream, North Island.

—Labial plate not as above **10**

10 Labial plate concave anteriorly with 8 low, rounded, black teeth; paralabial plates indistinct; mandibles triangular and darkly pigmented (Fig. 206) .... **Harrisius pallidus** Freeman

The larva of this species occurs inside partly decomposing wood in mountain streams. **48.**

—Labial plate not as above **11**

11 Labial plate with 14 teeth, the paired median and 2nd laterals largest and even in height (Fig. 207) .... **Polypedilum**

10 described species and possibly several undescribed species all belonging to the subgenus *Polypedilum; Polypedilum pavidus* (Hutton), *P. longicrus* Kieffer, *P. opimus* (Hutton), *P. harrisi* Freeman, *P. digitulus* Freeman, *P. cumberi* Freeman, *P. ignavus* (Hutton), *P. canum* Freeman, *P. luteum* Forsyth, and *P. alternans* Forsyth. *P. ignavus* may be a synonym of *P. canum*. Specific determination is possible only by examination of adult males. The genus is represented in a wide range of freshwater habitats: *P. pavidus* is common in the littoral zone of eutrophic lakes and some oxidation ponds, *P. opimus* and *P. harrisi* inhabit small streams and seepages, and *P. luteum* probably occurs in running waters. **42, 48, 56, 58.**

—Labial plate *usually* with an odd number of teeth (if even then greater than 14) **12**

12 8th abdominal segment with 1 or 2 pairs of ventral tubules (= blood gills) (Fig. 192) **13**

—8th abdominal segment without ventral tubules **14**

13. 2 pairs of ventral tubules (Fig. 192), variable in length, usually as long as segment 8; labial plate with 15 teeth (Fig. 208); 2 pairs of anal gills, each less than half the length of segment 8, directed posteriorly .... **Chironomus zealandicus** Hudson

This is the "thummi" type of the common, red "blood worm" and is found in the benthos of lakes, streams, and eutrophic waters such as oxidation ponds. The larva of *Chironomus analis* Freeman appears to be morphologically indistinguishable from "thummi" type *C. zealandicus* but differs cytologically. **42, 48, 55, 56.**

—1 pair of ventral tubules (arising distally on abdominal segment 8) with pointed ends; labial plate convex with 15 teeth (if 1st laterals are considered to be formed by lateral notches of the large median tooth); paralabials with finely serrated anterior edge and pointed ends (Fig. 209); anal gills bulbous towards apex and directed laterally .... **Kiefferulus opalensis** Forsyth

Found on wood and among roots of *Juncus* sp. in ponds and lakes. **43.**

14 Labial plate with 13 teeth, the outer lateral pair (i.e., 6th laterals) each with a slight notch, 5th laterals small (Fig. 210) .... **Cladopelma curtivalva** (Kieffer)

This larva, which is common in lakes, was described erroneously by Forsyth (**42**) as *Chironomus (Cryptochironomus) cylindricus.* **42, 49.**

—Labial plate not as above, with 15 or more teeth **15**

15 Larva an obligate commensal of the freshwater mussel (*Hyridella menziesi* (Gray)); labial plate variable, in the 4th instar with 5-8 small similar medial teeth forming a nearly straight line flanked by a smaller separate tooth, then a large tooth beginning a descending series of 7 smaller teeth. Teeth of the 3rd instar variable in number and disposition .... **Xenochironomus canterburyensis** (Freeman)

Probably widely distributed in lakes inhabited by the molluscan host. **45, 46, 47, 48.**

—Larva free-living; labial plate with 15 teeth **16**

16 Paralabial plates with coarsely serrated anterior margin and recurved striations (Fig. 211) .... **Parachironomus cylindricus** (Freeman)

This is the larva of Freeman's *Chironomus (Cryptochironomus) cylindricus* which Saether (**111**) assigned tentatively to the genus *Parachironomus*. This relatively uncommon species is found in lakes. **48.**

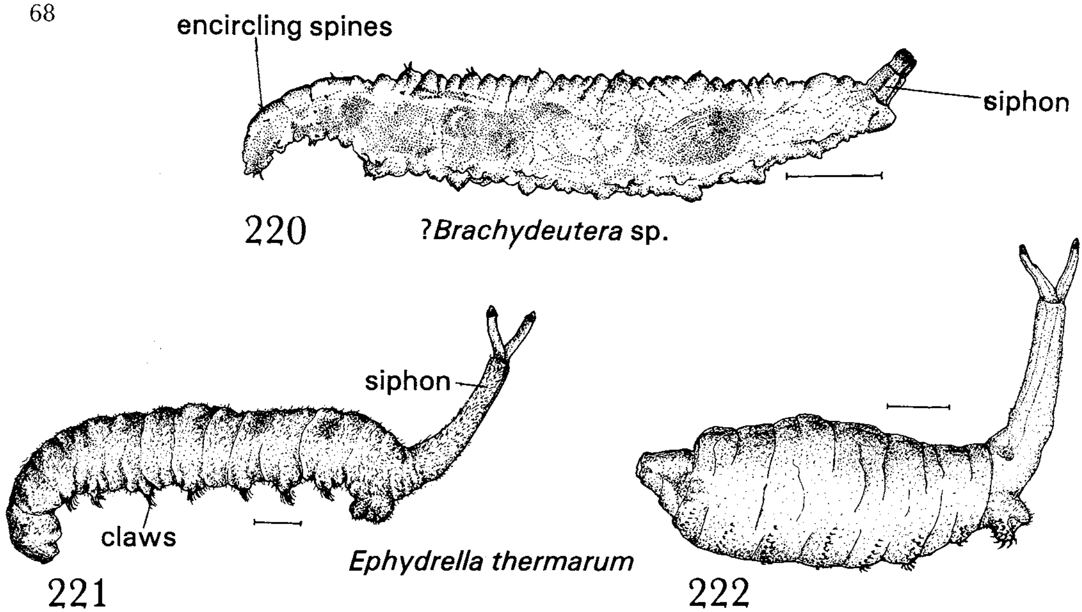
—Paralabial plate without serrated anterior margin; median and 2nd lateral teeth of similar size, 1st laterals smaller (Fig. 208) .... **Chironomus** sp. a

This species is the "salinarius" type of *C. zealandicus* Hudson and is found in many fresh-brackish-polluted water habitats. **42, 55, 56.**

ORTHOCLADIINAE

Wise (**142**) recorded 12 species in 10 genera from New Zealand but recent collecting indicates that there are many more species yet to be described. Of those in Wise's list, *Camptocladius stercorarius* (De Geer) is unlikely to have aquatic larvae as its immature stages occur in cow dung in Britain and parts of Europe (**31**), while the larvae of *Smittia verna* (Hutton) (**56**) are likely to be terrestrial like those of most other species in the genus. The larvae of only 3 of the other species listed by Wise are known. Those of *Corynoneura donovani* Forsyth (Fig. 219) and *Limnophyes vestitus* (Skuse) have been adequately described (**40, 42**), but the description of *Syncricotopus pluriserialis* (Freeman) (**42**) is insufficiently detailed to separate it from very similar *Cricotopus* species.

Because it deals with such a small proportion of the fauna and does not use generic or specific diagnostic characters to separate taxa, Forsyth's (**42**) key is of limited value. Keys written for use in other countries also have little utility in this country and it is not uncommon to find the same specimen will key to different genera in different keys. if overseas keys are used, the user should qualify his identification with a statement such as, "keys to *Cricotopus* sp. in Mason (1973)".



Figs 220-222. Diptera (Ephydridae). **220,** *?Brachydeutera* sp., larva. **221, 222,** *Ephydrella thermarum*: 221, larva; 222, pupa. Scale bar = 1 mm.

Sciomyzidae (marsh flies)

1 Body segments 9-12 bearing several elongate, setose tubercles ...... **Eulimnia**

Of the 2 known species, the larval stages of *E. philpotti* Tonnoir & Malloch has been described. This species is found in the South island, the larvae inhabiting swamps and marshy areas where they prey upon sphaeriid bivalves. *E. milleri* Tonnoir & Malloch has been recorded only from the North Island, but the larval habitat is unknown. **6.**

—Body without elongate, tubercles (Fig. 159) .... **Neolimnia**

4 species of the subgenus *Pseudolimnia* have aquatic larvae which may be common in still shallow water amongst vegetation at the margin of ponds, rivers, swamps, and lakes. Larvae feed on gastropod molluscs, but no larval descriptions have been published. **4, 5.**

Ephydridae (shore flies)

1 Anterior body segments with rows of short, encircling spines; abdomen lacking short, dark setae; respiratory siphon very short (Fig. 220) .... **?Brachydeutera**

B. sydneyensis Malloch is recorded from New Zealand and larvae keying to the genus (spiracles with 3 openings, margin of spiracular plate with short unbranched hairs) have been found in the Styx River near Christchurch. **140.**

—Without rows of encircling spines on anterior body segments; abdomen with abundant, short, dark, setae **2**

2 Ventral abdominal pseudopods and claws absent; retractile respiratory siphon very short .... **Neoscatella**

1 described species, *N. vittithorax* Malloch, whose larvae occur on damp substrates usually in association with algal mats. Habitats include estuary shores, shallow thermal pools and channels, and river margins. **131.**

—With 8 pairs of abdominal pseudopods bearing strong claws; siphon ¼-⅓ body length (Figs 221, 222) .... **Ephydrella**

5 species occur in New Zealand, but the only published larval description is for *E. thermarum* Dumbleton which inhabits North Island thermal waters. Larvae of *E. novaezealandiae* (Tonnoir & Malloch) occur in pools on the Avon-Heathcote estuary mudflats while other larvae (probably *E. aquaria* (Hutton)) occur alongside Canterbury shingle rivers. **36, 131, 132.**

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Glossary

abdomen — posterior body section lacking segmented legs.
antennae — the anteriormost pair of head appendages; sensory in function.
apterous — without wings.
benthic — bottom dwelling.
biramous — with 2 branches; forked.
brachypterous — short winged.
carapace — shield-like exoskeletal structure as in some Crustacea.
carina — keel or ridge.
caudal lamellae — posterior, plate-like gills of damselfly larvae (Odonata).
cerci — paired appendages of the posterior abdominal segment.
chelate — pincer-like.
clasper — a male genitalia appendage, e.g., in Corixidae (Hemiptera).
club — terminal antennal segments enlarged to form a knob or club-head like structure (as in some Coleoptera).
clypeal edge — anterior dorsal margin of head capsule as in larval Hydrophilidae (Coleoptera) in which the labrum is absent.
cocoon — outer covering of pupa, as in Simuliidae (Diptera).
compound eye — eye made up of numerous sensory units and lens systems.
cosmopolitan — world wide in distribution.
creeping welts — thickened, transverse ventral pads on several body segments, e.g., in some Tipulidae (Diptera).
dentate — toothed.
distal — the end away from the body, c.f. proximal.
elytra — hard wing covers (modified forewings) of beetles (Coleoptera).
endopterygote — with wings developing beneath the larval cuticle and not visible externally.
exoskeleton — outer cuticle or integument.
exuviae — cast exoskeleton or cuticle; shuck.
femur — 3rd segment of the leg following the coxa and trochanter.
frontoclypeus — the combined frons and clypeus, 2 plates making up the anterior "face" of the head capsule, bounded by the frontoclypeal suture.
gena — plate forming the side of the head beneath the eye.
haltere — reduced hind wing of a fly (Diptera).
hemelytra — forewings with a thickened basal section as in some Hemiptera.
hemimetabolous — with incomplete or partial metamorphosis from larva to adult, not involving a pupal stage.
holometabolous — with a complete metamorphosis from larva to adult via a pupa.
hyaline — glass-like, clear.
hyporheic — living deep in the substrate, e.g., of a stream bed.
hypostomium — labial plate; as in a simuliid larva (Diptera).
instar — the stage of development between moults or ecdyses.
integument — skin, outer body layer.
labium — "lower-lip", typically with a 3-segmented palp.
lamella — plate.
lateral line — lateral hair fringe on the abdominal segments of some Trichoptera larvae.
ligula — the anterior process of the labium projecting between the palps, e.g., in some larval Hydrophilidae (Coleoptera).
macrophyte — aquatic plant (angiosperm).
mandible — jaw or equivalent mouthpart.

marginal armature — small scale-like processes surrounding the segments on the dorsal surface of larval Blephariceridae (Diptera).
mask — the prehensile labium of Odonata.
maxillae — laterally placed mouthparts typically with 5-segmented palps.
nomenclature — system of naming.
notum — dorsal sclerotisation of a body segment.
ocellus — simple eye.
operculum — lid or plate closing the aperture of a chamber, e.g., in some Coleoptera larvae.
pala — the fore tarsus of Corixidae (Hemiptera).
papilla — a small protuberance.
proboscis — elongation of the head incorporating sucking mouthparts.
proleg — fleshy, non-segmented appendage usually bearing hooks or crotchets and functioning as a leg; pseudopod.
proximal — the end closest to the body, c.f. distal.
pseudopod — a non-segmented false foot, or proleg.
pupa — the life history stage in which an holometabolous larva metamorphoses into an adult.
respiratory histoblast — respiratory gill of pupa, as in Simuliidae (Diptera).
respiratory horn — breathing tube extending from the posterior abdominal segment of a dytiscid beetle larva.
reticulate — in the form of a network.
sclerite — hard, exoskeletal plate.
sclerotised — hardened and usually darkened (integument).
scutellum — the triangular piece between the bases of the elytra or hemelytra of some Coleoptera and Hemiptera.
semicircular sclerite — a narrow, curved plate at the posterior end of a larval simuliid (Diptera).
seta — bristle, hair.
spatulate — having a broad end and a narrow, attenuated base.
spiracle — external opening of trachea (respiratory tube).
sternum — ventral, sclerotised plate of a segment.
strigil — a series of comb-like teeth on the right side of abdominal tergite 6 of Corixidae (Hemiptera).
stylet — needle-like mouthpart, i.e., modified mandible or maxilla.
suture — line of junction or fusion of 2 plates.
tarsus — the 5th (distal) segment of the leg; often itself divided into segments.
tergum — dorsal, sclerotised plate of a segment.
thorax — the body section between the head and abdomen; bears the legs and wings if present.
tibia — the 4th leg segment, between the femur and tarsus.
trachea — respiratory tube.
trochantin — a structure often present on the outer side of the coxa (basal leg segment); anteriorly projecting in many Trichoptera larvae.
tubercle — a protuberance or projection.

Index

This index includes all genera and higher taxa used in the book. Page references to figures are given in bold type.

The Entomological Society of New Zealand (Incorporated).

The Society was founded in 1951 to provide a common meeting ground for everyone interested in entomology in New Zealand. It publishes an annual journal, the "New Zealand Entomologist", and occasional bulletins, and holds a conference each year. It has helped to prepare a computerised bibliography of New Zealand entomology.

Anyone interested in joining the Society or wanting further information should contact: The Secretary, Entomological Society of N.Z. (Inc.), 8 Maymorn Rd, TE MARUA, Upper Hutt.

21st Anniversary Research Fund. This fund was set up in 1973 to foster the objectives of the Society ("The improvement and diffusion of entomological knowledge in New Zealand"). Applications for grants can be made by both members and non-members and societies or groups. The applications are referred to a Grants Committee (a Convener, President of the Royal Society of N.Z., President of the Entomological Society of N.Z.) for consideration and decision, and the successful applicants are announced at the annual conference. Since 1975 about $9,000 has been awarded in 30 grants. Applications close at the end of February each year. Further information and application forms are available from: The Secretary, Entomological Society of N.Z.(Inc.), 8 Maymorn Road, TE MARUA, Upper Hutt.

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The Society was founded in 1968 to provide a common meeting ground for freshwater workers in New Zealand, and to encourage and promote the exchange of news and views between them. In particular, a newsletter is compiled and circulated at least once a year, and an annual conference is held.

Anyone interested in joining the Society or wanting further information should contact: Dr Jim Robb, Secretary/Treasurer, C/- Christchurch Drainage Board, P.O. Box 13-006, CHRISTCHURCH.

Other publications of the Entomological Society of N.Z.

The preparation and curation of insects. Annette K. Walker and Trevor K. Crosby, 1979. *N.Z. DSIR Information Series 130,* 55p. (ISSN 0077-9636).

This handbook is a joint DSIR/Entomological Society of N.Z. publication. It explains the methods and techniques to be used for preparing insects for an insect collection, and how the collection should be curated and managed. Detailed information is given on the following topics: the preparation of specimens, including relaxing, pinning, card point mounting, double mounting, slide mounting, and labelling; organisation and storage of the collection; loans and the dispatching of specimens; restoration of specimens. A checklist of the entomological supplies required for a collection is given.

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Bulletins of the Entomological Society of New Zealand (ISSN 0110-4527)

Bulletin 4: Standard names for common insects of New Zealand. D. N. Ferro (Chairman, Committee on recommended standard names), 1977.

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