The Spiders of New Zealand

PART I

by

R. R. FORSTER
Director, Otago Museum

Otago Museum Bulletin No. 1
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INTRODUCTION[1]

DESPITE the increasing interest in the spiders of New Zealand over the last few decades no successful attempt has been made to produce a comprehensive account of the fauna as a whole. Two difficulties encountered by earlier authors have been, first the identification of the species described by Urquhart, particularly as most of his type material is lost, and secondly the failure to realise that, despite the relatively small land mass encompassed by the region, a complex pattern of speciation is exhibited in most groups. This latter difficulty has been obscured by the limited collections available to earlier workers for study, and it is mainly due to the increased awareness of the need for more extensive collections, developing from these earlier studies, and the active co-operation of numerous field workers, that the present publication is possible at this stage.

While it was originally intended that the whole of the New Zealand spider fauna should be included in a single volume, preliminary study of a wide range of the families occurring in New Zealand showed that the fauna totals something over 1,500 species and it will therefore be necessary for the complete work to be produced in parts over a number of years.

Perhaps the main difficulty encountered during the preparation of this monograph has been to decide on the criteria to be used for species rank. Only limited use of the polytypic species concept has been made by spider systematists. Levi (1959, etc.) has used a broad species concept when dealing with a number of groups of the family Theridiidae in which some of the species defined include numerous allopatric units. However, in these papers the infra-specific units are illustrated and briefly commented on, but given no trinomial taxonomic standing. This procedure has been justified by Levi on the grounds that the allopatric units included in these species generally form a cline from which it is possible in many cases to describe characteristic and distinct individuals geographically separated, but that no clear-cut separation can usually be defined on a population basis. It should be noted however that this interpretation has been strongly challenged by Gertsch (1960) who after examining some of the material described by Levi came to somewhat different conclusions and did in fact raise a number of the infra-specific groups noted by Levi to full species rank. The distributional pattern found in New Zealand spiders consists of numerous allopatric groups, undoubtedly related one to the other, but in most cases separable by clear-cut morphological characters. It seems evident that this pattern, which is shared with many other invertebrates in this country, stems from the numerous past changes in the topography which have separated segments of widely distributed populations for periods sufficient to permit speciation to take place. There is no doubt that isolation brought about during periods of glaciation has also greatly influenced the composition of the fauna, and this is particularly so in the South Island. It would be tempting to consider that many of these related populations could be grouped as polytypic species but there are many instances where these forms occur sympatrically and in these circumstances there is no evidence of inter-breeding. In the present work the majority of these readily separated taxonomic units have therefore been accorded specific rank, while in most genera an attempt has been made to discuss the association of species in what appear to be natural groups.

The greatest obstacle met by potential students of our spiders in the past has undoubtedly been the lack of readily available introduction to the spiders as a group, and more particularly an outline of the families actually occurring in New Zealand. This introductory volume has therefore been prepared in an attempt to fill this gap. A brief outline of external morphology and internal anatomy and also a glossary of the terms commonly used is given. A key to the families occurring in New Zealand has been prepared and typical spiders of the families occurring here are illustrated, along with some general information to assist with family identification. Difficulty will still be experienced in placing a number of the atypical groups which are found in New Zealand, most of which are as yet undescribed, or at present incorrectly placed, but the majority of the species key out readily to the correct family.

Throughout this work keys will be normally included for genera but in most cases keys to species are omitted. While numerous characters are used in the diagnoses of species, all of

1. The research work on which this paper has been based has been supported in part by grant G.M. 11950, National Institutes of Health, Department of Health, Education and Welfare, U.S.A. and by a grant from the Scientific Research Distribution Committee, Golden Kiwi Lottery Funds. Publication costs have been met from the Colquhoun Fund of the Otago Museum and the Research and Publication Fund set up by Dr E. S. de Beer.

which have some bearing on the separation of species, the main characters which separate them are found in the palpal organ of the male and the epigynum and internal genitalia of the female. In general these organs are complex and the differences between species do not lend themselves readily to concise unambiguous terms suitable for use in a key. These structures are invariably illustrated and the use of the illustrations will lead to a quicker and more accurate identification than a dichotomous key where many of the alternatives would by necessity be couched in relative terms.

ACKNOWLEDGMENTS

I am deeply indebted to many persons for assistance. Mr C. L. Wilton has spent much time discussing with me the problems raised during the preparation of the manuscript and has also provided much field information. In addition he has taken over the final preparation of the bibliography and contributed the section in the second volume dealing with the family Migidae.

Professor B. J. Marples has given help and encouragement over a period of many years, provided field information and advice and also placed his extensive collections at my disposal.

I am extremely grateful to colleagues overseas who have assisted in many ways and I would mention specially Dr H. W. Levi, Museum of Comparative Zoology, Harvard University, Dr W. J. Gertsch, American Museum of Natural History, New York, and Dr V. V. Hickman, University of Tasmania.

The preparation of this work for publication was begun during sabbatical leave taken at the Bernice P. Bishop Museum, Honolulu, in 1964. I sincerely thank Dr Lindsay Gressitt for his assistance in arranging for this stay and for the many services he extended to me during this period and also to the Director of the Bishop Museum, Dr Roland Force, and the staff for the many kindnesses shown. I am deeply indebted to Dr Charles Brasch for his advice and assistance on the editorial problems involved in the production of this publication.

The drawings for the introductory volume and also a number of the illustrations for the systematic section have been prepared by Mr Barry Weston, working under the direction of myself or Mr C. L. Wilton, and I express my gratitude to him for his patience and skill.

I am grateful to Dr J. A. L. Cooke and the Director of the University Museum, Oxford, and also Dr G. Owen Evans of the British Museum (Natural History), for arranging the loan of a number of crucial specimens described by earlier workers. Much of the material studied has been loaned from other institutions and I would thank Sir Gilbert Archey, and later Mr E. G. Turbott, Auckland Museum, Dr R. S. Duff, Canterbury Museum, Dr R. A. Falla, Dominion Museum, Dr E. J. Hoy, Entomology Division and Dr D. Spiller, Plant Diseases Division of the Department of Scientific and Industrial Research, and Dr L. J. Gressitt, Bishop Museum, for the extended loan of collections under their care.

The collectors who have assisted in building up the collections studied are too many to list individually and they are acknowledged throughout the systematic section within the localities recorded for each species, but I would also like to extend my thanks here for their inestimable assistance.

HISTORICAL

THE FIRST record of spiders from New Zealand is found in the initial volume of Walckenaer's *Histoire naturelle des Insectes Aptères* published in 1837. The ten species described had been collected during 1827 by Quoy and Gaimard during the voyage of the French corvette *Astrolabe*. The descriptions are not sufficient for satisfactory identification and only three of Walckenaer's names are used today, *Porrhothele antipodiana, Aranea crassa* and *Aranea pustulosa*. Polack refers to two species of *Aranea* in the first volume of the account of his stay in New Zealand published in 1838, but both of these species are unrecognizable.

The spiders collected in 1841 during the expedition of H.M.S. *Erebus* and *Terror* which visited the Auckland and Campbell Islands and the Bay of Islands were described by Adam White in 1849. The types of the eight new species which he described are in the British Museum but are apparently in bad condition and only one of his species, *Cambridgea antipodiana*, is currently accepted. From this period little work was done on New Zealand spiders until the 1870s when the greatest period of activity began. In 1871 Ausserer described *Hexathele hochstetteri* and shortly after the first part of the *Die Arachniden Australiens* by L. Koch appeared. This latter publication, which was completed by Keyserling after failing sight forced Koch to abandon his studies in 1881, added thirty-five species to the New Zealand fauna. Towards the latter part of this decade a number of arachnologists in England and Europe began to publish extensively on the spider fauna not only of their own countries but also from overseas, and were willing to examine the material which was being collected by the naturalists now employed in the various museums and other scientific organisations being established at the time in New Zealand. Prominent among these local collectors was Captain F. W. Hutton, at that time Director of the Otago Museum, who forwarded a number of collections to the Reverend O. P. Pickard-Cambridge in England. These spiders and others forwarded to Cambridge were described in a series of papers in the *Proceedings of the Zoological Society of London*. L. Powell, a medical practitioner in Christchurch, apparently became interested in spiders through his study of the poisonous *katipo* on which he published a note in the *Transactions of the New Zealand Institute* in 1871. In the single taxonomic paper on the family Attidae published by Powell in 1873 he indicated that he was considering further publications, but apart from a note on the marine spider *Desis marina* these did not eventuate. R. Gillies who was farming in the Oamaru district, as well as being a prominent businessman in Dunedin, became interested in the habits of the trap door spiders, which are very numerous in the Oamaru district, and published an outstanding account of these spiders in the *Transactions of the New Zealand Institute* for 1876. Unfortunately the true importance of this study was lost when Pickard-Cambridge, to whom the spiders were sent for identification, concluded that the specimens collected by Gillies represented a single species, which he named *Arbanitis gilliesii*. It would seem from re-examination of this collection which is housed in the Hope Museum, Oxford, that at least six species were observed by Gillies but with the loss of his key numbers it is not now possible to relate the nests with the spiders. In 1884 Urquhart published the first of the important series of papers which were to be published over the next fifteen years in the *Transactions of the New Zealand Institute*. A. T. Urquhart farmed at Karaka in the North Island and many of the species he described in his earlier papers were collected from this area, but later he received material from other naturalists collecting elsewhere, resulting in a fairly broad coverage of the fauna. Unfortunately most of his type material has been lost and only a small portion of his collection (which is housed in the Canterbury Museum) is now available for re-examination. Many of the species which he described have been synonymized by subsequent authors but from examination of the limited material still available it seems that the bulk of his species were in fact valid at the time of publication. Urquhart obviously made use of the diagnostic value of the female epigynum and male palp to separate his species but in only few cases were these illustrated in his papers, and his descriptions, while voluminous, were vague so that many of the species described are not now recognizable. P. Goyen, an Inspector of Schools in Otago who developed a keen interest in spiders, published six papers in the *Transactions of the New Zealand Institute* between 1887 and 1892. A portion of his collection was located recently in the possession of his descendants but the bulk of it has been destroyed. His descriptions are detailed and it is probable that most of the species he described will be recognized. After the deaths of Goyen and Urquhart little work was done by New Zealand

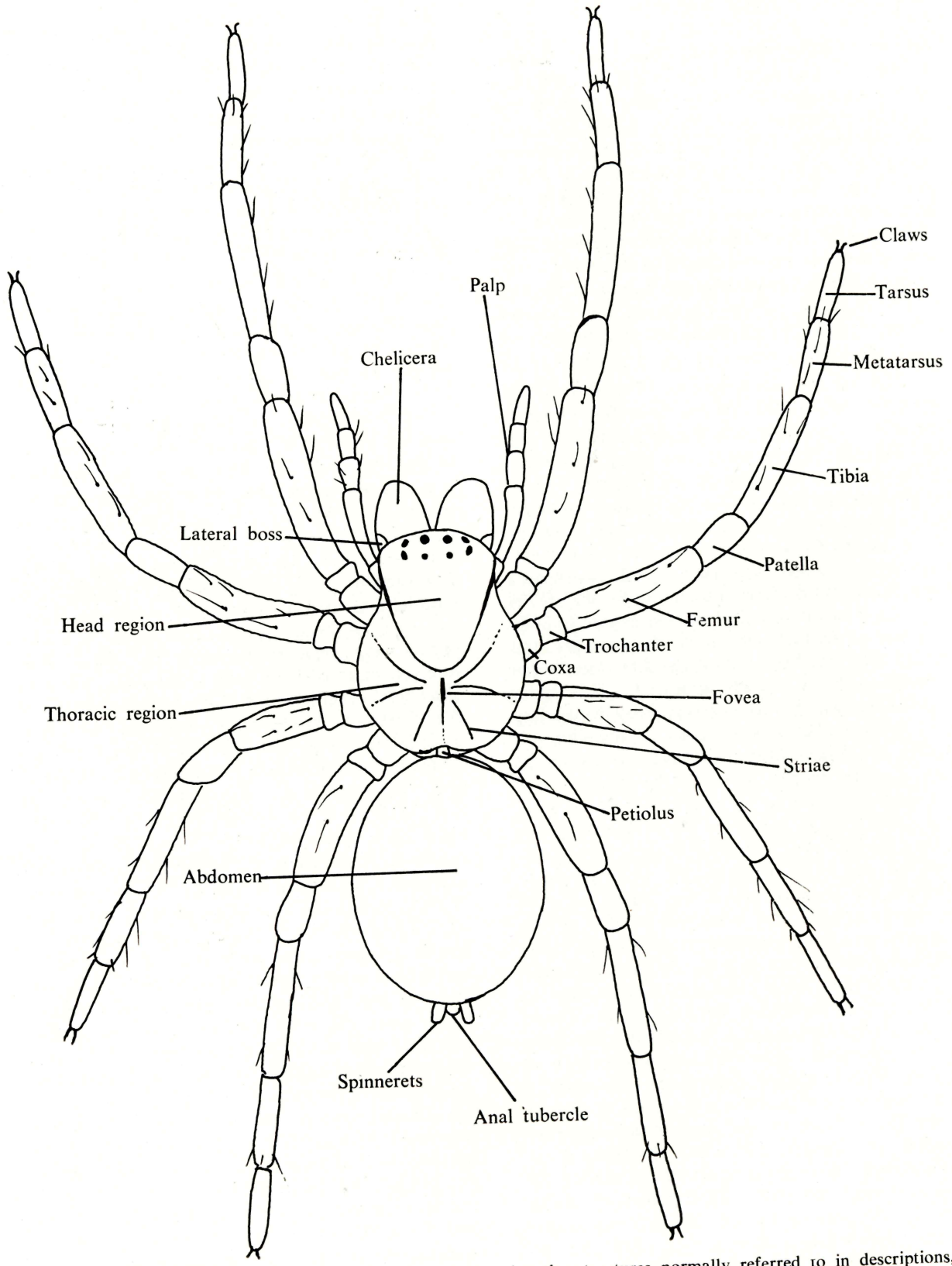


Fig. 1 Diagram of the dorsal surface of a spider, naming the structures normally referred to in descriptions, as seen from above.

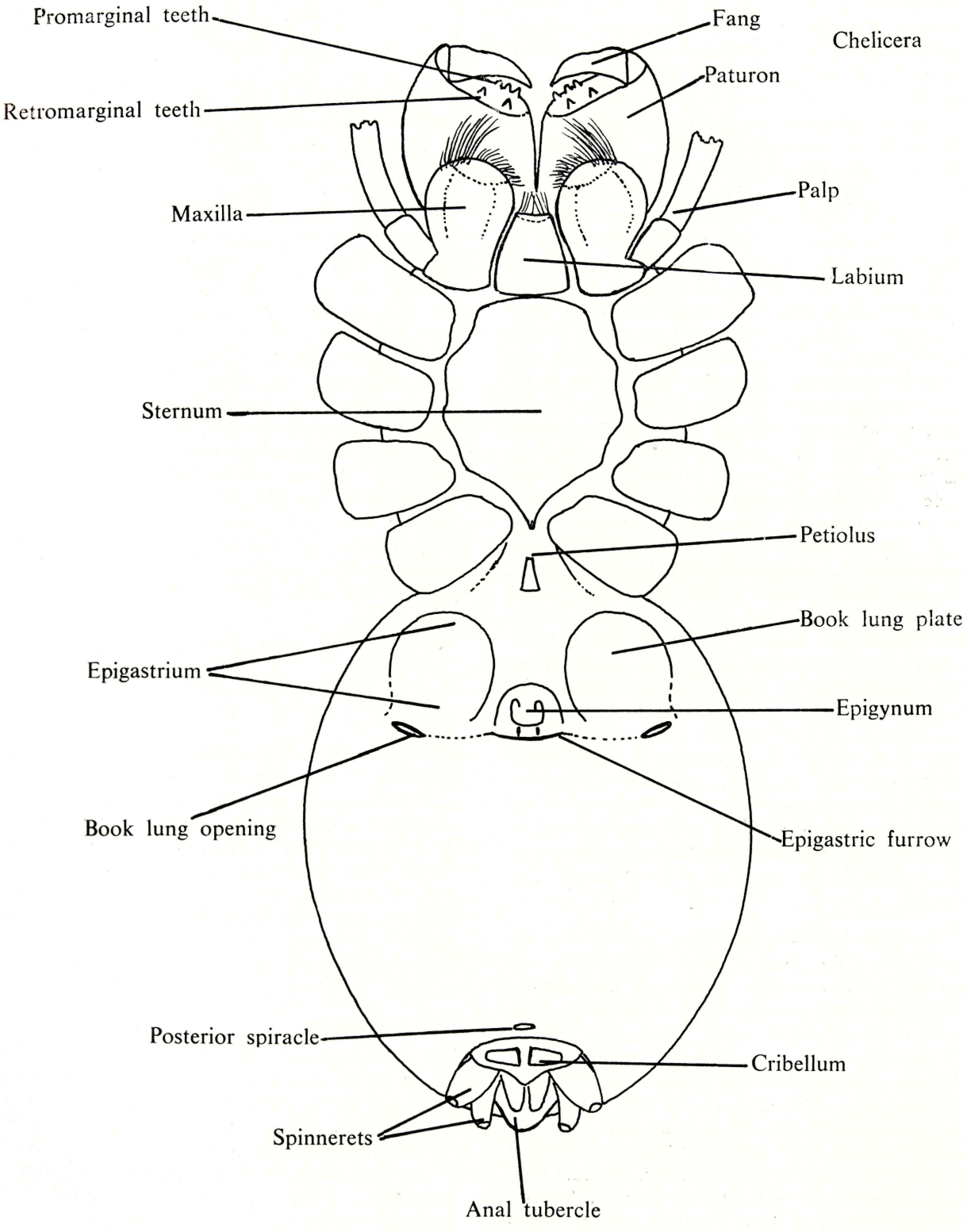


Fig. 2. Diagram of the ventral surface of a spider showing the structures, as seen from below.

students for some forty years. However during this period a number of papers were published on New Zealand spiders by overseas arachnologists, based on material housed in various institutions. H. R. Hogg, an Englishman who became interested in spiders while living in Victoria, Australia, continued to work on the spiders of Australia and New Zealand after his return to England in 1892, basing his work primarily on his own and the British Museum collections. His papers published mainly between 1901 and 1911 covered spiders from both the mainland of New Zealand and the sub-antarctic islands. Comte de Dalmas, a French amateur naturalist who had the good fortune to be financially independent and also to own a sea-going yacht, visited New Zealand in 1912, primarily for the trout and salmon fishing, but during his stay became interested in the spider fauna. He made extensive collections which he worked up on his return to France, under the guidance of Eugène Simon, as the basis for his paper *Araignées de Nouvelle Zélande* which was published in 1917. This paper, while dismissing too readily many of the species described by earlier authors, has been of great assistance to subsequent workers in obtaining a grasp of the fauna as a whole. The period between the two world wars was marked by a few papers by Berland which contained references to New Zealand spiders. The most important of these was his account of the spiders from the Auckland and Campbell Islands published in the *Records of the Canterbury Museum* in 1931. Miss E. B. Bryant, Arachnologist at the Museum of Comparative Zoology, Harvard University, published three papers (1933, 1935) in which she redescribed some of Urquhart's material in the Canterbury Museum and also described further species from the Canterbury Museum collections.

Although little was published by New Zealand workers in the period before and during the second world war an interest in spiders was developed independently by a surprisingly large number of individuals all of whom were working on an amateur basis in that they were not employed professionally for this work. A. W. Parrott who was engaged during the earlier period on freshwater biology and after the war as Biologist at the Canterbury Museum and then Curator of Insects at the Cawthron Institute built up a collection of spiders and prepared a Systematic Catalogue of New Zealand spiders which was published in 1946 and has since published a number of systematic papers on the New Zealand fauna. C. L. Wilton, a sheep farmer in the Wairarapa, carried out an intensive study of the spiders living in his district, describing the first species of Archaeid from New Zealand in 1946, and is at present collaborating on portions of the present publication. G. Chamberlain, by profession an industrial chemist, began publication of a revision of the spiders of New Zealand in 1944 but was forced by pressure of other work to defer further publication after the second part appeared in 1946. Professor B. J. Marples who has been studying New Zealand spiders for many years, has published an account of the spider fauna of the Three Kings Islands as well as a series of revisions of small groups which include many new and interesting field observations. Two excellent revisions have been carried out by students from the Department of Zoology, University of Otago, working under the direction of Professor Marples. The first of these was a revision of the mygalomorph spiders by Miss Valerie Todd in 1945 and the second a revision of the family Dictynidae by R. R. Marples in 1959. Both of these publications have proved to be of great assistance in the present work.

STRUCTURE

External Anatomy

Unlike many other arachnids the body of a spider is clearly divided into two portions, the *cephalothorax* or *prosoma,* and the *abdomen* or *opisthosoma.* These two portions are connected by a narrow waist — the *pedicel.* The cephalothorax bears the chelicerae, palps, with the associated mouthparts, the legs and the eyes. The abdomen bears the respiratory, reproductive and digestive systems and also the spinnerets and structures normally associated with these spinning organs.

Cephalothorax

The cephalothorax represents the head and the thorax which are fused into a single unsegmented unit. The dorsal portion of the cephalothorax is covered by a convex *carapace* which normally shows a more or less distinct U-shaped *cervical groove,* separating the higher more convex anterior portion — the *head,* from the more flattened posterior portion — the *thorax.* The head region bears the eyes and these are discussed more fully below. Behind the cervical groove on the

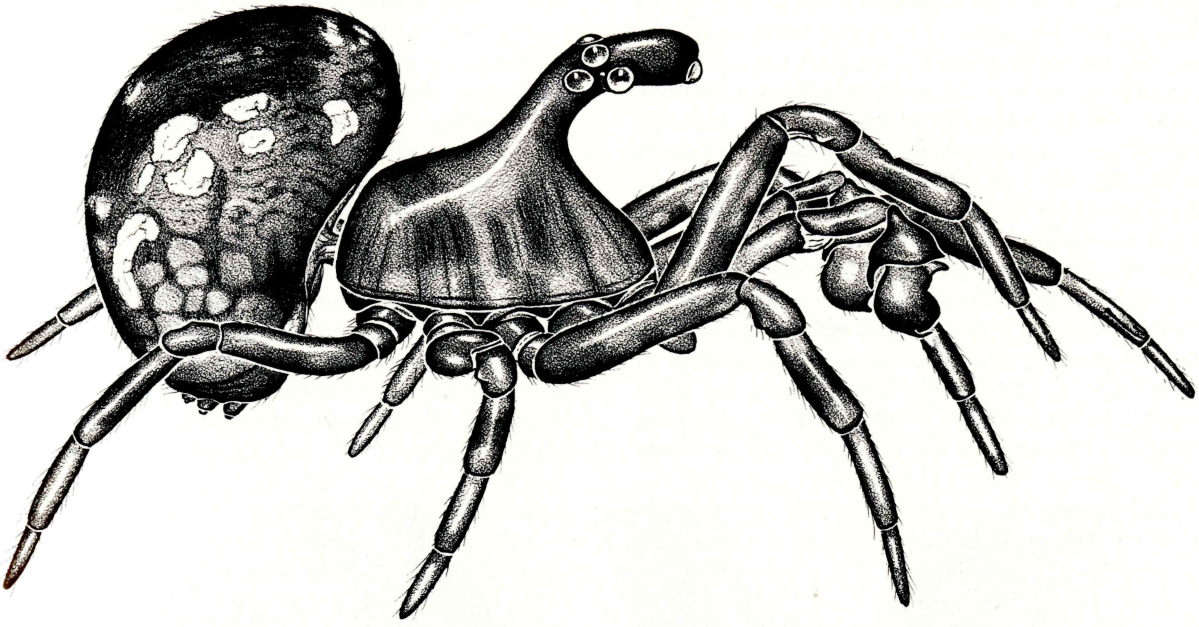
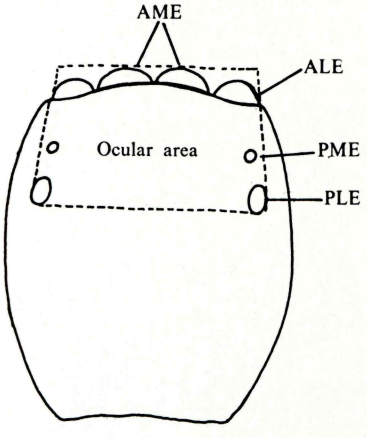


Fig. 3. *Trogloneta.* sp. male. (Symphytognathidae). Preserved specimen. Body length 1 mm.

median surface there is usually another short groove which may be transverse or longitudinal (and sometimes absent or indicated only by pigment). This is the *fovea.* From the fovea may extend laterally three pairs of *radial furrows.* The fovea and radial furrows mark the internal attachment of muscles. The radial furrows may be absent but are then often represented by rows of small bristles or hairs. The form of the carapace may be strongly modified with various humps and protuberances. The most common modifications in New Zealand spiders are either the elevation of the whole carapace (in both males and females) as in the Archaeidae and Symphytognathidae (Figs. 173, 174) or the elevation of the eye region alone as in *Trogloneta* (Fig. 3) where the modification is usually dimorphic and found only in the male. The major portion of the ventral surface of the cephalothorax is covered by a large unsegmented plate — the *sternum.*

Eyes

The eyes are simple ocelli. Most spiders have eight eyes, which is apparently the primitive



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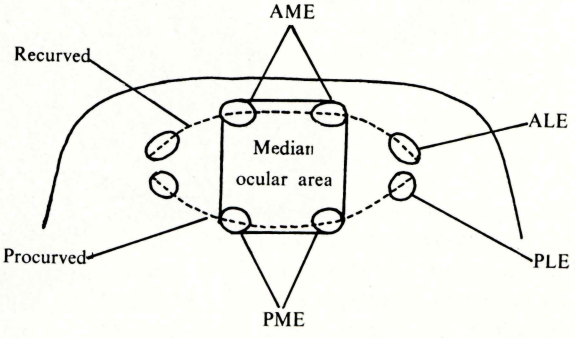

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Fig. 4. Diagram of carapace of a salticid spider showing the ocular area. Fig. 5. Diagram of the eyes of a spider illustrating the terminology used in descriptions.

number. These are usually arranged in two or three rows. Because the size and arrangement of the eyes varies greatly they are used extensively in separating both species and larger taxonomic groups. On the basis of the more common arrangement of the eyes in two rows they are grouped as the *anterior row* and the *posterior row* so that the terminology of the eye pairs is *anterior median* = AME, *anterior lateral* = ALE, *posterior median* = PME, and *posterior lateral* = PLE. This terminology is retained throughout on morphological grounds even though in some spiders the eyes have moved to positions where the term used may not be actually descriptive of the placing of a particular pair of eyes. The area enclosed by the AME and PME is termed the *median ocular quadrangle* or *area* and is used extensively in taxonomy (Fig. 5), while in some families such as the Salticidae where the eyes are present in three rows the whole region covered by the eyes is referred to as the *ocular area* (Fig. 4) and used in a similar way.

The rows of eyes are often curved. Where the curve is such that the outer ends of the line drawn through the row of the eyes is nearer to the front end of the carapace this is termed *procurved* and the opposite situation *recurved* (Fig. 5). In descriptions of spiders where the eyes are raised above the anterior margin of the carapace and are placed on a convex surface it is customary to specify whether the curve has been observed from directly above the eyes or from directly in

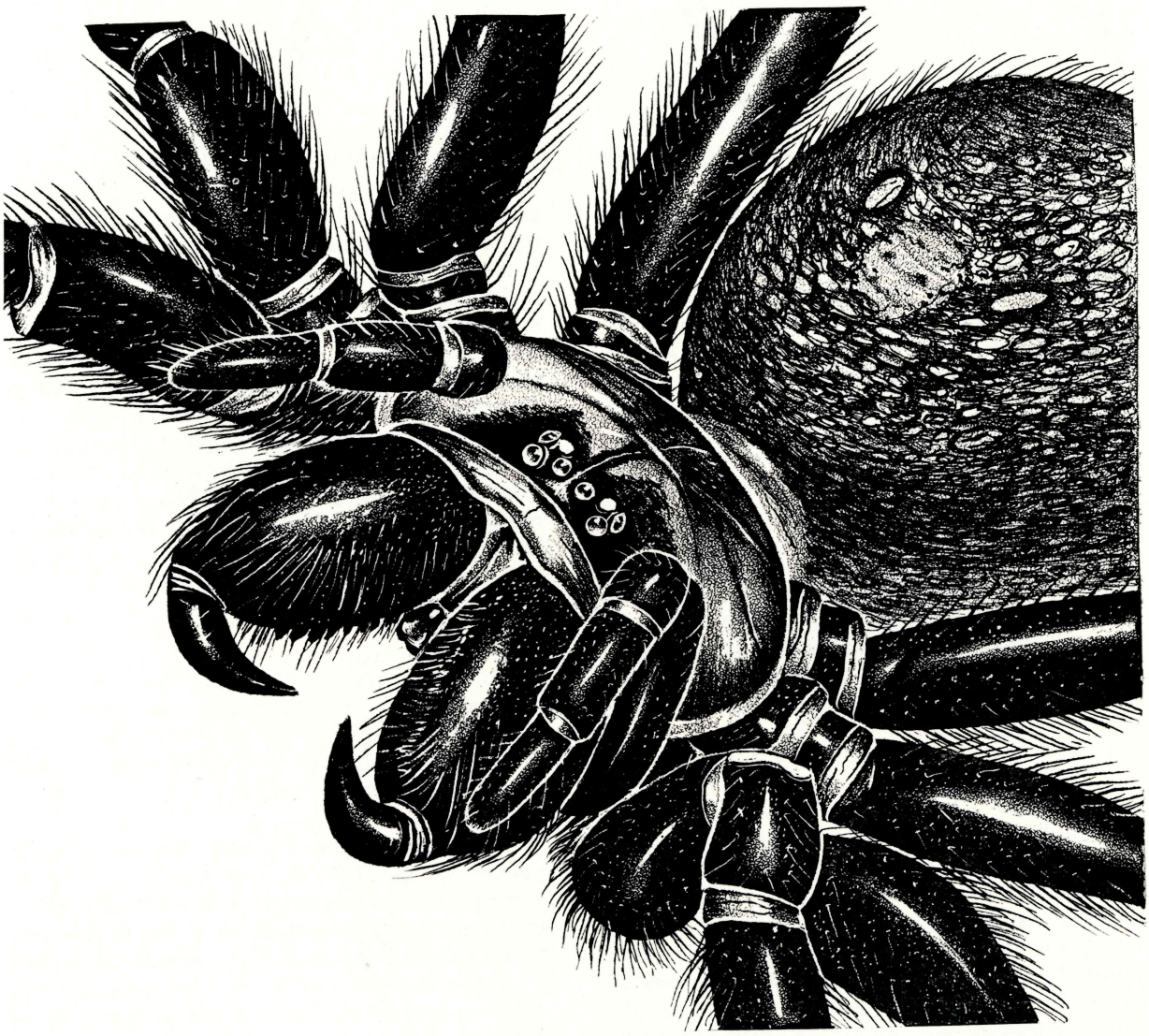


Fig. 6. *Porrhothele antipodiana* (Walck.) (Dipluridae) showing the position of the paraxial fangs when in use.

front of the carapace because the degree of curvature and at times the actual direction of the curve may be quite often different according to the angle of viewing. The AME are nearly always dark while the other eyes may be light in colour or have a pearly lustre, but they are sometimes dark like the AME. Where the eyes are both light and dark they are referred to as *heterogeneous* whereas if the eyes are all alike they are termed *homogeneous*.

The AME belong to the first somite of the head and are characterized by a direct retina. The other six eyes which belong to the second somite have an indirect retina. When there is a reduction in the number of eyes the AME are the first pair lost and this is the missing pair in all New Zealand six-eyed spiders. Further reduction is shown in overseas forms where four-eyed, two-eyed and even single-eyed spiders have been recorded.

The region between the anterior pair of eyes and the front margin of the carapace is called the *clypeus*. The *height* of the *clypeus* is the distance between the front pair of eyes and the anterior margin of the carapace and is referred to in units related to the width of the eyes, usually the AME when this is present.

Mouthparts

The *chelicerae* are preoral structures which are situated below the clypeus. Each chelicera consists of a stout basal segment — the *paturon* — and an apical *fang*. The paturon may have a *boss* or *lateral condyle* near the base on the outer surface. In some spiders where the chelicerae are directed forwards more or less horizontally they are described as *porrect*. Where the base of the chelicera is stout and directed forward for a distance before the main portion bends down vertically the chelicera are described as *geniculate*. The groove in which the fang lies when at rest is called the *cheliceral furrow*. The margins of the cheliceral furrow are often provided with small teeth and also bristles which are sometimes modified to form *rods* and these are frequently of importance in taxonomy. Those on the inner margin are termed *promarginal* and on the outer margin *retromarginal* (Fig. 2). In all but two groups of spiders poison glands are associated with the chelicerae. The actual poison gland may be contained within the paturon, as is the case with the mygalomorph spiders, but in most true spiders the gland is a voluminous sac which extends back into the head. A narrow duct passes through the fang and opens a short distance behind the tip (Fig. 49). Behind the mouth are the second pair of appendages — the *pedipalps* or *palps*, which are leg-like but possess only six segments. The basal segment of the palp, the coxa, is directly associated with feeding, and lies below the mouth. The coxae are little modified in the mygalomorph spiders but in most other spiders are expanded to form the *maxillae* which are flattened lobes with usually a scopula on the inner or anterior surface and in many spiders a row of minute teeth called the *serrula*. Between the maxillae is a small single median plate — the *labium* — which is attached to the sternum. In some spiders there is a distinct groove between the labium and the sternum so that the labium is referred to as *'free'* but where this groove is absent the labium is described as *'fixed'*. In some families the anterior margin of the labium is swollen or thickened and then the labium is described as *rebordered* (Fig. 100).

Palps

The female palp normally consists of six segments (Fig. 8) *coxa, trochanter, femur, tibia* and *tarsus* (metatarsus lacking), but in the family Symphytognathidae the number of segments may be reduced in the female and in some genera the palp in the female is completely absent except for the coxal segment with the maxilla. In females the tarsus is simple and may, or may not, be armed with a single claw. In mature males the tarsus carries a copulatory organ which stores the sperm, derived indirectly from the gonopore, and is the organ used to transfer sperm into the body of the female during mating. In many spiders the tibia, and, less often the patella and femur, is provided with apophyses, which by virtue of their varied form are used extensively in taxonomic descriptions (Figs. 9-11).

In the majority of spiders the tarsus of the palp of the male, when mature, is concave below where the bulb rests while not in use. This cavity is called the *alveolus* and the tarsus itself is then termed the *cymbium*. In a number of families (e.g. Linyphiidae, Epeiridae) a further appendage, the *paracymbium*, arises from the base of the cymbium (Fig. 10).

The palpal organ of the male, by virtue of the infinite variety of form it may take in different species, is of the greatest value in specific identifications. In those groups such as the mygalomorphs, the Oonopidae and Segestriidae which have no epigynum the palpal organ is in its simplest form. In these groups it is basically a single flexible bulb within which is a loosely coiled tube containing the sperm. The tube opens from a

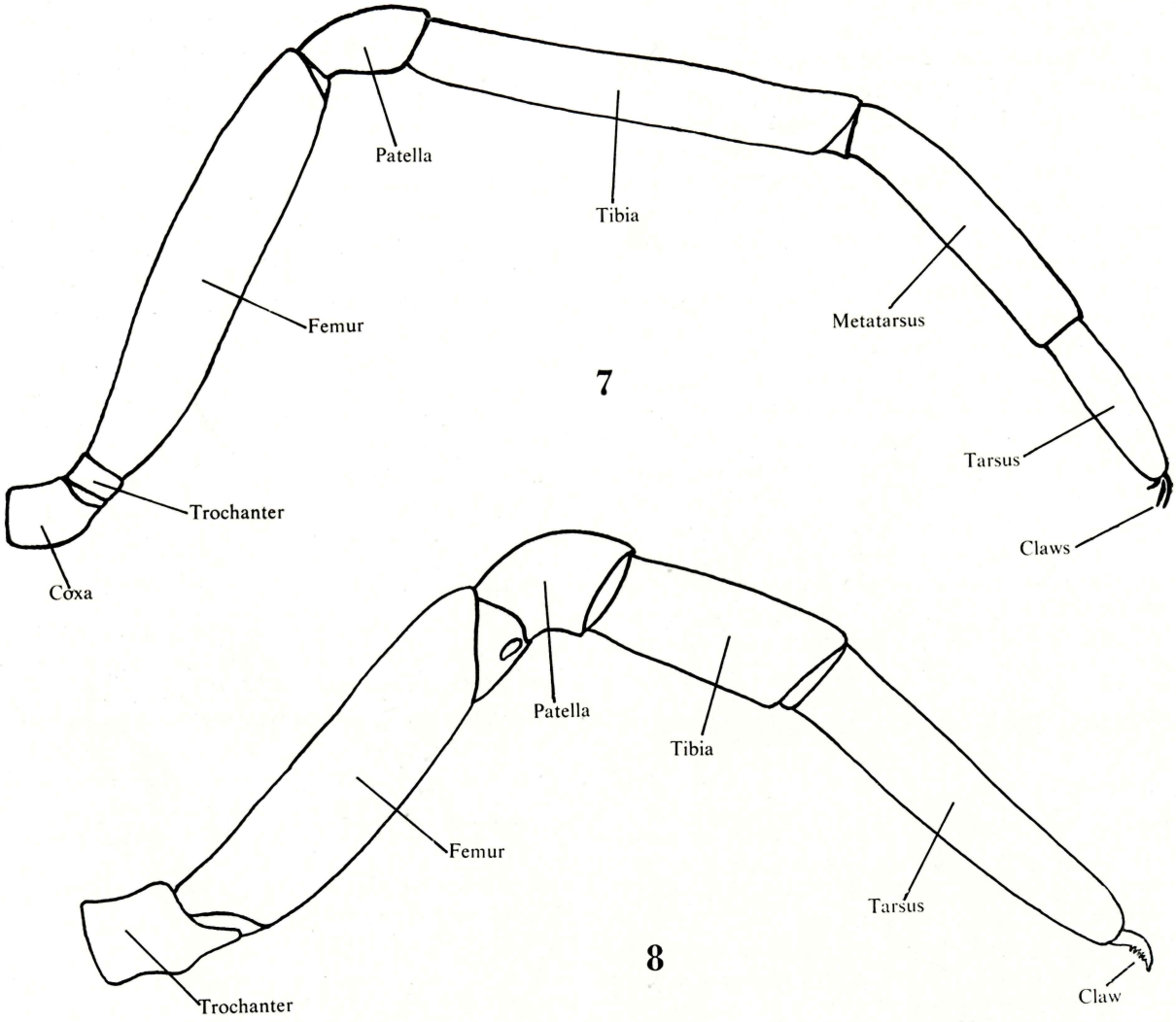
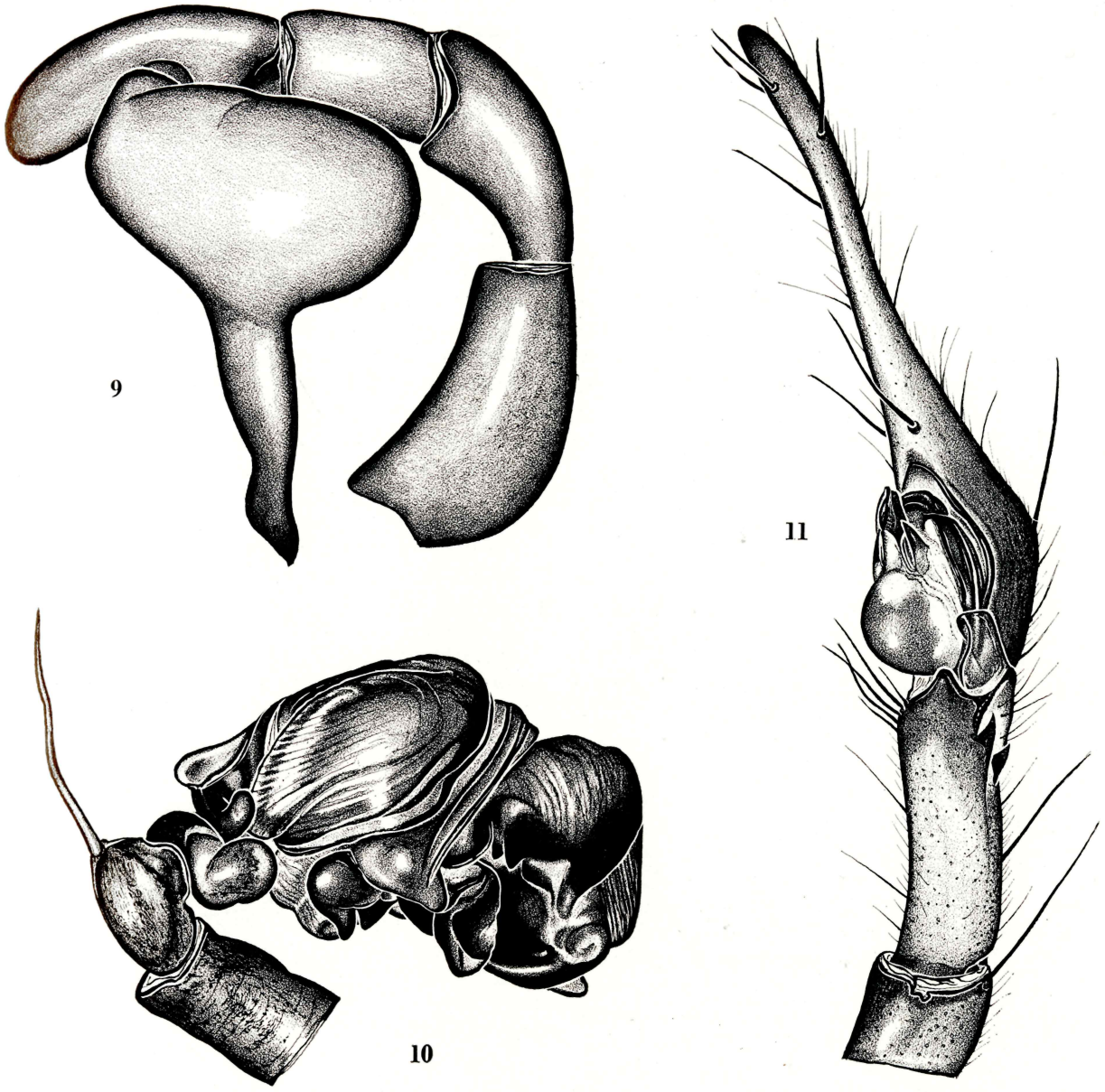


Fig. 7. Diagram of leg of spider. Fig. 8. Diagram of palp of female spider.

slender spine, which is usually distal, termed the *embolus* or in this simple form, the *style* (Fig. 9). While the basic mode of copulation remains the same in all spiders the form of the palpal organ becomes extremely complex in many families (Figs. 10, 11). In the more complex organs three main divisions are usually present but these are only seen clearly when the organ is distended, and most identifications are made from specimens where the organ is folded back into the alveolus. In common with most spider taxonomists great reliance is placed in the present work on clear illustrations of the palpal organ at rest rather than a detailed verbal description of each and every structure. However a number of parts are frequently referred to belonging to the middle and the apical division of the organ. The *median apophysis* belongs to the middle portion and is often present as a strongly sclerotized process or as a thin membraneous structure which may become expanded into a thin transparent plate. The two structures belonging to the apical division most commonly referred to are the *embolus* and the *conductor*. The embolus takes many forms but it may be recognized by the fact that the ejaculatory duct opens from it. The conductor is the process which normally lies along part or all of the length of the embolus when the organ is at rest and probably has a supporting function. When dealing with the families with complex palpal organs the structure and terminology used is discussed, but detailed accounts of the structure of the palpal organ may be found in Comstock (1912) and Gerhart and Kaestner (1937).

The similarity between the structure of the



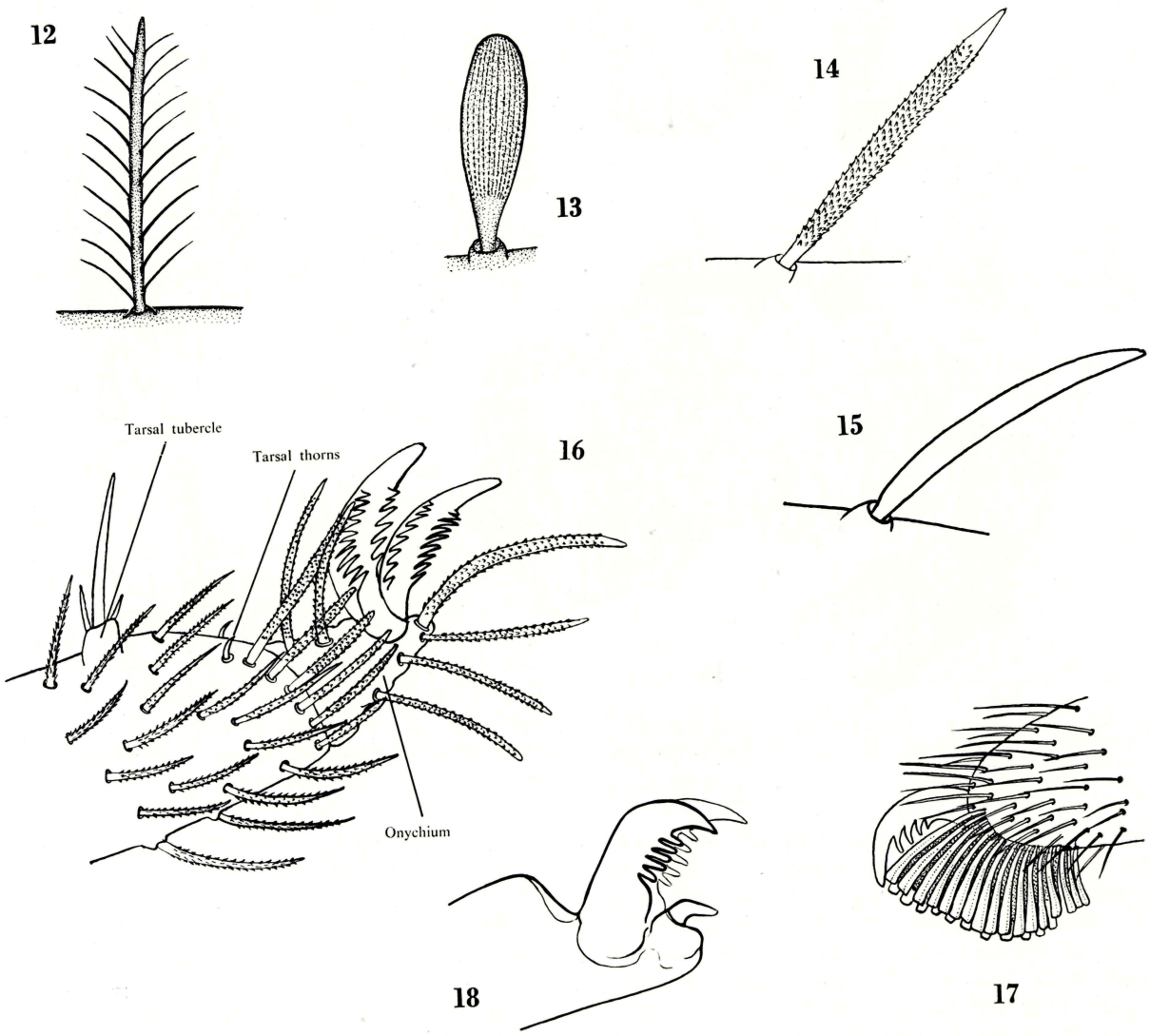
Figs. 9-11. Illustrations showing the appearance of typical male palps (hairs mainly omitted). Fig. 9. *Duripelta* sp. (Oonopidae). Fig. 10. *Aranea pustulosa* (Walck.) (Epeiridae). Fig. 11. *Cambridgea antipodiana* (White) (Agelenidae).

intromittent portions of the palpal organ and the ducts in the epigynum of the female in many spiders has led to the suggestion that there may be a direct relationship between the various structures of the two organs which would preclude interspecific mating. However many detailed studies have been carried out of which two of the more recent are by Gering (1953) and Merrett (1963). These tend to show that this 'lock and key' hypothesis has little merit and it is probable that the main barrier to cross mating lies in physiological and behaviouristic characters rather than structural form.

Legs

The four pairs of legs are attached to the cephalothorax laterally, between the sternum and the carapace. Each leg consists of seven segments — the *coxa, trochanter, femur, patella, tibia, metatarsus* and the *tarsus* (Fig. 7). The trochanter is generally the shortest segment and usually the first segment clearly visible when viewing the

spider from above. The femur is usually the longest segment. The patella and tibia are immoveable in relation to each other and are measured as a single unit by some authors. The metatarsus and tarsus are sometimes referred to collectively as the 'foot'. The metatarsus has also been called the *protarsus* by some of the earlier workers and this should not be confused with praetarsus. In some spiders such as the Pholcidae the tarsus may be broken up into pseudosegments. To provide a uniform system for recording the position of the various structures found on the legs it is customary to use the terms *dorsal* and *ventral* and the prefixes *pro* and *retro* in their morphological sense as determined by the plane of symmetry. The planes are determined by imaginary straight lines joining the articulation points of the basal and distal end of the same segment. The prolateral surface is then the side which in relation to this plane faces the anterior end of the body. In the front two pairs of legs of most spiders this will be the inner surface but in the posterior two pairs it will be the outer surface. In some spiders such as the Thomisidae the anterior legs may be turned so that the morphological prolateral surface becomes dorsal. This type of leg is termed *laterigrade* and the same term is used to describe the sideways type of locomotion which is usually associated with such spiders



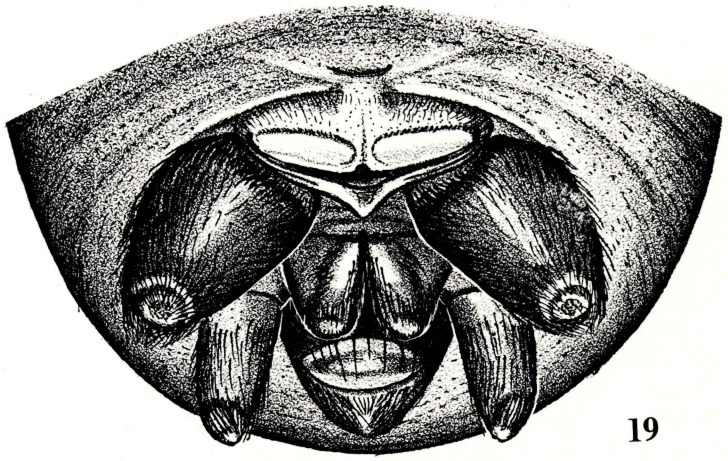
Figs. 12-18. Structures found on the legs of some spiders. Fig. 12. Plumose hair. Fig. 13. Spatulate hair. Figs. 14, 15. Two common forms of spines. Fig. 16. Distal portion of tarsus of *Pounamua* sp. (Oonopidae) showing tarsal tubercle, tarsal thorns, and onychium. Fig. 17. Distal portion of tarsus showing claw tufts. Fig. 18. Diagram showing the arrangement of the superior and inferior claws on a three-clawed spider.

(Fig. 154). When the legs are not turned they are named *prograde*. Spiders with prograde legs may use two types of locomotion — running, for which the term *citigrade* is used and jumping, for which the term is *saltigrade*. All legs are usually covered with *hairs* and in most spiders *spines* and *bristles* are also present. In practice it is difficult to provide a definitive method to distinguish between what might be termed a spine or a bristle. It will be found when dealing with closely related species that definite structures which may without hesitation be called spines in one species are represented by more slender weaker structures in another species which are then called bristles, but are undoubtedly homologous with the spines. In the present work bristles occurring in this way have usually been included in the spination with a note to indicate that the structure is present as a bristle. While it does not seem practical to establish a generalized pattern for spination from which a uniform spination formula could be developed, when dealing with related groups of species it is often feasible to establish the maximum number of spines which may be present on a particular surface and the notation is then based on the presence or absence of these spines. The hairs may be smooth, finely *ciliate* or *plumose* (Fig. 12). Occasionally they are modified to form *spatulate* and *squamiform* hairs which in some circumstances are referred to as scales (Fig. 13). The *trichobothria* are very fine hairs, usually smooth, but occasionally ciliate, which are set vertically in relatively large sockets (Fig. 41). These are specialized sensory hairs for which a variety of functions have been postulated; the most commonly held suggestions being the detection of air currents or of vibrations. The presence of trichobothria and their distribution, or in some cases their absence, is extensively used in taxonomy. In some spiders the ventral surface of the tarsus and less often the metatarsus is clothed with a dense brush of short, stiff hairs — the *scopula* (Fig. 108). When a tuft of similar hairs is present but restricted to the end of the tarsus below or around the claws these are called the *claw tufts* or *fasciculi unguiculares* (Fig. 17). While the presence of claw tufts is usually associated with two clawed spiders, a number of spiders, including some New Zealand species, do have both three claws and claw tufts. Not all two-clawed spiders have claw tufts.

The tarsi of all legs are terminated by either two or three claws. In general the spiders which capture their prey by active hunting have only two claws while web-building spiders have three claws, but this division is by no means true for all spiders. The upper pair of claws are called the *superior claws* and while usually pectinate in a single row may in some spiders (Oonopidae, *Aparua*) be pectinate in a double row. The pectinations may be the same on both claws, when the claws are termed *similar*, or one claw may have fewer pectinations, in which case the claws are termed *dissimilar*. The third claw or *inferior claw* when present is always below the superior claws and usually much smaller. Associated with the true claws of a number of three-clawed spiders are found strong serrated bristles which are called *false claws* or *pseudonychia*. The terminal portion of the tarsus may appear as a separate part carrying the claws. This is the *onychium* which is morphologically the *praetarsus* and is clearly seen in the New Zealand Oonopidae (Fig. 16).

Apart from the trichobothria there are a number of other structures found on the legs which are supplied with nerves and are certainly sensory organs but their true function is not clear. There is on the dorsal surface of the tarsus of many spiders a small blister enclosing a space which communicates externally through a small pore. This is called the *tarsal organ* or *tarsal drum* and it has been suggested that this structure functions as a chemoreceptor and also that it plays a part in the detection of water. These structures are not present in all spiders. *Slit sense organs* or *lyriform organs*, are always present on the legs as well as other parts of the body both as single slits and in groups. While these organs are usually held to be chemoreceptors recent work suggests that they may act to control torsion and assist in locomotion and other muscular activities. A number of other structures have been recorded recently in limited groups of spiders which while presumed to be sensory organs have not been examined histologically. Two which are found in New Zealand Oonopids are the *tarsal tubercle* a small mound usually provided with erect bristles (Fig. 16) which is always associated with two small curved spines, the *tarsal thorns*, placed above the onychium. An erect rod-like structure which is partly enclosed in a sheath is found on the tarsus of some of the New Zealand agelenids. This has been called the *tarsal rod*.

Spiders with a cribellum also have a *calamistrum*. The calamistrum consists of one or two rows of closely spaced curved bristles on the metatarsus of the fourth leg (Fig. 21). It is used by the spider to comb out the special silk pro-



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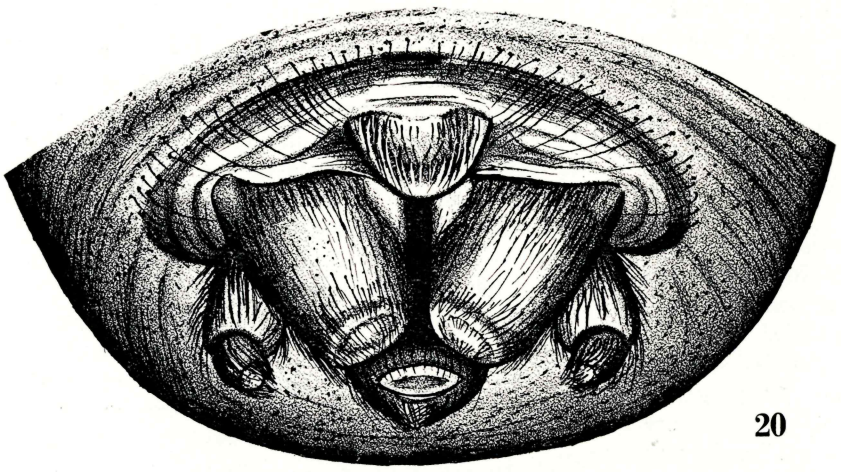

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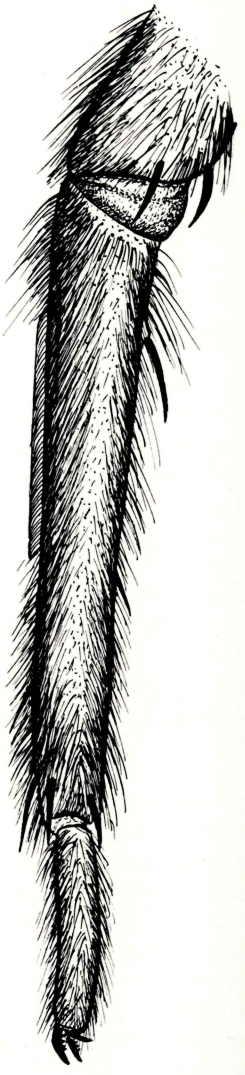

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Fig. 19. Postero-ventral view of abdomen of *Ixeuticus martius* (Simon) (Dictynidae) showing cribellum and spinnerets. Fig. 20. Postero-ventral surface of abdomen of *Cambridgea antipodiana* (White) (Agelenidae) showing colulus and spinnerets. Fig. 21. Fourth leg of *Ixeuticus martius* (Simon) showing the calamistrum.

duced from the cribellum. In most of the Theridiidae there is a *comb* on the ventral surface of the fourth tarsus which consists of a row of serrate bristles used in association with the swathing silk (Fig. 104).

Abdomen

The abdomen and the cephalothorax are joined by a narrow waist — the *pedicel* — which is the first true abdominal segment. The dorsal surface of the pedicel is called the *lorum* and the ventral surface the *plagula*. While the abdomen is most commonly oval it may be modified in many ways. Some of these modifications may take the form of protuberances as in *Celaenia* (Fig. 24) or result in an angular shape as in *Rhomphaea* (Fig. 23) and many species of *Tekella*, or be produced into a long tail as in *Arachnura* (Fig. 22). While some of the primitive liphistiids and related spiders from other countries do show segmentation, represented by sclerotized plates in the adult form, in New Zealand spiders, the presence of sclerotic plates has no definite relationship to primitive segmentation. Most of the New Zealand spiders which possess plates belong to the families Oonopidae, Symphytognathidae and Mimetidae (Figs. 128, 168, 174) where the plates are present on, and sometimes behind, the epigastrium and

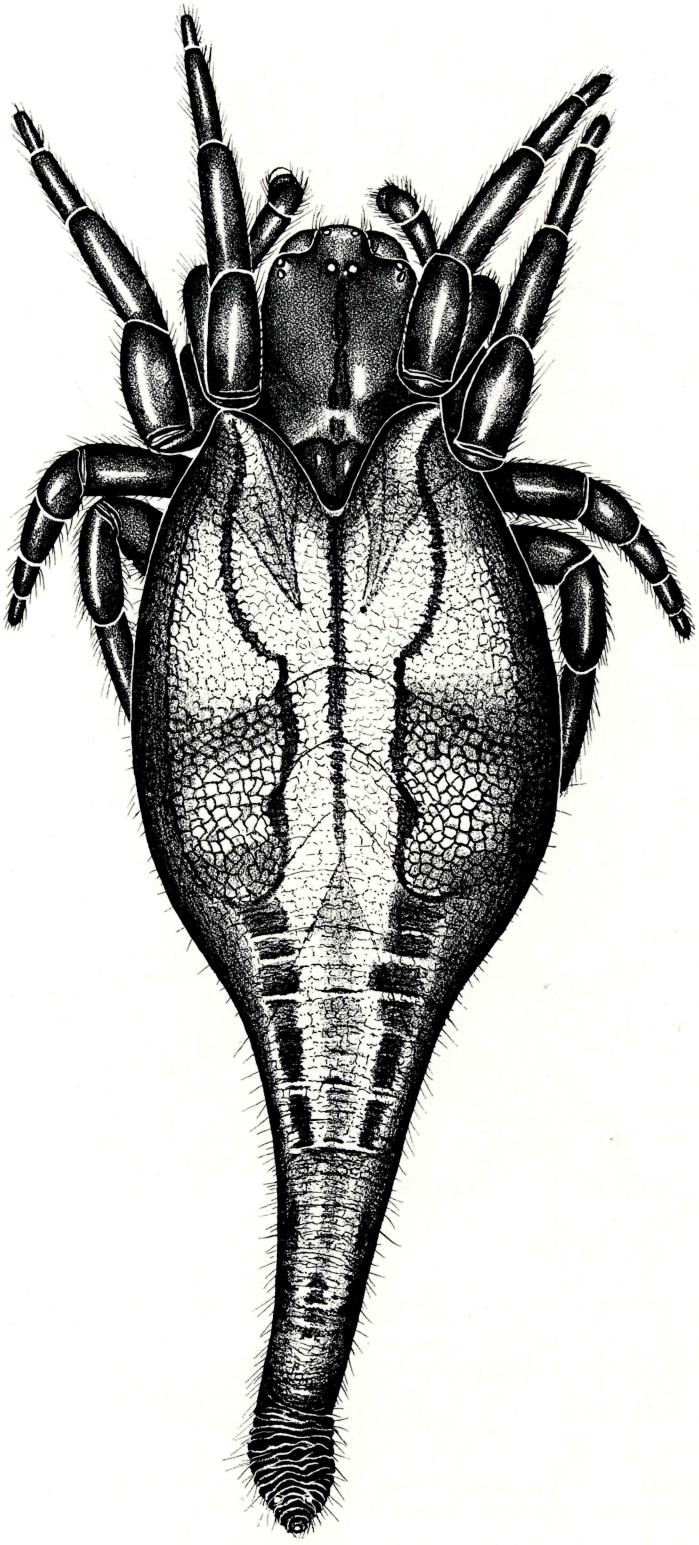
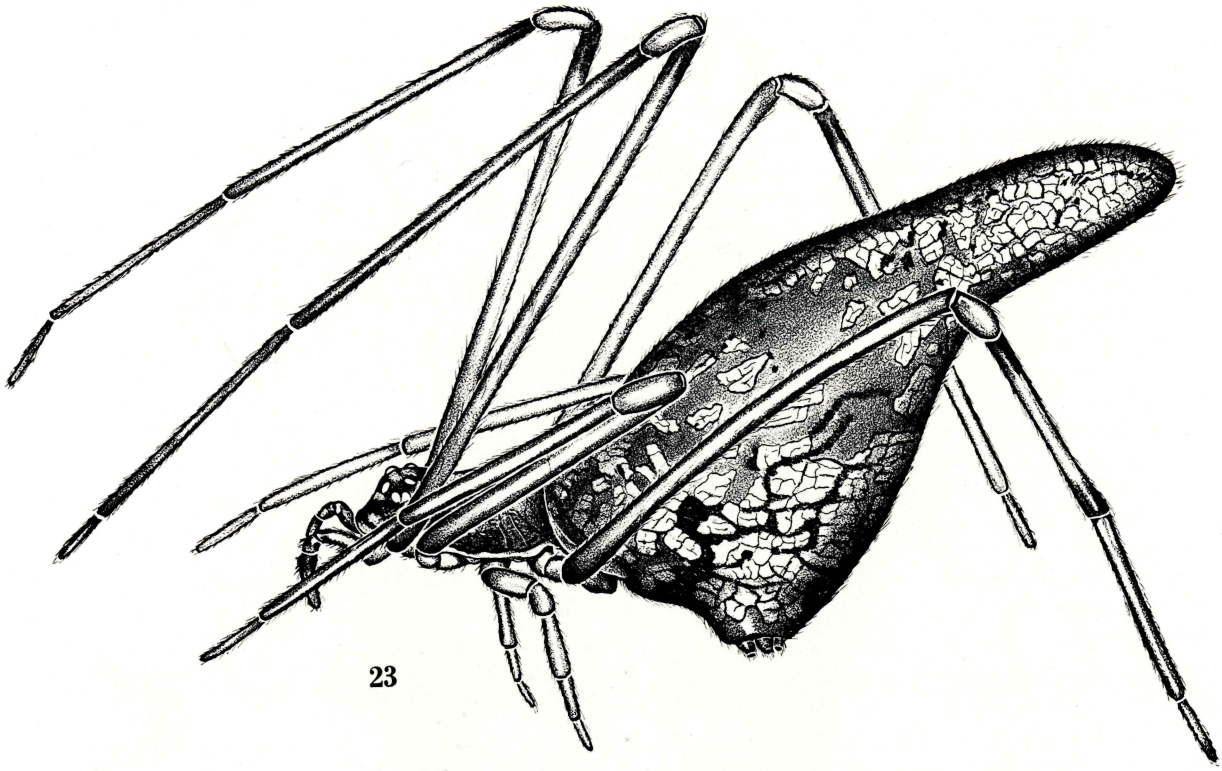


Fig. 22. *Arachnura feredayi* (Koch.L.) female. (Epeiridae). From life. Body length 11 mm.



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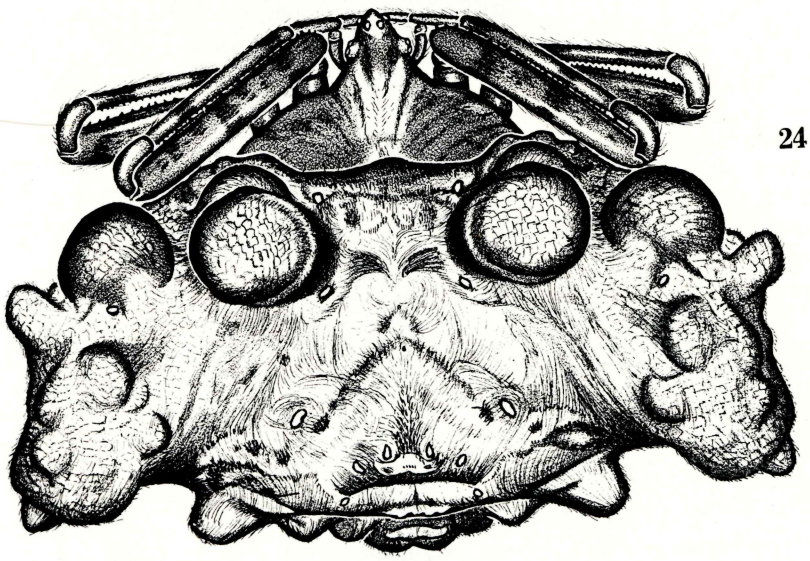

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Fig. 23. *Rhomphaea* sp. female. (Theridiidae). From life. Body length 3 mm. Fig. 24. *Celaenia* sp. female (Epeiridae). Preserved specimen. Body length 4.5 mm.

less often on the dorsal surface of the abdomen. It is commonly found that the plates are much more extensive on the abdomen of the male and in many species the males possess a dorsal plate which is absent in the females. The reproductive and respiratory organs open from the ventral surface (Figs. 25-28). In all spiders there is a more or less distinct transverse groove on the anterior half of the ventral surface which is called the *epigastric furrow*. In the Mygalomorph and Hypochilomorph spiders there are two pairs of slits on the ventral surface which are the external openings of book lungs. The presence of book lungs can usually be distinguished by a pale or sclerotized patch. In all other New Zealand spiders no more than one pair of book lungs is present, and in some families (Symphytognathidae in New Zealand) the anterior pair may also be replaced by tracheae. Two separate openings are found in some spiders behind the epigastric furrow which lead to tracheae but in most families the posterior trachea are fused so that there is a single opening in the mid-line which is normally situated near the base of the spinnerets. In some spiders the posterior spiracle is lacking.

In the mid region of the epigastric furrow is the *gonopore* which is a slit leading into the reproductive system. The region in front of the epigastric furrow is the *epigastrium*. This area is rarely modified in male spiders but in the females of many spiders there is a sclerotized plate associated with the gonopore which is called the *epigynum* (Figs. 29-31). From either one or two external openings, ducts lead to the seminal vesicles or *spermathecae*. Sperm is stored in the spermathecae and passed down from them through a fertilization duct to the uterus, when required, to fertilize eggs as they are laid. The epigynum and also the spermathecae and ducts show an infinite variety of form and like the male palpal organ are of great importance in the identification of species. In some spiders females in the penultimate instar may show some sclerotized structures which while smaller than the functional epigynum can lead to a mistaken impression that the specimen is mature.

On the dorsal surface of the abdomen are smooth depressions, usually two or three pairs, which indicate internal muscle attachments.

At the morphologically posterior end of the abdomen the digestive system opens from a more or less distinct *anal tubercle*. This is normally a simple lobe but may be somewhat modified as in *Oecobius* (Fig. 32). Below the anal tubercle are the spinnerets which in New Zealand spiders number one, two or three pairs. The spinnerets are provided with *spigots* from which a number of different kinds of silk is produced according to the type of gland associated with the spigot. It is usually considered that the spinnerets are homologous with the biramous pleopods of crustacea and that the eight spinnerets found in some Liphistiidae represent the primitive condition for

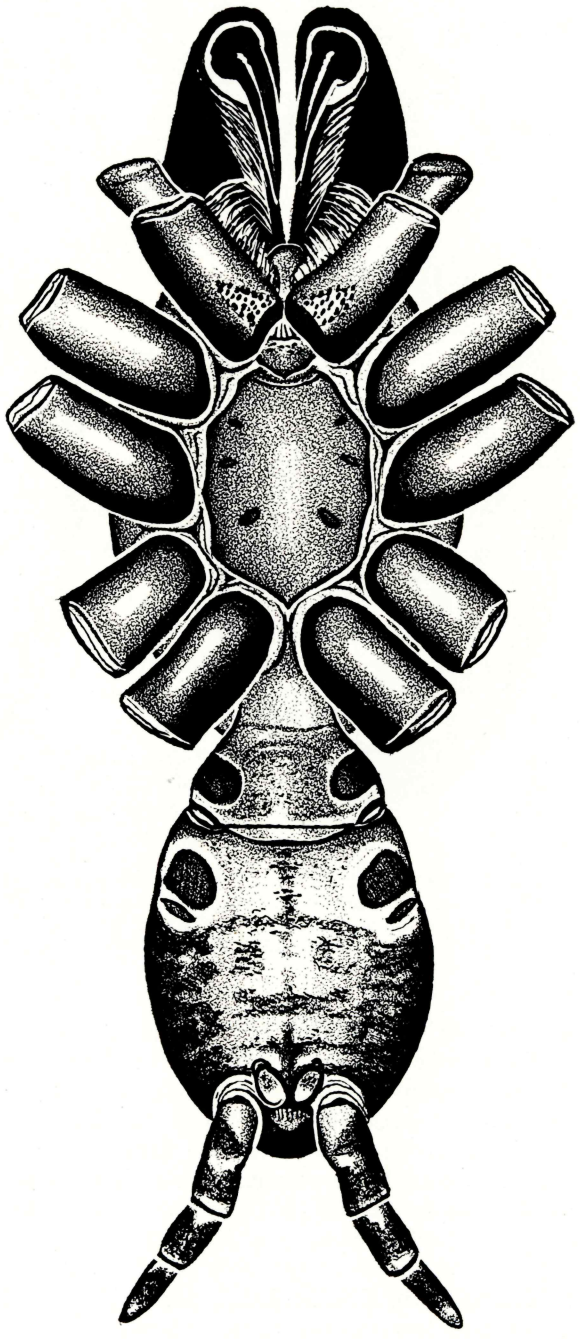


Fig. 25. Ventral surface of *Aparua* (Dipluridae) illustrating the absence of the maxillae, and the presence of paraxial chelicerae and of four book-lungs.

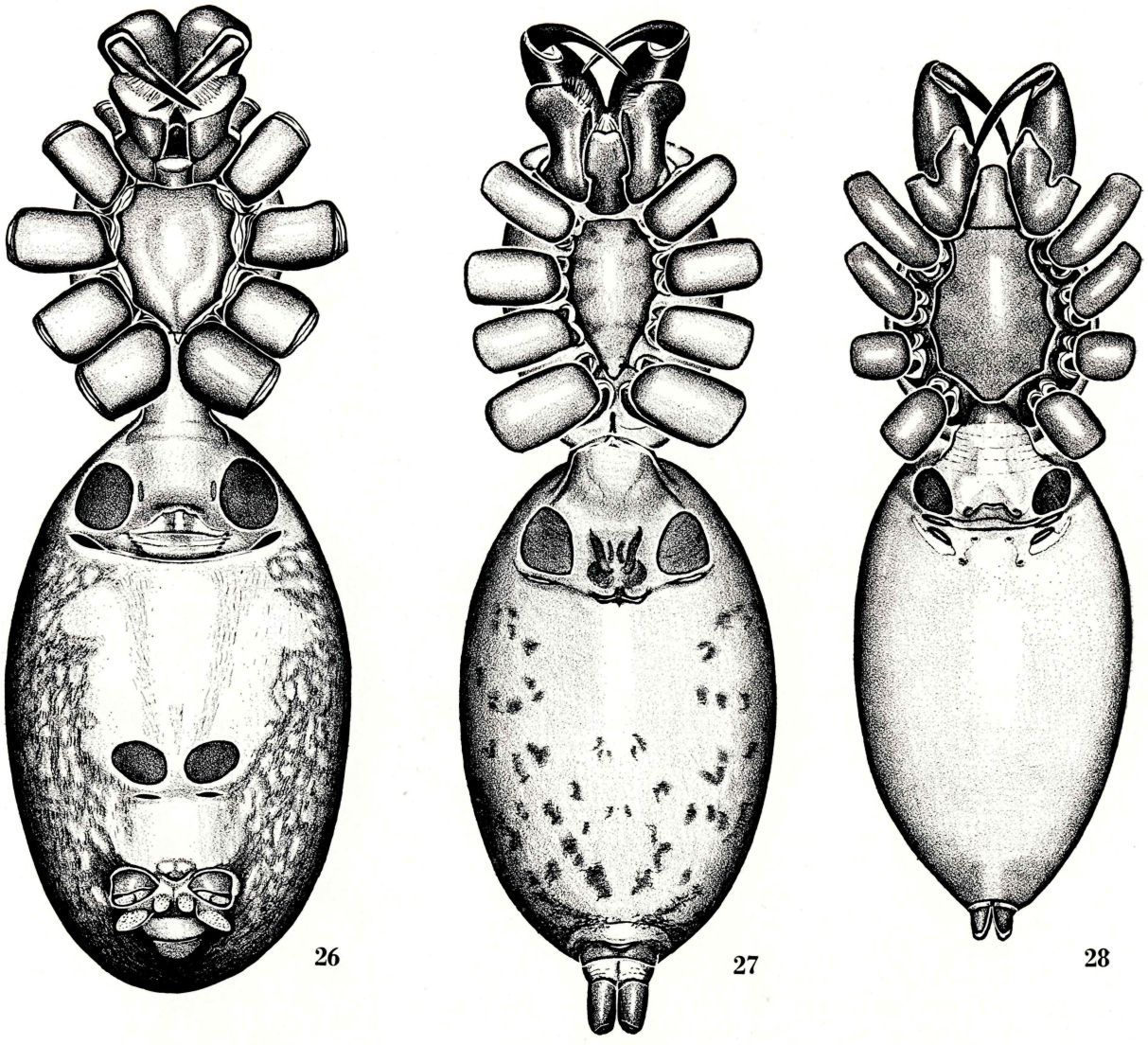
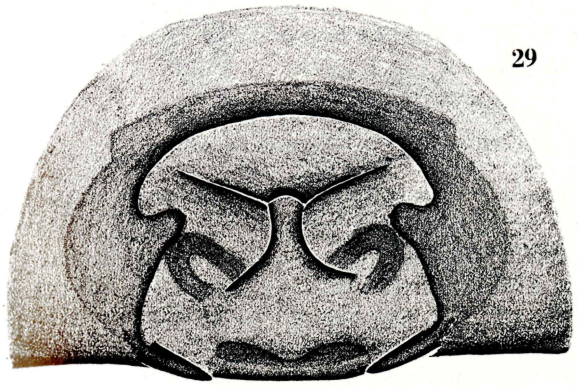


Fig. 26. Ventral surface of *Gradungula sorenseni* (Gradungulidae) showing diaxial chelicerae and four book-lungs. Fig. 27. Ventral surface of *Clubiona* sp. (Clubionidae) showing diaxial chelicerae, two book-lungs and single posterior spiracle near the spinnerets. Fig. 28. Ventral surface of *Dysdera crocata* (Dysderidae) showing diaxial chelicerae, two book-lungs and two tracheal spiracles near the epigastric furrow.

spiders. In a number of families (cribellate spiders) there is a small plate, or in some New Zealand spiders a small lobe, possessing a sieve-like surface immediately in front of the spinnerets. This is the *cribellum* (Fig. 19) from which a special type of silk is combed by the calamistrum on the fourth metatarsus. The cribellum is presumed to be homologous with the endopodite of the pleopod of the fourth abdominal somite. A small apparently functionless appendage is found in the same position in many spiders and this is termed the *colulus* (Fig. 20). The colulus is normally slender and pointed but in a number of spiders it may be somewhat flattened and in some represented only by a few hairs. It has been suggested that the colulus represents a direct relic of the anterior median spinnerets of primitive spiders, and by others that it has been derived indirectly from a cribellum. While both of these suggestions may well be represented in different phylogenetic lines it is evident from the study of the New Zealand cribellate spiders that this latter suggestion does have weight. In some endemic genera there are groups of closely related species where species range from those with a relatively well developed cribellum and calamistrum to



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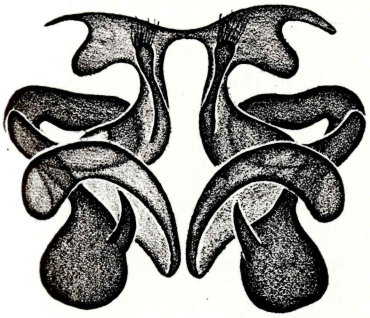

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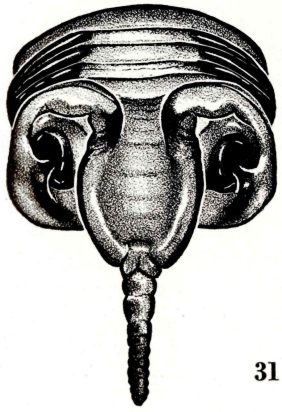

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Figs. 29-30. *Amphinecta decemmaculata* Simon (Agelenidae). Fig. 29. Epigynum of female from below. Fig. 30. Internal genitalia of female, from above. Fig. 31. Epigynum of *Aranea pustulosa* (Walck.) (Epeiridae).

some with a rudimentary cribellum and only a few hairs forming a calamistrum and also some species which appear to have no cribellum and calamistrum at all. The functionless lobe which is found in these latter species in front of the spinnerets is to all intents and purposes a colulus.

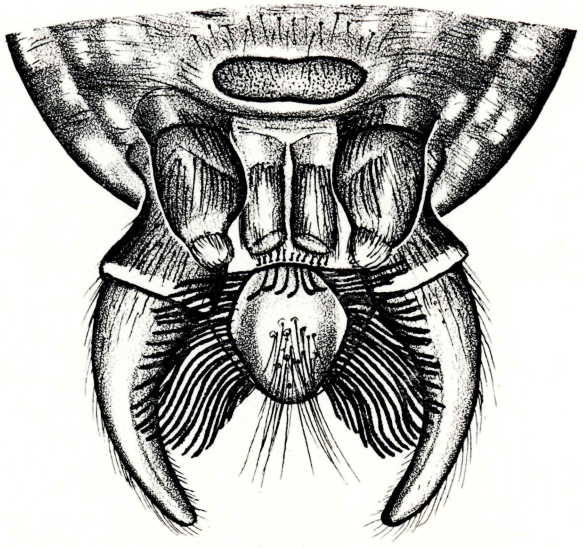


Fig. 32. *Oecobius annulipes* (Oecobiidae). postero-ventral surface of the abdomen showing the cribellum and modified anal tubercle.

Internal Anatomy

Skeletal System

The external skeleton of spiders consists of a pale brown cuticle and the underlying hypodermis. Colour is derived from two main sources, the physical effects of interference of light which produce iridescent colours, or various pigments. The source of iridescent colour is often the fine structure of hairs and scales but in some cases interference colours do arise from the cuticle itself. In most spiders however, colour is derived from various pigments in the hypodermis or the diverticula of the mid gut. Millot has established the presence of three types of pigments. Those with a melanin base produce black, grey and dark brown; those containing guanin produce white; and the carotinoid pigments are responsible for yellow, green, orange and red. The carotinoid pigments are alcohol soluble and are quickly lost in preserved specimens, while the other two pigments are relatively stable. All these pigments are excretion products.

In addition to the exoskeleton there is an endoskeleton of which the most conspicuous element is the *endosternite* in the cephalothorax (Fig. 33). This is a horizontal plate, above the nerve mass and below the alimentary canal, which serves as an attachment for muscles concerned with the movement of the appendages and the sucking stomach. The intrinsic muscles of the legs consist only of flexor muscles and the extension of the

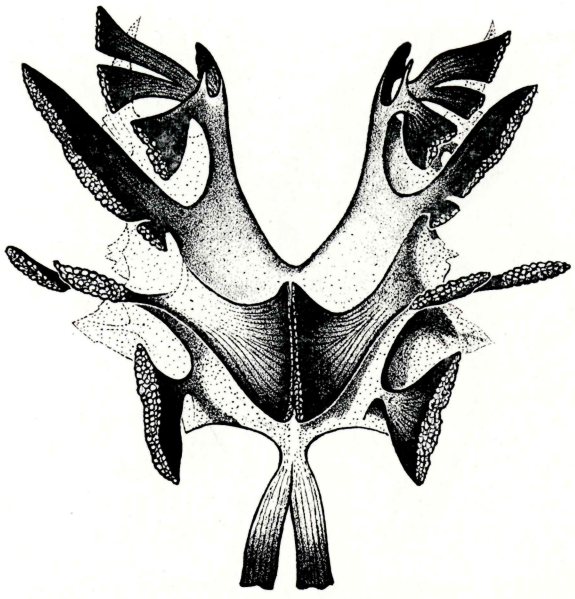


Fig. 33. Dorsal view of the endosternite of a lycosid showing the suspensory muscles (redrawn from Millot, 1949).

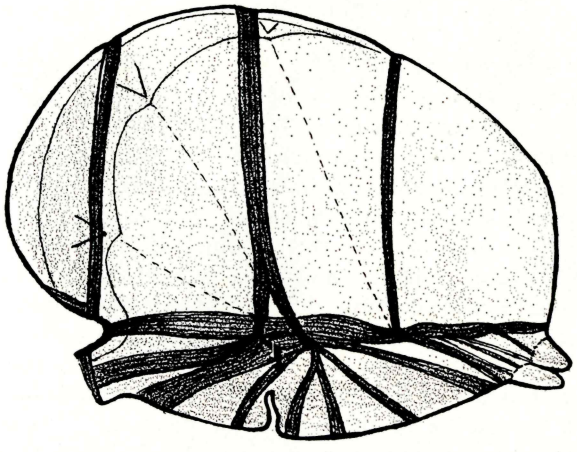


Fig. 34. Diagram of the abdominal musculature of *Teutana grossa* (Theridiidae) (redrawn from Millot, 1936).

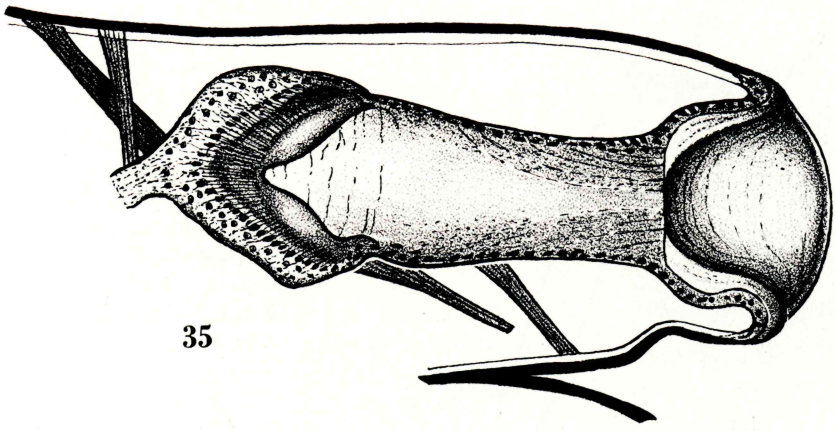
legs is controlled by variation in the pressure of the blood within the segment. The musculature of the abdomen is poorly developed. In all spiders a series of muscles extend from the petiolus to the spinnerets (Fig. 34). These are situated near the ventral surface of the abdomen and are the *longitudinal ventral muscles*. A number of *dorso-ventral muscles* are arranged segmentally in pairs and extend between the longitudinal ventral muscles and the dorsal body wall. The primitive number is probably four but the full complement is only found in the Liphistiidae, Hypochilidae and some mygalomorphs. In other families there are usually two or three pairs but the dorso-ventral muscles are also completely absent in a few families.

Nervous System and sense organs

The nervous system of all spiders is restricted to the cephalothorax and consists of a fixed number of paired ganglia. The larger portion, or ventral ganglionic mass, lies below the endosternite and the alimentary canal while a smaller dorsal portion or 'brain' lies above the alimentary canal. The dorsal portion is concerned only with the innervation of the eyes and chelicerae, and the relative size and complexity is related to visual ability. The ventral ganglionic mass receives the nerves from all other parts of the body. The first five neuromeres serve the legs and palp while nerve fibres from the remaining seven neuromeres extend back as a single large nerve through the petiolus to the abdomen where it is split into two secondary branches from which discrete branches extend throughout the abdomen. In spiders there are no ganglia within the abdomen.

The eyes are always simple. The *cornea* or *lens* is a modified and unpigmented portion of the body wall and is continuous with it. The cornea is renewed at each moult in the same way as the rest of the cuticula. Immediately below the cornea is the *corneal hypodermis* continuous with the hypodermis of the body wall and in fact a modified portion of this layer. The *retina* lies immediately below the corneal hypodermis and is composed of a layer of *visual cells*. Each visual cell consists of a cell body with a nucleus and a hard structure known as the *optic rod* or *bacillus*. Each visual cell is connected with the central nervous system by means of a nerve fibre. There are two types of retina found in spiders. The AME, which belong to the first segment of the head, are provided with a *direct retina*. In a direct retina the hard non-nucleated portion of the retinal cell — the optic rod — is directed forward towards the cornea and the nucleated cell body is situated near the base of the eye (Figs. 35, 36). In the indirect eyes, the nucleated portion is in front of the optic rods (Fig. 37). In pre-bacillar eyes the nerve fibres join the visual cell at the end of the portion containing the nucleus while in the post-bacillar eyes the nerve fibres join the visual cells between the nucleus and the rod.

The prebacillar eyes generally have a *tapetum* which is a layer of cells behind the retina containing small crystals which reflect back the light,



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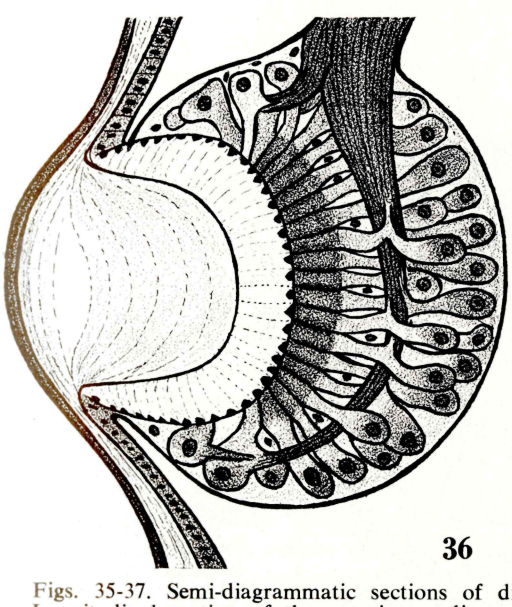

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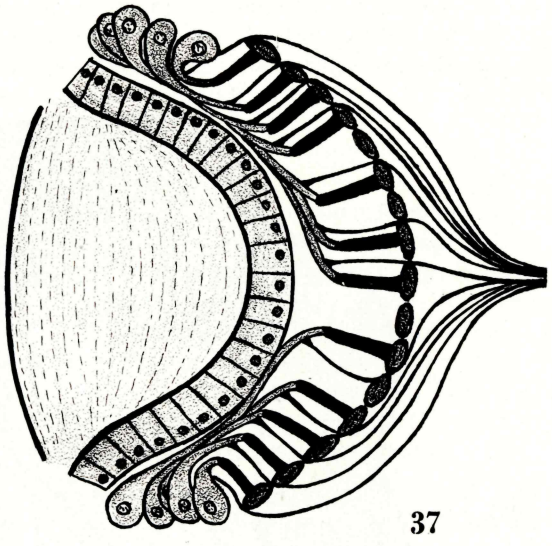

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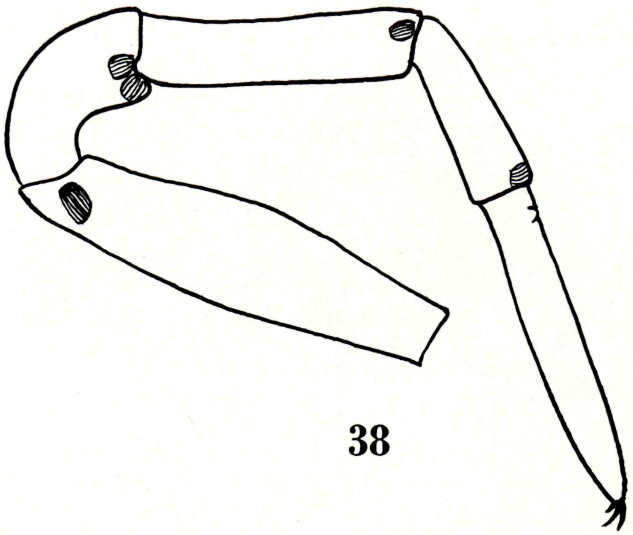
Figs. 35-37. Semi-diagrammatic sections of direct and indirect eyes. Fig. 35. *Salticus scenicus* (Salticidae). Longitudinal section of the anterior median eye showing the structure of the eye and the associated muscles (redrawn from Scheuring, 1914). Fig. 36. *Tegenaria domestica* (Agelenidae). Longitudinal section of the anterior median eye (after Widmann, 1908). Fig. 37. Longitudinal section of a lateral eye (after Verluys and Demoll, 1921).

and for this reason these eyes may appear light in colour, while the AME which lack a tapetum appear dark. However in some spiders a layer of pigment may be present in front of the tapetum so that the prebacillar eyes appear dark also, and conversely the presence of white pigment in the AME may give these eyes a pearly lustre resembling that of the prebacillar eyes.

Each anterior median eye is provided with a muscle extending from the eye capsule to the body wall and these are the only eyes in which the retina may be moved. While in most spiders the eyes probably only serve for light and shadow perception, in hunting spiders such as the Lycosidae and Salticidae the shape of objects may be perceived and this visual acuity is also expressed in the typically more elaborate courtship behaviour found in these families.

Most of the hairs found on the body and appendages of spiders play some part in the sensory mechanism and are supplied with nerve fibres. Some of the more specialized hairs are



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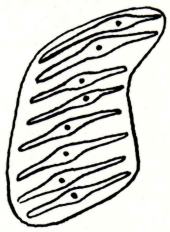

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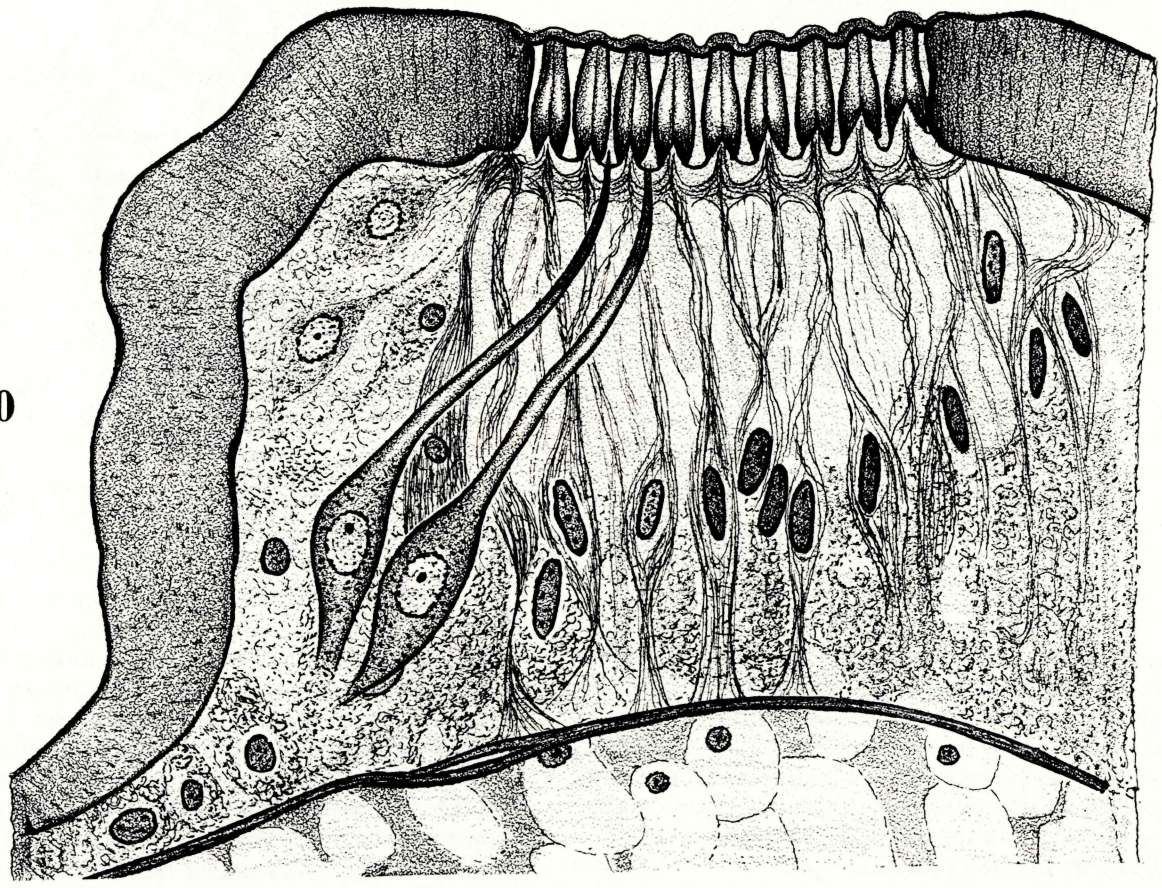

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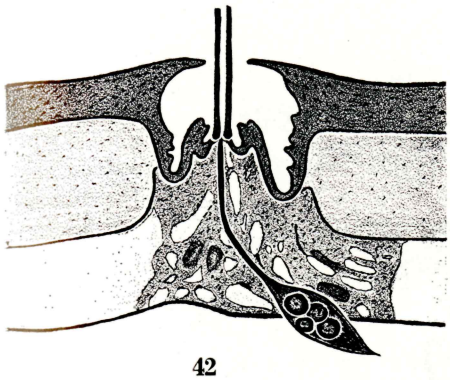
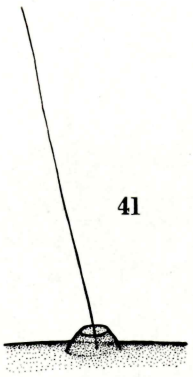
Fig. 38. *Pseudanapis spinipes* (Symphytognathidae). First leg showing position of lyriform organs and tarsal organ. Fig. 39. Surface view of a group of lyriform organs. Fig. 40. Section of a lyriform organ (after Kaston, 1935).





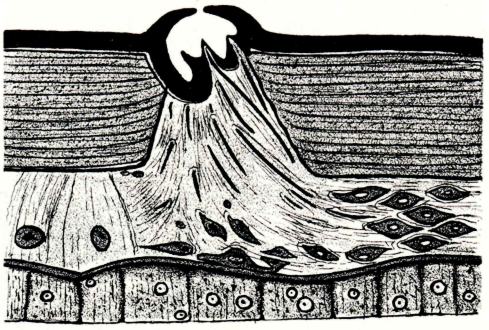


Fig. 41. Trichobothrium. Fig. 42. *Meta menardi* (Epeiridae). Section through a trichobothrium showing a multinucleate nerve cell (after Gossel, 1935). Fig. 43. *Aranea diadema* (Epeiridae). Section of a tarsal organ (after Blumenthal, 1935).

relatively fixed in number and position, and are therefore of importance in taxonomy. The trichobothria are fine, erect hairs rising from a cup-like base and are found on the legs and palp. These have been accorded a number of functions including hearing, the orientation of the spider in the web, the detection of air currents and the maintenance of muscular tonus.

The *slit organs* or *lyriform organs* consist of minute slits ranging from 10μ to 100μ in length and from 2μ to 3μ wide. On the floor of these slits is a very thin cuticle below which is a sensory neurone (Figs. 39, 40). These organs are found singly or in small groups on most parts of the body, but more consistently on the legs. These organs have been studied extensively by Kaston (1935) who concluded that they were probably contact chemorecpetors. More recently, (Keller 1961. Parry 1960, Legendre 1963). It has been shown that there are at least two kinds of lyriform organs which differ histologically and probably functionally and various experiments suggest that they may serve to detect a number of different stimuli, particularly those related to vibration and mechanico-tactile sources, in addition to playing some role as chemoreceptors.

A single tarsal organ is found on the dorsal surface of the tarsi of the palp and legs of many spiders. This is usually a dome-like raised cup, open at the top, and provided inside at the base with one or more small extensions each of which is served by neurones. Blumenthal (1935) who first studied these organs considered that they had an olfactory function and also that they played some part in the location of drinking water. However as these organs are absent from many groups of spiders their functions, whatever they may be, must also be served by other sense organs. It may be noted that only rarely are trichobothria found distal to the tarsal organ.

Excretion

In addition to the Malphighian tubules which are discussed with the digestive system and the occurrence of excretory pigments, the principal organ of excretion is the *coxal gland*. The coxal glands are situated within the cephalothorax. Buxton (1913) in his extensive study of these organs in the Arachnida concluded that there were four main types in the spiders (Figs. 45-48) which show progressive simplification.

In the Mygalomorphae the saccules which lie to the outside of the endosternite near the first and third legs are lined with cells which have the ability to excrete waste material. This waste material passes through a convoluted labyrinth into a straight tube from which the exit tubes pass the contents to the surface of the spider. In these spiders there are two saccules and the two exit tubes. One of the exit tubes opens from behind the coxa of the first pair of legs and the other behind the coxa of the third leg. In the true spiders the exit duct behind the third leg is not present, the posterior saccule is lacking and the labyrinth where present is not convoluted. In the Lycosidae, Thomisidae, Salticidae, Drassidae, Zodariidae, Selenopidae, Ctenidae, Agelenidae and Dictynidae there are extensions in the labyrinth near legs 2 and 3 (Type 2) while in the Dysderidae and Scytodidae these extensions are not present (Type 3). In the fourth type

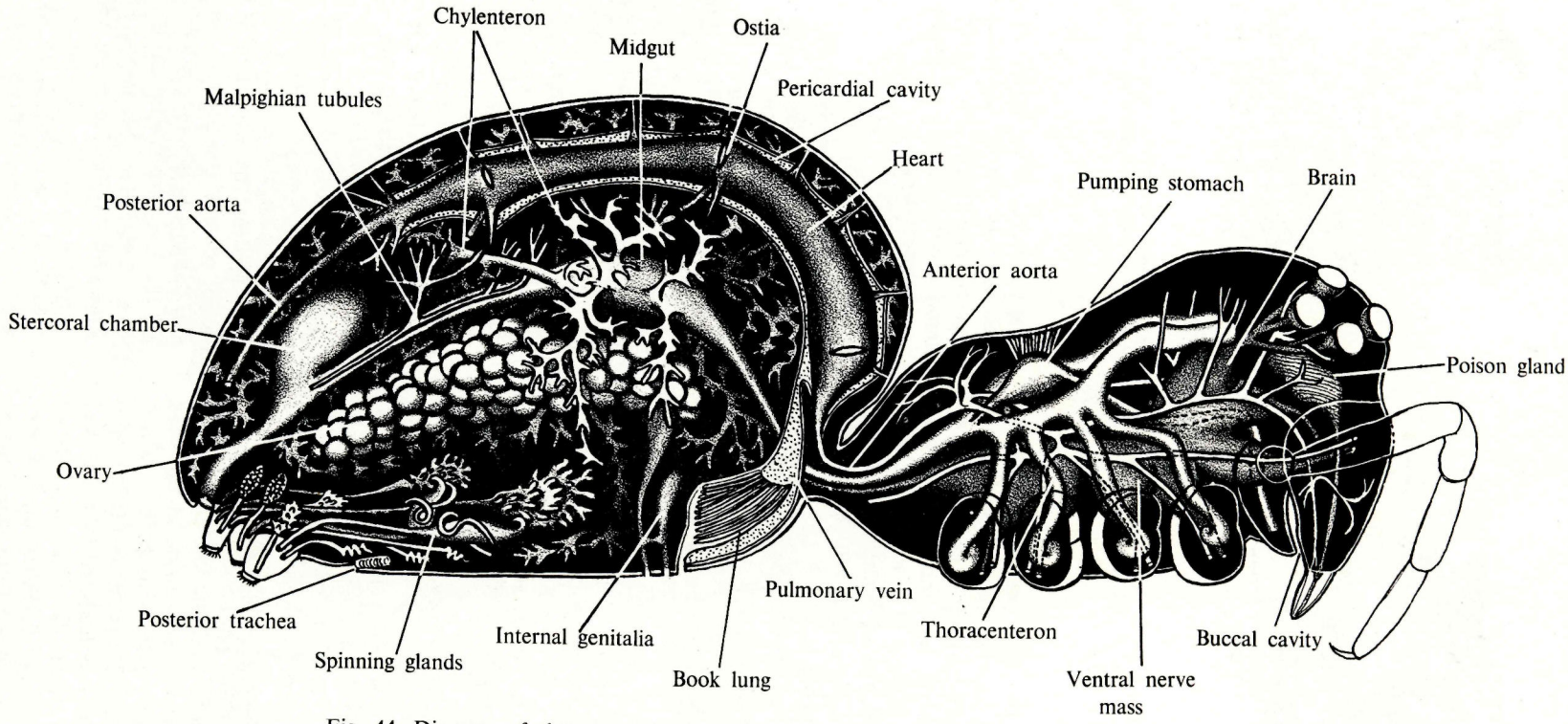
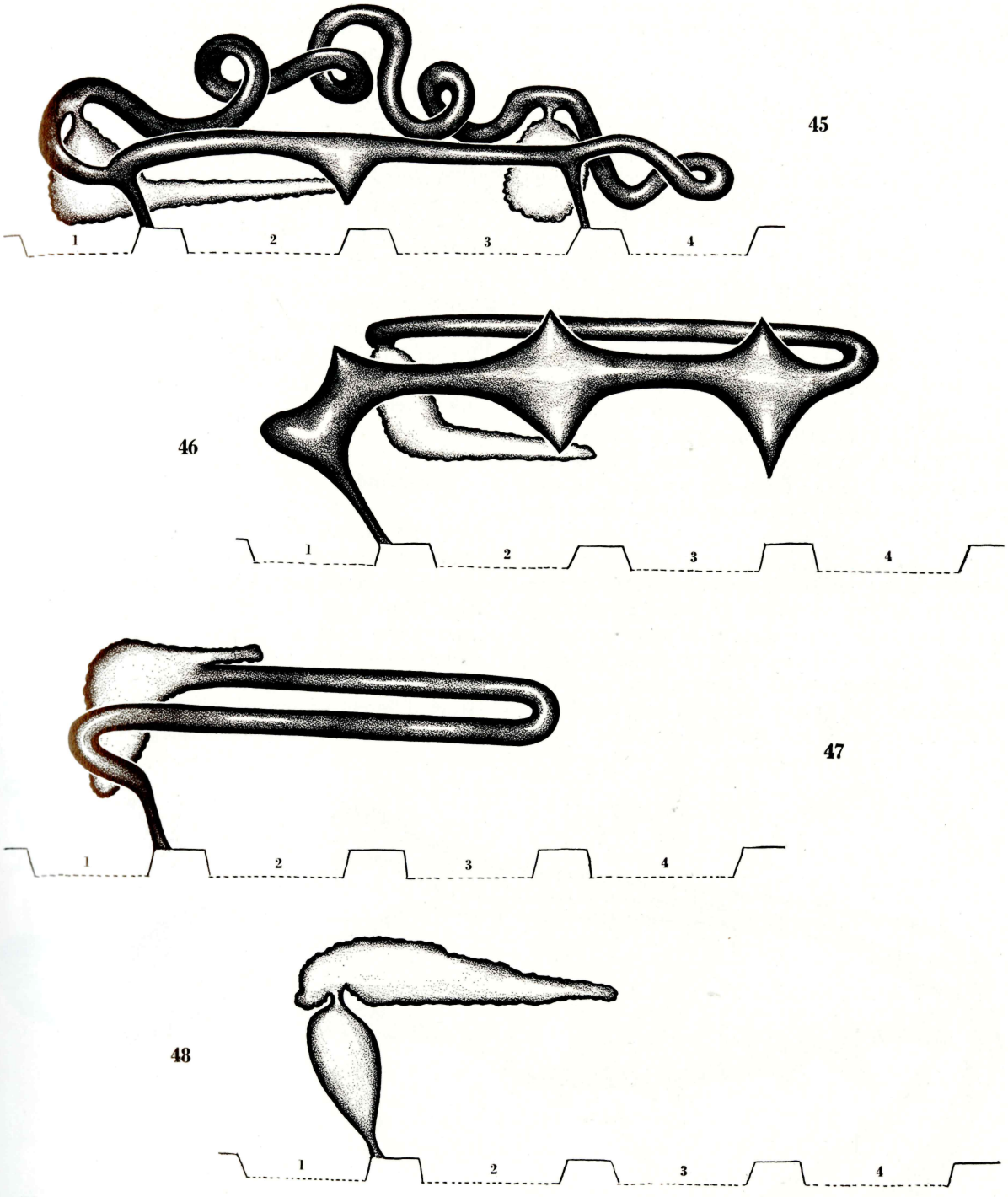


Fig. 44. Diagram of the anatomy of a two-lunged spider (redrawn from Comstock, 1912).



Figs. 45-48. Diagrams of Coxal Glands. Numbers 1-4 indicate the positions of the legs. Fig. 45 Mygalomorphae. Fig. 46. Hunting spiders (Lycosidae, Thomisidae etc.) Fig. 47. Sicariidae, Dysderidae. Fig. 48 Web spinners (Epeiridae, Theridiidae etc.) (redrawn from Buxton, 1913).

which includes the more advanced web spinners (Epeiridae, Theridiidae, Pholcidae and Filistatidae) the labyrinth itself is virtually absent so that the saccule opens directly to the surface from behind the first coxa.

Nephrocytes are found in the blood cavities of the cephalothorax. These nephrocytes are large cells which are derived from the reticular tissue and may have one or more nuclei. The multinuclear cells may attain a diameter of 80μ.

Poison glands

The venom apparatus characteristic of spiders consists of a single pair of glands, situated either in the chelicera, or in the cephalothorax, from which a narrow duct leads down the fang to open from a pore near the tip (Fig. 49). Typically the gland is more or less cylindrical and is enclosed in a thin elastic membrane held behind by a ligament — the *suspensorium*. Within this membrane is a layer of spirally arranged muscle fibres below which is the secretory epithelium consisting of a single layer of cells.

Millot (1931) who has studied extensively the development and structure of these glands has shown that there are a number of different types which are more or less typical for major groups. In the Mygalomorphae, Liphistiidae and the Hypochilidae the gland is small and enclosed within the paturon of the chelicera. In some araneomorph spiders (Salticidae, Tetragnathidae, Clubionidae, Gnaphosidae) the glands are also small but extend slightly into the cephalothorax.

In the greater majority of the Araneomorphae however, and also in the Gradungulidae, the glands are much more strongly developed and extend back into the cephalothorax, more or less covering the nerve mass. While the glands are normally cylindrical, they may be multilobed (*Sicarius, Palpimanus, Plectreurys*). These glands are further modified in *Scytodes* where they are very large and comprise an anterior and a posterior portion in which the cytological structure and the secretion is different. The venom is secreted in the anterior portion while the posterior portion produces a sticky substance which the spider ejects to trap its prey. In a few spiders (Uloboridae, Heptathelidae) the poison glands are absent.

Silk glands

The silk glands are restricted to the abdomen and may occupy a considerable portion of the ventral area of the abdomen. Each gland consists of a single layer of cells enclosing a lumen, and opens externally from a spigot on the spinnerets or from a pore on the cribellum. Many different forms of glands have been described from different groups of spiders. Apstein (1889) groups these into five main categories.

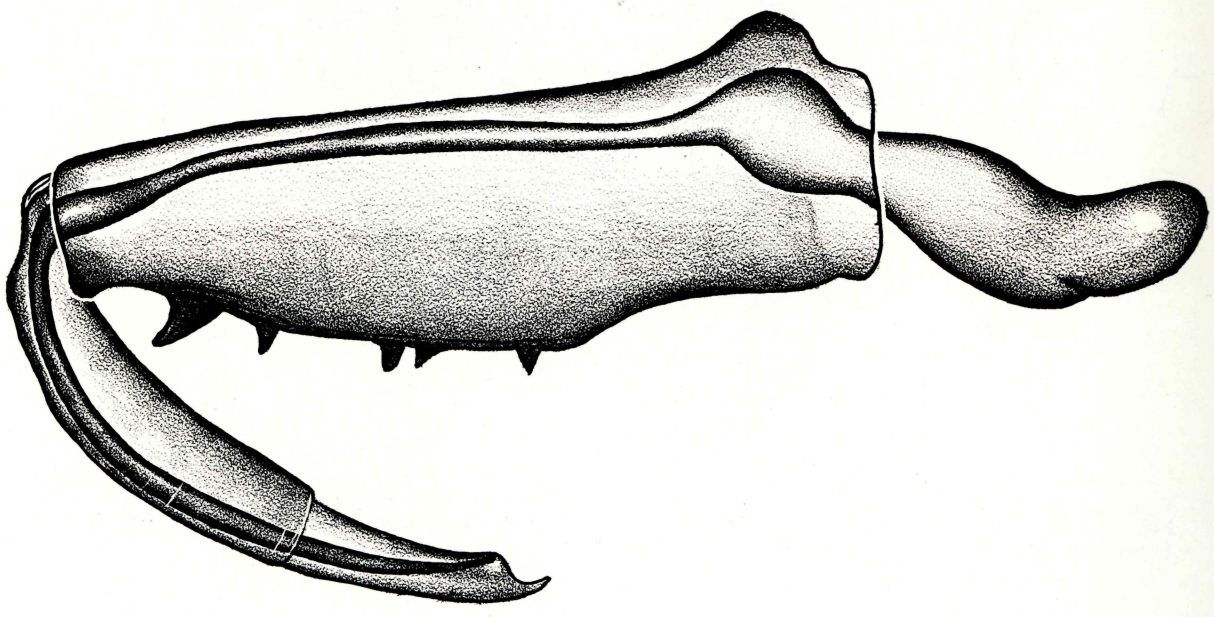
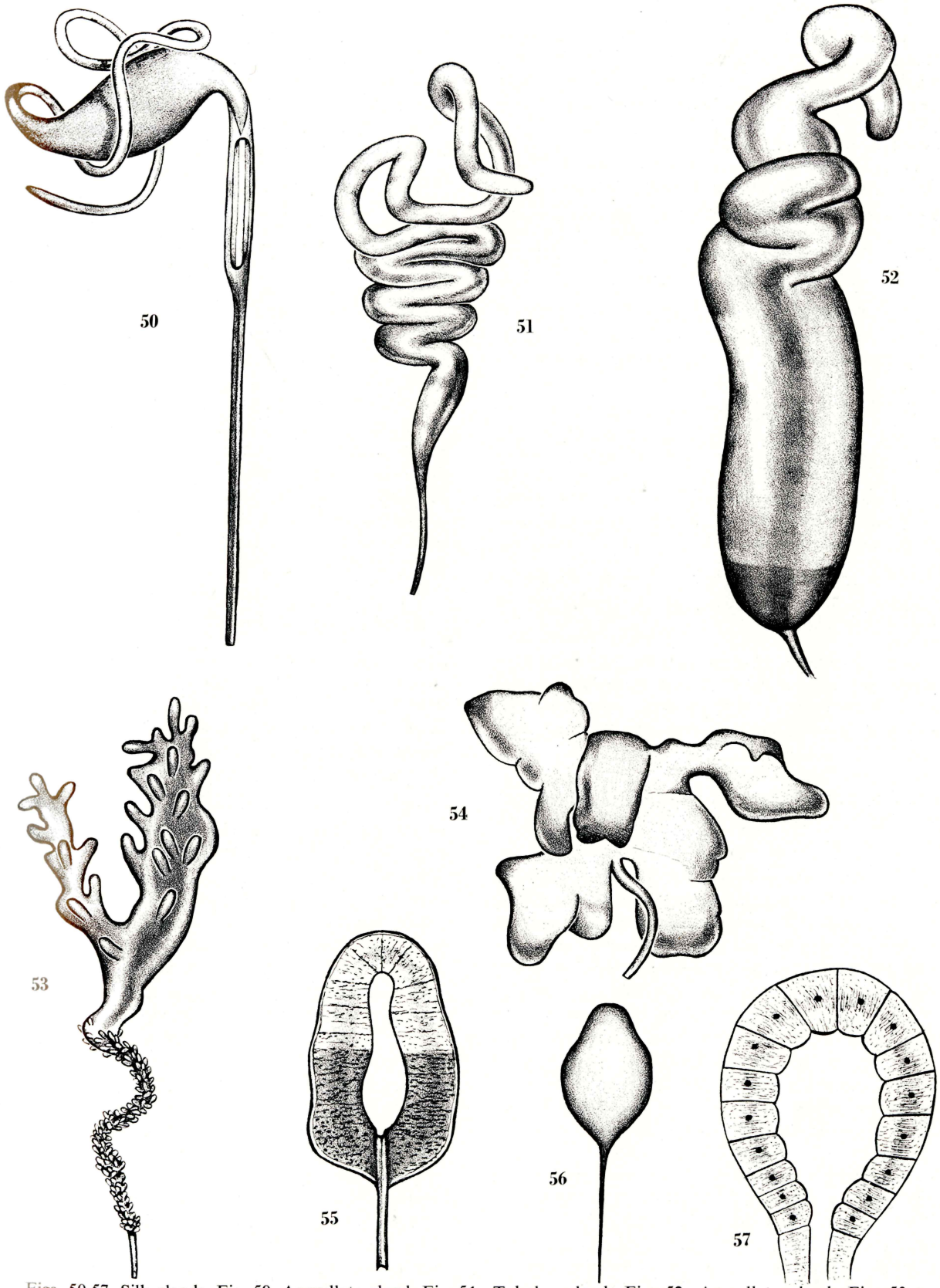


Fig. 49. *Cambridgea antipodiana* (White) (Agelenidae) Chelicera showing poison gland and duct.



Figs. 50-57. Silk glands. Fig. 50. Ampullate gland. Fig. 51. Tubular gland. Fig. 52. Ampullate gland. Fig. 53. Aggregate gland. Fig. 54. Lobed gland. Fig. 55. Section Pyriform gland. Fig. 56. Aciniform gland. Fig. 57. Section Aciniform gland. (Figs. 50, 51, 53, 54, 55, 57 after Comstock, 1912. Figs. 52, 56, after Millot, 1937.)

(1) *Aciniform glands* (Figs. 56, 57). Very small but usually associated in berry-like clumps. Each gland is spherical in shape with a short excretory canal. In section all cells stain evenly in contrast to the pyriform glands.

(2) *Pyriform glands* (Fig. 55). These are also found in compact groups and are similar to the aciniform glands in appearance but tend to be longer and narrower. The area near the mouth of the gland stains darker in section than the rest of the cells.

(3) *Ampullate glands* (Figs. 50, 52). These glands are never numerous and are in the form of a cylindrical tube with the median part greatly enlarged.

(4) *Tubular glands* (Fig. 51). These are cylindrical but are more or less even in width. They are often convoluted.

(5) *Aggregate glands* (Fig. 53). The gland is irregularly branched and lobed. The duct bears small knobs which are cellular.

(6) *Lobed glands* (Fig. 54). These consist of a mass of irregular lobes and are found only in the Theridiidae .

(7) *Cribellum glands*. These are the small spherical glands which are found associated with the cribellum in cribellate spiders. They are often grouped so that several may be enclosed in a common sheath.

No spider possesses all kinds of silk glands but five types are commonly found in the more complex web-builders.

The aciniform glands are associated with the median and posterior spinnerets and are found in all spiders. The swathing band is produced from these glands and possibly they provide silk for the eggsac of some spiders. The pyriform glands are found associated with the anterior pair of spinnerets and produce the silk used in the attachment disc. The ampullate glands are never very numerous, ranging from two to six pairs which open from the anterior and median spinnerets. They seem to occur in all spiders and are used to produce the silk for the drag-line and the dry threads of the web. The cylindrical glands are commonly present in female spiders but are absent from the Dysderidae and the Salticidae. These glands are reduced in number in males or are absent. In female spiders there are usually six glands which open from the median and posterior spinnerets. The silk is used to spin the eggsacs and the absence of the glands in the two families is correlated with the absence of a true eggsac. The aggregate glands are found only in the Epeiridae Linyphiidae and Theridiidae. There are usually six of these glands, four large and two small, and they open from the posterior pair of spinnerets. It is thought that these are the glands which produce the sticky threads. The lobed glands are found only in the Theridiidae and produce the swathing silk of these spiders which is manipulated by the tarsal comb on the fourth tarsus. Two or four lobed glands may be present and these open from the posterior pair of spinnerets. The cribellum glands open from the small pores in the cribellum and secrete the silk for the hackled band which is combed out by the calamistrum on the fourth metatarsus. Glands situated in the epigastrium of some male spiders and opening through hollow hair-like spigots have occasionally been recorded in the past. Recently (Melchers, 1964, Marples, 1967) these have been recognized as spinning glands which are present in most spiders and in fact provide the silk for the sperm web.

Blood circulatory system

The blood system of spiders is incomplete in that during a part of its course the haemolymph enters the body cavity. It consists of a simple tubular heart and a number of smaller ramifying blood vessels which are reduced in extent with the increase of the tracheal system.

The *heart* is situated near the anterior surface of the abdomen along the mid-dorsal line and is often visible through the integument of living spiders. It is a simple tube, without valves, surrounded by a pericardial membrane, and suspended by pericardial ligaments (Fig. 58). The wall of the heart is pierced by paired openings — the *ostia* — through which the blood is received into the heart. In the most primitive of spiders (Liphistiidae) five pairs of ostia are present while in the Mygalomorphae and Hypochilomorphae four pairs are usually present. In the Araneomophae only three or two pairs remain. The anterior portion of the heart is continued as the *anterior aorta* which continues into the cephalothorax where it branches and ramifies to supply blood to the organs of the cephalothorax and the appendages. A valve is present in the dorsal aorta which prevents backflow. The abdomen is supplied from the posterior end of the heart which continues as the *posterior aorta* and also from a series of paired *lateral*

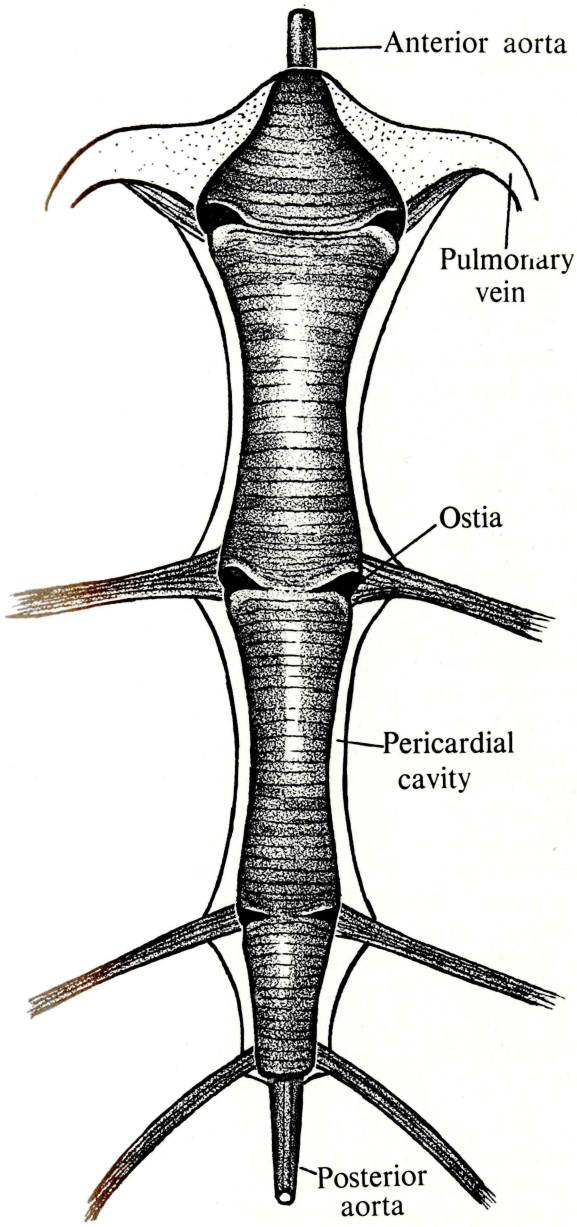


Fig. 58. Dorsal view of the heart of *Pholcus phalangioides* (Pholcidae). (redrawn from Millot, after Willem, 1917).

arteries which rise from the heart near each pair of ostia. After leaving the arteries the blood passes into the spaces of the body cavity and then is gathered in two longitudinal sinuses, one dorsal and one ventral, which lead to the base of the abdomen .The blood is here oxygenated through the booklungs and then passes to two large vessels — the *pulmonary veins* — which convey the blood to the pericardial cavity from which it enters the heart through the ostia.

Respiratory system

The respiratory organs of spiders are of two types — book lungs or tubular tracheae. In many spiders both organs are present but in the Mygalomorphae and most Hypochilomorphae two pairs of book lungs are present and in some spiders (Symphytognathidae, etc.) book lungs are absent. In the latter case the posterior tracheae, belonging to the third abdominal somite may also be lost leaving only the tracheae of the second somite. There are a few spiders (Pholcidae) where the posterior trachea are absent leaving only a single pair of book lungs.

The book lungs are formed by invagination of the integument to form a vestibule, the floor of which is secondarily invaginated into the space filled with exhausted blood from the body cavity. These invaginations are regular and usually numerous so that the appearance of the book lung is that of the leaves of a book. The leaves are kept apart by small thickenings on the outer surface, i.e. the inner surface of the air cavity. Circulation of the blood through the book lungs is achieved by the pulsations of the dorsal heart and not by muscular movement of the respiratory organs themselves.

The tubular tracheae usually extend from a small vestibule below the spiracle and ramify extensively to pass oxygen direct to the tissues. It is probable that there is no phylogenetic hiatus between book lung and tracheae in spiders and that the tracheae may have developed directly from the book lungs in different groups. The situation is found in a number of groups where this transitional stage appears to be present in living species (Forster, 1959).

The posterior tracheae belong to the third abdominal somite which extends from the epigastic furrow to the spinnerets so that the spiracle may be found anywhere between these two points, either paired, or singly where the paired tracheae have fused.

Digestive system

The alimentary canal consists of three sections which are of different origin. The fore gut is derived from the stomodaeum, the hind gut is derived from the proctodaeum and the mid gut is of endodermal origin. The fore and hind gut is lined with a chitinous layer continuous with the cuticle while the mid gut is lined with a layer of cells which forms the digestive epithelium.

The mouth is formed by the meeting of an anterior plate — the *rostrum* — and a ventral plate attached to the sternum — the *labium* — and also the maxillae, which are plates rising from the coxae of the palps. These are fringed with hairs which filter the food passing into the buccal cavity. While spiders only ingest liquid food, this includes the previously solid portions of the prey which have been broken down by digestive enzymes. The source of this digestive fluid which is exuded from the mouth during feeding is thought to be from glands in the rostrum and maxillae and also from the chylenteric caeca.

The foregut consists of a *pharynx* which leads up more or less vertically from the mouth into the *oesophagus* which passes back horizontally between the dorsal and ventral nerve masses to the *sucking stomach*. Dilator muscles are attached to the pharynx and the sucking stomach.

The midgut follows directly from the sucking stomach and is divided into two portions — the *thoracenteron* in the prosoma and the *chylenteron* in the abdomen which are joined by a narrow tube, the *connecting midgut*, which passes through the petiolus. The thoracenteron is composed of a number of diverticula ranging from simple lobes to most complex ramifications and these varied forms have been shown by Millot (1931) to be relatively characteristic for families.

The chylenteron fills the space defined by the heart dorsally and the silk glands and reproductive organs ventrally. It consists of lobed diverticula which produce digestive enzymes and also store food. The hindgut is enlarged dorsally to form a large diverticulum — the *stercoral chamber* in which the faeces are stored before being excreted.

The *Malpighian tubes* are paired and enter the alimentary canal near the union of the mid and hindgut. They are endodermal in origin and therefore not homologous to the organs of the same name in insects. Each of these tubes is branched and the branches ramify among the chylenteric diverticula. The malpighian tubes function as excretory vessels which remove waste products from the blood.

Reproductive system

With the exception of the male palpal organ the reproductive system of spiders is very simple. It consists of paired gonads, from each of which a duct extends forward, where they fuse to pass the products through the median gonopore. The female possesses large ovaries, which lie on the ventral surface of the abdomen, from which the paired oviducts extend to near the gonopore, where they fuse to form the uterus. In probably all spiders one or more of spermathecae are found below the gonopore, usually in pairs, where it is thought that sperm is stored until required to fertilize the eggs passing down the oviduct. In some groups (Mygalomorphae) there is a single opening to each spermatheca by which the sperms are presumed both to enter and leave during impregnation and fertilization but in most true spiders there is a second duct leading to the uterus — the *fertilization duct* — while the openings through which the spermathecae receive the sperm are situated externally on the epigynum. The spermathecae of mygalomorph spiders do however, seem to be very different from those of the majority of the true spiders. The sclerotized portion which is figured in the taxonomic descriptions forms the lumen of a large cellular sac which would seem to have a secretory function. The secretion from this gland enters the spermathecae through numerous pores which are associated with denticulate structures and the lumen is usually filled with this substance. Cooke (1966) demonstrated the presence of a similar gland in *Dysdera*, which however, is greatly reduced and empties into the end of the diverticulum. This gland he has called the *spermathecal gland*. *Ariadna*, which has however a median sclerotized sac, seems to approach the form of the mygalomorph spiders but the ducts enter the lumen near the base of the structure. In taxonomic descriptions the general term *internal genitalia* is used to cover all of these structures.

In the male the testes are simply long tubes lying parallel to one another in the ventral part of the abdomen from which narrow tubes extend to the gonopore where they are fused into a single tube.

LIFE HISTORY AND HABITS

LIFE HISTORY

Development

The development of the embryo takes place entirely within the cocoon which in most spiders contains a large number of eggs. All eggs within a cocoon hatch at about the same time. The

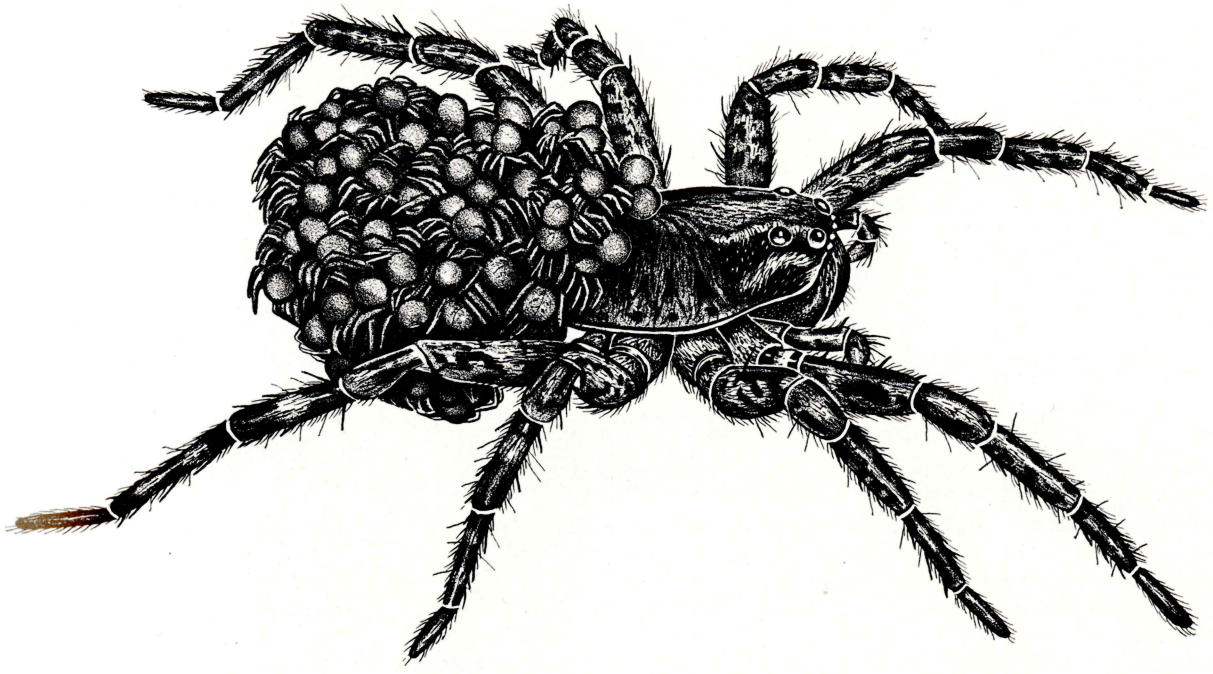
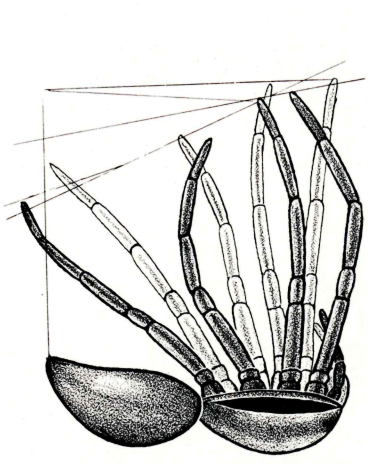


Fig. 59. Female lycosid carrying newly hatched spiderlings. Dunedin, Otago. From life. Body length 8 mm.

embryo is assisted in splitting the egg membrane by a small egg tooth at the base of each palp. The newly hatched spider is unable to feed or to spin and is dependent for nourishment at this stage on the egg yolk enclosed within its body during development. It is normal in most families for the spiderlings to moult once or twice within the eggsac before emerging. The behaviour of the spiderlings when they emerge from the eggsac differs greatly in different groups. In the Lycosidae the spiderlings climb on the mother's abdomen (Fig. 59) while in the Pisauridae they remain in a nursery web. Mygalomorph spiderlings remain for some time in the tunnels of the mother as do many of the other tube dwelling spiders (e.g. *Ariadna*) but eventually the young disperse to lead an independent life. The number of ecdyses through which a spider passes varies with species and would seem to be related to the ultimate size of the adult, the smaller spiders requiring fewer stages. The method of moulting is similar in all spiders (Figs. 60-66). Several days before moulting the spider does not feed and is rather sluggish and its colour may darken. Most spiders suspend themselves upside down with their legs grouped fairly close together but some may lie on their back or side. After a few hours the skin around the base of the carapace splits and the movements of the spider push the old carapace back where it remains attached at the petiolus. The skin of the abdomen then is split along the lateral margins and as the abdomen comes free the legs and palps are slowly withdrawn from the old skin with the help of a series of rhythmical movements. The freshly moulted spiders are soft and defenceless and remain suspended until the integument hardens. During this period the legs are repeatedly flexed and Bonnet has shown that without this movement the legs become stiff and distorted.

At all stages of the life history the loss of appendages may occur. Legs usually fracture at the joint between the coxa and trochanter but also in some spiders at the joint between the patella and tibia. At these joints the wound is quickly sealed by a thin membrane which is probably formed from blood. All of the appendages including the spinnerets are capable of regeneration. Bonnet has shown that for a new limb to appear at an ecdysis the loss of the limb has to occur during the first quarter of the period from the previous moult. The regenerated limb is always shorter than the original and usually three moults are required before the limb is of a normal size. The regenerating limb is formed within the coxa where it is coiled until it can be extended after the next ecdysis. While the regeneration of the female palps presents little



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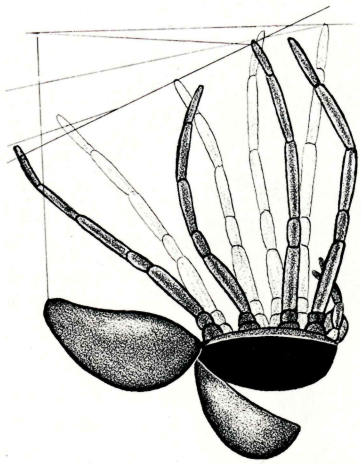

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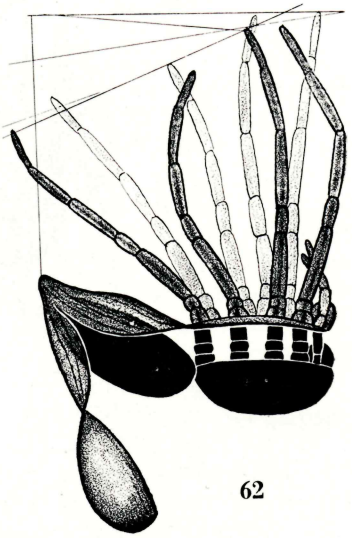

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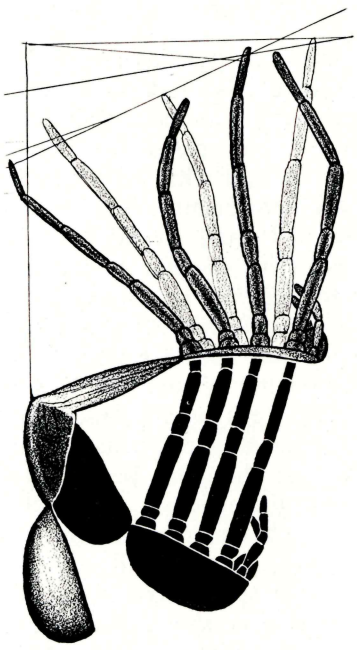

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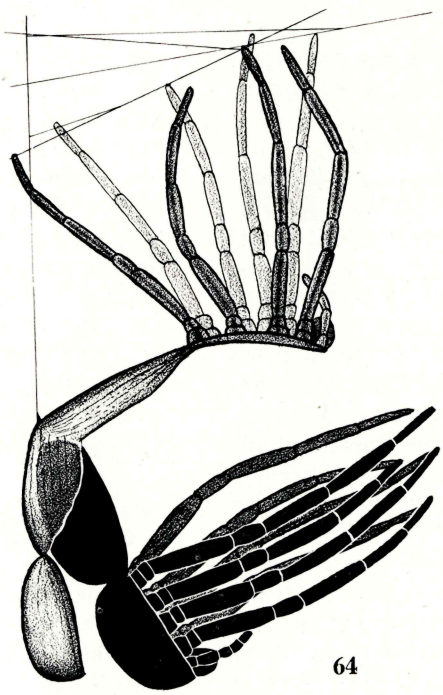

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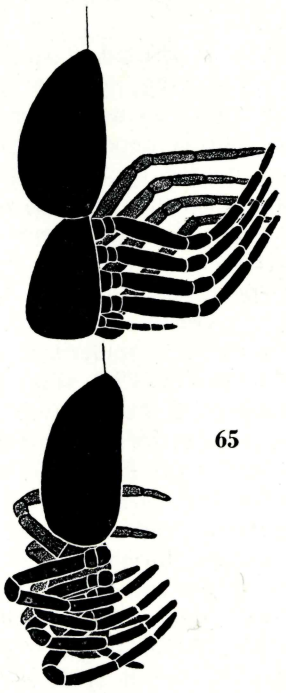

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Figs. 60-64. Successive stages during moulting. Fig. 65. Flexing of appendages after completion of moult (after Bonnet).

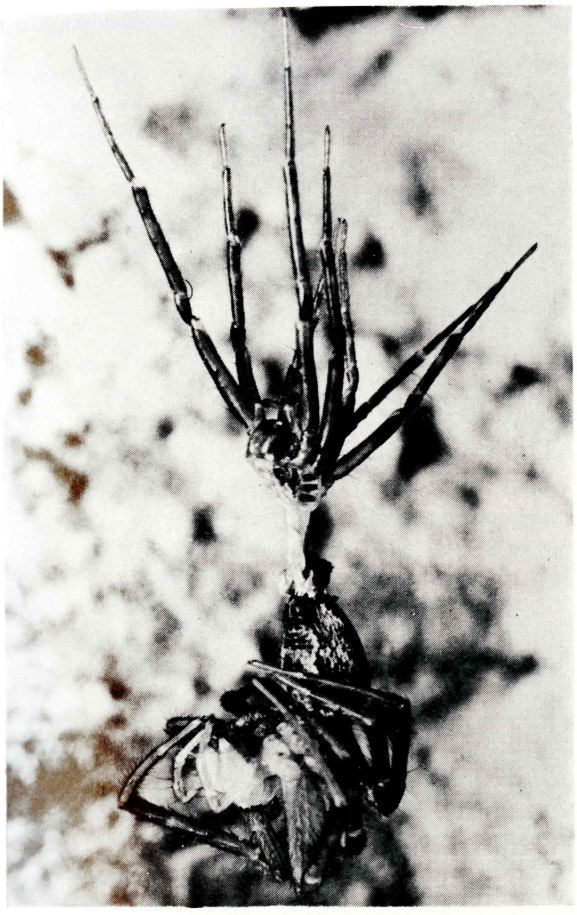

Fig. 66. Newly moulted female *Cambridgea antipodiana* flexing appendages (copied from Kodachrome slide). Punakaiki, Westland.

difficulty, at least three moults are usually required before the male palp may be regenerated properly formed and functional.

While it is commonly found that most spiders in temperate zones live only one year and are seasonal, in that the onset of the winter months greatly reduces their numbers and activity, this does not seem to be true to any great extent in New Zealand. This is probably primarily due to the fact that the winters are not very severe, but is also because the great bulk of our species live in the forest, which being evergreen provides greater protection against winter vicissitudes than deciduous forest. In the majority of species adults of both sexes are to be found at any time of the year, although the actual breeding season is restricted to the warmer months from September to March.

Silk

The use of silk is the most characteristic habit of spiders and one on which all spiders are more or less dependent in some phase of their behaviour. Most spiders other than the mygalomorphs lay down a dragline wherever they move. This is the line which is played out by the spider as it moves along and at intervals is fixed by an attachment disc to the substratum, so that if the spider drops it is supported by the line. Mygalomorph spiders use silk to line their tunnels and construct the trapdoors, or in some cases to construct quite voluminous tube webs as well as preparing the cover for their eggsacs. In many of the hunting or vagrant spiders silk is not used for snares but it is utilized in many other ways, such as for constructing nests to house the eggsac or for moulting or retreats which may be used between hunting. In many families of spiders a snare is constructed. The snares or webs take many forms which in a general way are characteristic for each group. These may be irregular meshed webs (c.f. Theridiidae), sheet webs (c.f. Linyphiidae), funnel webs (some Agelenidae), tube webs (*Hexathele, Porrhothele*). orb webs (Epeiridae) or combinations of these. The cribellated spiders use a hackled band which is viscid, and sticky threads are also found in the snares of the Epeiridae and some of the Theridiidae.

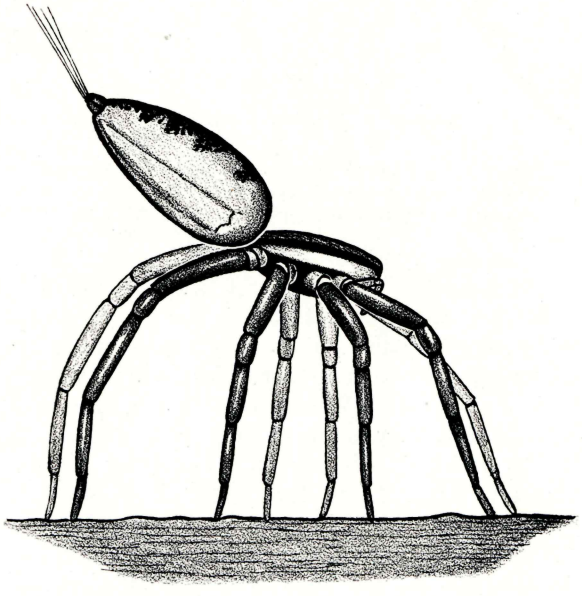

Fig. 67. Spiderling preparing for 'ballooning' (from Bristowe, 1958).



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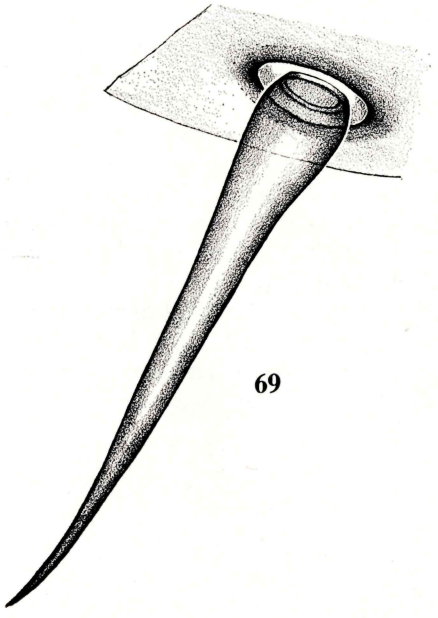

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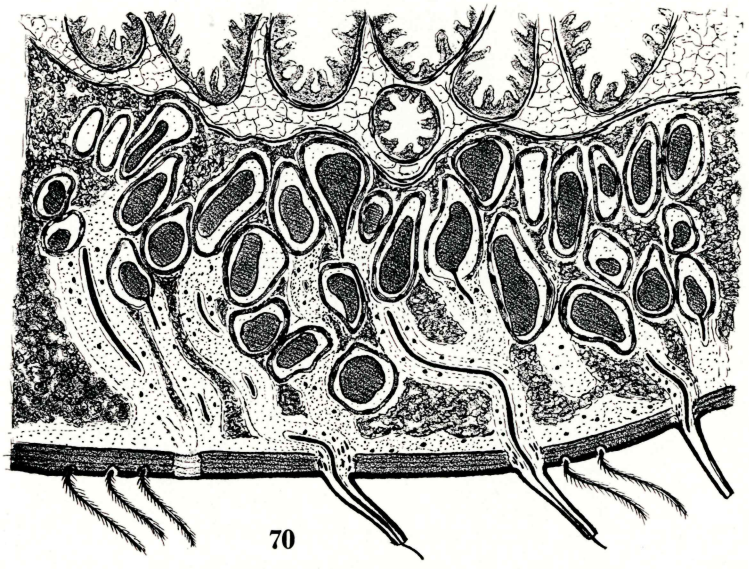

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Figs. 68-70. Epiandrous glands. Fig. 68. Portion of the epigastrium of *Porrhothele antipodiana* (Walck.) (Dipluridae), male, showing the spinning tubes. Fig. 69. Enlarged view of single spinning tube. Fig. 70. Section of epiandrous glands (from Melchers, 1964).

Perhaps the most interesting use of silk is for 'ballooning'. This habit is found mostly in spiderlings although in some families ballooning by adult spiders has been observed. The pattern of behaviour is very uniform (Fig. 67). The spider climbs as high as it can on grass stems, shrubs, etc. and then faces the wind. The legs are extended and the abdomen tilted upwards while the spinnerets are spread as the silk is emitted. As the pull of the wind becomes sufficient the spider lets go and floats through the air suspended from the floating threads which are then called gossamer. Ballooning does not seem to be as common in New Zealand as it is in many other countries and it is not known precisely just which New Zealand spiders do balloon. In the northern hemisphere by far the greatest bulk of gossamer comes from spiders of the families Linyphiidae and Micryphantidae whereas in New Zealand the latter family is represented by very few species, all of which may have been introduced by man, and many of the Linyphiidae live in evergreen forests where the opportunities for ballooning are few.

Reproduction

In most New Zealand spiders the sexes are alike although the male is often slightly smaller or more slender. However in some families there may be considerable differences in the size and sometimes in the form of the eye region and the abdomen. When there are gross differences in size it is usually the male which is small (*Celaenia, Arachnura*) and also where there are modifications of the head (*Dipoena, Trogloneta.* Figs. 3, 162) this modification is usually shown in the male. Most modifications of the abdomen however are more prominent in the female (*Celaenia, Phoroncidia,* Figs. 24, 165). In many of the Lycosidae and Salticidae epigamic structures, often in the form of bunches of hairs or scales, are found only in the male and these are displayed during courtship. The males of many species are also provided with structures, usually in the form of spurs or spines, which hold the female in some way during copulation. These structures are most often found on the legs (Cf. *Cantuaria,* Fig. 109. Symphytognathidae, Fig. 174) but also occur on the chelicerae (cf. *Dictyna,* Fig. 121) of some spiders.

During the mating season it is the male which actively hunts for the female. Shortly after the final moult the male spider constructs a small silken structure called the *sperm web.* This web, only a few millimetres in width, is used by the spider to support a drop of seminal fluid exuded from the gonopore. While it has always been assumed in the past that this web is spun from the spinnerets, recent studies by Marples (1967) and Melchers (1964) show that the silk comes from small glands on the epigastrium of the male

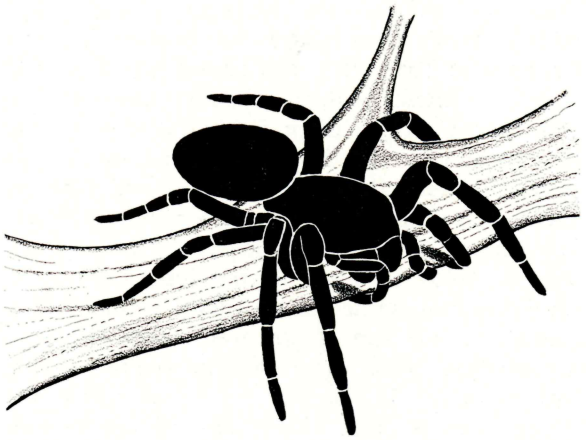


Fig. 71. Male spider charging palp. Direct method (after Bonnet).

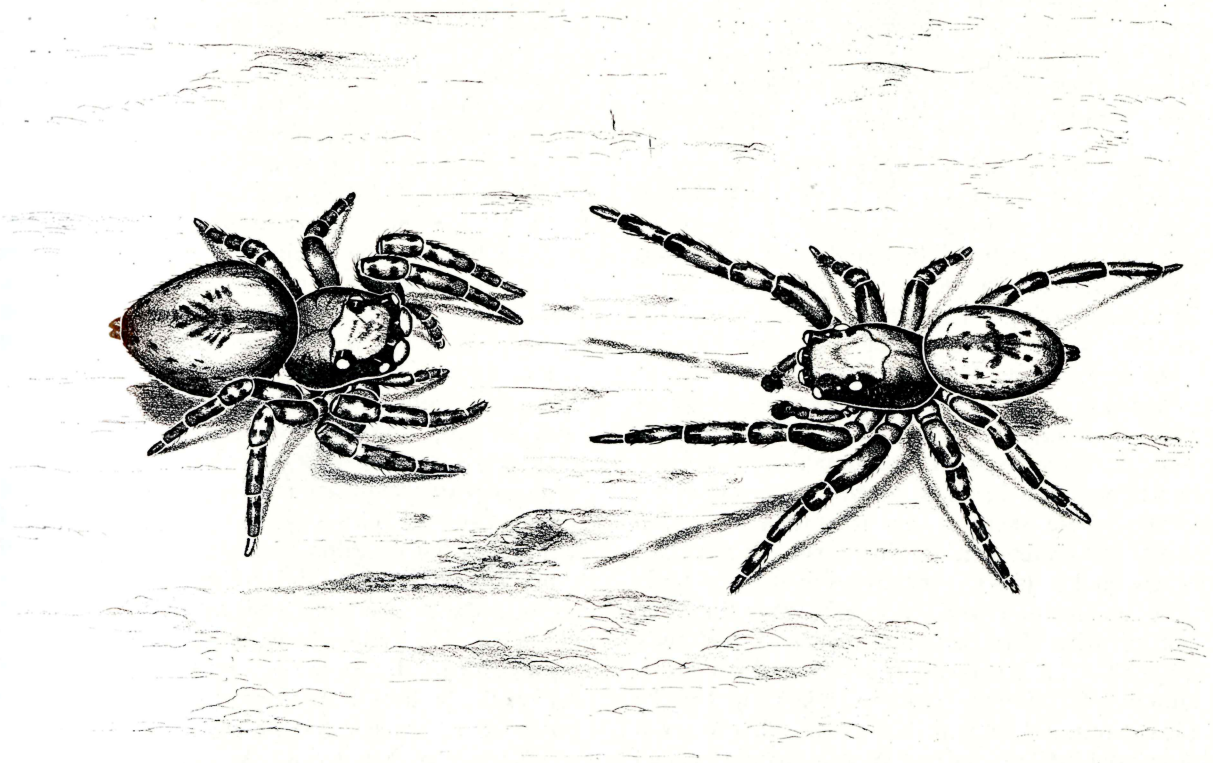


Fig. 72. Male and female salticids during courting behaviour. Dunedin, Otago. From life. Body length 6 mm.

called by Marples the *epiandrous glands* (Figs. 68-70). While these glands are present in most families, in some they are absent and it is not known if these spiders construct sperm webs. The palpal receptaculum is charged by dipping the organ into the drop of seminal fluid. This process is termed *sperm induction* and may be accomplished in two different ways, one of which is characteristic of any species. Most of the spiders which construct snares deposit the drop on the ventral surface of the sperm web and then, moving to the top of the web, reach the palp around and under it to fill the organ directly by immersion in the drop. This is called the *direct method* (Fig. 71). Many of the vagrant spiders however deposit the drop on the upper surface of the web but still reach the palp around and under the web to fill the palpal organ through the fibres of the web. This is called the *indirect method*. The mechanism by which the palp is charged is not completely known. It has in the past been suggested that this may be achieved by capillary action and also by the lowering of the pressure of the blood within the appendage. More recently however, Cooke (1966) has suggested that as it seems probable that ejection during copulation of the seminal fluid stored in the vesicle is achieved by the active secretion of a fluid from the palpal glands, the ability of these glands to resorb the secretion from within the vesicle during induction would provide the necessary mechanism. This suggestion has not yet been investigated.

Before mating actually takes place it is usual for some form of preliminary behaviour to take place and this is normally initiated by the male. In most of the web-building spiders the courtship preliminaries are tactile in nature and may consist of tweaking or drumming the web and presumably in some species by the use of stridulating organs. However many of the vagrant spiders carry out a marked courtship which is most pronounced in those families which have relatively keen eyesight, although it has been found that even in these groups there are some species where there is no non-tactile courtship at all. It is common in this form of courtship for the males to wave the palps or legs, or both, in a set fashion and this behaviour may be coupled with rhythmic movements of the body (Fig. 72). It has been found that there are a number of different positions taken up by the spiders during copulation and it is known that these positions are fairly constant within related groups. Gerhardt has divided these positions into five main types although many variations do occur.

Position 1 (Figs. 73, 74). The two sexes are facing opposite directions with the dorsal surface of the carapace of the male against the ventral surface of the female. In the non-web-spinning spiders, which assume this attitude, the male stands with his body at an angle to the female while in the web-builders the female is usually suspended upside down, with the male also upside down above her. This position is commonly found in the Mygalomorphs and those true spiders with a simple palp and no epigynum.

Position 2 (Fig. 75). In this position the two sexes are facing opposite directions but the male climbs on the back of the female. This is the position assumed by most lycosids and many agelenids.

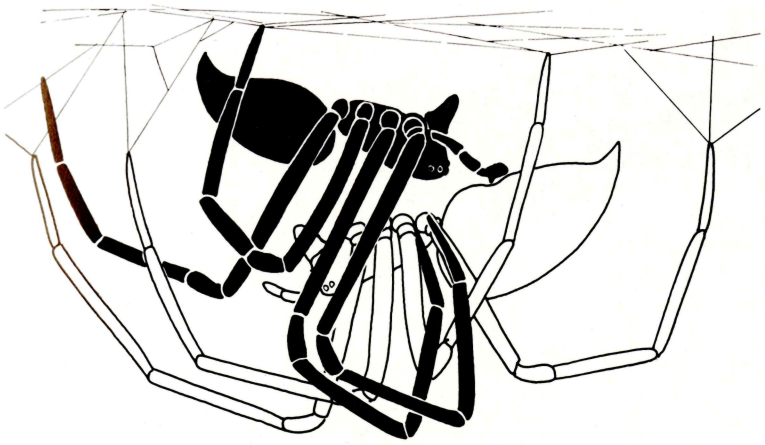
Position 3 (Fig. 77). In this position the male is beneath the female but they are venter to venter and facing in the same direction. This position is recorded for *Latrodectus, Argiope* and a number of thomisids. Kaston considers that this position has been developed independently from both positions 1 and 2.

Position 4 (Fig. 76). Recorded for *Chiracanthium* where the two sexes take up a position venter to venter but facing in opposite directions.

Position 5 (Fig. 78). The male is to one side behind the abdomen of the female and both are facing in the same direction. This position has been recorded in the Hahniidae.

While many of the spiders which mate in position 1 apply both palps together to the spermathecae beneath the genital furrow, most spiders apply the palps alternately. Gertsch considers that all or most of the spiders which use position 1 insert the right palp in the left orifice and vice versa, while all the other spiders, which generally are those with a well developed epigynum, insert the left palp into the left orifice and vice versa.

The time taken for the impregnation of a female may range from a few seconds to some hours. In the spiders with a complex palp and epigynum the insertion of the embolus may result only from the successful completion of a series of operations which are well described by Gertsch (1949). 'The palpus may be scraped across the epigynum until a spur on the tibia, on the tarsus or on the bulb itself, becomes fixed into a particular groove. Once firmly anchored in this starting point, the palpus swings to assume a position that, with the aid of ridges, grooves and other



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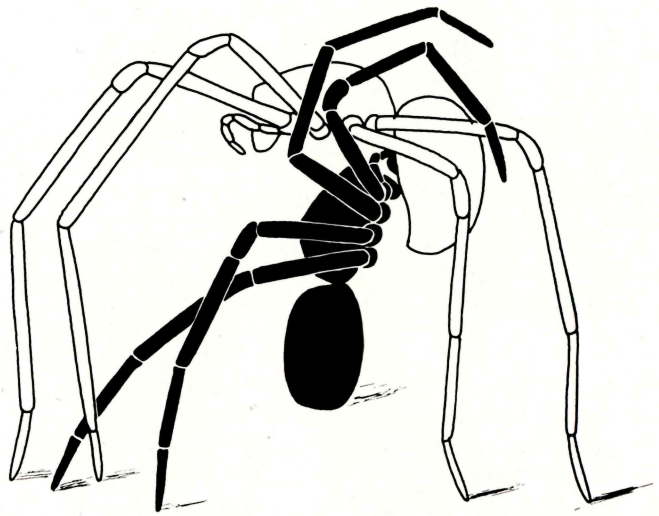

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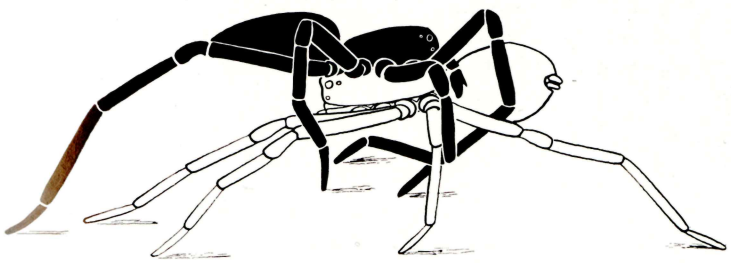

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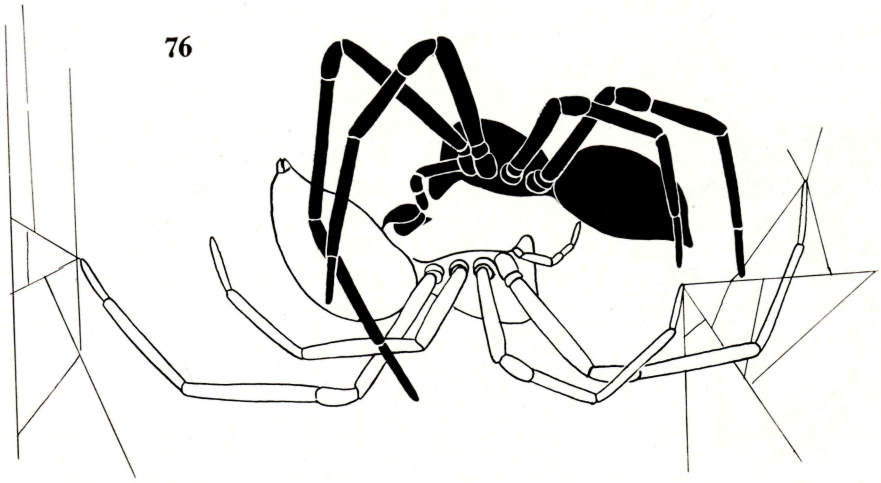
Figs. 73-75. Characteristic mating positions. Fig. 73 *Ostearius melanopygius* Cambr. (Linyphiidae). Mating position 1 (from Braun, 1961). Fig. 74. *Scytodes thoracica* (Scytodidae). Mating position 1, alternative form (from Kaston, after Gerhardt). Fig. *Lycosa rabida* (Lycosidae). Mating position 2 (from Kaston, 1948).



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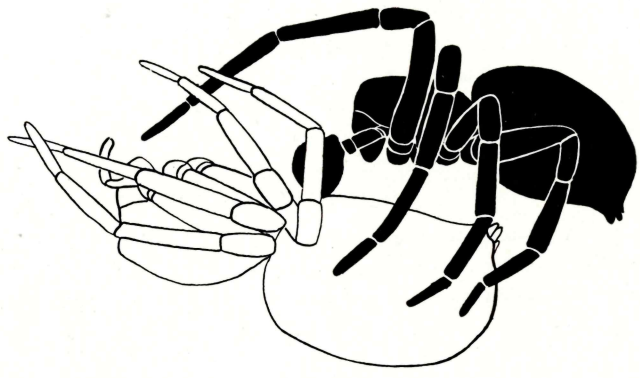

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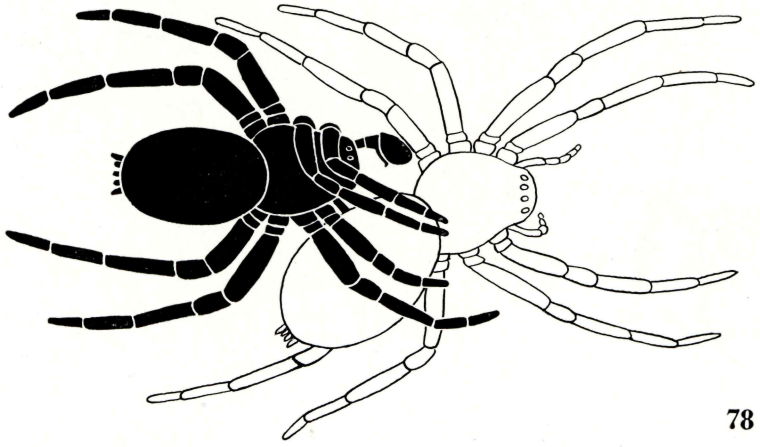

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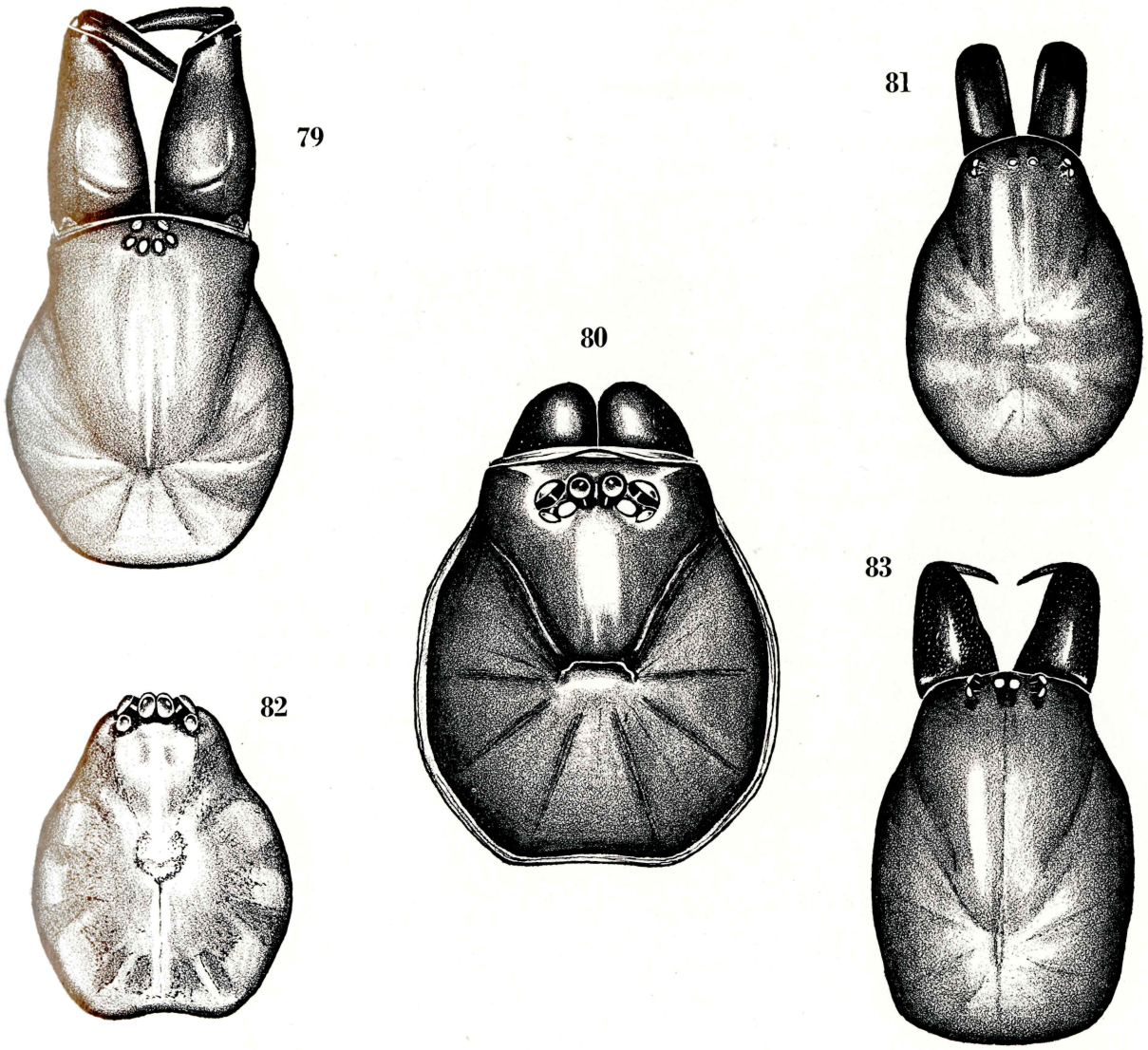
Figs. 76-78. Characteristic mating positions. Fig. 76. *Chiracanthium* sp. (Clubionidae). Mating position 4 (after Gerhardt). Fig. 77. *Xysticus triguttatus* (Thomisidae). Mating position 3 (from Kaston, 1948). Fig. 78. *Antistea* sp. (Hahniidae). Mating position 5 (from Denis, after Gerhardt).

processes on the epigynum corresponding to its own outline, make it possible to guide the embolus to exactly the right point for entering the orifice. At this stage, the bulb of the palpus is still largely in its resting position, lying folded in the cup of the tarsus, and the preliminary contacts serve to hold it firmly in place. Most spiders have at the base of the bulb various thin pouches, or haematodochae that swell up with the influx of blood until they attain enormous size. This distension causes the entire bulb to turn on its axis, which action forces the embolus into the appropriate opening.'

It is apparent that the sperm may remain viable in the receptacula seminis for long periods. While some females mate a number of times, in some spiders (Toxopidae, some Clubionidae, Theridiidae) where the epigynum is often found to be plugged with a hard black substance, it is probable that this substance is deposited from the epigynum or the male palp after the initial mating and so preventing any subsequent impregnation. In a number of groups it has also been shown that after a successful mating the female with not respond to the subsequent advances of another male.



Figs. 79-83. Dorsal view of the carapace of New Zealand spiders illustrating particularly the arrangement of eyes. Fig. 79. *Dysdera crocata* (Dysderidae) Introduced. Widespread in New Zealand. Fig. 80. *Migas kochi* Wilton (Migidae) female. Norsewood, Hawkes Bay. Fig. 81. *Periegops suteri* (Urquhart) (? Segestriidae). Banks Peninsula, Canterbury. Fig. 82. *Pounamua australis* Forst. (Oonopidae). Auckland Is. Fig. 83. *Ariadna* sp. (Segestriidae). Wellington.

KEY TO THE FAMILIES OF SPIDERS OCCURRING IN NEW ZEALAND

1. Two pairs of book lungs present (Figs. 25, 26) 2
   One pair of book lungs present or tracheae only (Figs. 27, 28) 5

2. Chelicerae paraxial (Fig. 25). Legs particularly strong. Eyes in a relatively compact group (Fig. 80) Mygalomorphae 3
   Chelicerae diaxial (Fig. 26). Eyes in two rows, not in a compact group. Retroclaw of legs I and II greatly elongate. Cribellum and calamistrum absent. Vagrant spiders, forest and cave dwellers (Figs. 117, 118) ..... **Gradungulidae**

3. Anterior and posterior pairs of spinnerets small, approximately equal in length Four or six spinnerets .Posterior pair very long, easily visible from above. Six sigillae on the sternum (Figs. 113-116) 4
   ..... **Dipluridae**

4. Chelicerae with rastellum. Sternum with six sigillae. (Trapdoor spiders, Figs. 107-112) ..... **Ctenizidae**
   Chelicerae without rastellum. Sternum with two sigillae (Figs. 105-106) **Migidae**

5. Cribellum and calamistrum present (Figs. 19, 21) 6
   Cribellum and calamistrum absent 8

6. Anal tubercle large, two jointed, with a fringe of long hair (Figs. 32, 126) **Oecobiidae**
   Anal tubercle not as above, normally with single segment 7

7. Eyes all dark. Femora with trichobothria. Chelicerae without boss (Fig. 127) **Uloboridae**
   AME dark but other eyes pale. No trichobothria on femora. Chelicerae with a boss (Figs. 119-125) ..... **Dictynidae**

8. Six eyes. Epigynum absent. Male palpal organ simple 9
   Eight eyes or if with six eyes then epigynum present and male palpal organ complex 11

9. Six eyes in a compact group 10
   Six eyes in three widely separate pairs (Figs. 130-134) ..... **Segestriidae**

10. Posterior row of eyes strongly procurved Claws pectinate in a single row (Fig. 129) ..... **Dysderidae**
    Posterior row of eyes strongly recurved Claws pectinate in a double row (Fig. 128) ..... **Oonopidae**

11. Legs with two claws 12
    Legs with three claws 18

12. Eight eyes arranged in three rows (Figs. 89, 92) 13
    Eight eyes arranged in two rows (Fig. 93) 14

13. Chelicerae without boss. Anterior row of eyes on more or less vertical face with the median pair largest. Carapace more or less square or oblong in outline (Figs. 178-180) ..... **Salticidae**
    Chelicerae with boss. Anterior row of eyes on same level as other eyes and relatively small (Figs. 89, 152) ..... **Ctenidae**

14. Colulus absent 15
    Colulus present. Living in silken nest near high tide mark (Fig. 147) .....
    ..... **Amaurobioididae**

15. Legs in the prograde position (Fig. 158). (*Hemicloea* is an exception — see fig. 159.) 16
    Legs in the laterigrade position (Figs. 153-155) 17

16. Anterior pair of spinnerets separated at their base by a distance about equal to the diameter of one of the spinnerets. Eyes heterogeneous (Figs. 102, 158-159) ..... **Gnaphosidae**
    Anterior pair of spinnerets contiguous or nearly so. Eyes homogeneous (Figs. 101, 156, 157) ..... **Clubionidae**

17. Very large spiders. Chelicerae with boss. Legs with scopulae (Fig. 155) **Sparassidae**
    Medium sized or small spiders. Chelicerae without a boss. Legs without scopulae (Figs. 153, 154) ..... **Thomisidae**

18. Eyes arranged in two triads. If eight eyes present them AME isolated from the triads (Fig. 90). Chelicerae fused at the base. Always with long and slender legs (Fig. 135) ..... **Pholcidae**
    Not as above 19

19. Tibia and metatarsus of legs I and II with a row of long spines on the prolateral surface, with shorter curved spines in the intervals (Figs. 167, 168) ..... **Mimetidae**
Legs without this arrangement of spines 20

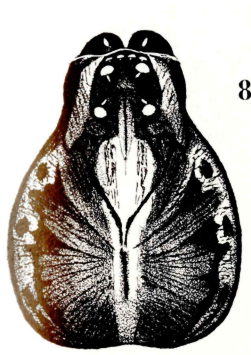
20. Tarsi with trichobothria 21
Tarsi without trichobothria 27

21. Chelicerae without a boss. Maxillae triangular and directed across the labium (*Huttonia* Fig. 142) ..... **Zodariidae**
Chelicerae with boss. Maxillae not as above 22

22. Eyegroup hexagonal, with anterior row strongly procurved and posterior row strongly recurved, Clypeus very high (Figs. 86, 87, 166) ..... **Oxyopidae**
Eyes not as above or if eyes approximating this condition then clypeus not high 23

23. Six spinnerets arranged in a transverse row, posterior spiracle removed from the spinnerets (Fig. 141) **Hahniidae**
Not as above 24

24. ALE smaller than AME and placed behind the level of the AME adjacent to the PLE (Figs. 85, 143-146) **Toxopidae**
Eyes not as above 25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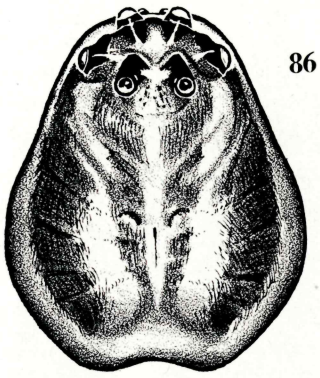
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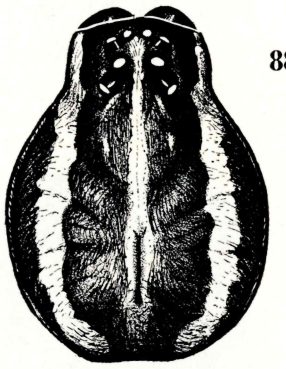
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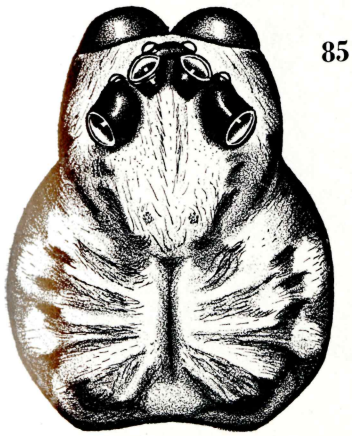
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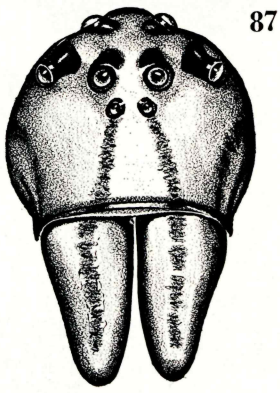
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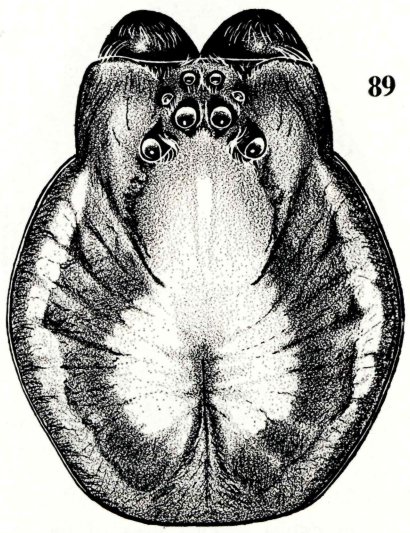
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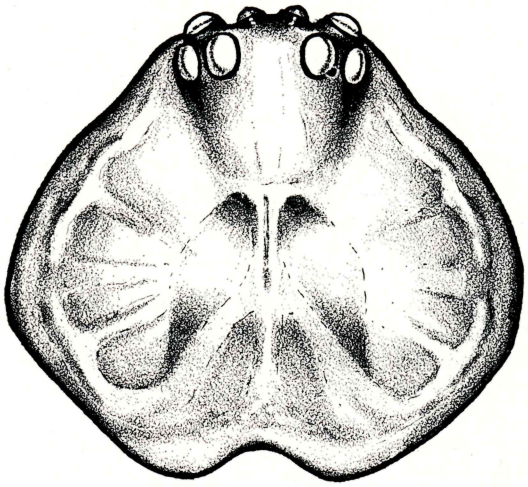
Figs. 84-89. Dorsal view of the carapace of New Zealand spiders illustrating the arrangement of the eyes. Fig. 84. *Lycosa* sp. (Lycosidae). Dunedin, Otago. Fig. 85. *Cycloctenus* sp. (Toxopidae). Homer, Fiordland. Figs. 86, 87. *Oxyopes* sp. (Oxyopidae). Dorsal and front view. Canterbury. Fig. 88. *Dolomedes* sp. (Pisauridae). Otago. Fig. 89. *Argoctenus aurens* Hogg (Ctenidae). East Harper, 3,500 ft., Canterbury.



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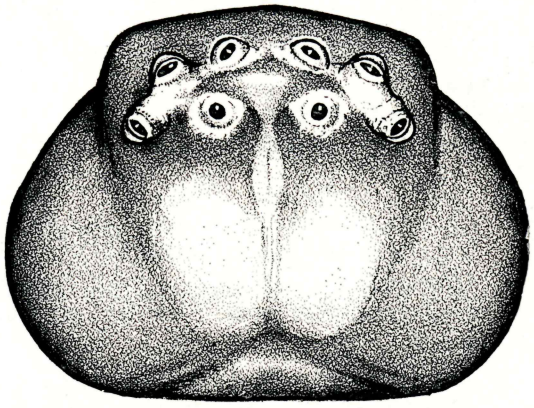

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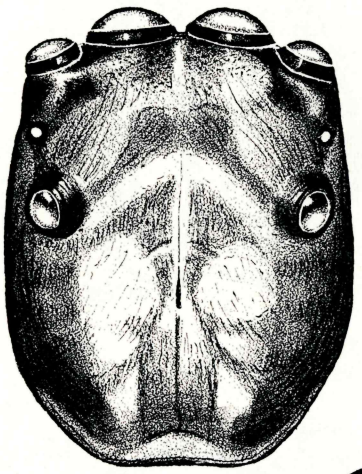

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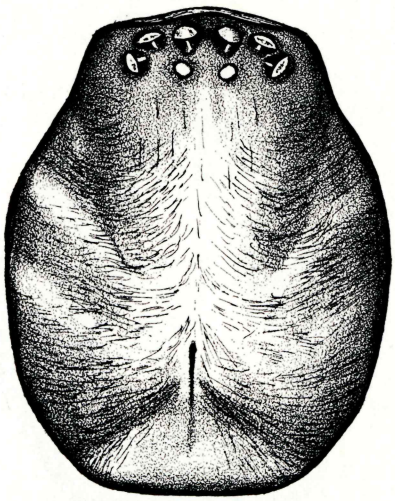

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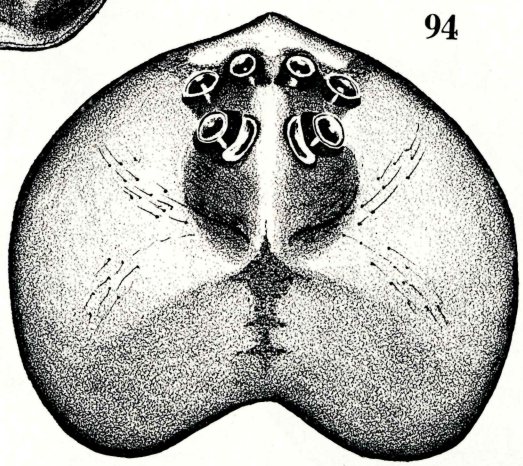
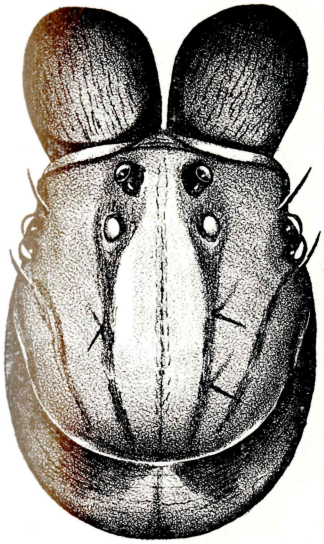


Figs. 90-94. Dorsal view of the carapace of New Zealand spiders illustrating the arrangement of the eyes. Fig. 90. *Pholcus phalangioides* (Pholcidae). Introduced. Fig. 91. *Diaea* sp. (Thomisidae) Canterbury. Fig. 92. Family Salticidae. Feilding, Manawatu. Fig. 93. *Hypodrassodes* sp. (Gnaphosidae). Houhoura, North Auckland Fig. 94. *Oecobius annulipes* (Oecobiidae). Introduced.



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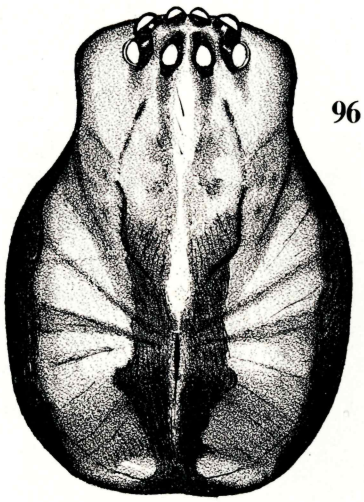

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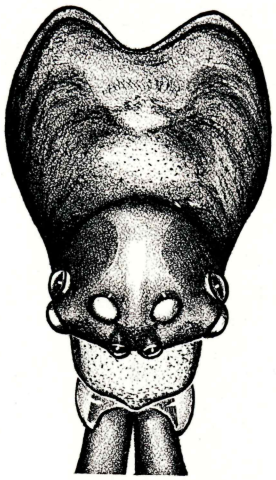

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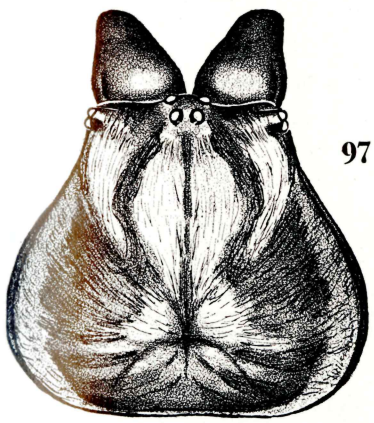

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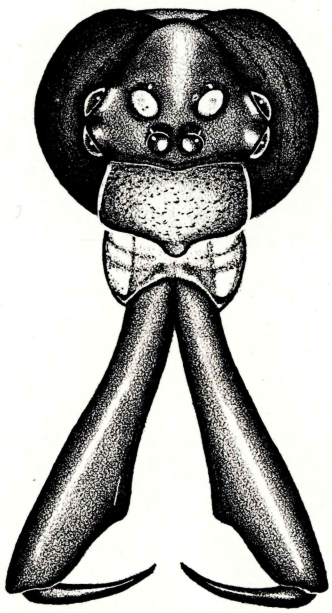

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Figs. 95-99. Dorsal view of the carapace of New Zealand spiders illustrating the arrangement of the eyes. Fig. 95. *Pararchaea magna* (Forster) (Archaeidae). Lake Te Au, Fiordland. Fig. 96. *Cambridgea antipodiana* (White) (Agelenidae). Martins Bay. Fiordland. Fig. 97. *Aranea pustulosa* (Walck) (Epeiridae). Widespread, probably introduced from Australia. Figs. 98-99. *Holarchaea novaeseelandiae* (Forster) (Archaeidae). Okarito, Westland.

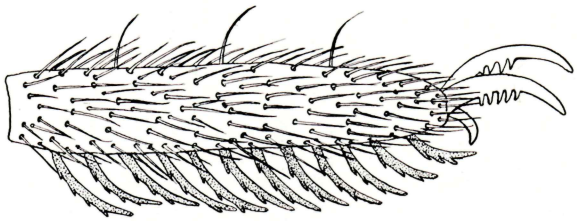


Fig. 104. Fourth tarsus of a Theridiid showing the tarsal comb (semi-diagrammatic).

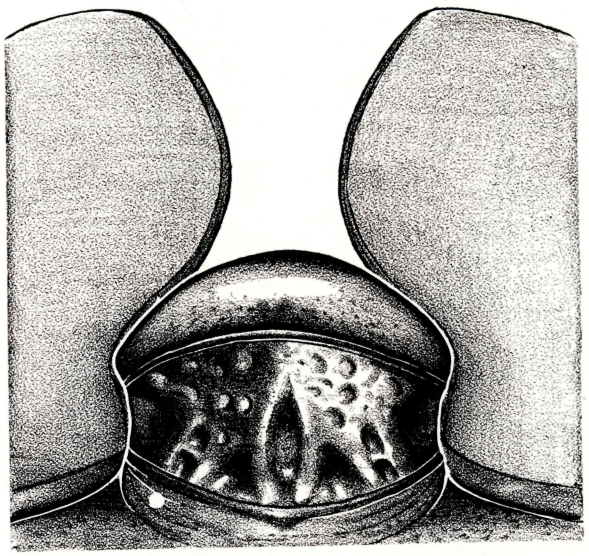


Fig. 100, Rebordered labium. Family Linyphiidae.

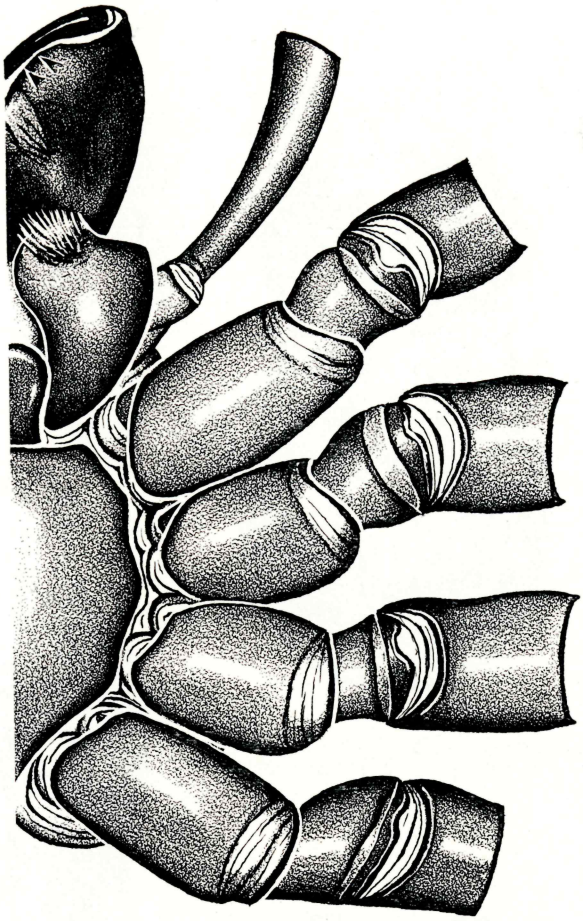
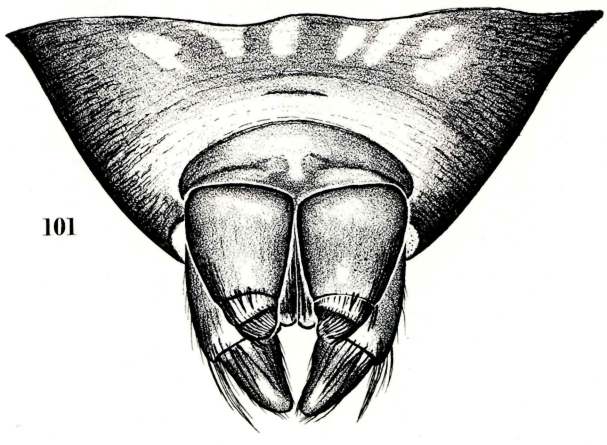


Fig. 103. Ventral surface of the cephalothorax of a lycosid showing the notched trochantera.



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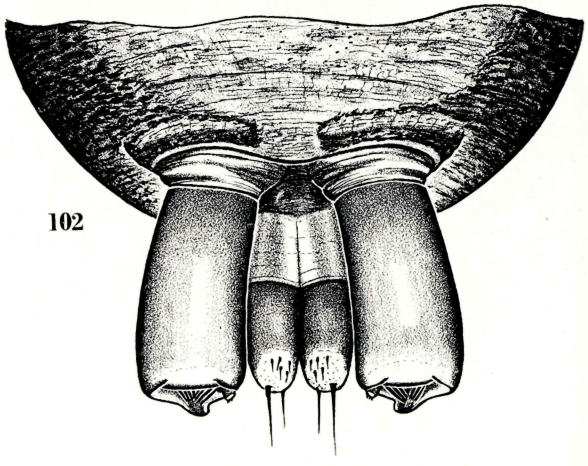

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Figs. 101-102. Spinnerets of spiders of the families Clubionidae and Gnaphosidae illustrating the relatively wide separation of the anterior pair of spinnerets in the Gnaphosidae. Fig. 101. *Chiracanthium stratioticum* (Clubionidae). Fig. 102. Family Gnaphosidae.

25. All trochanters with a notch on the distal edge of the ventral side (Fig. 103). Posterior row of eyes strongly recurved 26
Trochanters not notched, or if notched, posterior row of eyes never strongly recurved (Figs. 136-140) ..... **Agelenidae**

26. Posterior row of eyes so strongly recurved as to form two rows (Fig. 84). Inferior claw smooth or with a single tooth. Tibia of male palp without apophyses (Figs. 148, 149) ..... **Lycosidae**
Posterior row of eyes only slightly recurved so that it appears as a single row (Fig. 88). Inferior claw with two or more teeth. Tibia of male palp with apophysis (Figs. 150-151) ..... **Pisauridae**

27. Chelicerae inserted well above the mouth so that there is a pronounced space between the maxillae and the insertion of the chelicerae (Figs. 95, 98, 99, 173) ..... **Archaeidae**
Chelicerae not as above 28

28. Labium rebordered (Fig. 100) 29
Labium not rebordered 32

29. Eyes homogeneous. Sustentaculum often present 30
Eyes heterogeneous. Sustentaculum never present 31

30. Femora with trichobothria. Chelicerae large in most species always elongate (Fig. 172) ..... **Tetragnathidae**
Femora without trichobothria. Chelicerae not usually large rarely elongate (Figs. 164-171) ..... **Epeiridae**

31. Tibia of male pedipalp without apophyses. Tibia IV usually with two dorsal spines or bristles (Fig. 175, 176) ..... **Linyphiidae**
Tibia of male palp with apophysis. Tibia IV with a single dorsal spine or bristle, or none (Fig. 177) ..... **Micryphantidae**

32. Tarsus longer than metatarsus in at least one pair of legs. Female palp weak, reduced or absent. If present without claw. Carapace or eye region elevated, at least in the male. Tarsal comb absent (Fig. 174) ..... **Symphytognathidae**
Tarsi shorter than the metatarsi. Female palp normal, usually with claw. Carapace only rarely elevated in the male (c.f. *Dipoena* Fig. 162). Tarsal comb normally present (Figs. 104, 160-165) ..... **Theridiidae**

ILLUSTRATIONS AND DISCUSSION OF FAMILIES OCCURRING IN NEW ZEALAND

Migidae

The single New Zealand genus is *Migas* (Fig. 105). These relatively small mygalomorphs are similar in appearance to the Ctenizidae but do not have the rastellum on the chelicera and have only two sigillae on the sternum instead of six. Like the ctenizids they live in tunnels with a trapdoor lid but although a few construct these in the earth or sand most of them construct the complete nest of silk, with one or two trapdoors, on the surface of a tree trunk or on a rock face (Fig. 106). In these habitats the surface of the silk is covered with pieces of lichen, moss or bark so that the nest is difficult to see.

Ctenizidae

All of the New Zealand ctenizids are at present placed in *Cantuaria* (Figs. 107-109) and these are distinguished from all other mygalomorphs known from New Zealand by the presence of a group of strong teeth on the disto-dorsal surface of the paturon of the chelicera, known as the rastellum, which is used during the excavation of the tunnel. While most of the species construct a wafer lid which closes the entrance to the tube (Figs. 110-111) a few live in open tunnels (Fig. 112). The range of the family is from Wanganui

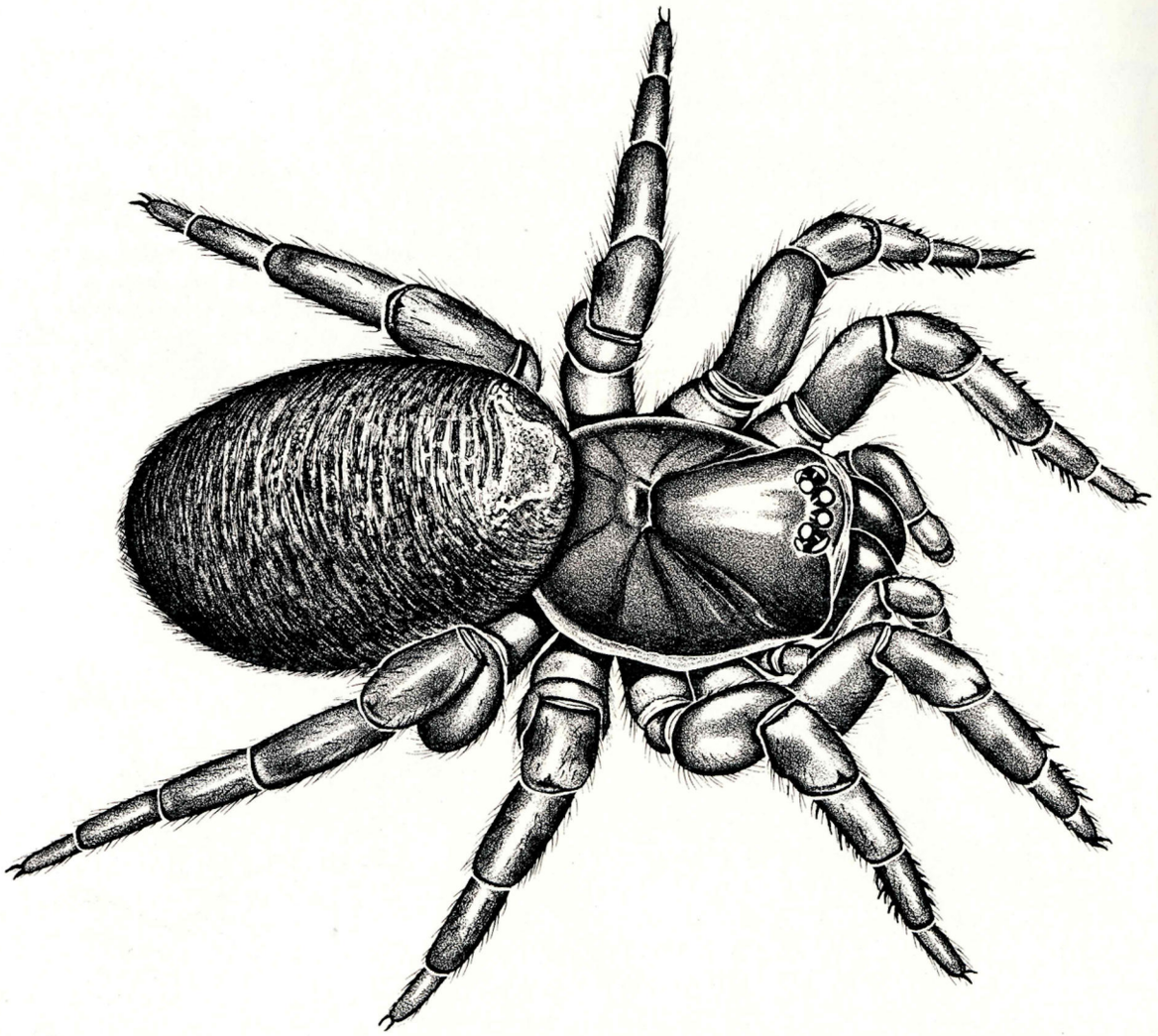

Fig. 105. *Migas kochi* Wilton female (Migidae). Norsewood, Hawkes Bay. From life. Body length 11 mm.

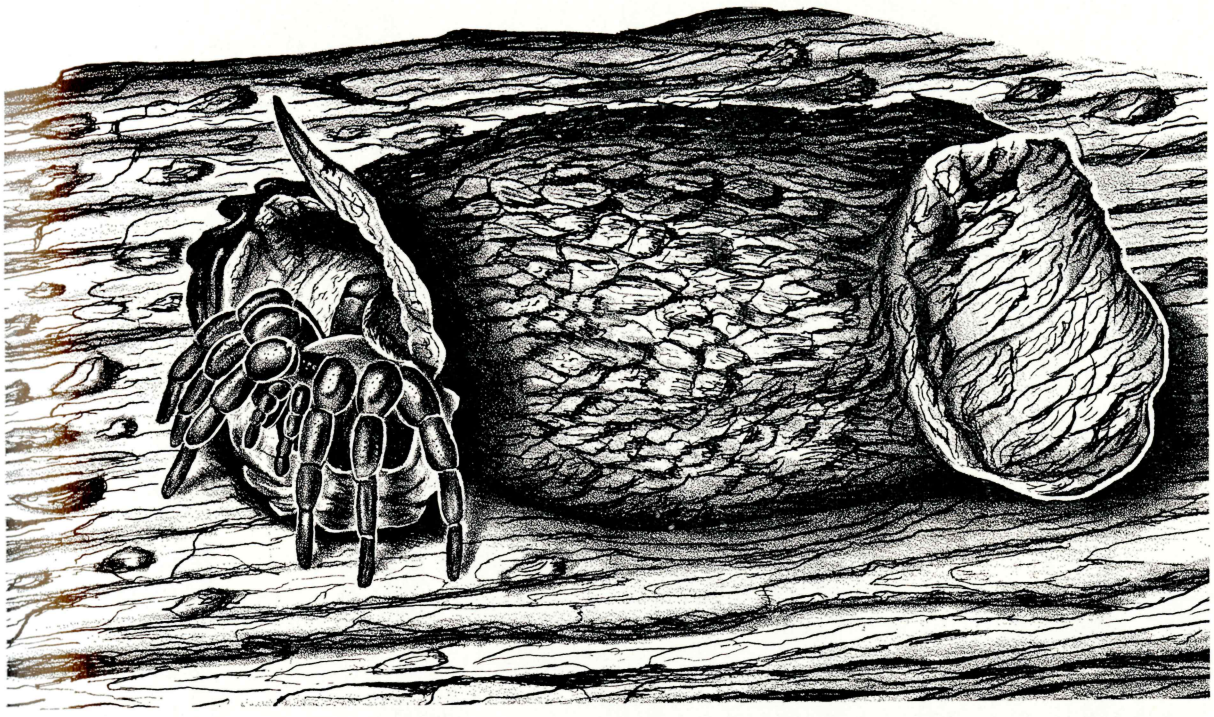

Fig. 106. Nest of *Migas cantuarius* Wilton (Migidae). The presence of two trap-doors is unusual but does occur sporadically in many species. The nests are usually constructed on tree trunks. Length 35 mm. From life.

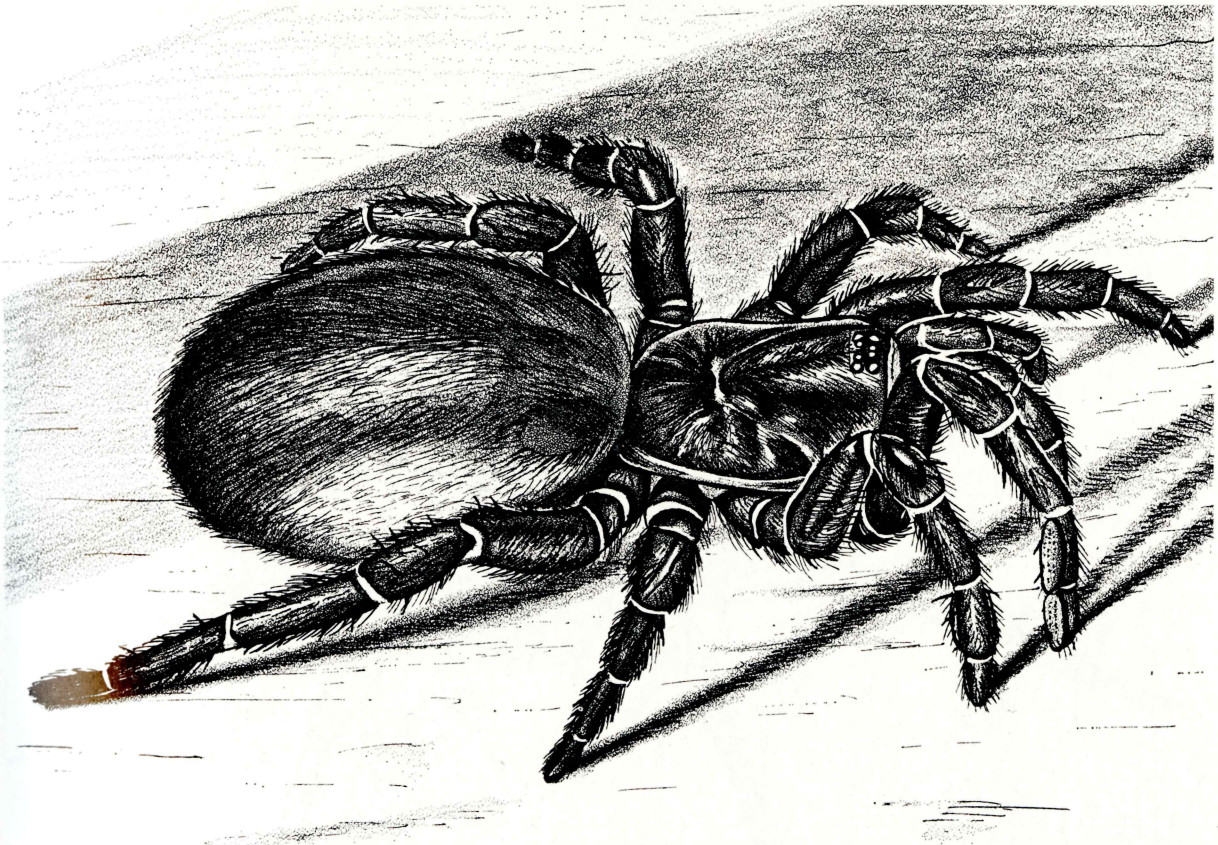

Fig. 107. *Cantuaria marplesi* (Todd) female (Ctenizidae). Otekaike, Otago. From life. Body length 14 mm.

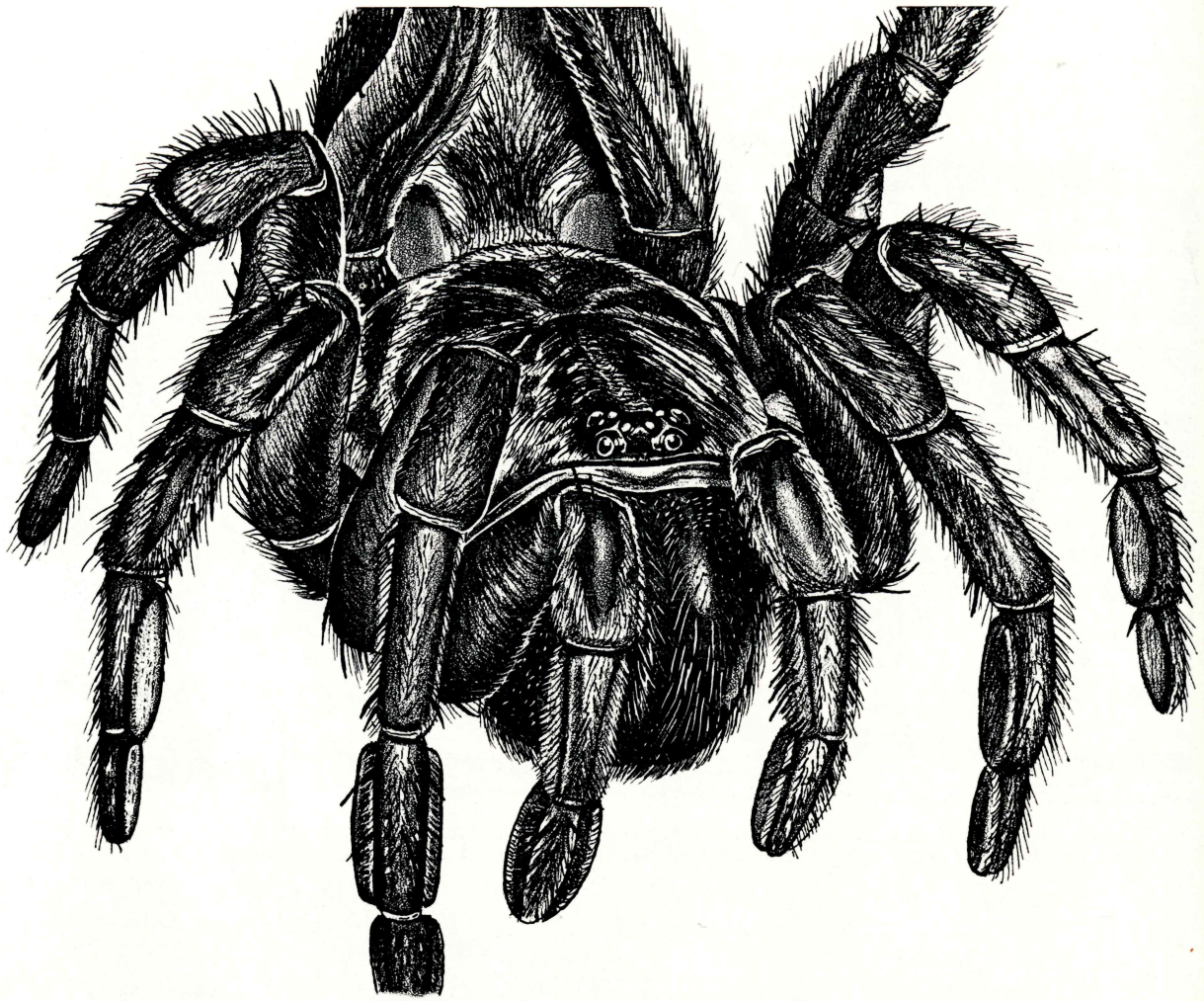

Fig. 108. *Cantuaria marplesi* (Todd) female (Ctenizidae). Otekaike, Otago. Front view to show the scopulae on the tarsi and metatarsi of the palps and first two pairs of legs, which are present in many species of *Cantuaria*. From life. Body length 14 mm.

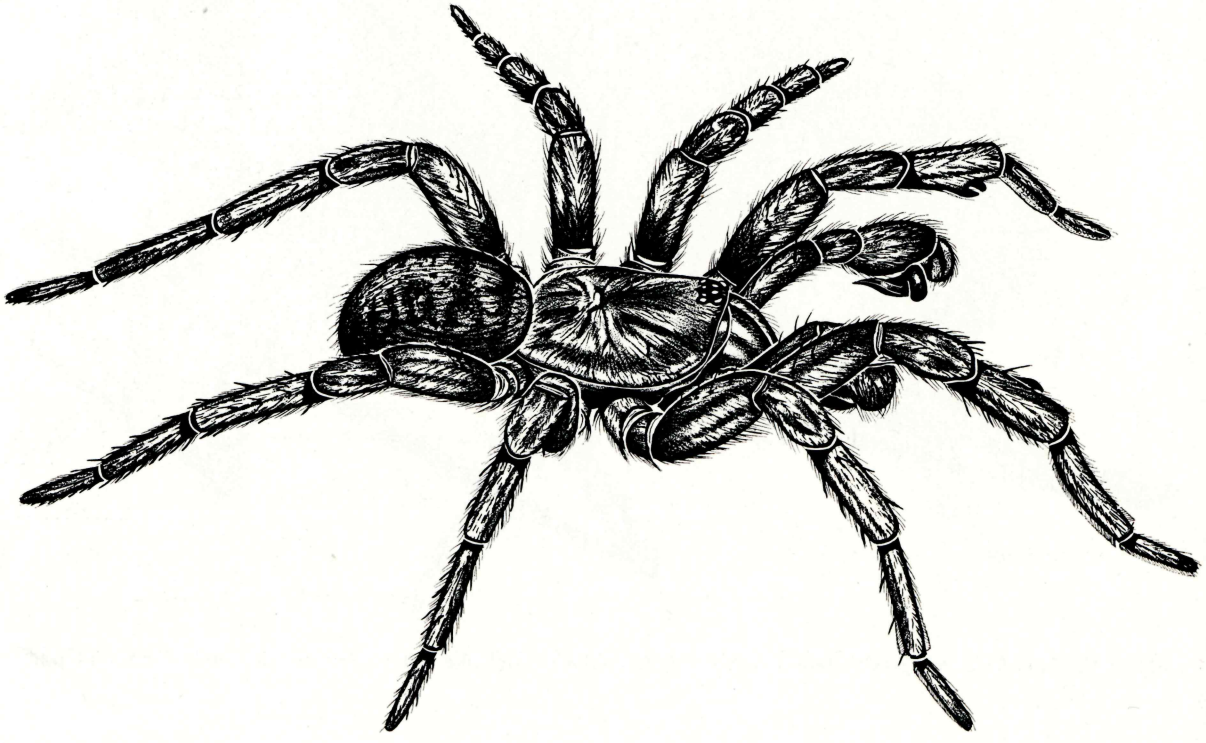

Fig. 109. *Cantuaria* sp. male (Ctenizidae). Tuapeka Flat, Otago. Note the processes on the tibiae of the first pairs of legs which are found in all members of this family in New Zealand .From life. Body length 18 mm.



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Figs. 110-111. Trap-door nest of *Cantuaria toddi* Forster (Ctenizidae). Alexandra, Otago. Fig. 110. Closed. Fig. 111. Partly open. Width of lid 14 mm. From life.



Fig. 112. Tunnel of *Cantuaria huttoni* (Cambridge) (Ctenizidae). Waipori Gorge on floor of beech forest. Spiders of the *huttoni* group do not construct doors and the tunnels are usually found in forest. Width of burrow 8 mm. From life.

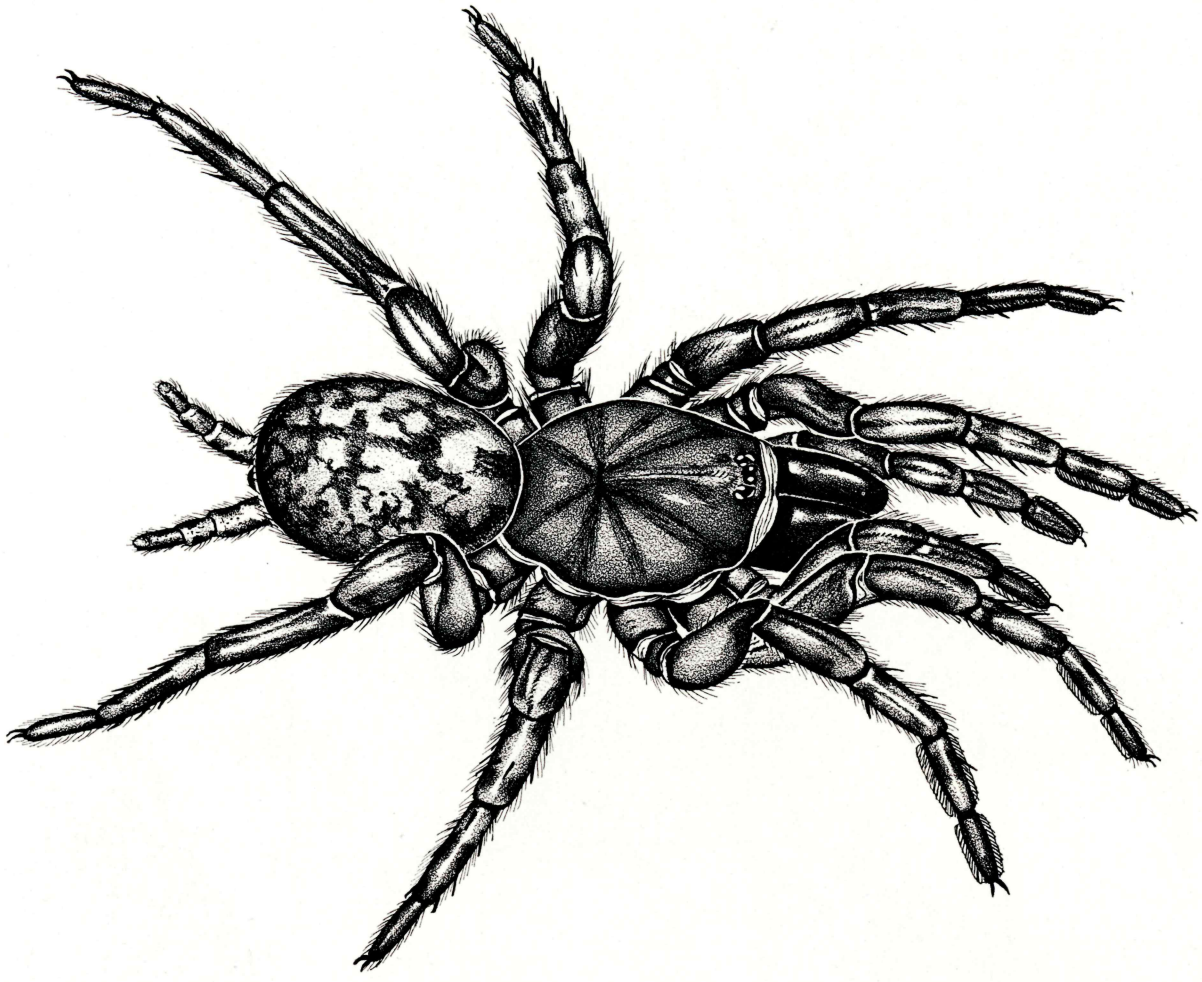


Fig. 113. *Aparua hollowayi* Forster female (Dipluridae). North Auckland. This species lives in a silken tube on the surface of the ground but other species live in tunnels in the earth. Preserved specimen. Body length 17 mm.

in the North Island down the west coast to Wellington, all over the South Island, on Stewart Island and many of the closer offshore islands.

Dipluridae

Three genera of these large mygalomorph spiders occur in New Zealand, and they are all distinguished by the very long pair of posterior spinnerets which project beyond the abdomen when it is viewed from above. *Aparua* (Fig. 113) has a mottled pattern on the dorsal surface of the abdomen, while the superior claws are doubly pectinate, and it also possesses four spinnerets. Some species live in open mouthed burrows, but others construct a typical silken tube on the surface of the ground beneath stones and logs. *Hexathele* (Fig. 114) which has six spinnerets and a single row of pectinations on the superior claws is also often distinguished by a chevron pattern on the dorsal surface of the abdomen which does however become obscured in the adults of some species. Like *Aparua* some species live in burrows while others construct a silken tube on the ground. *Porrhothele* (Figs. 115, 116) which also has a single row of pectinations on the superior claws, has only four spinnerets, and the abdomen is usually uniformly dark. While a few species may live in burrows by far the majority construct silken tubes on the surface of the ground under stones and logs or in cracks and crevices. Each of these genera ranges over most of New Zealand.

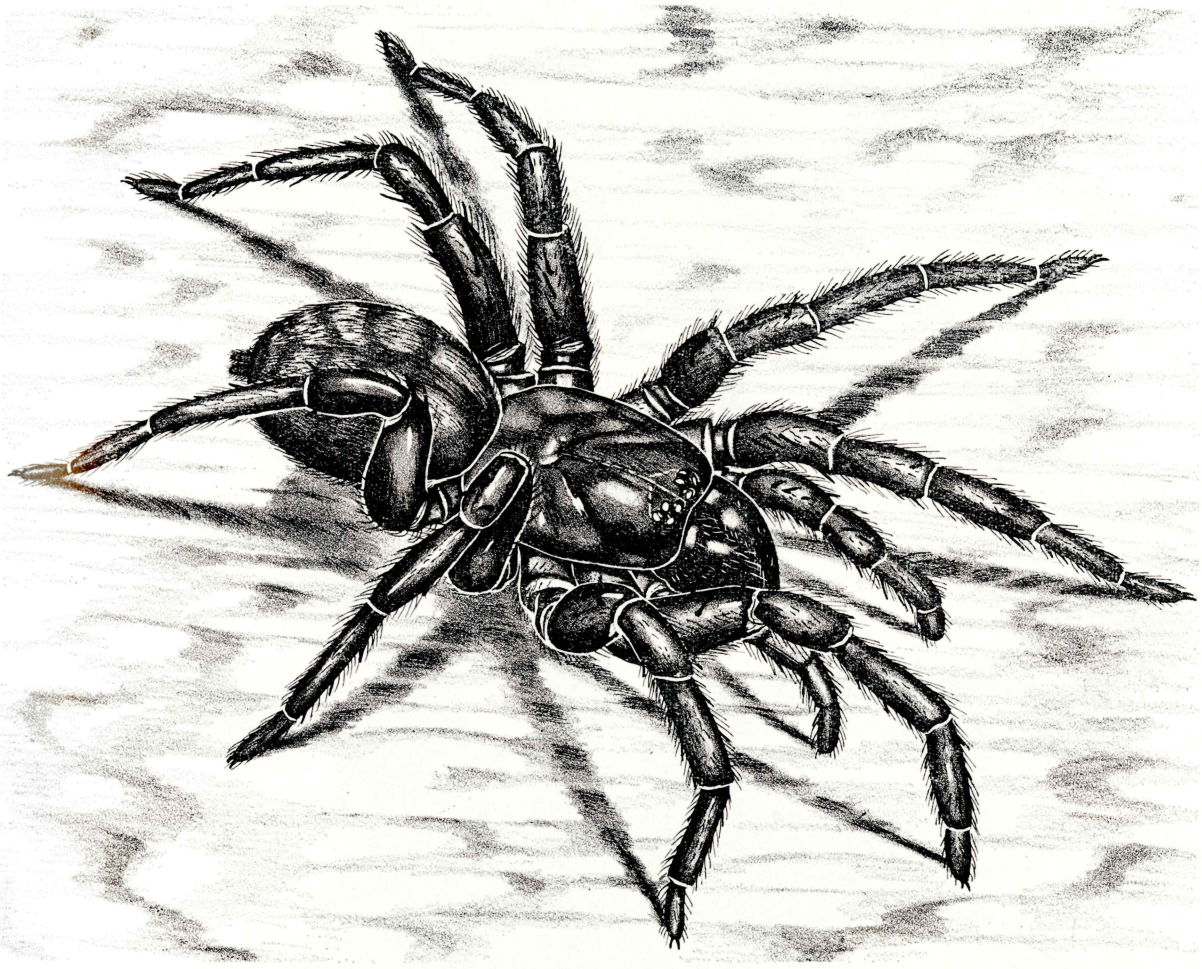
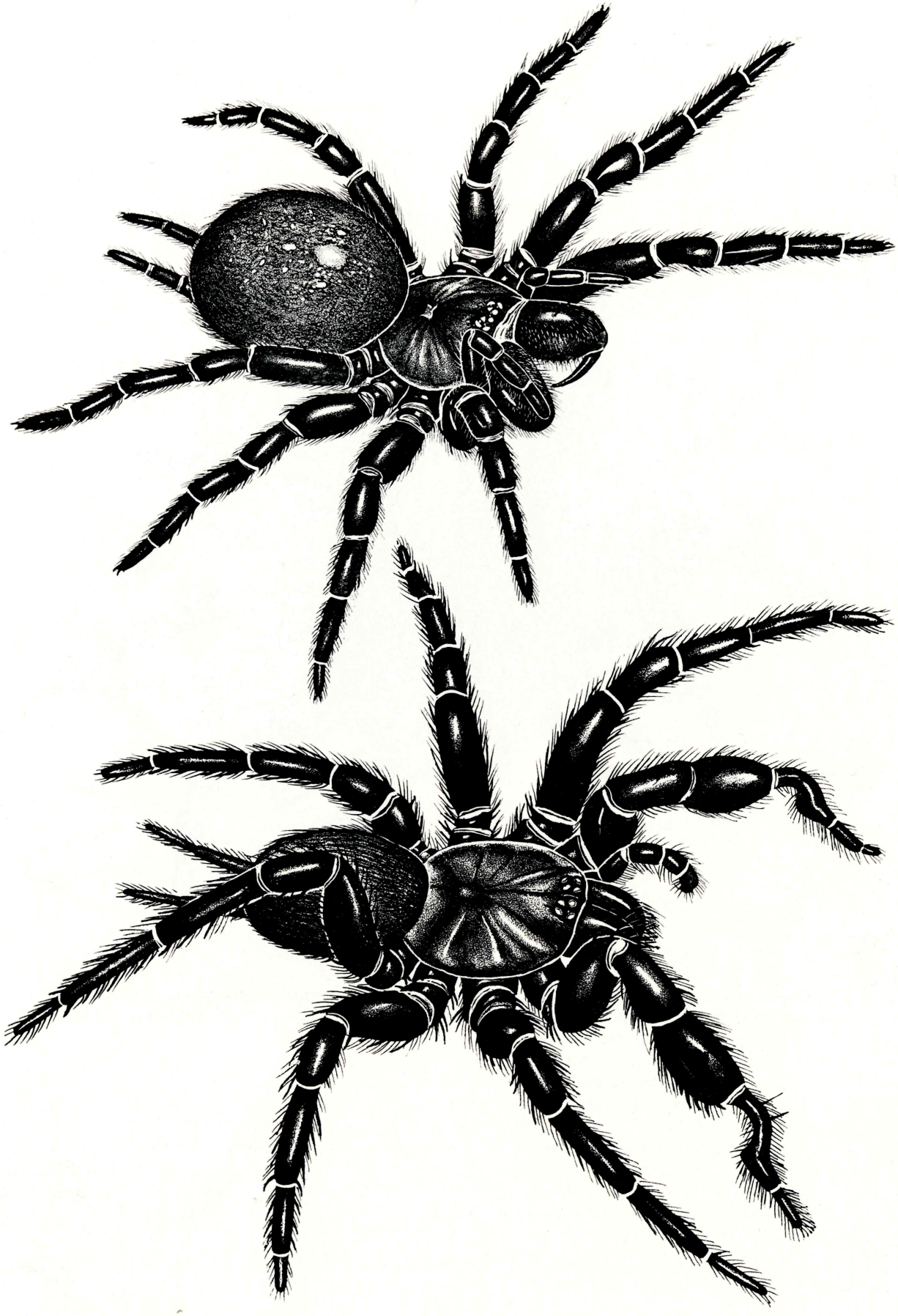


Fig. 114. *Hexathele hochstetteri* Auss. female (Dipluridae). Auckland. This species is normally found in a loose silken tube but other species may live in tunnels in the ground. Preserved specimen. Body length 18 mm.



Figs. 115-116. *Porrhothele antipodiana* (Walck.) (Dipluridae). Bideford, Wairarapa. Above female. Below male. From life. Body length, female 23 mm., male 21 mm.

Gradungulidae

The family Gradungulidae is found in both New Zealand and Australia, and these are the only spiders found in New Zealand with diaxial chelicerae and four lung books. All known species (one in Australia, two, one undescribed, in New Zealand) belong to the genus *Gradungula* and possess the peculiar, conspicuously modified, superior claws on the first and second pairs of legs (Figs. 117-118). In contrast with the Hypochilidae they do not have a cribellum and calamistrum and being vagrant spiders do not construct a snare. They live in forest or in caves. The cave dwelling species constructs a large spherical eggsac which is suspended by a thin stem from the wall of the cave and it is probable that the other species construct a similar sac.

Dictynidae

This is the most numerous group of cribellate spiders in New Zealand and in this publication includes both the Dictynidae and Amaurobiidae of some authors. The commonest species, found particularly on the weather boards of houses is *Ixeuticus martius* (Fig. 119), probably introduced from Australia, which constructs a large web with zig-zag sticky cribellate threads leading back to a tunnel retreat. Many of the forest species are small or minute, and construct relatively small snares. *Dictyna cornigera* Dalmas (Figs. 121, 123) belongs to the widespread genus *Dictyna* but, unlike overseas species which usually construct their snares in shrubs or grass, is found in and under stones on creek and river beds. A related group of small green spiders are found in shrubs in New Zealand (Fig. 124). In some of the New Zealand species the cribellum and calamistrum is reduced and in others seems to have been lost completely. The native species occupy all terrestial habitats including the seashore. *Matachia* (Fig. 122) lives in old insect burrows in twigs and small branches and these spiders have the first three pairs of legs directed forward, Various species of *Oramia* (Fig. 120) live in most parts of the South Island and the southern portion of the North Island. Most construct a conspicuous sheet web leading out from a retreat.

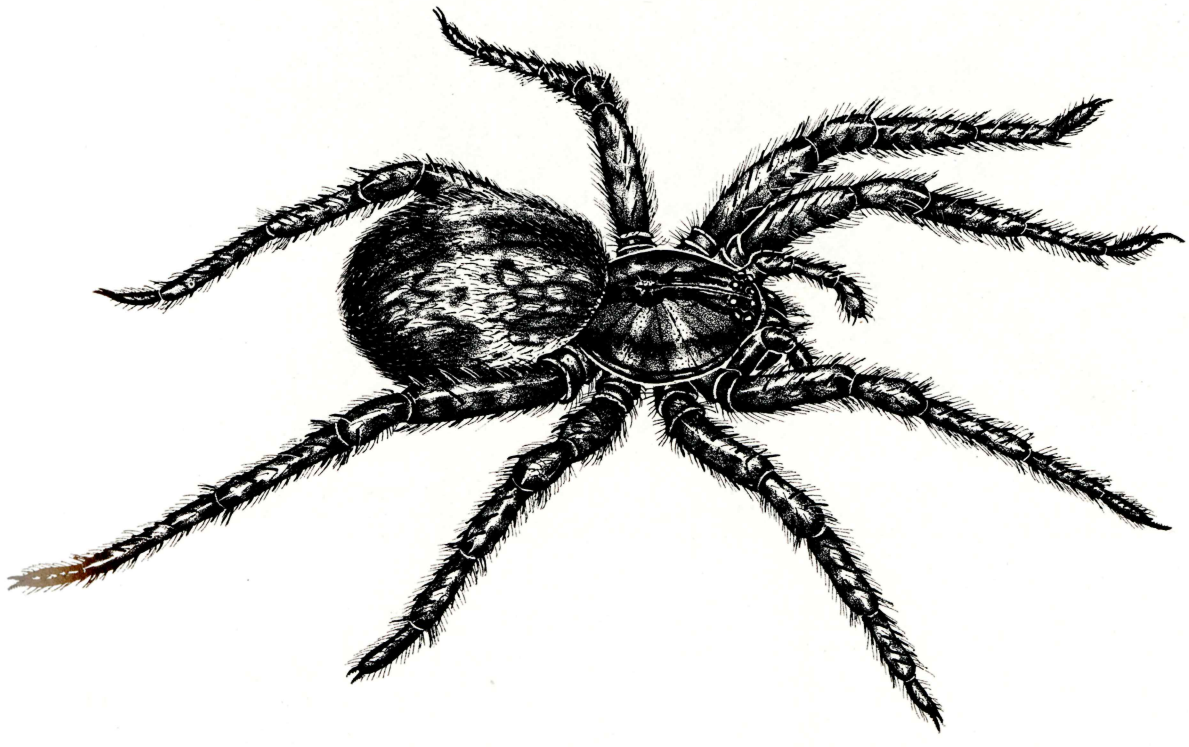


Fig. 117. *Gradungula sorenseni* Forster female (Gradungulidae). Buller Gorge, Westland. From life. Body length 6.5 mm.

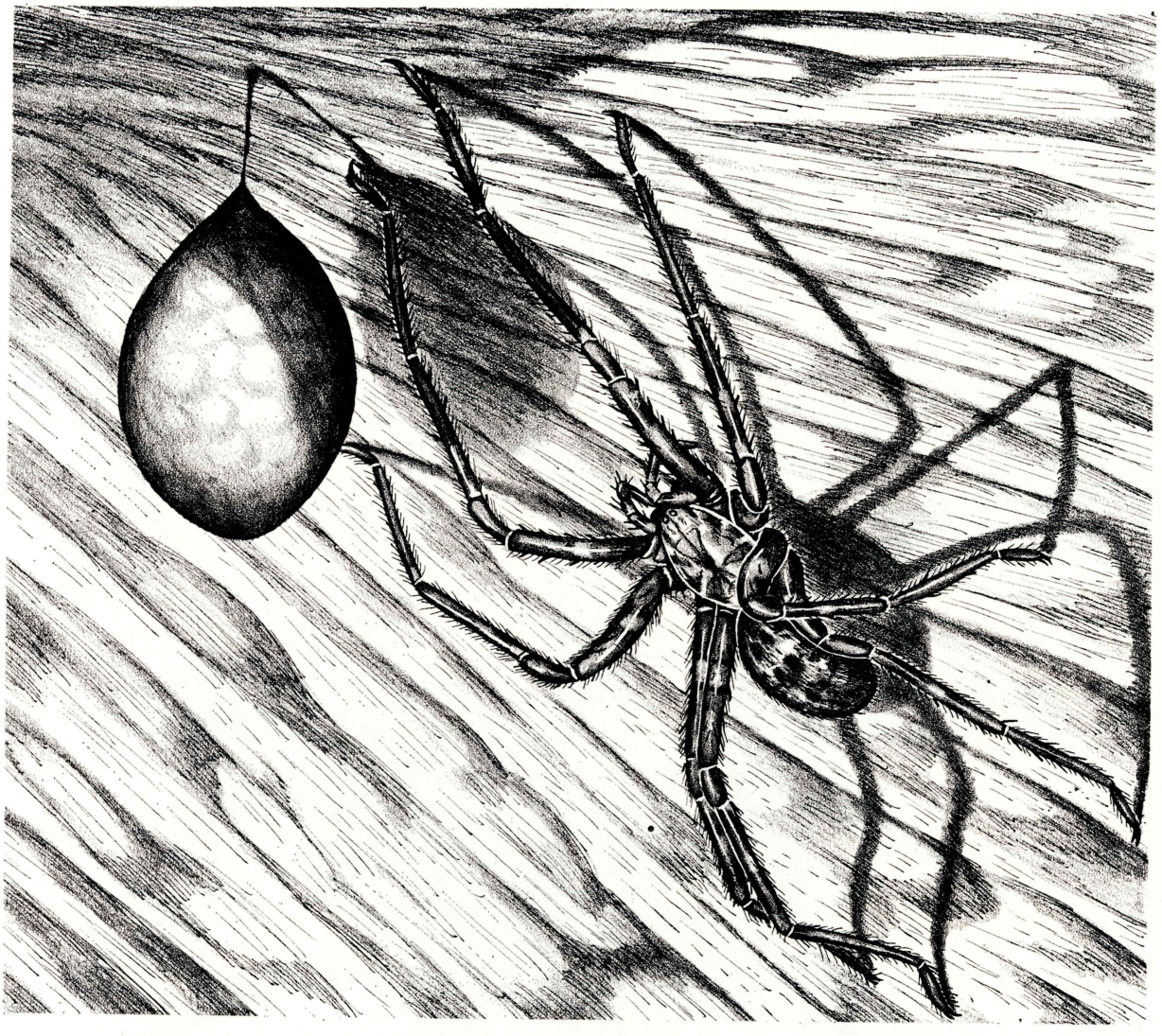


Fig. 118. *Gradungula* sp. female (Gradungulidae). Nelson. This is the largest spider found in New Zealand. The leg spread may be up to five inches. Found in caves in the Nelson-Karamea district. The egg-sac is attached to the wall of the cave. Preserved specimen. Body length 25 mm.



Fig. 119. *Ixeuticus martius* (Simon) female (Dictynidae). Found throughout New Zealand in and near houses and sheds where it constructs conspicuous webs with a retreat. Probably introduced from Australia. From life. Body length 14 mm.

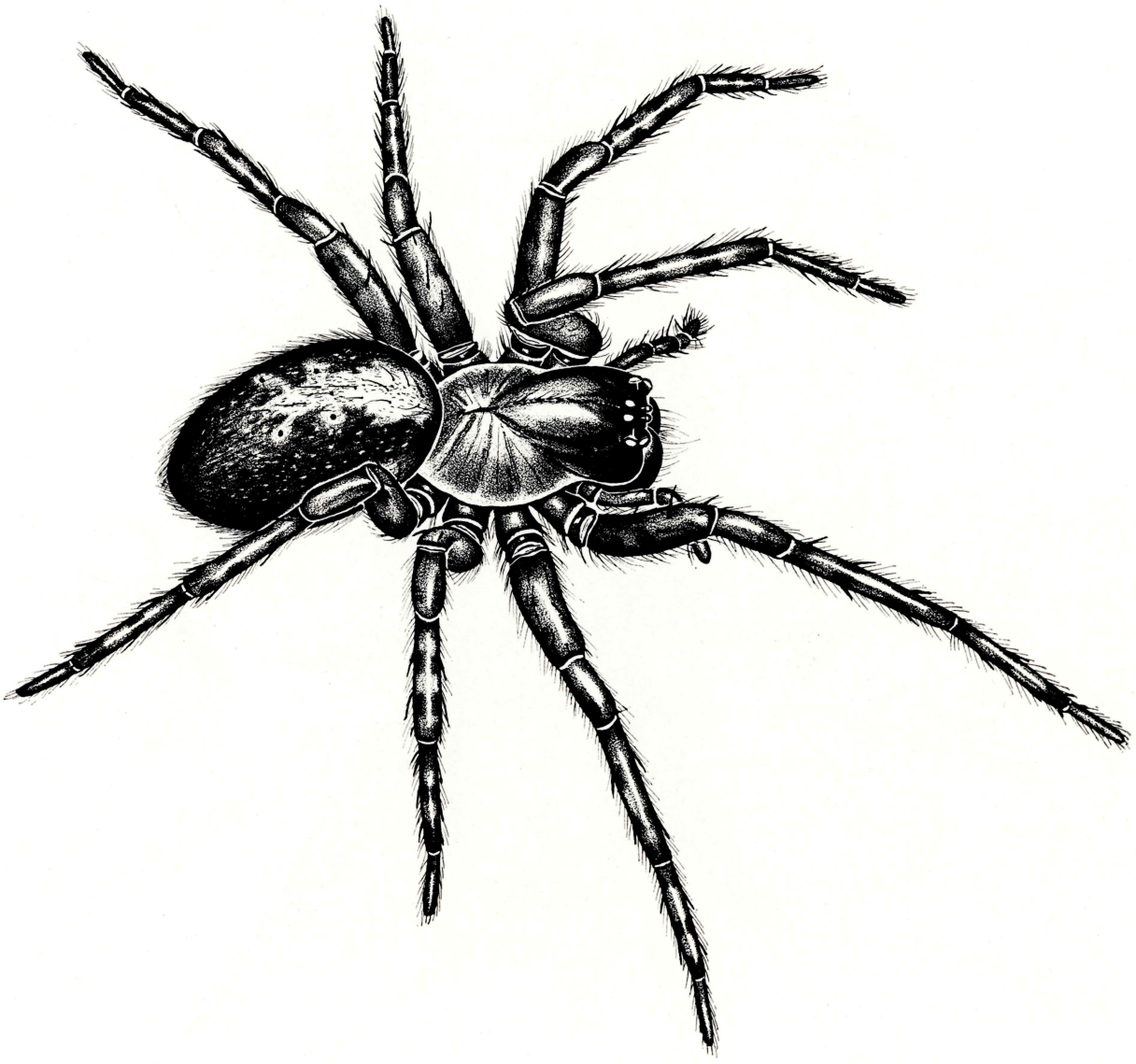


Fig. 120. *Oramia charybdis* (Hogg) female (Dictynidae). Fiordland. Similar species are found throughout the South Island and the southern portion of the North Island. Some construct large sheet webs leading to a retreat. From life. Body length 16 mm.

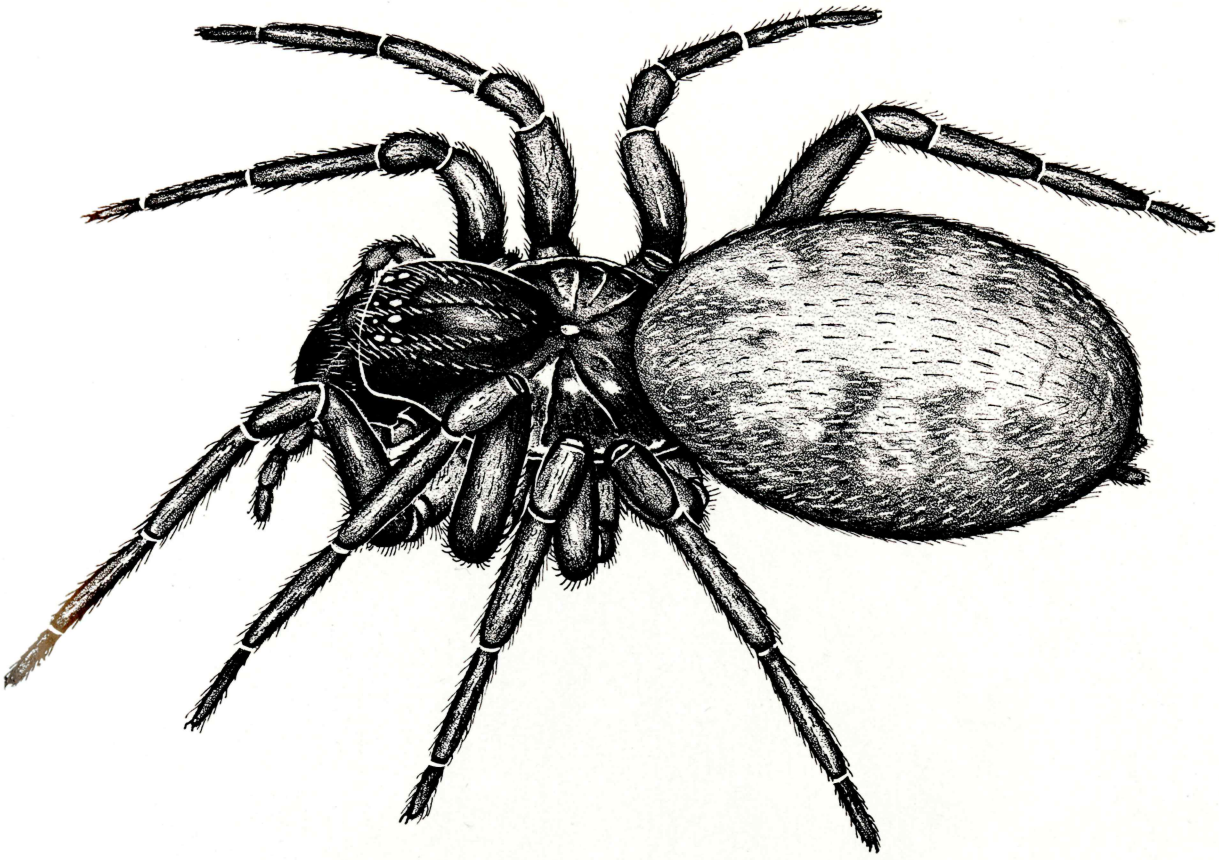


Fig. 121. *Dictyna cornigera* Dalmas female (Dictynidae). Waipara River, Canterbury. This species constructs a web among stones on river beds in both the North and South Islands. From life. Body length 4 mm.

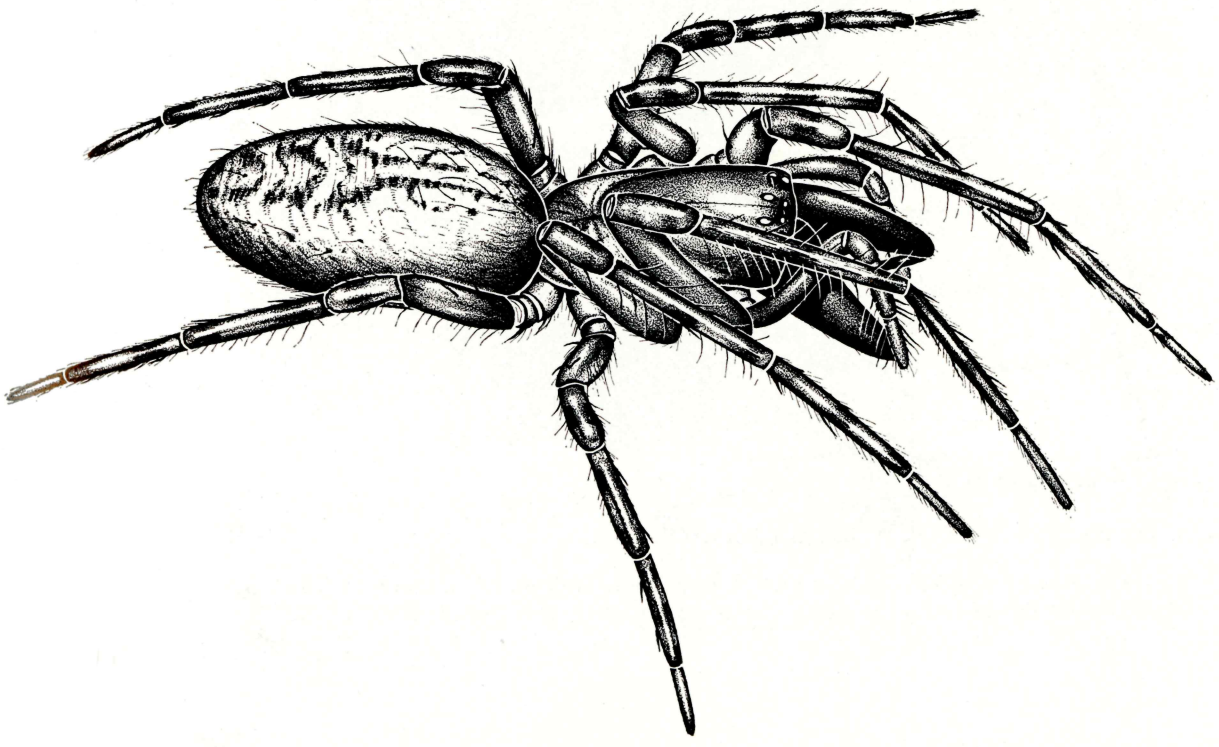


Fig. 122. *Matachia hirsuta* Marples female (Dictynidae). Gore, Southland. Two similar species have a distribution covering all New Zealand. The spiders live in old insect burrows in twigs and branches from which they construct a large web. From life. Body length 7 mm.

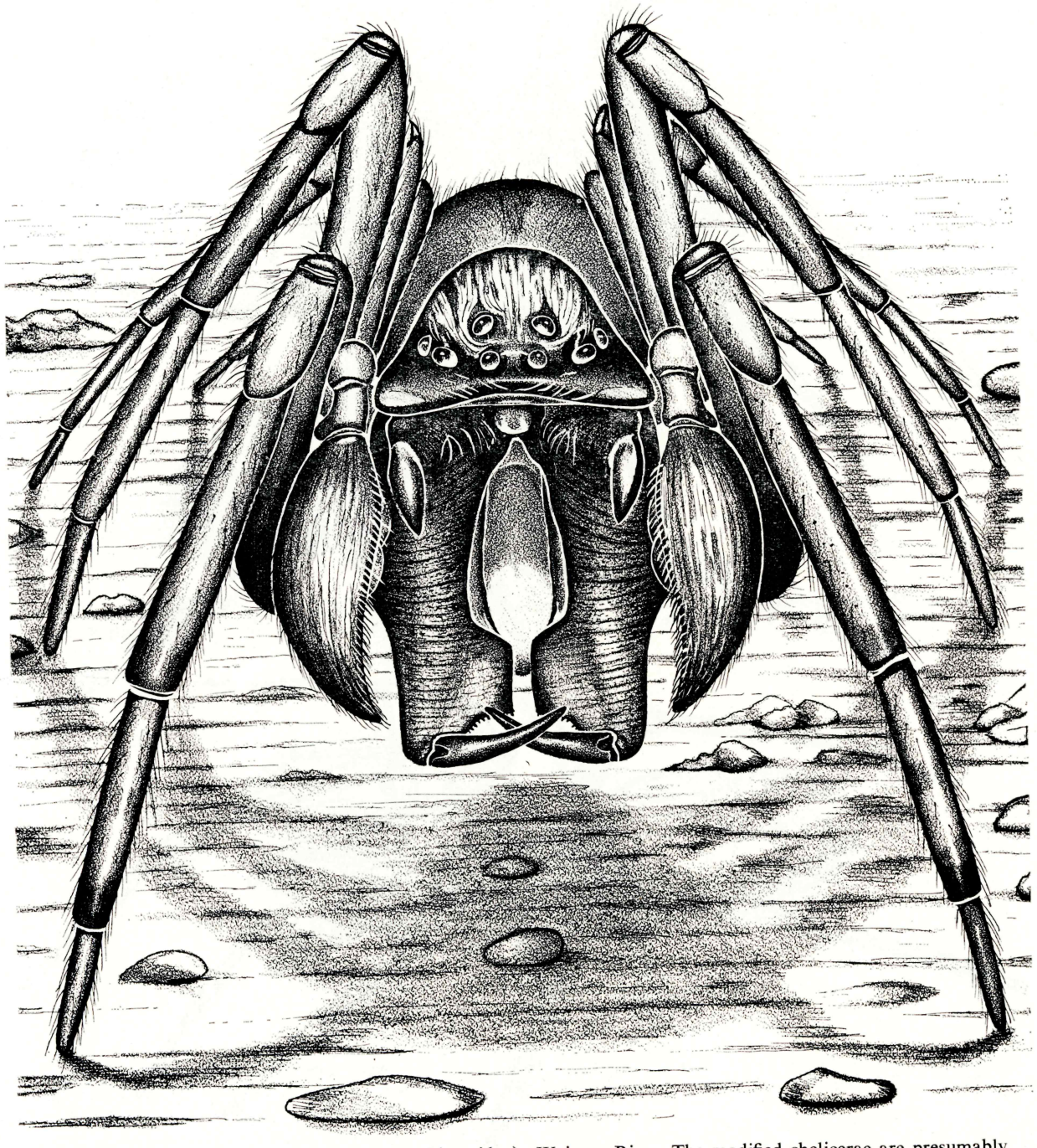


Fig. 123. *Dictyna cornigera* Dalmas male (Dictynidae). Waipara River. The modified chelicerae are presumably of use during mating.

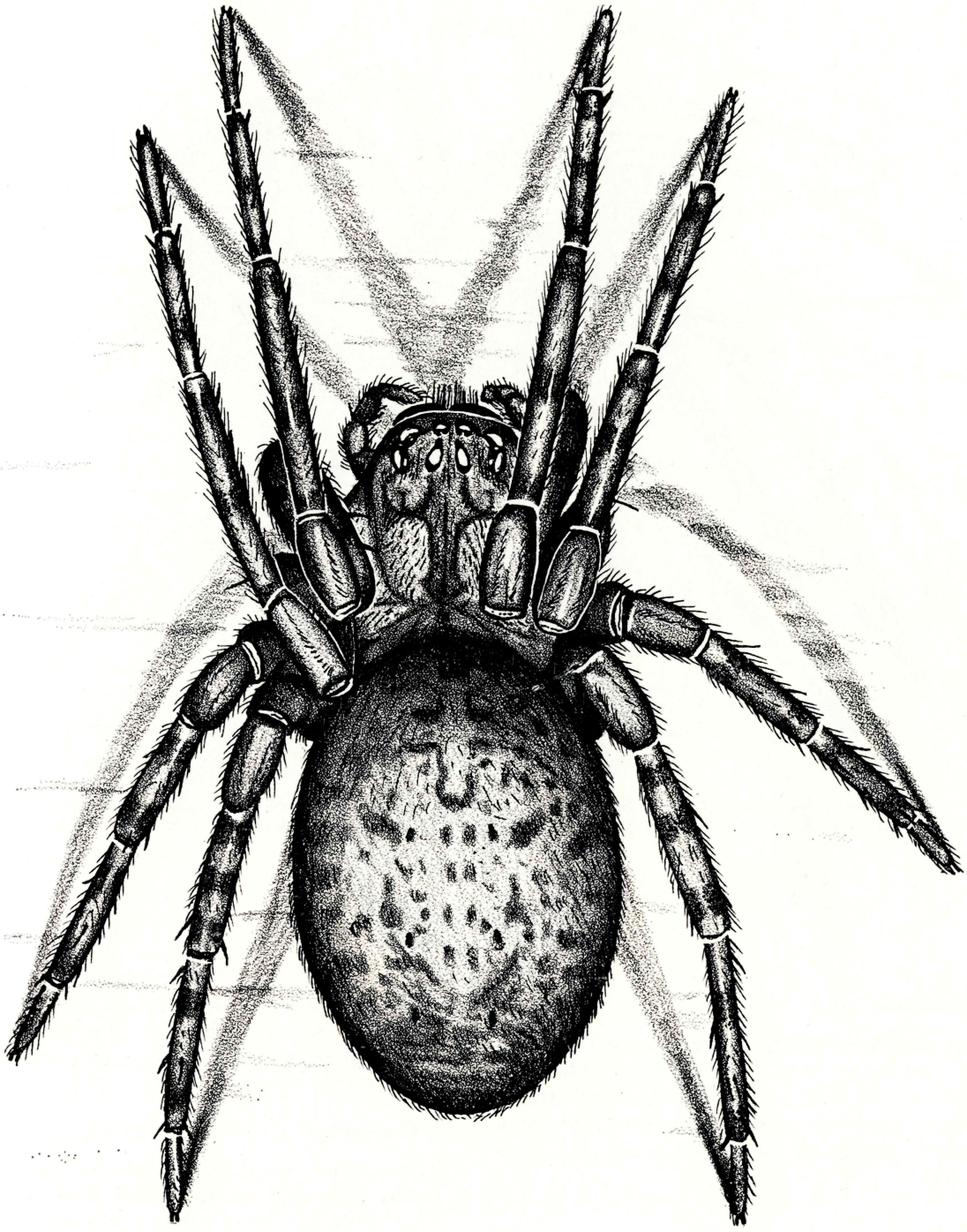


Fig. 124. *Megadictyna thilenii* Dahl female (Dictynidae). Mangatapu, Marlborough. Found in the northern half of the South Island and the southern portion of the North Island usually on forest floor. Preserved specimen. Body length 11 mm.

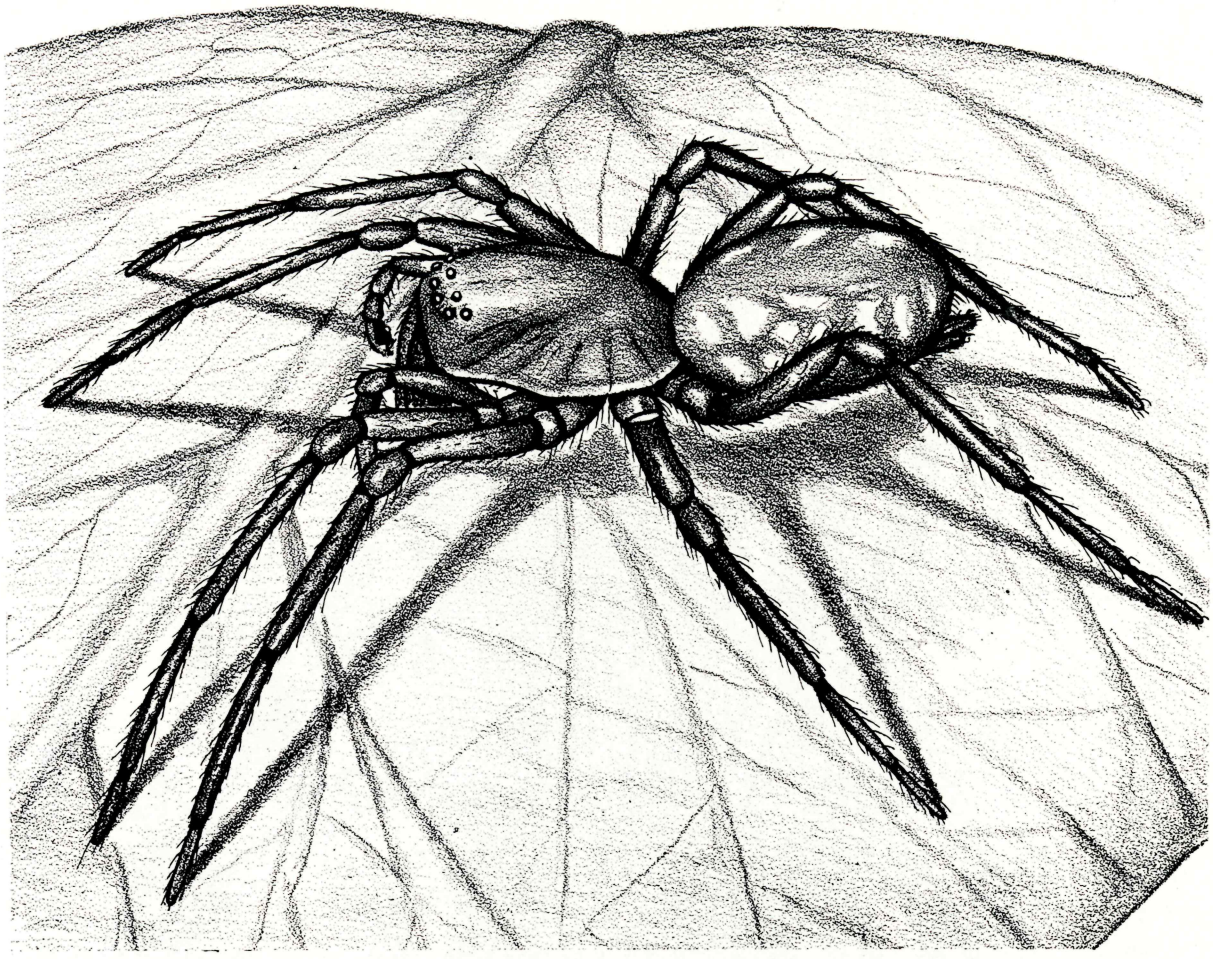


Fig. 125. Family Dictynidae female. Seacliff, Otago. A number of species of these small green spiders, related to *Dictyna,* live on shrubs in the forest. Found throughout New Zealand. From life. Body length 2 mm.

Oecobiidae

These minute cribellate spiders are not native to New Zealand. The cosmopolitan *Oecobius annulipes* (Fig. 126) is found in the North Island where it constructs a web, less than an inch in diameter, across cracks on the walls of houses and sheds.

Uloboridae

The uloborids are predominantly spiders of the subtropical and tropical regions. A single species *Uloborus waitakeriensis* (Fig. 127) has been recorded from the North Island. These are cribellate spiders which construct an orb web but in this group the sticky spiral thread comes from the cribellum, not the spinnerets. The web is small and insignificant and is usually constructed among small shrubs or grass.

Oonopidae

These small, six-eyed, spiders live among leaf debris and moss on the forest floor (Fig. 128). They construct silken tubular retreats where they hide during the day but emerge to search for prey at night. Most of them are less than two millimetres long but a few are twice as long. The eggs, which usually only number two or three are contained within a thin silken covering and are laid within the retreat.

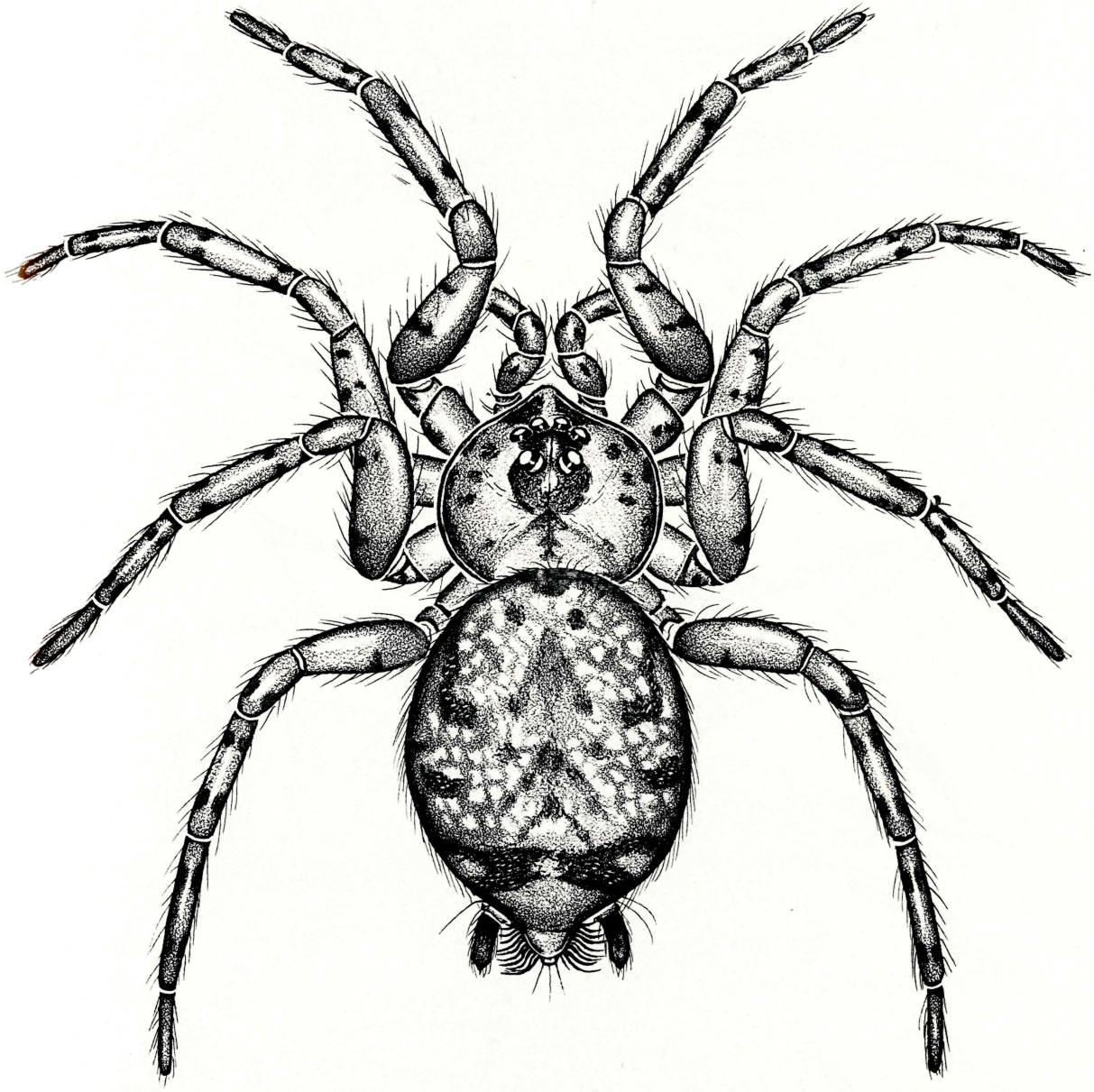


Fig. 126. *Oecobius annulipes* female (Oecobiidae). Taradale, Hawkes Bay. These minute spiders, only a few millimetres long, have been found in a number of places in the North Island where they are associated with houses. Introduced. Preserved specimen.

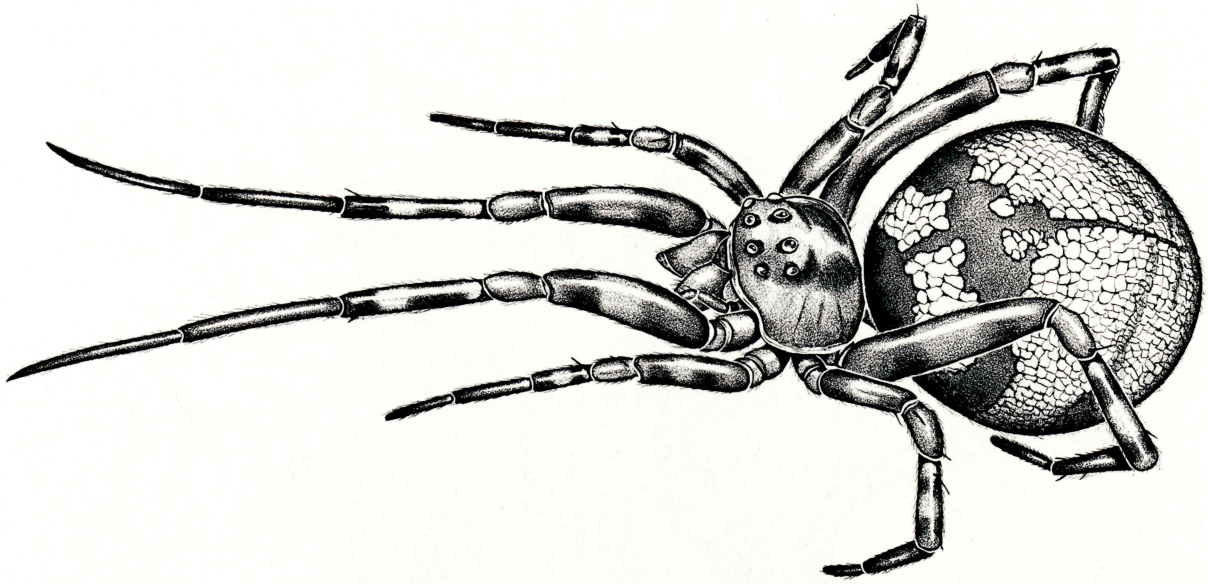


Fig. 127. *Uloborus waitakeriensis* Chamb. female (Uloboridae). Mamaku Bush, Auckland. This is a cribellate spider which constructs an orb web. North Island. Preserved specimen. Body length 3.5 mm.

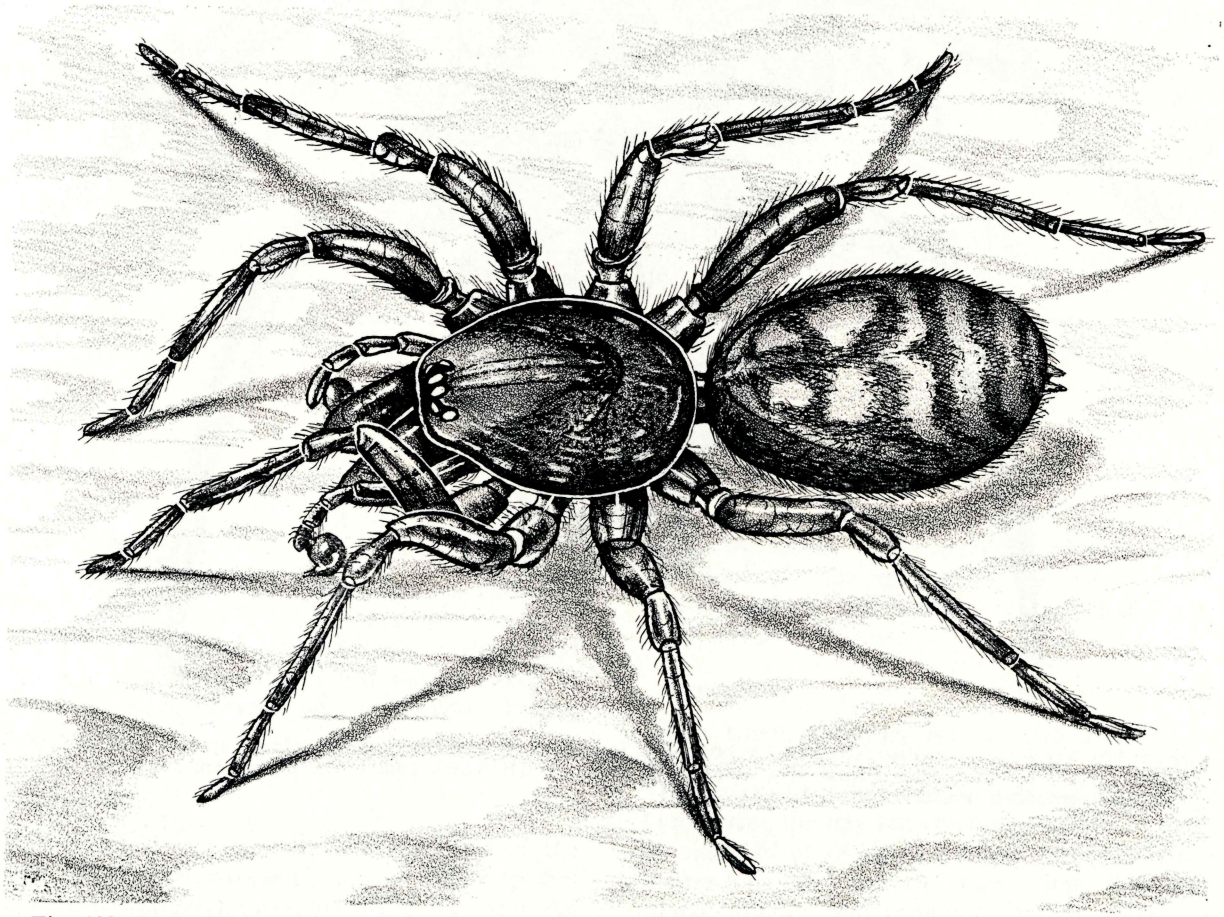


Fig. 128. *Duripelta* sp. male (Oonopidae). Nelson. Some thirty species of these minute spiders, some with and others without abdominal plates, are found in New Zealand, mainly on the forest floor. From life. Body length 1.5 mm.

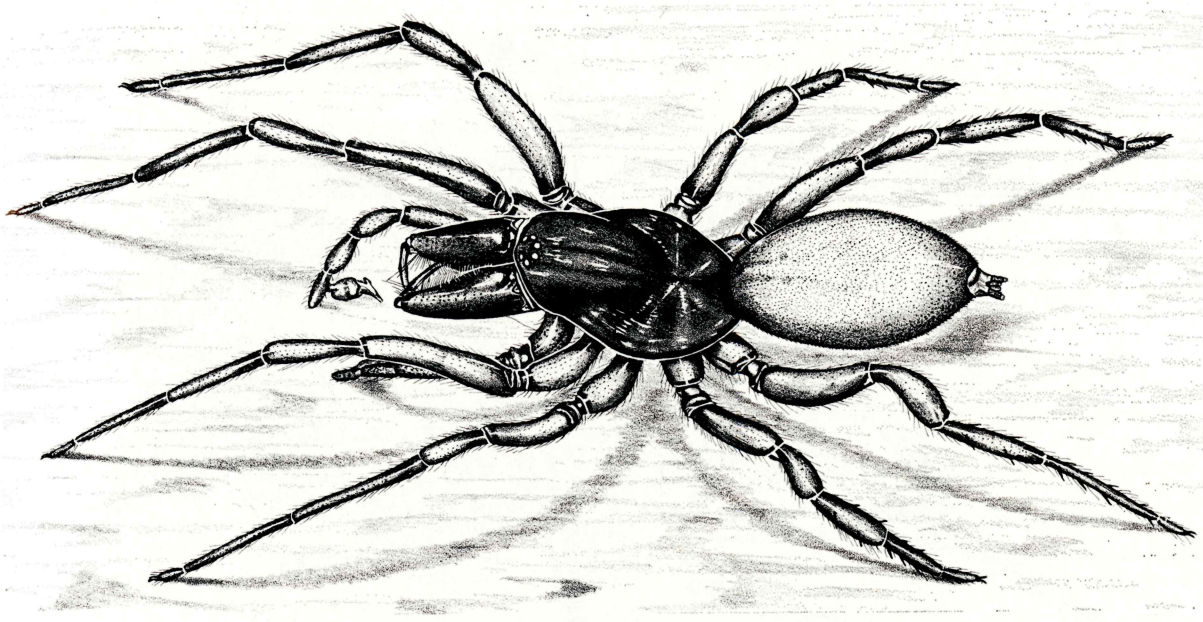


Fig. 129. *Dysdera crocata* (Koch) male (Dysderidae). Found throughout New Zealand, usually in gardens where slaters are available for food. World-wide. From life. Body length 14 mm.

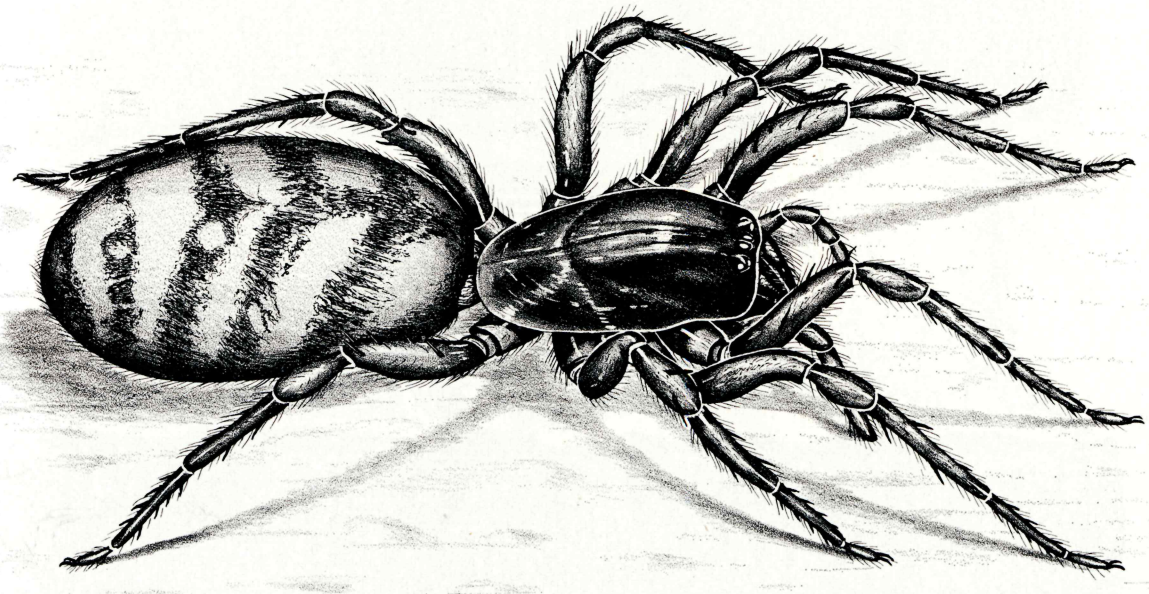


Fig. 130. *Ariadna septemcincta* (Urquhart) female (Segestriidae). Titirangi, Auckland. These spiders inhabit old insect burrows in twigs and bark. Preserved specimen. Body length 12 mm.

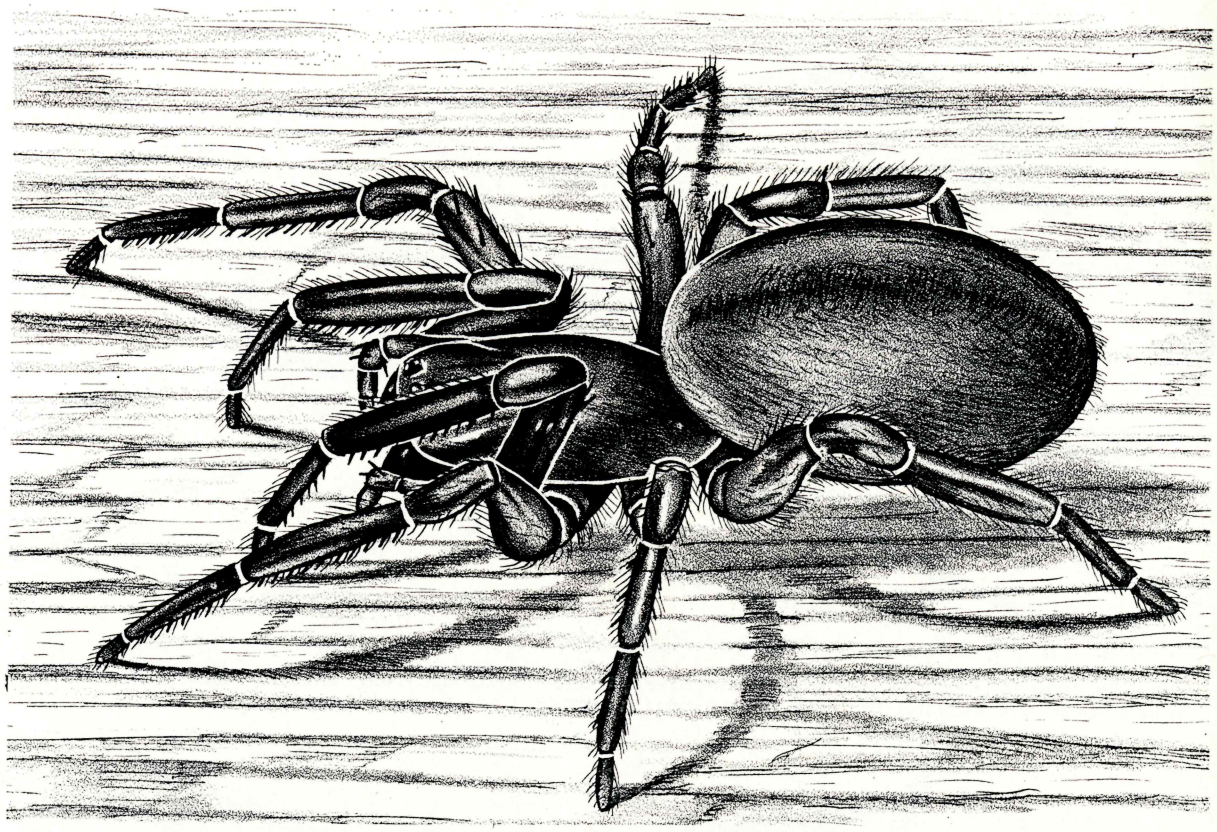


Fig. 131. *Ariadna* sp. female (Segestriidae). Similar species are found throughout New Zealand living in old insect burrows or constructing their own silken tube in cracks or under stones. No radiating threads are present. From life. Body length 10 mm.

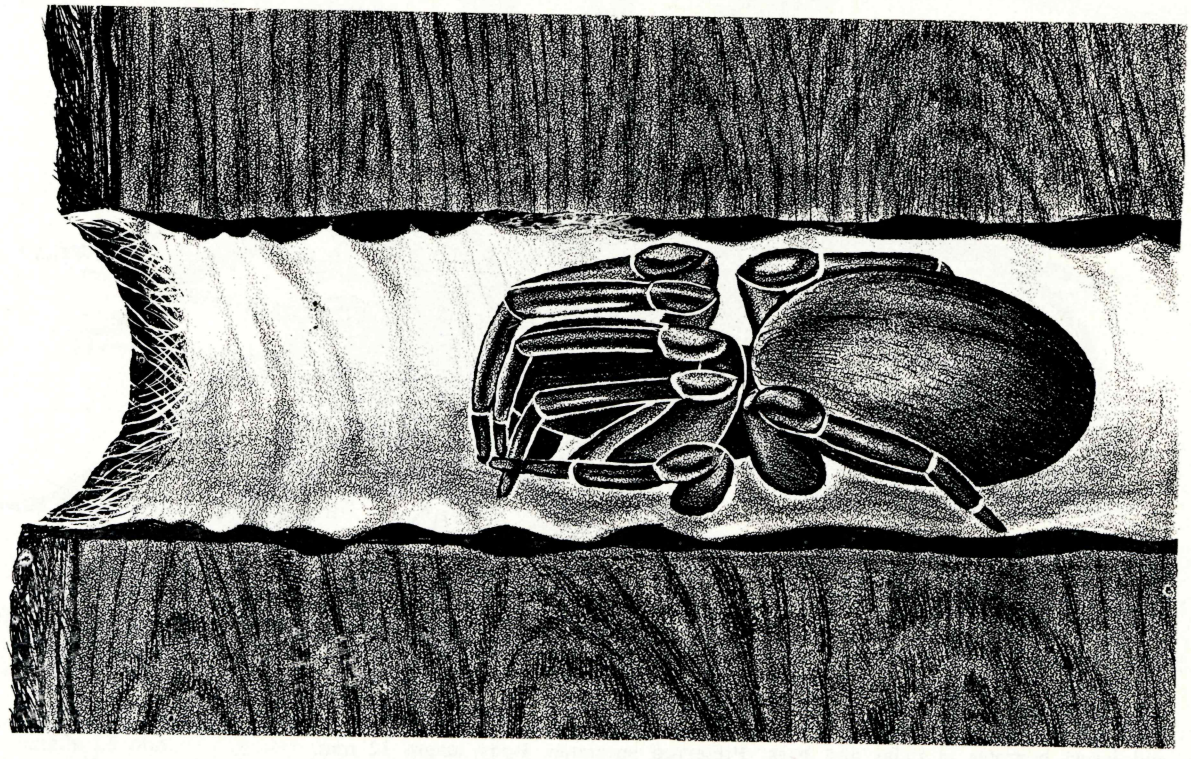


Fig. 132. *Ariadna* sp. female (Segestriidae). Cross section of burrow in log showing the resting position of the spider with the three anterior pairs of legs directed forwards. From life. Body length 10 mm.

Dysderidae

The family Dysderidae is probably not represented in the native New Zealand fauna but the cosmopolitan *Dysdera crocata* (Fig. 129) is common. This large six eyed spider is immediately recognised by the bright orange red cephalothorax and appendages and cream abdomen. Specimens have been recorded from all parts of New Zealand but usually from houses and gardens. They live in silken tubes and are considered to feed almost entirely on slaters.

Segestriidae

The family Segestriidae is represented in New Zealand by species belonging to the widespread genera *Ariadna* (Figs. 130-132) and *Segestria* (Fig. 133). All species are similar in form and habit. A simple tube is constructed in cracks and crevices of rocks or in tunnels in trees left by wood-boring insects or occasionally the complete silken tube may be constructed on the lower surface of stones or under bark. Some species also construct a number of threads which radiate out

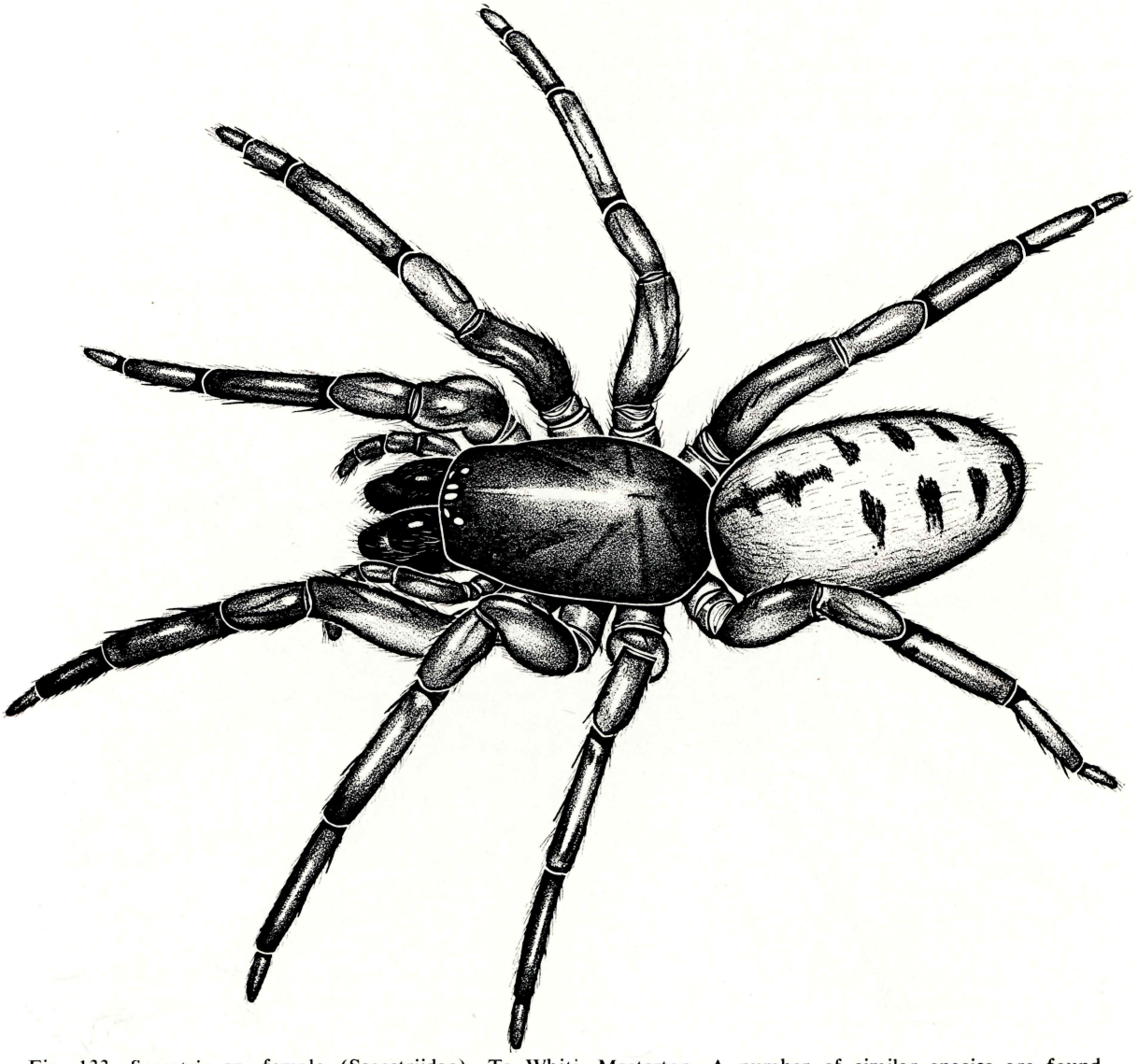


Fig. 133. *Segestria* sp. female (Segestriidae). Te Whiti, Masterton. A number of similar species are found throughout New Zealand. Found living in burrows similar to *Ariadna* with threads radiating out from the opening. From life. Body length 12 mm.

from the mouth of the tunnel. Species have been found in all parts of New Zealand from the seashore to the sub-alpine zone. The spiders are characterized by the six eyes being placed in three separate pairs and in common with other tube-dwelling spiders the first three pairs of legs are directed forward instead of only the first two pairs as is common for most spiders. Prey is grasped when it approaches the mouth of the tube and dragged inside the tube to be eaten. The eggs and young spiderlings are found within the tube with the female. *Periegops* (Fig. 134) which occurs locally in the South Island is usually placed within the sub-family Periegopinae of the Sicariidae but will probably be placed eventually in a separate family. The leg spines characteristic of *Ariadna* and *Segestria* are lacking, and only the first two pairs of legs are directed forward. These spiders are not tunnel dwellers but construct a thin silken retreat under stones and logs in forest.

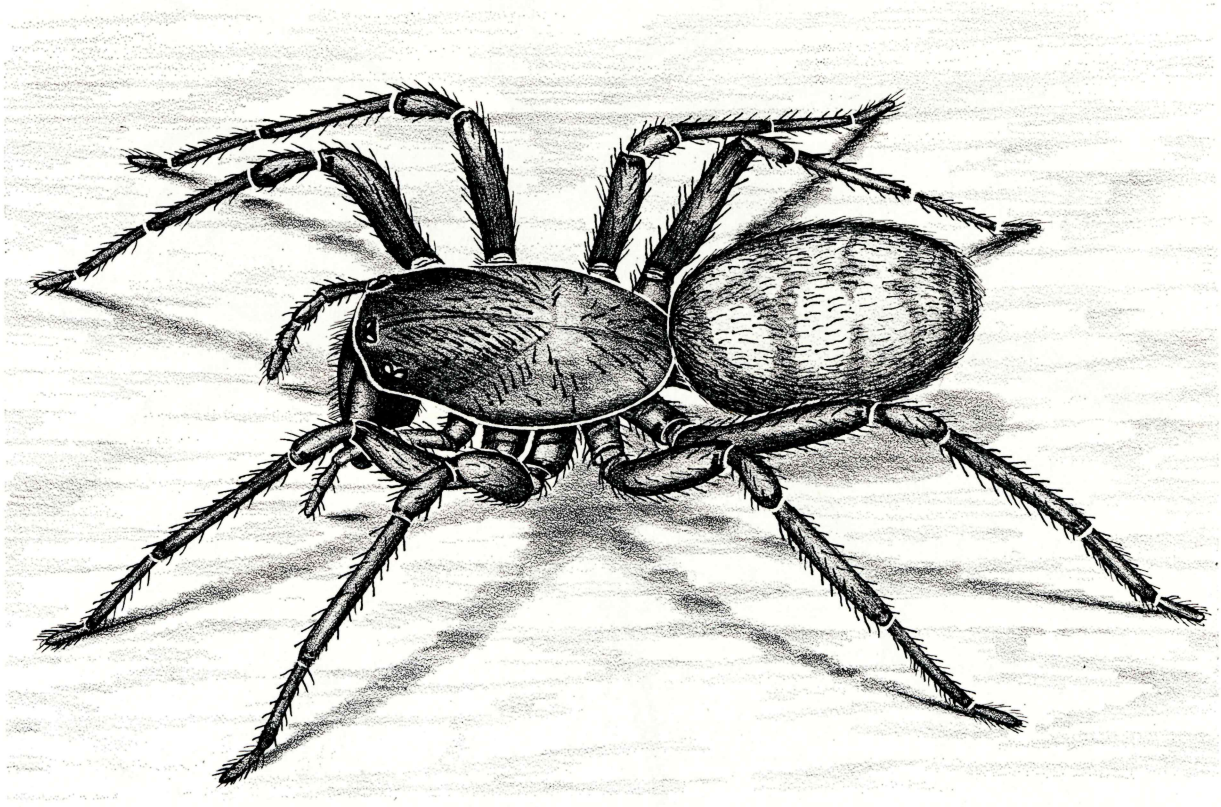


Fig. 134. *Periegops suteri* (Urquhart) female (? Segestriidae). Kaituna Valley, Banks Peninsula, Canterbury. Constructs a thin silken tube under stones and logs on the forest floor. Found only on Banks Peninsula. Preserved specimen. Body length 9 mm.

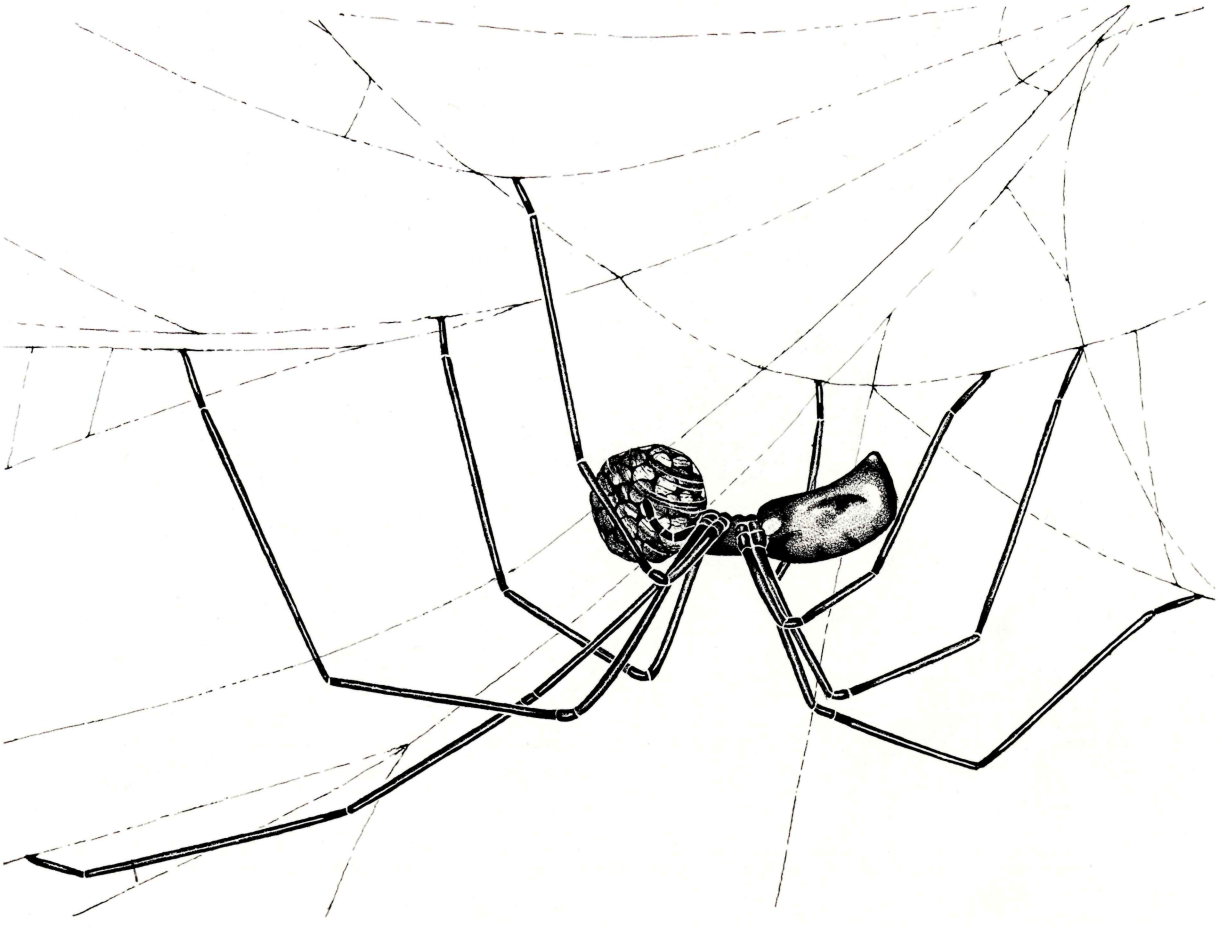


Fig. 135. *Pholcus phalangioides* (Fuess.) female with eggs (Pholcidae). Found throughout the North Island and the northern portion of the South Island in and around houses. Introduced, world-wide. From life. Body length 6 mm.

Pholcidae

The pholcids are all small, long legged spiders which construct tangle webs. Few species are found in New Zealand and these are probably all introduced. The arrangement of the ALE, PLE and PME in two groups of three immediately distinguishes these spiders from native spiders of similar appearance. The cosmopolitan *Pholcus phalangioides* (Fig. 135) is found in houses and sheds throughout the North Island and the northern half of the South Island and it is usually called the 'daddy long legs'. The eggs when laid are held together by a few threads of silk in a spherical bundle and this is carried in the chelicerae by the female during the three or so weeks it takes to hatch.

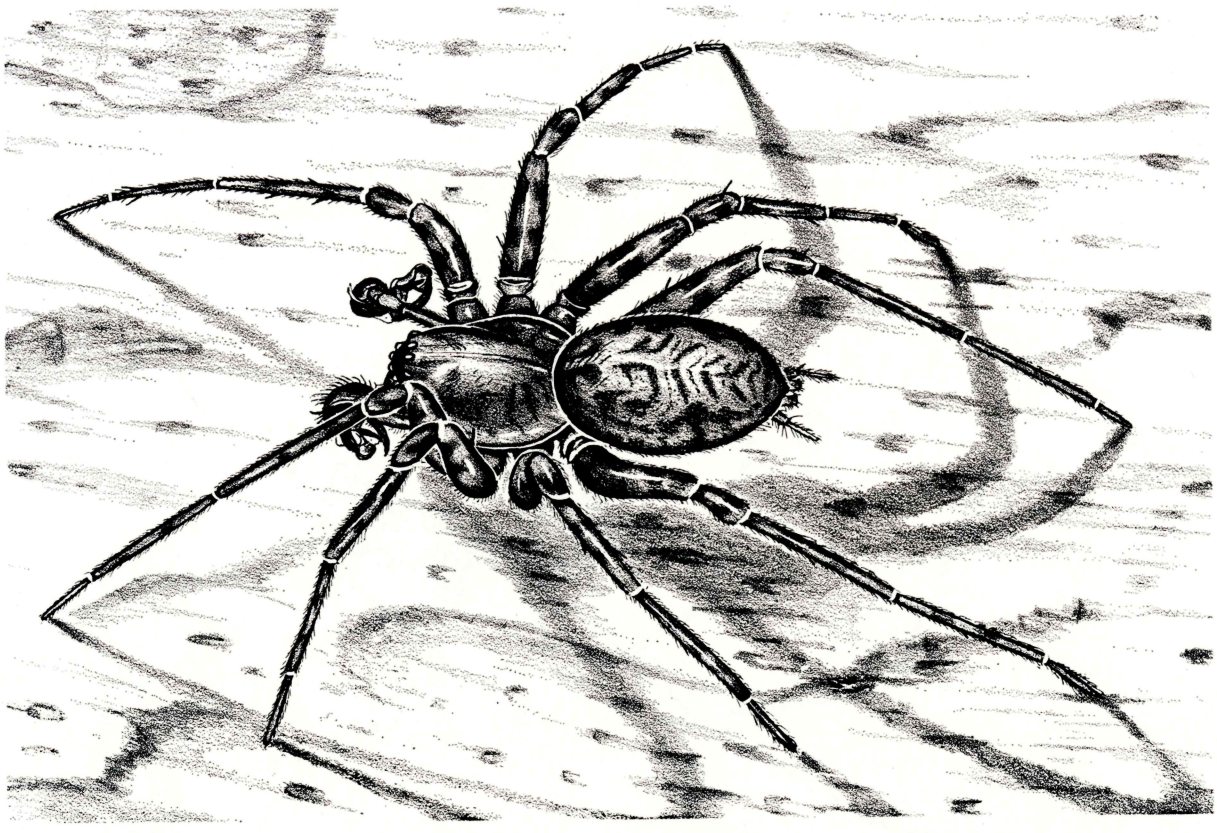


Fig. 136. Family Agelenidae male. Undescribed genus characterized by the long posterior spinnerets. There are a number of species found in forest throughout New Zealand. Constructs small sheet web. From life. Body length 4 mm.

Agelenidae

Apart from one genus all of the native species are placed in the subfamily Cybaeinae where the posterior pair of spinnerets are no longer or only slightly longer than the anterior pair. The subfamily Ageleninae, in which the posterior spinnerets are much longer than the anterior pair, is represented by the introduced *Tegenaria derhami*, which constructs a conspicuous sheet web leading back into a tunnel retreat around houses and sheds, and an undescribed genus of smaller native spiders (Fig. 136) which are found on the forest floor. The Cybaeinae are represented by numerous genera many of which have probably descended independently from cribellate genera and therefore do not represent a homogeneous assemblage. The closest affinities of a number of genera are therefore with genera placed in the family Dictynidae. Apart from *Cambridgea* (Fig. 137) which constructs a large sheet web, and is often found in settled areas, most of these spiders, such as those at present placed in *Rubrius* (Fig. 138), construct a small inconspicuous web and are found only in forest. Their colour is usually drab grey and brown. They may be separated from other three clawed spiders by the boss on the chelicerae, more or less parallel maxillae, and the fact that the ALE are never smaller than the AME. *'Habronestes' marinus* Goyen (Fig. 140) lives only on the seashore under stones.

Desis marina (Fig. 139) which is distinguished by a bright reddish-brown cephalothorax and pale abdomen lives between the high and low tide marks where it constructs a tube nest by lining with silk a cavity under a rock or in a crevice or occasionally an empty seashell. The single opening is closed with a sheet of silk as the tide comes in and also during the period when the female is enclosed with the developing eggs. This silken sheet seems sufficient to keep out the sea water or at least to retain the air space within the nest. *Desis marina* probably feeds on small intertidal arthropods and has been recorded preying on amphipods.



Fig. 137. *Cambridgea antipodiana* (Cambr.) female (Agelenidae). Young construct sheet web from which the spider hangs. The web loses this form when the spider becomes adult. Common in forest and also around houses. Chelicerae of the male are strongly developed. From life. Body length 15 mm.

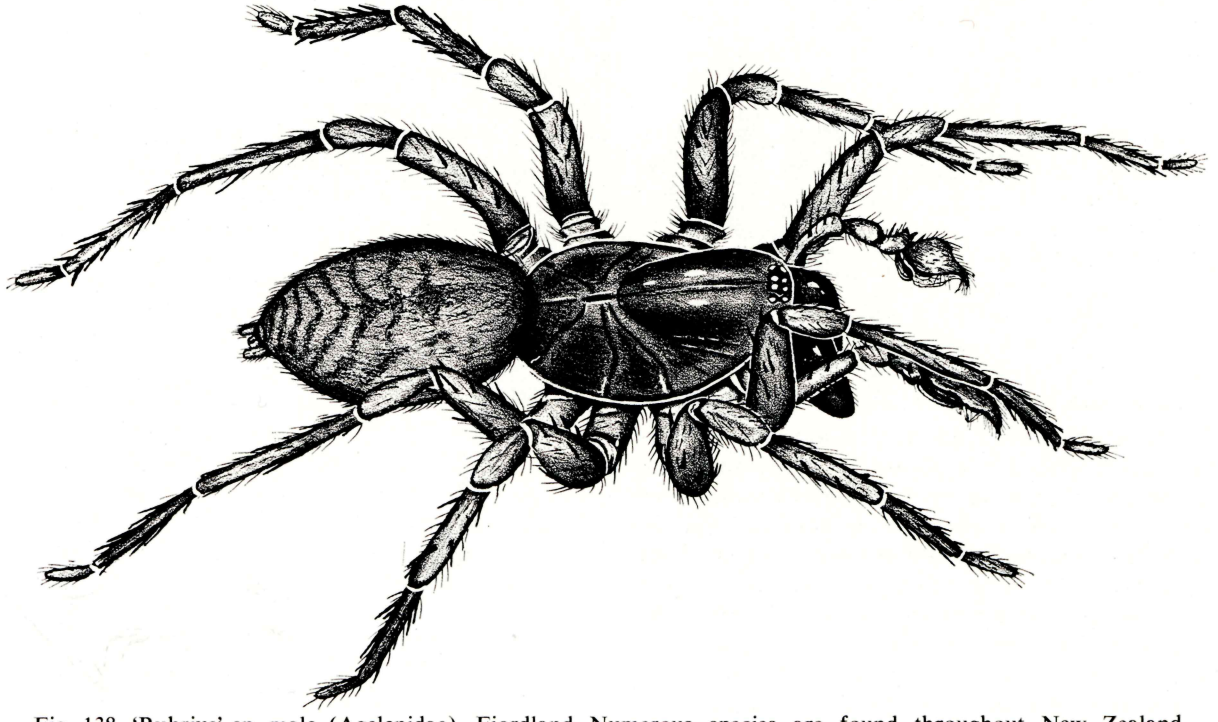


Fig. 138. 'Rubrius' sp. male (Agelenidae). Fiordland. Numerous species are found throughout New Zealand in the forest. The young spiders construct a tube web open at both ends. At present the various species described are placed in the South American genus *Rubrius*. From life. Body length 12 mm.

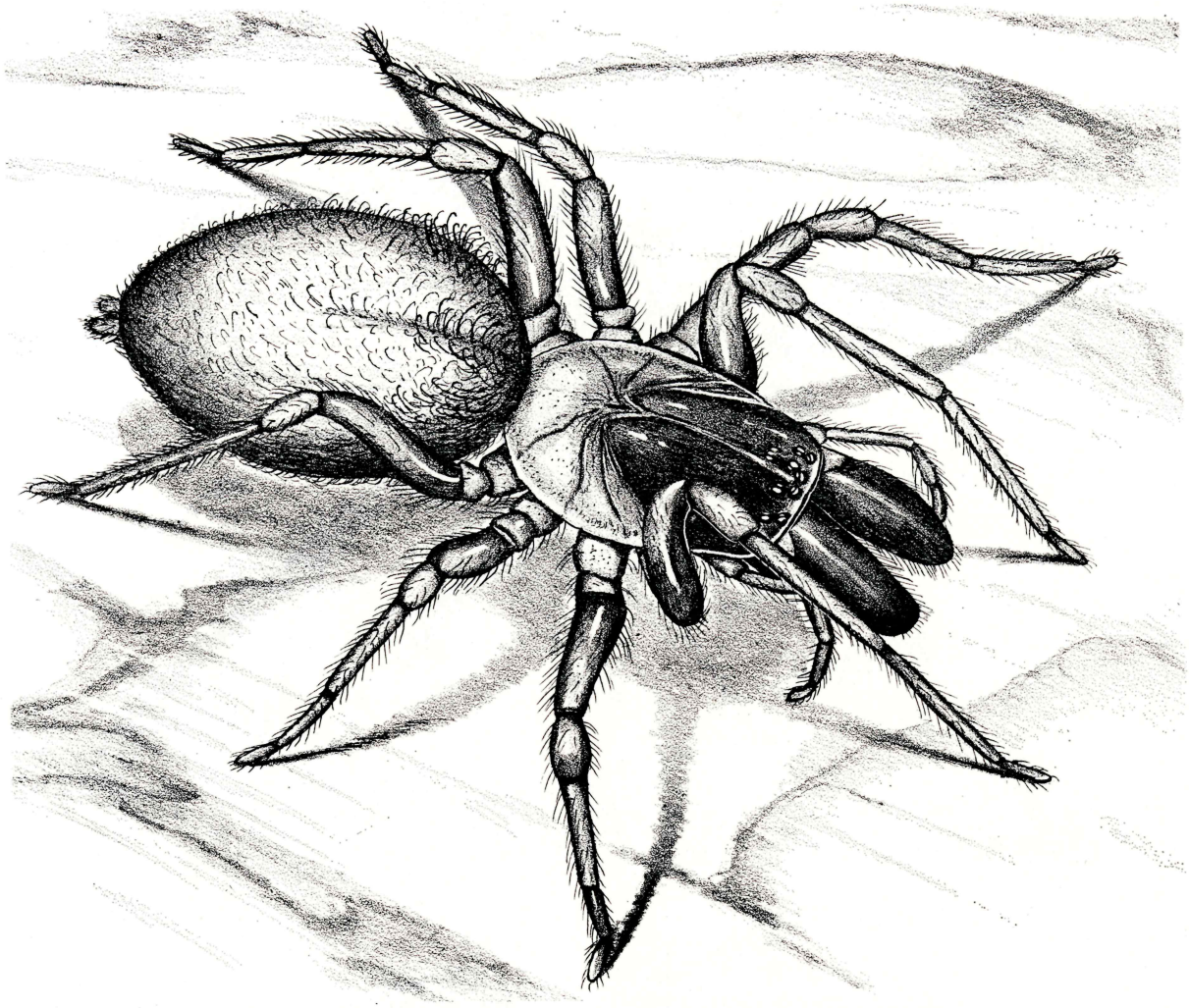


Fig. 139. *Desis marina* Hector female (Agelenidae). Chatham Islands. This spider is found between high and low tide levels along most of the New Zealand coast. It constructs a silken retreat in cracks or worm holes in rock or in empty shells and is submerged as the tide comes in. From life. Body length 8 mm.

Hahniidae

These small spiders are rather squat in appearance and clearly distinguished by the arrangement of all six spinnerets in a single transverse row (Fig. 141). None of the New Zealand species exceeds two and a half millimetres in length. They construct small inconspicuous sheet webs near the surface of the ground which are rarely seen and the spiders are usually found by sifting leaves and debris from the forest floor or grassland. The family is related to the Agelenidae in which it is sometimes included as a subfamily.

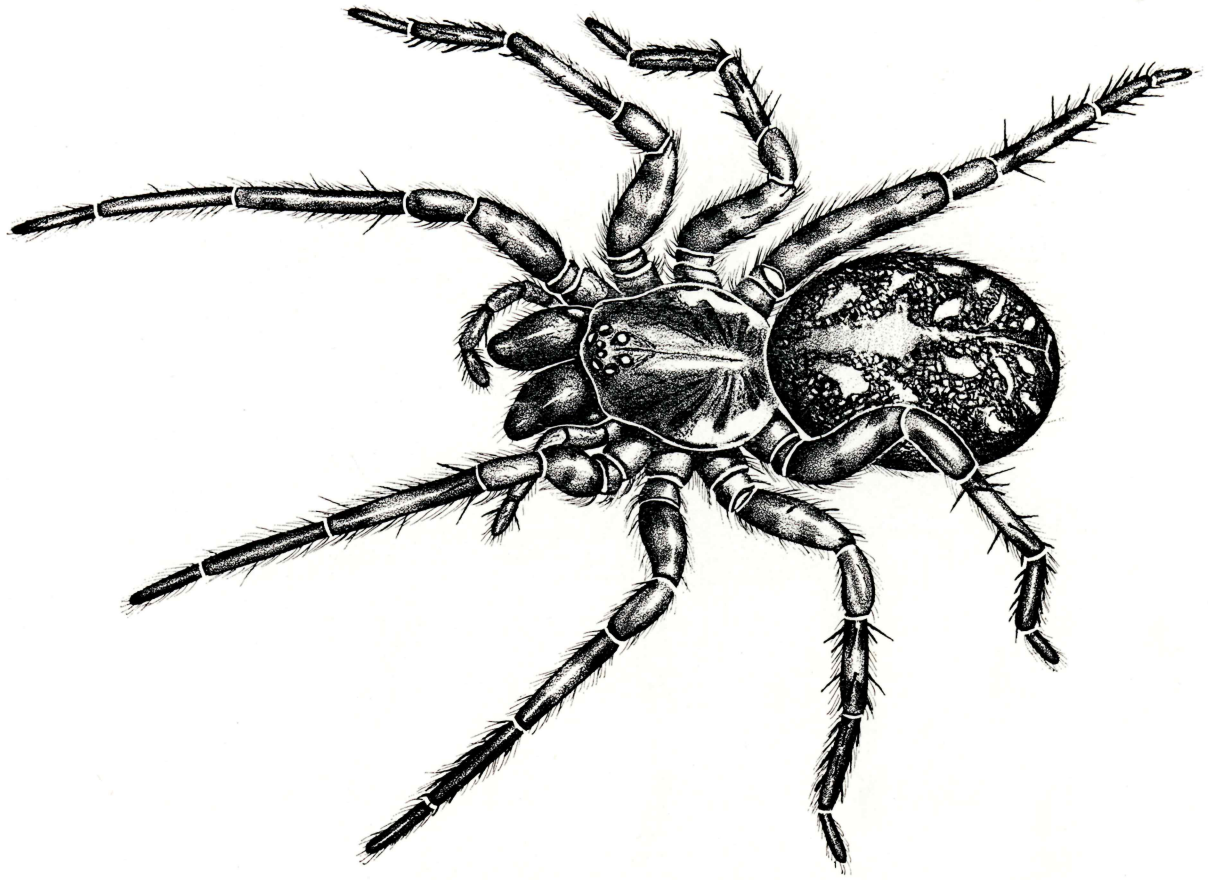


Fig. 140. *'Habronestes' marinus* Goyen female (Agelenidae). Portobello, Otago. These spiders live amongst the stones at high tide level along beaches. A number of similar species are found along most of the New Zealand coast. From life. Body length 6 mm.

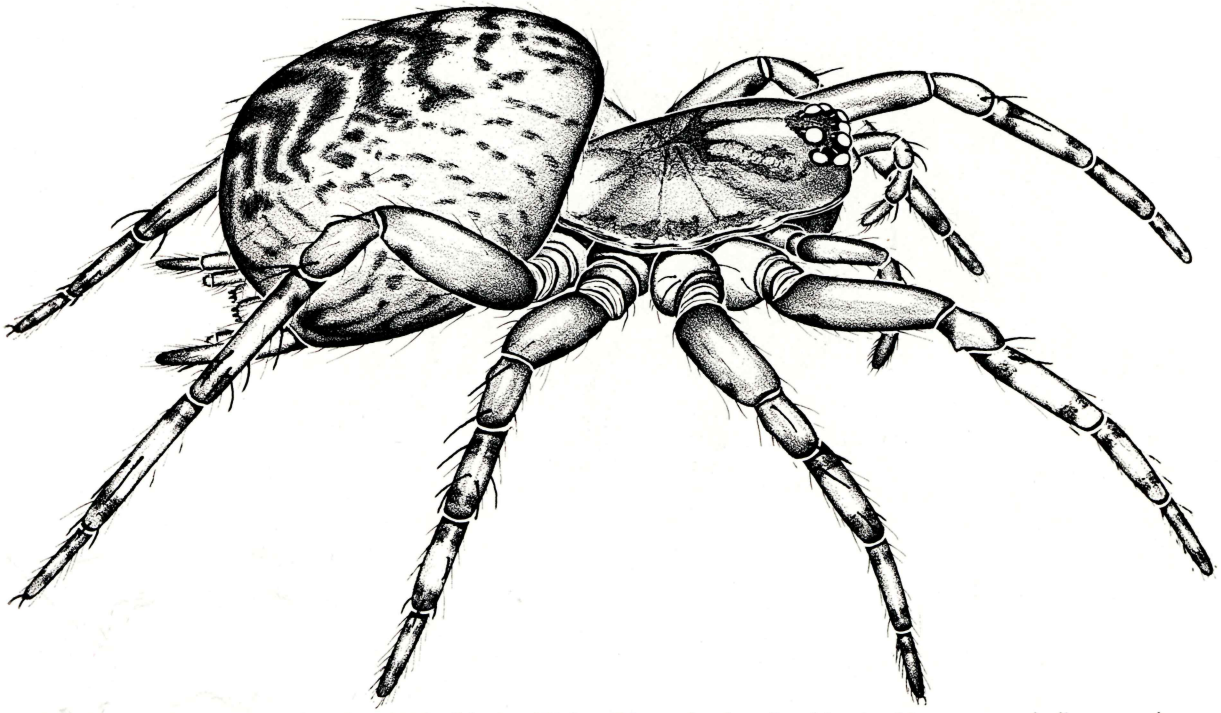


Fig. 141. *Hahnia* sp. female (Hahniidae). Waiau River bank, Southland. Numerous similar species, characterized by the transverse row of spinnerets, are found throughout New Zealand. From life. Body length 2.5 mm.

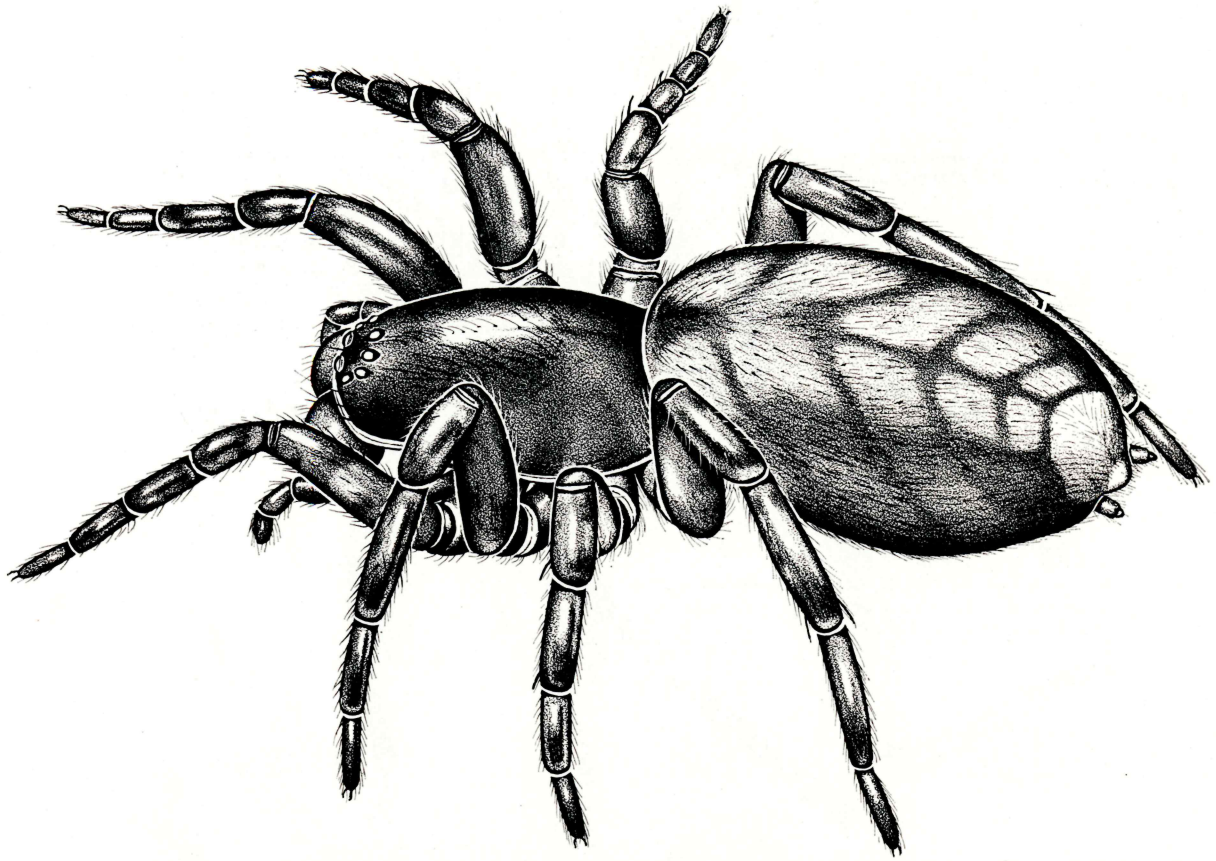


Fig. 142. *Huttonia palpimanoides* Cambr. female (? Zodariidae). Gore, Southland. A number of species of these small spiders are found on the forest floor throughout New Zealand. From life. Body length 4 mm.

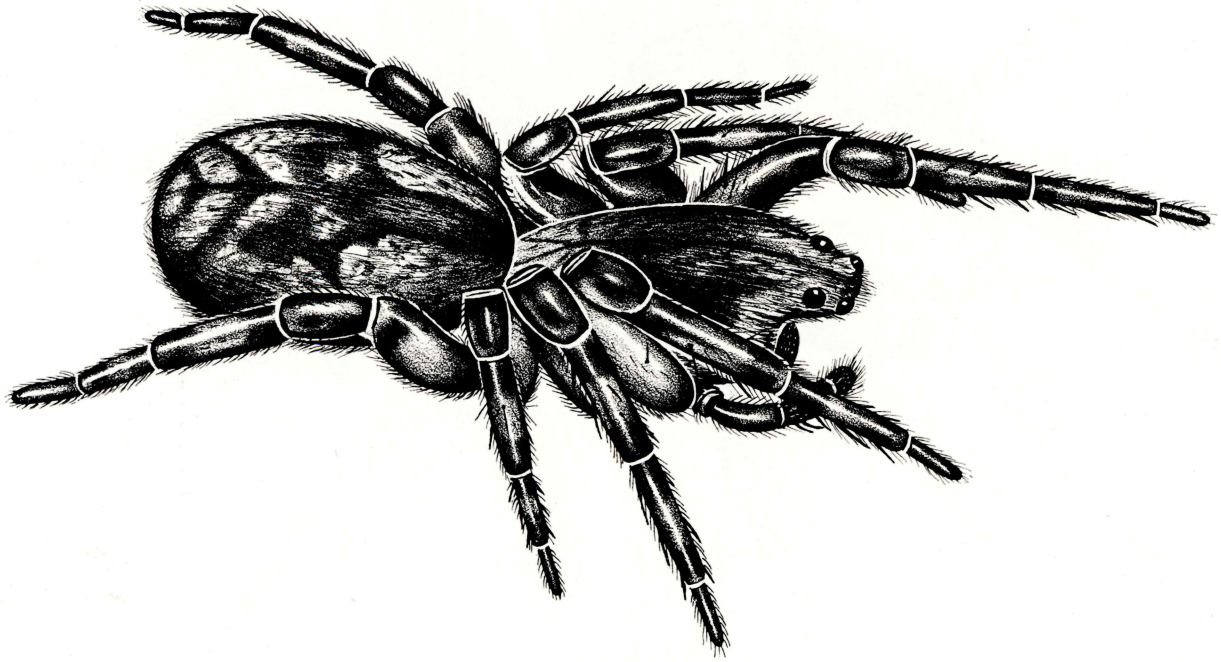


Fig. 143. *Plectophanes* sp. female (Toxopidae). Dunedin, Otago. A number of similar species are found throughout New Zealand. The spiders live in old insect burrows in dead branches of trees and do not construct a web. From life. Body length 7 mm.



Fig. 144. *Plectophanes* sp. female (Toxopidae). Dunedin, Otago. Showing the typical position while waiting in an old insect burrow for prey. From life.

Toxopidae

Toxopid spiders are all distinguished by the unusual arrangement of their eyes. The ALE are small and are placed behind the level of the AME so that they are adjacent to the PLE. They are hunting spiders and do not construct a snare. The species of *Plectophanes* (Figs. 143, 144) remain in a silk-lined retreat from which they emerge to catch prey as it approaches the opening then drag it back into the tube to be eaten. These spiders usually utilize the tunnels left in dead twigs and branches by wood-boring insects and



Fig. 146. *Toxopsiella* sp. female (Toxopidae). Waitati Valley, Otago. A number of similar species are found on forest floor in most parts of New Zealand. From life. Body length 6 mm.

like many tunnel dwellers the first three pairs of legs are directed forwards. The pecular modification of the head seems to project the eyes beyond the mouth of the tunnel, while it waits for its prey. The other three genera known from New Zealand are vagrants which hunt on the forest floor and tree trunks as in *Toxopsiella* (Fig. 146) and *Cycloctenus* (Fig. 145) or as in the case of *Laestrygones* on small shrubs and grasses. The egg sacs are lenticular and are attached to the substratum which the spider frequents. They are abandoned by the mother after construction. At present this family is known only from New Zealand and Australia.

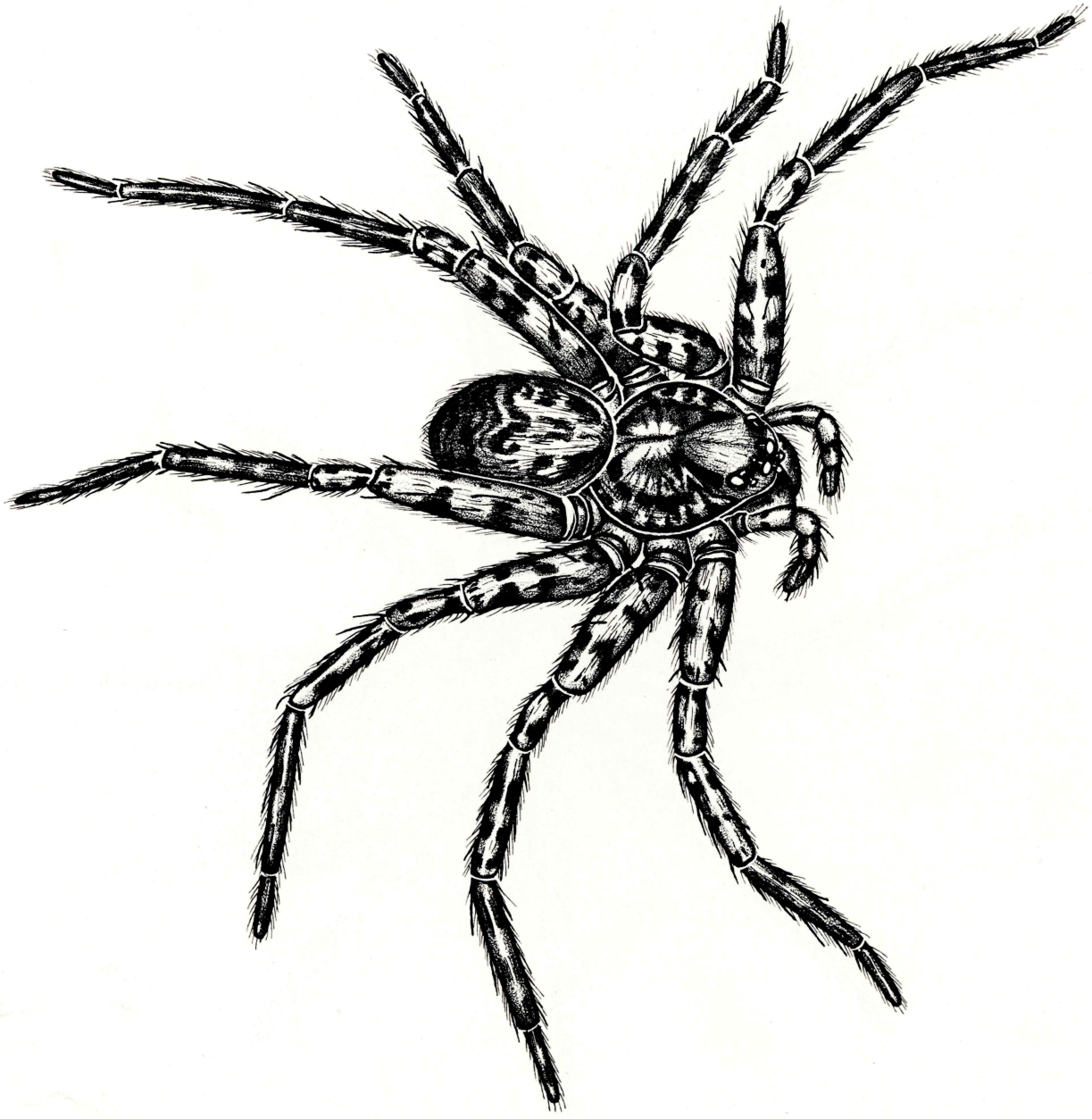


Fig. 145. *Cycloctenus* sp. female (Toxopidae). Gore, Southland. Numerous species are common in forest and in sub-alpine habitats throughout New Zealand. They are all fast moving hunters. From life. Body length 7 mm.

Amaurobioididae

Only a single species, *Amaurobioides maritima*, is known and this is found in New Zealand, Australia and South Africa as well as on some of the subantarctic islands near New Zealand (Fig. 147). The spiders are only found near the sea, usually just above the high tide mark, where they construct a strong tube nest with a single opening, in cracks on the rock faces. Food consists mainly of littoral isopods. The eggsac is lenticular and attached to the inside of the tube. During the development of the eggs the female remains within the nest after sealing up the opening with silk.

Lycosidae

The lycosids are three-clawed hunting spiders which are all alike in general structure but species may differ greatly in colour pattern and habits. Most habitats are utilized but very few if any species overlap from one habitat to another.

The arrangement of eight eyes in three rows of 4.2.2, with the four front eyes fairly small, is constant and the trochanter of the legs is always notched (Fig. 103). The females of all species carry the eggsacs along behind them attached to the spinnerets (Fig. 148). The spiderlings when they hatch clamber onto the back of the mother where they are carried about for a few days (Fig. 59).

A number of species are found in the open grassland and tussock and these species generally retire into a burrow in the ground which may be more or less lined with silk and sometimes provided with a well developed silken turret. Many species are found in riverbeds and these may live in small burrows under stones and logs while others merely hide among the stones. Other groups of species are found among the screes on the mountain side well above the bushline and some seem to live only on the seashore among the driftwood above the high tide mark. Only a

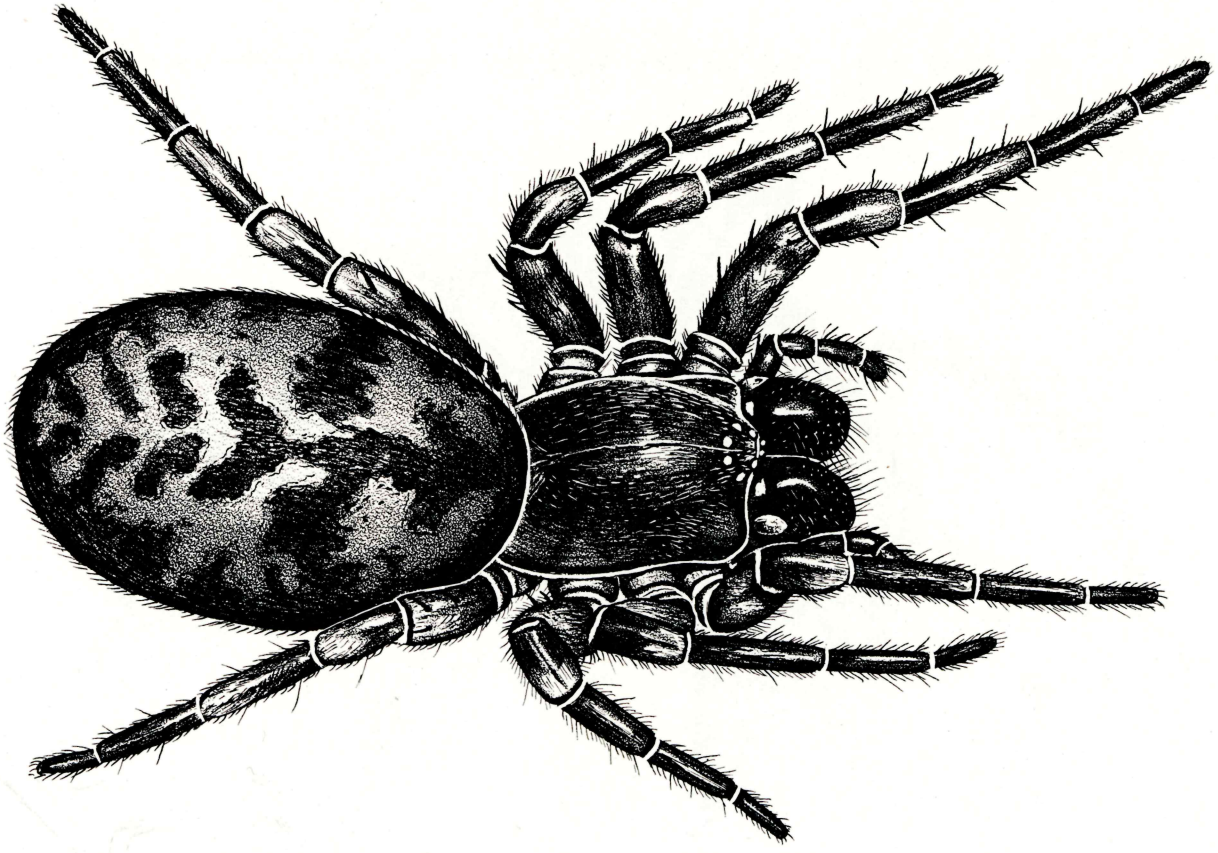


Fig. 147. *Amaurobioides maritima* (Cambr.) female (Amaurobioididae). Long Beach, Otago. Found living within silken retreats among rocks and on cliff faces above high tide mark along the coast of the South Island and southern North Island. From life. Body length 13 mm.

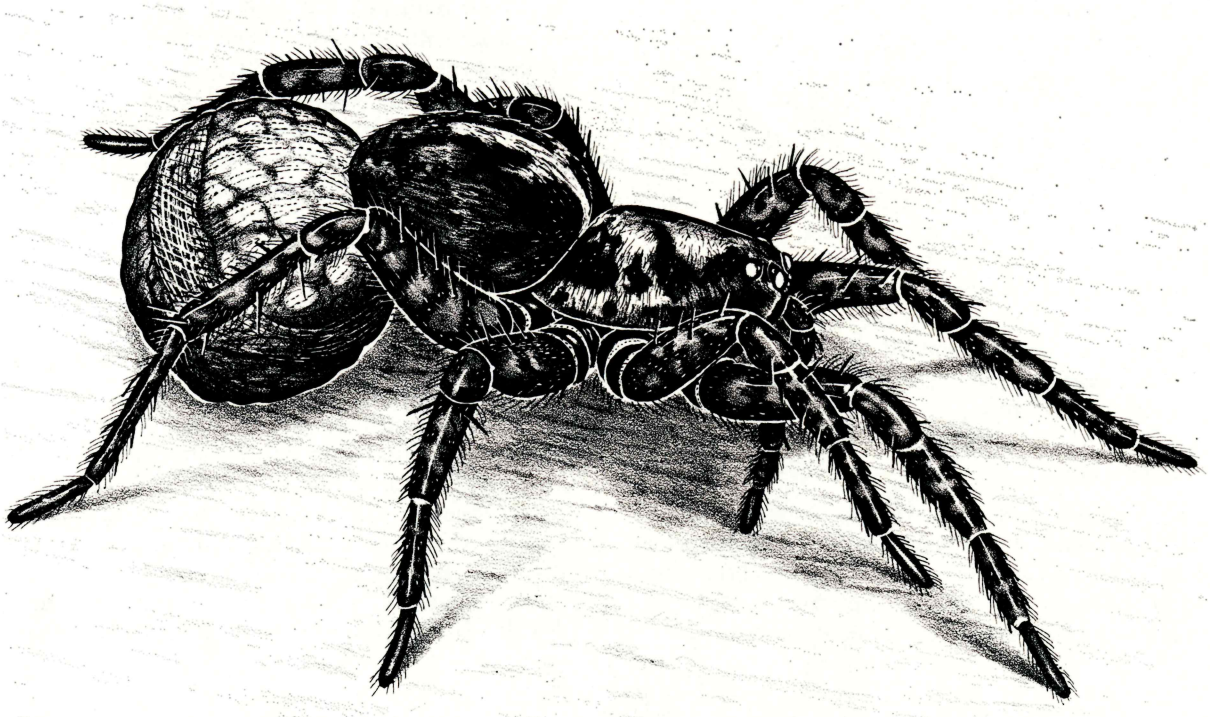


Fig. 148. *Lycosa* sp. female with egg-sac (Lycosidae). Dunedin, Otago. From life. Body length 6 mm.

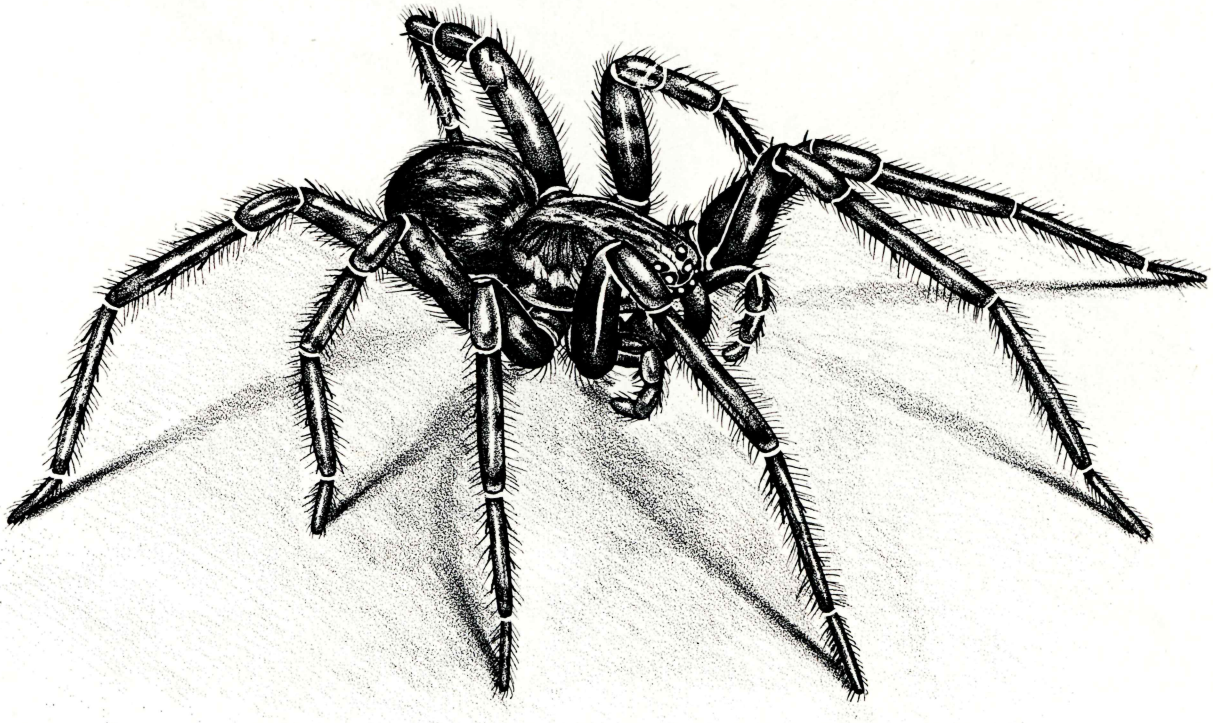


Fig. 149. *Allotrochosa schauinslandi* Simon female (Lycosidae). This species is the only lycosid normally found in forest. Distributed throughout New Zealand. From life. Body length 6 mm.

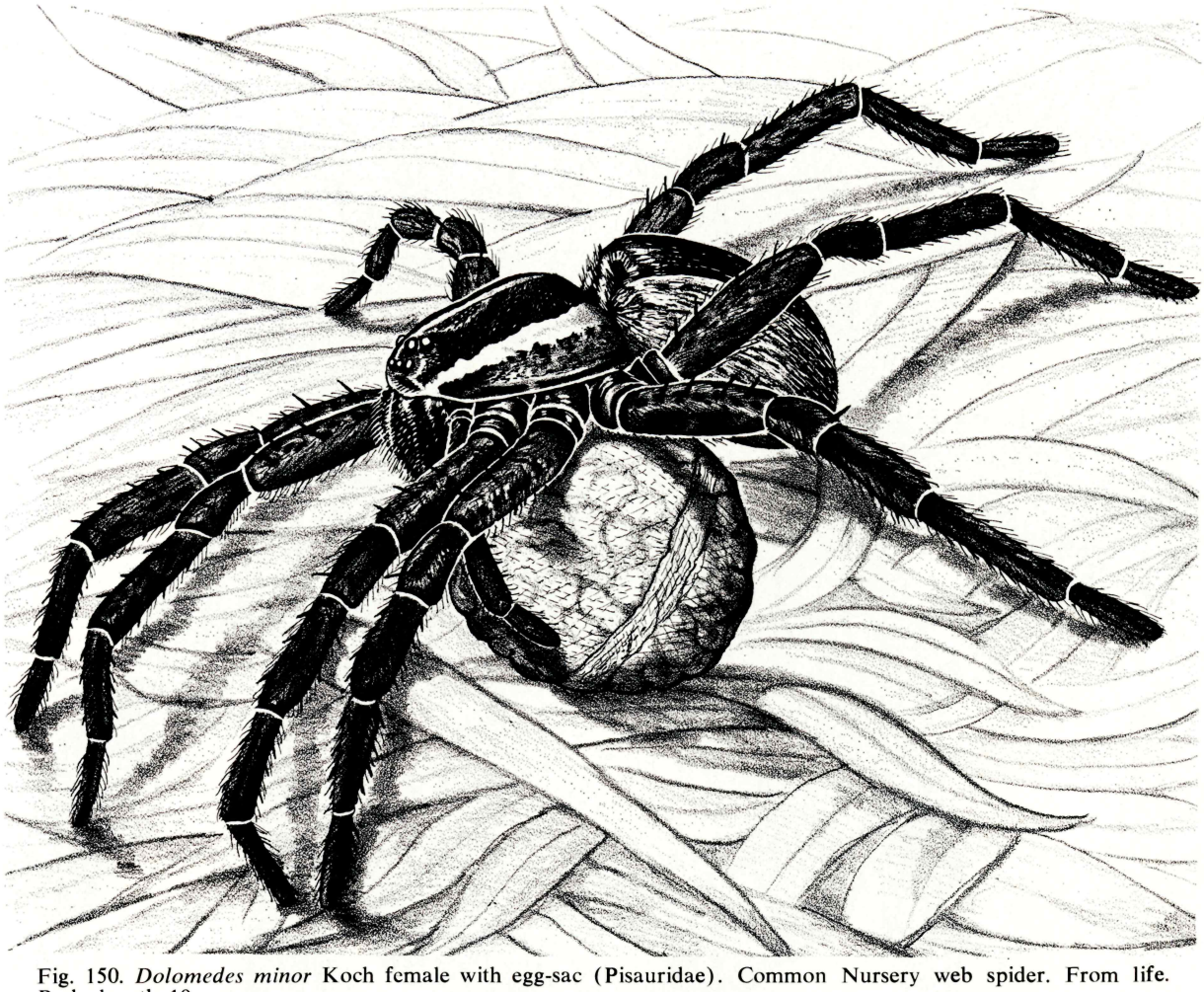


Fig. 150. *Dolomedes minor* Koch female with egg-sac (Pisauridae). Common Nursery web spider. From life. Body length 19 mm.

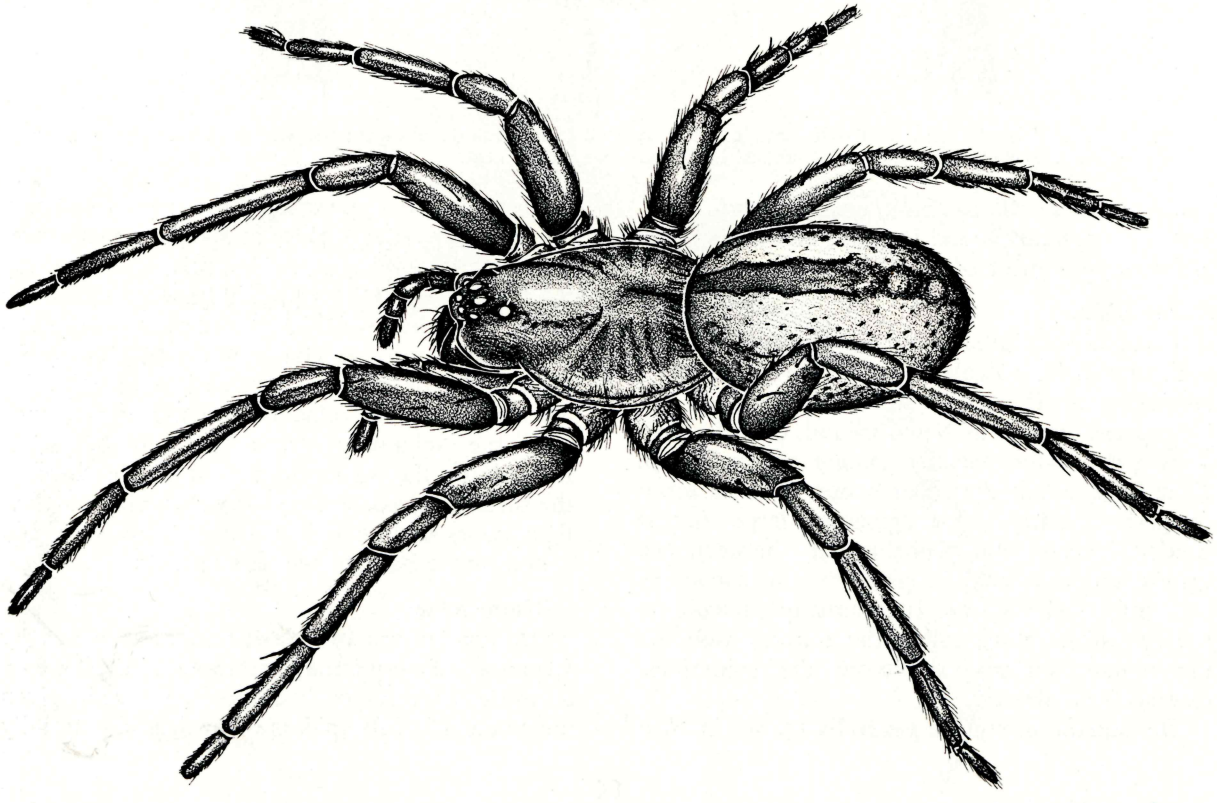


Fig. 152. *Argoctenus aurens* Hogg female (Ctenidae). East Harper River, 3,500 ft., Canterbury. This species, our sole ctenid, is found under stones above the bushline in the mountains of the northern portion of the South Island. Preserved specimen. Body length 9 mm.

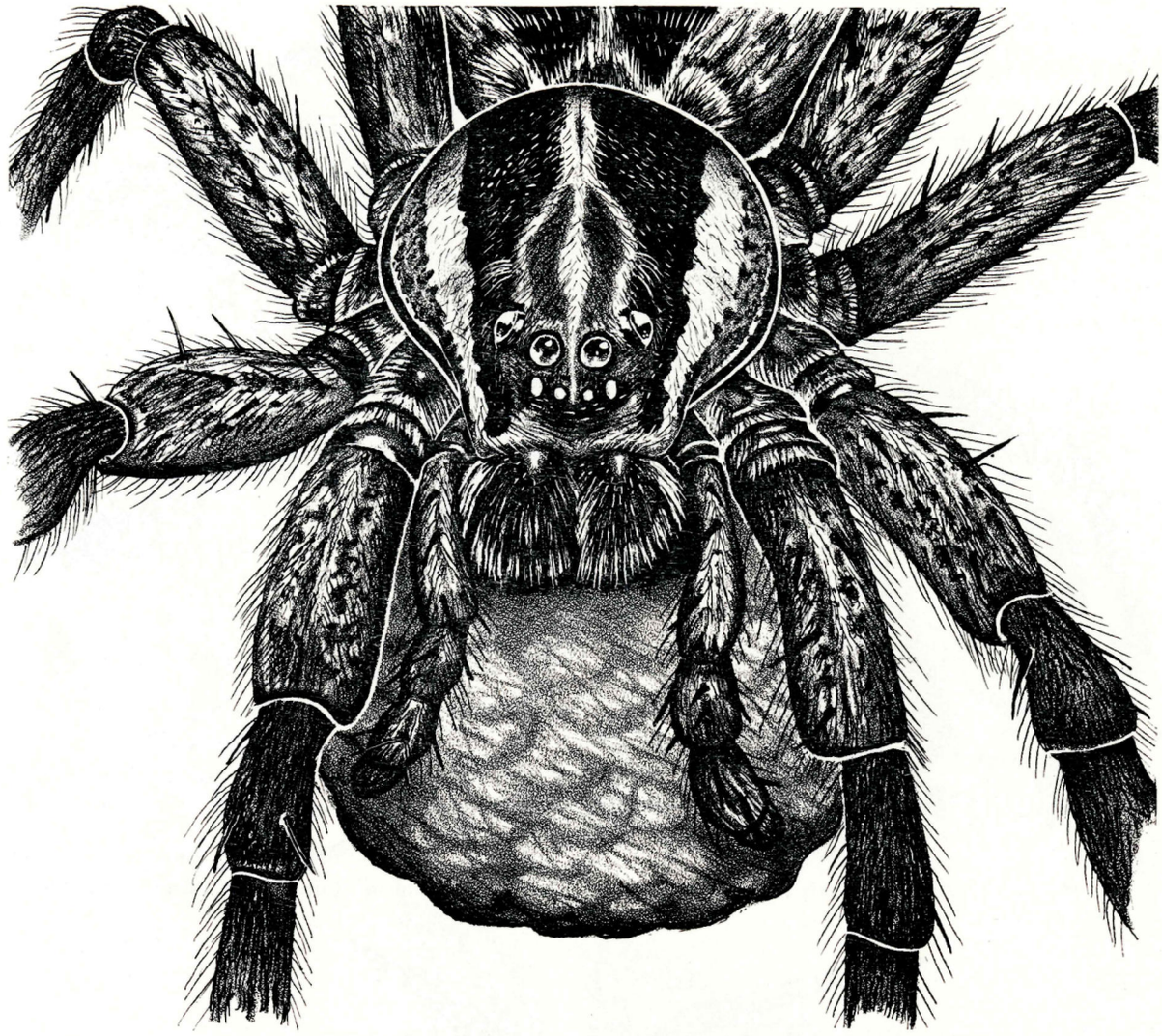


Fig. 151. *Dolomedes minor* Koch female with egg-sac (Pisauridae). Showing the way in which the egg-sac is held by the chelicerae and palps. From life. Body length 19 mm.

single species *Allotrochosa schauinslandi* (Fig. 149) is commonly found in forest and this species is found over most of New Zealand.

Pisauridae

These are all large hunting spiders which look alike and in New Zealand are placed in the widespread genus *Dolomedes* (150, 151). There are two species groups in New Zealand, one of which lives near water, usually among the rocks on river beds, while the other group lives in scrub or grass country. The eggsac is large and is carried beneath the cephalothorax between the legs where it is held in place by the chelicerae and palps. This eggsac is eventually enclosed in a large silken nest, called the nursery web, by the female spider just before the spiderlings emerge from the sac.

The aquatic group are generally known in New Zealand as water spiders and are often seen moving over the water surface and pulling themselves beneath the surface to catch prey. In this group the nursery web is constructed between the stones on the river bed while the other group constructs the nursery web so commonly seen throughout the country on clumps of tussock or low shrubs. The female spider remains with the nursery web until the spiderlings leave the nest but it is normal for the spider to retreat to the base of the shrub or grass holding the web during the daylight hours and so it is not commonly seen, but it does move back to the nest at night.

Thomisidae

These spiders are two-clawed vagrants which by virtue of their general appearance and their ability to move sideways or backward have been given the name of crab spiders. The legs are usually

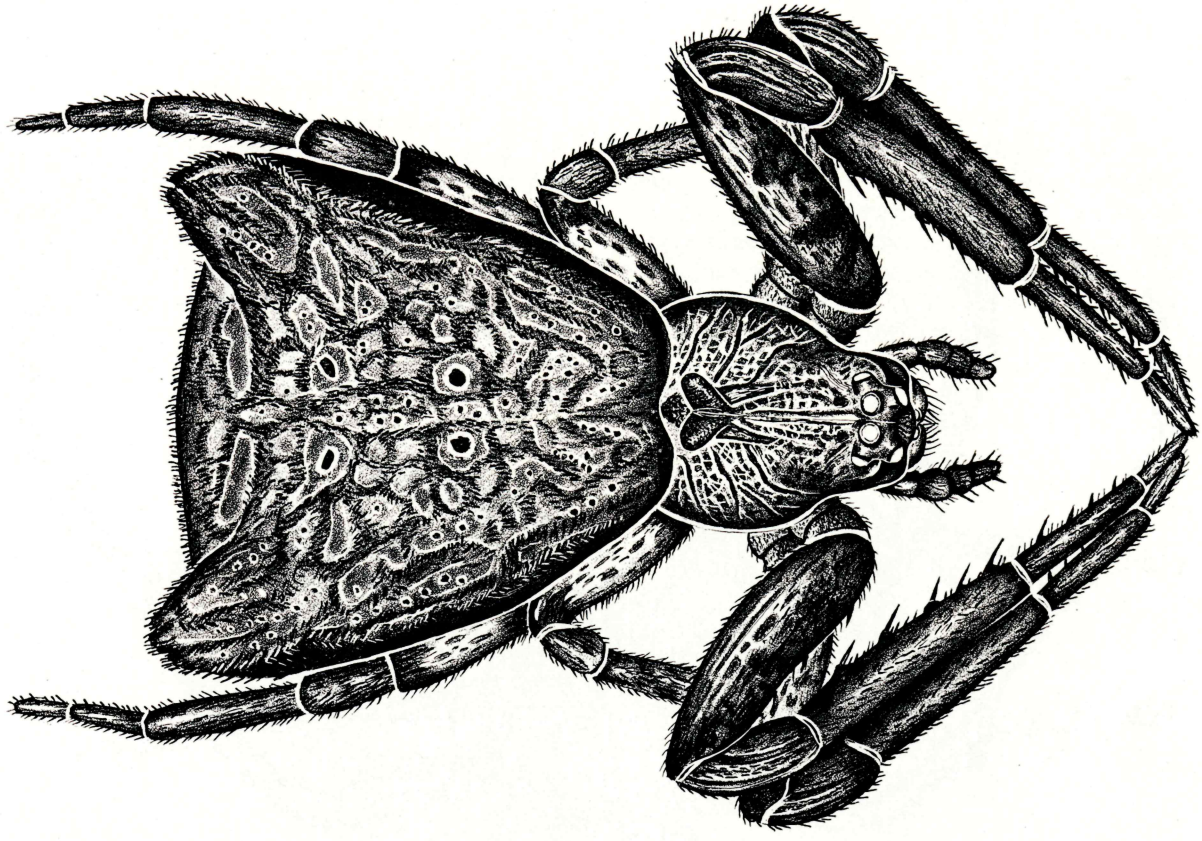


Fig. 153. *Sidymella* sp. female (Thomisidae). Dunedin, Otago. Similar species are commonly found on shrubs and tree trunks throughout New Zealand. From life. Body length 10 mm.

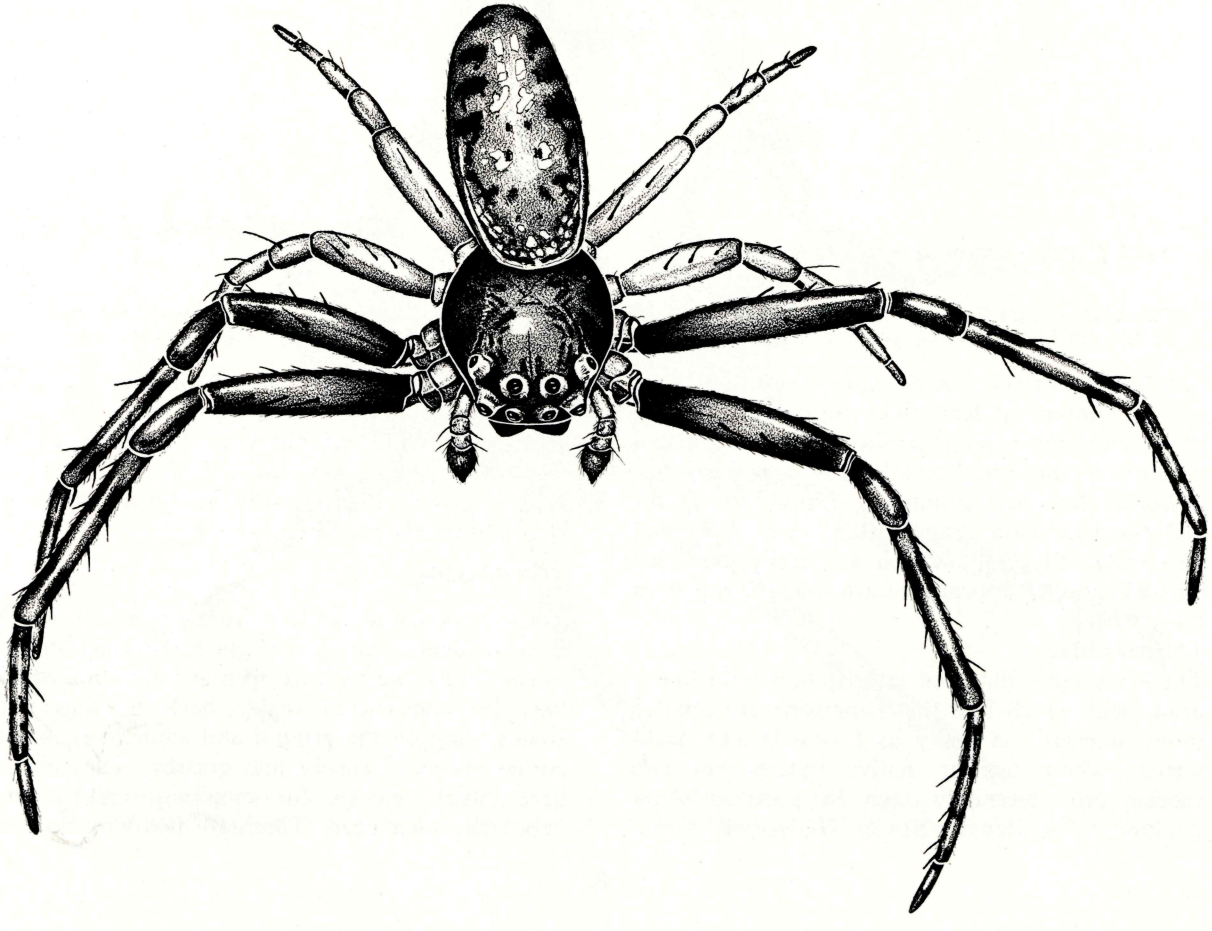


Fig. 154. *Diaea* sp. male (Thomisidae). Nelson. Numerous green or yellow species are found throughout New Zealand, on shrubs, both in forest and scrub. From life. Body length 3.5 mm.

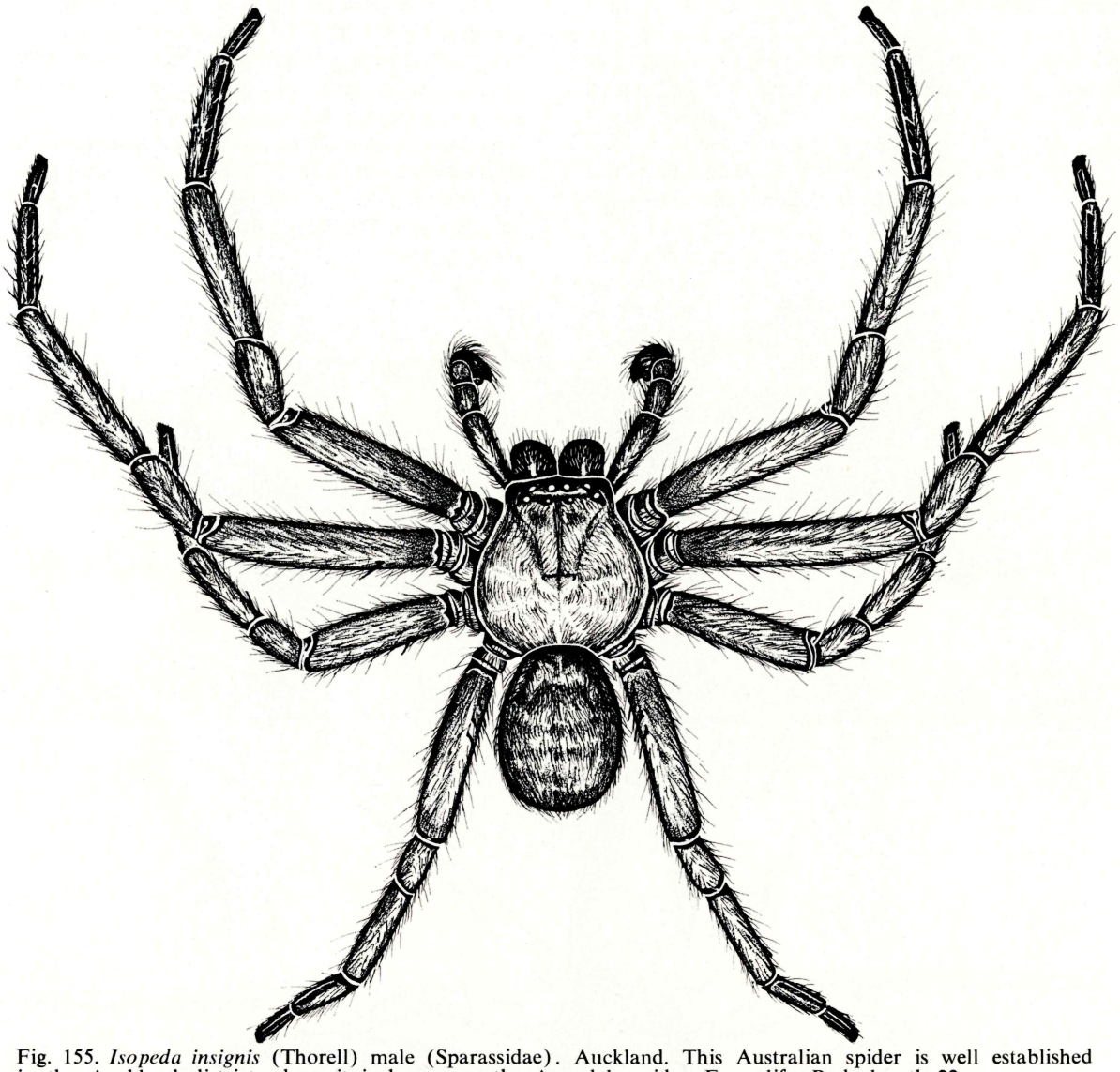


Fig. 155. *Isopeda insignis* (Thorell) male (Sparassidae). Auckland. This Australian spider is well established in the Auckland district where it is known as the Avondale spider. From life. Body length 22 mm.

directed sideways in the laterigrade position. They are all hunting spiders which do not construct a snare and being without keen eyesight depend mainly on ambush to catch their prey. In New Zealand they are commonly found on shrubs and the two main genera *Diaea* (Fig. 154) and *Sidymella* (Fig. 153) which are easily identified by their general appearance are found throughout the country.

Sparassidae

These are giant flattened crab spiders with laterigrade legs which like the Thomisids are able to move sideways as easily as forwards and backwards. There are no native species but two species are commonly seen in parts of New Zealand. The Banana Spider *Heteropoda venatoria* is often brought into New Zealand with fruit, particularly bananas, but it does not seem able to become established. The even larger Australian species *Isopeda insignis* Thorell (Fig. 155) is now well established in Auckland where it is commonly found in houses.

Clubionidae

These two-clawed spiders are all vagrants which hunt at night. During daylight hours they remain in small tubelike retreats open at both ends which may be constructed under bark or logs and stones lying on the ground and sometimes in the curled leaves of shrubs and grasses. The spiders use similar retreats for moulting, mating and depositing their eggs. There are two very distinct

genera commonly found in New Zealand, each of which contains many similar looking species. All of the species of *Clubiona* (Fig. 156) are pale in colour with little to differentiate them in general appearance other than variation in the dorsal pattern of the abdomen. They are medium-sized spiders, relatively fast in their movements, which are also capable of hopping. They may be found in practically all habitats in New Zealand from the seashore to riverbed, and in scrubland or forest. The second group of these spiders are at present placed in the genus *Uliodon* (Fig. 157) but are related to the Australian spiders placed in the genus *Miturga*. These are large brown spiders, generally found in a tubular retreat under logs and stones which is often constructed in a depression excavated by the spider. These spiders are basically forest dwellers but some species are found under stones on the mountain sides above the bushline.

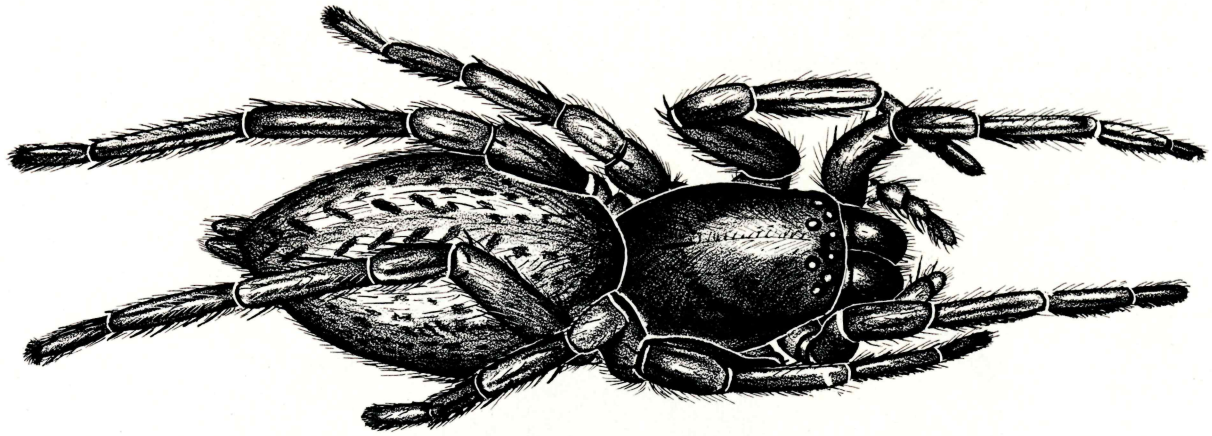


Fig. 156. *Clubiona* sp. female (Clubionidae). Dunedin, Otago. Many similar species are found in all parts of New Zealand. From life. Body length 9 mm.

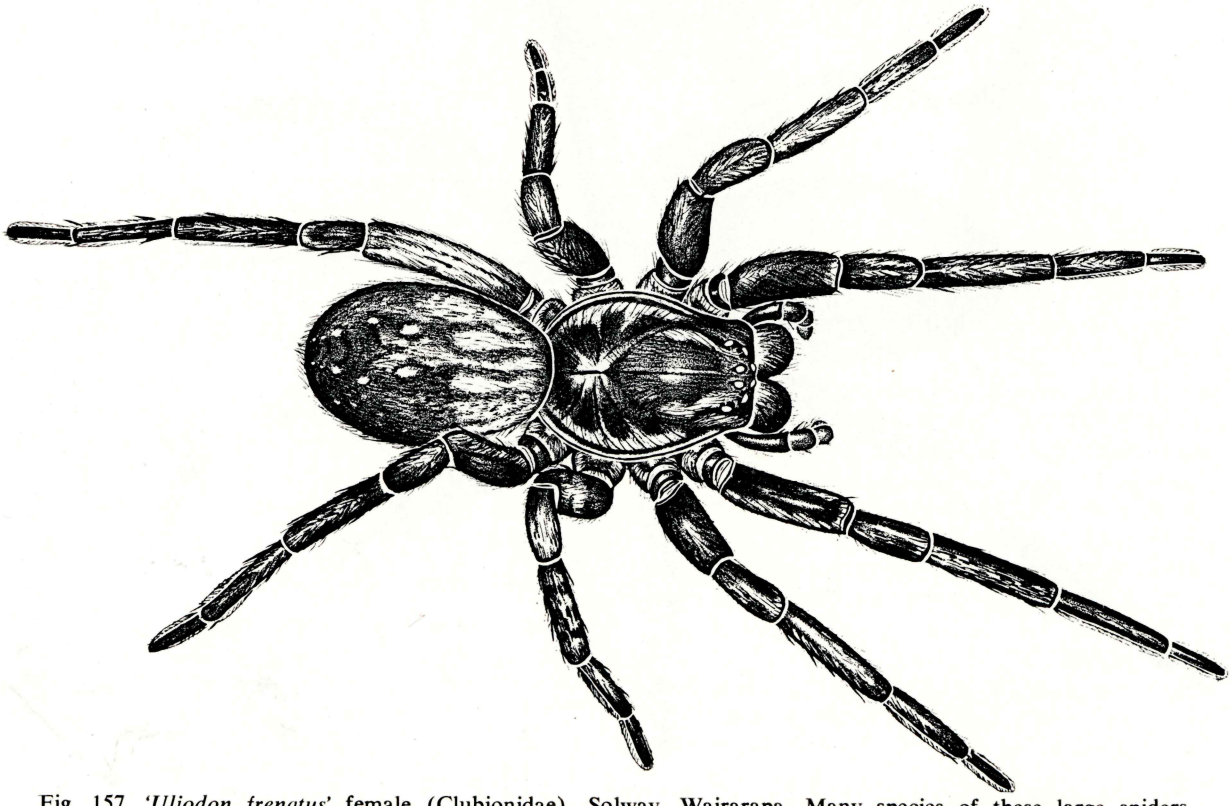


Fig. 157. *'Uliodon frenatus'* female (Clubionidae). Solway, Wairarapa. Many species of these large spiders occur in forest. They are related to the Australian species of *Miturga*. From life. Body length 20 mm.

Gnaphosidae

The New Zealand gnaphosids are all sombre coloured, in grey or black or brown, and a close covering of short hair gives many of them a glossy velvet appearance. Their habits are similar to the clubionids but the majority of them are ground dwellers. The family is closely related to the Clubionidae and many species may be confused with *Clubiona* but these gnaphosids are easily identified by the widely separated anterior spinnerets (Fig. 102). *Anzacia gemmea* (Fig. 158) is found throughout New Zealand as is the Australian bark spider *Hemicloea rogenhoferi* (Fig. 159).

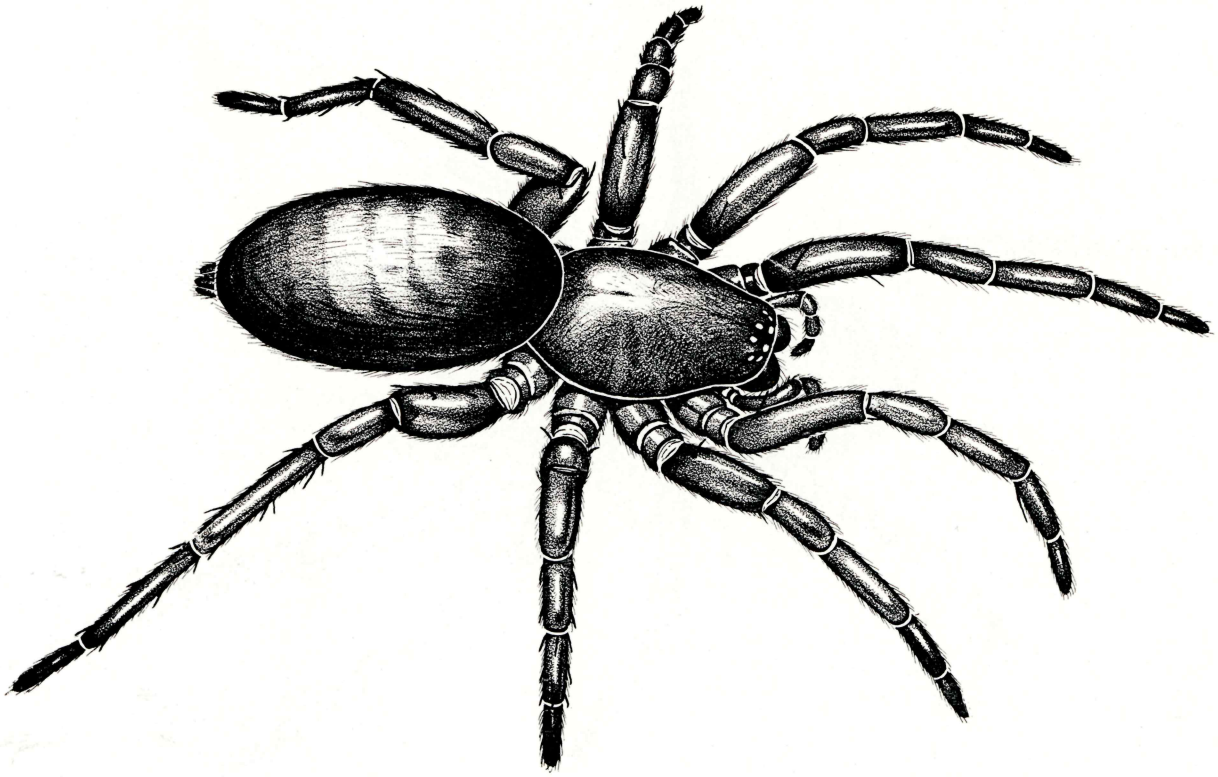


Fig. 158. *Anzacia gemmea* (Koch) female (Gnaphosidae). Haast, Fiordland. This is the most widespread species of the family, most of which have short hairs on the abdomen which give the spider a metallic gleam. From life. Body length 4.5 mm.

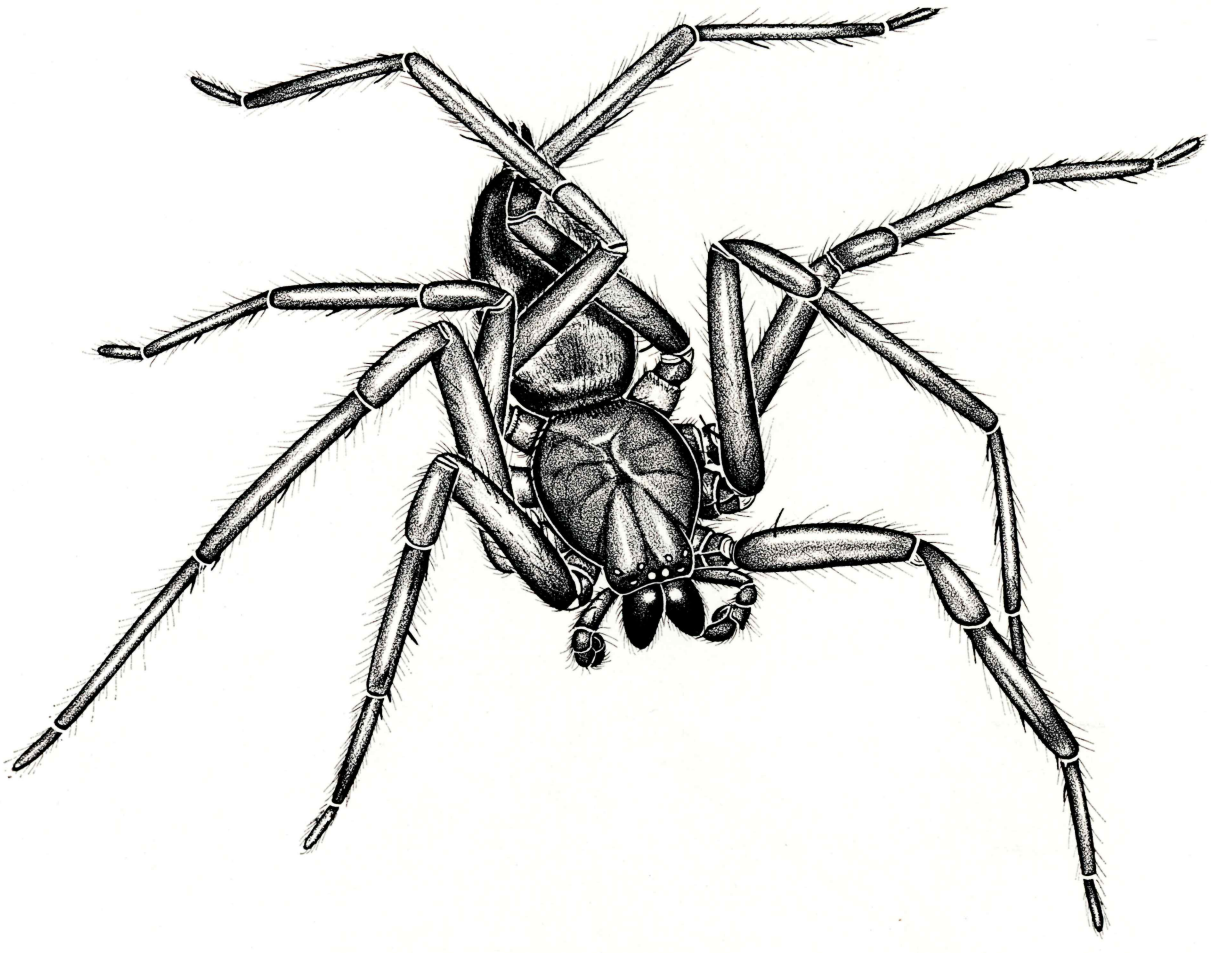


Fig. 159. *Hemicloea rogenhoferi* Koch male (Gnaphosidae). These flattened spiders are distributed throughout New Zealand and are usually found under loose bark. Introduced from Australia. From life. Body length 10 mm.

Theridiidae

The theridiids are known as the 'comb footed' spiders because the great majority of them have a row of serrated bristles on the fourth tarsus which they use for flinging out the special swathing band to entangle their prey after it has been caught in the web. The snares are usually 'space webs' which consist of an irregular criss cross of thread but there are many modifications culminating in the single thread used by *Phoroncidia*. The range of body form is great and only a few of the more common and typical genera are illustrated.

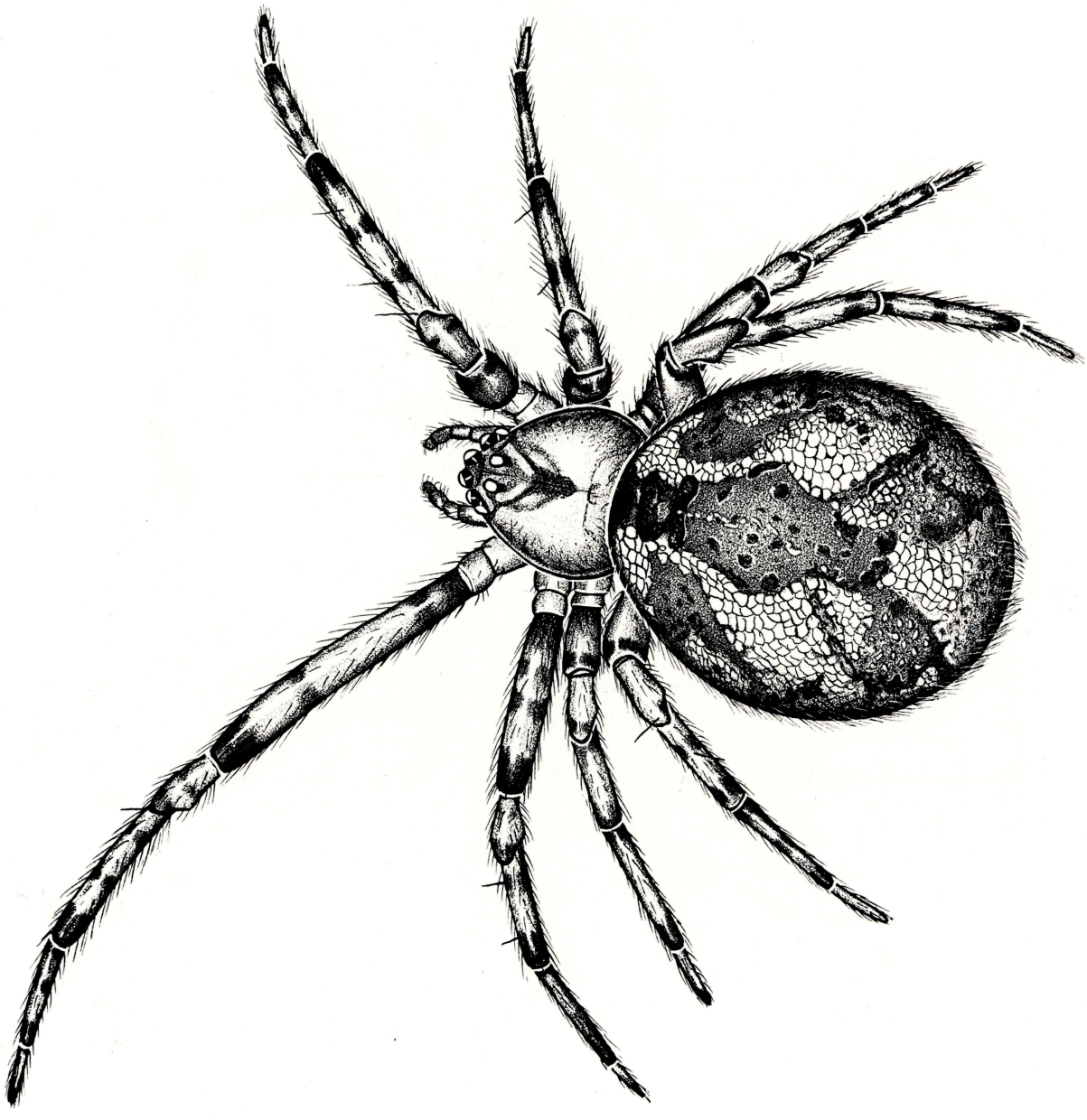


Fig. 160. *Achaearanea veruculata* (Urqu.) female (Theridiidae). Dunedin, Otago. Common cobweb spider which is typical of the many species present in New Zealand. From life. Body length 5 mm.

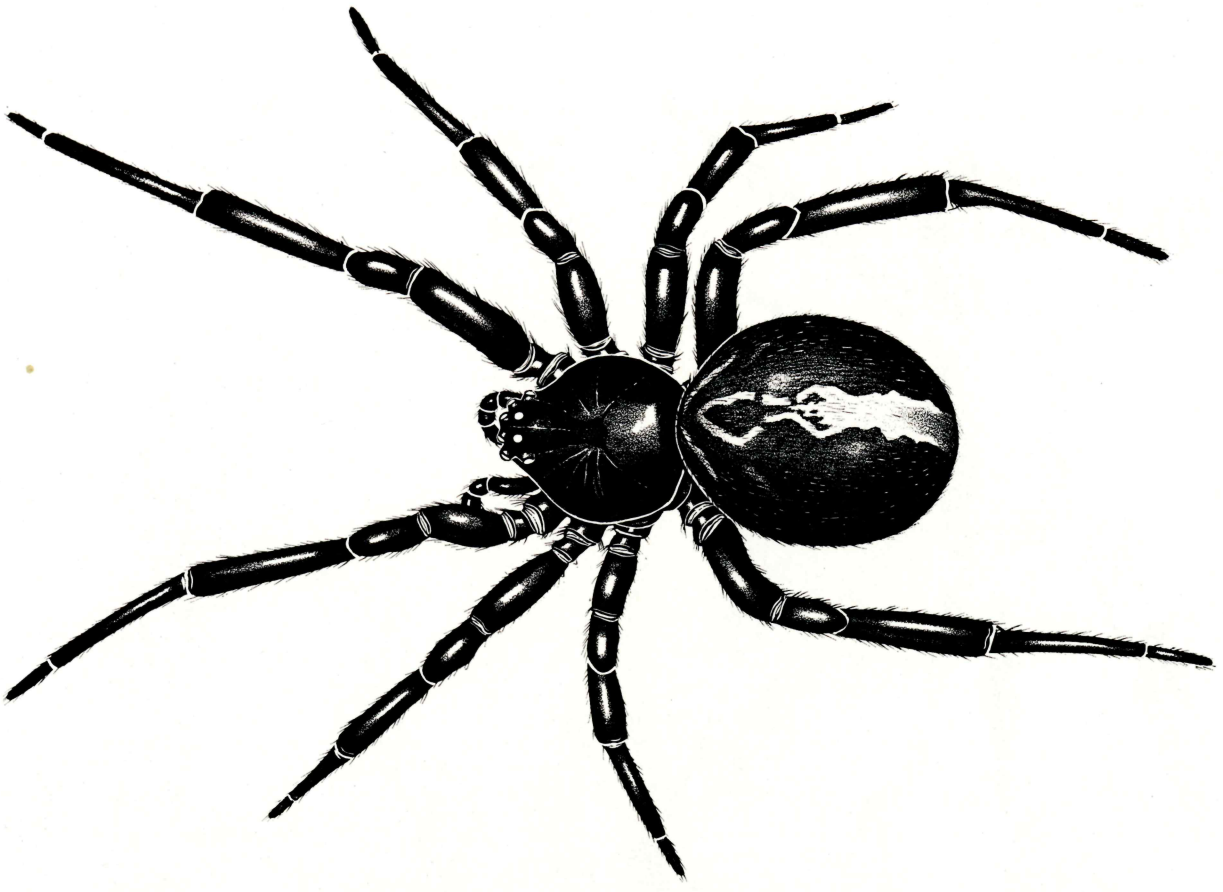


Fig. 161. *Latrodectus katipo* Powell, Katipo, female (Theridiidae). Doctors Point, Otago. This well-known poisonous spider is found near beaches along the coast of the North Island and in the South Island as far south as Dunedin. The band on the abdomen is red. The male is smaller with the red band often replaced by white marking. From life. Body length 6 mm.

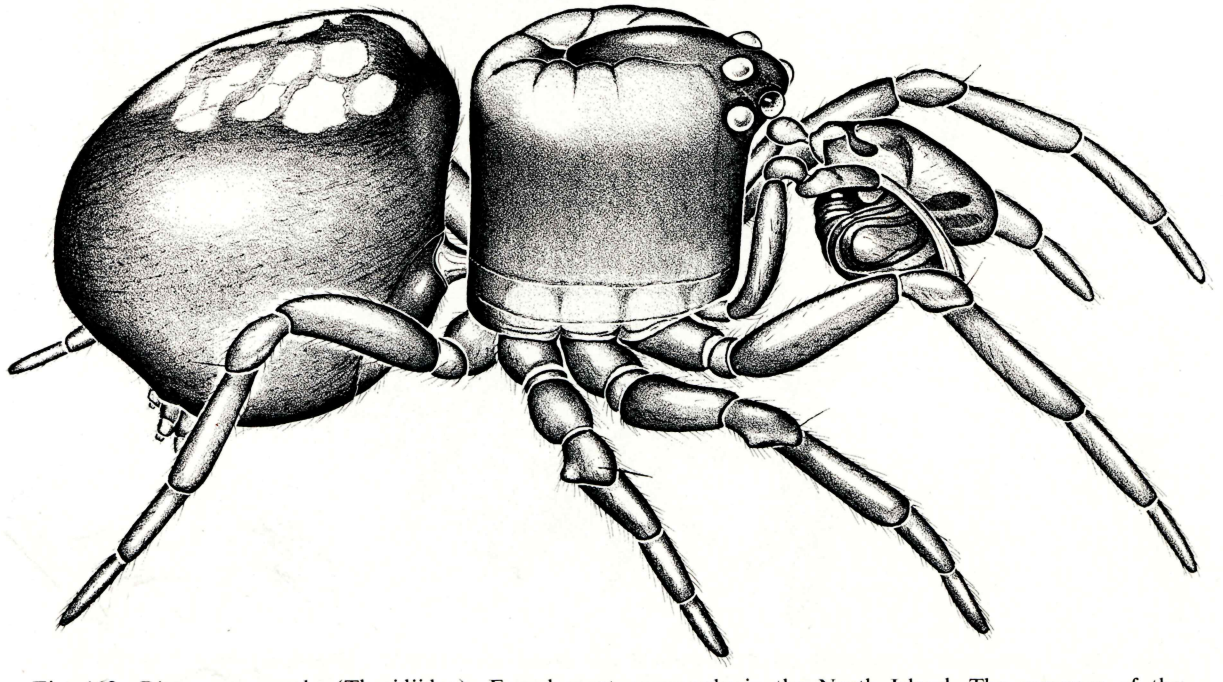
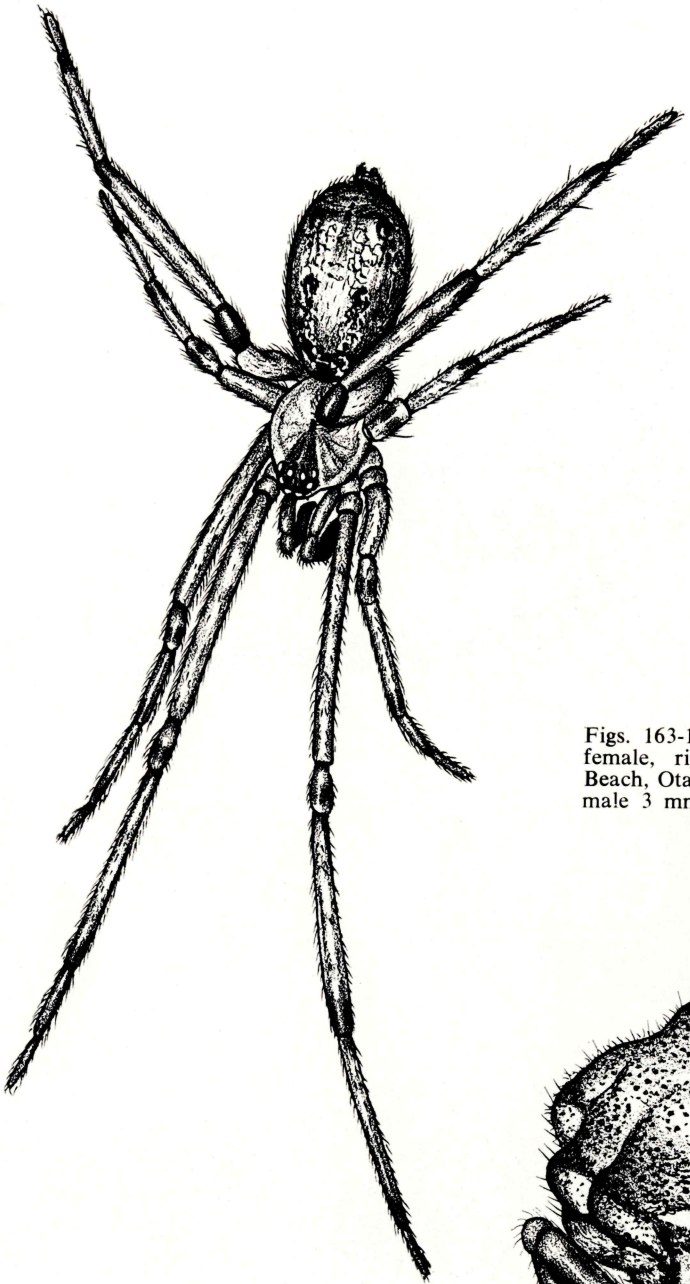
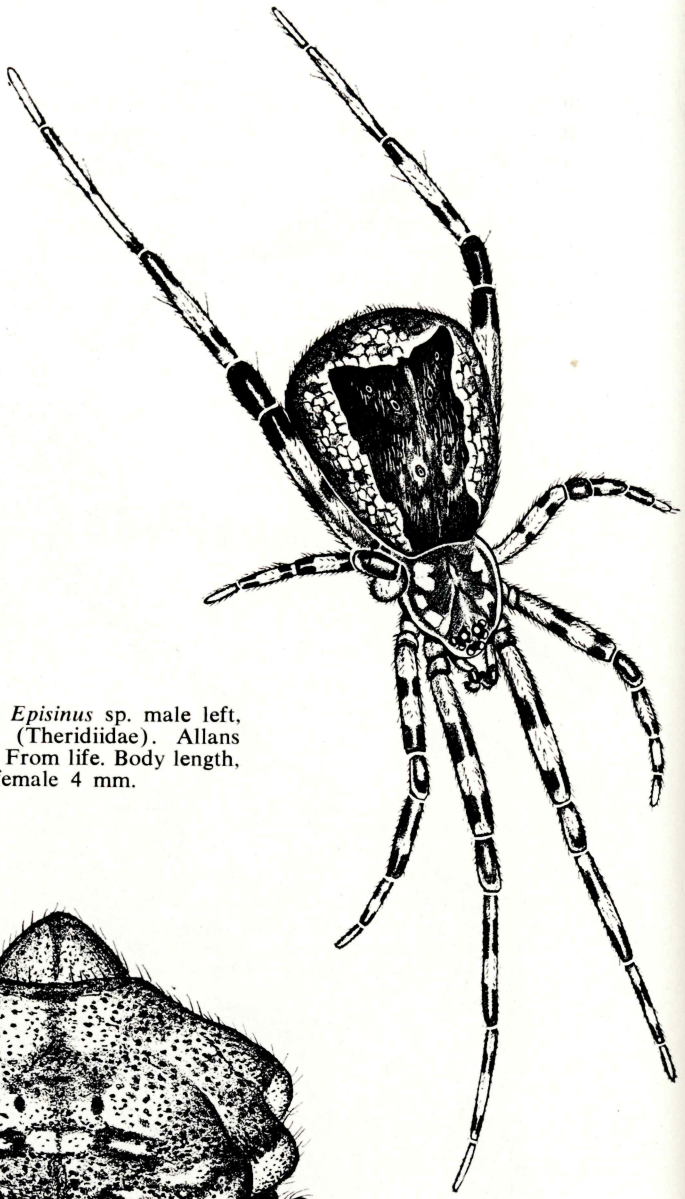


Fig. 162. *Dipoena* sp. male (Theridiidae). Found most commonly in the North Island. The carapace of the female is however similar to that of other Theridiid spiders. Preserved specimen. Body length 2 mm.





Figs. 163-164. *Episinus* sp. male left, female, right (Theridiidae). Allans Beach, Otago. From life. Body length, male 3 mm, female 4 mm.

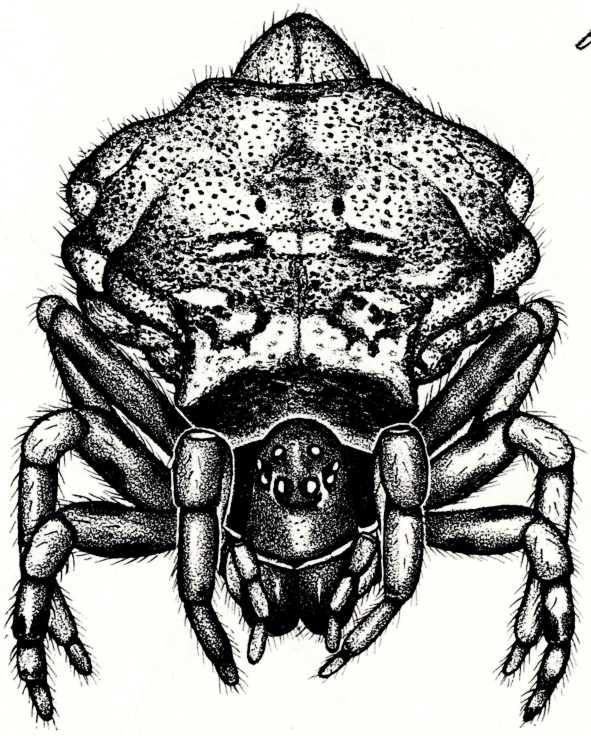


Fig. 165. *Phoroncidia* sp. female (Theridiidae). Dunedin, Otago. These minute spiders use a single stretched thread as a snare and are usually found in forest. From life. Body length 1.5 mm.

Oxyopidae

The lynx spiders, found usually on low shrubs and tussock, are agile hunters, which combine both rapid running and jumping (Fig. 166). They are easily recognized by the high oval thorax and the abdomen which tapers to a point behind. In New Zealand these spiders are all yellowish brown in colour. Lynx spiders are most commonly found in tropical regions and in New Zealand are more abundant in the North Island. The eggsac is usually attached to a twig and the mother remains to guard it until the spiderlings hatch.

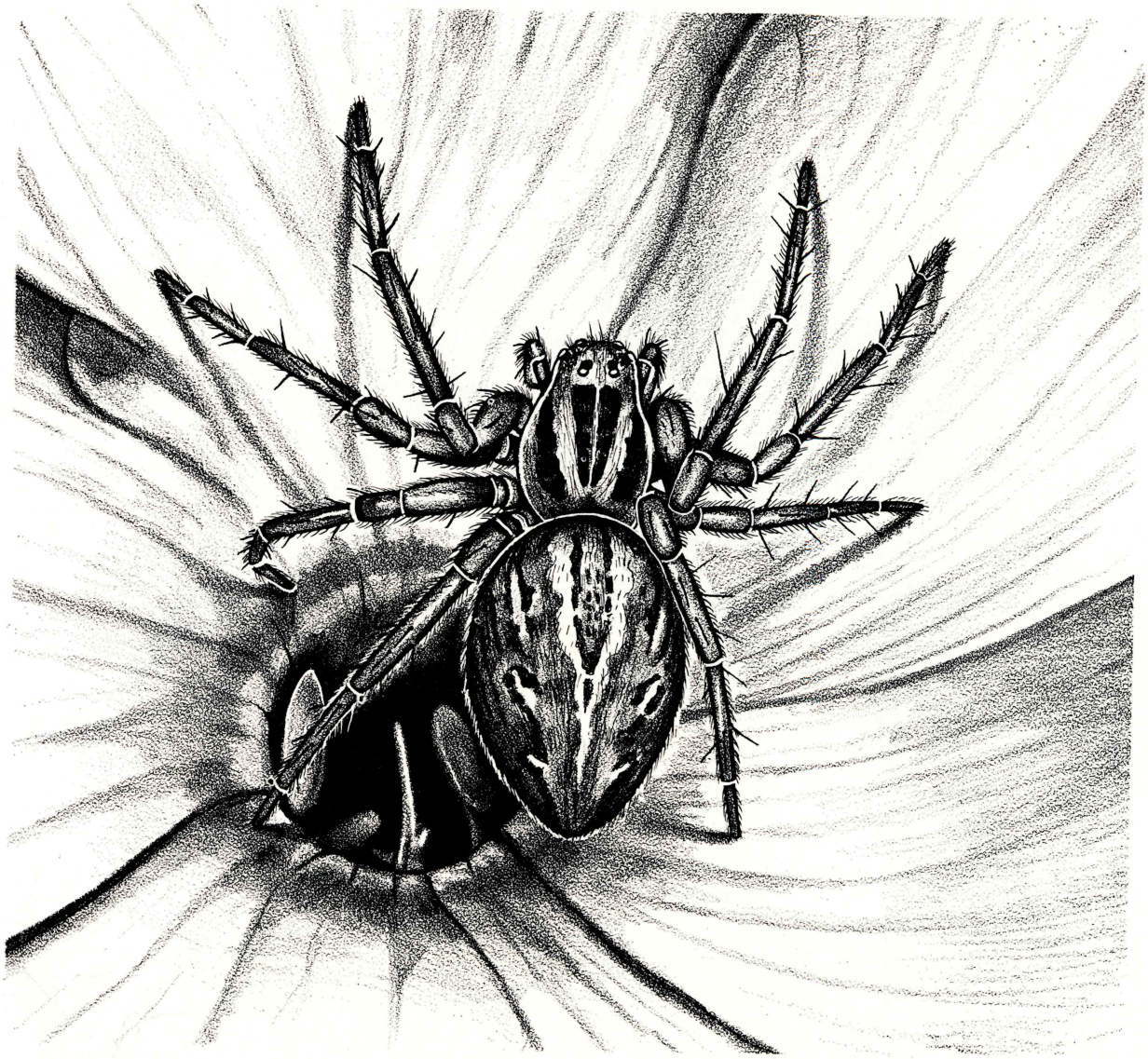


Fig. 166. *Oxyopes* sp. female (Oxyopidae). Feilding. These fast-moving hunting spiders are found in shrubs in both the North and South Islands but are more common in the North Island. From life. Body length 5 mm.

Mimetidae

Observations made on representatives of this family from the Northern Hemisphere suggest that all or most of them feed on other spiders and for this reason they have been called 'Pirate Spiders'. This behaviour seems probable for at least the group of the New Zealand mimetids similar to overseas forms at present placed in *Mimetus* (Fig. 167) which are usually collected from shrubs. These spiders are often found in the webs of other spiders. A second group found in New Zealand living on the forest floor is distinguished by the presence of hard plates on the abdomen; their habits are not known (Fig. 168). Mimetids are all characterized by the distinctive arrangement of the spines on the first two pairs of legs.

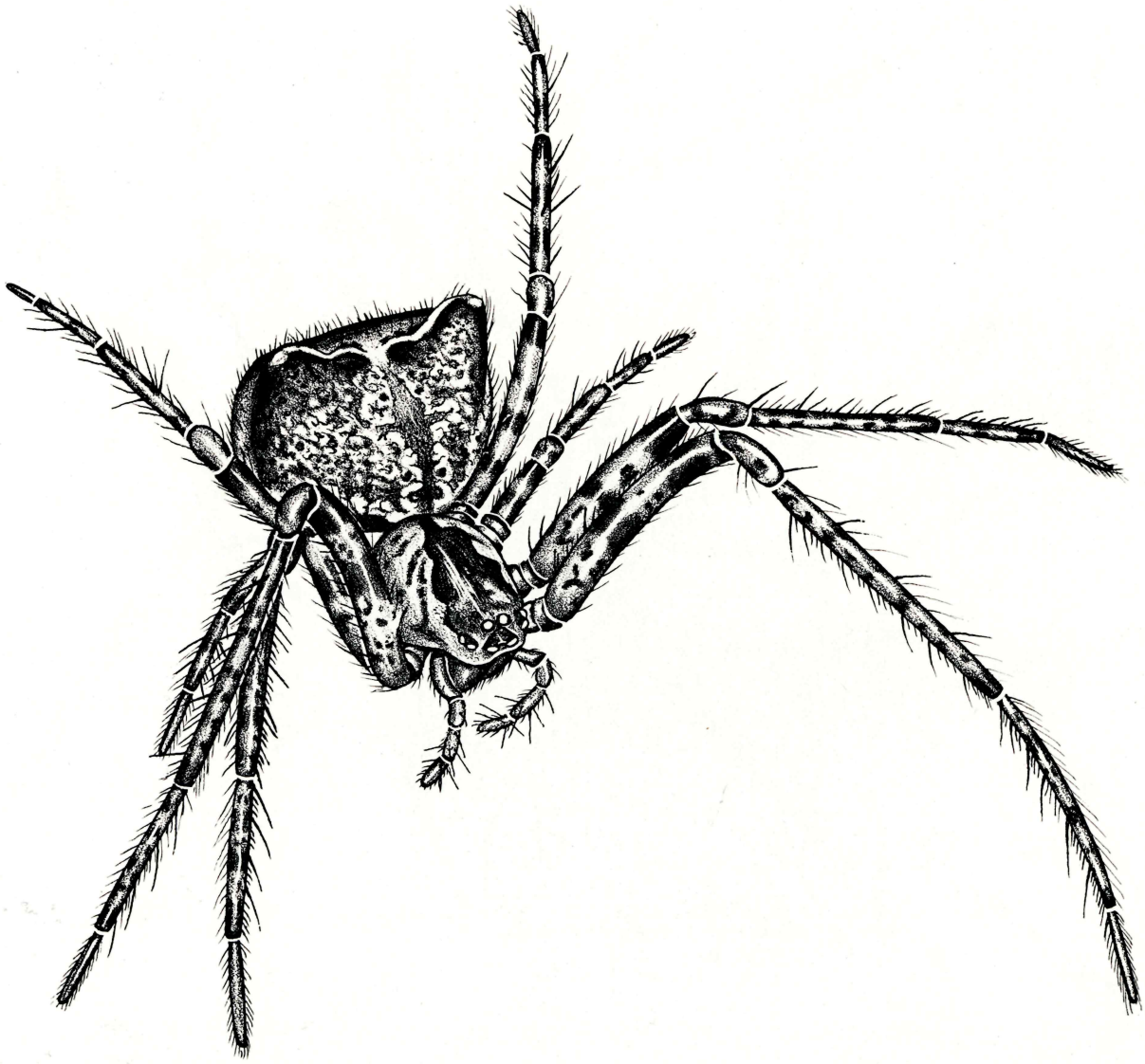


Fig. 167. *Mimetus* sp. female (Mimetidae). Dunedin, Otago. The arrangement of long and short spines in a row on the first two pairs of legs is characteristic for this family. Found throughout New Zealand. From life. Body length 2.5 mm.

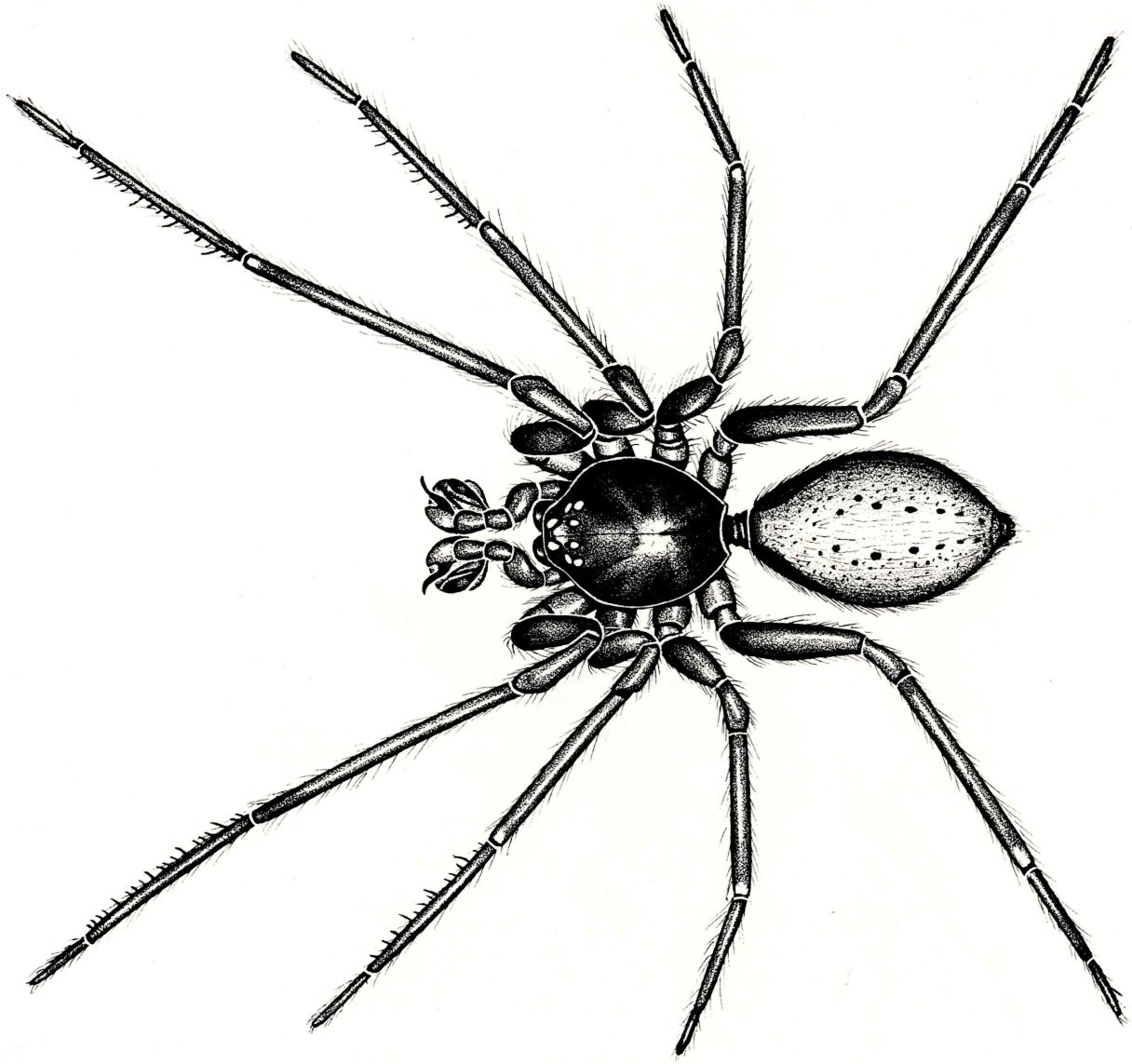


Fig. 168. Family Mimetidae male. Mount Arthur Track, Nelson. Similar species belonging to this undescribed genus are found in forest throughout New Zealand. Preserved specimen. Body length 4 mm.

Epeiridae

The spiders in this family are diverse in appearance but most of the groups can be recognized from the six species illustrated. Except for *Celaenia* all species construct an orb web and this form of snare is shared only with the Tetragnathidae, the Uloboridae and a few Symphytognathidae. *Celaenia* (Fig. 24) is unusual both in appearance and habits. These spiders do not construct a snare but rest on a twig or leaf at night and catch moths with their front legs as they approach. Observations on Australian species suggest that these spiders have some means of attracting the moths which are almost invariably males, and it has been suggested that this may be accomplished by the use of scent. All of the New Zealand species of epeirids apart from the Metinae are also characterized by the wide separation between the lateral eyes, which are contiguous, and the median eyes.

Tetragnathidae

This family is often placed in the Epeiridae but forms a compact and easily identifiable group by itself. They construct orb webs and in New Zealand these spiders are most commonly found near water, in creeks, swamps or marsh. The spiders are all elongate in form, with long legs, and are often found with the legs directed fore and aft so that the spider looks like a stick. The chelicerae are very long and strong and are heavily toothed, while further processes on the male chelicerae are used to engage the chelicerae of the female during mating.

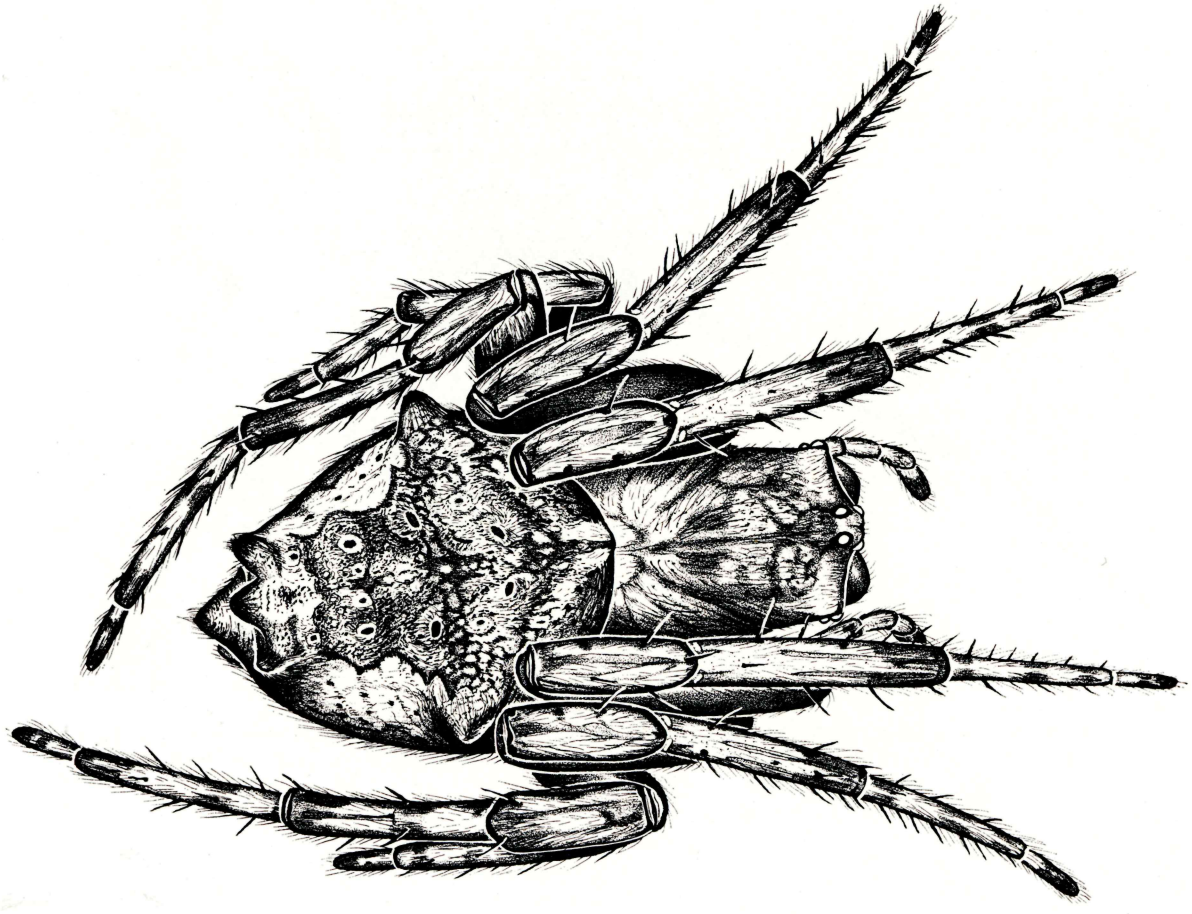


Fig. 169. *Aranea pustulosa* (Walck.) female (Epeiridae). Dunedin, Otago. Common orb web spider. This species has probably been introduced from Australia but many similar species are native to New Zealand. From life. Body length 11 mm.

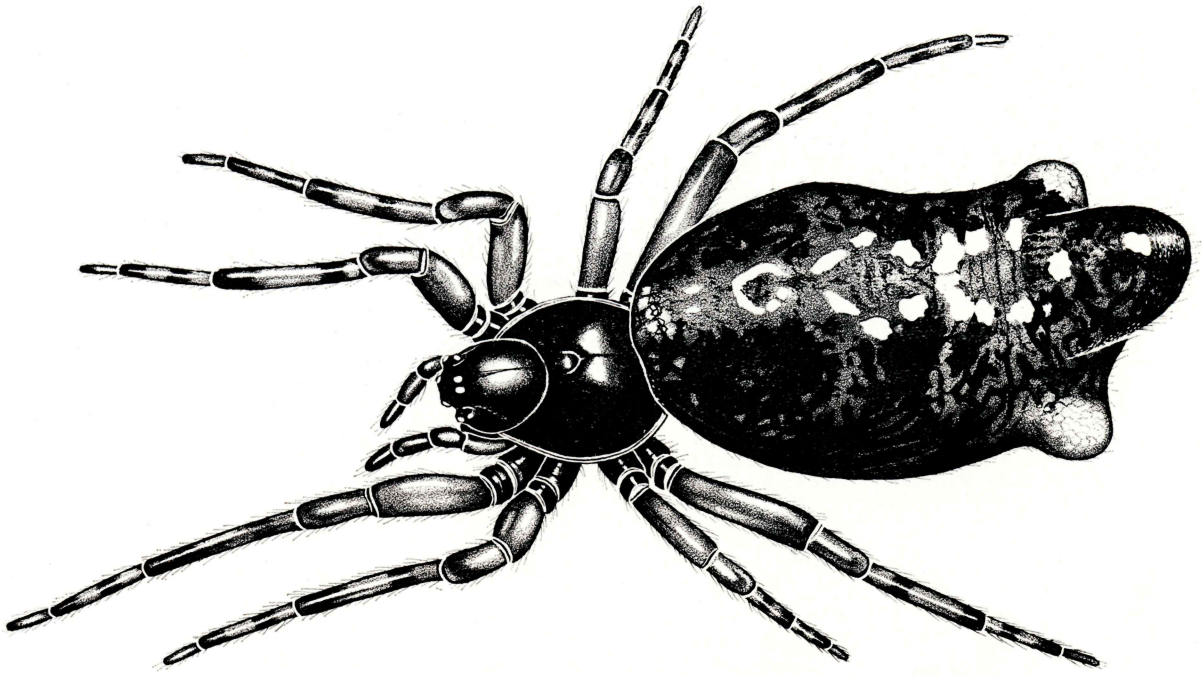


Fig. 170. *Cyclosa trilobata* (Urqu.) female (Epeiridae). Masterton, Wairarapa. These orb web spiders are usually communal but each spider builds its own web. Often the egg-sacs of a number of spiders are placed together along a twig so that it looks like the seed pod of Kowhai. From life. Body length 7 mm.

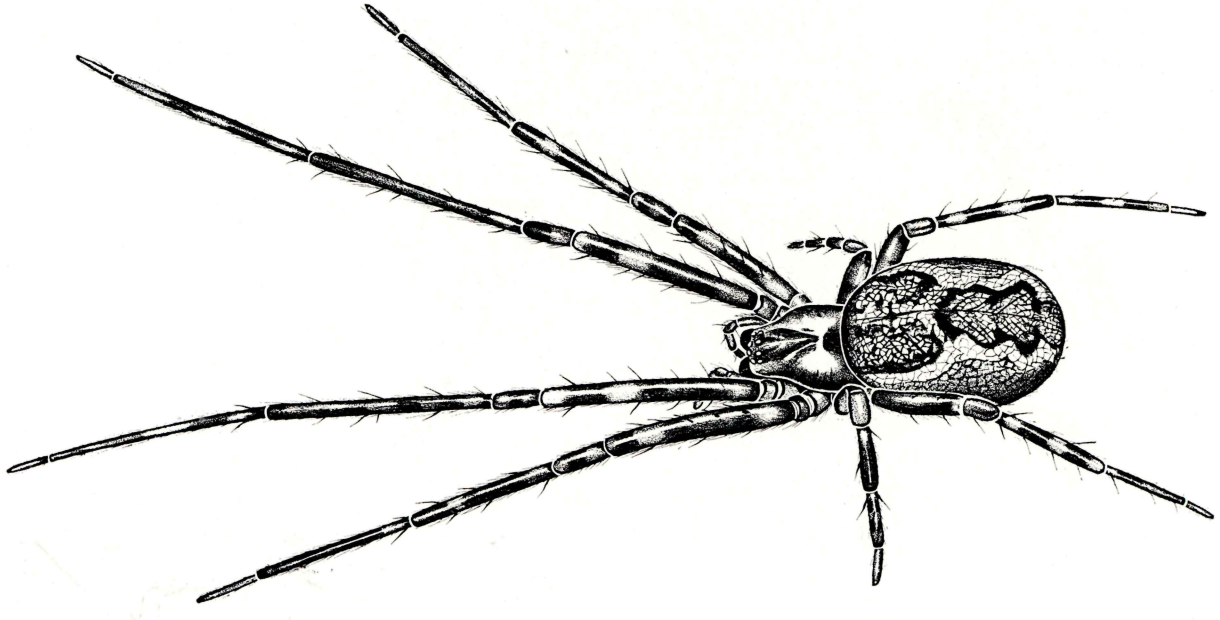


Fig. 171. Sub-family Metinae female (Epeiridae). Whare Flat, Otago. The orb web of these spiders is often stretched horizontally across a small stream. A number of different species are found in New Zealand. From life. Body lenth 7 mm.

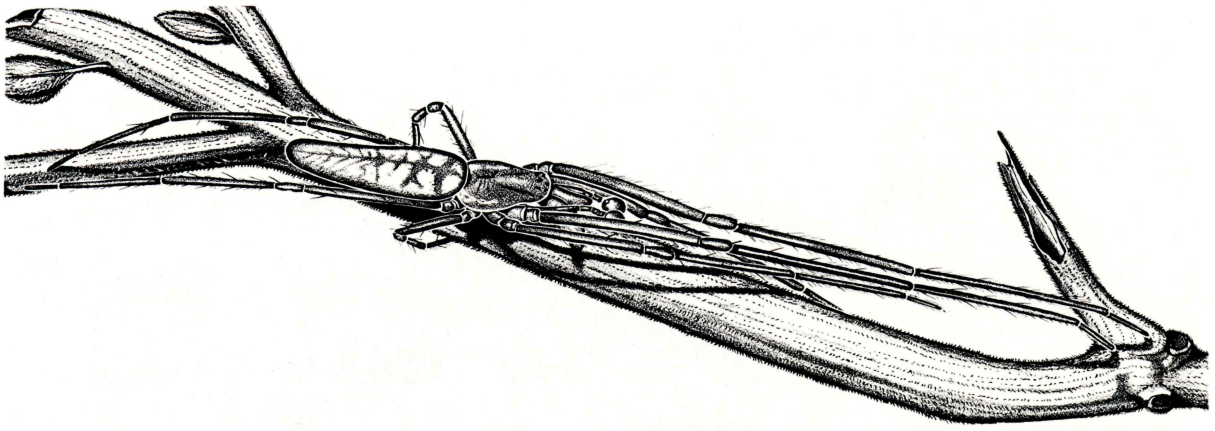


Fig. 172. *Tetragnatha* sp. male (Tetragnathidae). Bucklands Crossing, Otago. Many species of *Tetragnatha* are found in New Zealand, all looking alike. Their orb webs are most commonly found near water. From life. Body length 8 mm.

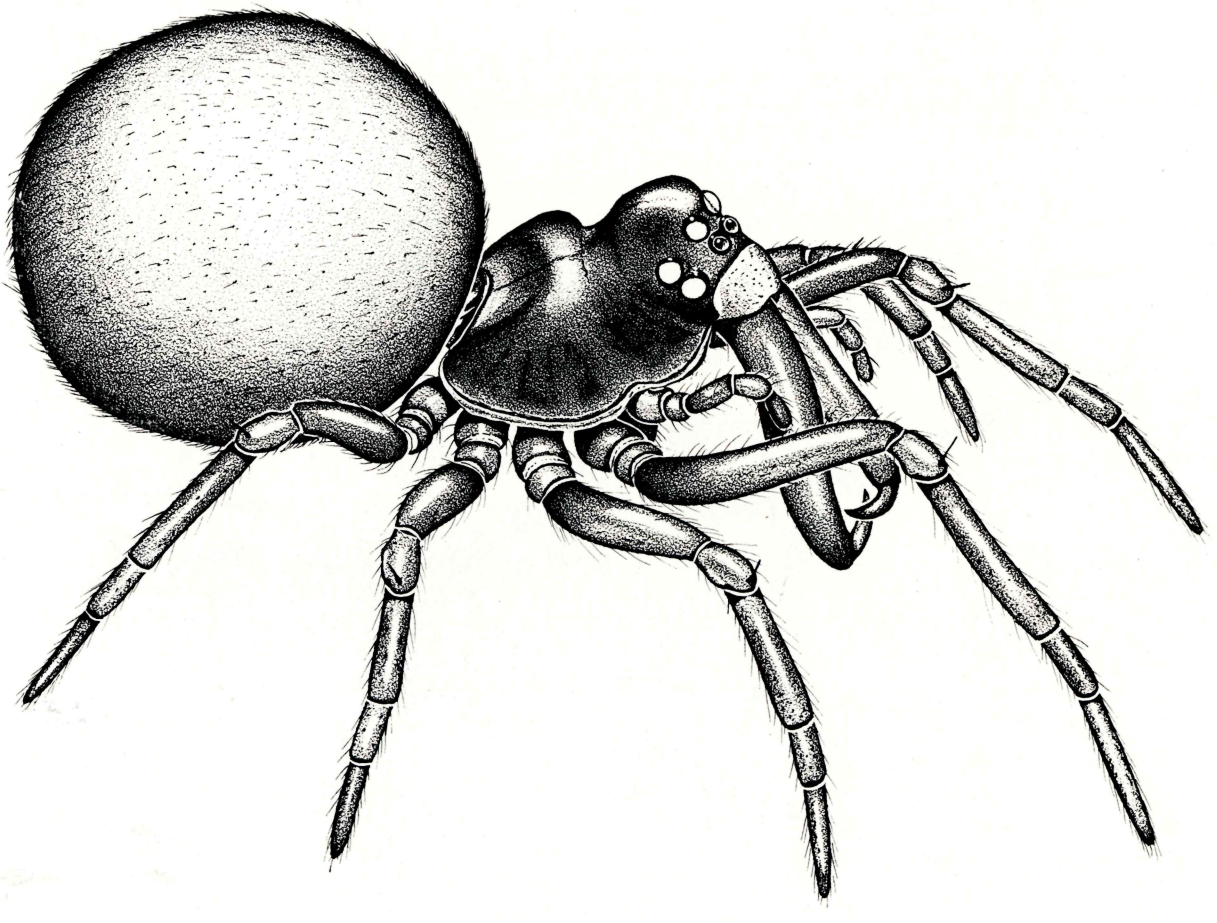


Fig. 173. *Holarchaea novaeseelandiae* (Forster) female (Archaeidae). Caswell Sound, Fiordland. A number of species belonging to this family are found in both the North and South Islands in moist forest. Preserved specimen. Body length 0.5 mm.

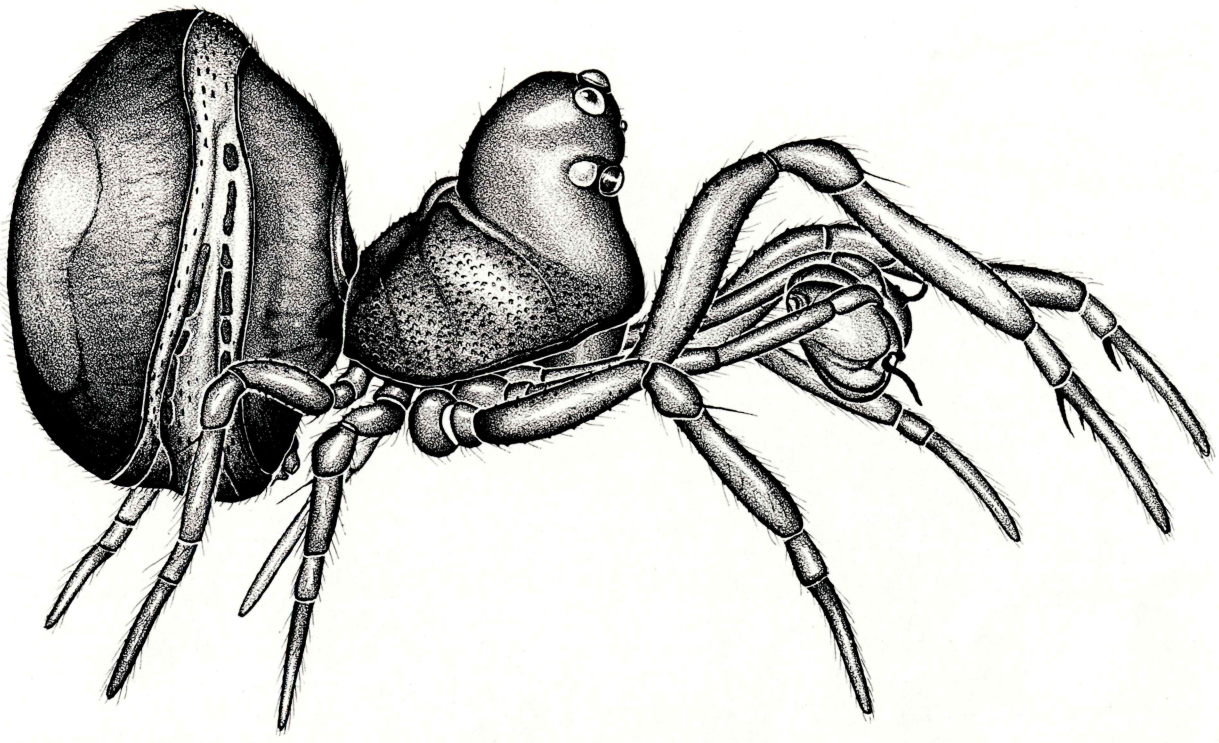


Fig. 174. *Pseudanapis spinipes* (Forster) male (Symphytognathidae). Many species of these minute spiders are common in the leaf-mould of the forests. Preserved specimen. Body length 1.5 mm.

Archaeidae

The Archaeidae are distributed over most of New Zealand but are restricted to forested areas. The elongated chelicerae, inserted well above the mouth, are characteristic, while the carapace is always high in both sexes and the palps are relatively small (Fig. 173). They are slow moving and do not appear to construct a snare. During daylight hours they are found hiding under logs, bark and moss, but may be collected at night while hunting on the forest floor or tree trunks. It is generally accepted that these spiders like the Mimetidae feed on other spiders but no observations have been made on the New Zealand species. The form of the eggsac is not known.

Symphytognathidae

Spiders of this family are minute and are rarely seen unless specifically searched for. Practically all of the species live in forest and all seem dependent on a high relative humidity. Some of the species construct a small orb web but others construct sheet or tangled webs and these minute webs are usually found among moss and liverworts on the forest floor and on the trunks of trees. Most of the species are characterized by an elevated carapace which is present in both sexes (*Pseudanapis*, Fig. 174) but a few are modified only in the male (*Trogloneta*, Fig. 3). There is a tendency for the female palp to be reduced both in size and the number of segments and in some species the palp is lacking. The tarsus is usually longer than the metatarsus and this condition is unique among New Zealand spiders. The family is also of interest because book lungs are absent and respiration is achieved by tracheae alone.

Linyphiidae

The more commonly found linyphiids are black spiders with small white markings on the abdomen, which construct a sheet web under logs and stones (cf. *Mynoglenes*, Fig. 175). These spiders may be separated from similarly coloured theridiids by the more elongate abdomen. Numerous small, long-legged, spiders found in forest probably belong to this family but are not yet identifiable.

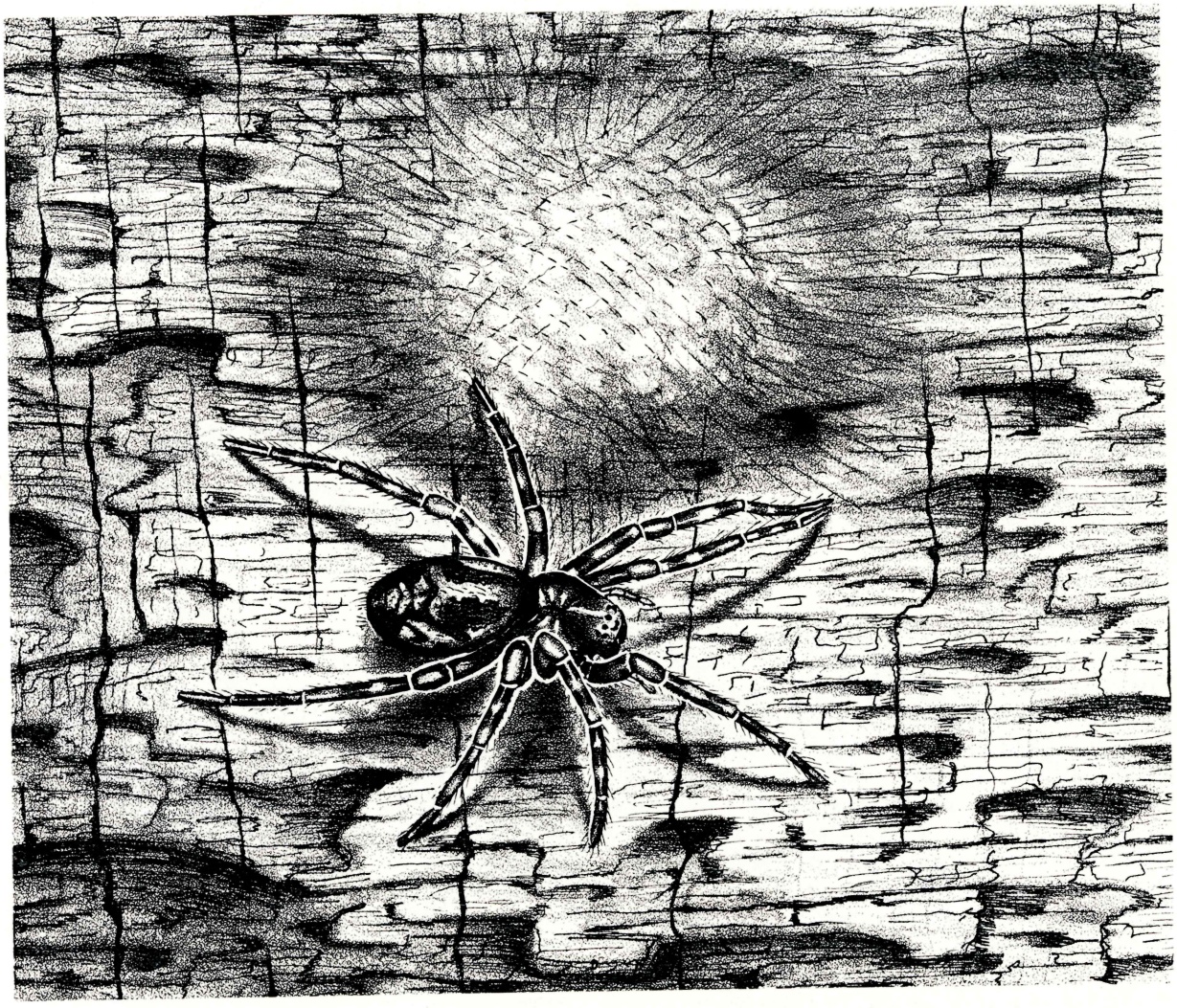


Fig. 175. *Mynoglenes* sp. female with egg-sac (Linyphiidae). Dunedin, Otago. From life. Body length 4 mm.

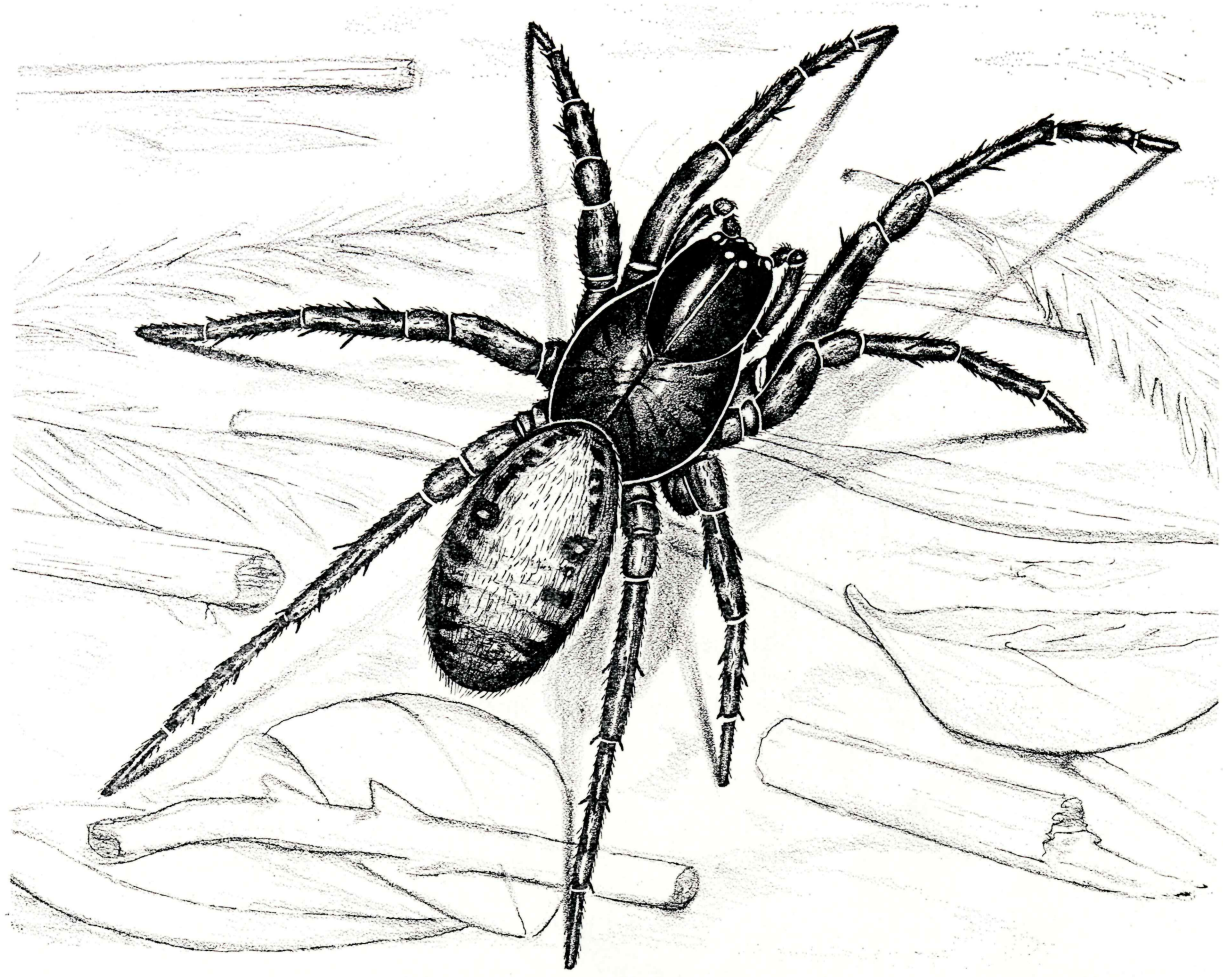


Fig. 176. *Mynoglenes* sp. female (Linyphiidae). Dunedin, Otago. From life. Body length 4 mm.

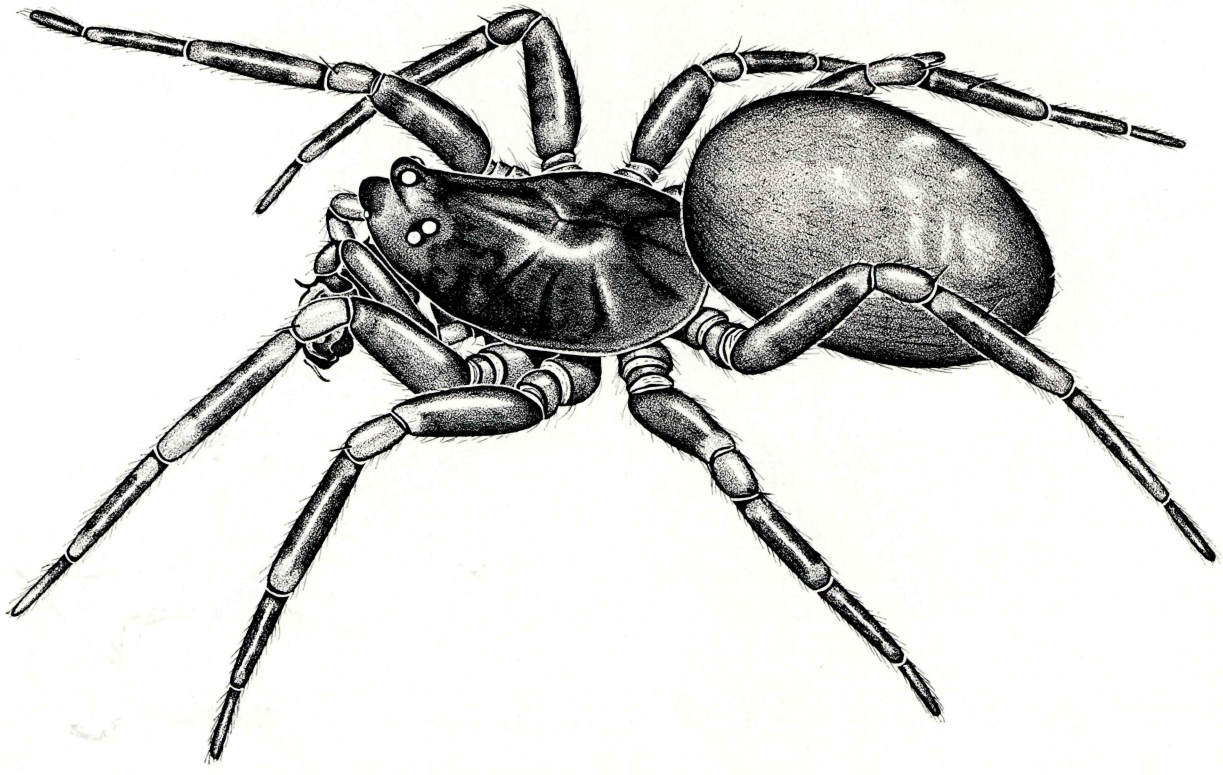


Fig. 177. *Diplocephalus cristatus* (Blackw.) male (Micryphantidae). This is the minute black spider usually called the 'money spider' in New Zealand. Introduced. Widespread in New Zealand. Preserved specimen.

Micryphantidae

This group of minute spiders, often placed within the Linyphiidae, is the most numerous group in the Northern Hemisphere. In many of the species the head of the male is modified into grotesque shapes and it is thought that in these forms the head is grasped by the female during mating. It is probable that this family does not occur naturally in New Zealand and that all of the species present are introduced. Two genera have been recorded, *Erigone* and *Diplocephalus*. The small, black, so-called money spiders which are found throughout New Zealand in pasture, on lawns and in gardens, are usually *Diplocephalus cristatus* (Fig. 177) which has been introduced from England.

Salticidae

The jumping spiders are all easily identified by the square or oblong outline of the carapace and the 4.2.2 arrangement of the eyes with the four front eyes very large, as well as by their distinctive movements. The brighter coloured species usually lead an arboreal life while many of the duller coloured species live among stones on the beaches, riverbeds and mountain screes, where their colour blends closely with their surroundings. A number which live in forest are normally found under bark or among moss and lichens. They are all hunters and possess the keenest eyesight of all spiders. The prey is usually stalked to within a few inches and the final distance covered by a single jump. The front pair of legs are normally longer and stouter than the others and are used to grasp prey but it is actually the hind legs which are used for leaping. A white silken retreat is constructed and used between hunting as well as for moulting and hibernating. The females also lay their eggs in the retreats which then are sealed up with the female inside until the eggs hatch and the spiderlings are ready to disperse.

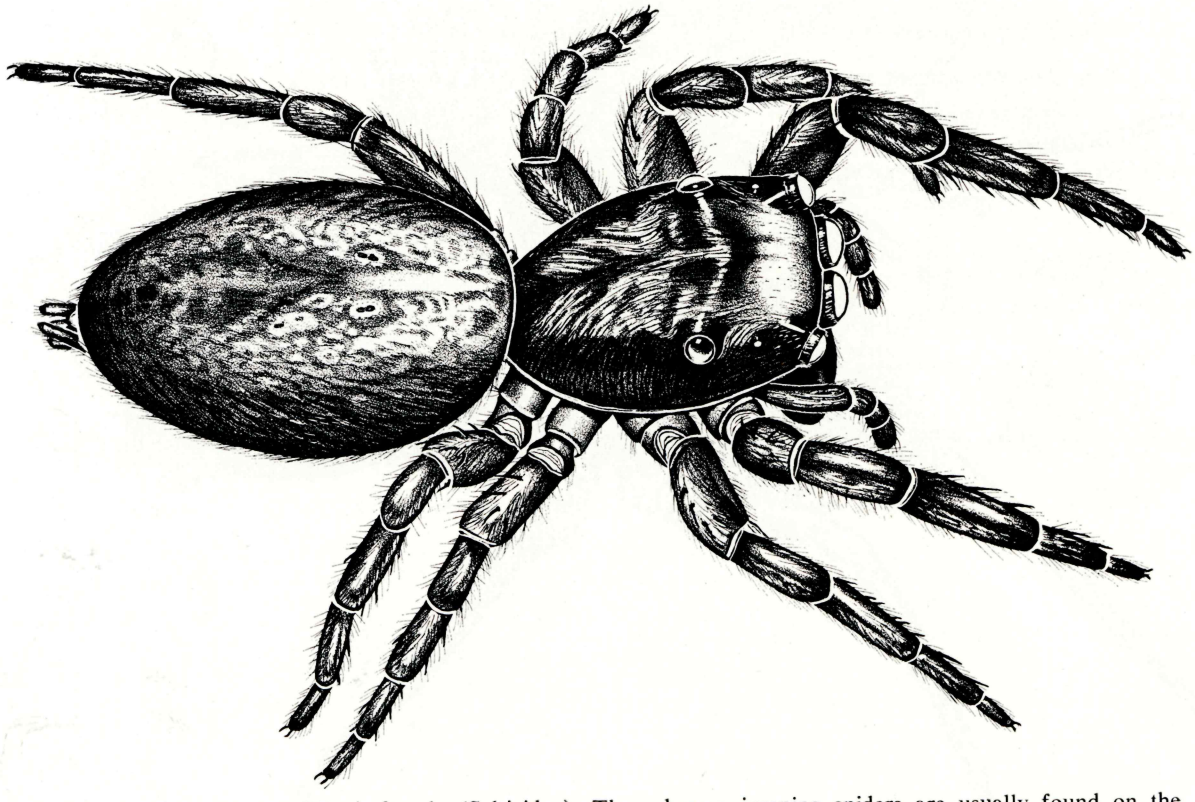


Fig. 178. *Trite auricoma* (Urq.) female (Salticidae). These brown jumping spiders are usually found on the forest floor. Common all over New Zealand. From life. Body length 10 mm.

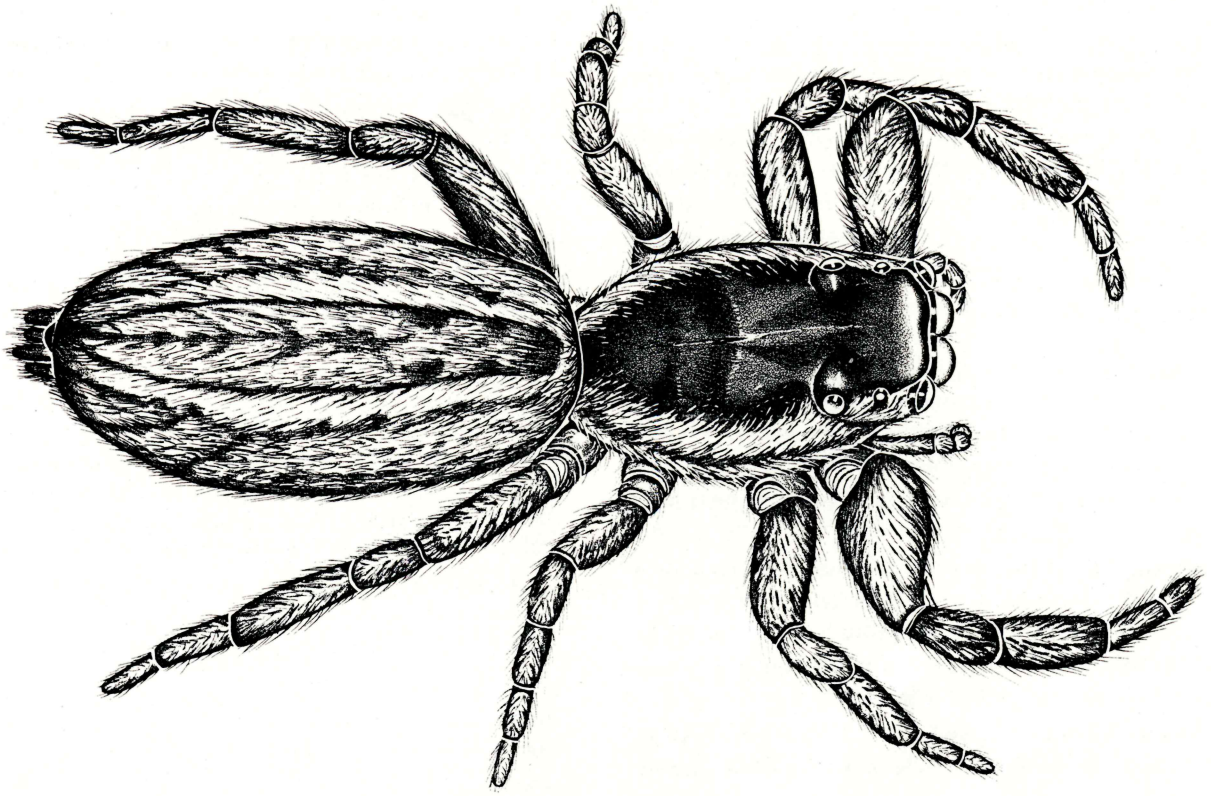


Fig. 179. *Holoplatys* sp. female (Salticidae). A number of these flattened jumping spiders are often seen hunting on tree trunks or on fences. From life. Body length 4 mm.

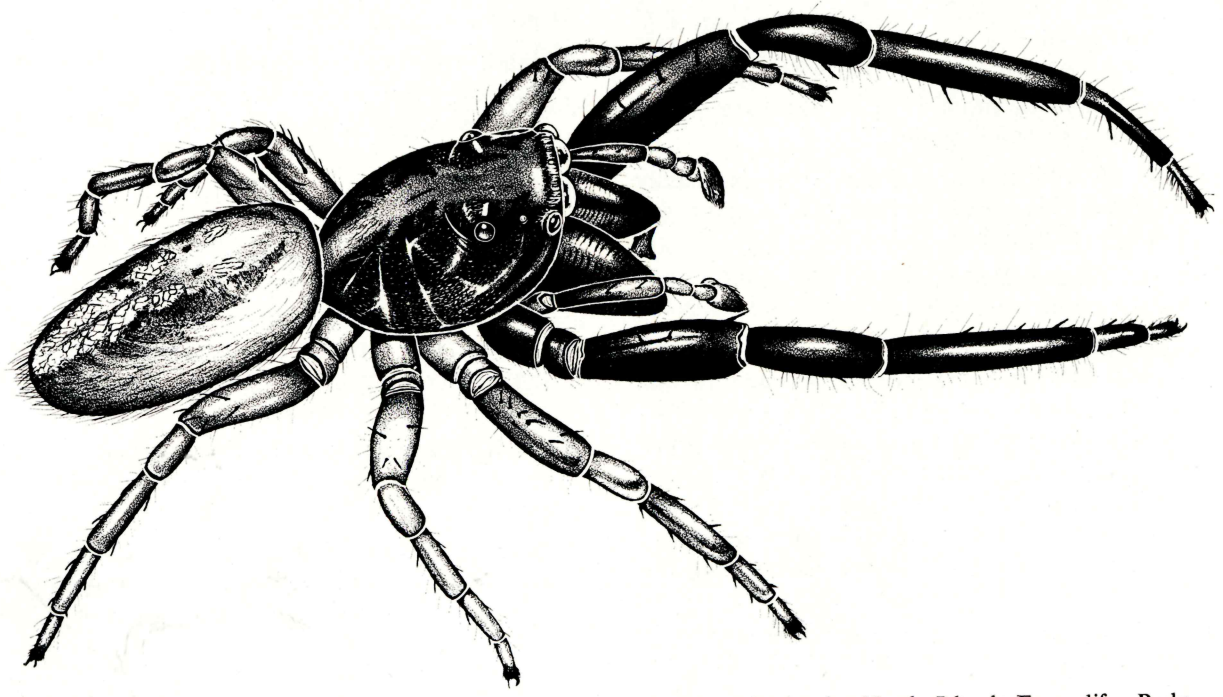


Fig. 180. *Trite planiceps* Simon male (Salticidae). Common in shrubs in the North Island. From life. Body length 9 mm.

GLOSSARY

Accessory claws: Serrated bristles found near the true tarsal claws of some spiders.

ALE: Anterior lateral eyes also used to refer to a single eye. Usually situated at each end of the front row.

Alveolus of cymbium: The cavity of the tarsus of the male palp in which the palpal organ lies.

AME: Anterior median eye or eyes. The middle pair of the front row.

Anal tubercle: A small projection at the end of the abdomen above the spinnerets, associated with the anal opening.

Apneumone: Lacking book lungs. In New Zealand the typical condition for Symphytognathidae.

Apophysis: Term used for a process arising from the segments of the palp or legs, which is not readily described as a spine.

Arachnidium: Collective term for the spinnerets, and cribellum when present.

Atrium of the epigynum: The cavity found in many spiders into which the spermathecae open.

Book lungs: Respiratory pouches. One pair belonging to the second abdominal somite on ventral surface. Opening by slits along the epigastric furrow. In Mygalomorphae and Gradungulidae a second more posterior pair present. Absent in Symphytognathidae.

Boss: A smooth prominence at the base of the chelicera in some spiders.

Bristle: A cuticular appendage which is usually long and thin. More slender than a spine and stronger than a hair.

Bulb or **Genital Bulb:** Used to refer to the male palpal organ as a whole.

Calamistrum: A row of curved bristles or hairs on the dorsal or retrodorsal surface of the metatarsus of leg 4 of cribellate spiders. Two rows may be present although only a single row has been recorded in New Zealand spiders.

Carapace: The hard plate forming the dorsal surface of the cephalothorax representing the fused tergites of the prosoma.

Cephalothorax: The prosoma or anterior part of the two divisions of the body into which the spider is divided. Same as carapace when used by Urquhart.

Cervical groove: The groove indicating the boundary between the head and the thorax. Often indistinct or lacking.

Chelicerae: The first pair of appendages of the head consisting of a stout basal portion (paturon) and a terminal fang which fits into a groove (furrow) on the paturon.

Clavus: Same as scape.

Claw tufts: Bunches of hairs at the tip of the tarsi of some spiders, usually associated with two claws.

Clypeus: The space between the anterior margin of the carapace and the nearest eyes.

Colulus: A small, apparently non - functional median appendage, somewhat similar to a small spinneret, situated immediately in front of the spinnerets of some spiders.

Conductor: A structure in the palpal organ of some male spiders which is parallel to or associated with the embolus for all or part of its length.

Coxa: The segment of the leg nearest to the body.

Cribellate: A general term used to refer to a spider possessing a cribellum and calamistrum.

Cymbium: The tarsus of the male palp when hollowed out to receive the palpal organ.

Denticle: A small tooth.

Diaxial: Used to describe chelicerae where the paturon projects forward or down but the fang is so articulated that it moves transversely.

Dionychous: Possessing two claws on the tarsus.

Dorsal groove: Same as thoracic groove.

Ecribellate: Not possessing a cribellum and calamistrum.

Embolus: The intromittent portion of the male copulatory organ containing the terminal portion of the ejaculatory duct.

Endocheliceral: Contained within the chelicera — as with the venom glands of the Mygalomorphae.

Epigastric furrow: The furrow on the ventral surface of the abdomen marking the posterior limits of the second abdominal somite. The anterior pair of book lungs open at the edge of the furrow as does the gonopore. The egigynum lies in front of this furrow in females.

Ejaculatory duct: The slender tube extending from the apical portion of the bulb to the embolus through which the sperms are transferred during copulation.

Epigastric plates: Thickened sclerites found on the ventral surface of the abdomen below the book lungs or in apneumone spiders below the anterior tracheae.

Epigastric scute: A thickened plate anterior to the epigastric furrow, sometimes encircling the pedicel and sometimes with extensions posterior to the furrow.

Epigastrium: The portion of the abdomen on the ventral surface anterior to the openings of the book lungs, anterior spiracles and genitalia.

Epigynum: A sclerotized plate associated with the gonopore of females containing openings through which the sperm is passed into the spermathecae.

Face: A general term for the clypeus, eyes and head when viewed from in front.

Falces: Chelicerae.

Fang groove: The groove at the distal end of the paturon in which the fang rests.

Fang of chelicera: The distal portion of the chelicera which articulates with the paturon within which the poison duct passes.

Fasciculi unguiculares: Claw tufts.

Femoral index: A figure used to compare the relative thicknesses of femora, obtained by dividing the length of the femur into 100 times the maximum width of the femur.

Femur: The third segment of the palp and legs from the base of the appendage.

Fissidentate: Teeth having more than one point, usually used with reference to teeth on the retromargin of the cheliceral fang furrow in some Salticidae.

Folium: Used in a general way to refer to a well defined pattern down the median dorsal surface of the abdomen. In particular to a pattern which by virtue of a scalloped margin may appear leaflike.

Fossa of the epigynum: A depression or cavity present in the epigynum of some spiders into which may open the ducts to the spermathecae.

Fovea: A depression on the thoracic region of the carapace where muscles are attached. May be longitudinal, transverse or absent.

Geniculate: Knee-like. Used to refer to chelicerae where the base is thickened so that the anterior face projects forward from the clypeus before sloping down vertically to the fang.

Genital bulb: Male palpal organ.

Genital furrow: Same as epigastric furrow.

Gnathocoxal lobe: Same as Maxilla.

Endite: Same as Maxilla.

Haematodocha: A sac-like structure attached to the cymbium, between the cymbium and the other portions of the palpal organ of the male. Distended during copulation.

Head region or simply **head:** The anterior portion of the carapace bounded by the thoracic groove and bearing the eyes.

Heterogeneous: Unlike. Used in reference to eyes when some are dark and some light in colour.

Homogeneous: Alike. Used to refer to eyes when all of the same colour.

Humeral tubercles: Humps or knobs at the antero-lateral dorsal surface of the abdomen.

Inferior claw: The single claw ventral to the paired claws in spiders with three claws.

Inframamillary: Below or anterior to the spinnerets.

Inframamillary organ: Cribellum.

Interpulmonary furrow: Epigastric furrow.

Internal genitalia: A cumulative term used for the internal structures associated with the epigastrium of the female.

Labium: The median sclerite on the ventral surface of the cephalothorax between the maxillae and anterior to the sternum to which it is articulated or fused.

Lamella: A triangular plate on the promargin of the cheliceral furrow (Pholcidae) or an elongate thin plate extending along the furrow (Agelenidae).

Lateral condyle (of chelicera): Same as boss.

Lateral eyes: The eyes at the ends of the row in which they lie — usually the ALE and PLE.

Laterigrade: A sideways type of motion (crab spiders). Also the way the legs are turned so that the morphologically dorsal surface is posterior and the prolateral surface appears to be dorsal.

Leg formula: The relative length of the legs represented by the first four numbers in sequence of greater length. For example 4123 means that the fourth leg is longest and third shortest.

Leg index: A figure for comparing the relative lengths of the legs. It is obtained by dividing the length of the leg, not including the coxa and trochanter, into 100 times the length of the carapace.

Lip: Same as labium.

Lorum: The sclerites representing the tergum of the pedicel.

Lower claw: Median claw.

Lung slits: The openings of the book lungs. One pair is located along the epigastric furrow. If a second pair of book lungs are present the slits are posterior to the epigastric furrow.

Lyriform organ: Minute sense organs indicated externally by small slits. Found all over the body but more commonly on the legs.

Mamillae: Spinnerets.

Mandibles: In early literature used incorrectly for chelicerae.

Mastidion: A small denticle or tubercle on the anterior face of the chelicerae of some spiders.

Maxilla: One of the mouthparts ventral to the mouth opening and lateral to the labium. Formed from the coxa of the palp.

Median apophysis of the palpal organ: An appendage arising from the middle division of the male palpal organ of some spiders.

Median claw: Inferior claw.

Median eyes: The two middle eyes of each row.

Median ocular quadrangle: The area limited by the four median eyes, including the eyes themselves.

Metatarsus: The sixth segment of the legs counting from the base. Not present in the palp.

Ocular quadrangle: The area included by all the eyes in the Salticidae.

Eyegroup: Used to refer to eyes as a whole.

Ocular tubercle: A protuberance on which one or more of the eyes are borne.

Onychium: The small distal portion of the tarsus on which the claws are borne in some spiders (Oonopidae).

Palp: Those segments of the pedipalp distal to the coxa.

Paracymbium: An accessory branch of the cymbium, arising from near the base.

Paraxial: The situation where the paturon projects forward and the fang is articulated so that it moves more or less parallel to the axis of the body.

Pars cephalica: Same as head.

Pars thoracica: Same as thorax.

Patella: The fourth segment of the leg or pedipalp from the base.

Paturon: The basal segment of the chelicera to which the claw is articulated apically.

Pectinate: Set with teeth in a row as in a comb.

Pedicel: Same as petiolus.

Plagula: The sclerite when present representing the sternum of the petiolus.

Pedipalp: The second appendage of the cephalothorax, posterior to the chelicerae but anterior to the legs.

Petiolus: The constricted region joining the cephalothorax and the abdomen. Actually the first segment of the opisthosoma.

PLE: Posterior lateral eyes or eye.

Porrect: Used to describe chelicerae which are directed forward considerably.

Pluridentate: Having more than one tooth. In Salticidae used to categorize groups having two or more teeth on the retromargin of the cheliceral furrow.

PME: Posterior median eyes or eye.

Posterior lateral eyes: The eyes at the ends of the second row.

Posterior median eyes: The two intermediate eyes of the second row.

Praetarsus: Same as onychium.

Proclaw: The superior claw nearest the prolateral surface of the tarsus.

Procurved: An arc curved so that its ends are nearer than its centre to the anterior end of the body. When used for the eye row the lateral eyes are in front of the median eyes.

Prograde: Locomotion in a forward direction or with the form of legs suitable for this movement.

Prolateral: The surface of the appendages of the cephalothorax nearest the anterior end of the body when the true dorsal surface is uppermost.

Promargin: The margin of the cheliceral furrow away from the maxillae — sometimes called the upper margin.

Protarsus: Same as metatarsus.

Pseudonychia: Same as accessory claws.

Radial Furrows: Same as striae.

Rebordered: With a thickened edge. The anterior margin of the labium in Epeiridae, etc.

Receptacula: The seminal vesicles or spermatheca of the internal genitalia.

Recurved: An arc so curved that the ends are nearer than its centre to the posterior end of the body.

Retroclaw: The superior claw which is nearer to the retrolateral surface of the leg.

Retrolateral: The surface of the leg or palp nearest the posterior end of the body when the appendage is considered with the true dorsal surface uppermost.

Retromargin: The margin of the cheliceral furrow nearer to the maxillae.

Saltigrade: A jumping type of locomotion.

Scape of the epigynum: An appendage usually soft and flexible lying in the middle line of the epigynum.

Scopula: A brush of hairs: Found on the promargin of the chelicera, the distal end of the maxillae or the ventral surface of the tarsi and metatarsi of some spiders.

Scuta or **Scutes:** Sclerotized plates sometimes found on the abdomen of spiders.

Serrated bristles: A type of bristle, slightly curved, bearing serrations or small teeth along one side. May be found as false claws in some spiders or as a row on the ventral surface of the fourth tarsi in some Theridiidae.

Serrula: A uniform row of small teeth on the distal surface of the maxilla of many spiders.

Sieve plate: A sclerotized band seen on the internal duct of the male palpal organ of some Oonopidae bearing the openings for the ducts from the palpal gland. Also more commonly used to refer to the openings on the maxillae from the maxillary glands.

Sigillae: Slightly indented areas, free of hairs and usually oval, on the sternum of Mygalomorph spiders.

Sigilla ratio: Three figures representing in arbitrary units the separation of the sigillae from the margin of the sternum, the greatest width of the sigillae and the distance apart of the sigillae, in that order, with the width of the sigillae enclosed in brackets. e.g. 6(5)10 or if sigillae marginal (5)10.

Slit organ: Same as lyriform organ.

Spermathecae: The seminal receptacles in the epigynum.

Spination: The arrangement of the spines on the legs and palps.

Spine: A cuticular appendage, heavier than a bristle which is usually articulated.

Spinnerets: The appendages near the caudal end of the abdomen below the anal tubercle. These are usually three pairs. The anterior or ventral are lowermost; the posterior or dorsal are uppermost and the median which are often small are between them.

Spiracle: Same as tracheal spiracle.

Spur: A cuticular appendage considerably heavier than a spine, used loosely for both an articulated structure and for an unarticulated outgrowth from the cuticle.

Spurious claws: Same as accessory claws.

Sternum: The plate on the ventral surface of the cephalothorax lying between the coxae and behind the labium.

Stigmatic plates: Same as epigastric plates.

Striae: Paired depressions or lines extending out from the centre of the carapace to the edges, often originating from the fovea when this is present.

Stridulating area: An area with numerous parallel grooves or modified spines presumed to be used for stridulation.

Style: Same as embolus, often used with reference to simple palpal organs.

Superior claws: The larger paired claws at the ends of the tarsi.

Sustentaculum: A strong spine bent upwards at its tip, inserted on the ventral surface of the fourth tarsus near the claws of some Epeiridae.

Tarsal comb: A row of serrated bristles on the ventral surface of the fourth tarsus of some Theridiidae.

Tarsal drum: Same as tarsal organ.

Tarsal notch: An indentation of the margin of the cymbium of the palp of some spiders.

Tarsal organ: A small smooth raised area with a minute apical pore on the dorsal surface of the tarsus of some spiders often seen as a pale spot.

Tarsal spine: Same as sustentaculum.

Tarsal rod: An erect rod-like structure on the dorsal surface of the tarsi of the legs of some Agelenidae.

Tarsal thorns: Two short, stout bristles found on the disto-dorsal surface of the tarsi of the legs of some Oonopidae.

Tarsal tubercle: A low tubercle with bristles on the dorsal surface of the tarsi of the legs of some Oonopidae.

Tarsus: The last segment of the leg or palp.

Teeth: Stout sclerotized apophyses unarticulated and usually pointed apically such as those found on the margins of the cheliceral furrow.

Tegulum: The sclerite forming the wall of the median division of the palpal organ.

Teneral: Freshly moulted spiders which have not attained their full colouration.

Terminal apophysis: A strongly sclerotized structure present in the embolic division of the palpal organ of some spiders.

Third claw: Same as inferior claw.

Thoracic groove: Same as fovea.

Thoracic furrow: Same as fovea.

Thoracic region: That portion of the carapace posterior to the cervical groove.

Thorax: Same as thoracic region.

Tibia: The fifth segment of the leg or palp counting from the base.

Tibial apophysis: The apophysis on the tibia, usually retrolateral in position, of the male palp of some spiders.

Tibial index: A figure used to compare the relative thicknesses of different legs. Obtained by dividing the combined length of the patella plus tibia into 100 times the width of the patella.

Tracheal spiracle: The opening of the tubular tracheae on the ventral surface of the abdomen.

Trichobothrium: A very fine hair of variable length arising from a hemispherical socket and extending out at right angles to the surface of the leg.

Trionychous Having three claws on the tarsi.

Trochanter: The second segment from the base of a leg or a palp.

Unguis: Same as fang.

Ungues: Same as superior claws.

Unguicules: Same as inferior claw.

Unidentate: Having one tooth. Used to particularize those Salticidae having only one tooth and that with a single point on the retromargin of the cheliceral groove.

Upper claws: Same as superior claws.

Vulva: Same as epigynum.

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