Biological Notes on New Zealand Heteroptera.

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1. INTRODUCTION.

THE order Hemiptera in the widest sense includes all those insects which bear sucking mouth-parts and undergo a gradual metamorphosis. Several writers have pointed out that no order of insects has been more neglected by entomologists or is more directly connected with the welfare of the human race than the Hemiptera. (Britton, 1923, p. 10.) Probably the most neglected forms of the whole order are included in the suborder Heteroptera, distinguished, except in a few aberrant species, by the division of the forewings, or *hemielytra*,* into a basal thickened portion (made up of *corium* and *clavus*) and an apical membranous part. The Heteroptera, so far as the palaeontological evidence goes at present, are the younger of the two suborders. Morphologically the Homoptera show the greatest diversity, but ecologically the Heteroptera are the most varied. Thus the former include only plant-feeding forms,† the latter both vegetarian and carnivorous species; the Homoptera are all free-living, while the Heteroptera include obligate ectoparasites; the Homoptera are all terrestrial,‡

* Hart (1919) and Saunders (1892) call the same organs "elytra," the former writer using this as "a convenient term for thickened opaque forewings generally." But as only part of the wing is thickened and opaque it is surely more logical to use the term "hemielytra" in this case. Kirkaldy termed the forewings of both Heteroptera and Homoptera "tegmina," but it seems more convenient to reserve this appellation for the uniform-textured, usually more or less coriaceous forewings of Homoptera and Orthopteroid orders.

† Kirkaldy (1909, p. 51, note 7) mentions an isolated instance of a Fulgoroid sucking blood from a man's bare foot. Lawson (1920, pp. 20–21) mentions instances in the Cicadellidae.

‡ Certain Aphididae live on water-lilies and may be occasionally submerged.

but the Heteroptera range from the driest stations to the surface of the open ocean itself, in this last case exhibiting a completer independence of land than any other members of the class Insecta.

The study of the biology of Heteroptera, or *bugs* proper, has received a great impetus in recent years by the publication, firstly, of E. A. Butler's monumental work on the bionomics of the British species, embodying the labours of a lifetime; and, secondly, of such intensive studies as Hungerford's *Biology and Ecology of Aquatic and Semi-aquatic Hemiptera* (1919) and Hart's *Pentatomoidea of Illinois* (1919). Reuter's classical *Charakteristik und Entwickelungsgeschichte der Hemipteren Fauna der Palaearktischen Coniferen* (1909) remains a model for ecological work on the Hemiptera.

The present paper, the preparation of which has been assisted by a New Zealand Institute research grant of £10, contains complete data for not a single species. Nevertheless, it brings together all that is at present known of the biology of the Heteroptera occurring in this country. In view of the writer's departure from New Zealand at an early date, it was deemed advisable to gather up all material so far collected and place it on record as a basis for future work. In order that the technical descriptions may be kept as brief as is consistent with accuracy, most of the essential features in pre-adult structure have been expressed as much as possible by illustrations, leaving chiefly the important matter of colours and colour-patterns for treatment in the text.

Dr. E. Bergroth, the highest living authority on the Heteroptera, has now been working for some years on the New Zealand species. The present paper therefore deals solely with life-history, distribution, seasonal occurrence, host plants, and habits—in short, with such studies as must necessarily be made by a person on the spot—leaving the whole of the systematic work in far more capable hands.

Owing to the fact that frequent travelling while most of the actual rearing of bugs was in progress subjected the insects to most unnatural changes of climate, and sometimes of food, little importance can be attached to the periods taken for the different stages of development. In several cases it was only constant attention by my wife which ensured any results at all.

To many New Zealand entomologists and others who have collected Heteroptera for the writer hearty thanks are due. In most cases their names are mentioned under the names of the species concerned.

For assistance of every kind generously offered I am deeply indebted to the following overseas hemipterists: Drs. E. Bergroth, H. M. Parshley, H. B. Hungerford, J. R. Malloch, and Dayton Stoner, and Messrs. F. Muir, A. E. Butler, and W. Downes. Mr. Butler kindly gave me the fullest information from his lifelong experience of rearing these insects.

Mr. E. H. Atkinson, besides collecting material himself, gave me every assistance in the botanical side of the study. Nearly all plant-identifications were made or confirmed by him.

The writer is very grateful to Mr. E. B. Levy and to Mr. Harvey Drake for the photographs which are respectively credited to them.

2. THE NEW ZEALAND HETEROPTERA FAUNA.

Bergroth (*in litt.*) recognizes forty-four families of the Heteroptera of the world. Of these, nineteen are represented in New Zealand. The order in which the New Zealand families are discussed exactly follows the grouping of the above writer. So far as number of species is concerned, no census

can be taken until his work on the material already in hand is finished. The writer has based the following survey on the results of his own collecting and of such other workers as have sent him material.

The three families, Miridae, Lygaeidae, and Aradidae, together probably possess more species than all the sixteen other families combined. The Miridae are strongest also in number of individuals, with the Lygaeidae and the Aradidae almost certainly coming next in this order; but such a matter is rather difficult to estimate.

The next most numerous family (in species), the Pentatomidae, has only eight species, while the Anthocoridae, Saldidae (Acanthiidae), Reduviidae, Nabidae, Cydnidae, Henicocephalidae, Notonectidae, Veliidae, and Corixidae follow in that order with fewer than eight. The remaining families—Peloridiidae, Cimicidae (introduced), Gerridae, Tingidae, Neididae, and Pyrrhocoridae (introduced)—are represented in collections each by one species only. While future collecting will indubitably add greatly to the number of species, it is unlikely to change materially the relative strength of the various families as estimated above. The conspicuous Pentatomidae will probably not be added to very much, so that this family may be placed even lower on the list.

The Miridae are very much neglected by collectors, and the representation of this family will certainly be enormously increased, while the Lygaeidae and the Aradidae are particularly abundant in those cryptozoic habitats which the forest conditions of New Zealand foster so pre-eminently, and which without a doubt still shelter numbers of undiscovered forms. Field-work in the future will therefore probably show these three families to dominate the Maorian Heteroptera fauna to an extent even greater than is at present suspected. Since the Miridae are the most abundant Heteroptera in any fauna, forming, for instance, almost one-third of the total Heteropterous fauna of the palaearctic region (estimated from Oshanin's *List*, 1912), their dominance in New Zealand demands no special explanation. The Lygaeidae are also usually rich in species, forming, for example, about one-seventh of the British Heteroptera; but the New Zealand percentage is higher, being approximately one-fifth. The Aradidae, however, form no more than one-eightieth of the British Heteroptera fauna, while in New Zealand they will include nearly one-tenth of the total Heteroptera. New Zealand was originally and above all a land of forests—the North Island, with the exception of the narrow Aupori Peninsula in the extreme north, being once almost wholly wooded, while in the South Island the bush covered only a slightly smaller proportion of the total area. Beneath the bark of such countless trees a rich fauna of Aradidae was to be expected; and, further, the accumulated leaf-mould of the forest-floor gave refuge to a teeming population of both Aradids and Lygaeids.

Among the other peculiarities of the fauna are the complete absence of the almost cosmopolitan Nepidae and Coreidae,* the lack of the widely spread families Gelastocoridae, Hydrometridae, Mesoveliidae, Hebridae, Naucoridae, and Belostomatidae, and the very scanty representation of aquatic and semi-aquatic bugs generally. Of these last only the Corixidae, Notonectidae, Gerridae, and Veliidae occur at all, and these make up only

* A new species of the Coreid genus *Leptocoris* (*Serinetha*) has been found at Taihape by Mr. W. G. Howes. It is possibly endemic, but Dr. Bergroth thinks it more probable that it has been accidentally imported from some other Pacific island or from Australia.

about half a dozen species among them. The Corixidae, which form one-sixteenth of the British Heteroptera fauna, make up here only about one-hundredth. This scarcity of water-bugs in a country so well watered as New Zealand, abounding as it does in lakes, rivers, and streams, is very remarkable. The streams are, however, generally swift and rock-bottomed, and the lakes clear and cold. Blepharoceridae, Simuliidae, Plectoptera, Perlaria, and other groups which in their aquatic instars prefer swiftly-flowing water, are abundant, at least in individuals. But Culicidae and Dytiscidae are poorly represented, like aquatic Heteroptera, in number of species. It seems probable, therefore, that conditions favourable both to surface-film insects (*e.g.*, Gerridae, Veliidae) and free-swimming insects are lacking in New Zealand. The absence of the bottom-dwelling Nepidae is harder to explain, but it is certainly a fact that stretches of suitable more or less stagnant water are not common features of the usually hilly New Zealand landscape. The Saldidae, since they are not entirely dependent on water, have not been included in the discussion on water-bugs, but the fact that they are well represented, at least in individuals, is in keeping with the general abundance of torrent insects, because Saldids are addicted to running on the rocks and stones bordering even the swiftest streams.

After the extremely rich and varied Pentatomid fauna of Australia, where these bugs form the most abundant family of described Hemiptera, with nearly four hundred species, the scanty representation of this family in New Zealand is surprising. Nor is the infinitesimal number of endemic forms—only four—likely to be materially increased, since Pentatomids are the most often collected of Heteroptera. The New Zealand species are among the most obscure of the family, although a remarkable dull-black brachypterous form, discovered a few years ago by Miss Stella Hudson, and now being described by Dr. Bergroth, is of the highest taxonomic interest.

3. DEVELOPMENT AND METAMORPHOSIS.

Comstock (1920) has given his support to a scheme which distinguishes between insects with a metamorphosis (Metabola) and insects without (Ametabola). In the former he recognizes three main types—viz.; complete, or *holometabolous;* incomplete, or *hemimetabolous;* and gradual, or *paurometabolous*. All Hemiptera in their passage from egg to adult undergo a gradual metamorphosis, the young hatching in a form fairly similar to that of the parent, furnished with mouth-parts and legs of the same kind as the adult, but devoid of wings until maturity. The wings develop in external pads in the typical exopterygote manner. The transformations of certain sternorrhynchous Homoptera approach somewhat near to true holometabolic development.

The student of the Lepidopterous insects or other Holometabola usually feels well on the way to a complete life-history when he has discovered and described the larva and pupa of the insect under consideration. But the larva may be any one of several instars from egg to pupa, each instar corresponding to one of the definite stage-forms of an Hemipterous insect, although seldom presenting the diversity which characterizes the latter. In view of this diversity, the student of the Paurometabola usually requires to know every one of the five well-marked stadia from egg to adult.

This brings up the question of a name for the pre-adult instars in Paurometabola. Kirkaldy (1907B, p. 136) strenuously maintained that the

terms "larval" and "pupal" have no place rightly in the horismology of the Homomorpha. He therefore called all instars between egg and adult (usually five in Heteroptera) by the term "nymph," in which usage he has been followed by a large and increasing number of hemipterists, especially American workers. Thus Comstock (1920) very neatly restricts the titles "larva" and "pupa" to the Holometabola, and for the instars between egg and adult in Hemimetabola and Paurometabola uses the names "naiad" and "nymph" respectively.

Some British and Continental workers largely apply the term "larva" to pre-adult instars in Heteroptera, sometimes calling the last one a "nymph." This latter usage corresponds with the practice of ixodologists, who almost unanimously speak of the first instar in the Ixodidae as a "larva" and the second as a "nymph." Also, as Comstock (1920, p. 176) writes, "In old entomological works, and especially in those written in the early part of the last century, the term 'nymph' was used as a synonym of pupa."

The term "larva" is, of course, a general one in zoology, and the use of special terms like "nymph," "naiad," and "pupa," to say nothing of "nauplius" and "zoea," and a host of others which have been found necessary in the study of animal ontogeny, unfortunately tends to obscure the essential homology which would be expressed were the term "larva" and no other used for all pre-adult stages. But the needs of comparative study demand a specialized nomenclature, and the terms "larva", and "pupa," "naiad," "nymph," indicating as they do so neatly the three main types of insectan metamorphosis, seem to the writer to meet these needs. It is perhaps unfortunate that to the most specialized type (holometabolous) the most generalized name (larva) should be given, while the less specialized types which lead up to this in evolutionary series receive more specialized titles; but the students of holometabolous metamorphosis are so greatly in the majority, and have so long used the term "larva" in an entirely specialized sense for their caterpillars, grubs, and maggots, that this usage must be considered as irrevocably set—a usage as deplorable as that which borrowed terms from vertebrate anatomy for the wholly non-homologous segments of the insect-leg.

In this paper I use the term "nymph" for all instars between ovum and imago, thus emphasizing the gradual change through which they pass, and avoiding any confusion with the specialized terms of holometabolous development, among which titles that of "larva," in the strictly entomological sense, must certainly be included.

In all Heteroptera known to me there are five nymphal instars. This appears to be general throughout the suborder. In 1921 (p. 237) I wrote that "Although Osborn considers five instars to be the normal number in the Hemiptera, Kershaw and Kirkaldy note eight in the case of *Dindymus sanguineus* Fabr., an Oriental Pyrrhocorid; and there is every indication that *Ctenoneurus hochstetteri* passes through an equally large number of stadia." Kershaw and Kirkaldy, in the same paper, however, state that "such a large number of moults in a Heteropteron is unprecedented, and requires wider investigation" (1908, p. 597). They mention the only other case of more than five instars in the Heteroptera—that of the Ethiopian Pentatomid, *Bathycoelia thalassina*, which Schouteden reports to have seven nymphal instars. Bergroth, however, has found more than five in some Nabidae. The whole tendency of modern research on the Heteroptera goes to show that five is the number of stadia in the great majority of species. This is certainly true of all New Zealand bugs

investigated fully enough, with the doubtfully possible exception of *Ctenoneurus* quoted above, which was not bred uninterruptedly from egg to imago. Without such direct rearing there is the possibility that changes in colour and size between moults were mistaken for true metamorphosis.

It is usual, at least in the Pentatomidae, for the first instar to take no nourishment, but to remain clustered, often near the empty egg-shells.

4. BRACHYPTERY AND PTERYGO-POLYMORPHISM.

A reduction in the organs of flight is a well-known phenomenon in the Hemiptera. In some cases the abbreviation characterizes all the members of a species; at other times both brachypterous and macropterous forms occur within the limits of a single species—this condition being known as "pterygo-polymorphism."

Detailed studies in this connection have been made on the European fauna by Flor, Sahlberg, Reuter, and Butler. Too little is yet known of the New Zealand Heteroptera, and too few series have been collected, to analyse completely the incidence of these phenomena here. A few notes may, however, be of interest.

Brachyptery occurs in New Zealand in the following families: Miridae, Cimicidae (introduced), Nabidae, Reduviidae, Lygaeidae, Neididae, and Pentatomidae. The completely apterous condition is attained by certain members of the Gerridae, Veliidae, Reduviidae, and Aradidae. The Corixid *Diaprepocoris zealandiae* usually lacks hindwings, according to Hale. Thus out of the eighteen established families of the Maorian region no fewer than eleven, or 61 per cent., possess some species exhibiting reduction in flight-organs. The corresponding percentage for the British fauna is still higher, being 64.

Of the families in which reduction of alary organs is least frequent the Pentatomids are the most noteworthy. Yet the hitherto undescribed New Zealand species in which brachyptery occurs appears to be represented only by short-winged individuals. Of this interesting alpine Pentatomid, however, only two specimens have so far been collected, and very little is known of its habits.

Reuter (quoted by Kirkaldy, 1906, p. 283) mentions that species with forms more or less brachypterous usually live on herbage or on the ground itself, and are never found on trees or bushes. Kirkaldy (*op. cit.*, p. 284) disputes this so far as the Homoptera are concerned, by stating that "in the tropics there are certainly many dimorphic leaf-hoppers arboreal." Reuter's observations were, however, made largely on the Heteroptera, and in this suborder observations on the New Zealand fauna, as indicated by the above review, strongly support his conclusion.

For speculation as to the cause and function of pterygo-polymorphism the reader is referred to Butler (1923, p. 8) and Kirkaldy (1906, pp. 282–84). The writer has no new data or fresh theory to contribute to this aspect of the matter.

5. DISTRIBUTION.

In this section the discussion is forced to neglect a large proportion of the undescribed forms, including nearly all the Miridae. For this and for other reasons, therefore, the effect of future work in the following statistics will probably be to add more and more to the endemic element.

This section, then, is very incomplete, in that it deals with only forty-eight species; but collecting by the writer and his friends has been

sufficiently widespread in both Islands to give a fairly reliable indication of the distribution of these forms, at least as far as the mainland is concerned. The outlying islands remain, of course, almost a *terra incognita* to the hemipterist, the Kermadecs and the Chathams being the only ones from which Hemiptera have been recorded. From Stewart Island, even, apparently only one species of Hemiptera has been collected.

Of the forty-eight species discussed, five are practically cosmopolitan, seven occur also in Australia, one in Australia and Ceylon as well as New Zealand, three are found also in other Pacific islands, and, finally, thirty-two appear to be endemic, including one species closely related to an Australian form.

The Peloridiid, related to the Magellan genus *Peloridium*, and the Ploiariine, *Ploiaria huttoni*, found in New Zealand and Juan Fernandez, are, as suggested by Bergroth, evidences of South American affinities. A full elucidation of the relationships of New Zealand Heteroptera must await the completion of Dr. Bergroth's work. In a local worker like the present writer the necessarily wide knowledge of outside faunas is lacking.

The cosmopolitan species include two predaceous bugs, two forms which accompany man in his dwellings and sheds, and one which is attached essentially to introduced plants.

The Australian element consists of a species attached to introduced plants, two predaceous species, three with no very restricted feeding-habits, and one (*Arocatus rusticus*) occurring on *Parsonsia heterophylla*, an endemic plant belonging, however, to a genus which has representatives in Australia.

The other non-endemic species include one pelagic form, one carnivorous, and two wide-ranging species with non-restricted feeding-habits.

Taking the foreign element altogether, probably four species have been introduced by the agency of the white man, these being *Cimex lectularius*, *Lyctocoris campestris*, *Stenotus binotatus*, and *Eurystylus australis*. At least one other introduced Mirid—a species of *Calocoris*—occurs commonly on grasses. *Cimex lectularius* was quite unknown to the Maori people before the advent of Europeans (see Myers, 1922, pp. 7–8).

Turning now to the endemic species, we find that three occur in both North and South Islands and in the Chathams, sixteen are found in both North and South Islands, ten are confined to the North Island, and three, apparently, to the South Island. There is thus a strong indication that the North is the richer in Heteroptera. The Australian species in the fauna tend to be commonest in the north of the North Island, and to decrease in abundance southwards, being sometimes altogether absent from the South Island, or frequently reaching no farther south than the Nelson district, lat. 41°, which is as far north as the southern portion of the North Island. This is even more clearly exemplified by several species of introduced Australian Homoptera, which occur in phenomenal numbers in the North Island, but are rare or absent in its southern portion south of 39°, and in the case of one species are found commonly in Nelson (lat. 41°). The extension of a considerable number of North Island species to the northern part of the South Island is paralleled by a similar distribution in the case of the plants. Thus Cockayne (1907, p. 313) states: "Strange as it may seem, Cook Strait forms no line of demarcation between the North Island and the South Island floras—so far, at any rate, as the lowland region is concerned. It is not until latitude 42° south is reached that the South Island vegetation properly commences. . . ."

6. GENERAL ECOLOGY.

In considering the ecology of the Heteroptera no distinction will be made between indigenous and introduced species so long as the latter are established. The following scheme takes account of all species known to me, whether described or not, provided sufficient data are available to gauge their ecological position. The most important factor in the distribution of the Heteroptera seems to be their relation to plants. This relation tends to be expressed rather in terms of flora than of vegetation: in other words, a bug is restricted to a group (whether order, family, or genus) of allied plants rather than to the plants of any given association or formation. For instance, a single species of Mirid of a pale-green colour marked with vivid red is attached both to the tree-fern *Cyathea dealbata* in the forest and to bracken-fern (*Pteridium esculentum*) in the open. *Rhopalimorpha obscura* affects grasses and sedges usually in clear country, but it also occurs on the latter when these plants fringe the course of a forest-stream. A species of *Nysius* occurring almost solely on *Raoulia tenuicaulis*, and abounding at elevations up to 4,000 ft., follows this plant in river-beds down to sea-level; but here we have a somewhat different case, since the new habitat obviously offers more points of ecological similarity than in the case of the fern-loving Mirid and of *Rhopalimorpha* cited above.*

The following categories will be found to exhibit surprisingly little overlapping. The habitats described are, as far as can be ascertained, those in which the species in question spend the greater part of their lives. Seasonal changes in population due to differences between hibernation shelter and summer haunts are indicated in the detailed notes accompanying the main scheme.

(1.) *Species confined to Buildings and their Vicinity.*—Here belong *Cimex lectularius* (Cimicidae) and *Lyctocoris campestris* (Anthocoridae), both, be it noted, practically cosmopolitan, and both more or less parasitic. The apterous Ploiariine, *Ploiaria huttoni*, occurs in sheds. This is a carnivorous species.

(2.) *Widely-ranging Carnivorous Species.*—The two Pentatomids *Cermatulus nasalis* and *Oechalia consocialis* may be included here. The other predaceous bugs, such as the Reduviidae and Gerridae, are all specialized to a certain extent in habitat.

(3.) *Species occurring on Trees, Shrubs, and Lianes.*—When the vast extent of originally forested country in New Zealand is considered, it is no matter for surprise to find that more than half the Heteroptera must be included here. A good case could be made out for treating this section as forest species, and bringing in also the forms confined to the leaf-mould which is so characteristic a feature of the forest-floor. Thus would be obtained an unbroken sequence from the upper layers of forest foliage to the leaf-mould stratum itself, the latter being ecologically much more similar to the cortical and subcortical habitat than to any of the terrestrial stations of open country. Such treatment is, however, rendered impracticable—firstly, by the occurrence of numerous phytophagous species on woody plants entirely outside the forest (*e.g.*, Miridae attached to *Leptospermum* and *Cassinia*); and, secondly, as mentioned above, by the restriction of various other phytophagous species to botanical families rather

* Evidence will be adduced in a forthcoming paper on New Zealand auchenorrdynchous Homoptera showing, apparently, that these insects are restricted almost as much to plant associations as to botanical families.

than to plant associations. The essentially tropical character of the New Zealand rain forest has here its important effects. The Heteroptera of the forest change their quarters very little throughout the year, and then usually only from one part to the other of the same tree or its vicinity; the trees, with two or three exceptions, are all evergreen, and offer as much shelter in winter as in summer. This is in striking contrast to palaearctic conditions, under which Reuter found a large and varied assemblage of bugs seeking winter quarters on the conifers, which are there practically the only evergreen trees.

The species affecting woody plants and leaves fall readily into the following three minor groups :—

(*a.*) Those living among live foliage and twigs. Here is included considerably more than half the Miridae; the Lygaeids *Targarema stali*, *Arocatus rusticus*, *Nysius clavicornis*, and *Nysius* sp. 1; and the Pentatomids *Oncacontias vittatus* and *Zangis amyoti*.

(*b.*) Species occurring among masses of dead vegetation and epiphytes such as mosses and lichens. These are pre-eminently sylvan species. The dense masses of dead fronds (Plate 81, fig. 1) hanging from the heads of such tree-ferns as *Cyathea medullaris*, and the thick growth of Hymenophyllaceae, Polypodiaceae, mosses, and lichens covering the trunks of trees and logs, afford shelter to the insects of this category. Typical families are Anthocoridae and Reduviidae (Ploiariinae only).

(c.) Species living beneath bark of living or dead trees. The bark of such trees as *Dacrydium cupressinum* and *Podocarpus dacrydioides* flakes off, while that of *Leptospermum*, *Fuchsia excorticata*, *Podocarpus totara*, *Dacrophyllum Traversii* is shed in long, fibrous strips, of which several layers may be detached at once. In these situations a considerable number of bugs may be found; but the typical bark-dwelling species, the Aradidae, occur more plentifully beneath the loosened bark of dead trees, thus incidentally proving that the sap of live trees cannot be their main food. Some species of the Aradidae, as mentioned later, occur, particularly in their nymphal stadia, in the forest-floor. The abundance of Aradidae in New Zealand has been already emphasized. The other bark-dwelling Heteroptera include one undescribed Henicocephalid, found with its immature stages in the same situation; an undescribed Ploiariine Reduviid; and a few Anthocorids, the flattened form of which cannot be an adaption to subcortical existence, since it is equally developed in species common elsewhere. Outside Heteroptera may occasionally seek subcortical shelter for hibernation.

(4.) *Species occurring on or near the Ground.*—These species are more considerably augmented than those of any other section by a distinct winter population of hibernating forms, especially in open country. Four minor groups may be distinguished,—

(*a.*) Those of low herbage generally (open country). Most of the Nabidae and the Lygaeids, *Nysius huttoni*, *Nysius* spp. 2 and 3, and *Taphropeltus putoni* must be placed here. Probably our only Neidid should also be included.

(*b.*) Species frequenting grasses, sedges, and rushes (Plate 81, fig. 2) (of forest or open country, or both).—A very large number of species is attached to these plants. Among them are most of the remaining Miridae; the only recorded Tingid; the Lygaeids *Cymodema* n. sp., *Orthoea nigriceps*, and *Margareta dominica*; and the Pentatomids *Dictyotus caenosus* and *Rhopalimorpha obscura*.

(*c.*) Burrowing forms. These occur in open country only, and include the Cydnids *Hahnia australis* and *Chaerocydnus nigrosignatus*, both more or less attached to the sea-coast. The other Cydnid, *Pangaeus scotti*,* almost certainly will be placed here when its biology is known.

(*d.*) Species inhabiting the leaf-mould of the forest-floor. From a strictly ecological point of view these should follow immediately on the groups 3 (*b*) and 3 (*c*), to which they are closely related. The majority of them, both in species and in individuals, are Aradids and Lygaeids, especially nymphal instars. The chief species of the latter family belong to the genus *Metagerra*. Plentiful also, in certain localities, is a species of *Henicocephalus*, both as nymph and adult. The latter is also, of course, at times a thoroughly aerial insect, its habit of dancing in the air in companies being well known. The leaf-mould is swarming with mites and with the immature stages of numerous other Arthropods, on both of which *Henicocephalus* possibly preys. Finally, in this habitat occurs the Peloridiid *Xenophyes*, both as adult and nymph. In passing, it may be noted that several Homoptera spend their earlier stages in the leaf-mould, and one at least (a new genus of Ulopidae) passes there its whole life-cycle.

(5.) *Water-frequenting Species.*—The anomalies of the New Zealand water-insect fauna have already been mentioned in the introduction. Only five families of aquatic and semi-aquatic Heteroptera occur, and these achieve only the barest representation. They may be grouped in two minor categories:—

(*a.*) Semi-aquatic forms. The Acanthiidae are numerous in certain localities in individuals, but the number of species is apparently small. While occasionally they venture on to the surface film itself, their chief haunts are the rocks and mud of the shore. The margins of rocky torrents, of rivers, ponds, and lagoons, of the clear lakes, and of the sea itself, yield specimens of these insects.

(*b.*) Aquatic forms. Here belong the two Corixids and the two Notonectids, both families living most of their time below the surface; and the two Veliids (*Microvelia* spp.), and the Gerrid *Halobates sericeus*, all three insects of the surface film, the latter species living on the face of the ocean itself.

The relations of Heteroptera to plants from a floristic point of view have been dealt with under European conditions by Butler (1923) and Reuter (1909). The New Zealand data, though necessarily much more scanty than that collected by the above writers, afford some interesting comparisons. Thus the Orchidaceae, altogether avoided by the British Heteroptera, are similarly shunned in New Zealand, in spite of the fact that the species of indigenous orchids are almost twice as numerous as in Britain. Butler (1923, p. 10) gives a list of other plant-families which are entirely avoided in Britain. Among these the Linaceae and Apocynaceae both contain plants attractive to Heteroptera in this country, *Linum* sp. yielding *Nysius huttoni*, and *Parsonsia heterophylla* (Apocyn.) acting apparently as sole food-plant to *Arocatus rusticus*. Butler finds the Ranunculaceae, Cruciferae, and Caryophyllaceae with few adherents; in New Zealand these three families are entirely neglected. The Leguminosae are fairly popular, although less so than in England; but the very widespread and abundant introduced *Ulex* and *Sarothamnus*, which are among "the special favourites" in their native land, have so far yielded no Heteroptera in New Zealand.

* I am entirely unacquainted with this species.

Yet the similarly introduced *Medicago* and *Trifolium* support a considerable number. The Rosaceae, with the Malaceae, are attractive in both countries; but again there is a curious anomaly, in that *Crataegus*, "the chief favourite" in England, seems here to have no Heteroptera attached to it, although it has been planted extensively in every part of the country. The Umbelliferae are much less frequented in New Zealand than in Britain. The Onagraceae show no cases of definite food-plants in this country.

The Composites are the second most favoured family in New Zealand, and are popular also in Britain. Butler remarks that "the Rubiacaee are particularly associated with certain Capsids," a fact specially interesting in view of the abundance of these bugs in New Zealand on several indigenous plants of the Rubiaceous genus *Coprosma*. The Scrophulariaceae are little attractive in either country. *Veronica*, the chief New Zealand genus, is noted for its astringent properties. The Ulmaceae (introduced in New Zealand) and the Urticaceae yield relatively fewer species than in England, *Elatostema* in the latter family being singularly barren of insects generally. The Fagaceae are very popular among the Heteroptera of both faunas. The Gramineae support by far the largest number of species in New Zealand, and are strongly favoured in England also. The Juncaceae, very attractive in both countries, are especially used as hibernating-quarters in New Zealand.

Perhaps the greatest contrast occurs in the case of the Pinaceae. In Europe these "are very productive . . . not only are they the food-plants of many species, but also, as evergreens, they often furnish a winter residence to such species as survive that season in the adult form, since they afford much better protection from the weather than the then leafless deciduous trees. Reuter (19) has recorded 190 species of palaearctic Heteroptera as having occurred on coniferous trees . . . These he classifies into three groups according as (i) they depend upon deciduous trees or low plants for their food and resort to the conifers only for hibernation, or (ii) are found on both conifers and deciduous trees or low plants even in summer-time, or (iii) occur exclusively on coniferous trees." In New Zealand the Coniferae are represented chiefly by Taxaceae, which are plentiful and widespread, but from which I can find only four records of Heteroptera, two of which were probably cases of hibernation, while from the two indigenous Pinaceae (*Agathis* and *Libocedrus*), and from the numerous and extensively planted imported pines, none of these insects have been taken. As most of the indigenous broad-leaved trees are non-deciduous, the conifers are not necessary as hibernating shelters, while as food-plants the evidence seems to indicate that the Taxaceae in New Zealand are very much less attractive than the Pinaceae in Europe.

The ferns, as might be expected by their abundance in New Zealand, are considerably more favoured than in England, although as food-plants probably not proportionately so. As shelter they attract a number of carnivorous forms.

Among popular New Zealand plant-families which have no representatives in Britain may be mentioned Myrtaceae, Pittosporaceae, Cunoniaceae, Epacridaceae, and Myoporaceae.

The most noteworthy cases of definitely restricted association include those of a Mirid with *Pteridium* and *Cyathea*, of *Megaloceroea* and *Rhopalimorpha* with *Glumiflorae*, of *Stenotus binotatus* with Gramineae, of *Margareta dominica* with *Gahnia*, of *Romna* sp. with *Leptospermum*, of *Arocatus rusticus* with *Parsonsia*, of certain Mirids with *Myoporum* and with certain *Coprosmas*

respectively, of *Nysius* sp. 1 with *Cassinia leptophylla*, of *Nysius* sp. 2 with *Raoulia tenuicaulis*, and of a Mirid with *Senecio elaeagnifolius*.

To sum up, the most attractive orders in New Zealand, arranged in descending order, are the Glumiflorae, Rosales, Campanulatae and Myrtiflorae (equal), Filicales, Rubiales, Fagales, Polygonales, Liliiflorae. The most favoured families are Gramineae (many introduced plants), Compositae, Juncaceae (especially for hibernation) and Myrtaceae (equal), Rubiaceae, Fagaceae, Polygonaceae, Cyperaceae, Cyatheaceae, Rosaceae, Malaceae (introduced), Leguminosae (chiefly introduced plants), Onagraceae.

Among large New Zealand plant-families from which no Heteroptera have been recorded may be mentioned the following (arranged in descending order, and compiled from Cockayne, 1921, pp. 309–10): Orchidaceae, Ranunculaceae, Borraginaceae, Cruciferae, Gentianaceae, Halorrhagaceae, Caryophyllaceae, Thymelaeaceae, Campanulaceae, Chenopodiaceae. The largest genus of vascular plants in the flora—namely, *Veronica*—yields only a single record of Heteroptera.

In concluding this section a comparison may be made with Hawaiian conditions, which are more similar than those of Britain. Kirkaldy (1909B, p. 23) writes: "The principal Hawaiian plants, from a hemipterological point of view, are *Nani* (= *Metrosideros*) *polymorpha*, *Pipturus*, *Myrsine*, *Ipomaea*, *Sida*, various tree-terns, *Myoporum*; and to a less degree, *Acacia koa*, *Cyathodes*, *Elaeocarpus*, *Eugenia*, *Freycinetia*, *Dodonaea*, and *Bobea*. Of these, I find on reference to Kirk's great work on New Zealand forest-trees (the only such work I have for reference) that *Cyathodes*, *Elaeocarpus*, *Eugenia*, *Dodonaea*, *Nani*, *Myoporum*, and *Myrsine*—and, I suppose, *Freycinetia*, *Ipomaea*, and *Sida* also—are well represented in New Zealand. It is almost impossible to believe that they too are not the shelters or food plants of a large hemipterous fauna there." Acting on this prophecy, the writer in collecting has always paid particular attention to such of these plants as he has met. Only *Myoporum* and the tree-ferns have proved specially attractive in New Zealand, at least so far as Heteroptera are concerned. Of the other genera, there are scanty records of Heteroptera from only *Cyathodes* and *Freycinetia*.

7. SEASONAL OCCURRENCE.

A very large proportion of the New Zealand heteroptera seem to winter as adults, seeking definite hibernating shelter such as that afforded by the bases of rush clumps (*Juncus effusus* L.), which are shared also to a surprising extent by other wintering Arthropods, including nymph ticks (*Haemaphysalis bispinosa* Neumann). Thus in all our Pentatomidae of which any details are known, in the Cydnidae and Lygaeidae, and perhaps in certain of the Miridae, the imago is the overwintering stage. Most of the European Miridae, according to Butler, pass the winter in the egg—a procedure to which the usual deposition of the ova *within* plant-tissues is perhaps an adaptation. Too little is known of the majority of the New Zealand Mirids to indicate how they spend the winter, but the probability is that most of them resemble their northern cousins in this matter.

Frequently, in species which hibernate as imagines, only one brood is reared in the season, but in some, such as *Arocatus rusticus*, *Nysius huttoni*, *N. clavicornis*, and possibly *Metagerra obscura*, there are strong indications of two or more generations. The water-bugs *Anisops* and *Arctocorisa*, however, and such unrelated families as the Anthocoridae (*Lyctocoris*), Reduviidae (Ploiariinae), and Aradidae, seem to breed all the year round,

or at least in winter as well as in summer. It is evidently no mere coincidence that these five families affect habitats in which conditions change relatively little with the seasons. Their species are certainly exposed less to atmospheric conditions than those of any of the families containing forms which winter only as adults. Moreover, their food-supply would fluctuate less than that of most plant-feeding forms.

In many of the bugs there is thus a definite seasonal movement from hibernation quarters to food-plants in spring, and *vice versa* in autumn, the travelling instar in both cases being the imago. So conspicuous is the endemic Pentatomid *Oncacontias vittatus* at these times that it has won the distinction of the only popular name bestowed upon a Heteropteron in New Zealand—viz., "Little Miss Nothing" (*teste* Mr. E. H. Atkinson).

Seasonal movements of a different kind take place among some of the Aradidae. In the hottest weather of late summer both *Aradus australis* and *Ctenoneurus hochstetteri* take flight in considerable numbers and spread like swarming ants over the countryside. When we consider the similar dispersal habits of cryptozoic social insects such as ants and termites, and when we remember the tremendous companies of Aradidae which habitually congregate beneath limited areas of loose bark, although these assemblages have never to my knowledge been dignified by the title of "societies," the analogy is altogether very striking.

8. ECONOMIC IMPORTANCE.

Without deprecating the probability that all the species have a definite role to play in what J. Arthur Thomson has called "the web of life," the writer has confined his remarks in this section to those forms which exhibit direct and definite economic relationships. Such species are included in the following families: Notonectidae, Miridae, Cimicidae, Anthocoridae, Nabidae, Reduviidae, Lygaeidae, and Pentatomidae. All the remaining families, so far as present knowledge indicates, are entirely negligible economically. Of the eight economic families, the Notonectidae, Nabidae, and Reduviidae contain only beneficial species, the Anthocoridae and Pentatomidae comprise both injurious and useful forms, while the remaining economic families are almost solely injurious.

The Notonectidae are noteworthy enemies of mosquito larvae. The New Zealand species cannot be large enough to be dangerous to even the youngest fish. At the worst, they can only offset the good done in the destruction of mosquito larvae by the devouring of certain quantity of other organisms suitable as food for young fish. Hale has shown that certain Australian Corixidae also feed upon mosquito larvae.

The Nabidae are all predaceous, but exact data as to their prey in New Zealand are lacking. In many cases it is doubtless the nymphs of plant-feeding mirids.

The Reduviidae also are purely predaceous, but, as the common New Zealand members all belong to the subfamily Ploiariinae, containing delicate insects confined to obscure haunts, the insects on which they prey are economically insignificant.

The Anthocoridae are another largely predaceous family; but one species, *Lyctocoris campestris*, has been recorded outside New Zealand as biting man, horses, and cattle. However, the reputation of this species in the Dominion has so far been blameless.

Of the Pentatomidae, both *Oechalia consocialis* and *Cermatulus nasalis* are predaceous and highly beneficial, especially the latter species, which is far more common. *Cermatulus* is especially destructive to Noctuid larvae,

including several important pests of agriculture, and to the pear-slug (*Eriocampoides limacina*). *Zangis amyoti* may become a pest of hedge-plants, though in at least one instance it may be occasionally predaceous. The purely phytophagous species *Dictyotus caenosus* and *Rhopalimorpha obscura* are sometimes exceedingly numerous on meadow-grasses, including cocksfoot.

In the Miridae, the introduced *Stenotus binotatus* is a well-known pest of cocksfoot (*Dactylis glomerata*) and rye-grass (*Lolium perenne*). A species of *Romna* has been observed to feed on a leaf-eating lepidopterous larva.

The Lygaeidae are apparently all phytophagous, but only one has yet been convicted of serious damage: *Nysius huttoni* is a pest of lucerne (*Medicago sativa*).

The Cimicidae are, of course, all parasites of vertebrates. The single species in New Zealand is the introduced bed-bug (*Cimex lectularius*), which is a source of annoyance to man, and may possibly be implicated in the spread of disease.

The Tingidae, which are generally among the most injurious of the Heteroptera, are represented in New Zealand by one very rare species only.

The depredations of sucking-insects like the Heteroptera are immeasurably less spectacular than the wholesale destruction brought about by biting-insects such as locusts and Noctuid larvae. The attack is insidious, and the drain on the plant continuous and weakening, producing added susceptibility to disease. Apart from this, however, there is a rapidly accumulating body of research indicating sucking-insects, and Hemiptera in particular, as agents in the spread of the bacterial, fungous, and "virus" diseases of plants.

9. SPECIES DEALT WITH.

Biological observations, amounting very rarely, however, to anything like a complete life-history, have been made on the following species:—

Arctocorisa arguta
Diaprepocoris zealandiae
Xenophyes cascus
Anisops wakefieldi
Anisops assimilis
Megaloceroea reuteriana
Megaloceroea sp.
Romna capsoides
Romna scotti
Romna sp.
Stenotus binotatus
Eurystylus australis
Cimex lectularius
Lyctocoris campestris
Cardiastethus sp.
Halobates sericeus
Henicocephalus sp. 1
Henicocephalus sp. 2
Reduviolus capsiformis
Ploiariodes rubromaculatus
Ploiaria huttoni
Tingidae n. gen. and sp.
Arocatus rusticus
Nysius huttoni
Nysius clavicornis
Nysius anceps
Nysius n. sp. 1
Nysius n. sp. 2
Nysius n. sp. 3
Metagerra obscura
Orthoea nigriceps
Targarema stali
Margareta dominica
Taphropeltus putoni
Cymodema n. sp.
Neides wakefieldi
Aradus australis
Ctenoneurus hochstetteri
Aneurus brouni
Oechalia consocialis
Cermatulus nasalis
Zangis amyoti
Dictyotus caenosus
Rhopalimorpha obscura
Oncacontias vittatus
Pentatomidae n. gen. and sp.
Hahnia australis
Chaerocydnus nigrosignatus.

The somewhat miscellaneous subject-matter is dealt with under every species in taxonomic order, arranged under the following headings: Copulation; Oviposition; Eggs; Nymphal Instars; Life-history; Seasonal Occurrence; Host Plants, Habitat, and Feeding-habits; Distribution; Miscellaneous Notes.

The New Zealand families are numbered serially, while the number at which each respective family stands in the world list (after Bergroth) is given in brackets.

Family 1 (1). CORIXIDAE.

Arctocorisa arguta (F. B. W.).

Nymphs.

Specimens from Mount Peel are presumably of this species, but as none were bred the identity is not quite certain.

Intermediate Instar.—Length, 3·4 mm. Colour dull brown, eyes darker and appendages lighter. Hemielytral pads projecting out from body, not reaching to level of posterior margin of metanotum (at middle).

Fifth (?) Instar.—Colour as above. Hemielytral pads reaching just past middle of third (dorsal) segment of abdomen, tips of hindwing pads being conterminous. Spine on hind coxae already large, but the tiny supplementary and adjacent one of the imago not yet indicated. One specimen has two black pegs near distal end of intermediate tibia. I can find no such structure in the adult of either sex.

Seasonal Occurrence.

Imagines have been taken in January, February, June to August, October, and November. Fairly advanced nymphs occurred in January. Early in June nymphs were most numerous, but by the middle of July only adults could be found. At Mount Peel in February Mr. Philpott found only nymphs of apparently third, fourth, and fifth instars. There is probably no quiescent (hibernating or aestivating) period, at least in the North Island, but records are not yet sufficient to indicate the number of broods per year. In Britain, according to Butler, Corixids winter as adults, sometimes burying themselves in the mud.

Feeding-habits.

Until 1917 it was commonly assumed that most of the water-bugs, including the Corixidae, were predaceous; but in that year Hungerford published certain results which led him to believe that the common North American forms at least subsisted largely on Algae, which they procure from the ooze at the bottom of their ponds. From his later work (1919, pp. 248–49) is quoted the following summary of his extended experiments: "Corixids sweep in the organic ooze of the pool with its attendant populations, both plant and animal, the bulk of the material being of plant origin. The presence of long filaments of *Spirogyra*, *Zygnema*, and *Oscillatoria* cannot be accounted for in any incidental manner. The deliberate action of the bug in feeding on the chlorophyll of *Spirogyra*, as indicated above, is conclusive evidence of the herbivorous tendencies of these creatures. . . . As a basis for the propagation of Corixids in artificial quarters it has been discovered by experiment that a satisfactory food-supply can be obtained by grinding the water-soaked leaves of cattail that have laid in the marsh over winter and allowing them to reach a state of balance. A brown

flocculent mass is thus produced, in which develop a flourishing population of tiny organisms, both plant and animal. In such a culture *Palmocorixa* has been carried from egg to adult."

Hungerford mentions having seen Corixids catch prey (1919, p. 236), but finds that this does not represent the usual feeding behaviour. On the other hand, Hale (1922, pp. 310–11), experimenting on Australian forms, writes: "For months I kept in aquaria several species of Corixidae, as well as members of Notonectidae and Naucoridae, and during that time they were fed only upon larvae of *Culex fatigans* and *Scutomyia notoscripta*. Even newly hatched Corixidae were observed to capture tiny mosquito larvae, increasingly large examples being taken during the successive stages of the metamorphosis. If, as seems certain, aquatic bugs feed upon these larvae in their native ponds, there is every reason to suppose that they mitigate the mosquito nuisance and are thus of considerable economic importance. The malaria-carrying mosquitoes particularly breed in isolated pools and temporarily inundated grass-grown hollows, localities in which fish do not usually occur, but to which aquatic bugs, possessing the power of flight, have easy access."

As remarked by Hungerford, the feeding-apparatus—both rostrum and forelegs—of Corixids certainly differs very widely from that of the typical predaceous water-bugs.

Distribution.

From the notes on feeding-habits it will be obvious that only fairly stagnant waters can afford a suitable habitat for this species, unless its requirements in this respect differ from those of Corixids in general. Artificial ponds are much favoured.

This insect keeps much nearer the shore than do the Notonectids, and the peculiar and characteristic Corixid coloration of brownish variously marked with blackish renders it almost invisible against the background of a muddy bottom.

Arctocorisa arguta occurs from sea-level to 3,300 ft. (Arthur's Pass), 4,500 ft. (Mount Hector, Tararua Range), and 5,000 ft. (Mount Peel, Nelson). Hutton (1898B, p. 180) records it from Auckland to Otago. The North Island localities are Hawera, Hastings (D. Miller), Wanganui, Tararua Range, and Wellington; South Island—Mount Peel, Arthur's Pass, and Bold Peak (Wakatipu); but these doubtless represent only a small portion of its range.

Miscellaneous Notes.

The attraction of Corixids by light has been often recorded for exotic species. A specimen of *A. arguta* flew into a lighted room at York Bay, Wellington, in February. Hudson (1904, p. 96) found thirteen specimens of this insect among the stomach-contents of nine trout caught in South Canterbury.

Diaprepocoris zealandiae Hale.

In 1922 (p. 8) I wrote, concerning the allegedly doubtful occurrence of *D. barycephala* Kirkaldy in New Zealand, "There are, however, indubitable specimens, labelled 'Auckland,' in the Canterbury Museum." These were probably the specimens which led Hutton to include the species in the *Index Faunae* (1904, p. 224). Kirkaldy (1909B, p. 27) states rather dogmatically that it "has not been taken in New Zealand." More recently,

however, I have seen four specimens of *Diaprepocoris* in the Percy Buller collection of Coleoptera at the Dominion Museum. These were almost certainly taken in New Zealand, but unfortunately they lack data. According to Miss A. Castle and Mr. H. Hamilton, most of Percy Buller's collecting was done in the Wellington and Auckland districts. Mr. H. M. Hale, the authority on Australian water-bugs, is now examining both the Canterbury and Dominion Museum material. He states (*in litt.*) that he has already in the press the description of a New Zealand *Diaprepocoris* distinct from *D. barycephala*, and it seems probable that the eight above-mentioned examples belong to this new species.

Since writing the above I have received from Mr. Hale the following note :—

***Diaprepocoris zealandiae* Hale.**

Diaprepocoris barycephala Hutton, *Index Faunae Novae Zealandiae*, 1904, p. 224 (*nec* Kirk).

Diaprepocoris zealandiae Hale, *Trans. Roy. Soc. S. Aust.*, vol. 48 (1924).

Through the courtesy of Mr. Myers I have been able to examine the four specimens from the Canterbury Museum upon which Hutton's New Zealand record (*ut supra*) was based, and other four examples from the P. Buller collection in the Dominion Museum. *D. zealandiae* was described from a single damaged female; the examples now before me are perfect, and both sexes are represented, so that some little addition to the original description is necessary.

The scutellum is variable in size *inter se*, and is smaller in these specimens than in the type. The hemelytral membrane is not fully developed. Metathoracic wings are wholly wanting in the type, and also in two males which were relaxed and examined for this character; it may be found that metawings are usually absent in this species, but, as I have shown elsewhere, a degeneration of hemelytra and alae cannot be relied upon as a character of specific importance.

In the male the form is more slender, the vertex of the notocephalon is more obtuse, and the eyes are slightly larger than in the female. On the dorsal surface of the male abdomen is a stridulatory apparatus similar to that present in the male of the two Australian species.

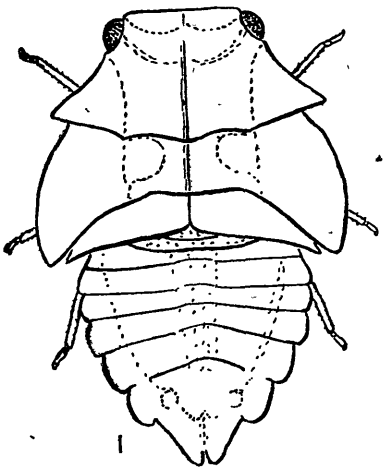
Length, 5 mm. to 6·1 mm. HERBERT M. HALE.

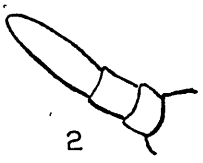
Writing later still, Mr Hales states there are four other specimens in the British Museum from Waitaki (Otago), and another labelled, perhaps wrongly, "Tasmania."

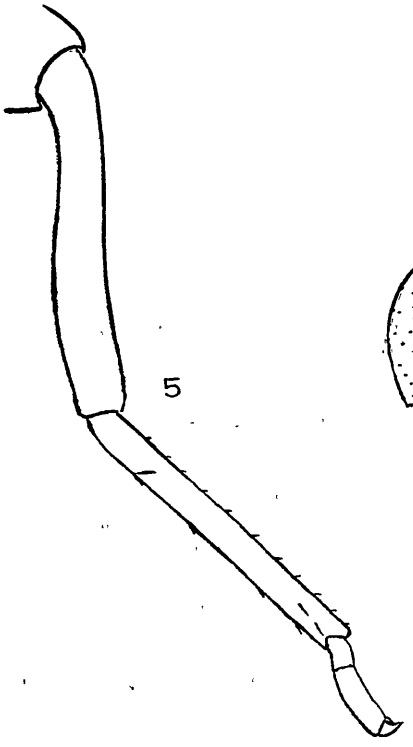
Family 2 (2). PELORIDIIDAE. (Text-figs. 1–5.)

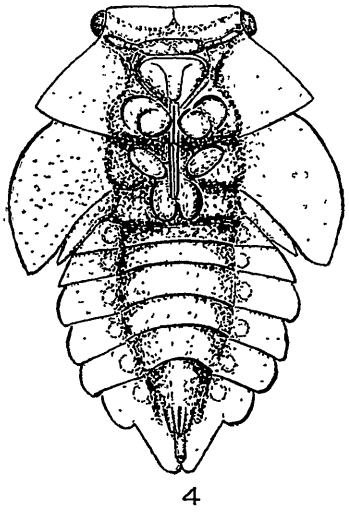
Xenophyses cascus Bergr.

In November, 1920, Mr. H. Hamilton, in sifting leaf-mould for Coleoptera, discovered one nymph and one imago of a new genus belonging to this aberrant family. The adult has now been described by Dr. Bergroth (1924), to whom I am indebted for information on its systematic position and references to the existing literature. In view of the great interest which accrues to the species, from the facts—firstly, that it is only the second known species and genus of the family, the other genus (*Peloridium* Breddin) being confined to the Straits of Magellan; secondly, that the members of the family as a whole are now represented in collections by only four known specimens; and, thirdly, that the Peloridiids exhibit certain morphological features which are apparently distinctly Homopterous, although their nearest relatives are evidently the Ochtheridae (Bergroth), I have thought it advisable not only to describe and figure the nymph, but also to give a few notes on the habitat to which it appears to be confined. Energetic collecting at and around the locality from which the original leaf-mould was procured, although prosecuted on several occasions by Mr. T. R. Harris, who resides in the vicinity, and by Mr. Hamilton, and myself









FIGS. 1–5.—*Xenophyses cascus:* 1, advanced nymph; 2, antenna; 3, eye; 4, under-surface; 5, metathoracic leg.

The magnifications are not uniform, and the sizes of the various instars are in most cases not comparative; however, the fifth instars of the Pentamoids (text-figs. 12 and 17; Plate 5, fig. 4; Plate 6, figs. 2, 3) are equally magnified.

on several special visits, has so far yielded no more specimens. It may therefore be safely asserted that the bug is very rare. It is of interest to note that the South American species also was collected on the floor of the forest.

(Since the above was written a third genus of Peloridiidae has been described—namely, *Hemiodoecus* China, 1924, from Tasmania; while Dr. Bergroth has received a nymph of unknown species from Lord Howe Island.)

Nymph.

Fourth or Fifth Instar.—For comparison the parts are described in the same order as in Breddin's account of the imago of *Peloridium hammoniorum* (1897, pp. 12–13):—

Length, 2·52 mm.; greatest width (across hemielytral pads), 1·70 mm.

Above flat, abdomen somewhat concave; lower surface convex, except for lateral expansions which are flat. Head with flat straight-edged membranous extension reaching cephalad between the eyes, and with slight median longitudinal ridge extending caudally on to thoracic nota. Pronotum with two wide membranous extensions in the shape of equilateral triangles, one on each side. None of the above membranous areas are areolate. Pronotum seems to be fused with head. Hemielytral pads projecting well out from the body, flat with no signs of venation. At their proximal ends, a long way outside of body proper, they seem to be fused with paranota of pronotum. Abdomen with very wide lateral expansions constricted at segments, of which six ordinary ones are visible on dorsal view, followed by a long conical terminal "segment" notched at tip. What I take to be spiracles are situated on ventral surface of abdomen just near junction of abdomen and connexivum, thus agreeing with *Peloridium* (adult), of which Breddin says, "Stigmatibus a margine exteriore valde distantibus."

Antennae three-segmented, apical segment longest, reaching to mesal border of eyes. Rostrum appearing to arise just cephalad of fore coxae, and extending to hind coxae. Two segments are visible in rostrum, but it is difficult to see whether or not there are further articulations near base. Eyes with large facets. Tibiae of all legs feebly bristly or spinose. Tarsi all appear to be two-segmented with basal segment very short.

Details of pedal, rostral, antennal, and stigmatic characters not obtainable without a certain amount of preparation and dissection, to which I do not propose to subject the unique specimen.

Colour above olivaceous, lateral expansions naturally paler; metanotum suffused with darker; eyes reddish-brown, Below olivaceous, the first four visible segments of abdomen darker than remainder of under-surface; rest of abdomen very pale, but genitalia tinged with yellowish-brown; antennae, legs, and rostrum not appreciably darker than body. Whole surface practically glabrous.

The leaf-mould was gathered in forest near the railway-station of Ohakune, at an elevation of about 2,100 ft. At this spot the dominant tall tree was *Weinmannia racemosa* L., with a sprinkling of *Dacrydium cupressinum* Sol., *Podocarpus spicatus* R. Br., *P. ferrugineus* Don, *Olea Cunninghamii* Hook. f., *Fuchsia excorticata* (Forst.) L., and some *Aristotelia racemosa* (A. Cunn.) Hook. f. nearer the edge. Shrubby undergrowth, represented by a few bushes of *Alseuosmia macrophylla* A. Cunn., *Myrtus pedunculata* Hook. f., *Drimys colorata* Raoul, *Melicytus ramiflorus* Forst., and *Nothopanax arboreum* (Forst. f.) Seem., was extremely sparse. The lowest tier

of vegetation consisted almost solely of *Blechnum discolor* (Forst, f.) Keys, with a few scattered plants of *Microlaena avenacea* (Raoul) Hook. f. and *Histiopteris incisa* (Thunb.) J. Sm. Between the *Blechnum* plants the surface of the very deep layer of leaf-mould was bare; a thick deposit of *Weinmannia* leaves apparently inhibits the growth of mosses and liverworts.*

Since my last visit to the district Mr. Richard Mundy has been so good as to made a detailed botanical survey of the immediate vicinity in which the Peloridiid was taken. He finds that a belt of almost pure *Weinmannia* trees, 30 ft. to 50 ft. high, extends from the bank of the River Mangawhero at least 30 yards into the forest. Farther from the river—say, from 30 to 50 yards—is a belt of more mixed bush, where, although *Weinmannia* is still by far the commonest tree, the large taxads mentioned above become conspicuous. The habitat of the insect in question appears to lie on the border between these two belts; but very scanty data are so far available.

Family 3 (5). Notonectidae.

Anisops wakefieldi F. B. W.

Seasonal Occurrence.

Adults of this rather rare species have occurred in January and in July.

Distribution.

Hutton records it from Canterbury and Otago, "in ponds" (1898B, p. 180). Kirkaldy (1909B, p. 27) saw specimens from the Chatham Islands. My specimens came from a slow-running stream, shallowed and muddied where it crossed a road, and from a small, very clear lagoon in the sand-dunes of the foreshore, both in the Wellington district. In the stream mentioned *A. assimilis* was also present, and much more numerous; in the second locality *A. wakefieldi*, though not pentilful, seemed to be alone. The sexes were present in about equal numbers.

Anisops assimilis F. B. W.

Seasonal Occurrence.

Adults have been taken in January and August. Very young nymphs were abundant in middle of January, while in June advanced nymphs, almost certainly of this species, were plentiful and almost alone.

Distribution.

Hutton (1898B, p. 180) records this species only from Otago. My specimens have come from Onehunga, Wanganui, and the Wellington district, and in the South Island from Arthur's Pass (3,300 ft.).

The ecological requirements of this species are elastic. It occurs in ponds, in slow-moving streams, in alpine tarns, and in brackish lagoons. The two latter habitats were both stocked apparently only with a form whose entirely black scutellum gave it a strong superficial resemblance

* For the identification of two of the above plants and for much detailed information on the Ohakune forest, freely imparted, I am indebted to Mr. Richard Mundy.

to *A. wakefieldi*. The tarn in question was a shallow but wide pool, surrounded by typical subalpine bog, and supplied with dark-coloured but perfectly clear water on a bottom of soft flocculent ooze of considerable depth, and with a surface unbroken save by a few large bluish slimy egg-masses of the dragon-fly *Procordulia grayi*. In the water itself *Arctocorisa arguta* (F. B. W.) and a magnificent scarlet water-mite (*Eylais* sp.) were abundant.

The other specimen of the black-scutellumed form was taken in a pool just above high-water mark at Onehunga. The water was thick with *Spirogyra* sp. containing numerous *Ephydra* larvae and the empty puparia of the same fly.

Miscellaneous Notes.

I have previously remarked (1922, p. 9) that "the scheme of coloration is that adopted by many aquatic animals—namely, a shining white, in this case on the dorsal surface, since this is always the under-surface, and a sombre tint on the ventral, which is uppermost (in the ordinary swimming position). The water-boatman is thus more or less invisible when seen from below, with its white dorsum viewed against a light-coloured sky, while, from above, every collector knows how difficult it is to distinguish the insect against the dingy background of the depths." In a muddy pool where both *Anisops assimilis* and *Arctocorisa arguta* were plentiful it was interesting, in connection with a consideration of the colour-scheme, to see how the latter hugged the muddy bottom near the shore, while the *Anisops* is much more wary than *Arctocorisa*.

D. Miller (1920, p. 13, fig. 13) states, "The natural enemies of adult and pre-adult mosquitoes are numerous, Amongst their insect foes occurring in permanent areas of water are the 'water-boatmen,' or *Notonecta* (fig. 13). Experiments were carried out by the writer demonstrating that these insects destroyed large numbers of larvae." Fig. 13 is apparently *Anisops assimilis*.

Fifth-instar nymphs in my collection are probably of this species, but, as they were not reared and thus identified with certainty, description is deferred.

Family 4 (10). ACANTHIIDAE (SALDIDAE).

These are often numerous, but as the species are not yet worked out I cannot give much additional to my previous brief note (1922, p. 8).

In the Hutton collection at Canterbury Museum the specimens labelled "*Salda laelaps*" and "*Salda australis*" are Mirids, some of which are undoubtedly referable to *Romna scotti* (F. B. W.).

Family 5 (13). MIRIDAE (CAPSIDAE).

These bugs are very plentiful in New Zealand, and make up a large proportion of the heteropterous fauna. Until they have been approximately worked out taxonomically very little can be recorded of them. In Britain, according to Butler (1922, p. 201), the majority pass the winter in the egg state. Therefore the plant into which the ova are inserted need not be a food-plant, and in many cases certainly is not. Internal insertion of ova seems to be a provision enabling these very fragile species to carry through the winter. In New Zealand insufficient data are available, but in view of the inexhaustible evergreen shelter—as much available as in summer—it would not be surprising if some manage to winter as adults.

In the Hutton collection at Canterbury Museum are four specimens labelled "*Calocoris laticinctus*": of these, three are *Romna* sp., while the fourth is apparently *Romna capsoides* (F. B. W.).

Megaloceroea reuteriana F. B. W.

Seasonal Occurrence.

Nymphs have been collected in December. Adults occur from November to March. There is therefore a strong probability that this bug passes the winter in the adult stage.

Host Plants.

M. reuteriana has been swept from pasture and from marram-grass (*Ammophila arenaria* (L.) Link.), the latter being much favoured. The linear form and striped coloration are strong evidence of its practically exclusively graminicolous habit.

Distribution.

North Island localities range from North Auckland through Lake Taupo (E. H. Atkinson!) to Wellington. In the South Island it has been collected at Mount Grey (J. W. Campbell!) and Governor's Bay (J. F. Tapley!). Hutton (1898B, 176) records it from Canterbury.

In the central plateau of the North Island it ascends at least to 3,000 ft. (E. H. Atkinson).

Megaloceroea sp.

This green species, which occurs on cocksfoot (*Dactylis glomerata* L.) at Wanganui in December and January, is mentioned here chiefly in order to correct a passage in which the writer wrongly recorded it as a Nabid (Myers, 1922, p. 6). It has occurred also at Auckland on *Juncus lampocarpus* Ehr., in February.

Romna capsoides (F. B. W.).

I have seen a specimen collected at Wainuiomata, 25th December (G. V. Hudson).

Romna scotti (F. B. W.).

This is not the *R. scotti* mentioned in Myers, 1922 (p. 8).

Seasonal Occurrence.

Adults have been collected in April, and October to January.

Host Plants.

Miscellaneous undergrowth must be included here, but especially *Urtica ferox* Forst f. and *Muehlenbeckia australis* (Forst. f.) Meissn., also *Coprosma robusta* Raoul.

Distribution.

This is a common species at Wellington and at Arthur's Pass (3,000 ft.). Hutton (1898, p. 177) gives the range as "Canterbury and Otago." The writer has taken it also at Wanganui and at Kohukohu (Hokianga).

Romna sp.

This brilliant reddish species, larger than *R. scotti*, is apparently attached to manuka (*Leptospermum scoparium* Forst.), where both adults and nymphs are often abundant throughout the Wellington district. In February a small green caterpillar, probably the larvae of *Ctenopseustis obliquana* (Walk.), was suspended by its silken thread from the manuka, with one of these bugs sitting on it. In capture they were unfortunately separated, but the *Romna* searched assiduously, with outstretched rostrum, apparently for the caterpillar, on which it had almost certainly been feeding. This species was incorrectly determined by me as *R. scotti* (Myers, 1922, p. 8). A second species of *Romna* was taken on the snow on Mount Ruapehu in January, 1924, by Mr. T. R. Harris. The exact elevation was not ascertained, but was probably about 7,000 ft.

Stenotus binotatus (Fabr.).

"The egg is of the usual Capsid type, with a well-developed collar at the anterior end" (Butler, 1923, p. 409).

Seasonal Occurrence.

In Europe the adults occur from May to October, and the nymphs up to the end of June (Butler, 1923, p. 409). In New Zealand the adult appears in October, is plentiful in November, excessively abundant in December and January, and occurs also in February. Nymphs are plentiful in January. Absence of adults in autumn, coupled with the fact of internally deposited eggs, points to ovum being the wintering stage, as in many Miridae in Europe.

Host Plants and Feeding-habits.

S. binotatus is essentially a frequenter of grasses, chiefly the introduced English species, including cocksfoot (*Dactylis glomerata* L.) and perennial rye (*Lolium perenne* L.). On these it occurs in almost incredible numbers. "The insects may be seen inserting their beaks into the heads of the grasses, and moving quietly round to the opposite side when approached too closely. The imagines take wing very readily." (Myers, 1922, p. 8.)

In Europe "it is a common wayside insect, found on grasses and other plants both there and in rough meadows. The only plants given by Reuter (12) besides grasses are *Chrysanthemum leucanthemum* and *Erica*." (Butler, 1923, p. 409.)

In North America Howard (1893, pp. 90–92) has indicated it as a serious pest of timothy-grass (*Phleum pratense* L.)—"almost every head examined carried from six to fifteen bugs."

Distribution.

This very common species was certainly introduced from Europe. "It is found over Europe, Asia Minor, and Syria, and also in North America, where it sometimes does damage to grasses; it extends also into the Ethiopian region. In Britain it is often a very common insect and is fairly widely distributed, being recorded from twenty-six English counties . . . and it is found in Ireland, but there are no records from Scotland." (Butler, 1923, p. 410.) In New Zealand it is plentiful in the North Island

from the extreme north (Te Paki), Hokianga, and Auckland to Raglan (Miss Parker), Taupiri (T. Cockcroft), Waitomo (C. E. Clarke), Makatote (D. Miller), Ohakune (T. R. Harris), Hastings, Wanganui, Greytown, and Wellington; and in the South Island at Nelson, Riwaka (David Miller), Canterbury, and the West Coast (T. R. Harris). At Ohakune it ascends to 2,100 ft.

Miscellaneous Notes.

"This is a most variable species; there is not merely the very different coloration of the sexes, but each of these varies indefinitely, especially as regards the amount and intensity of the black markings" (Butler, 1923, p. 409). It is probably sufficiently numerous on and destructive to pasture grasses to be considered a pest.

Eurystylus australis Popp.

Seasonal Occurrence.

Adults have been collected in February and March.

Host Plants.

This species has inflicted very serious damage on passion-vine (*Passiflora edulis* Sims), and has been taken also on apple, and frequently on grasses. On passion-vines the shoots are attacked.

Distribution.

Dr. Bergroth, who kindly identified this species, writes that it was "described from Botany Bay, Sydney, and is apparently imported from Australia into New Zealand." In New Zealand it occurs in the Auckland (including Waikumete and Henderson) and Nelson (A. Philpott) fruit-growing districts.

Family 6 (17). CIMICIDAE.

Cimex lectularius Linn.

The bed-bug, although introduced into New Zealand by the agency of the white man, is very much more widely distributed than the four records—Pukehuia (North Auckland, in June, David Miller); Wanganui; Wellington (January); and coastal passenger-steamers—would imply. It is practically a cosmopolitan species.

Family 7 (19). ANTHOCORIDAE.

Individuals of this family are abundant, particularly among dead leaves, and in the "beards" or dead hanging fronds of the large tree-fern *Cyathea medullaris* (Forst. f.) Sw. None of these presumably endemic species have yet been identified.

Lyctocoris campestris (Fabr.).

Egg undescribed (Butler, 1923, p. 323).

Nymph.

An intermediate instar—" ovate, reddish-testaceous, with a clear testaceous margin to the whole of the body behind the head; head convexly triangular, rather longer than broad at base; pronotum trapezoidal, transverse, rather convex on disc and explanate at margins; wing-pads quite small; the whole surface finely punctate and pubescent, except down centre of dorsum; where it is finely transversely striate; legs and antennae testaceous; tarsi two-jointed, basal joint very short.

" Later instar, 3 mm. Similar to the above, but with larger wing-pads. The whole body is more or less shiny." (Butler, *l.c.*)

Seasonal Occurrence.

In Europe " the imago is found practically all the year round . . . the indications are that there are specimens which reach maturity at various times during the spring and early summer months, although no doubt the majority belong to the brood which matures in August." (Butler, *l.c.*)

In New Zealand adults and fourth- and fifth- stage nymphs occurred together in August.

Habitat and Feeding-habits.

In England " they are found most abundantly in the thatch of hay, straw, and bean stacks, and also in the refuse of the stacks and in granaries . . . Probably any kind of vegetable rubbish will form a suitable nidus for them." (Butler, 1923, p. 324.)

" Parfitt found it feeding on the larva of a species of *Thrips* . . . The insect can inflict a sharp prick with its rostrum. Reuter maintains that it was originally a vegetable feeder, living in the open, but that, being introduced into stables and cattle-stalls with straw, it then abandoned its vegetarian habits and became a blood-sucker on both horses and cattle." (Butler, *l.c.*)

The writer found nymphs and imagines very common on the white-washed walls and roof of a cow-shed, in the bails, and especially in the folds of the cow-covers which were taken off the animals during the warmth of the day. They were so abundant that it was difficult to understand on what they could be feeding. I think it would have been noticed had they been biting the cattle. Most of the cows had a few lice, *Trichodectes scalaris* Nitzsch, but these were hardly plentiful enough to form the main food-supply, even if attacked. In captivity the adults preyed readily on green spruce-aphis (*Myzaphis abietina* (Walk.)).

Distribution.

" Spread all over the Continent and in North Africa and Syria, it inhabits also the Oriental, Nearctic, and Neotropical provinces. It is probably also one of the commonest Heteroptera we possess in this country. . . It has spread even to New Zealand (Buchanan White, 4), and Wollaston found it in St. Helena (Buchanan White, 6)." (Butler, *l.c.*)

In the New Zealand region it occurs at Aramoho (Wanganui), and on Sunday Island, Kermadec Archipelago (W. L. Wallace !).

In view of its very wide distribution it is difficult to say whether it is indigenous here or introduced, but it is probably introduced.

Family 8 (22). Gerridae.

Halobates sericeus Esch.

The only known occurrence of this oceanic bug in the waters of the New Zealand region was recorded by the writer (1921c, p. 257). In this instance six females and twelve males were found on the beach at Denham Bay, Sunday Island, Kermadec Islands, by Mr. W. L. Lawrence, in 1908.

Family 9 (23). Veliidae.

Some confusion exists between the species, at least two (*Microvelia*) occurring in New Zealand. Until this is clear little can be profitably recorded of their bionomics.

Family 10 (27). Henicocephalidae.

Henicocephalus.

The New Zealand species, of which there are at least two, are being revised by Dr. Bergroth.

Egg. (Text-fig. 6.)

One egg laid in the middle of January was more or less elliptical, with parallel sides and rounded ends, much longer than thick, and of a beautifully frosted white appearance. After preservation in alcohol the chorion appear perfectly colourless and transparent with a very faint indication of pitting; this may have been due to contents. The egg was fastened firmly by its side to a rootlet. In the course of a couple of days it shrivelled completely, showing probably that it was not fertilized. This egg was laid by a large specimen from leaf-mould at Ohakune (2,100 ft.).

Seasonal Occurrence.

Nymphs have been taken in October, November, and January; adults from December to February.

Distribution.

Specimens have been examined from Pokaka (D. Miller), Ohakune (T. R. Harris, H. Hamilton, J. G. Myers), and Wellington district (T. Cockcroft, G. V. Hudson, J. G. Myers), all in the North Island; and a smaller species (?) from Reefton, in the South Island (A. L. Tonnoir). The North Island species occurs up to 2,100 ft.

Miscellaneous Notes.

That these bugs are in the habit of flying in groups about sunset or even in the late afternoon sun, frequently hovering like gnats, is well known. Mr. Harris (Jan., 1924) saw several swarms on a cloudy morning, and caught thirty or forty examples with one sweep of the net.

The habitat of the larger common North Island form appears to be only the leaf-mould of the forest-floor. The small South Island form collected by Mr. Tonnoir was, on the other hand, found under bark, in company with its nymphs.

In captivity the North Island species throve well in leaf-mould. When touched, these specimens would rear up the head and thorax into a

vertical position and hold out, wide apart, the powerful first pair of legs, with the tibiae bent at about right angles to the femur. With these legs striking motions were frequently made. When the winged forms act thus the soft membranous hemielytra are bent almost at right angles at about one-third from their base. This would be impossible in normal Heteroptera.

In ordinary walking the long and peculiar head is turned from side to side in a way very reminiscent of a mole-cricket (*Gryllotalpa*), except that in the latter it is the prothorax plus head which moves thus. They cannot walk up a vertical glass surface.

Family 11 (28). NABIDAE.*

Reduviolus capsiformis Germ.

Seasonal Occurrence.

Adults have been taken from January to April (Canterbury).

Host Plants.

It has been taken "amongst weeds" (W. L. Wallace), on grasses, lucerne (*Medicago sativa* L.) and red clover (*Trifolium pratense* L.), and on a sward of *Juncus lampocarpus* Ehr., interspersed with *Sparganium subglobosum* Morong and *Cyperus* sp.

Distribution.

This is the most abundant and widely distributed Nabid in New Zealand. Hutton (1898, p. 178, under name *Nabis saundersi*, which Dr. Bergroth informs the writer is a synonym) gives the range as Auckland to Otago. The writer has seen specimens from the Kermadec Islands (W. L. Wallace), Kaitaia, Whangarei, Auckland, and Wellington; and in the South Island from Blenheim, Nelson (including Dun Mountain), and Governor's Bay.

N. capsiformis is an almost cosmopolitan species.

Family 12 (29). REDUVIIDAE.

Pirates ephippigera (White).

It seems to me extremely doubtful whether this Australian species occurs in New Zealand. Neither Hutton, Buchanan White, nor myself saw specimens from this country, nor, apparently, did Kirkaldy.

Ploiaria huttoni (Scott).

Eggs.

Eight eggs were deposited by a female in autumn. Soon after the completion of oviposition the female died. The eggs were laid on the surface of the cork stopping the mouth of the tube in which the insect was confined. Some were glued firmly by their length to the plane surface; others were deeply inserted into crevices in the cork, only the collared end visible.

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* Dr. Bergroth informs me that the correct orthography is *Nabididae*.

The shape of the eggs is shown in fig. 7. Surface without sculpture, or with a faint trace of pitting, primarily smooth, colourless and transparent, but covered, more in some eggs than in others, with a black soot-like deposit, removable without difficulty. One or two eggs were quite black and roughened with this material.

Length, 0·8 mm.; greatest width, 0·3 mm.

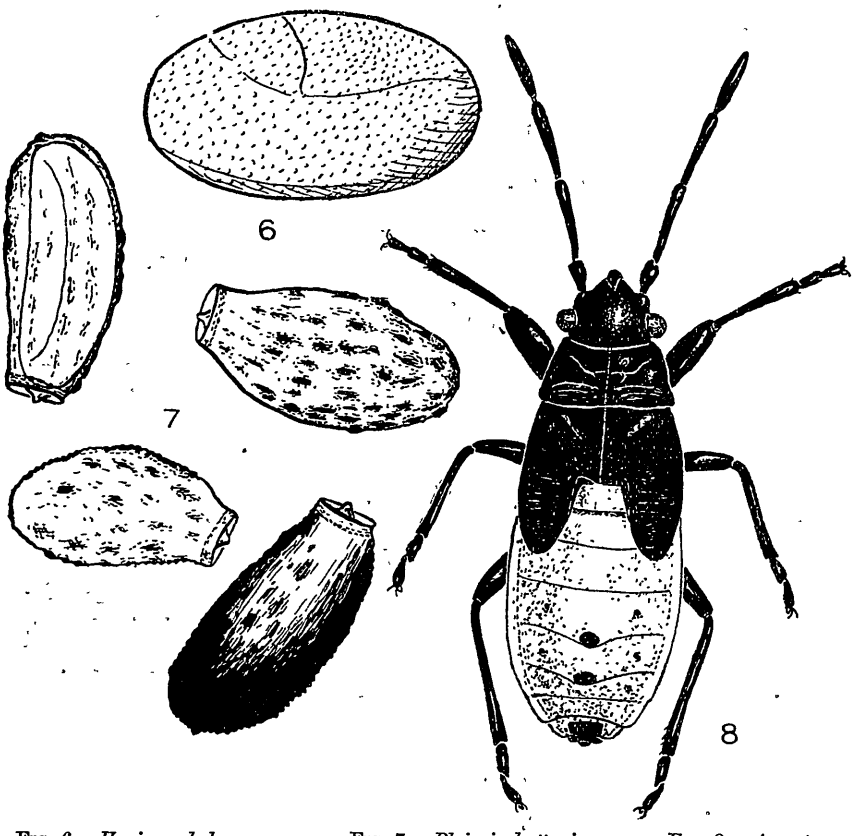


FIG. 6.—*Henicocephalus* sp.: egg. FIG. 7.—*Ploiaria huttoni*: eggs. FIG. 8.—*Arocatus rusticus*: fifth instar.

Occurrence and Distribution.

I have two specimens, a male and a female, taken by Mr. W. R. B. Oliver in a shed at Seatoun, Wellington, in April. Hutton (1898, p. 179) gives as localities Auckland and Wellington. Bergroth (1923, pp. 398–99) has recently recorded it from the Island of Juan Fernandez. He states, "The occurrence of this wingless New Zealand species on Juan Fernandez is one of the proofs of the existence of an ancient land connection between New Zealand and Chile."

Ploiariodes rubromaculatus Blackburn.

Seasonal Occurrence.

Adults have been collected in November, January, February, April, and May.

Host Plants and Habitat.

This species has been beaten from the foliage of *Citrus grandis* (L.) Osbeck (poor-man orange) and from *Blechnum filiforme* (A. Cunn.) Ellingh., clothing a tree-trunk; but the greatest numbers may be secured from the dead hanging fronds of tree-ferns, especially *Cyathea medullaris* (Forst. f.) Sw. and *Dicksonia squarrosa* (Forst. f.) Sw. The former tree-fern (Plate 81, fig. 1) retains much more of its dead foliage than any of the others, and shows at all times a heavy beard offering splendid shelter for insects of many orders, including Lepidoptera (adult Noctuids, Selidosemids, and various "micros"), Psocoptera, Diptera (*e.g.*, Tipulidae), Coleoptera, Heteroptera (Anthocorids, Ploiariinae).

One specimen was found in November on the side of a cottage in the forest.

Distribution.

I have seen specimens from Whangarei and the Wellington district in the North Island; and from Tisbury (A. Philpott), and Moutere, Nelson (R. J. Tillyard).

Bergroth (1923, p. 398), in recording it from Juan Fernandez, writes: "This species is almost cosmopolitan. It was originally described from Hawaii, and has since been described under different names from the Fiji Islands, California, and New South Wales. Mr. J. G. Myers has recently sent me specimens of it from New Zealand, and Mr. Malloch . . . informs me that he knows the species also from the Atlantic coast of U.S.A. and from Madeira."

There is another species from Nelson, now being described by Dr. Bergroth.

Family 13 (31). TINGIDAE.

There is a correction to make in my remarks on this family in New Zealand (1922, p. 6). The supposed Tingid mentioned as collected in leaf-mould by Mr. H. Hamilton has nothing to do with this family. The only New Zealand species so far discovered is the one recorded in the footnote (*l.c.*, p. 6), collected by the writer on sedges in Gollan's Valley, Wellington, 5th February, 1921. I have recently received three additional specimens as a generous gift from Mr. G. V. Hudson, who took them in the Karori Reservoir Reserve, Wellington, probably from *Cassinia leptophylla*, on 8th March, 1924. This species is being described by Dr. Bergroth.

Family 14 (34). LYGAEIDAE (MYODOCHIDAE).

This very numerous family includes both leaf-mould-dwelling and plant-haunting forms, but most of the latter show a decided preference for low-growing vegetation.

Arocatus rusticus Stal.

This beautiful species has not been reared through all its stages, but the Misses Hursthouse have carried it over from fifth instar to imago. The following instars are therefore delimited without absolute certitude. (Plate 82, figs. 1–3, and text-fig. 8.)

First Instar (Plate 82, fig. 1).—Head, pronotum, and mesonotum blackish-brown; on metanotum only two lateral heavily chitinized triangles are dark; rest of metanotum and greater part of abdomen crimson; two black scent-gland areas small and elliptical; genital segment black.

Antennae almost as long as body, hairy; posterior margin of mesonotum straight or very slightly convex, caudad in middle; rostrum reaching middle of abdomen. Shape long and narrow; thorax parallel-sided; abdomen somewhat wider. Length, 2·1 mm.

Second Instar.—Similar in colour and proportions; rostrum reaching not quite to middle of abdomen. Length, 2·4 mm.

Third Instar (Plate 82, fig. 2).—Head, pronotum, mesonotum, and appendages blackish-brown; a narrow median longitudinal pale line sharply demarcated down thorax; dark chitinized sclerites of metanotum relatively smaller in extent; abdomen as in previous instars; rostrum reaching nearly to mid-abdomen; underside almost entirely red; exterior angles of mesonotum very slightly produced caudad. Length, 3·0 mm.

Fourth Instar (Plate 82, fig. 3).—Colour as in previous instar. Rostrum reaching base of abdomen. Abdomen with row of small depressed black spots down each side of dorsum. Hemielytral pads extending just past posterior edge of first abdominal tergite. Length, 4·7 mm.

Fifth Instar (Text-fig. 8).—Considerably elongated; rostrum still reaching base of abdomen; hemielytral pads nearly attaining middle of third tergite. Length, 7·7 mm.

Some of the nymphs exhibit oligomery of the antennae; in other words, one of these organs may show fewer than the usual number of segments together with a lengthening of certain of the segments that remain. In view of Butler's remarks that brachyptery and antennal oligomery are associated usually with ground-dwelling habits, the occurrence of the latter phenomenon in a practically entirely arboreal species like the present one is of great interest.

Seasonal Occurrence.

All instars, including adult, have occurred in April, third and fourth instars have been taken in March, fifth in March, and imagines in September, November, December, and April.

Host Plants.

Specimens found in early September under the bark of dead kahikatea (*Podocarpus dacrydioides* A. Rich.) were probably hibernating. The favourite food-plant is certainly *Parsonsia*, especially *P. heterophylla* A. Cunn., on which nymphs and adults are always to be found in their respective seasons.

Distribution.

Hutton (1898B, p. 173) states that the range is from Auckland to Otago. The writer has seen specimens from Manakau (D. Miller), Wanganui, Waikanae (D. Miller), and Wellington district (T. Cockcroft, J. G. Myers), all in the North Island. Kirkaldy (1909B, p. 25) writes, "A common Australian species. I have recorded it from French Pass" (South Island).

Nysius huttoni F. B. W.

Life-history.

At the last ecdysis the cuticle splits along the median longitudinal line of the thorax, the fissure extending along the posterior margin of the head, and forward between the vertex and the eyes.

Seasonal Occurrence.

Adults of this small species have been taken during November to April inclusive, with a maximum during the three summer months. Nymphs have occurred in March and April, the three older instars in the latter month. There is probably more than one brood per year.

Host Plants.

N. huttoni occurs on ground herbage and on the ground itself. It has been taken from the following plants and grasses: *Cassinia leptophylla* R. Br., *Medicago sativa* (lucerne), and *Linum* sp.

All stages were swept in considerable numbers from lucerne. In one case, in the Wellington district, they had apparently done considerable damage to the crop, which was extremely patchy. The areas of poor crop, making up about seven-eighths of the half-acre, were covered with stunted, dirty-coloured plants, and the bugs were in evidence, both nymphs and adults, on the surface of the soil, which was dusty and drier and consequently warmer than that of the healthy patches protected by the taller and closer plants. The species of *Nysius* are noteworthy sun-lovers. In Blenheim in the previous March large numbers of the bug were swept from lucerne; but here in April (same year) no specimens were obtained by sweeping, owing to the insects keeping more to the ground. In the good patches of lucerne not a bug could be found, either on the plants or on the ground. In the stunted areas, on the other hand, they were in large numbers; and, according to the owner, had been present in phenomenal swarms a month previously. Although it could not be proved that all the damage was attributable to *Nysius huttoni*, there was no reasonable doubt that it had been an important factor.

Distribution.

Hutton (1898B, p. 173) writes: "Canterbury and Otago, common, running on the ground in gardens, &c." Specimens have been collected at Te Paki (extremest north), Kaitaia, Whangarei, Auckland, Ohakune, Hastings, Levin, and Wellington, in the North Island; and at Stephen Island (R. J. Tillyard), Blenheim, and Central Otago, in the South. It is thus widely distributed throughout both Islands. Kirkaldy (1909B, p. 25) has recorded it from the Chatham Islands. On the Tararua Range it is plentiful up to an altitude of 5,000 ft.

Nysius clavicornis (Fabr.).

Seasonal Occurrence.

Adults taken in September in dead kiekie (*Freycinetia*), and in October on more than one occasion *in copula*, seem to indicate hibernation in the imaginal state. The adult has been collected from September to April

inclusive, with a maximum of abundance in January. There is probably more than one brood per year. Third-instar nymphs have occurred in late summer.

Host Plants.

Grasses, *Metrosideros scandens* Sol., *Fuchsia excorticata* (Forst.) L., *Cassinia leptophylla* R. Br., and dead foliage of *Dacrydium cupressinum* Sol. and of *Freycinetia Banksii* A. Cunn. have all yielded this widely ranging and abundant species. In gardens it is often extremely plentiful on the flowers of garden marguerite (*Chrysanthemum* sp.). On *Cassinia* it is the flowers that attract it.

Distribution.

In the North Island it has been taken at Whangarei, Ohakune? (T. R. Harris), Pokaka (D. Miller), Lake Taupo (E. H. Atkinson), Mount Ruapehu (Miss Stella Hudson), Hastings, Wanganui, Tararua Range, and Wellington; in the South Island at Stephen Island (R. J. Tillyard), Nelson (A. Philpott), Greymouth (R. Helms), Dun Mountain, Motueka (T. Cockcroft), Dunedin (W. G. Howes), and Lake Wakatipu (G. V. Hudson). Hutton (1898B, p. 173) writes, "Auckland to Otago; common in Auckland, in gardens."

On the Tararua Range (Mount Hector) it ascends to the highest level—viz., 5,000 ft. Miss Stella Hudson (1922, p. 94) found specimens on a glacier on Mount Ruapehu at an elevation of 7,500 ft. under circumstances which may be described in her own words:—

"On January 11th, 1922, during an attempted ascent of Ruapehu, a slightly active volcano, 9,000 ft. high . . . I had the good fortune to observe many hundreds of insects stranded on a glacier at a height of 7,500 ft. Five orders were represented among the insects thus seen. They were all lowland forms, and must either have been blown up from the surrounding plains, or, as I think more probable, were migrating across country. It has been previously observed that insects occasionally congregate on mountain-tops during migration. Ruapehu is the highest summit in the North Island, and is surrounded by many miles of undulating forest and tussock-clad country, practically in its primitive condition, and ranging from 2 000 ft. to 4 000 ft. in height above sea-level. It thus seems highly probable that insect swarms should occur on this mountain. At first sight I thought the glacier was covered with fine dust, but on a closer examination the 'dust' proved to be minute dipterous insects."

The other orders represented were Coleoptera, Lepidoptera, Odonata, Perlaria, Trichoptera (plus the two previous listed as Neuroptera), and Hemiptera. The deposit apparently consisted entirely of winged insects. The writer is inclined to agree with the first suggestion made—that the insects were blown to this unaccustomed elevation by the wind.

Nysius anceps F. B. W.

Seasonal Occurrence.

Imagines have occurred from August to November, January, and March. The August specimens were hibernating under bark.

Host Plants and Habitat.

It is usually swept from grasses and rushes. One specimen was taken in a house. Hibernating adults have been found under bark of blue-gum (*Eucalyptus globulus* Labill.).

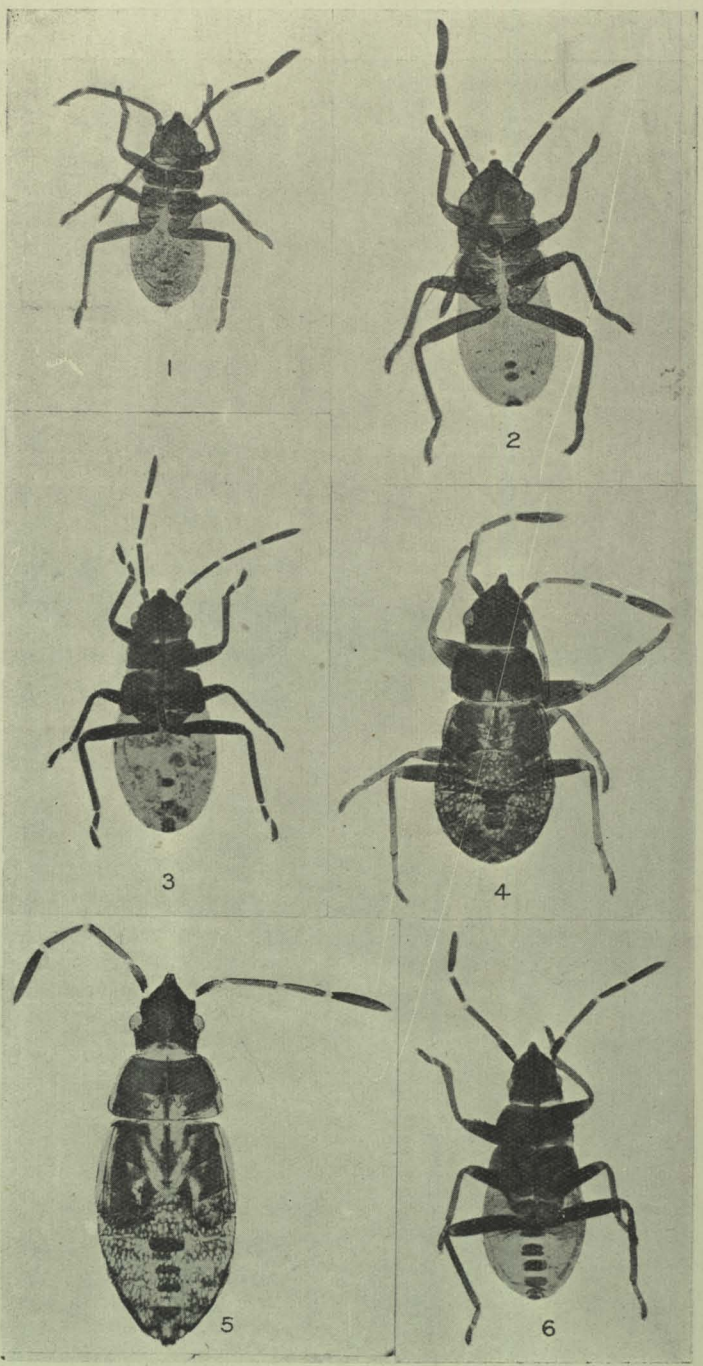
[*E. B. Levy, photo.*

FIG. 1.—Grove of mamaku (*Cyathea medullaris*).

[*J. G. Myers, photo.*

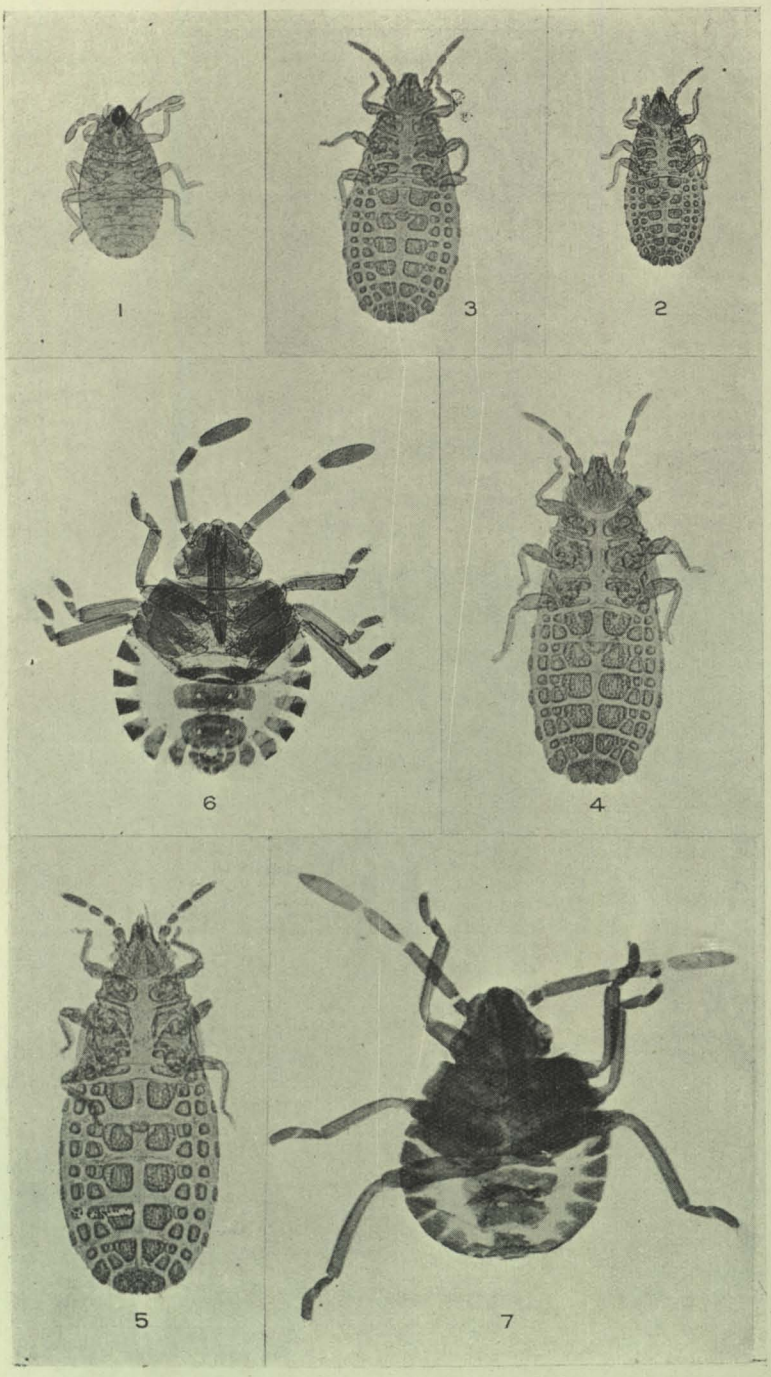
FIG. 2.—Rushes, or wiwi (*Juncus effusus*), in pasture.

Face p. 480.]



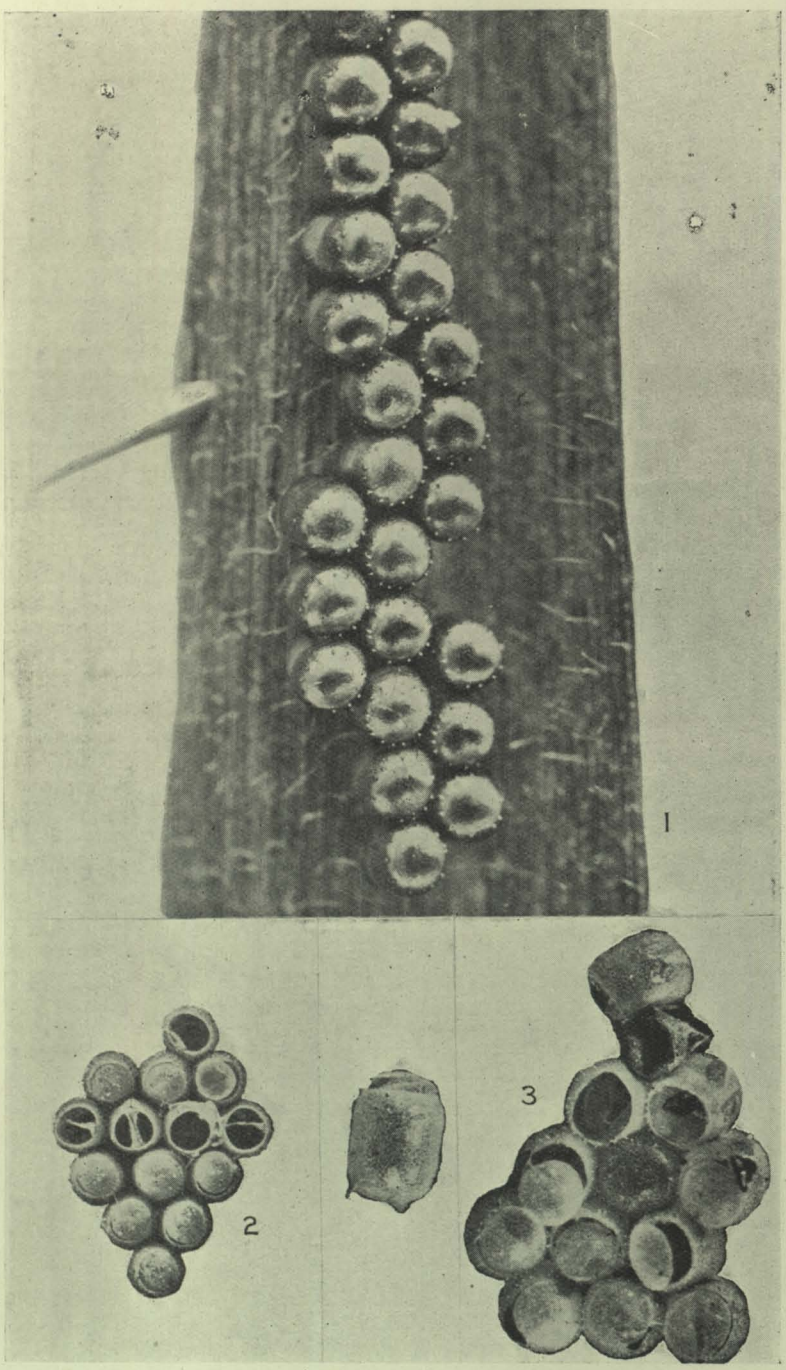
[*W. D. Reid and H. Drake, photo.*

FIGS. 1–3.—*Arocatus rusticus :* 1, first instar ; 2, third (?) instar ; 3, fourth instar.
FIGS. 4–5.—*Orthoea nigriceps :* 4, intermediate instar ; 5, fifth instar.
FIG. 6.—*Margareta dominica :* intermediate instar.



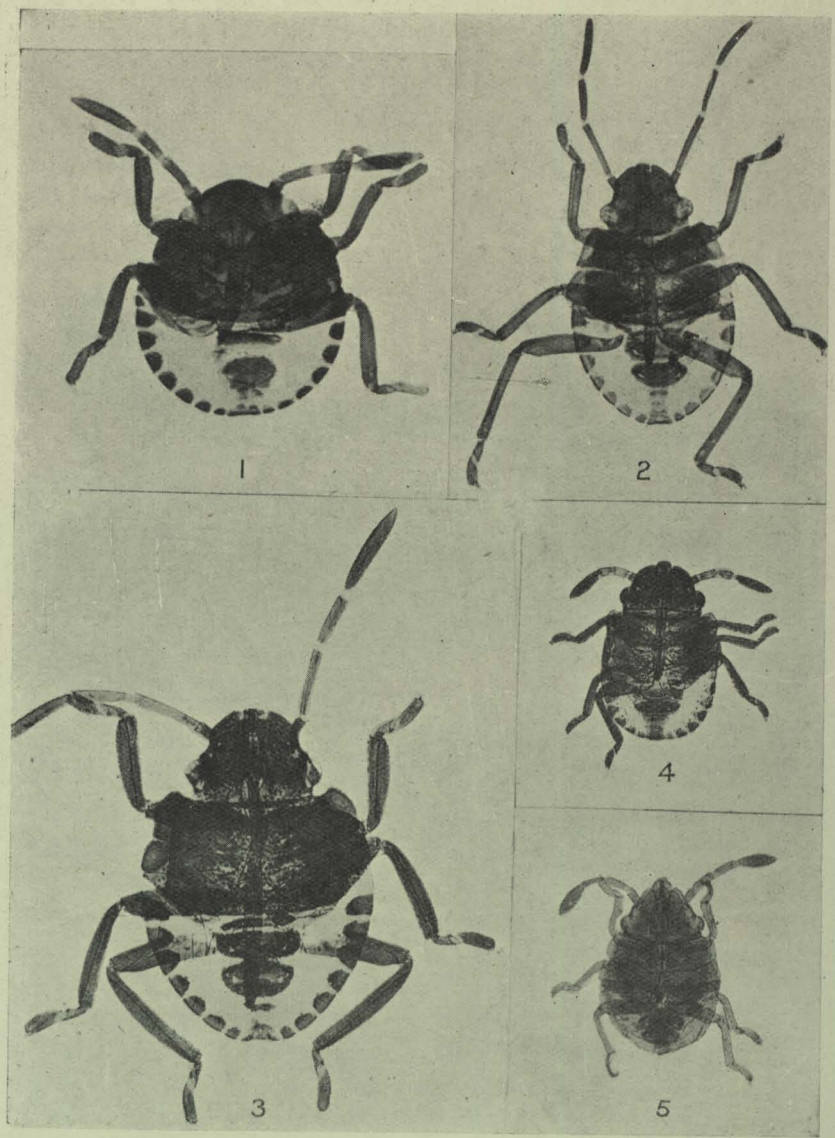
[*W. D. Reid and H. Drake, photo.*

FIG. 1.—*Ctenoneurus hochstetteri :* second instar.
FIGS. 2–5.—*Aneurus brouni :* 2, second instar; 3, third instar; 4, fourth instar; 5, fifth instar.
FIGS. 6–7.—*Cermatulus nasalis :* 6, first (?) instar; 7, second instar.



[*W. D. Reid and H. Drake, photo.*

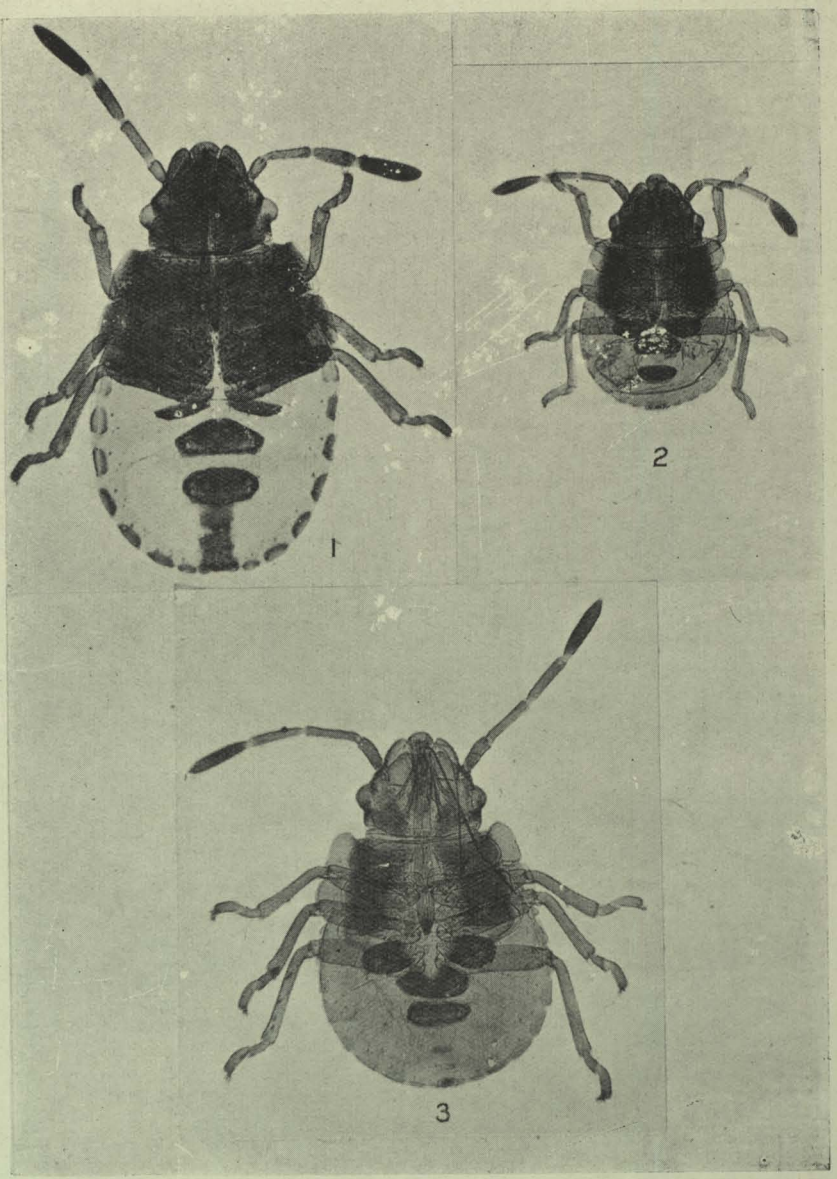
FIG. 1.—*Cermatulus nasalis :* eggs.
FIG. 2.—*Zangis amyoti :* egg-shells.
FIG. 3.—*Dictyotus caenosus :* eggs.



[*W. D. Reid and H. Drake, photo.*

FIGS. 1–3.—*Zangis amyoti:* 1, first instar (KOH preparation); 2, second instar; 3, third instar (much less magnified).
FIG. 4.—*Dictyotus caenosus:* first instar.
FIG. 5.—*Rhopalimorpha obscura:* second instar.

Follows p. 84.]



[*W. D. Reid and H. Drake, photo.*

FIG. 1.—*Rhopalimorpha obscura :* intermediate instar.
FIGS. 2–3.—*Oncacontias vittatus :* 2, second instar; 3, third instar.

Distribution.

The only North Island specimens seen by me were collected in the Wellington district, where it is not uncommon. In the South Island it has occurred in Canterbury (Hutton), and more specifically at Little River (T. Lee), Darfield (J. G. M.), Governor's Bay, Timaru (J. W. Campbell), Stephen Island (R. J. Tillyard), and Greymouth (R. Helms).

Miscellaneous Notes.

This species appears invariably to be brachypterous. I have seen no variation in this condition towards either longer or shorter hemielytra.

Nysius spp.

Four or five species of this genus are in the hands of Dr. Bergroth for description.

One species, very common in the Wellington district, is confined apparently to tauhinu, or cottonwood (*Cassinia leptophylla* R. Br.). A second species is specially attached to *Raouli tenuicaulis* Hook. f., and has been collected on the Tararua and Rimutaka Ranges from sea-level up to 4,000 ft., and at Arthur's Pass up to 3,800 ft. Adults occur also on the flowers of *Angelica montana* (Forst.) Cockayne. In September incalculable thousands were found clustered on the summit of Mount Matthews (lower Rimutakas, 3,000 ft.) beneath stones and under the boards of the old and broken trigonometrical station. In November the bugs were swarming on the open flowers of *Raoulia tenuicaulis*, many being found *in copula*. These two facts indicate hibernation in the adult stage. Towards the end of December and during January all stages of nymphs are abundant on the same *Raoulia* plants. The bugs run actively on these mat-plants and over the sun-warmed stones between them.

A third species of *Nysius* appears to be purely subalpine in distribution. It has occurred at Arthur's Pass from 2,600 ft. to 3,500 ft., at Lake Wakatipu (G. V. Hudson), and at Gouland Downs (2,500 ft.) (R. E. Grimmett), in November, December, and January. It is very abundant on the flowers of *Celmisia coriacea* (Forst. f.) Hook. f., and in December may be found *in copula* in this situation both during the day and at 8 p.m. At night they were extremely sluggish and gave every indication of spending the night in these great flower-heads.

One undescribed species, much smaller than the other described New Zealand species, has been found on *Juncus* at Ashburton (South Island) by Mr. W. W. Smith.

Metagerra obscura F. B. W.

Seasonal Occurrence.

Adults have occurred in July, October to January, and in April, with one maximum of abundance in October and another in January. There may therefore be two broods per year. The conditions of life in such a cryptozoic species are probably very uniform, and the influence of the seasons perhaps not great.

Host Plants and Habitat.

It is rare for this little species to occur anywhere else than in the leaf mould of the forest-floor, where it is one of the most plentiful species; but it has been taken also on *Gahnia* sp., on *Muehlenbeckia* sp., and on ferns.

Distribution.

Owing to its cryptozoic habitat this bug is probably overlooked in many localities where leaf-mould has not been sifted, and the range is almost certainly wider than the present records indicate. In the North Island it has been taken at Ohakune (T. R. Harris), Porirua, and Wellington district; in the South Island at Otira (T. Cockcroft), and in Canterbury (Hutton). Dr. Bergroth has received it from Greymouth, on the west coast, where it was taken by the late R. Helms.

Orthoea nigriceps Dall. (Plate 82, figs. 4, 5.)

Nymphs.

An Intermediate Instar (Plate 82, fig. 4).—Head black, eyes dark reddish-brown; pronotum black with two yellow spots at middle of posterior border, edges paler; mesonotum blackish with two yellow spots on middle of fore-border, two smaller laterad of these and two on posterior border; a very narrow but distinct median longitudinal pale line on mesonotum; hemielytral pads reaching posterior edge of metanotum, blackish with paler edges externally; metanotum black with two yellow spots at middle of hind-border and a continuation of pale median longitudinal line of mesonotum. Abdomen with three dark scent-gland areas separated by zones tinged slightly with reddish; connexivum marked with one large pale spot in each segment; rest of abdomen maroon-brown with a plenitude of clear pale roundish spots; second abdominal segment with two parallel dark-brown lines along posterior margin. Antennae long, pale orange except proximal half of first segment and whole of last, which are infuscated. Legs infuscated, but pale at joints, distal two-thirds of tibia. and first tarsal segment; fore-femora very thick. Under-surface with region of gula and of coxae whitish, rest of head and thorax black except edge of latter; abdomen brownish, mesally pale-yellowish and laterally very dark with pale spots as on dorsum. Rostrum pale with black terminal segment, reaching intermediate coxae. Length, 2·83 mm.

Late Instar (Plate 82, fig. 5).—Head, antennae, and pronotum as in previous instar; mesonotum with two triangular pale spots on fore-border continuous with those on hind-border of pronotum, and outside these two yellow vittae commencing on fore-border and converging caudad almost to meet on hind-margin; outside these again two longitudinal vittae and finally two further ones confluent with the thin pale outer edging of the pads; hemielytral pads with pale-yellow vitta on inner (dorsal) edge; metanotum as far as visible resembling that of intermediate instar; abdomen with scent-glands areas relatively larger.

Fore-femora very stout, pale at base, then piceous, and finally pale red distally; second femora similar in colour but very much thinner; rostrum barely reaching intermediate coxae. Length, 3·41 mm.

Seasonal Occurrence.

The dominant instar at Auckland in February was the fifth. At this time adults and fourth-instar nymphs were not uncommon, while a few third instars were seen. Imagines have occurred in August, September, February, March, May, June, and July. Those found in May and July

were hibernating at the bases of *Juncus effusus* L., in company with nymphal ticks (*Haemaphysalis bispinosa* Neumann); many more of the bugs being present in the later month. In June wintering adults were found in the crowns of strawberry-plants, while in August they were plentiful in the tightly rolled dead leaves of *Phormium tenax* Forst.—a very secure shelter.

Host Plants.

This species is nearly always about low herbage or on the ground itself, although the Kermadec record is from *Coprosma* sp. (W. L. Wallace). The writer has collected it on strawberry (*Fragaria vesca* L.), *Phormium tenax*, *Juncus effusus*, and especially the early stages in great numbers on a dense dark-green sward of *Juncus lampocarpus* Ehr. interspersed with *Sparganium subglobosum* Morong, a species of *Cyperus*, and *Lotus major* Sm., *Bulbilis dactyloides* (Nutt.) Raf., and *Polygonum persicaria* L. It would be difficult to discover whether it was restricted to any one plant in this association.

Distribution.

Hutton (1898B, p. 174) gives the habitat as Auckland. Kirkaldy (1909B, p. 26) writes, "also recorded from the Hawaiian Islands, Tahiti, and the Philippines. The synonymy of this species is perhaps a little doubtful. I have recorded the var. *inornata* (Walker) from Chatham Islands." The writer has seen specimens collected at the Kermadec Islands (on Sunday Island) by Mr. W. L. Wallace.

So far as the New Zealand mainland is concerned, it is apparently confined to the North Island, in which again it is abundant only in the northern portions. In the North Auckland Peninsula and in the vicinity of Auckland City it is plentiful, but outside these limits it has occurred only at Greytown and Wellington (one straggler floating on a pool of water).

Writing of Hawaiian conditions, Kirkaldy (1907A, p. 246) remarks, "F. B. White, on Blackburn's authority, states that this species does not occur below about 1,000 ft. above sea-level, but that was probably a mistake then, and certainly is so now, as it comes at night to light in houses from sea-level upwards."

Targarema stali F. B. W.

Seasonal Occurrence.

Adults have occurred in November to March inclusive, with an overwhelming maximum of abundance in January, during which month pairing has been observed (I. H. Myers).

Host Plants.

T. stali may be beaten from a number of shrubs in the undergrowth of the forest. Specifically, it has been taken on *Leucopogon fasciculatum* (Forst. f.) Diels, on *Nothofagus Solanderi* (Hook. f.) Oerst, and in great abundance on the flowers of *Weinmannia racemosa* L.

One pale, soft, recently-emerged specimen taken at Ohakune in leaf-mould may indicate this material as the nidus of the immature stages.

Distribution.

Hutton (1898B, p. 174) mentions the range as Auckland. The writer's material has come from Whangarei, Ohakune (T. R. Harris, 2,100 ft.), and the Wellington district; so that it is probably generally distributed throughout the North Island.

Miscellaneous Note.

"*Targarema* sp. nov." in the Hutton collection at Canterbury Museum is a Mirid.

Margareta dominica F. B. W. (Plate 82, fig. 6.)

An Intermediate Instar (Plate 82, fig. 6).—Head and thoracic nota blackish-brown, rather hairy; a very narrow pale line along middle of nota; abdomen brick-red slightly brownish basally; three almost equal scent-gland areas each divided into two by white lines parallel with or equivalent to segmental margins; antennae brownish, darker distally; legs brownish, femora darker; rostrum infuscated at tip, almost reaching middle of abdomen; abdomen beneath brick-red with a blackish patch towards apex. Length 2·95 mm.

Seasonal Occurrence.

All stages of nymphs have occurred on the food-plant in January. Adults have been collected from December to February inclusive. There is probably only one brood per year.

Host Plants.

The whole life-history appears to be passed on *Gahnia*, usually and possibly solely on *G. xanthocarpa* Hook. f., from the shining dark-brown fruits of which it is extremely difficult to distinguish the bugs when seeds and insects fall together into the net.

Distribution.

Hutton (1898B, p. 174) gives the range as Auckland. I have seen specimens from Auckland (C. E. Clarke), Tararua Range, and the Wellington district (T. Cockcroft, J. G. Myers). On the Tararua Range it ascends to 4,500 ft. and 5,000 ft.

Taphropeltus putoni (F. B. W.) Bergroth (= Scolopostethus F. B. W.).

Seasonal Occurrence.

Only the adult has been collected, and this in August, and from October to March inclusive, and in May. It has been found wintering at the bases of *Juncus effusus* L. and *Bromus unioloides* H. B. K. It is most plentiful at midsummer, but is not collected in large numbers.

Host Plants.

Fuchsia excorticata (Forst.) L., *Juncus effusus*, and *Bromus unioloides* have yielded this species. It occurs in sweeping mixed herbage and undergrowth, but never plentifully.

Distribution.

Hutton (1898B, p. 175) gives the habitat as Auckland. It is probably generally distributed throughout the North Island, as I have examined material from North Auckland (Kaitaia), Ohakune (2,100 ft., T. R. Harris), Levin, and the Wellington district.

Cymodema sp.

Seasonal Occurrence.

Adults have been taken in August, December, and February in the sweeping-net, and in May and July in winter quarters at the bases of rush-clumps, where they were most abundant in the later month.

Host Plants.

Meadow-grasses, especially *Bromus unioloides* H. B. K., are favoured. In winter the bases of *Juncus effusus* L. afford them shelter, in company with nymph ticks (*Haemaphysalis bispinosa*) and other hibernating Arthropods.

Distribution.

This undescribed species, for the generic location of which I am indebted to Dr. Bergroth, has been collected in North Auckland (Kaitaia), Wanganui, Levin (Weraroa), and Waikanae.

Family 15 (35). NEIDIDAE.

Neides wakefieldi F. B. W.

Seasonal Occurrence.

This by no means abundant species has been taken in December and April. I have seen only adults.

Host Plants.

The writer beat a single specimen from masses of creeper on the edge of a clearing in kahikatea forest at Wanganui (Long-acre). Mr. J. F. Tapley took numerous examples by sweeping grasses and other herbage.

Distribution.

Hutton (1898B, p. 172) gives Wellington as the locality. My specimens came from Wanganui, and from Governor's Bay, Canterbury (J. F. Tapley). It seems to be very rare in the North Island.

Miscellaneous Notes.

Buchanan White (1878, p. 31) writes: "It is very probable that this is an apterous form of a dimorphic species—dimorphism being not infrequent in this family, though the species are rarely so brachypterous as in this instance." It should be noticed that Buchanan White's term "apterous" is incorrect as applied to this species, of which all individuals save one examined by me, in both sexes, possess short hemielytra—extending, it is true, only a third of their own length past the base of the abdomen. The

single specimen exhibiting a different condition has well-developed hemielytra extending past half the length of the abdomen, and hind-wings reaching about half-way down the abdomen. The hemielytra in this case are less punctate than in the brachypterous form. This condition is only relatively macropterous, since flight would be quite impossible. There can be no doubt that brachyptery is the normal condition.

Family 16 (37). Pyrrhocoridae.

The single species of the family, *Dindymus versicolor* H. S., recorded from this country by Kirkaldy (1909B, p. 29), has probably not become established. So far as the present writer knows, Kirkaldy's single specimen of this common Australian bug is the only one known from New Zealand.

Family 17 (39). Aradidae.

The very numerous representation of this family both in species and in individuals in this country has been noticed in the general account. These bugs are said to subsist on fungi, but their feeding-habits have not yet been definitely ascertained.

Aradus australis Erichs.

Seasonal Occurrence.

Only adults have been collected, and these all in February, except for three occurrences in November, December, and January. February appears to be a flying-period, during which the bugs may be found in the most unlikely places—in houses, on windows in cities, and often in large numbers in spiders' webs.

Distribution.

Hutton (1898B, p. 175) states that it occurs in Otago and Canterbury. I have specimens from Pokaka (D. Miller), Ohakune (2,100 ft., T. R. Harris), Paraparaumu, and Wellington.

Kirkaldy (1909B, p. 25) writes, "also from Australia, Tasmania, and New Caledonia. I have recorded it from Chatham Islands."

Ctenoneurus hochstetteri (Mayr). (Plate 83, fig. 1.)

I have elsewhere given a brief account of the life-history of this abundant species (Myers, 1921A, pp. 235–37, figs. 1–5 and pl. 44). For details reference must be made to this paper.

The egg is 1½ mm. long, elliptical, and pure-white, the surface hexagonally punctate. "The ova are deposited promiscuously or in patches on the bark or portions of the trunk, and are gummed lightly by the long axis of the eggs." At hatching the chorion splits along two-thirds of one side to the end, with one or two transverse fissures not extending more than half-way round the egg.

"The first instar (Plate 83, fig. 1) is white or colourless except for a yellow scent-gland area. The second instar shows little structural change; but colour appears as a dark grey on the head" and as grey markings on the dorsum.

" The subsequent nymphal history is marked by an enormous increase in the size of the body relatively to the length of the appendages; by the appearance of spines on the lateral margins of the head; by the growth of tubercles and spots on the posterior margins of the abdominal segments; by the increase of granulation over the whole dorsal surface; and, above all, by the gradual curving of the mesonotal and metanotal posterior margins with the formation of wing-pads. . . The compound eyes of the second and subsequent instars are brilliant red."

There are indications that *C. hochstetteri* passes through more than five stadia, but this needs further investigation.

Seasonal Occurrence.

Eggs and all stages of nymphs have occurred in September, intermediate ones in April, and fairly advanced nymphs in June and July. Eggs have hatched as late as April. Adults have been collected in June, July, September, October, December, January, and April. In 1921 I wrote, " Individuals of most instars are found throughout the season." There is thus an indication that breeding goes on throughout the year, not greatly affected by seasonal change.

Host Plants and Habitat.

This, our commonest Aradid, is found most often under the bark of dead trees, including *Beilschmiedia tawa* (A. Cunn.) Benth. and Hook. f., *Weinmannia racemosa* L., and the introduced *Ulmus campestris* Smith and *Eucalyptus globulus* Labill. Probably any loose bark is suitable.

Distribution.

Hutton (1898B, p. 175) gives the locality as Auckland. My specimens were taken at Kaitaia, Wanganui, Levin (Weraroa), Tararua Range, and the Wellington district, in the North Island; and at Mount Arthur (T. Cockcroft), Blenheim (W. Purdie), and Governor's Bay (J. F. Tapley), in the South.

Miscellaneous Notes.

The abundance of this species, especially under tawa-bark, is often phenomenal, and their odour most pronounced. They are said by bushmen to bite like bed-bugs (*Cimex*).

In December, in North Auckland, a few individuals were found flying at midday in hot sunlight. This seems to point to a wandering period similar to that of *Aradus australis*, though the migrations are probably not so extensive.

It may be of interest to note that imagines of *C. hochstetteri* are sometimes found carrying several first- or second-instar nymphs on their backs and sides. Considering the gregarious habit of the species, perhaps we should rule out maternal solicitude as an explanation; but it is significant that these young nymphs apparently do not cling to older nymphs which closely approach imagines in size.

Walker (1868, p. 137) described a specimen of the common large black Blaltid, *Platyzosteria novae-zealandiae* (Brunner) (= *Periplaneta fortipes* Walker), as feeding on bugs under the bark of trees. The bugs mentioned would probably be *Ctenoneurus hochstetteri*.

Aneurus brouni (F. B. W.). (Plate 83, figs. 2–5, and text-fig. 9.)

Eggs. (Text-fig. 9.)

The eggs are somewhat elliptical, with three chorionic projections at the micropylar end and apparently no sculpture. They thus differ much from the sculptured but simply elliptical ova of *C. hochstetteri*. They are pure-white. Length, 1·1 mm.

Nymphs.

Second Instar (Plate 83, fig. 2).—Cream-coloured with brownish areas of higher chitinization; these sclerites are distributed as shown in the figure; last joint of antennae infuscated; eyes red; scent-gland, which is apparently single, showing red through the thin dorsal cuticle; general shape long oval, broadest posteriorly. Length, 2·0 mm.

Third Instar (Plate 83, fig. 3).—Like second except that the head is more acutely angulate and the appendages relatively smaller; a slight curving of the mesothorax caudal margin is discernible. Length, 2·8 mm.

Fourth Instar (Plate 83, fig. 4).—Mesonotum greatly enlarged. Length, 3·3 mm.

Fifth Instar (Plate 83, fig. 5).—Great development of wing (hemielytral) pads. Length, 3·9 mm.

Seasonal Occurrence.

Eggs and practically all nymphal instars, together with adults, were found in July. Imagines have been collected also in the months from November to January inclusive.

Distribution.

This is not a common species. It affects the same subcortical habitat as *C. hochstetteri*.

Hutton (1898B, p. 176) records it from Auckland. The writer has specimens from Ohakune (2,100 ft., T. R. Harris) and Wellington district (T. Cockcroft, J. G. M.) in the North Island; and from Mount Arthur (T. Cockcroft, elevation not noted) in the South.

Family (40). SCUTELLERIDAE.

The records of New Zealand specimens of the Australian bugs *Calliphora imperialis* (Fabr.) and *Scutiphora pedicellata* Kirby are probably incorrect. If not, then nothing more than the merest stragglers could have been taken here, since neither species is established, nor has either been collected in New Zealand since. The supposed Scutellerine nymph recorded by Kirkaldy (quoted by Alfken, 1904, p. 583) is undoubtedly one of the instars of *Zangis amyoti*.

Family 18 (41). PENTATOMIDAE.

The Australian species *Diemenia immarginata* (Dall) and *Poecilometis gravis* (Fabr.), and the European *Sciocoris helferi* Fieber, have been recorded from New Zealand, almost undoubtedly in error. *Nezara viridula* is also very doubtful as a New Zealand species. Including the recently

discovered brachypterous species, there are thus only eight Pentatomidae occurring in the Maorian region—a truly remarkable paucity.

Hart (1919, p. 158), writing of North American forms, states that most bugs of this family are single-brooded, and many hibernate as adults. This applies also to the New Zealand species so far as known.

Butler (1923) and Reuter (1912) seem to imply that all the eggs of this family are operculate. In the New Zealand species there is, however, a sharp distinction between the eggs of Pentatominae and Asopinae on the one hand and those of the Acanthosomatinae on the other. The latter are beyond comparison simpler, usually spheroidal, pale-coloured, with non-pigmented, practically unsculptured chorion and no operculum: hatching takes place by a more or less even splitting of the chorion, and there is no egg-burster. In all these respects the ova of the two Acanthosomatines, *Rhopalimorpha* and *Oncaconties*, are much alike. Such a relatively unspecialized egg agrees well with the theory that the subfamily in question is primitive.

The eggs of the other two subfamilies mentioned, as exemplified by the species *Zangis amyoti, Dictyotus caenosus* and *Cermatulus nasalis*, bristle, however, with specializations. The chorion may be brilliantly coloured and heavily sculptured, an operculum is present, often surrounded by pedicellate chorionic processes, varying in number with the species, and for forcing up the operculum at hatching a membranous appendage within the egg is provided distally with a heavily chitinized T-shaped or anchor-shaped egg-burster. In structure generally the ovum of *Dictyotus* stands intermediate between that of *Zangis* and *Nezara* on the one hand and that of *Cermatulus* and *Oechalia*—the two Asopines—on the other.

The nymphs of New Zealand Pentatomidae are sufficiently like their parents, and the species are so few, that specific identification of immature instars should be easy. The only ones which can possibly be confused are those of *Cermatulus nasalis* and *Zangis amyoti* in the very early stages, and to a less extent in the later. Always, however, the stout carnivorous Asopine beak of the former will distinguish it at a glance.

Oechalia consocialis (Boisd.).

Life-history.

Nothing is known under New Zealand conditions. In Australia Froggatt (1907, p. 330) writes: "They lay their rounded glassy eggs in patches of about a dozen on the foliage, and the freshly emerged bug is dark brown and flattened in form. The adult bug varies very much in size." Kirkaldy (1907B, pp. 141–42, fig. 1) has described and figured the egg of the closely related *Oechalia grisea* (Burm.) in Hawaii. It bears a considerable resemblance to that of *Cermatulus nasalis*, described below, but is more rounded, has "a circular row of about fourteen short black teeth on the *operculum*," and the sides "reticulated with granules."

Seasonal Occurrence.

This species is very rare in New Zealand. The writer has seen four specimens, one taken in October, two in March, and one in April.

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* Two specimens of a new black brachypterous Pentatomid were taken by Miss Stella Hudson in alpine meadow, at about 3,500 ft., on the slopes of Mount Aurum, near Lake Wakatipu, in January, 1921 They are being described by Dr. Bergroth.

Host Plants and Feeding-habits.

"In Australia, *Oechalia* is (at least partly) carnivorous, preying on the larvae of *Phalaenides glycine* (the vine-moth) and of *Galerucella semipullata* (the fig-leaf beetle)" (Kirkaldy, 1909B, p. 24). It has been taken in New Zealand on pear and *Rubus fruticosus* L. (blackberry). A specimen from the latter was placed in a tube for some days with three live vine-hoppers, *Scolypopa australis* (Walk.), but of these insects it took no notice at all. On one occasion it ejected with considerable force a mass of foamy yellow excreta, which formed a circular patch, 3 mm. across, on the side of the tube about ½ cm. away. Froggatt (1907, p. 330) states that it feeds on several species of cutworms. Kirkaldy (1909A, p. 82) states that it is carnivorous. He proceeds to quote Bergroth to the effect that it "se nourrit des cadavres de divers animaux." Mr. Cockcroft found two adults on plants of *Cosmos* sp. in a garden at Hamilton.

Distribution.

Hutton records it from Auckland (1898B, p. 109). My records are Auckland (D. Miller), Hamilton (T. Cockcroft), Wairoa, H.B. (J. G. Myers), and Nelson (A. Philpott).

"The record from the Philippines is almost certainly a mistake" (Kirkaldy, 1909B, p. 24). Its headquarters are evidently Australia and Tasmania.

Cermatulus nasalis (Westwood). (Plate 83, figs. 6, 7; Plate 84, fig. 1; and text-figs. 10–13.)

Eggs.

On the 3rd November, 1922, just at the lower edge of beech (*Nothofagus*) forest, eggs were found on the under-surface of a single blade of a tall culm of sweet vernal (*Anthoxanthum odoratum* L.), which was bearing an inflorescence still green through growing in the shade of the beeches, and which carried below the attachment of its single leaf about twenty-two egg-nests of the common cicada, *Melampsalta cruentata* (Fabr.), crammed with ova. The leaf was horizontal, and the *Cermatulus* eggs were arranged in three rows, a little nearer base of leaf than apex, and all parallel with the long axis of the blade. In one row were fifteen eggs, in the next sixteen arranged alternately to those of the contiguous first row, and three only in the third row, closely applied to the second near its end. The batch thus contained thirty-four eggs, all of which appeared to be solidly glued to the support and to the adjacent eggs, both of their own row and of the next rows.

A second batch was deposited on the leaf of a fruit-tree at Pukekohe, and contained a dozen eggs in a compact group. A third cluster which I refer to this species, and which came from the neighbourhood of Christchurch, consisted of two close rows on a slender twig, with about ten ova in each row.

The shape of the egg is oblong or cylindrical, with parallel sides and flattish rounded ends. At the edge, where the perpendicular sides merge into the top, or operculum, is a circle of black spinous chorionic processes, twelve or fourteen in number, arranged at more or less regular intervals. Each process bears a thin inwardly-arching pure-white opaque pedicel, carrying at its extremity a rounded or pear-shaped knob of similar whiteness

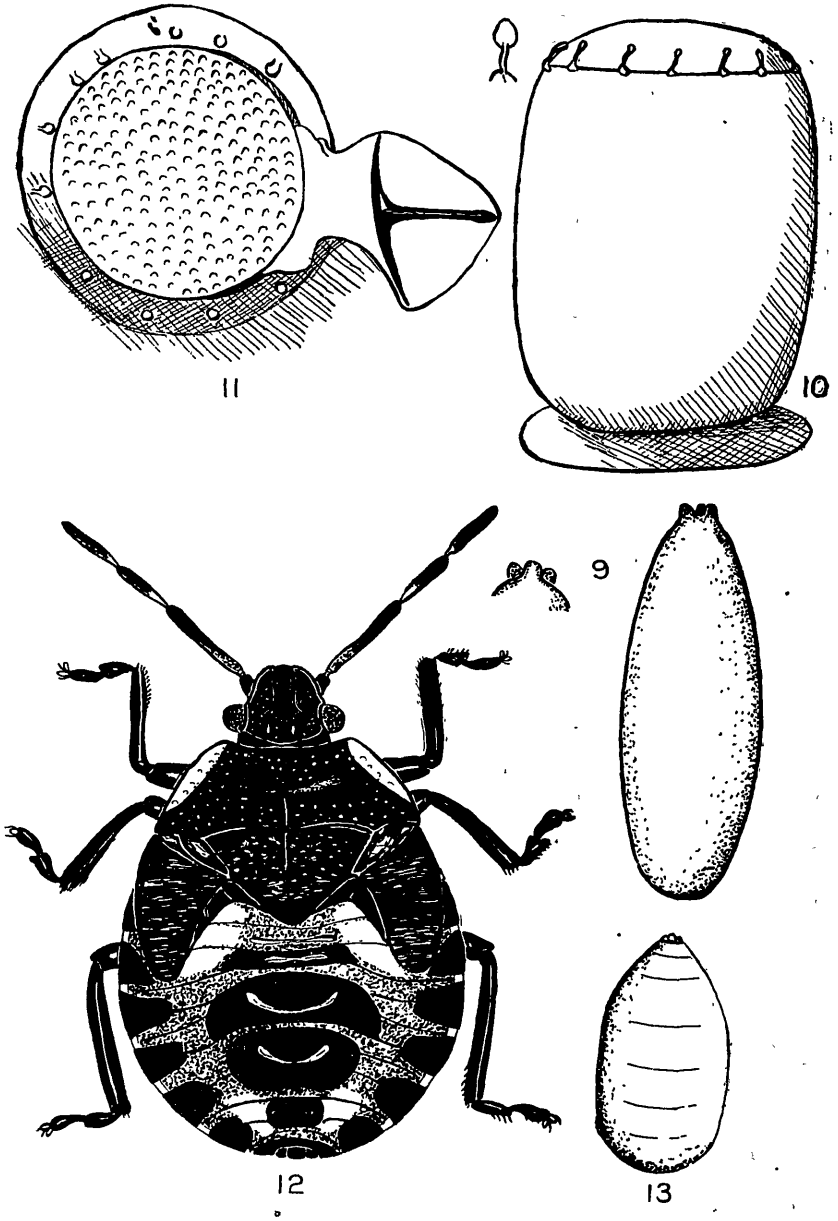


FIG. 9.—*Ctenoneurus brouni*: egg.
FIGS. 10–13.—*Cermatulus nasalis*: 10, eggs, enlarged; 11, egg-shell, showing egg-burster; 12, fifth instar; 13, puparium of dipterous ? parasite.

and opacity. In many the pear-shaped end, or even the whole pedicel, had been broken off. Often a whole circle is damaged or broken.

Height of egg, 1·3 mm.; diameter of operculum, 1 mm.

The colour is a pure and beautiful metallic gold. The surface is covered with a very faint hexagonal reticulation.

Hatching: The operculum usually remains covering the opening of the empty egg-shell, and the egg-burster protrudes from beneath its edge.

Nymphs.

First Instar.—The general appearance is black with two bright-yellow spots. Head, thorax, legs, antennae, most of connexivum, odoriferous orifices all shining-black; terminal portions of all antennal segments pale-reddish; abdomen dark-reddish, almost black to the naked eye; a bright-yellow spot extending on each side of first odoriferous orifice and occupying the length (cephalo-caudally) of at least two segments; two similar but very indistinct and paler spots at extremity of abdomen.

Fifth Instar.—Considerably longer than broad, coppery black relieved with cream-coloured spots and marks. Head completely black; thoracic nota black with narrow edging of cream; base of abdomen, between wing-pads and scutellum, cream, forming thus two conspicuous cream-coloured spots about middle of body; dorsum of abdomen occupied chiefly by a considerable swelling spot of black containing odoriferous orifices; on each side of this are cream-coloured areas speckled with black and extending to black edges, where connexivum exhibits a wide crescent of cream-colour in each segment forming an interrupted continuation of cream edging of thoracic nota. Under-surface blackish-red; whitish between coxae; rostrum almost black, but distal half, except actual tip, somewhat paler than the rest; antennae very characteristically marked—first segment short and black, second pale red with black tip, third with proximal half pale red and distal half black, fourth black except a very small pale-red portion at base. Tibiae with a wide band of white near middle (narrower in first pair of legs); remainder of leg black.

In a slightly smaller specimen, evidently belonging, however, to the same instar, the areas mentioned above on each side of odoriferous openings are not wholly cream-coloured, but blackish except caudally, where there is a cream-coloured spot on each.

Life-history.

1. Eggs found, 3rd December, 1922; hatched, 16th December; first ecdysis, 27th December.

2. Eggs found, 19th November, 1923; hatched, 24th November; first ecdysis, 2nd December.

3. Fifth instar found, 17th December, 1923; last ecdysis, 5th January, 1924.

On hatching, the young clustered together in a close body on the opposite side of the leaf to the egg-mass. Later they grouped themselves together on the stalk. They seemed never to feed. The second instars, as soon as they hatched, crawled about actively, but were killed later, probably by the cold weather at Arthur's Pass, whither the writer had travelled. Perhaps under the influence of cold they had begun to cluster like the first instars, but could always be stirred to swarming activity, like larval ticks, by the warmth of one's hand.

At the last ecdysis the notal split does not extend to posterior border of mesonotum, whereas in *Zangis amyoti* it includes the whole of the metanotum as well.

Seasonal Occurrence.

Eggs have been found in November and early December, first instar in January (South Island), second instars in December and January, third instars in December, fourth instars in January and March, fifth from December to March, and adults from August to March and in May.

In the last month mentioned, Mr. T. Cockcroft found an adult under a log, in which situation it was probably hibernating. The indications are that *Cermatulus nasalis* passes the winter as an adult, and that it produced one brood per year, like many other Pentatomidae whose life-history is more fully known.

Host Plants and Feeding-habits.

Plants function chiefly as shelter and hunting-ground for this typical carnivorous species. Hutton (1898B, p. 170) mentions that it occurs "generally on trees." The writer has taken it from the following plants: *Muehlenbeckia australis*, mixed undergrowth of *Nothofagus* forest, *Carex* sp., *Anthoxanthum odoratum* L., and flowers of *Metrosideros scandens* (white rata).

As with many predaceous insects, specimens are usually few and far between. On one occasion, however, the writer found the fifth instar very plentiful on *Muehlenbeckia australis* heavily infested with the Ricaniid *Scolypopa australis* and an unnamed large green Bythoscopid. The abundance of these Homoptera, which, especially in their nymphal stadia, probably formed the food of *Cermatulus*, was to be gauged by the fact that the foliage was black with fungus growing on the honeydew secreted by these hoppers.

In captivity the older instars throve amazingly on a diet of "pear-slug"—the larva of the pear and cherry saw-fly (*Eriocampoides limacina* (de Geer)). Broun (1896, p. 9) has seen the same larvae attacked in nature; the rostrum of the bug, according to this observer, being often thrust through the leaf into the "slug" from below. The caterpillars of the following Noctuid moths are devoured: *Agrotis ypsilon* Rott., *Cirphis unipuncta* Haw., *Heliothis obsoleta* (Fabr.), and *Persectania composita* (Guen.). Their pupae may also be destroyed. A large larva may be sucked, but not emptied till a second meal some hours afterwards. Even the common cicada, *Melampsalta cruentata* (Fabr.), has been known to fall a victim to the adult *Cermatulus* (see Myers, 1921B, p. 240). That such powerful and wary prey can be mastered indicates a high degree of skill in the bug's method of attack.

The food of the early instars is unknown. A first or second instar remained alive and apparently healthy for six days in a closed tube with nothing but a few leaves of *Coprosma rhamnoides* A. Cunn. At the end of the period, moreover, its abdomen looked quite swollen as though with food, so it may have taken to a vegetable diet—although, of course, the first instar in the normal course of events rarely feeds. Finally some sow-thistle covered with aphides was introduced. Over this the bug crawled energetically, plying its antennae vigorously, and often stopping to tap the surface of the leaf with these organs. The rostrum meanwhile, often held in a porrect position, kept up an incessant dabbing motion. Frequently it stopped and drew its antennae very deliberately through the basal portions of the apposed fore-tarsi. Occasionally the rostrum was cleaned

in precisely the same way. No notice was taken of the aphides, but the honeydew with which these insects bespattered all surroundings may have been tasted. In two days the bug was dead, apparently entangled in the now sticky leaves.

Kirkaldy (1909A, p. 82) writes: "I have . . . recently received some nymphs of . . . *Cermatulus nasalis* with caterpillars of *Asaphodes megaspilata* (on *Leptospermum scoparium*) attached to their beaks, from my friend Mr. George Howes, of Wellington."

That the species may turn occasionally to a vegetable diet is indicated by the following observations of Hudson (1892, p. 121, pl. 20, fig. 6, imago; fig. 6*a*, "larva"): "This insect may be beaten out of various trees during the summer, and is usually taken in some abundance in February amongst white-rata blossoms, on which it may be often observed sucking the honey from the blossoms with its long rostrum. Its larva, which is represented at fig. 6*a*, is found in similar situations." I myself have taken this bug on the flowers of white rata (*Metrosideros scandens*) in February, so these are evidently a favourite resort.

The bug appears to be partially nocturnal in its habits.

Distribution.

As might be expected, this bug has a wider range of habitats than the strictly phytophagous species. It is frequently found on either cultivated ground or forested country.

The altitudinal range is from sea-level to at least 3,000 ft. (Arthur's Pass). North Island localities extend from Rangitoto Island and Pukekohe, near Auckland, in the north, southward to Lake Taupo (E. H. Atkinson !), Ohakune (T. R. Harris !), Makatote (D. Miller !), Raglan (Miss E. M. Parker !), Wanganui River, Wanganui, Manawatu (D. Miller !), Waikanae, and Wellington. In the South Island it occurs at Blenheim (C. Craigie !), French Pass and Stephen Island (Kirkaldy), at Jackson's and Greymouth on the west coast (S. and C. Lindsay, T. Cockcroft !), on both sides of Arthur's Pass and at Little River (T. Lee !), and finally at the Port Hills (Christchurch) (E. S. Gourlay !). Hutton (1898, p. 170) gives the range as "Auckland to Otago" The species is plentiful also in Australia and Tasmania.

Miscellaneous Notes.

Cermatulus nasalis is probably the most beneficial member of the order Hemiptera in New Zealand. Its extensive menu includes several important pests of agriculture, notably the various cutworms and army-worms.

A specimen was seen in May flying in hot sunshine with a loud humming like that of a humble-bee.

The half-grown nymph, with its dark coloration relieved by conspicuous pale spots, is often mistaken for a ladybird.

Miss Janet Anson brought me a supposed egg of this species. The object, which had appeared in a box containing nothing but a specimen of the bug (sex not ascertained), is shown in text-fig. 13. It is apparently the puparium of a dipterous parasite, but although I kept it for several years nothing emerged from it. Possibly also parasitized was a specimen of the bug sent me from Ohakune by Mr. T. R. Harris in 1923, with a neat almost circular hole bored in the under-surface of the abdomen near the tip, and about 1·3 mm. in diameter. This hole may, however, have been the work of museum pests since the insect was pinned.

Zangis amyoti (Dallas). (Plate 84, fig. 2; Plate 85, figs. 1–3; and text-figs. 14–17.)

Eggs. (Plate 84, fig. 2; and text-figs. 14, 15.)

Eggs found on leaves of *Coprosma robusta* Raoul in the Hokianga in December were buffish in colour, changing to dull orange in a few days. One patch contained fourteen eggs, arranged irregularly, but all touching, on the upper surface of a leaf near the tip. A second lot contained also fourteen eggs, arranged rather more regularly near the base of a small leaf. A third batch of fourteen was deposited fairly regularly near the base of a large leaf. All three lots were on the upper surface of their respective leaves, and were not hard to discover. Other eggs, from Auckland and from Dargaville, were deposited on the upper surface of *Pittosporum* leaves, probably *P. Colensoi* Hook. f.

The empty shells are pale buff, with uniform but not very pronounced pitting. Dimensions, 1·5 mm. by 1·4 mm. Shape as indicated in Plate 84, fig. 2, much more rounded than in *Nezara*. Judging by the way they adhere to one another when detached with no great force from the leaf, they are stuck together very firmly.

On hatching, the egg-burster remains just within the opening of the empty shell, and the operculum frequently becomes completely detached and lost.

Nymphs.

First Instar (Plate 85, fig. 1; and text-fig. 16).—Length, 2·0 mm. As broad as long (practically circular), shining jet-black above and below except a white spot on each side at base of abdomen; segments of antennae slightly paler towards their tips.

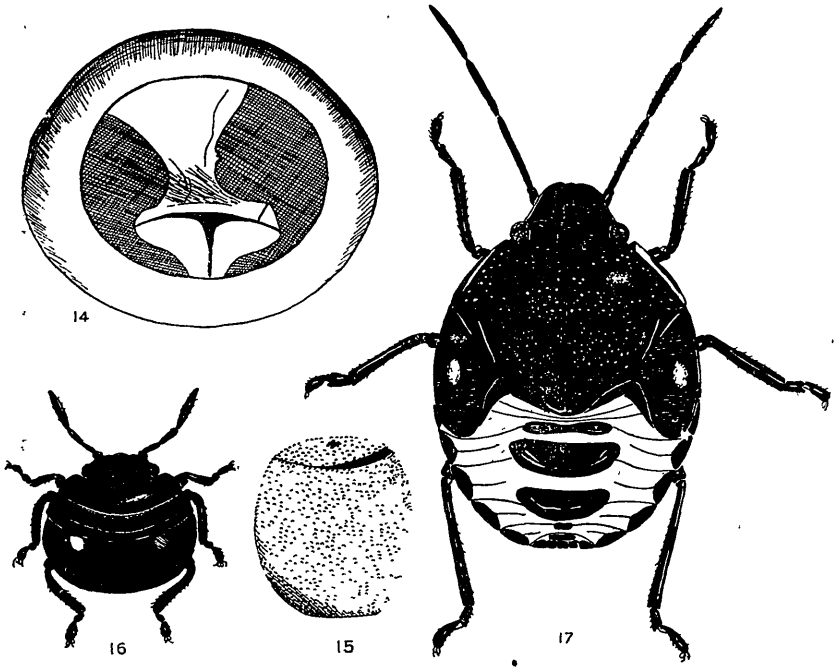
Second Instar (Plate 85, fig. 2).—Length, 3·1 mm. Rather longer than broad; jet-black; the two white spots of previous instar unaltered, but in addition a whiter spot at base of abdomen, but in a much more lateral position on each side (actually, in fact, on the connexivum), simulating exactly a constriction or waist. Only very close examination reveals that these are really spots.

Third Instar (Plate 85, fig. 3).—Length, 4·0 mm. Head almost entirely orange-brown, with black eyes and an area on caudal border and a narrow edging to remainder of head also black; two faint orange-brown spots on each side of thoracic nota—one on pronotum and other on mesonotum—rest of nota greenish-black, the connexivum green; abdomen pure rich green; odoriferous areas shining black; a large bright-yellow spot on each side of base of abdomen; connexivum with six black plaques or semicircles ("lateral plates" of Hart) in relief, on each side, corresponding to first six visible segments of abdomen. Ventral surface pale-greenish; coxae, femora, underside of head, sterna greenish-yellow; rostrum yellowish-amber with black setae and terminal segment; tibiae and tarsi brownish-black; antennae wholly brownish-black; whole under-surface very narrowly edged with black.

Fourth Instar.—Head, thorax, antennae, and legs almost wholly shining jet-black; abdomen with scent-gland areas and semicircular plaques ("lateral plates") on connexivum in each segment jet-black, remainder blackish except a bright-yellow spot on each side of basal segment, connected by narrow yellow line; a very narrow greenish line of division between scent-gland areas. The two yellow basal spots may form a wide

continuous band. Under-surface of head, thorax, a narrow edging and median longitudinal line of abdomen black; rest of abdomen pale-greenish (underside).

Fifth Instar.—Length, 10·0 mm. Head, thorax, antennae, and legs greenish-blackish-bronze, with a slightly paler area (brownish tinge) on each side of thorax; scutellum darker; abdomen bright yellowish-green; the three scent-gland areas shining greenish-black, separated from scutellum in front and from one another by narrow areas of bright canary-yellow



FIGS. 14–17.—*Zangis amyoti:* 14, egg-shell, showing egg-burster; 15, eggs further enlarged; 16, first instar; 17, fifth instar.

(the first yellow band wider and much longer than others and extending from one wing-pad to the other); connexivum edged extremely narrowly with black, which widens into an elliptical black mark ("lateral plate") in each of the first six visible segments (first two marks are, however, hidden by wing-pads). Ventral surface pale yellowish-green edged peripherally very narrowly with black.

Life-history.

1. Eggs found, 19th December, 1923; eggs hatched, 20th December: first ecdysis, 29th December; second ecdysis, 14th January, 1924; third ecdysis, 26th–28th January; fourth ecdysis, 8th–10th February.

2. Eggs found, 19th December, 1923; eggs hatched, 24th December; first ecdysis, 4th January, 1924; second ecdysis, 14th January; third ecdysis, 30th January; fourth ecdysis, 12th February.

3. Eggs found, 19th December, 1923; eggs hatched, 24th December; first ecdysis, 4th January, 1924; second ecdysis, 17th January; third ecdysis, 30th January; fourth ecdysis, 11th February; fifth ecdysis, 4th March.

As in so many other Pentatomids, the newly hatched nymphs remain clustered and quiescent near or on the egg-shells. After a few days they may begin to move about a little, but I believe no food is taken in this stadium. In marked contrast to this behaviour, the second instar is very active.

Intrastadial colour-changes are somewhat marked. Thus about halfway through the second stadium, sometimes sooner or sometimes later, the nymphs look appreciably larger, and a bright-yellow spot appears on each side of the base of the abdomen, just mesad and caudad of the white spot which gives the appearance of a waist. Is this the conspicuous spot of the third instar (see description above) showing through the second instar cuticle? Again, in the fourth instar, some nymphs have an entirely pale-green abdomen, except for yellow basal band and black marks on connexivum (" lateral plates ") and scent-glands (" dorsal plates " of Hart), while in others it is wholly blackish. The recently emerged fifth instar is almost wholly pale green except for the usual yellow markings and the general yellowish tinge of the abdomen. Even at three days from ecdysis the only really black markings may be confined to an edging on head and thorax, the scent-gland areas (or dorsal plates), and the connexival plaques (lateral plates), the rest of head and thorax being brownish-green. How far this may indicate an actual dimorphism in the nymphs my material was not sufficiently abundant to decide. Dallas (1851, p. 279) mentions a " var. totus griseo-virescens, antennis obscurioribus," but such a colour in a cabinet specimen can be produced by killing it too soon after ecdysis. Buchanan White in the following passage (1878, p. 276) indicates what may be a dimorphic form: " In addition to typical specimens, there are three examples (more or less fuscous brown, with a greenish tint) which seem to be immature individuals of this species." It is possible, of course, that these are just recently emerged imagines, as White suggests, since I have had such specimens dry with a brownish tinge. At ecdysis the split extends medio-longitudinally along the nota, from posterior margin of metanotum to anterior edge of pronotum; thence it extends along posterior border of occiput and between the eyes and head to the front of the eyes. In the earlier instars the split does not quite reach the eyes.

Seasonal Occurrence.

Eggs occur in December and February. Nymphs of all stadia have been taken in December and February. A late instar nymph was collected by Mr. W. G. Howes in March, in which month both fourth and fifth instars have occurred. Adults have been collected from January to March. *Zangis amyoti* therefore probably resembles several other Pentatomids in wintering as an adult and producing one brood per season.

Food Plants and Feeding-habits.

In New Zealand this bug has been beaten from *Nothopanax arboreum* (Forst. f.) Seem. (R. E. Grimmett), *Pittosporum Colensoi* Hook. f., and *Coprosma robusta* Raoul. In captivity all stages throve on ripe and partially ripe berries of *Coprosma robusta*. That it may not be entirely phtyophagous is indicated by the following incidents: One advanced instar nymph was about half emerged from its exuviae when it was attacked by a third (?) instar, pierced in the mesonotum, and almost drained dry. Broun (1896, p. 9) noticed *Z. amyoti* feeding on " pear-slug " (*Eriocampoides*

limacina (de Geer)) in company with and after the same manner as *Cermatulus nasalis* (*q.v.*). On *Coprosma* bushes the berries are evidently the chief attraction, since many more bugs are beaten from female than from male plants.

Distribution.

The present species occurs also in Australia. In New Zealand I have found it very local. Outside the Auckland district, particularly North Auckland, it is extremely rare. In the Auckland district itself, at the height of its season, I have examined heavily-fruiting *Coprosma robusta* bushes with no success, though one adult was taken at light. The North Island localities are Kohukohu (J. G. Myers), Hokianga (R. J. Nisbett), Dargaville (J. Munro), Auckland (Mrs. I. Woodhouse), New Plymouth (W. G. Howes). In the South Island it has been taken at Nelson (R. E. Grimmett) and French Pass (Kirkaldy, 1909B, p. 24), both extremely northerly localities.

I have recorded it from Sunday Island (Kermadecs), where two were found in 1908 by Mr. W. L. Wallace on Denham Beach (Myers, 1921C, p. 257).

Miscellaneous Notes.

At Auckland, in March, a fine specimen flew into a lighted room at night.

A second instar was observed, while on a berry, to jerk itself galvanically from side to side in a most peculiar manner.

It is rather remarkable, considering the damage committed by the closely-related bugs of the genus *Nezara* in many parts of the world, that *Z. amyoti* has not yet been observed to pay any attention to fruit or fruit-trees.

This species is very likely to be confused with *Nezara viridula* (Linn.), if the latter does occur in New Zealand, which the writer very much doubts. Superficially the adults are much alike, but the eggs and intermediate stages are very dissimilar (see *N. viridula*).

Nezara viridula (Linn.)..

Under the name of *Rhaphigaster prasinus* Linn., Walker (1867, p. 356) mentions five specimens (*ggggg–kkkkk*) from New Zealand, presented by Colonel Bolton. It seems to the present writer quite possible that Walker confused *Zangis amyoti* with this species. In any case, the above five specimens are the only ones ever recorded from New Zealand, and their re-examination in the British Museum would soon settle the point. Stragglers of such a cosmopolitan species might easily wander as far as New Zealand. Bueno (quoted by Jones, 1918, p. 11) observes that *Nezara viridula* is recorded "from the whole of Europe except the extreme north, Asia, Africa, Malaysia, Australia, New Zealand, South America (at least in the north), Central America, and enters into the United States at the south, being found in Texas and Florida."

Its economic status is that of a serious pest. In the United States cotton, cauliflowers, beans, tomatoes, potatoes, sweet potatoes, and other crops are attacked, especially at the growing-points and the developing fruit (when present) (Jones, 1918). In New South Wales it damages tomatoes, French beans, and potatoes. From an agricultural viewpoint its scarcity or possible non-occurrence in New Zealand is a matter for congratulation.

Although the adult in size and coloration so much resembles *Zangis amyoti*, all the pre-adult stages, including the egg, can be distinguished at a glance. Good illustrations of eggs and nymphs are given by both Jones (1918) and Froggatt (1916). The egg is remarkably parallel-sided, rising directly at right angles with the surface on which it is deposited, while that of *Zangis amyoti* is much more spheroidal.

The first instar has a large pale-yellow area occupying a considerable portion of the thoracic nota, while all succeeding instars are conspicuously marked on thorax and abdomen with *large, rounded, clear-white spots.*

Regarding the imagines, four specimens collected in Barbadoes and kindly given to the writer by Dr. Dayton Stoner show that they may be distinguished without difficulty from *Zangis amyoti* by the narrower apex of the scutellum, by the less glossy surface of the whole dorsum, and by other characters which need not be detailed here.

Dictyotus caenosus (Westwood). (Plate 84, fig. 3; Plate 85, fig. 4; and text-figs. 18–21.)

Eggs. (Plate 84, fig. 3; and text-figs. 18–20.)

A batch of eighteen was deposited on the upper surface of a grass-blade (an introduced species). They adhered firmly both to the leaf and to one another. On discovery, the colour was pale yellowish-green. In the subsequent absence of the writer, Mr. David Miller kindly watched development. He found that the eggs became pale lemon-yellow, which colour finally, just prior to hatching, changed to pink. He noted, moreover, that the little collection of ova hatched at one end first, and not all at once, several days elapsing before the last egg went through the process.

The empty choria were pure-white, the surface irregularly reticulated with fine ridges, giving the whole a frosted appearance. Height, 0·94 mm.; diameter, 0·90 mm. As in *Cermatulus nasalis*, the operculum almost invariably remains, covering the opening as though hinged at one point, and the egg-burster projects from beneath it. Surrounding the operculum but actually arising from the top of the side walls are about thirty-six fine white chorionic processes, very difficult to discern.

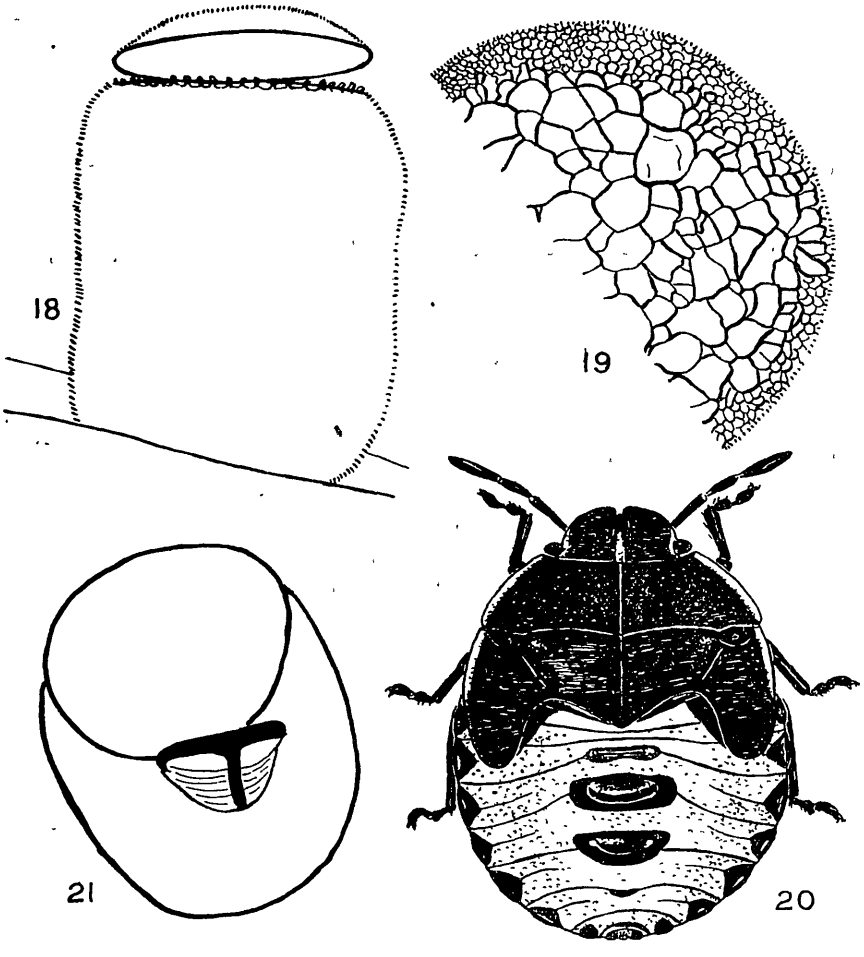
Nymphs.

First Instar (Plate 85, fig. 4.)—Almost circular in outline and dome-shaped in appearance. Head, pro-, meso-, and meta-notum shining blackish-brown; eyes reddish; abdomen yellowish, scarlet laterally, caudally, and between scent-gland areas. First scent-gland area double and very narrow, second and third very large and transverse; lateral plates jet-black; segmental margins scarlet.

Fifth Instar (Text-fig. 21).—Length, 7 mm.; greatest breadth, 4·5 mm.

Head and nota brownish-black with a very narrow white transparent edging, the beginnings of a median longitudinal pale stripe indicated at the base of vertex; antennae black with white articulations; whole of ventral surface of head black; rostrum black with proximal portion of second segment pallid; sternum black except round and between coxae pallid; rostrum reaching just to posterior coxae; abdomen creamy, very thickly freckled with reddish specks, each speck forming the base of a minute blackish granulation, thus giving the effect of blackish-red freckles; the odoriferous orifices jet-black and shining, each surrounded by a black

area—the first a narrow transverse stripe, the second a broad oblong transverse band, the third nearly semicircular, and following these a fourth narrow transverse stripe of black; under-surface of abdomen cream-coloured thickly speckled with reddish like a turkey's egg; a distinct heavy oblong black spot on middle of third and each succeeding ventral



FIGS. 18–21.—*Dictyotus caenosus:* 18, egg-shell; 19, structure of operculum; 20, egg-shell, showing egg-burster; 21, fifth instar.

segment to the last, increasing in size caudad; a semicircular black spot occupying lateral margin of every ventral abdominal segment; legs jet-black; tibiae slightly bristly. First segment of antenna less than half second; second one-fifth shorter than fourth; third about two-thirds of second; two-jointed tarsi with second segment longer than first.

Life-history.

Little is yet known. Adults swept from grasses on 14th December deposited a batch of eggs on 27th December; but this period is untrustworthy, since the eggs had meantime been taken to much colder conditions (from Wellington to Arthur's Pass). Hatching commenced on 19th January, after the return to Wellington.

At the last ecdysis the cuticle splits along the whole median longitudinal line of the thorax; side fissures are almost absent.

Seasonal Occurrence.

Ova have been deposited near the end of December. Third-instar nymphs have been collected in January and March, and fifth instar from January to March. Adults occur in October to May inclusive and in July, being especially abundant in March at most localities, but always to be found during autumn and winter in some numbers in hibernation. More were found in hibernation shelters in July than in May. The imago is the wintering stage. Apparently only one brood is produced per year.

Host Plants and Feeding-habits.

Dictyotus caenosus seems to prefer grasses and low herbage generally. It has been swept from English grasses, including cocksfoot (*Dactylis glomerata* L.) and rye-grass (*Lolium perenne* L.), from lucerne (*Medicago sativa* L.), red clover (*Trifolium pratense* L.), and from pastures and roadside grasses. In the course of an investigation of the cattle-tick (*Haemaphysalis bispinosa* Neumann) in New Zealand, this bug was found in large numbers sheltering with the wintering nymph ticks at the bases of the clumps of rushes, or wiwi (*Juncus effusus* L.), which form such a conspicuous feature of the North Auckland and other pastures. Attempts to lead the bugs to eat the nymph ticks, either in the ticks' unfed or engorged condition, met with no success. Most of the nearer relatives of *Dictyotus* are known to be phytophagous, and it is probable that *D. caenosus* is entirely so.

Fifth-instar nymphs have been found plentifully on blackberry-plants (*Rubus fruticosus* L.) (A. S. Wickens). They were reported to be sucking the ripe fruit, especially after it had been picked. Mr. E. O. Hyde states that the adults are a source of constant annoyance to blackberry-pickers in the Nelson district. They swarm over the ripe fruit, and have to be constantly picked out from among the berries in the containers.

This is essentially an insect of open country. We have only one truly forest-dwelling Pentatomid—*Oncacontias vittatus*.

Distribution.

In the North Island it occurs from Kaitaia, in the far north, through Whangarei, Auckland, Raglan (Miss E. M. Parker), Wanganui, to Wellington.

In the South Island it is plentiful in Marlborough and Canterbury (E. S. Gourlay! T. Lee!). Hutton records the species from Auckland to Otago, which is probably correct as far as it goes. It is found also in Australia and Tasmania.

Rhopalimorpha* obscura White. (Plate 85, fig. 5; Plate 86, fig. 1; and text-figs. 22, 23.)

Eggs. (Text-fig. 22.)

A batch of five eggs was laid in a single straight row on the upper surface of the midrib of a *Carex* blade. These were obtained away from the laboratory under conditions that rendered only a pocket-lens examination possible: this showed the eggs to be apparently devoid of sculpture and of markings. Later scrutiny of the empty choria brought to light an extremely faint irregularly-hexagonal reticulation over the entire surface. The shape was spheroidal and the colour greenish, so that the ovum bears a close resemblance to that of the related *Oncacontias vittatus*. The surface appeared remarkably glossy. In six days two red eye-spots were conspicuous on each egg. At hatching the chorion split almost in two, and the halves immediately twisted into rolls. The empty chorion was colourless and transparent.

A second batch was laid in captivity on the under-surface of a cocksfoot (*Dactylis glomerata*) blade between midrib and edge.

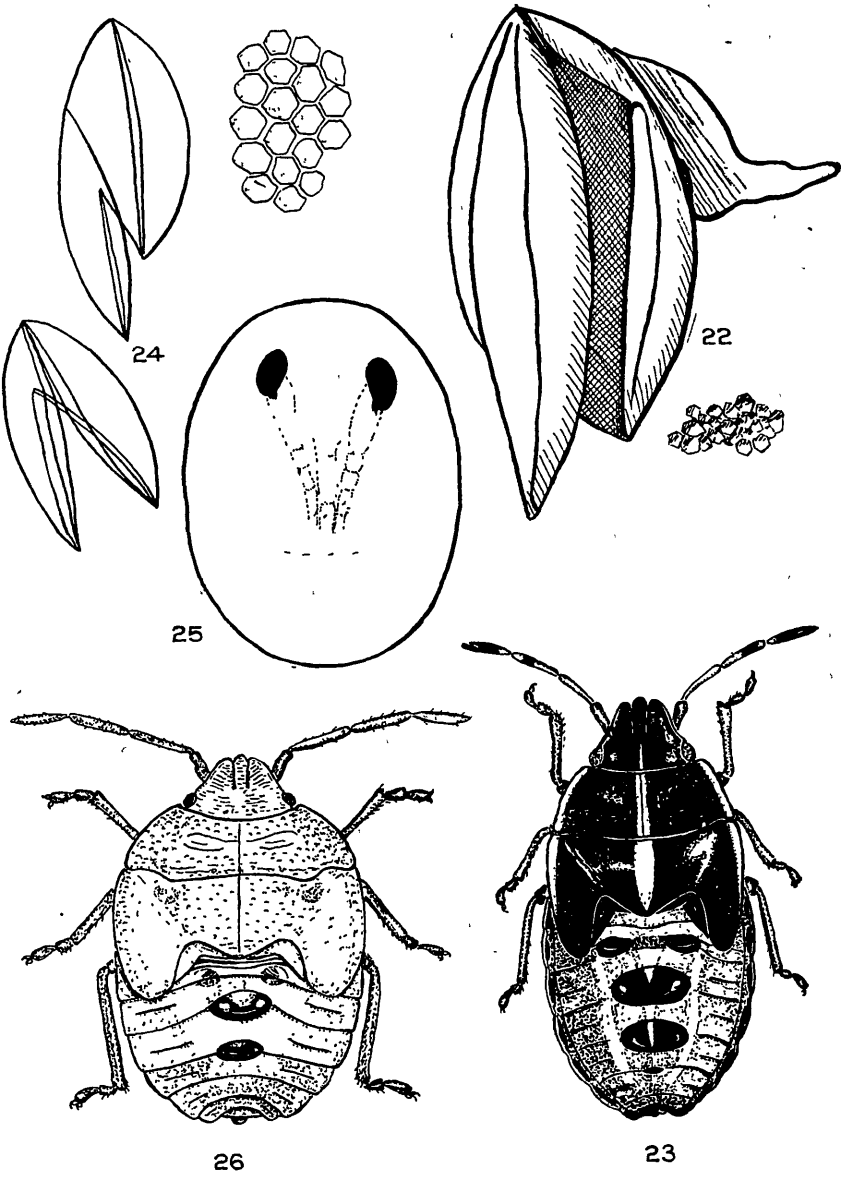
Nymphs.

First Instar.—Almost circular, with dorsum very strongly arched, so that the insect approaches a hemisphere in shape. Head and thorax (forming anterior half of bug) shining black; abdomen pale translucent yellowish-red with three black scent-gland areas surrounded by blackish brown and then by red, except laterally, where these areas are edged with white; a white spot on vertex is in line with a white median longitudinal stripe commencing as a spot on thorax and extending as a narrow line to caudal extremity of abdomen, but interrupted by scent-gland patches of black; appendages almost transparent greenish-yellow.

Second Instar (Plate 85, fig. 5).—Not quite so rounded as first; with very long conspicuous antennae. Head entirely shining black or very dark brown with no pale spot; eyes purplish-red; thoracic nota shining black with yellowish-white median longitudinal stripe commencing at fore-border and extending to cephalic edge of second scent-gland area (first scent-gland area is double and the stripe passes between the two halves); abdomen vivid pinkish-red; the second scent-gland area is double almost like the first; third is transversely elliptical; all scent-gland areas black narrowly edged with white especially laterally; connexivum wholly pale, semi-transparent; appendages transparent yellowish with darker extremities; antennae with the large terminal segment nearly black. Ventral surface nearly black on the thorax and reddish on the abdomen, darker caudally.

Third Instar (Plate 86, fig. 1).—Head and nota practically black; eyes red; lateral margins of thorax and median longitudinal stripe or nota white. Abdomen scarlet with three strong black scent-gland areas, the first divided into two lateral parts; there is a small vestigial fourth area. A whitish median longitudinal stripe continues that of thorax; there is another on each side parallel and lateral of scent-glands, and a third stripe similar and parallel just mesad of connexivum which has very small black lateral plates with white outer (laterad) borders giving a white edging to the whole connexivum. Rostrum reaching just pass intermediate coxae; appendages pale-brownish; abdomen beneath pale reddish-yellow with five scarlet longitudinal stripes—one median, one latero-discal, and one in

* Dr. E. Bergroth informs me that the correct orthography is *Rhopalomorpha*.



FIGS. 22, 23.—*Rhopalimorpha obscura:* 22, egg-shell; 23, fifth instar.
FIGS. 24–26.—*Oncacontias vittatus:* 24, egg-shell; 25, egg, showing embryo; 26, fifth instar.

connexivum interrupted by lateral plates; three well-marked black ventral plates and a vestige of a fourth. Hemielytral pads reaching posterior edge of metanotum. Length of bug, 4·1 mm.

Fifth Instar (Text-fig. 23).—Much more elongated. Coloration as in third instar (as described above) but more strongly contrasted. The white stripe of nota now extends on to head. Rostrum barely reaches intermediate coxae. Spiracles and trichobothria (setigerous punctures accompanying stigmata, and usually two to every spiracle in Pentatomidae) black and conspicuous. Hemielytral pads reaching half-way down third abdominal segment (segments counted in dorsal view). Length of bug, 7·0 mm.

The newly-emerged imago is a very pale greenish with the median stripe paler still, and the head, thorax, and scutellum suffused with red. The red connexivum shows through the hemielytra. Eyes dark red.

Life-history.

1. Adults collected on Dun Mountain, Nelson, 23rd January, 1923; eggs laid, 24th–25th January; eggs hatched in Wellington, 31st January.

2. Adults collected *in copula*, North Auckland, 12th December, 1923; eggs laid, 15th December; adults again pairing, 19th December; red eye-spots appeared on eggs, 21st December; eggs hatched in early morning, 22nd December; two more eggs laid (these never hatched), 24th December; first ecdysis, 30th December.

It will be noticed that the hot climate of North Auckland caused development to proceed only a very little faster.

As in so many other insects, hatching and emergence appears to take place at night or in the early morning.

The first ecdysis is accomplished by a median longitudinal split which does not include the head cuticle. At the fourth ecdysis the cuticle splits along the latero-caudal edges of the scutellum and between the head and pronotum. In the exuviae the head is strongly deflexed and the rostrum extended along the venter, leaving a wide gap between the occiput and pronotum.

Seasonal Occurrence.

Eggs have been laid in December (North Auckland) and January (South Island, subalpine). Advanced nymphs occur in February and March. Adults have been taken in September to April inclusive and in July; *in copula* in November, December, and January. One imago was found in July in company with wintering nymph ticks (*Haemaphysalis bispinosa*) at the base of a clump of rushes (*Juncus effusus*). Another adult was taken under bark at Lake Wairarapa in September (T. Cockcroft). The imago therefore probably hibernates, and only one generation passes in a year.

Host Plants and Feeding-habits.

Rhopalimorpha obscura bears the pale median stripe which is so often an indication of grass-haunting habits. It is also much more elongated than the species of any other genus in New Zealand.

Sweeping has procured it from miscellaneous herbage, long grass, English grasses, sedges, *Carex* sp., and more specifically from cocksfoot (*Dactylis glomerata* L.), wiwi (*Juncus effusus* L.), and *Carex virgata* Sol. In a swampy pasture at Wainuiomata the close restriction of this bug to clumps of *Carex virgata* was remarkable. On cocksfoot the nymphs and adults feed with avidity on the fully formed but not yet hardened seeds.

Though essentially attached to grasses, sedges, and rushes, this insect may enter the forest where *Carex* sp. grows on the margins of bush-creeks. I believe it to be purely phytophagous.

Distribution.

Hutton (1898B, p. 171) gives the range as "Auckland to Otago," in which he is probably entirely correct. The writer has seen specimens from North Auckland, Auckland, Cuvier Island (R. S. Sutherland), Motutapu Island (David Miller), Lake Roto-aira (E. H. Atkinson), Ohakune (T. R. Harris), Wanganui district, Wellington district, Lake Wairarapa (T. Cockcroft); and in the South Island from the Dun Mountain, Nelson, Little River, Canterbury (T. Lee), West Coast (T. R. Harris).

Kirkaldy has recorded it from French Pass and from the Chatham Islands (1909B, p. 24). The last locality is interesting in view of the fact that these islands possess also the melanic form, *R. ignota* Hutton. *R. obscura* is the only Hemipteron so far recorded from Stewart Island (Howes, 1914, p. 100).

Miscellaneous Notes.

This is easily the most plentiful Pentatomid in New Zealand, to which country it is confined.

The second instar, if not others, feigns death when disturbed, unless it be in strong sunlight.

Numerous examples of adults and nymphs were kept in a dry Petri dish for a week with heads of fairly dry cocksfoot. At the end of that period a cocksfoot-head was dipped in water, shaken to get rid of superfluous moisture, and placed in the dish. In a very short time all the other heads were deserted and the bugs crowded upon the wet one all day.

The female is usually slightly larger and wider, and brownish in colour. The male is distinctly greenish.

Rhopalimorpha ignota Hutton (1898A, p. 159) is not worthy even of subspecific rank. In fact, its author himself omits it altogether from his *Index Faunae* (1904, p. 221). The type in the Canterbury Museum, recently lent to me through the kindness of Mr. Tonnoir, Assistant Curator, is accompanied by an exactly similar specimen labelled "Whangarei," apparently by Hutton himself. Both specimens are rather dark, but that is the only distinction. Hutton writes, "without any smooth band on the head and pronotum," and makes this the chief if not only difference. Yet in the type itself this smooth pale band is discernible on the pronotum with the naked eye. There is a strong tendency to melanism in Chatham Island insects. Thus the Chatham forms of the Cicadid *Melampsalta cruentata* (Fabr.) (see Myers, 1921A, p. 250), and of the Cercopid *Philaenus trimaculatus* (White), are extremely dark.

Oncacontias vittatus (Fabr.). (Plate 86, figs. 2, 3; and text-figs. 24–26.)

Copulation.

On the 28th October, 1922, a pair was captured together, though not actually *in copula*. It was probable that union had occurred previously, and, in any case, it was resumed very soon after capture, but discontinued a few hours later (in the evening). Next day no observations were made, but on the 30th the bugs were *in copula* from 10 a.m. till 1 p.m., on the 31st from 11.30 a.m. till 3 p.m. At 3.45 p.m. oviposition had commenced

and eleven eggs were already laid. When two more had been laid the male returned and copulation was resumed until 4.50 p.m., at which time the female commenced once more to oviposit, but this time at another spot. At 6.20 p.m. the bugs were again *in copula:* The next day saw two long periods of copulation, one at midday and one in late afternoon. The same programme was followed on the two succeeding days; but on the 4th there was no copulation, and on the 6th the male was dead. The female survived till the 15th, and the eggs hatched on the 17th. To sum up, copulation took place for several hours at a time during at least seven days, and had probably commenced before capture. No copulation appeared to take place at night. No feeding during copulation was observed.

During the actual process the female dragged the male backwards wherever she wished. Frequently the female stopped and cleaned her feet by rubbing one on another. Occasionally she struck the male on the underside of his abdomen with a hindmost leg, violently and repeatedly, then with the opposite hind leg—sometimes varying the process by tapping with both alternately—beating a rapid tattoo. The tips of the membrane of the male's hemielytra were turned up dorsally and permanently owing to the fact that when the female went forward the apparently resisting male was habitually slewed round so that his long axis formed a backward continuation of hers, the heads pointing in opposite directions (see Whitmarsh, 1917, fig. 10, where *Nezara hilaris* Say is shown in an exactly similar position). Then, his abdomen being beneath the tip of hers, the slight amount by which his hemielytral membranes extended beyond his abdomen was bent up over his body by the tip of the female's abdomen. Frequently the female shook her whole body in a jerky manner, from side to side, while persistently beating him with her hind feet. On occasion she even spread her wings in an attempt to fly. The male was sometimes on his back, sometimes swinging freely as the female climbed a stem. Occasionally the female was perched on the back of the male, head to head and tail to tail, with her venter appressed to his dorsum. In such a position the torsion of the male organs must be great. Whitmarsh (1917) gives an account of copulation in *Nezara hilaris* showing great similarity to the behaviour of the present species, though these two Pentatomids are rather widely separated taxonomically. The main differences appear to be that copulation may occur in *Nezara* not only at night but all night, and a certain amount of feeding may be done during the act. The copulation periods are much longer than in *Oncacontias* and are extended over a longer period. How far such differences are individual and how far specific has not been ascertained.

Oviposition.

After being *in copula* continuously from 11.30 a.m. and struggling violently from 2.20 p.m., the female at last broke loose at 3 p.m. She went to the farthest end of the vessel and stayed in one place on the side of the glass, where oviposition commenced. At 3.45 p.m. eleven eggs had been laid, and others were being deposited with very little interval between them. There appeared, as viewed through the glass from below, first a droplet of moist substance, which may have signalized either the first contact of the wet ovum with the glass, or else a spot of adhesive to which the egg was to be attached. Then came the egg itself, apparently with considerable labour. It appeared pale green and almost spherical, and was pressed down and continually manipulated by the hindmost legs—chiefly, in fact, by the distal ends of the tibiae, which seemed to pass to and fro rapidly

over a diagonal row of dark spots* (openings ?) on each side of the ventral surface of the abdomen—then applied to the eggs with a stroking motion from apex to base. This last operation was frequently repeated on each egg. The laying of two eggs was observed, and then the male, who had previously arrived on the scene, clambered on the female's back and then departed, came once more, inserted his bulky genital segments from a semi-lateral position and again copulated. The female made the above-described jerks to free herself, pulled the male about the vicinity for some time, and finally settled to quietude *in copula* till 4.50 p.m. Some time before 6 p.m. oviposition was resumed and 6 eggs were laid on the muslin cover. One egg fell from this situation and adhered to the glass farther down the tube. At 6.20 p.m. the bugs were again copulating, the female struggling hard.

Eggs. (Text-figs. 24, 25.)

Egg spheroidal with rounded ends. Length, 1·1 mm. Colour pale green. Fastened apparently by adhesive material. As development proceeds the eyes of the young nymph appear as crimson spots anterior and ventral. Just before hatching the segments are marked dorsally with faint blackish streaks. At hatching the rupture of the chorion is longitudinal. The chorion is transparent, colourless, and so elastic that at hatching the edges immediately turn in and each hemisphere of the empty egg-shell becomes elongated. The whole surface is hexagonally reticulated, though under a low power it appears smooth.

Nymphs.

First Instar.—Pale-greenish, with appendages and connexivum colourless and eyes crimson. Region of scent-glands yellow. The mouth setae appear as a hair-like streak through the transparent labium which reaches past the hind coxae. The whole insect is so flat ventrally and convex dorsally as to appear dome-shaped.

Second Instar (Plate 86, fig. 2).—At first almost uniformly pale green, darkening, however, to the following coloration: Eyes brown, with very distinct facets: antennae pale amber but with basal joint black and ultimate joint somewhat infuscated. Legs pale transparent amber, all appendages with a few black hairs, especially distally; rostrum pale transparent amber infuscated at tip; head shining brownish-black; thoracic nota also black with a hair-like median longitudinal white streak; lateral edges transparent and colourless. Abdomen dorsally pale green with whitish transparent connexivum; depressions along connexivum appear in certain lights as brownish spots; first scent-gland area very large and double, the two lateral halves separated by a continuation of pale median line of thorax; second and third scent-areas very large, transversely elliptical, separated and more or less outlined by narrow reddish line; there appears to be a vestige of a fourth scent-gland area; all scent-gland areas black and evidently heavily chitinized.

Third Instar (Plate 86, fig. 3).—The hair-like median streak of the second instar began towards the end of that stadium to lose the distinctness of its edges and to widen a little; now in the third instar it has widened to a great extent and the only dark colour left on thoracic nota consists of a

* In the female, on each side of the fourth and fifth ventral segments is a circular deeply impressed dark spot, some distance in from the margin. There is thus a pair of these spots on each side of venter. No signs of these are present in the male. It is hoped to investigate these structures more fully at a later date.

lateral band between disc and connexivum on each side, continuous with a little on hind-margin of vertex; the median hair-like stripe of white is, however, still visible traversing a pale dirty area of rhomboid shape. The raised scent-gland areas are still jet-black edged with bright red and then with white; the rest of abdomen is greenish, except the connexivum, which is whitish with a blackish spot (lateral plate ?) in each segment. Eyes castaneous; antennae and legs amber with dark tips, as is also the rostrum.

Fourth Instar.—Pale green with a lighter olivaceous tinge on head and connexivum. A median longitudinal narrow white line along thoracic nota. The three scent-gland areas as in previous instar; the second scent-gland area forms the apex of a black V, arms of which extend cephalad to include the two separate portions of first scent-area and finally end on pronotum, thoracic part of the V being olivaceous brown and converging somewhat cephalad. Apex of V is filled with white, as is also the space between second and third scent-gland areas. Ventral surface pale green with a thin black line down each side of head and thorax within inner border of connexivum. Setae of rostrum showing very plainly and darkly through the pale-green labium; eyes dark brown; antennae wine-red, except last segment, which is fuscous or almost black, all articulations white; legs pale olivaceous, claws brown.

Fifth Instar (Text-fig. 26).—Coloration resembling that of fourth instar. Rostrum reaching just past intermediate coxae. It is interesting to note that there is no trace of the conspicuous abdominal spine so pronounced in the imago.

Life-history.

Copulation, 28th October to 3rd November, 1922; eggs laid, 31st October; eggs hatched, 17th November; increased in size and paler in colour, 21st November; ecdysis (first), 24th November; ecdysis (second), 17th December.

The mortality was very heavy, and no bugs were reared beyond this point. Owing to artificial conditions the periods given above are probably not normal. On hatching the young bugs were pale green, transparent, and very inactive, waving their cream-coloured legs only at intervals. All remained clustered near the egg-cases in a manner common to many, if not most, Pentatomids.

Seasonal Occurrence.

The adult bugs have been taken from August to May—that is, in all except the two main winter months. Most have been collected in October and November. They are then less but still moderately abundant till February. The fourth and fifth instars have been taken in January. In the South Island the fifth has occurred in March This clearly indicates that the species hibernates in the adult state, emerges from its shelter in spring, lays its eggs in late spring, passes through the nymphal stages in summer, and goes into hibernation as an adult in late autumn, thus completing the cycle. There is apparently only one brood per year.

Food Plants and Habitat.

I have not found this species to be other than purely phytophagous. The nymph seems more restricted than the adult, since the latter may be beaten from a variety of shurbs and bushes, while the former is more plentiful on grasses and allied plants, but in no stage does this bug appear very specialized in its feeding-habits. Nymphs have been taken from toetoe (*Arundo conspicua* Forst. f.) and konini (*Fuchsia excorticata* (Forst.) L.).

The adult has occurred on grasses, herbage, *Plagianthus divaricatus* Forst., various bushes, and on ferns, but by far the greater number have been found crawling or even flying in the hot sunshine on fences, walls, roads, and paths, and in spring and in autumn, evidently emerging from hibernation shelters in the former season and seeking them in the latter.

Distribution.

This bug occurs in flax (*Phormium*) swamps, in the forest itself, but especially in secondary growth, and in subalpine scrub. The altitudinal range is from sea-level to 3,000 ft. Specimens on a glacier on Mount Ruapehu at 7,500 ft. were probably blown to an elevation beyond their normal range.

North Island localities range from Lake Taupo (E. H. Atkinson), Mount Ruapehu (Miss Stella Hudson), and Ohakune (2,100 ft., T. R. Harris), to Hastings, Wanganui, Tararua Range, Waikanae, and Wellington. In the South Island it has been collected at Mount Arthur (T. Cockcroft), Greymouth (T. Cockcroft), West Coast (T. R. Harris), Arthur's Pass (J. G. M.), Kaituna (S. and C. Lindsay), Little River (T. Lee), and Lake Wakatipu (G. V. Hudson). Hutton (1898B, p. 171) gives the range as "Auckland to Otago." It is probably generally distributed throughout both Islands.

Miscellaneous Notes.

There are indications that this beautiful species is distasteful to spiders. It has been found hanging quite fresh and untouched in the web of a full-grown Epeirid (*Araneus pustulosus* (Walck.)). The Peckhams (1898, p. 161) as the result of an experiment (quoted fully in Myers, 1922, p. 3) decided "that stink-bugs are protected from spiders." Although the colour of *Oncacontias* might be construed as procryptic when the insect is among its food-plants, yet the imago when searching for or leaving hibernation shelter is one of the most conspicuous insects in New Zealand, while the nymph is well-marked with white, black, and crimson on the green ground-colour. It is interesting that the white, black, and red, which in so many insects, notably the Hymenoptera, are well known to be warning colours, should be displayed solely round the orifices of the repugnatorial glands. Moreover, in nearly all the other terrestrial Heteroptera these gland-openings are marked with some one or other of these colours, usually black. On the other hand, in the case of the nymphal *Oncacontias* the white, black, and red may function in the same way as the bold slashes of colour on the green sides of the privet-caterpillar (*Sphinx ligustri* L.), which are said to break up the outline and render the large larva less conspicuous than if it were uniformly green.

Miss Stella Hudson (1922, p. 94) found this species represented in a considerable deposit of insects on the surface of a glacier on Mount Ruapehu at an elevation of 7,500 ft. (see under *Nysius clavicornis*).

There is a very distinct and remarkably constant form of this species characterized by the total replacement of green in the colour-scheme by brilliant red. For specimens of this very handsome insect the writer is indebted chiefly to Mr. G. V. Hudson, who has taken it in some numbers, almost solely from the living foliage of rimu (*Dacrydium cupressinum* Sol.), as the records of the following specimens examined by me will indicate: Eight specimens from live rimu foliage, Makara Bush, Wellington, April, May, 1923; three specimens from the liliaceous epiphyte, *Astelia* sp., in the top of a recently felled rimu, Korokoro, Wellington, September, 1921. This is the only intimate attachment known between a New Zealand heteropteron and a gymnosperm.

Family 19 (43). CYDNIDAE.

Hahnia australis Erichs.

Seasonal Occurrence.

I have seen only the adult, and that in October, November, April, and May. In the three former months it occurred on roads, running actively in strong sunlight. In May it was not uncommon under stones on the foreshore among closely-grazed turf at Lyall Bay, Wellington.

Distribution.

My specimens are all from the Wellington district. Hutton (1898B, p. 172) gives "Auckland to Canterbury" as the range. Kirkaldy (1909B, p. 25) says it is "distributed over Australia, Tasmania, New Caledonia, and Ceylon."

Miscellaneous Notes.

Buchanan White (1878, p. 275) writes; "A note is appended to one of Mr. Wakefield's specimens stating that he 'once found this in numbers on the sea-beach at Sumner, either floating in salt-water pools or crawling on the sand.'"

Chaerocydnus nigrosignatus F. B. W.

This endemic species appears to be very rare. The only three specimens I have seen were taken, one in a burrow on the sandy beach at Rona Bay, Wellington (J. Roberts), and the second and third in the South Island, at New River (A. Philpott). All three were taken in the last week in November. Hutton (1898B, p. 172) gives the range as "Canterbury and Otago."

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