AUSTRALIAN INSECTS.



W. W. FROGGATT.

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AUSTRALIAN INSECTS ***

AUSTRALIAN INSECTS.

BY

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Member of the Association of Economic Entomologists, U.S. America;
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With 37 Plates, containing 270 Figures, also
180 text-blocks.



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PREFACE.

There have been so many enquiries from people in all parts of Australia, as well as from visitors from other countries, for a book dealing with our insects, that the writer thinks that the time has come when a Text Book dealing exclusively with Australian Entomology will be well received, both at home and abroad, by all those interested in this subject.

The difficulty has been to write in a popular style so as to interest the general reader, and induce him to further follow his studies of the wonders of Natural History, yet at the same time to define the characteristics of the insects described and give some idea of their classification, so that it will not lose its value as a Text Book to the student while enlarging the circle of its readers.

Since the year 1770, when Sir Joseph Banks captured the first diamond beetle on the sandy shores of Botany Bay, the majority of our insects have been described in rare old English or foreign publications, the Zoology of Voyages and Travels, or the Transactions and Proceedings of Scientific Societies consisting of many hundreds of volumes written in many different languages.

Many of these original descriptions, written in English or Latin, are so brief and obscure that without seeing the type they are quite unintelligible even to the trained entomologist, and therefore are absolutely of no value to the beginner.

Most of the earlier describers of Australian insects

confined their attention to beetles, moths, and butterflies. Among the few exceptions are Westwood, who has identified himself with insects in nearly all the orders, and as he figured many of them (often in colours), there is no trouble in determining his species; and Walker, who also described many unique Australian insects (chiefly in the British Museum Catalogues); but his often vague descriptions, without details or figures, have puzzled all entomologists who have not had access to his types.

During the last decade, however, as specialists have taken up the work of monographing the more neglected orders, and as large general collections of insects have been obtained from what were, at one time, inaccessible parts of Australia, a writer can now obtain satisfactory data as to the classification and number of Australian insects hitherto wanting.

With these views the present text book has been prepared.

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"The White Ant City," Somerset, Cape York, N. Queensland.

(After Savelle-Kent)

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INTRODUCTION.

The chief drawback to the study of entomology by the outsider has been, until modern times, the dry-as-dust technical terms used in the descriptive work, and the formidable names attached to many of the interesting little creatures, without any information about their habits or life histories. This is not surprising when we know the methods of some of the writers, and the material on which they often worked; namely, specimens obtained from abroad, often in a more or less damaged condition, discoloured and aborted from being squeezed among spirit collections, and with a brief or no record of their native home.

This has been all changed since trained students like Darwin, Wallace, Bates, and many others have spent years in the wilds studying zoology under natural surroundings, recording their observations while they made collections, and, with this wealth of material and accurate knowledge, gave such descriptions, that they have led into many new fields of investigation, one of the most important of which is economic entomology.

The Economic Entomologist has become more necessary and important every year. His investigations, carried on in the field and insectarium, have not only done much to popularise entomology, but have saved the countries interested untold wealth by the discovery of methods for checking the spread and ravages of injurious insects. The technical description of an insect is not sufficient to satisfy a practical man; he wants to know where it

passes the earlier stages of its existence, what it feeds upon, and its place in the insect world.

In the open-air study of God's tiny creatures many pleasant and profitable hours may be spent, and dwellers in the country need never feel time hang heavily on their hands, after they have once had their eyes opened to the wonders of Nature around them. It is the writer's privilege to know and correspond with a great many busy men and women, scattered all over Australia, who are doing valuable work in collecting specimens, making notes, and seeing both with eyes and brain—true bush naturalists in every sense of the word.

In acknowledging my obligations to friends who have helped me in the course of this work, I desire to express my thanks to Mr. Masters for notes on the habits and range of insects, and the examination of specimens in the Macleay Museum; to Messrs. Sloane, Lea, Lyell, R. Turner, Tillyard, Tepper, Kershaw, Dun, Dr. Jefferis Turner, Dr. Goding, and Rev. T. Blackburn for various notes, specimens, and help generally. From Mr. C. French and C. French, Jr., I have had the loan of papers, books, and specimens unobtainable in Sydney, and from Mr. J. J. Fletcher suggestions and references to works in the N.S.W. Linnean Society's library.

Many other correspondents have greatly assisted me in examining and determining specimens—Dr. Horvath, Dr. Forel, M. André, Dr. Sharp, Mr. W. F. Kirby, Mr. C. C. Green, Dr. Silvestri, Dr. Howard, Mr. W. M. Ashmead, and Mr. D. W. Coquillett.

I am indebted to Mr. Maiden for the identification of the native food plants of many insects.

I am also greatly indebted to Mr. W. S. Campbell

for permission to use the drawings of Messrs. Grose, Burton, and Chambers, which have previously appeared in the pages of *The Agricultural Gazette of N.S.W.*, and which for beauty and accuracy have rarely been surpassed. To Mr. Burton and Mr. Gurney my thanks are also due for their care in arranging and photographing other specimens. To the other friends who have kindly aided me in this undertaking in any way I beg here to offer my best thanks.

AUSTRALIAN INSECTS.

CLASSIFICATION.

In considering the classification of our insects, I have on the whole followed that adopted by Sharp in his “Insects” (vol. v., vi., 1895, 1899), Cambridge Natural History, but at the same time have considered it advisable, in a work of this kind, to leave out whenever possible the definition of the smaller sub-divisions. I have also made one important alteration in his scheme of classification by placing the Termitidae after the Blattidae, following on with the Embiidae and Psocidae, as I consider that these are nearer primitive Orthoptera than Neuroptera in their wing structure; we thus do away with Pseudo-Neuroptera that has always appeared to be an unnecessary division; and we should have the courage of our convictions and place them on one side or the other.

In zoological classification, the sub-kingdom Arthopoda, comprising creatures whose bodies are composed of rings or segments, and jointed legs, contains four large groups: (1) Arachnidae, spiders, mites, ticks, and scorpions; (2) Crustacea, crabs, shrimps, wood lice, &c.; (3) Myriapoda, centipedes, millepedes, &c.; (4) Insecta, insects; and a fifth group, Onychophora, containing the *Peripatus*, is now included. Though these creatures are broadly related, insects are readily distinguished from the members of the preceding groups.

The word Entomology is derived from two Greek

words, *Entomos*, an insect; and *Logos*, a discourse. Insects are arranged by entomologists in Orders, Families, Genera, and Species. The first clearly-defined classification was published by Linnaeus in his "Systema Naturae," 1758, where he divided them up into seven great orders; namely, Coleoptera, Hemiptera, Lepidoptera, Neuroptera, Hymenoptera, Diptera, and Aptera, distinguished by the number and structure of the wings. Later on (1778) Fabricius founded another classification, based on the structure of the organs of the mouth, but this artificial arrangement soon became obsolete.

In 1815, Kirby and Spence issued the work in four volumes entitled "An Introduction to Entomology or Elements of the Natural History of Insects," a second revised edition coming out in 1816. This was the first attempt in England to popularise entomology, and to give the ordinary reader an idea of classification. In it will be found a great deal of general information that all young entomologists should read.

In Westwood's "Introduction to the Modern Classification of Insects," published in 1839, a great advance was made, and the science placed on a sound footing; this has been a great help to all workers. He divided the insects into thirteen orders; but, though the tendency of American and European writers has been to increase these divisions, we have reduced them, and in Kirby's "Text Book of Entomology" only seven are used. In the last work, "Insects" (Cambridge Natural History, 1895), by Sharp, the same seven orders are used, though in a somewhat different manner, with the addition of an eighth, Thysanoptera, to contain the single family Thripidae.

The correct naming of insects is based on the

following rules: First comes the Order, which may contain a number of Families, all with certain peculiarities; as, for example, the straight-winged insects, Order Orthoptera, of which we will take the Family *Acridiidae*, "locusts." This Family is again subdivided into smaller divisions or groups, called Genera; all the individuals comprised in the Genus have some well-defined external characters that form a common link binding them together: the individuals are known as Species. Therefore each insect when it has been described has a generic or group name, and a specific or individual name. The generic name should be based on some Greek or Latin root, preferably the former, but it cannot of course be compounded from both languages; it should on translation give some clue to the general distinctive character of the group. The specific name should be derived from Latin, and give the student some idea of the locality, markings, colour, or shape of some part of the insect under observation; thus, *Locusta australis*, Brunner, is the southern locust or grasshopper. As a matter of convenience to students, the name or abbreviated name of the entomologist who first described the insect follows the name when mentioned in scientific articles or catalogues, but is not usually done in general work.

The rules here laid down, however, are much more observed in the breach than in the observance. In former times most descriptions of insects were written in Latin, but at the present time they are being described not only in English, French, and German, but many other languages difficult for the ordinary English student to translate, such as Russian, Bohemian, Hungarian, &c., so that it is very difficult in many instances to find out whether some generic names have any meaning. The difficulty of

creating generic names with pure roots that are not preoccupied by previous writers is always increasing, and to save the trouble of going through the lists of genera already in use, many zoologists use the names of other naturalists, names of localities, or "nonsense" names compounded of a jumble of letters. Then, again, when the genus is an extensive one containing many species, the describer gives it the Latinised name of the collector or some friend he wishes to honour, so that we may come across both a generic and specific name that throws no light on the identity of the insect. As an example, *Grabhamia curriei*; Coquillett named this mosquito in the first instance *Culex curriei*, Currie's mosquito, which was consistent, but Theobald found on subsequent examination that it belonged to his Genus *Grabhamia*, dedicated to Dr. Grabham.

Even without these drawbacks, a beginner naturally finds the classification of insects a serious task, and the simple committing to memory of the scientific names a big undertaking; but when he has once grasped the rudiments, the system will soon appear to him.

One of the most difficult things the popular writer meets with in scientific work is to find a suitable vernacular name to fit a common insect; a beetle may be bright yellow, with a brown head; the first man comes along and calls it the "Yellow-bodied Beetle," another passes by and says it is the "Brown-headed Beetle," yet neither would be quite accurate or define its main peculiarities. Again, we often find a popular name that designates a particular insect in one district is used for quite a different species in another part of the State: quite recently I asked several correspondents for specimens of the beetle in

the Maitland district known as the “Jackeroi,” and had four distinct species of weevils forwarded under that name. The “Dicky Rice” is the name given to a tiny grey weevil (*Prosayleus phytolymus*) by the orchardists about Windsor, but in other districts it is used indiscriminately for a number of other weevils.

Should any one take up a box full of unnamed and unclassified insects, he will feel like a stranger in a picture gallery without a catalogue; for, while everything is very beautiful, how much more interesting if he only knew something about the subject; for the same reason, each insect named and arranged has an individuality that it did not previously possess.

DISTRIBUTION.

The insect fauna of Australia is as remarkable and distinctive in its peculiarities as the flora, and probably for the same reason,—the fact of its isolated position from the larger continental areas, and the configuration of the continent. If we take away the eastern mountain range running north and south from Cape York to Gippsland, we find an immense tract of almost level country with hardly a river of any size except the Murray and its tributaries, covered with thick scrub or open forest, great flat unbroken plains in the south; rolling downs towards the north; sand-hills, and low timbered ranges in the interior. It is half the year without any permanent water for hundreds of miles at a stretch; scorched with a blazing sun and fierce hot winds in summer, bleak and cold in the winter. Yet there is no desert country of any extent in the strict sense of the word in the most arid portion; for given a good fall of rain, the country, apparently parched beyond recovery, soon puts on a coat of green, wild flowers shoot out, insects and little creatures of all kinds emerge from their hiding places, and birds appear as if by magic.

Naturally our fauna, and the insects in particular, have had to adapt themselves to these extremes, and we find them with many curious habits without parallel in more normal countries.

Our fauna is extremely rich in gall-producing insects in many different orders; there are about 50 different species of coccids that form well defined galls upon their host plants, yet the only record of a gall-making coccid outside Australia is a single

species in Mexico. Numbers of *Thripidae* produce galls in the leaves or flower buds of our native shrubs, while the galls of *Psyllidae*, *Diptera*, and *Hymenoptera* are very abundant.

Ants, *Formicidae*, swarm in the driest parts of the interior; and flies, of all kinds, blow flies, blue bottle, and the small house flies, are a perfect pest all through the summer months.

All our coastal scrubs are rich in flowering shrubs which provide food or hunting ground for a large insect population. The flower wasps, *Thynnidae*, (in which the males are large and handsome with well developed wings, but the females are diminutive and wingless,) comprise several hundred described species; the only other countries in which they are represented are the west coast of South America, and a few in the Pacific Islands. The allied ant-like *Mutillidae* with their wingless females are more numerous in the interior. Though our country is very rich in Sawflies, *Tenthredinidae*, they all belong to genera peculiar to Australia; the members of the typical genus *Cimbex* extending its range as far east as Japan do not reach us.

The low stunted flowering shrubs covering large patches of both the eastern and western coasts support an immense number of Jewel-beetles, Genus *Stigmodera*, also peculiar to this continent. We appear to have few forms allied to North or South America; our affinities are with Africa, and the Malay Peninsula; insects of well sustained flight, as the Orthoptera, are found here identical with species found in Africa and Asia.

Many insects abundant in the eastern coastal districts are very limited in their range; but on the western watershed others may be found ranging

right across to the Indian Ocean.

STRUCTURE.

The imago or perfect insect is encased in a more or less perfect horny integument composed of a substance called chiten, which forms in many a regular box containing all the vital organs. Every insect can be divided into three primary divisions: first, the head, to which is attached the mouth parts, antennae, and eyes; second, the thorax or chest, sometimes forming a solid mass, but properly composed of three segments, namely, the prothorax, mesothorax, and metathorax, to which are attached three pairs of legs, and two pairs of wings (there are, however, many exceptions to the last, as some have only one pair, and others are wingless); third, the abdomen or body, consisting of a number of segments variously estimated from five to eleven, the normal number being ten, which enclose the digestive, breathing, and reproductive organs.

Every insect in the first instance comes from an egg or living larva produced by the female, and though, even to the naturalist, it seems very hard to account for the countless millions of some of the smaller insects such as aphids and scale insects which suddenly swarm as if by magic over plants, there is no such thing as spontaneous generation; insects cannot come out of the ground from nothing, or be produced from the crystalline dew upon the foliage as we have sometimes found stated in newspapers. Again, a grain weevil cannot change into a flour moth, or *vice versa*, as many of our farmers will say in all good faith. In some groups the insects are produced as living larvae, and commence to feed at once; but in the majority, eggs are

deposited in or upon the food, in which state they may remain without hatching but a few days, or more than a year. As soon as the little caterpillar or grub emerges, it starts upon its food, spending the whole of this stage of its existence in eating and growing, moulting at intervals by casting off the outer skin to accommodate its increasing bulk; when full-grown and ready for the final moult, it stops eating, crawls away into a suitable place, and forms a cocoon, cell, or shell, in which it pupates. It is now a chrysalis or pupa, quiescent, without any movement except a slight twitching of the tip of the abdomen when disturbed. Under the pupal covering the different organs of the perfect insect become gradually defined, until one bright day the last evolution is completed, and with a few convulsive movements the perfect insect bursts out of its enveloping swaddling clothes and appears in all its beauty and perfection.

Some groups, however, undergo a much more simple or incomplete metamorphosis; emerging from the egg a baby insect ready to eat, (like the grasshopper,) the same food as its mother; it undergoes a series of moults, and after casting its skin every time, becomes more nearly perfect without any true pupal stage, and finally after the last moult comes forth with well-developed wings, a perfect insect.

The typical insect is furnished with a large compound eye on either side of the head composed of a number of small sections called facets, varying in number from sixteen to several thousands in some of the more highly developed families, and two or three simple eyes forming bright shining dots between the compound pair called ocelli. In some

groups these ocelli are wanting; in others both eyes and ocelli, so the insects are therefore blind.

The mouth parts are composed of several hard plates; in chewing or biting (mandibulate) insects, they consist of a pair of stout jaws, in front of which lies the labrum, and behind the maxillae; again behind the maxillae follows a second pair fused together to form the labium. Both labium and maxillae are provided with a pair of slender jointed appendages known as labial and maxillary palpi; these are used as fingers to assist in drawing food into the mouth. In those groups with sucking (haustellate) mouths these various parts are coalesced into a simple sucking tube ending in a sharp style-like tip, which is buried in the tissue of the plant when the insect is feeding. The antennae when well developed consist of a number of distinct rings or segments, standing out on either side of the head, and generally attached to the front of the head between the eyes; they serve as organs of touch, smell, and probably hearing. The legs contain five distinct joints; first, the coxae or hips; next, the trochanters, small joints with a ball and socket-like action from which the femora or thighs move backward and forward; to these are attached the tibiae or shanks terminating in the tarsi or feet at the extremity. Most insects are also furnished with a pair of tarsal claws, between which may be a small pad, called the pulvillus or empodium.

The wings of insects vary considerably. Some are membranous and smooth; others are covered with down or scales; while in many the fore pair are solid chitinous wing-cases, useless for flight, and chiefly acting as protective covers to the hind pair, which, when the insect is at rest, lie folded up beneath

them. The flying wings are traversed with branching tubes called nervures, which, while strengthening them, also perform an important function in the breathing of the insect, and are pierced with small openings; these openings are very distinct in some of the hymenoptera.

Insects breathe by means of openings situated along the sides of the thoracic and abdominal segments called spiracles, opening out into branching air vessels called trachea, which pass into the interior, ramifying throughout the body and extending into every part and appendage, even to the tips of the antennae. The nervous system, the life and movement of the insect, consists of a double chain of ganglia, (*ganglion*, a knot,) nerve cells, which are connected with finer encircling nerve tissues, that radiate in all directions, returning to the ganglia, the latter regulating the nerve sensation. Therefore, as their perceptions are so much less confined to the brain than in vertebrate animals, they cannot feel to the same extent. Thus, you can frequently find a locust, beetle, or ant that has escaped from a bird, minus its abdomen, still crawling about, quite able to move all its remaining organs. You can even remove the long slender body of a dragon-fly, and carefully insert a bit of grass stalk of the same length and weight to balance the wings, and it will fly off quite readily; but of course they will not live long after such injuries.

We know that many insects must have very keen perceptions of sound, or the movement of the air around them, for they will drop to the ground at the least alarm, before the bush upon which they are resting has been touched. Very little is understood about the organs of hearing, except in the case of

grasshoppers and locusts where the ears have been located at the base of the abdomen or on the front leg; these in some species can be detected with an ordinary lens. It is considered by some writers that the hairs and spiracles upon the different parts of the body may transmit sound and act as ears. The organs of sound are very interesting, but can be better treated when dealing with the different groups.

Usually, there are only two sexes of insects, males and females; but among those living in social communities, like the bees, ants, wasps, and termites, the majority of the inhabitants are neuters. These neuters are usually aborted females, which do all the work in the construction of the nest and look after the food supply of the rest of the community.

FOSSIL INSECTS

In comparison with other countries, fossil remains of insects are scarce; only ten species have been described and named. My information on this subject is obtained from Messrs. Etheridge and Olliff's Memoir of the Geological Survey, (Palaeontology No. 7,); "The Mesozoic and Tertiary Insects of New South Wales," 1890. The first record of fossil insects was made by Moore in the Quarterly Journal of the Geological Society, 1870, entitled "Note on a plant and insect bed on the Rocky River, N.S.W." "These insects were obtained from a chocolate-coloured micaceous laminated marl, forming a bed ten feet thick, at a depth of about one hundred feet from the surface, and forming a portion of the Tertiary drift worked at the above locality. The latter are probably of Pliocene age." (E. & O.)

Jack obtained the wing of a dragon fly in the

Cretaceous beds of the Flinders River, N. Queensland, which was described and figured by Woodward under the name of *Aeschna flindersensis* in the Geological Magazine, 1884. It was entombed in a dark chocolate limestone.

The insects described and figured by Messrs. Etheridge and Olliff consist of a cicada (*C. lowei*) from the "Taeniopteris-bearing beds of the Talbragar River in New South Wales, and of Lower Mesozoic age": a fly, *Chironomus venerabilis*: and a mayfly, *Ephemera culleni*: and a beetle larva belonging to the *Lampyridae*, under the name of *Palaeolycus problematicus*, from the Tertiary beds at Emmaville, New England.

From the Ipswich Coal Measures of Queensland comes the fossil wing of a Buprestid beetle, allied to existing Stigmodera, which they called *Mesostigmodera typica*. Among the insect remains from this locality the authors note several wings that appear to belong to weevils and other beetles allied to existing species.

Mr. W. S. Dun informs me that insect remains have been found at Narellan N.S.W. in Wianamatta shales, and also in the brick pits at St. Peters near Sydney.

Order I.—APTERA.

Spring-tails and Silver-fish.

These tiny little creatures are wingless in all stages of their existence, with only six segments in the abdomen; they are active little creatures of very delicate structure, found in all kinds of situations. We have many indigenous species, but on account of their small size and retiring habits they have been seldom noticed, and a wide field awaits some future entomologist who undertakes the study of these interesting insects.

Very little systematic work had been done with these insects until Lubbock's "Monograph of the Collembola and Thysanura" was published by the Ray Society in 1873. In this work not only are a large number described, but observations made upon their habits and life histories are recorded.

Family 1. Spring-tails.

COLLEMBOLA.

These are among the smallest insects, for the largest does not measure more than ⅓ of an inch in length, and most of them are very much smaller. They are chiefly found in damp situations among loose soil, decaying vegetable matter, and such like material, and can stand a very cold temperature. They are easily distinguished from the silver-fish by the few joints in the antennae, and the great powers of jumping they possess by means of their long jointed tail appendages.

Our common species, *Lipura sp.*, is at times very abundant in the loose soil; after a sudden thunderstorm they are often washed out in such numbers that, carried into the little pools along the road side, they form a dull blue scum on the surface of the water. They measure ⅓ of a line in length; are of a dull blue colour, and have short, thickened antennae and legs; the body is distinctly segmented and rounded at the tip. Resting on the surface of the water they are constantly in motion, springing up every moment like little rubber balls.

Another species belonging to the Genus *Smynthurus*, allied to *S. viridis*, a European form, but probably an undescribed native species, appeared in great numbers in lucerne paddocks in S. Australia in 1896, where they did a great deal of damage by eating the surface of the leaves, swarming over the fields in countless millions.

It is a member of this genus (*Smynthurus lutus*) that Lubbock has described in such an entertaining manner when recounting the courtship of these queer little creatures.

Family 2. Silver-fish.

THYSANURA.

The silver-fish are divided into two distinct groups: those clothed with fine loose silver-like scales, and those in which the scales are absent and are replaced by fine hairs. The abdomen contains ten segments; their bodies are elongated, furnished with long, slender, many jointed antennae tapering to the extremities, and the tip of the abdomen carries two or three slender thread-like tail appendages. Though the group has been divided into four divisions, there

are not many species described; they frequent warm, dry, dark situations.

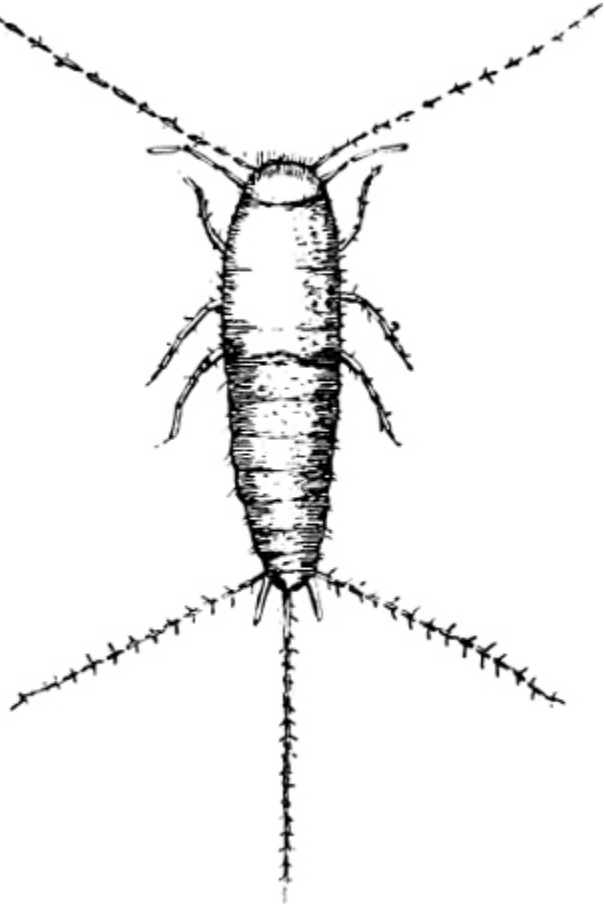


Fig. 1.—*Lepisma saccharina* (Linn.).

The common Silver-Fish.

(Redrawn from Marlatt's "Household Insects.")

Lepisma saccharina, the Common European Silver-fish, measures up to ½ an inch in length, and is covered with delicate lead-coloured scales that give it a dull metallic lustre. They are great pests in

libraries, where they eat the glaze on papers or clothbound books, pasted labels, or even the surface of etchings and engravings. Our common species was generally supposed to be this insect; but Dr. Silvestri, to whom I submitted a number of specimens caught in Sydney houses, says that it is *Lepisma longicaudata*, the common African species unknown in Europe.

There is another tiny, little, dull yellow species found under stones in ants' nests that Silvestri has named *Lepisma cursitans*. In the dry western scrubs of the interior under stones, hiding in the dust, I collected *Lepisma producta*. In a natural open cave among the sandstone cliffs on the sea shore near Gosford N.S.W. I found a number of a very large species resting on the bare rock, with a striking resemblance to small dried shrimps; for this peculiar species Silvestri proposes the name of *Allomachilus froggatti*.

Order II.—ORTHOPTERA.

Cockroaches, Grasshoppers, Termites, &c.

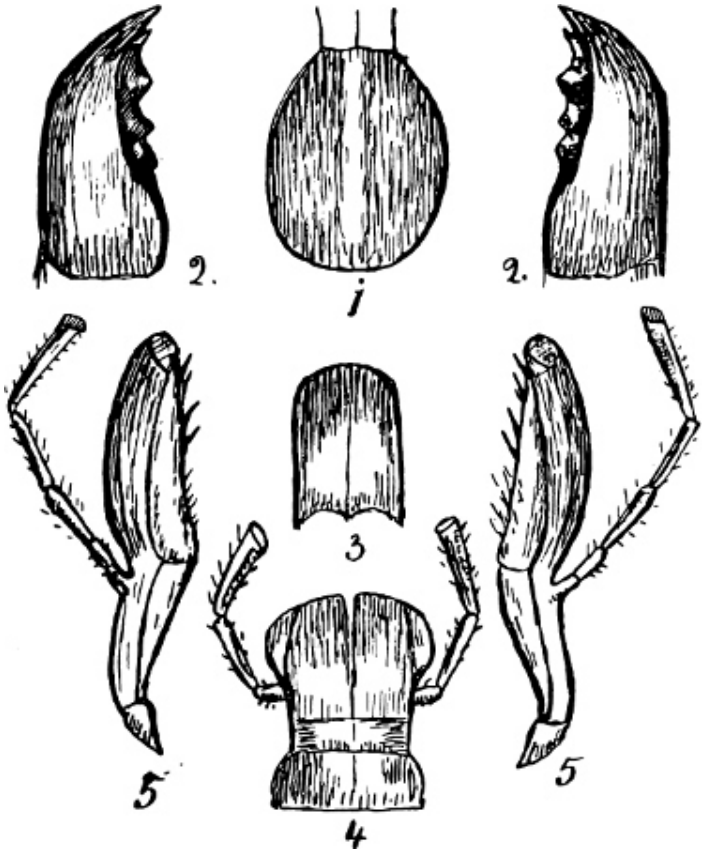


Fig. 2.—Mouth Parts of a Grasshopper, Showing the different parts.

1. The labrum, or upper lip.
2. Mandibles.
3. Jaws.
4. The lower labrum.
5. Tongue.

(Redrawn from Duncan's "Transformations of Insects.")

The members of this order are known as straight winged insects, because the narrow membranous fore wings (elytra) are usually laid flat along the sides of the body, covering the fan-shaped hind wings that are folded up beneath them. In some of the families we find groups or individuals with the wings rudimentary or so modified in structure as to be useless for flight, and in a few the perfect insects of one or both sexes are wingless. In some, like the typical grasshoppers, the hind legs have the thighs greatly developed and adapted for springing or jumping; in the Mantids the two hind pairs of legs are simple, but the front pair are produced into curved, spined tibiae and femora, weapons well adapted to capture their prey. The mouth parts are composed of a rounded upper lip, with two stout mandibles, and a pair of jaws to which are attached jointed appendages (maxillary palpi), the labrum or hind lip bearing similar appendages called the labial palpi; besides these they have a stout spade-shaped tongue, so that they both bite off and chew up their food.

Though the majority are vegetarian in their habits, one group, the mantids, are carnivorous, and in these insects the mouth parts are produced into a sharp point to the tip of the jaws.

They emerge from the eggs that are deposited singly or in masses in or upon the ground or attached to the twigs of their food plant; as baby insects they are much like the adult, undergoing a series of moults without any true pupal stage, until in the last moult they emerge with fully developed wings and reproductive organs.

The Orthoptera comprise a number of very

different looking insects, among them some giants of the insect world like the stick and leaf insects. I have placed the earwigs, cockroaches, termites, embids, book lice, grasshoppers, crickets, mantis and phasmids together, though there is some difference of opinion among entomologists as to the exact position of the termites, embids, and book lice. The latest list of the Orthoptera is W. F. Kirby's "Synonymic Catalogue of Orthoptera, vol. I.," containing all the named species of the *Forficulidae*, *Hemimeridae*, *Blattidae*, *Mantidae*, and *Phasmidae*. This work was published by the Trustees of the British Museum, 1904: a second volume (not yet published) dealing with the locusts, grasshoppers, and crickets will complete this work. The latter were catalogued by F. Walker 1869–1870 in five parts, (Catalogue of the Specimens of Dermaptera, Saltatoria, and Supplement to the Blattariae in the British Museum), which this work of Kirby's when finished will supersede.

Among the chief specialists on Orthoptera may be mentioned Henri de Saussure, who besides his monographs in the "Biologia Centrali-Americana," has published many papers in scientific journals, of which the most important (containing descriptions of Australian species) is his "Melanger Orthopterologiques" in the Memoirs de la Societe de Physique et d'Histoire Naturelle de Geneve 1863–4, and in subsequent volumes. Brunner von Wattenwyl has described other Australian species in different German publications, and in 1893 published his "Révision des Système des Orthoptères" in the Annali del Museo Civico di Storia Naturale di Genova.

Kirby described other of our species chiefly in papers contributed to the "Annals and Magazine of

Natural History," and the Transactions of the Zoological and Entomological Societies.

Family 1. Earwigs.

FORFICULIDAE.

These insects are slender in form, with somewhat rounded heads bearing two large facetted eyes, but no ocelli; and long slender antennae composed of short oval joints. The elytra, very short, usually not extending beyond the hind margin of the thorax, cover the hind wings when at rest. These hind wings are short but broad, somewhat resembling a human ear when expanded for flight, but neatly folded up beneath the abbreviated elytra at other times. In many groups however both elytra and wings are absent, the insects trusting to their legs and powers of burrowing to get out of danger, and even those with well developed wings seldom use them. The thorax is narrow; the legs stout, well adapted both for digging and running; and the abdomen, tapering to the extremity, terminates in a pair of callipers or pincer-like processes, sometimes curved and toothed into remarkable shapes. It is the possession of these curious anal appendages that has led to the earwig being popularly credited with all kinds of evil propensities; but though they certainly look very formidable they can only give one's finger a harmless pinch if handled carelessly, and are otherwise perfectly harmless.

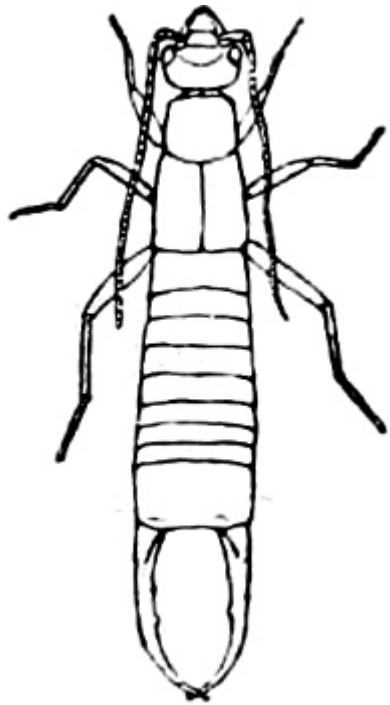


Fig. 3.—*Labidura truncata* (Kirby).

The common Earwig found in the sand along river banks.

(Original W. B. Gurney.)

Earwigs are met with chiefly in damp situations; some of the smaller ones can be collected by pulling the rotten bark off dead trees; others are to be found under stones or logs; and in summer time many will be found in burrows in the damp sand on the water's edge after the manner of mole crickets. In point of numbers this is not a large family, only about 520 species being described from all parts of the world; and only about 20 from Australia, so that they are poorly represented in this country.

The Genus *Labidura* contains 15 described species from all parts of the world; *Labidura riparia*, a

cosmopolitan species ranging from Europe to Asia and Africa does not reach Australia; but we have a typical species in *Labidura truncata*, which has similar habits, living in burrows in the sand along the edges of lagoons and creeks. It measures an inch in length, and is of a general reddish brown tint mottled with dull yellow; and the dorsal segments of the abdomen are deeply barred with reddish black almost confluent down the centre. The head is large; the prothorax small, with the elytra and wings well developed; the abdomen, rather narrow at the base, is broadest behind the large callipers, which are slender, furnished with two blunt teeth on the inner edge and meet at the extremities. It differs from *L. ripara* in having the apical edge of the last abdominal segment truncate, and not scalloped as in the former.

The next large Genus *Anisolabis* is also world wide in its range and contains 36 described species, 3 of which are recorded from Australia, 2 from Tasmania, 1 from New Zealand, and 1 from Norfolk Island. *Anisolabis colossea*, our largest common wingless species, also recorded from New Caledonia, was described by Dohrn (Ann. Museo Genov. 1879), and a second variety by Burr under the name of *A. minor* in 1902; but it is most variable in size, ranging from over 1½ inches in length to less than half an inch. It is of a uniform dull reddish brown colour, with a rounded head, truncate thorax, and elongate broad abdomen terminating in a pair of short stout finger-like appendages fitting close together and turned up slightly at the tips.

A second species of *Anisolabis* common in Tasmania and recorded from the top of Mount Wellington is black, somewhat broad and flattened on the dorsal surface, with the anal appendages

short, slender, and twisted over to the left side as if they had been damaged. It was described by Bormans (C.R. Soc. Ent. Belg. 1880) under the name of *Anisolabis tasmanica*.

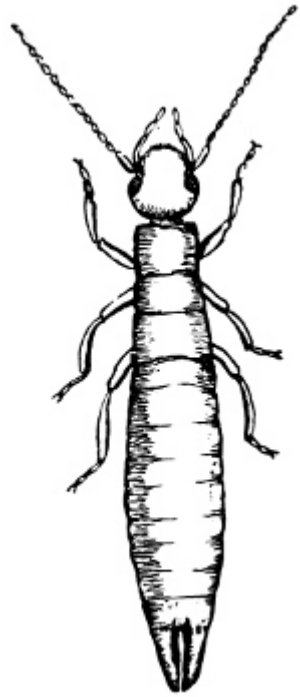


Fig. 4.—*Anisolabis colossea* (Dohrn).

The large wingless earwig.

(Original W. W. Froggatt.)

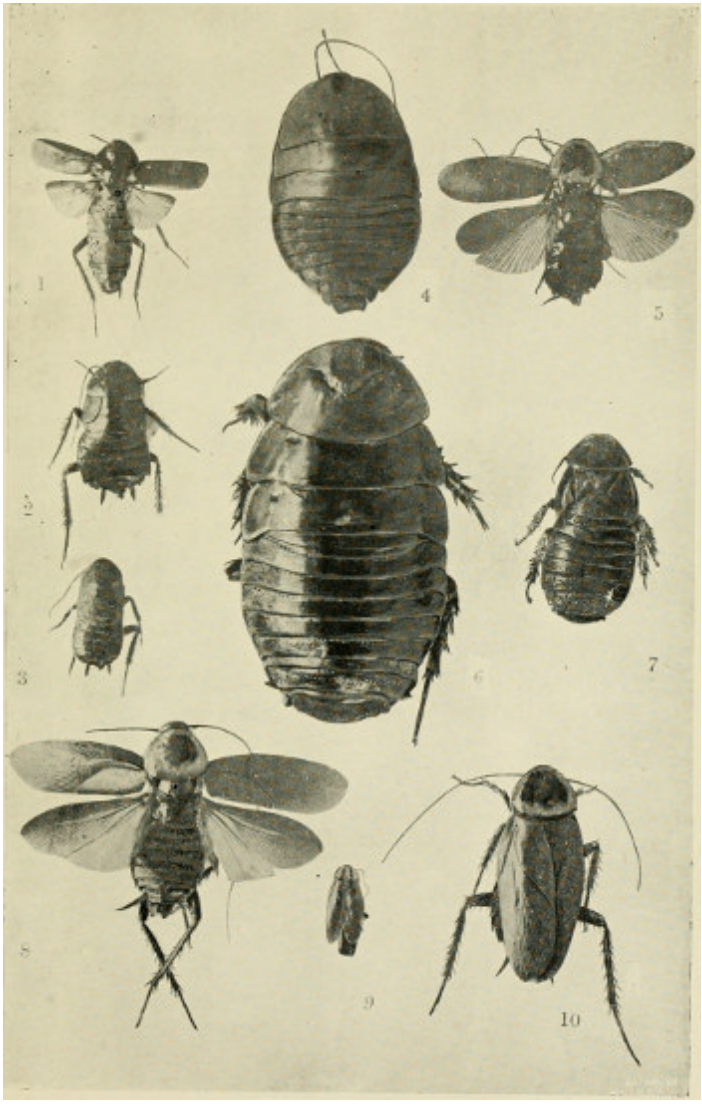
Labia grandis described by Dubrony (Ann. Museo Genov. 1879) comes from North Australia. The genus contains 47 described species; several undetermined species in my collection are small dark brown earwigs with well developed elytra, and anal appendages very narrow at the base, small, and curving over at the sharp tips.

Plate I.—ORTHOPTERA.

Family BLATTIDAE.

1. *Blatta orientalis* ♂ (Linn.).
2. *Blatta orientalis* ♀ (Linn.).
3. *Blatta orientalis* Larva (Linn.).
4. *Polyzosteria limbata* (Burm.).
5. *Periplaneta australasiae* (Fabr.).
6. *Geoscapheus giganteus* (Tepper).
7. *Panesthia laevicollis* (Sauss.).
8. *Periplaneta americana* (Linn.).
9. *Phyllodromia germanica* (Linn.).
10. *Periplaneta americana* (Linn.).

Plate I.—ORTHOPTERA.



Apterygida arachidis, a cosmopolitan species recorded from all parts of the world, is found in Australia; and the common European typical species, *Forficula auricularia*, which is widely distributed over the old world and America, is not recorded from

Australia in Kirby's Catalogue, but I have specimens in my collection given me by Mr. J. J. Walker taken in New Zealand, who told me he had also captured it in Tasmania, so that it is more than probable it will be found on the mainland.

Family 2. Cockroaches.

BLATTIDAE.

The typical cockroach is a shield-shaped insect, with stout horny plates covering both the dorsal and ventral surfaces of the thorax and abdomen. The head, tucked under and hidden, when viewed from above by the rim of the prothorax, is furnished with two large compound eyes placed well in front; in some groups there are also two ocelli; the antennae springing from below the eyes are very long and slender, composed of a great number of short ringed segments. The jaws are well adapted for their vegetarian habits, though some among the domestic species are almost omnivorous in their tastes. Tepper considers that several species destroy the grubs and caterpillars of injurious cut-worms, but this wants further confirmation. Their legs are long and stout, covered with spines, and in the species living under stones and logs the legs are usually thickened. Many species are provided with two pairs of stout membranous wings, while the front pair (elytra) are thickened, opaque and coarsely veined; the hind wings, though frequently small, are fan-shaped, membranous and well adapted for flight.

The cockroach is one of the most ancient of insects, and roaches are common in fossil beds both in Europe and America, many of them allied to our still existing forms.

The female has a curious habit of carrying her keeled egg capsule protruding from her abdomen for some time before she deposits it in a suitable situation.

A number of cosmopolitan species might be called domestic insects as they are only found about houses or the haunts of man; in London *Blatta orientalis* is commonly known as the "black beetle," swarming in cellars and kitchens. In Sydney the large yellow roach that comes flying round the room to the light is *Periplaneta americana*, an introduction from America, which has almost driven the smaller indigenous *Periplaneta australasiae* out of our houses; while in some of the southern and eastern States of America our Australian roach has been introduced and become the common domestic pest. The little German Roach, or "Croten Bug" of America, *Phyllodromia germanica*, is sometimes found about the Sydney wharves. Many of these bush and household roaches are provided with glands at the tip of the abdomen, from which they can discharge (when disturbed) a foetid odour as a means of defence. The cockroaches are a very extensive family; Marlatt estimates that at least 5,000 occur all over the world; about 212 species are given by Kirby (Catalogue Orthoptera vol. I. British Museum 1904) as Australian. Most of our typical forms are wingless, and live under rotten logs or stones; some of the largest species are to be found in the dry interior.

Saussure has described a number of our species (Mem. Soc. Geneve 1863–4–9): Walker many others, (Brit. Mus. Catalogue Blattidae 1868): and Tepper has been a constant worker at this group in South Australia for some years; descriptions of most of his species will be found in the Transactions of the Royal

Society of S. Australia between 1893–95, and the Zoology of the Horn Expedition 1896.

The Genus *Panesthia* contains 44 described species ranging from India to Australia, of which 7 are peculiar to this country.

Panesthia laevicollis is common in forest land, where it is found burrowing in damp rotting logs. It is a wingless black insect, measuring nearly 1½ inches in length, with the thorax narrow and flattened above the head, the latter furnished with comparatively short antennae; the legs short but very spiny; and the dorsal surface of the abdomen covered with irregular punctures.

Cosmozosteria coolgardiensis is a very distinctive, wingless, dull yellow species broadly marked with black on the thoracic segments, and finely barred with the same colour on the upper edges of the abdominal segments. It measures about 1¼ inches in length, and ranges from South Australia to the central parts of Western Australia.

Polyzosteria limbata is a large dark brown cockroach margined on the outer edge of the dorsal plates with yellow; it is common in the vicinity of Sydney, and may be often noticed in the neighbourhood of Botany resting on stumps and fences; it has the habit, like several other species, of discharging a most offensive liquid when disturbed. *Polyzosteria pubescens* is an allied but much larger insect, measures up to 2 inches in length and 1½ inch in breadth; it is of a uniform dull brown tint, and is common about Kalgoorlie W.A., and will be probably found to range over a large portion of the interior.

Polyzosteria mitchellii is a variegated, dull metallic

green cockroach ranging over the same country, but not more than 1½ inches in length. It has the upper surface margined on the edges with yellow, and is mottled on the legs and under-surface.

Fig. 5.

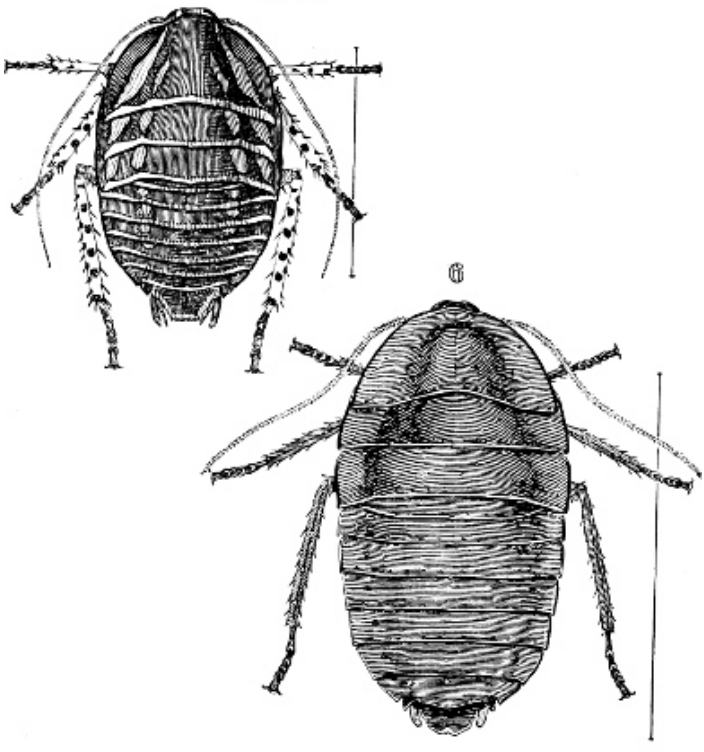


Fig. 6.

Figs. 5 and **6**.—Desert Cockroaches.

5. *Polyzosteria mitchellii* (Angas). The green-banded cockroach.
6. *Polyzosteria pubescens* (Tepper). The Pubescent cockroach.

("Agricultural Gazette," N.S.W.)

Geoscapheus giganteus is our giant cockroach, measuring 2½ inches in length and 1½ across the

middle of the body. Like the last three it is wingless, with the large prothoracic shield overlapping the head. In colour it is bright reddish brown, crenulated and very rugose in the centre of the dorsal surface. In the same year (1895) that Tepper obtained this fine species, Saussure described another large roach under the name of *Macropanesthia rhinoceros*, forming a new genus for its reception and adding a second species which he named *M. muelleri*.

Family 3. White Ants.

TERMITIDAE.

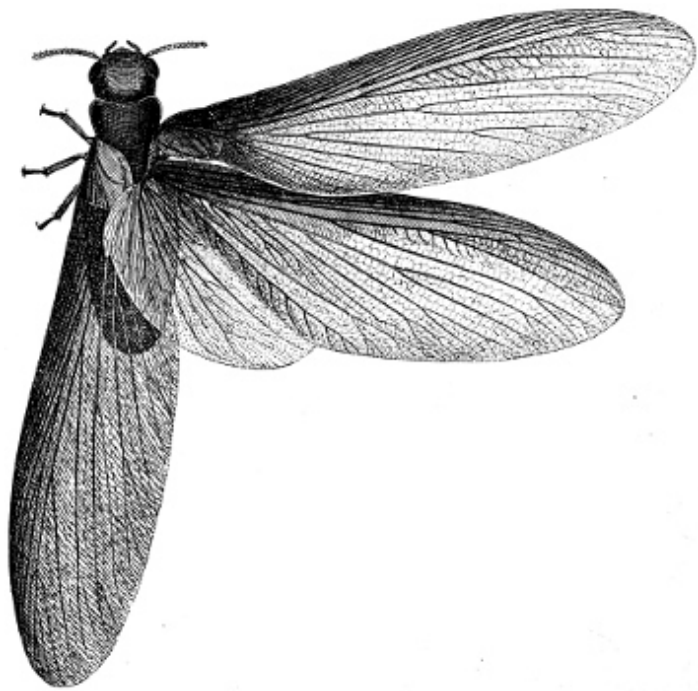


Fig. 7.—*Mastotermes darwiniensis* (Froggatt).

The giant termite of Northern Australia, showing the structure of the wings of the male.

("Agricultural Gazette," N.S.W.)

The exact position of these insects in every scheme of classification has been more or less vague, and while some writers place them in the Orthoptera, more include them in the Neuroptera; others again to get over the difficulty have formed a halting ground between the two and called them Pseudo-Neuroptera. In the "Genera Insectorum," Desneux has followed Brullé and Comstock and placed them in a distinct order as Isoptera. Grassi, one of the greatest living authorities on the anatomy of insects, considers they are allied to the Neuroptera: but taking the broad ground of outward structure upon which the Orders were formed, and comparing the perfect termites, especially my giant species from North Australia, *Mastotermes darwiniensis*, with other families, I consider they are closely allied to the cockroaches, and therefore place them here. Take the wing away from some of the larger species and they have a striking resemblance to earwigs, and one of our greatest authorities on the family (Hagen) actually described a damaged earwig from Japan as a termite.

Termites are widely distributed over all the warmer regions of the world, though most numerous in tropical countries; and a number of fossil species have been described from Europe and America.

When Hagen's "Monograph of the Termitidae" was published in 1858, only seven species were recorded from Australia and Tasmania, and one or two of these are very doubtful. In my "Australian Termitidae" (Pro. Linn. Soc. 1896–1897) the number was brought up to 35, and there are probably many more to be discovered, so that the family is very well represented in this country. Our species have been

subdivided into nine genera placed in six sub-families, which are chiefly formed on the wing structure.

Broadly speaking their habits are very similar, and each nest or community consists of the same castes. First in order come the dark brown perfect winged male and female insects, only found in the regular nests in the early summer months; for soon after their wings are developed, the workers cut openings in the clay walls of the nest, and they fly out in a continuous stream, generally just before sunset, and when all have left the workers again close up the openings for another year. In the winged state they are known as “flying ants,” and on a warm summer night sometimes come in such numbers round the lights, dropping their easily detached wings all over the table, that they are a regular nuisance.

These perfect termites have well developed eyes; slender antennae composed of short, rounded, bead-like joints standing out in front of the rounded flattened head; and a short stout thorax fitting close against the elongate rounded abdomen. They are furnished with two pairs of similar, elongated, narrow wings of uniform width rounded at the tips, with primitive parallel neuration; these are loosely attached to the basal wing-flap by a cross suture, where they readily tear them across; when at rest they are laid flat over each other down the back, extending well beyond the tip of the body: the legs are short and stout.

Their flight is feeble, and of the millions that swarm out and flutter away from the nest, probably not more than halfa-dozen couples are fortunate enough to get into a suitable place to found a fresh colony.



Fig. 8.—Diagram of head of worker termite. Dorsal view, showing the jaws and mouth parts. *Coptotermes (Termes) lacteus* (Froggatt).

("Agricultural Gazette," N.S.W.)

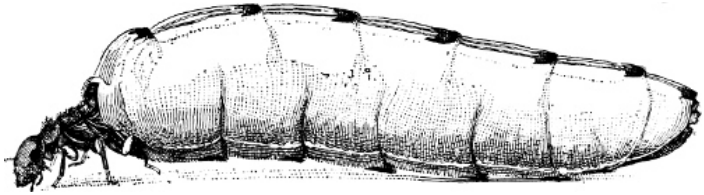


Fig. 9.—*Coptotermes (Termes) lacteus* (Froggatt). Fully developed female or Queen.

("Agricultural Gazette," N.S.W.)

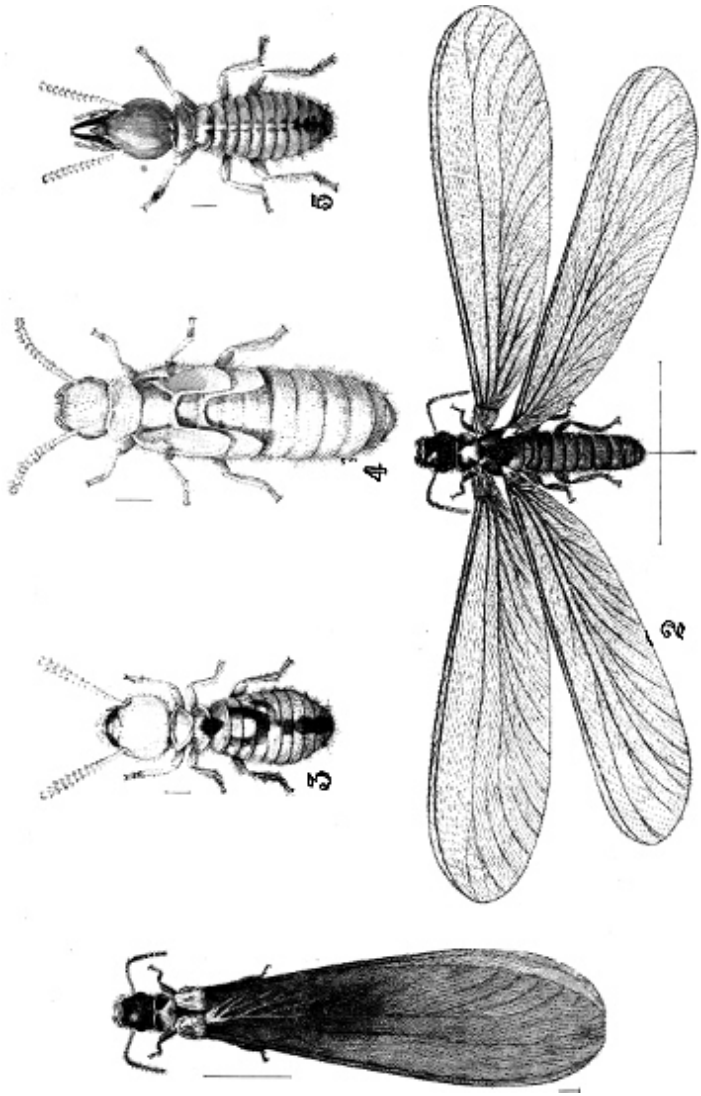
Plate II.—ORTHOPTERA.

Family *Termitidae*.

Coptotermes (Termes) lacteus (Froggatt).

1. Male (wings closed).
2. Male (wings expanded).
3. Worker.
4. Nymph.
5. Soldier.

Plate II.—ORTHOPTERA.



The next caste, that form the bulk of the life of the nest, are the workers, delicate soft white creatures with pale yellow, rounded, flattened heads; blind, but furnished with slender antennae; and a pair of short stout toothed jaws hidden by the labrum, and

which in the course of their labours do such immense damage to all kinds of both native and imported timber. The third caste, also always present, are the soldiers, that simply act as guards for the whole nest, leaving all the work of building, feeding the young, and gathering supplies to the workers. In the fourth we have the Queen, which was originally one of the winged forms; after casting her wings she is impregnated, and while the head, thorax and appendages remain as before, the abdomen swells into a white cylindrical sack as thick as one's little finger; the chitinous plates that once fitted close together are now widely separated and appear as narrow black bands. She is simply a mass of egg tubes; and, looked after and fed by the attendant workers, she devotes her life to laying eggs, which, like grains of sugar, are carried away and piled up by the workers in adjacent chambers under the nursery. From these eggs develop tiny white specks of matter that gradually develop by a regular series of moults into workers, soldiers, and immature winged forms; the latter have large rounded bodies and rounded wing pads representing the future wings. Supplementary Queens are sometimes found that have never gone through the winged stage; they have the general structure and large corrugated bodies of the mature queens. The typical white ants' nest, known as a Termitarium, usually consists in the first instance of a mass of woody laminated material that might be likened to papier-mache, originally a stump or portion of a log that has been chewed up and voided in the form of a mortar-like substance. This termitarium is full of irregular galleries running like a network all through the mass, with the means of exit running out under the nest; a mass of stout terraced structure above the ground level surrounds

the Royal Chambers, which might be likened in size and shape to an inverted saucer, from which the enclosed Queen cannot escape, but the attendant workers can pass to and fro. Above this is a rounded oval mass often as big as a child's head, which resembles stiff brown paper folded round and round, full of fine openings, and is easily crumbled up; this, for want of a better word, I call the nursery, as it contains all the minute larvae as they emerge from the eggs. The formation above the nursery is more irregular, and terminates in a rounded cap. The whole of this woody structure is covered with a stout enveloping wall of fine clay, which, carried up grain by grain, has been cemented together into a firm earthy wall in contact with the woody structure at the base of the nest, but often with a cavity at the apex.

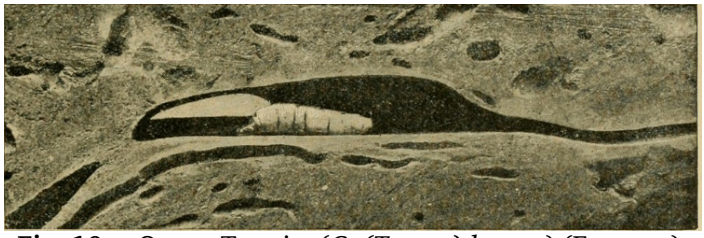


Fig. 10.—Queen Termite (*C. (Termes) lacteus*) (Froggatt). Showing her in the Royal Cell or Queen's Chamber.

("Agricultural Gazette," N.S.W.)

The nests of the *Eutermes* are sometimes built over stumps, but more often on the branches or trunks of trees, where they form rounded or oval masses a foot or two in diameter, with covered galleries leading down to the ground. In these nests there is no distinct outer earthy sheath; when near the ground, earth and wood are blended together in a very compact mass, full of small galleries running at every

angle, and have no distinct structure like the first group. When the nest is placed on a tree trunk or branch away from the ground it consists almost entirely of woody matter, and may be quite soft and papery beneath the outer crust. In the West Indies these nests are popularly known as “Negroheads.”

Other groups are never known to construct true nests, but form chambers and galleries under the bark of trees, in banks, or simply under logs and stones. Some in the interior are said to disappear underground from their nests in the dry summer time, returning with the first rains and mending up the dilapidated walls.

The members of the two genera *Mastotermes* and *Calotermes* have the wings much more thickly veined than the more simple *Termes* and *Eutermes*.

Mastotermes darwiniensis is the largest common species taken flying round the lights at night in North Queensland and Port Darwin. It is very dark brown, with thickly veined wings, and measures 1⅓ inches in length from the front of the head to the tip of the folded wings. Nothing is known of its nests or the other forms of this species. It is the sole representative of the sub-family. I have, through the observations of Mr. N. W. Christie of Port Darwin, good reasons for believing that *Termes errabundus*, described from the soldiers and workers only, is identical with this giant termite. He informs me that at Point Charles he finds the nests in every old post or stump in the wet season.

Calotermes longiceps is the common Sydney species of this group, of which we have six described from Australia, and one from New Zealand. The soldier measures ½ inch in length, with a long broad head armed with blackish projecting jaws, which are

irregularly toothed on the inner edges. The *Calotermes* live in logs and trees in small communities; they form no regular nest; this species is found in logs of firewood about Sydney. In some species the soldiers are very rare, the community consisting of immature winged forms and workers.

Plate III.—ORTHOPTERA.

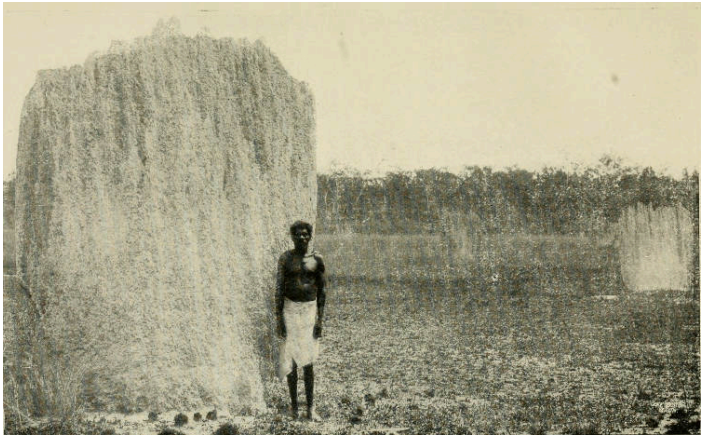
Family TERMITIDAE.

Termitarium of the Meridonial White Ant, *Termes meridionalis* (Froggatt).

"The Magnetic Nest," Palmerston, Port Darwin, N. Australia.

(Original photo. N. Holtz.)]

Plate III.—ORTHOPTERA.



In the RHINOTERMINAE we have two species, differing from the former group in having the wings very finely wrinkled or reticulated; and also in having two distinct forms of soldiers, one much larger than the other, but both with pear shaped

heads and pointed finely-toothed jaws. *Rhinotermes intermedius* is not uncommon in old stumps about Sydney; the winged forms are of a light reddish brown colour with delicate wings; both the workers and soldiers of the major type have large yellow heads, the latter armed with curved jaws; while the heads of the small form of soldiers are much more slender.

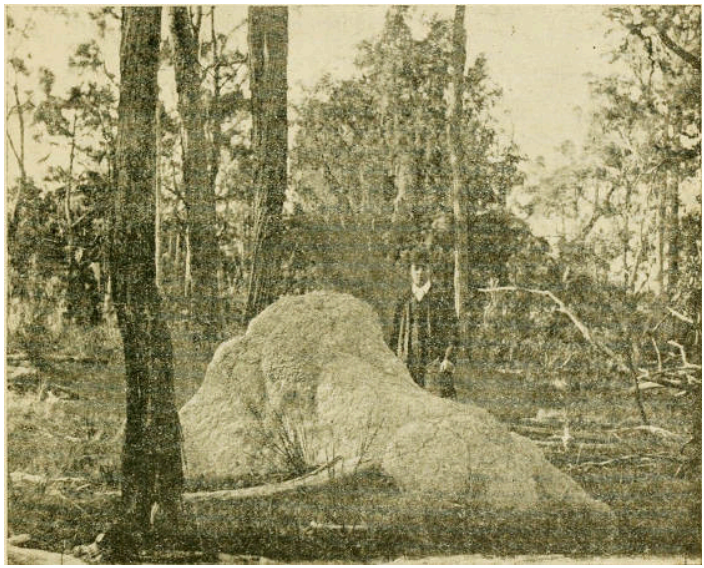


Fig. 11.—Typical Domed Termitarium or "White Ants' Nest" from the coastal districts of New South Wales. Formed by *Coptotermes (Termes) lacteus* (Froggatt).

("Agricultural Gazette," N.S.W.)



Fig. 12.—Vertical section of nest of the same species shewing the structure of the woody interior, with the outer clay covering.

("Agricultural Gazette," N.S.W.)

The typical TERMITINAE comprise nearly all the species that build regular mounds, containing countless thousands of individuals. *Termes lacteus* is the common species that does so much mischief to buildings about Sydney, and though not a mound builder about the city, yet from Colo Vale to Victoria and also northward it forms tall rounded nests up to six feet high and very regular in structure. The soldier is about ¼ inch long, with a bright, yellow, pear shaped head, and a pair of curved jaws; it also has an opening in the front of the head above the jaws from which it can discharge a globule of milk-

like fluid when disturbed. This species with several allied forms has been placed in the genus *Coptotermes*. *Termes meridionalis* has a small soldier, almost white, with a rounded yellow head armed with two slender curved jaws, and an incurved tooth in the centre of the inner margin; it measures a little over ⅛ of an inch in length. It has a world wide reputation on account of building what is known as the "Magnetic Nest," built like a brick wall and always pointing north and south, with the wall facing east and west. Jack (Pro. Royal Society, Queensland, 1897) considers that this is done by the termites always building towards the rising sun; so that, as they work at night, the clay will dry rapidly. They are found in several localities on Cape York and near Port Darwin. Several very distinct species are found in the interior. *Termes perniger* ranges from Kalgoorlie W.A. to Western Queensland; the soldier is a very dark coloured insect with a very large head furnished with large powerful toothed jaws, and is very savage. *T. rubriceps* is found in small colonies in Central Australia, forming their nests at the roots of the tussocks of spinifex grass. *T. krisiformes*, a species in which the soldier has slender irregular jaws like a Malay kris, makes tiny little mounds about Bulli N.S.W. or forms colonies under the shelter of a log.

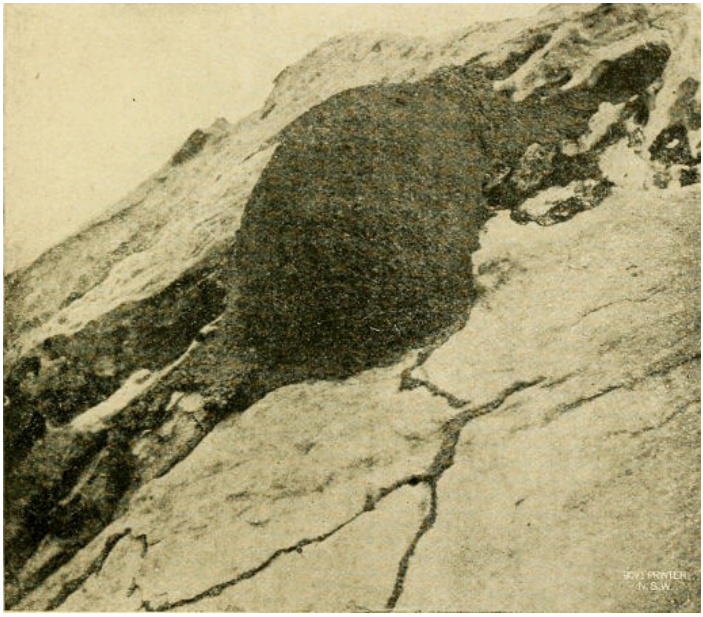


Fig. 13.—Nest of White Ant (*Eutermes fumipennis*) (Walker), upon the summit of a rock where a small stump had been situated. Manly, near Sydney, N.S.W.

(Original photo. W.W.F.)

The members of the genus *Eutermes* are common all over Australia; they construct hard woody nests seldom more than a foot or two high; though at the same time, the largest known termitarium is also built by one species, *Eutermes pyriformis*, pillar shaped and often 18 feet in height, probably in the first instance commenced over a dead tree trunk.

The soldiers are very curious looking creatures; the peculiar oval or rounded heads produced into an awl-like point in front, the centre being filled with a clear honey-like fluid; this is discharged down the projecting snout and smothers their enemies, because they have no true jaws above the mouth: most of them are much darker brown insects than the other

termites. The two species, *Eutermes fumigatus*, the darker, smaller species, and *E. fumipennis*, the lighter tinted, are common in the vicinity of Sydney.



Fig. 14.—Typical nest, of the Spinifex termite (*Eutermes triodiae*) (Froggatt), about 14 feet high. Hall's Creek, Kimberley, W.A.

(Original photo. Mansbridge.)

Family 4. Web-spinners.

EMBIIDAE.

These rare and curious little chocolate brown creatures are elongate in form, not unlike a slender adult termite after it has shed its wings, and they form another group that has puzzled entomologists in regard to their classification. Only twenty species are known from all parts of the world; but from their affinities to prehistoric insects they have been carefully studied. Grassi worked at the life-history of a species found in Southern Europe under stones: Wood-Mason has figured and described Indian forms and placed them in the Orthoptera: Perkins says that the species in Hawaii is common on tree trunks where they conceal themselves under a fine web like spiders.

Plate IV.—ORTHOPTERA.

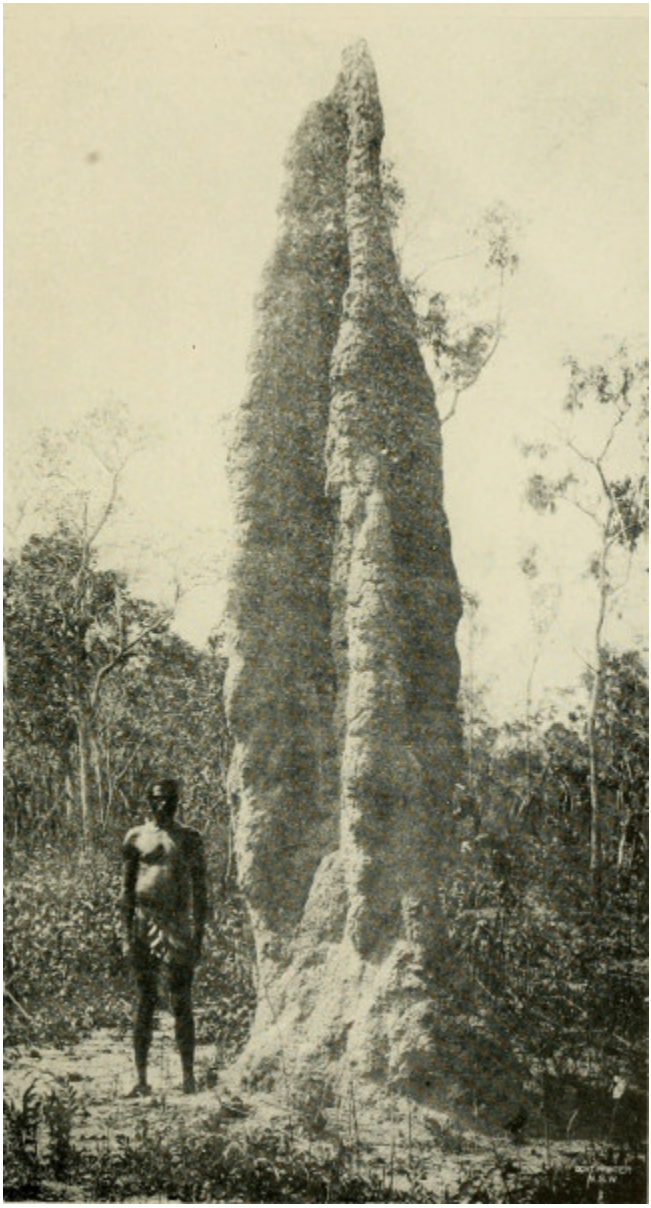
Family TERMITIDAE.

Termitarium of the Great Mound-nest White Ant, *Eutermes pyriformis* (Froggatt).

Palmerston, Port Darwin, N. Australia.

(Original photo. N. Holtz.)

Plate IV.—ORTHOPTERA.



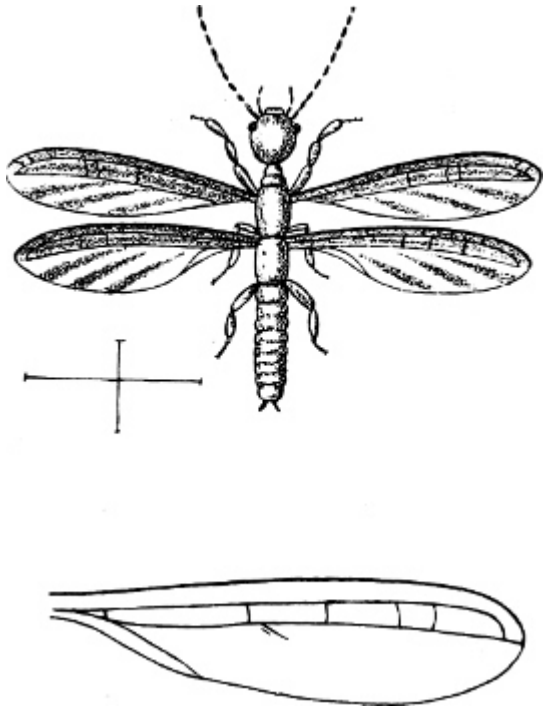


Fig. 15.—*Oligotoma gurneyi* (Froggatt). The web spinning embiid. With a diagram showing the primitive structure of wing.

(Proc. Linn. Soc. N.S.W.)

They measure up to about ½ an inch in length; are elongate in form with large globular heads, small toothed jaws, and long, slender antennae composed of 20 or more bead-shaped joints which they are constantly moving when they run about. The thorax is formed of three very elongated segments, so that each pair of legs is very wide apart; and in the winged forms the slender oar-shaped wings with very primitive nervures are so far from each other that they have quite a comical look; the abdomen is short, cylindrical, composed of 10 segments, rounded at the tip, with large anal appendages (cerci). The legs are

curiously thickened, with the tarsi of the front pair shaped somewhat like a weaver's shuttle. Until last year they were unknown in Australia, when I described two species (Proc. Linn. Soc. 1904); the first *Oligotoma agilis*, is a wingless form, of which I found two specimens while turning over granite boulders at Bomen near Wagga N.S.W. The second, *Oligotoma gurneyi*, was obtained by Mr. Gurney in a lighted room one evening in a suburb of Sydney; it had well developed wings. Soon afterwards Mr. Steel had his attention called to what one of the men in the Colonial Sugar Co.'s refinery at Pyrmont called a "white fungus" under one of the windows. This Mr. Steel found to be a mass of white web matted with excrement and full of slender brown insects, which he collected into a bottle and handed to me. Though most of them were mature, only a few showed regular wing pads, but otherwise they appear to be *O. gurneyi*; in captivity they spun a great quantity of delicate white web among which they hid, but when wet sugar was placed on the cork they ate it readily.

Family 5. Book Lice.

PSOCIDAE.

These are very delicate little creatures that run about on moss grown fences, tree trunks, among foliage, or hide in boxes, old baskets and other litter. In some groups, while the larvae and pupae are wingless, the perfect insects have two pairs of delicate wings with curious curved transverse nervures and very few cross veins, so that the cells are few. In other groups the perfect insects are wingless, or if present, aborted and useless for flight. They are all furnished with long slender antennae consisting of from 11 to 25 joints; the head is large,

rounded in front, with convex eyes, and three ocelli (wanting in the wingless forms).

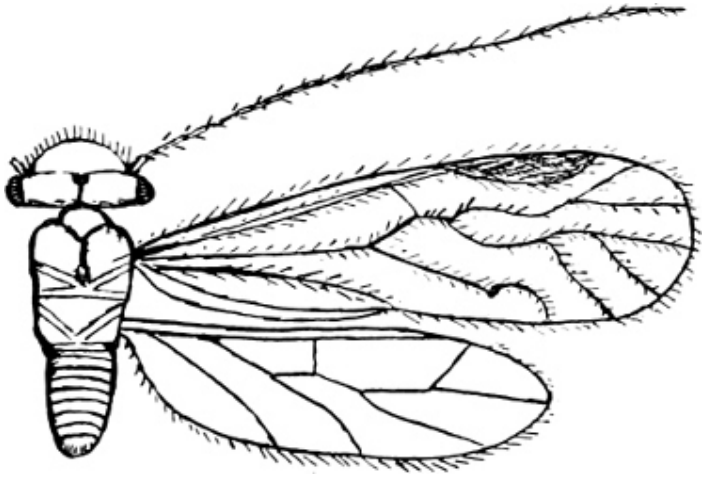


Fig. 16.—*Philotarsus froggatti* (Enderlein). A typical specimen of the Psocidae found near Sydney, N.S.W.

(Redrawn from Enderlein's figure,—W.W.F.)

They can be collected into a small tube on fences or tree trunks, or shaken into a net or umbrella; but they must be handled very gently, and are best placed in dry tubes, and killed and mounted at home. Many handsome species are found in Australia, and some probably have a wide distribution, as they are easily introduced into a new country with many kinds of produce. One dull winged species is very common on the foliage of the orange trees, where it lays its metallic green eggs in patches of 9 or 12 on the midrib of the leaf, covering them over with a delicate white silken sheet.

A number of species were obtained in Australia by the Hungarian entomologist L. Biro, collecting for the Royal Museum of Hungary, chiefly captured in the neighbourhood of Sydney. In 1903 Dr. Enderlein

classified and described these (Die Copeognathen des Indo-Australischen Faunengebietes), published in the Annals of the above Museum, and illustrated with many fine drawings. In this monograph he divides the family into 16 sub-families, 39 genera and 115 species, 15 of which are described from Australia.

Philotarsus froggatti, a tiny creature 2⅓ millimetres in length, with clear wings, is found on the Blue Mountains.

Family 6. Mantids.

MANTIDAE.

We have no exact popular name for these peculiar insects; some of the bush children call them “Forest Ladies,” on account of the dainty form and graceful motion of several of our smaller species, which is rather appropriate; but unfortunately several lace-wings go under the same fanciful name. In the United States the common species are called “Rear Horses” from the way they stand at rest with raised fore legs. The Romans called them “Soothsayers;” and at least two species are known as “Praying Mantis,” namely *Mantis religiosa* in Europe, and *Mantis carolina* in the United States, from their pious attitudes.

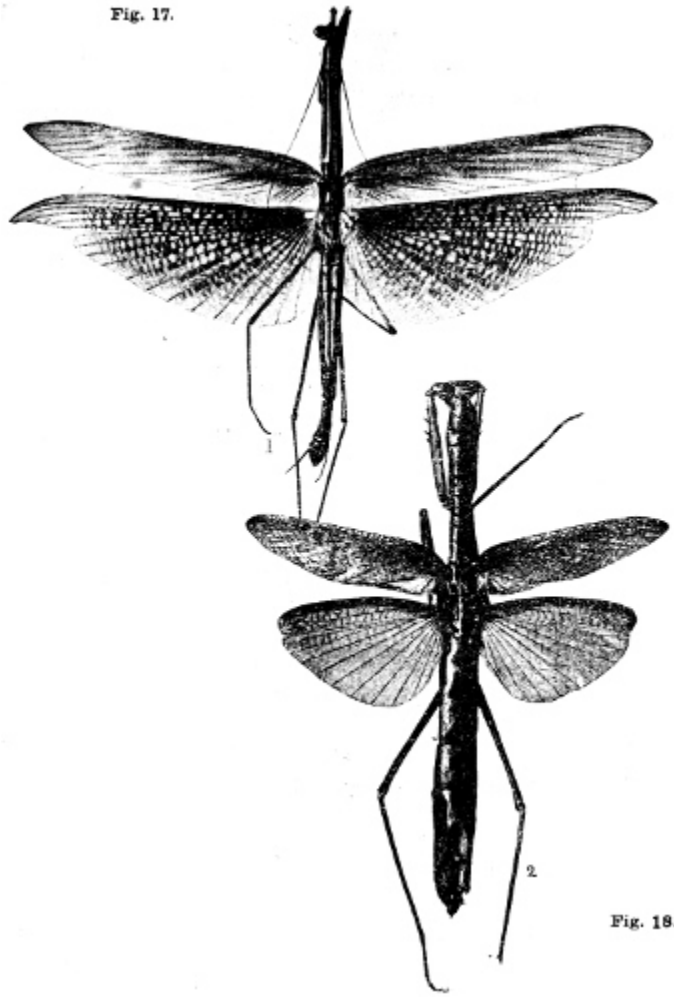
They are most numerous in tropical countries, and are well represented in Australia; Westwood in his “Synopsis of the Species of Mantidae,” published in 1889, records 624 described species, only 30 of which come from this country. Kirby’s Catalogue (1904) brings the list up to about 843, and adds 5 more to our list of described species.

With the exception of some curious little neuroptera (*Mantispa*), which can be easily

distinguished by their lace-like wings, the members of this family cannot be confused with other groups. The long slender prothorax, supporting a very flexible narrow head, forms an elongate neck, to which are attached, well in front, the formidable spined fore legs, which are seldom used as means of progression, but as weapons of offence to capture other insects upon which they prey, for they are tigers of the insect world, lying in wait, perfectly motionless, with their colouration adapted to the foliage among which they hunt. The two apical portions of the thorax, and slender body, which in the ordinary type is covered with two pairs of wings, the first pair narrow like that of a grasshopper and the hind pair fan-shaped, with the two pairs of slender legs, are orthopterous; while the front portion, consisting of the narrow head turned down in front into a pointed mouth, with large projecting eyes, and thread-like antennae, show its carnivorous habits. The female deposits her eggs upon the twigs or bark of trees in an almond-shaped mass, consisting of regular rows of elongate eggs piled above each other, with the tips all pointing outward, and which are covered with an enveloping coat of a sticky brown secretion that, as it hardens in the sun, becomes dry and papery. When the baby mantids emerge from the eggs they are attached to them by two slender threads fastened to the anal appendages (cerci); they hang head downward, like a mass of tiny squirming caterpillars, until they cast their first larval skin, when they fall to the ground, soft, wingless, little stick-like creatures, ready to hunt for themselves. These egg masses are very conspicuous objects in the bush and orchard, and are often received from my correspondents with enquiries as to what they are, and whether they should be

destroyed. As each is the home of some hundreds of little creatures that destroy thousands of smaller injurious insects, they should never be disturbed by the gardener.

The commonest species in our gardens is the "Thick shouldered green mantis," *Orthodera ministralis* better known under the name of *Orthodera prasina*, but as it was described many years before under the first name, the latter has become a synonym. It is about 1½ inches in length, somewhat stout and thickset, the front portion of the neck-like prothorax as wide as the head, fitting up close against it, and narrower where it joins the mesothorax. It has well developed wings and flies very well, but it usually remains immovable and alert, resting on a leaf as green as its own bright coat, its treacherous deadly fore-legs are raised, ready to lash out and seize any incautious moth or butterfly that comes within reach, and it will often secure one larger than itself. It ranges from Tasmania round to North-west Australia, and has been recorded from New Zealand, into which place it could have been easily introduced from Australia with foliage plants.



Figs. 17 and **18**.—Australian Mantidae.

17. *Tenodera australasiae* (Leach), the long-winged mantis.

18. *Archimantis latistylus* (Serv.), the short-winged mantis.

(Original photo. Burton.)

The Genus *Archimantis* contains five species described from Australia, of which *Archimantis latistylus* is the commonest species about Sydney. It

measures 4 inches in length, is furnished with large well developed wings, and varies in colour from dull green to brownish yellow; the female is smaller, with more thickened body and shorter wings. The fore-wings, or more properly elytra, are brown, rounded at the tips, often marked in the centre with a dark spot; the hind wings are semitransparent. It hides among the dull-coloured foliage of the Leptospermum and Melaleuca bushes, which assimilate well with its own uniform tint. This species will be found, figured, in colours in McCoy's "Zoology of Victoria, Decade xiii."

Archimantis montrosa, a slightly larger species, comes from Victoria River, North Australia; the type was taken by Elsey, naturalist to the Gregory Exploring Expedition in 1856. *A. armatus*, a smaller brown species, from the same district, has the prothorax curiously spined on the outer margins, and the under-surface covered with coarse tubercles.

Tenodera australasiae is another of our best known species, not uncommon about Sydney in the summer months on the low scrub. It was first described, and figured in colours, by Leach in his "Zoological Miscellanies" 1815; and Westwood states that the type is in the Banksian Collection in the British Museum. It has a wide range over Australia, and is also a native of New Caledonia, New Guinea and Ceram. It is a more brightly-tinted insect, 3½ inches in length, of a general yellowish brown colour; the apical edge of the elytra striped with green, followed with a stripe of pale salmon colour, and the rest semitransparent; the wings are tinged with pink along the front margin, the whole mottled with black and brown, thickest towards the body.

There are a number of active, little, black or dark

brown mantids with curiously shaped bodies that run about on the dull coloured tree trunks, seldom flying, (though many of them are winged), but trusting to their imitative tints to escape observation; several of our species belong to the Genus *Paroxypilus*.

Family 7. Stick or Leaf Insects.

PHASMIDAE.

These are sometimes in general appearance not unlike mantids, but the distinctive characteristics are well defined; for though the prothorax is more or less elongated into a neck, and the abdomen, wings, and hind legs long, it will soon be noticed that the fore pair of legs are not spined, but are regular walking or clinging legs like the hind ones. The head is oval or rounded, with a somewhat simple mouth adapted for chewing foliage; smaller eyes; and large, thicker jointed antennae.

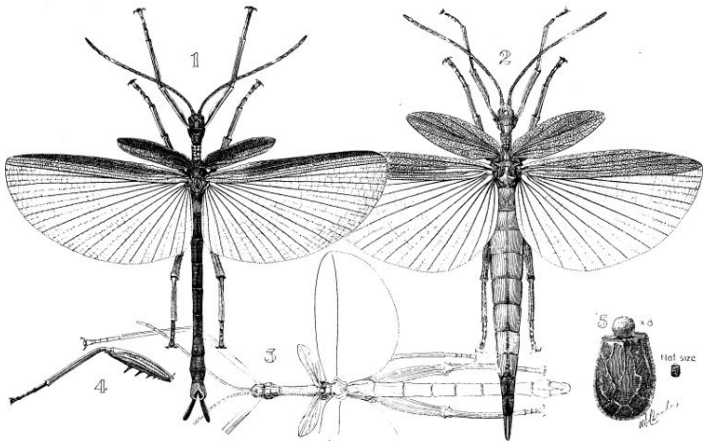
Plate V.—ORTHOPTERA.

Family PHASMIDAE.

Podacanthus wilkinsoni (Macleay).

1. Male.
2. Female.
3. Immature male.
4. Showing structure of hind legs of immature male.
5. Egg (enlarged).

Plate V.—ORTHOPTERA.



They in the matter of colouration also adapt themselves to their surroundings, and are usually green or brown when at rest, though when the wings are expanded they exhibit some brilliant tints. In some groups the species are winged in both sexes; others have only winged males; and one group is wingless in both sexes, the latter generally long, slender, and stick-like.

This family contains some of the giants of the insect world; specimens of several of our Australian species measure 12 inches in length; while supposed closely allied fossil forms unearthed in the Carboniferous deposits of Europe measure up to 19 inches and were supplied with immense wings. The female while crawling about among the foliage drops her eggs singly on the ground beneath, where, protected in their hard shells among the litter, they sometimes remain over a year before the baby phasma comes out. The remarkable form and texture of these hard oval egg cases has attracted the attention of entomologists in many countries, and Sharp has figured and described some from New

Britain.

Just as the Mantis has adapted its colour and shape to catch its prey, so the phasma to protect itself from its many enemies has evolved wonderful leaf-like processes upon the wings and legs, agreeing in style with the surrounding foliage. It is noticeable that the larger bodied female is often more leaf-like than her slender mate, probably because more helpless; this is particularly so in the gravid or egg-laying condition.

G. R. Gray described a number of our species in the Transactions of the Entomological Society 1836, and others in the "Entomology of Australian Phasmidae" 1833, and later in his "Synopsis Phasmidae"; Westwood in his "Catalogue of the Orthopterous Insects in the British Museum" 1859 describes some; a few have been described by Macleay, Leach, McCoy and Rainbow, bringing our list up to about 60 species. In Kirby's Catalogue 95 species are listed from all parts of the world, but no additions are made to our list.

The members of the Genus *Bacillus* are slender, wingless, stick-like creatures of which 5 species are recorded from Australia. The Great Brown Phasma, *Acrophylla titan*, is the type of one of our groups, containing 11 species described from this country. The female measures 8 inches to the tip of the body, and is slightly broader across the outspread wings; the general form of head and thorax to base of tegmina is slender; the abdomen is thickened; the legs and mesothorax are spiny. The general colour is greyish brown; the tegmina light brown, but thickly blotched with blue-black so that it is often more black than brown; the wings are very large with the costal area broad and similar in colour to the

tegmina, but shaded with red at base, the hind membranous part of them light chocolate irregularly mottled with dull greyish brown. The male is more slender in form, about an inch shorter, the smaller tegmina mottled with greenish yellow; the front of the wings, which are proportionately small, are of the same colour, and the hind portion dark chocolate finely mottled with light brown. This large stick-insect used to be common about Sydney before the scrub was cleared away, and ranges northward up the coast. Gray says: “It is found on low scrubs about Port Jackson where the inhabitants call it “Walking Straw” or the “Animated Stick.”

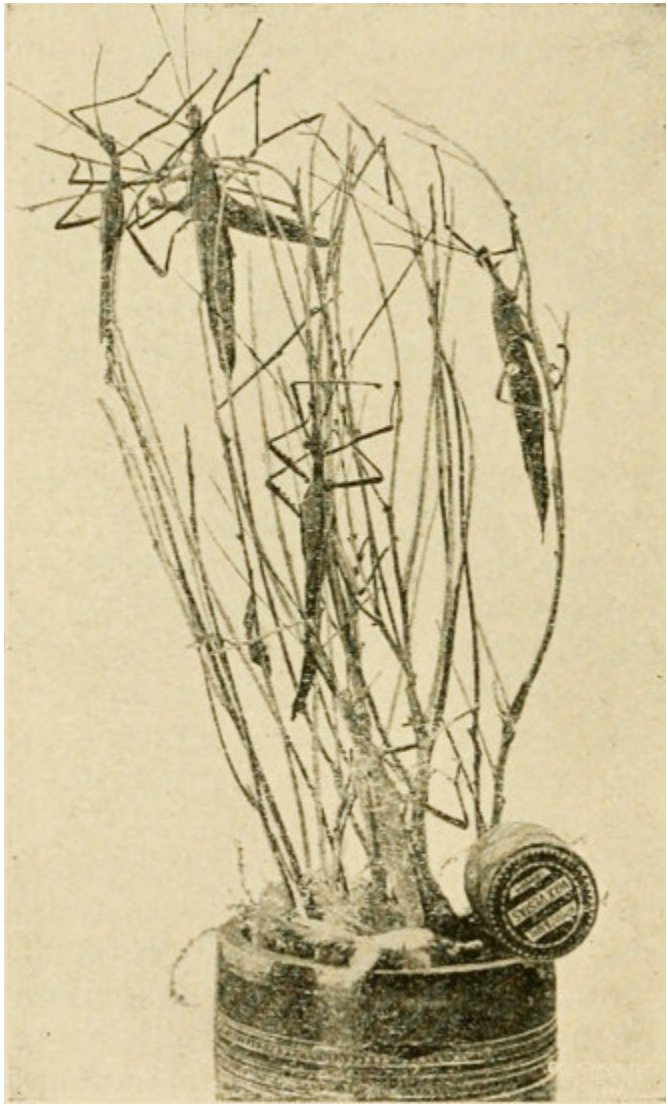


Fig. 19.—Group of Gregarious Phasmids, *Podacanthus wilkinsoni* (Macleay) resting upon denuded eucalyptus foliage.

("Agricultural Gazette," N.S.W.)

The Genus *Podacanthus* is represented by 3 fine

species. The large pink winged phasma, *P. typhon*, has a wide range from Victoria to Queensland. When resting with closed wings it is of a uniform rich green tint, but when the wings are opened out, the upper surface of the abdomen and the wings behind the frontal stripe are bright rose red. The female measures 5 inches to the tip of the body and over 7 inches across the outspread wings. In this genus the mesothorax is short, the dorsal surface covered with short spined bosses and the metathorax swelling out into a thickened body tapering to the large boat shaped ovipositor. The male is smaller and much more slender.

P. wilkinsoni is a gregarious species, appearing in the summer in the New England forests in countless thousands, stripping every leaf off the eucalyptus bushes as they travel along to the south-east, so that all the trees look as if they had been killed by ringbarking, from which habit they have received the name of "Lourie's Ringbarkers," Mr. Lourie being the owner of Noundoc Station, where they are very numerous. The female measures about 3½ inches to the tip of the body, which is broad and thickset from the shoulders, of a general uniform bright green tint on the dorsal surface, with the ventral somewhat blackened and roughened. When the wings are expanded the front margin shows the basal part pale orange yellow, and the membranous part behind varying from rich rose red to pink. The male is a more slender insect of a dull olive green tint, about the same length, with the broad wings delicate purple. They appear with well developed wings about New Year, and are depositing their eggs toward the end of February, the first frost killing the last of them off.

Didymuria violescens was described and figured in Leach's "Zoological Miscellanies 1815" as our typical Australian Phasma; Gray again figured it in colours in his "Entomology of Australia" under the name of the "Violet-winged tailed Spectre." It is a slender species not unlike the last, of a brownish yellow colour, with wings of a deep violet almost red tint; and it has 3 large spines on the thighs of the hind legs.

The Genus *Tropidoderus* contains four species according to the latest catalogue, though there is some doubt whether one or two should not be defined as only varieties of *T. childreni* described by Gray.

T. rhodomus is figured and described by McCoy; it measures 6 inches in length and 9 across the outspread wings. With closed wings it is a rich green, but when they are expanded, the basal portion of the wings is bright red, with the apical portion green, and the rest semitransparent. The tegmina is short, leaf-like, green above, but shaded with red on the under-surface. This is one of the short-necked broad-bodied forms, and while the fore-legs are long and slender, the thighs of the mid and hind pair are dilated into flattened leaf-like forms; it is found, clinging among the foliage of the gum trees, from Victoria to Queensland. The typical *T. childreni* differs from this form in having the basal portion of the apical area of the wings yellow instead of red, and the hyaline wings tinged with yellow. McCoy has figured another under the name of *T. iodomus*: and Rainbow a fourth from the neighbourhood of Sydney under the name of *T. decipiens* which also comes very close to the typical species; it has the basal portion of the apical area of the wings purple.

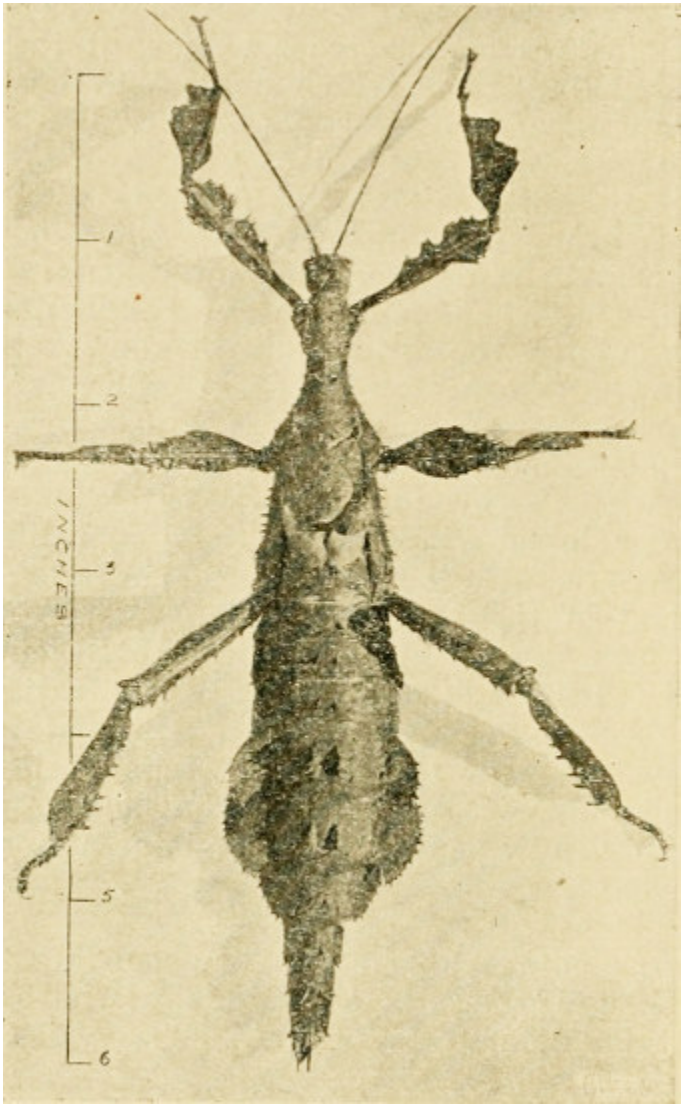


Fig. 20.—The Spiny Green Leaf Insect. *Extatosoma tiaratum* (Macleay).

("Agricultural Gazette," N.S.W.)

Extatosoma tiaratum is remarkable for the great

difference in the sexes; the male is a rare insect, about 4 inches long; is a dull dark green, with small tegmina; the wings are large, rounded at the tip, the apical margin green with the rest semiopaque, dark brown, mottled with whitish bands; the head is conical, coming to a point at the summit and cleft in the centre, covered with fine tubercles.

The female measures about 5 inches, is of a similar colour, large and swollen in proportion; the tegmina are represented by two flaps, and the wings are wanting. The head is of the same conical shape as that of the male, but larger; neck short and stout; the legs produced into dilated spiny leaf-like processes, cut out and arcuate like the leaves of holly; and the lower segments of the abdomen are fringed with spiny leaf-like appendages. Often the large body is mottled with white specks and smutty blotches, giving it a wonderful resemblance to the foliage among which it hides. It has a very wide range from Tasmania to New Guinea.



Fig. 21.—A group of Spiny Green Leaf Insects, *Extatosoma tiaratum* placed on a Japanese Holly bush to show protective mimicry.

("Agricultural Gazette" N.S.W.)

Clemacantha regale is a large, handsome, very long phasma over 9 inches in length, of a combined yellow and green tint; the head is striped with parallel green and pale yellow. The leaf-like tegmina

are striped with white; wings have the apical area green shaded with pink at base; rest semitransparent with a blue tint. It ranges from N.S. Wales to Queensland.

Family 8. Short-horned Grasshoppers.

ACRIDIIDAE.

These are insects with the thighs of the hind legs swollen or enlarged, much longer than the fore legs, and adapted for jumping. The tarsi are composed of three distinct segments. The antennae are short, containing less than 30 joints; the ovipositor of the females is not sabre-shaped, but composed of short plates adapted for boring into the ground; and the organs representing ears are placed on the sides of the first abdominal segment. This group of the Orthoptera may be described as the short-horned locusts or grasshoppers in contradistinction to the tree or grass dwelling green grasshoppers with long thread-like antennae. All the true plague locusts that ravage many of the warmer countries and do an immense amount of damage belong to this division. Many species have a wide range; our locusts are allied to the African and Indian forms. Most of the species are winged, and many are capable of long sustained flight; these are furnished with air sacs in the interior of the thorax and abdomen; these when distended with air assist in lightening the otherwise heavy body. The remarkable shrill notes produced by some of these insects are caused by rubbing the inner edge of the hind thigh against the outer surface of the wing covers which are frequently furnished with ridges or raised veins for this purpose. The so-called ears consist of a membrane covering a small opening

on the abdomen, and are of a somewhat different structure in different groups.

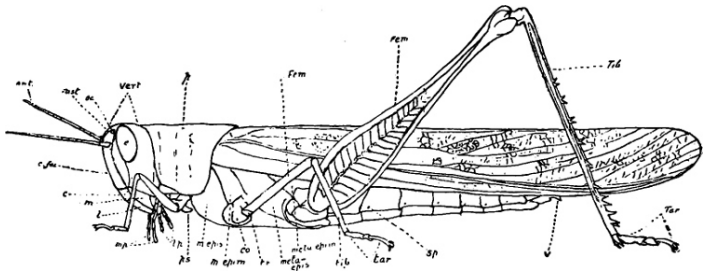


Fig. 22.—Diagram of Grasshopper. *Cyrtacanthacris exacta* (♀) (Walker).

ant, antennae; *e*, eye; *vert*, vertex; *oc*, ocellus; *fast*, fastigium; *c. fac*, costae facialis; *c*, clypeus; *m*, mandible; *l*, labrum; *mp*, maxilliary palpi; *lp*, labial palpi; *ps*, prosternal spine; *p*, pronotum; *m. epis*, meso-episternum; *m. epim*, meso-epimeron; *co*, coxa; *tr*, trochanter; *meta-epis*, meta-episternum; *meta-epim*, meta-epimeron; *fem*, femur; *tib*, tibia; *tar*, tarsus; *sp*, spiracle; *v*, ventral valves of ovipositor.

(Original W. B. Gurney.)

The reproductive organs of the female consist of several anal plates that are used after the manner of an auger to cut a circular pit in the hard soil, the abdominal segments being extended while the operation is going on; the eggs are deposited at the bottom of the hole, enclosed in a similar exudation as that which encloses the eggs of the mantis, and some of the plague locusts deposit two or more egg masses before they die. These grasshoppers have been studied by many entomologists, who have subdivided them into different groups. Brunner von Wattenwyl places them under nine sub-families or tribes chiefly based on the structure of the head. Saussure has described some of our species; Walker, Stoll and Blanchard others.

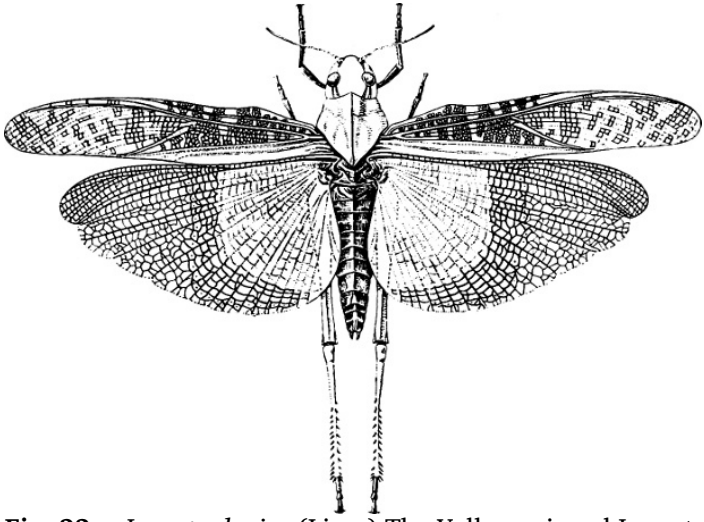


Fig. 23.—*Locusta danica* (Linn.) The Yellow-winged Locust.
("Agricultural Gazette," N.S.W.)

The Yellow-winged Locust, *Locusta danica*, is common in open forest country all over Australia, and usually makes a rustling noise as it flies up; it is too well known to need describing; with its wings closed it is a mottled, dull brown and green insect up to 2 inches in length, with a short broad head and crested thorax; when the wings are opened it shows a large patch of rich yellow banded with black. The male is often fully a third smaller than the female. It has been described under a great number of different names, but is now considered the same insect as found in the South of Europe, Africa and Asia.

The Blue Mountain Locust, *Oedaleus senegalensis*, might easily be mistaken for a smaller dull coloured specimen of the last one, but the yellow tint, when present, is very slight, and the wings have the tips blackened as well as the inner band. It has a wide range over Australia, and is also found in Africa from which place it was described by Krauss.

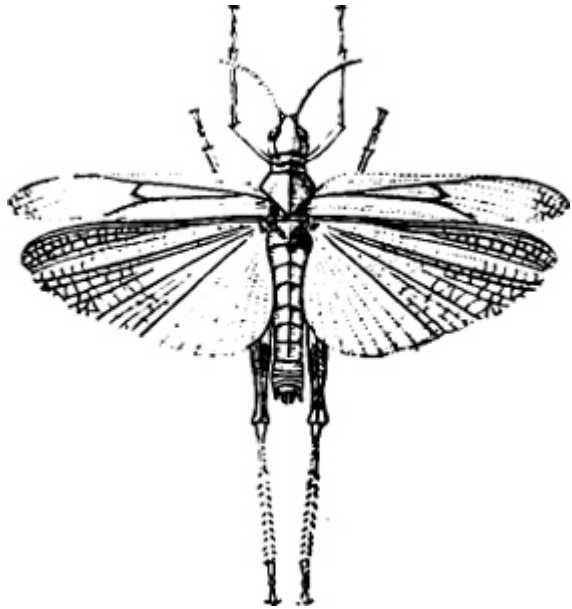


Fig. 24.—*Chortoicetes pusilla* (Walker). The small Plague-locust of the interior of Australia.

("Agricultural Gazette," N.S.W.)

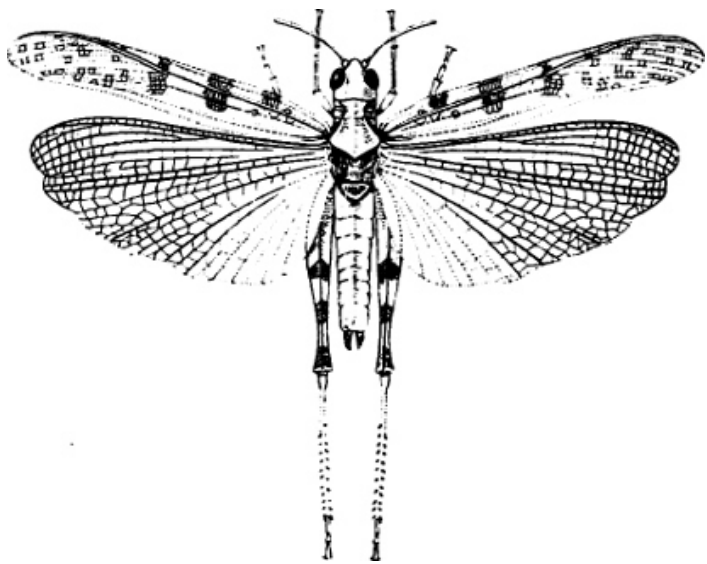


Fig. 25.—*Chortoicetes terminifera* (Walker). The larger Plague-locust.

("Agricultural Gazette," N.S.W.)

The Large Coast Locust, *Acridium maculicollis*, is sometimes found in gardens; it measures 3 inches to the tip of the wings, and is greyish brown with darkly mottled elytra. *Locusta australis* is like the Yellow-winged Locust, with more regularly mottled elytra, and clear transparent wings. The small plain Locust, *Chortoicetes pusilla*, is under 1 inch in length; the male is of a general bright yellow colour, and the female, somewhat larger, of a general greyish brown tint. It is the species that for the last few years has done so much damage to our grass and crops in the Western country. *C. terminifera* is one-third larger, and is of a general light brown mottled colour, with the wings semitransparent, tipped with dull brown; it at times is one of our plague locusts. The Rose-winged Locust, *Hyalopteryx australis*, is one of our small but very noisy locusts, about 8 lines in length; when at rest it is light brown mottled with darker tints, the expanded hind wings are brightly shaded with rose pink and clouded with black. It is found in open grass lands, and when disturbed rises with a very shrill screech. The Red-legged Locust, *Cirphula pyrocnemis*, is a short broad insect about 1 inch long; is of a general dark brown tint, with the expanded wings dark yellowish brown: the head and thorax are roughened; the abdominal segments are dull yellow with several black bands on the sides: it is common on the open flats about Sydney in summer. The common "Great Striped Locust," *Cyrtacanthacris exacta*, measures nearly 3 inches; it ranges all along the Eastern coast and is often seen in secluded gardens; it has a broad dorsal stripe down the centre, varying from yellow to dull green.

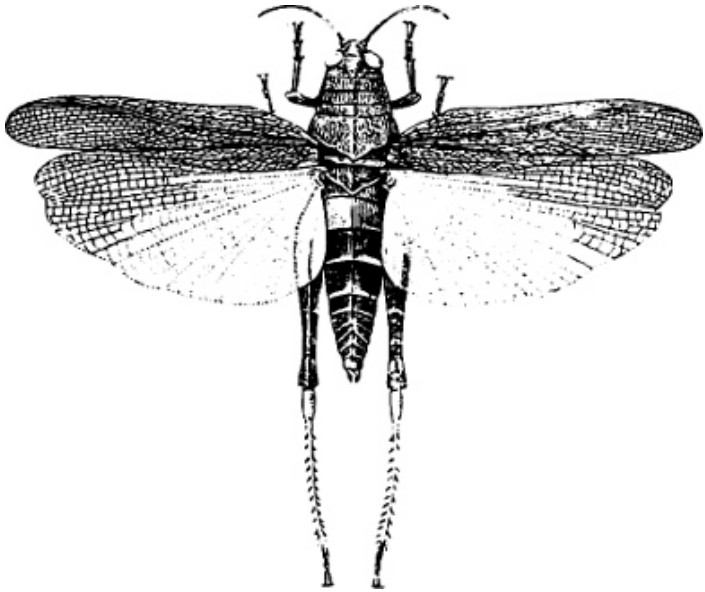
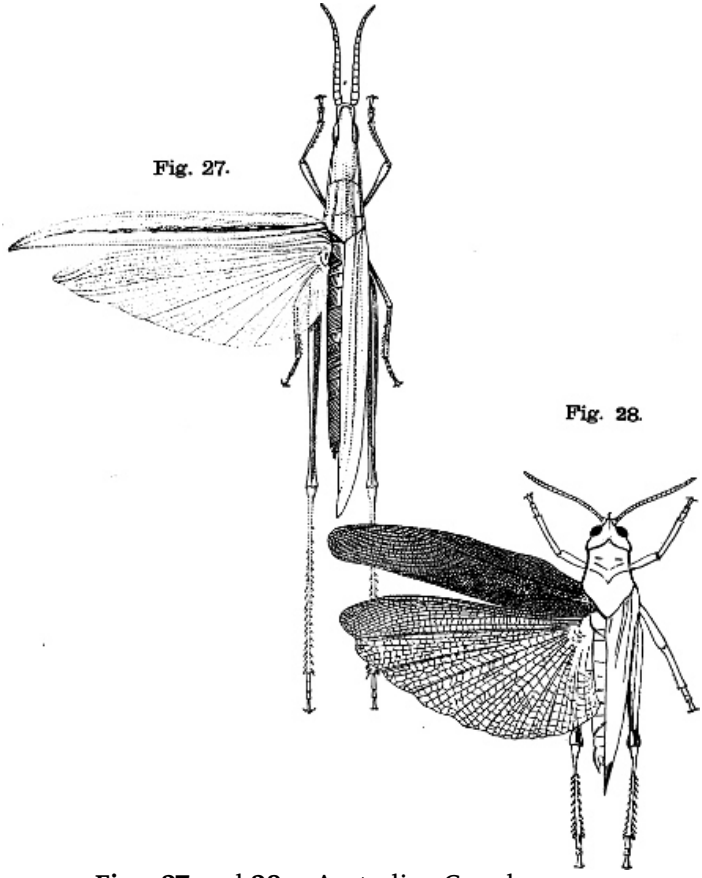


Fig. 26.—*Cirphula pyrocnemis* (Stäl). The Red-legged Locust.

("Agricultural Gazette," N.S.W.)



Figs. 27 and **28**.—Australian Grasshoppers.

27.—*Tryxalis rafflesii* (Blanchard). The Slender Narrow-headed Grasshopper.

28.—*Goniæa australasiae* (Leach). The Ridge-backed Grasshopper.

("Agricultural Gazette," N.S.W.)

The Long-nosed Locust, *Tryxalis rafflesii*, is very common in open grassed flats; the female is nearly 3 inches long, with a slender pointed head, and long pointed body, varying from all shades of grass green to pale salmon colour. It is easily recognised by its

curious finger-like antennae, and grotesque head. The male is a very slender, much smaller insect. The pink-winged Tryxalid, *Atrastemorpha crenaticeps*, is much smaller; it has a pointed head of a uniform pale green tint; the wings are brightly tinted with red, deepest at the shoulders. The Ridge-backed Grasshopper, *Goniaea australasiae*, is a large, stout, reddish brown insect about 2 inches long, which lives on the hills in open forest; the male is a much smaller hopper, but both sexes have the head, thorax, and closed wings forming a sharp ridge down the back. In similar open forest country we find *Coryphistes cyanopterus*, which usually rests on the tree trunks, with its slightly roughened head, thorax, and mottled elytra closely resembling the bark. It measures 2½ inches in length, but though it is very variable in size and outward colouration, the wings when expanded always show a rich blue tint. The Crested Locust, *Ecphantus quadrilobis*, is one of our western forms that rests among the dry grass on the plains; it is dull green to yellow, short and thickset; is 1½ inches long; with the back ridged, and the crested thorax formed into 4 lobes. The spotted locust, *Stropis maculosa*, is another of our western forms; it is broad and thickset; about 2 inches long; of a uniform dark brown tint, with the thorax barred, and the elytra mottled with large patches of light yellow.

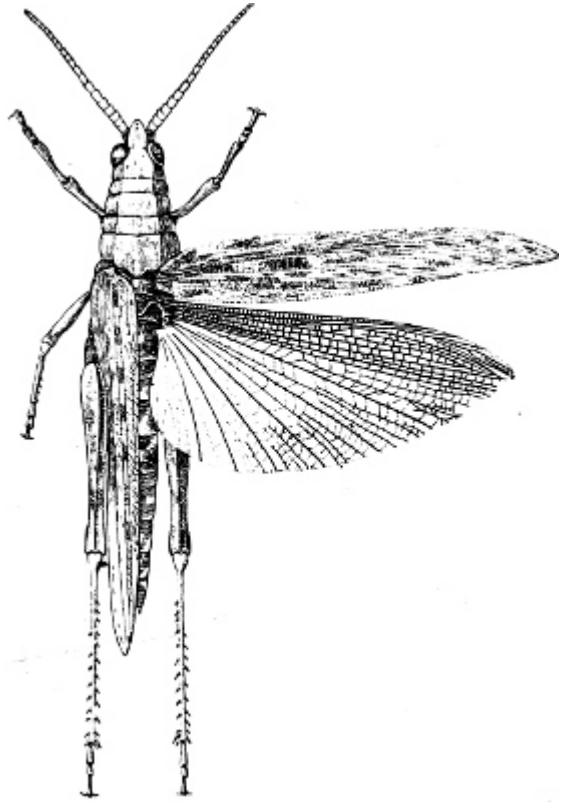


Fig. 29.—*Coryphistes cyanopterus* (Charpentier). The Blue-winged Locust.

("Agricultural Gazette," N.S.W.)

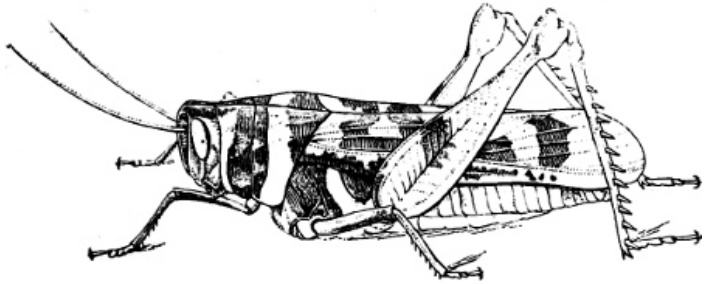


Fig. 30.—*Stropis maculosa* (Stäl). The Spotted Ground-locust of the interior.

("Agricultural Gazette," N.S.W.)

There are also many other curious forms of wingless, short-horned locusts in the interior, belonging to several genera, and probably some fine things that have never reached our museums.

Family 9. Long-horned Grasshoppers.

LOCUSTIDAE.

These grasshoppers are found not only among the grass but on low shrubs, or in tree tops, feeding upon the foliage; while others, many of them wingless, live underground after the manner of crickets. Among those that frequent trees are some that, like the phasmids, have the legs and wing-covers so wonderfully veined and spotted that they are an exact imitation of the leaves of their food plant. They are easily distinguished from the previous group by their long, slender, thread-like antennae composed of a number of fine joints; in most cases the body is softer; and in the female furnished with a sabre-like ovipositor with which she generally deposits her eggs in rows along the side of a leaf or twig, though others place them on the ground. The basal portion of the thigh of the hind leg is generally thickest, and most of the species have four jointed tarsi, with the ear process not upon the base of the abdomen, but on the knees of the fore-legs. Some are said to be carnivorous, and I have twice seen a large green species which comes to the flowers of the stunted angophora devouring honey bees, but probably more for the honey they contain than the blood of the bee.

Brunner von Wattenwyl has written a great deal about these insects and described a number of Australian species. Tepper is one of the few

Australian entomologists who has taken up this group, describing some in the Transactions of the Royal Society of S. Australia: in the Locustidae of the world Sharp groups them into fifteen tribes. Most of these Orthoptera are solitary or found in pairs; some too have a very musical note.

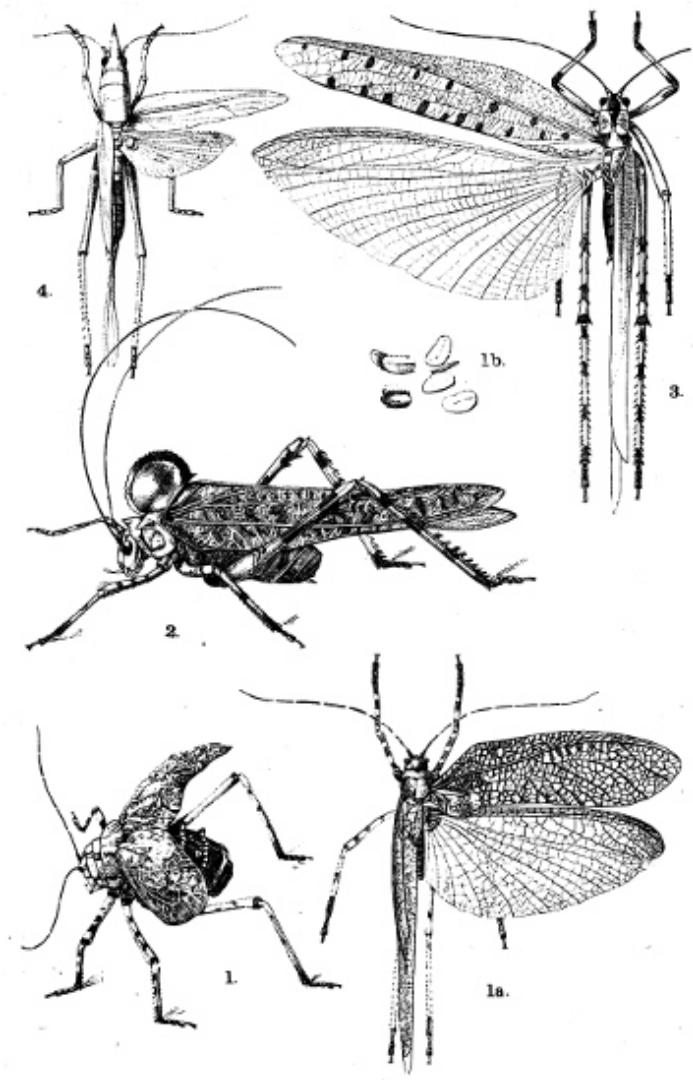
The Mountain Grasshopper, *Acridopeza reticulata*, is such a curious looking creature that it has been figured and noted by many naturalists. Both sexes are of a uniform dull brown colour, but very different in structure; the male measures 2 inches; has long pointed elytra, and well developed wings; the head is small; the antennae slender and thread-like; the eyes stand out on the side of the head, and the thorax is saddle shaped. The female is furnished with a very short, rounded body richly mottled with blue, white, and red, covered with a pair of rounded, short, shell-like elytra, but the wings are wanting. When disturbed she stands on tiptoes, arches her body, raises her elytra exposing all the bright tints of her body, which probably act as a warning to her enemies.

Plate VI.—ORTHOPTERA.

Family LOCUSTIDAE.

1. *Acridopeza reticulata* (Guérin), ♀.
1*a*. *Acridopeza reticulata* (Guérin), ♂.
1*b*. *Acridopeza reticulata* (Guérin), eggs.
2. *Alectoria superba* (Brunner).
3. *Ephippitytha* 32-*guttata* (Serv.).
4. *Pseudorhynchus lessonii* (Serv.).

Plate VI.—ORTHOPTERA.



Another remarkable grasshopper is *Alectoria superba*, found in the dry western country among the grass; it is a long, slender, green insect, measuring 2½ inches; the elytra and legs are richly mottled with bright reddish brown; the thorax is produced

into a large circular crest edged with bright red, a large boss below on either side, and another projecting above the head. The female has a very small lance-like ovipositor. The Speckled Green Grasshopper, *Ephippitytha 32-guttata*, is about the same length as the last, of a somewhat lighter green tint, and has the elytra mottled with a double row of black spots varying from 32 to 44 in number. The head is small, the thorax short and somewhat saddle-shaped. It is found about Sydney on flowering shrubs; and there is a darker variety which has a wide range over the interior, to which Tepper has given the name of *E. quadrigesima-guttatus*. The Small Green Grasshopper, *Caedicia valida*, is one of our dainty, slender, green species found in the gardens, where it sometimes damages the young fruit by gnawing patches off the skin, or nibbles holes in the foliage; it produces a sharp musical note uttered three times in succession.

The Large Green Leaf Grasshopper, *Locusta vigentissima*, figured by McCoy, is also found on low shrubs in the summer; it measures nearly 3 inches, and is of a uniform dull green colour, with the head, legs and antennae more or less yellow: the head is broad; the thorax stout; the legs long and spiny; the elytra long, tapering to the tips; the wings large, semitransparent; the abdomen short, in the female furnished with a long sabre-like ovipositor. The Lance-headed Grasshopper, *Pseudorhynchus lessonii*, has a wide range along the eastern coast among the long grass; it is green, with the tips of the elytra marked with yellow; the wings are small, and the front of the head produced into a lance-like point. Among the foliage of the eucalypts in Southern Australia there is a very handsome large grasshopper with the head small, the thorax very square, and the

elytra very leaf-like in form; it has a curious bloom upon it like that upon many of the gum leaves, and is a very fine case of mimicry.

The Genus *Anostosoma* comprises a number of reddish brown wingless locusts more like crickets in many ways, for they live chiefly in holes in the ground, have long thread-like antennae, and stout spiny legs. *Anostosoma australasiae* is a very formidable looking insect with immense head and jaws, originally described from Moreton Bay; it is sometimes found about Sydney, measuring 3 inches in length; it has antennae over 4 inches long. The smaller species, *Anostosoma erinaceus*, is of a similar colour and form, but not more than 1½ inches in length; it is not uncommon in gardens.

Paragryllacris combusta lives in hiding during the day under a curled leaf spathe of a palm frond, or in a cavity in a tree trunk; if in the last it often forms a white tough substance of a net-like structure over the front, and if disturbed will snap at a grass blade or straw and shake the net, making a distinct sharp sound. It is of a uniform, yellowish brown tint, measuring about 2 inches to the tip of the large curled wings closely folded over the body.

The curious Cave Locust, *Pachyrhamma sp.*, with its small oval body, and long slender antennae and hind legs, is always found in caves. It is a dull brown wingless creature, whose slender thread-like antennae are many times longer than the body.

Family 10. Crickets.

GRYLLIDAE.

These are the black field and house crickets which are so well known by their shrill note; this is caused

by the insect rubbing the stout wing covers or elytra together; those of the males have a distinct circular wavy neuration forming distinct ridges for this purpose.

Crickets are easily distinguished by their slender thread-like antennae, short rounded heads, black wings folded down the back, and spiny hind legs adapted both for creeping through the grass or jumping out of the road of their enemies. The abdomen is furnished with a pair of slender spined appendages on the sides, and the female with a stiletto-like ovipositor composed of two grooved pieces by which the eggs are deposited in the ground.

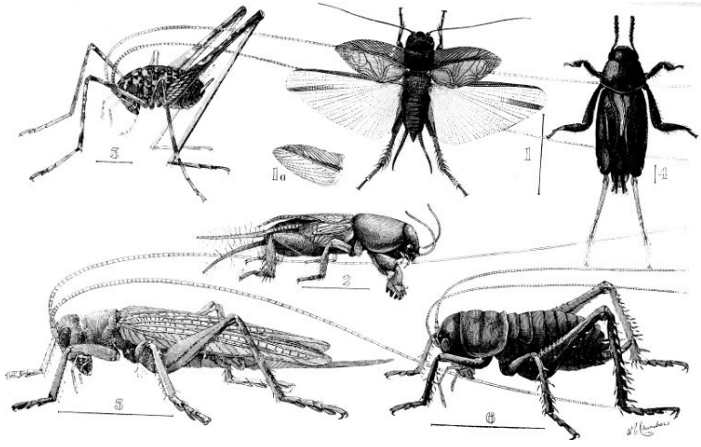
We have a number of field crickets in this country; Walker in his catalogue of the family gives 12 species, of which *Gryllus servillei* is our common field cricket, sometimes swarming out in sufficient numbers to do a great deal of damage to field crops and vegetable gardens. It is of a uniform black tint, with a short, shining, round head; it measures about 1 inch in length, and has a wide range over Australia. The Mole Cricket, *Gryllotalpa coarctata*, is found all over the interior, forming underground tunnels in the sand along the edges of watercourses; it was collected in the Horn Expedition in Central Australia, and is also found about Sydney. It is of the usual dull brown tint, with hooded thorax and spade-shaped fore-legs. Another curious little black cricket is common about the edges of watercourses, and when disturbed often jumps in and swims about on the surface; it belongs to the Genus *Nemobius*, and is only ⅛ of an inch in length.

Plate VII.—ORTHOPTERA.

Family GRYLLIDAE.

1. *Gryllus servillei* (Sauss.).
1*a*. *Gryllus servillei* (Sauss.). (Elytron ♀.)
2. *Gryllotalpa coarctata* (Walk.).
3. *Pachyrhamma sp.*
4. *Nemobius sp.*
5. *Paragryllacris combusta* (Germ.).
6. *Anostostoma erinaceus* (Gray).]

Plate VII.—ORTHOPTERA.



Order III.—NEUROPTERA.

Lace-winged Insects.

After excising the families usually treated as *Pseudo-Neuroptera* from this order, these insects can be defined as the "lace wings," furnished with two pairs of delicate gauzy wings reticulated with a network of fine transverse and parallel veins forming a great number of more or less irregular cells. The head is furnished, with a few exceptions, with stout jaws adapted to their carnivorous habits; large eyes; and antennae of many different forms, sometimes short, thickened, or clubbed, but in others long, slender, and filiform. The legs, suited to their clinging habits when at rest, are generally slender, and the body more or less elongate.

Most of them undergo a complete metamorphosis; the active larvae are furnished with large sucking or biting jaws; in the terrestrial forms they live among foliage or on the ground, and feed upon aphids, mites, ants, &c., and when full grown pupate in regular cocoons. While some of the aquatic forms go through a pupal stage in cells in the mud or under stones, others, like the dragon flies, have no true pupal form, simply going through a series of moults, and changing from an aquatic life to an aerial one by crawling out of the water and emerging from the pupal case, leaving it attached to the water plant.

Sharp places the Neuroptera in eleven families, further divided up into a number of sub-families under five tribes. In excising the *Pseudo-Neuroptera* seven families remain, though the *Hemerobiidae*

includes a number of sub-families that by some writers are ranked as families.

The Neuroptera are represented in Australia by many very handsome and curious insects, of which the dragon flies are probably the most typical and well known.

Family 1. Stone-flies.

PERLIDAE.

The Stone-flies are not an extensive group, and though the European and American forms have been studied, very little is known about our species. In England several species are much prized by fishermen as tempting bait for fly-fishing.

The perfect insects have oblong, flattened bodies of uniform width to the tip of the abdomen, terminating in a pair of long slender tails or setae. The head is long, provided with large prominent eyes, three ocelli, slender thread-like antennae, and weak mouth parts; the fore-wings are slightly longer than the hind ones, which are very broad and folded down the middle when closed. They are generally found about watercourses in early summer, and lay an immense number of eggs (5,000 to 6,000 some authorities state are laid by each female); these eggs are dropped on the surface of the water. The larvae are very like the perfect insects except that they have no wings; they are active carnivorous creatures living in the bottom of swift running streams, crawling under the stones, and feeding chiefly on the larvae of mayflies.

Only four or five species have been described from Australia; I had a number of specimens sent me from

Hobart, Tasmania, the larvae of which were said to be damaging the woodwork down a well. It has been identified as *Eusthenia spectabilis*. This insect was named by Westwood, and is figured in Griffith's "Animal Kingdom," (page 348, plate 72). It measures about 2 inches across the outspread wings; its general colour is dark brown, with the fore wings lighter, mottled with brown at the base and the lower half dull red; the hind pair brighter red with the tips blackish. The head is flattened, with long slender many jointed antennae tapering to the tips. The thorax is slender, flattened on the upper surface; the legs stout; and the tip of the abdomen bears two slender jointed tails (setae). This insect is also found in Australia. A second species, *Eusthenia thalia*, is described from Tasmania by Newman; I have one from Gippsland Victoria probably a new species. Several species have been described by Walker (Brit. Mus. Catalogue, Neuroptera 1852) in the typical Genus *Perla* from Tasmania.

Members of the Genus *Cupnia* are often found upon the snow in Northern Europe.

Plate VIII.—NEUROPTERA.

Family ODONATA.

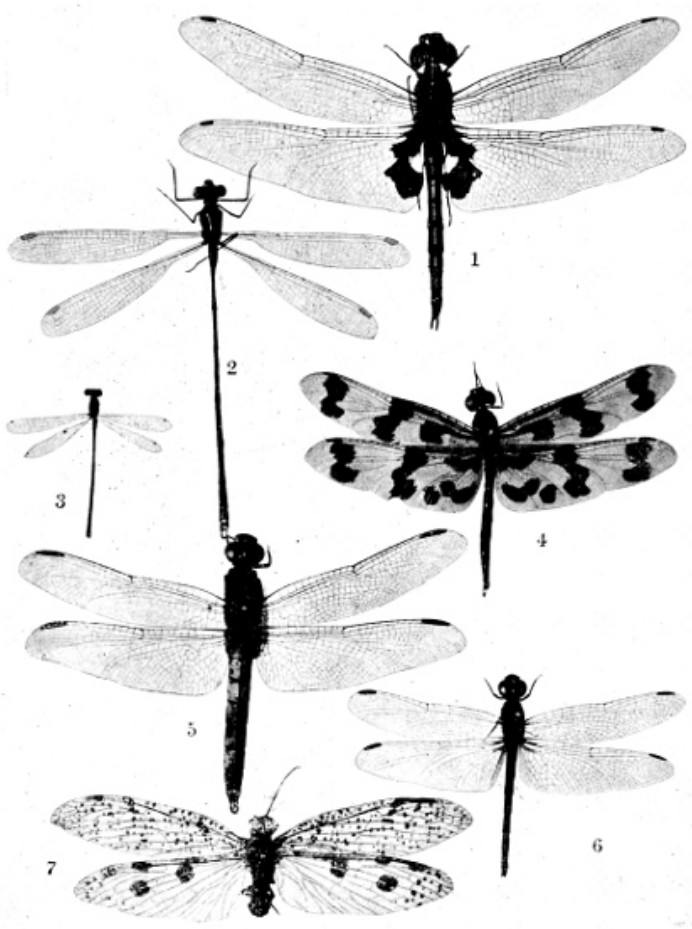
1. *Tramea loewii* (Brauer).
2. *Synlestes weyersii* (Selys).
3. *Ischnura delicata* (Selys).
4. *Rhyothemis graphiptera* (Ramb.).
5. *Orthetrum nigrifrons* (Kirby).
6. *Diplacodes (Diplax) bipunctata* (Brauer).

Family SIALIDAE.

7. *Chaulcodes guttatus* (Walk.).

(Original photo. Burton.)

Plate VIII.—NEUROPTERA.



Family 2. Dragon Flies.

ODONATA.

Everyone has noticed dragon flies that sail and dart about over swamps and rivers, the embodiment of grace and beauty in flying creatures. In England and Australia they are popularly known as “horse-

stingers," a very misleading name, for they cannot sting, and if they frequent the vicinity of horses it is for the sake of the flies or gnats they can capture. In America the country folk know them under the still more peculiar name of "Devil's Darning Needles," while the French children, who recognise their beauty and dainty form, call them "demoiselles." Westwood places the dragon flies in the family *Libellulidae*; but both Kirby and Sharp call them *Odonata*; the former again divides them into the *Libellulidae* and the *Agrionidae*, and the latter subdivides them into groups with the same characters, namely the *Anisopteridae* and *Zygopteridae*.

The members of the first group are those with the hind pair of wings slightly larger than the front pair, and the second with wings of equal size or the hind pair smaller. Specialists have further subdivided them into seven smaller sub-families containing about 300 genera.

Dragon flies are widely distributed over the world, but are most plentiful in the warmer zones; about 2,000 have been described from all parts of the world, of which 107 species are recorded from Australia; but as Billinghurst was able to collect 41 species in one circumscribed district in Victoria (Victorian Naturalist No. 1, 1900), systematic collecting would certainly add many more to our list.

In the early stages of their life dragon flies are aquatic; the female deposits her eggs on the foliage of water plants, sometimes dipping into the water to be sure they are submerged. The slender larvae with wing pads in place of the future wings have somewhat the form of the adults, and are carnivorous, feeding upon all kinds of smaller water

insects.

The dragon flies form a very distinct division of the Neuroptera; every organ is beautifully adapted for their aerial life, their immense eyes giving them an outlook on all sides, while the slender cylindrical body does not impede their flight; and the great oar-shaped wings strengthened with many stout nervures enable them to twist and turn in the air with wonderful ease and rapidity.

The LIBELLULIDAE are thick-bodied dragon flies of medium size, and comprise a number of fine species. The larvae are short broad creatures with wide heads; they live in the mud on the bottom of ponds. *Rhyothemus graphiptera* belongs to a genus containing over 30 species ranging from Africa to China, and the Eastern Archipelago to the New Hebrides. It measures 2½ inches across the wings, which are yellowish brown, beautifully mottled with darker tints; the front pair are blotched at the base, a slender stripe in front running into the first of 2 irregular transverse bands about the centre and tip; in the hind pair the two apical bands have basal markings consisting of three small irregular blotches: it is found in the northern parts of N.S. Wales.

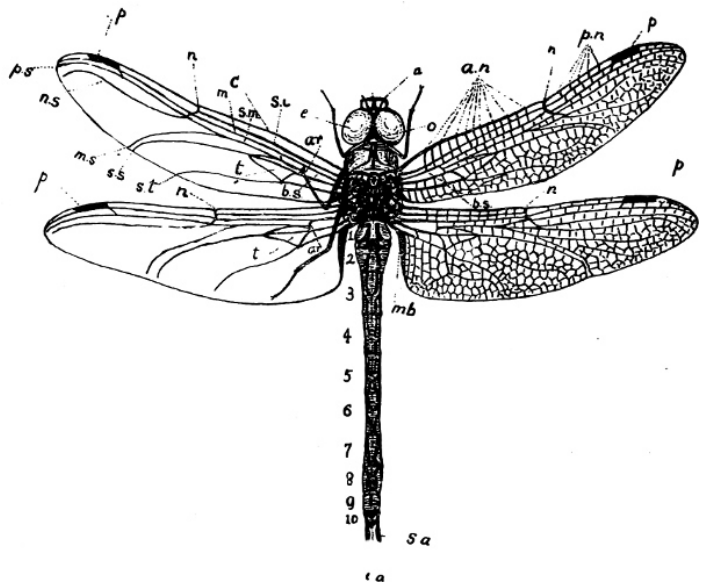


Fig. 31.—Diagram of a Dragon Fly.

a, antenna; *ar*, arculus; *b.s*, basilar space; *c*, costal nervure; *s.c*, sub-costal nervure; *e*, eye; *f*, front; *m*, median nervure (or radius); *s.m*, sub-median; *m.s*, median sector; *m*, membranule; *n*, nodus; *n.s*, nodal sector; *o*, occiput; *p*, pterostigma; *p.s*, principal sector; *s.s*, short sector; *s.t*, sector of triangle; *t*, triangle; *i.a*, inferior appendage; *s.a*, superior; *a.n*, antenodals. The numerals refer to the segments of the abdomen.

(Original R. J. Tillyard.)

The Genus *Diplax* contains a number of more delicate, short-winged insects, of which *Diplax rubra*, a typical form, is common both along the rivers and in the open scrub, often quite a distance from water. It is a moderate-sized dragon fly, tinted with pale yellow at the base of the hind wings, and has a distinctive bright red body. *Diplacodes (Diplax) bipunctata* has much the same habits, and a wider range over the country; it is common about Sydney, and is slightly smaller than the previous species, and

of a general yellow tint. *Orthetrum nigrifrons* is a more thickset dragon fly about 2 inches across the wings; the head and front of thorax are black, with the hind portion of the latter and body deep blue; it is a very distinctive species along the watercourses and in the open bush. *Orthetrum villosovittatum* is a slightly larger form found in Southern Queensland, with slightly clouded wings, blotched close to the body with yellowish brown: the head and thorax are brown, and the body is red.

The AESCHNIDAE contain the giants among the dragon flies: *Petalura gigantea* is our largest species, and varies much in different localities; most of ours on the Blue Mountains measure about 5 inches across the wings, but Tillyard captured them at Cairns N.Q. 6½ inches. It is a very robust insect of a dull brown tint, with a single, broad, pale stripe on the sides of the large square thorax, and when viewed from the side seems to have the abdomen attached to the under-side of the thorax. The pterastigma of the wing is long.

Hemianax papuensis is typical of one of our large species, often flying in numbers about Sydney hawking for gnats high up in the air before a storm. It measures 4 inches across the wings, which have a slight smoky tint.

Aeschna brevistyla is about the same size as the previous species, but the wings are clear, and the abdominal segments are marked with two angulated white blotches, one on either side of the dorsal stripe. The larvae are curious, elongate, oval creatures, with large heads, living in the mud at the

bottom of stagnant ponds and are common about Sydney.

The AGRIONIDAE are the delicate slender-bodied dragon flies with oar-shaped wings, and narrow heads with the eyes standing out on either side. *Lestes analis* is our common type of the large genus; it is of the usual slender form, with the body nearly as long as the expanse of wings, and is of a general reddish brown colour. *Synlestes weyersii* is a very beautiful slender creature nearly 3 inches across the wings, and over 2 inches from the front of the head to the tip of the body. It has transparent wings with an oval whitish pterastigma toward the tips, and the whole head and body is deep rich metallic green. It flies in a very graceful manner up and down the edges of the watercourses, resting every now and then on a reed or overhanging twig, and is very easily captured. *Ischnura heterosticta* is our tiny, little, banded, blue and brown dragon fly, with the female of a more sombre brown tint: Tillyard has recorded two forms of females in this species, one taking on the garb of the bright-coloured male.

Ischnura delicata, very similar in size and form, has the basal two-thirds of the abdomen red and the apical portion blue. The larvae of both these species are common in the ponds about Sydney in the early summer. Tillyard (Pro. Linn. Soc. N.S.W. 1905) has recently added three new species of the Genus *Austrogomphus* collected in the Cairns district N. Queensland.

Family 3. May-flies.

EPHEMERIDAE.

These delicate gauze-winged insects were named Ephemera from the old idea that their life as perfect insects lasted only for a day; they were born in the morning and died at the fall of day. Though their span of life is short, as they possess only rudimentary mouths incapable of absorbing food, and only live a short time after the eggs are laid, it is generally a matter of a few days.

They have large prominent eyes; three ocelli; and minute antennae consisting of two thickened joints surmounted with a needle-like hair or bristle: the prothorax is small, the middle portion large; and the somewhat small body, generally composed of ten segments, is provided with a slender articulated hair-like tail on either side. The wings are broadest at the base, rounded at the extremities, with the hind pair small, in some genera the hind pair absent. The larvae live in burrows in the mud at the bottom of ponds or watercourses, and when full grown climb up the stalks of grass or plants and cast their pupal coverings.

Most of our species are only found in odd pairs, and do not assemble in swarms as they sometimes do in England; but in 1885, in the Royal Geographical Society's Exploring Expedition in New Guinea, when ascending the Fly River we met with great clouds of the large white Mayfly, *Palingenia papuana*, flying along over the surface of the water just as described by D'Albertis in his work on New Guinea; specimens I collected are now in the Australian Museum.

The commonest species about Sydney is *Atalophlebia australasica*, a small chocolate brown insect marked with black; the wings are vitreous

with black markings on the veins, the front margin tinged with umber brown on the cross veins. It was described by Pictet in his "Natural History Neuroptera" (1843–45): Walker has described another from Tasmania: Eaton three more from different parts of the mainland: and Burmeister one in his "Handbook of Entomology" as far back as 1839. The members of this genus have a wide range from South America through Africa, Japan, and Ceylon. A single species of the Genus *Coloburiscus* has been described from Melbourne.

The chief work on these insects is Eaton's "Revisional Monograph of Recent Ephemeridae or May-flies," Parts I.-V. (Transactions of the Linnean Society 1883–87;) in this work he subdivides them into three groups containing 55 genera and 270 species.

Family 4. Alder Flies and Snake Flies.

SIALIDAE:

This small division contains two groups that Westwood treated as two distinct families, the *Sialidae* and the *Raphidae*; but Sharp points out, that in general structure and habits they are very closely related to each other,—the latter chiefly differing from the former in the remarkable elongation of the prothorax, and he thus only ranks them as sub-families.

The Alder Flies have two pairs of broad wings, wide at the base, the hind pair slightly smaller and capable of being folded behind; they are all traversed by numerous veins forming irregular cells. They are slow in their movements, and are to be found clinging to bushes in the vicinity of water. Our

commonest species is the *Chauliodes guttatus*, described by Walker; it is a large, dull brown insect with an elongated thorax and body; the head is furnished with long, slender, annulated antennae, large prominent eyes on the sides, and three ocelli on the summit. The wings are semiopaque, the fore pair finely spotted with black, thickest on the front margin; the broader hind pair are only lightly spotted at the extreme tip, with from 4 to 5 larger rounded spots about the centre. It measures over 3 inches across the outspread wings, and 1¼ inches from the head to the tip of the abdomen; it has a wide range from Victoria to Queensland.

The larvae are remarkable for having fringed filaments on the sides of the abdomen; they crawl about in the mud or among the weeds in water-holes, and are carnivorous, feeding upon other aquatic insects; when ready to transform, the pupae come out of the water and crawl under stones, or sometimes under the loose bark on tree trunks.

The Snake Flies are curious looking creatures with elongated necks, and the female is provided with a very curious, long, curved ovipositor. They are found under bark on tree trunks, both in the perfect and larval state; they are unknown in Australia, but Howard states that an attempt was made some years ago to send living *Raphidians* from California to destroy codlin moth grubs, but that nothing has been heard of them since.

Family 5. Scorpion Flies.

PANORPIDAE.

These insects have the head turned down in front with the mouth parts forming an elongate beak; large

projecting eyes; and slender antennae. The prothorax forms a slender neck to the larger mesothorax; the wings are narrow and somewhat oar-shaped, traversed with a network of veins; the legs are long and slender, except the hind pair, which are thickened on the thighs and stoutly spined; the tarsi are large and coated with a sticky membrane, which assists it in catching flies.

At first sight many of them might be taken for crane-flies of somewhat clumsy build; in the European *Panorpa* the males are furnished with a peculiar anal appendage from which they take the popular name of Scorpion Flies. Members of the Genus *Boreus* are wingless and resemble tiny grasshoppers; in America they are often found on snow. The family is represented in Australia by *Bittacus australis*, which has a wide range from Tasmania to Queensland, and is very abundant in the early summer, hanging about the leptospermum and ti-tree bushes. It rests among the foliage, with the large hind legs hanging loosely down below but ready to strike out the moment an incautious fly comes within range. The long flexible tarsi fold round the captive with the stout spines transfixing it, while the Bitticus draws its leg round under the head so that it can press its sharp beak into the victim and suck up its blood. Its general colour is reddish brown marked with black; the wings are clouded, narrow, rounded at the tips, and reticulated with fine nervures. Nothing is known about the earlier stages in the life-history of this insect, but specimens in captivity laid a number of flattened bun-shaped eggs which did not hatch out.

Plate IX.—NEUROPTERA.

Family HEMEROBIIDAE.

1. *Nymphes myrmeleonides* (Leach).
7. *Porismus strigatus* (Burm.).

Family MYRMELEONIDAE.

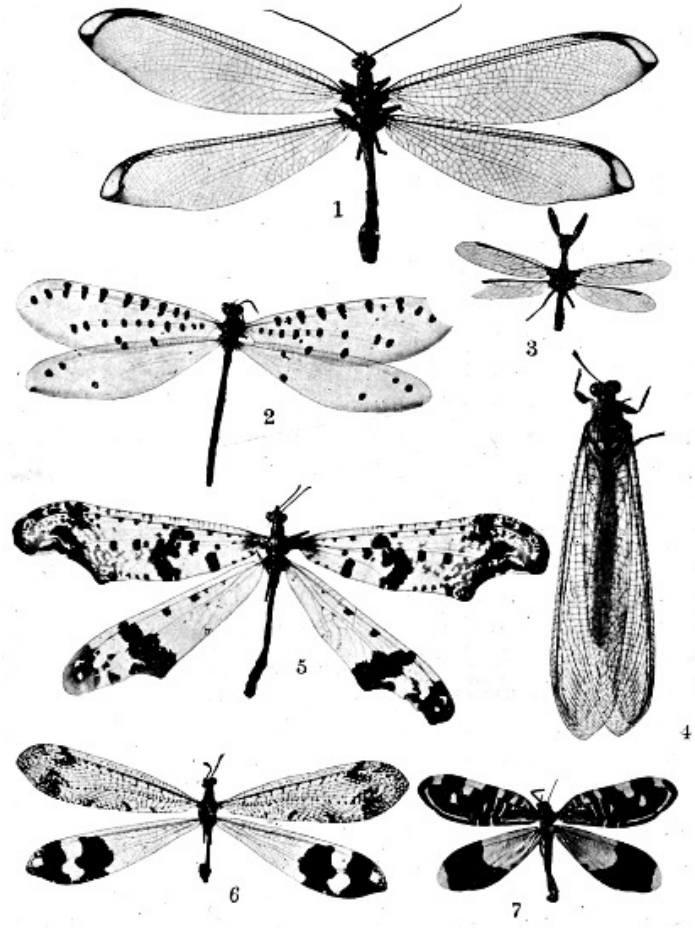
2. *Glenurus erythrocephalus* (Leach).
4. *Glenurus falsus* (Walker).
5. *Glenurus circuiter* (Walker).
6. *Glenurus pulchellus* (Kirby).

Family MANTISPIDAE.

3. *Mantispa strigodes* (Westwood).

(Original photo. Burton.)

Plate IX.—NEUROPTERA.



Family 6. Ant-lions and Lace-wings.

HEMEROBIIDAE.

This interesting division of the Neuroptera comprises a number of smaller groups, ranked by some entomologists as families, but now generally regarded as sub-families. Westwood divided them into two families, the first containing the true ant-

lions; both Kirby and Sharp treat them as one, but the latter places them in seven well defined sub-families.

They come naturally together from the fact that all the larvae are provided with large, curved, hollow, sucking jaws, and are carnivorous in their habits, while the perfect insects have simple biting jaws. They all have, in the perfect state, long slender bodies, provided with two pairs of finely reticulated wings, folded over each other when at rest; the head is short, with large projecting eyes; ocelli generally wanting; and the antennae are composed of many short annular joints.

The MYRMELEONIDES are the true ant-lions, whose larvae in many species construct funnel shaped pits in soft sandy soil an inch or two in depth, at the bottom of which, buried in the loose soil, with only the tip of their large jaws visible, they lie in wait for any ant or other small insect that may happen to slip over the edge and tumble to the bottom, where it is immediately seized in the ant-lion's powerful jaws and devoured; when however, as often happens, the trapped visitor manages to regain its footing and nearly succeeds in clambering out, the ant-lion presses its head downward like a spade and throws a quantity of sand right at its prey, generally bringing its quarry within reach again. It generally excavates its pit under the shelter of a log or rock so that it is protected from the rain, and when full grown pupates at the bottom of its shaft. The larva is a short thickset little brown creature covered with tufts of short stout bristles; the head is broad and rounded behind, attached to the heart-shaped body by a neck-like thorax. They are easily captured by slipping a knife blade under them and

throwing them out when they are intent on catching a struggling ant. In captivity they are easily kept in a saucer full of sand, and have the power of going for weeks without food; when placed on a smooth surface they always arch their heads and crawl backwards.

Most of our described species belong to the Genus *Glenurus*, all slender elongated insects resting with their long narrow wings folded over their backs against a twig or grass stem, and when disturbed flitting away in a very awkward manner; they are very easily captured.

Glenurus pulchellus is the commonest species about the coast, with a wing expanse of about 2½ inches; its general colour is chocolate brown, mottled and marbled with lighter tints; the fore wings are speckled with black; the apical portion of the hind pair deeply blotched with chestnut brown, encircling a white patch, with a second smaller one nearer the extremity. *Glenurus falsus* is a shade smaller; the fore wings darker; and a single dark patch on the hind wings. *Glenurus striola* is a slightly larger species with semitransparent wings, marked on the posterior margin of the hind pair with a narrow light brown stripe. I found this species very plentiful in some swampy flats near Brisbane, Q., in October, where they were resting on the rushes. *Glenurus fundatus* is our largest species, often measuring up to 4 inches across the wings, and is of a general uniform mottled grey tint spotted with brown; it is common along the coast in North Queensland. *Glenurus circuiter* is easily recognised from all the others by the shape of the fore wings, which are broadened to the tips, cut out behind at the extremities, and both pairs are irregularly blotched and spotted dark brown, giving

it a very handsome appearance. *Glenurus erythrocephalus* has semitransparent wings, elongate and rounded at the tips, the fore pair thickly covered with spots and blotches of dark brown, the hind pair usually only marked with three spots, but the spotting is very irregular and variable. It comes from the more northern parts of N.S. Wales and Queensland.

The ASCALAPHIDES are all moderate-sized, clear-winged insects with a stigma toward the tip, and curious long slender antennae clubbed at the tips; they might be likened to dragon-flies with butterflies' heads. *Suphalasca sabulosa* measures about 2½ inches across the wings; the head and thorax are fringed with fine hairs, the stigma on the wings black. It is generally found on bush land clinging to a grass stalk or twig, with the wings folded down, and the slender body sticking out at right angles. I have found the larvae living under the dry bark attached to dead tree trunks, their short hairy bodies covered with tufts of stout bristles, their large jaws pointing upward; and from their situation they probably capture the large sugar ants. In captivity they would remain for days resting against the side of the box without any movement, and lived for several months without taking any food, and finally formed a round cocoon.

The female places her eggs in a double row along the edge of a blade of grass, and the young ones, when they hatch out, sit in the bottom of the eggshell, all head and jaws, waiting for something to turn up, and must often undergo long fasts.

Stibopteryx costalis is a stout bodied insect with a wing expanse of 3 inches, a large, dragon-fly-like head, and narrow rounded wings banded with parallel bands of chocolate brown. It ranges from Sydney right round Australia.

The NEMOPTERIDES are a very curious group of lace-wings, which have the hind pair of wings produced into slender or clubbed appendages of most peculiar form. Kirby (Annals and Magazine of Natural History 1900) has listed all the known species from all parts of the world, 33 species in 7 genera.

Chasmoptera hutti, described by Westwood from Western Australia, has a wing expanse of 1½ inches, and the hind pair are produced into a spoon-shaped tail. *Croce attenuata* is a smaller, dull coloured, brown insect, with the fore wings like those of a mayfly, and the hind pair forming a pair of antennae-like processes longer than the body. It was taken by my correspondent, Mrs. Black, round a lamp, and comes from North Queensland. It is described by me in the Proceedings of the Linnean Society 1904.

The MANTISPIDES are lace-wings that in general form, imitate the orthopterous mantis; with the same elongate neck, spined fore legs and broad head, but the structure of the wings soon shows its affinity to the lace-wings. We have some very fine species in Australia, which are usually found hiding among the foliage of trees, and are generally captured when beating the bush for beetles. Nothing is known about the earlier stages of any of our species, but Brauer studied the larval and pupal forms of the European *Mantispa*, and found that the eggs were stalked; the larvae are long slender creatures with large jaws. Westwood has figured and described a number of our

species (Trans. Ent. Soc. 1852).

Mantispa biseriata, one of our largest species, measures up to 2½ inches across the outspread wings. Its general colour is dull reddish brown; the wings are mottled with very fine black dots, and the stigma on the fore wing forms a dull red blotch. It has a wide range from Victoria to North Queensland. *Mantispa strigipes* is a smaller darker species, with no distinct stigma but a stripe of dull red along the front margin of both pairs of wings, thickest toward the extremities. It ranges over Victoria and N.S. Wales.

The HEMEROBIIDES are well represented in Australia by some very beautiful insects, which when at rest are recognised by the way in which their wings are folded against each other, forming a ridge above the back; the antennae, generally long, consist of a number of short annular joints. The eggs are laid upon the food plant; the larvae feed upon small insects.

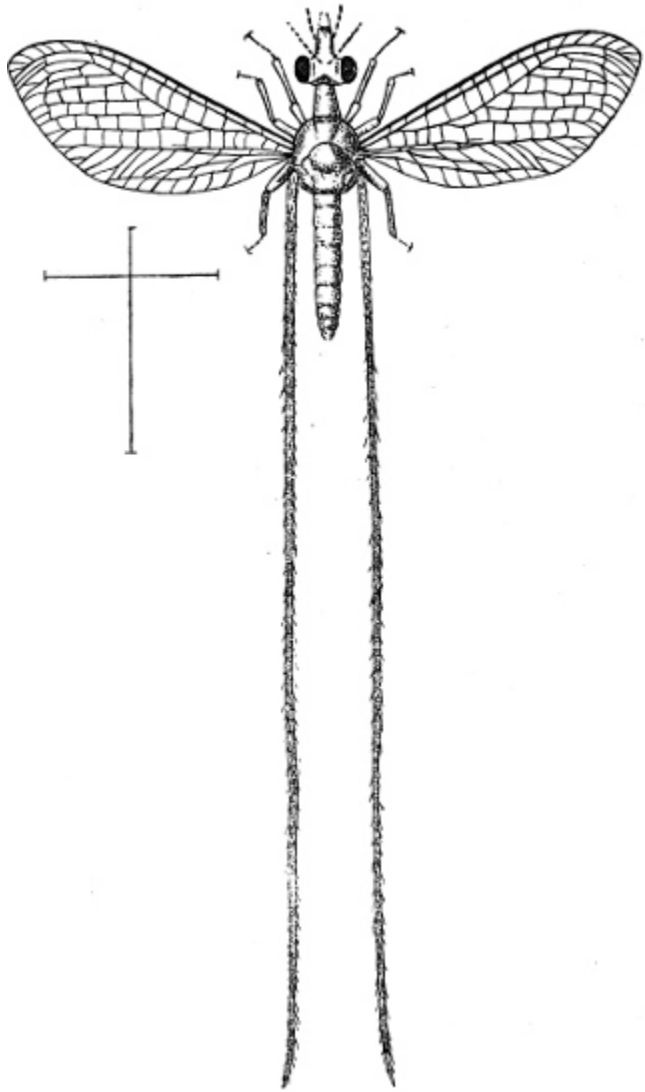


Fig. 32.—*Croce attenuata* (Froggatt). The Thread-winged Nemopteron.

(Pro. Linn. Soc. N.S.W.)

Nymphes myrmeleonides, described and figured by

Leach in 1814, has a somewhat robust body, long slender antennae and narrow head; the wings, which have an expanse of 3 inches, are large, of equal size, and semitransparent, except the tips, which are ornamented with an elongate brownish blotch enclosing an irregular white spot in the centre. It is a very ungainly insect when flying, with its large oar-shaped shining wings; it has a very wide range along the eastern coast. The larvae live under the shelter of logs hiding among the dust and dirt with only their jaws projecting; specimens obtained near Armidale, N.S.W., lived for some time in captivity, forming the usual spherical parchment-like pupal case, from which the insect emerged about a month later.

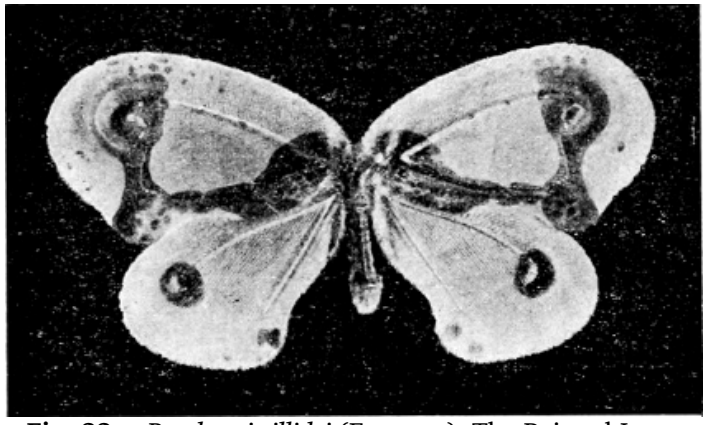


Fig. 33.—*Psychopsis illidgi* (Froggatt). The Painted Lace-wing.

(Pro. Linn. Soc. N.S.W.)



Fig. 34.—*Psychopsis coelevagus* (Walker). The small Metallic Lace-wing.

(Pro. Linn. Soc. N.S.W.)

The Genus *Psychopsis* was formed by Newman in 1840 (Newman's Entomologist p. 415) to contain the curious creamy white moth-like insect *Psychopsis mimica*. It has broad rounded wings covered with fine hairy veins shading from buff to grey or creamy white, spotted with red on the base of the fore wings and a dull brown spot on the centre of the hind pair; the head is turned down in front when resting. It measures about 1½ inches across the outspread wings and is found from South Australia to Queensland. I figured and described all our known species (Notes on the Genus Psychopsis Newman, with descriptions of new species) in the Proceedings of the Linnean Society N.S.W. 1903, where I added two new species. *Psychopsis coelivagus* is our smallest species, measuring 1 inch across the outspread wings, which are creamy white thickly mottled with a central band of metallic coppery brown; it comes from S. Queensland.

Psychopsis illidgi is one of the most remarkable

looking of all our Neuroptera, with its large rounded buff fore wings with confluent ochreous yellow markings crossing them, and the usual dull spot in the centre of the smaller hind wings. It measures about 2¾ inches across the wings, and is a rare insect. Illidge has taken several specimens that came flying in to the light at night on the top of Mount Tambourina in South Queensland.

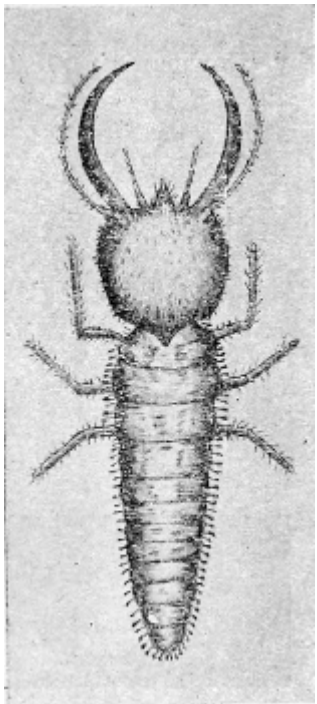


Fig. 35.—Larva of *Psychopsis mimica* (Newman). Bred from the egg (much enlarged).

(Original W.W.F.)

Psychopsis insolens and *P. meyricki* are both dull coloured smaller insects, the first found about Sydney and Brisbane, the latter on the top of Mount Kosciusko, resting on the rocks.

The eggs are not stalked but are attached to the food plant; the young elongated larva, furnished with stout projecting jaws, crawls upon the foliage and feeds upon aphids. This Genus was considered peculiar to Australia, until in the last few years two species have been described from Africa and a third from Burmah.

The curious black mottled lace-wing, *Porismus strigatus*, has a narrow red head furnished with long slender antennae and large rounded eyes; the front portion of the thorax forms a regular neck. The narrow elongate black wings, blotched and tipped with pale yellow shading into white, are folded over the back forming a ridge when at rest on a tree trunk. They are sometimes met with about Sydney, and are common in New England toward the end of summer. I found larvae and eggs under logs in that district which I believe to be those of this insect; the former were stalked and deposited in a narrow semicircle attached to each other; the larvae, of the usual tick-shaped form, covered themselves over with bits of burnt ashes, and clung to the surface of the log, where they easily escaped notice with their protective covering.

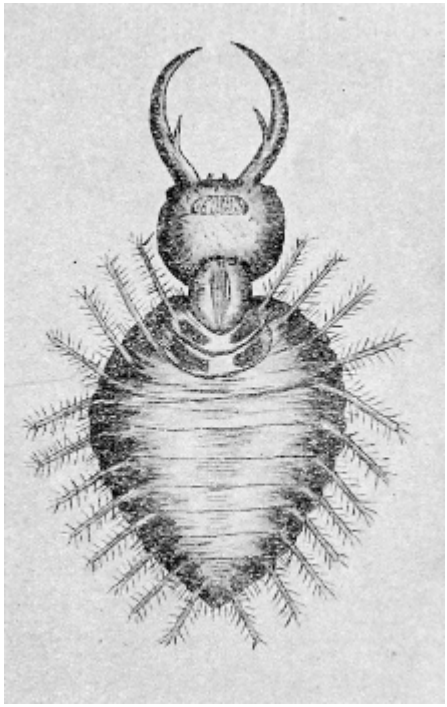


Fig. 36.—Larva of *Porismus strigatus* (Bohem). The adult Lace-wing is shown in Plate VI., Fig. 7.

(Original W.W.F.)

The Genus *Osmylus* contains a number of slender insects with longer, semitransparent, spotted, brown wings, and fine antennae clothed with short hairs. The larvae, active little creatures, feed about among the leaves destroying aphids. *Osmylus tenui* measures about 1¼ inches across the outspread wings, is of the usual dull brown tint, and is found in Victoria.

In the Genus *Drepanopteryx* the fore wings are short, broad, rounded in front at the shoulders, and arcuate on the hind margin; the hind pair are rounded, semitransparent, with a darker costal margin; when resting upon a twig they tuck the head

down under the thorax, and turn the wings upward, almost standing on their heads; they could be easily passed over from their resemblance to a brown leaf.

Drepanopteryx binocula and *D. instabilis* are found in N.S. Wales and Victoria; the first has dark fore wings and measures about ¾ of an inch; the second is somewhat smaller and lighter coloured.

Fig. 37.

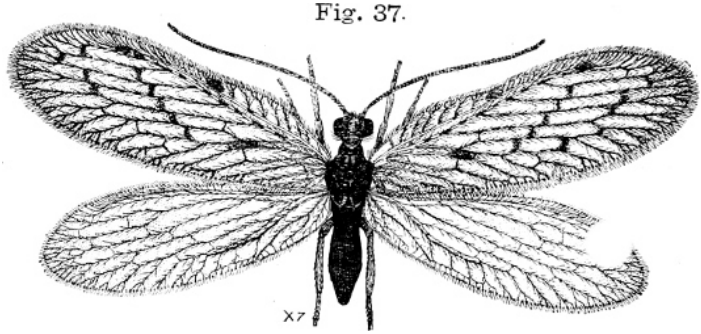


Fig. 38.



Figs. 37 and 38.—Life History of the Brown Lace-wing.

37.—*Micromus Australis* (Froggatt).

38.—Larva.

("Agricultural Gazette," N.S.W.)

The CHRYSOPHIDES comprise the lace wings known as "Ruby Eyes" from their rich metallic tint, or "Aphis Lions" on account of the voracious habits of their larvae. They hide among the foliage in the day time, and in summer often come buzzing round the lamp, several species giving out a most objectionable smell when handled. They are generally slender-bodied green or yellow insects with large delicate glassy wings, folded over the back. They attach their eggs to the foliage on long slender stalks, probably a means of protection against other

larvae that might otherwise find and devour them. The larvae are active little creatures with large heads furnished with scythe-shaped jaws; their rounded backs are covered with short stiff hairs, by means of which they hold bits of dirt, sand, or wood, with which they cover themselves when feeding upon the aphids or scale. If when in captivity these bits are brushed off they run round and replace them bit by bit; pushing the bits into the jaws with their fore legs, then turning their heads backward, they drop each bit upon their backs, repeating the operation until they are again completely covered. When full-grown they spin a white hemispherical cocoon composed of fine white threads and the longer hairs of the body, from which in summer the perfect insects will emerge in a fortnight.

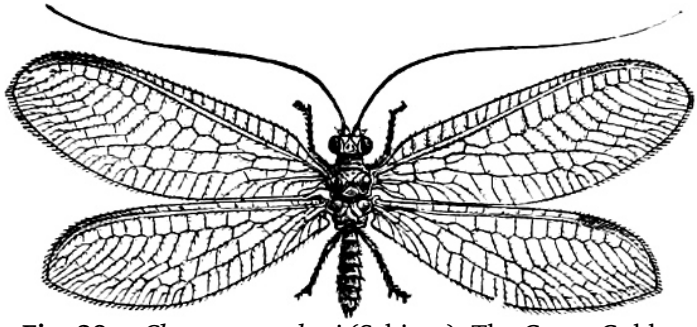


Fig. 39.—*Chrysopa ramburi* (Schiner). The Green Golden Eye.

("Agricultural Gazette," N.S.W.)

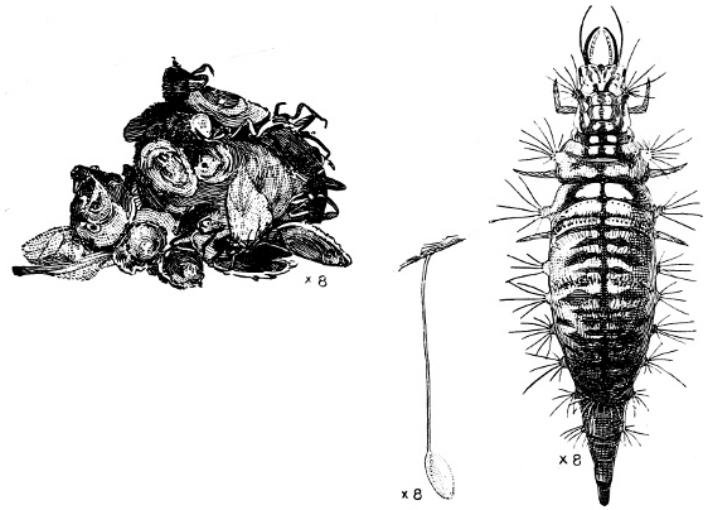


Fig. 40.—Life history of *Chrysopa ramburi* (Schiner).

Larva; stalked egg; and pupa enclosed in hemispherical cocoon covered with the remains of the aphis upon which it has fed during the larval stage.

The Green Lace Wing, *Chrysopa ramburi*, is our common orchard friend; and where plentiful they soon clean the trees of aphid and scale insects. Its general colour is bright green fading into yellow after death; the large golden eyes are so bright that they can be seen through the cocoon some time before it emerges. The Brown Lace Wing, *Micromus australis*, is common among dead bushes, and also in summer in orange orchards; it is much smaller than the last, only slightly over ¼ of an inch across the expanded wings; is of a general light brown colour mottled all over the wings with darker tints. The broad head is furnished with large bronzy eyes, and slender hairy antennae composed of 44 very short annular joints. Both the slender, brown, ferret-like larvae and the perfect insects are very active little creatures, always on the move. This species was described by me in the Agricultural Gazette N.S.

Wales, 1904.

Family 7. Caddis Flies.

TRICHOPTERA.

The larval forms of these interesting little creatures are common in our creeks and water-holes, encased in their cocoons or sacks formed of silken strands covered with bits of sticks, leaves, sand or small stones; they may be often noticed floating on the surface or crawling about under the water among the weeds and mud. These are protective coverings, for though the head and front of the thorax, that are projected in front when the larva is moving along, are hard and leathery, the abdominal segments are covered with a thin integument, and would soon fall a prey to the many carnivorous water insects in the ponds if it were not for their case-bearing habits. These cases, unlike those of the terrestrial case moths, are open at both ends, so that the water can flow right through when the creature is crawling about.

They are known in England as “water moths,” or “caddis-flies,” and are much sought for by anglers as bait for fly-fishing. The perfect insects have two pairs of membranous wings with fewer cross veins than other members of the Neuroptera; the hind pair are broadest and folded when at rest; most of them are clothed with fine hairs instead of scales. The head is small, with very long, slender, thread-like antennae composed of many short indistinct joints, and the biting mouth is rudimentary; the prothorax is short, with an elongate body rounded at the extremity; and the legs are well developed, and more or less provided with spines. The female deposits her eggs,

enveloped in a gelatinous mass, in the water, often carrying them about with her attached to the tip of the abdomen for some time before they are dropped.

Some of the smaller species are so wonderfully like small tinead moths, that it takes an experienced eye, aided with a good lens, to pick them out of a box when mixed up with small microlepidoptera; and from their delicate form and small size most of my specimens have not been taken as caddis-flies, but obtained from the leavings of insect boxes of moth collectors.

Between the years 1874–80 McLachlan published his fine "Monograph of the European Trichoptera," illustrated with a great number of very fine drawings; over 500 species are identified and described in this work. According to Howard, about 150 species have been described from North America.

McLachlan treats them as an Order in his work, dividing them into a number of families, chiefly based upon the number of spines on the legs, the joints of the palpi, and the ocelli.

Judging from my own collection of caddis-flies I should think that Australia is rich in species, but they are a much neglected family and I do not know of a single named specimen in any of our Museum collections.

In the British Museum Catalogue of Neuroptera published in 1852, Walker gives only four species from Tasmania and Australia: *Leptocerus magnus* and *L. oppositus*, which he describes from Tasmania, and *Plectrotarsus gravenhorsti*, described by Koller from Australia; the latter measures nearly an inch across the wings, and ⅓ of an inch in the body, and is of a

general yellow tint, thickly clothed with yellow and black hairs; the fore wings are bluish black marked with white, yellow at the base and along the fore border; the hind wings are yellow but blackish toward the tips.

Monopseudopsis inscriptus, described by Walker, is a larger fly, of a general black colour, with pale wings spotted with yellow, the hind pair clouded. The locality of this species is given as Australia.

Order IV.—HYMENOPTERA.

Bees, Ants and Wasps.

This division contains an immense number of very interesting insects which, though generally known as bees, ants, and wasps, comprise many other just as important families; some are unfortunately popularly called flies, such as saw-flies, gall-flies, and ichneumon-flies, but all true flies have only one pair of wings. Hymenoptera are, with a few exceptions, furnished with two pairs of semitransparent membranous wings, sometimes shaded with black or yellow tints, devoid of hairs or scales, but traversed by stout nervures forming irregular cells; the hind pair are the smaller, and are furnished with a row of spines along the front margin capable of hooking into the hind edge of the fore pair, thus adding to their powers of flight.

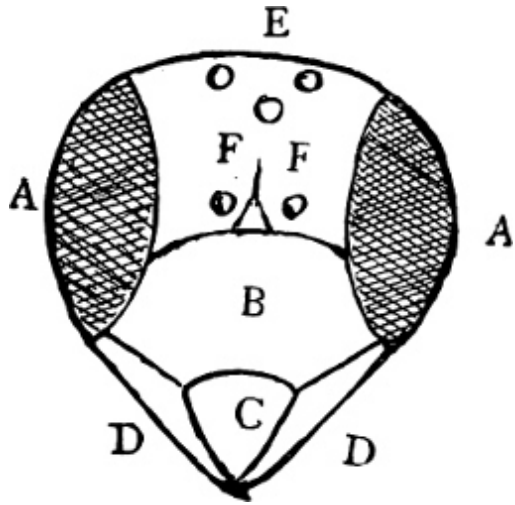


Fig. 41.—Diagram of the Head of a Wasp.

a, eyes; *b*, clypeus; *c*, labrum; *d*, mandibles; *e*, ocelli; *f*, insertion of the antennae.

(Redrawn from Cresson's "Hymenoptera of North America.")

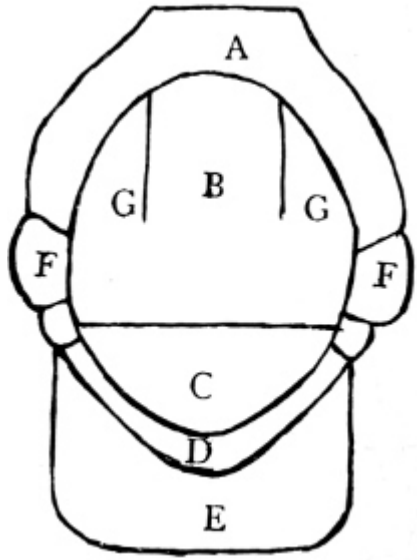
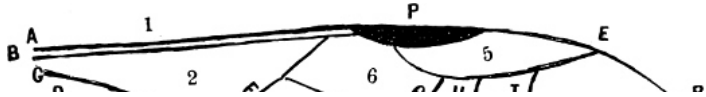


Fig. 42.—Diagram of the Thorax of a Wasp.

a, prothorax; *b*, mesothorax; *c*, scutellum; *d*, postscutellum; *e*, metathorax; *f*, tegulae; *g*, parapsidal grooves.

(Cresson's "Hymenoptera of N. America.")

In a few anomalous groups we find the females wingless, such as *Thynnidae*, *Mutillidae* and others; in some like the fig insects *Blastophaginae*, the males are wingless and blind; in the ants, while the males and females are winged, the bulk of the community consists of wingless workers forming a third sex or caste.



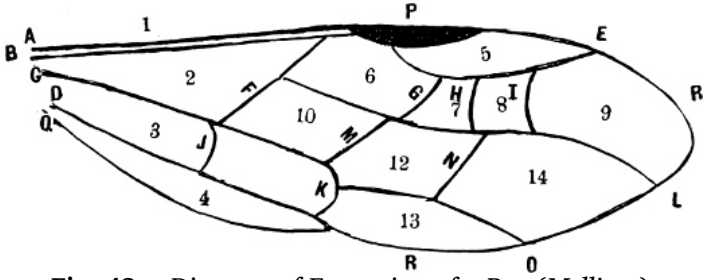


Fig. 43.—Diagram of Fore-wing of a Bee (*Mellinus*).

1, Costal cell; 2, median or externo-medial cell; 3, sub-median cell; 4, anal cell; 5, marginal or radial cell; 6, first sub-marginal or cubital cell; 7, second s.-m. or cubital cell; 8, third s.-m. or cubital cell; 9, fourth s.-m. or cubital cell; 10, first discoidal cell; 11, second d. cell; 12, third d. cell; 13, first apical cell; 14, second a. cell. *a*, Costal nervure; *b*, sub-costal nervure; *c*, externo-medial nervure; *d*, anal nervure; *e*, marginal or radial nervure; *f*, basal nervure; *g*, first transverso-cubital nervure; *h*, second t.-c. nervure; *i*, third t.-c. nervure; *j*, transverso-medial nervure; *k*, discoidal nervure; *l*, cubital nervure; *m*, first recurrent nervure; *n*, second r. nervure; *o*, sub-discoidal nervure; *p*, stigma; *q*, posterior margin; *r*, apical margin.

(Cresson, "Hym. N. America.")

These insects are furnished with well developed antennae; large compound eyes, in some groups composed of an immense number of facets; usually 3 simple eyes or ocelli, but these are sometimes wanting; a more or less tubular mouth adapted for sucking up food (commonly called the proboscis), though mandibles are always present. The thorax is stout and broad; the three primary portions, prothorax, mesothorax and metathorax, are distinct on the upper surface with well defined lateral or ventral plates. The legs are generally large, with spined tibiae, and slender tarsi terminating in a double claw or hook, but varying much in size and

shape in the different families. The abdomen takes all kinds of remarkable forms, from the thickened sessile body of the sawfly to the slender stalked abdomen of the sand-wasp, and the female is furnished with an ovipositor, sting, or saw at the extremity.

The Hymenoptera are considered by naturalists to be one of the most highly developed or specialised orders of insects, on account of the social habits of some of the chief families, and the care they display in providing for the safety and food supplies of their larvae.

They undergo a complete metamorphosis: from the egg is hatched out a soft, generally legless larva which when full grown, if in a protected cell, is simply enveloped in a thin skin, but otherwise forms a stout silken or parchment-like cocoon; the larva usually takes a considerable time to change into the pupa; the change is not rapid as that of a butterfly.

Australia is very rich in hymenoptera; most of the typical families are well represented, and we also have a few very distinct groups peculiar to this country.

There have been many schemes of classification and sub-divisions of these insects proposed by various authors, and the present idea among specialists seems to tend to a still closer definition of the families, as exemplified in Ashmead's recent Classification running through the pages of the Canadian Entomologist; but in a book of this kind, I can only deal with the most important divisions and refer my readers to the work of such specialists.

Westwood divided the first section, *Terebranti*, in which the females are provided with a more or less

projecting instrument for depositing their eggs, into two sub-sections, *Phytiphaga*, in which the abdomen is sessile, and *Entomophaga*, in which the body is stalked. Some of the French entomologists had previously suggested dividing them up into five large families defined by the peculiarities of the ovipositor or borer. Kirby used the same terms as Westwood, but I have followed Sharp, who uses the names *Sessiliventres* instead of the first, and *Petioliventres* for the second, for they certainly express more clearly the form of the body of the groups under observation. The first group contains four families.

Family 1. Stem-Sawflies.

CEPHIDAE.

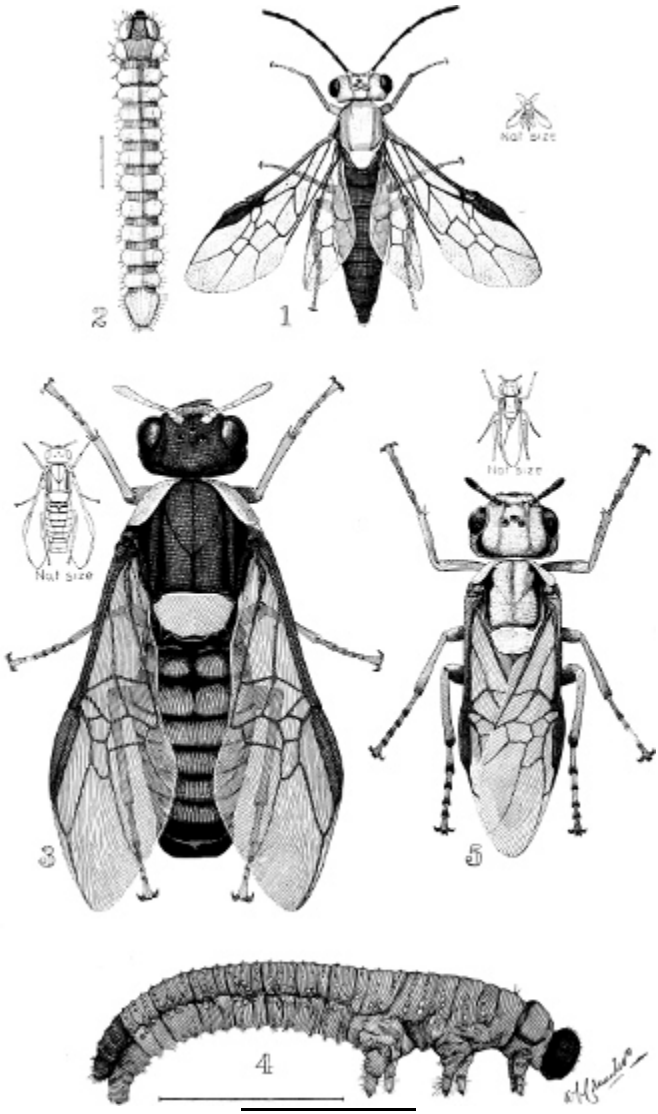
The first group comprises what Sharp terms "Stem-Sawflies," which are not represented in Australia. They are slender little insects with long antennae; the larvae feed in the stems of plants; one damages wheat stems in Europe, another infests willows in America, a third is recorded from Japan; but they are unknown in Australia.

Plate X.—HYMENOPTERA.

Family TENTHREDINIDAE.

1. *Phylacteophaga eucalypti* (Froggatt).
2. *Phylacteophaga eucalypti* (Froggatt), Larva.
3. *Perga dorsalis* (Leach).
4. *Perga dorsalis* (Leach), Larva.
5. *Perga lewisii* (Westwood).

Plate X.—HYMENOPTERA.



Family 2.

ORYSSIDAE.

This family consists of the single Genus *Oryssus*, of

which only 20 species are known. They are remarkable for the curious situation of the antennae on the under-surface of the head, the cylindrical rounded abdomen, and the exposed needle-like ovipositor. Turner has described one from Mackay, Queensland, in the Proceedings of the Linnean Society N.S.W. under the name of *Oryssus queenslandicus*. It is a small black insect measuring ½ an inch in length; with mottled brown wings, and typical shape of the genus.

Family 3.
SIRICIDAE.

These handsome Sawflies are common in Europe and America, the larvae living in timber; the members of the typical Genus *Sirex* have long cylindrical bodies rounded to the apex; the borer of the female extends beyond the tip of the abdomen. One species, *Sirex australis*, has been described from Australia by Kirby (List of Hymenoptera 1882). I have never heard of another specimen being found, and believe the type is unique.

Family 4. Sawflies.
TENTHREDINIDAE.

These are the typical stoutly built Sawflies, with the pronotum narrow, and the thorax generally broader than the head; the abdomen sessile, and provided in the female with a beautiful saw-like instrument on the under-surface of the tip of the abdomen, with which she slits the leaves to deposit her eggs in the tissue. The larvae are caterpillar-like creatures usually furnished with three pairs of legs;

they feed upon the foliage of many plants.

Our species all belong to genera peculiar to Australia: Klug described several in the Berlin Magazin in 1814; Leach figured and described others in his “Zoological Miscellanies 1817”; Westwood described and figured a number in an important paper in the Proceedings of the Zoological Society 1880, others in his “Arcana Entomologica 1841”; and Kirby added to them in his List of Hymenoptera, B.M. Catalogue 1882.

The Genus *Perga* contains about 50 of our largest Sawflies, broad thickset insects, with reddish or light brown opaque wings, and short antennae forming an elongate club at the extremity. The larva is black or brown clothed with short scattered shining bristles, black head, three pairs of short stout legs, broad thorax, and abdomen tapering to a rounded tip. They feed gregariously upon the foliage of eucalypts, often stripping off all the leaves of the young bushes; they rest in the day time clustered together in a bunch of 50 or more round a branch, holding on with the legs; when disturbed they raise and rap the tip of the abdomen against the leaves, at the same time discharging a sticky yellow fluid from the mouth smelling strongly of eucalyptus extract. They are very subject to the attacks of dipterous and hymenopterous parasites, which these means of defence may keep away. When full grown they bury themselves in the soil, and form elongate, oval, parchment-like cocoons clustered together.

The Steel Blue Sawfly, *Perga dorsalis*, is slightly over 1 inch in length; is of a deep metallic blue, marked on face and thorax with bright yellow, and has stout reddish brown wings; the smaller male has the upper surface of the abdominal segments clothed

with silvery pubescence. *Perga kirbyi* is dark reddish brown, similar in form and size to the last species; *Perga lewisii*, a much smaller yellowish brown insect, flattened on the dorsal surface, is common about Sydney upon the foliage of the "blood-wood" (*Eucalyptus corymbosa*), where she lays her eggs in the leaf in a double row, and stands over them until the tiny larvae hatch out and are able to move away; while thus occupied you can pick her up, but she will not move away, but raise her wings and fight like a hen over her chickens. Though this is our commonest species, and I have taken hundreds of females, I have never seen a male. *Perga cameronii* is like the last species, but larger, with more distinct markings on the back; it is found on the Blue Mountains.

In the Genus *Pterygophorus* about 10 species are described; they are much smaller insects, with bright metallic blue colours marked with reddish yellow; the male has the antennae produced into a comb or feathery structure, those of the female are formed of short rounded joints. The larva is a dull olive green creature covered with small warty tubercules; the head is broad, and the abdomen tapers off into a slender pointed tail; it has seven pairs of abdominal legs. It feeds upon the foliage of *Leptospermum*, wild dock and other plants, and when full grown bores into dead wood, pupating in a rounded oval cell.

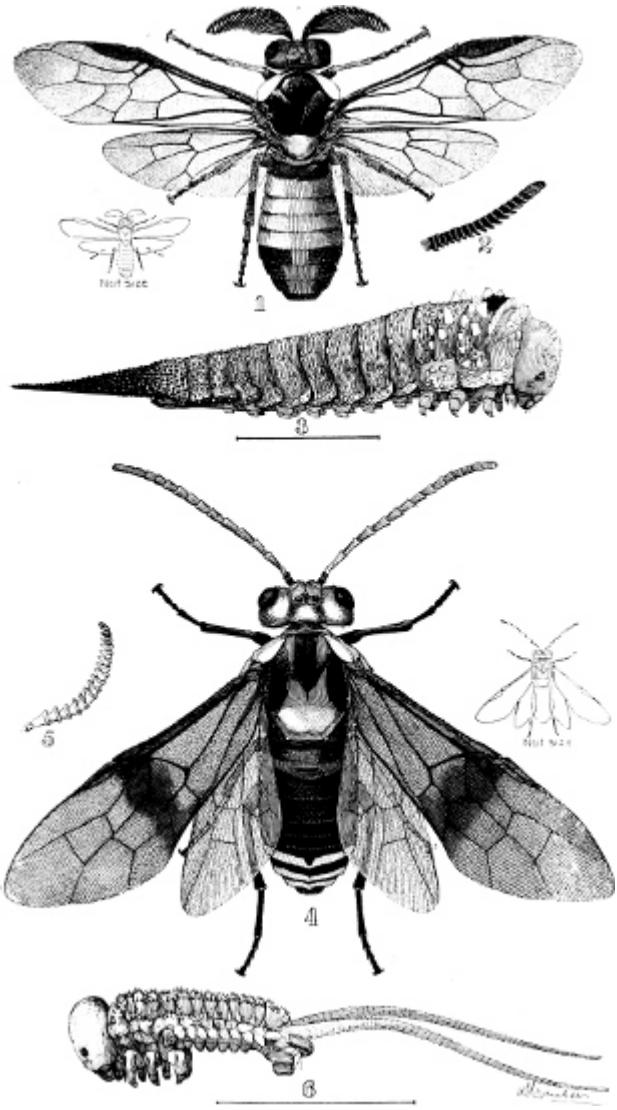
The Ringed Sawfly, *Pterygophorus cinctus*, ½ an inch in length, is dark blue marked with deep reddish orange on the thorax, with a ring round the centre and tip of the abdomen of a similar colour; the wings are marked and clouded with black.

Plate XI.—HYMENOPTERA.

Family TENTHREDINIDAE.

1. *Pterygophorus cinctus* (Klug).
2. *Pterygophorus cinctus* (Klug), Antenna ♀.
3. *Pterygophorus cinctus* (Klug), Larva.
4. *Philomastix glaber* (Froggatt).
5. *Philomastix glaber* (Froggatt), Antenna.
6. *Philomastix glaber* (Froggatt), Larva.

Plate XI.—HYMENOPTERA.



The Pale Coloured Sawfly, *P. interruptus*, slightly larger, has the thorax marked with orange yellow, and the abdomen deeply blotched with the same colour, forming interrupted bands on the sides; both

these species are taken upon flowers in the summer months.

Philomastix glaber has very curious larvae that feed upon the wild bramble on the northern rivers of N.S. Wales; they have large heads, no abdominal legs, and two slender rat-like tails on the tip of the body. The sawfly measures 1 inch in length; the general colour is shining yellow, mottled with dull metallic blue on the thorax and abdomen; the semiopaque wings are barred with dark brown; the male has shorter antennae composed of short funnel shaped segments. There are a number of small species, belonging to the Genera *Eurys*, *Euryopsis* and *Polyclonus*, found chiefly upon flowers; *Polyclonus atratus*, sole representative of the Genus, has 18 jointed antennae, each joint furnished with a hairy finger turning inward at the tips. The Blister-leaf Sawfly, *Phylacteophaga eucalypti*, punctures the leaves of small gum trees; the larva feeds in the tissue, and when full grown pupates in a chamber in the centre, forming a distinct blister in the leaf: in the pupal state it has power to bend the body and rap against the side of the chamber. The sawfly measures ¼ of an inch in length; the male is black with a red head; the slightly larger female has the head and thorax reddish brown; the antennae have eight joints, long and slender. They have long stout legs, and are very active when they first emerge from the leaves, making a loud buzzing sound as they run about and try to escape.

Family 5. Gall-flies.

CYNIPIDAE.

This is the first group of the *Petiolata*, which are often known from their small size as *Micro-*

hymenoptera. They are all small creatures, differing from the succeeding families in that they are broadly speaking plant eating, usually forming galls in which they live and pupate. However, there are some that live upon the gall-making forms; others live only upon the tissue of their cousins' galls without disturbing their host; and again some that are known as inqualines (visitors that dwell in the cavity with the true gall-maker); so that their life histories are somewhat complicated.

The typical gall-fly deposits her eggs in the tissues of the selected plant by means of her ovipositor, which is beautifully adapted for the purpose; she injects in some cases a fluid that keeps the wound from closing up at once and so destroying the delicate egg. Most of the Cynips galls are rounded woody excrescences. The Gall Wasps have wings with few cells and no stigma; the front portion of the thorax is joined to the second; the ovipositor is concealed; the antennae straight, containing from 13 to 15 joints. I described three hymenopterons forming galls on wattles (Proc. Linn. Soc. N.S.W. 1892), but these insects submitted to Dr. Mayr some years afterwards proved to belong to another family. The only species described from Australia are 3 named by Ashmead (Pro. Linn. Soc. N.S.W. 1900), which were collected by Koebele without any exact locality being given; and *Hypodiranchis aphidis* described by me as a parasite of the common peach aphis in the Agricultural Gazette N.S.W. 1904.

Family 6. Parasitic Wasps.

CHALCIDIDAE.

This is a very extensive family, the members of

which differ from the other small wasps in having the antennae elbowed, the first segment often as long as all the others combined; the antennae may be simple, but are often clubbed at the tips, and in the males of some groups with the segments or joints feathered or furnished with slender branching fingers. The delicate gauze-like wings are traversed by very few veins, and the abdomen is produced into all sorts of curious shapes, ornamented sometimes with remarkable anal appendages; and the ovipositor of the female, though often short, is sometimes much longer than the whole insect, and is usually prominent. These tiny little creatures deposit their eggs in the eggs, larvae, and pupae of other insects, wood galls, and excrescences produced by other insects, though a few groups are plant feeders and even produce galls.

Most of them are very minute, and can only be collected by keeping infested galls, leaves, eggs and cocoons in jars and breeding them out, so that the majority of them escape the eye of the ordinary collector, though among the most beautiful of all insects in rich colours and delicate structure.

Walker described a number of Australian species in the British Museum Catalogue, Hymenoptera 1846, others in his Monograph of the family 1839, and the Proceedings of other Journals (1863, &c.); but his usual locality is simply “New Holland,” and without access to the types one would have some difficulty in determining any species. Westwood obtained and figured some of our largest; and Haliday others in the “Entomologist” 1842; while the few others described are those obtained by the zoologists on the various scientific expeditions visiting this country. Ashmead has contributed the

only modern paper (Pro. Linn. Society N.S.W. 1900) on these and other parasitic hymenoptera collected by Mr. Koebele and myself. The species in the Genus *Leucaspis* are large thickset chalcids, with the ovipositor curving round and fitting into grooves in the dorsal surface of the abdomen. *Leucaspis darlingi* was obtained by Westwood from the Darling Downs Queensland (I have specimens from Mackay Q.): it is black mottled with yellow, and has brownish wings; the hind legs are swollen: the antennae thickened; and it measures ½ an inch. *L. australis* was obtained by Walker from S. Australia. Nothing is known about their habits, but *Leucaspis gigas* in Europe lays its eggs in the nests of mud-dauber wasps, piercing the clay walls with its stout ovipositor. *Trichoxenia cineraria*, a slightly smaller black insect, is deeply punctured all over the dorsal surface of the head and thorax; the wings are clouded at the apex; and the upper surface of the body is thickly clothed with dense yellow down, thickest toward the apex. Specimens in my collection were taken about Sydney.

The typical Genus *Chalcis* contains a number of short stout insects, generally black, sometimes marked with yellow and brown; they are easily distinguished by the globular form of the thighs of the hind legs, which are sometimes nearly as large as the abdomen. These insects are chiefly parasitic upon the larvae of small leaf-rolling moths: *Chalcis vicaria* is black, with the base of the tibiae and tarsi yellow; it is common about Mackay Queensland. I have bred numbers of *Chalcis phya*, a small black species with white mottled hind legs, from the chrysalids of the lucerne moth (*Tortrix glaphyriana*). Another undetermined yellow legged species has been bred from the codlin moth pupa. *Eurytoma binotata*, a tiny

black insect clothed with a white pubescence, has the pronotum spotted with yellow, and the antennae and legs marked with reddish brown; it can be bred from the galls on the twigs of the turpentine gum. *E. eucalypti*, a smaller black species, slightly over ⅛ of an inch, comes out of eucalyptus galls collected at Uralla N.S.W. The members of the extensive Genus *Megastigmus* are all obtained from galls; they are more elongate in form, with broad globular heads, the males with short cylindrical bodies, but the larger females furnished with bristle-like ovipositors turning upward often longer than the whole insect. *Megastigmus brachyscelides* measures $^{1}/_{12}$ of an inch, and is black to dark brown marked with yellow; it is bred from the large galls of *Brachyscelis crispa*. *M. iamenus*, originally described from Tasmania, I have bred from another gall coccid (*B. pileata*); also a larger light yellow species bred from dipterous galls on the Snow-bush (*Aster ramulosus*) has been named by Ashmead *M. asteri*; *M. brachychitoni*, ⅙ of an inch, reddish brown and yellow, is common in the large fleshy galls on the Kurrajong tree.

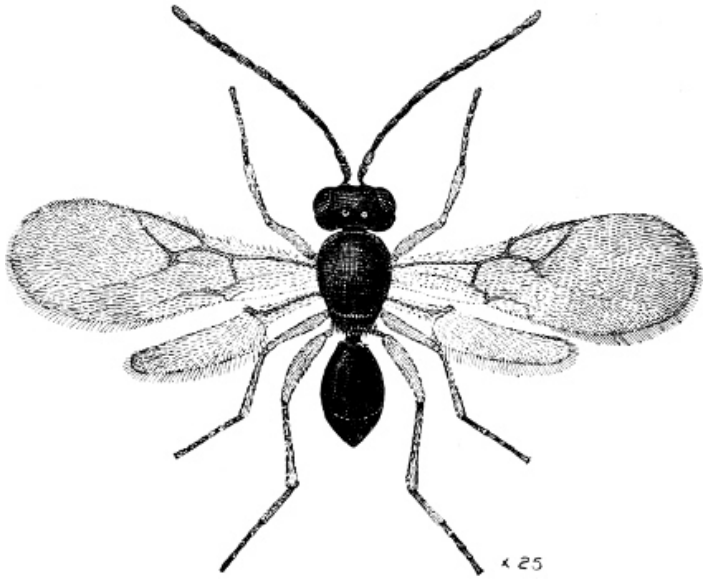


Fig. 44.—*Hypodiranchis aphidis* (Froggatt). A cynips parasitic upon the peach aphis.

("Agricultural Gazette," N.S.W.)

Stilbula peduncularis is a remarkable looking insect, with broad, rich metallic coppery red head and thorax; the basal portion of the abdomen forms a slender stalk with the apical tip produced into a small oval club. I have had a closely allied form out of the pupal cocoon of the red bull-dog ant.

The PERILAMPINAE comprise some of the largest and most remarkable chalcids: *Thaumasura terebrator* has been described and figured by Westwood; my specimens came from S. Australia, and were sent by Mr. Blackburn. It is a slender, rich metallic purple insect, about ¼ of an inch in length to the apex of the flask-shaped body, which is continued in a long jointed tail three times the length of the whole insect. *T. femor-rubra* is a smaller insect with a tail not so long as the body, and of a general black

colour with transparent wings and reddish legs. *Dinoura auriventris* is a very curious, metallic tinted species ¼ of an inch in length, with the apical portion of the attenuated abdomen produced into four flanges. I have bred a number of these wasps out of the large wood galls of coccids (*Brachyscelinae*), chiefly *B. pileata*. *Pteromalus puparum* is an introduced parasite of butterfly pupae, and is common about Sydney, where it infests that of the orange feeding butterfly (*Papilio erectheus*). Another tiny little metallic tinted chalcid, *Eupelmus antipoda*, infests the eggs of our common mantis.

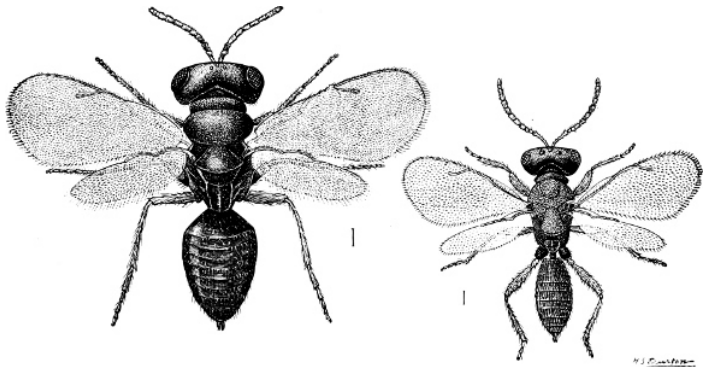


Fig. 45.—*Pteromalus puparum* (Linn.). ♂ and ♀.

Parasitic Chalcids that destroy the pupae of many species of butterflies.

("Agricultural Gazette," N.S.W.)

About twenty species of the cosmopolitan Genus *Tetrasticus* are described by Walker, chiefly from Tasmania. The allied *Tetrastichodes froggatti* is a very tiny creature, described by Ashmead from shot-like galls on the leaves of eucalypts. *Euryischia lestophoni*, a larger black insect with mottled wings, is interesting to economic entomologists, as it is a secondary parasite of the Cottony Cushion Scale (*Icerya purchasi*), feeding on the fly parasite.

The BLASTOPHAGINAE are remarkable little creatures, for there is a very great difference in the sexes of the same species; the males, yellow or brown, wingless, and blind, are more like white ants in general appearance than chalcids. They breed in the interior of figs, and are numerous in Australia. Saunders (Trans. Ent. Soc. 1883) described our common species (*Pleistodontes imperialis*), found in the fruit of the Moreton Bay fig about March. The tiny male, $^{1}/_{12}$ of an inch in length, is of the typical form and colour; the elongate, shining black female (which is figured) is so different a looking creature that it would never be taken for the opposite sex of the insect. Their life history and remarkable habits have been described in the Agricultural Gazette (June 1900). *Idarnis australis*, described in the same paper, is a slender, bright, metallic green wasp, with a long tubular ovipositor nearly twice the length of the whole insect, which she also uses by pressing it down against the fig to jump like an acrobat, as well as for puncturing the skin of the fruit. The insect I described as the supplementary male of *P. imperialis*, is, Dr. Mayr tells me, the wingless male of this species. Mayr in "*Neue Feigen-Insekten* 1906" states that he finds that my identification is wrong and this is not the one named by Saunders but a new species which he calls *Pleistodontes froggatti*, and places my *Idarnis* in his Genus *Sycoryctes*.

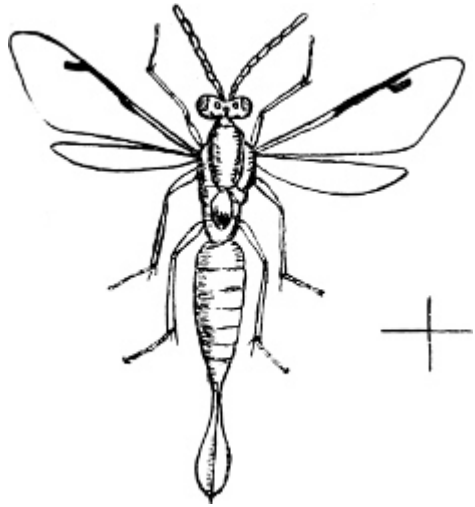


Fig. 46.—*Dinoura auriventris* (Ashmead).

A parasitic Chalcid that destroys the gall-making coccids (*Brachyscelinae*) by devouring the females and pupating in the cavity.

(Original, W.W.F.)

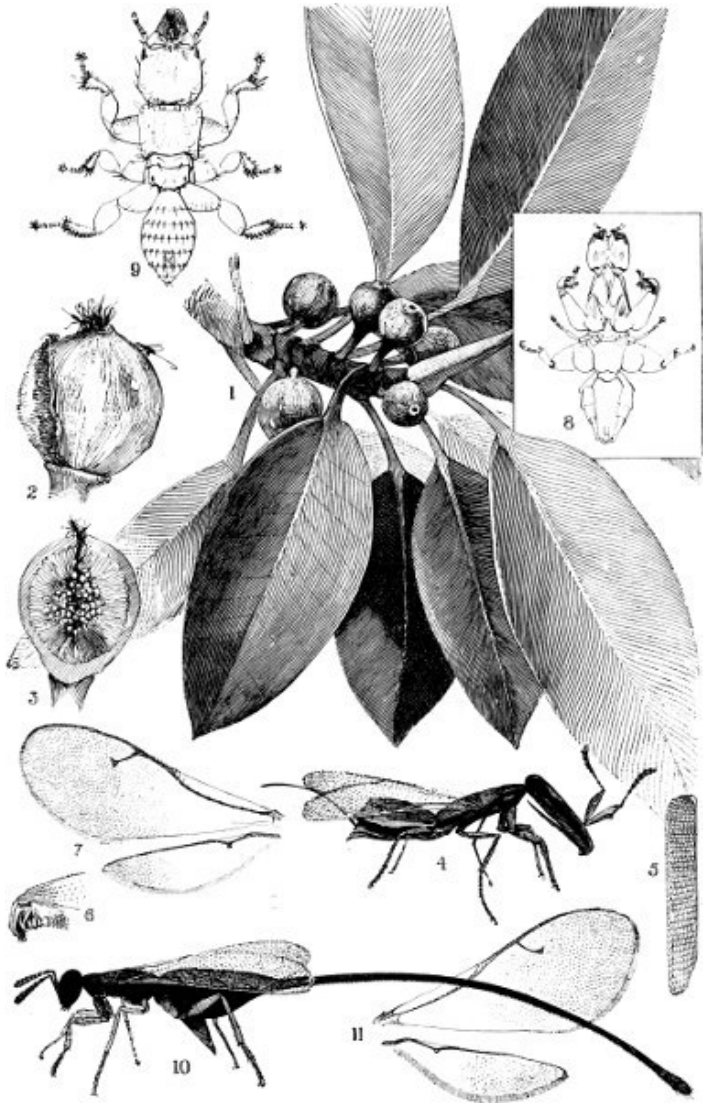
Plate XII.—HYMENOPTERA.

Family CHALCIDIDAE.

1. Branch of Moreton Bay Fig (*Ficus macrophylla*).
2. Immature fig attacked by *Pleistodontes froggatti* (Mayr), which are cutting their way into the fig. A female *Idarnis australis* on the right-hand side of the fig.
3. Section of fig, showing insects in the centre.
4. *Pleistodontes froggatti* (Mayr). ♀.
5. Cutting plate (mandibular appendage) used by the insect to cut into the fig.
6. Point of head, showing beak-like extremity, and the base of the mandibular appendage where attached to the head.
7. Wings of *Pleistodontes froggatti* (Mayr).
8. *Pleistodontes froggatti* (Mayr). ♂.

9. *Idarnes australis* (Froggatt). ♂.
10. *Idarnes australis* (Froggatt). ♀.
11. *Idarnes australis* (Froggatt), Wings.

Plate XII.—HYMENOPTERA.



Additional species of CHALCIDIDAE have been added to our fauna by the researches of Messrs. Perkins and Koebele (Bulletins 1, pts. 6 & 8 Hawaii 1905). In the *Encryritinae* he describes 12 new species, most of them bred from the pupae of the Dryinids collected in Queensland, but a few from more southern regions. *Chalcerinys eximia* is only $^{1}/_{25}$ of an inch in length; is of a rich metallic green tint marked with black and brassy-yellowish tints, and is furnished with long antennae. It ranges from Bundaberg to Sydney. In the EUPELMINAE he describes one new species parasitic upon the parasite fly, *Pipunculus cinerascens*, under the name of *Anastatus pipunculi*. It is a bright metallic green and purple little creature about $^{1}/_{12}$ of an inch in length. One species of the TETRASTICHINAE, which he calls *Ootetrastichus beatus*, has been bred from the eggs of leaf-hoppers from both Queensland and Fiji, while another parasite on the eggs of a Jassid embedded in the branchlets of a Eucalyptus was bred in Southern Queensland. Perkins describes it under the name of *Pterygogramma acuminata*, a tiny creature not $^{1}/_{25}$ of an inch in length, of general brown and yellowish tints.



Fig. 47.—*Megastigmus brachychitoni* (Froggatt) ♀. A yellow and brown Chalcid, bred from the large fleshy galls on the kurrajong trees.

("Agricultural Gazette," N.S.W.)

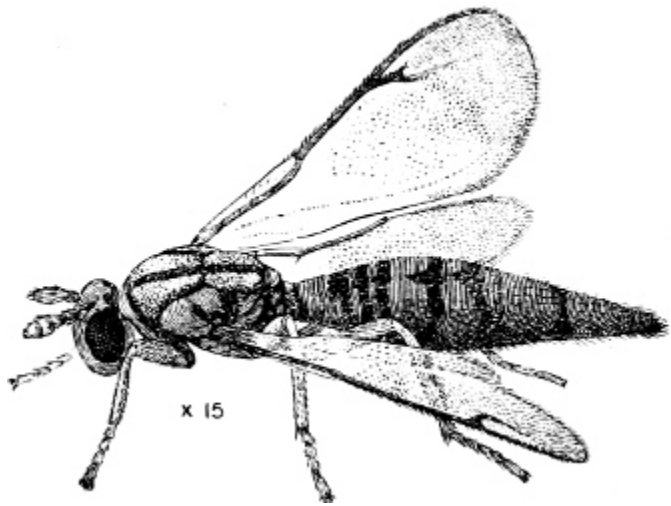


Fig. 48.—*Coelocyba viridilineata* (Froggatt). A pale yellow and green Chalcid infesting the large fleshy galls on the kurrajong trees.

("Agricultural Gazette," N.S.W.)

Five species of the parasitic wasps belonging to the MYMARIDAE are described from Queensland.

They are all tiny little creatures with slender feathered wings and long legs. They deposit their eggs in the eggs of different species of leaf-hoppers, and some species are very abundant. Four species of the more robust parasites belonging to the Genus *Aphanomerus* are also described as egg parasites from Queensland. After studying the galls and insects from the wattles which I described in the Proceedings of the Linnean Society 1892, as belonging to the Cynipidae, Dr. Mayr finds that the insects will not fit into any known genera, so he has formed the Genus *Trichilogaster* to contain *T. maideni*, which forms galls on the branchlets of *Acacia longifolia*, and *T. a-longifoliae*, which aborts the flower buds of the same wattle into oval or rounded red and yellow galls as big as marbles. He describes a third species I sent him, *T. pendulae*, forming rounded galls on *Acacia pendula*, and has made the remarkable discovery that the tiny wasp deposits a female egg, which forms the central cavity on the gall with a second male egg in a small cavity on the side of the same gall, so that a male and female wasp is always produced from each gall, and he thinks this will be the case with our two common species when they are examined.

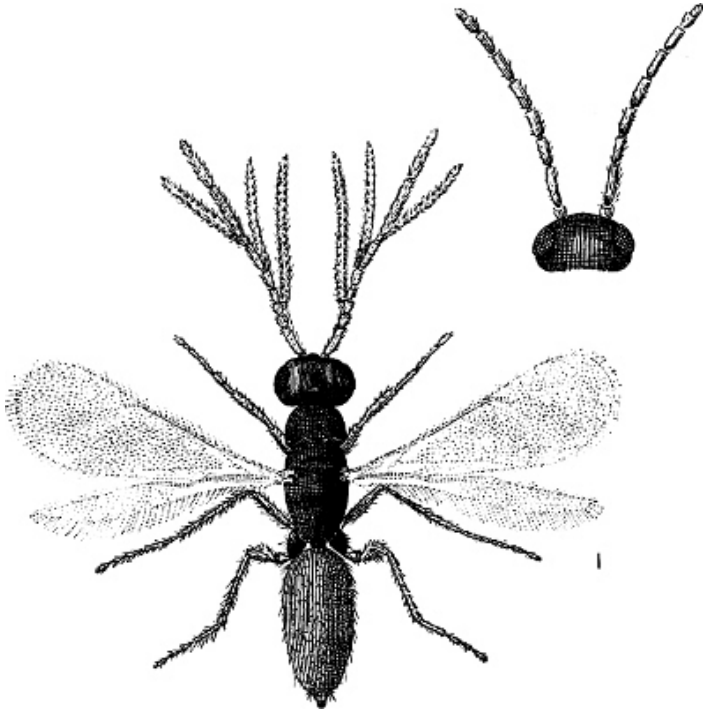


Fig. 49.—*Ceraphron niger* (Curtis) ♂. A tiny black parasitic Chalcid that infests the pupae of the leaf-mining fly (*Phytomyza affinis*). **49a.**—Head of Female.

("Agricultural Gazette," N.S.W.)

Family 7. Micro-hymenoptera.

PROCTOTRYPIDAE.

In general appearance these tiny creatures, some of the smallest in the insect world, would seem to be almost identical with those of the previous family; but Ashmead says: "If the anomalous group MYMARINAE are removed there will be no difficulty in distinguishing at a glance a Proctotrypid from a Chalcid," and defines them thus: "In all true

Proctotrypidae the pronotum extends back to the tegulae, and the ovipositor issues from the tip of the abdomen, the sheaths in a few abnormal cases being conjoined and forming a more or less cylindrical tube or scabbard for the reception of the two spiculae and the ovipositor proper."

Sharp on the other hand considers that this is one of the most difficult groups of the Hymenoptera to define; to a specialist of course they can be easily separated, but anyone who first takes up the study of these Micro-hymenoptera (and bear in mind that we are talking about insects, so small that when a collector breeds them out in jars he has to liberate them upon a window pane that he may see them against the light), he will I think endorse Dr. Sharp's decision. Besides the peculiarities of the abdomen previously noted, the antennae, sometimes twice the length of the whole insect, are composed of from 7 to 15 joints, and in the typical groups, though the first joint may be long, it is not elbowed as in the Chalcids, and is seldom branched. The wings are delicate, without any nervures, except in a few small groups where the veins are somewhat like those of small ichneumon wasps. The hind legs are generally longer than the others, and though some have the thighs swollen as in the Chalcids, they are as a rule much more slender, and the abdomen is usually pointed.

They can be bred from galls, particularly those of small Gall-flies (*Cecidomyia*), the eggs of all kinds of insects, and the larvae of small beetles, moths, and other wasps.

In Ashmead's "Monograph of the Proctotrypidae of North America" nearly 600 species are described, and a number have been added since these were

recorded in 1893. The Australian species are probably numerous, judging from my own observations when studying gall-making insects; but very few have been described. Westwood described four in his "Thesaurus Entomologicus, Oxford 1874," belonging to the BETHYLLIDES, the peculiarities of which he defines, and figures with coloured plates. Ashmead describes another (Pro. Linn. Soc. N.S.W. 1900) under the name of *Ateleopterus longiceps*, obtained by me in a hollow twig of a wattle tree; a shining black ant-like creature about ⅛ of an inch in length, rusty red legs, and transparent wings clouded at the base, probably parasitic on the larva of some wood boring beetle. *Sierola antipoda* was bred from the curious bract-like gall of *Cecidomyia frauenfeldi* on the twigs of Melaleuca bushes. A second species of this genus was collected by Webster, and forwarded to Ashmead, who named it after the sender.

In 1890 Riley described "An Australian Hymenopterous parasite of the fluted scale" in "Insect Life" which he named *Ophelosia crawfordi*; it is a tiny reddish brown wasp with a shining black body, and the wings obscurely barred with smoky brown; it is easily bred from this mealy bug, which it greatly keeps in check. *Goniozus antipodum*, described by Westwood from S. Australia, is a little shining black ant-like wasp which has been lately discovered destroying the grubs of codlin moth both in S. Australia and N.S. Wales. The larvae feed upon the outside of the grub, burying their heads in the tissue, and when full grown spin a loose silken cocoon.

Perkins has recently added a number of new species to this family belonging to the DRYINIDAE. In his Bulletins Hawaii 1905, Nos. 1 & 10, "Leaf Hoppers and their Natural Enemies," he describes 45 new species, chiefly collected by Koebele in Queensland, but some from the neighbourhood of Sydney. These curious little proctotrypids are parasitic upon the larvae and pupae of the small homopterous insects commonly known as Leaf or Frog-hoppers (Families JASSIDAE and FULGORIDAE). The adult wasp captures the insect, holding it with its curious clawed feet while it deposits its egg in its body; when full grown the larva spins a white silken cocoon, from which the active winged insect emerges in about 18 days.

Gonotopus australis is a tiny wingless ant-like creature about $^{1}/_{12}$ of an inch in length, which attacks jassids and fulgorids feeding upon grass and low herbage. This species comes from Bundaberg Queensland; but Koebele has bred a second species about ⅛ of an inch in length, of a general brownish colour, from a Jassid collected near Parramatta. The curious little sacs or larval bags of these parasites can be readily noticed projecting from the sides of the thoracic segments. Most of these insects have well developed wings, but, according to Koebele's observations, they stalk their prey when looking for the host for their egg.

Family 8. Larger Parasitic Wasps.

ICHNEUMONIDAE.

These are commonly known as Ichneumon Flies, and the family is a very extensive one. They play an important part in the economy of Nature in destroying thousands of the moth and other larvae that would otherwise strip our fields and forests of their grass and foliage, and they are therefore useful allies to the agriculturist; though they also often destroy other beneficial insects as well as pests, and thus discount their usefulness. Ichneumon Flies are moderately sized insects furnished with long slender antennae composed of from 16 to upward of 60 joints, with the basal one often thickened, but never elbowed. The wings are well developed, with a distinct stigma and numerous nervures forming regular cells; a few species are wingless in both sexes, but these exceptional ones have not been recorded from this country. The legs are long, generally slender, and well adapted for running about; the abdomen is usually long, rounded or cylindrical, joined to the thorax on the under side, and more or less stalked, while the ovipositor of the female is characteristic of the group and adapted or modified for laying the eggs in or upon the different hosts they prefer to adopt for their offspring; when they infest wood boring caterpillars that are somewhat out of reach, the ovipositor is correspondingly long and the sheath and “tails” produced so as to guide the eggs to their resting place on the grub, out of the sight of the parent ichneumon. When the species lays its eggs on the back of leaf-eating insects with no protective covering, the ovipositor is generally short and stout, the tip sometimes so stiff and sharp, that several species are credited with stinging people when handled. The little wasp-grub, hatching from the egg either deposited on the back or placed beneath the

skin, feeds upon the substance of the body of its victim without touching the vital organs, so that in most instances where the caterpillar of a moth is infested, it yet has the power to form its cocoon and pupate before the wasp-grub has finished growing; the latter thus finishes its final transformation in the destroyed moth pupa, and cuts its way out through the side of the cocoon when ready to emerge. Usually, if it is a large species, the ichneumon deposits only one egg in its victim, but in some of the smaller ones half a dozen can be bred from a single cocoon. Over 6,000 species of these insects have been described from all parts of the world, and in many countries, such as this, the native species are still hardly known, and much confusion exists in their classification on account of their parasitic habits and the number of different hosts that the same species may infest; but now that so many economic entomologists are at work all over the world, it will probably not be long before they will have many admirers, and a rich field awaits the entomologist who takes up the study of Australian ichneumons.

Cresson in his "Synopsis of the North American Hymenoptera" lists over 1,100 described species, while in Australia up to the time when Brullé published his "Histoire Naturelle des Insectes, Hymenopteres," in 1846, only one or two had been described, to which he added eighteen species; Kirby, Smith, Cameron and several foreign entomologists have added a few more; and in Ashmead's recent paper ten more Australian species are described, which makes a very meagre list.

The Spotted Black Ichneumon, *Pimpla intricatoria*, is one of our largest common species, having a wide

distribution over Australia, and it breeds in a number of different moths. It measures nearly 1 inch in length to the tip of the short ovipositor, and is of a uniform black colour with red legs and antennae; the thorax and abdomen are ornamented with pale yellow spots, those on the latter oval, forming a row on either side.

The Dark-winged Ichneumon, *Rhyssa semipunctata*, is a more slender species of about the same length; is of a uniform dull red colour except the basal half of the abdomen, which is black with white markings on the sides; the wings are clouded with brown, darkest on the inner portion. These wasps always follow up the cut worms and caterpillar plagues, and destroy immense numbers in the pupal stage.

The Spotted Ichneumon, *Mesotenus albopictus*, is somewhat smaller, with slender stalked abdomen and the slender ovipositor turned downward: the general colour is black, with the antennae marked with yellow toward the apical portion; the head, thorax and abdomen are richly marked with light yellow; light brown wings and red legs mottled with black and yellow. This ichneumon breeds in a great number of different cocoons, and frequently emerges from the oval cup-like ones of the "Stinging Caterpillars" (*Doratifera* and *Limacodes*).

The OPHIONINAE comprises a number of genera, of which the typical species are reddish brown insects, with clear wings and curiously curved, laterally flattened bodies, broadest at the extremity. They are frequently noticed in numbers among the low scrub in the day time, and in the summer evenings often fly into the house round the lighted lamp. Six species of the typical Genus *Ophion* are described from Australia; but none of the Genus

Anomalon have been recorded.

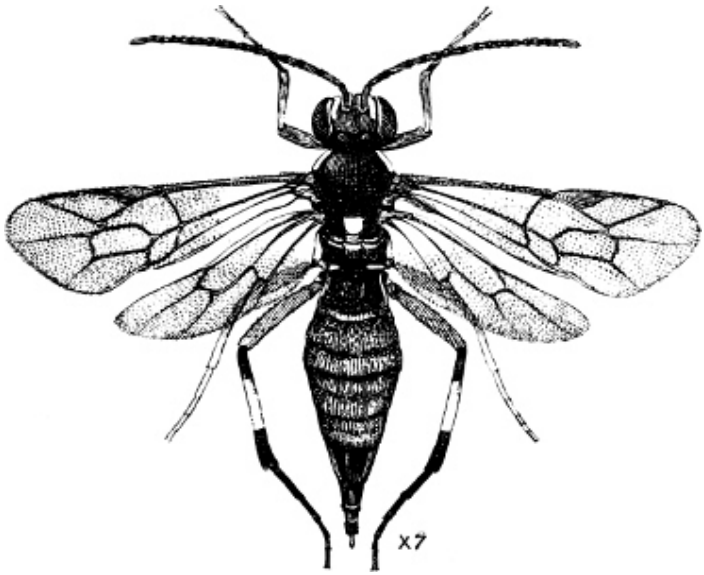


Fig. 50.—*Bassus laetatorius* (Fabr.). An Ichneumon wasp that destroys the pupae of Syrphid flies.

("Agricultural Gazette," N.S.W.)

Bassus laetatorius is a well known Ichneumon which has a very wide range over the globe, and is not a useful species, for it lays its eggs in the larvae of Syrphid flies, which feed upon different kinds of plant lice (*Aphis*) and are very useful insects to the gardener. It measures about ¼ of an inch in length, with the head, thorax, tip and base of the abdomen black, the rest reddish brown with yellow markings on the head. The tibiae of the hind legs are very distinctly banded with white, black, and reddish brown, giving it quite a distinctive character.

Family 9. Small Ichneumons.

BRACONIDAE.

These are insects with very similar habits but easily separated from the large ichneumon wasps by the structure of the fore wings, as they have the outer cross veins wanting, thus showing two long outer cells, which in the former are divided into two cells. The antennae are always composed of more than fifteen joints, and the segments of the abdomen are more soldered together. Many of them, like the *Microgasters*, are very small, others are as large as many of the smaller true ichneumons. This country is probably very rich in indigenous species, while we have a considerable number that have been introduced with their host insect; but hardly anything has been done in describing our species. As far back as 1775 Fabricius named 4 species of the typical Genus *Bracon*, to which only three other species have been added, though over 500 species are listed in Dalla Torre's Catalogue in the cosmopolitan Genus *Bracon* from other parts of the globe.

The typical Braconid is usually very small; many of them are no larger than some of the Chalcids. Wherever the cabbage aphis or other plant infesting insects such as caterpillars are to be found, these little wasps can be observed hovering round, waiting for an opportunity to deposit their eggs. They differ from the large ichneumons, in that while the latter only deposit a single, or at most a dozen eggs upon a victim, these often place hundreds in a large caterpillar, which, emerging when full grown, form little white oval silken cocoons on the top of the remains of their hosts, that are sometimes surrounded with a mass of white fibre exactly like cotton wool. After a plague of cut worms has passed over a paddock it is quite common to find clusters of these little cocoons attached to the grass stalks; these

have been often sent to me from the country with the information that they were the eggs of the plague caterpillars or cut worms.

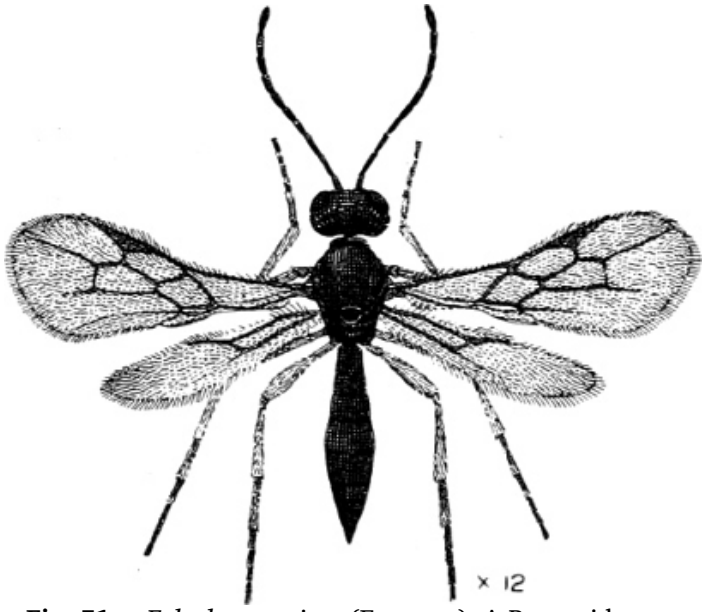


Fig. 51.—*Ephedrus persicae* (Froggatt). A Braconid wasp that lays its eggs on the bodies of aphids.

("Agricultural Gazette," N.S.W.)

Bracon limbatus, one of our larger typical species, is found in Tasmania, and has a wide range over Australia. It measures about ½ an inch from the front of the head to the tip of the abdomen, and is of a general black colour on the upper surface, with dusky almost black wings, and a red head. The under-surface is marked with brown, with the thorax, thighs, and tibiae of the front and middle legs black; the three slender curled hair-like tails forming the ovipositor being longer than the whole insect. Eight other species of *Bracon* are described, several of which are also recorded from New Guinea and

New Zealand. Among the introduced species is *Lepolexis rapae* of Curtis, which is parasitic upon the cabbage aphis in Europe; it can be collected in gardens about Sydney. Aphids containing these parasites are always swollen, round, and apparently dead skins through which each braconid eats its way.

Five species of the Genus *Agathes* are described; they are remarkable for their showy particoloured wings, and large size in comparison with other members of this family. Ashmead has described a tiny black species marked with yellow bred by me from the larva of a Noctuid Moth, an undetermined species of *Agrotis*, under the name of *Apanteles antipoda*; and a second larger one as *Apanteles australasiae*. In his Genus *Microbracon* he has described a dainty little black and yellow creature that infests the larvae of our scale-eating moth (*Thalpochares coccophaga*) under the name of *Microbracon thalpocaris*.

Family 10. Ruby Wasps.

CHRYSIDIDAE.

The popular and scientific names of these insects refer to the brilliant metallic blue, green, golden or copper coloured tints of their armour-plated bodies, which are also covered with coarse punctures, finest upon the abdomen. They are stout thickset wasps with short curled antennae and large eyes; the thorax is broad and closely attached to the abdomen, the latter composed of from three to five segments, the first generally much shorter than the second, with the last toothed along the hind margin, and characteristic of the different species; the under-surface of these plates is concave, with the tip of the

abdomen produced into a tubular process, so that when alarmed the wasp can curl her body round into a ball, protected on all sides by the armour-like integument; and as she lays her eggs in the nests of other wasps and bees, and is sometimes caught in the act, this habit is probably a wise provision of Nature which enables her to resist the sting of the lawful nest maker.

Some of the earlier observers called them "Cuckoo Wasps," under the impression that their larvae, when hatched out in the nests of hunting wasps or bees that filled the cells with insects or bee bread, fed upon the stored food supplies, but later researches show that, though the egg of both the lawful occupant and the intruder may be deposited in the cell, the latter does not hatch until the former has devoured all the food placed there by his mother and is ready to pupate; then the ruby wasp baby comes out, attaches itself to the full fed larva beside it, and sucks him dry, pupating in his skin.

Most of our species that I have bred out are parasitic in the clay nests of the smaller Mason Wasps, *Odynerus* and *Alastor*, though in Europe many species live in the nests of bees. The perfect insects are generally found crawling over or flying round old fences or stumps and dead trees in the hottest part of the day. Our species were described by F. Smith in 1874 in his revision of the family, in the Transactions of the Entomological Society of London; a few others have since been added to the list by Mocsáry, who monographed the Chrysididae in 1889; and Gribodo in the Annals of the Mus. Geneva, 1879.

No member of the typical Genus *Cleptes* common in Europe and America is recorded from Australia;

but two well defined species of the beautiful ruby wasps of the Genus *Stilbum* that has a world wide range are described, *Stilbum splendidum* confined to Australia and New Caledonia, and *Stilbum amethystinium*, found also in Asia, Africa and America. The great Genus *Chrysis*, which contains over 600 described species, is represented here by about 27 species.

Family 11. Hatchet-bodied Wasps.

EVANIIDAE.

Under the recent classification of this family it now comprises three very well defined genera, which have moderately thick antennae, not elbowed, consisting of thirteen or fourteen joints; the nervures of the wings not so well defined as those of the Ichneumons; and the stalked abdomen attached to the upper part of the metathorax. They are well represented in this country, and have been chiefly described by Westwood and Schletterer.

Plate XIII.—HYMENOPTERA.

Family MEGALYRIDAE.

1. *Megalyra fasciipennis* (Westwood). ♀.

Family ICHNEUMONIDAE.

2. *Pimpla intricatoria* (Fabr.). ♀.

Family EVANIIDAE.

3. *Gasteruption sp.*

Family MUTILLIDAE.

4. *Mutilla formicaria* (Westwood). ♀.

Family CHRYSIDIDAE.

5. *Stilbum splendidum* (Fabr.).

Family THYNNIDAE.

6. *Diamma bicolor* (Westwood).
10. *Thynnus variabilis* (Kirby). ♀.
11. *Thynnus variabilis* (Kirby). ♂.

Family SCOLIIDAE.

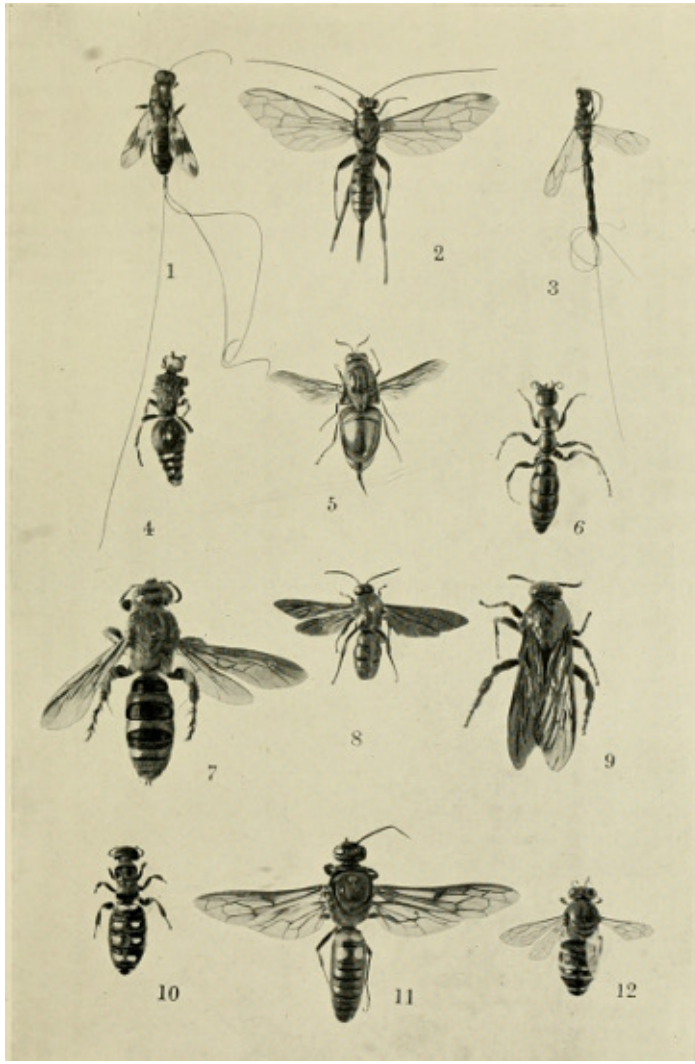
7. *Trielus zonata* (Smith). ♀.
8. *Discolia verticalis* (Fabr.). ♂.
9. *Discolia soror* (Smith). ♀.

Family SPHEGIDAE.

12. *Bembex tridentifera* (Smith).

(Original photo. Burton.)

Plate XIII.—HYMENOPTERA.



The members of the typical Genus *Evania* are generally shining black insects, sometimes variegated with dull red markings; the head and thorax are short and broad; the abdomen has the first segment produced into a slender stalk, and the remaining ones forming a vertically compressed hatchet-like

body. They are parasitic upon the egg cases of cockroaches; some with a very wide range have been introduced in all probability with their cosmopolitan hosts, while they are often found in the house flying on the window panes, evidently introduced in the same manner. In the bush the perfect insects are commonly found on flowering shrubs in the summer time. About 20 species are described from Australia and Tasmania. *Evania princeps* is of a uniform black colour with dusky wings, and is recorded from most parts of Australia, Woodlark Island and New Guinea. It is one of our largest species, measuring ½ an inch in length, broad in proportion, and furnished with very long spined legs.

The Genus *Gasteruption*, which takes the place of the Genus *Foenus* in the earlier catalogues, contains 36 described species from Australia; as they are rare insects, there are probably many more to be discovered. Nothing is known about their habits for certain, but they are supposed to be parasitic upon the larvae of wood boring insects; I have generally found them flying round the trunk of a dead or burnt tree. They differ from the former genus in having the head almost globular, with antennae standing out straight in front, and large oval eyes on the sides; the thorax is more elongate, rounded in front, so that the insect appears to have a slight neck. The abdomen springs from a rounded node on the thorax, with the basal segments slender, swelling out gradually, and broadest at the tip; the females bear a very long hair-like ovipositor. The legs are slender, the hind pair longest, with both the thighs and apical half of the tibiae thickened in a very distinctive manner. Ten species are described from Sydney; and one, *Gasteruption pedunculatum*, is also common to New Zealand.

The Genus *Aulacus* contains ten described species of smaller insects. *Aulacus apicalis* is parasitic upon the larvae of a longicorn beetle (*Piesarthrius marginellus*). I have found as many as fifty, each enclosed in a thin parchment cocoon, all matted together in a single cavity. This little wasp has a long extended ovipositor, and measures about ½ an inch in length; the head and greater portion of the abdomen is black, the rest reddish brown, with a blotch of yellow on the upper surface of the base of the abdomen; the hyaline wings are tipped with black.

Family 12. Long-tailed Wasps.

MEGALYRIDAE.

These remarkable parasitic wasps, peculiar to Australia, are comprised in a single genus containing 16 species, none of which are very common. They are all shining black insects; the head short, broad and almost rounded, the thorax broad and stout, both very rugose and clothed with fine silvery hairs on the sides; the eyes large, circular, and very prominent; ocelli small; the antennae composed of irregular wiry joints; the wings semitransparent, generally banded with black, and the transverse nervures wanting in the apical half; legs long, with the thighs thickened. The abdomen is closely attached to the thorax, cylindrical, tapering to the extremity, and in the females furnished with an ovipositor often more than three times the whole length of the insect, looking exactly like three black horse-hairs. These elongated ovipositors are used for depositing their eggs in the wood-boring larvae of longicorn beetles belonging to the Genus

Phoracantha, and probably others of like habits, which feed under the bark in the sap wood of different eucalypts. The perfect insects are generally found about flowers on low shrubs in summer.

Megalyra shuchardi is of the usual black colour with silvery pubescence; the wings are pitch black and opaque: the whole insect measures slightly under 1 inch in length, with the ovipositor over three inches. It is found in Victoria and New South Wales, and also recorded from Melville Island on the North Coast. *Megalyra fasciipennis* was described by Westwood when he founded the genus, in the Transactions of the Entomological Society 1841; and it is again figured in Griffith's Animal Kingdom, Insects, Vol. II. It is much smaller than the previous one, of similar form, the legs and ovipositor reddish brown, the wings hyaline, barred across the centre and clouded at the extremities with blackish brown. The male is much smaller than the female, with similar wings, but the body is more slender and comes to a point at the tip, furnished with a curious bifid anal appendage. This is the species we have found breeding from the longicorn larvae.

Six other species have been described, some by Schletterer (Berliner Entom. Zeitschrift 1889); one, *Megalyra melanoptera*, closely allied to Westwood's dark winged species. In 1902 Szepligeti (Termes Z. Fuzetek, xxv.) monographed the family and added one more; and Bradley last year, describing the last new form (Trans. Ent. Society of London 1905) appends a translation of the former's tabulation of all the known species, seven in number. I have (Pro. Linn. Soc. N.S.W. 1906) since added 8 new species to the list.

Family 13. Ants.

FORMICIDAE.

The ants are among the first insects that attract one's notice in a new country; civilization seems to agree with many species which form their nests in the lawns or gardens, and even take up their quarters in the house. Within the last decade a small introduced species has appeared in the heart of London, and the small red ant, *Monomorium pharaonis*, is a world wide pest in houses from Europe to Australia.

Ants live in communities forming nests in the ground, under logs or stones, or in dead trees, and sometimes among the foliage of plants. These communities consist of winged males and females, and wingless aborted females known as workers, the bulk of the family consisting of the latter; in some groups there are several varieties of workers, that are often called soldiers on account of their great size and swollen heads. In those species that are furnished with a sting both the workers and winged females should be handled with care.

They are divided into five sub-families, based on the difference in the structure of the segments of the body, absence or presence of a sting, and a few other minor characters. The leading specialists differ somewhat in the sequence of these groups; I follow Forel in placing the *Ponerinae* at the head of the family; and for a good classification and definition of the genera would refer my readers to Emery's paper in the "Annales de la Societe Entomologique de Belgique," Vol. xl., 1896. All our species described before 1858 are listed in Smith's British Museum "Catalogue of the Formicidae," where he described a

number of new species: Lowne described a number of new species collected in the neighbourhood of Sydney in the Entomologist, Vol. ii., 1865: Mayr in several papers, chief of which are "Myrmecologische Studien," "Neue Formiciden," and "Die Australischen Formiciden" added many up to 1876. Emery, Forel, and others have since added to the list; and in Dalla Torre's great "Catalogue of the Hymenoptera," published in 1893, all species described up to that date are recorded. I have lately (1905) published a list of Australian species (Miscellaneous Publications No. 889, Dep. Agr. N.S.W.), including all Forel and others have added to our fauna, in which nearly 400 species are recorded, without counting the large number of races and varieties into which some of them are divided. From my own researches I think a great many more will be found when they are systematically collected in the tropical scrubs and the dry districts in the interior, which as yet have hardly been touched.

The sub-family PONERINAE includes many large or medium sized ants with elongated bodies furnished with only one constricted segment or node at the base of the abdomen, and the latter terminating in a powerful sting. The larvae are enclosed in stout silken cocoons. The Genus *Myrmecia* contains most of our largest typical species peculiar to Australia, popularly known as "bull-dog ants," "inchmen," or "jumpers"; about 34 species have been described, some of which have a very wide range. The "Jumper," *Myrmecia albo-cincta*, forms its nest under the shelter of a low bush; it is a low mound with an opening on the summit, and another on the side level

with the ground; when disturbed these ants come rushing out like a pack of dogs with a series of short jumps, and attack everything they meet. It is one of the smaller species, about ½ an inch in length, of a uniform black colour, with only the front and hind portion of the thorax brownish red to yellow. *Myrmecia forficata* is our large red and black "bull-dog ant," with a very extended range like the previous one from Victoria to Queensland. They measure up to 1 inch in length, and are of a uniform dull red, except the eyes and abdomen, which are black. They live in rather large colonies up to 200 in number, digging deep circular shafts or irregular chambers under logs; when away from the latter, they form regular domed mounds over the nests, which in summer contain the large, elongated, oval, brown sacks enclosing the pupae, and often a number of winged males and females; the former with small heads and jaws, the latter with jaws as large or larger than those of the workers. *Myrmecia gulosa* is of a lighter red colour, with the tip of the abdomen black. *M. tarsata* is our common black bull-dog ant, with yellow jaws, and antennae and tips of the legs reddish brown; it has a great habit of hunting up and down the larger tree trunks, and drops to the ground at the least alarm; when disturbed in the nest, if the first two or three are captured, the others will usually retreat down their burrows, and not show fight like the other species. Sharp notes the bull-dog as forming large mounds (Cambridge Natural History); but I think he was misinformed, as the nests of the Mound Ant, *Iridomyrmex detectus*, are often confounded with these ants. The Genus *Odontomachus* contains a number of curious slender black ants with large heads and long projecting jaws; they are more

tropical in their range, but *O. ruficeps* and its varieties are found from the Darling River N.S. Wales through Queensland to North Australia.

The "Green-head," *Ectatomma metallicum*, is a common ant of medium size that lives in small communities under stones or logs, and often makes nests in the dry banks of lawns in our gardens. Though somewhat sluggish, they sting sharply if they crawl on one when resting on the grass. About 28 species and many varieties of this genus occur in Australia; one in New Zealand; and 3 in New Caledonia. The members of the Genus *Ponera* are remarkable for their extended range; we have several species or varieties in Queensland closely allied to species from South America, Borneo, Europe, and Africa, while three are recorded from New Zealand; *Euponera lutea*, a slender pale yellow ant with the abdominal segment constricted, lives in small communities under stones or roots. It ranges from Sydney to Fremantle, round to N. Queensland. *Pachycondyla piliventris* is a large, hairy black ant with large head and rounded body, roughened, and clothed with fine rusty down. They are generally found under stones in communities of a dozen or so, and when exposed or disturbed pretend to be dead, with their legs folded up under the body; they are common about Sydney.

Six species of the Genus *Sphinctomyrmex* are found chiefly in the North. They are somewhat rare ants; I have found two species, both small, slender, dull brownish yellow insects living under stones; *S. froggatti* in a vineyard near Sydney; and the second, *S. hednigae*, in the New England district under large stones.

The second sub-family, DORYLINAE, comprises ants with the antennae placed close together in the front of the head, the abdomen elongated, with the first segment forming an irregular node. This group contains some very remarkable ants in Africa and America, but is only represented in Australia by two species belonging to the Genus *Ænictus*, both of which are described from specimens collected by Turner at Mackay, Queensland.

The third sub-family, MYRMICINAE, is well represented here; they are all small or medium sized ants, with the base of the abdomen formed into two small nodes, and the sting rudimentary; the pupa naked and not enclosed in a cocoon. Many of them live in very large communities.

The members of the Genus *Meranoplus* are tiny little brown ants with rounded heads and bodies, resembling some of the small wingless female Mutillid in shape and habits, for though they form irregular galleries under stones or in dry banks, they are generally found running up and down tree trunks; when touched they curl up the body and sham death. *Meranoplus oceanicus*, reddish brown, is common in N.S. Wales; *M. pubescens* has a very wide range right round Australia.

Monomorium pharaonis is our tiny red house-ant introduced from Europe, now world wide in its range; and when once it becomes established in a house is a difficult pest to destroy. *M. rubriceps*, a

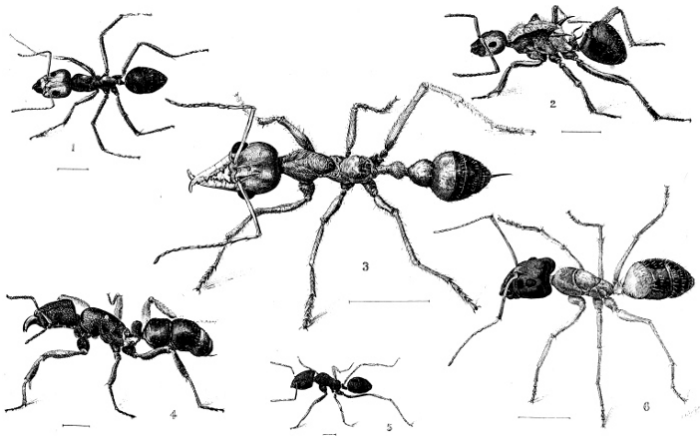
much larger species but under ¼ of an inch in length, is bright reddish brown, with the nodes very small and the apical portion of the abdomen black, and broadly rounded. It is found crawling upon the trunks of trees, and has a wide range from Sydney to Cape York. The typical tree-trunk ants included in the Genus *Podomyrma* are much larger ants, sluggish in their habits, forming their nests in tree stems and always found crawling about the trunks. They are broad-headed ants with short stout jaws toothed at the tips; the thorax is widest in front, tapering to the narrow pedicle of the broadly rounded abdomen; the thighs of the legs are thickened in the centre. *Podomyrma gratiosa*, under ½ an inch in length, is bright reddish brown, rugose and spined on the front margin of the thorax, with the abdomen black, smooth, and shining; it is widely distributed over Australia from Adelaide to Cape York. *P. adelaidae* is a smaller species with black legs, and a distinct oval brown blotch on either side of the black abdomen; it is common in South Australia and Victoria. *P. bimaculata* is still smaller, with the blotches on the abdomen smaller and more oval; I have had it from Kalgoorlie W.A., and Wagga N.S. Wales.

Plate XIV.—HYMENOPTERA.

Family FORMICIDAE.

1. *Iridomyrmex detectus* (Smith).
2. *Polyrhachis semi-aurata* (Mayr).
3. *Myrmecia gulosa* (Fabr.).
4. *Ectatomma metallicum* (Smith).
5. *Iridomyrmex rufoniger* (Lowne).
6. *Camponotus nigriceps* (Smith).

Plate XIV.—HYMENOPTERA.



The Genus *Pheidole* is well represented in Australia by 22 species and many varieties found in all parts of the country, forming irregular chambers and galleries under stones and logs; they are tiny reddish brown ants, with a very large headed form of soldiers often four or five times the size of the ordinary workers. The winged forms are also very large in proportion. *Pheidole bos* is dark reddish brown, the soldiers furnished with very large swollen heads; it ranges from Western Australia to Victoria. *P. anthracina* is a darker coloured form, ranging from the northern portion of N.S. Wales into Queensland. The members of the Genus *Cremastogaster* are very small black, brown, or dull yellow coloured ants with longer legs, and heart-shaped bodies; they live in large communities in nests under logs and stones. *C. fusca* is black with reddish tarsi, and a reddish tint on the thorax; it comes from Queensland. *C. pallipes* and *C. ruficeps* are lighter coloured, found under stones about Sydney.

Sima laeviceps is a very curious elongated shining black ant with reddish brown antennae and tarsi, which ranges up the Queensland coast to N.W.

Australia, and is found crawling about on tree trunks, when touched curling its body up like a wasp and shamming death.

The sub-family DOLICHODERINAE comprises a number of small or medium sized ants living often in very large communities and having naked pupae. The base of the abdomen consists of a single small node with no constriction between the two following segments; sting practically wanting (rudimentary). The typical Genus *Dolichoderus* is represented here by five species widely distributed. *D. doriae* is common about Sydney living in large communities under logs, often clustered over each other like a swarm of bees; they collect on the leaves of eucalypts, upon which the sugar lerp psylla, (*Spondylaspis eucalypti*) constructs its larval scales, and suck or lick up the sugary exudation. This ant measures ¼ of an inch in length; the head and thorax are black and roughened; the legs reddish brown, and the flattened heart-shaped abdomen clothed with a silvery pubescence. *Leptomyrmex erythrocephalus* might well be called the "Silly Ant" from the aimless manner in which it rushes about with its head stuck up in the air, and its abdomen curled over its back. They live in underground nests sometimes deep down, but others live under stones; they are slender-bodied, long-legged black ants under ½ an inch in length, with an oval red head, rounded behind with long slender antennae, and the front of the thorax produced into a slender neck. In some varieties the whole of the thorax, legs, and head are yellowish brown.

The typical Genus *Iridomyrmex* contains 18 distinct species, some of which have been subdivided into three or four varieties or races; most of them are small, except our "Mound Ant," sometimes known as the "Meat Ant," *Iridomyrmex detectus*, which is the commonest and most widely distributed ant in Australia. They construct large mounds a couple of feet above the surface of the ground, and two or three yards in diameter; they are formed of the soil excavated from beneath when forming their network of irregular open galleries; the upper surface is pierced with numbers of rounded vertical shafts, up which they swarm in countless thousands and attack any intruder, biting savagely with their stout sharp jaws and making things generally unpleasant for the stranger. When a mound is situated in open grassed country, one can trace regular bare roads leading off from the nest, worn smooth by the regular stream of ants passing backward and forward day after day. It is too well known to need description, but measures about ⅓ of an inch in length, and is of a general brownish purple tint, with the head light reddish brown. Smith described the worker under the name of *Formica purpurea*, and the male as *F. detectus*, so in most Museum collections it will be found under the former specific name. Forel has made a new variety, which he calls *Var sanguineus*, of the coastal form found in North Queensland, with the head and thorax light reddish brown.

Most of the other species are small black ants: *Iridomyrmex rufoniger* is very common in the bush and in the gardens; a variety which Forel has called *domesticus* is the common black ant that comes into the house in Sydney, and is a regular pest in the summer in many districts. *Tapinoma minutum* is about as large as the "Mound Ant"; black; the head

and thorax deeply pitted and corrugated; the abdomen slightly constricted in the centre, smooth and shining. It comes from Townsville, N.Q.: a second species, *T. melanocephalum*, taken in Cairns, is also found in Samoa and the Tonga Islands.

The last sub-family, CAMPONOTINAE, is a large division well represented in Australia; they live in more or less large communities, and with a few exceptions have the pupae enclosed in cocoons. The base of the abdomen forms a single node, and there is no constriction between the second and third abdominal segments; the sting is wanting, and the anal orifice is fringed with hairs. In the works of early entomologists a number of our ants were described under the Genus *Formica*, but they have been gradually identified and placed in their proper genera, until we only have about half a dozen still remaining in this genus, probably more on account of the difficulty of identifying them than because they really belong here.

The Genus *Acantholepis* is represented by four species all described by Forel from specimens I have collected and sent him from N.S. Wales, so that their range seems to be restricted. They are all small, reddish brown, smooth, shining ants; *A. bosii* was found under stones at Cooma, N.S.W.

The Green Tree-ant, *Oecophylla smaragdina*, found in tropical Africa, India, and New Guinea, is common in the tropical scrubs on the coast of North Queensland. They live in large communities among the foliage of the trees, in nests formed by webbing the leaves together into an irregular mass varying in

size from a cricket ball to a man's head. The material with which they make these nests is obtained by the workers, by squeezing the pupae and using the secretion they discharge. The winged female measures nearly ¾ of an inch in length, has a broad thorax and large oval body; the worker is only about ¼ of an inch, and slender in proportion, but for his size is the most pugnacious creature in the insect world; if one damages a nest pushing through the scrub, down tumble a swarm of green tree ants on one's head and neck, and wherever they drop they stick their jaws in and hang on, and each one has to be picked off in detail. In these forests they destroy an immense number of insects, catching the little bees as they come out of their nests in the tree trunks, and dragging the small beetles off the twigs by main force. I have often seen half a dozen hanging on to the legs of a stout weevil, apparently trying to wear him out, for they would remain for hours in the same position, and probably succeeded in the end.

The great Genus *Camponotus* contains about 400 described species from all parts of the world, of which about 60 are recorded from Australia. Most of them are found in open forest country, forming their nests in the ground, under logs or stones, or near the butts of trees. Several of our common species are known as "sugar ants," as they come about at night and invade the pantry and store room in search of sweets; but they are omnivorous in their tastes, and will often come round the camp fire at night, prowling about for the small moths that flutter round, often rushing right into the edge of the ashes to capture a moth when it falls with singed wings. *Camponotus intrepidus* is one of our largest species, varying from black to reddish brown in tint, and is

thickly clothed with short hair. They form nests in the open sandstone country about Sydney, sometimes raising a little mound or producing a fragile funnel-shaped structure above the opening leading into the nest. The Sugar Ant, *Camponotus nigriceps*, is the commonest house species; it forms large chambers under stones or logs in which they all cluster together. The general colour is black, with all the abdomen except the base dull yellow, but the variations of the yellow and black are common; it measures to ¾ of an inch in length.

Camponotus inflatus is the curious "honey ant" of Central Australia figured and described by Lubbock in his "Bees, Ants, and Wasps." The naturalists on the Horn Exploring Expedition obtained a number of this and other species, described by me in the Zoology of this Expedition. The ordinary members of the "honey pot ants" are of the usual normal form, but certain individuals of each nest of these species are crammed with a honey secretion (probably obtained by the workers from aphids or psyllids), until the abdomen swells out of all proportion to the rest of the ant; the honey pot ants remain hanging about in the bottom of the nests like a number of bottles of honey, incapable of leaving the nest; the supply is probably used as food for the larvae. Spencer says that the blacks dig up these nests and look upon the "honey pots" as great luxuries. The honey is sweet with an acrid taste like the honey of our native bees. They are apparently common in Central Australia; Miss Ormerod sent me some from England which she had received from a correspondent at Kalgoorlie; and recently Mr. Field of Tennant's Creek sent me a fine red species from the far north.

Camponotus claripes, a smaller pale coloured

species, generally makes its galleries at the base of a tree trunk, and has a very wide range from Victoria to North Queensland. I found the cocoons of this species in a nest at Howlong infested with full grown red velvet mites (*Trombidiidae*), which occupied the whole space.

The Genus *Polyrhachis* contains a number of black ants of fair size, most of which build their nests in dead logs, and live in rather large communities, but others form small nests by matting the foliage of trees together; the latter are confined to Queensland, and are generally smaller shining black forms. The true "wood ants" are more or less covered with bright metallic pubescence and fine hairs, and with the hind portion of the thorax and the node of the abdomen ornamented with a pair of slender spines.

Polyrhachis ornata is black, with the thorax and base of the spines richly tinted with gold; it comes from Queensland. *P. ammon*, ranging from Victoria to Queensland, is clothed with pale golden pubescence lightest on the head and thickest on the abdomen. *P. semi-aurata* has both the head and thorax golden, with the abdomen smooth, black and shining. *P. laevior* is one of the smaller tree nesting forms, and is smooth and shining without any metallic tints, and the thoracic and abdominal spines are very small. *P. turneri*, also a northern form, has the head golden, and large well developed spines.

Family 14. Solitary Ants.

MUTILLIDAE.

Though these interesting little creatures were once placed in the Formicidae, and are still popularly known as "Solitary Ants" in Europe and "Cow Ants"

in America, they are now classified as the first family of the fossorial wasps. Unlike the true ants, they are solitary in their habits and probably all parasitic in other insects' nests. Until quite recently they were all placed in the Genus *Mutilla*, in which about 1,000 species have been described from all parts of the world, and about 130 from Australia; the earlier ones by Messrs. Westwood and Smith, the later ones by Andre, who has had the great advantage of obtaining a great many specimens from Mr. Gilbert Turner, who was able to sex the species, add valuable notes about their habits, and give the exact locality of the specimens collected. Turner, who was a most careful observer, after some years of collecting was not positive where they passed the earlier stages of their existence, but told me that he believed that some of them were parasitic in the nests of ants. Several of the European *Mutillidae* are known to be parasitic in the nests of bees: I have on several occasions dug the females of the smaller species out of moss at the foot of tree trunks, and our two largest species are generally found under stones in open chambers, while on hot summer days both sexes of *Mutilla cordata* and several other species are found running up and down the tree trunks.

The males are furnished with two pairs of dark or semiopaque wings. The head is rounded; the antennae curving round; with large eyes and ocelli; the thorax broad, but showing the segmental divisions, and the abdomen rather short and rounded, without any pedicle; the legs stout, and spined on the middle pair. The whole insect is rugose and deeply punctured or roughened, and more or less clothed with pubescence and longer hairs. The females are wingless, with shorter curled antennae, very different in size, sculpture, and even colouration

to the males of the same species; with the body more elongated and terminating in a long powerful sting. Andre remarks upon the brilliant metallic colouration of many of the Australian species, which is much more pronounced than in those from other parts of the world. He also says that they resemble the American species in the fact that they can be divided into two groups by the configuration of the eyes.

Within the last few years specialists have subdivided the Genus *Mutilla* into a number of new genera; and Andre places nearly all the Australian species in the Genus *Ephutermorpha*, but for simplicity I retain the old name.

Mutilla rugicollis, described by Westwood many years ago, is our largest species, measuring in the larger female over ¾ of an inch in length. She is black, very deeply punctured, thickly clothed with black and silvery white hairs, the latter forming white patches on the hind portion of the head, sides and under-surface of the abdomen, and has a dorsal row of five distinct spots down the back. The male is much smaller, with somewhat similar but not so distinct white markings, and is furnished with dark brown wings, which are hyaline, close to the sides of the thorax.

Mutilla quadrisignata has about the same measurements as the female of the last species; with blackish hairy covering, except on the under surface of the abdomen, and four dark, reddish brown, oval spots forming a square on the dorsal surface. Both these species have a wide range over Australia. *Mutilla ferruginata* is a smaller species with a similar deeply punctured surface; is of a uniform dull rusty red colour, thickly clothed with darker brown hairs;

the legs and antennae deeper coloured than the body. *Mutilla cordata* is typical of the smaller active forms that frequent tree trunks; the male is black with dark wings and slender abdomen, and measures about ⅓ of an inch in length; in this case much larger than the female, which has a rounded body with the centre of the dorsal surface occupied with a large rounded golden blotch. I have found the best time to collect these insects is in the hottest part of the day, when they are running up and down the larger tree trunks; but they are very active, and drop at the least alarm, so that it takes some practice to capture them.

Family 15. Flower Wasps.

THYNNIDAE.

These handsome flower wasps are closely allied to the members of the previous family, as they have similar wingless females of such peculiar shapes that, if examined alone, they would never be taken for the consorts of the large wasp-like *Thynnus*, with its long stout antennae, well developed legs, and large powerful wings. The males fly about the flowers of leptospermum and eucalypts, and when captured bite and pretend to sting by turning up the tip of the abdomen, which ends in a horny, harmless process. Fortunately, when hunted for in the summer, most of our commoner species can be taken *in copula* with the smaller female, with which he flies about quite easily; when caught the female immediately detaches herself and falls to the ground, where she crawls out of sight, so that care must be taken by the collector to keep each pair captured in a box by themselves, or else when once mixed up it is impossible to determine unknown species. Australia is the

headquarters of this group, for of about 400 described species, 300 are peculiar to this country; the others are chiefly confined to Brazil and Chili in South America, with a few from Asia and the Islands. Smith has described a great number in the British Museum Catalogues; Westwood others; and Guerin those collected during the Voyage de Coquille in 1830; but as many of these were determined from single specimens of one sex, it is certain that when a collection of sexed specimens can be compared with the types, the number of species will suffer considerable reduction.

Nothing definite is known about the earlier stages of their development; I have however obtained cocoons composed of a stout silken case enveloped in a thin outer second papery covering, oval in form, with a nipple-like projection at the extremity, from which I have bred one of our large species. These cocoons are buried several inches in the ground like those of the *Scolias*, so that the females, which are furnished with short, stout, spiny legs well adapted for digging, probably lay their eggs in lamellicorn larvae living in the loose soil.

A number of our common species are plentiful on the flowering Leptospermum and Melaleuca bushes, and many of the smaller ones may be found feeding upon the honey dew covering the foliage of small eucalypts that are infested with scale insects. *Thynnus variabilis*, our commonest species, is a very handsome wasp measuring over ¾ of an inch in length, and nearly 1¾ across the outspread wings; the general colour is brown; the front of the head, hind margin of thorax, and broad bands or double dots across the abdominal segments bright yellow; the semiopaque wings reddish brown. The female,

very broad in proportion, is shorter than the male; she is reddish brown; the abdominal segments are rugose and blotched with yellow, forming transverse bars of rounded dots on the hind portion. The antennae are short and curled; the head broad, with a stout thorax; and she has short hairy legs. *Thynnus leachellus*, slightly smaller, is found in the vicinity of Sydney. The abdomen is broader and shorter in proportion; the general tint is black, richly marked on the head and thorax with bright yellow, and each of the abdominal segments carries a narrow transverse band of the same colour, broken by a dorsal stripe of black. The female is much smaller, short and thickset; is of a general reddish brown colour; the abdomen is marked with yellow blotches and bands, only the last one divided as in the male. *Thynnus flavilabris*, somewhat larger, is quite black, with only the face marked with deep yellow; the wings are dark, smoke-coloured; and the hind margin of the thorax is thickly covered with white hairs.

Thynnus brenchleyi is a type of the North Australian forms; it is nearly as large as *T. variabilis*, but has the whole upper surface smooth and shining, the hind margin of the thorax and the base of the abdomen truncate and fitting close against each other. The head and prothorax are bright yellow, the rest black. This handsome insect was described by Smith in the Zoology of the Voyage of the Curaçoa, and it was said to come from the northern coast of Western Australia; my specimens were taken near Charters Towers, North Queensland. A female, sent with this species as its mate, is black, marked on the head, sides of thorax, and abdomen with yellow, and is furnished with a curious fringe of pale buff hairs on the hind margin of the thorax, and along the front of the first abdominal segment.

In the Genus *Rhagigaster* the males are more slender in form; the abdomen, elongated and deeply constricted or corrugated at the junction of the segments, is usually black, with more or less dark coloured wings: the females are very small in proportion.

Among the most remarkable is the "Blue Ant," *Diamma bicolor*. In this case the female is most common; about Sydney I have caught scores of females, but so far have never taken a male. She measures 1 inch in length, and is of a rich metallic blue to purple colour, smooth and shining, the antennae and legs reddish brown. She is furnished with a fine pair of jaws and a powerful sting, more formidable than that of any ant, and when disturbed turns over on her back and shows fight with both jaws and sting. The male, much smaller in size, is black, with red legs and black tarsi; the wings are semitransparent with black nervures. The whole upper surface of head and thorax is rugose, and the insect very ant-like in general appearance.

Mr. Roland Turner is at present engaged in working up the Australian Thynnidae at the British Museum, having his own and my collection of specimens to identify; probably this combined collection is the largest in existence, and contains an immense number of sexed specimens collected in the field, as we have both spent a great deal of time over these typical Australian insects.

Family 16. Hairy Flower Wasps.
SCOLIIDAE

These insects are easily distinguished from the Thynnidae in being thickset hairy wasps; both sexes

are furnished with wings in which the neuration is distinct at the base, but the nervures fade out before they reach the tips; the thorax is broad, rounded in front, with a very short pedicle attaching it to the stout abdomen. The legs are stout, compressed, very hairy, and spiny, with one stout spur on the tibiae of the middle pair of legs well adapted for burrowing. The males are easily distinguished from the females in being more slender in form, with longer straight antennae (in the latter sex short, thickened, and curling round the sides of the head); and the legs are slender, with fewer spines. Several species are plentiful about the Sydney gardens and bush, where they can be easily captured on the flowers. In observations made by earlier entomologists, their life history seems to have been confused with those of the long legged sand wasps, which burrow in the ground and form regular nests provisioned with other insects and spiders; but the SCOLIIDAE form no true nest; the female burrows into the ground or under logs, where she finds the larvae or white grubs of the larger lamellicorn beetles, on which she deposits a single egg, first carefully stinging the beetle grub (according to Fabre, the French naturalist, who studied the habits of several European species). The young wasp hatching out attaches itself to the helpless grub in such a manner that it does not injure the vital organs, and by the time it has devoured its host it is ready to pupate, spinning a brown silken cocoon which fits into the cavity first occupied by the unfortunate beetle grub; when fully developed it digs its way up to the surface.

About 50 species have been described from Australia; Smith listed and described a number of new species (British Museum Catalogue

Hymenoptera 1855): Saussure described several in the same year (Memoires de la Societe de Physique, &c., Geneve), and later on others in the Annals of the Entomological Society of France 1858. In 1864 he and Sichel monographed the family: Smith described 8 more four years after: and Kirby going through the British Museum Collections in 1889 revised the Genera and added another to our list.

Discolia soror is our commonest shining black species; the female measures over 1 inch in length, and is easily identified by its beautiful, iridescent, opaque, dark blue wings. It may be often seen in our gardens on the flowers or hovering in numbers over a dead stump, looking for beetle larvae in which to deposit its eggs. *Scolia fulva* is our largest species; the female measures up to 1½ inches in length, and is broad in proportion; it is black and reddish yellow, but so thickly clothed with coarse reddish hairs that it is more the latter tint; and the semiopaque wings are reddish brown. This species is figured and described by Gray in Griffith's Animal Kingdom 1832.

Scolia radula is a smaller black species, under 1 inch in length; the head, apex of thorax, base of abdomen and most of the under-surface are clothed with grey hairs, but the hind margin of the head and dorsal surface of abdomen are clothed with reddish brown; the latter is orange yellow above, but marked with black at the base and tip.

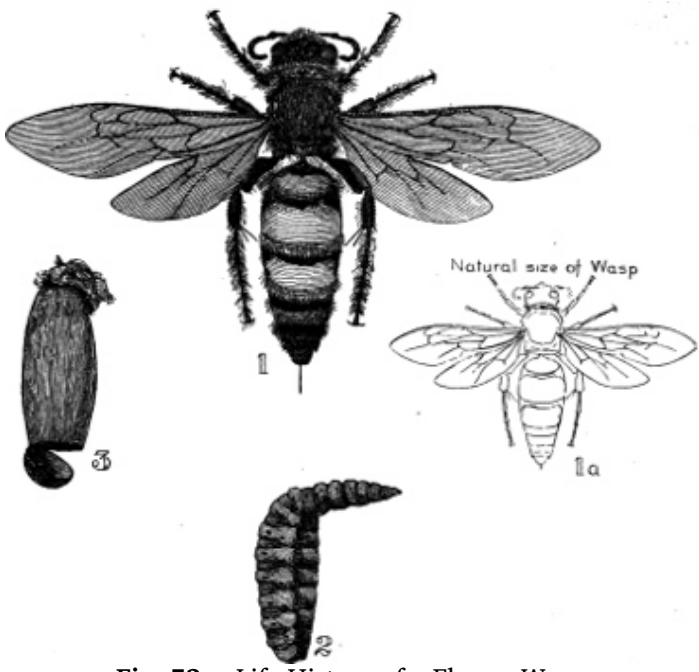


Fig. 52.—Life History of a Flower Wasp.

1. *Dielis formosa* (Guérin). ♀. (1a.—Life size.)
2. „ „ Larva.
3. Pupal Cocoon, showing opening whence the wasp has emerged.

("Agricultural Gazette," N.S.W.)

Dielis 7-cincta, one of our commonest species, often clustering in numbers on flowering shrubs in the gardens, was described by Fabricius, and is the male of *Dielis (Scolia) formosa* which was not described till 1846 by Guérin. The male, ⅔ of an inch in length, is very slender in form, of a general black colour, clothed with fine grey hairs, and marked with light yellow on the head and thorax, with five broad bands of the same colour on the body. The female, under 1 inch in length, is black,

with the abdomen marked on the upper surface with reddish yellow somewhat variable in its distribution, and clothed with reddish brown hairs, thickest on the head and thorax. This insect has been found in Queensland destroying the underground grub of the Sugar-cane Beetle (*Lepidoderma albo-hirtum*).

Family 17. Sand Wasps.

POMPILIDAE.

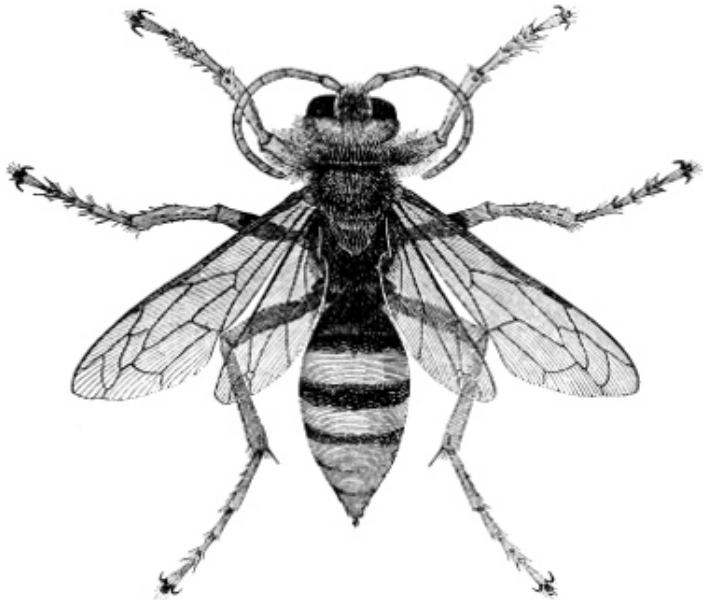


Fig. 53.—*Salius (Priocnemus) bicolor* (Fabr.).

Large sand-burrowing wasp, that attacks cicadas.

("Agricultural Gazette," N.S.W.)

This group is well represented in Australia, and widely distributed over the country; about 60 species have been described: several collected by Sir Joseph Banks in 1775 were described by Fabricius; Smith, in the Catalogue previously noticed, in a series of

papers between 1862–69 in the Transactions of the Entomological Society, other Journals, and a British Museum publication (New Species of Hymenoptera 1879) published after his death, has described most of our species; Saussure in the Hymenoptera of the Reise Novara; and later Kohl has enriched our list.

The typical genera *Pompilus* and *Salius* comprise a number of large yellow and black wasps with coloured wings tipped with black. They have long legs well adapted for running over the ground, and may be seen any warm sunny morning hunting about for spiders, with their antennae and wings constantly on the move as they rush about. They will attack the largest spider whether on the ground or hidden in a tree trunk; one large black undetermined species even ventures down the nests of the Trap-door Spiders and drags them forth. Sometimes one of the larger ground spiders shows fight, and it becomes a duel to the death, the wasp now and then being captured by its intended victim. They often place the spider in any suitable cavity with their eggs, but others form extensive burrows in the soil. *Salius (Priocnemus) bicolor* is one of our largest yellow and black species, often measuring 2 inches across the wings, but variable both in colouration and size. She forms a burrow as large as a mouse hole, several feet in length, with quite a large mound of excavated soil outside the entrance; when emerging from the chamber she looks a most formidable creature, but unless captured never attempts to attack anyone. She sometimes stores her nest with cicadas many times larger than herself, which she rides down to their tomb before they are quite dead. The young larva is usually attached to the cicada's breast when hatched out; but I have never been able to keep any alive after being dug out of the nest. This wasp has a

curious habit of flying round and dragging a cicada off a branch when it is sucking up the sap; taking its place, she calmly stands over the spot and drinks up the sap that exudes from the puncture the dispossessed cicada had made in the bark. The members of the Genus *Pepsis* are large black wasps with a beautiful metallic lustre on the wings; they are chiefly confined to the tropics, but Saussure has described one species, *P. australis*, from this country.

Family 18. Smaller Sand Wasps.

SPHEGIDAE.

Westwood placed these wasps and the POMPILIDAE in a single family, but Kohl, while separating the latter, has grouped a number that were once ranked as families, under the SPHEGIDAE, calling them simply sub-families, thus making this a much more extensive division, the SPHEGIDAE proper forming only a part of the whole.

Dalla Torre in his Catalogue treats them as a sub-division of the CRABRONIDAE; but Sharp takes Kohl's classification, which I follow.

The *Sphegides* are easily distinguished by the peculiar structure of the abdomen; the basal portion is produced into a slender rod-like stalk or pedicle, with the apical part forming a rounded or oval tip; they are very active creatures with the habits of the larger sand wasps.

The world-wide Genus *Ammophila* is represented in Australia by four described species; they make their nests in sandy ground, digging out a straight burrow with an enlarged chamber at the end, which they store with different kinds of caterpillars they

capture on the plants while hunting; these they sting but do not kill, but though paralysed and incapable of motion, remain alive long enough to furnish the baby wasps with a supply of fresh food.

Ammophila suspiciosa is a slender black insect under 1 inch in length; the thickened tip of the abdomen is dull red. This is our common species found all over the western country. *A. instabilis* is a larger black species with semiopaque wings and reddish legs; the tubular portion of the body and base of the thickened part are reddish brown: this one is a northern form found in Queensland.

Pelopaeus laetus is a very handsome black and yellow wasp with a somewhat similar shaped body tipped with black; it is very variable in size, the largest measuring about 1 inch in length. It has a wide range over Australia, and differs from the former insects in being a regular "mud dauber," forming a regular clay nest consisting of a number of different cells, each of which is filled with paralysed spiders. It is a very friendly insect, often flying into the room on a summer day; and will build its nest on the edge of a roof or wall.

The typical Genus *Sphex* contains a number of fine black wasps more or less clothed with silver or golden pubescence on the head and thorax, with the slender pedicle at the base of the thorax very well defined, and the hind portion of the abdomen almost round or oval. They form underground burrows branching out into a chamber at the end, in which they store all kinds of different insects, each species seeming to have a preference for its particular choice. *Sphex vestita*, one of our largest species, has the face thickly clothed with silvery pubescence; it is often common in sandy patches in gardens, where it

hunts for small orthopterous insects, and is particularly fond of a species of small brown cricket which lives in the long grass. *S. opulenta* is a smaller species about ¾ of an inch in length, with the face and back of the thorax bright silver, and the dorsal surface of the latter coppery. About 30 species are described from Australia, some of which have a very wide range over the interior.

The LARRIDES are medium sized black wasps with the abdomen not stalked, but coming to a point at the junction with the thorax, and often ornamented with golden or silvery pubescence forming bands on the body.

Shuckard described a number of our species belonging to the Genus *Pison* (Trans. Ent. Society 1837–40), where he gives some account of the group. Smith in the same Transactions, 1869, catalogued those previously described, and added a number of new species; and also added the Genus *Parapison*, containing species from India, Ceylon and Australia. The European *Tachytes*, which Westwood says are captured in sand banks, are represented here by three species, all shining black insects about ½ an inch in length. Saussure (1855), and Kohl later have described others.

Pison spinolae and *P. decipiens* are both black wasps with silvery bands upon the sides of the abdomen; the latter are the smaller. They are both common about Sydney, and have a very wide range over the country; they are very fearless insects, flying into the house, and wherever they come upon a convenient hole in the rung of a chair, or even a key hole, will set to work and line it with clay, forming an irregular chamber, which they store with small spiders, deposit the egg, and after closing it up fly

away quite satisfied. Sometimes they form a row of round clay cells on a coat or other garment hanging on a wall.

The NYSSONIDES comprise a smaller group of closely allied forms, differing chiefly in the venation of the wings. Smith has described most of our species. The members of the Genus *Gorytes* are represented by five described species; all small, active, bee-like insects with coppery fasciae upon the abdomen; several of these are known in the bush as "policemen flies" from their habit of coming round and catching flies upon one's clothes and even snapping one off the back of one's hand; these flies are killed with their stout jaws and deposited in their nests constructed in the ground.

The curious, large, reddish brown wasp, *Stizus pectoralis*, from Queensland, at first sight might be taken for a *Thynnus*, but the distinct form of the body, and the antennae thickened toward the tips, show that it could not belong to the flower wasps. It is now placed in the allied Genus *Sphecius*.

The PHILANTHIDES are easily distinguished from the other groups by the curious rugose or punctured integument which makes them look as though coated with armour plate, and the curious constrictions or rings between the abdominal segments, becoming smallest toward the tip. They are generally black or reddish brown, marked with pale yellow spots and bands. With the exception of one species of the Genus *Philanthus* all ours have been placed in the world-wide Genus *Cerceris*. I have generally captured them about flowers, or flying round bushes infested with scale insects that were throwing off honey dew, which sweet secretion has a great attraction for small hymenoptera of many different families. Eight

species are described by Smith and Saussure; there are probably many new species to be recorded. Nothing is known about their habits in this country, but the European species form nests in the ground, which they provision with small beetles; and each species is said to confine its attention to a different group of beetles; one uses only small weevils; another carries off chrysomalids, and so on with each species.

The CRABRONIDES are another small group, and under the present classification all our species have been placed by Smith in the world-wide Genus *Crabro*. They are medium sized black wasps with broad stout heads and unstalked bodies, generally banded with orange, red, or yellow; they form burrows in the stems of plants, which they store with captured flies. Five species have been described from Australia and Tasmania.

The BEMBECIDES are very handsome, smooth, shining wasps of fair size, with broad bodies, rounded and broadly pointed at the extremity. They are generally met with along sandy pathways and roads, flitting along in front of one, settling on the ground and rising again, so that they are easily captured with a net. They make shallow burrows on the roadside in which they place flies, which they capture with their powerful jaws.

Nearly all our species have been described by Smith in the British Museum Catalogue Hymenoptera 1856, and the Annals and Magazine of Natural History 1873. Under 20 species are recorded from Australia. *Bembex tridentifera* was described by Smith from Moreton Bay, Queensland, but it has a wide range southwards to Victoria. It measures just under ¾ of an inch in length; is of a general black colour;

the face yellow with a black trident-like mark above and two black spots below the antennae; the legs yellow lightly marked with black; the upper surface of the thorax spotted and barred with yellow, and the abdomen beautifully banded with irregular white bands on the 2nd to 4th segments, with the first and last only marked on the sides. *B. vespiformis* ranges from West Australia to S. Australia, is somewhat smaller than the last, and viewed from above is black, with very faint markings on the thorax, and a broad white band on either side of the first segment of the abdomen almost meeting on the back.

DIPLOPTERA.

The true wasps have the antennae generally elbowed and thickened toward the tips, and the eyes notched. They have the wings folded like a fan in repose, but can fly well, and have legs and feet adapted for walking. Some species are solitary in their habits, and consist of males and females only; others live in large communities, and, like the ants, comprise males, females, and workers, the latter aborted females.

Family 19. Solitary Wasps.

EUMENIDAE.

This group is well represented in Australia; they are well known to residents in the country from their habit of constructing clay nests under the shelter of the verandah or the eaves of the houses. They usually appear in pairs, and rapidly build up the structure, flying backward and forward with their earthen loads; from this habit they get the name of “Mud Daubers” in America, and “Mason Wasps” in

this country. A number of our species are described and figured in Saussure's "Monograph des Guepes Solitaires" published in 1851.

The Genus *Eumenes* contains a number of very handsome insects that are easily recognised from the basal portion of the abdomen forming a more or less slender stalk, and the apical portion rounded at the junction and tapering to a sharp point at the tip. They build clay nests containing a number of cells, and store them with caterpillars, which they do not appear to be able to paralyse in the same manner as the large sand wasps, for they are capable of movement after they are enclosed in the cell. By some wonderful instinct, the female wasp does not deposit her egg haphazard among the wriggling grubs that would easily damage it, but suspends it by a fine stalk to the roof of the cell in such a manner, that when the little wasp larva hatches out, it can safely reach down and feed upon the nearest caterpillar, until it has finished the last bit, when it spins a thin parchment cocoon and pupates in the cavity which before was its larder.

Eumenes bicincta has a wide range over Australia; it measures about 1 inch in length; the stalk is not quite so long as the base of the abdomen, and is of a uniform deep orange yellow colour, with the top of the head, centre of thorax, and broad band in the middle of the abdomen black. *Eumenes latreillei*, a larger species, has the stalk of the abdomen shorter and thickened, with the basal half of the body from the stalk black. *Eumenes servillei*, the smallest of the three, is more slender in shape, has more black upon the thorax, and the stalked portion of the body is variegated with black. *Eumenes arcuatus* is a more northern species common in Queensland; it measures

over 1 inch in length, and is the only one with blackish wings; it has a very long slender stalked abdomen. It is black, mottled on the head and thorax with yellow; and the abdominal segments are barred on either side with yellow, which appear to form regular slender bands across, but do not actually meet in the centre.

Two of our handsomest mason wasps belonging to the Genus *Abispa* measure 1 inch in length, but are so stout in form that they appear much larger; they are black and deep orange yellow, with dull yellow wings tipped with black, and the stout broad thorax fits close against the base of the abdomen. *Abispa splendida* has the front half of the first abdominal segment black, with the hind portion yellow, while in *Abispa ephippium* the whole of the first abdominal segment is yellow. They both build very large, solid, clay nests generally containing two rows of cells, about 6 in number, above each other, with thick partitions between them; the outer surface is rounded on the sides; each cell is stored with caterpillars upon which the larva feeds, and finally pupates in a reddish brown parchment-like cocoon.

The Genus *Rhynchium* comprises about six described species, handsome insects not unlike the former in general form, but with the abdomen more tapering. *Rhynchium mirabile* measures ¾ of an inch in length; it is of a general black colour, the head marked with, and collar of thorax, yellow; and the hind margin of the abdominal segments is ringed with slender bands of orange yellow. *Rhynchium superbum* is a smaller insect of similar form and colour, with the basal half of the abdomen black and the hind portion rich yellow. Both these species come from Queensland.

The Genus *Odynerus* contains a great number of small thickset wasps, that make clay nests of various shapes, sometimes very delicate in structure, forming a finger-shaped row of clay cells or rounded cup-shaped chambers; while some species make use of a hole in the wood or wall and simply coat it over with clay. Australia is rich in species, some of which have a very wide range. *Odynerus bicolor*, one of our commonest species, is black, with the collar of the thorax, legs, and all the abdomen except the basal segment, dull reddish yellow. *Odynerus nigro-cinctus* is of a general dark orange yellow colour, with the head and centre of abdomen black. The closely allied species forming the Genus *Alastor* differ slightly in the venation of the wings, but their habits are identical; about 30 species have been described from Australia, chiefly by Saussure, some of which are figured in colours in his Monograph. These wasps may be captured round water-holes in the summer months, and may sometimes be found resting upon grass stalks in the early morning.

Family 20. Social or Paper-nest Wasps.

VESPIDAE.

These typical wasps are found all over the world, and next to the bees have probably received more attention from the casual observer than most of the other groups. Each community consists of males, females, and workers, and though the structure of their nests differs considerably in the various groups, the social economy is the same. The female first starting the nest constructs a stout stalk at the apex attached to a twig or roof, and constructs a six-sided cell from which the whole mushroom-shaped nest is built. In each little cell she deposits an egg from

which the legless white grub emerges, attaches itself to the roof of the cell and hangs head downward, being fed by the mother wasp until full grown with food chiefly composed of masticated spiders, when it pupates under a silken cover spun over the apex of the cell. As soon as it emerges it sets to work to help on the nest, so that the community rapidly increases in numbers. The nest of *Polistes tasmaniensis* sometimes measures six inches in diameter. Some confusion as to the identity of this species and *P. variabilis* seems to exist, but from Saussure's description, our common species appears to be *P. tasmaniensis*.

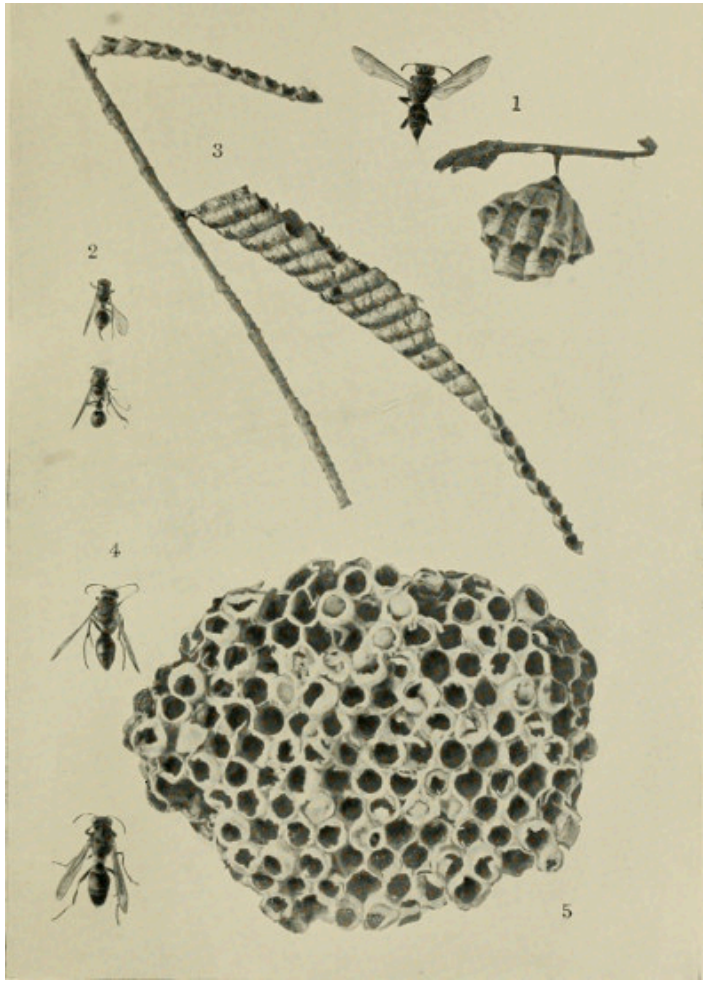
Plate XV.—HYMENOPTERA.

Family VESPIDAE.

1 & 5. Nests of *Polistes tasmaniensis*.
2. *Icaria gregaria* (Sauss.).
3. Slender nest typical of Genus *Icaria*.
4. *Polistes tasmaniensis* (Sauss.).

(Original photo. Burton.)]

Plate XV.—HYMENOPTERA.



The widespread Genus *Vespa*, though it is recorded from as far down as Java, is unknown in Australia. We have however allied species belonging to the genera *Icaria* and *Polistes*. Those of the genus *Icaria* are the smaller wasps, the largest well under ½ an inch in length; most of them are reddish brown, or mottled with black and yellow; the abdomen is contracted into a stalk at the base, then becomes

rounded, with the apical segments small and telescopic, so that when retracted it looks as if it were damaged. They all form similar nests commencing with the usual stalk, but, unlike the larger *Polistes*, the cells follow on in rows, forming finger-like nests. *Icaria gregaria*, our commonest species, forms these slender nests up to six inches in length. It is a dull reddish brown wasp mottled with black on the thorax and legs, with the apex of the abdomen lightest in colour.

Some of the members of the Genus *Polistes* grow to a considerable size, and armed with a powerful sting are very formidable insects; several of the largest form small stalked nests on the under-side of fallen logs; when hunting for insects and turning over dead wood one is liable to disturb a family party and find it wise to beat a hasty retreat. They differ from the previous group in having no stalk to the abdomen, which is very slender at the base, rounded to the middle and tapers to a pointed apex. *Polistes tasmaniensis*, our most sociable species, is very fond of building her large nest (previously noticed) under one's verandah, or the porch over the door, and is quite ready to attack any one when disturbed. It is one of the smallest species, measuring under ¾ of an inch in length; is of a general dark brown colour marked with reddish brown; the abdomen is irregularly banded, with the first basal band finest. *Polistes tepidus*, one of our largest wasps, is almost black, with face, tips of legs, and thorax marked with dark orange yellow, and the abdomen banded with rusty red. *Polistes humilis* is of an almost uniform yellowish brown tint, with the face marked with black. In the Queensland Museum there are some very large paper-nests of some undetermined wasps that have a regular comb-like structure containing

thousands of cells, and which are several feet in length.

Family 21. Shining Wasps.

MASARIDAE.

These curious wasps stand quite alone as the last group of the true Vespidae, and are a comparatively small family, comprising several distinctive genera containing altogether sixty species found in the Mediterranean region, South and North America, and Australia.

They are wasp-like in waist, with the antennae thickened toward the tips or clubbed; the wings contain two sub-marginal cells; and the feet are furnished with curious toothed or rather hooked claws. The European species are known to build nests in the ground, forming a tunnel ending in a clay cell in which the larvae live and are fed by the mother in the same manner as the true wasps forming the papery nests; others construct clay chambers attached to twigs.

Shuckard when he formed the typical Australian Genus *Paragia* named it “in allusion to its deceptive habit, which is precisely that of a Vespa.” Saussure wrote a monograph on the Masaridae forming the third part of the Vespidae published in 1856; Smith has also contributed to our knowledge of Australian species in the British Museum Catalogue 1857, and subsequently in several papers in the Entomological Society of London between 1864–1869.

Seventeen species have been described in the Genus *Paragia*, but nothing has been recorded about their habits or life history: several are described from Tasmania and New South Wales, but all the

specimens in my collection come from the northern part of Australia.

Paragia decipiens was described and figured by Shuckard in the Transactions of the Entomological Society, 1837; it measures under ¾ of an inch in length, and is of a general black colour, with the front and sides of the thorax spotted with yellow, and the whole of the smooth rounded abdomen of the same bright colour except the base, which is black; the wings are smoky brown, with the nervures black. *Paragia bicolor* is a larger insect measuring nearly 1 inch in length; the head and thorax are black, and the abdomen bright metallic blue; the under surface and sides of the first three segments, and the base of the thorax, are marked with bright yellow.

Family 22. Bees.

ANTHOPHILA or APIDAE.

The Australian region is rich in bees peculiar to the country; and while we have representatives of many of the foreign groups, yet several well-known genera, such as *Apis*, *Bombus*, *Eucera*, *Colletes* and *Osmia*, though ranging over the greater part of the world, are unknown in Australia.

The classification of the bees is still somewhat unsatisfactory. Latreille termed them MELLIFERA, honey gatherers, or ANTHOPHILA, lovers of flowers: Westwood and others, while keeping this as a group name, subdivided them into two large families, ANDRENIDAE, short-tongued bees, and APIDAE, long-tongued bees, dividing the last family into five smaller groups based upon their different structure and habits. The European bees have been since

placed under six headings; while in Dalla Torre's Catalogue dealing with the bees of the whole world, there are no less than fourteen sub-families. Most of our species have been described by Smith, in the British Museum Catalogue, Hymenoptera 1853; others in the Transactions of the Entomological Society 1862–68, and New Species, British Museum 1879. Cockerell (Ann. & Mag. Nat. History 1905) described a number of new species of our bees examined by him in the British Museum Collections, and added some interesting information on species already described; as many of these specimens were collected by Turner, Walker, and myself and sent to the British Museum, the Australian localities are given.

None of the short-tongued bees store up honey, but form cells or burrows in the ground, walls, cavities in rocks, or the stems of plants, in which they form a row of cells or little chambers each containing an egg and sufficient bee bread for the development of the larva. Some of these bees are parasitic, and live at the expense of the industrious species, crawling into the open nests and laying their eggs upon the food supply of the rightful occupant; these are popularly known as "cuckoo bees."

The members of the Genus *Prosopis* are handsome, shining black or steel blue bees, marked with bright yellow upon the face and thorax. With the additions that Cockerell has made to the list, nearly fifty species are described from Australia, and a number are common in the vicinity of Sydney. *Prosopis vidua*, our largest species, but considerably smaller than the honey bee, is found upon the crimson flowers of the bottlebrush (*Callistemon*). It has the head and thorax black, with a yellow spot on the face and the base of

each fore wing; the abdomen is bright metallic blue. A smaller undetermined species may be often noticed hovering round and entering holes in the soft sandstone rocks where it appears to nest. *Prosopis metallica*, a shining black species, smaller than *P. vidua*, with face and shoulders broadly marked with yellow, was bred out of a row of half a dozen brown papery cocoons placed in an empty burrow formed in the branch of a wattle tree by the larva of some longicorn beetle.

Lamprocolletes plumosus and several other species of the genus frequent the flowers of the Leptospermum. It is a handsome dark brown bee, under ½ an inch in length. The abdomen has a metallic sheen, and the head and thorax are clothed with fine down.

Hylaeoides concinnus is a very remarkable looking black bee, with clouded smoky wings, marked with bright red on the face, and with bands of the same colour on the base and tip of the abdomen. I have usually captured this bee upon bushes; it bears such a decided superficial resemblance to a small clay nesting (*Odynerus*) wasp, that this may be a case of protective mimicry. The Genus *Paracolletes* has been added to by Cockerell, who describes twelve new species in his recent papers. *Paracolletes crassipes* was described by Smith from W. Australia, but it is common on low scrub in the early part of the year on the Blue Mountains N.S.W. It is a handsome black bee about ½ an inch in length, with the head and thorax thickly clothed with pale buff hairs, and the abdominal segments banded on the upper surface with dull brown.

Gastropsis (Oestropsis) pubescens is nearly as large as a honey bee, with curious thickened antennae,

slender at the basal joint. It is somewhat flattened on the upper surface and clothed all over with a dense coat of pale buff coloured hairs, only showing indistinct brown bars on the abdomen. I know nothing about the habits of this curious bee; it has been described from Western and South Australia.

The Genus *Halictus* is represented by about thirty described species; nothing has been recorded about the habits of our species, but most of the European form galleries in the ground connected with a large excavation or chamber in which the larvae are placed in cells. *Halictus floralis* is a small bee with a reddish brown body; the front of the head, antennae, legs, front and middle of thorax are light yellow. *H. bicingulatus* is black with the legs reddish brown, and the segmental divisions of the abdomen light coloured. They are found on grass and field flowers. *Nomia australica*, under ½ an inch in length, is common on the flowers of the *Leptospermum*; it is a dull, metallic blue bee with antennae, labrum, legs, and extreme tip of abdomen reddish brown. The latter has a greenish sheen, and is somewhat heart shaped, terminating in a fine point. Cockerell has added six new species to our list, most of which are described from Queensland.

Exoneura froggatti is a little bee not much over ¼ of an inch in length, black with smoky rings, reddish legs and a curiously sack-shaped reddish brown abdomen, broadest near the apex, but contracted to a point at the tip. I have frequently cut them out of small burrows in the dead stems of wattle trees. *Exoneura bicolor* is a slightly larger species, with a darker, broader abdomen, and it comes from Queensland. Cockerell has added three more new species, all from the neighbourhood of Sydney. The

great Carpenter Bees of the Genus *Xylocopa* are represented by four species, which are more common in Queensland and the northern parts of Australia; but one species at least, *Xylocopa aestuans*, ranges southwards. It is of the typical broad form with dark coloured wings; the upper surface of the thorax is clothed with yellow, other portions with black hairs. *Xylocopa bryorum* is a larger species measuring about 1 inch in length, with a wing expanse of nearly two; the whole of the upper surface is thickly clothed with golden yellow hairs, the brown beneath giving it a greenish tint. The wings are light brown with black nervures, and the hairs on the legs and under-surface are dark brown to black.

The closely allied Carpenter Bees of the Genus *Lestis* are peculiar to Australia. The male of *Lestis bombylans* measures over ½ an inch in length, and is of a rich metallic green, with the front of the face striped with white; the thorax and base of abdomen are clothed with golden hairs, those on the front of the thorax forming a double bar; the hairs on the front pair of legs yellow, those on the hind pair black; the wings are brown with faint iridescence. The female has the face silvery, but no yellow down upon the thorax; the abdomen is deep purple; and the wings almost opaque, varying from dark brown to rich metallic violet colour in different lights. The second species, *Lestis aerata*, is slightly larger, with the stripe on the face of the male yellow, and all the legs fringed with yellow pubescence, while the female is of a uniform brassy green, with wings light coloured, more like those of the males, and only showing a slight iridescence. Both species have a wide range; those about Sydney form their nests in the dead flower stalks of the grass trees (*Xanthorrhoea*). It begins by boring a circular hole

3½ lines in diameter towards the centre, then turns downward, excavating all the pith to a depth of about 4 inches, and then works out about the same distance above the opening, so that the full length of the chamber is 8 inches, with an average of ½ an inch in diameter. This is divided off into a row of cells, each about ½ an inch in length, with a ball of bee bread and an egg deposited in the far end; each cell is separated by a stout wad of triturated pith. I have never found the centre of the chamber in front of the opening closed up with cells, a space always being left unoccupied on both sides. The larvae are of the usual cylindrical form, attenuated at the extremities, and of a dull white colour, about ½ an inch in length, and can be found in all stages of development in November. The pretty banded bees, formerly known under the name of *Anthophora*, but now placed in the Genus *Podalirius*, are world wide in their range. All our species have the head and thorax clothed with a dense coat of buff or pale yellow hairs, and the body banded with black and blue of various tints. *Podalirius emendatus*, our largest species, is found on the northern rivers of N.S. Wales and is common in Queensland; it has the head and thorax covered with rusty red pubescence, and the low abdominal bands broad. *P. cingulatus* is slightly smaller, with the pubescence pale buff, the abdominal bands much the same; *P. pulcher*, much smaller, with the pubescence darker, is our commonest species about Sydney. *P. aeruginosus* has the whole of the abdomen as well as the head and thorax thickly clothed with a dull greenish yellow pubescence. My specimens of this species come from Mackay, Queensland. Five new species are added to this genus by Cockerell.

The Genus *Crocisa* contains a few very handsome

moderate sized bees of a uniform black colour with smoky rings, and brightly marked bodies. *Crocisa albo-maculata*, our largest species, has the face, upper and under surface, and legs thickly marked and spotted with white pubescence. It is a somewhat rare insect about Sydney. *C. lamprosoma* is a smaller bee with the marks and spots pale blue, those upon the abdomen forming a more regular pattern of four well defined rows. In *C. nitidula* the pubescence forms rich metallic blue spots and blotches, most brilliant on the upper surface of the abdomen, where they run right round the basal segment and form a regular row of short bands on either side but not meeting on the dorsal surface. It is found in New South Wales and Queensland.

Plate XVI.—HYMENOPTERA.

Family APIDAE.

1. *Xylocopa aestuans* (Linn.). ♂.
1. *Xylocopa aestuans* (Linn.). ♀.
2. *Lestis aeratus* (Smith). ♀.
2. *Lestis aeratus* (Smith). ♂.
5. *Crocisa nitidula* (Fabr.).
6. *Crocisa lamprosoma* (Boisd.).
7. *Sarapoda bombiformis* (Smith).
8. *Megachile pictiventris* (Smith).
9. *Megachile blackburni* (Froggatt).

Family ANDRENIDAE.

3. *Hyleoides concinna* (Fabr.). ♀.
10. *Paracolletes crassipes* (Smith).

Family EUMENIDAE.

4. *Abispa splendida* (Guérin).
11. *Odynerus nigro-cinctus* (Saussure).
12. *Rhynchium mirabile* (Saussure).
14. *Eumenes arcuatus* (Fabr.).

Family SPHEGIDAE.

13. *Ammophila impatiens* (Smith).

Family PHILANTHIDAE.

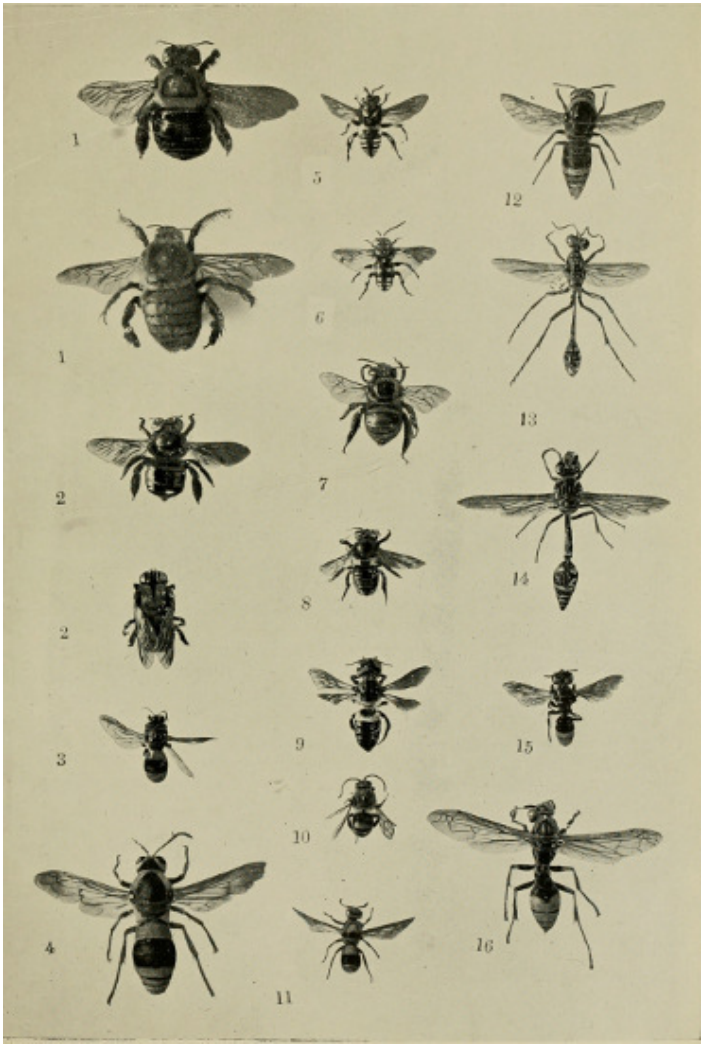
15. *Cerceris sp.*

Family VESPIDAE.

16. *Polistes tepidus* (Fabr.).

(Original photo. Burton.)

Plate XVI.—HYMENOPTERA.



The great Genus *Megachile* contains the leaf-cutting bees, so called from the curious habit they have of cutting circular pieces out of the leaves of growing plants with which they line their nests; these are sometimes built in excavations in old walls, or dead wood, or simply constructed like a cigar

under stones. About 30 species have been described from Australia; the two largest are *Megachile monstrosa*, figured in Brenchley's "Cruise of the Curaçoa," published in 1873; and *M. blackburni*, described by me from specimens obtained from Central Australia by the Elder Exploring Expedition. *Megachile mystacea*, a medium sized species found in Queensland and Northern Australia, is also recorded from India; it is black, with the head and face clothed with silvery hairs, and the whole of the abdomen covered with rich reddish brown pubescence; while *M. pictiventris* has the hind margin of the thorax clothed with silvery hairs, the apical half of the under-surface with reddish brown hairs which extend to form a fringe round the extremity. *M. chrysopyga* is a native of Tasmania and Victoria. I found a nest of this species under a stone in the latter State, which could be lifted up bodily without breaking. It was about the shape and length of an ordinary cigar, and consisted of about nine cells containing the larvae. These cells, like a series of shallow thimbles, were enfolded in the outer shell of looser leaf.

The Genus *Coelioxys* comprises a number of curious bees that in general appearance are so very like the "leaf cutters," that a French naturalist having bred one out of a Megachile's nest described it as the male form of the species. They are now known to be parasitic in the nests of these bees in Europe, so that the similarity in form may be of great protective value to them. They differ chiefly in the form of the abdomen, which in the males is produced into forked spines at the extremity, and in the females into a sharp point.

I have two undetermined species in my collection

from Queensland obtained some years ago, but until last year the presence of this group had not been recorded from Australia. Cockerell recorded (1905) two species from this country; *Coelioxys albolineata*, measuring about ⅓ of an inch in length, comes from Queensland, and is of the usually grey and brown tints.

The last group we have to deal with are the Australian stingless honey bees, belonging to the Genus *Trigona*, which range all over Australia. They collect quantities of dark coloured somewhat acid flavoured honey, which they store up in little jug-shaped cells of dark brown wax, forming an irregular comb attached to the walls of the cavity in which they have constructed their hive by a network of irregular rods of wax. They generally choose a cavity in the heart of a large gum-tree with a small opening from the outside, and before commencing to make their comb they plaster up all the cracks and inequalities of the chamber with the sticky sap or gum of the Turpentine Tree (*Syncarpia*). This chamber is usually about the size of a man's head, and the comb as a rule contains not more than a pint or two of honey. This is the typical nest found in N.S. Wales, but in the tropical scrubs of North Queensland many of them form a small funnel or spout projecting round the opening, composed of a waxy-substance an inch or more in length. As the green tree ants often capture these bees and are always swarming over the tree trunks, this is probably a necessary protection. The honey gatherers of *Trigona carbonaria*, our common species, are black, thickset little bees measuring about ⅛ of an inch in length. They are fearless little creatures when at work, and will allow themselves to be picked off the flowers without any attempt to fly. Several species

have been recently added to our fauna, and though Dalla-Torre in his Catalogue places the members of the genus Trigona in the *Melipona*, which until then had only contained the allied stingless bees of South America and the tropics, Cockerell retains them in the old genus, describing a new species from Port Essington, and recording a species known in Ceylon (*Trigona canifrons*) also from the north coast of Australia.

Order V.—COLEOPTERA.

Beetles.

This group is the best known of all the orders, for nearly every entomologist starts collecting as a "beetle hunter." They are the most frequently observed because they are found everywhere; there is hardly a log or stone that does not shelter some beetle; they infest all kinds of timber, damage the living trees in the forest, devour foodstuffs, stored grain, skins, furs and drugs; others are attracted to all kinds of decaying animal or vegetable matter; while hundreds either in the larval or perfect state are to be found all through the year upon the flowers, foliage, or bark of trees and plants.

Thus they are readily collected, and when obtained are much more easy to look after and keep than the more delicate insects, on account of their stout horny structure.

Beetles are typical insects in that the head, thorax, and abdomen are very well defined, and can be readily distinguished from each other; the insect is more or less protected with a stout horny integument. But the joints are flexible, so that though the parts fit close and the body appears ensheathed in regular armour plate, most of the species are very active. They are all furnished with cutting, biting, or chewing jaws, and are therefore called mandibulate insects; and with very few exceptions have well developed eyes and antennae, the latter produced into all kinds of curious shapes in some groups, but usually slender, filiform and many

jointed. The thorax consists of one solid segment, the three portions, so apparent in some insects, being soldered together to form one uniform mass when viewed from above. The large abdomen is said to contain ten distinct segments on dissection, but when viewed from the under-surface generally only five can be seen. Instead of the thin flying, or membranous fore-wings of other insects, the first pair in the beetles are transformed into two horny plates completely covering the dorsal surface of the abdomen and called the elytra. When at rest they fit close together over the back, but can be readily opened out in flight. Though of little use in flying, they probably assist a large heavy beetle in balancing or steering through the air, and always cover the two large pointed membranous hind flying wings, which when not in use are folded up beneath them. In some beetles the elytra are not divided, but form a solid shield; and the hind wings are wanting, or if they exist are simple pads. The various families have the head, mouth parts, and legs admirably adapted to their different habits and diet.

Their larvae are also as variable in form as the perfect insects; many are active, slender grubs with three pairs of legs, and large powerful jaws, as in the carnivorous species; elongate cylindrical jointed creatures with scaly heads, or short and wrinkled grubs like the wood borers; others quite slug-like feed upon the surface of the foliage; and a few are clothed with fine hairs.

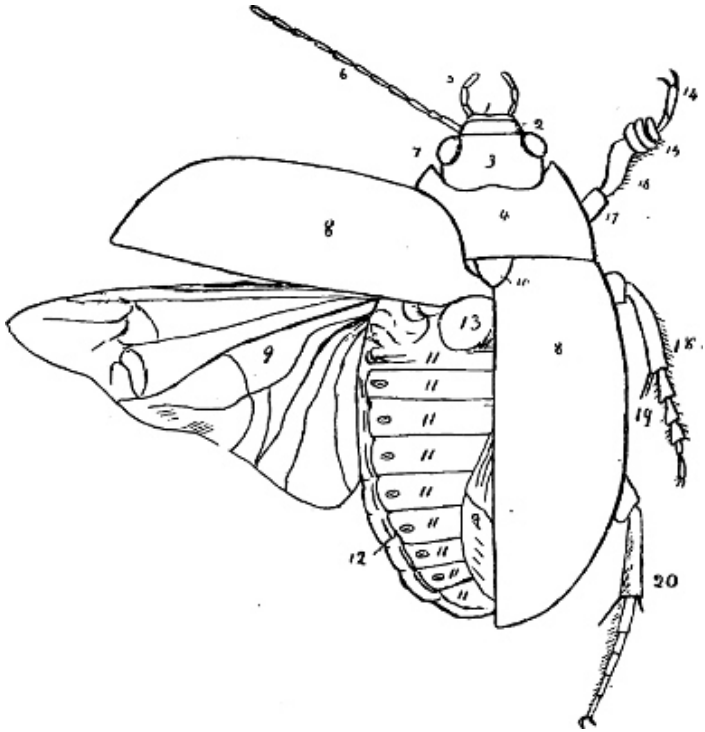


Fig. 54.—Diagram of a Water-Beetle, showing the Dorsal surface.

1, Labrum; 2, clypeus; 3, head; 4, prothorax; 5, maxillary palpus; 6, antennae; 7, eyes; 8, elytron; 9, wings; 10, scutellum; 11, abdominal segments; 12, scutellum of the metathorax; 13, claws of the feet or the fore leg; 14, tarsus; 15, tibia; 16, femur; 17, middle leg; 18, spines or spurs on tibia; 19, tarsus; 20, hind leg.

(Redrawn from Westwood [Griffiths' Animal Kingdom].)

In the pupal state, for all beetles undergo a complete metamorphosis, they are inactive, mummy-like creatures showing the outlines of the future beetle, with the wings, antennae, and legs closely folded down, and the whole enveloped in a thin membrane. Some form regular cocoons from the

material among which they feed; others seal up at both ends the cavity in which they have been feeding before they pupate; but many do not even take this precaution.

The classification of the Coleoptera has been undertaken by many entomologists. In Gemminger and Harold's great Catalogue of the Coleoptera, seventy-five families were enumerated; Sharp has recently adopted eighty, but when it comes to the larger sub-divisions none of them agree. Westwood in his Classification has an alarming array of sections, tribes, stirps, and sub-families: Kirby gives fourteen sections in his Text Book; while Sharp simplifies the matter by forming six series, some of them on the old lines, but his third series is apparently more of a dumping ground than anything else for those that will not fit into the other five, for it includes such dissimilar families as the Staphylinidae, Buprestidae, Coccinellidae and many others.

As Masters' Catalogue of the Described Coleoptera of Australia is the list used by all Australian collectors, I shall follow his grouping of the families (originally based on that of Gemminger and Harold), defining the groups of each important or distinct family, though through want of space many of them can be only briefly noticed.

There have been so many describers of Australian beetles, that their names alone would take some enumerating; so that I propose to omit them here and notice them later on when dealing with the families upon which they have worked. Australia is rich in large and handsome specimens, which attracted the attention of the colonists at a very early date in the history of the country, and quite a

number of collections were made and the specimens forwarded to England. Most of the exploring expeditions that traversed the back country had a collector of some sort on their staff, and it was usually beetles that formed the bulk of the entomological specimens obtained. Again the Scientific Exploring Ships, fitted out by our own and foreign countries, that visited the different ports, collected many zoological specimens, so that many of our larger beetles were known and described many years ago. Over 7,200 are listed in Masters' Catalogue, and since its publication some thousands have been added to our list.

Family 1. Tiger Beetles.

CICINDELIDAE.

This family is well represented in Australia by about forty-five species, chiefly described by Macleay (Trans. Ent. Soc. N.S.W. 1871), and later on (Proc. Linn. Soc. N.S.W., 1887–8); and Count Castelnau (Trans. Royal Soc. Victoria). The typical Tiger Beetles are slender graceful insects, with broad short heads, furnished with large projecting eyes, and great powerful jaws; the thorax is produced into a cylindrical neck; and the short rounded elytra cover large wings.



Fig. 55.—*Megacephala cylindrica* (Macleay).

The Metallic Green Tiger Beetle.

(Original photo. Burton.)

The larvae are elongated creatures, with large curving jaws; they live in burrows in the ground, generally in the vicinity of a waterhole or creek where there is a sandy shore; here they remain hidden during the day, and come out at night to capture and devour the less powerful insects they come across. One of our largest and most handsome species is *Megacephala cylindrica*, found in the western country, where it hides deep down in the cracks of the soil; it lives chiefly upon ants. It measures over ¾ of an inch in length, and is of a rich metallic green colour: the mouth, antennae and legs are brownish yellow. A second species, *M. frenchi*, has been recently described by Sloane, and ranges from North West Queensland into Western Australia. The Genus *Tetracha* contains a number of handsome, shorter, broad-bodied Tiger Beetles with green metallic tints and reddish brown or yellow legs, and

similar coloured markings on the wing covers. They form burrows, like their larvae, along the sandy margins of rivers and water-holes, coming out and running along the water's edge at twilight, and often flying into the lamp at night. *Tetracha australis* has a wide range from the Murray river to the interior; I have dug them out of the sand round an artesian bore near the Queensland border. It is smaller than the previously described one, which it somewhat resembles in general colour, but can be easily distinguished by the larger jaws, shorter body, and the elytra tipped with yellow near the apex.

T. australasiae and *T. hopei* are smaller species, dull green, marked with reddish brown on the wing covers; they are found in North West Australia, while several other species are recorded from Queensland.

The *Cicindela* are not common about Sydney; two species, however, are to be found; *Cicindela ypsilon*, about ½ an inch long, is so named from the dark markings on the cream-coloured wing cases resembling the Greek E; they are to be found running about on the seashore in hundreds in midsummer, and can easily be caught by throwing a handful of sand over them: though so numerous, I have never been able to find their larvae. In captivity one ate raw beef quite readily, burying its jaw in the strange food and sucking up the juice.

C. circumcincta is a smooth, dark green beetle with the outer edges of the wing covers marked with yellow; it is sometimes taken about Sydney, but is not very common.

The smallest Australian species is *C. tenuicollis*, described by Macleay from specimens I collected on a sandy flat near the Barrier Ranges in N.W. Australia; it is a rich, metallic red insect with slender

legs and small thorax. On a sandy road near Cairns, N. Queensland, several small species were so plentiful that they often flew up in clouds, and I have taken scores in half an hour with a butterfly net.

The tropical Genus *Distypsidera* is represented by about a dozen species, chiefly confined to North Queensland, where they hunt over the stems of trees; when approached they run round the trunk to keep out of sight; they are broader and more thickset than the *Cicindela*, and their eyes are very large and prominent; *D. flavicans* is the only one that comes down as far as Northern N.S. Wales.

The researches of Hacker in North Queensland have added several new and interesting species of Tiger Beetles from the Coen River, some of which are closely allied to New Guinea forms.

Family 2. Carnivorous Ground Beetles.

CARABIDAE.

These are broader and thicker set than the Cicindelidae, varying in size from several inches to a line in length; the head is smaller than the thorax; and most of them are black or reddish brown, while others are richly marked with metallic tints.

They are most numerous in open forest country, hiding under logs or stones during the day and hunting over the ground at night: when camped in the bush, where logs are plentiful, the entomologist can often trap many interesting species by sinking empty tins into the soil, into which they readily tumble.

The larvae are slender creatures with three pairs of simple legs; their bodies are protected with stout

horny plates, and the head is furnished with large powerful jaws; they are found in the same situations as the adult beetles, and devour all kinds of insects that they can capture; the larger ones even eat small frogs. This family has been divided into a great number of sub-families which it is hardly necessary to enumerate here.

Australia is very rich in *Carabidae*; over 1,600 species have been described. Chaudoir described many in Russian and Belgian; Newman, Westwood, Pascoe, Hope, and Bates in English; Castelnau, Macleay, and Sloane in Australian scientific journals; so that the literature dealing with these beetles is very scattered, but the references can be found in Masters' Catalogue.

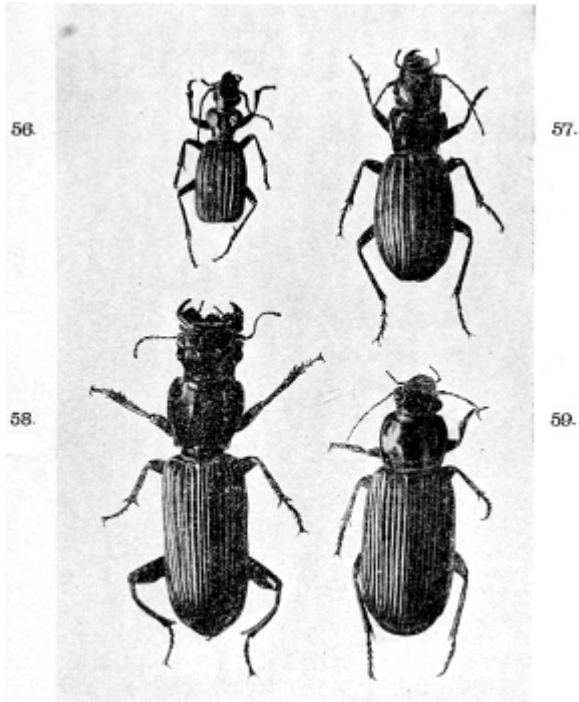
Calosoma schayeri is our type of this cosmopolitan genus. They live in cavities in cultivated fields, and are very useful insects where numerous, for they devour the larvae and pupae of many species of cut-worms. It measures about 1 inch in length, has a small head, narrow rounded thorax, and very broad, short, rounded abdomen; the whole is bright metallic green. It has a wide range over Australia, and may sometimes be even taken in the Sydney streets.

The Genus *Pamborus* contains many distinctive black beetles, some of which are marked with coppery green tints; they measure up to 1 inch in length, and are broad in proportion. When captured, many of them discharge an acrid fluid or gas that stains the fingers reddish brown.

Pamborus viridis is black, with the wing covers thickly ridged with parallel punctured striae marked with green.

P. alternans is a larger beetle, 1¼ inches long, with

the same small head, and rounded thorax tapering and narrow behind; the coppery-tinted elytra have very broad parallel ridges.



Figs. 56–59.—Typical Carabidae.

56. *Helluo costatus* (Bonelli). The Desert-Carab.
58. *Hyperion schroetteri* (Schreib.). The Forest-Carab.
57. *Trichosternus renardi* (Chaud.). The Scrub-Carab.
59. *Catadromus australis* (Casteln.). The Swamp-Carab.

(Original photo. Burton.)

Drypta australis is a small beetle about 5 lines in length; it has a pointed head, large projecting eyes, and the thorax forms a cylindrical neck hardly broader than the head; the wing covers do not quite cover the tip of the abdomen. In general colour it is

yellowish brown, with the antennae, legs, a broad stripe down the centre and the edges of the wing covers dark purple to black; the wing covers are very finely striated and punctured. They live on the edges of swamps, and sometimes fly into the lamp at night.

A beetle with a very wide range is *Helluo costatus*; it is a medium sized brown beetle; the head and thorax are about the same length, the latter rounded on either side in front but narrowed behind; the wing covers are flattened, broadly ridged, and not reaching to the tip of the abdomen.

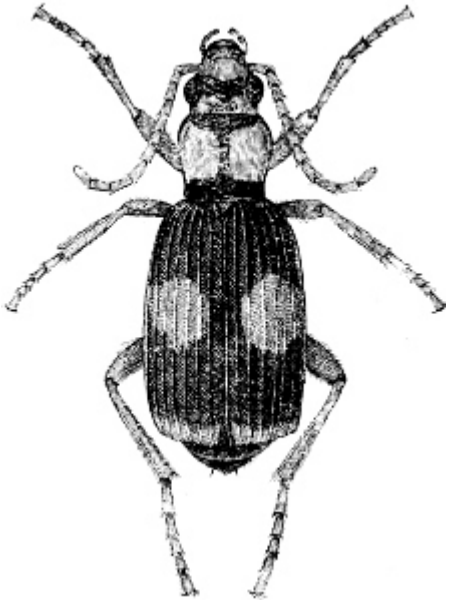


Fig. 60.—*Pheropsophus verticalis* (Dejean).

The Yellow Bombardier Beetle which discharges an acrid gas when disturbed.

("Agricultural Gazette," N.S.W.)

Our Common "Bombardier Beetle," *Pheropsophus verticalis*, is another widely distributed species; it measures over ½ an inch in length, and is of a

general dark brown tint, with the head, antennae, and thorax dull yellow; the wing covers, which do not reach to the tip of the abdomen, are blotched on either side and the tip with the same colour. It can be found in any damp spot under stones or logs; and as soon as disturbed, it discharges a small cloud of vapour with a distinct report, and which feels quite warm to the fingers.

The Genus *Scopodes* contains a number of tiny beetles that are common on the plains and about crabholes and swamps.

Scopodes sigillatus has the wing covers roughened, and measures about 2 lines in length; with its large projecting eyes it might be mistaken for a small Tiger Beetle.

We now come to a group, PSEUDOMORPHIDES, comprising a number of genera that live under the loose bark on tree trunks; they have adapted themselves to their confined hiding places, so that they have become flattened and rounded, and even remarkable in colouration; and so, unless a collector carefully examines them, he would never at first sight think of including them among the Carabidae.

The Genus *Silphomorpha*, in which over 40 species have been described, are yellow and black, or yellow and brown beetles up to ½ an inch in length; all their parts fit close together into a convex or oval form very like some of the water-beetles.

Silphomorpha colymbetoides and *S. nitiduloides* are found about Sydney. The first has the head and thorax reddish brown, the elytra pale yellow broadly blotched in the centre with black: the second, much larger (¼ of an inch in length) is blackish, and the centre only of each wing cover blotched with dull

yellow.

The members of the Genus *Adelotopus* are mostly black, narrow, and shield-shaped, with the tips of the wing covers truncated; while in *Philophloeus*, though very thin and flattened, they have the head and thorax well divided from the broad abdomen; and are dull yellow, striped, and barred with darker brown.

Turning from these we come to the giant of all our carabs, *Hyperion schroetteri*, which lives in cavities in tree trunks, where it is often found by splitters in the red gum forests in Victoria and N.S. Wales. I have taken it at night round the camp fire on the Murray frontage. It is shining black, and measures 2½ inches in length, but being narrow in proportion it appears much longer than it really is; while with its large elongate head and immense jaws it is a very formidable-looking creature.

The next in order is a large and interesting group, the SCARITIDES, which are not only wingless, but have the wing covers soldered together into one solid armour plate; their legs are adapted for digging, and many of them live in underground tunnels of considerable length. In most species the head, armed with large powerful jaws, fits close into the thorax, so that they move together; and in some groups the insect appears to be formed only of two parts, for the head and thorax taken together are as long and broad as the abdomen. After a heavy fall of rain in the interior, some species may be found in numbers under logs and stones, driven out of their holes and deep burrows. They are much sought after by collectors; and Macleay, Blackburn, and Sloane have described a number of curious species.

Eutoma tinctilatum, found about Sydney, and

typical of the elongate slender Scaritides, was described by Newman many years ago, and figured by Westwood in his “Arcana Entomologica 1841”; it is a shining black beetle about 8 lines in length.

Carenum bonelli, the commonest Sydney species of this genus, measures about ¾ of an inch and is broad in proportion; it is black, with bright metallic green tints on thorax and elytra.

The members of the Genus *Philoscaphus* are short and broad, with the elytra covered with rows of warts.

P. tuberculatus has a wide range over the western country; it measures over 1 inch in length; is black; the head and thorax are broader than the body; the latter oval, with the elytra finely rugose.

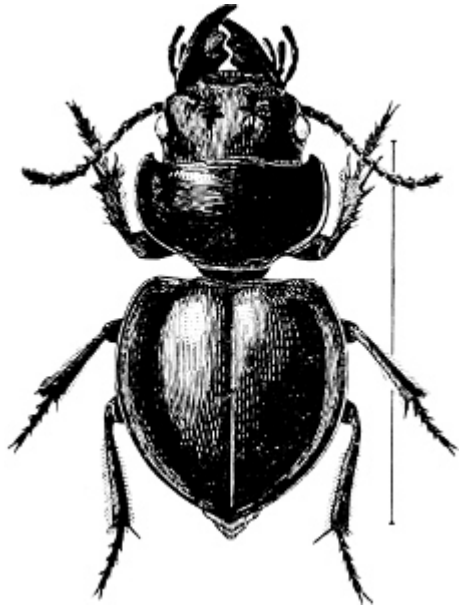


Fig. 61.—*Euryscaphus lobicollis* (Sloane).

The Great Ground Scaritid Beetle, found in the interior.

The Genus *Euryscaphus* contains the giants of the group.

Euryscaphus titanus, a shining black beetle, is nearly 2 inches in length, and measures ¾ of an inch across the elytra; while *E. lobicollis*, a smaller beetle, has the body still broader in proportion to its size; both these and several other fine species are not uncommon on the Western Australian goldfields about Kalgoorlie.

The allied CLIVINIDES, recently monographed by Sloane (Proc. Linn. Soc. N.S.W. 1896) are like elongate miniature Carenums furnished with dilated fore-legs adapted for digging; they are generally taken along the edges of swamps and watercourses under logs or the debris on the soft mud. They are world wide in their distribution, and are most plentiful in the warmer portions of the globe: Australia is rich in species: Sloane lists 55 species in his paper.

Clivina basalis has a wide range over S. Australia, Victoria, and N.S. Wales; it measures ¼ inch; is black, with the basal portion of the elytra and the legs red.

C. australasiae, slightly larger, is all black; it has a similar range, and is also recorded from New Zealand and Lord Howe Island.

The next group comprise the typical *Chlaenius*; they are rather long-legged beetles with a small head and somewhat heart-shaped thorax forming a slight neck behind, and with a broad, oval, convex abdomen. They are active beetles, generally found under stones or wood near water-holes; many of them have a greenish dull metallic tint. *Chlaenius puncticeps* is black, with the legs and an irregular blotch at the apical half of each wing cover dull

yellow. *C. maculifer*, from Queensland, is smaller; *C. laeteviridis* is dull green with the edges of the wing covers yellow; *C. marginatus* is a larger and brighter green beetle with the wing covers marked with yellow in a similar manner.

Promecoderus concolor, typical of the genus, is a shining black beetle about ½ inch in length, of a curious cylindrical shape with the head turned down in front. These beetles are found all over the interior in dry country under stones or logs. The allied Genus *Parroa* was formed by Castelnau for several curious beetles taken in the interior near the Paroo River. *Parroa noctis*, from Kalgoorlie, W.A., measures over 1 inch in length, and is a rounded solid-looking black beetle. The bulk of the species once included in the Genus *Harpalus* is now divided up into a number of groups; most of the small black carabs running about in the suburban gardens in the early summer belong to this division.

The FERONIDES comprise a number of our largest carabs: *Catadromus australis* measures nearly 2 inches in length, is broad in proportion; it is shining black with the wing covers broadly ridged, and their margins and the hind portion of the thorax richly marked with bright metallic green. *C. lacordairei* is smaller, and similar in general form, with the thorax smaller and the metallic colouration on the thorax running right round to the hind margin of the head. Both these beetles are found along the edges of swamps and lagoons in the Murray country living under dead logs, where their black banded larvae may also be found, sometimes feasting on small frogs.

All the beetles known under the Genera *Homalosoma* and *Trichisternus* have been placed in

the new Genus *Castelnaudia* by the Russian entomologist Tschitscherini, as both the former names were preoccupied. This group contains many large handsome beetles, chiefly confined to our coastal forest country, where they live under dead logs.

Castelnaudia renardi is one of the common species in the Tweed River scrubs; it measures 1½ inches in length; is black with the parallel striae on the elytra widely apart; the head very large, is turned down and furnished with long powerful jaws.

C. imperiale, from Southern Queensland, is a very handsome species; it is about the same size as the former but has the thorax and elytra more flattened; and the head, thorax, and margins of the wing covers are rich metallic green.

In November I took several specimens on the top of Mt. Tambourine, S. Queensland, under deeply buried logs by the roadside, where they live in broad excavated galleries; in two nests I found three larvae and eggs. The former, probably by their size only a few weeks old, were elongate, flattened, light brown to ochreous coloured creatures, with the head and dorsal surface of segments chocolate brown. The head is broader than long, flattened, and furnished with long curved brown jaws, and has also a stout incurved tooth near the base of each jaw. They were very active creatures and lived for over a month in captivity. The eggs were dull yellow, ⅜ of an inch long, broadly rounded, and were enclosed in a thin clay shell like the rind of an orange.

The Genus *Notonomus* has been recently revised by Sloane (Pro. Linn. Soc. N.S.W. 1902); in this paper he enumerated 72 species, a number of them previously undescribed. These beetles are apterous, and

confined to the coastal forests of Eastern Australia. Sloane says: “From the Grampians in Western Victoria, along the coast of Eastern Australia as far north as the Burnett River in Queensland, and many species are very restricted in their range.”

Notonomus australasiae is one of the commonest species around Sydney; it measures under ¾ of an inch in length, and is of a uniform black colour; the broad thorax is arcuate behind the head, swelling out and broadly rounded on the sides; it has a rich blue metallic tint, and a distinct medium suture; the wing covers are distinctly striated, forming broad parallel ridges.

Passing over a number of more or less important genera we finish with the Genus *Bembidium*, which contains a number of small active beetles generally found along the edges of swamps.

B. ocellatum is a shining black beetle under ⅛ of an inch in length, with a broad head, and the thorax rounded on the hind margin.

Family 3. Water Beetles.

DYTISCIDAE.

This group contains the first division of the Water Beetles; these have the antennae bare and filiform; short palpi and undivided eyes; the legs fringed with hairs, the front pair not longer than the hind pair, adapted for swimming. They live in the water both in the larval and beetle stage; the former are slender, elongate creatures, with a body consisting of twelve segments; the head is broad and furnished with powerful hollow jaws; they are very voracious creatures, devouring all sorts of aquatic insects, and

even the smaller and weaker of their own species. When full grown they pupate in cells which they form in the soft mud.

These beetles are perfectly at home in the water, and breathe by coming to the surface; turning head downwards, and with the tip of the wing covers slightly raised, they draw in a supply of air which occupies a cavity on the back, and when the elytra are closed down, the beetle can remain under water until the supply is exhausted. Many species can be easily captured in the water with a small hand-net; on a warm summer night numbers leave the water and come flying in to the lighted lamps. Many are very small, few over ½ an inch in length; they are quite as numerous in the colder waters of the globe as in the tropics, and many species have a very wide distribution.

We have representatives of most of the typical genera; our species have been described by Clark (Journal of Entomology 1862), and Sharp (Trans. Dublin Soc. 1882).

The members of the Genus *Bidessus* are small, brown, boat-shaped beetles not much over ½ an inch in length; about 18 species are listed in Masters' Catalogue; *Bidessus bistrigatus* has the head marked with black and the wing covers clouded with dark brown; it has a wide range over Australia. *Antiphorus gilberti* is more than twice the size, has the wing covers mottled, and is common in the waters of Victoria and South Australia. *Macroporus howetti* is dark brown, more shining and slightly larger, the dark markings forming two irregular black bands connected by a dorsal stripe. *Hydroporus collaris*, from the north-west coast of Australia, measures under 2 lines in length; it is all black with the dorsal

surface convex and finely rugose. *Platynectis 10-punctata* was described by Fabricius at a very early date from Australia; it is common along the edges of the Murray lagoons, where it is to be found in the soft mud under the water-weeds. It is a smooth, shining black beetle, with very convex wing covers. *Rhantus pubescens* is an oval beetle, under ½ an inch in length, of a dull brown colour, with the whole of the wing covers granulated with black. *Colymbetes lanceolatus* is a more elongate insect of a similar brown colour, the back of the head and wing covers marked with irregular parallel black lines, thickest in the middle. *Copelatus acuductus* is a larger shining black beetle, typical of the genus, of which about twenty species are described from this country.

Cybister tripunctatus is one of our largest species; it measures over 1 inch, and is broad and flattened in proportion; it is of a blackish or dark olive colour, margined right round from the front of the head to the tips of the wing covers with a dull yellow stripe. As children we often pulled these beetles out of the water hanging on to the bait used for catching crayfish, and we called them “clocks,” why I do not know. This species has a very wide range over Australia, and it is recorded from Lord Howe Island. It was once known under the name of *C. gayndahensis*. A second species has been described by Blackburn under the name of *C. granulatus* from the Northern Territory of South Australia. *Eretes australis* is another widely distributed species; it measures about ½ an inch; is broad and flattened, and is of a general yellowish brown tint, marked with black between the eyes, and the wing covers are finely punctured with close black spots.

Family 4. Whirligig Beetles.

GYRINIDAE.

This family, small in number of species, is well known to all lovers of Nature, for it contains the water beetles that float about in shoals on the margin of any quiet stream or waterhole, or dart about like bits of silver, twisting and turning round in most remarkable gyrations, from which they take the popular name of Whirligig Beetles.

They are distinguished from the last family (which they resemble in the earlier stages of their development) in having very short antennae; the fore-legs much longer than the two hind pairs; and in having the eyes on either side divided, thus having two eyes looking down into the water and two above, so that they can see both sides at the same time, an admirable adaptation of vision for beetles living so much on the surface of the water and liable to be attacked from above or below. The tip of the body is not covered by the elytra, and when diving downward they carry a bubble of air attached to the extremity. These beetles are well represented in Australia, and have been described by Clark previously mentioned, Regimbart (Annals Soc. Ent. France 1882), Macleay (Trans. Ent. Soc. N.S.W. 1871), and Boisduval in the "Entomology of the voyage de l'Astrolabe." Our common species about Sydney, *Macrogyrus canaliculatus*, is of the usual boat-shaped form, silvery black, with the wing covers finely striated; it measures about ½ an inch in length. *M. oblongus* is a somewhat smaller species not so broad in form; is browner, and the wing covers are very slightly striated; it is also found in the vicinity of Sydney. *M. paradoxus* was described and figured by Regimbart from Australia with no exact

locality, but I have collected it on the North West coast of Australia, and seen others from Southern Queensland, so that it has a wide range. It is not much over ¼ of an inch in length; is dark olive; the outer margin is dull yellow, and it has a few fine striae on either side of the elytra. I have found the pupae of one species, probably *M. oblongus*, in clay cells attached to a bit of board on the bank of a waterhole in the western country of N.S. Wales.

Family 5. Clubbed-horned Water Beetles.

HYDROPHILIDAE.

This family is also known under the Group *Palpicorna* in reference to the clubbed antennae, and made to include a second family, which are very closely allied but are terrestial in their habits.

These beetles have five jointed tarsi; short clubbed antennae, with the palpi slender and much longer than the antennae. Most of the beetles are vegetarian in their diet, though many of them in the earlier stages of their existence are carnivorous.

These are the largest of the Water Beetles; and the typical species are ovate and very convex in form; the thorax very broad; the tibiae slightly spined on the edges, terminating in a stouter spine at the apex; the tarsi ciliated. They are poor swimmers when compared with the two last groups.

Most of our species have been described by Macleay (Trans. Ent. Soc. N.S.W. 1871), and Blackburn (Pro. Linn. Soc. 1888). *Hydrophilus latipalpus* is of the usual boat-shaped form; shining black; and the wing covers are very finely marked with punctured parallel striae. It measures nearly 1½

inches, and is found about Sydney. *H. albipes* is a much smaller beetle of similar form and colour; it is found in the Murray River districts.

Family 6. Rove Beetles.

STAPHYLINIDAE.

These peculiar beetles can be readily distinguished from most of the other families by their abbreviated elytra, which do not protect more than a third of the abdomen leaving the hind portion quite bare; while the well developed hind wings are tucked away out of sight under them, but can be quickly extended and used for flight. The apical segments of the abdomen are very flexible, and most species have the habit of turning up the tip of the body when running along; others have the power of discharging a strong scent, in some cases with quite a pleasant odour.

They are slender elongate insects with stout jaws, and the antennae thickened or clubbed at the extremities; the tarsal joints are variable in number. Rove Beetles are found in many different situations, but chiefly upon the ground in the vicinity of manure, decaying vegetable matter, dead animals, and even on the seashore hiding under stones and seaweed, though most of them only seek these places to devour other small creatures, for they are carnivorous in their habits. Some of the foreign species are found living in the nests of ants, but I do not think any with this peculiarity have been recorded from Australia.

The principal writers on our Staphylinidae are Macleay (Trans. Ent. Soc. N.S.W. 1871), and Fauvel in his work on “Les Staphylinides de l’Australie et de la Polynesie” (1878). In 1886 Olliff commenced his

revision of the Staphylinidae of Australia (Proc. Linn. Soc.), but this only ran into the third part and was never finished. Others have been described by Blackburn (Trans. Royal Soc. S.A. 1887). About 400 species have been recorded from this country representing most of the typical sub-families.

The Genus *Aleochara* contains a number of small short black beetles with thickened antennae; those in *Homalota* are even smaller but more slender; several species are found under cowdung.

Quedius luridipennis measures over ⅓ of an inch in length; the shining black head and thorax are almost globular, the latter the larger; the broad flattened fore wings are red; the margins of the abdomen are flanged and slightly spined, and the tip fringed with three tufts of bristles.

The Devil's Coach-horse, *Creophilus erythrocephalus*, is our largest common species and has a very wide range; it measures over ¾ of an inch in length and is very broad in proportion; its general colour is black with the head bright red, the eyes and a rounded spot between them black; the elytra have a metallic purple tint. It can be often found in stables, or hunting round dead animals in the bush; when disturbed it cocks up its head, turning up the tip of its body at the same time in a very comical manner, from which habit the allied European species has probably derived the above popular name.

Actinus macleayi is slightly longer but more slender, and is our most beautiful species of this somewhat dull coloured family; the head and thorax are rich metallic coppery green, the elytra deep metallic purple; the basal portion of the abdomen is black, and the tip, antennae, and legs bright yellow.

It is a native of the tropical scrubs of North Queensland; in the neighbourhood of Cairns I captured specimens in tins I had baited with bits of meat and had sunk in the ground to trap Carabidae, and into which they had been attracted by the food.

Xantholinus erythrocephalus lives in the stems of rotting grass trees, where the beetles can be collected in all stages of development; the beetle measures over ½ an inch in length; is of a much more elongate form; black; the elytra dull red, and the tip of the abdomen yellow.

Paederus cruenticollis is one of our commonest species, and is often found under stones in the bush; it is a very distinctly marked little beetle about ¼ of an inch in length, slender in form with long thickened antennae; black, with the thorax and centre of the abdomen red, and the elytra deep metallic blue.

Sartellus signatus is a curious little yellow beetle quite unlike the typical Rove Beetle; it is short and rounded in form, with the fore wings much longer than usual; is of a uniform light yellow colour, with a curious reddish brown mark in the centre of each elytron. It is common on our sandy beaches, where it hides under the seaweed and rubbish and feeds chiefly upon dead barnacles.

Family 7. Ant Beetles.

PSELAPHIDAE

This group includes a number of small beetles that have the elytra usually not covering more than half of the abdominal segments; the antennae thickened toward the tips; maxillary palpi large, and the tarsi

three jointed. The ordinary collector is very apt to pass over these small creatures, but many interesting forms are found in this country by sifting rubbish, or examining debris along the water's edge, which can be gathered up in a stout bag and afterwards shaken over a sheet of white paper. I have captured them along the edges of lagoons in summer time by pouring buckets of water over the dry cracked mud, and as they were drowned out gathering them into small tubes. They can also be taken with a sweeping net when on the wing; in Europe many species are found in ants' nests. Westwood believes that they feed chiefly upon *Acari* and other small creatures.

Large numbers have been described from this country, chiefly through the researches of the Rev. R. L. King (Trans. Ent. Soc. N.S.W. 1865). Messrs. Sharp, Westwood, Schaufers and Blackburn added to this number; while in 1900 Raffray published his Monograph on the family (Pro. Linn. Soc. N.S.W. 1900), in which he described 45 new species, and brings the number known up to 200.

Pselaphus lineatus, a reddish beetle, measures 1½ lines in length, and is found about Sydney; it has a wide range over N.S. Wales, Victoria, and South Australia.

Lea (Pro. Royal Soc. Victoria 1905) records four species of the Genus *Articerus* found in ants' nests, all of which appear to have a wide range; *A. curvicornis*, originally described by Westwood from ants' nests in Melbourne, is also found in Tasmania, S. Australia and N.S. Wales.

Family 8. Comb-horned Beetles.

PAUSSIDAE.

These are remarkable looking beetles, easily distinguished by their broad flattened toothed antennae curving round on either side. The head is short and angular on the sides; the thorax flattened; and the elongate elytra truncate at the apex and not quite covering the tip of the abdomen. Most of the species are of moderate size, and reddish brown in colour; they are confined chiefly to Africa, the East Indies, and Australia. Most of the African species are said to dwell in ants' nests, but though I have had several records of species being found under stones in ants' nests, most of ours are found under logs, bark, or crawling about on the grass or ground. This family attracted the notice of entomologists at a very early date; Latreille formed the family to contain the two genera *Paussus* and *Cerapterus*, which he called *Paussili*, afterwards changed by Leach to *Paussides*. Donovan described the first species from this country in 1815. Westwood has written a great deal about them; he monographed the family (Proc. Linn. Soc. 1849–1850); in his "Arcana Entomologica" he described a great many from Australia and other countries; others in the "Annals of Natural History," 1851; and again figured others in his "Theosaurus Entomologica," Oxen. 1874. Macleay added 32 new species (Trans. Ent. Soc. N.S.W. 1873), all belonging to the Genus *Arthropterus*; while Blackburn placed 3 more to the list 1891–1892, one of them in the typical Genus *Paussus*.

Arthropterus brevis is one of our smallest species; it measures slightly over ¼ of an inch in length; the antennae are rather short and broad; the thorax broad and rounded on the sides; the elytra expanded slightly to the truncate tips, leaving the apical portion of the abdomen exposed. This is our commonest species, and can be sometimes obtained

in numbers near Sydney under the papery bark of the ti-trees.

A. humeralis comes from the Wellington district, and measures under ¾ of an inch; the antennae are large; the head angular; the body long, narrow, and rounded to the extremity, with the elytra short and truncate above the tip of the abdomen. General colour dark reddish brown, lightly clothed with short scattered brown hairs.

Family 9. Ant Beetles.

SCYDMAENIDAE.

The members of this family are minute creatures of which little is known. Sharp says: "Allied to the *Silphidae*, with the hind coxae separated, and the facets of the eyes coarser; tarsi five jointed; the number of abdominal segments visible six."

It is owing to the Rev. R. L. King that we first knew anything about this group in Australia; he described about 15 species (Trans. Ent. Soc. N.S.W. 1864); to which 2 more have been added by Macleay and Sharp.

Heterognathus carinatus was described by King from the nest of small black ants found in the neighbourhood of Parramatta; Lea has lately recorded it from the nests of ants (*Iridomyrmex nitidus*) taken in the Mallee country of North Western Victoria. He says: "It can be distinguished from all its congeners by the prothorax having a short longitudinal carina at the base, on each side of which is a transverse impression."

Family 10. Burying Beetles.

SILPHIDAE.

The typical European species are popularly known as Burying Beetles from the curious habit they have of excavating the ground beneath any small dead bird or animal they find, and finally burying it under the soil. This family contains a number of interesting beetles both large and small; the antennae are thickened or clubbed; the tarsi 4 or 5 jointed; and the whole dorsal surface flattened. They are poorly represented in this country, but there are several large distinctive species found about dead animals or decaying vegetable matter. A large number of blind Silphids are found in the caves of Europe and America, but I have never found any as Australian cave fauna.

Thirteen species have been described from this country by a number of different writers, chief of which is Blackburn (Trans. Royal Soc. S.A. 1891–94).

Necrodes osculans comes from Queensland; I found it common about Cairns, feeding amongst decaying matter in the scrub. It measures over 1 inch; is a broad flattened beetle of a general black colour; the elytra mottled with dull orange, ribbed, and truncate at the extremity, showing the tip of the abdomen. The head is small, turned down in front, but furnished with large clubbed antennae; the thorax is finely punctured and rounded in front.

Ptomaphila lachrymosa is a dull reddish brown beetle, with the centre of the head and thorax black, the head small and somewhat hidden by the large flattened thorax; the elytra round, somewhat depressed; both marked with irregular parallel black ribs and bosses; they feed about dead animals. Length about 1 inch.

In the following family, TRICHOPTERYGIDAE, only two species are described, one from Tasmania, and the other from West Australia. They are minute beetles with fringed wings, the middle joints of the antennae smallest.

Family 11. Round Fungus Beetles.

SCAPHIDIDAE.

The members of this family are small, broad, short insects that live in fungus, and are very active. Macleay described several species from Gayndah (Trans. Ent. Soc. N.S.W. 1871): Reitter and other foreign writers have added to the list.

Scaphidium punctipenne, though described from Queensland, is also found in the neighbourhood of Sydney. It is a small rounded seed-shaped insect, but with slender legs and slightly clubbed antennae; its upper surface is deep orange yellow irregularly barred with black.

Family 12. Mimic Beetles.

HISTERIDAE.

When touched these beetles contract their legs and pretend to be dead, from which habit they take their family name from *Histris*, the Latin for a stage mimic. They are shining black, or metallic coloured beetles; many are flattened and broad in shape, with the elytra truncate at the apex, leaving the tip of the abdomen uncovered; the exposed integument is however very much thickened, and all the parts fit close together; the antennae are thick, clubbed at the apex; the legs short and stout. Most of the flattened forms are found under bark, others in or under dead

animal matter; both the beetles and their larvae are carnivorous.

This family is well represented here: Macleay described some from Gayndah; Marseul described others in the Annals Museo Genevre 1879, and the Annals Ent. Belg. 1870; Schmidt in the Ent. Nachr. 1892; and a few are described by other writers.

Hololepta sidnensis, one of our commonest species, can be collected in early summer by chopping up the dead grass tree stems; but I have never been able to find the larvae. It measures ½ an inch, and is shining black; it is very much flattened and broad in proportion to its length; two stout horns project in front of the eyes, coming together at the tips; the thorax is slightly impressed in the centre, and punctured on the sides; the elytra is smooth and shining, but the exposed abdominal plates are spotted with large punctures. Many of this genus are found under bark or crawling about on tree trunks.

Platysoma strongulatum is a broadly flattened black insect about ⅛ of an inch long; the head is small; the thorax truncate; the elytra smooth in the centre, with four distinct striae on each side, straight at the apex, with the tip of the abdomen turning downwards. This is another common Sydney species found at the base of the flower stalks of the "grass trees" (*Xanthorrhoea*).

Saprinus laetus, typical of another group, is a short, thickset, rounded, oval beetle, ¼ of an inch in length, with the upper surface convex; the head is small, shining green; the thorax broad, bright metallic pale copper; and the short truncate elytra and exposed tip of the abdomen deep metallic green. This almost seed-shaped beetle is usually found under dead birds or animals lying in the bush. It has

a very wide range over Australia.

Family 13.
PHALACRIDAE.

Only one species of this family is listed in Masters' Catalogue, described by Erichson from Tasmania in 1842; but in Blackburn's paper (Trans. Royal Soc. S. Australia 1891) 16 new species are described from all parts of Australia. They are short oval beetles, very small, the largest not much over $^1/_{12}$ of an inch in length; black or brown in colour.

Litochrus palmerstoni is of a uniform ferruginous colour, with the apex of the elytra pale testaceous; without the punctures of the other species; of the typical oval form; and only ⅘ of a line in length and $^1/_{24}$ of an inch in width. This tiny creature comes from the Northern Territory of S. Australia.

This family is not an important one, but is well represented in Europe and America, where the larvae live in flowers, boring their way down the stems and pupating in earthen cocoons.

Family 14. Fruit Beetles.
NITIDULIDAE.

These are all small black or brownish beetles that breed and feed upon decaying vegetable matter, and some are very partial to ripe fruit. Some have well developed wing covers, but in others these are very short, reminding one of the smaller Rove Beetles, but the club of each antennae consists of three joints, and fewer abdominal segments are exposed to view. About eighty species have been described from

Australia, chiefly by Reitter (Verh. Ver. Brünn, 1874–75, and other Journals); Murray in his Monograph of the Family; Macleay (Trans. Ent. Soc. N.S.W. 1871); and Blackburn (Trans. Royal Soc. S. Australia 1891).

Brachypeplus binotatus is one of our commonest species, widely distributed over Australia; it is a typical form of the family, about ⅕ of an inch in length; of a general dark brown colour, with reddish brown antennae and legs; the abbreviated wing covers leaving the abdominal segments exposed, the latter marked with deep orange yellow. Olliff (Agricultural Gazette N.S. Wales 1893) describes and figures this beetle and its larva, which he describes as feeding upon the fungus on the damaged sugar cane.



Fig. 62.—*Pochadius pilistriatus* (Macleay).
Living in the seed pods of the Kurrajong.
("Agricultural Gazette," N.S.W.)

The Genus *Carpophilus* contains 11 described species, most of which have a wide range over

Australia; two are well known about Sydney from their habit of crawling into damaged fruit and feeding round the stone, causing it to decay very rapidly; they are also said to cluster round the fruit stalks, and by gnawing the base cause the fruit to drop. *Carpophilus pilipennis* is a small reddish brown boat-shaped beetle, with the wing covers cut off at the hind margin, exposing the tip of the abdomen; it measures 1½ lines in length. *C. aterrimus* is a somewhat larger flatter species of a uniform black colour, with the whole of the upper surface finely punctured; the legs and antennae are reddish brown. The abdomen is not so pointed as in the first species and much more of it is exposed on the dorsal surface. A curious little species, *Pocadius pilistriatus*, about ⅛ of an inch in length, is an elongate rounded brown beetle clothed with fine hairs. It feeds and breeds in the seed cases of the Kurrajong; the larvae are reddish brown grubs, elongate in form; they have three jointed antennae, and short black jaws, with well developed legs, and the tip of the abdomen bears two pairs of spines, the first pair erect, the second at the extremity but turning upwards.

Family 15.

TROGOSITIDAE.

These are beetles of moderate size with five jointed tarsi, the first so small that unless closely examined it is not noticeable. They are found chiefly under dead bark or wood, but are carnivorous in their habits, and very dissimilar in form.



Fig. 63.—*Lophocateres pusillus.*

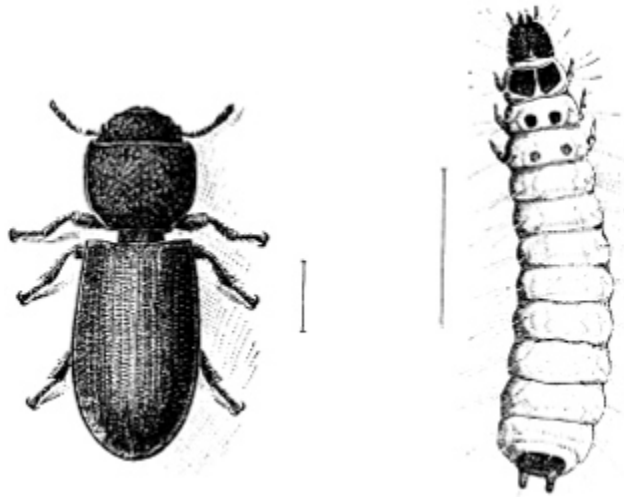
A tiny introduced Beetle belonging to the Family *Trogositidae* that attacks dried fruit.

("Agricultural Gazette," N.S.W.)

The cosmopolitan "Cadelle," *Trogosita mauritanica*, frequently found in bagged wheat, where the larvae gnaw out the embryo of the grain, is world wide in its range. It is a flattened, shining, black beetle; it was once placed among the *Heteromera*; and at first sight might be taken for a flattened carab.

The Genus *Leperina* contains a number of curious, elongate beetles flattened on the under surface; the dorsal surface is convex, and rounded at the extremities, with the integument covered with mottled grey, brown, and black tufts of scales imitating moss, and probably of a protective character, for they are generally found clinging to bark. *Leperina decorata* was described by Erichson from Tasmania in 1842, but it has a wide range over the mainland. It measures from ¼ to ½ an inch in

length; its ground colour is light chestnut brown mottled with black; the sides of the thorax deeply blotched with creamy white, and the back marked with indistinct patches of whitish scales.



Figs. 64 and 65.—Life History of the Cadelle.

64. *Trogosita mauritanica* (Linn.).
65. „ „ Larva.

("Agricultural Gazette," N.S.W.)

Pascoe described some of ours (Annals of Nat. Hist. 1872), and the Journal of Entomology 1860. Macleay described others in 1871; Reitter in 1876–77; Olliff (Proc. Linn. Soc. N.S.W. 1886); and later Blackburn (Trans. Royal Soc. S.A. 1891).

Family 16.
COLYDIDAE.

These are small, reddish brown or black beetles, elongate in form, with four jointed tarsi, the coxae of the two pairs of fore-legs globular, and those of the

hind legs transverse. They are usually found under dead or decaying bark, or among rotten wood. Several members of the Genus *Bothrideres* are found about Sydney; they have the thorax flattened and the elytra ribbed.

About 70 species of this family have been described from this country, chiefly by Macleay 1871; Pascoe in the Journal of Entomology 1860; Reitter in 1877 in several German journals; and later by Blackburn 1891; and Olliff in the Memoirs of the Australian Museum 1889 on species from Lord Howe Island.

Family 17.
RHYSODIDAE.

This family consists of only a few known species; Olliff has described one species, *Rhysodes lignarius* (Pro. Linn. Soc. N.S.W. 1885), a pitchy black shining beetle about ⅓ of an inch in length; it was found in rotten wood at Yass, N.S.W.

Family 18. Bark Beetles.
CUCUJIDAE.

The members of this group are very curious beetles, most of our species being found under dead bark on the trunks of the smooth gums; both the beetles and their larvae have adapted their form in such a remarkable manner to their surroundings that they are often as flat and thin as a bit of paper, while others living in more roomy quarters are quite normal in shape.

Hectarthrum brevifossum is a slender, somewhat cylindrical, shining black beetle, with thickened

antennae composed of eleven bead-shaped joints; the head is depressed in front, with the thorax more elongated, and the slender ribbed elytra rounded at the tips.

Platisus integricollis is a reddish brown beetle, the basal joints of the antennae elongated and the apical ones bead-shaped; the head is angular, buried in the short broad thorax; the body is flattened, with the elytra slightly ridged round the edges. The larva is as flat as a knife blade, with a large head armed with stout jaws; the thoracic segments are furnished with short thick legs; it has seven simple flattened abdominal segments, with an eighth spade-shaped one, on which is a four-pronged trident-like process standing up at the apex, and a small spine at either side. The insects both in the beetle and the larval stage are often to be found under the same bit of bark.

Brontes lucius, found in the same situations, is a darker reddish insect with the antennae very long and slender; the front of the thorax is spined on the sides; the elytra slightly convex, elongated and rounded at the extremities. *B. militaris* can be easily distinguished from the last species by its darker colour, more flattened smooth elytra, with two oval light brown blotches on the basal half of the wing covers. About 60 species are described from Australia; among the chief writers are Grouvelle (Bull. Soc. Ent. France 1877); and other Journals 1876–1883, &c.; Olliff (Proc. Linn. Soc. N.S.W. 1885); Reitter 1878, and Blackburn 1892.

Family 19.

CRYPTOPHAGIDAE.

In Masters' Catalogue only one species (*Cnecosa fulvida*) is recorded, described by Pascoe in the "Journal of Entomology" 1865, from Sydney. Since then Blackburn has described 12 more species (Trans. Royal Soc. of S.A. 1887). They are all minute beetles which feed upon mould. In Europe the larvae of several genera live in the nests of bumble bees, and the perfect insects in flowers.

Families 20–21.

LATHRIDIDAE and MYCETOPHAGIDAE.

These are composed of minute beetles found on fungus. Macleay in 1871 described some; Blackburn others (Trans. Royal Soc. S.A. 1887–1891); most of these were found in fungi or under bark. They are very small, the largest about ⅒ of an inch in length. In Europe the larvae of some species are covered with curious hairs, and the perfect beetles of others live in ants' nests; but nothing is known about the habits of our species.

Family 22. Bacon Beetles.

DERMESTIDAE.

This is a well-known group, for the hairy larvae do a great deal of mischief to sheepskins by gnawing holes in them when they are piled on each other; getting into bacon and other animal foods; even gnawing holes in bones. The beetles have somewhat short antennae clubbed at the tips; five jointed tarsi; the coxae of the fore-legs conical, the hind ones cylindrical.

The typical Genus *Dermestes* contains 5 species found in Australia; most of them have been

introduced from other parts of the world, and several have penetrated far into the interior.

Dermestes cadaverinus measures over ⅓ of an inch; the upper surface is clothed with pale pubescence, and the under-surface thickly clothed with white hairs. Its general form is elongate; the head is tucked under the front edge of the thorax, which forms a slight hood.

D. vulpinus is slightly larger; has the same elongate form; is black, with the dorsal surface covered with short brown hairs, and the under surface with more buff coloured pubescence. Both these species have a very wide range, and can be found under dead animals in the bush, in sheepskins, bacon, &c., and I have even taken larvae in bags of grain. Under favourable conditions these beetles increase in countless numbers; quite recently, Mrs. Black, writing from N. Queensland, says that toward the end of the drought when the country was covered with bones and dead stock, whenever the station hands camped to eat their dinners, these beetles would swarm out in thousands from under logs and stones to pick up the bits of food scattered about. Gilbert in Gould's "Birds of Australia," records a similar instance on the Hautmann's-Abrolhos Islands off the coast of W. Australia, a great nesting place for the Noddy Tern, where immense numbers of the young birds are killed by the lizards, which only eat the brain and marrow. The remains cumbering the ground were food for *Dermestes lardarius*, which swarm over the islands in immense numbers.

This is the common European Bacon Beetle, and is listed in Masters' Catalogue as found in Australia, but I have never seen an Australian specimen of this very distinct beetle, and think Gilbert may have mistaken

the species.

The members of the Genus *Trogoderma* are small, broad, and rather flattened black beetles, generally found under bark on tree trunks in the dead pupae of moths upon which they feed.

Trogoderma froggatti is short and broad; it measures under ⅛ of an inch; is a shining black beetle, with the elytra clothed with dark scattered hairs; it was bred from larvae taken close to Sydney. *T. apicipenne* is slightly larger, and darker black, very thickly clothed with black hairs; a dull red blotch on either side of the apical half of the elytra gives it a very distinctive character. These beetles and their hairy larvae feed upon the remains of dead caterpillars under the dead bark, pupae and other organic matter.

The *Anthrenus* are known as "Museum beetles," for they are the greatest pests that curators of Museums have to deal with; their small hairy larvae attack every kind of specimen, and are most destructive to pinned insect collections, though the adult beetles are generally found in the gardens frequenting flowers.

Anthrenus varius is our greatest pest; it is an introduced species, variable in size, the largest measuring about 1½ lines; it is almost round, with the small head furnished with clubbed antennae tucked down when at rest or disturbed; the ground colour is black, but it is so thickly clothed with grey and brown pubescence that it has a mottled buff appearance. Blackburn states that this is the species that has been confounded with *A. museorum*, which he says is not found in Australia. *A. nigricans* is about the same size; black, with a delicate fascia of fine white hairs which give it a very distinctive character.

About 44 species of Dermestidae are recorded from Australia: Fabricius and Linneaus described the earlier ones: Macleay others from Gayndah 1871. Reitter described more in several German publications: and Blackburn all the later ones (Trans. Royal Soc. S.A. 1891).

Family 23. Pill Beetles.

BYRRHIDAE.

These are small beetles, found under stones. They take their popular name from their rounded form, which is more noticeable from the fact that their legs and antennae are retractile. Thirteen species are described from this country.

Microchaetes sphaericus, described by Hope from W. Australia, is also found in N.S. Wales; it is a small, rounded, black beetle, under 2 lines in length; is very rugose on the upper surface, which is covered with tufts of brown scales which give it a curious roughened appearance and a brown tint.

Family 24.

GEORYSSIDAE.

This family is a small obscure group. They are small beetles with short clubbed antennae, inhabiting damp wet ground. Only a dozen are described from all parts of the world, two of which are peculiar to Australia. King described one from Parramatta under the name of *Georyssus australis*: Macleay the second from Gayndah, Queensland.

Family 25.

PARNIDAE.

These are aquatic beetles living under stones or close to water; they are thickly clothed with fine silky hairs like a waterproof coat; their antennae are thickened, and sometimes very short. Six species were described by King (Trans. Ent. Soc. N.S.W. 1864); and two others by Messrs. Blackburn and Lea (Proc. Linn. Soc. N.S.W. 1894–95). Most of these belong to the typical Genus *Elmis*, the members of which are found clinging to stones under water.

Plate XVII.—COLEOPTERA.

Family LUCANIDAE.

9. *Lamprima latreillei* (W. S. Macleay).
11. *Cladognathus arfakanus* (Lansb.).

Family CETONIDAE.

4. *Trichaulax macleayi* (Kratz).
7. *Eupoecila inscripta* (Janson).
8. *Chlorobapta besti* (Westwood).
10. *Diaphonia olliffiana* (Janson).

Family RHIPIDOPHORIDAE.

2. *Pelecotomoides conicollis* (Castelnau).

Family SCARABAEIDAE.

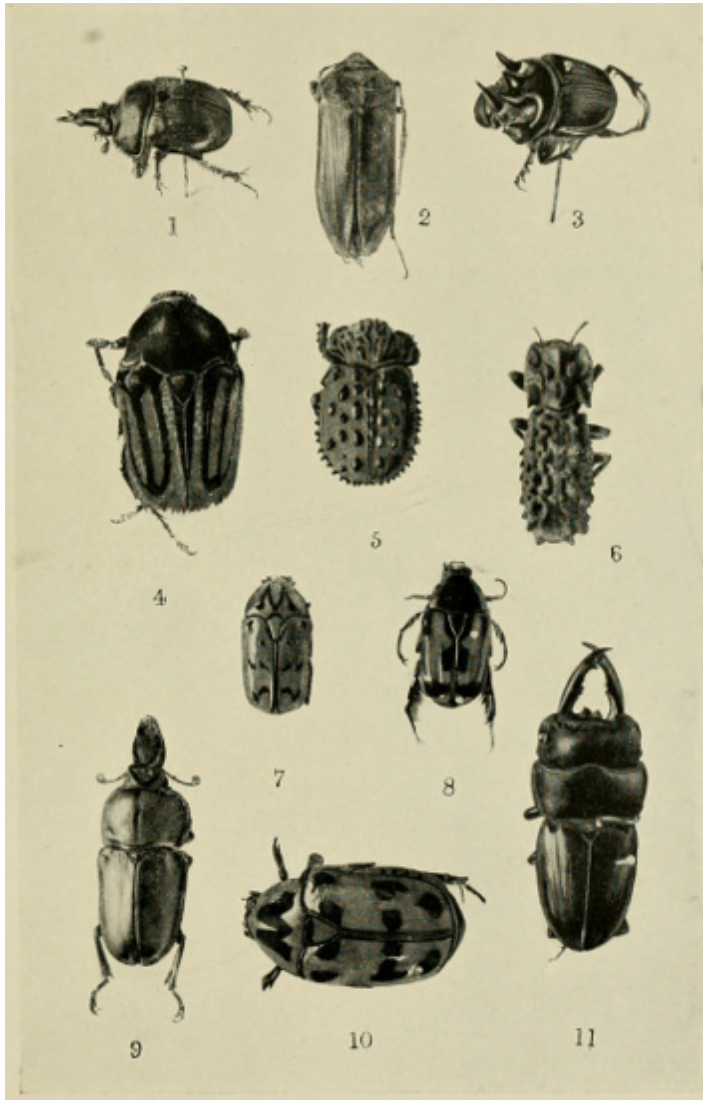
1. *Bolboceras proboscidium* (Schreibers).
3. *Onthophagus australis* (Guérin).
5. *Trox dohrni* (Harold).

Family TENEBRIONIDAE.

6. *Zopherosis georgii* (White).

(Original photo. Burton.)]

Plate XVII.—COLEOPTERA.



Family 26.

HETEROCERIDAE.

This group contains a number of small beetles that are semi-aquatic in their habits; these are also clothed with fine hairs, and have short clubbed antennae with the two basal joints enlarged. They are found burrowing in mud or wet sand close to water. Only seven species are recorded from this country, most of them belonging to the Genus *Heterocerus*; Westwood described two (Proc. Ent. Soc. London 1874): Macleay another from Gayndah 1871: and Blackburn four others (Trans. Roy. Soc. S.A. 1887–91).

Family 27. Stag Beetles.

LUCANIDAE.

This is the first group of the Lamellicorn beetles, which are defined by the structure of their short antennae composed of 9–10 joints ending in a three-jointed lamellated club. In the Stag Beetles the antennae are ten-jointed, and in the typical forms have the mandibles, especially in the males, produced in front of the eyes like horns. Australia is rich in these beetles, both in number and beauty of form and colouration. The chief writers upon them are Macleay (Proc. Linn. Soc. N.S.W. 1885); and Westwood (Trans. Ent. Soc. London 1885–63–71).

Rhyssonotus nebulosus is a dark brown beetle mottled with black upon the dorsal surface; the small narrow head is furnished with projecting horns with several distinct points; the thorax is broad, curiously divided into rounded areas interspersed with depressed punctured patches; the body is rather short; the wing covers very indistinctly ribbed and mottled with black. It measures slightly over 1 inch in length, and has a wide range over N.S. Wales and

Southern Queensland. I have bred this beetle from the fleshy white grub of the usual Lamellicorn Beetle type taken under rotten logs.

In the Genus *Lamprima* we have 12 described species of our beautiful "Gold Beetles," which in the larval state live in rotten wood, from which the beetles emerge and crawl up the twigs of the young gum saplings; in favourable localities they can often be taken in great numbers while mating. They are all rich metallic green, gold, blue, or coppery in tint; the horns, projecting and turning up in front, are clothed with fine hairs along the inner margin; the thorax is very convex, rounded on the sides; the fore-legs very robust; the body not twice the length of the thorax, and rounded at the apex. Many species are so variable that it is probable that when carefully studied the number of species will be much reduced.

Lamprima latreillei is our commonest species; it measures 1¼ inches in length; the head is rich coppery red, the rest metallic green; the thorax deeply and coarsely punctured. It is however a very variable species both in size and colouration; in a large series we can find them all shades to metallic blue; with stout horns or long horns; and ranging from the dimensions given to ½ an inch smaller.

L. rutilans is the southern form found in Victoria: *M. insularis* is only found in Lord Howe Island. *Phalacrognathus muelleri*, one of the largest and most beautiful of all our beetles, was named by Macleay after Baron von Mueller, from specimens obtained from Cairns, North Queensland; it could be best described as a giant gold beetle, 2 inches long; of a brilliant green and coppery red tint. The male has the horns greatly produced in front of the head.

Lissapterus howittanus measures nearly 1½ inches,

and is broad in proportion; the abdomen is shorter than the head and thorax combined; the horns curve round in front and are thickened and serrate at the base; the rugose head forms a ridge in front, fitting closely into the punctured thorax. The female is about 1 inch in length; has the head more flattened, and furnished with short, stout, toothed mandibles. This curious beetle is peculiar to Victoria.

The Genus *Ceratognathus* contains 7 species of our smallest Stag Beetles, none of which measure ½ an inch; they are black or brown; the mandibles of the male are produced into short curved horns with a square flange on the outer basal margins. I obtained the larvae of the species named after me by Blackburn in considerable numbers in the outer bark of *Eucalyptus robusta*. The larva is a white, shining, semitransparent grub with a slender abdomen; the pale brownish head is round and slightly elongate, with stout three-toothed mandibles; with long slender legs; and with the dorsal surface of the body clothed with fine ferruginous spines interspersed with hairs.

Figulus regularis is a small, shining, elongate black beetle measuring slightly over ½ an inch; it has short angular mandibles, finely punctured thorax, and striated elytra. It has a wide range over Australia, and is very common under decaying logs.

The PASSALIDES are a group of what might be called flattened hornless Stag Beetles (some of very large size), that are found under rotting logs. *Aulacocyclus kaupi*, measuring 1¼ inches, is shining black; has short curved mandibles in front; the head is excavated in the centre, with a short, bent, finger-like horn curving forward above the hollow; the thorax is broad; and the elytra ribbed. The larva is

dull white, long, slender, and somewhat cylindrical; it has a small head, and very long legs furnished with sickle-shaped claws. When full grown, they pupate in elongate, oval, smooth, brown cocoons of earth and woody matter.

Kaup in 1871 published a Monograph of the *Passalidae*, in which many of our species are described.

Family 28. Digger and Chafer Beetles.

SCARABAEIDAE.

The group contains an immense number of handsome beetles, among which are some of the giants of the beetle world, though there are also many tiny ones; most of them in the earlier stages of their lives are thick, fleshy, white grubs that live in the ground or decaying woody matter, and sometimes do a great deal of damage to the roots of grass and cultivated crops. Though these beetles vary much in form and size, they have the antennae always produced at the tip into a laminate or pectinate club, which when expanded forms a comb or brush-like process.

Kirby divides this family into eleven sub-families; Westwood into ten; while Sharp reduces them to five, which is quite sufficient for our purpose.

The first comprise the COPRIDES, or true Dung-burying Beetles; they feed upon animal droppings, boring vertical shafts beneath fresh dung, and carrying portions several inches under ground; on this they not only feed, but also deposit their eggs in rounded balls of the same material. In the more tropical parts they are also attracted to dead animals, which they feed on in the same manner. They have a

shovel-like rim round the front of the head, often ornamented above with spines or horns both on the head and thorax, particularly in the male sex; and their legs are admirably adapted for digging.

The Sacred Beetle, worshipped and carved on the monuments by the ancient Egyptians, *Ateuchus sacer*, is typical of the group.

Cephalodesmius armiger is a black beetle, about ⅓ of an inch in length; it has a small head produced in front along the outer margin into four spines or horns standing out straight in front, the two middle ones longest; the thorax is finely punctured; and the wing covers are slightly striated.

Temnoplectron rotundum, about the same length, is a shining black beetle; the head is flattened and turned down; the whole of the dorsal surface is smooth, and the wing covers are oval toward the apex.

The Genus *Onthophagus* contains most of our typical Dung Beetles; over 60 species have been described, chiefly by Macleay, 1864–1887–1888, and Harold 1869.

Onthophagus pentacanthus is ¾ inch in length; the male has a large slender horn rising up from the centre of the head; a curved shorter one on either side; and a short two-pronged process in the centre of the thorax, which is finely granulated above, and clothed with reddish hairs on the under side.

O. kershawi has the head armed with a similar horn but without the side ones on the thorax; the central ones are longer and more slender than those on the process of the previous species. *O. cuniculus*, one of our commonest species, is only about ¼ inch long; the head and thorax are bright metallic green;

the central portion of the latter is produced (in the male) into a conical point; the wing covers are shining black and rugose. Another common species, *O. granulatus*, is slightly smaller; it has the dorsal surface flattened; the head and thorax dull metallic blue; and the wing covers are mottled, light chocolate brown and finely granulated; the whole insect is covered with short reddish hairs, lightest on the dorsal surface. *O. rufosignatus*, which I once took in numbers busily engaged burying a dead wallaby in N.W. Australia, is slightly over ¼ inch in length; it is black with the centre of the thorax and sides of the elytra richly blotched with red.

The members of the Genus *Bolboceras* are even more remarkable in regard to the peculiar forms into which the head and thorax are produced in many species; most of them are reddish brown, and thickly clothed with coarse reddish hairs on the under surface. In structure they are somewhat similar to the former species. They are commonly taken at night flying to the lamp or camp fire.

Bolboceras sloanei is a broad hemispherical beetle, just under 1 inch in length; the male has a great horn standing up in the middle of the head, and a shorter one on either side of the thorax, with an excavation above and below them; the female is about the same size without any appendages, and the front of the thorax is hollowed out and the hind portion very rugose. *B. proboscidium* is common in the southern districts; it is smaller than the last species; of a darker reddish tint. The male has the front of the head produced into a lance-shaped process, standing out straight; this tapers toward the tip, which turns down like a hook, and has a short blunt spine on the upper surface. The female has a small truncate head,

quite unlike the male. About 30 species were described in Masters' Catalogue; Blackburn in his Monograph of the group lists 43 species (Proc. Linn. Soc. N.S.W. 1904).

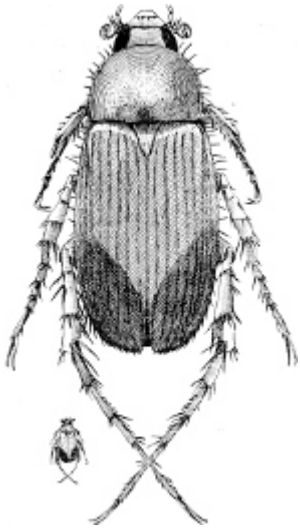


Fig. 66.—*Phyllotocus macleayi* (Fischer).

The Honey Beetle, common on flowers in summer time.

("Agricultural Gazette," N.S.W.)

Members of the Genus *Trox* feed chiefly on decaying animal matter, and are to be found under dead animals, and a few in caves among the accumulated dung of bats; they are curious dull brown insects, convex and rounded on the upper surface; the head is so small and retractile that it appears to be wanting. *Trox dohrni*, from Central Australia, one of our largest species, is just under 1 inch; is almost black, covered with a regular armour plate of shining black bosses and ridges all over the dorsal surface. *T. australasiae*, our common species, is about half the length, and is dull brown, with the bosses on the elytra more regular and ridged.

The MELOLONTHIDES are mostly small beetles with the tip of the abdomen not always covered; they feed chiefly upon the foliage of plants. The Genus *Phyllotocus* contains about 27 described species of small reddish brown beetles with long black or yellow legs: some species are very abundant about Sydney, swarming over the flowers of native scrubs; they even come to the garden plants to feed upon the honey.

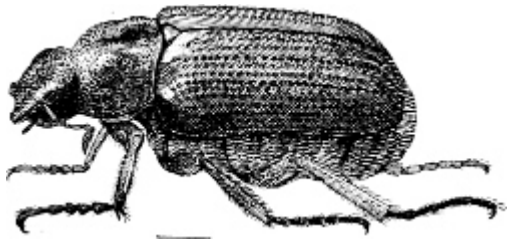


Fig. 67.—*Diphucephala aurulenta* (Kirby).

The Metallic Green Wattle Beetle. In Tasmania it damages young apples by eating off the skin.

("Agricultural Gazette," N.S.W.)

Phyllotocus macleayi has even been found swarming round bee-hives, probably attracted by the smell of the honey. It is a smooth, shining, yellowish brown beetle about ⅓ of an inch in length, with the apical portion of the wing covers blackened. *P. marginatus* is smaller than the last, and of the usual dull reddish colour; the head, centre of thorax, and stripe down the centre of the wing covers black; the whole lightly clothed with fine hairs. *Diphucephala aurulenta*, typical of another group of bright, metallic coloured, broad bodied beetles, measures ¼ of an inch in length, and has the dorsal surface of a rich reddish-copper tint, thickly and coarsely punctured; the under surface and legs are deep green, clothed with fine grey hairs. It is common upon the foliage of

the black wattle about Sydney. *D. rufipes*, a smaller beetle, is coppery green with reddish legs; is not uncommon about Sydney. *D. colaspidoides*, a southern species, is metallic green; the thorax smooth; the elytra deeply and thickly marked with punctured striae. *Maechidius tibialis*, representing another group, is a flattened, reddish brown beetle over ⅓ of an inch; the head is produced into two shell-like flanges in front of the eyes; the thorax is finely punctured; and the elytra ribbed, with closely punctured striae. I have found both the beetle and its larva, a soft white grub, in numbers in the open galleries of the termitaria built by our common White Ant (*Termes lacteus*) in the Shoalhaven district, N.S.W., where they seemed to live in harmony with the swarms of White Ants.

Xylonychus eucalypti is a large cockchafer-like beetle about 1 inch long; it is of a delicate pale grass-green colour; its under surface and legs darker and thickly clothed with fine hairs. This beetle feeds about Sydney upon the foliage of the Swamp Mahogany (*Eucalyptus robusta*), and is not uncommon in early summer. The members of the Genus *Liparetrus* are small, dark reddish brown, or almost black beetles, often thickly clothed with fine hairs; the wing covers are generally shorter than the abdomen. Many species swarm over the tops of the young gum trees devouring the foliage. Nearly 100 species of this extensive group have been described from Australia, chiefly by Macleay and Blackburn (Proc. Linn. Soc. of N.S. Wales, 1886–1888).

Liparetrus marginipennis, common about Sydney, is black; it measures under ⅓ of an inch; the elytra, except the basal edges, are dark reddish brown; the whole insect is thickly clothed with light brown hairs

that form a fringe round it. *L. hispidus* is a smaller dark brown beetle, thickly clothed with dull yellow hairs.

Lepidoderma albo-hirtum is a large cockchafer; it measures 1¼ inches; all the dorsal surface of the head and thorax and both dorsal and ventral portions of abdomen are reddish brown; ventral surface of head, thorax and legs black. The whole of the upper and portion of the under surface are so thickly clothed with fine pale scales that it has a uniform grey tint. The larva, a large white grub, is a well-known pest to the Queensland sugar planters, for it eats off the roots of the growing cane; they are so numerous in some districts that as much as a shilling a pint is paid for these sugar cane grubs.

The RUTELIDES comprise a number of large beetles, popularly called Cockchafers; some species swarm out in immense numbers, stripping the foliage off the native bush and sometimes attacking the shade-trees in the gardens. Most of their larvae are large, white, subterranean grubs, either feeding on roots of grass and plants, or living in or under decaying logs. Dr. Ohaus has just published a "Revision des Anoplognathides" 1904, in which he describes 72 species included in 13 genera. *Repsimus aeneus* has a dark blue to coppery tint; the tip of the abdomen is reddish, and the hind legs are thickened. They are found clinging to low bushes, and are common about Sydney.



Figs. 68. and **69**.—Life History of the Shining Cockchafer.

68. *Anoplognathus porosus* (Dalm). 69. Larva. 69a. Pupa.

Calloodes grayanus is a very handsome bright green beetle with the outer margins of the thorax and wing covers edged with yellow; it measures 1¼ inches long; is found in Queensland, but seldom in numbers. The two beautiful, little, metallic gold coloured species placed by Macleay in this genus have been removed by Ohaus into *Anoplognathus*, which now contains 41 species. Among these are our large reddish brown cockchafers. *A. viridaeneus*, the "King-beetle," is our largest cockchafer; it measures 1½ inches and is broad in proportion; has a general bright metallic reddish golden sheen; and the tip of the abdomen is deep green. It is usually found clinging to the foliage of the smaller gum trees in early summer. *A. velutinus* takes its name from the velvety patches of curious little white scales scattered all over its dull brown coat; it is found about Sydney, but is not plentiful.



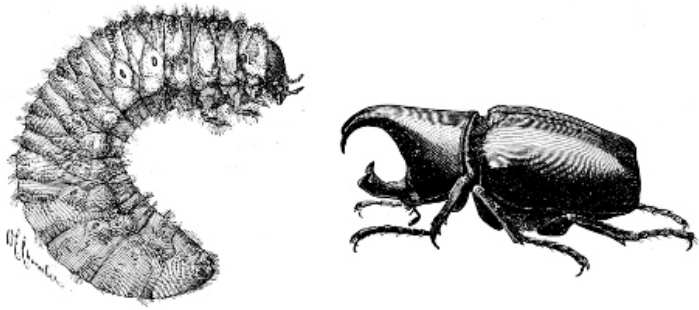
Fig. 70.—*Pentodon australis* (Blackburn).

The larva and adult feed upon grass roots and sometimes damage growing corn.

("Agricultural Gazette," N.S.W.)

A. porosus is a light brown beetle; the wing covers are marked with tiny dark spots that form irregular, short, parallel lines; the head and thorax are shining; it is ¾ of an inch in length. It, and *A. analis*, a large reddish shining beetle furnished with a tuft of hairs at the tip of the abdomen, are two of our commonest species; their larvae have been found destroying strawberry plants by eating off their roots; and they are frequently met with when digging over the garden in early summer.

Anoplostethus opalinus, just under 1 inch in length, is a very beautiful pale opaline green beetle, and is peculiar to Western Australia.



Figs. 71 and **72.**—Life History of the Queensland "Elephant Beetle."

71. *Xylotrupes australicus* (Thorn), Larva. 72. *Xylotrupes australicus*, Male Beetle.

("Agricultural Gazette," N.S.W.)

The DYNASTIDES contain the giants of the family, and in several genera the males have the head and thorax greatly enlarged and produced into blunt spines and horns; while the female has them of the usual rounded form. *Oryctes barbarossa* is one of our largest black lamellicorns; it comes from N. Australia. *Pentadon australis* is a shining black beetle about ¾ of an inch in length, which has been found damaging young maize plants about Sydney. The Queensland Elephant Beetle, *Xylotrupes australicus*, in the larval state feeds upon decaying vegetable matter, from which the beetles emerge and climb up the first tree to hand, and upon which they cling during the day, but come buzzing round to the lamps at night. The male measures 2 inches in length; is of a uniform black colour; the head curves out in front into a double-pronged horn; and the front of the thorax is produced into a second swollen one curving downward over the horns on the head, arcuate and

toothed on either side of the tip. The female as usual in this group is smaller, and the head and thorax are of the ordinary rounded structure.

The CETONIDES comprise the beautiful "Rose Chafers," with their shorter, broader, flattened bodies, small heads, and the angular thorax broadest behind. Australia is rich in these flower-haunting beetles, and some species are very abundant in the summer months. A great number were at one time placed in the Genus *Schizorrhina*, but in 1880 Kraatz in a paper on the revision of the family (Deutsche Ent. Zeit. xxiv.) divided them into a great many new genera, in some cases with very little reason.

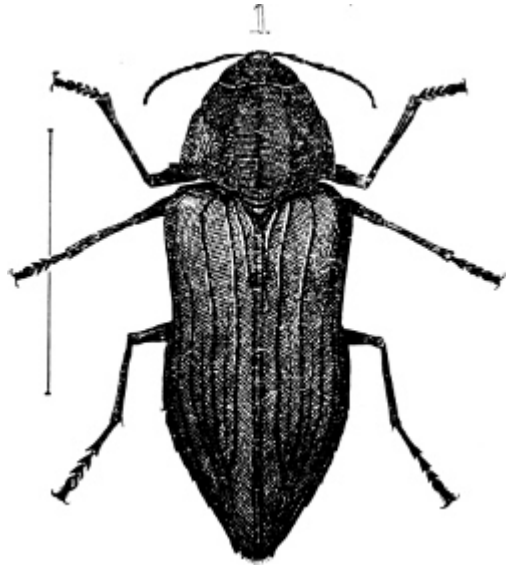


Fig. 73.—*Merimna atrata* (Lap. et Gory).

A Buprestid Beetle that has the curious habit of flying into the fire.

("Agricultural Gazette," N.S.W.)

The members of the Genus *Lomaptera* are chiefly found in the more tropical parts of this continent, and are easily distinguished from the other groups by the shape of the thorax, the hind margin produced into an angular wedge into the centre of the elytra; while in the other typical Rose Chafers the thorax is truncate, and a wedge-shaped piece separated from the thorax occupies the centre of the back. *Lomaptera wallacei* is of the usual flattened form; uniform rich shining green; and measures just an inch in length. It is found upon flowers in the tropical scrubs of North Queensland. *L. duboulayi*, about the same size, is of a duller green tint, with the outer margin of the head, thorax, elytra and under-surface dull yellow: *L. cinnamea*, slightly smaller, is of a uniform shining reddish brown colour.

Dilochrosis atripennis is one of our largest typical cetonids; it measures over 1½ inches in length and is broad in proportion; it is shining black, with the sides of the thorax and elytra, except a stripe down the centre (broadest in front), rich reddish brown. It is not uncommon about Cairns, N. Queensland, and ranges down, according to Masters, to the extreme north of N.S. Wales. The Fiddler, *Eupoecila australasiae*, about ¾ of an inch in length, is black and reddish brown, marked upon the thorax and elytra with green stripes, forming a fanciful resemblance to a lyre upon the back, from which it takes its popular name. The larvae of this and the following species, (thick fleshy white grubs) feed in the rotting trunks of dead grass trees, forming stout oval cocoons in the larval stage; and the beetles are very abundant upon the Angophora flowers in the early summer.

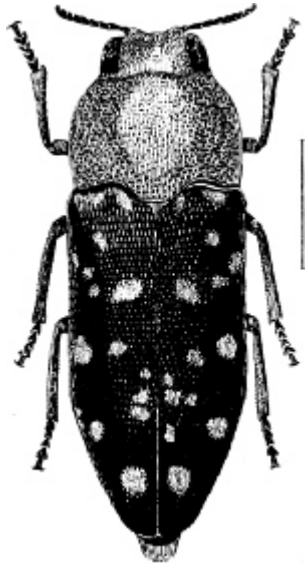


Fig. 74.—*Cisseis leucosticta* (Kirby).

A Leaf-eating Flower Beetle, common on the Black Wattle.

("Agricultural Gazette," N.S.W.)

Micropoecila cincta is another common species about Sydney; is slightly smaller; of a general black colour, the outer edges of the thorax and wing covers broadly margined with reddish yellow; and its life history and habits are identical with the "Fiddler."

Polystigma punctata is one of our smaller common species; is of a dull yellow colour irregularly but finely spotted all over the upper surface with black dots. A second species, described under the name of *P. octopunctata*, is I think only a variety; my specimens all come from the Shoalhaven, N.S.W. *Cacochroa gymnopleura*, about the same size, is black, rather downy on the under surface; and is remarkable for having a variety as common as itself, with reddish brown thorax and elytra.

The members of the Genus *Trichaulax* are

remarkable for having the elytra deeply furrowed, and these depressions filled with close short hairs. They are all large fine beetles over an inch in length; *Trichaulax philipsii*, taken about Sydney on the flowers of the blood-wood late in the summer, is marked with grey hairs. *T. marginipennis* is common to N.S. Wales and Queensland; it has bright reddish hairs completely clothing the tips of the wing covers and abdomen.

Diaphonia dorsalis is a large common species, of a general black colour, with the upper surface of the thorax and elytra yellowish brown variably marked with black in the centre. It often comes flying about the garden with a loud hum, and even sometimes comes in through the open window.

D. olliffiana is a very rare species about the same size, with the upper surface reddish brown and the wing covers irregularly marked with black blotches. All the specimens known, about half a dozen in number, come from the same locality, Colo Vale, N.S.W., and nothing is known about their habits. *Glycyphana brunnipes* is common on the flowering scrub about Sydney, and has a wide range round the coast of Australia; it measures about ⅓ of an inch, and varies from dull brown to green in colour, irregularly spotted and marked.

Family 29. Jewel Beetles.

BUPRESTIDAE.

This is one of our largest and most typical groups of the Coleoptera, containing a great number of large beetles rich with metallic tints, chiefly found upon flowering shrubs, and most plentiful on the coastal districts of Victoria, New South Wales, and West

Australia. They are elongate in form, with the head short, fitting closely into the broader thorax, and furnished with large eyes and slender, slightly serrate antennae. The abdomen is long with closely fitting wing covers, and well-developed wings which enable them to fly well, though they usually drop to the ground when disturbed. The larva is a slender flattened white grub with small black jaws and head; the thoracic segments are very broad behind and rounded to the much narrower abdominal segments. They are wood borers, feeding in the sapwood under the bark, and finally burrowing into the solid timber where they pupate; some of the smaller ones feed in dead wood; and a few form regular galls upon the roots or branchlets of shrubs.

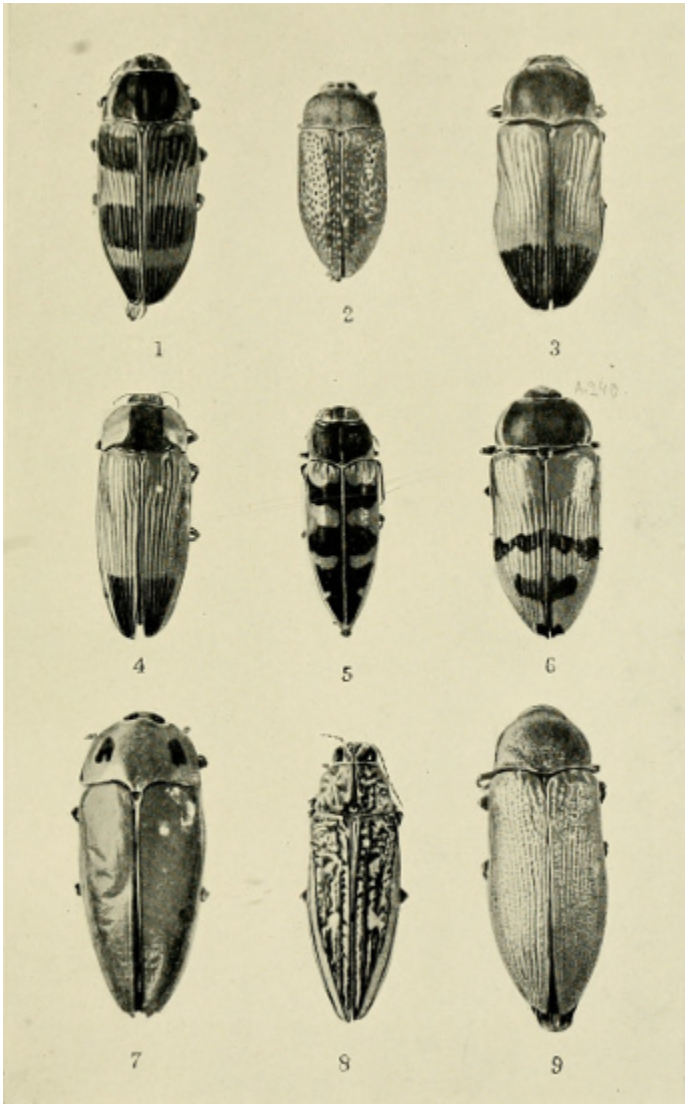
Plate XVIII.—COLEOPTERA.

Family BUPRESTIDAE.

1. *Stigmodera fortnumi* (Hope).
2. *Stigmodera macularia* (Donov.).
3. *Stigmodera pascoci* (Saunders).
4. *Stigmodera thoracica* (Saunders).
5. *Cyria imperialis* (Donov.).
6. *Stigmodera variabilis* (Donov.).
7. *Calodema regalis* (Lap. et Gory).
8. *Chalcophora vittata* (Waterhouse).
9. *Julodimorpha bakewelli* (White).

(Original photo. Burton.)]

Plate XVIII.—COLEOPTERA.



The Banksia beetle, *Cyria imperialis*, has a wide range and is common about Sydney upon the foliage of the stunted honeysuckle bushes (*Banksia*); the larvae feed in the stems. It measures 1½ inches in length; is of a uniform shining black colour, richly

marked on the upper surface with bright yellow forming four irregular bands across the elytra, and the under surface is lightly clothed with grey hairs. The Genus *Diadoxus* contains two very distinct species, the larvae of which feed chiefly on the stems of our native cypress pines, and sometimes attack and destroy introduced pine trees. *Diadoxus scalaris*, very variable in size, measuring from ¾ to 1¼ inches, is a slender pale yellow beetle, with the hind margin of the head and thorax marked with black, and the wing covers so thickly mottled with reddish brown that the yellow only forms a row of blotches down the back. It has a wide range from N.S. Wales to West Australia. *Diadoxus erythrurus* known in the west as the "pine scrub beetle," is a much smaller insect slightly over ½ an inch; the head and thorax are almost black; the wing covers are dark, the basal portion has a double blotch of yellow on each side followed by a row on either side of three spots; the under surface has a greenish tint when alive. The larvae of this species first feed round the stem under the bark, cutting the sap wood, and where the infested tree is small, cause it to snap off.

The large rich metallic green or coppery *Chalcophora* are more tropical beetles, the largest of which are restricted to Queensland and North Australia; Masters lists 24 species in his catalogue, chiefly described by Saunders (Trans. Ent. Soc. London 1872), and Waterhouse in the same Journal three years later.

Chalcophora vittata measures nearly 1¾ inches in length, and is broad in proportion; its general colour is deep metallic green, with the head and thorax shaded with rich coppery tints; the elytra are finely ribbed and are powdered with a yellow pubescence

lining the parallel striae, and also forming two spots on the sides. *Chalcophora farinosa* is a smaller and more slender species with a narrow thorax, and pointed wing covers; in the neighbourhood of Cairns, N.Q., I used to take them in the early morning resting on the wild banana leaves.

Nascio parryi is a small black beetle with a long thorax of a uniform width; the wing covers are short in proportion, and curiously marked with reddish orange. It is generally found upon the foliage of eucalypts, but nothing is known about its life history. The members of the Genus *Melobasis*, of which about 30 have been described, are small, brilliantly coloured metallic green and gold beetles. *Melobasis splendida*, not much over ¼ of an inch in length, is bright green, the thorax and elytra marbled with dull purple. The larvae feed in the dead branches of *Acacia longifolia*.

Julodimorpha bakewelli is found in South and Western Australia; it is a large handsome beetle with a deep coppery red thorax and deep yellow wing covers. It is elongate, but more cylindrical in form than the *Stigmodera*.

The typical Australian Genus *Stigmodera* contains about 240 described species which are found in open scrubby country where flowering shrubs are abundant; the extensive scrubs round Sydney, and similar class of country on the west coast of the continent are the head quarters of most of the larger species. *Stigmodera tibialis* measures 2 inches in length, and is broad in proportion; the head, thorax and under surface black, with the wing covers reddish chestnut with two irregular bands of dull orange yellow across the apical half. *S. heros* is half an inch longer, one of the giants of the group; it has

the under surface dark bronzy brown, the dorsal surface deep dull red; the thorax finely punctured, and the elytra coarsely striated. Both these beetles range from South to Western Australia. *S. pascoei* is a handsome rare species from Western Australia, measuring under 1 inches in length; it is of a rich yellow tint with the upper surface of the head, thorax, and legs rich metallic coppery red, and the apical third of the finely striated elytra black with a fiery red sheen. *S. thoracica*, slightly smaller, is black on the under surface except the sides of the thorax and tip of abdomen; the dorsal surface is yellow, except the head, a band through the centre of the thorax, and the tip of the wing covers which are bluish black. *S. fortnumi* is one of the few large species found in the interior; it measures 1¾ inches in length, and is broad in proportion; the under surface is rich metallic green marked with yellow; the upper surface yellow with the greater part of the thorax and three broad bands across the elytra deep metallic blue.

Stigmodera grandis sometimes measures 2 inches, and is the largest species found about Sydney; its general colour is dark bronzy brown with the outer edges of the thorax and elytra margined with yellow. The common jewel beetle, *Stigmodera variabilis*, is very abundant when the *Angophora* is in bloom; its general colour on the under surface, head and thorax is bronzy black, with the edge of the latter and the wing covers bright yellow; the markings upon the latter are most variable; specimens are sometimes thickly barred with black, others without a spot upon them, so that it is difficult to get two alike. *S. macularia* is purple to black, with the wing covers bright yellow deeply pitted all over with purple dots. *S. jacquinoti* might be easily mistaken for the last,

which it resembles both in size and markings, but the tips of the wing covers are produced into sharp spines; and the markings are coarser; it is a much rarer beetle than the former, which is one of the commonest large species. *S. gratiosa* is the type of a group from W. Australia, all of a rich metallic green tint with deeply punctured wing covers; it has the head and thorax bronzy green and very finely punctured, with the elytra green and very coarsely punctured; its length is about ½ an inch, and it is short and broad in proportion. This brilliant little beetle is plentiful in some districts, and specimens set in gold are often used for earrings and brooches, for which its solid integument makes it adaptable.

Calodema regalis from the scrubs of Southern Queensland and the extreme north of N.S. Wales, is possibly our most beautiful beetle in shape, size, and colour. Measuring nearly 2 inches in length and broad in proportion, the whole of the under surface, head and thorax are rich metallic green, with two conspicuous blotches of dark red on the dorsal surface of the thorax; the wing covers are bright yellow, almost smooth, slightly spined at the tips, with a very fine pencil of green down the sides of the inner edges.

The members of the Genera *Ethon* and *Paracephala* form galls; the first are short, thickset beetles of a dull coppery tint, with wavy markings on the wing covers. *Ethon corpulentus* and *E. marmoreum* make rounded galls upon the roots of *Dillwynia cricifolia*, sometimes as many as twenty on one plant clustering round the base of the stem. *E. affinis* forms galls upon the stems of *Pultenea stipularis*. *Paracephala cyaneipennis* forms galls on the branches of the stunted Casuarina (*C. distyla*), growing about Sydney.

It is a slender dull metallic green beetle about ⅓ of an inch in length. The Genus *Cisseis* contains a number of very pretty little metallic tinted beetles, the larvae of which feed in the wood of *Acacias* and other small shrubs, and the perfect beetles feed upon the foliage. *Cisseis 12-maculata*, a pretty deep blue-black beetle covered with large white spots, is found on the grass tree; *C. leucosticta*, *C. similis*, and *C. maculata* upon the black wattle.

Family 30. False Click Beetles.

EUCNEMIDAE.

The beetles in this group form a sort of connecting link between the Flower Beetles and the Clicks: many of them are very like the latter, but they cannot jump; they have a large terminal joint in the palpus, and the antennae when resting are hidden in the grooves along the under side of the thorax.

Sixteen species are listed in Masters' Catalogue, all of which, with one exception, are described in Bonvouloir's Monograph of the family (Annals of the Soc. Entom. France 1871–7).

Family 31. Click Beetles.

ELATERIDAE.

These beetles are found in many different situations, upon flowers, hidden under bark, or in cracks on the tree trunks. They are well known from their habit of flying in to the lamp at night, and falling on their backs go skipping all over the table. They are elongate in form, with slender serrate antennae, and a small head deeply sunk into the thorax, which is rounded in front, truncate on the

hind margin and with a slight spine on the edge; while on the under side the thorax is furnished with a process that fits into a groove in the first segment of the abdomen, which enables it to get enough leverage, by pressing the head down when on its back, to jump a considerable distance upward. The larvae are slender, cylindrical, shining brown grubs popularly known as "Wire Worms," and some European species are said to do considerable damage by eating off the roots of grass and crops.

About 350 species have been described from Australia, most of them dull brown or black in colour, though a few are brightly tinted or marked. *Agrypnus mastersi* measures 1 inch, and is of a uniform brown colour clothed with fine buff down; it ranges from Queensland to Western Australia. The Genus *Lacon* contains a great number of short, broad, dull brown clicks usually found under bark or stones. *Lacon caliginosus*, half an inch in length, is dull brown; it ranges from Tasmania to Queensland. *Alaus gibboni* comes from the Richmond River; it measures 1¾ inches, and is broad in proportion; its true colour is black, but it is so thickly clothed with fine short grey down that it is almost a dull white. *A. sericeus* is a smaller beetle clothed with an admixture of buff and chocolate down; I have found them pupating in decaying bark on dead trees on the Richmond River. *Tetralobus cunninghami* is typical of a group of the large cylindrical "clicks," in which the male has feather-like antennae, and the thorax is rounded. It is 1½ inches long, dark brown, with the under surface of the thorax clothed with reddish hairs. These large clicks are generally found in the interior on the trunks of trees. The Genus *Monocrepidius* contains a number of slender black or brown insects usually living on flowers or foliage. *Ophidius histrio*, 1 inch

long, is black, richly marked with dark yellow lines forming four parallel bars down the thorax, and a more irregular lance-shaped pattern on the wing covers; this is another fine species from the Northern Rivers, N.S.W. *Anilicus semiflavus* is found on the Angophora flowers about Sydney; it is ½ an inch long, black, with the basal half of the elytra bright red.

Family 32. Feather Horns.

RHIPIDOCERIDAE.

This is not a big family; the species are confined to the warmer parts of the world, and are chiefly distinguished by the peculiar structure between the tarsal claws, and the beautiful feathery antennae of the males. *Rhipidocera mystacina*, our typical form, is ¾ of an inch in length, elongate in form, with narrow sloping thorax and large feather-like antennae; the general colour is black, with the sides of the thorax and whole of the wing covers thickly spotted with white downy dots. I have often taken this insect in numbers in the North-West of Victoria.

Family 33. Fire-Fly Beetles.

MALACODERMIDAE.

The members of this family have a softer integument than most beetles. They do not all emit light; the true “fire-flies” and “glow-worms” belong to the sub-family LAMPYRIDES.

The Genus *Metriorrhynchus* contains about 50 small, elongate, flattened beetles of a dull red colour marked with black; the wing covers are deeply ribbed but soft and flabby. The larvae are curious,

smoky black creatures with blunt spines along the sides of the body, and live under stones or logs. *M. rufipennis*, one of the largest, is ¾ of an inch in length; the head and thorax are black and roughened; the wing covers are light red, deeply ribbed and reticulated: Waterhouse figured and described many of these (Trans. Entom. Soc. 1877). Our true fire-flies belong to the Genera *Luciola* and *Atyphella*. On these Olliff has written an interesting paper entitled "New Species of Lampyridae with notes on the Mount Wilson Fire-fly" (Pro. Linn. Soc. N.S.W. 1889). Our fire-flies are small, light brown beetles, which during the day cling to the foliage, flying about at night, emitting a bright flash of phosphorescent light from the tip of the abdomen as they move their wings. Several species are found on the Blue Mountains and in the tropical scrubs of North Queensland; they are very brilliant after night-fall: *Luciola flavicollis*, ¾ of an inch, is our common species. The Soldier Beetles, chiefly belonging to the Genera *Telephorus* and *Selenurus*, are common upon low bushes and flowering shrubs. *Telephorus pulchellus*, ½ an inch in length, is a slender, dull orange coloured beetle; the dorsal surface is shining blue black except the apical half of the thorax, which is bright yellow. This beetle sometimes appears in great numbers; I have seen the Melaleuca scrub on the Blue Mountains black with them.

Family 34. Hunting Beetles.

CLERIDAE.

There are many handsome little beetles in this family which spend their time hunting over logs, tree trunks, or in flowers to catch smaller insects which they devour; most of them lay their eggs in the

bodies of the pupae of wood moths and other insects. A freshly fallen tree is a good locality to look for Clerids, as they find many small beetles attracted by the withering bark: in Europe the larvae of several groups infest the nests of wild bees.

Natalis porcata, 1 inch in length, is black covered with a whitish down, and is found under the dead bark on tree trunks; it is probably parasitic upon the grubs of longicorn beetles (*Phoracantha*). *Cleromorpha novemguttatus* measures only ⅕ of an inch; it is rich metallic blue, lightly clothed with black hairs, and the elytra spotted on either side with white dots: it is common in the flowers of the *Angophora* in early summer. The Genus *Aulicus* contains a number of bright metallic green or blue beetles which live on flowering shrubs; about 20 species are described, chiefly by Cheverolet (Memoirs of the Cleridae 1878). *Aulicus instabilis*, one of the smallest, is only ¼ of an inch in length; it has a wide range over Australia. *Trogodendron fasciculatum* is another widely distributed species, and may be often seen flying about in the height of summer; if captured it bites most viciously. I have on several occasions pulled its body off, leaving the head with the jaws buried in my finger: it is parasitic on the pupae of our large wood moths. It is variable in size, about 1 inch in length, thickset and broad in proportion; is dark brown, with bright yellow antennae, and broad black fasciae at the base and apical half of the elytra. *Zenithicola obesus*, ⅓ of an inch in length, is like the last in general form, but with dull yellow thorax and shining black elytra marked with white: *Z. australis*, a slightly larger species, has a black thorax. The members of the Genus *Eleale* are elongate, dark metallic green or blue beetles clothed with fine hairs and deeply

punctured wing covers; they also live among flowers. *Tarsostenus zonatus* is typical of the small, slender, cylindrical clerids that infest the gall-making coccids, and are often bred from these galls. It has a bright reddish brown head and thorax, and green wing covers barred across the centre with white. *Lemidia hilaris*, ⅛ of an inch long, is a short broad beetle of a shining black tint, with the basal half of the elytra red. The Red-legged Ham Beetle, *Necrobia rufipes*, an introduced species, is found all over the world. In the interior it swarms under dead animals, feeding upon fresh bones; and is also often found about cheese and other preserved foods in the pantry.

Family 35. Anobiums.

PTINIDAE.

These beetles are small insects, with the head hidden under the thorax; they have filiform, pectinate or slightly clubbed antennae; and several species are world wide in their range, for as they live in all kinds of dried food stuffs they are easily introduced into new countries. *Gibbium scotius* is a curious little beetle hardly over $^{1}/_{12}$ of an inch in length, with a bright shining brown body, and the legs and antennae covered with yellow scales; it feeds upon feathers, and is often found in birds' nests. *Anobium paniceum* is known as the "Biscuit Weevil," but feeds upon all kinds of things; I have found it in boots, seeds, drugs, botanical specimens, and it is said to have been found burrowing through sheet lead. The Cigarette Beetle, *Lasioderma serricorne*, is another little brown beetle common in Sydney in waste tobacco. Olliff has described a number of Australian species (Proc. Linn. Soc. N.S.W. 1886); and Westwood others (Ent. Soc. 1869),

among which are several members of the Genus *Ectrephes*, which live in ants' nests.

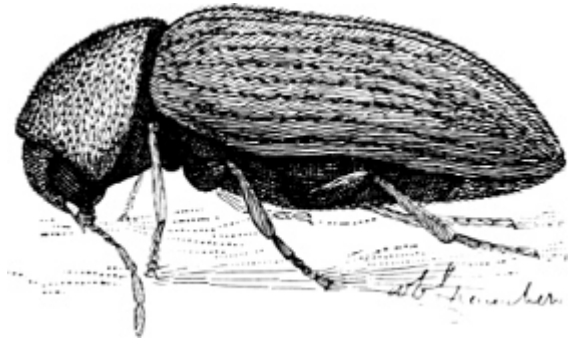


Fig. 75.—*Sitodrepa (Anobium) panicea* (Fabr.).
The omniverous drug-store beetle (Introduced).
("Agricultural Gazette," N.S.W.)

Family 36. Powderpost Beetles.

CIOIDAE.

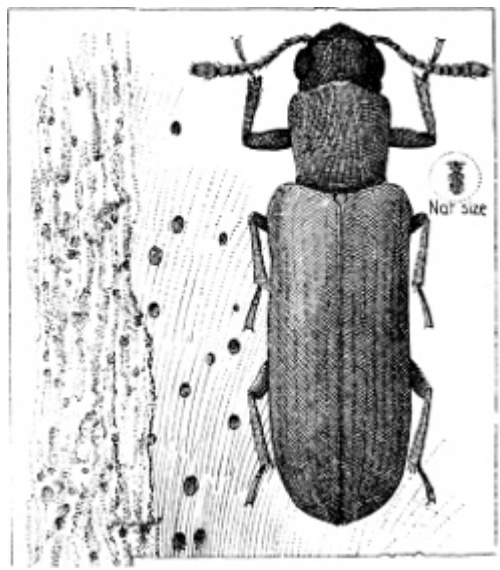


Fig. 76.—*Lyctus brunneus* (Douglas).

The Beetle so destructive to Rattan furniture.

("Agricultural Gazette," N.S.W.)

Though small in size and number of species, these are very important beetles on account of the damage they do to rattan furniture and sapwood in unseasoned timber. *Lyctus brunneus*, a small elongated, reddish brown beetle about ⅛ of an inch in length, lives and breeds in wood, and is only too common about Sydney. A second species has been described from South Australia by Blackburn.

Family 37. Auger Beetles.

BOSTRYCHIDAE.

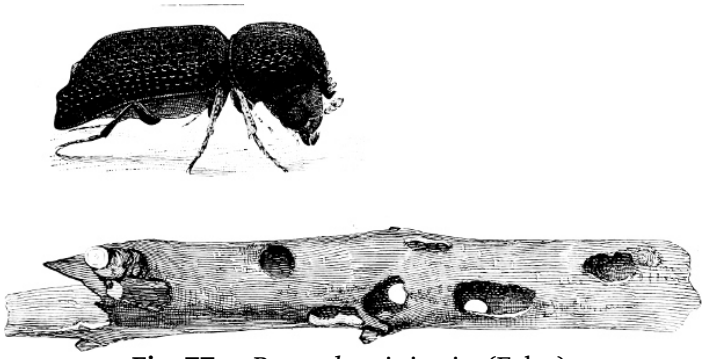


Fig. 77.—*Bostrychopsis jesuita* (Fabr.).

The Auger Beetle which attacks dead or dying trees. Orange tree stem in which a number have been feeding.

("Agricultural Gazette," N.S.W.)

These beetles are easily recognised by their curious cowled thorax, with the head turned down beneath, and the last 3 joints of the antennae forming a well-defined club; the body is long and cylindrical, adapted for burrowing in dead wood. Specimens of these beetles can generally be found

upon fallen trees or freshly-cut timber. *Bostrychopsis jesuita*, one of the largest of the group, about ½ an inch in length, is black, cylindrical, with the rounded thorax rugose in front, and the tip of the wing covers truncate. *Bostrychus gibbicollis*, about ⅓ of an inch, is dark reddish brown, with a spined thorax and the tips of the wing covers produced into blunt teeth. *B. cylindricus*, about the same size and similar colour, has elytra furnished with three curled spines on each side. It has been found damaging wine casks. In the Genera *Apate* and *Rhizopertha*, also found in dead timber, we have a typical form in *Apate collaris*, measuring ¼ of an inch in length, with a dull yellow thorax, dark brown wing covers spined at the tips.

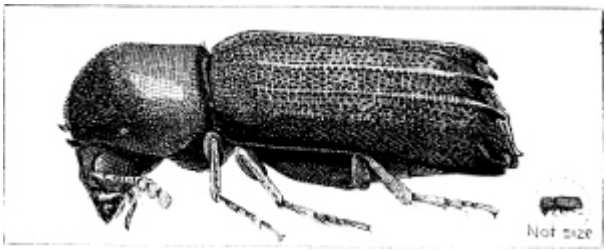


Fig. 78.—*Bostrychus cylindricus* (Macleay).

The Wine-cask borer.

("Agricultural Gazette." N.S.W.)

Family 38. Mealworm Beetles.

TENEBRIONIDAE.

This is a very large family of beetles, generally dull brown or black in colour, but varying much in shape; many of the more typical forms are found under logs and stones, and might easily be mistaken at first sight for carnivorous carab beetles until the mouth parts and head are noticed. They have somewhat thickened antennae placed on the sides of

the head; some have wings, others are wingless; most of them are slow, heavy beetles, very easily captured. The larvae are usually slender shining cylindrical brown worm-like creatures living in rotten wood, of which the introduced Mealworm is a typical example. Our species have been described by a great many English and foreign writers, chief among which are Pascoe, in the Journal of Entomology 1869, and Annals of Natural History 1869–80; Hope in the Transactions of the Entomological Society of London 1842–48; Bates in the same journal 1873; and later on in the Proceedings of the Australian Societies by Macleay and Blackburn. Carter has within this last year described a number of new species (Pro. Linn. Soc. N.S.W. 1905–6).

The Ironbark Beetle, *Zopherosis georgii*, is found in the northern scrubs of N.S. Wales, generally climbing on tree trunks; it is an elongated, flattened, dull brown beetle, slightly over 1 inch in length; the antennae thickened, and the whole of the upper surface covered with rounded irregular knobs; it is not unlike a caricature of a large click beetle.

The members of the Genus *Pterohelaeus* are smooth, shining, tortoise-shaped black beetles, found under dead bark on the trunks of trees. *P. piceus*, common in S. Australia and N.S. Wales, is just under 1 inch in length, but broad in proportion.

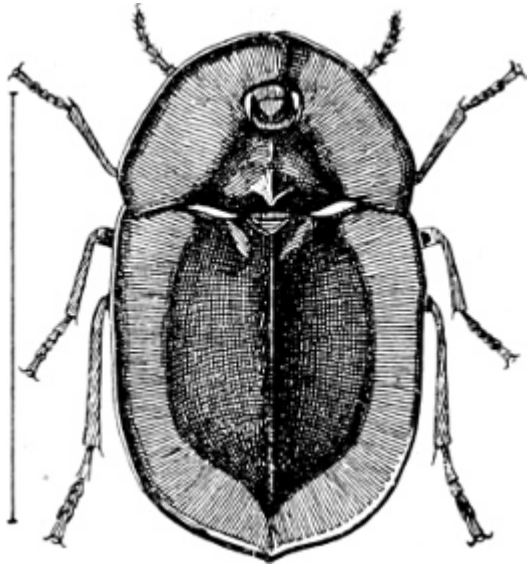


Fig. 79.—*Helaeus subserratus* (Blackburn).

The Tortoise Beetle.

("Agricultural Gazette," N.S.W.)

Helaeus subserratus, from Western Australia, is typical of a very curious group not only wingless, but having the elytra and abdominal segments soldered together into a broad flattened box with a wide thin flange running right round, continued round the thorax, and overlapping in front of the head, which latter is turned down and is thus situated in a regular frame; this one is dark brown, with the outer flange lighter coloured; it measures 1⅓ inches in length, and is broad and rounded in form. These beetles are usually found in the driest parts of the interior, where they live under stones or logs among the dust, and in spite of their size, remain so motionless that they can be very easily overlooked.

Saragus floccosus, found on tree trunks in the north of N.S.W., is a smaller tortoise-shaped insect, under

¾ of an inch; is convex and keeled down the centre of the thorax; and the elytra have a more narrow flange running right round but curving in and rounded on either side of the head. When alive, it has the whole of the upper surface covered with loose flocculent matter like soft sawdust, evidently as a protective covering, but this is easily brushed off when dead. *Hypaulax tenuistriata* is one of the common large black beetles found under dead bark; it measures about 1 inch in length; the head is small, projecting; the thorax broad, rounded, shining; and the broad wing covers are distinctly ribbed with punctured striae.

Chartopteryx childreni is one of our most remarkable and rare species; it is 1 inch long; the only specimen I have seen alive, I caught alighting on a tree trunk at Mosman, near Sydney; it is elongate, broad, oval in form, with the head and thorax turned down, and the convex, shining, black elytra deeply punctured and clothed with dull yellow moss-like material; the head and thorax are ornamented with fine white hairs, forming an elongated mark on either side of the latter and two parallel lines down the centre of the head and thorax.

Blepegenes aruspex is a shining coppery black coloured beetle measuring ¾ of an inch; it is slender in form, remarkably like a carab, with a small thorax that is produced into a spine on either side; the elytra are deeply ribbed; it is found under logs in the Illawarra district, N.S.W.

Cardiothorax howitti is also found under logs; it is an elongate beetle, black with a dull purple tint on the thorax, which is flattened and almost round, a regular rim running round the margin; it is arcuate

behind the head, and produced into a spine on the hind margins; the wing covers are elongated to the apex, and ribbed. The members of the extensive Genus *Adelium* are found under logs; some species are quite common, clustering together in considerable numbers; they are all black or coppery tinted. These beetles are about ¾ of an inch in length; the thorax is roughened, and the wing covers more or less striated.

The Genus *Chalcopterus*, which now includes most of those described as *Amarygmus*, are black or brightly metallic coloured beetles; the head and thorax are small and curve downward; the wing covers are large, convex, and pointed at the tips. They are found crawling about on tree trunks, or hidden under dead bark, and give out a very pungent offensive odour when handled. *Chalcopterus variabilis* measures ½ an inch in length; its head and thorax are black, the elytra rich coppery red, and it is common about the Sydney scrubs.

The common Mealworm, *Tenebrio molitor*, has a world-wide range; it was introduced into Australia at a very early date, and not long ago a packet of seeds imported from England was found on examination by one of the inspectors of the Agricultural Department N.S.W. to be full of the shining wireworm-like larvae of these beetles. It is a common beetle in stables and produce stores.

Family 39.

CISTELIDAE.

These are delicate, elongate, long-legged beetles, with weak integument, and are closely allied to the TENEBRIONIDAE, only differing from them in having

comb-like or pectinate claws on the tarsi; and their larvae are like wireworms. The Genus *Atractus* comprises a number of slender beetles of bright metallic tints common upon the flowering shrubs in summer; *Atractus viridis*, ½ an inch in length, is bright metallic green, with the thorax and shoulders tinted with coppery red, the wing covers deeply marked with punctured striae. *A. virescens* is a smaller species with a more dull metallic coppery tint. The members of the Genus *Allecula* are larger beetles, with long slender legs and antennae, shining brown or black in colour, with finely striated elytra; the larvae are slender, dark, shining brown wireworms living in decaying wood. *Allecula subsulcata* is slightly over ½ an inch in length, of a uniform black colour, with the last three joints of the antennae and the last two of the tarsi pale ferruginous. The larvae breed in the rotten stems of dead grass trees, and the beetles are generally found hiding among the foliage.

Family 40.

LAGRIIDAE.

This is another small group containing few species, but *Lagria grandis* is one of our very common beetles, and can be collected on low scrub anywhere about Sydney. The larvae are to be found under logs or among damp leaves on the ground, and are thickset, black, shining creatures. covered with short reddish hair on the upper surface; short antennae standing out in front; and the tip of the abdomen is produced into a pair of pointed spines. The beetle is light reddish brown, closely covered with fine confluent punctures and short scattered brown hairs. It is slightly over ½ an inch in length, with a small

head, slender, narrow thorax, and with the front of the wing covers forming a broad shoulder in front.

Family 41.

ANTHICIDAE.

These are small ant-like beetles, with the head having a regular neck and the thorax narrow and elongate; most of them are found among rubbish upon the ground, or along the edges of creeks and watercourses. It is chiefly owing to the researches of King, who collected and described a great number of the species found about Sydney (Trans. Ent. Soc. N.S.W. 1869), that we know much about this family.

Family 42.

PYROCHROIDAE.

This is a small group containing some beetles with the head attached to the thorax by a neck, and with the wing covers much broader than the thorax: *Lemodes coccinea* is a pretty little bright red beetle with black legs and antennae, the latter tipped with white; it measures slightly over ¼ of an inch in length; is common under logs in the Illawarra district. Another species, *L. splendens*, has recently been described by Lea (Pro. Linn. Soc. N.S.W. 1906) from specimens obtained by me at Noundoc, N.S. Wales.

Family 43. Pintails.

MORDELLIDAE.

This group, in which the *Rhipidophoridae* are now included, are very distinctive beetles; they have the

head tucked down in front; the thorax large, broad, and rounded at the base, with the hind margins angular and fitting closely into the wing covers, which taper down to the apex; the end of the abdomen forms a stout spine-shaped tip extending beyond the wings.

They are very active little beetles; several species are very numerous and swarm over the flowers of the low scrub. *Mordella leucosticta*, ½ an inch in length, is black; the whole of the upper surface is thickly spotted and marked with dull white, and the legs and under surface are also mottled. *M. limbata* is a much smaller black beetle ⅛ of an inch in length, and has a pale silvery sheen: *Tomoxia flavicans*, from the northern rivers, is a shorter broader insect. *Pelectomoides conicollis* is 1¼ inches in length; is of a uniform dull brown colour, with pectinate antennae; the head is small, turned down, and the thorax is broad and rounded. This fine beetle is found about Sydney. Lea has described and listed the members of this family (Trans. Ent. Soc. London 1902).

Family 44. Oil and Blister Beetles.

CANTHARIDAE.

The true Blister Beetle is a slender insect with soft integument, and a small head produced into a neck behind; the thorax is small in proportion to the slender rounded abdomen and wing covers. A number of species have been described from this country by different writers, among whom Fairmaire has been chief (Stett. Ent. Zeit. 1880). Most of them belong to the Genus *Zonitis*, of which about 40 species have been described. *Zonitis bipartita*, under ½ an inch in length, has the head, thorax, base of the

wing covers, and under surface of abdomen orange yellow, with the abdomen and rest of the elytra dark shining blue: *Z. brevicornis* is a very similar insect, but has the whole of the wing covers deep metallic blue.

The true Oil Beetles are more rare; unable to fly, they are found crawling about on the ground with the body distended and the wing covers overlapping each other at the base. Nothing is recorded about the larvae of our species of this family, but in other countries they are known to feed upon the eggs of locusts; others attach themselves to bees, and are thus carried into their nests, where they devour the eggs and afterwards the honey.

The OEDEMERIDAE are somewhat similar looking insects to the Blister Beetle; *Ananca puncta* is found in the northern parts of N.S. Wales; it is a very slender long-legged beetle over ½ an inch in length, of a general dull yellow colour, with the head, thorax, and legs mottled with dull blue, and the whole of the elongated wing covers dull blue except a dorsal stripe of the prevailing yellow which widens out towards the apex.

Family 45. Woodborers.

SCOLYTIDAE.

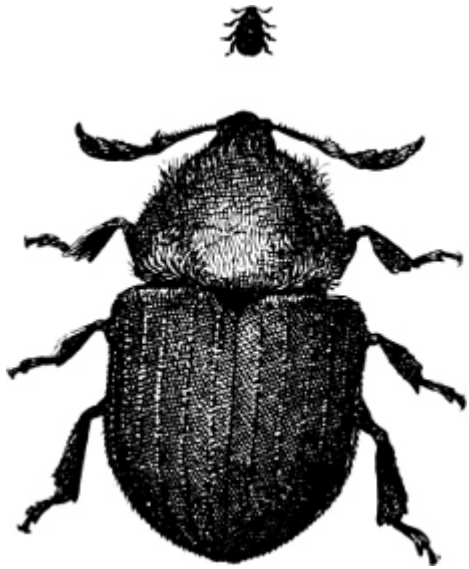


Fig. 80.—*Hylesinus fici* (Lea).

The Fig-branch Beetle, better known under the name of *H. porcatus* (Chap.).

("Agricultural Gazette," N.S.W.)

This is a group the members of which are allied to the Weevils, but differ in having a short broad snout with clubbed antennae, and the tibiae toothed on the outer edge. Only a few species have been described from this country, but several of them are well-known pests, and like the smaller species of the Auger Beetles are usually attracted to dying trees. In the Genus *Hylesinus* we have one, *H. porcatus*, which attacks the terminal buds of both the wild and cultivated figs. It is a short thickset black beetle, about 2 lines in length, with the head turned down to the fore-legs, and the clubbed antennae 5 jointed; the head and thorax are rugose, and the wing covers finely striated; the whole insect is lightly clothed with fine hairs. The Ambrosia Beetle, *Xyleborus solidus*, is a common beetle in the bush, and has

lately turned its attention to fruit trees; boring into the branch and then gnawing a chamber right round under the bark, she deposits her eggs at the end of the burrow, at the same time killing the branch and causing it to snap off. This beetle is about ⅛ of an inch in length, of a uniform black colour, with the legs and antennae reddish brown. It is stout and cylindrical in form; the head is turned down in front and hidden from above; the rounded thorax is nearly as large as the body, covered with short rasp-like points in front; the wing covers are flattened and squared off at the tips.

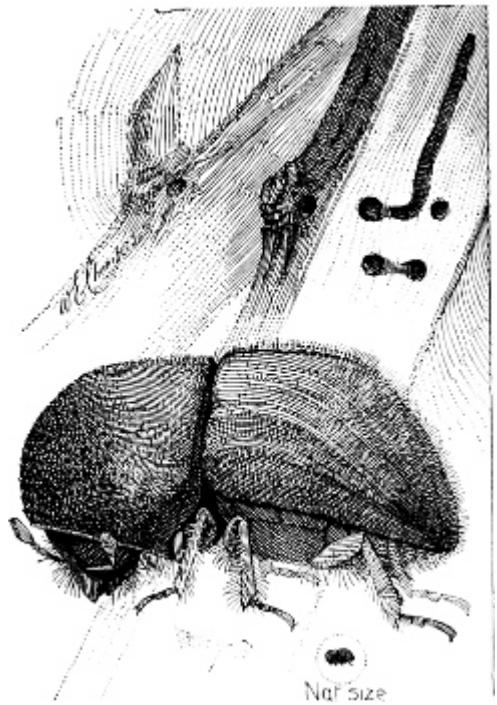


Fig. 81.—*Xyleborus solidus* (Eichhoff).

The Scolytid Beetle that damages the Apple tree Branches.

("Agricultural Gazette," N.S.W.)

Family 46. Slender Weevils.

BRENTHIDAE.

These are remarkable looking beetles, very long and slender in form, with the snout never turned down but standing out straight in front of the head; the antennae not elbowed, but composed of a number of bead-like joints attached near the tip on either side; and the jaws situated at the extremity of the snout. In many of the larger forms the males are much bigger than the females, and have the snout much longer; they are chiefly found in the tropical scrubs, two small species however coming from the south. *Trachelizus howetti*, a shining reddish brown beetle about ¼ of an inch in length, has the antennae thickened to the tips; and *Cordus hospes*, a larger beetle of a somewhat darker colour, is found under dead bark on the tree trunks, and also sometimes in ants' nests. *Ectocemus pterygorrhinus* comes from North Queensland, and is common on the low scrub about Cairns where timber has been felled; it is somewhat short and thickset; the male is about 1¼ inches in length, with the tip of the rostrum produced into an angulate process, and very long cylindrical antennae. The general colour is dark reddish brown, with the wing covers ornamented with four parallel rows of shining dull yellow bars. *Ithystenus hollandiae*, also from Cairns, is found in similar situations; it is very long and slender, 1½ inches long, blackish brown, with two parallel light reddish brown lines down the centre of the wing covers, and the extremities produced into a tooth at either side. *Homocerus fossulatus*, found under rotten bark, is of a general dull brown colour; is thickened and flattened, with the wing covers much roughened. The male measures about 1¾ inches in length, but

the female is much smaller. *Mesetia amoena* is a very pretty, slender, bright reddish yellow beetle, with the head, legs, and sides of the thorax black, and a dark medium stripe down the thorax and elytron. It is about 1 inch in length, and is common in the scrubs about the Richmond River N.S.W.

Family 47. Carnivorous Weevils.
ANTHRIBIDAE.

These beetles are allied to, but very distinct from, the true weevils, and are usually found on the trunks of dead trees, where they hunt for and devour the small wood-boring beetles that are attracted to the dead twigs, or which breed out of fungus. They have a short blunt snout, and many have long slender antennae which are not elbowed; they are most plentiful in the northern scrubs and forests.

Ecelonerus albopictus is typical of those with short antennae clubbed at the tips; it is a stout thickset dark brown beetle, thickly covered with pubescence, and the whole of the under surface, front of thorax and middle and tip of the body blotched with white pubescence. It measures over ½ an inch in length, and is found in the northern parts of N.S. Wales.

Ancylotropis waterhousei is a good example of the long-horned forms; it measures over ½ an inch in length, but looks shorter as its head and thorax are curved downwards. It is a very slender beetle of a uniform brown tint, but thickly clothed with buff and grey down; the thorax tapers to the front, and the head is elongated but swells out again in front, and is furnished with long slender antennae. *Doticus pestilans* is known as the “Dried Apple Beetle,” from the habit that the beetle has of laying its eggs in any

dried immature apples that are left over the season upon the trees; in its native state the larvae breed in the large wattle galls. It measures only about ⅓ of an inch, and is a short, thickset beetle, with the head turned downward, furnished with slender clubbed antennae. The general colour is reddish brown; it has a raised ridge on either side of the wing covers; the fore-legs are curiously prolonged with large tarsi, and it has a peculiar jumping habit. Pascoe has described most of our beetles belonging to this group (Journal of Entomology 1860, and Annals and Magazine of Natural History 1859).

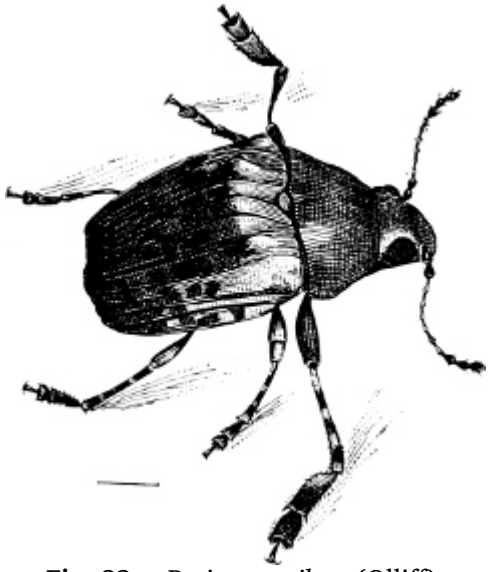


Fig. 82.—*Doticus pestilans* (Olliff).
The Jumping Anthribid or "Dried-apple Beetle."
("Agricultural Gazette," N.S.W.)

Family 48. Weevils.
CURCULIONIDAE.

The Weevils or Snout Beetles are one of the largest and best defined groups of the Coleoptera, and though they comprise a great number of very different looking beetles in shape, they all have the front of the head produced into a more or less elongated snout with the jaws placed at the tip, and with the distinctly elbowed antennae standing out on either side of the snout, forming a regular angle. Most of them are provided with well developed wings, the elytra being usually very solid; and the whole insect is encased in thick armour plate integument. The majority are slow, sluggish beetles,

that trust as a rule more to their shape and protective colouration harmonising with their surroundings, than to their activity. They feed chiefly upon foliage and bark, and when at rest cling to the twigs or stalks of their food plants, falling at the least alarm to the ground, where they remain perfectly motionless, with their legs and antennae tightly closed until the danger has passed.

Those living in the dry western country are represented by curious wingless forms with very short stout snouts, and are usually found under logs and stones in open grass lands; while in the tropical scrubs they are chiefly arboreal, and frequently richly coloured. They are all vegetarian in their habits both in the larval and perfect states; some infest seeds, others destroy the buds, foliage or roots of plants and do a great deal of damage to farms and gardeners' crops. About 1200 described species are listed in Masters' Catalogue, and a great number of new species have been added during the last few years by Messrs. Blackburn and Lea in the Proceedings of the Linnean Society of N.S. Wales, and Transactions of the Royal Society of S. Australia. Pascoe, one of the most prolific writers on this family, described a great many between the years 1869–1883 (Journ. Linn. Soc. & Ann. Nat. Hist.). They have been divided into a number of sub-families, among which only the most important can be noticed here.

The remarkable Long-necked Weevil, *Rhadinosomus lacordairei*, measures under ½ an inch in length; is of a uniform dull reddish brown tint with a silvery white spot on either side of the rounded elytra, which are produced into a spine on each side. It breeds in the cavity in the large

Brachyscelid galls, feeding on the woody tissue; Lea says that in Tasmania it is a pest to strawberry growers.

The members of the Genus *Myllocerus* are dainty little oval weevils found resting upon grass stalks or among the foliage of small shrubs peculiar to North Queensland and North West Australia. *Myllocerus carinatus* is about ⅓ of an inch in length, and is finely striated and densely clothed with metallic green scales. *Catasarcus spinipennis* is another West Australian insect of a brownish buff tint, with the abdomen broadly rounded; and the hind portions of the elytra covered with sharp spines. About 40 species of this genus are described, all of which with one exception are confined to West Australia. *Cherrus ebeninus* is one of the large stout black weevils common in the bush around Sydney, where it is usually found clinging to the twigs of the blood-wood, *Eucalyptus corymbosa*. It is black, with broad rugose thorax and ribbed wing covers.





Figs. 83 and**84.**—*Wattle Weevils.*

83. *Rhinotia hœmoptera* (Kirby). The Red Weevil.
84. *Leptops tribulus* (Fabr.). The Wattle "Pig-beetle."

("Agricultural Gazette," N.S.W.)

The Genus *Leptops* contains a large number of very characteristic beetles feeding upon the foliage of wattles and other scrub trees. They are usually grey, buff, or dark brown insects with thickened snouts and broad bodies. The Apple-root Borer, *Leptops hopei*, is sometimes a pest to the orchardist, damaging the roots of his apple trees; the beetle emerging from the soil crawls up the tree trunk, and laying her eggs upon the leaf, turns the edges over

and gums them together with a sticky secretion; the young grubs hatch and crawl down to the roots. *L. tribulus*, often called by the Sydney boys the "Wattle Pig," feeds upon the foliage of the black wattle; it is a much larger species, about 1 inch in length; dark brown to black in colour; the broad rounded body covered with short blunt spines, thickest towards the apex. The Grey-banded Leaf Weevil, *Ethemaia sellata*, described from S. Australia, has a wide range over the interior. The larvae are pale green legless creatures about ⅓ of an inch in length, lightly clothed with short hairs; they remain buried in the soil, coming out at night to feed upon plants, but if disturbed by a light they will drop to the ground and bury themselves very quickly. The beetle is ⅓ of an inch in length, dark brown, shaded with grey, which forms an irregular pattern on the thorax, legs, and elytra; rugose, deeply pitted; and the whole surface is clothed with white and brown scales.

The AMYCTERINAE are a large group of weevils with such short thick snouts that they are quite unlike the typical forms generally found in open forest country among grass or hiding under logs or stones; they are wingless, the elytra soldered together forming a very thick solid integument. Macleay described a great number (Trans. Ent. Soc. N.S.W. 1865). *Psalidura elongata*, common in the interior, measures slightly over 1 inch in length; is of a uniform black colour with a reddish brown tint; the short head and flattened thorax are finely granulated, with the elytron closely ribbed and punctured. *Talaurinus tuberculatus*, about ⅔ of an inch in length, is black, very coarsely granulated on the thorax, with the whole of the flattened elytron thickly covered with blunt tubercules. Nearly 90 species or this genus have been described, chiefly by

Macleay, ranging all over Australia. *Amycterus draco* is one of the most remarkable armour plated species in the interior; it is black, with a small deeply ribbed head and angulated thorax; and the broad, somewhat elongated elytron is turned down at the extremity and covered with rows of raised bosses. *Acantholophus echinatus*, as the generic name implies, represents a group containing a number of species covered with spines that extend even over the upper surface of the head and thorax. The Genus *Cubicorrhynchus* contains the smaller ground beetles, almost cylindrical, with short rounded head and thorax: they dwell under stones, and when exposed lie quite motionless as if dead, their dull brown tints matching the ground. *C. morosus*, about ⅓ of an inch in length, is of the usual form and colour, with a very wide range, and often very numerous in grass lands.

The GONIPTERINAE comprise a number of diverse forms found upon foliage clinging to the twigs. The Genus *Oxyops* contains a number of stout moderate-sized beetles which are remarkable for the curious habits of their legless slug-like larvae, which, covering themselves with a slimy secretion, crawl about over the surface of the eucalyptus leaves, feeding upon the epidermis and covering their backs with their excrement; when full grown they pupate on the ground among the rubbish beneath their food plant. *Oxyops concreta* has a narrow short head with the thorax broadest behind; the elytra broadly swollen, rounded, deeply striated, and clothed with fine scales. *Bryachus squamicollis* has a wide range over Australia, and is usually found clinging to the twigs of stunted gum trees; it measures about ½ an inch in length; is of a uniform dark chocolate brown, but thickly mottled all over with fine grey and black scales. This beetle forms rounded cells of a brown

gummy substance (very much like large Lecanium scales) which are attached to the twigs, in each of which she places three eggs; from these emerge pale yellow oval larvae; when full grown the larva is an oval smooth rounded grub of a purplish tint, legless, flattened on the ventral surface, and with the head hidden from above, like a "pear-slug" larva; when adult it falls or crawls to the ground, and pupates among the rubbish. Mr. Gurney first discovered the curious egg-capsules on trees in the Bogan River district N.S.W. *Gonipterus gibberus* is a small reddish-brown beetle with a white blotch on either side of the elytra; it has an elongated head and thorax, and is usually found clinging tightly to the tip of a eucalyptus twig. *Aterpus cultratus*, typical of the next group, measures ⅓ of an inch in length; the dorsal surface is flattened; is of a general dull brown tint, with the head, front of the thorax and tip of the abdomen buff. Usually found under dead bark on tree trunks, its larva forms a loose cocoon of bits of bark on the stems of Melaleuca bushes. *Lixus mastersi*, the weed weevil, is very common in neglected gardens, as its larvae feed in the roots of *Amaranthus* and *Chenopodium*, causing them to swell out into cylindrical galls; the beetle is ⅓ of an inch in length, slender and cylindrical in form, of a light brown tint, but when freshly emerged is covered with a yellow mealy pubescence which soon rubs off.

The "Botany Bay Diamond Beetle," as Donovan described it, *Chrysolophus spectabilis*, is one of our commonest and at the same time one of the most beautiful of our weevils. It has a very wide range all over Australia, and is found wherever the black wattle thrives, but also feeds upon many other species. It is very variable in size, measuring to 1 inch in length; is of a uniform black tint, but so

thickly covered with patches of bright metallic green scales, that in freshly emerged specimens it seems more green than black. It deposits its eggs about the butt of the wattle tree buried in the bark; the stout fleshy grubs form irregular tunnels in the wood.

The Elephant Beetle, *Orthorrhinus cylindrirostris*, whose stout fleshy grubs do a good deal of damage to citrus trees, has a very wide range over Australia: it is a dark brown weevil, covered on the dorsal surface with fine buff and grey scales; the thorax is covered with irregular bosses which form ridges on the elytra. It measures about ½ an inch in length, and has a long slender snout turned down in front, and very long fore-legs terminating in large feathered tarsi; in its native state it feeds upon gum trees. *O. klugi* is a much smaller species that feeds and breeds in wattles, but is also known as an orchard pest, infesting the canes of vines, and also eating the leaf buds.

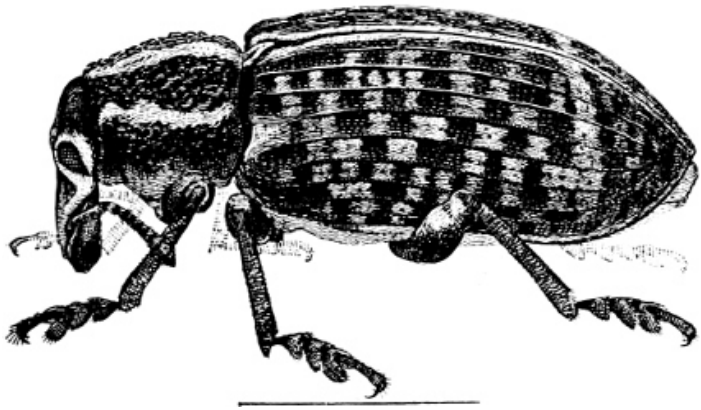


Fig. 85.—*Chrysolophus spectabilis* (Fabr.).

The Botany Bay Diamond Beetle.

("Agricultural Gazette," N.S.W.)

Eurhamphus fasciculatus is one of our largest and

most remarkable looking weevils; it measures 2½ inches in length, and is of a general black tint, but the greater portion is finely clothed with grey and rusty red scales, which give it a uniform buff tint; it is further clothed with tufts of long soft reddish brown hairs forming a raised ridge down either side of the thorax, and are scattered in rows on the elytra intermixed with small tufts of long grey hairs, giving it a very remarkable spiny appearance. It is a rare insect as a rule, ranging from Pine Mountain, Queensland, to the Clarence River, N.S. Wales; but many years ago Masters when collecting in the north came upon a large dead pine tree in the scrub literally covered with hundreds of these great weevils boring into the dead timber with their long slender snouts, making a distinct scratching sound. It is therefore probable that they are confined to the strip of country where the Hoop or Maryborough Pine grows, and breed on it.



Fig. 86.—*Myrmacicelus formicarius* (Chev.).

The Ant-like Weevil.

("Agricultural Gazette," N.S.W.)

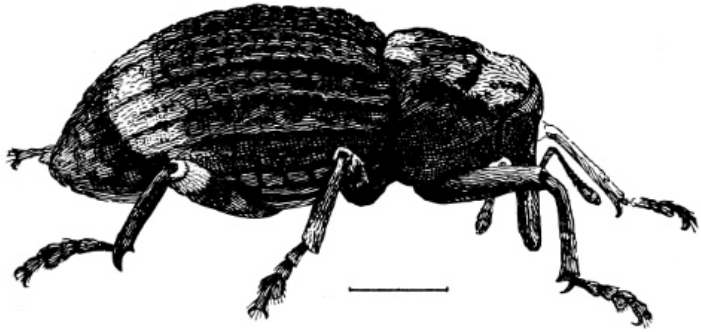
Tranes sparsus, ⅓ of an inch in length, is common among the coarse palm-like foliage of the

Currawong; it is of a uniform reddish brown tint with a slender snout, rounded flattened thorax, and oval, flattened, finely striated elytra. A smaller black species, *T. xanthorrhoeae*, is found in the foliage of the grass trees. The Genus *Belus* contains a number of very slender weevils with the snout standing out in front of the head, long antennae, thickened thighs, and the slender elytra coming to a point at the apex. They feed upon wattles, and are very active, flying about in the heat of the day. *Belus semipunctatus* is about ¾ of an inch in length; of a uniform dark reddish brown tint, with a broad white stripe down each side of the thorax and down the centre of the back, with small spots on each side. *B. bidentatus* is a stouter thickset beetle; and is of a darker brown colour, with a rounded buff spot on either side of the wing covers. *B. plagiatus* is a smaller almost black species, richly variegated with reddish yellow spots and blotches; it comes from the more tropical scrubs of N.S. Wales and Southern Queensland. *Rhinotia hoemoptera*, a very handsome slender cylindrical weevil, is about ¾ of an inch in length, with the snout furnished with thickened antennae turned down below the head; it is rich black with bright brick red wing covers which have a fine dorsal black stripe down the centre. The curious large-headed larvae feed in the stems of the Sweet-scented Wattle, *Acacia suaveolens*. *Eurhynchus acanthopterus* is the type of another group, which has a shorter snout, and the head broad and rounded, fitting closely into the somewhat attenuated thorax; the body is broadly oval, and the wing covers furnished with short conical spines in the centre of the back. It measures about ½ an inch, and is of a uniform reddish brown tint. The Ant Weevil, *Myrmacicelus formicarius*, usually found crawling about on the trunks of wattle

trees, is a shining black weevil about ⅛ of an inch in length, and is as ant-looking as its names suggest. The Genus *Balaninus* represents the tiny little rounded weevils with very long slender snouts adapted for feeding upon seeds. *B. amoenus* is black spotted with white; is almost oval in form, and about ⅛ of an inch in length. It feeds upon the ripe fruit of the little yellow fig, *Ficus rubiginosa*.

The Genus *Laemosaccus* contains a number of short flattened weevils of a general black or dark brown colour ornamented with white or buff down; they are generally found feasting upon the bark of freshly fallen tree-trunks, particularly wattle and eucalypts, in which they also bore holes and deposit their eggs. *Laemosaccus electilis* measures ¼ of an inch in length; is black with white pubescence on the under surface, and white markings on the tips of the wing covers, which are finely striated. My specimens come from Condobolin, N.S. Wales.

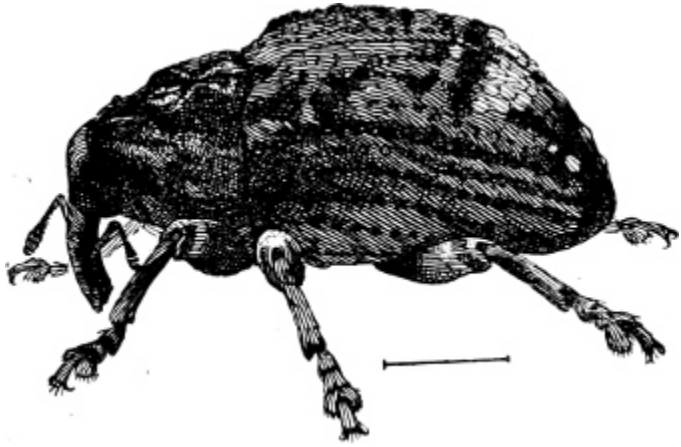
The members of the Genus *Haplonyx* contain a number of curious, short, broadly rounded beetles generally found clinging to the twigs of eucalypts, but their larvae breed in the fleshy galls of the Brachyscelid coccids, where they destroy the gall makers and pupate in the cavity. *Haplonyx centralis* is a typical dark brown species with a large white circle occupying the centre of the back. *Perissops ocellatus*, about ½ an inch in length, comes from the Tweed River N.S. Wales and Southern Queensland: it is of a general light brown tint; is oval and rounded in form, with the wing covers marked with buff, so that when viewed from behind it resembles a pair of eyes and nose on a man’s face.



Figs. 87 and 88.—Kurrajong Weevils.

87.—*Axionicus insignis* (Pascoe).

The Mimic Bark-weevil.



88.—*Tepperia sterculiae*, (Lea).

The Seed-pod Weevil.

("Agricultural Gazette," N.S.W.)

Axionicus insignis is always found upon the trunk of the Kurrajong tree hidden in the crevices of the bark, where in spite of its size (¾ of an inch in length) it is very difficult to detect, owing to the exact blending of its white grey and brown markings with the tints of the bark. It lays its eggs in the injured bark; the larvae are typical obese legless

white grubs; they feed between the bark and the wood often in such numbers as to kill large branches. They pupate in regular oval cocoons formed of gnawed wood and bark. *Tepperia sterculiae* breeds in the seed pods of the Kurrajong, and is a smaller but somewhat similar tinted beetle clothed with brown and grey scales, the latter forming a well defined patch toward the apex of the wing covers. The two species of the Genus *Enteles* are smaller, smooth, shining, black beetles, with the head and legs curving underneath the body; they are both found in the semi-tropical scrubs of the north. *Enteles vigorsi* is marked with two white transverse lines crossing the elytra; while *E. ocellatus* has more parallel lines crossing the transverse ones, making an eye-like pattern upon the back. The Grass-tree Weevil, *Trigonotarsus rugosus*, is 1½ inches in length; is of a uniform black colour; and of the typical Calandra or palm weevil shape, with a slender curved snout, and small head sunk into the thorax, with the dorsal surface of the thorax and elytra flattened. The obese white larva feeds in the roots of the grass-trees. Allied to this are the two tiny cosmopolitan grain weevils, *Calandra orizae* and *C. granaria*, which are destructive pests to all kinds of grain and other food stuffs.

Family 49. Longicorns.

CERAMBYCIDAE.

The longicorn beetles from their number, variety, size, and the damage they do to timber and plants, are well known beetles, and have always been a favourite group with collectors. They are usually elongate in form, with powerful gnawing jaws, and

long slender many-jointed antennae standing out in front of the head, the basal joint often half encircled by the large compound eye; the elytron is always divided down the centre, and the large hind wings well adapted for flight are folded beneath them; the legs are strongly developed, well adapted either for running about or clinging to their food plant.

They deposit their eggs in bark or timber; the larvae burrow into the tissue beneath, upon which they feed; they often remain, long cylindrical or flattened naked grubs, for several years before they pupate in the end of their last gallery.

They are divided into three large sub-families by modern entomologists; our species have been chiefly described by Newman in "The Entomologist" 1842; "Annals of Natural History" 1840; and a number of other Journals. Pascoe contributed a great many papers to over half a dozen of the leading entomological societies in England between 1857 and 1875. Hope, in the Proceedings of the Entomological Society of London 1841, and other Transactions, added largely to our list, while Messrs. Boisduval, Germer, White, Saunders, and others described odd specimens. In our own Journals, Macleay and Blackburn have also dealt with these beetles.

The PRIONINAE comprise a number of large broad thickset beetles with the front coxae large and transverse, and the prothorax having well developed side margins. The determination of several of our commonest species was a matter of some doubt, so I submitted most of our common forms to Professor Lamare of Brussels, who has identified them and enabled me to speak with some authority.

Sceleocantha glabricollis is one of the shortest

thickset forms; about 1¼ inches in length; of the usual uniform reddish brown tint; the small shining thorax furnished with a fine spine on either side; and the broad rounded elytron finely granulated. It is found along the southern coast of N.S. Wales. The common large white grub which bores in the trunks of the honeysuckle (*Banksia serrata*) growing along the coast of the south-east of N.S. Wales, Victoria and Tasmania, is the larva of *Paroplites australis* described in 1842 by Erichson; in most of our Museum collections it is known as *Macrotoma servilis*. It is variable in size, measuring to 2 inches in length, and is of a dull dark brown tint, with a flattened rugose thorax with serrate edges. *Eurynassa australis* is a large somewhat slender species 2¼ inches in length; the broad flattened dull coloured thorax is marked in the centre with two shining triangular patches pointing toward the head; the reddish brown elytra are finely granulated. *E. odewahni* is a smaller species, with the thorax more constricted, shining, rugose, and serrate on the margins; it is found in the interior, and has an extended range westward from N.S. Wales to W. Australia. *Agrianome spinicollis* comes from the north-east of N.S. Wales; it is a broader more flattened form, about 2 inches in length; the thorax is rounded and serrate on the sides; and the general colour is light reddish brown. *Iotherium metallicum* hardly measures over ½ an inch; is of a rich metallic purple tint; the thorax is produced into a broad spine on the sides; and the wing covers are broadly round at the apex. The male is a much smaller coppery tinted beetle, and was described under the name of *Phaolus macleayi*; it is usually taken on grass stalks in open forest country.

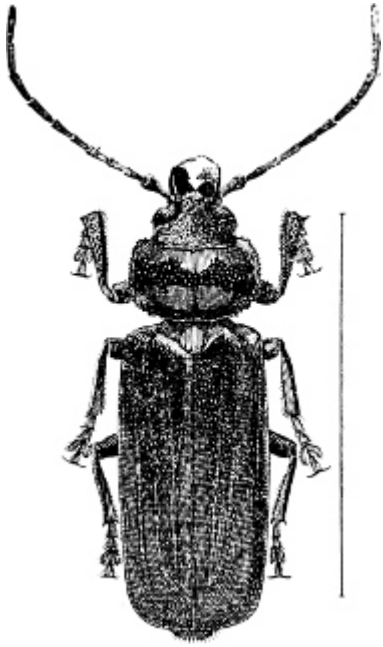


Fig. 89.—*Eurynassa odewahni* (Pascoe).

The great brown Longicorn.

("Agricultural Gazette," N.S.W.)

The CERAMBYCINAE comprise a much larger division of the longicorn beetles, differing from the last group in having the first coxae not greatly extended transversely; the thorax not margined, and the last joint of the maxillary palpus usually broad. *Pachydissus sericus* is a slender silvery dark brown beetle about 1¼ inches in length, with the tip of the wing covers spined and the basal joint of the antennae thickened. It is generally found clinging to the rough bark of tree trunks. They deposit their eggs in the bark of *Acacia longifolia*; the larvae bore all through the trunk and larger branches; they have a wide range over the southern half of Australia.

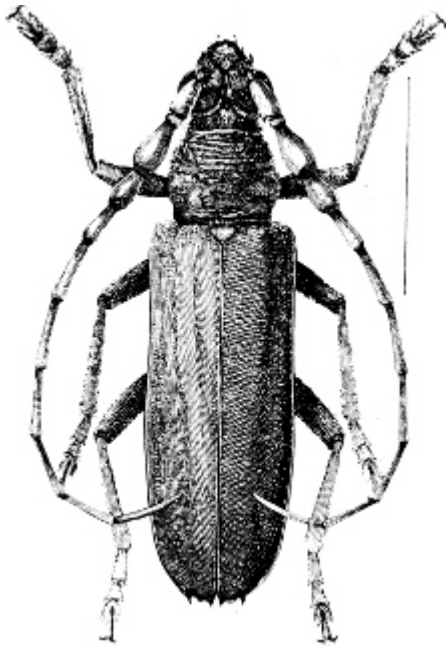


Fig. 90.—*Pachydissus sericus* (Newman).

The Silvery Longicorn, breeding in the stems of *Acacia longifolia*.

("Agricultural Gazette," N.S.W.)

The Genus *Phoracantha* contains a number of typical dark yellow or mottled brown beetles which in the larval state feed between the bark and sapwood of different gum trees when the trees are dead or dying; several species are common in firewood blocks about Sydney. The beetles are remarkable for long antennae fringed on the inner edge with fine hairs and short spines at the joints, and a single large spine on the sides of the thorax. *Phoracantha recurva* has a very wide range from the North-west coast to Victoria; it measures under 1 inch in length; is of a general dull yellow tint, with the apical half of the wing covers crossed with a

broad band of reddish brown. *P. tricuspis* is a much larger, darker reddish brown beetle with mottled wing covers that lives in the timber of the ironbark gums. *P. semipunctata*, smaller than the last, has a regular pattern of dark brown on its back; it is common about Sydney N.S.W., and has a wide range over Australia. *Epithora dorsalis* is remarkable for its very long fringed antennae, and is easily distinguished by its uniform reddish tint marked across the centre of the wing covers with a broad patch of dull yellow. It also has a wide range over the continent, and is often taken about Sydney in summer on flowering shrubs. *Aphanasium australe* is a slender, light reddish brown beetle, under ¾ of an inch in length, the larvae of which feed in the stems of the prickly Hakea bushes. *Piesarthruis marginellus* is a very distinctive dull reddish brown insect with the centre of the wing covers pale brown; the smaller more slender male is furnished with remarkable feathered antennae. The larva breeds and pupates in the centre of the branches of *Acacia longifolia*, and can be easily reared from infested wood, though it is very rarely found on the food plant, for as soon as it emerges it crawls up to the top of the tree and clings to the branchlets.

Strongylurus thoracicus is a handsome brown longicorn brightly marked with white on the sides of the thorax. Its larva is very destructive in gardens, cutting off large branches of white cedar and pittosporum bushes.

In the Genus *Uracanthus* the beetles are long and slender, with almost cylindrical bodies, and the thorax contracted slightly behind the head. *Uracanthus triangularis* in Victoria confines its attention almost exclusively to the branches of the

black wattle; but in N.S. Wales I have bred it from a number of different shrubs. It measures about 1 inch in length; is of a general uniform reddish brown colour, but so thickly clothed with fawn-coloured pubescence that there is only an angular bare reddish patch on the sides of the wing covers. *U. cryptophagus*, the largest known species, is nearly twice the length, more cylindrical in form, and of a uniform buff tint. In its native state it fed in the northern scrubs of N.S. Wales upon the wild lemon, from which it migrated to the cultivated orange, and the larvae burrowing through the branches did a great deal of mischief to the trees. *Syllitus grammicus* is a slender reddish brown beetle with six parallel grey lines running down the elytra, and is under ½ an inch in length. *Lygesis mendica* breeds on the twigs of the black wattle in the neighbourhood of Sydney. It measures under ½ an inch in length; is of a uniform reddish brown colour, and has a slender head and long cylindrical thorax. The wing covers are rounded at the tips, and the whole insect is clothed with stout white hairs. *Macrones rufus* is a long, slender, bright reddish brown beetle about 1¼ inches in length; the thorax is roughened into rounded bosses; the body is narrow in the centre, but swells out into a rounded apex; the wing covers narrow, and not reaching to the tip of the abdomen give it a very wasp-like appearance. It is usually taken upon flowers in the summer months.

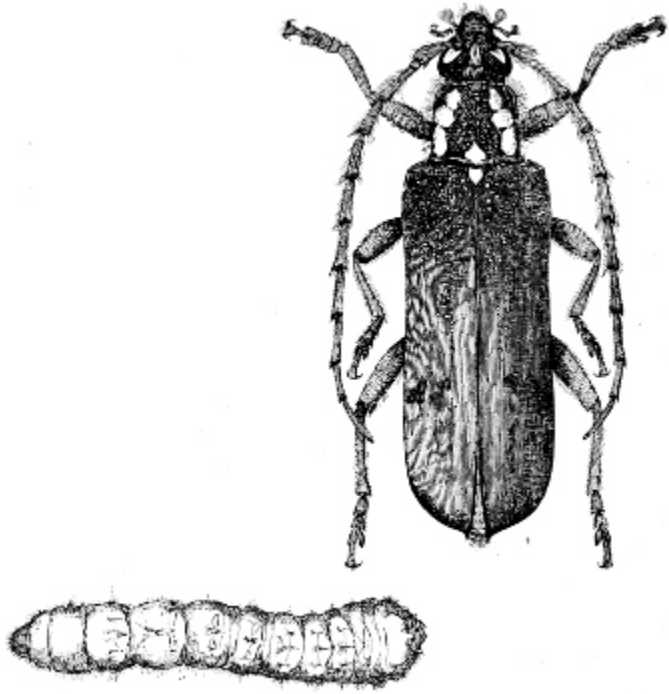


Fig. 91.—*Strongylurus thoracicus* (Pascoe).
The Pittosporum tree borer, and larva.
("Agricultural Gazette," N.S.W.)

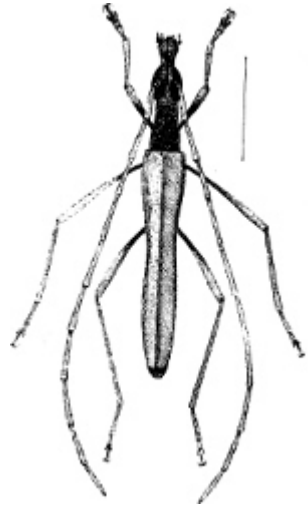


Fig. 92.—*Lygesis mendica* (Pascoe).
The slender grey-haired Longicorn.
("Agricultural Gazette," N.S.W.)

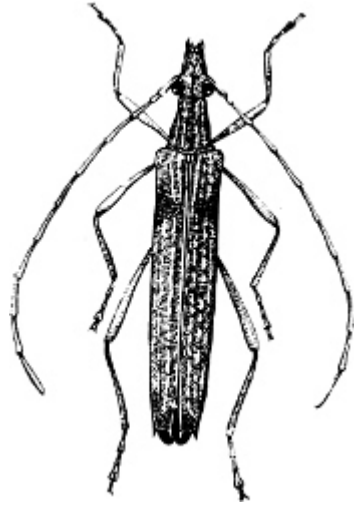


Fig. 93.—*Uracanthus cryptophaga* (Olliff).
The great Orange-tree Borer.
("Agricultural Gazette," N.S.W.)

The Genus *Hesthesis* contains a number of brightly marked yellow and brown beetles that mimic flower-wasps both in colour and shape, and are found in similar situations upon flowering shrubs. The wing covers are shortened into rounded pads only covering the shoulders, while the wings are exposed. *Hesthesis vigilans*, under ¾ of an inch in length, is black, mottled on the thorax, and barred with two bands of bright yellow on the abdomen, and one on the front of the thorax. *H. ferruginea*, slightly larger, is bright yellow banded with black; and *H. cingulata*, about the same size, is black, blotched upon the thorax, and marked with three white bands on the abdomen. *Distichocera macleayi* has the smaller male black with feathered antennae, and deeply ribbed wing covers tapering to the apex. The female, nearly 1½ inches in length, and broader and thickset in proportion, has the dorsal surface clothed with rusty red pubescence. *D. maculicollis* is a much smaller species, hardly over ½ an inch in length in the male, which is of a dull black faintly marked with white; the larger female is rusty red except a parallel stripe of black down the centre of the thorax. This species breeds in the stems of *Kunzea corifolia*; commencing under the bark the larva gnaws irregular passages backwards and forwards, finally hollowing out several large parallel chambers toward the centre of the stem, in one of which it pupates. Among the most beautiful of our flower haunting longicorns are the members of the Genus *Tragocerus*, with stout angular thorax and broad deeply ribbed wing covers almost truncated at the extremities. *T. lepidopterus* is variable in size and colouration in the sexes, the smaller male being darker coloured than the large reddish brown female, which measures nearly 1¾ inches in length; both have the wing covers mottled

with little patches of grey hairs. *T. spencei* is a smaller species without the white patches, but having dark wavy bands crossing the centre of the back.

The members of the Genus *Clytus* are active little ant-like beetles, common in the more tropical parts of Australia, running up and down on freshly fallen tree trunks in the bright sunlight, or hunting over flowering shrubs; some are richly marked with golden yellow or red on the rounded thorax. *Clytus curtisi*, measuring under 1 inch in length, is black spotted and mottled with white. One of our commonest and most widely distributed flower haunting longicorns is *Aridaeus thoracicus*, a reddish yellow beetle with short rounded thorax, and the wing covers crossed in the centre with two black V-shaped bands. It is very variable in size, the largest measuring nearly 1 inch in length. *Purpuricenus quadrinotatus* is a very handsome black and bright red beetle about ¾ of an inch in length, with a short broad almost globular thorax, and a short body round at the apex. It is common along the Flinders River N. Queensland upon low scrub, and I have taken them in all variations of red and black; usually the head and thorax are black, with the wing covers red blotched with black; a variety with the thorax red is described as a distinct species.

The LAMIINAE comprise the third division which, usually stout and broad in proportion, are found chiefly upon branches or twigs feeding upon bark; and are frequently very numerous upon fallen timber in forest clearings. They differ from the former group in having the front coxae round and deeply embedded; the maxillary palpi pointed at the tips; and the fore tibiae with a more or less distinct

groove on the inner side.

Microtragus mormon is typical of several closely allied genera of short, thickly coated longicorns, with the rounded slightly spined thorax and the tapering body ridged or coarsely punctured; they are found upon logs or tree trunks on the ground, and somewhat resemble the ground weevils. This species comes from Kalgoorlie, W. Australia, but has a wide range over the western country; it is of a dull reddish brown tint, and measures about 1 inch in length. *Ceraegidion horrens*, not uncommon in the Illawarra district N.S.W., is a smaller darker coloured beetle covered with stout spines upon the dorsal surface of the thorax and elytra. The Genus *Monohammus* contains a number of very fine brown or mottled beetles with long stout antennae; the small rounded thorax produced into a blunt spine on either side; and the broad wing covers arcuate at the tips and sometimes spined on the sides. *M. holotephrus* is of a uniform dull buff tint and measures over 1 inch in length; it comes from S. Australia and Queensland. *M. ovinus* is a much smaller species with the thorax spined on the summit and sides; it is of a pale brown tint finely mottled with grey. It has a wide range, being recorded from Kalgoorlie W.A., N.S. Wales, Queensland, and S. Australia.



Fig. 94.—*Batocera frenchi* (Blackburn).

The great Fig-tree Longicorn.

(Original Photo. Burton.)

The tropical Genus *Batocera*, containing many of the largest and most handsome of our longicorns, is well represented in our semi-tropical scrubs. *Batocera frenchi* has a very wide range from the Northern Coast of N.S. Wales to Cape York. The great white grubs burrow in the trunks of native figs and other forest trees, and the collectors in Cairns, N. Queensland, capture the beetles by cutting down fig trees and waiting for them at twilight when they come to feed upon the bark. This species measures over 2 inches in length, has a spined rugose thorax, broad wing covers, and immense stout spined curved

antennae; its general colour is slate grey to dark brown, with the elytra marked with irregular oval white spots. *B. sapho* is a more reddish brown beetle, somewhat more slender, and with fewer spots on the wing covers: it is found in the forests of Cape York, N. Queensland. *Rosenbergia megacephala* is larger still, and is of a beautiful creamy white tint, with the basal portions of the elytra finely spotted with black; the thorax is deeply ridged and spined: it is found at Port Darwin N.A., and Cairns, Queensland. Horace Brown informs me that this large beetle frequents fig trees in the forests of N. Queensland, where they can often be detected by the number of small branches scattered beneath, which have been cut off by their powerful jaws. *Thyada barbicornis* is a very handsome greyish brown mottled beetle with an oval blackish spot on each side of the elytra, and the antennae are so thickly fringed with fine hairs that it forms a regular brush toward the extremities; it measures under ¾ of an inch in length, and is common on the foliage of native figs on the Tweed River N.S.W.

The Genus *Hebecerus* contains a number of moderate-sized, grey or brownish mottled beetles, many of which lay their eggs in the bark of the wattle trees; the larvae feed and pupate in the tips of the dead twigs. *Hebecerus australis*, a thickset greyish brown species about ½ an inch in length, has a wide distribution over Australia, and has been described under half a dozen synonyms: *H. marginicollis* is a smaller beetle, with the sides of the thorax marked with buff. *H. crocogaster* is smaller still, of a similar general tint, with the antennae barred with grey and brown.

The Genus *Symphyletes* contains a number of large and handsome longicorns that are found clinging to

twigs and branchlets; many of them in the larval state burrow in the stems of wattles, gum trees and other smaller shrubs. *Symphyletes neglectus* is an elongate dull brown beetle about 1 inch in length; it girdles the branches of *Acacia longifolia*, laying its eggs under the bark of the dying portion in which the little grub feeds in the early part of its life. *S. nigrovirens* is a much smaller beetle, with the head, thorax, and base of the elytra clothed with dull yellow hairs; the rest of the wing covers is deep green striped with white on the sides. It feeds upon a number of small shrubs, but its commonest food plant is the stunted prickly wattle (*Acacia juniperina*). *S. solandri*, a larger beetle clothed with a dense coat of fine buff hairs, breeds in the flower stalk of the grass tree, often cutting it right through and causing the upper half, beneath which it pupates, to fall off. *S. vestigialis* measures ¾ of an inch; it is brown, richly mottled with buff and grey. It feeds upon wattles; it has a wide range over Southern Australia.

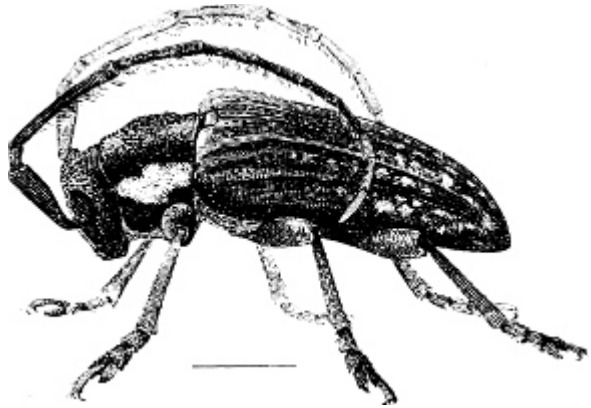


Fig. 95.—*Hebecerus marginicollis* (Boisd.).

The White-cheeked Longicorn.

("Agricultural Gazette," N.S.W.)

The Genus *Penthea* comprises a number of more

thickset beetles with similar habits, and which have the upper surface of the thorax and wing covers granulated or ribbed and these are either covered with a dense pubescence or mottled all over in a very characteristic manner. *Penthea vermicularia*, one of the commonest and with a very wide range, is black with the antennae banded, and the elytra covered with irregular wavy white markings. It is very variable in size, 1¼ inches to under ¾ of an inch in length. *P. saundersi*, found in W. Australia, is much larger, of a more shining dark chocolate brown tint, and more deeply impressed with well defined spots, blotches and irregular buff coloured markings. *P. sannio*, smaller than the last and with a more constricted thorax, has the whole of the upper surface clothed with a creamy grey pubescence overlaid with deep orange red, and irregular dark lines crossing the wing covers; this beautiful beetle is a native of Queensland. *Rhytiphora argus* takes its name from the dark brown eye-like spots all over its back showing through the rich buff pubescence; it also ranges over a large part of Queensland. *Depsages granulosa* resembles a *Penthea* in its robust form; it measures over 1½ inches in length; is of a uniform dark dull brown tint, with the elytra covered with fine granules or bosses. It is common about Sydney, found clinging in summer time to the stems of gum saplings. *Zygrita diva* is a handsome little dark orange yellow coloured beetle irregularly marked and mottled with black. It is very common upon grass stalks in the open forest country of North Australia.

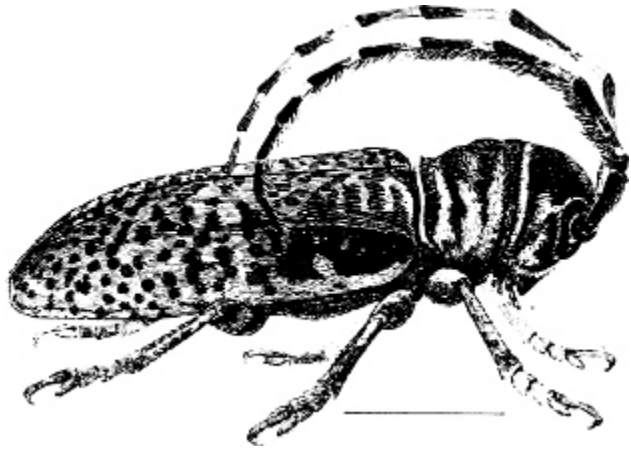


Fig. 96.—*Symphyletes vestigialis* (Pascoe).
The Buff-painted Longicorn.
("Agricultural Gazette," N.S.W.)

Family 50. Plant-eating Beetles.
CHRYSOMELIDAE.

These foliage-destroying beetles have a regular, thickened, more or less oval or rounded form, with the thorax sometimes forming a neck; but in other groups are rounded and fit closely into the head and abdomen. The head, buried up to the eyes in the front of the thorax, is furnished with short stout biting jaws, and slender filiform antennae composed of many short segments; the tarsi are generally four jointed. They are as a rule small insects, rarely measuring over ½ an inch in length; their prevailing colours are red, yellow, or brown, marked with black or bright metallic tints. They lay their eggs on the foliage or twigs of their food plants, upon which the larvae feed when they emerge, and when full grown crawl down and pupate in the soil beneath.

This is a very large family; about 18,000 species

are described from all parts of the world, and most of the typical groups are represented in this country. We have had a number of workers on the Chrysomelids: Baly (Ann. Nat. History 1862), (Jour. Linn. Soc. 1864), and (Trans. Ent. Soc. of London 1877): Clark in the "Journal of Entomology" 1864: Marsham (Trans. Linn. Society 1808): Chapius has described a number (Soc. Entom. Belgium Vol. xvii.), and (Journal, Museum Godeffroy xiv.): while Lea (Trans. Ent. Soc. London 1904) has monographed the CRYPTOCEPHALIDES; and Blackburn revised the Genus *Paropsis* (Pro. Linn. Soc. N.S.W. 1896 and 1901), adding many new species.

The SAGRIDES are very distinctive beetles, with the thorax elongated in front and broad behind; some of the more tropical forms are of rich metallic tints, with the thighs of the hind legs greatly enlarged; and our beautiful representative species, *Sagra papuana*, is known to collectors in the North Queensland scrubs as the "Kangaroo Beetle." It measures 1 inch in length, and the swollen hind legs fringed with reddish hairs and a large angular spine are fully another inch in length. It is a uniform deep metallic blue. *Carpophagus banksiae* measures ½ an inch in length; is of a uniform dark reddish brown, with the elytra irregularly striped and banded with dark yellow; the thighs of the hind legs are thickened, and the under surface is clothed with fine grey hairs. It has a wide range, and is found about Sydney clinging to the low scrub. *Mecynodera coxalgica* is a larger, broader, dull reddish brown insect, clothed with a lighter tinted pubescence, and is found in similar localities.

The CRYPTOCEPHALIDES are a group of short, oval or truncate beetles, with long slender antennae: the

sexes often differ in size and markings; they are usually found feeding upon the tender tips of the branches of wattle, young gum, and other low shrubs. *Elaphodes tiqrinus* is a small, oval, reddish brown beetle, thickly clothed with golden yellow pubescence forming a mottled pattern over the elytra; it feeds upon the foliage of the black wattle. The members of the Genus *Ditropidus* are small oval beetles, similar in shape and habits, black and shining; over 100 species have been described from Australia. The Genus *Cadmus* contains some very handsome ovate insects, with long slender antennae; they chiefly frequent the young eucalypts: the larvae have the curious habit of living in jug-shaped cocoons fitting closely to the body, with the horny flat forehead closing the opening at the apex; when moving along the fore-legs are extended like those of a bag-moth. *Cadmus rubiginosus*, our largest common species, is under ½ an inch in length; it is of a general reddish brown colour, with darker markings. *C. litigiosus* is a smaller yellow beetle; the head and thorax are black above, and the elytra yellow, finely punctured and spotted with black. The Genus *Cryptocephalus* comprises a number of similar shaped beetles with smaller wrinkled head and thorax, and the tip of the abdomen truncate. *Cryptocephalus scabrosus* is black, very rugose on the upper surface, with the tip of the elytra tinged with reddish brown: it measures about ¼ of an inch, and is common about Sydney. *C. viridinitens* is slightly larger, of a uniform dark metallic green on the upper surface.

The EUMOLPIDES are represented by one of our most beautiful species, *Spilopyra sumptuosa*, common on low scrub on the northern rivers of N.S. Wales: it is about ½ an inch in length, and is of a fiery coppery red and deep metallic tint, giving out

beautiful shades of colour in a bright light.

The Genus *Edusa* contains a number of bright metallic coloured beetles of oval form, which are chiefly found among the foliage of eucalypts. *Edusa distincta* is of the usual bright coppery red tint, with greenish head and thorax; it measures nearly ⅓ of an inch in length. *Rhyparida didyma* is a dull yellow beetle, with a narrow parallel stripe of black down each side of the elytra; it is of the usual elongate oval form with the head turned down in front. They are found clinging to grass stalks; this and several other species are common on the North West coast of Australia.

The CHRYSOMELIDES are one of the typical groups; many of them are rich in bright metallic tints; are either rounded or oval in form; and their larvae are active six legged grubs that crawl about the foliage. *Aesernoides nigrofasciatus* is a handsome, broad, convex, black beetle, with the elytra crossed with three broad irregular bands of dark orange yellow; it measures nearly ½ an inch in length, and is common on several shrubs in the Northern River scrubs. The Genus *Phyllocharis* contains a number of more elongated beetles with thicker antennae; they are chiefly found upon grass. *Phyllocharis cyanicornis* measures slightly over ⅓ of an inch in length; the general colour is dark orange, with the antennae and legs black; and the dorsal surface of the thorax and elytra are irregularly blotched with shining blue-black. It has a wide range over Australia and Tasmania. *P. cyanipes*, a larger species from N. Australia, has the head, thorax, blotch on each side of base, and tips of elytra light yellow, with the rest of the wing covers shining black. *Lamprolina perplexa* is a smaller, elongate, metallic, dull bronze coloured

beetle, with yellow head and thorax; it is common upon the foliage of the native blackthorn, *Busaria spiniferous*.

The larvae of several species of the Genus *Calomela* feed upon the foliage of the black wattles: they are short, squat grubs, with black heads and small green oval bodies. *Calomela paralis* measures 2½ lines in length; its general colour is dark orange yellow, with a broad parallel band of rich metallic green occupying the centre of each wing cover and tapering down to the tips; the elytra are deeply and finely punctured. Twenty-five species are described from various parts of Australia, chiefly by Baly (Trans. Ent. Soc. 1856–1863: and Ann. and Mag. N.H. 1862).

The Genus *Paropsis* is the most extensive and characteristic of all our plant-eating beetles, and some of our common species are very plentiful about Sydney. Marsham wrote a monograph of the species (Trans. Linn. Soc. 1808), placing them in the Genus *Notoclea*; in Masters' Catalogue 269 species are listed; since then, Blackburn has revised the Genus (Pro. Linn. Soc. N.S.W. 1896–1901), and added a number of new species.

The beetles are found chiefly upon the foliage of young eucalypts, and lay their yellow spindle-shaped eggs in a ring round the small twigs: the young larvae when first hatched cluster together, but as they increase in size they scatter all over the foliage upon which they feed. They are very active, short, stout grubs, with three pairs of well developed legs; when full grown they crawl down and pupate in the soil. The beetles are very convex and broadly rounded; most of them are more or less yellow, brown, or black in tint; some are very richly and

delicately shaded with metallic tints, which however unfortunately fade after death. *Paropsis variolosa*, one of our largest species, measures ¾ of an inch in length, and is nearly as broad in proportion; it is of a general yellowish brown tint mottled with lighter yellow and closely punctured; the under surface except the legs is black. *P. alternata* is a smaller, dark brown beetle, the elytra banded with parallel lines of black and reddish brown: *P. immaculata* is about the same size; dull reddish brown, with the outer half of the elytra darkest; it is usually found feeding upon the foliage of the black wattle. *P. liturata* is slightly smaller than the last, with the wing covers irregularly spotted with pale yellow. It is common on the eucalypts about Sydney, and has a wide range over the State. The small green larvae of *P. pictipennis* feed upon the foliage of *Leptospermum*; the beetle is a small form, dull yellow marked with bright spots, but fades into a dull brown when dead.

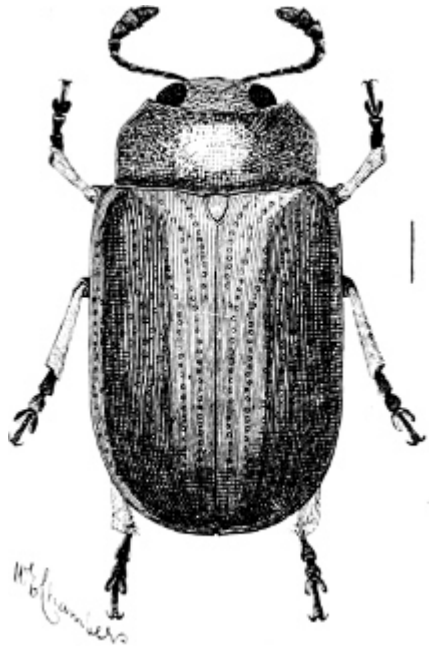


Fig. 97.—*Calomela paralis* (Lea).

The Green Striped Wattle Beetle.

("Agricultural Gazette," N.S.W.)

The HALTICIDES are popularly known as "flea beetles," as they have the thighs of the hind legs swollen out into rounded lumps which enable them to jump to a considerable distance: specimens are often found feeding upon sedges about watercourses. *Nisotra submetallica* is a tiny, shining green beetle, with a light reddish brown head and thorax; it is often a pest in the herb bed, where it feeds upon mint. *Arsipoda macleayi* is a much larger, deep metallic blue beetle with very large thighs; it has been found eating the surface of vine leaves in the Gosford district N.S.W., and covering them all over with brown blotches.

The GALLERUCIDES comprise several very

destructive garden pests, among which is the well known Pumpkin Beetle, *Aulacophora olivieri*, a reddish yellow and black beetle often called a "lady-bird," and which in many parts of Australia swarms over the young melons and cucumbers and devours the flowers and foliage. *Monolepta rosae* is a delicate pale yellow beetle, with the front half of the elytra shaded with rose red; it has a wide range, and on the northern rivers congregates in great numbers at times, eating up the young foliage of the citrus trees. The Fig-leaf Beetle, *Galleruca semipullata*, lays its spindle-shaped eggs in patches on the leaves of both the wild and cultivated figs, upon the surface of which the dirty yellow coloured larvae feed, finally crawling down the trunks and pupating in the ground. The beetle measures about ⅓ of an inch in length; is of a dull ochreous yellow, with the outer margins of the broad elytra striped with dull bluish black. *Hoplostinus viridipennis* is a much smaller, dull brownish yellow beetle, with shorter, rounded, deep metallic green elytra. It feeds upon the foliage of the nettle trees growing in the scrubs of the Northern Rivers, N.S.W.

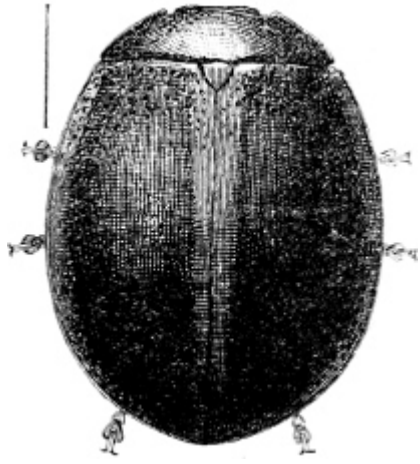


Fig. 98.—*Paropsis immaculata* (Marsham).
A typical Leaf-eating Beetle.
("Agricultural Gazette," N.S.W.)

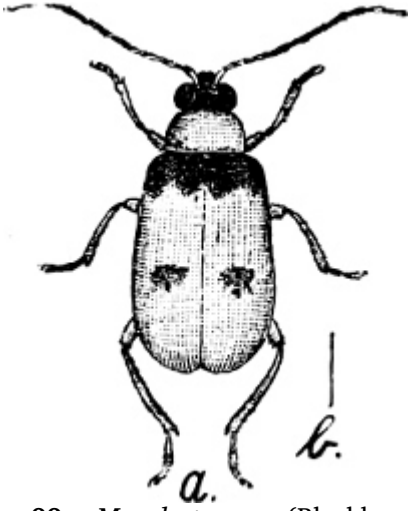


Fig. 99.—*Monolepta rosae* (Blackburn).
The Painted Leaf Beetle.
("Agricultural Gazette," N.S.W.)

The HISPIDES are a very distinct group of the plant-eating beetles, whose larvae are sometimes very destructive; they bore into the foliage or stalks of plants, feeding in, and not upon the plant tissue. The beetles might be divided into two sections; those that are short and broad shouldered like *Monochirus multispinosus*, which measures ⅛ of an inch in length, is black in colour, with the whole of the dorsal surface covered with short fine spines, and is common upon grass blades on the South coast of N.S. Wales; and the elongate almost cylindrical forms found on sedges belonging to the Genus *Euryspa*. These beetles are remarkable for the situation of their antennae, which are very close together at the

base, and stand straight out in front of the head. *Brontispa froggatti*, belonging to the latter section, is a very serious pest on the cocoa nut palms in New Britain and Solomon Islands.

The CASSIDIDES are curious ladybird-like beetles of a general yellow or light brown colour spotted or marked with black, with the outer margins of the elytra spreading out into an encircling flange or rim. They are confined to the more tropical forests of Queensland, but one species, *Aspidomorpha deusta*, comes into the northern scrubs of N.S. Wales; it is of the usual shape and mottled tints, measuring about ¼ of an inch in length.

Family 51. Fungus Beetles.
EROTYLIDAE.

The larvae of these beetles can be often found in numbers feeding in the different kinds of woody fungi that grow upon tree trunks, old fences, and fallen logs. If these infested fungi are collected and kept in a box the beetles can be very easily bred out. They can be readily recognised by their elongate, boat-shaped form, and clubbed antennae.

Episcaphula pictipennis, one of our commonest species, is black, but thickly mottled with deep orange red forming three interrupted bands across the elytra. It measures about ¼ of an inch. *Thallis janthina* is a smaller, shining, blue black beetle, slightly roughened on the elytra; it breeds in the large, spongy, white fungus growing on the tree trunks known as “punks.”

Family 52. Lady-bird Beetles.

COCCINELLIDAE.

These well-known beetles differ from the last family (which many of them resemble in outward appearance) in having 3 jointed tarsi, and the short usually 11 jointed antennae (occasionally 8–10) being slightly clubbed at the tips. In their habits however they differ in being carnivorous both in the larval and adult state, with the exception of the members of the Genus *Epilachna*, which are phytophagus. They are all small rounded beetles; the short head fits close into the thorax, which in turn rests against the front of the elytra: most of them are yellow, spotted or marked with darker yellow, metallic blue or black, and are slightly pubescent. These insects are well known in our gardens to the children as "lady-birds," and the quaint rhyme of "Fly away lady-bird" is said to have originated in the hop fields of Kent: after the hop picking, the dead plants, where the common English lady-bird was abundant feeding upon the hop aphis, were burnt off, and this was a warning by the children to them to fly away before the fires were started. They have been closely studied by economic entomologists because they are the natural enemies of so many aphis and scale insects.



Fig. 100.—*Epilachna 28-punctata* (Fabr.).

The Spotted Leaf-eating Lady-bird.

("Agricultural Gazette," N.S.W.)

Over 2,000 species have been described from all parts of the world, and in the latest list given by Lea (Pro. Linn. Soc. N.S.W. 1901), 110 are recorded from Australia. Mulsant published his great work (Species Coleopteris Trimeres Securipalpes) in 1850: Crotch published his "Revision of the Coccinellidae" in 1874; in both of these will be found descriptions of Australian species. Blackburn (Trans. Royal Soc. S.A. 1892) and Lea previously quoted, added a number of new species to our fauna.



Fig. 101.—*Epilachna guttatopustulata* (Fabr.).

The Potato-leaf Lady-bird.

("Agricultural Gazette," N.S.W.)

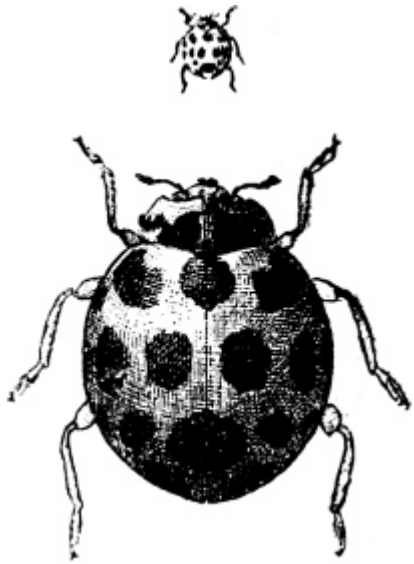


Fig. 102.—*Leis conformis* (Boisd.)

The Common Spotted Lady-bird.

("Agricultural Gazette," N.S.W.)

The Genus *Epilachna* contains all our plant-feeding lady-bird beetles, two of which are common. The 28-spot lady-bird, *Epilachna 28-punctata*, has a wide range extending from China and India to all parts of Australia; it measures about ⅓ of an inch in length, is of a dull yellowish brown tint marked with rounded black spots, and clothed with a fine pubescence. Crotch says: "This species varies almost to infinity, and gradually runs into the common 6-spotted type, so that I cannot give any structural differences." Its curious gregarious larvae are dull yellow covered with black spined tubercles; about Sydney they are often found upon the foliage of the trumpet flower (*Datura stramonium*), but in the north of N.S. Wales often damage the foliage of potatoes. *E. guttatopustulata* ranges from Tasmania to North

Australia, and is a common insect in the Richmond River scrubs, N.S.W.; it is a large beetle, easily recognised by the large, rounded, yellowish red blotch on the sides of the elytra.

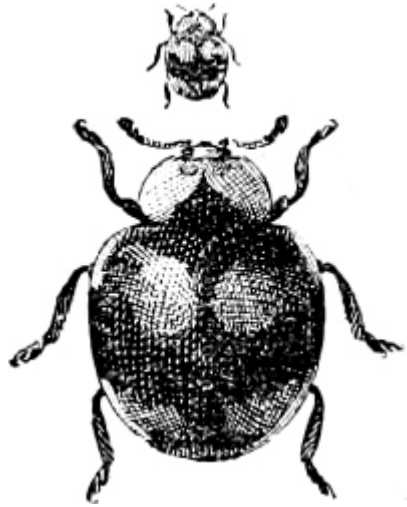


Fig. 103.—*Thea galbula* (Mulsant).
The Yellow-shouldered Lady-bird.
("Agricultural Gazette," N.S.W.)

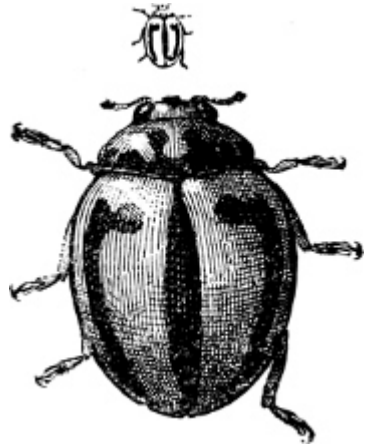


Fig. 104.—*Verania frenata* (Erichson).

The Striped Lady-bird.

("Agricultural Gazette," N.S.W.)

The typical *Coccinella repanda* measures ⅕ of an inch in length; it is a little, rounded, bright yellow beetle, with the head and thorax blackish, the elytra striped down the centre, and marked on either side with two irregular black V-shaped blotches. It has a wide range over Australia, and feeds upon all kinds of aphids, sometimes appearing in great numbers all over the country. *Leis conformis* is a larger species, of a uniform bright orange yellow, thickly spotted with black. It is a common garden insect, where the clusters of its slender yellow eggs may be often noticed attached to the bark of aphis infested trees; and its elongated, smoky tinted larvae, blotched on the sides with orange, may be often watched feeding upon rose or peach aphis. *Thea galbula* is a dainty little lady-bird, with the dorsal surface bright pale yellow, marked with black in the centre of the thorax; the dorsal stripe down the centre of the elytra connects two pairs of black blotches crossing the centre and base. It measures about ⅙ of an inch in length, and is at times common in our gardens. *Verania frenata* is ⅙ of an inch; it is yellow, with the thorax black behind, and with three stripes of the same colour down the elytra. It has a wide range from Tasmania to New Caledonia and the Malayan Islands.

The Genus *Orcus* contains a number of metallic blue-black lady-birds which feed chiefly upon scale insects; their larvae are grey and black creatures with the dorsal surface covered with fine spines; several species are common on scale infested citrus trees. *Orcus chalybeus*, measuring about ⅛ of an inch in length, is of a uniform deep metallic steel blue. *O.*

australasiae is a larger species with two rounded yellow spots on each side of the elytra. *O. bilunulatus* is a still larger insect, with only one yellow blotch on either side of the front of the thorax.





Fig. 105.—*Orcus chalybeus* (Boisd.).

The Steel-blue Lady-bird.

("Agricultural Gazette," N.S.W.)



Fig. 106.—*Orcus australasiae* (Boisd.).

The Six-spot Blue Lady-bird.

("Agricultural Gazette," N.S.W.)

Novius cardinalis is a tiny red and black lady-bird, very variable in its black colouration; it was better known as *Vedalia cardinalis*, when it was collected in great numbers and forwarded to America to destroy the Fluted or Cottony-cushion Scale (*Icerya purchasi*), which had been introduced from this country into California and damaged the orange trees. It has since been introduced into other parts of the world, and is now cosmopolitan. The Genus *Rhizobius* contains a number of small black beetles finely punctured and clothed with pubescence, that gives them a rusty tint. *Rhizobius ventralis* is very common in the bush upon young eucalypts that are infested with *Eriococcus coriaceous*; it measures about ⅛ of an inch in length and is very pubescent. *Cryptolæmus montrouzieri*, a great foe to all kinds of mealy bugs, has been introduced into Hawaii with good results. The larvae are flattened brown insects that cover themselves

with short white overlapping filaments, so that their identity is quite lost; they frequently swarm in thousands upon the trunks of scale infested Auracaria pines, pupating in such numbers that they form large white patches over the tree stems. The beetle is ¼ of an inch in length; is of a uniform black tint, with the head, thorax and tip of the elytra light yellow. The Genus *Scymnus* contains many of our smallest species: *Scymnus vagans* is a minute black beetle only $^{1}/_{24}$ of an inch in length, which can be found on mite infested foliage. *S. notiscens*, more than twice the size, is common both on wattles and orange trees; it can be easily identified by the distinct reddish blotch in the centre of each wing cover.

Order VI.—LEPIDOPTERA.

Butterflies and Moths.

Butterflies and moths are scale winged insects, and are among the giants of the insect world; they can be defined as insects with two pairs of membranous wings well adapted for extended flight, clothed with scales overlapping each other like the slates on the roof of a house, flattened and rounded on the surface of the wings, but more or less hair-like upon the body. The head is usually provided with a tubular proboscis or mouth, that can be curled up like a watch spring when at rest, and is admirably adapted for sucking up the honey from flowers when expanded.

The caterpillars may be smooth and naked, or thickly clothed with spines or hair; with few exceptions they feed upon the foliage or wood of plants: after undergoing a series of moults they either spin a cocoon, bury themselves in the ground, or (if wood borers) close themselves up in the burrow where they undergo a complete metamorphosis. If the larva of a butterfly, the caterpillar attaches itself to a twig by the tip of its tail and casts the larval skin, which slips off, leaving the naked transformed pupa simply enclosed in a stout, close-fitting pupal jacket. Some species of moths appear in such numbers at times that they do a great deal of damage to plant life, and are very serious pests.

Lepidoptera on account of their beauty and size have always been very popular with entomologists, and large numbers have been collected from all parts

of the world, so that this is one of the best known orders. Sharp estimates that 50,000 species are described, and every year adds to this long list.

They are divided into two great groups, somewhat artificial, but definable as RHOPALOCERA, butterflies; and HETEROCERA, moths.

RHOPALOCERA.

Butterflies.

The typical butterflies are usually slender-bodied insects, with filiform and more or less clubbed antennae, delicate legs, and large richly tinted wings; they fly about in the bright sunlight, visiting flowers and feasting upon the nectar that they find in the blooms. They have large compound eyes so that they can see very well; and the slender tubular mouth is very highly developed in all butterflies. The eggs are laid upon the food plant: the caterpillars are generally more or less elongated, and naked or covered with scattered tubercles rather than hairy; when full grown they attach themselves to the under side of a twig or leaf by the tip of the abdomen. Some groups are furnished with a silken girdle round the middle attached at each end to the leaf or twig; and another section roll themselves up in leaves. They do not form a cocoon, but as the larval skin slips off, it reveals the regular pupal form fitted with a skin-like jacket through which the indistinct lines of the rudimentary wings, legs and antennae can be traced. The pupa may remain in this quiescent state for several months before the butterfly splits the skin and emerges, a perfect, fully developed insect.

As many of our butterflies have an extended range, some of them were originally described from

other countries, and when captured here were named as new species; so that a good deal of confusion has existed in the proper identification of some of our common species as to whether they were Australian or only varieties of foreign species. In 1805 Donovan figured some of our commonest species in his "Insects of New Holland." After Kirby's "Catalogue of Rhopalocera" was published in 1871, Masters compiled and issued a list of our Australian species. In 1878 Semper published his list of Australian species; and in 1891 Miskin produced his "Catalogue of the Australian Butterflies," in which he included and described some new species (No. 1, Annals of the Queensland Museum); this remained our working list until Waterhouse published his "Catalogue of the Rhopalocera of Australia" as No. 1 Memoir of the New South Wales Naturalists' Club 1903. In Waterhouse's list a great many changes have been made in the genera and species; a number of our well-known names have vanished, with very little explanation; for example, *Pieris teutonia*, our common white, appears under the name of *Belenois java*; this is unavoidable to a certain extent in bringing Catalogues up to date, but is very confusing to beginners in the work of classification.

For a list of the writers upon, and references to our butterflies, the student is referred to Waterhouse's Catalogue.

I am indebted to Messrs. Anderson and Spry for notes on the life histories of some of the southern species described in their "Victorian Butterflies" (Melbourne 1893).

Family 1. Brush-footed Butterflies.

NYMPHALIDAE.

This group comprises a number of large or medium sized butterflies that are known as "Fritillaries," "Emperors," "Admirals," and many other popular names in England, and are generally brightly coloured; many have a very wide range over the world. The fore-legs of both sexes are imperfect, the male with one or two, the female with four or five tarsal joints. The larvae are usually spiny, or clothed with hairy warts; and the pupae are suspended by the tail. Sharp places them in eight sub-families, four of which are well represented in Australia.

The DANAINAE are brightly coloured butterflies of a general reddish brown tint with blackish markings; the larvae are smooth cylindrical caterpillars with the tips of the body ornamented with a fleshy tail. The Genus *Danais* contains six species, of which the best known in Eastern Australia is the "Monarch" or "Brown Gypsy," originally a North American insect but now almost world wide in its range; it is known under at least four names, and though usually figured as *Danais archippus*, its correct name is *Danais menippe*. The handsome banded black and cream coloured larva feeds upon the introduced "bladder-weed" (*Gomphocarpus fruticosus*), and turns into a beautiful pale green pupa with metallic markings. This large, deep reddish brown and black lined butterfly is too well known to require description.

Plate XIX.—LEPIDOPTERA.

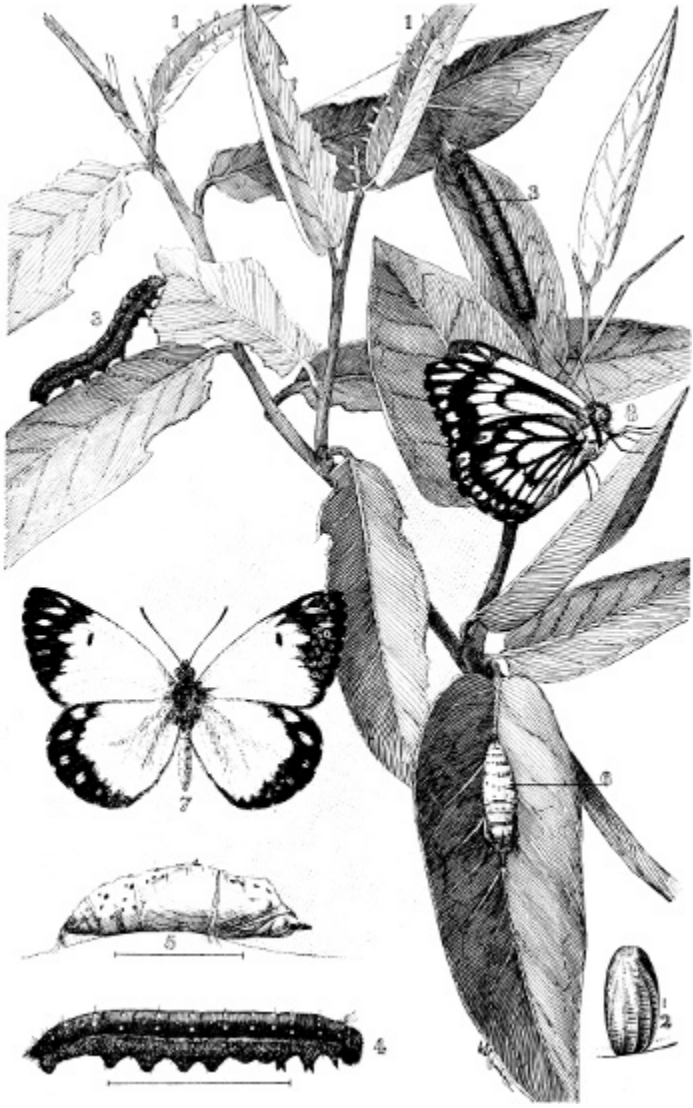
Family PIERIDAE.

1. *Pieris teutonia* (Fabr.). Eggs on foliage.
2. *Pieris teutonia* (Fabr.). Eggs enlarged.
3. *Pieris teutonia* (Fabr.). Caterpillar.
4. *Pieris teutonia* (Fabr.). Caterpillar (enlarged).

5. *Pieris teutonia* (Fabr.). Pupa (enlarged).
6. *Pieris teutonia* (Fabr.). Pupa on leaf.
7. *Pieris teutonia* (Fabr.). Showing upper surface.
8. *Pieris teutonia* (Fabr.). Showing under surface.

This butterfly is now known under the name of *Belenois java* (Sparrman).]

Plate XIX.—LEPIDOPTERA.



D. petilia, a much smaller butterfly, has broader white markings on the tip of the fore wings and none round the edges of the hind pair. It has a wide range over Australia, across Asia to Europe. The caterpillar is of a lavender colour and feeds upon the cotton

grass; it transforms into a beautiful green chrysalis marked with scattered golden spots and a band of the same colour round the abdomen. *D. hamata*, a fine pearly blue and black species, is recorded by Olliff from Cape York to as far south as Shoalhaven, N.S.W., but is a rare insect in the south.

Fourteen species of the Genus *Euploea* are described, of which *E. corinna* is a mottled black and white species, very abundant in sheltered gullies in N. Queensland, also ranging southward to Sydney. The larva feeds on a creeper (*Mandevillia*); it is a slender, dull-coloured caterpillar with four pairs of fleshy tentacles on the back. The pupa is suspended to a leaf, and is a rich, bright metallic silver.

The ACRAEINAE contains a single species, belonging to the typical Genus *Acraea*, which is found from North Queensland to Sydney. *A. andromacha* measures 2¾ inches across the wings; is blackish brown; the fore wings are transparent with dull brown markings; the hind pair are opaque, creamy white, edged with brown; it always looks as though badly rubbed. It has a range from New Guinea, Fiji, and Samoa into Australia. The yellowish brown caterpillar clothed with branched fleshy spines, feeds upon the passion vine, and is not uncommon in Sydney gardens.

The NYMPHALINAE comprise a number of handsome butterflies, which differ from the previous ones in having the cells of both pairs of wings open

or imperfectly closed. The larvae are very variable, some being slender hairy caterpillars or armed with spines and tubercles; others are short and cylindrical, furnished with horns upon the head.

The fine East Indian Genus *Cethosia* is represented by three species: the Crimson-winged Butterfly, *C. cydippe*, is not an uncommon insect in North Queensland frequenting the clearings on the edge of the scrub; it measures 3½ inches across the large rounded wings, the hind margin of the second pair being deeply scalloped; the central portion of both surrounding the body is bright red, the outer deep purple, with white markings toward the tips of the front pair; and the under surface of both is barred and spotted. *Cynthia ada*, ranging from Brisbane to Thursday Island, is a large light ochreous yellow butterfly, with a dark line diagonally crossing both wings from the middle of the fore pair to the level of the tip of the body; a double band of crenulated markings encircle the wings; and there are a pair of eye spots on the hind ones. *Cupha prosope* is the representative of another northern genus ranging from the Richmond River N.S.W. to Thursday Island. It is a medium sized butterfly with dark orange coloured wings, the front pair tipped and edged with black; all the under-surface is pale orange yellow, mottled and barred, with a row of eye spots round the edge of the wings. The Australian Fritillary, *Argynnis inconstans*, measures about 3 inches across the wings; it is of a uniform dull yellow colour with a double row of black spots along the edge of the wings, with the inner portion covered with an irregular pattern of spots and dashes. It is common along the cleared tracks in the Queensland jungle, and has been recorded from as far south as Hunter River, N.S. Wales. *Pyrameis kershawi*, figured and

described by McCoy from Victoria, is found throughout Australia, and is so closely related to the "Painted Lady," *P. cardui*, of Europe, that it was until lately only considered a variety. It measures under 2 inches across the wings; its general colour is dull brown mottled and barred with black and white. The larvae feed upon "everlastings" (*Heliochrysum*) and the introduced cape weed; they are slender brown creatures covered with black spines, and the chrysalis suspended by the tail is marked with shining golden spots. *P. itea*, slightly larger than the previous species, has the edges of both pairs of wings scalloped; the fore wings are black, each with three small yellow spots at the tip, and a large elongated patch crossing through the centre, with the inner portions of both pairs bright ferruginous brown, and a row of four small black eyes on the hind wings. The slender spiny caterpillars feed upon the foliage of nettles. The angulated chrysalis is often marked with golden spots. The Genus *Junonia* contains two common butterflies, one *J. villida* found all over Australia; it measures about 2 inches across the wings and is of a general brown tint edged with delicate white and grey markings, and ornamented with a pair of eyes on each wing ringed with yellow. It has a curious habit of flying along the track in front of one, settling on the ground, then flitting ahead again. The cylindrical somewhat stout larva is blackish brown, spined behind the head and clothed with fine hairs; it feeds upon rib grass (plantains). The short stout chrysalis is light brown marked with darker spots. *J. albi-cincta* does not come south of Brisbane; it is about the same size, with the eyes upon the wings smaller, and the hind wings mauve, giving out a bright metallic sheen. The Brown Leaf-winged Butterfly, *Doleschallia australis*, is nearly 3

inches across the wings, which are elongated and oval in form, with the tip of the hind pair produced into a tail; the upper surface is dull reddish brown with yellow in the centre, while the under surface is greyish brown mottled with wavy lines, with a central larger bar crossing the centre and running out into the tail. It flits about in the undergrowth, a conspicuous insect when on the wing, but the moment it settles and folds its wings over its back, it is lost to sight, for its leaf-like wings, when closed with the tail forming a stalk, so closely resemble the foliage, that while it remains at rest it is very difficult to detect. It ranges from the Richmond River to North Queensland. The Blue-eyed Butterfly, *Hypolimnas bolina*, ranges from Cape York to Sydney, but is a rare insect about the latter place. It differs in the sexes both in size and markings; the male is rich velvety black; has both wings deeply scalloped, a double white spot towards the tip of each, with a blotch of opaline white in the centre encircled with iridescent violet blue. The play of colour in this beautiful butterfly flashing about in the bright sunlight with its ever changing tints of blue and black, makes it one of our most striking species. The female is somewhat larger; has the central markings on the fore wings more elongated and lighter coloured, with a blotch of fulvous red below it; the hind wings are much whiter in the centre and are only slightly clouded with blue. *Neptis shepherdi*, ranging from Brisbane to Cape York, has the typical delicate black wings spotted and striped with white. The Tailed Emperor, *Charaxes sempronius*, is our sole representative of the genus, the home of which is Africa and the East Indies; it is nearly 4 inches across the wings, the inner portions of which are creamy white, the outer edges, tips and margins black, and

with a row of creamy spots along the edges and two spots behind. The marginal black edging on the hind wings is broad, shaded on either side with pale blue, which covers the broad scallops in the wings; there are two stout wedge-shaped tails on each hind wing, and a bright reddish-yellow blotch on each inner edge. The larva is a very curious, short, stout, pale green caterpillar, with a slightly forked tail, and four short stout horns on the top of the head; it feeds upon the foliage of the black wattle. This species ranges from Sydney to Derby, N.W. Australia, where I took a specimen upon a baobab tree which is now in the Macleay Museum; Waterhouse gives Cairns, Q., as its northern limit, but this gives it a much extended range.

The SATYRINAE are chiefly small butterflies, black, brown, or sometimes white, generally marked with eye spots, and the wings are rounded. The larvae feed upon different grasses, and are smooth or clothed with fine short hair: the head is round; and the body tapers to each extremity, and ends in a forked tail.

The Genus *Mycalesis* contains five species; they are all reddish-brown butterflies of small size, that flit about in open forest country, of which *Mycalesis terminus* is a very good type: it measures 1½ inches across its dull, rusty red wings, which are indistinctly marbled, and darkest at the tips; the edges of the hind pair are marked with fine black lines. On each wing are a pair of small eyes, the hind one on each wing being largest; these also show on the under surface, and those on the hind wings are encircled

with silvery lines. It is a northern species found along the coast of North Queensland. *Tisiphone abeona* is a common species in Victoria and on the eastern coast of N.S. Wales, usually found flitting along damp gullies, never flying high or in open country. It measures about 2½ inches across the wings, and is of a uniform dark brown tint: the front wings are ornamented with two eyes, the first smallest; a broad irregular band of yellow bisects the wings about the middle, crossing behind the eyes; the hind wings are plain, with a small eye on the inner margin, and are slightly scalloped round the edges. The delicate green caterpillar has a small rounded head; it is broadest in the centre, tapering to the head and forked anal extremity. It feeds upon the sedges. The chrysalis is of a delicate emerald green tint, with the edges of the wings outlined in yellow. *Ypthima arctous* ranges from Sydney to Cape York; it is a small, dull brown insect with a very large eye on the tips of the fore wings, and a very small one on the hind pair.

The Genus *Heteronympha* contains seven species, all of which have a wide range along the coast; the Yellow Wood Nymph, *H. merope*, being one of the commonest in all open forest country from Tasmania to Brisbane; it is remarkable from the fact that the sexes differ both in size and markings. The male measures 2½ inches across the wings, which are of a general dull tawny yellow colour mottled with black and brown, the fore pair in a scroll-like pattern, the hind ones only barred along the edges and slightly touched with black. The female, ½ an inch broader, has the greater part of the fore wings black, enclosing two yellow patches fading into tawny yellow toward the basal portion, and with a large yellow angular blotch standing out on the posterior

sides; each wing in both sexes has a small eye towards the tip. The dull brown larvae feed upon various grasses, and hide close to the roots. The chrysalis is not attached to the food plant, but rests in a frail network on the ground. *H. mirifica*, found between Sydney and Brisbane, is about the same size as the female of the last species; it also haunts sheltered country. It is of a uniform, blackish brown tint with small eye spots and a broad irregular white stripe across the middle of the fore wings.

The Genus *Xenica* is peculiar to Australia; it contains nine species, four of which are confined to Tasmania, several being found only on the higher portion of the mountain ranges. They are all small, tawny yellow or reddish brown butterflies of small size, spotted and mottled with brown, and have small eyes upon the tips of the wings. *Xenica achanta*, one of the largest, measures about 2 inches across the wings, and is of a uniform dark orange yellow, with the apical portion of the fore wings marbled with dark brown; the hind pair are regularly mottled all over; and the margins of both are edged with two fine black lines; it ranges from S. Australia to Queensland. Several smaller species have been described from the Australian Alps. *X. correae*, described by Olliff from Mt. Kosciusko, feeds upon the native fuschia: *X. fulva*, also described by Olliff, is the male of this species.

Family 2. Horned Butterflies.

LIBYTHEIDAE.

This family contains only a single genus, representatives of which are found scattered over all the warmer parts of the world, but the largest and

most brightly coloured forms are found in New Guinea. They are remarkable for the formation of the palpi, which, standing out in front like a beak, are four times the length of the head; the wings are angulated, and the pupa hangs by the tip of the abdomen. One species, *Libythea nicevillei*, ranging from Port Moresby across to Cape York, represents the family in Australia.

This group appears to form a connecting link between the Nymphalidae on the one hand, and the Lycaenidae on the other.

Family 3. The Blues.

LYCAENIDAE.

The "blues," "coppers," or "hair-streaks" are so named on account of their rich colourations or wavy markings on the under side of the wings. Though often passed over by the ordinary collector because of their small size, they are much sought after by lepidopterists for their beauty and bright metallic tints. Their bodies are slender, and the wings somewhat fragile; though they can fly well, they usually prefer to flit about the bushes and sheltered gullies, and when they settle have the habit of folding their wings in an erect position above the body, so that unless disturbed they are not very noticeable. The prevailing colours are metallic blue, or coppery red, with eyes upon the wings in some groups, while others are ornamented with dainty feathery tails, or lobes upon the hind wings. The colours and markings of the sexes often differ in the same species on the upper surface, but always correspond on the under-side. The legs are more developed than in the Nymphalidae, the tarsi of the

male somewhat aborted, but that of the female complete. The larvae are curious, short, slug-like, greasy grubs, dull brown or green; some of them are gregarious, clinging to the twigs by day and feeding at night. The pupae are attached to the twig by the tip of the abdomen and girthed with a silken thread round the middle.

In Miskin's Catalogue 110 species were given under 18 genera; in Waterhouse's list 114 species are recorded, divided into 31 genera. Waterhouse has monographed this family, where descriptions of all the known Australian species will be found (Pro. Linn. Soc. N.S.W. 1902–1903). A number are rare and restricted in their range, and many are confined to the rich tropical scrubs of North Queensland. The Genus *Danis* contains six species, most of which are confined to North Queensland; *Danis taygetus* is a very distinctive little butterfly, common in the Queensland scrubs, and extending as far south as the Richmond River, N.S.W. The male has the fore wings pale violet blue, with the centre of the hind ones white, the edges of both pairs black; in the female both pairs are marked with white with a faint shade of blue; on the under surface the centres of the wings are white edged with black, with a broad band of bright metallic blue occupying the lower half of the hind pair encircling a row of black spots. The Genus *Miletus* contains fifteen species: *M. delicia* has the upper surface brownish black, with the base of the fore and centre of hind wings pale metallic blue; the under side is dull yellowish brown, variegated with angulated blotches or spots forming bands round the wings and a parallel stripe across the front of the fore pair. This butterfly ranges from Victoria to Queensland. *M. ignita* has a very wide range over the southern parts of Australia into Queensland; it was

figured and described by Leach in 1817. *Candalides absimilis* is a medium sized insect; the male has the upper surface dull blue with the edges fringed with white; the female is dark brown with an oval patch of white in the centre of both wings and metallic tints round the body; the under surface is pale bluish white marked with fine wavy lines round the wings. It is found from Victoria well into Northern Queensland. *Polyommatus boeticus* has had many names, for not only has it a very wide distribution over Australia, but it extends over Asia, Africa, and Europe. It is of a uniform brown tint; has the centre of both wings shaded with pale metallic blue; the hind one terminates in a fine slender tail, with two eye spots at the base; the under side is creamy white with slate grey lines and eye spots touched with blue.

Plate XX.—LEPIDOPTERA.

Family PIERIDAE.

1. *Terias hecabe* (Fabr.).

Family PAPILIONIDAE.

2. *Papilio sthenelus* (Macl.).

Family NYMPHALIDAE.

3. *Junonia albi-cincta* (Butler).
5. *Pyrameis itea* (Fabr.).
6. *Pyrameis cardui* (Linn.).
7. *Danais petilia* (Stoll.).

Family HESPERIDAE.

4. *Trepezites symmomous* (Hubn.).

Family LYCAENIDAE.

8. *Chrysophanus aenea* (Miskin).

Plate XX.—LEPIDOPTERA.



Lucia lucanus, one of the smaller forms, has all the upper surface of a dull ochreous tint, with the centres of the fore wings pale yellow. A fine fringe of hair-like scales of alternate tufts of black and white gives it a delicate pencilled appearance; the under

surface is mottled and brownish, the white of the fore wings showing through. It has a wide range from South Australia to Mackay, Queensland, and is common about Sydney. *L. pyrodiscus* has the upper surface black, with the centre of the fore wings and the greater part of the hind ones dull red. The whole of the under surface is purplish and finely marbled with a very fine tail on the outer edge of the hind pair. It ranges from Victoria to N. Queensland.

The Genus *Ogyris* contains eleven species, most of which are recorded from the southern portion of Australia. *Ogyris abrota* has the upper surface dark brown with a patch of pale metallic green in the centre of each fore wing; the hind pair are all brown and scalloped along the edges; the under side is pale creamy white mottled with wavy lines. The larva feeds upon the foliage of *Loranthus*; it measures about an inch in length; is of a uniform dark yellowish brown, with the upper surface rough, clothed with fine bristles; they feed at night, and pupate in the usual manner of all members of this family.

The Genus *Ialmenus* contains eight species, among them several of our best known "Blues": *Ialmenus evagorus* ranges from South Australia into Southern Queensland, and was figured by Donovan in his "Insects of New Holland" in 1805. It is described by Olliff under the name of the "Imperial Blue," but I would suggest that the "Black-wattle Blue" would be a much more distinctive name, for all along the coast the short, dull green, slug-like grubs may be met with, congregated in little groups clinging to the twigs of this wattle. Hundreds of ants are always swarming over them attracted by the secretion they discharge from glands on the back.



Figs. 107 and **108**.—Wattle Butterflies.

107. *Ialmenus ictinus* (Hewitson).

The Inland Wattle Butterfly.

108. *Ialmenus evagorus* (Donovan).

The Coastal Wattle Butterfly.

The presence of ants is probably of great value to the larvae, for they keep parasitic insects and birds from molesting them. When full grown they sling themselves to the twigs to pupate, and are often so numerous that the branches are covered with pupae hanging like bunches of grapes. The butterfly measures nearly 2 inches across the wings, which on the upper surface are black on the margin, with the rest pale metallic blue shading into white in the centre; the hind pair are scalloped and produced into fine feathery tails with spots of dark orange yellow at the base; the under side is pearly grey, banded and spotted with black. *I. ictinus*, with identical habits, about the same size, takes the place of this species in the inland districts. *Pseudalmenus myrsilus* is a handsome little butterfly with the centres of the wings deep orange divided with dark nervures, and the hind pair with long black tails; it is found from Tasmania to the southern districts of N.S. Wales. The

last species of this family, *Liphyra brassolis*, is only found in North Queensland; its larvae live and pupate in the arboreal nests of the "Green Tree-ants." An interesting account of the life history of this butterfly is given by Dodd in the "Entomologist" 1902.

Family 4. The Whites and Yellows.

PIERIDAE.

The members of this family are popularly known as "Whites" and "Yellows" on account of their prevailing colours. Both sexes have six perfect legs, and are butterflies of moderate size, with the hind wings rarely crenulated or produced into tails. Their larvae are slender, hairy caterpillars with small heads, and are often gregarious in their habits; the pupae are sharply angulated to each extremity, attached both by the tail, and a silken girdle round the body of their food plant.

In Miskin's Catalogue 34 species are listed, contained in 7 genera; Waterhouse reduces them to 31 species, and discards several well-known genera.

The Genus *Terias* contains all the small "Yellows," which are low flitting, dainty, little butterflies found in the tropical jungle, but equally at home in the far western scrubs and open forest land. *Terias smilax*, our smallest species, is common about Sydney, and has a wide range both north and south from Adelaide to Rockhampton. It is bright yellow, with the black markings in the fore wings extending to the tips of the hind pair. The Mottled Yellow, *T. hecabe*, is much larger than the last; is of a bright yellow colour with the black markings coming round to the edge of the hind wing and swelling out into a rounded patch; the

hind wings are lightly edged with black, and on the under side are thickly mottled with yellowish brown spots. It extends from Sydney to Queensland, and has a wide range out northward and eastward among the islands.

The Genus *Elodina* contains several small, pearly white butterflies, with wings edged with black. The small white, *Elodina angulipennis*, is found about Sydney, ranging as far north as Mackay, Queensland. Our common white butterfly known under the name of *Pieris teutonia*, and the sole representative of that well defined genus, has been recently identified as *Belenois java*, and as Sparrman described it some few years before Fabricius, this well-known name will unfortunately have to give way. This butterfly has a wide range over Australia, especially in the interior, where several native shrubs belonging to the *Capparidae* are plentiful; upon these the slender brown and yellow caterpillars feed. This is the species that sometimes comes flying over the eastern coast in immense swarms. It measures 2½ inches across the wings, and is black and white on the upper surface, with the under portion more mottled with black and canary yellow. It ranges from Australia to Fiji, Tonga, and the Malay Archipelago. The smaller Whites, which have the under side of the hind wings of a more uniform yellow tint, are represented by *Appias (Tachyris) ega*, first described by Boisduval in 1836; it has an extended range from Victoria to Cape York, Queensland.

The typical Genus *Delias* is represented in Australia by 8 species, three of which can be collected from Sydney to Cape York, and two others from South Australia northward. The Painted Delias, *D. harpalyce*, first figured by Donovan in 1805,

measures 3 inches across the wings, which on the upper surface are creamy white, broadly margined on the apical half with black, the fore pair banded with a row of white spots; on the under surface the white markings above are much broader, and the hind wings are blotched with a bright red band surrounded with black but lined with white. The larvae feed upon the native mistletoe (*Loranthus*) which grows upon the she-oaks, and are slender, dark coloured caterpillars covered with fine hairs. They are gregarious in their habits, often 20 to 30 in a family, and not only do they keep together when feeding, but they spin a curious web over the denuded twigs of their food plant to which they attach themselves when pupating. The pupa is dark brown, slightly over 1 inch in length, armed with short black spines along the sides of the body, and the front of the head is furnished with a curious two-pronged fork.

The Tinted Delias, *D. argenthona*, is a Queensland species, with the outer half of the hind wings on the under surface black, enclosing a number of bright red blotches; while on the hind wings of the Striped Delias, *D. mysis*, the red forms a continuous broad curved band round the tips. In the Yellow-tinted Delias, *D. aganippe*, the wings of the male on the upper surface are creamy white, while those of the female are tinged with yellow, and the black extends further into the wing; on the under surface both sexes have the wings blackish, mottled with large white blotches, and yellow markings; a patch of bright red on the shoulders; and with a row of rounded spots of the same colour running round the hind wings. The larvae feed upon the foliage of *Loranthus*. The Dusky Delias, *D. nigrina*, generally flies high, and is not so easily caught; it has an

extended range from Sydney to North Queensland; the upper surface is of the usual colour, but the whole of the under surface of the wings is dull black washed with grey; there is a band of yellow on the fore pair, and the hind pair is marked with the same colour and a horse-shoe band of red. The larvae when full grown are almost black spotted with yellow, and with fine white hairs; they are gregarious and also feed upon the *Loranthus*.

Catopsilia (Callidyras) pomona is a large light butterfly, with the upper surface creamy white tinged with yellow, and with dusky spots toward the tips of the wings; all the under surface is dull yellow, with a few white spots, and with pale purple markings, forming a darker patch in the centre of each wing. It is found from Sydney northward through the Malay Peninsula, and into Ceylon.

Family 5. Swallow Tails.

PAPILIONIDAE.

The members of this group of butterflies are popularly known as “Swallow Tails” from the peculiar structure of the hind wings of the typical species, which are produced at the tips into spatulate lobes or tails; though in a large number these tails are wanting. They are all furnished with well developed legs; antennae distinctly clubbed; and the pupae are attached both by the tip of the body and a silken girdle. In this family many of the largest and most beautiful insects in the world are congregated.

The Bird-winged Butterflies (*Ornithoptera*) are represented by three more or less distinct species from the mainland, and a fourth from Darnley Island. *O. richmondia*, typical of the group, is the southern

form, ranging from the Richmond River, N.S.W., into Southern Queensland. The smaller male measures about 6 inches across the wings, which are rich velvety black, with a bright green stripe along the front of the fore wings; the whole of the body is golden; and the hind wings except the black margins and four black spots are of a slightly brighter tint. The large female is of a uniform dark blackish brown with white markings on the wings. *O. (cassandra) euphorion*, found from Mackay to Cairns, N.Q., is somewhat larger, with a second stripe of green on the fore wings, and a row of golden spots on the hind pair. The large black caterpillars have short black fleshy spines along the sides of the body, with the front ones bright red.

Rippon has recently monographed the Ornithoptera, and places our species in the Genus *Troides*, but I prefer to retain the original name, under which our species are so well known. The Genus *Papilio* contains 18 species in Miskin's Catalogue, reduced to 15 in Waterhouse's list, many of them with a very wide range. *Papilio sarpedon* is common in Sydney gardens, and extends away up the coast to India and Ceylon. Olliff called it the "Wanderer" from its rapid restless flight. It is of a general black colour, with sharp angular fore wings, and rounded crenulated hind wings coming to a blunt finger-like tail at the tips. The centre of both pairs of wings is pale green forming a broad elongate stripe, widest in the centre, and with a row of fine crescent-shaped spots down the sides of the hind pair. The larvae are short, green, slug-like creatures with a patch of yellow on the back; they feed upon the foliage of the camphor laurel.

The Black Orchard Butterfly, *Papilio erectheus*

(now known as *P. aegeus*), is a larger black insect with an irregular band of white crossing the tips of the fore wings; the centre of each hind one is occupied by a rounded mauve patch; the edges are crenulated, tipped with white, and have a red eye-like spot on the inner margin. The female is much larger; has the inner portion of the fore wings black, but the outer portions dusky white; the hind wings are black at the base, banded with white shaded with black, and have a row of red spots round the margins. The mottled orange green larva is furnished with a broad head, from which shoot out a pair of retractile fleshy horns when touched, at the same time giving off a musky scent. They feed upon the foliage of orange trees, and when numerous are a nuisance in the plant nurseries. The larvae of Macleay's butterfly (*Papilio macleayanus*) feed upon the foliage of the Sassafras in the Illawarra district, and range from Tasmania to Cairns N.Q. The butterfly is somewhat after the same slender shape as *P. sarpedon*, but has the hind wings produced into slender swallow tails. The portion of the wings surrounding the body is pale green, the outer parts black, with three small green patches toward the front of the fore pair, and a row of small spots along the lower edges of the hind pair.

The Imperial Swallow Tail, *Papilio ulysses*, measures 5 inches across the wings, which are rich metallic blue margined with deep velvety black, and are produced into long swallow tails behind. It is found in the tropical scrubs of North Queensland ranging up into the Malay Archipelago, and for shape and colour is one of the most beautiful butterflies in the world, but should be seen in its native haunts to fully admire its beauty as it goes floating through the tropical brushes.

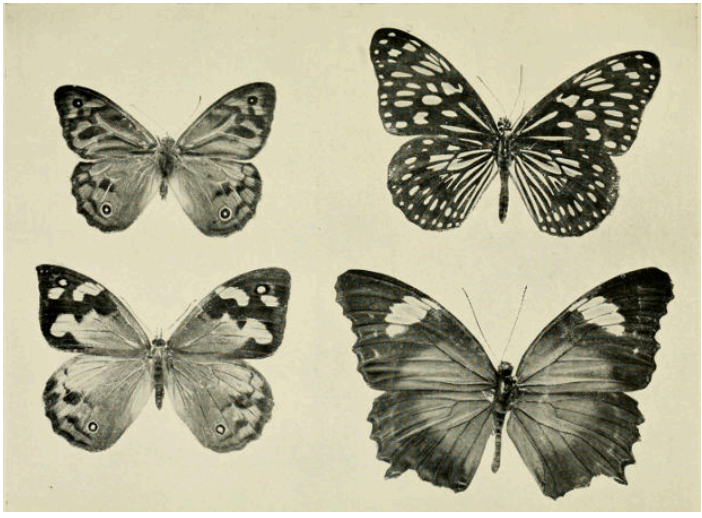
Plate XXI.—LEPIDOPTERA.

Family NYMPHALIDAE.

1. *Heteronympha merope* (Fabr.). ♂.
2. *Heteronympha merope* (Fabr.). ♀.
3. *Danais hamata* (Macl.).
4. *Cethosia cydippe* (Linn.).

(Original photo. Burton.)]

Plate XXI.—LEPIDOPTERA.



The last of this genus I shall notice is the very distinct yellow and black butterfly, *Papilio sthenelus*, which has a wide range from South Australia to Queensland, and is one of the very few large butterflies found far inland. The Painted Gauzewing, *Eurycus cressida*, is a rare species in N.S. Wales, though recorded from as far south as Sydney, but is abundant in the tropical northern scrubs. The male has the fore wings denuded of scales and semitransparent, with the shoulders and two spots in the front black; the hind ones are black mottled with white and red, the latter colour also on the sides of

the thorax and tip of the abdomen. The female is smaller, of a dull brown colour, with semitransparent wings, looking very much like a small rubbed specimen of the male; the amateur collector generally discards them under that impression.

Family 6. Skippers.

HESPERIDAE.

These butterflies are popularly known as "Skippers" on account of the peculiar way they fly, so different from all the other groups. They have broad, short, thickset heads and bodies; and the antennae, wide apart at the base, are produced at the tip into an irregular club or pointed hooked process. The legs are perfect in both sexes and often spined; most of them are brown or reddish yellow, more or less variegated. The larvae are long, cylindrical, naked caterpillars, with the head hard and horny; the prothorax narrow, forming a regular neck. When full grown they attach themselves by the tail to the leaf, which they roll round themselves into a primitive kind of cocoon.

Messrs. Meyrick and Lower have lately revised this group (Trans. Roy. Soc. S.A. 1902), and list 79 species that they identify, and note a number of others that are so badly described that they cannot be determined.

Netrocoryne repanda, one of our largest species, of a uniform light brown tint, has the tips of the wings darkest, the centres of the fore pair marked with large translucent blotches of a pale yellow tint, and a single spot in each hind one. It has an extended range from Sydney to N. Queensland.

The Genus *Hesperilla* contains 31 species, some of

which are very local, while others have a very wide range: *H. picta* is about 2 inches across the wings; its general colour is dark brown with a dull greenish tint on the body, ornamented with five yellow spots on the fore wing; the centres of the hind ones and the hind margins of the same yellow colour, and with the markings on the under surface more numerous. *H. ornata* is a smaller species, of a general dark brown; the fore wings carry a number of spots and four angular golden yellow blotches; the hind pair are reddish orange mottled on the under surface of the body, the tips of the fore and the whole of the hind wings with pale yellow. It has an extended range from Victoria up to Cooktown N.Q. *Trapezites iacchus*, one of our commonest species, described by Fabricius in 1775, measures 1¾ inches in length, and is of a uniform, dull brown colour shaded with yellow; the fore wings are blotched with small irregular marks; those on the hind pair are parallel and confluent. The under surface is dull yellow; the fore wings are mottled and the hind ones marked with four to five small purple spots ringed with black. It has a wide range from Tasmania over Australia. *T. symmomus* is a darker, larger species very similar in the markings, only the yellow spots are more defined. It does not range further north than Brisbane.

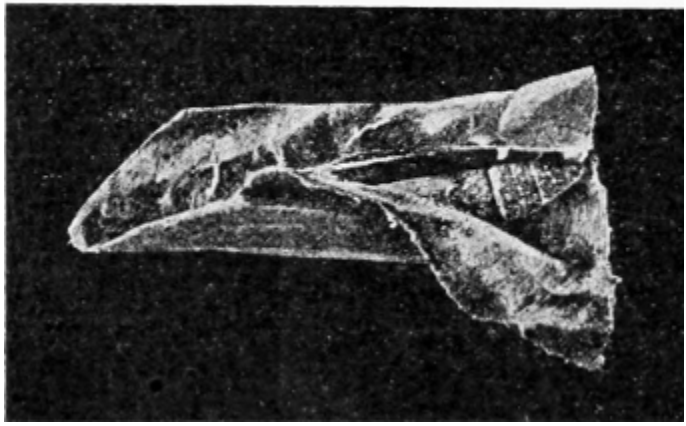
Figs. 109 and **110**.—Earlier stages of the Palm Skipper, *Pamphila augiades* (Fielder).

Fig. 109.



109. Larva.

Fig. 110.



110. Pupa.

Apaustus lascivia is one of the small dull brown skippers washed with yellow, with pale slender transverse bars crossing the centre of the wings; the body is marked with white; the under surface is dull yellow, with the tips of the fore wings darkest. The larvae of *Pamphila augiades*, another common species in the Sydney gardens, and found as far north as Bowen, Queensland, feeds upon the foliage of young palms; that of *Erynnis sperthias* is found on the same plant.

Badamia exclamationis is a light brown species with the fore wings narrowed to the extremities, and the hind pair arcuate on the edges. It measures 2 inches across the wings, and ranges from Sydney to Cape York. In the Genus *Hasora* we have several large skippers, all northern species, with the upper surface dark; the under surface richly marked with purple and pale golden yellow in *H. discolor*; and with simple silvery stripes on the under surface in *H. hurama*.

HETEROCERA.

Moths.

Moths differ from butterflies in having the abdomen stout and thickset, and not pinched or constricted in front at the junction with the thorax; and the antennae, instead of being clubbed or thickened at the tips, are either slender filiform appendages or are uniformly thickened, pectinate, or feathered; when of the latter form they are much more pronounced in the males.

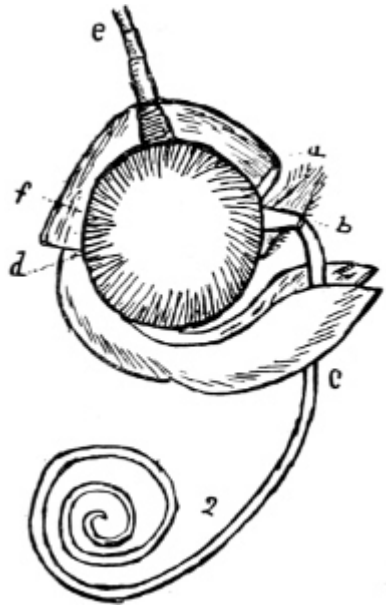


Fig. 111.—Head of Hawk Moth.

a, upper lip; *b*, mandibles; *c*, proboscis; *d*, lower lip; *e*, antennae; *f*, eyes.

(Redrawn from Duncan's "Transformations of Insects.")

Most moths are nocturnal in their habits; in the day time they are usually found hiding among the

foliage or resting in dark corners, and many can be obtained by shaking the bushes over a net. The larger species may be killed at once in the cyanide bottle, but must be transferred to a box as soon as they are dead, for they rub very easily; the smaller forms can be placed alive in glass-topped or chip boxes, and afterwards killed, and then mounted before they are stiff. The members of a few groups fly about in the daylight; for instance *Agarista glycine*, our vine moth, but they are exceptions. The beautiful hawk moths only flit about at twilight, and are known as “crepuscular” moths.

This great group contains some giants of the insect world, such as some of the Atlas Moths of India, and Wood Moths of Australia, which are as big as small bats; while among the Micro-lepidoptera we come to many tiny creatures which require to be examined with a lens before their identity can be established.

The typical moth caterpillar constructs a stout silken bag or cocoon, within the shelter of which it casts its skin and becomes a well defined pupa; but there are many which bury themselves in the ground, or pupate in cavities in timber that form no true cocoon but simply undergo their transformations in such secure hiding places.

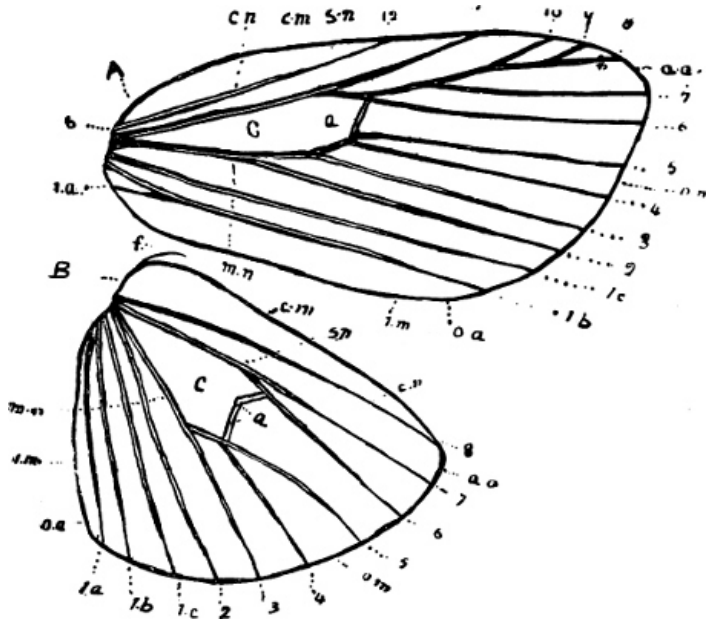


Fig. 112.—Wings of Moth.

A, Fore wing: *c.m*, costal margin; *o.m*, outer margin or termin; *i.m*, inner margin; *a.a*, apex; *o.a*, outer angle or tornus; *c*, discoidal cell; *d*, discocellulurs.

B, Hind wing: *c.n*, costal nervure; vein 12 fore wing, 8 of hind wing; *s.n*, sub-costal nervure; *m.n*, median nervure; *1a*, *b*, *c*, three branches of internal nervure; *2*, *3*, two branches of median nervure; *4*, *5*, *6*, three branches of radial nervure; *7*, *8*, *9*, *10*, *11*, five sub-costal branches of fore wing; *7* sub-costal nervure of hind wing.

Moths are well represented in all parts of Australia, but are most numerous in well wooded country: a considerable amount of work has been done in this group by Messrs. Lewin, Scott, Walker, Meyrick, Lower, Turner, and others in Australia, and Messrs. Guérin, Boisduval, and many other foreign writers. I have in the arrangement of the families followed Lower's Catalogue of Victorian Heterocera

(Victorian Naturalist Vol. x. 1893—Vol. xiv. 1898).

Family 1. Connecting-link Moths.

CASTNIIDAE.

The members of this group comprise a few insects that form an intermediate state of development between butterflies and moths; for while there is no doubt that they are moths, they have hooked or thickened antennae like the "Skippers," somewhat similar habits, and even the general colouration. They are chiefly confined to South America and Australia. *Euschemon rafflesiae* is one of the largest hesperid-like forms; is black, blotched with white, and is found in the northern parts of Australia.

The Genus *Synemon* contains a number of small reddish brown moths which flit about over the grass, just like small butterflies: *Synemon sophia* is about 1½ inches across the wings, which are brown, slightly marbled in front, and the hind pair blotched with dull yellowish brown; it is common on the grassy flats along the eastern coast. *S. hesperoides* is common in Victoria in similar localities; is about the same size, but of a darker brown colour; the fore wings marbled with fine wavy grey lines, and the hind ones with a rusty red tint.

Family 2. Butterfly Moths.

URANIIDAE.

These are large usually day-flying moths with slender antennae; broad wings, the hind pair crenulated and produced into tails; the abdomen like that of a stout butterfly, and never extending beyond the hind wings.

The typical species (Genus *Urania*) are found in America, others in Madagascar; but our beautiful forms belong to the Genus *Nyctalemon*, one species of which, *Nyctalemon orontes*, is very common in North Queensland. In the neighbourhood of Cairns a score of this species can often be taken in the early morning resting on the low scrub, and small swarms of them can often be seen flying across the rivers in the middle of the day. This species is a very handsome large velvety black moth marked with broad dull green bands, and having short creamy swallow tails. Several very beautiful species are also found in Southern New Guinea.

Family 3. Day Moths.

AGARISTIDAE.

This family has been lately revised by Hampson (Catalogue of the Lepidoptera Phalaenae Vol. I. British Museum 1898); he divides them into 55 Genera containing 225 species, of which some typical forms are peculiar to Australia; they are conspicuously coloured and further noticeable from their habit of flying in the daytime. The members of this family are chiefly confined to the tropical parts of the Old World and the Australian region; in America a few only are found in Mexico and Brazil.

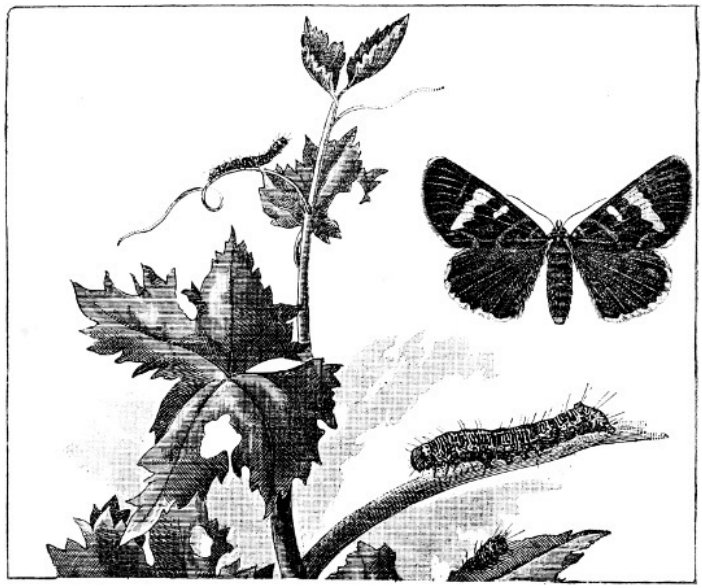


Fig. 113.—*Phalaenoides glycinae* (Lewin).

The Caterpillar and Adult of the Vine Moth.

("Agricultural Gazette," N.S.W.)

The Vine Moth, *Phalaenoides (Agarista) glycinae*, better known under the old generic name of *Agarista*, is one of our regular vine pests in the caterpillar state, devouring the foliage and young grapes. The moth lays her eggs upon the vine canes; the grubs when full grown measure up to 2 inches; are of a general deep greenish yellow tint, with the whole of the upper surface covered with small tubercles each bearing a single hair; and they have a band of bright red blotches round the dorsal surface of the anal segment. They bury themselves in the ground, forming a dark reddish brown chrysalid enclosed in a primitive cocoon or covering of particles of earth. The moth measures 2¼ inches across the wings, and is of a uniform black colour marbled on the head, thorax, and sides of the wings with white; the fore

wings are tipped with white, and an irregular transverse bar of pale yellow is followed by a smaller blotch through the centre; in the hind pair the outer margins are irregularly edged with white. *Phalaenoides tristifica*, formerly known under the name of *Agarista lewinii*, is slightly smaller; the fore wings are more mottled, and the hind pair have an irregular white spot in the centre by which it can be easily identified. *Cruria donovani*, also smaller than the Vine Moth, has the fore wings mottled with a number of small white blotches, and a broad irregular patch in the centre of the hind ones. *Eutrichopidia latina* comes closer still to the Vine Moth in size and colour, but can also be easily recognised by having a single broader, irregular, dull yellow band across the outer half of the fore wings. The Painted Day Moth, *Agarista agricola*, attracted the attention of our earliest entomologists by its brilliant colouration, and was described and figured in colours by Donovan in his "Insects of New Holland" 1805, and again by Dr. Leach in his "Zoological Miscellanies" published in 1815. It has a wide range from Sydney northward, and the several sub-species placed under this name extend its range to New Guinea and Timor. This is now the sole type of the Genus *Agarista*, in which so many of our species were formerly placed; it is a handsome black moth; measures up to 3 inches across the wings, the fore-pair of which are richly blotched with pale yellow, deep orange, and blue; in the hind pair the centre is bright red and blue, and the margin is white. The head and thorax are pale yellow above; the legs and under surface red; the tip of the abdomen dark orange. The larva is a handsome dark coloured caterpillar clothed with scattered and curious long clubbed hairs.

Plate XXII.—LEPIDOPTERA.

Family NOTODONTIDAE.

1. *Danima banksiae* (Lewin).

Family AGARISTIDAE.

2. *Hecatesia fenestrata* (Boisd.).
6. *Agarista agricola* (Donov.).

Family HYPSIDAE.

3. *Nyctemera amica* (White).

Family SPHINGIDAE.

4. *Cizara ardenia* (Lewin).
8. *Hemaris hylas* (Lewin).

Family LIPARIDAE.

5. *Darala ocellata* (Walker).

Family SYNTOMIDAE.

7. *Syntomis annulata* (Fabr.).

Family CASTNIIDAE.

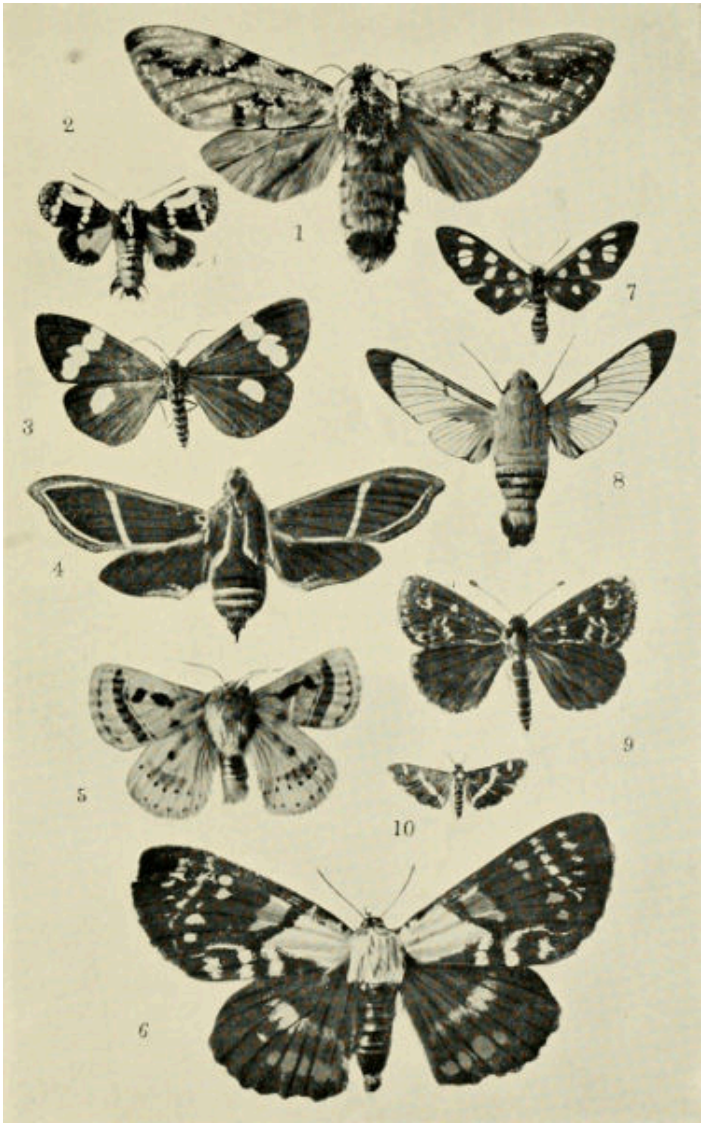
9. *Synemon hesperoides* (Feld).

Family PYRALIDAE.

10. *Zenckenia recurvalis* (Fabr.).

(Original photo. Burton.)]

Plate XXII.—LEPIDOPTERA.



The Genus *Hecatesia* contains our curious "whistling moths," which fly about just at dusk, making sharp continued notes like the calls of some of our small cicadas. The sound is said to be

produced by the male rubbing his curiously clubbed antennae against a pellucid ridged area in the front of the fore wings. Hampson doubts this, and says it is probably caused by rubbing the tarsal spines against the ribbed space. *Hecatesia fenestrata* is a pretty little moth, about 1 inch across the wings; is of a general dark brown tint; the outer margins of the fore wings are provided with a broad semi-lunate ribbed band (the musical apparatus) in front, and two white lines behind; the centre of the hind pair and abdomen richly blotched with reddish yellow; the head, antennae, centre of thorax, and outer margins of the wings marked with white.

Three species of this Genus are recorded from Australia, two of which were described from the west coast, while *Hecatesia fenestrata* has a range from South Australia into N.S. Wales.

Family 4. Ringed Moths.

SYNTOMIDAE.

The typical Genus *Syntomis*, in which Hampson places all our species that were previously described under the Genus *Hydrusa*, comprises about 138 species, chiefly confined to Africa, Asia, the Malay Archipelago and Australia; 12 species are recorded from this country. They are all rather small moths of a general black or brown tint mottled with orange yellow or lighter brown.

Syntomis annulata, about 1 inch across the outspread wings, has a very wide range from the Philippines through New Guinea and Australia, and naturally varies much in different localities; our variety is of a blackish tint, with six orange spots in the fore wings, and two more angular blotches on the

hind ones; the abdomen is regularly banded with orange and black. *S. aperta* measures 2 inches across the wings, which are of a brownish tint with large blotches of orange yellow occupying the greater portion of the surface, divided from each other by slender lines. It ranges from New Guinea and Queensland round to S. Australia, and has been captured out west about Bathurst, N.S.W.

Euchromia creusa is a very handsome form about 2 inches across the narrow fore wings, which are black with two large transparent divided spots forming a double row across them, and another very small one at the base: the hind pair have two similar blotches. The head, thorax, and basal portion of the abdomen are black, shot with metallic blue; the basal abdominal segments are crimson, finely barred with black. This beautiful moth has a wide range over the Malay Archipelago and the Pacific Islands, coming down to Thursday Island and North Queensland.

Many of the foreign species in the larval state feed upon lichens or grass.

Family 5. Burnet Moths.

ZYGAENIDAE.

These moths form an extensive family represented in most parts of the world; they are also day-flying moths, and some are very brilliant in colour. In England some of them are known as “Burnet Moths” and “Green Foresters.” They have long narrow wings, and the antennae thickened toward the middle.

Most of our species belong to the Genus *Procris*, which are also very abundant in Southern Europe. They are small creatures measuring under 1 inch across the wings, and are of a general dark brown

tint with greenish markings. *Hestiochora bicolor* is a curious little moth remarkable for its bright colouration, which has a wonderful resemblance to one of our small parasitic wasps (*Braconidae*). The wings are clouded with black; the head and front of the thorax are red, the hind margin of the latter black; the abdomen black and white.

Family 6. Hawk Moths.
SPHINGIDAE.

The hawk moths have a stout rounded abdomen tapering to a point; thickened antennae; stout narrow pointed wings; the proboscis or sucking mouth-tube very long, curled up under the head when at rest, but capable of being uncurled in front of the head to suck up the nectar from the deepest tubular flower while the moth is hovering over it. They hide during the day, and are most active just at twilight, when they dart about, over, and around the flowering shrubs. Their caterpillars are very handsome thick cylindrical grubs marked with brilliant eye spots and stripes of various striking colours, and are easily distinguished by a curious curved fleshy horn on the dorsal surface of the tail segment.

They take their scientific name from the fanciful resemblance of their stiff horny pupae (which are naked and generally buried in the sand beneath their food plant) to the Egyptian Sphinx, and their popular names of “hawk” and “humming-bird moth” from their powers of flight.

Our species have been divided into five sub-families, and in Miskin’s “Catalogue of the Australian Sphingidae” (Proc. Roy. Soc. Queensland) 42 species are listed under 13 genera; to which list a few

species have since been added.

The first group contains what are popularly called the "Clear-winged Hawk-moths," from the large bare scaleless areas in the wings; they fly about in the daytime with a loud humming noise, very much resembling some of the Carpenter-bees when hovering over the flowers. *Hemaris kingi* is marked with black and yellow, and has a thick tuft of stiff hairs on either side of the abdomen; it is not uncommon in Southern Queensland. *H. hylas* is a similar stout moth with unspotted wings which has an extended range across Queensland to Japan, Asia, and Africa; while a third species, *H. janus*, ranges from Brisbane to Rockhampton. In the Genus *Macroglossa* 4 species are recorded from Queensland, some of which extend into our north coast scrubs.

In the second group we have a very distinctive little banded hawk moth, *Cizara ardenia*, which ranges from New South Wales into Southern Queensland; most of my specimens come from the Illawarra scrubs, N.S.W., where the larva feeds upon the wild vine. Its ground colour is dark brown with narrow grey bands running round and crossing the middle of the wings, with a curious eye spot on the shoulders. The Genus *Chaerocampa* contains a number of large handsome hawk moths, some of which are introduced species world wide in their range; about 17 are recorded from Australia. The Silver Stripe, *Chaerocampa celerio*, is a common European species, that is well known here. French describes the caterpillar as a vine pest in Victoria; it is a cylindrical greenish to purple tinted grub with eye spots on the hind segments. The moth measures 3 inches across the wings; its ground colour is greyish fawn, with four slender lines of silvery white

forming a stripe down the centre of the fore wings, and the body marked with silver spots; the hind wings are bright pink. *C. oldenlandi*, which comes close to this species, feeds upon vines in N.S. Wales. It differs in having no short oblique silvery stripes on the front of the fore wings, hardly any red on the hind ones, and has an unbroken silvery dorsal stripe down the abdomen. *C. erotus*, about the same size, has dark reddish brown fore wings, slightly marbled, and the hind pair yellow, darkened on the hind margins; its larvae sometimes feed upon sweet-potatoes. *C. scrofa* is a much smaller species of a lighter brown colour, with the hind wings dull brick red, darkest along the hind margin. This is one of our commonest species with a wide range over Australia; the brown small-headed larvae feed upon grass and low herbage. Among our most striking forms are the two species of the Genus *Coequosa*, both about the same size, sometimes measuring up to 7 inches across the wings. *Coequosa triangularis* is of a reddish brown and grey tint, mottled on the hind wings with bright yellow, the darker brown forming a large angular patch in the centre of the fore wings; *C. australasiae* is of a light buff or fawn colour, more marbled, with the wedge-shaped blotch merging into the colouration of the tip of the wing; and the hind pair yellow, only edged with brown on the hind margin. The caterpillar of *C. triangularis*, our commoner form, is dull green, with a rough granulated skin and a small elongate head; the tip of the abdomen is furnished with a pair of stout plates used as claspers to cling to its food plant; above this on either side is a black shining bead-like eye, which is only an ornamental process, but this often leads people to think that this is the head end, and in some places it is known as the double-headed caterpillar. It

feeds upon the foliage of *Persoonia* and *Acacia*, and when touched has a habit of swinging its body round, as if trying to strike; when full grown it is enclosed in a black shining pupa-case hidden among the rubbish beneath the trees. The Genus *Macrosila* contains 4 species, two of which are not uncommon in N.S. Wales. The She-oak Hawk-moth, *M. casuarina*, measures up to 5 inches across the wings, and is of a general greyish mottled brown colour, with a darker blotch in the centre of the fore wings, which are slightly mottled with black toward the tip; and the hind wings are often very dark brown.

The Convolvulus Hawk-moth, *Protoparce convolvuli*, ranges all over the world, the caterpillars feeding upon the convolvulus; and it is also sometimes quite a pest upon sweet-potatoes. The moth measures 3½ inches across the wings, and is of a general dark grey colour thickly mottled with dark brown; the abdomen has a broad brown stripe down the centre with short transverse white, pink, and black bars on either side.

The Privet Hawk-moth, *Sphinx ligustri*, has light brown fore wings, the abdomen and hind wings being marked with pink and black. It, like the vine hawkmoth, has a world wide range, and the caterpillars, with their delicate green tint beautifully striped with white, are very common in our gardens toward the end of summer on privet and other garden shrubs. In spite of their large size, they are very difficult to detect until the damaged foliage calls attention to their presence.



Fig. 114.—*Protoparce convolvuli* (Linn.).
The Hawk-moth of the sweet potato and convolvulus.
("Agricultural Gazette," N.S.W.)

Family 7. Wood Moths.
HEPIALIDAE.

This is a very distinct group, the members of which usually have long deflexed wings rounded at the extremities, and the neuration of both pairs of wings alike; the tongue is generally obsolete; ocelli absent; the tibiae without spurs; while the abdomen is very long and cylindrical in the typical forms. They lay their eggs upon the bark of different forest trees; the little caterpillars, after feeding for a short time on the surface, tunnel into the tree trunk, becoming fleshy naked grubs which bore cylindrical chambers of various forms in the timber, in which they sometimes remain for years, finally pupating in the burrows. The moth develops and escapes in the summer from the pupal case, which is frequently found projecting from the hole in the trunk or root after it has emerged. The moths are generally found clinging to the tree trunks, where they are easily captured. They frequently come to the light at night, but are difficult things to kill and mount, on account of their size and the ease with which the scales rub

off. The females of some species lay many thousands of eggs. If these eggs are not removed from captured specimens and the bodies stuffed before setting, they generally become greasy and spoil in a very short time.

On account of their large size and beautiful colouration the wood moths have attracted a great deal of attention; Scott figured and described a number in his "Australian Lepidoptera," part of which has been published by the trustees of the Australian Museum N.S.W. Meyrick published a revision of the family (Proc. Linn. Soc. N.S.W. 1889), which is much more satisfactory, and has been followed in these notes. The moths, which Meyrick considers to be the ancestral forms of the *Bombycina*, have a world wide distribution, and are well represented in Australia.

Donovan in his "Insects of New Holland" described one under the name of *Hepialus australasiae*, which is now known as *Perissectis australasiae*. With outspread wings it measures up to 3½ inches across; the body and fore wings are of a general dark yellowish colour, marbled and mottled with dark brown, and the hind wings have a reddish tint. The Genus *Porina* contains 8 described species from this country; others are recorded from New Zealand and Africa; they are smaller moths of a general brown, yellow, or grey tint.

The Genus *Hepialus* comprises a number of very beautiful moths with all kinds of delicate green, yellow, pink, and silvery shades of colour. The moth lays her eggs upon a tree stem; the newly hatched larva eating off the surface of the bark forms a matted web under which it bores into the centre of the branch, and then makes a vertical shaft

downward, varying in length from a few inches to several feet, in which it feeds and pupates. The best method to obtain specimens of these moths is to collect the infested branches or stems, cutting them off a foot or more on either side of the silken webs (which often form a regular ring round the stem), and placing them in several inches of damp sand in a box, with a sheet of glass over the top. The wood thus dries slowly and does not damage the delicate pupae or larvae from which, if collected at the proper time, the perfect moths of several species will readily breed out. The males and females of the same species differ from each other in size, colour and markings.

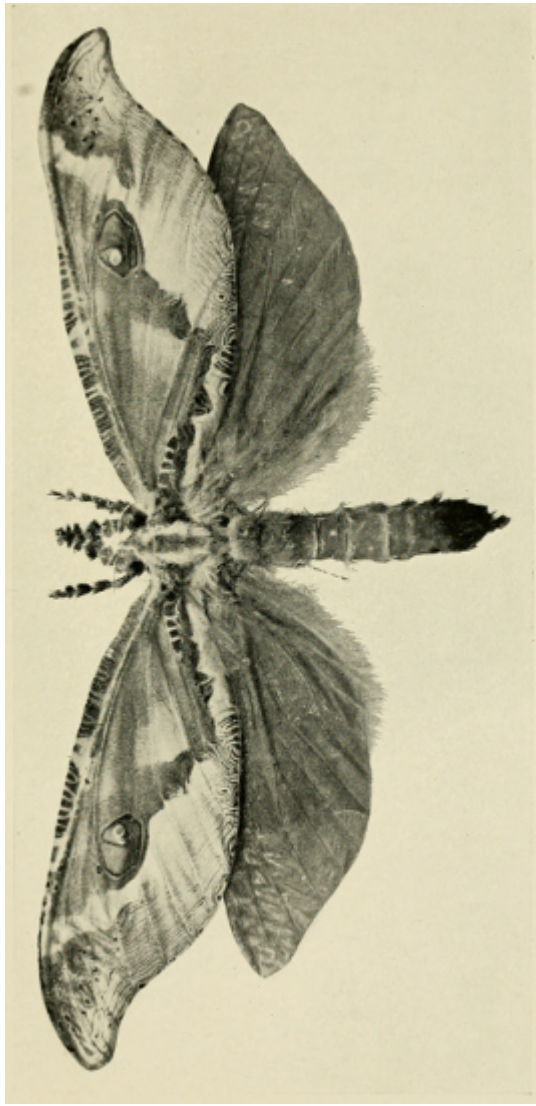
Plate XXIII.—LEPIDOPTERA.

Family HEPIALIDAE.

Leto staceyi (Scott).

(Original photo. Burton.)]

Plate XXIII.—LEPIDOPTERA.



Lewin's wood-moth, *Hepialus lewini*, is one in which the sexes are very different. The larger female measures 2½ inches across the wings; the fore pair, head, and thorax are dull claret red, mottled on the centre and tips of the wings with green; the hind pair

dull yellow, with a pinkish tint. In the male, the head, thorax, and fore wings are pale green, the latter banded with opaline white; the hind pair of a paler green with white tints. This is one of our common species, and feeds in the stems of the Casuarina.

The larva of *H. exima* feeds on the stems of the "Lilly-pilly" and Water-gums, forming quite a felted bag round the branch, and is said to remain in the larval state for several years; like the great wood-moth, before it pupates it eats the web off in front of its chamber and replaces it with a wad to protect the opening; this it can easily push out with its horny pupal head when ready to emerge. This is a much larger green form, with the edges of the fore wings marked with brownish yellow and two eye spots of the same colour in the centre; the small male has the green fore wings marked with opaline white. *H. ramseyi* is easily recognised by its greater size and the green fore wings richly mottled with large silvery white spots forming irregular transverse bands.

The Bent-wing, *Leto staceyi*, is one of our most remarkable moths both for size and colour: it was originally described by Scott under the generic name *Zelotypia*, but Meyrick placed it in the Genus *Leto*, in which another species has been described from S. Africa. Both of these species are peculiar in having the hind wings tufted with stout shaggy hairs. This moth, chiefly obtained in the forest country about Newcastle, has been largely bred from the infested timber by miners in the district, who had a ready sale for them, and who at this work naturally learnt a good deal about their habits. When the young larva enters the tree trunk it covers the opening so carefully with web and particles of bark, that it

requires an observant eye to detect the injury. According to some of the collectors the larva lives and grows in its shaft, about a foot in depth, for a period of six years (but this needs verifying); it generally pupates early in December after blocking the opening with a felted wad; but soon after its transformation it pushes this wad out. The chrysalid fits close to its vertical shaft, and aided by rows of fine spines round the apex of each abdominal segment can move up and down; when reaching maturity it has a favourite habit of resting in the shaft with the top of its head level with the transverse burrow, and dropping downward if disturbed. Thornton, who bred or captured nearly 100 in the Newcastle district, generally obtained them in the month of March, and found that those under observation invariably came out about 3 o'clock in the afternoon. The larger female measures up to 8 inches across the wings, of which the front pair are long, slender, and arcuate on the hind margins; these are of a general greyish fawn brown, wonderfully marbled with black and brown, and with a large eye-spot in the centre toward the tip: the hind wings and body are reddish yellow. Meyrick suggests, in his paper previously quoted, that the curious eye-spots on the wings, together with the general outline of the moth resting upon the tree trunk, might be a case of protective mimicry, resembling a snake's head; this appears to me however to be very far fetched. Skuse reproduced a drawing of the moth and a monitor lizard's head in the "Records of the Australian Museum," to show this fancied resemblance, but if the correct colouration had been added the resemblance would have been very much less marked.

The Genus *Pielus* contains some large brownish

moths with very hairy legs, two of which have been described from Australia: *Pielus hyalinatus*, slightly under 4 inches across the wings, is of a general chocolate brown tint with an irregular silvery white stripe and dark lines running through the centre of the fore wings; the hind pair are brown. The larvae feed in the roots of several species of wattles, and are frequently attacked by *Cordiceps*, the curious fungus that turns them into what are known as "vegetable caterpillars." This species has a range from the southern parts of W. Australia through Victoria to North Queensland. Messrs. Olliff and Prince figured and described (Proc. Linn. Soc. N.S.W. 1887) a handsome variety of this moth under the name of *Pielus imperialis*. The marbled wood-moth, *Trictena labyrinthica*, is a large dark brown moth, measuring up to 6 inches across the wings, which are covered with a scroll-work pattern of lighter colour. The larvae of these also feed upon the roots of trees.

In the COSSIDAE we have a typical goat-moth, *Culama caliginosa*, resembling the English species in form and habits. The larva is a short, dull, red, naked grub that feeds in the stem of the apple-gum, tunnelling round under the bark until nearly full grown, when it bores into the wood and pupates in a cocoon at the end. The moth is of a uniform delicate slate-grey, finely marbled with black lines all over the broad rounded wings, which are folded downward when at rest.

The ZEUZERIDAE comprise some of our giant wood-boring moths; some are as large as small birds, with great rounded bodies, and grey wings thickly mottled with black, brown and fawn: *Zeuzera eucalypti* has received an unfortunate specific name, for it feeds in the larval state in the stems and

branches of several different species of wattles, and kills a great number of these trees by perforating them with great circular burrows; when ready to pupate, it forms a silken bag close to the outer skin of the bark, which has been gnawed away so that it can easily push its way out when ready to emerge. The moths have the usual brown tint mottled with irregular blotches of grey. The rust-coloured wood moth is a much larger species, and is commonly known under the name of *Z. liturata*, but is probably identical with *Z. cinerens*. It measures up to 4¼ inches across the wings, and is of a delicate mottled grey and brown tint, with the hind wings and central portion of the dorsal surface of the abdomen bright chocolate brown. The larvae of this and the following species live in the centre of the stems of large forest gums, and are said to take a number of years to come to maturity.

Macleay's wood moth, *Zeuzera macleayi*, said to be identical with Herrick-Schafer's *Eudoxula boisduvalli*, has a large cylindrical body, and is the giant of the family, measuring up to 10 inches across the wings. They are brown thickly mottled with grey scales; when taken they are generally found clinging to the tree trunks, upon which each female deposits many thousands of small shot-like eggs.

Olliff has given a detailed description of *Leto staceyi*, and an account of a variety (Pro. Linn. Soc. N.S.W. 1887). In a general account of these wood-moths (Pro. Linn. Soc. N.S.W. 1894) I recorded a number of Thornton's observations.

Family 8. Bag Moths.

PSYCHIDAE.

The members of this group are more remarkable in the caterpillar than in the moth stage, for as soon as they emerge the larvae construct protective caps of silken threads and bits of their food-plant, which as they increase in size become regular silken sacks open at the neck, through which the head and fore-legs protrude as they crawl about, but retract at the least alarm. They take their popular name of “Bag” or “Case Moths” from this peculiar habit, and the different species construct different forms of bags and ornament them with sticks or leaves. In Germany they are called “Sacktragers”; in America are known as “Basket Worms”; and the family is fairly represented all over the world.

This country is rich in large species, some of which were noticed as curiosities at a very early date, and Westwood described and figured most of our bag moths (Proc. Zool. Soc. 1854) under the Genus *Oiketicus*: McCoy in his “Podromus of Natural History of Victoria” Decade iv. gave additional notes on the habits of two of our common species; and an interesting paper on how they construct their portable homes will be found in the “Victorian Naturalist” by Hill (1898). The caterpillars themselves are short, naked, dull green creatures with stout horny heads, and are apparently so well protected from their many enemies that one would hardly expect to find them suffer from the attacks of parasites. But they must have some weak point in their armour for a very large percentage, even when collected and kept in breeding cages, produce only wasp and fly parasites. When full grown the caterpillar closes up the neck of its bag and fastens it by a stout silken band to a twig before changing into the chrysalid state; but while the male turns round and pupates head downward, the female remains

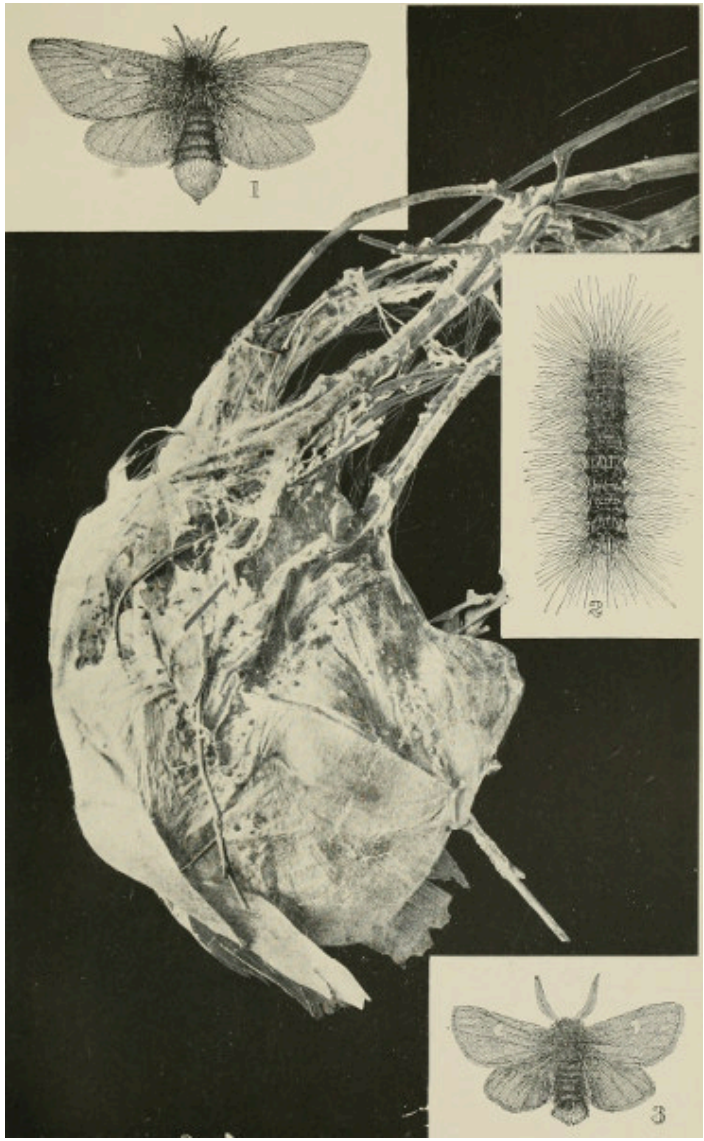
head up as before, and when she casts her pupal skin is an aborted wingless creature, with small head and legs; the body simply develops into a great swollen sack of eggs, which hatch out in her body, or in the shelter of the cocoon; and the larvae make their way out at the open tip of the bag, each attached to a silken thread, a squirming mass of hundreds of little black creatures, leaving her only a shrivelled skin in the cocoon. The male moth, which is rare, is a very active creature, which dashes about as soon as he emerges from the pupal case, and damages his wings (even when bred in captivity) before he can be caught. He has curious toothed antennae; the head and body are thickly clothed with fine hairs; the body has telescopic segments, capable of being protracted to double their ordinary length when impregnating the female enclosed in her cocoon. The wings are narrow, very lightly covered with scales, and without any very distinctive pattern.

Plate XXIV.—LEPIDOPTERA.

Family LIPARIDAE.

1. *Teara contraria* (Walker). ♀.
2. *Teara contraria* (Walker). Caterpillar.
3. *Teara contraria* (Walker). ♂.
4. *Teara contraria* (Walker). Bag shelter among the foliage of *Eucalyptus albens*.

Plate XXIV.—LEPIDOPTERA.



About 13 species of these moths are described from Australia, of which several are very common at times in the bush. Saunders' Case Moth, *Metura elongata*, is our largest species; the larva constructs

an elongate silken sack often up to 4 or 5 inches in length, broadest in the centre and tapering to both extremities; the outside is covered with short lengths of sticks nibbled from the food plant, or picked up during its wanderings. On an average these sticks are about as long as wooden matches, and are securely attached at irregular distances, the lower ones often extending beyond the silken tip. The caterpillar, of which only the head, thorax, and fore-legs can be seen, is a stout, naked, dull brown grub barred with black and reddish orange, measuring about 2 inches in length. The female moth differs so little from the caterpillar that it is hardly worth noticing, but the active winged male, with a wing expanse of about 2 inches, has the head and thorax thickly clothed with bright reddish orange down, and the dusky wings are lightly clothed with fine scales. Though the moth is a somewhat rare insect, the bag cocoon can be often found on a twig or attached to a fence, for in spite of the large house they carry they are great travellers. The Faggot Case-moth, *Entometa ignoblis*, forms a very different kind of portable home; the silken sack is covered with a coat of stout sticks which are generally cut from the gum trees and laid parallel to each other, and closely fastened to the silken surface, so that it reminds one of a bundle of faggots. They vary much in size and length; the larger measures up to 3 inches; one stick will be often found projecting an inch or more beyond the others; this is said to be a resting place for the male moth when seeking the enclosed female. She is of the usual obese form; of a general brown tint, the head and thorax creamy white spotted with black. The male moth with a wing expanse of 1¼ inches is of a uniform brown colour. The Leaf Case-moth, *Thyridopteryx hubneri*, forms a shorter oval silken sack averaging about 2½

inches in length and broad in proportion, covered with different kinds of leaves, for they feed on many shrubs and trees; but the commonest are clothed with bits of gum leaves attached only on the upper edge, and might be likened to a rag mat. When they infest pine trees in the garden, they are uniformly clothed with short lengths of pine needles and have a much neater appearance. The caterpillar is a stout black grub with the head and thorax dull white, mottled with brown. The male moth is a pretty little creature, with reddish brown antennae, the body thickly clothed with black down; the wings have very few scales, and are almost transparent, with a slight blotch in the centre of the hind pair.

The Ribbed Case-moth, *Thyridopteryx herrichii*, differs from the others in constructing a smooth white silken bag, oval in form, angled on the sides, and with a slender tail at the base; and the long attenuated neck forms a regular stalk when attached to the twig; it measures about 2 inches, and is never covered with sticks or leaves. The caterpillar is blackish brown with the head and first thoracic segment lighter coloured. The moth is about 1 inch across the wings, thickly clothed with black hairs, and a reddish orange spot behind the thorax; the wings are semitransparent, with very few scales.

Family 9. Cup or Slug Moths.

LIMACODIDAE.

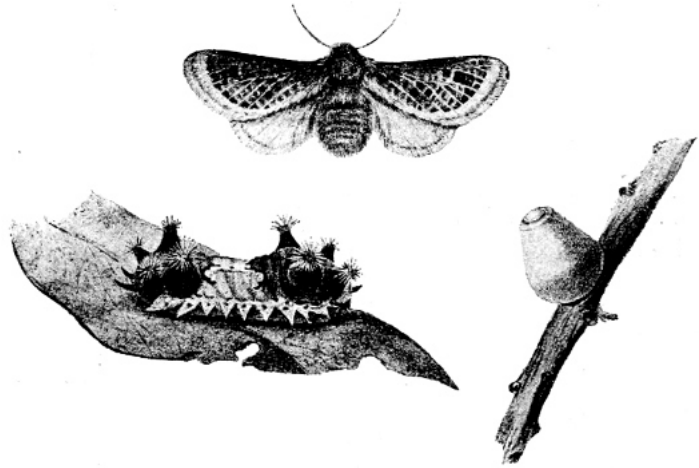


Fig. 115.—*Doratifera vulnerans* (Lewin).

The "Cup or Slug Moth," with larva and cup-shaped cocoon.

("Agricultural Gazette," N.S.W.)

These are moderate sized moths with plump bodies thickly clothed with shaggy hairs, retracted heads, and toothed antennae. The caterpillars are curious short stout slug-like creatures feeding on the surface of the foliage; their feet are almost obsolete, while the under surface is quite flat, soft and fleshy; the whole body rests on the leaf when crawling along like that of a snail. The upper surface is saddle-shaped, with the two extremities raised and ornamented with fleshy spiny tubercles, with little bunches of sharp retractile spines like rosettes, which can be withdrawn into the tubercle or erected at will; the spines are sharp and appear to be hollow, and give a smart sting if they touch the body; in some of the American species, the stinging sensation is so severe as to cause serious swellings. When full grown they spin curious egg-shaped, brown, parchment-like cocoons attached at the base to the twig, with the

apex rounded and forming a circular cap or lid, which, closely cemented on, is loosened and pushed off by the enclosed moth when she emerges. They do not pupate as soon as the cocoon is finished, but remain for a long time in a semi-caterpillar state before the chrysalis is formed.

The Painted Cup Moth, *Limacodes longerans*, is one of our commonest species. The female is about 1¾ inches across the wings; has a very large abdomen; is of a general dull brownish tint; the head and thorax are slightly coloured with red, and the under surface dark brown, the wings chocolate brown, with the outer margins light brown. The much smaller male has semitransparent wings, with the head and thorax marked with bright red. The larvae feed on eucalypts and are of a delicate green colour and of the typical form; about 1 inch in length; with four large tubercles at each end carrying a rosette of retractile red spines; the centre is marked with red and blue, and the outer margins are fringed with short tubercles. They form regular oval cocoons generally attached on their sides to the twig or bark. The Mottled Cup Moth, *Doratifera vulnerans*, is another common species, the larvae of which sometimes attack the foliage of apricot trees. It is a larger slug caterpillar than the last, with a patch of bright yellow in the middle of the back. The cocoons are pear-shaped with the apex somewhat contracted, showing the lid more distinctly. They sometimes swarm over the bush about Sydney N.S. Wales. The moths are of a general reddish brown tint with the fore wings marbled in the centre with a redder shade; the hind wings are lighter brown; they are

somewhat smaller than the last species.

Doratifera quadriguttata is of a dull reddish tint; the fore wings are crossed with a row of 3 darker raised spots, the hind wings being much lighter: the female measures about 1¼ inches, the male somewhat smaller. The larvae, when young, cluster together up to a dozen in number, and feed on the under-side of the leaf, but when full grown they scatter about, destroying much of the foliage of the gum trees. Numbers were collected near Gosford N.S.W. about the end of February. They are short and broad, black, with a pair of dull yellow fleshy horns in front, and 4 tubercles surmounted with bunches of yellow spines tipped with black at each extremity; the centre of the flattened back has rows of short yellow spines with a fringe of similar ones round the outer margins. When full grown they form the usual egg-shaped brown cocoon.

D. acasta is a very similar moth, with a row of 6 or more similar spots crossing the fore wings. The larvae feed in the same manner, and are very plentiful toward the end of summer in the Bathurst district, N.S.W. Rainbow has figured the larvae of this species in the “Records of the Australian Museum” 1904.

The curious warty, pale green, oval, slug-like caterpillar with a yellow stripe down the centre of the back that is figured by Scott as *Apoda xylomeli* feeds upon the under surface of the leaves of the

waratah; and when at rest along the midrib of the leaf, with the yellow dorsal stripe in line, in spite of its size it is very hard to detect, and is a wonderful instance of protective colouration.

Family 10. Tiger Moths.

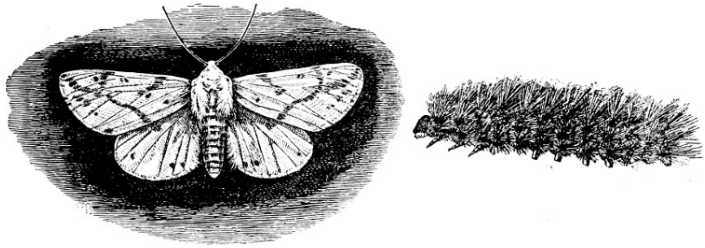
ARCTIIDAE.

This family, including the LITHOSIIDAE, known to collectors as "Footmen," is now one of the largest divisions of the moths that were once all grouped among the true silkworms. The larvae of most of the species are short hairy grubs popularly known as "woolly bears," feeding on all kinds of low plants, and common in our gardens. In this country they comprise a number of delicate and often very handsome moths of medium size, with moderately long pectinate antennae, the body often large, and the wings brightly coloured. The "Footmen" differ from the "Tiger" moths in having the fore wings longer, more slender, and folded over the shorter, more elongate body; they take their popular name from the livery-like pattern of their markings, as the latter take theirs from the tiger-like stripes and spots; while others again are known as "Ermine" moths from their soft silken wings.

The Genus *Tigriodes* contains a number of small moths hiding under or among foliage and therefore not often noticed. *Tigriodes alterna* is of a uniform yellowish brown tint, with darker brown markings upon the thorax and wings, forming zig-zag lines across the fore pair, and clouding the hind ones. It measures about 1 inch across the wings and ranges from Victoria into New South Wales. *T. furcifera* is slightly smaller, of a bright yellow on the fore wings,

with three slender parallel stripes separating into finer lines at the extremities; the hind pair paler with traces of black lines toward the edges; there is a wedge-shaped patch of the same colour on the thorax. Another species common about Sydney N.S.W. is *T. heminephes*, pale orange yellow with the apical edges of the wings and thorax blotched with blackish brown.

Among the "Footmen" we have in the Genus *Spilosoma* a number of fine white to greyish brown moths, mottled with blackish spots and dashes. The Light Ermine, *Spilosoma obliqua*, is common in Victoria and N.S. Wales; it has a wing measurement of 2 inches; is of a uniform dull white, lightly mottled over the wings with dark brown spots, some of them forming a slender irregular transverse band across; the abdomen is red with a dorsal stripe of black dots. *Spilosoma fulvohirta* is about the same size, but much more darkly and thickly marked with brown, also forming dark stripes on the thorax. *Spilosoma fuscinula* is a much smaller moth, slightly over 1 inch across the wings; it has a general rich pink tint, very variably spotted and blotched with black; the latter is sometimes quite the predominating colour, in others only marking the tips; the hind wings are spotted in the centre and on the hind margins only. The larvae are short, flattish, hairy grubs of a reddish colour, and feed upon the foliage of young gum trees.



Figs. 116 and **117**.—*Spilosoma obliqua* (Walker).

116. The Light Ermine Moth.
117. Larva, known as a "Woolly bear."

("Agricultural Gazette," N.S.W.)

The Genus *Termissa* contains a number of smaller pretty little moths flying low and hiding among the foliage; about 10 species are well known. *Termissa shepherdi*, slightly over 1 inch across the wings, has the fore pair broad at the tips, is blackish brown, with 3 irregular yellow transverse bars; the hind pair yellow, with two rounded marks on the outer margin. *T. nivosa* is a smaller moth of a delicate creamy white, with the front and outer margins of the fore wings delicately edged with dark yellow and black, and with two indistinct spots on the front margin; there is a small dot on each hind wing. Anderson says about Melbourne the larvae are to be found under the bark of gum trees in August. *Clauca rubricosta* measures 1 inch across the wings; is of a general blackish tint with the palpi and collar behind the head dull red, a slender costal stripe of reddish yellow along the fore wings, and a yellow spot on the centre of the inner margin forming a distinctive mark when the wings are folded; the hind pair are pale yellow with dark edges. The Genus *Mosoda* contains several moths whose larvae feed upon moss and lichens on the surface of the rocks about Sydney. *Mosoda anartoides*, under 1 inch across the wings, has

the fore pair dark brown, delicately mottled; the hind pair dull orange yellow irregularly edged with brown. *M. consolatrix*, a smaller moth, has the fore wings greyish mottled brown; the hind pair pale buff. *M. jocularis* is slightly smaller, pale buff yellow; the fore wings tipped and speckled with black and the outer tips of the hind pair clouded with brown. The Genus *Comarchis* contains 8 described species, all small moths; *C. aspectatella* is under 1 inch across the wings, the fore pair grey barred with yellow, and the hind pair pale ochreous; it is common in January on Mt. Kosciusko; *Eutane terminalis* and *Asura lydia* are two little black moths thickly mottled with dark orange yellow forming bars and spots on the fore wings; the hind wings of the former are yellow in the centre, thickly margined with black; in *A. lydia* the yellow of the hind wings is divided in the centre by a black band. The larvae feed upon moss. The larvae of the Speckled Footman (*Deiopeia pulchella*) feed upon the forget-me-not; it is of a bright leaden colour, with a white stripe down the back and red spots on the sides of the segments. The moth has a very wide range over the world, and has probably spread from Europe. I have generally taken these moths on the grassy flats close to the sea shore; it is a slender winged creamy white moth, the fore wings mottled with black and red spots, and the hind pair irregularly edged with black. *Nola metallopa* is a silvery grey moth with the fore wings marked with darker coppery tints. The curious hairy larva feeds upon the foliage of young gum trees; when it moults the skin of the head remains attached to the hairs above the head, forming a regular crest.

The members of the small family HYPSIDAE, chiefly found in the tropics, are represented in this country by 4 genera containing about 18 species.

They differ from the last in the venation of the hind wings, and are medium sized brown or yellow moths.

Nyctemera amica is one of our commonest species with a wide range from Victoria to Queensland; it may be found flying about or resting on flowers at all times of the year. The larvae, marked with black and red and furnished with tufts projecting on either side of the head, feed upon the "native ivy" (*Senecio scandens*). The moth is of a general blackish brown tint; the fore-wings are mottled with two irregular pale yellow blotches forming a transverse bar toward the tips; each of the hind pair has a more regular blotch in the centre.

Fig. 118.

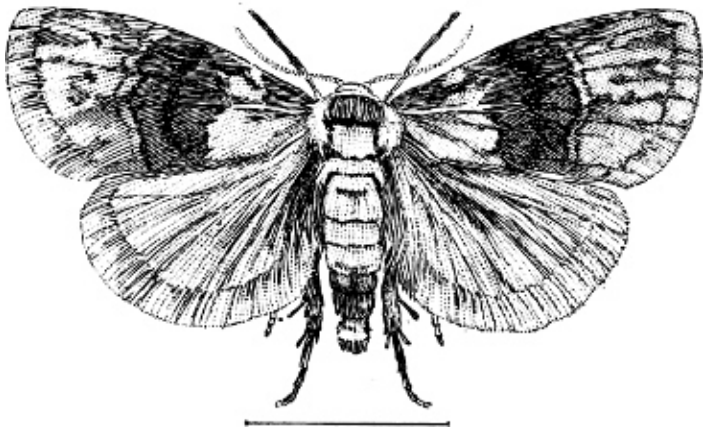


Fig. 119.

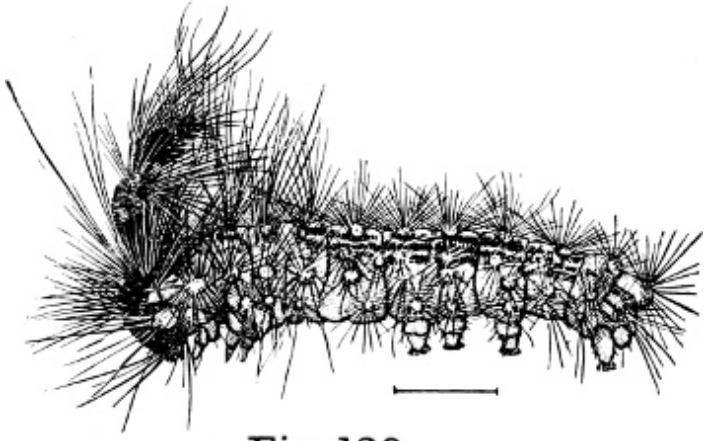
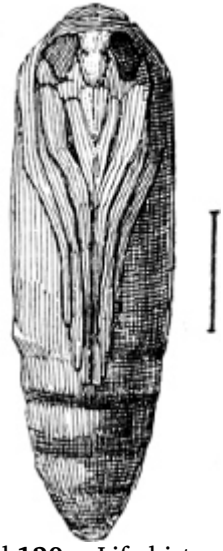


Fig. 120.



Figs. 118, 119 and **120**.—Life history of *Nola metallopa* (Walker).

The Seedling-gum Moth.

118. Moth. 119. Larva. 120. Pupa.

Family 11. Brown Tails.

LIPARIDAE.

These are the "Tussock" moths of America, and the "Vapourers," "Brown-tails," and "Black-arches" of English collectors; some of ours are known as "Bag-shelter moths" from the curious silken bags the gregarious larvae spin, in which they shelter during the day and come out at night to feed upon the foliage. The typical "Brown-tails" are stout, thickset moths with rather long hairy fore-legs generally stretched out in front when resting; the antennae are pectinate in both sexes, and the abdomen is tipped with tufts of downy hairs; in some species the females are wingless. They lay their eggs in clusters on the under-side of the leaves, covering them over with a felted mass of the hairs from the tip of the abdomen.

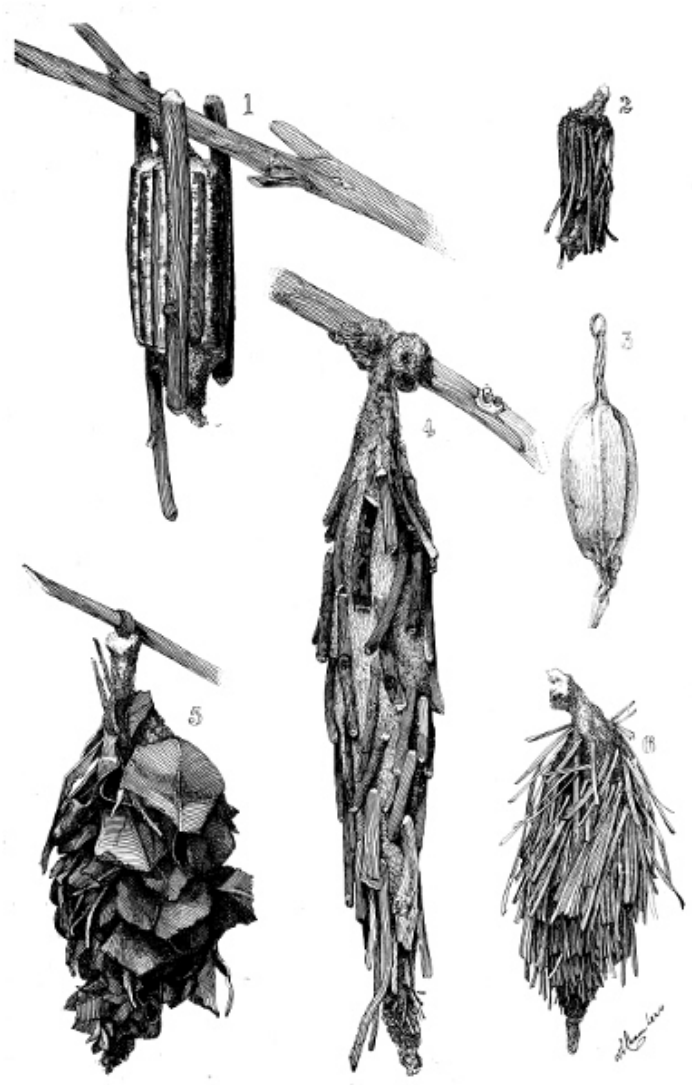
The famous "Gypsy Moth," common in Europe, belongs to this group; it was introduced into the State of Massachusetts, where it has multiplied so enormously that it has become a regular plague, and though hundreds of thousands of dollars have been spent in fighting it, it is still a serious pest. *Porthesia obsoleta*, one of our typical species, measures about 1½ inches across the wings, and is pure white with a black body tipped with golden brown hairs. It was described by Donovan in 1815 in his "Insects of New Holland," and is more common in Victoria than New South Wales. *Trichetra marginalis* is a moth with a wingless female; the male is a little larger than the last species; is of a uniform greyish brown colour, with the outer edges of the fore wings white, and the hind pair pale brown. The larva feeds upon the foliage of gum trees.

Plate XXV.—LEPIDOPTERA.

Family PSYCHIDAE.

1. *Entometa ignoblis* (Walker). Cocoon of Faggot Case-moth.
2. *Entometa ignoblis* (Walker). Cocoon made with Cherry stalks.
3. *Thyridopteryx herrichii* (Westwood).
4. *Metura elongata* (Saunders).
5. *Thyridopteryx hubneri* (Westwood). Cocoon made of gum leaves.
6. *Thyridopteryx hubneri* (Westwood). Cocoon made of pine needles.

Plate XXV.—LEPIDOPTERA.



The Genus *Teara* contains over 20 named species of the “Bag-shelter Moths,” with gregarious larvae. *Teara contraria*, one of the largest species, measures up to 2½ inches across the wings; it is of a general dark brown tint with a small white spot in the centre

of each wing; the thorax thickly clothed with long lance-shaped plumes yellow at the tips; and the abdomen rich orange yellow barred with black. The caterpillars are thickly clothed with long hairs, and when they take up a position on the branch of their food tree (generally a eucalypt or wattle) they spin a silken bag, drawing the leaves and twigs together, but not acting like the "Leaf-rollers," for the silk forms a regular felted brown covering which soon becomes full of their excrement and cast skins, among which they rest during the day. They trail out at night in a regular procession and often strip all the foliage of the tree. When full grown they crawl down the trunk and pupate in loose open cocoons (formed from their body hairs) buried in the ground, and the large liver-coloured silken bag remains long after they have deserted it. This species in some districts makes its home upon wattles, but in other localities attacks the eucalypts in a similar manner. *Teara tristis* is not more than 1¼ inches across the wings, and varies from blackish brown to silvery grey; the fore wings are marbled with white and yellow and a light circular spot in front; the hind ones are nearly black with a minute white spot in the centre; the head and thorax are grey; the abdomen black, barred and tipped with orange; it is common in Victoria and N.S. Wales, generally clinging to some low bush, and slow and sluggish in its movements. *Teara melanostica* is larger than the last; silvery grey, spotted, with the front edge and transverse bar black; hind wings yellow edged with brown; head and thorax silvery white, hind portion dark brown; abdomen barred, and tipped with yellow. The larvae feed upon the leptospermum bushes, and form soft loose cocoons. *Ptilomacra senex* is a large handsome moth about 3 inches across the straight, square-cut fore wings; is of

a general dark brown colour with wavy irregular dark lines and scattered grey scales giving it a greyish tint. It is remarkable for its large feathery antennae.

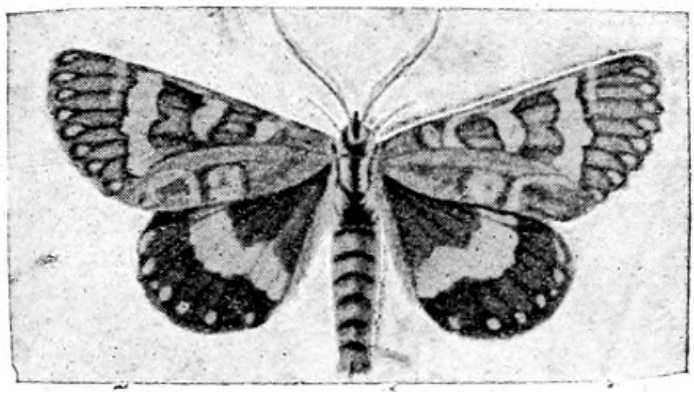


Fig. 121.—*Apina callisto* (Doubleday).

The day-flying cut-worm moth.

Apina callisto is a brightly mottled yellow and brown moth that flies about in the daylight. Its curious hairy larvae feed upon the open grass lands, and are often very numerous. It has a wide range over Australia.

Chelepteryx collesi is one of our largest bat-like moths, measuring to 6 inches across the wings; it is of a uniform dark brown colour with an irregular marbled pattern upon the wings; but it varies much in size and pattern in the sexes. Where common they may be often seen fluttering round the street lamps in the suburbs of Sydney, N.S.W. This handsome moth was first taken to England by a Mr. Colles, after whom Grey described it (Trans. Ent. Soc. 1835). The caterpillars are great, reddish brown creatures, thickly clothed with stout spiny bristles, feeding on the small white stemmed eucalypts, and often found crawling over the rocks and fences. They spin long

silken cocoons, and as they pupate force all the body spines through the silk, making the cocoon a very awkward thing to handle, for the fine spines are easily detached, and sticking into the fingers cause a very unpleasant itching.

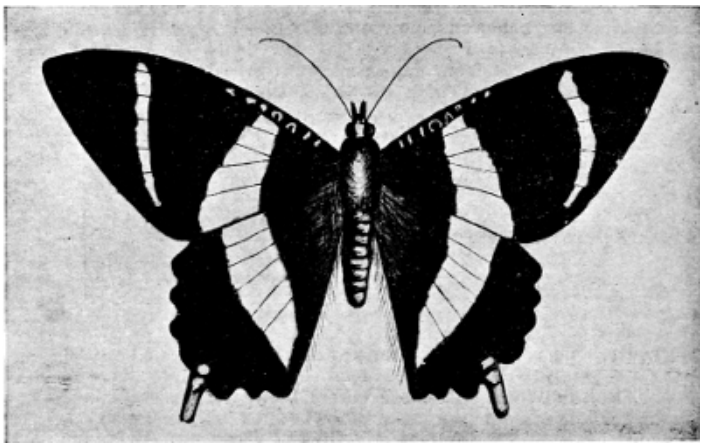


Fig. 122.—*Nyctolemon orontes* (Linn.).

The great day moth of the Queensland scrubs.

(Original drawing, W.W.F.)

The Genus *Darala* is peculiar to Australia; about 30 species have been described; their larvae are short, thick, black, hairy caterpillars often found crawling about in the gardens, and constructing soft fluffy or white silken cocoons attached to the foliage. *Darala ocellata*, one of our commonest species, measures 1½ inches across the wings, and is of a uniform brownish fawn colour, with two black spots in the middle of the fore wings and a pattern of spots or parallel black lines in the central portion. *Darala acuta* is slightly larger, with very variable markings upon a general greyish fawn to dull yellow ground; the fore wings are broad with an acute point at the extremity. The Wattle-moth, *Teia anartoides*, which in the larval state often appears in the orchards and

destroys the apple-tree foliage, is sometimes very abundant. The larvae are short brown hairy grubs with a tuft of hairs standing out in front on either side of the head, and several stiff brushes of grey hairs upon the centre of the back. The males are much smaller than the females, and in the pupal state when hanging up in their loose flimsy cocoons can be easily distinguished. The adult female is wingless, simply crawling on to the top of her cocoon to lay her eggs and die. The male is a handsome little moth about 1 inch across the wings; the fore pair are dark brown marbled with slender lines and black spots, the hind pair bright yellow surrounded with black, and the outer edges yellow; the antennae are large and feather-like.

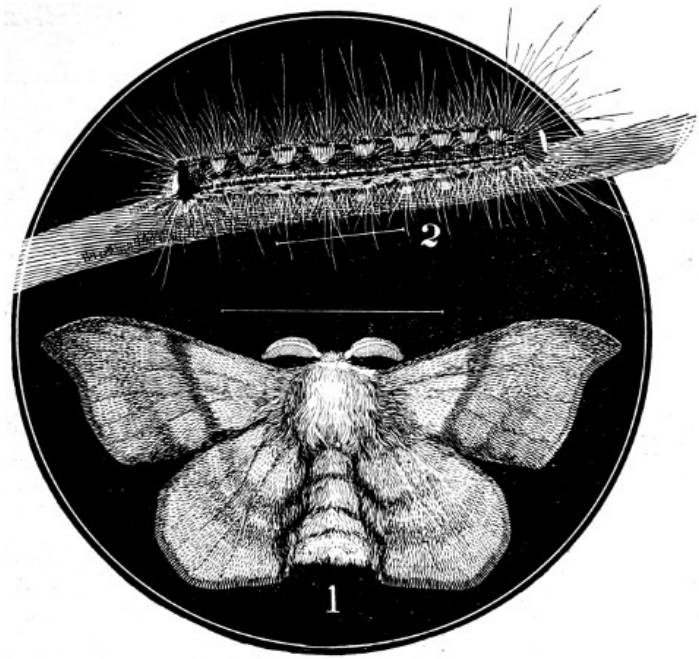


Fig. 123.—*Ocinara lewinae* (Lewin) and Caterpillar.

Ocinara lewinae is a handsome light reddish brown

moth with darker lines running round the wings. It was described by Lewin in 1803, who figured it in colours and called it the "Hook Tip." The larva is a slender caterpillar covered with fine hairs. They are gregarious, and web the leaves of the eucalypts together with a loose, open, silken strand.

Family 12. Silkworm Moths.

BOMBYCIDAE.

In this group I include several families that may be broadly placed together as typical silkworm moths. Some writers divide them into three families; Packard on the other hand adds a number of other well defined groups, such as the Psychidae, Arctiidae, and others, to the Bombycidae.

Typical silkworm moths have thick heavy bodies, with small heads furnished with pectinate antennae and an imperfect mouth; the wings are large and often falcate. The larvae are usually fleshy thickset caterpillars covered with scattered tubercles, and are of somewhat sluggish habits; but all form stout silken cocoons. Our silkworm moths are more closely related to the Atlas moths of India, Saturnidae, than to the silkworm moth of domestic fame, *Bombyx mori*, which, originally a native of China, is now bred and cultivated in many parts of the world for commercial silk.

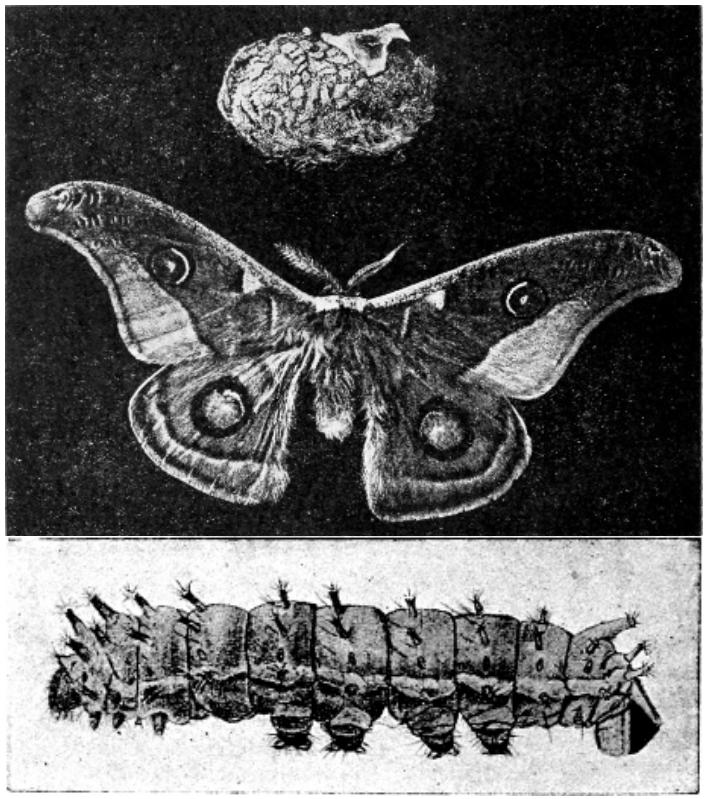
Bombyx trimacula measures 1¾ inches across the wings; it is a dark brown moth, mottled and marbled with white on the head, thorax, and tip of the abdomen, and forming a delicate wavy pattern across the fore wings interspersed with some blackish markings; it is found in Victoria. *Odonestis australasiae* has been known under many different

names: Lewin called it *Bombyx nasuta*, and his specific name was much more appropriate than the former, as it has the head produced into a regular point in front. The larger female measures about 2 inches across the wings, which are of a uniform dull reddish brown colour with faint markings on the fore wings; the hind ones are of a lighter tint. The short hairy caterpillars have a tuft of hairs standing out on either side of the head; in their natural state they feed upon the foliage of the black wattle, forming white silken cocoons, attached to the plant. It is sometimes called the "Long-nosed Wattle Moth," and in Victoria is said to turn its attention to the apple-tree foliage. *Pinara despecta* is a large, handsome, reddish fawn moth, with fore wings ornamented with several zig-zag bands across the centre. It is a thickset moth, often measuring over 3 inches across the wings. The larva feeds upon the foliage of the eucalyptus, and is a very slender caterpillar of a general greyish brown tint, with the sides of the body fringed with fine downy hairs, and when it is resting the fringes lie along the twig so closely that it is very hard to detect. It spins a large silken cocoon tinted with pink, attached to the leaves of the gum trees. *Cosmotriche exposita* is a pretty little thickset moth of a uniform greyish brown tint, covered with fine soft downy hairs round the body and hind wings; the fore pair are thickly mottled with dark brown; the larger female measures about 1½ inches across the wings; the smaller male is a much darker brown insect with fine mottled fore wings. The caterpillar feeds upon the foliage of the "she-oak" (*Casuarina*), and is a slender greyish creature lightly clothed with grey hairs, marked with yellow and carmine on the sides of each segment, and black marks on the back. It forms an elongate oval cocoon

attached to the twigs.

The second group, NOTODONTIDAE, are known as "Prominents" to English collectors from the curious angular form of the caterpillars, though this is not noticeable in our typical forms. The Banksia Moth, *Danima banksiae*, was named by Lewin after its food plant, though it feeds equally upon the Hakea bushes. It is a very handsome moth, nearly 3 inches across the wings, which are of a general slate brown tint; the thorax and tip of abdomen are thickly blotched with white, which is also sprinkled over the body and fore wings in the form of little white scales; the central portion of the abdomen is orange yellow. The caterpillar is a rather slender, cylindrical, ochreous brown creature with the tip of the body lead colour, and the whole surface irregularly blotched with white spots encircled with black, forming irregular bands round each segment. They are generally found feeding in groups of three or four, and when disturbed turn both the head and tip of the abdomen over the back, and protrude two red fleshy filaments from the under-surface of the first segment.

The SATURNIDAE are our most important group for size and colour, and an immense fellow, *Coxinocera hercules*, is found in Cape York. Another very beautiful Chinese species, *Attacus cynthia*, which feeds on the foliage of *Ailanthus glandulosa*, has been accidentally introduced into Australia, and is sometimes taken about the Sydney gardens.



Figs. 124 and **125**.—Life history of the Australian Silkworm Moth.

124. *Antheraea eucalypti* (Scott). Moth and Cocoon.
125. Caterpillar.

The Genus *Antheraea* contains some of our finest moths; others are found in Japan and India that yield a strong brown silk. Our commonest species, *Antheraea eucalypti*, is variable both in colour and size, ranging from delicate fawn to dull brick red, and is from 4 to 5½ inches across the wings, which in the male are smaller and narrower behind; each wing is ornamented with a circular eye-spot in the centre, those on the hind pair being larger and

ringed with black, with narrow irregular dark bands running round or across the hind margin. The tip of the fore wings in the smaller males is rounded, corrugated, and touched with pink. The large green caterpillar, covered with scattered tubercles tipped with clusters of retractile red and blue spines, feeds upon the foliage of eucalypts, but has acquired a taste for the foliage of the cultivated pepper tree (*Schinus mollis*). It constructs a stout, hard, dark brown cocoon in which it pupates, and is furnished with a curious spine at the base of the fore wings, which enables the moth to cut her way out through the tough cocoon when ready to emerge. *A. helena*, very similar in general appearance to the former, is slightly larger, with broader wings of a more uniform reddish brown colour, without a white mark on the fore wings; the inner bands are more irregular and rounded, with the parallel bar not continued into the hind wings. *A. simplex* is a smaller species varying in colour from pale yellow to reddish brown, with smaller eye-spots, those upon the hind wings somewhat oval, broadly marked along the costal nervure; the parallel bar and band on each hind wing are very narrow, and both pairs are wrinkled at the tips. The black and yellow caterpillars are very common at times in the Richmond and Clarence River scrubs, N.S. Wales, and more gregarious in their habits, often covering the bushes with their light coloured rather flimsy cocoons, which are very subject to the attacks of ichneumons. *A. janetta* is about the same size as *A. eucalypti*, but with flatter broader wings of a much duller reddish brown tint without any eye-spots, and only a simple white spot in the centre of each of the fore pair; two fine irregular lines run round the outer half of both pairs with an extra row of small spots along the hind

wings. The larva forms a hard shell-like cocoon on the trunks of the she-oaks. *A. loranthiae*, described by Lucas from North Queensland, is a large handsome reddish moth, the larvae of which when pupating form their cocoons in a mass on the top of a stump or branch.

Family 13. Loopers.

GEOMETRIDAE.

In this family there are a number of handsome delicate moths with slender bodies, large flattened wings often toothed round the edges, which when the insects are at rest (usually upon the under surface of leaves) are pressed flat and spread out like a fan against the surface. The caterpillars are slender cylindrical creatures, green or brown in tint and so imitative of the twigs or foliage among which they feed, that it is possible to pick off a branch upon which a caterpillar is resting without observing the creature until it moves; they are furnished with the usual six legs on the thoracic segments close behind the head, and two pairs of abdominal legs near the anal claspers, so that they have legs at each end, and when moving along they draw the hind portion of the body up to the head before the front legs are moved: thus at every step forward the body is arched up into a semicircle, from which habit they are popularly known as “Loopers.” The best method of collecting the moths and their caterpillars is by beating or shaking the low scrub in the early morning; and the latter are very easily bred in captivity if supplied with material from their food plants. These moths are well represented in Australia; most of the earlier species have been described by Walker and Guérin (Proc. Linn. Soc.

N.S.W.). Meyrick has classified and described a great number of species of this family in a series of papers entitled "A Revision of Australian Lepidoptera," which the student will find in the volumes dating from 1886 to 1891.

The Genus *Euchloris* contains a number of beautiful moths with delicate pale green wings frequently marbled with white lace-like tracery. Meyrick (Proc. Linn. Soc. N.S.W. 1887) lists 43 species; and Lower, in his "Catalogue of Victorian Heterocera," published in the "Victorian Naturalist," lists 15 as Victorian species; but some of these have a wide range.

Euchloris submissaria measures about 1½ inches across the outspread wings; its general colour is rich deep green, with the antennae, front margin of each fore wing, outer edges of both pairs of wings, a central stripe on the thorax and body, and the legs creamy buff white. The caterpillar is of the usual cylindrical form, varying from dull buff to light brown, and it feeds upon the foliage of the black wattle.

Crypsiphona occultaria measures nearly 2 inches across the wings, and is of a uniform light greyish brown on the upper surface, very finely banded in irregular circles; but the under surface is pearly white, spotted on the fore wings with black, crimson and brown; the hind ones are banded with brown and crimson. It has a very wide range, and has a habit of resting against weather-worn posts and walls, its outspread wings matching the colour of its surroundings. The larva feeds upon the foliage of the gum trees, and is of a uniform dull green tint, striped down the sides, the head pointed in front; the whole caterpillar looks wonderfully like a eucalyptus twig.

The Genus *Selidosema* contains a large number of cosmopolitan species; Meyrick lists 29 species as Australian; they are usually grey or brown with darker lines and blotches. *Selidosema lyciaria* is one of our largest species, measuring about 2 inches across the wings; is of a uniform brownish grey, with both pairs of wings marbled in a regular pattern with black and chocolate brown, and crenulated round the edges. The larvae feed upon the black wattle, and vary much in colour, from grey to dark brown; the head is curiously notched, and there are two little projections upon the back by which they can be easily identified. *S. excursaria* has a range from S. Australia to N.S. Wales, and is one of our commonest species; it measures 1½ inches across the wings, and is of a uniform dull greyish tint, very finely pencilled with darker transverse markings, but is somewhat variable in colour. The caterpillars are of a general light brown colour, with the sides pencilled with fine parallel white lines running down the whole length of the body; they are said to feed upon a number of different plants, but are common on the wattles. *S. canescaria*, slightly larger than the last, has a dull grey tint, thickly mottled with dark brown wavy lines; it ranges from S. Australia to Queensland. Another species, *S. acaciaria*, is a little larger, of somewhat similar colour, with whitish markings; it is common in this country, and is also found in India, Ceylon, and S. Africa.

Fig. 126.

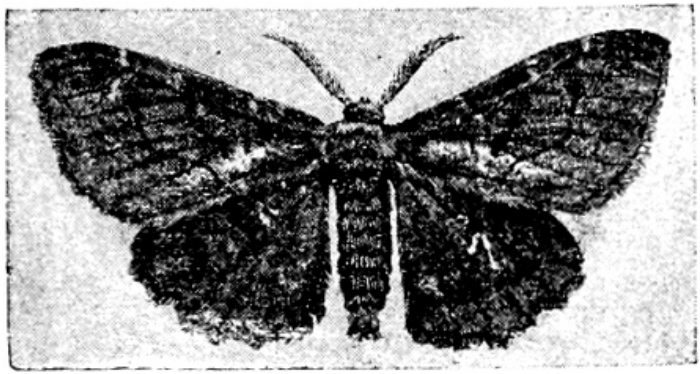
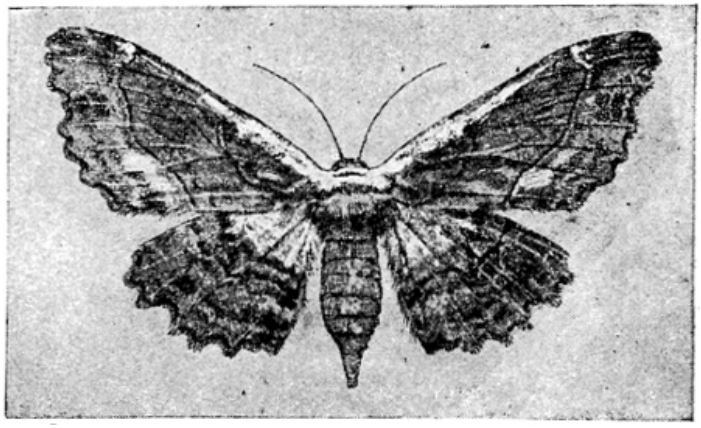


Fig. 127.



Figs. 126 and **127**.—The Marbled Looper.

126. *Lophodes sinistraria* (Guérin) ♂.
127. *Lophodes sinistraria* ♀.

Lophodes sinistraria is slightly over 2 inches in the large females; the sexes vary much in size and colour. They are of a general dark chocolate brown tint blotched with grey along the front of the fore wings, with a distinct row of short grey stripes round the hind wings in a line with the dentate

crenulations. It has a wide range over Victoria and Eastern Australia. The larvae feed upon the foliage of the black wattle, but I have also recorded them damaging the foliage of young apricot trees. They are reddish brown caterpillars, covered with transverse bands of darker coloured spots, and they measure about 1½ inches in length.

The Genus *Thalaina* contains 5 described species, all of which are very handsome moths easily separated from the other loopers. *T. clara* measures 1½ inches across the wings; it is of a uniform pearly white, with the fore wings marked with regular transverse bands of reddish brown forming the letter W when viewed from the side; the hind pair have only a blackish blotch on the outer edge. It has a wide range, and in the larval state feeds upon wattles. *T. inscripta* is about the same size, with a similar ground colour of white, but the markings on the fore-wings form a less perfect W, and there is a row of short bars of the same colour round the edges; the hind pair are more deeply blotched. It has a wide range from Tasmania over the south and eastern portion of Australia. *Gastrophora henricaria* is a large handsome moth, in which the sexes differ both in size and colouration; the smaller brown male has bright orange hind wings, and very fine feathered antennae; the female has the fore wings mottled but not striped. The slender dark brown striped larva, according to Anderson (Victorian Naturalist 1902) feeds upon the foliage of eucalyptus.

Family 14. Cutworm Moths.

NOCTUIDAE.

This from an economic point of view is a very

important family, for the cut-worms do an immense amount of damage to pasturage and gardens. These moths are of medium size with stout bodies; their fore wings generally speaking are narrow, stiff, and triangular, with the broader rounded hind ones folded beneath; the antennae are only slightly toothed in the males of a few species, and the mouth is produced into a tubular proboscis with which they can suck the nectar out of the flowers. In colouration they vary from bright brown to black, a few being marked with white or metallic tints; they are nocturnal in their habits, resting under bark, rocks or other sheltered places, and at night often flying into the lighted lamps. The larvae, which are known as "cut-worms," "plague caterpillars," and "army worms," are usually elongate, dull brown, or greenish, naked caterpillars of a uniform thickness with 8 pairs of legs. When full grown they pupate underground, forming no regular cocoon, though a few groups form a flimsy silken one attached to their food plant.

The world wide Genus *Agrotis* contains a number of variable forms whose larvae are typical "cut-worms," hiding in the ground or under rubbish during the day, and coming out at night to feed. The short stout moths have the head scaly; the fore wings black to grey, the hind pair always lighter coloured; the antennae of the males are slightly pectinate.

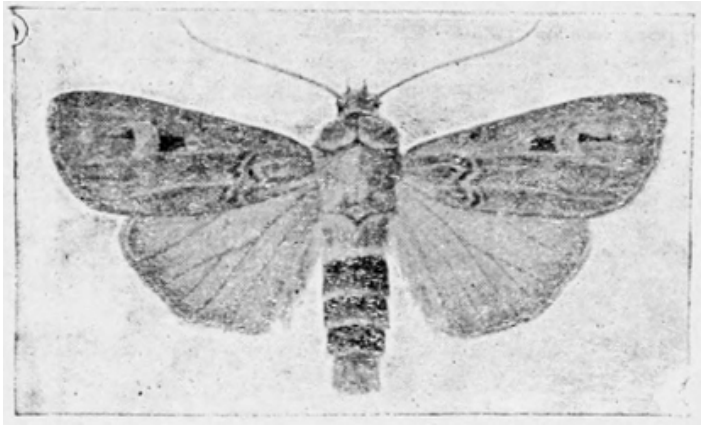


Fig. 128.—The Bugong Moth, or Plague-Cutworm.

Agrotis infusa (Boisd.).

The "Bugong Moth," *Agrotis infusa*, has gone under many different specific names, and is quite an historical insect. It is a dark brown moth, the fore wings marked with two parallel black lines, two dull grey spots in the centre and wavy lines at the extremities; the hind pair are light brown. These moths frequently appear in immense swarms, and take their popular name from the Bugong Mountains among the rocks of which they used to congregate in millions; they formed an important food supply to the natives who used to sweep them off into their bags, and after denuding them of their wings and scales over a small fire, pound the bodies (at this time distended with eggs) into a dough or paste. Dr. Bennett has given an interesting account of this in his "Naturalist in Australia." A rather curious error regarding this Bugong Moth has crept into popular natural history books. In the Rev. J. G. Wood's "Insects Abroad," he figures and describes a butterfly, *Euploea hamata*, as the Bugong Moth; Aflalo in his "Natural History of Australia" makes the same statement, and in a recent magazine article on

"Insects as Food" Theodore Wood repeats the same error.

Scott (Trans. Ent. Soc. N.S.W. 1867) gives an account of an appearance of Bugong Moths in Sydney, when they were so numerous one Sunday morning at North Shore that the service at St. Thomas' Church could not be held, and some observant persons counted 80,000 moths on the windows. They have appeared at irregular intervals about Sydney and the coastal districts in similar swarms, the last time being in 1905.

Agrotis breviuscula is a smaller variable species ranging from reddish brown to grey; the antennae are long; the fore wings have a dark spot of irregular form in the centre, a few fine dots along the edge, and a fine line round the tips; the hind wings are light brown. *Agrotis ypsilon* is not unlike the "Bugong Moth" and by some writers is considered only a large variety, but it has a distinct mark like the Greek letter e in the centre of the fore wings, the tips finely marbled with wavy lines; and the light brown hind wings give a metallic sheen.

Fig. 129.

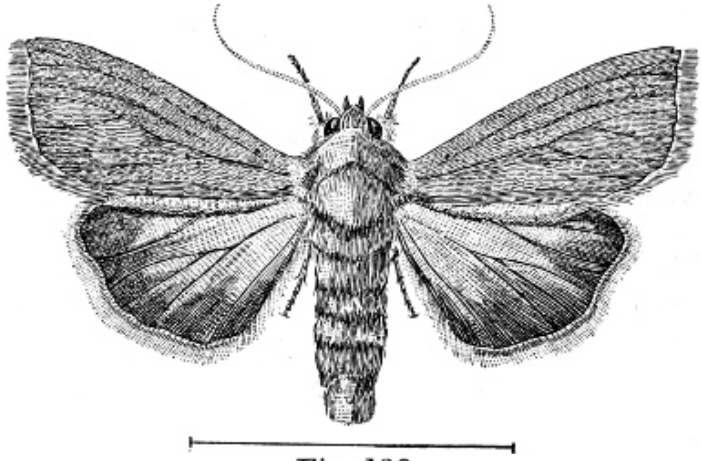
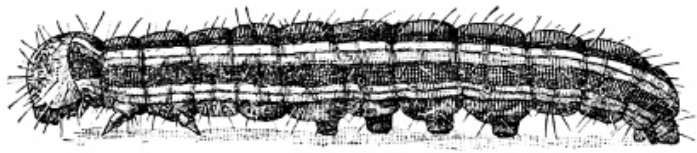


Fig. 130.



Figs. 129 and **130**.—The Climbing-Cutworm or American Army-worm.

129. *Leucania unipuncta* (Horvath).
130. *Leucania unipuncta*, Larva.

Leucania unipuncta is one of the most destructive caterpillars found in North America, where it is known as the "Army worm," devouring crops, grass, and garden stuff. Though the moth has been known for many years in Australia it was not until 1903–4 that it was observed as a plague caterpillar, attacking crops and grass nearly all over Eastern Australia. The caterpillars, 1¼ inches long, are dull olive green with light stripes down the back and sides. The moth measures 1½ inches across the wings, which are of a uniform reddish fawn colour finely speckled with

little black scales.

The "Boll Worm," or "Maize Moth," *Heliothis armigera*, is another cosmopolitan cut-worm which does a great deal of damage to cotton bolls and maize; is common in the pea crops, and also damages tomatoes. The moth measures about 1 inch across the wings; the fore pair are greyish yellow with purplish-brown tints, but are very variable in colouration; the hind wings are silvery grey with the apical portions dark brown; the latter pair are constant in their markings.

The handsome little moths belonging to the Genus *Thalpochares* are remarkable for their curious plump naked larvae, which feed upon different kinds of scale insects, at the same time covering themselves with a portable cocoon composed of fragments of the coccids matted together with silken strands. *Thalpochares coccophaga* is a pretty creamy winged moth with the basal portion shaded with brown and reddish tints, and measures about ¾ of an inch across the wings. The larvae feed upon a number of different insects native to the bush, and have lately been of some economic value in destroying olive scale (*Lecanium oleae*) in the orchards. Several other species have been described with identical habits. *Earias fabia* is a pest of the cotton plant; I have bred numbers obtained in the cotton bolls growing at the Hawkesbury College, N.S.W.; the larva is a slender dull green grub, which when full grown forms a stout, oval, light brown, felted cocoon attached to the dead foliage. The moth is slightly over one inch across the wings, which are of a uniform pale yellow colour, each with a greenish bar in the centre; the hind pair are lighter. In forming such a well-made cocoon this moth seems out of place in the Noctuids;

and Lower says in his Catalogue, “that some writers refer this moth to the BOMBYCINA.” Westwood and Swinhoe place it in the TORTRICIDAE.

The Genus *Hadena* contains a number of Australian species rather more abundant in Tasmania than the mainland; it is another cosmopolitan group, found in Europe and America. *Hadena expulsa*, slightly over 1 inch across the wings, has the fore pair of a general grey tint, mottled with brown; the hind pair are darkest towards the apex and are fringed on the margin with fine white down.



Fig. 131.—The Grey-Cutworm Moth.

Mamestra ewingii (Westw.).

Mamestra ewingii is typical of another large world wide genus. Its larvae are among our most destructive cut-worms to crops and grass: it is a pale slate-coloured moth, marked with short parallel lines of a darker tint on the tips of the wings. *Spodoptera exempta* was figured in the Agricultural Gazette 1898 under the name of *Phlegetona carbo*. It is one of our climbing cut-worms, and in that year the caterpillars swarmed all over the Camden and South Coast districts of N.S. Wales. They are very active grubs,

olive green to almost black in colour, striped on the sides with fine yellow lines; and when full grown measure 1½ inches in length. The moth is under 1½ inches across the wings; is of a general dark brown tint, indistinctly mottled all over the fore wings with yellowish or sometimes silvery grey scales; the hind wings are silvery and semitransparent.

Prodenia littoralis is a handsome moth of about the same dimensions as the last; the fore wings are dark brown finely striped and pencilled with grey lines; the hind pair pearly white. The moth often lays her eggs upon the foliage of apple and other trees; the young on hatching out feed upon the foliage but afterwards make their way to the ground. *Plusia verticillata* is a species that feeds upon the foliage of peas, beans, and potatoes; the slender pale green grub differs from the typical "cut-worm" in moving about like a "looper," and when full grown pupates in a flimsy silken cocoon it spins upon the under surface of the leaf. The moth, measuring 1½ inches across the wings, has the fore pair brown tinted with mauve, marbled with a coppery tint, and with two elongate oval spots of silvery white scales in the centre of each, and fine lines behind; the hind wings are dark brown fringed with grey down. *Plusia argentifera* is a smaller form with a silvery mark in the centre of each fore wing. The handsome dark brown caterpillar of *Calogramma festiva*, which was figured by Donovan in his "Insects of New Holland," feeds upon the foliage of the Crinea lilies; they are sometimes plentiful in the Botanic Gardens. This moth measures 1½ inches across the wings, and is of a uniform pale creamy-yellow colour, thickly mottled on the base of the wings with red and black.

We now come to a curious allied group, the

OPHIDERINAE, the members of which are known as the "Orange-piercing moths"; they are large handsome insects with the head and thorax thickly clothed with scales forming a regular crest, and furnished with a proboscis which, pointed and barbed at the tip, enables them to thrust it through the rind of oranges and other ripe fruit and suck up the juice. Tryon has figured and written an interesting account of these moths in the Queensland Agricultural Journal Vol. ii. 1898.

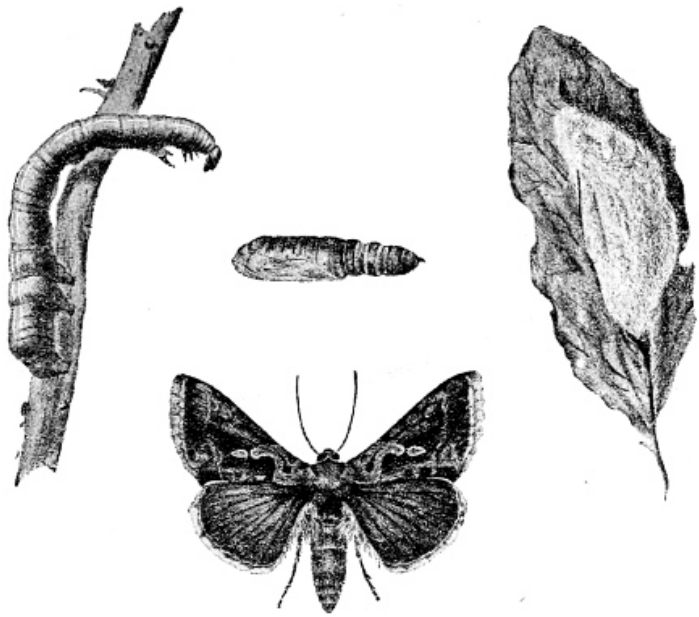


Fig. 132.—Life History of the Bean Moth, *Plusia verticillata* (Guérin).

Showing the half looper form of the caterpillar, and the loose silken cocoon of the pupa.

Maenas salaminia measures 3½ inches across the wings; the fore pair are bright olive green, with a broad stripe of creamy white along the anterior margins; the hind wings are an orange yellow colour,

and each with the margin and centre black. The thorax is bright olive green, and the abdomen of an orange yellow colour. It ranges from the northern parts of New South Wales to North Queensland, and at Cairns I used to capture them at night with a net and bull's-eye lantern, as they hovered round bunches of ripe bananas hanging under the house. *Othreis fullonica*, slightly larger than the last, has the fore wings mottled with grey and brown among the olive green; the body and hind wings are of the same rich orange colour as the former species, with smaller black markings on the hind margins. This species ranges from Queensland to Africa, India, Ceylon, and the New Hebrides. *Argadesa materna* is about the same size, but has lighter coloured fore wings, and further distinguished by a much smaller black spot in the centre of each hind wing. The caterpillars of these moths are large handsome cylindrical creatures with the body humped up at the eleventh segment, and two large spots like eyes on either side of the body. They feed upon several different creepers in the scrub.

The EREBIDAE contains a number of large dark brown moths often curiously mottled with zig-zag lines running round the wings, and a dull coloured eye-spot in the centre of each fore wing. Several species are common in Australia; they often come into the house at night and will be found resting on the ceiling in the morning. One of the largest moths known, the great owl moth of Brazil, measuring a foot across the wings, belongs to this family. *Dasypodia selenophora* measures 3 inches across the wings, and is of a uniform pale chocolate brown tint; the outer margins of the wings are finely crenulated and spotted with white; the centre of each fore wing has a large irregular eye-spot of black, mauve and

orange tints. It ranges from Australia to Tasmania and New Zealand. *D. cymatoides*, about the same size, is of a much darker brown colour, with less distinct eye-spots, a black transverse band behind each white one, and the whole of the inner surface thickly covered with zig-zag wavy lines. This species ranges from Sydney to North Queensland.

Sericea spectans is a slightly larger moth not unlike the last, but a little darker, with the transverse band thicker and more blurred, and with an eye-spot on each hind as well as each fore wing.

Plate XXVI.—LEPIDOPTERA.

Family Ophiderinae.

1. *Moenas (Ophideres) salaminia* (Fabr.).
2. *Othreis fullonica* (Linn.). ♂.
4. *Othreis fullonica* (Linn.). ♀.

Family NOCTUINA.

3. *Sericea spectans* (Guérin).

(Original photo. Burton.)]

Plate XXVI.—LEPIDOPTERA.



Family 15. Leaf Rollers.

PYRALIDAE.

These moths are a very interesting division of the smaller lepidoptera on account of the habits of their

larvae, which live upon the foliage of different plants in small communities, matting and drawing the leaves together with silken strands and feeding under the shelter thus constructed; when ready to pupate they usually curl the remains of one of the half-devoured leaves into a flimsy cocoon with a little silk, from which the moth emerges later on in the season.

The majority of these moths are small and unattractive; at the same time we have some brightly green and yellow tinted species of medium size. The caterpillars are slender naked larvae, often green marked with black spots and a few scattered hairs; they are very active and drop to the ground whenever disturbed.

These moths are easily separated by specialists from the preceding groups by the structure of the nervures of the hind wings. Several specialists have undertaken their classification: Meyrick (Trans. Ent. Soc. London 1890) placed them as a group containing 8 families: Ragonet (Ann. Ent. Soc. France 1890), while restricting them to 2 families, made 17 smaller divisions which he called tribes: Lower, who partly follows Meyrick, gives 13 families in his “Catalogue”; I simply deal with them here as a group, describing a number of typical forms with their life histories.

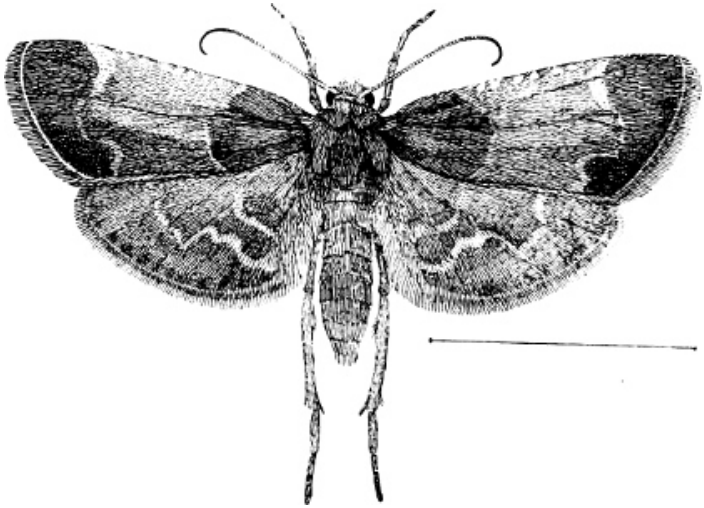


Fig. 133.—The Common Flour Moth.

Asopia farinalis (Linn.).

Margarodes vertonalis is a handsome bright green moth, with the margins of the outer edges of both pairs of wings marked with dark reddish brown; it measures about 1½ inches across the wings. The caterpillars, about an inch in length, are bright green mottled with black; the head shining reddish brown. My specimens were collected in the Botanical Gardens, Sydney, at the end of January; they were matting the tips of the branches of one of the ornamental shrubs (*Ochrosia moorei*) into irregular rounded masses. They pupated a week later and emerged before the end of the month.

Sceliodes cordalis, measuring slightly over 1 inch across the wings, is of a uniform creamy tint; the whole of the fore wings are mottled with light brown, the tips blotched with the same colour; and the hind pair more spotted; my specimens were bred from the foliage of the egg plant.

Asopia farinalis is the well known "meal moth" common, in most parts of the world; the caterpillars feed upon all kinds of corn, bran, pollard, and flour; it mats its food particles together with a silken web into a tube in which it hides. The moth is often found upon the walls of feed houses, mills, &c., and sometimes comes into the light at night. It measures 1 inch across the wings, and has a ground colour of yellow buff to dull greyish yellow, blotched with a darker tint at the base and tip, the latter marbled with grey; the hind wings are silvery. *Zinckenia recurvalis* is a common little moth about Sydney; it is under 1 inch across the wings, which are of a dark brown tint, with a white bar traversing the centre of each wing, and with a second white spot on each fore wing towards the tip. The caterpillars are sometimes found destructive to salt-bush hedges about Sydney by stripping off the foliage and causing the bushes to die back.

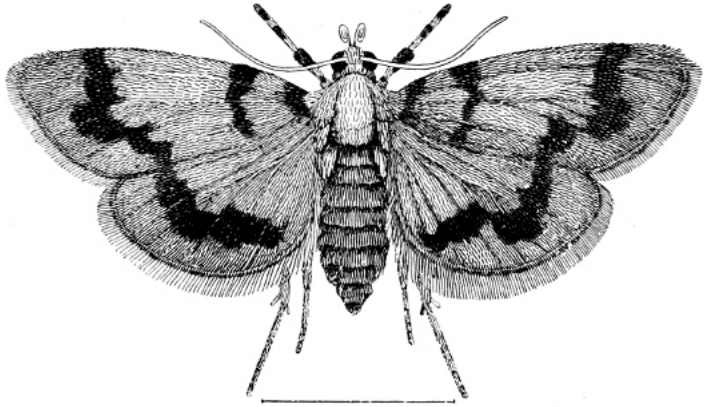


Fig. 134.—*Notarcha clytalis* (Walker).

The Kurrajong Leaf Roller.

Notarcha clytalis is a bright yellow moth with an irregular wavy line of black crossing the outer portions of the wings, and another shorter band near

the base of each fore wing. The gregarious larvae are green spotted with black; they roll the leaves on the terminal branches of the Kurrajong into regular slender masses up to a foot or more in length, in which they finally pupate. It has a wide range over the country, rendering these handsome trees very unsightly when numerous. The larvae of *Godara comalis* is a greenish yellow caterpillar barred with lighter yellow at the back of each segment, and lightly clothed with long brown hairs; it feeds upon the leaves of the horse radish and turnip. The moth measures 1 inch across the wings; the fore pair are buff irregularly mottled with dark brown; the hind wings of a uniform silvery white with a brown patch at the apical margin.

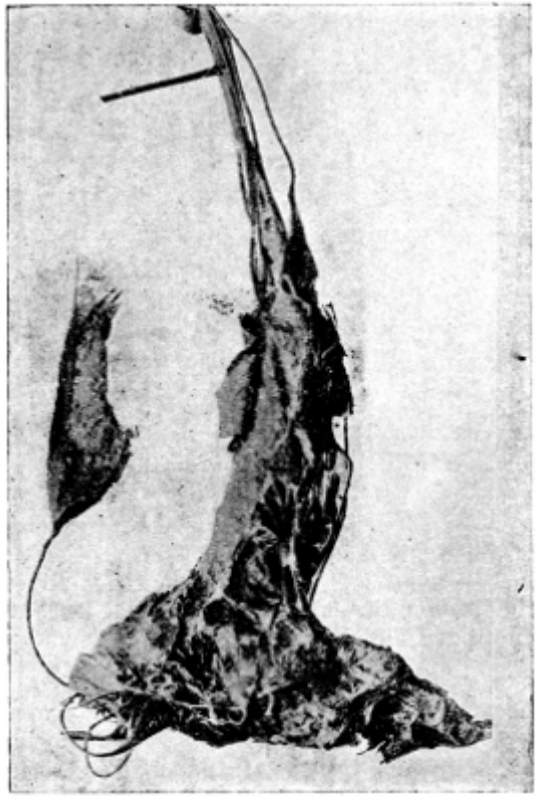


Fig. 135.—Nest of *Notarcha clytalis* (Walker).
Showing how the caterpillars roll up the foliage.

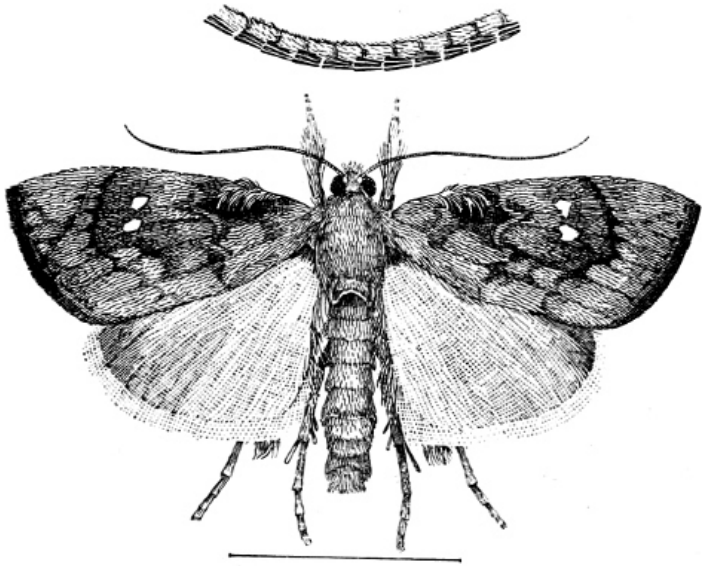


Fig. 136.—*Godara comalis* (Guérin).

The caterpillar of which webs the leaves of the horseradish.

("Agricultural Gazette," N.S.W.)

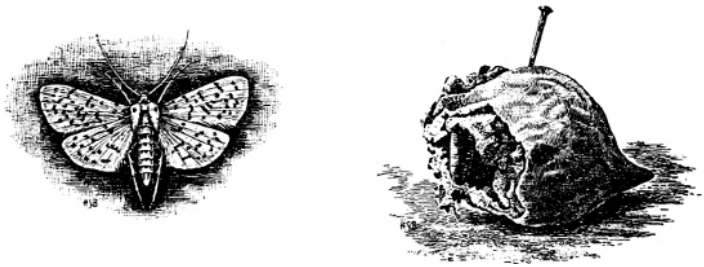


Fig. 137.—*Cognogethes punctiferalis* (Guérin).

The Northern Peach Moth, with damaged peach.

Mecyna polygonalis defoliates the tree lucerne (*Citysus prolifera*); I have also bred it from broom bushes in gardens at Armidale, N.S.W., and on a native bush (*Templetonia*) in the western plains, so that it has a wide range: Mr. Lyell tells me it is very destructive to the foliage of willows in some parts of

Victoria. The caterpillars are slender light green creatures spotted with black and white shaded with yellow on the sides; when full grown they spin a loose silken cocoon. The moth is slightly under 1½ inches across the wings; the fore pair are light brown, and the hind pair each blackish brown round the outer portion and bright yellow in the centre. The two introduced bee moths, *Achraea grisella* and *Galleria melonella*, belong to a division of this family: the moths lay their eggs about the hive, the grubs crawl in and feed upon the wax which they mat together with silken web, and if overlooked they destroy the whole of the hive; in the days of the old-fashioned hives they were a great source of trouble to bee-keepers, but now with well constructed bar-hives they are easily checked. The first named is of a uniform brown colour with the fore wings rounded; the second has the wings arcuate behind and irregularly mottled.

Aphomia latro measures about 1½ inches across its slender somewhat pointed fore wings; is of a general buff colour shot with fine black spots, and divided down the centre of the fore wings with a broad dull white parallel stripe; the hind wings silvery grey. The larvae live in small communities feeding upon and matting together the scape of the flower stalk of the grass trees, in which they pupate within an elongate white silken cocoon.

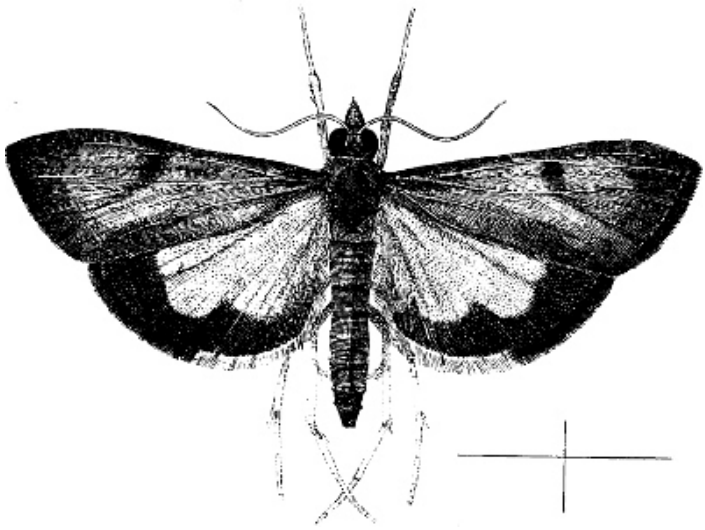


Fig. 138.—*Mecyna polygonalis* (Hubner).

The Native Broom Bush Moth.

The Peach Moth, *Conogethes punctiferalis*, is a bright yellow moth thickly mottled with black spots. The larvae attack peaches when ripening, eating and webbing the surface and pupating on the side of the stone. It is common in the northern districts of N.S.W.

The "Mediterranean Flour Moth," *Ephestia kuhniella*, though not an Australian moth, is worthy of note, for it is widely distributed over the country, and causes a lot of annoyance by the bad habits of its larvae of webbing the flour into masses with its silken strands. Another cosmopolitan moth, *Plodia interpunctella*, is known in America as the "Indian Meal Moth," though it feeds upon all kinds of dried foods; it is a much smaller moth of a general brown tint, the apical portion of the wings much darker than the basal part. This moth also is very common in Australia.

Family 16. Bell Moths.

TORTRICIDAE.

These moths have slender bodies; short generally broad fore wings, truncate at the extremities; the hind pair also broad; and when they are at rest during the day time their wings are folded flat down. The costal margins of the fore wings are much rounded when the wings are folded, giving a general bell shaped form; from which these moths take their popular name. They are sometimes called “leaf twisters” or “leaf rollers,” but differ from the true gregarious leaf roller caterpillars in seldom matting a number of the leaves together. The caterpillars also feed upon seeds.

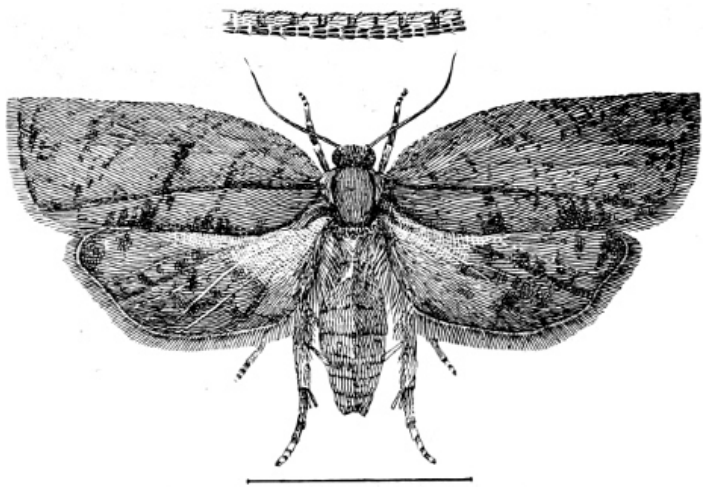


Fig. 139.—*Cacaecia postvittana* (Walker).

The light-brown Apple Moth.

The members of the Genus *Cacaecia* are interesting insects because several have been found attacking fruit in orchards: *C. postvittana*, was recorded by Olliff gnawing in apples like a codlin moth. It measures ¾ of an inch across the wings; is

of a general dull yellow marked with brown, but its colour and markings are very variable. It has a wide range over Tasmania and the eastern coast of the mainland into Queensland; and about Sydney the caterpillars feed upon half a dozen different common native shrubs. French in his Handbook of the Destructive Insects of Victoria Pt. I. 1891 has named and figured one, *C. responsana*, the "Light Brown Apple Moth," as an apple pest in Victoria; this is probably *C. postvittana*. *C. Australasiae* is a larger species of a dark brown colour; the fore wings are lightly mottled or marbled. *C. lythrodana* is a smaller, similar coloured moth, but the colouration is finer. *Paramorpha aquilina* is a tiny, creamy-grey moth not quite ½ an inch across the wings: in its native state it frequents damp or marshy ground, flying low among the herbage. The larva is a short, pale green grub that, in several of the orange growing districts, attacks the ripening oranges; boring through the skin, it feeds upon the pith between the rind and flesh, where it finally pupates and causes the orange to turn yellow and drop off.

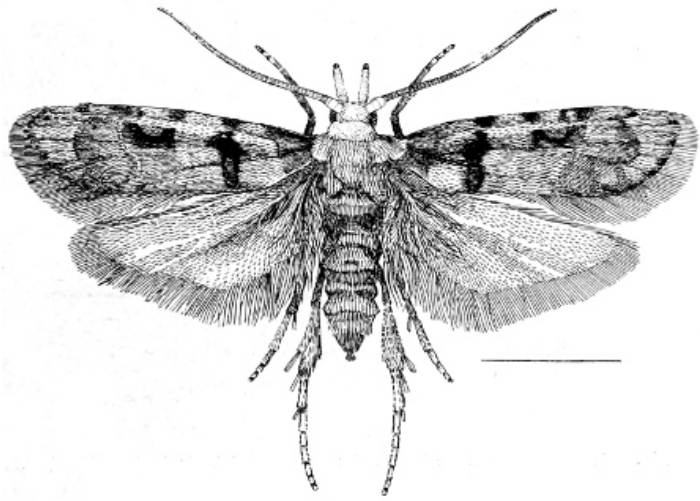


Fig. 140.-*Paramorpha aquilina* (Meyrick).

The Orange-skin Borer.

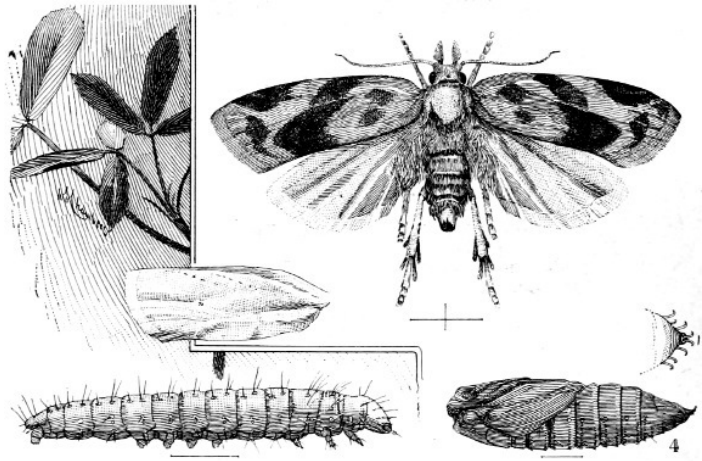


Fig. 141.—Life history of the Lucerne Leaf Roller, *Tortrix glaphyriana* (Meyrick).

The Lucerne Moth, *Tortrix glaphyriana*, is a small, dark yellow moth about ½ an inch across the wings; the fore pair are light buff with a silvery tint, blotched with irregular patches of dark brown. The caterpillars are dark green with scattered white hairs on the segments; they are a regular pest in lucerne paddocks in the Hunter River district, N.S. Wales, feeding upon the lucerne tops and drawing them together with silken threads. *Arotrophora ombrodelta* is a handsome little moth which I bred out of the seed pods of *Acacia farnesiana* growing near Lismore, N.S.W.; the yellowish brown caterpillar has a pink stripe down the back, and each segment is spotted with green; they devour the seeds and then pupate inside the pod close to the hole, through which the pupa works its head just before the moth is ready to emerge; the anal segments being ringed with fine spines enable it to screw right out of the hard pod, so

that the moth is not damaged. The moth, under 1 inch across the wings, has the fore pair chocolate brown, mottled and darkest at the tips; the hind pair are brown. Meyrick says that the larva of another species feeds enclosed in a short, stiff, silken tube among the leaves of *Lomantia silarfolia*; and a third feeds in the flower cone of our common honeysuckle (*Banksia serrata*). The Codlin Moth, *Carpocapsa pomonella*, the world-wide pest to apple growers, is found in most parts of Australia; but though the reddish tinted caterpillar is universally known, there are a great many orchardists who do not know the moth, though it is easily recognised from all other species by the copper coloured blotch on the apical portion of the fore-wings.

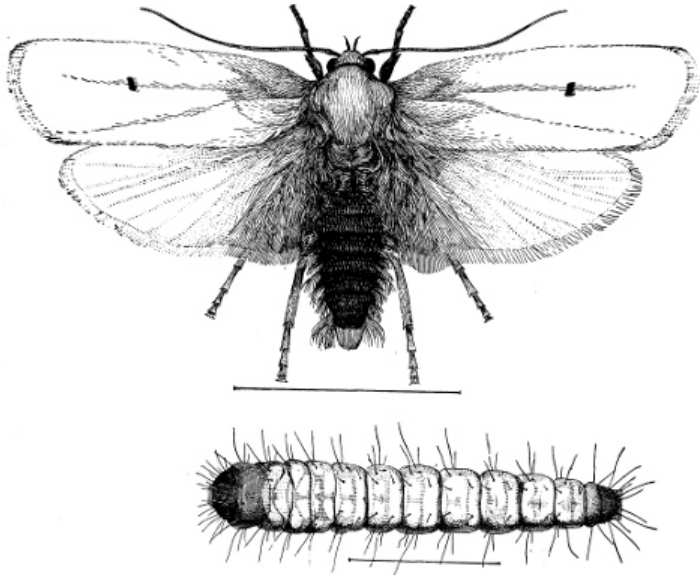


Fig. 142.—*Cryptophaga unipunctata* (Donovan).

The Cherry-stem Borer, showing the larva.

We now come to an anomalous group, whose exact place in the classification of Lepidoptera has

puzzled entomologists, but which is usually placed at the end of this family. These are the CRYPTOPHAGINAE, whose larvae, naked, slender caterpillars, live in shallow chambers or short tunnels in the branches of the smaller forest trees. They cover the entrance to their burrow with a screen of loose silken web covered with gnawed bark and droppings. Resting during the day, they come out at night and, biting off some of the leaves, drag them down into the burrow (the ends often sticking out through the web) to feed on at their leisure. When full grown they pupate within the burrow. *C. unipunctata* is a very handsome satiny white moth about 1½ inches across the wings; the fore pair each have a single black dot in the centre; the abdomen is black fringed with yellow hairs forming a tuft at the extremity. In its native state the caterpillars feed upon the branches of our common honeysuckle (*Banksia serrata*), but have a very great liking for the branches of cherry trees in the orchards; where neglected, they often kill large branches by their attacks. *C. irrorata* is a larger moth, measuring up to 2 inches across the wings, the fore pair being very broad and square at the extremities; they are of a uniform greyish brown, slightly mottled with a darker pattern round the outer margins; the hind pair are silvery brown fringed round the edges. The larva feeds on the stems of *Casuarina*. *C. rubriginosa* is nearly as large as the last; the fore wings are reddish brown. There is a salmon tint on the thorax extending on to the base of the fore wings; the hind wings are brownish yellow. The larvae feed in the stems and branches of several species of *Acacia*.

Family 17. Grain and Clothes Moths.

MICRO-LEPIDOPTERA.

In concluding the Lepidoptera I place these families, often grouped together under the comprehensive term *Micro-lepidoptera*, in the above division. Most of these moths are small, but the group is very important in that it contains some of the most destructive pests of grain, cloth, &c., and they are world-wide in their range. Meyrick has made a special study of these moths, and has classified and described an immense number in a series of papers in the Proc. Linn. Soc. N.S.W. 1878–1904.

The larvae of the different groups are usually slender naked grubs with a few scattered hairs, and are sometimes legless; but others again have from 14 to 18 pairs of legs. They feed upon all kinds of material, sometimes forming tubular cells out of their food, while others move about quite freely. The moths may be obtained by beating or shaking bushes, or breeding them from the material among which they feed.

The Family OECOPHORIDAE is the most extensive in Australia; in his first paper on the group in 1883, Meyrick estimated that over 2,000 species would be discovered, and later in 1889 he had actually described 756 species, most of them new. The Genus *Philobota* contains 105 described species, many of them handsome brightly marked little moths. *P. arabella*, slightly over ¾ of an inch across the wings, is of a general greyish brown tint, with the central portions of the fore pair pale yellow edged with brown forming wedge-shaped patches. *P. catascia*, slightly larger, has the fore-wings silvery white, slightly clouded; the hind ones dull yellow in the centre fringed with light brown. *P. productella* a little smaller, is all silvery white, with yellowish tints in

the hind pair; and *P. agnesella* is a larger silvery one with a narrow irregular dark stripe along the centre of each fore wing from the base to the apex. *P. gascialis*, a very different larger winged form, has the fore pair dark orange yellow, each with a broad brown blotch through the centre, and tip dark brown; the hind pair dull brown fringed with fine plumes. *Macrobatha platychroa* is under ½ an inch across the wings; the fore pair are marked with alternate bars of white and black, and the hind pair greyish brown. *Heliocausta hemitelis*, about twice the size, has the fore wings yellow, tipped and blotched with purplish brown, the blotch on each hind margin angular; the hind wings brown. *Zonopetala decisiana*, under ½ an inch across the wings, has the fore pair white, each with a large brown blotch across the centre, and others at the tip, and with a band of the same colour across the thorax; the hind wings light buff and fringed with hairs. The caterpillar of *Ocystola hemicalypta* constructs a protective covering about as thick and long as a large wax match out of a section of a gum twig, in which it lives and feeds after hollowing it out like a tube; these curious cocoons are not uncommon in the bush on the leaves of eucalypts.

The GELECHIADAE is another large family recently revised by Meyrick (Pro. Linn. Soc. N.S.W. 1904); he says that these moths are not so numerous as in Europe, but as they are such small, inconspicuous insects there are probably a great number still to be discovered. He describes 274 species, of which 207 are new, and 85 of which belong to the Genus *Protolechia*. Several species that infest grain belong to this group: *Gelechia simplicella*, a tiny little brown moth, has pointed slender wings, the fore pair nearly black, with a very distinctive irregular white bar

across each apical half. Meyrick has placed it in the Genus *Anacampsis*; it has a wide range over Tasmania and Australia: I have bred it from the foliage of Soy beans, which the larvae matted together and seriously damaged. *Sitotroga cerealella* is a tiny yellowish brown moth with pointed wings. It has a wide range round the Australian coast, and has been introduced from Europe or America with corn upon which the larvae feed. It is known as the "Angoumois Grain Moth" from the province of that name in France, where in 1760 it swarmed over the country and nearly caused a famine. I have bred it from wheat at Bingara N.S.W.

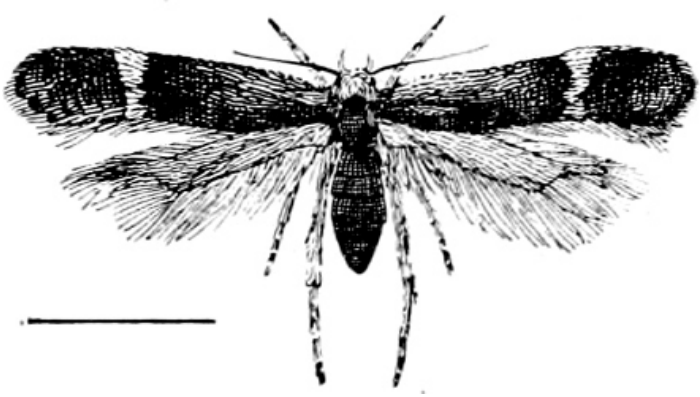


Fig. 143.—*Gelechia simplicella* (Walker).

The Soy-bean Moth.

The ELACHISTIDAE were described and revised by Meyrick (Pro. Linn. Soc. N.S.W. 1897), who lists 254 species, most of which were new. He says: "The species of this family are almost all small and therefore often neglected by collectors. Larva with 10 prolegs seldom almost apodal, usually mining in leaves, or amongst seeds or in stems, sometimes case-bearing, rarely amongst spun leaves."

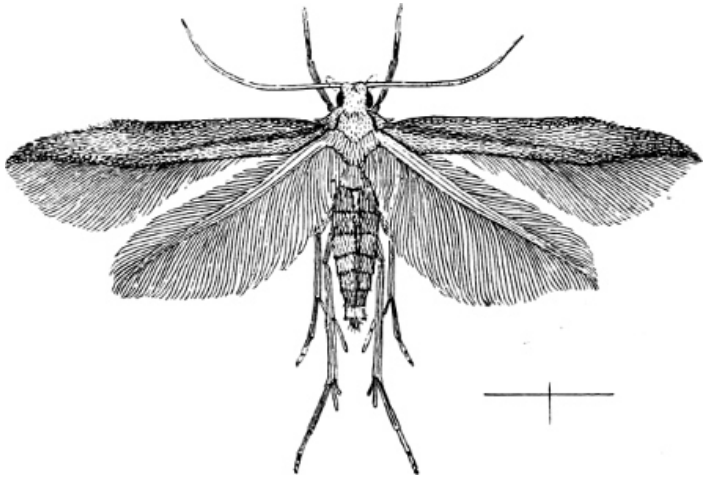


Fig. 144.—*Batrachedra sparsella* (Walker).

The larva of which constructs a web amongst, and feeds on, scale insects.

The larvae of the members of the Genus *Batrachedra*, according to Meyrick, feed usually upon seeds. *B. arenosella*, a small dull pale yellow moth with spotted fore wings and grey hind ones, is common over Australia, Tasmania, and New Zealand. The larvae web the seeds and stalks of sedges together, and form a cocoon among the seeds. I have bred a species of *Batrachedra*, *B. sparsella*, Walk., but can find no record of this species in Meyrick's list. The larva of this moth spins a web on the trunks of trees that are infested with scale insects which they devour, finally forming an elongate cocoon attached to the bark; in the orchard they destroy white louse on oranges, and San Jose scale on peach trees. *Strathmopoda melanochra*, a little brown moth, has the fore wings dull white with metallic reflections and darker markings; the wings are very finely fringed on the hind margins.

The Family PLUTELLIDAE contains one very

destructive little pest in the Diamond-backed Cabbage Moth, *Plutella cruciferarum*; the slender green larvae gnaw holes in the leaves and pupate in net-like cocoons on the foliage. It has a world-wide range and is very common in Australia.

The Family TINEIDAE, containing the clothes moths, is defined by Meyrick (Proc. Linn. Soc. N.S.W. 1892) as the rough-headed *Tineina*, with the palpi strongly developed in front of the head, and the hind wings usually as broad as the fore wings, sometimes narrower but seldom broader. Larva with 16 legs, or legs wanting.

The Genus *Xystmatodoma* contains 29 species, of which *X. guildingi* is a typical form described by Scott in his "Australian Lepidoptera"; it is a slender-winged dull brown moth, the larva of which crawls about in a stout silken sack like that of an immature case moth, and feeds upon low scrub. *Scardia australasialla* is a handsome little moth, which is figured in Donovan's "Insects of New Holland"; it measures about 1¼ inches across the wings; the fore pair are dull brown but so thickly covered with shining white to pale yellow spots that it looks very brilliant; the hind pair are brown fringed with long plumes. *Blabophanes ethelella* is about ¾ of an inch across the wings; the fore pair are dark brown finely spotted with white and some have a comparatively large white dot in the centre of each wing, the hind margin also edged with white; the hind pair light brown. The Genus *Tinea* is represented by a number of both native and introduced species. The common clothes moth, *Tinea pellionella*, is too well known to need description; it is world-wide in its range, and lays its eggs upon clothes on which the larvae feed and finally use particles to construct their cocoons. *T.*

tapetzella feeds among furs and skins. *Tineola biselliella* is a third cosmopolitan species of clothes moth. *Tinea fuscipunctella* feeds upon dried animal matter, refuse and such like; it also is world wide in its range. Among our native species, *T. nectaria* is under ½ an inch across the wings; the fore pair have the basal two thirds silvery yellow with the tips black; the hind pair dull yellow darkest at the tips. Meyrick says that these larvae make cases out of eucalyptus leaves, but my specimens were bred out of blister-like excrescences or galls upon the leaves of a shrub in the Botanic Gardens Sydney. *Thudaca obliquella*, about 1 inch across the wings, is a beautiful little silvery white moth, with the fore wings deep yellow thickly marked with parallel and transverse bars of silvery white; the hind pair broad, silvery, lightly clouded, and fringed behind with long plumes.

The EPIPYROPIDAE comprise a small group of moths that have been raised to the rank of a family by Perkins (Bulletin I. part 2, "Leaf Hoppers and their Natural Enemies," Hawaii 1905), though it would probably be more correct to place them as a sub-family of the Tineidae. Sharp (Cambridge Natural History: Insects part II.) places them in the *Limacodidae*. They are small black, grey or brown moths, with small eyes; no ocelli; the palpi wanting or very minute, and the mouth parts little developed. They have remarkable parasitic habits in the caterpillar state living upon the backs of different leaf hoppers (*Homoptera*) and feeding upon the waxy or sugary secretions discharged by their hosts. Perkins describes 7 new Australian species, which are placed in three genera, based on the neuration of the wings. Three species come from Cairns, N. Queensland, and four from the neighbourhood of

Sydney. *Heteropsyche melanochroma* measures under ½ an inch across the outspread wings and is of a general black or fuscous colour with purple tints on the fore wings. Koebele records it as common about Sydney, parasitic upon a number of different Fulgorids and Jassids.

Rothschild (Novitates Zoologicae 1906) has named another species, *Epipyrops doddi*, after the well known collector, P. F. Dodd, who had worked out its life history in North Queensland.

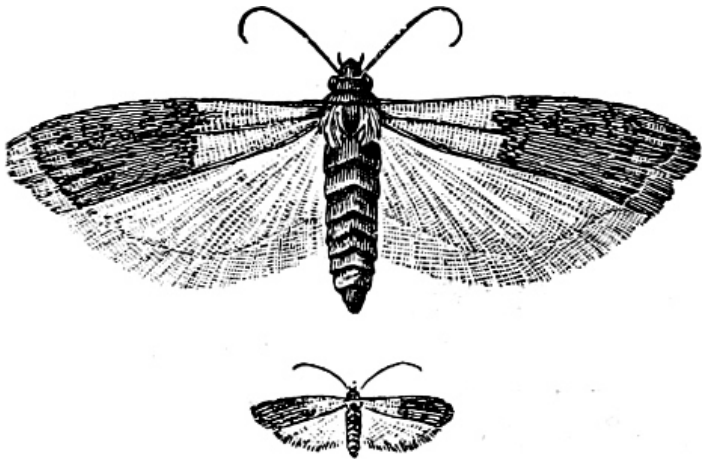


Fig. 145.—*Plodia interpunctella* (Hubner).

Order VII.—DIPTERA.

Flies.

House flies are well known to everyone; but as a number of other insects belonging to different orders are often called flies, such as “saw-flies,” which are Hymenoptera, and “lace-winged flies” and “May-flies,” which are Neuroptera, it is advisable to define them. Some of the Diptera might be mistaken by a casual observer for Hymenoptera which the members of several families often mimic in form and colouration, but they can be readily separated by the absence of a second pair of wings, which are represented by two little clubbed processes, known as balancers, poisers, or halteres. The mouth parts are very variable in structure in the different groups, but always adapted for piercing or sucking; the eyes are large, often occupying the greater part of the head and consisting of an immense number of fine facets; the small ocelli are three in number; and the antennae, except among midges, are short, composed of few joints, and often terminate in a bristle.

The thorax is not so distinctly divided into the three segments as in some other insects, nor the parts so well defined as in the hymenoptera; the wings, transparent or parchment-like, are seldom coloured; the legs, usually not thickened, are furnished with five tarsi, and well developed claws, with a small pad under each, known as the pulvillus. The abdomen is composed of a variable number of segments ranging from four to nine, but in the former case though not visible the terminal ones are probably absorbed into the anal tube at the extremity. Most diptera are

brown, black, or grey, though metallic tints predominate in some families; and are clothed with short scattered hairs or bristles.

The typical fly larva is an elongated legless maggot with the head portion slender, enclosing a pair of black retractile hooked jaws, with tracheae opening behind and running through to the broadened anal segment where they form small rosette-like processes round the external aperture. The eggs are laid in all kinds of decaying vegetable or animal matter, with the exception of the few that produce galls, or otherwise damage plant tissue; when full grown they change into a hard shell-like chrysalis, the tip of which is pushed off by the perfect fly when ready to emerge.

Though this country is very rich in Diptera and many cosmopolitan species have been introduced such as the house flies, they have been much neglected by Australian collectors and entomologists. The Diptera are divided into two large sections, which are further subdivided into four main groups, to which a fifth has been lately added for the reception of the fleas, which however are often placed by specialists in a class by themselves (*Siphonaptera*). The older writers subdivided them into about 70 families but latterly these have been reduced, and most of our species will come under about 30 families, of which I can only note our most striking representatives.

In 1830 the French naturalist Robineau Desvoidy published his “Essai sur les Myodaires,” in which some of our species were described. Between the years 1834 and 1835 Macquart brought out his “Histoire naturelle des Insectes Diptères” (forming part of the great French work Suites à Buffon),

followed (1838–42) by his "Diptères exotiques, nouveaux ou peu connus" comprising two volumes and many plates, with 5 supplements (1846–55). Walker between 1848 and 1855 compiled a "Catalogue of the Diptera of the British Museum" consisting of 7 volumes; and others are described in his "Diptera Saundersiana" 1856.

In 1864 Dr. Schiner estimated that the number of described Australian Diptera was 1056, including those which he described (Diptera des Novara), collected by Frauenfeld in the neighbourhood of Sydney during the visit of the Austrian Frigate. In a long series of papers reaching from 1859 till just before his death in 1892 Bigot described a great many species (among them some from Australia) chiefly in the Annales de la Societé Entomologique de France.

The only systematic Australian work is Skuse's "Monograph of the Australian Diptera" (Pro. Linn. Soc. N.S.W. 1888–90), which however was never completed, dealing only with the NEMATOCERA comprising the Culicidae, Tipulidae, Cecidomyidae and some of the smaller families. There is no complete catalogue of Australian Diptera, but I have been greatly assisted in my work on this family through the identification of my specimens by Mr. Coquillett of Washington.

Family 1. Gall-Gnats.

CECIDOMYIDAE.

This is an extensive family of small delicate midges with long slender antennae composed of many bead-like segments beautifully feathered with whorls of hairs. The abdomen is stout at the base,

short and tapering to the tip; the legs are long and slender without spurs; the wings are clothed with fine hairs that easily rub off, and furnished with very few longitudinal veins, and in some genera only one cross nervure.

They are known as “Gall-gnats,” or “Gall-flies,” and though the habits of the larvae are very diverse, some living under bark, others in animal matter, and a few predaceous or even cannibalistic in their habits, the majority of them are found in plant tissue and produce malformations or regular well defined galls, often of very remarkable structure, upon the foliage or twigs of their food plant.

The egg is deposited in or under the bark, epidermis of the leaf, or frequently in the flower buds of plants, the irritation caused by the active larvae producing the aborted tissue. These larvae are very easily recognised if examined with a lens after they have been extracted from the gall, as they are furnished with a “breast bone,” an anchor shaped process that stands out very distinctly in the centre of the ventral surface and is unknown in the larvae of any other gall-producing insect.

Through the discovery of Wagner, a Russian entomologist, that the larva of a Cecidomyia produced young; also through the curious exudations of the larvae and pupae of others which are sometimes called “flax seed” from their shape; and the very destructive habits of several species which damage the wheat, like the Hessian Fly in America, this family has received a great deal of attention. Over 1,000 species have been described from all parts of the world, and Australia is particularly rich in these insects. Skuse (Pro. Linn. Soc. N.S.W. 1888 and 1890) has described over 100 species and

figured some of the most peculiar galls.

Cecidomyia frauenfeldi was named by Dr. Schiner after the naturalist who collected the galls on *Leptospermum* in the vicinity of Manly, N.S. Wales. These galls are produced upon a leaf-bud and consist of a number of rounded leaf-like bracts, not unlike the petals of a rose bud; folding over each other, brown in colour, soft and loose, and about the shape and size of a small marble. The enfolded larva will be found in the base at the centre, and the gnats can be easily bred out in a glass jar. The Acacia Gall-gnat, *C. acaciae-longifoliae*, infests the flowers of this wattle, depositing its eggs in such numbers that every tiny seed-pod is produced into a contorted mass of finger-like tubes, together forming a rounded base attached by a stalk, and each tube containing a larva. This is one of our commonest species and the galls can often be collected in numbers in the neighbourhood of Sydney.

Diplosis frenelae produces very remarkable little light brown spherical structures upon the tips of the foliage of the desert cypress, about the size of small peas; these when mature split into four shell-like sections, quite unlike the usual gall. They are very abundant in the early summer upon cypresses in Wagga and the western pine scrubs of N.S. Wales. *Diplosis paralis* forms curious little blisters upon the young foliage of *Eucalyptus corymbosa*, dotting the leaves all over with reddish spots with a keyhole-like mark on the apex. A third species, *D. eucalypti*, aborts the young twigs of Eucalypts into gouty swellings in which a number of larvae feed and pupate.

There are certain red rounded shot-like galls of the Eucalyptus, generally several in number on the midrib of the leaf, which, on account of the pupal

skins always remaining in the holes in the sides of the galls through which the flies have escaped, can be easily distinguished from many very similar ones that are the work of micro-hymenoptera. These are formed by a large stout gnat named *Hormomyia omalanthi* by Skuse, who first obtained specimens from galls on the under side of the leaves of *Omalanthus populifolius*.

Lasioptera miscella aborts the leaf stalks of *Eucalyptus haemastoma*, one of our white stemmed gums growing about Botany, N.S.W., with its irregular swellings.

I have also bred several undetermined species from galls on the twigs of the Weeping Myall, *Acacia pendula*, and other wattles in the western scrubs. There is a rich field awaiting the naturalist who takes up the study of the life-history of our Gall-gnats.

Though the Hessian Fly, *Cecidomyia destructor*, is not known in Australia it has been introduced into New Zealand, and in the United States of America is one of the most serious pests that the wheat farmers have to fight. This gnat deposits her eggs under the sheath of the growing wheat stalks; the larva sucks up the sap, so that the ear is impoverished and no grain forms in the head; and when they are numerous the greater part of the crop is destroyed.

Family 2. Shade Midges.

MYCETOPHILIDAE.

These small flies, popularly known as “Midges,” are placed by Skuse in four well defined families, which I place under the one heading as their habits are very similar.

The SCIARIDAE are the typical "Shade midges" infesting forest country; their larvae live under dead bark or decomposing leaves and are slender, cylindrical, semi-translucent maggots, white or pale yellow in colour, with the body composed of 13 segments including the head. The perfect insects have moderately long, curved, many jointed antennae; two ocelli; long slender legs; and the wings often clouded. Skuse has described 42 species in this group, all of which with one exception he placed in the typical Genus *Sciara*; these have the wings longer than the abdomen, the surface of them microscopically pubescent, and the wing-lobes more or less developed.

The MYCETOPHILIDAE are popularly known as "Fungus-midges" from the fact that the larvae, which are slender white maggots attenuated at both extremities, and with horny heads, are often found feeding upon the juices of fungi; some spin silken webs under which they live, and a few are said to be luminous. They are small flies with beautifully marked wings in many species, and have slender antennae; 3 ocelli; and a short proboscis; the rather long legs have the coxae elongated and are furnished with spurs upon the tibiae; the wings, without a discoidal cell, have more veins than those of the Gall-gnats. Walker described 4 species (Insecta Saundersiana 1856); to which Skuse added 31 new species. *Lyomya setiosicaudata* was described by Skuse from the neighbourhood of Sydney in the Genus *Acrodicrania*, but it has an extended range: I have taken it with a sweeping net about Inverell N.S. Wales. It measures about ⅛ of an inch in length; has a shining head and thorax; abdomen black, and variegated black and yellow legs.

The SIMULIDAE contains a number of small Diptera abundant in Europe and America, where they are known as "Sand-flies," "Black-flies," or "Buffalo-gnats"; they swarm in the marshy lands of the Mississippi where Howard says, "They rival the mosquito in their blood-thirsty tendencies, and not only do they attack human-beings, but poultry and domestic animals are frequently killed by them." We are fortunate in having very few of these pests; only one species was discovered by Skuse, who named it *Simulium furiosum*, and says it is a rare fly only found in the Gosford district N.S. Wales. These flies must not be confounded with the midges known in Australia as "Sand-flies," which are very different insects belonging to the Genus *Ceratopogon*, of the Family Chironomidae.

The BIBIONIDAE are medium sized flies with thickset bodies somewhat hairy; smoky wings; robust legs; short antennae; and three ocelli. The females deposit their eggs in dung or vegetable matter, and the maggots have rows of transverse bristles on the segments; and traces of eyes can be found in the head segment. The perfect flies are sluggish in their movements and are commonly found upon flowers. Twelve species have been described from Australia, of which *Bibio imitator* is our commonest species; it is very abundant in the early summer upon the flower heads of *Astrotricha floccosa*, which grows in most of the valleys round Sydney; it has a wide range from Tasmania northwards in similar forest country. The male is under ½ an inch in length and is of a uniform black tint, with the thorax dull red; while the larger female is of a uniform reddish brown, and both sexes have the typical dark clouded wings.

The South American Genus *Plecia* is represented

by four species, two of which I collected in North Queensland. The North American Genus *Scatopse*, the larvae of which breed in all kinds of decaying matter and in sewers, is represented by two species, of which *Scatopse fenestralis* is so common about Sydney that Skuse says: "In the spring months it is scarcely possible to find a window without one or two specimens, while I have frequently seen hundreds swarming on the inside of shop windows in the city."

Family 3. Mosquitoes.

CULICIDAE.

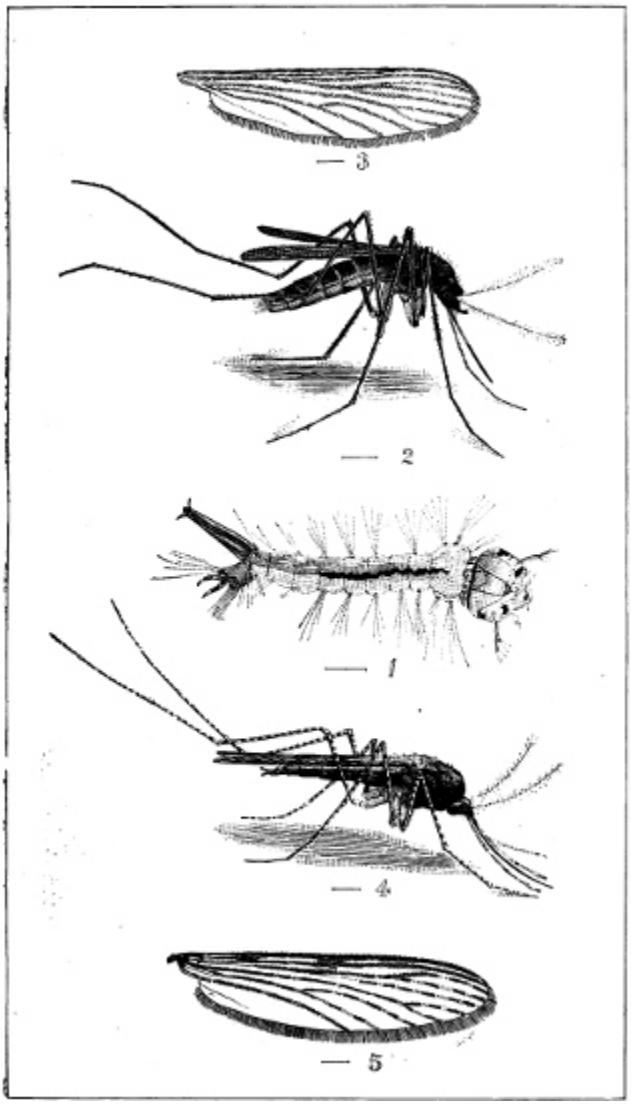
No insect pests are better known or more world wide in their distribution than mosquitoes. As might be expected, they are abundant in tropical countries, yet one would hardly expect them to be much of an annoyance in the temperate regions. Yet in Lapland, and even farther north, they worry the inhabitants and the reindeer all through their brief summer.

Plate XXVII.—DIPTERA.

Family CULCIIDAE.

1. *Culex fatigens* (Wiedermann). Larva.
2. *Culex fatigens* (Wiedermann). ♀.
3. *Culex fatigens* (Wiedermann). Wing.
4. *Anopheles annulipes* (Walker). ♀.
5. *Anopheles annulipes* (Walker). Wing.

Plate XXVII.—DIPTERA.



They are insects with long slender legs; delicate narrow wings folded down over an elongate body; the head is provided with a proboscis projecting below. The proboscis is adapted for sucking blood, though many of the bush species seldom or never

taste blood and obtain their nutriment from the sap or moisture upon plants. The male mosquito is a more delicate creature than the female, furnished with plumose antennae; he does not bite, but hides away in dark sheltered corners taking no food in his short life of four or five days, but has a low droning hum, noticeable when a number are disturbed. The larger females on the other hand swarm into the house, and bite whenever they get the chance. She lays her eggs in little boat shaped masses of elongate eggs, which within 24 hours give birth to larvae that are often called water-fleas or "wrigglers." Thread-like in form at first, the "wriggler" has a rounded ciliate head, and the tip of the body is provided with a pair of tubular breathing appendages. They move about with a series of jerks, always coming to the surface head downward; they increase in size rapidly and in seven or eight days are full grown, when they change into pupae, the creatures becoming quite different; the head and thorax are drawn up into a rounded mass with two trumpet shaped horns, which are its new breathing tubes, rising upon the sides. The abdominal segments are short and turn downward; and though it does wriggle slightly, it usually rests in an upright position floating close to the surface; it remains in this state for two or three days, when the pupal skin splits along the top of the head, and the perfect insect emerges, using the floating skin as a raft from which to rise into the air and fly away.

Only 9 species of mosquitoes had been described from Australia when Skuse commenced his work on these insects in the Macleay Museum Collections (Pro. Linn. Soc. N.S.W. 1889), where he listed all the known species and added 19 new ones. Since then Theobald, in his "Monograph of the Culicidae of the

World" 1900–1903, with a great deal more material to study, revised the genera, made several of Skuse's species synonymous, and described others, bringing our list to about 34 species.

The typical Genus *Culex* contains 21 species scattered all over Australia; several are cosmopolitan and have been introduced from abroad. Our common house mosquito, that appears in the early summer, is *Culex albo-annulatus*, a moderate sized species with the reddish thorax densely clothed with brownish golden scales, traversed by five very fine lines; it has regularly white banded legs. It was described by Macquart in 1732, and ranges from Southern Queensland to Sydney, Mittagong, and the Blue Mountains N.S.W. *Culex fatigans* is widely distributed over Australia: *C. macleayi* and *C. skusei* according to Theobald are only sub-species or varieties; it is one of the cosmopolitan mosquitoes also found in America, Africa and Asia, and was probably introduced into this country in the water tanks of the old sailing vessels many years ago. After New Year a smaller, darker mosquito is the most annoying about Sydney; this has been described by Theobald under the name of *Culex marinus*; its larvae were discovered by Dr. Bancroft, Queensland, breeding in salt water. It also flourishes freely in any stagnant water left in tanks, buckets, or water-holes, and has a wide range down our eastern coast.

Four species of the Genus *Anopheles* are found in Australia; these insects have long palpi with clubbed or spatulate tips, and dark spotted wings. *Anopheles annulipes*, described by Walker, said to be identical with Skuse's *A. musivus*, is found about Sydney and Newcastle N.S.W. ranging northward; the members of this genus are well known as the mosquitoes that

transmit the germs of malarial fever, and have a wide range over the world. The important results that have come from the study of the relation of tropical fevers to mosquito bites, have led to the collection and description of these insects from all quarters of the globe. *Mucidus alternans*, one of our largest species, is thickly clothed with grey and light brown scales and hairs which give it a striking appearance. It is a day flying species famous for its biting powers; it has a wide range; in the Maitland district N.S.W. about the Hexham swamps it is locally known as the "Hexham Grey"; in Queensland it is sometimes called the "Scotch Grey." I have also taken it at Bourke on the Darling River N.S.W. Skuse described this species as *Culex hispidosus*, but Westwood's name, *C. alternans*, has a prior claim.

Stegomyia notoscriptus is one of the small dark mosquitoes that bite so sharply just at dusk in our gardens around Sydney in midsummer, and has a wide range from Adelaide S.A. to Queensland. It belongs to the same genus as the dreaded Cuban Yellow-fever Mosquito, *Stegomyia fasciata*, which has been introduced into Hawaii. Theobald has in the last volume of his Monograph formed a new Genus *Skusea* for the reception of two Queensland species and a third from Africa.

Family 4. Sand-flies.

CHIRONOMIDAE.

This group comprises a number of small flies which have the head furnished with a fleshy proboscis; the slender antennae adorned with fine hairs, thickest upon the male; and the ocelli wanting. Their wings are usually narrow; and many of the

large species have the general appearance of mosquitoes.

The members of this family are very extensive and world-wide in their range; the larvae of the typical Genus *Chironomus* live chiefly in stagnant water. They sometimes swarm in such numbers in the North American lakes that they form the chief food of the fresh-water fish. In England on account of their colour they are known as "blood-worms." Some species live in salt water, and others breed in excrement and dung. The perfect insects are easily collected with a sweeping net in the vicinity of swamps and watercourses.

Skuse has described 64 species from Australia (Pro. Linn. Soc. N.S.W. 1889), previous to which only 8 species, described by Messrs. Walker and Macquart, had been recorded. The family is divided into a number of genera, of which *Chironomus* includes 21 species of the more typical slender-bodied midges, and the Genus *Ceratopogon* 17 species of our vicious "Sand-flies." These pests are also found in Great Britain and in North America, ranging as far south as Chili.

Ceratopogon molestes, described by Skuse, is our common "Sand-fly," though there are others probably quite as annoying if not so abundant. It is a tiny little dark coloured midge, so quiet and small that it is usually felt before it is seen. There is another very large grey "Sand-fly" I have met with in the interior of N.S. Wales on the Darling River that frequents grassy watercourses and flies straight at the hands or face like a wasp.

It has been reported from Central Queensland that after the great flood and abundant growth of grass (1905) the sand-flies increased in such numbers, that

they caused the blindness and death of a great number of marsupials, through biting them in the eyes.

Family 5. Crane-flies.

TIPULIDAE.

The Crane-flies or Daddy-longlegs are a large family with long slender legs, from which they take their popular names, and might be described as exaggerated mosquitoes that do not bite. They have the usual small head and long thread-like antennae (in some groups the latter are clothed with long hairs, in others short and feathered); in most species the ocelli are wanting. The thorax has a V-shaped transverse suture, and the well developed wings have a complete venation. They are to be found in all situations among low scrub, but prefer the shelter of cliffs, or tree trunks in damp gullies, often resting in considerable numbers in retired spots during the day, where they can easily be captured. They require to be killed and mounted in the place of capture to secure good specimens, as their legs drop off very readily, and on this account are not a popular group with the ordinary collector. The larvae live in the ground or among decaying vegetable matter.

They are divided into two large groups, characterised by the possession of long or short palpi, the *Tipulidae brevipalpi* and *Tipulidae longipalpi*; about 20 species had been recorded from Australia when Skuse's Monograph, "Diptera of Australia Pt. VII." (Pro. Linn. Soc. N.S.W. 1889) appeared; in this he added over 80 new species.

The Painted Crane-fly, *Gynoplistia bella*, described by Walker in 1835, is one of our commonest species,

frequenting flowers and low scrub in the early summer months. It is a very distinctly marked black and orange yellow fly, the wings thickly barred and mottled with the former colour; and is one of the short-legged species. It has a wide range from Western Australia and Tasmania to N.S. Wales; the genus is represented by 17 described species in Australia.

The Long-horned Crane-fly, *Macromastix costalis*, has a wide range from Tasmania to Queensland. In the neighbourhood of Sydney they are commonly found resting among the low scrub. It has a uniform dull brown tint with clear transparent wings, striped along the front margin with dull brown, and can be easily recognised from its large size, with the long slender antennae three times the length of the wings in the male, and its curious darting flight when disturbed. It was described by Swederus as *Tipula costalis* in 1787, and has been renamed half a dozen times since. *Clytocosmus helmsi* was described by Skuse from specimens obtained at Mt. Kosciusko; it is a large handsome fly with the stout thickened abdomen black, and bordered or mottled along the segments with white; the wings are semitransparent shaded with yellow; the head and thorax are reddish yellow.

The Genus *Semnotes* contains two very large and handsome crane-flies, both of which were originally described by Westwood. They are giants of the family, with a large thorax, and swollen abdomen narrowed slightly into a waist, coming out broad and rounded to the tip; the general colour is bright yellow mottled with black, with semitransparent wings. *Semnotes ducalis* has dark markings on the wing, and is the rarer species. It is recorded by

Westwood from North Australia, and by Skuse from Manly, N.S.W. *S. imperatoria* is found in Victoria, about Sydney and the Blue Mountains N.S.W.; it is slightly larger than the former, and can be easily distinguished by the very long tarsi, the plain wings, and the different markings on the body.

Family 6. Soldier Flies.

STRATIOMYIDAE.

These are flat-bodied flies with narrow strongly veined wings; 3-jointed antennae; and the pronotum furnished with slender spines. Comstock has called them "Soldier Flies" on account of the bright coloured stripes with which many species are marked. The larvae of most of these flies live in decaying vegetable matter, but some are known to be carnivorous in their habits.

Neoexaireta spinigera is one of our commonest species, often to be found in the early summer months resting on the window pane with its broad hind legs flattened out; it is very easily captured. It is a slender shining black fly about 1 inch in length, with banded legs; the sides of the body fringed with white hairs, and the apical half of the wings clouded with black enclosing a small white blotch; the pronotum is furnished with four slender spines standing out from the hind margin. The larvae are usually found under damp rotting bark or decaying vegetable matter, and are elongate flattened brownish and distinctly segmented creatures, with narrow horny heads standing out in front like a stalk; they are sluggish creatures with very little movement. I figured and described a species (doubtfully) under the name of *Ephippium albitarsis* in

my “Entomology of the Grass-trees” (Pro. Linn. Soc. N.S.W. 1896) with somewhat similar larvae breeding in the decaying stems of these trees. The little black fly measures about ⅓ of an inch in length; it has white tarsi and dusky wings; the pronotum has the usual short spine on either side; and the legs are stout. *Odontomyia stylata* is an elongate, broad, flattened, bronzy green fly with the outer edges of the abdomen light green; and the long pointed wings are folded down over the back; the head is very broad; the rounded thorax is long, furnished with two small spines behind the pronotum, and the abdomen is broadly rounded at the tip. It is a common rather large fly about ½ an inch in length, usually found resting on foliage in damp places. It has a wide range over Australia. In other parts of the world these flies are numerous, and about 1,000 species of the family have been described.

Family 7. March Flies.

TABANIDAE.

These flies are large or moderate sized insects, with broad heads furnished with a fleshy proboscis well adapted for biting; the 4-jointed antennae stand out in front of the head and do not terminate in a bristle; in the male the large eyes meet in front, but in the female are separated; the wings are large, often long, and well adapted for flight; the legs moderately stout; and the abdomen long, broad, and somewhat flattened.

They are common in the early summer months in open forest country, and are popularly known in Australia as “March Flies”; in England and America they usually go under the name of “Horse or Gad

Flies," and are a great pest to both man and horse; they are so persistent in their endeavours to bite and suck up blood that they are very easily captured with the hand.

The larvae of TABANIDAE live in damp earth, or are found in water; they are carnivorous, feeding upon larvae and pond snails. The flies deposit their eggs in bunches on herbage or low shrubs. These flies are very interesting from an economic point of view, for they are said to be sometimes responsible for outbreaks of anthrax by introducing the bacillus when biting. Some years ago an outbreak of malignant pustules on cattle in New Caledonia was said to have been traced to an undetermined species of *Pangonia* (Megnin and Germain, Bulletin Soc. Ent. France Vol. viii. ser. 5).

The Genus *Pangonia* is well represented in this country by many large handsome flies that differ from the typical *Tabanus* in having ocelli, and the third joint of the antennae elongate instead of compressed. *Pangonia guttata* was figured by Donovan in his "Insects of New Holland"; it measures over 1 inch in length, and is broad in proportion; its general colour is black, clothed with little tufts of white downy hairs fringing the thorax in front of the wings, and forming a band round the outer edge, with similar spots down the centre of the abdominal segments; the under-surface is variegated with longer white and black hairs, and the wings are clouded with black. This large handsome fly is common in the coastal forests, usually found resting on tree trunks in the heat of the day. *P. rufovittata* is a smaller more showy insect of a dull yellow colour. The eyes, parallel markings on the thorax, and broad transverse bands on the abdomen of black, the

alternate abdominal bands of beautiful golden hairs, together with the yellow clouded wings, give it a very striking appearance; it also has a wide range over Australia, and is occasionally taken in the neighbourhood of Sydney. *P. auriflus*, about ½ an inch in length, also black, has the face, front of thorax, under-surface and outer margins of the abdomen clothed with silvery hairs, while the hind margin of the thorax, a blotch in the centre, and the tip of the abdomen are richly coloured with bright yellow hairs. *P. concolor*, a much larger fly, is of a uniform reddish brown colour, with black eyes, and mottled wings; *P. violacea* is a small bright metallic violet tinted insect not unlike a blue bottle fly, but is easily distinguished when the antennae are examined.

The Genus *Tabanus* contains many of the typical "March Flies": *Tabanus brevidentatus* measures ½ an inch in length; is of a uniform grey ash colour, with the hind edges of the abdominal segments barred with light brown. *T. edentulus* is a slightly larger, darker coloured fly with greyer bands on the body; it is common on the slopes of Mt. Kosciusko. *T. abstersus* is still larger and darker, but with the same general colour; the head and under-surface are clothed with white hairs; the wings clouded; the base and sides of the abdomen reddish brown with the dorsal surface barred with fine white hairs. *T. sanguinarius*, one of the largest species, is of a uniform reddish brown, with black eyes; the thorax tinted with yellow; and the wings clouded. It has a wide range over Queensland and N.S. Wales. *Silvius angusta* is like a very small specimen of *Tabanus brevidentatus*.

The members of the small Family LEPTIDAE are

distinguished from the preceding one, in having the third joint of the antennae simple and furnished with a bristle, and the tibiae spined. The curious looking larvae have the abdomen divided into two points at the tip; they live in pits like the ant-lions. *Leptis aequalis* is a greyish looking species about the size of a house fly, with the head composed of two large globular eyes touching in the centre; the legs are long; the wings smoky; the elongated abdomen rounded at the tip, and barred with black; the whole insect clothed with scattered hairs standing up thickly on the dorsal surface. These flies are very common flying over aphis infested wheat fields; my specimens come from Molong, N.S. Wales.

Family 8. Bee-flies.

BOMBYLIDAE.

These are popularly known as bee-flies, on account of their remarkable powers of flight, and hairy appearance. They are all more or less clothed with delicate downy hairs, furnished with 3 jointed antennae, and slender legs terminating in fine claws.

They frequent flowers, hovering over them like bees; and many species have the wings richly marked with black. The life history of our species is but little known, but I have bred several out of the clay nests of wasps, and two out of lepidopterous pupae (*Agrotis sp.*). A European species is said to drop her eggs upon the clay nests of wasps; the newly hatched larva is furnished with a boring apparatus in front of its head by means of which it works its way through into the chamber; there it undergoes another stage of development and emerges from it with a simple sucking mouth to eat up the wasp larva. The larva of

those attacking the "cut-worms," *Agrotis*, devours the whole of the moth grub and pupates inside the chrysalid skin. The pupa is a very curious looking creature enclosed in a dark brown shining skin about ¾ of an inch long, with projecting spines on the head and extremity. The body is cylindrical with the first 7 segments furnished with a band of rasp-like spines or ridges on the dorsal surface, with which it moves round and round when touched. *Anthrax nigricosta* is a handsome little black fly, with the head, under surface of the body, and two bands across the abdomen fringed with white down. The wings are deeply marked with black on the front margin, widest at the base. It measures about ½ an inch in length, and comes from Queensland. *Comptosia albo-fasciata* is a large black fly shaded with fine reddish hairs on the dorsal surface of the body; the wings are brown, very long, with white tips; the body measures about ¾, and across the outspread wings 1½ inches. *Neuria quadripennis* is a much smaller, but somewhat similar looking fly, with the dorsal surface and margins of the body more hairy; each wing is darkly clouded, with the base light, and the tip white. Both these species are not uncommon in New South Wales.

Acreotrichus gibbicornis is a beautiful little black fly with brown eyes; not much over ¼ of an inch long; the elongate antennae and head are clothed with tufts of black and white down; the rest of the body is enveloped in long silvery white down. *A. fuscicornis* is of a rich violet black tint, a yellow line round the hind margin of the head, and a broader band round the dorsal margin of the thorax of a similar colour; the broad rounded abdomen is lightly banded with pubescence. These flies were taken in numbers hovering over the flowers of plum-trees in an

orchard near Sydney.

Family 9. Bladder Flies.
ACROCERIDAE.

These are very curious looking flies with such very small round heads, that at first sight one would think that they were broken off; but on closer examination the little knobs in front will be found to consist of two large eyes joining together on the inner edge, with small, 2 or 3 jointed antennae. Nothing is known about the larval habits of our species, but in Europe they are parasitic on spiders or their cocoons.

The members of the Genus *Pterodontia* have the body inflated like a bladder; we have several species in Australia, generally found resting on twigs or tree trunks. *Pterodontia mellii* measures under ½ an inch in length; the thorax and body are swollen out like a bladder; it is of a general black colour, with a mark on the back, the fore legs, and a large blotch on either side of the body bright ochreous yellow; but the dark portions are thickly clothed with fine black downy hairs like a bumble bee. The wings on account of the swollen body look much smaller than they really are. I have specimens from Queensland, and Hunter River N.S.W., and they probably have a wide range.

Panops flavipes is a very curious looking fly from Moruya, N.S. Wales, measuring over ½ an inch in length; it is of a general dark bronzy black tint thickly clothed with fine down, silvery on the tip of the abdomen. The head is very small, black and shining, with the thickened cylindrical antennae standing out in front; the thorax, swollen out behind the head, has a large angular white patch on either

side; the abdomen not quite as thick as the thorax is deeply corrugated. The wings have the front half deeply clouded and the hind portion transparent.

Acrodes fumatus is a much smaller species about ⅕ of an inch in length; the head and thorax are black; the bladder shaped abdomen is tawny yellow, with parallel stripes of black down the centre and sides, and transverse white bars at the apex of each segment. They were collected in numbers about Cook's River, near Sydney.

Family 10. Mydas Flies.

MYDAIDAE.

These might be called "mimic flies," because, with their large thickened antennae (often swollen out into a compressed club at the tips), their broad heads, elongated bodies, and bright variegated black and yellow markings, they can be very easily mistaken at first sight for Pompilid wasps. The mimicry is further emphasised by the thickened spined legs, and coloured wings.

We have a number of species in Australia; they are allied to the "Robber-flies" which some of them resemble. The larvae of foreign species are predaceous, feeding upon the grubs of various wood-boring beetles.

Mydas fulvipennis has the greater part of the head, thorax, under surface of the abdomen, and thighs black; with the face, antennae, legs, wings and rest of the abdomen except two indistinct narrow bars, bright reddish yellow. It measures over ¾ of an inch in length, and is of the usual elongate robust form with long clubbed antennae and thickened legs. My specimens come from Southern Queensland.

Plate XXVIII.—DIPTERA.

Family MUSCIDAE.

1. *Chaetogaster violacea* (Macq.).

Family TABANIDAE.

2. *Pangonia guttata* (Donov.).
6. *Pangonia auriflus* (Donov.).
14. *Tabanus abstersus* (Walk.).
7. *Lamprogaster laeta* (Guérin).

Family ASILIDAE.

3. *Asilis grandis* (Macq.).
8. *Craspedia coriaria* (Wied.).
12. *Phellus glaucus* (Walk.).
13. *Blepharotes splendissima* (Wied.).

Family DIOPSIDAE.

4. *Zygotricha sp.*

Family BOMBYLIDAE.

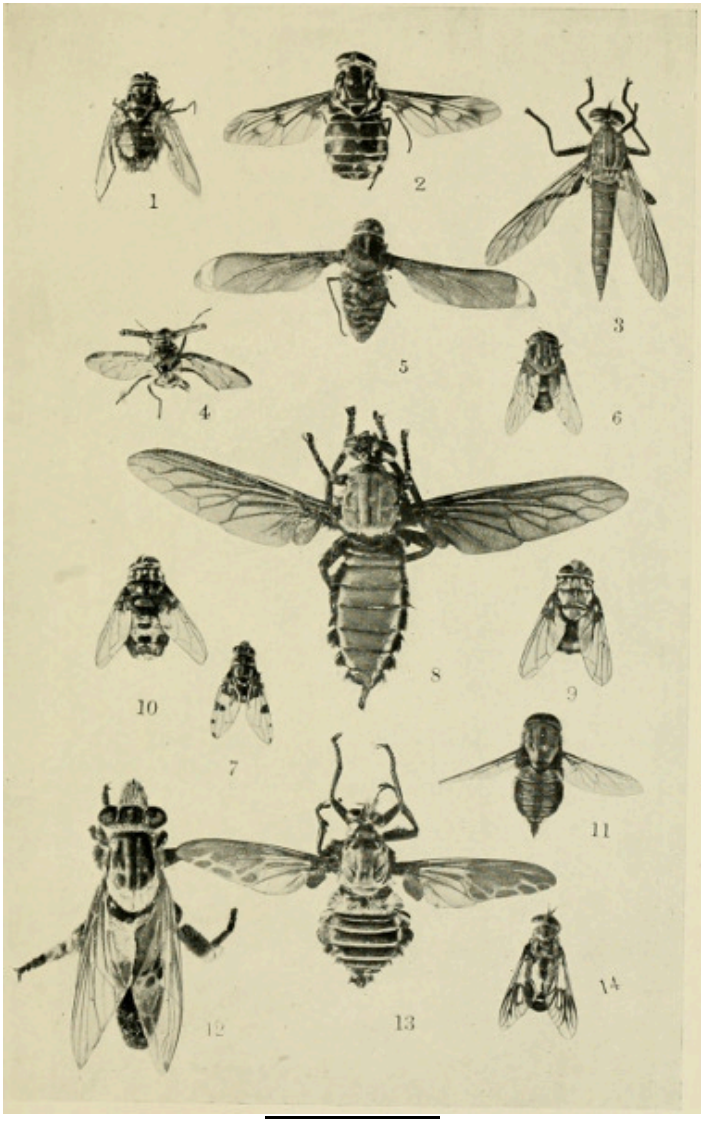
5. *Comptosia albo-fasciata* (Thomp.).
11. *Trichophthalma eques* (Sch.).

Family DEXIIDAE.

9. *Rutilia decora* (Guérin).
10. *Amphibolia fulvipes* (Guérin).

(Original photo. Burton.)]

Plate XXVIII.—DIPTERA.



Family 11. Robber-flies.

ASILIDAE.

This group is well represented in Australia by

some very large handsome robber-flies which attack and kill many insects larger than themselves, transfixing them with their horny bayonet-like proboscis. The large projecting eyes forming the greater part of the head are well separated from the thorax; the three jointed antennae stand out at an angle from each other; the legs are long, stout, and covered with stiff hairs well adapted for holding their prey; they have more or less clouded wings; and a slender, rather cylindrical body tapers to a blunt tip in the female, but in the male terminates in a pair of pincer-like processes. It is an extensive family, over 3,000 species being described from all parts of the world; they are very numerous in America, where one is a very serious pest to honey bees. Their larvae live in the ground and are predaceous, feeding upon the larvae of other insects, particularly those of beetles.

The members of the Genus *Dasypogon* are small delicate flies that cling to grass stalks, and are easily taken with a sweeping net; they have the typical form of the family, and their slender bodies taper to a point. *Laphria diversipes* is a common insect about Sydney often taken on fences; it is slightly over ½ an inch in length; its general colour is black, with stout reddish brown legs variegated with black. The head is clothed with stiff grey hairs, the upper surface mottled with golden pubescence, and scattered black hairs. *Laphria rufifemorata* is a somewhat large insect from Queensland, with the abdomen of a deep metallic blue. *Leptogaster geniculatus* is a remarkably slender bodied fly, about the same length, found about the Blue Mountains N.S.W. The head is short but wide across; the thorax is oval, and the linear abdomen swells out slightly to the apex; the legs are long and slender, the hind pair with the thighs

swollen in the centre. The general colour is shining black with the legs marked with white.

The typical Genus *Asilis* contains some handsome flies generally met with in open forest country: *Asilis inglorius*, over 1 inch in length, has large black eyes; the front of the head is clothed with grey bristles; the thorax is olive green, marbled with grey pubescence, thickest on the ventral surface; the legs are red, the tarsi black; and the wings are clouded with yellow; the abdomen is much elongated to the pointed tip, reddish brown, the first 3 segments thickly clothed with long, pale, golden, downy hairs, and with the terminal segments covered with very short reddish brown hairs. *A. plicatus* is slightly larger, of a general greyish brown tint, with pale reddish brown markings on the thorax; the legs are darker brown; the abdomen is lightly clothed with fine scattered grey hairs. *A. fulvitarsus* is a much smaller species of a somewhat uniform buff tint, inclined to a golden tint on the lower portion of the abdomen; the face is clothed with grey and buff hairs, and the wings are light brown.

Blepharotes splendidissma is a very handsome fly with the abdomen flattened, broad, and almost heart shaped; it measures nearly 1½ inches in length, and 2½ across the outspread wings. It is of a general black colour with the abdomen of a shining bronzy green tint; the face is clothed with yellow bristles; the thorax has grey pubescence on the sides, and the outer margins and tip of abdomen are fringed with tufts of yellow and black downy hairs. I have frequently captured it flying about in the Botanic Gardens, Sydney, in the early summer. *Phellus glaucus* is a very curious fly found in the interior of Western Australia; it measures nearly 2 inches from the front

of the head to the tip of the wings; a great tuft of bright yellow hairs stand out in front of the head; it is thickly clothed on the under-surface of the head with pale yellow hairs; the legs are very stout and hairy, and clothed with black down marked with white and large yellow tufts on the hind legs. The abdomen is thickened, elongated and broadly rounded to the tip, of a uniform deep metallic blue tint, but so thickly clothed with short black down that its rich colour is somewhat obscured. *Craspedia coriaria* is one of our largest robber-flies, widely distributed all over the interior of the continent; its mouth is produced into a stout pointed awl-like process, with which it can pierce the integument of the stoutest insect, and it can be often seen flying along with its beak buried in the back of a large cockchafer beetle (*Anoplognathus*), and with its large legs clasping its victim as it sucks up its blood. Its general colour is black, with the broad, flattened, more elongate abdomen thickly clothed with short brick-red hairs; the legs and under surface are very hairy, with tufts of stiff black hairs fringing the outer edges of the abdominal segments. The wings are opaque and almost black, with an expanse of about 3 inches.

Saropogon princeps, described by Macquart, has a large reddish brown wasp-like form that at first sight might be easily mistaken for a Pompilid wasp. It measures 1½ inches in length, with a wing expanse of about 3 inches. The head, under-surface, centre of the thorax above, the basal segment, and two bands on the abdomen are black; the rest is dull red, with the hind margin of the wings hyaline. I have a specimen from Mittagong N.S. Wales. *Brachyrhopala ruficornis* comes from Mackay, Queensland, and has a very wasp-like appearance both in the colouration

and shape of the body. It is under ½ an inch in length with the typical robber-fly head and spiny legs, but the abdomen is contracted into a cylindrical waist behind the thorax, rounded in the centre, and tapered to the tip. The head and thorax are almost black; the hind margin of the latter and legs are dull red; the abdomen is dull yellow with the basal segments marked with blackish brown, forming two almost confluent bands round the broad centre.

Family 12. False Robber-flies.

APIOCERIDAE.

These flies are of medium size not unlike *Muscidae*, with large elongated bodies, short antennae, and clear wings. This is a small family containing two genera, the species of which are peculiar to North America, Chili, and Australia.

Apiocera bigotii, described by Macquart, is about ¾ of an inch in length; it has a short head not so wide as the thorax, with a long projecting proboscis; the elongate broadly rounded thorax is truncated behind; the abdomen is broadest in front, rounded, and tapers to the tip, which terminates in a tuft of fine spines. The wings are somewhat iridescent with reddish veins; the general colour of the fly is a dull brown, with white hairs and silvery pubescence clothing the hind portion of the head and under-surface of the thorax, and also mottling the dorsal surface of the body with grey. Some specimens in my possession come from the Shoalhaven district. *Apiocera asilica* described by Westwood is a larger much darker insect, with black hairs on the upper surface and grey on the under surface; it ranges from Queensland to the Blue Mountains N.S.W.

Family 13. Big-eyed Flies.

PIPUNCULIDAE.

These are tiny little creatures with very large heads consisting almost entirely of two great hemispherical eyes. The short antenna terminates in a bristle.

About 80 species had been described, chiefly from Europe, until Perkins published the descriptions of 26 species from Australia (Leaf Hoppers and their natural enemies Pt. iv. Pipunculidae) Hawaii 1905.

They are remarkable for their habits in the larval state, being parasitic upon the larvae and pupae of frog-hoppers, chiefly Jassidae, particularly those Homoptera that have the tip of the abdomen clothed with waxy filaments. When full grown the dipterous larvae leave their host and bury themselves in the soil, where they pupate. Mr. Koebele allowed me to examine the collection he made of these little flies before they were described by Mr. Perkins. Many of these he reared from infested frog-hoppers in Queensland when studying sugar-cane pests.

Pipunculus helluo was observed swarming round the larvae of *Siphanta*, which were abundant on fig trees near Bundaberg Queensland; this species was also taken by Koebele near Sydney. *P. cinerascens* is remarkable in the larval form, as it does not fall to the ground and pupate in the soil, but forms its puparium upon the surface of the living leaves in the open. *P. cruciator* comes from the district of Cairns, N. Queensland.

Family 14. Hover Flies.

SYRPHIDAE.

Several species are well known and common in gardens, where they are popularly known under the name of “Bee” or “Hover Flies” from a way they have of poising, apparently motionless, over flowers and aphid-infested bushes, for the movement of their wings is so rapid as scarcely to be detected. The perfect flies, which among the carnivorous species have slender bodies more or less barred or banded with yellow, lay their eggs upon aphis-infested plants; the young larvae emerging from the white eggs feed exclusively upon aphids and plant lice; the full-grown larva is legless, very elongate in form, and has great powers for extending and contracting its abdominal segments, so that the body, from a rounded mass, can extend into a long and slender form. The full-grown larva pupates in an oval hard chrysalid which usually falls to the ground.

The typical Genus *Syrphus* is well represented in Australia by several fine species, all of which are aphid eaters, and fly about in the bright sunshine but shelter among the foliage at other times; whenever aphis appear the syrphid flies soon follow, and I have seen them round the aphid-infested briar bushes in countless thousands. *Syrphus pusillus*, figured in the Agricultural Gazette N.S.W. 1904 under the name of *Syrphus viridiceps*, is our commonest species found upon aphis-infested rose bushes, orchard trees, and wheat fields. It measures about ⅓ of an inch in length; has large reddish eyes, yellow face, and dull metallic green thorax with yellow scutellum; the darker abdomen is banded with three interrupted transverse yellow bands, and smaller marks on the apical segments. *S. viridiceps* is a more slender form, with a green face; the whole of the thorax is shining lead colour, with fine yellow bands on the abdomen; the legs are dark, and the whole fly is lightly clothed

with fine hairs. Both these species may be taken on the same bush, and both have a very wide range over Australia.

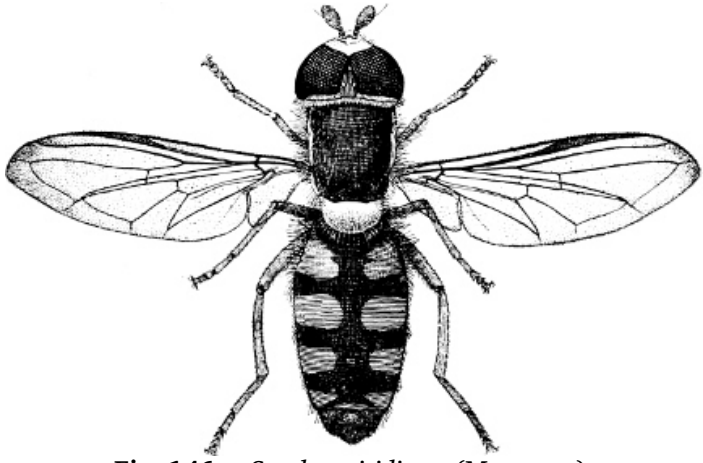


Fig. 146.—*Syrphus viridiceps* (Macquart).

A common Hover-fly that destroys rose and peach aphis.

("Agricultural Gazette," N.S.W.)

The Drone or Bee Fly, *Eristalis tenax*, is another common garden fly with a very wide range, and is an introduced European species. It measures over ½ an inch in length and is broad in proportion; the head and thorax are clothed with yellowish brown down, and the smooth shining abdomen is mottled with black and brown. The larvae are dirty white maggots with slender rat-tails at the tip of the body, and they live in all kinds of rotten or semi-liquid refuse.

Helophilus bengalensis is a smaller, robust fly with rounded eyes; the thorax is richly barred with parallel grey lines on the dorsal surface; and there are two large lunate yellow spots at the basal portion of the abdomen. The lower part of the abdomen tapers to a rounded tip and is clothed with yellow down. This fly was originally described from Bengal

by Wiedemann; Schiner has reported it from Batavia; my specimens come from Queensland. *H. griseus* was described and its life history given in my "Entomology of the Grass-trees" (Pro. Linn. Soc. N.S.W. 1896) under the name of *Orthoprosopa nigra*. The larvae, elongate in form, with a short anal tubular tail, swarm in great numbers between the outer shell and the caudex of the dead rotting trunk of the grass-trees among the slime and water. They pupate in the damp earth in captivity, forming a light brown oval case with the remains of the larval tail shortened and retracted. This handsome black fly, over ½ an inch in length, has the face and antennae bright yellow; the dorsal surface clothed with fine black pubescence; the scutellum smooth and shining; the sides fringed with scattered grey hairs; and the wings clouded. There is a second species found in similar situations; the larvae have the typical slender rat-tails, and when they pupate transform the tail into a curved tubular process at the extremity of the chrysalis.



Fig. 147.—*Eristalis tenax* (Linn.).

The Drone or Bee-fly; usually found upon flowers.

("Agricultural Gazette," N.S.W.)

Sphiximorpha australis, from Southern Queensland, is a very curious broad thickset black and yellow fly, with spatulate tipped antennae standing out in front of the two large eyes; the head is slightly larger than the thorax, which is stout and thickened; and the broad abdomen is rounded at the extremity. The general colour is black, with the face, three spots on the sides of the thorax, scutellum, apical portion of legs, and two bands on the abdomen rich yellow. The wings are clear, except a dark stripe along the front margin. This curious fly has a striking resemblance to some of the yellow banded mud-nest wasps (*Odynerus* and *Alastor*), but the reason for their bright colouration and abnormal shape is at present unknown.

Family 15. Wasp-flies.

CONOPIDAE.

These are handsome flies of moderate size, many of which are very wasp-like in the shape of the abdomen and in general colouration; they have the proboscis prolonged but usually drawn up and hidden; the 3-jointed antennae inserted in front of the head are close together at the base, with the first joint very short. Comstock says that the larva of *Conops* is a soft whitish 11-jointed flask-shaped grub, with a long neck and mouth armed with lips and hooks (mandibles) and two lateral elevated plates supporting the two spiracles. It was found by Lachat and Audouin living in the body of a *Bombus*. Most of the members of this family are found as parasites upon different bees and wasps; the flies deposit their

eggs upon the perfect insects; the larva bores into the abdomen, feeds upon the contents, and finally pupates in the shell of the body. They are considered by most writers to be allied to the *Syrphidae*.

This is a small family in regard to numbers of species, but they are widely distributed: Van der Wulp lists 14 species of the Genus *Conops* from South Asia, including the Malay Archipelago (Cat. Described Diptera 1896), and others have since been described.

Conops pica, described by Macquart from Australia, is found in the Mittagong district, N.S.W. It is slightly over ¼ of an inch in length; has large lance-tipped antennae standing out in front; a large head; the abdomen very slender at the base swelling out to a broadly rounded tip, giving it a striking resemblance to the small "mud-nest wasps." This resemblance is further borne out by its general dark brown colour marked and banded with yellow, which upon the abdomen forms two broad bands, a spot on the sides, and a large rounded blotch on the extreme tip; the legs are banded, and the wings are striped in front with brown.

Family 16. Fruit Flies, Leaf Mining Flies, &c.

MUSCIDAE ACALYPTRATA.

Under this heading Sharp places a large division of closely related flies comprising 29 families, which he treats in a very brief manner; we have a large number of interesting species in some of these families that are worthy of notice, for some of them are very serious pests to the gardener and orchardist. Sharp says: "Taken collectively, they may be defined as small flies with 3-jointed antennae (frequently

looking as if only 2-jointed) bearing a bristle that is not terminally placed; frequently either destitute of squamae or hairy, these imperfectly developed so as not to cover the halteres; and possessing a comparatively simple system of neuration, the chief nervures being straight, so that consequently few cells are formed."

The DIOPSIDAE comprise in the typical Genus *Diopsis* some very curious looking flies, rather slender in form, with narrow wings, and the sides of the head produced into an elongate stalk, at the tip of which is placed the rounded eye, reminding one of the stalk-eyed crabs. Westwood monographed this genus in the Transactions of the Linnean Society 1835, where he figured and described 21 species from Africa, India and Java. I have two very fine species from North Queensland, belonging to the Genus *Zygotricha*, and a number of allied forms placed in the Genus *Achias* by Van der Wulp (Catalogue of the Described Diptera from South Asia 1896) recorded from New Guinea. The Stalk-eyed fly, *Zygotricha sp.*, measures nearly ½ an inch in length, with the eyes measuring over ¼ of an inch from tip to tip; its general colour is yellowish brown, the face bright yellow; eyes black; thorax finely striped with grey; wings mottled; the curious angulated abdomen shining with metallic tints, and tipped with stout hairs.

The cosmopolitan "Skipper" in cheese, is the larva of *Piophila casei*; it pupates in a slender dark chrysalid; the small slender dark fly swarms round over-ripe cheese, fat, and other dried foods.

The little "Fruit Flies" belonging to the DROSOPHILIDAE, sometimes also known as "wine flies" from their habit of swarming round the freshly-

filled wine casks, lay their eggs in decaying vegetable matter; they are often attracted to over-ripe fruit, and by their presence sometimes cause it to decay; they are common all over the world. The maggots sometimes found among pickles in vinegar and brine belong to flies of this group. *Drosophila obscura*, a tiny light brown fly with a dark coloured head, breeds in damaged tomatoes.

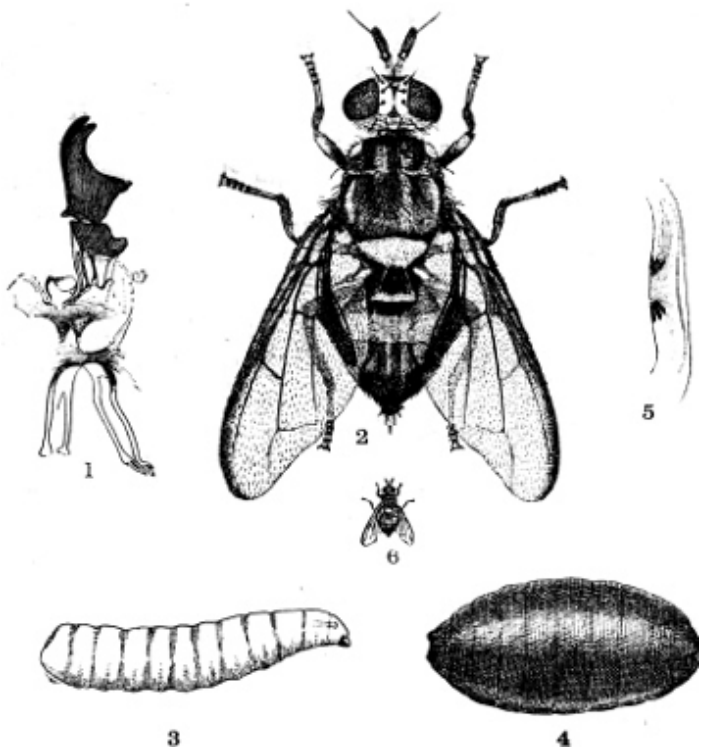


Fig. 148.—*Dacus (Tephritis) tryoni* (Froggatt). The Queensland Fruit Fly.

1. Showing the jaws of the larva; 2. adult fly enlarged; 3. larva; 4. chrysalid; 5. tip of the abdomen showing the breathing orifices; 6. fly natural size.

The TRYPETIDAE comprise the true “fruit flies,”

many of them very handsome little creatures; some of them form regular galls in the twigs of plants; others with their needle-like ovipositors puncture the ripening fruit, depositing their eggs beneath the skin; the maggots cause the fruit to rot, often before it can be gathered, and thus do a great deal of damage in Australian orchards. The Queensland Fruit-fly, *Dacus (Tephritis) tryoni*, ranges from Queensland (where it probably originally infested native bush fruits) into N.S. Wales, and is now a serious orchard pest in both States. It is a dull brown insect marked with yellow, about the size of a large house fly, with a rather wasp-shaped body, and large transparent wings. I have described several other allied species coming into Australia from the Islands in damaged fruit, "Notes on Fruit-maggot Flies with Descriptions of New Species" (Agr. Gazette N.S. Wales 1899). *Dacus (Tephritis) psidii* was bred out of guavas imported from New Caledonia; it is about ¼ of an inch in length; is dull yellow, with the thorax distinctly striped, and the abdomen black; the transparent wings are thickly mottled with brown. Tryon says that it is a common fruit-fly pest in Queensland, damaging bananas and other fruits. *Trypeta musae* was obtained from bananas brought from the New Hebrides: it is a slightly larger fly, with the head and thorax dull yellow; it has no distinct dorsal stripe on the thorax, and the wings are very thickly mottled. *T. bicolor* is a larger native species with reddish brown head and thorax; with black body; with beautifully mottled black wings having the base and sides unclouded. I have taken it on the trunks of wattle trees near Bathurst, N.S. Wales. The "Mediterranean Fruit Fly," *Ceratitis (Halterophora) capitata*, first recorded from oranges brought from the Azores to London, was described by Macleay in 1826; it has a

wide range, and was introduced into New South Wales some years ago; it is now one of the most serious pests that orchardists have to fight. It is a smaller more thickset fly than the Queensland pest, with the thorax dark metallic brown, and the wings richly variegated. The male is remarkable in having a pair of spatulate hairs, like a second pair of antennae, springing out in front between the eyes. *Trypeta poenia* is a tiny little fly with a grey pubescence over the thorax and abdomen; the thorax is finely mottled, and the delicate wings are very finely but thickly marked with dark brown; I have taken this species when beating the low scrub in the western country round Condobolin, N.S. Wales. *Lonchaea splendida* is a very brilliant metallic green fly with pale smoky wings; it is smaller than a house fly, with a much more elongated body; its larvae infest decaying tomatoes, potatoes, egg-fruit and other solanums; it has a wide range from the Pacific Islands and New Zealand, over Australia.

The family ORTALIDAE is represented here by a very handsome species, *Ortalis coerulea*; it is about the size of a house fly, with deep metallic blue thorax and banded black abdomen; the transparent wing is clouded with black at the base and the tip, and has a black V-shaped band in the centre. It is very common in summer usually resting on the foliage of the grass-trees, and can be easily captured with a net. *Lamprogaster laeta* is another fine species, with a wide range from Victoria to Queensland. It measures nearly ½ an inch from the front of the head to the tip of the body; the large semitransparent wings are blotched along the front with black. The dorsal surface and curious angular abdomen are deep metallic blue; the legs and under-surface reddish brown. I have usually found it on the highlands, and

it is common on the Blue Mountains N.S.W. in the summer months.

The AGROMYZIDAE are small yellow flies, sometimes marked with green; they puncture the tissue of plants and cause excrescences and galls upon the foliage and flower buds. One tiny species, *Agromyza sp.*, attacks the midrib of the leaves of the "Blood-wood" (*Eucalyptus corymbosa*), common about Sydney; producing soft yellow spongy excrescences aborting all the young foliage. *A. phaseoli* is a great pest to the growers of french beans in the Gosford district N.S.W.; the fly inserts her eggs in the stem of the young plant just above the surface of the ground. It is a tiny black fly, with bluish tints on the body. It was described by Coquillett (Pro. Linn. Soc. N.S.W. 1899) from specimens I sent to him for identification.

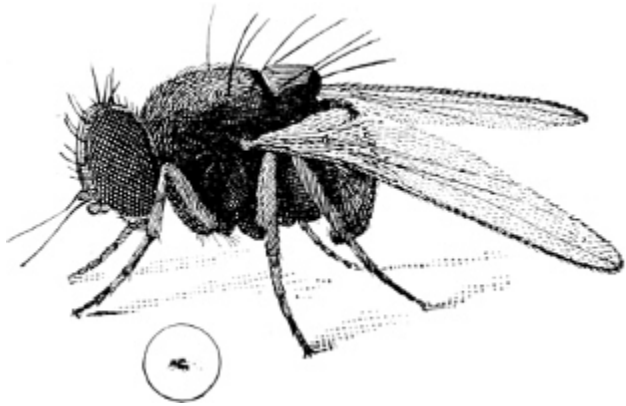


Fig. 149.—*Agromyza phaseoli* (Coquillett).

The French-bean fly, the larva of which feeds on the stems.

("Agricultural Gazette," N.S.W.)

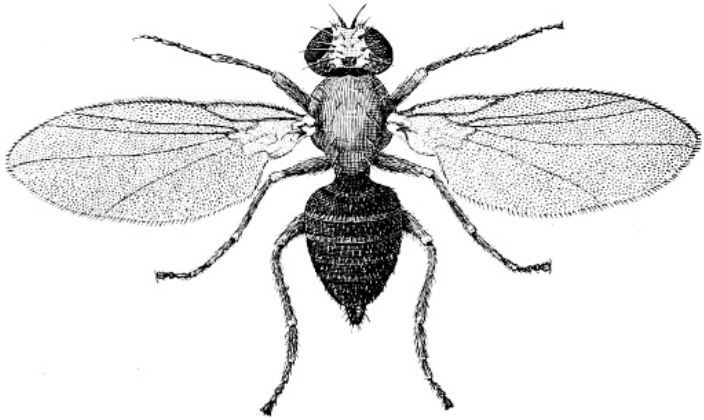


Fig. 150.—*Phytomyza affinis* (Fallen).

An introduced Leaf-mining fly, and a common garden pest.

("Agricultural Gazette," N.S.W.)

The PHYTOMYZIDAE are small dark coloured flies, whose larvae are leaf miners; and several species are well known pests to the gardener. *Phytomyza affinis* breeds in the winter in the leaves of the sow thistle; the next generation swarm on the marguerites, sunflowers and many others of the *Compositae*, thereby causing them to wither and fall.

The SAPROMYZIDAE contain a great number of small flies which are generally met with resting among the foliage when sweeping or beating the scrub in the early morning. They seldom have the wings spotted, and the abdomen is broader than that of the former group. The larvae feed under the bark of trees, or among decaying vegetation. *Sapromyza fuscicornis* is of a uniform pale brownish yellow, with dark eyes, and with scattered stout bristles on the thorax; it is a large species over ¼ of an inch in length to the tip of the closed wings. It has a wide range over Australia. *S. decora* is a very much smaller dark brown fly, with a fine white stripe on each side

of the thorax extending across the sides of the head above the eyes. It is common in summer in the orchards among the orange trees.

In the members of the Genus *Celyphus* the scutellum is so abnormally inflated that it covers all the posterior parts of the body, so that these tiny shining black creatures are quite unlike the typical Diptera. A dark brown fly about the size of a house fly that has been described under the name of *Batrachomyia nigritarsis* by Skuse, is a parasite in the larval state on the back of several of our common frogs, where feeding under the skin it forms a regular blister; when full grown the larva makes its way through the skin, and pupates in the damp soil.

The SCATOPHAGIDAE are slender, elongate, medium sized flies that can be bred out of dung or decaying vegetable matter, and are found in most parts of the world. *Scatophaga guerini* measures over ⅓ of an inch in length; it is of a dull greyish brown tint, marked on the head and thorax with parallel whitish bars, thickly clothed on the stout legs with fine hairs; and the long wings are folded over the back when at rest. It has a wide range; I have it from Sydney, and have bred it from the cylindrical white maggots in "toad-stools" collected on the banks of the Darling River, N.S. Wales.

The Genus *Nerius* (placed by Van der Wulp in the Sub-family CALOBATINAE, following the SCIOMYZINAE) is represented by two fine species common in North Queensland. They are very slender, long-legged flies, with long, straight-veined wings, rounded at the extremities, and folded over the narrow pointed abdomen; the head, which has a distinct neck, might be described as pear-shaped, with short, stout, lance-shaped antennae standing out

in front, and elongate flattened eyes with a dorsal depression between them; the abdomen is elongate, oval; and both species, about the same size, measure ½ an inch in length. *Nerius inermis*, "the Banana-stalk Fly," is of a uniform dull brown colour, with the dorsal surface of the head and thorax striped with white, and the whole of the under surface and thighs (except a brown comma-like mark on the sides) white. The slender white maggots feed in the ends of the decaying stalks of the bunches of Queensland bananas, forming elongate reddish brown chrysalids when they pupate; they are easily bred out in captivity. This species was originally described from the Nicobar Islands by Schiner; and has also been recorded from Celebes and Aroe. *N. lineolatus*, described by Wiedemann from Java, is common in North Queensland; it differs from the last species in having the dorsal surface more thickly and brightly striped with white, and the legs being barred with white.

Family 17. Anthomyia Flies.

ANTHOMYIDAE.

In general appearance they are very like the house fly, of small size and indefinite colour; they differ in the structure of the wings, and the eyes of the male are generally large and in contact; the antennae are bare or feathered. In their larval habits they vary very much: some are simply scavengers; others feed on living vegetation, and like the onion and cabbage flies are serious pests; and a few are parasitic. The family is a large one, and species are found in most parts of the world.

The common bluish fly resting on the decaying

weed, and flying along in front when one is walking along the sea shore, belongs to the Genus *Lispe*; it looks like a house fly with longish legs and a pale tint.

Ophyra analis is a very common inland fly, and may be found swarming round dead sheep, or bred from pupae found under carrion lying in the bush. It is a shining blue black fly about the size of an ordinary house fly, and is lightly clothed with bristles on the sides of the thorax; it has a somewhat heart-shaped body, and clear wings. A second species, *O. nigra*, originally described by Wiedemann from China, is found in Australia, and is also recorded by Walker from the East Indies. It may be found swarming about dead sheep in summer. *Phoania personata* might be taken for a large house fly from the regular stripes on the thorax, but it is more thickly clothed with bristles, and the abdomen has a deep metallic blue tint. I have bred numbers from larvae pupating in rotting oranges piled on the ground. *Limnophora ruficoxis* is a somewhat smaller fly with the dorsal surface of the thorax and abdomen clothed with a dull buff pubescence; and the scutellum is smooth and shining. I have specimens from Sydney, N.S.W., and Gatton, Queensland.

Family 18. Parasite Flies.

TACHINIDAE.

This is one of the most useful groups of flies to the agriculturist, for nearly all the members deposit their eggs upon the living larvae of other insects such as the plant-destroying cut-worms, many different moths, and the grubs of our large saw-flies, and

immature grasshoppers. This is a family of considerable extent, for over 1,000 species have been described from America alone, and in Van der Wulp's Catalogue 187 species are listed from South Asia, but very little has been done in working up the Australian species.

In general appearance they are not unlike large house flies, but more bristly; the bristle of the third antennal joint is bare; the posterior cell of the wing almost or quite closed, and the large squamae cover the halteres. They attach their white eggs to the surface of the caterpillar with a gummy secretion, and it is quite common in summer time to find caterpillars thus infested, the perfect flies generally emerging from the pupal shell of their victim.

The members of the Genus *Winthemia* are rather large flies, parasitic upon the larvae of different moths; several American species are great checks upon the increase of the "Army worm" (*Leucania unipuncta*). *Winthemia lata* measures slightly under ½ an inch in length, and is thickset in proportion; it has a silvery face, with the brownish thorax covered with short stout bristles on the sides; the abdomen is black, with the sides and outer margin of the segments blotched with dull yellow; and the whole upper surface is lightly clothed with fine bristles. I have bred this fly from our Native Silkworm Moth (*Antheroea eucalypti*), from Lewin's Moth (*Ocinaria lewinae*), and from an undetermined hawkmoth.

The Genus *Miltogramma* comprises a number of smaller flies common in Europe, which lay their eggs upon the captured prey of the sand wasps while the latter are placing them in their burrows in the ground; and not only does the parasitic fly larva devour the food supply, but also when that is

finished, feeds on the baby wasp. An Indian species is parasitic upon one of the large plague locusts. I have a very handsome undetermined species from Southern Queensland which has the abdomen ringed with bright yellow bands; this would suggest that it may deposit its eggs in the underground chambers of a similarly banded *Bembex*. Another much smaller species, not unlike the house fly in size and general colouration, has the grey abdomen barred with black.

Family 19. Metallic Green Flies.

DEXIIDAE.

These flies differ from the Tachinidae, which they otherwise resemble, in having longer legs, and the bristle of the antennae pubescent or plumose. Australia is rich in large handsome species, often brightly marked with metallic tints; they are usually most plentiful in open forest country, often resting on tree trunks; when flying round they make a loud humming sound. Most of them are parasitic in their habits, depositing their eggs upon the larvae of lamellicorn beetles that are buried in the ground.

Chaetogaster violacea is of the usual thickset form, with a broad body and long pointed wings; it measures nearly 1 inch from the front of the head to the tips of the folded wings. It is of a general dark metallic blue colour, with the dorsal surface of the head and thorax marked with grey, and the whole insect is clothed with scattered black bristles. The wings are clouded with dull yellow on the basal half, giving it a very distinctive appearance. *Amphibolia fulvipes* is another very handsome and smaller fly with a broader body than the last, but the wings are

shorter and clouded at the base; the head and legs are yellow; the rest black, with the thorax spotted behind and marked with a row of short broken parallel bars in front; the greater part of the abdomen above and below is creamy white mottled with seven bilobed blotches of black forming a pattern on the dorsal surface. It is found about Sydney and has a wide range on the eastern coast.

Amenia leonina is about ½ an inch in length with a more rounded abdomen. The large head is bright yellow, with the thorax and abdomen rich metallic blue; the sides of the thorax and abdomen are marked with several white circular dots, the last two on the tip of the abdomen very distinct. It is found in Tasmania, and ranges along the eastern coast of the mainland into Queensland.

The typical Genus *Rutilia* is well represented in Australia by a number of large, showy flies rich in metallic tints, and as a general rule not so thickly or coarsely clothed with bristles. *Rutilia formosa*, originally described from New Holland by Desvoidy, is not uncommon along the eastern coast in the summer months. It measures from ¾ to 1 inch in length; is of a general rich light metallic blue tint; the abdomen indistinctly barred with black is rich metallic coppery red, duller in the larger females, which have the abdominal segments more hirsute and bristly. The larvae are parasitic upon beetle grubs, probably those of the brown cockchafer (*Anoplognathus*). *R. decora* is about the same size and has much the same habits and range. The thorax is rich metallic blue, darker in front, with a row of short black bars; the abdomen is black with a double row of bright green metallic spots down the centre, the two at the anal tip largest. *R. vivipara* measures

about 1 inch in length, with a wing expanse of 1½ inches; it is of a general dull greyish brown tint; the abdomen is lighter brown, and has a dark line down the centre and the sides and tips lightly clothed with grey hairs. *R. inornata*, about the same size as the last species, is a much darker fly; the abdomen is of a uniform dull shining black with grey hairs on the sides but none on the tip. Both these species have an extended range in forest country.

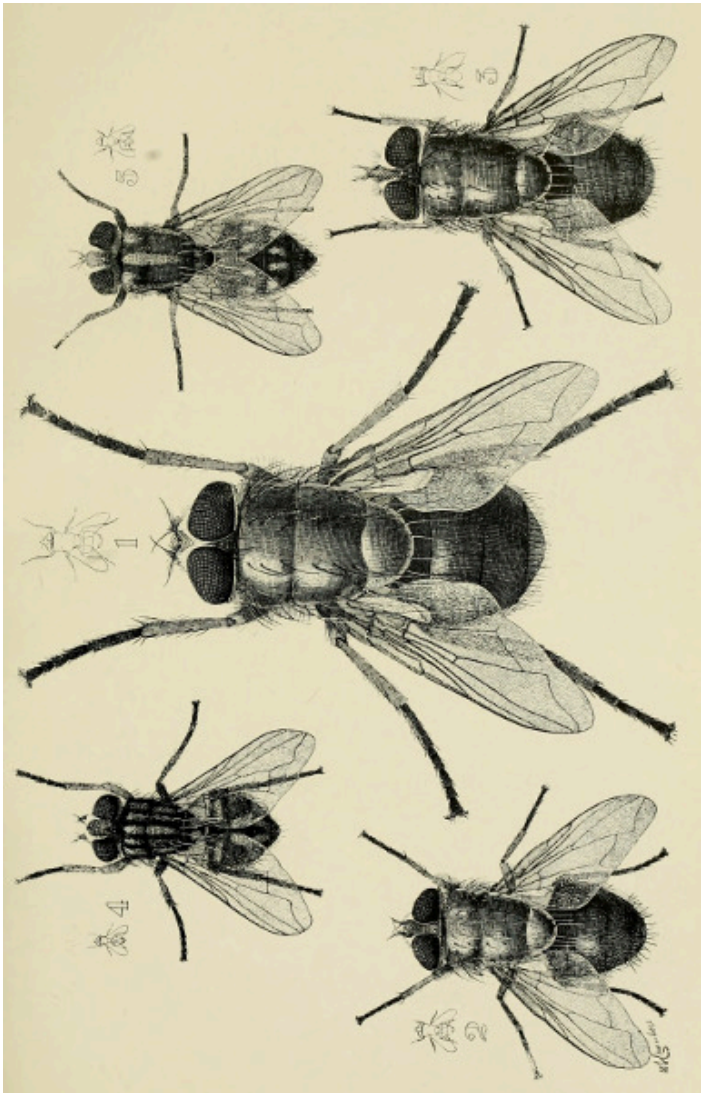
Myocera longipes has the general colouration of a house fly, with long, clear wings behind which are large white squamae; and it has very long slender legs. It has a curious habit of resting on the tree trunks with its long legs spread out in a very characteristic manner.

Plate XXIX.—DIPTERA.

Family MUSCIDAE.

1. *Lucilia tasmaniensis* (Macquart). Large blue-bottle fly.
2. *Lucilia caesar* (Linn.). Introduced sheep fly.
3. *Lucilia sericata* (Meigen). Metallic blue-bottle fly.
4. *Musca domestica* (Linn.). Common house fly.
5. *Musca corvina* (Fabr.). Bush fly.

Plate XXIX.—DIPTERA.



Family 20. Flesh Flies.
SARCOPHAGIDAE.

These flies differ from the true house flies in

having the bristle of the antennae plumose at the base but fine and hair-like at the extremity. They lay their eggs or living larvae upon meat or other exposed food, and are also known as “Scavenger” flies because they frequent evil-smelling places like pig-sties and slaughter-yards. Some species are known to deposit their larvae in the nostrils of animals, and there are several records of the death of human beings from infestation by these maggots.

The typical Genus *Sarcophaga* is world-wide in its distribution, and contains a number of well known species. *Sarcophaga aurifrons* is our commonest species in Australia, and is also found in the Malay Archipelago. It is over ⅓ of an inch in length; the front of the head is golden; the large eyes deep red; the legs black; and the thorax and abdomen black but thickly clothed with silvery grey pubescence; the black shows through, forming three black bands on the front of the thorax; and the abdomen is mottled with indistinct spots. *S. frontalis* is a slightly larger species with the face very bright golden yellow; the black bars on the thorax finer and darker; and the abdomen mottled with a more irregular pattern. A much smaller species, hardly larger than a house fly, was described by Skuse (Agricultural Gazette N.S.W. 1891, p. 251) as a parasite of the plague locust; he named it *Masicera pachytyli*; this fly Mr. Coquillett says belongs to the Genus *Sarcophaga*. I have since bred a much larger species from the bodies of locusts in the Bombala district, N.S.W. *Tachina oedipoda*, described by Olliff (Agr. Gaz. N.S.W. 1891, p. 769), I am also informed by Mr. Coquillett, should be *Sarcophaga oedipoda*, and is closely allied to *S. aurifrons*: it also is a parasite on the same species of locust.

Family 21. House Flies.

MUSCIDAE.

This group comprises all the typical house flies, some of which are world-wide in their distribution. All of them have the bristle that forms the tip of the antennae hairy or plumose, while the abdomen is spineless, without bristles except at the extremity.

They deposit their eggs in stable manure or other decaying matter; the maggots, developing very rapidly in warm weather, form the usual hard parchment-like chrysalids from which the perfect flies emerge. Many interesting observations have been lately made on the habits of house flies and the danger of their spreading diseases by carrying germs or particles of putrid matter upon their feet, and thus contaminating food or transferring germs into open wounds; it was proved in the Spanish-American war that the swarms of flies had a great deal to do with the spread of fever in this manner. *Musca domestica*, the common house fly, is almost world-wide in its distribution, and is the chief species found inside the house. In the larval state it chiefly develops in stable manure. It measures about ¼ of an inch in length; is of a uniform black tint but is so thickly clothed with grey tomentum that it appears to be brown; the eyes are red; the thorax is clothed with stiff black bristles, and has four parallel bars down the centre of the dorsal surface. The freshly deposited eggs hatch within a day or two; the maggots develop within six days, and remain in the pupal state for only a few days in the summer; so that it is no wonder that they multiply with such marvellous rapidity, particularly when we discover that one house fly will lay over 1,000 eggs in the season. *Musca corvina* is a smaller darker tinted species, showing only two parallel

stripes down the thorax. It is a common bush species and a great pest in the bush all through the summer, swarming in countless thousands from the eastern coast into the interior. It has a wide range over Europe, North America, Ceylon, and the Malay Archipelago. *Stomoxys calcitrans* is of a more brownish tint, with the abdomen more flattened, and it differs from the last two species in having a well developed biting mouth; this fly is a troublesome pest to horses, and will alight on one's hand and bite quite sharply. It has a wide range from Europe across Asia to Ceylon, Java, and Australia.

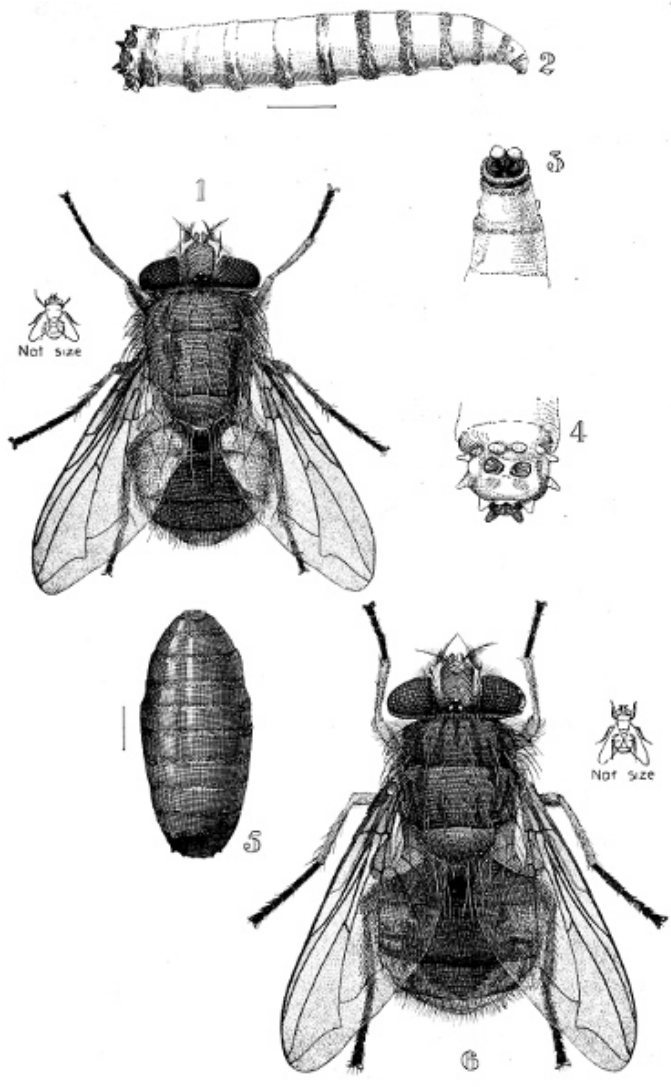
The Genus *Calliphora* is well represented by several very distinct species of typical "Blow-flies"; but though the common European species, *Calliphora vomitaria*, is said to be common in New Zealand I have never taken it in Australia. *C. villosa* is our large common blow-fly; it measures about ½ an inch in length; is of a general slate grey colour with the abdomen thickly clothed with fine golden pubescence giving it a bright mottled yellow tint. *C. oceaniae* is the smaller blow-fly with a steely blue abdomen, the base on either side bearing a dull yellow blotch by which it can be easily distinguished. Both these species are found in the bush and in the house; they lay their eggs on any food they can gain access to; but in the summer, or when they cannot get at food in time, the egg is hatched in the body of the mother and dropped as a living maggot. Some of the bright metallic species also come in this Genus; *C. rufifaces* is a much smaller bright rich metallic blue fly, with a silvery face, red eyes, and white flaps behind the wings; it, and the much smaller *C. varipes* with a yellow face and darker tinted body, are common about dead sheep or decaying matter in the interior.

Plate XXX.—DIPTERA.

Family MUSCIDAE.

1. *Calliphora oceaniae* (Desv.). Blue-bodied blow-fly.
2. *Calliphora oceaniae* (Desv.). Maggot.
3. Head segment of maggot, showing mouth hooks.
4. Anal segment of maggot, showing tubercles.
5. Pupa.
6. *Calliphora villosa* (Desv.). Yellow blow-fly.

Plate XXX.—DIPTERA.



Neocalliphora ochracea is somewhat thicker and broader than *Calliphora villosa*, and a much rarer species; it is of a general dull reddish brown colour, with the head and thorax darkest.

In the Genus *Lucilia* we have the typical "Bluebottle" flies, which are well represented in this country: *Lucilia sericata* and *L. caesar*, both of a moderate size and deep metallic green and coppery tints, are widely distributed. *L. tasmaniensis* is a larger species, measuring under ½ an inch in length; it is of a uniform bright metallic blue, and has a wide range.

Family 22. Bot-flies.

OESTRIDAE.

The members of this family are well known in most parts of the world in the larval state as "bots," internal parasites in the stomach of the horse, in the nostrils of sheep, and the skins of cattle. The life history of the common European bot-fly, *Gastrophilus equi*, is well known; the active fly lays her eggs upon the shoulders or jaws of the horse, attaching them to the hair by a gummy secretion; the horse licking itself transfers the eggs into its mouth, where the tiny maggots hatch out and are carried down into the stomach. They are provided with a pair of fine curved hooks in front of the head by which these little creatures hook themselves into the membrane of the stomach, absorbing their nutriment from the liquid with which they are surrounded. When fully developed these oval spiny bots detach themselves and pass out with the excrement, the maggots at once burying themselves in the damp soil and pupating; the perfect fly emerges early in February in most parts of N.S. Wales. The flies, about ½ an inch in length, have large thickset bodies thickly clothed with short brown or golden hairs, giving them the general appearance of a hairy bee; the male has a short rounded abdomen; that of the female is greatly

elongated and usually curled up underneath. There are probably several introduced species now common in Australia with a wide range over the country. It is remarkable that though they do not bite or sting the horses when laying their eggs, yet as soon as the horses hear the loud hum of the bot-fly they gallop about and show an inherited fear of this pest, which, though it does not kill them, must be a very unpleasant parasite when numerous. The members of the Genus *Hypoderma* are a very serious pest in Europe and other countries where they infest cattle, and are known both as “warble” or “bot-flies.” The fly lays her eggs upon the back of the beast; the tiny larva makes its way through the hide, beneath which it lives and feeds upon the putrid matter caused by the irritation of its presence; it finally produces an inflamed blister-like swelling or “warble,” eventually working its way out through the hide and falling to the ground, where it buries itself and pupates. No species have been found in Australia, but in some parts of England very serious damage is caused to the health of the beast, and the skin by being perforated loses value for making leather.

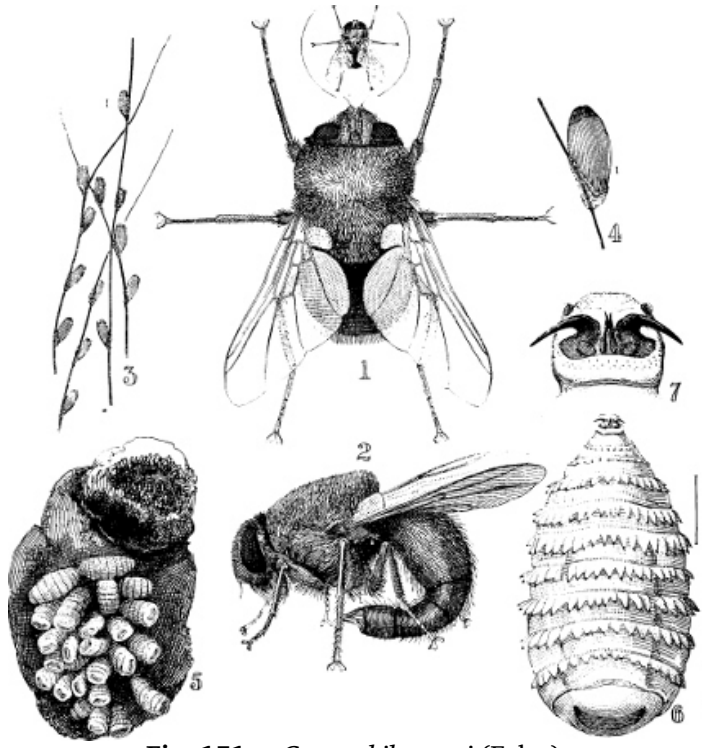


Fig. 151.—*Gastrophilus equi* (Fabr.).

1 and 2, The introduced Bot-fly, showing dorsal and lateral view of female; 3, eggs attached to hairs of horse; 4, egg enlarged (the eggs should be more truncate at the tips); 5, larval bots attached to piece of the stomach of a horse; 6, bot much enlarged; 7, enlarged head of bot showing the mouth hooks.

The Sheep Nostril Fly, *Oestrus ovis*, has a wide range over the world, and was probably introduced into Australia many years ago, though it has been noticed only quite recently as a serious pest. This fly lays living maggots in the nostril of the unfortunate sheep; the maggots work their way up into the frontal sinuses of the head, where they remain until fully developed, when they turn downward and are

usually sneezed out by the sheep in their efforts to get rid of the obstruction. The fly is slightly under ½ an inch in length; the upper surface of the head and body are grey to dull yellow, spotted or mottled with darker tints; the abdomen is yellowish mottled with darker markings. It has been found chiefly in the Blue Mountains N.S.W.

Family 23. Louse or Spider Flies.

HIPPOBOSCIDAE.

These are parasitic Diptera, that having taken to idle and slothful habits (though some of them can fly very well), take up their quarters among the fur or feathers of different animals and birds, where they live and are carried about by their hosts. To suit this method of existence they have become quite altered in structure; they have flat leathery bodies, and their feet are produced into large pincer-like claws which enable them to cling to the skin of their host. Some have large wings with stout nervures but very rudimentary venation; a few though provided with wings at birth bite them off soon after; and others like the well known “sheep tick” are wingless.

As a rule their presence even when numerous does not seem to incommode the infested animals after they have become used to them, for the wild ponies in the New Forest in England are often covered with the horse-fly, *Hippobosca equi*, and they take no notice of them. Yet if one alights upon a horse unaccustomed to the presence of the fly he becomes almost crazy with fright, probably from the pinching or tickling sensation produced by their claws.

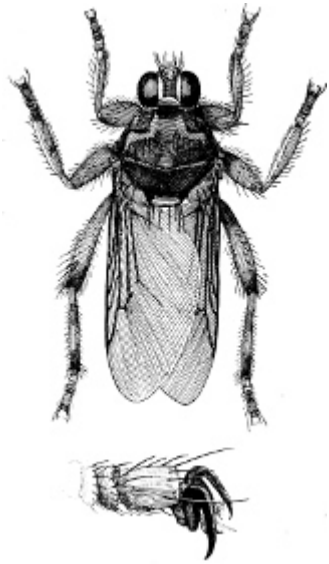


Fig. 152.—*Ortholfersia macleayi* (Leach).

A parasitic fly that lives upon wallabies. Figured by me as *Olfersia macleayi* (Leach) in the "Agricultural Gazette," N.S.W.

The Common European Sheep Tick, *Melophagus ovinus*, was introduced at a very early date into this country among the wool on the backs of sheep. It is a dark-brown, wingless creature thickly clothed with fine hairs, more like a stout-legged spider than a fly in general appearance, but it has not the requisite fourth pair of legs. These bristly legs are furnished with the usual stout curved claws, between which is a slender appendage like a short string, supposed to be used to hang on with by coiling it round the wool. From their blood-sucking habits and these pincer-like claws, they are very annoying to the sheep when numerous.

The Wallaby Louse Fly, *Olfersia macleayi*, is very common on small marsupials in Australia and Tasmania. When the dogs while hunting pull down

and kill a wallaby, these flies generally crawl off and cling to the dog's nose, rendering him very unhappy. It is a winged form, measuring under ½ an inch to the tip of the folded wings, and is of a uniform shining dark brown tint with a greenish shade very noticeable in the legs. Speiser (Annals Musei Nationalis Hungarici 1904) has placed this species in his Genus *Ortholfersia*.

Ornithomyia perfuga, taken on an owl (probably *Spiloglaux boobook*) near Brisbane, has been recently described by Dr. Speiser: it is a larger species of a more reddish brown colour. A very fine louse fly, also taken in Southern Queensland upon a white hawk, measures nearly ¾ of an inch to the tip of the folded wings, and has been identified by the same gentleman as *Ornithoctona nigricans*, described originally by Leach. Among the few other species described from Australia is one found on our pretty little emu wren, which was described by Schiner in the "Zoology of the Voyage of the Novara 1850" under the name of *Ornithomyia stipituri*. A number of our native birds act as hosts for these curious flies; the fruit pigeons, swallows, fly-catchers, and others are known to have them; and when they are systematically collected our list will probably be a large one.

The NYCTERIBIIDAE are another typical family of louse-flies found upon different bats, which are very small in comparison with the true louse-flies: they are always wingless, and have a world-wide distribution. They are reddish brown creatures covered with stout spines; the head is buried in the thorax; and the legs, very long and slender, terminate in immense pincer-shaped claws. Nearly all our bats are more or less infested with these

"spider flies," and several species have been described. Rainbow has recently described one under the name of *Nycteribia pteropus* from a flying fox taken at Batavia River, N. Australia (Records Australian Museum 1904).

Family 24. Fleas.

PULICIDAE.

The classification of the fleas has always been a matter of doubt; modern entomologists usually place them at the end of the Diptera, considering them a group of degraded flies that from their parasitic habits have become wingless, and have developed wonderful jumping powers; other specialists who have devoted much attention to the question consider them as worthy to rank in an Order, and follow Latreille, who called them SIPHONAPTERA; other writers, like Taschenberg, who wrote his Monograph entitled "Die Flöhe" in 1880, formed them into distinct families. The latest revision of the family is Baker's "Revision of American Siphonaptera, &c." (Smithsonian Institute 1904); in this he gives a list of the described species, placing them in five families, and records a total of 134 species from all parts of the world.

Messrs. Jordan and Rothschild in a "Revision of the Sarcopsyllidae" (University of Liverpool 1906) criticise Baker's classification, and reduce the families to four, extending the limits of the Family SARCOPSYLLIDAE, and adding seven new species.

The flea differs from most other insects in having the whole wedge-shaped body vertically flattened. It is admirably adapted for crawling through hair or feathers, and the large stout spiny legs are well

suited for jumping. The head, indistinctly separated from the body, is short, furnished with jointed antennae situated above but behind the eyes; the mouth is produced into a stout pointed proboscis with which it punctures the skin and sucks up the blood of its host. They are all of a more or less reddish brown tint, clothed with scattered stout bristles, and the abdomen is rounded at the apex; the legs are furnished with a pair of tarsal claws. The fact that fleas are capable of spreading the germs of plague and even leprosy has caused a great deal of attention to be devoted to this group, and they have during the last few years been sought for and collected from all parts of the world.

Two species are common in the house in Australia, of which the "domestic flea," *Pulex irritans*, is too well known to need much description. They deposit their eggs, which are tiny ribbed crystalline spheres (very beautiful objects under the microscope) in the dry dust in cracks and crannies in the floor, or in the corners of badly-swept rooms. From these eggs hatch out slender, legless, transparent grubs with several short bristles on the anal extremity; these grubs feed upon the dust and, when full grown, spin a silken tube in which they pupate buried in the dust.

P. serraticeps is known as the dog and cat flea, though it is not uncommon at times in the house where animals are running about; but though it sometimes comes on man, it is an accidental infestation, and it gets away to its natural host as soon as it can escape. It can be easily distinguished from the common house flea by its more elongate form, and by the black comb-like spines fringing the back of the head and the first thoracic segment, which are absent in the former.

The Rat and Mouse Flea, *P. fasciatus*, is a paler coloured, more slender flea, also with a very extended range over the world. It is notorious as the species that, when living upon plague-infested rats, can transmit bubonic plague to man.

Denny (Annals and Mag. Nat. Hist. XII. 1843) has described another species, which he placed in this Genus, obtained from Tasmania and found upon the *Echidna*, and which he has called *Pulex echidnae*. About a dozen indigenous species have been recorded from Australia.

The Genus *Echidnophaga* was created by Olliff (Pro. Linn. Soc. N.S.W. 1886) to contain a species he described under the name of *Echidnophaga ambulans*; it is remarkable for its very long proboscis, and short legs which render it unable to jump. Large numbers of this flea were found upon a Porcupine Ant Eater (*Echidna hystrix*) in the Australian Museum. Messrs. Jordan and Rothschild in the Revision previously noticed place 8 species in Olliff's Genus, adding two more to the Australian fauna, *E. macronychia* from West Australia found upon a small marsupial (*Bettongia lesueuri*), and *E. liopus* also from West Australia on *Echidna aculeata*, at the same time recording the last-named species upon rats at Agra, India. They give a number of additional hosts of *E. ambulans*, namely: the opossum, several other marsupials, and the brown snake; and they extend its range from Sydney to West Australia.

The Chicken Flea, *E. gallinaceus*, which they place in this Genus (originally described by Westwood under the generic name *Sarcopsylla*) though it has not been recorded from Australia has a range from America, Africa, and Russia to Fiji; it infests a great number of both wild and domestic animals and birds.

Skuse (Annals of the Australian Museum 1893) described a very curious flea, found in the pouch of a native cat (*Dasyurus*) which he called *Stephanocircus dasyuri*. I have since had the typical legless larvae, found also in the marsupial pouch of the same animal, and it is also common upon the bandicoot in Queensland. This flea has an elongate body, with the front of the head flattened and fringed with fine spines; it has no eyes.

Skuse is said to have described two species belonging to different genera as the sexes of his flea; and Rainbow in the same journal (Records Aust. Mus. 1905) proposes the name of *Ceratophyllus rothschildi* for the second. Rothschild has described two other species in this genus, *C. hilli* from N.S. Wales on the native cat, and a second, *C. woodwardi*, from W. Australia.



Fig. 153.—*Stephanocircus dasyuri* (Skuse).
Flea of the "Native-cat" and "Bandicoot."
(Original photo. G. Turner.)

Rothschild also describes two other species which he places in Skuse's Genus *Stephanocircus*, namely *S. thomasi* (Nov. Zool. X. 1903) from Barrow Island N.W. Australia, and *S. simsoni* (Entomologists' Month. Magazine XVI. 1905), which comes from Tasmania, taken upon a native cat, *Dasyurus maculatus*. In the Entomologists' Monthly Magazine 1906 Rothschild forms a new Genus *Pygiopsylla* for a large Tasmanian flea taken on a native rat which he calls *Pygiopsylla colossus*. He makes *Ceratophyllus hilli* the type of this new genus, in which he also places three other Australian species originally described in the latter genus, namely: *C. woodwardi*, *rothschildi*, and *echidnae*, in the new one.

Order VIII.—HEMIPTERA.

Bugs, Frog-hoppers, Scale Insects, &c.

The structure of the mouth is the distinctive character of the insects of this great Order. Instead of the biting jaws (or sucking mouth) of many other insects previously described it is produced into a slender pointed tube of complicated structure, which usually lies along the under-surface of the head and thorax. This beak, called the rostrum, consists of a jointed sheath (labium) enclosing hair-like setae (mandibles and maxillae). When the insect feeds the sharp tip is pressed into its food, and the sap or juice sucked up, not by the proboscis-like sheath, but by the delicate enclosed setae. Kirkaldy doubts if the sheath "ever even penetrates the tissues, either vegetable or animal, unless these be already lacerated by the setae"; and it is often used only as a fulcrum to steady their operations.

In the outward appearance (often a deceptive character in classification) the members of this group are very dissimilar; probably no two insects could be more unlike than the typical plant bug and the ordinary scale insect.

They all undergo an incomplete metamorphosis, often changing their colours and even shape in the various moults before they are fully developed. The eggs of those living upon plants are generally deposited in clusters, and these are often very beautiful crystal spheres with stellate caps upon the summits. In other groups the eggs are buried in the tissue of the food plant or covered with woolly or

sticky secretions.

They take the name Hemiptera from the structure of the fore wing, one half of which is, in the typical bugs, horny and the rest semitransparent.

The families of the plant and water bugs are much more closely related to each other than to the frog-hoppers, cicades and scale insects; and the whole Order has been separated into groups or sub-orders, viz., HETEROPTERA; HOMOPTERA; ANOPLURA; MALLOPHAGA.

Sub-order I. HETEROPTERA.

Bugs.

This sub-division contains all the plant, carnivorous, and water bugs, which vary in size and shape from the tiny little leaf-infesting forms to the great "fish-killer," *Belostoma indicum*, found in our water-holes.

They are usually furnished with two pairs of wings. The basal portion of the front pair is horny and opaque, and the apical half more or less transparent; this pair covers the larger hind pair, which, well adapted for flight, are folded up beneath when at rest. The members of some groups however are apterous.

Many are furnished with glands on the body secreting an offensive, buggy-smelling fluid, which they discharge when handled or disturbed.

Some species are serious pests to plant life, and swarm in countless thousands over vegetation, sucking up the sap and causing it to wither and die in consequence, as in the case of the Chinch Bug of North America upon wheat, and the Rutherglen Bug

in Australia among field crops. Others are predaceous and very useful, destroying great numbers of leaf-eating grubs and caterpillars.

These insects are well represented in Australia, and many of the larger and more showy ones were collected and described at a very early date, and their descriptions are scattered through the pages of many scientific journals. Numbers of our species have been described by Westwood (Hope Catal. 1837); Dallas (List Hemip. 1851); Walker (Catal. Heter. Brit. Museum 1867); Distant (Trans. Ent. Soc. London, 1886, etc.); Kirkaldy (The Entomologist); and others in English journals; while among the Continental writers Messrs. Stal, Bergroth, Montandon, Horvath, and Reuter have been the chief workers.

In 1893 Messrs. Lethierry and Severin commenced a "Catalogue of the Described Heteroptera of the World"; three parts were published, but, probably owing to the death of Lethierry, it was never completed, part three closing with the ANTHOCORIDAE, and most of the aquatic groups are not listed. Dr. Mayr has in his "Monograph of the Belostomidae 1871" noted our species.

Plate XXXI.—HEMIPTERA.

Family PENTATOMIDAE.

1. *Biprorulas bibax* (Bredden).
3. *Peltophora pedicellata* (Kirby).
4. *Chaerocorus paganus* (Fabr.).
7. *Plautia affinis* (Dallas).
8. *Cuspicona simplex* (Walk.).
10. *Dindymus versicolor* (Herr. Sch.).
11. *Tectocoris lineola* (Fabr.).
13. *Oncoscelis sulciventris* (Stal.).

Family PYRRHOCORIDAE.

2. *Dysdercus sidae* (Montrz.).

Family COREIDAE.

5. *Mictis profana* (Fabr.).

Family LYGAEIDAE.

6. *Oxycarenus luctuosus* (Mont.).
12. *Oncopeltus quadriguttatus* (Fabr.).
15. *Lygaeus hospes* (Fabr.).

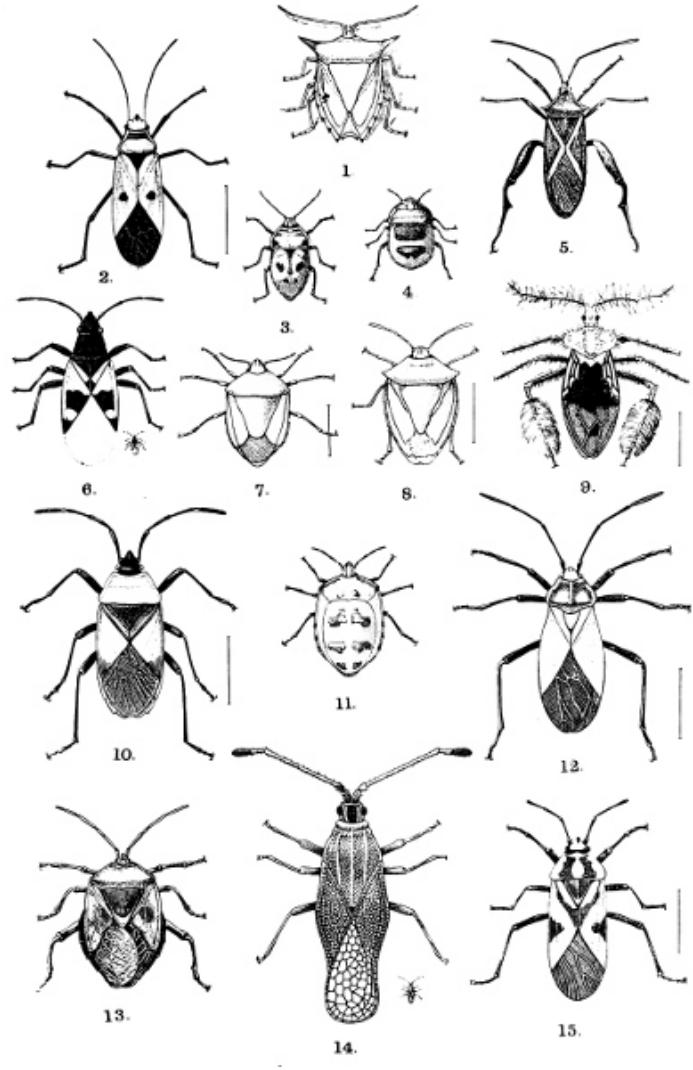
Family REDUVIIDAE.

9. *Ptilocnemus femoralis* (Horvath).

Family TINGIDAE.

14. *Froggattia olivina* (Horvath).

Plate XXXI.—HEMIPTERA.



The Heteroptera have been divided into about twenty families, chiefly defined by the structure of the head and wings; these families are again subdivided into a great number of sub-families, many of the more important being represented in Australia.

Family 1. Shield Bugs.

PENTATOMIDAE.

This group comprises many of our largest and most brilliantly marked tropical plant bugs, distinguished from all those of other families by the remarkable size of the scutellum which frequently covers the two pairs of wings and dorsal surface of the abdomen. The majority of these insects fly well. The head is usually furnished with 5-jointed antennae (though some are restricted to four joints), and two ocelli. It is one of the largest groups, and has been divided into fourteen sub-families. There are over 4,000 species in the family, and it is well represented in Australia. This family is sometimes known under the name SCUTELLERIDAE.

The Cherry Bug, *Peltophora pedicillata*, is a bright metallic green bug mottled with black spots on the back; the greater part of the under surface, edges of the thorax, and two blotches at the base of the scutellum are bright coral red: it measures ½ an inch in length and is broad in proportion. It has a range from New South Wales (where it is often found on strong-scented flowering shrubs and has been recorded as a cherry pest) to N. Queensland, where it is very abundant on the wild fig trees. *Tectocoris lineola* is so variable in size and colouration that it has been described under eight varietal names and has an extended range from the north of N.S. Wales through Queensland to New Caledonia and China. It has a broad, elongate, convex body of a bright orange colour edged on the margins of the body with metallic green; the dorsal surface is covered with curious green or blue patches reminding one of Chinese letters; sometimes these markings are almost absent, in others so confluent that it is more blue

than red. Donovan named our variety *T. banksi*, after Sir Joseph Banks, who first obtained specimens from Australia. *Chaerocoris paganus* is under ½ an inch in length, and of an oval, beetle-like form; its general colour is red with dull metallic green forming blotches on the back, head, and sides of the thorax. It is very common at times crawling about on the rocks and ground about Sydney. *C. similis* is a smaller darker form, only taken about Gunnedah, N.S.W., but it probably has a wider range.

Philia basalis is one of the common fruit bugs of N. Queensland. It is slightly over ½ an inch in length, with elongate convex scutellum, and a uniform rich metallic green tint, with a bright coral-red spot behind the head and two similar ones at the base of the scutellum; the sides of the abdomen are bright red on the under surface. *P. senator* is a smaller, more variable form, with the coral-red markings not so distinct. *Philia regia*, about the same size as the last species, is of a rich coppery-red tint, with the hind portion of the back bright yellow, and the ventral surface and legs bright green and yellow. Both these species and *P. senator* are found along the Queensland coast.

The Genus *Calliphara* contains a number of large bugs, elongate but broadly rounded in front, with the scutellum forming a complete convex shield over the back; 26 species are described ranging from China through the Malay Peninsula to Queensland. *Calliphara imperialis* measures over ¾ of an inch in length, and has the whole of the dorsal surface, except the tip of the abdomen, bright shining red; the under surface, legs, and tip of abdomen are dark metallic green. *C. billiardierei*, about the same size, has the back and the under surface of the abdomen

(except the tip) red; the head, thorax, legs and tip of abdomen deep metallic green with dull purple tints. *C. cruenta* is a much smaller species, the thorax and basal half of the back red, shading into purple toward the tip. *C. nobilis* has the head and thorax dark, with the dull red back spotted with black. All our species of this genus are found in the tropical scrubs of N. Queensland.

Cantao parentum measures over an inch in length, and is more elongate in form; it is of a uniform dull red tint, with the whole of the dorsal surface marked with small irregular black dots; the legs and under surface are black. It ranges along the Queensland coast. It has been reported to have attacked cherries in Southern Queensland. The Genus *Testrica* contains several little brown bugs, short and broad, with the front of the thorax more or less produced into a spine, and the extremity of the abdomen broadly rounded. *Testrica bubala* is not more than ⅙ of an inch in length, with the shoulders sharply spined; it is found upon the foliage of small gum trees.

The sub-family CYDINAE contains a number of curious little black shining bugs that live on the ground and are often found hiding under stones. They are quick and active in their habits, and might easily be mistaken for small black beetles. *Geobia australis*, under ¼ of an inch in length, is of a uniform pitch-black colour, with the exposed tips of the elytra greyish-brown; it has spiny legs; the head is clothed with scattered hairs forming a fringe. *Adrissa* atra is a much larger black bug; it has pitch-coloured elytra with brown tips. This common species is found about Sydney under stones and rubbish.

In the PENTATOMINAE we have a large number of

species. They are broadest across the base of the thorax, which is sometimes slightly angulate; the scutellum is large and angular, occupying the centre of the back but not covering the whole of the wing covers. *Notius depressus* measures over ½ an inch in length, and is broad in proportion; the general colour is deep blue to purple, the sides of the head and thorax and ventral surface marked with yellow. It ranges from Tasmania to N.S. Wales.

Eumecopus australasiae has a wide range, and is often found in wattle scrub resting on tree-trunks. It measures about an inch in length, is a very active insect, and flies readily when disturbed. Its colour is dull brown, mottled with small dull yellow spots; these form several short parallel rows on the pointed head, and there is a distinct yellow spot at the apex of the scutellum.

The Genus *Poecilometis* contains 14 species peculiar to Australia. They are of the same general form as the last group, are found in similar localities, and are all of a more or less reddish-brown tint. *Poecilometis histricus*, about ¾ of an inch in length, is of a light brown colour with ochreous markings. *P. gravis*, found upon wattle scrub, is smaller than the last species and is of a more reddish-brown tint. *P. strigatus*, about ½ an inch in length, is of a similar brownish colour.

Dictyotus plebejus is one of our commonest little dull brown bugs; is about ¼ of an inch in length and nearly as broad as long. It has a wide range over Eastern Australia, and is found, often in numbers, under stones, dry cowdung, or dead logs. The genus is peculiar to Australia, and contains 18 described species.

Commius elegans is common on the foliage of the

native cherry about Mittagong, N.S.W.; it is just under ½ an inch in length; is of a general blue black colour with the thorax and under surface yellow blotched with black; the sides and apex of the scutellum are edged with yellow; and a narrower transverse band of dull white crosses the back just below the tip of the scutellum. It has a wide range over Australia, and was described by Donovan in 1805. *Plautia nigripennis* is a much smaller plant bug, with the upper surface green, and the sides and tips of the elytra reddish brown; it ranges up the Queensland coast from the Tweed River, N.S. Wales. *P. affinis* is a pretty little green insect which feeds on rice and other plants in the northern district of N.S.W. It measures about ⅓ of an inch in length.

The members of the Genus *Cuspicona* range from India to Australia and New Caledonia; eight species are described from Australia. *Cuspicona simplex* is a finely rugose and green coloured bug about ⅓ of an inch in length, with the sides of the thorax produced into blunt spines, and the elytra broadly rounded to the tip. It infests many field crops and has been reported as doing serious damage to growing potatoes. *C. thoracica* is a small green species, with the thorax produced into a stout spine on each side. The head and a broad band across the thorax are reddish brown; the margins of the thorax and the centre of the scutellum are marked with bright yellow. It is common in the eastern coastal districts, and has been found feeding on ground crops about Gosford, N.S.W. *C. forticornis* is a larger green species with the thoracic spines red, and the dorsal surface thickly and finely punctured. It is common in the northern scrubs of N.S. Wales.

The ASOPINAE contains two well known species of

Australian bugs: *Cermatulus nasalis* is common on the Richmond and Tweed Rivers, N.S.W. It measures slightly over ½ an inch in length, and has a somewhat rounded form, with a small projecting head. Specimens vary from an olive brown to almost black colour, and are mottled with deep red; the upper surface is deeply and closely punctured, and the tips of the elytra are metallic bronze. The Vine-moth Bug, *Oechalia schellembergi*, is one of our most interesting species from an economic point of view because it preys upon the caterpillar of the vine moth (*Phalaenides glycine*), several species of cut-worm, and the larvae of the fig-leaf beetle (*Galeruca semipullata*). They lay their rounded glassy eggs in patches of about a dozen upon the foliage, and the freshly emerged bug is dark brown, and flattened in form. The adult bug varies very much in size; the largest is about ½ an inch in length; it is very finely punctured, and is of a general light reddish brown colour mottled with yellow; the sides of the thorax are stoutly spined, and the abdomen is rather tapering toward the tip. It has a wide range over Australia, and is recorded from New Zealand.

The Spined Orange Bug, *Biprorulus bibax*, is a well known orange pest about Moree and the Tweed and Richmond Rivers, N.S.W. It is a handsome bright green bug when alive, but after death usually changes to dull yellow; it measures nearly an inch in length and ¾ of an inch across from tip to tip of the large thoracic spines; the front of the thorax between these stout spines is somewhat depressed; the abdomen is broad and rounded, and the dorsal surface finely punctured.

The TESSARATOMINAE are usually large insects found upon plants, and among them are several

destructive species. Among a number of hemiptera submitted to D'Horvath for identification were two species, viz., *Rhoecocoris (Oncoscelis) sulciventris* and *Stilida indecora*, which both in the larval and perfect state swarm over the orange orchards in the north of N.S. Wales and, by sucking up the sap of the stalks, cause the unripe oranges to fall. Their habits and life history being identical, *Rhoecocoris (Oncoscelis) sulciventris*, which was identified by Olliff in the Agricultural Gazette N.S.W. 1892, I at first confused with *Stilida indecora* (Ag. Gazette, N.S.W., 1901). *S. indecora* is of a more reddish brown tint than *R. sulciventris*, with the dorsal surface of the thorax not punctured, and the apical areas of elytra more bell shaped, while the venation is much finer; while the thorax of *R. sulciventris* is distinctly punctured and the anterior edge of the apical area of the elytra is broadly rounded. *Oncomeris flavicornis* is our largest Australian plant bug, over 1½ inches in length, of a broad shield shape, over ¾ of an inch across the rounded thorax, and of a general dark reddish brown almost black colour on the dorsal surface; each elytron is richly marked on the basal half with bright yellow, and the apical portion is rich metallic purple. It comes from the tropical scrubs of N. Queensland.

In the Sub-family DINIDORINAE we have *Megymenum insulare*, a typical form very common on the foliage of the low scrub of the semi-tropical forests of N.S. Wales and Queensland. It is of a general chocolate brown tint, with the inner apical markings of the elytra dull white; it measures just under ½ an inch; the sides of the head and the front of thorax are furnished with short angular spines, which are also present round the outer edge of the abdominal segments; and the whole of the dorsal surface is rugose. The immature larvae are brown,

flattened, and fringed right round with bract-like processes.

Family 2. Gum-tree Bugs.

COREIDAE.

This group contains bugs in which the scutellum does not extend as far back as the middle of the body; the head is generally furnished with four-jointed antennae inserted above on the sides of the head; there are two ocelli; and the sheath of the proboscis consists of four segments. Many species have the femora of the hind legs dilated or armed with blunt spines. The majority are dull coloured insects that have no distinctive common name in Australia, so for want of better, I propose to define them as "Gum-tree bugs," as many typical forms feed upon the young shoots of our gum trees (*Eucalyptus*). In America they are sometimes called "Squash Bugs" from their fondness for pumpkin plants. Over 1,500 species have been described and placed in 29 sub-families; and they are well represented in Australia.

The MICTINAE are represented by one of our best known species, which I called the "Crusader Bug," *Mictis profana*. It is a somewhat variable elongate insect just under an inch in length, of a uniform dull drab-brown, with the inner edge of each elytron marked with a dull yellow stripe, which, intersecting each other in the centre, produce a distinct cross on the back. The hind legs are thickened and the apex of the tibia forms a blunt spine. It has a wide range over Australia, and of late years has been found infesting the citrus orchards, where it punctures the young shoots and causes them to die back.

The Genus *Amorbus* contains 15 described species

peculiar to this country, most of which feed upon the foliage of young gum trees and give out a very strong odour when touched; the young larval forms are often brightly coloured, but in the adult state all these bugs are dull brown. *Amorbus angustior*, under ¾ of an inch in length, has the dorsal surface flattened; the abdomen swells out on the sides beyond the edge of the folded elytra, and the whole surface is granulated or roughened. It is of a uniform chocolate colour with the antennae and abdomen rusty red. *A. robustus* is a much larger species, stout in proportion, with the same elongate form, but the edges of the abdomen not projecting beyond the wings.

Mutusca brevicornis is a very slender brown bug, about ½ an inch in length, usually found resting among the grass. The head and thorax are elongate, with the former produced in front of the antennae into two slender lobes; the elytra are long and slender, and the wings well adapted for flight. *Riptortus robustus* is also an elongate bug, but shorter and stouter, with the head short and angular; the thorax is short, rounded in front, and produced into a ridge behind, with a stout spine on either side. The body is long, constricted in the centre, and rounded at the tip: the thighs of the hind legs long, thickened and armed with a row of spines along the inner edge. The general colour is reddish brown.

The Genus *Leptoglossus* contains some handsome species which are remarkable for having the tibiae of the hind legs dilated into leaf-like processes. *Leptoglossus membranaceus* is an elongate, flattened, black bug banded with a slender red line across the thorax; the head is small, projecting in front of the triangular thorax; and the shield shaped body comes

to a rounded tip. The fore legs are slender, but the hind pair are slightly thickened on the thighs and roughened on the inner edges; and the tibiae have leaf-like projections on either side, giving it a very remarkable appearance. It is common in North Queensland and ranges over Africa, India, Ceylon, and the Philippines.

Family 3. Chinch Bugs.

LYGAEIDAE.

This is a family containing about 1,400 described species divided into thirteen sub-families, but many of the latter are very restricted in their numbers, the majority coming under the typical sub-family LYGAEINAE. Their general characters are similar to those of the Coreidae except that the antennae are inserted below the eyes, and the head is not so flattened and more angular in front. They are smaller bugs of more delicate structure, and their prevailing colours are brown or black variegated with red and yellow; some of them, such as the Chinch Bug of North America, are very destructive pests. As they have no distinctive group name I have adopted Professor Comstock's name of "Chinch Bugs."

The LYGAEINAE contain most of the bright coloured species, often marked with red; the wing covers are usually of a somewhat delicate texture.

Astacops laticeps, about ⅓ of an inch in length, is a slender black bug with the head and sides of the elytra bright red. *Scopiastes vitticeps*, about the same size, has the head, thorax, and sides of the body red. Both these insects are common on the grass and field crops on the Northern Rivers of N.S. Wales. *Lygaeus hospes* measures ½ an inch in length, is of the typical

elongate form, and is black marked with bright red forming a broad indistinct cross on the basal portions of the elytra. It has a wide range from China and India to Australia and New Caledonia. *L. mactans* is a much smaller insect, with the head, base of thorax, and the greater part of each elytron bright red. It has a wide range over Australia, and is also recorded from Fiji. *L. decoratus*, about ½ an inch in length, has the whole of the head, thorax, and sides of the elytra banded with red and black; it comes from Queensland.

The Cotton Bug, *Oncopeltus quadriguttatus*, figured in my notes in the Agricultural Gazette 1901, should be according to Horvath *O. sordidus*, Dallas, though the latter name is given as a synonym of the first in L. and S.'s Catalogue. It measures ½ an inch in length, is of a general black colour, with the head and two depressions in the centre of the thorax dull red, and the scutellum and basal half of each elytron deep orange red; the abdomen is dull red and clothed with short down. They lay their eggs to form a ring round a twig, sometimes as many as a hundred in a cluster; the larvae are flat and almost circular in form, of a general red colour mottled with metallic blue spots, and the legs and antennae are dark coloured. This bug is common on the cultivated cotton plants about the Richmond River, and ranges from Sydney into Queensland.

The Rutherglen Bug, *Nysius vinitor*, is one of the most destructive plant bugs in Australia; breeding in grass lands, during the summer it swarms over all kinds of field crops and fruit trees in countless millions, sucking up the sap of both the foliage and fruit. It has a very wide range, and takes its popular name from the town in Victoria, in which it was first

recorded damaging grapes. It is a tiny creature, under ⅛ of an inch in length, is dull brown to grey in colour with silvery grey wings; it is very active and flies well. It is so common that under favourable conditions it might become here as serious a pest as the Chinch Bug of North America. The Genus is a very extensive one, containing 69 species distributed from Greenland to S. America, thus almost world wide in its range.

The Coon Bug, *Oxycarenus luctuosus*, is a tiny black and white bug about the same size, originally described from New Caledonia. It is very common, chiefly in the inland districts, swarming over the ground in millions. When in the larval state, before the wings are developed, its general colour is bright red, and it is then much more noticeable, giving the fences on which it rests in the day time a curious blood-red tint. So far it has never been recorded as a plant pest, but that is probably only because it is chiefly a western species, where little fruit is grown.

Family 4. Fruit Bugs.
PYRRHOCORIDAE.

These bugs differ from the last family only in the fact that they are not provided with ocelli. It is a small family containing under 400 described species, placed in two sub-families.

The LARGINAE contains a number of red coloured bugs, the majority of which are confined to South America. The members of the Genus *Physopelta* however belong to the Indian and Malay region; and *P. famelica* ranges from Ceram to Woodlark Island, and down the Queensland coast to the Tweed River. It measures under ¾ of an inch in length, is of the

typical form, and of a general dull red tint, with the head, centre of the thorax, and legs dark brown; the centre of the scutellum and four spots on the sides of the elytra are black.

The PYRRHOCORINAE comprise the bulk of this family, which are chiefly found in Africa and Asia. The "Harlequin Fruit-bug," *Dindymus versicolor*, was originally described from Tasmania, but has a wide range over Australia. They shelter and breed in the crevices on tree trunks, and often damage ripe fruit. It measures slightly over ½ an inch in length; the under surface is yellowish, with the head and thorax blood red, the latter barred with white. The upper surface and legs are black, with the greater part of the thorax and basal half of the side of each elytron bright red. *Dindymus circumcinctus* is a slightly smaller, much darker species, the red only showing on the outer margins of the thorax and elytra. I have specimens collected near Sydney.

Dysdercus sidae belongs to a genus world wide in its distribution, and containing over 50 described species. This species is common on the Richmond River N.S.W., frequenting the cultivated cotton plants, where it can be seen running over the opening cotton bolls, and discolouring them with its excrement in the same manner as the "American Cotton Stainer," *Dysdercus suturellus*, is reported to do in the United States. Our species measures about ½ an inch in length; it is red, with the scutellum and a distinct rounded spot in the centre of each elytron black. The antennae, eyes, and apical areas of the elytra are also black; the front and sides of the thorax marked with dull white.

Family 5. Lace Bugs.

TINGIDAE.

These are all small plant bugs without ocelli; the terminal joint of the antennae is swollen or clubbed; the pronotum is large, covering the scutellum; the neuration of the elytra is very distinct, forming intricate, lace-like patterns; the feet consist of two joints. They are true plant-feeding bugs, generally sucking up the sap from the under-side of the leaf, and when numerous often become pests. Between four and five hundred species of TINGIDAE have been described, and are placed in two sub-families. Few species have been recorded from Australia, but this is probably not owing to their absence, but because collectors are apt to overlook these small creatures.

Serenthia pectipennis is a tiny dark brown bug, hardly ½ of an inch in length; the oval body is convex, and broadly rounded to the apex, with a curious lighter brown pattern on the elytra. It comes from Glen Innes, N.S.W.

The Olive-tree Bug, *Froggattia olivina*, was described from specimens sent to Horvath; its native food plant is the wild olive (*Notalaea longifolia*); the larvae infest the under surface of the leaves, and cause them to wither and drop off. It has now transferred its attention to the cultivated olive, and when numerous will almost defoliate the trees; it has a wide range over N.S. Wales, but I know no record of it from the other States. It is a slender, handsome little dark brown bug, about ⅛ of an inch in length, and has typical clubbed antennae. The elytra are swollen out toward the base, arcuate on the sides, and rounded at the extremities, with lace-like reticulations on the apical areas; the thorax is rounded and convex.

Oncophysa vesiculata is another curious little elongate bug, about the same length; of a uniform dark brown tint; the upper surface is marked with distinct ridges and fine punctures, and a pair of large bulbous processes stand up prominently at the base of the elytra. It is common about Sydney, where it feeds upon the little native cotton bush.

Plate XXXII.—HEMIPTERA.

Family REDUVIIDAE.

1. *Opistoplatys australasiae* (Westw.).
3. *Pirates ephippiger* (White).
6. *Pristhesancus papuensis* (Stal).
12. *Gminatus nigroscutellatus* (Bredden).
15. *Gardena australis* (Horvath).

Family PENTATOMIDAE.

2. *Cuspicona forticornis* (Bredden).
4. *Poecilometis strigatus* (Westw.).
7. *Megymenum insulare* (Westw.).
8. *Philia basalis* (Grey).
9. *Poecilometis histricus* (Stal).
13. *Cermatulus nasalis* (Westw.).
14. *Geobia australis* (Erich.).
16. *Notius depressus* (Dall.).

Family COREIDAE.

5. *Amorbus robustus* (Mayr).

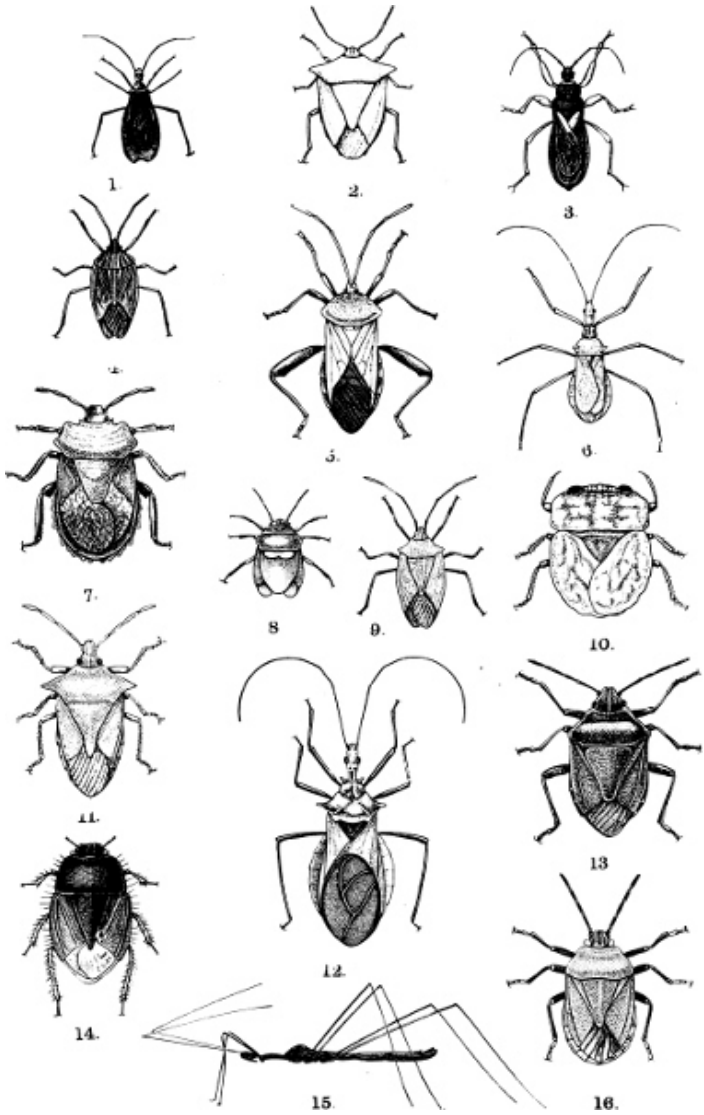
Family GALGULIDAE.

10. *Mononyx annulipes* (Horvath).

Family PENTATOMIDAE.

11. *Oechalia schellembergi* (Guérin).

Plate XXXII.—HEMIPTERA.



Family 6. Fungus Bugs.

ARADIDAE.

These are dull coloured black or brown bugs of moderate size, with the dorsal surface very rugose, and the whole insect thin and flattened, admirably adapted to the life it leads hidden under the dead bark on tree trunks, their chief food being fungous growths found upon the damp bark. Howard calls them “Flat Bark Bugs,” and remarks that they look as if they had been stepped upon.

They have the tip of the abdomen exposed, as the elytra are shorter than the body, which is also exposed on the sides when the wings are folded. Like the Lace-bugs (*Tingidae*) they have no ocelli, but, unlike them, they have the scutellum exposed. This family contains about 300 described species, divided into four sub-divisions. Erichson has described several from Tasmania (Arch. 1842); Bergroth (Verh. Z. b. Ges. Wien 1886) and Walker (Cat. Heter. 1874) others from Australia.

There are a number of undetermined species in our Museum collections, most of which are to be found upon fallen timber where the bark is rotting and peeling off the trunk.

Family 7. Water Striders.

HYDROMETRIDAE.

These are aquatic insects, living upon the surface of the water, and some are even found on the open ocean, hundreds of miles away from land. They, like most other water-dwellers, are covered with a velvet-like pubescence; the head is ornamented with large projecting eyes; the antennae are four-jointed. They may be wingless; when present, the elytra are of a uniform texture. Most of the species are furnished with very long legs. The tarsi are two-jointed. About

160 species are described under four sub-families; only three or four are described from Australia; but more from the open waters of the Pacific Ocean.

In the genus *Gerris*, Skuse (Records of the Australian Museum, 1893) described a species from the waters of Sydney Harbour under the name of *Gerris australis*. It varies from dark shining olive to black on the dorsal surface; the ventral surface is yellow with grey tints. It is covered with a fine silvery pubescence, and measures ⅓ of an inch in length. *Hydrometra strigosa*, described by Skuse from specimens from the swamps about Botany, N.S.W., is a larger insect, of a uniform brownish yellow tint; and it has a more slender shape.

Halobates whiteleggi is a small ochreous water-bug about ⅙ of an inch in length, and was obtained by Skuse in swarms in the sheltered nooks of Sydney Harbour. Another species discovered in Torres Straits has been named *Hermatabates haddeni*, after its discoverer, Professor Hadden.

The closely allied small family HENICOCEPHALIDAE consists of a single genus, the members of which are widely distributed. We have one described from Tasmania by Westwood under the name of *Henicocephalus tasmanicus*. They fly in swarms, dancing in the air together like midges. It is noticed they give off a musk-like smell.

Family 8. Assassin Bugs.
REDUVIIDAE.

This is a large division of the Hemiptera, and its members are carnivorous, destroying different kinds of insects, which they impale with their beaks, and from which they suck the blood; many can give a

painful stab with the stout beak if handled carelessly. The head is long, narrowed behind, and freely movable; the rostrum or beak is short, stout, and is curved under the head, not extending far under the thorax; the antennae are long, slender towards the tips; the legs are long, slender, and often hairy; the elytron consists of three divisions. Some species are wingless. They exhibit much variety in size and colouration, and their shape is often adapted to their habits. The large immature forms of one undetermined species, found plentifully about Maitland, N.S.W., hides in the sand under the shelter of a log or stone; each covers its back with bits of sand or dirt, and, thus disguised, it lies in wait for its prey. Over 2,000 species are described from all parts of the world, and they are grouped into 14 sub-families.

The EMESINAE contain a very curious group of slender grey bugs with long legs. They might at first sight be mistaken for "daddy longlegs" or "crane-flies"; and are found, too, in similar situations, viz., resting on tree trunks or under the cover of logs and bark; and they probably live chiefly on these long-legged flies. *Gardena australis* is of a uniform brown tint, mottled on the legs and elytra with grey. It is of the usual slender form, with elongate hairy legs. It and several similar but undetermined species are common about Sydney.

Opistoplatys australasiae, representing the small sub-family TRIBELOCEPHALIDAE, was described and figured by Westwood in 1859; it is not uncommon on tree trunks about the Richmond River, N.S.W. It measures over ½ an inch in length, and is flattened on the dorsal surface; the abdomen is elongate, and rounded at the apex; its general colour is dull

chocolate brown, with the centre of the back slightly pubescent.

In the group HOLOPTILINAE are some species with feather-like hind legs, the tibiae being densely clothed with long dark hairs. They are usually found on the trunks of dead trees, under the shelter of the drying detached bark, where they are found in all stages of development; they probably feed upon the small insects that come there for shelter. Horvath has identified those I have sent him as *Ptilocnemus femoralis*, a new species, though there are four other species described from Australia. This new species measures over ⅓ of an inch, and has the head, thorax, and joints of the legs dull yellow; the under surface and apical areas of the elytra are marbled with black and brown; the antennae, head, thorax and legs are fringed with long black hairs, which on the hind tibiae are so thick as to give the appearance of a feather or brush. *Aradellus cygnalis*, figured and described by Westwood (Thesaurus Ent. 1874), is also found hiding under dead bark on tree trunks. Some specimens were taken at Gunnedah, N.S.W., but I also have a closely allied, if not a new species, from Bathurst, N.S.W. It measures slightly over ⅛ of an inch in length, is of a general blackish brown colour, with yellowish legs, and the elytra are black, mottled with blotches of white; the curious thickened antennae and legs are fringed with short stout, bristle-like hairs.

The ACANTHASPINAE are larger slender-legged bugs, well represented in Australia. The genus *Sphedanocores* contains several distinct species with a wide range. *S. distinctus* measures over ¼ of an inch in length, and is mottled and barred with dark orange and black; the head is turned downwards and

the rostrum is stout; the thorax is very rugose. *Reduvius personatus* is a cosmopolitan species that takes up its quarters in the house, covering itself with bits of dirt and feeding upon the common bed bug. It is recorded both from Australia and Tasmania. The larval form of an allied bug has the broad back concave, and covers itself with particles of sand; it rests under the shelter of logs and stones where it lurks during the day. *Reduvius rivulosus* is a large bug measuring ¾ of an inch in length; it is of a general dull brown colour with the elytra mottled with dull yellow, while the whole insect is clothed with fine woolly hairs, denser upon the legs. It comes from the Shoalhaven district, N.S.W.

The PIRATINAE comprise some of the so-called "Assassin bugs"; in colour most of them are dark brown or black, marked with dull yellow; they hide under stones in the daytime, and often in summer come flying to the lights in the house at night, when, if carelessly handled they can inflict a very severe stab with the beak. *Pirates ephippiger* is one of our largest species, measuring over ¾ of an inch in length. It is of a uniform dull black, with the stout legs reddish brown in colour, and there is a heart-shaped patch of bright yellow behind the scutellum. The prothorax is narrow, smooth and rounded, with a constriction separating it distinctly from the broader mesothorax which is also smooth and rounded. *P. flavopictus* is a very much smaller species, black in colour, with the yellow blotch behind the scutellum. The whole insect is clothed with fine hairs. It is a common species in New South Wales, and has a wide range over the southern part of the continent. Twelve other species of this large genus are described from Australia and Tasmania.

The HARPACTORINAE is the largest division of this family, and comprises both the large spiny "assassin bugs" that crawl about among the foliage or hunt over the tree trunks, and some typical forms, most plentiful in tropical countries.

Havinthus depressus is a small, flat, dark brown species, under ½ an inch in length, with the outer margins of the body mottled with dull red. *H. rufovarius* is a larger bug of a general black colour, with the head, front of thorax, legs, bases of the elytra, and under surface of the abdomen marked with deep red. The body is rugose and clothed with short stiff hairs. It has a wide range over Australia; and a very large variety, with blood red markings, from Kalgoorlie (W.A.), measures over an inch in length.

The members of the Genus *Gminatus* are peculiar to Australia, and are found hunting over tree trunks and flowers. The body is somewhat constricted behind the thorax, broadening towards the rounded apex. *Gminatus nigroscutellatus*, over ½ an inch in length, is of a general bright red colour, with the legs and scutellum black, and the apical areas of the elytra rich metallic bronze. The dorsal surfaces of the head and thorax are ornamented with a number of tubercles or spines. *G. australis*, slightly smaller and more slender than the previous one, differs in having the head black; the prothorax black and furnished with two pairs of black spines, and the shorter spines in the rest of the thorax tipped with black. The Bee Killer, *Pristhesancus papuensis*, is a large brown bug, nearly 1¼ inches in length, and thickly clothed with short buff hairs. The outer edge of the thorax is produced into erect blunt tubercles, seven in number, forming an angle on the outer margins. The dorsal

surface of the abdomen is very concave; the folded elytra lie sunk well below the sides of abdomen, which are flanged and raised.

It has been observed sitting on the tassels of maize cobs, catching and sucking the blood out of hive bees as they come for the pollen. It is common on the Tweed River, N.S.W., and in Queensland.

The members of the Genus *Helonotus* are similar large carnivorous bugs. Specimens are recorded from Cape York (Queensland), and the tropical scrubs of New Guinea.

Family 9. Bed Bugs.

CIMICIDAE.

The family to which the common bed bug of unsavoury reputation belongs, is a very small one, comprising only a few genera and about a dozen species. They have no ocelli; the wing cases are short and do not reach to the tip of the abdomen; the head is short, with the rostrum when at rest fitting into a groove beneath it.

Cimex lectularius, the common house bug, is supposed to have come originally from Asia into Europe, and thence transported over the world. Several other species are found in Europe and America, another in India, and indigenous species both in Chili and the Isle of Bourbon. A fossil bug has been found in the Lower Tertiary beds in Scotland which is said to be very similar if not identical with the present household pest. Kirkaldy has recently created the Genus *Klinophilos* to contain our common bed bug, though it has always been considered to be Linne's type of the Genus *Cimex*.

Family 10. Leaf Bugs.

CAPSIDAE.

These are all small plant-eating bugs of somewhat delicate structure, and form a family of considerable size; over 2,000 species having been recorded from all parts of the world. Several species are well known pests in India and Ceylon, and a few in America are said to prey on small insects. Very little attention has been paid to the collection of these small bugs in this country, but Mr. Kirkaldy informs me that 35 species have been described from Australia, chiefly by Walker, Reuter, Distant and himself.

They have no ocelli; the antenna is four jointed, with the second joint usually very long; the scutellum is triangular and very small; the elytra and wings are large, the former remarkable for having only two cells in each apical area; the female is furnished with a well-defined ovipositor. In his "Memoir upon the Rhynchotal family Capsidae" (Trans. Ent. Soc. London 1902), Kirkaldy lists 6 described species, and also defines 5 new species which were collected at Alexandria, Victoria. *Eurybrochis zanna* is a mottled reddish brown insect, darkest towards the extremity, measuring under ¼ of an inch in length, and of the usual form. *Austomiris viridissimus* is a longer, more slender bug of a general greenish tint. *Zanessa rubrovariegata* is again a little longer, of a uniform brown tint marked with red on the elytra.

Stal (Eugenie's Resa Novara 1859) described 3 Australian species.

Family 11. Water Bugs.

CRYPTOCERATA.

The several families included in this group comprise a number of aquatic or semi-aquatic bugs.

The GALGULIDAE, known as "Sand-bugs," are curious little creatures distinguished from the others in having ocelli. They are very short and broad in form, with projecting eyes, and in general appearance each suggests a miniature crab. They have short four jointed antennae situated below the eyes, and are furnished with legs well adapted for running on the ground. They are found on the edges of swamps or creeks, and feed upon different kinds of small insects. In colour they are usually of a uniform dull brown to black; the upper surface is generally much roughened. Never moving unless touched, they trust to their sordid colours to escape detection, for as they match the ground so well, they are difficult to find.

Mononyx annulipes, one of our commonest species, is about ¼ of an inch in length; is of a uniform dirty brown tint, with the legs and under surface dull yellow; the body is very rugose and fringed on the outer edges with fine bristles. Montandon has described several other Australian species (Bulletin, Societé des Sciences, Roumania, 1899).

The NEPIDAE are popularly known as "water scorpions" on account of the curious tail appendages projecting from the tip of the abdomen. They live in ponds, and feed upon different water insects, attaching their eggs to the leaves of the plants. They have the wing covers folded closely over the back protecting the wings from the water, and fly rapidly from pool to pool when the water dries up. There are many species found in Australia, most of which have a wide range. *Rantara varipes*, under 1 inch in length, has a tail about as long again as the body, and is of a

light yellowish brown colour. It might be likened to a mantis, with its slender form and fore pair of legs furnished with spines on the inner edges to hold its prey. The other legs are long and slender with curved claws at the extremities.

In the Genus *Nepa* the insects have the head and body flattened; the elytra cover the wings; the abdomen is broadly rounded at the extremity, terminating in a pair of long slender bristles. The beak curved under the head is large and stout; the eyes are large, the fore legs are spined, and the other legs furnished with a pair of slender curved claws.

Nepa tristis, measuring about 1 inch to the tip of the body, is of the usual form and dull brown colour, with the upper surface of the abdomen showing bright red when the wings are expanded. It is found in the bottom of ponds crawling about among the weeds.

Family 12. Fish-killers.

BELOSTOMIDAE.

In the typical genus of this family we have some of the largest known Hemiptera, measuring up to 3 inches in length and broad in proportion. They are aquatic, generally living in still waters, feeding on small fish which they capture with their stout spined legs; they play havoc with the small fry in a pond, and are popularly known in consequence as “Fish-killers.”

The body is broad, but flattened on the dorsal surface, coming to a rounded point at the apex; the well developed wings are folded beneath the horny elytra; the whole shape being well adapted to the life they lead. In summer time they often leave their

ponds, and, attracted by the light, come flying to the windows.

Belostoma indicum has a wide range from Southern India to Australia; it measures slightly under 3 inches in length, and is of a uniform dark brown colour. The large curved beak bent under the head, projecting eyes, and great spined fore legs show its carnivorous propensities; the middle and hind legs are fringed with delicate swimming hairs, and terminate in a pair of fine claws. Unlike most of the other aquatic hemiptera, the abdomen terminates in an oval tip without any anal appendages.

Sharp speaking of this family (Insects Pt. II. p. 567) says: "In the waters of the warm regions of the continents of both the Old and New Worlds they are common insects, but as yet they have not been found in Australia." However, Mayr records it from Australia, "Die Belostomiden 1871" (Verh. Z. C. Gesell, Wien); and I have a specimen from Port Darwin, Northern Territory, and also a number of specimens from Southern Queensland.

Sphaeroderma equis is a curious oval-shaped water-bug that crawls about among the mud and water weeds in water-holes and creeks; it has a very wide range, probably all over Australia; the female has the curious habit of carrying her eggs stuck upon her back in a regular sheet covering the whole of the elytra. It is of a uniform shining brown colour, and measures ¾ of an inch in length; the head is smaller than that of *B. indicum*, with the eyes not so prominent and angular.

Family 13. Back-Swimmers.

NOTONECTIDAE.

These water-bugs have oval convex bodies and always swim with the belly upwards; their eyes are very large, situated on the sides of the head, the latter inserted into the prothorax, which overlaps it. The front legs are shortest, the fore tarsi not flattened but furnished with two claws. Their bodies are provided with long hairs which enable them to carry an air supply about with them. They are very active insects, and can be often observed in our water-holes and ponds swimming beneath the water, or coming to the surface and raising the tip of the body to obtain a fresh supply of air, when they can be easily captured with a hand net.

They insert their eggs in the stems of water plants, which the female pierces with her sharp ovipositor; and some European species are known to hibernate in the mud at the bottom of the pools and water-holes.

Several species are common in our ponds and creeks, and are savage little creatures destroying many other aquatic insects, and even small fish.

Enithares bergrothi is our common species with a very wide range over Australia. In their larval state they are silvery white in appearance, but as the elytra develop and cover the back they change to dark brown, mottled, shining creatures, with the body measuring about ⅓ of an inch in length.

Family 14. Water-Boatmen.
CORIXIDAE.

The members of the family CORIXIDAE differ from the "Back-swimmers," though both are often called "Water-Boatmen," in having the fore tarsi flattened, fringed with hairs on the edges, but without any

claws, while the head overlaps the thorax. They swim the opposite way (with the back upwards), and are flattened on the ventral surface. One or more species may be often captured with a net in the same situations as the members of the former group.

Corixa eurynome, described by Kirkaldy, is our common species found in creeks and water-holes all over Australia. It measures over ⅓ of an inch in length, with the scythe-shaped hind legs projecting behind; it is of a uniform chocolate brown colour on the dorsal surface, except the space between the eyes, which with the legs and ventral surface are dull yellow. The large flattened lead-coloured eyes are almost triangular.

Sub-Order II.—HOMOPTERA.

This sub-division was formed to include some families of haustellate insects which, though closely related to the true plant bugs, have well-defined characteristics that bring them into a natural Sub-Order of their own. They all have the typical suctorial mouth, but the front of the head is much inflexed so as to be in contact with the coxae. The front pair of wings are not true elytra, being generally membranous, and are usually referred to as tegmina. Some, like the aphids, have both pairs of wings delicate and transparent; while in the scale insects, the females are always wingless, and the male is provided with a single, imperfectly veined pair only. When at rest, the wings in the typical homoptera are folded over the back like a roof, forming a ridge. All the families are well represented in Australia, except the *Aphidae*, of which no indigenous species have been recorded, the *Psyllidae* with similar habits taking their place, at any rate in

our western scrubs. Like true hemiptera, they each undergo an incomplete metamorphosis, some moulting many times before the final ecdysis; and all feed in the immature and perfect state on the sap of plants.

Kirkaldy has recently described about 200 new species of the families Fulgoridae, Membracidae, Cercopidae, and Jassidae (Leaf Hoppers and their Natural Enemies Bulletin I. pt. IX., Hawaii 1905), collected by Messrs. Koebele and Perkins chiefly in Queensland. In his classification based on Hanson's (Ent. Tedssker xi. 1890) he divides them into 8 families and creates 76 new genera.

Family 1. Cicadas.

CICADIDAE.

The most familiar sound in the summer months in Australia, particularly along the coastal districts is the harsh, incessant screech of the cicadas; the hotter the day the shriller the tone, and from the first week in November to the end of January it is more or less constant. They are too well known to need much description, but it might be remarked that it is very unfortunate that they are commonly called "locusts" for, strictly speaking, the term "locust" should only be applied to the short-horned grasshoppers belonging to a different order, Family Acridiidae.

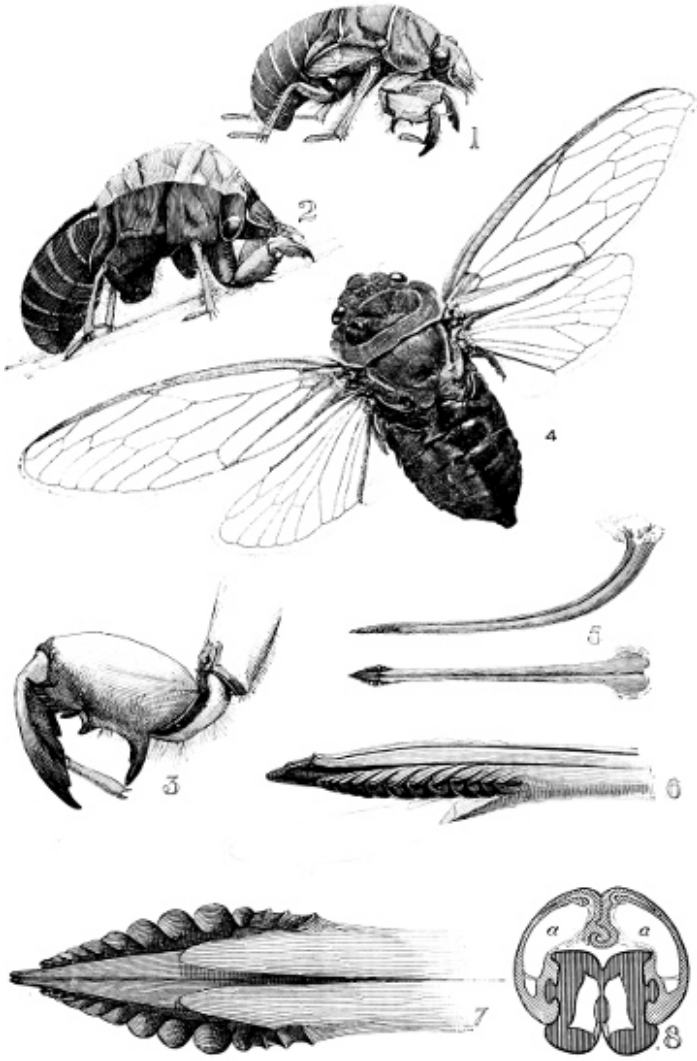
Plate XXXIII.—HOMOPTERA.

Family CICADIDAE.

4. *Cyclochila australasiae* (Donovan).
1. Pupa on emergence from the ground.
2. Pupa casting its skin.
3. Fore-leg of pupa.

5. Ovipositor and sheath separated.
6. Side view of ovipositor.
7. Ovipositor viewed from above.
8. Cross section of ovipositor, showing cutting saws and egg passages.

Plate XXXIII.—HOMOPTERA.



The head is broad, more or less truncate in front, with prominent eyes on the sides, and small gem-like ocelli arranged triangularly on the summit; each antenna consists of one stout basal joint surmounted with several (usually four) segments forming a bristle. The tegmina or fore wings, larger and stouter than the hind pair, are furnished with thickened veins, and are frequently mottled with brown, usually forming bands or spots on the cross nervures. The swollen fore legs are spined; the thorax is well developed; and while the large hollow abdomen of the male is pointed at the extremity, that of the female (usually the larger insect) is furnished with a horny retractile ovipositor, which is adapted for cutting the bark of the twig, wherein she deposits her eggs.

The complicated musical apparatus of the male is situated between the thorax and base of the abdomen, and consists of a large plate on either side attached to, but extending over the basal portion of the abdomen (these plates are often called the drums or opercula); beneath in the abdomen is a cavity formed into two cells within which are two thin glass-like plates called mirrors; above these mirrors are bundles of muscles which lead to two membranes formed like kettle-drums; each membrane has a concave and a convex surface, the latter folded and full of ridges.

Haswell (Pro. Linn. Soc. N.S.W. 1886) describes it thus: “The loud shrill note emitted by the insect is the result of a quick succession of crackling sounds produced by the movement of the stiff membrane with its horny ribs, through the agency of the muscle. Under ordinary circumstances, the sounds follow one another with sufficient quickness to

produce a continuous note, and this is effected not by the contraction of the muscle as a whole, but by the successive contraction of individual *fasciculi* (different filaments forming the whole), all of which act on the horny plate, and thus the movements of the muscle on the tendon during the production of the note resemble those of the hammer-board of a piano when a number of keys are being struck in quick succession."

The life history of cicadas has attracted much attention; on first emerging from the eggs they might easily be taken for minute shrimps, apparently all heads and claws. They cast themselves off the branch and, falling to the ground, burrow into the soil and follow down the roots, where they feed upon the sap and undergo a series of moults. We do not know the length of time that they take to develop underground, but the adults of several of our large species, though each year more or less in evidence, appear in greater numbers every third year, so that it is probable that three years is about the cycle of their subterranean existence. The grotesque pupa burrowing upward when fully developed, bores a vertical shaft often several feet long before it comes to the surface, when it crawls out and climbs up the nearest tree trunk or fence, where it clings till the skin splits down the back, and the perfect cicada emerges. The dry brown pupal shells firmly attached by the sharp claws remain long after the inmates have departed.

Cicadas are well represented in our insect fauna, a number of large handsome species being found along the coastal forest country, and many smaller ones in the interior. The large ones attracted the attention of collectors at a very early date: Donovan, Leach, and

Guérin described several, and Walker (British Museum Catalogue, Homoptera 1850) added a number of new species from material in the Museum collections, but his localities and descriptions are very vague and unsatisfactory. Since then Distant between 1882 and the present date has greatly increased our list of described species. In 1904 Dr. Goding and I monographed the Australian Cicadas (Pro. Linn. Soc. N.S.W.), describing a number of new forms, and bringing the number up to 120 species in 18 genera. Last year (1906), the Trustees of the British Museum issued a "Synonymic Catalogue of Homoptera, Part I., Cicadidae," compiled by Distant; in this a number of alterations in the earlier classification are made, as indicated in his recent contributions on this family in "The Annals and Magazine of Natural History" 1900–1906. He places them in three distinct sub-families which are subdivided into seventeen smaller divisions. Many of our species are now placed in other genera.

The sub-family CICADINAE contains many of our largest and most striking species. Its members have the front edge of the basal abdominal segment on each side produced forward in a leaf-like expansion, which more or less covers the sound organs.

The genus *Thopha* contains two very fine species: *Thopha saccata*, "The Double Drummer," takes its popular name from the great size of the opercula projecting on the sides of the thorax. It is a reddish brown cicada, its wings marked with brown and black, and it measures 5 inches across the outspread wings; it lives in open forest country; has a loud, distinct note; and ranges from South Australia to Brisbane. *Thopha sessiliba* is a somewhat smaller but brighter-coloured species ranging northward along

the Queensland coast from Townsville, and is found in Central Australia at Tennant's Creek.



Fig. 154.—*Thopha saccata* (Fabr.).

The large Cicada called by the children "The Double Drummer."

("Agricultural Gazette," N.S.W.)

The Genus *Arunta* was formed by Distant to contain two Australian species, of which *Cicada perulata* described by Guérin is the type. It is a handsome insect, 4 inches across the wings; is of a reddish brown tint mottled with lighter colours; the wings are unspotted; and the male can be easily recognised by the large white frosted opercula. It is not a very common species; it is taken sometimes about Sydney.

The next division contains three genera typical of Australian species. The Genus *Cyclochila* until lately contained a single species, but Distant has lately described a second from N. Queensland. *Cyclochila australasiae* is our common large green cicada, called by the children the "Green Monday." The whole insect is rich green, the colour extending into the nervures of the tegmina; there is a yellow variety not so common, called in consequence the "Yellow Monday": I have counted as many as 40 of these fine insects resting on the trunk of a small oak-tree in my garden in the early morning.

The Genus *Psaltoda* contains 7 species peculiar to Australia. *Psaltoda moerens*, our common black cicada, is called the "Red Eye" by the Sydney boys on account of the bright colour of the ocelli. It measures over 4 inches across the wings, which are mottled with black on the tegmina, and marked with the same colour on the wings. It frequents the smooth white-stemmed gum trees, and ranges from Brisbane, Queensland to Adelaide, South Australia, and is also found in Tasmania. *P. harrisi* is a smaller and somewhat variable form both in size and colour; it varies from black to brown and even dull green; the wings are very slightly mottled, and it can be easily distinguished from the "Red Eye" by the more distinct silvery patch on the sides of the body.



Fig. 155.—*Psaltoda (cicada) moerens* (Germer).

The Common Black Cicada or "Red Eye."

The members of the Genus *Henicopsaltria*, four in number, are also peculiar to this country. *Henicopsaltria eydouxi*, one of our commonest species, frequents the trunks of the rough-barked gum trees; I have counted over 300 on a single tree on the coast near Gosford, N.S.W. It measures nearly 5 inches across the wings; is of a general mottled light brown and chestnut colour, with the wings infuscated with three zig-zag bands of brown; the opercula are orange red. *H. fullo*, peculiar to W. Australia, is a

very distinctive blackish coloured species measuring about 3 inches across the wings; it can be easily identified by its banded wings and the dorsal surface of the abdomen ornamented with a transverse white band about the centre of the body. The Genus *Macrotristria* now contains 7 species; most of these were originally described in the Genus *Cicada*, and have representatives in all parts of Australia, two coming from W. Australia, and two richly-coloured green species from the tropical forests of N. Queensland, while *Macrotristria angularis*, our common, large, dark brown species, variegated with light yellowish spots on the head and thorax and with deeply infuscated wings, ranges from Adelaide, S.A., to Queensland.

The Sub-family GAENINAE contains a number of South American and Asiatic cicadas, among them some with very brightly coloured wings. Two members of the Genus *Tettigia* are found in North Queensland and North Australia, both of which were once placed in the genus *Tibicen*; while *Tettigia tristigma* is the type of the Genus *Tamasa*. The handsome black and yellow mottled *Gaeana maculata*, common in India and China, has been recorded by White from Australia, and Goding and I had specimens from the Northern Territory of S. Australia, but Distant does not notice this record.

The Sub-family TIBICININAE have the front edge of the basal abdominal segment straight, not produced forward; and the sound organs are entirely uncovered. *Venustria superba* is a curious ferruginous insect with rich coppery tints upon the tegmina and wings, which comes from North Queensland. Dodd usually collected it in the neighbourhood of termite nests.



Fig. 156.—*Henicopsaltria eydouxi* (Guérin).

The Mottled Grey Cicada.

("Agricultural Gazette," N.S.W.)

The Genus *Abricta* now includes most of our species previously placed in the Genus *Tibicen*; thirteen are listed from Australia. *Abricta curvicosta*, one of the largest, measures about 4 inches across the wings; is reddish brown with a pale stripe down the centre of the prothorax, and three black spots on each of the tegmina. It is one of the common species about Sydney, N.S.W., in midsummer, and is called the "Floury Miller" on account of the silvery pubescence covering the body which makes it look as if it had been dusted with flour. *A. aurata* ranges from Tasmania and Victoria into the southern districts of N.S. Wales, and is usually found upon the fern trees; it is a smaller darker coloured cicada with a large, sometimes double, black spot on each tegmina.

Distant (Pro. Zool. Soc. 1882) described a number of new species chiefly obtained from North Queensland; and, finding it difficult to give them distinctive specific names that would define their peculiarities, he got over the difficulty by naming them after Australian explorers. *A. willsi* is a small species measuring about two inches across the wings, which are marked with two small spots, and it can be easily distinguished from all the others by the

curious rugose yellowish patch on the sides of the prothorax. It has a very wide range over N.S. Wales, Queensland, North, and probably W. Australia, both along the coast and in the interior.

Parnkella muelleri is only about 1½ inches across the wings which have two spots on each tegmina, and is of a pale yellow tint. It is restricted in its range to North Queensland. The tiny little yellowish green cicada found upon the grassy plains of Southern Victoria and S. Australia, described as *Tibicen infans*, is now placed in the South African Genus *Quintilia*.



Fig. 157.—*Macrotristria (cicada) angularis* (Germer).

The "Fiddler."

("Agricultural Gazette," N.S.W.)

The Genus *Chlorocysta* contains two curious pale green insects with vitreous tegmina and wings, the former much more closely reticulated than the ordinary cicada, with many cross and parallel nervures. The head is small, and the body of the male is swollen and cylindrical. *Chlorocysta vitripennis* was described by Westwood (Ann. Nat. Hist. 1851); the larger male measures slightly over 2 inches across the wings. The female is greenish or reddish, the abdomen conical but not inflated. They frequent low scrub; the southern forms found about

the Tweed River, N.S.W., are green or yellowish; those from North Queensland quite brown. *Glaucopsaltria viridis*, described by Goding and me from S. Queensland, is placed by Distant in this genus.



Fig. 158.—Section of stem of eucalyptus, in which the Black Cicada (*Psaltoda moerens*) has laid her eggs.

The Genus *Melampsalta* contains a great number of our small black or dark brown cicadas often marked with orange red or dull yellow. The members of the genus are found over Asia, Africa and Europe, over 40 are described from Australia, and 7 from New Zealand. Some species are very numerous in early summer, and are known as “Squeakers” on account of their musical notes. *Melampsalta torrida*, originally described by Erichson from Tasmania, has a wide

range round from Queensland to W. Australia. It is almost black, with several light marks in the centre of the thorax, and two irregular rounded confluent black spots at the tips of the tegmina. It measures about two inches across the wings, but is variable both in size and in the wing markings. *M. abdominalis*, about the same size, is black, with two lines of reddish yellow on the apical portion of the dorsal surface of the abdomen, and the under surface red; when the tegmina are closed there is a distinctive opaline mark on either side. It is common in S. Australia and N.S.W. *M. eyrei* is a much smaller species, with the head and thorax black, lined with yellow, and the whole of the abdomen except the black tip, bright yellow; it is common in N. Queensland.

The members of the Genus *Pauropsalta* are easily distinguished from those of the previous group by having five apical areas in the wings, while the former have six. Sixteen species are described from Australia. *Pauropsalta encaustica* is our commonest species with a very wide range over Australia; it is of a uniform black tint, with faint pale brown marks on the head and prothorax, and an infuscated patch on the hind margins of the wings; the abdominal segments are finely ringed with white to reddish brown. *P. annulata* is a synonym of this cicada. *P. nodicosta* is a small brown species from Kalgoorlie, W.A., with a curious node in the centre of the costal nervure of the tegmina. *P. mneme*, larger, and broader than *P. encaustica*, has the abdominal segments richly edged with red. It is common on the Blue Mountains, N.S.W.

The Genus *Cystosoma* was created by Westwood (1842) to contain the great green “Bladder Cicada”

which he called *Cystosoma saundersi*, that at one time was common in the orange orchards around Newcastle, N.S.W. Mrs. Ross says it is now common about Armidale, N.S.W., on the sweet brier, and I have also had it on willows from Glen Innes N.S.W. A second much smaller species, with similar opaque green tegmina, *C. schmeltzi*, ranges up the coast of North Queensland.

The two curious hairy brown cicadas belonging to the Genus *Tettigarcta* are restricted in their range. *Tettigarcta tomentosa*, the darkest in tint, has each side of the thorax produced into a distinct spine; it is only found in Tasmania. *T. crinita* comes from similar country in the Gippsland forests, Victoria; it is not quite so hairy, and has the thorax rounded on the outer margin without any spines.

Family 2. Frog-Hoppers.

CERCOPIDAE.

The members of this family are not very numerous though world-wide in their distribution. They are stout, wedge-shaped, elongate insects of moderate size; the head is furnished with large flattened eyes on the sides; with a few exceptions two ocelli are present on the vertex between the eyes; the small, short antennae, composed of two bead-shaped joints surmounted with a bristle, are placed in front of and between the eyes. The pronotum is large with the triangular scutellum occupying the centre of the back; the tegmina, longer than the body, are coriaceous, reticulate, with two long discoidal and five or more apical cells. The coxae and femora are short; the posterior tibiae are hardly longer than the others, rounded at the base, spatulate at the apex,

armed on the outer margins with two stout spurs, the second twice the length of the first; the tibiae and basal joints of the tarsi are terminated with rows of spines.

Most of our known species were described by the French naturalists, Amyot & Serville (Annals Soc. Entom. de France 1845); and Walker (Brit. Museum Cat. Homoptera 1851); and but little attention has been paid to them since. Our most characteristic species belong to the Genus *Eurymela*. Seventeen species are listed by Walker from all parts of Australia. They are large, thickset frog-hoppers, with the head broad and truncate in front with the face much inflexed; their general tint is blue-black with the head and elytra marked with red or white bands or spots. They lay their eggs under the bark of young gum trees, slitting it in regular rings with their stout ovipositors and leaving a white papery substance along the punctures. The young cling to the twigs in clusters after they emerge, and they may often be seen in different stages of growth upon the same bush. They are very active little creatures, creeping round the twig when disturbed, and jumping as soon as they are touched. Many of them are much sought after by ants which come to them for the honey dew they secrete.

Eurymela bicincta measures ½ an inch in length, and is broad in proportion; it is of a uniform dark shining blue tint, with the head, thorax, and base of the elytra bright red. It has a wide range and may often be found in colonies of 30 or 40 clustering together on a gum sapling. *E. rubrovittata* is about the same size; it is black, with the under surface, face, and three narrow transverse bands round the thorax and elytra bright red. It has a range from Western

Australia to Queensland. *E. speculum* is a common species, recorded from Tasmania to Queensland; it is of a uniform dark blue-black tint with a white patch on either side of the face, and two irregular oval white spots on each wing cover. *E. pulchra* is smaller, with the head and thorax marked with red, and two irregular broken bands of white on the side of each wing cover.

Five species of the Genus *Aphrophora* are described by Walker from Tasmania and Australia. The members of this genus are known as "Cuckoo-spittle Insects" from the remarkable habit the larvae have of enveloping themselves in a mass of frothy liquid, which is supposed to be formed to protect their soft bodies from insects that might prey upon them; it, however, really makes them very conspicuous objects on a twig, and several species of wasps are known in America to drag them out of this covering and use them to provision their nests.

Our common "Cuckoo-spittle Insect," found upon the she-oak (Casuarina), ti-tree (Leptospermum), and Melaleuca, is *Chalepus teliferus*; the larvae are pale-brown soft oval creatures, which jump when removed from the frothy liquid, and in this liquid they remain enveloped until they are ready to emerge. The perfect insect measures under ½ an inch in length, is of an elongate boat-shaped form; the head is produced in front as a slender process, curved upwards; the tips of the elytra come to a compressed point; the general colour is dull reddish brown, with the horn on the head ferruginous, and the wing covers mottled on the sides with black. A second species, *Chalepus pugionatus*, has been described by Stal from Australia.

Family 3. Tree-Hoppers.

MEMBRACIDAE.

This is a group of homopterous insects chiefly confined to the tropical parts of the world. They are well represented in Australia, though we have nothing like the remarkable creatures covered with horns and spines found in South America and popularly known in consequence as "little devils." They are remarkable for the wonderful development of the prothorax which, projecting in front, often forms a hood above the head, so that the latter is much hidden when viewed from above; the eyes are globular and project on the sides of the head, and there is a pair of ocelli in a line between them; while the short bristle-like antennae are well below the eyes on either side of the base of the stout rostrum (beak), which at rest is turned down between the legs. The abdomen is covered with the wings and parchment-like tegmina, the extremities of which come together to form a sharp point. The legs are short and stout, without the numerous spines common on the "frog-hoppers"; and the tarsi consist of three joints, the first longest. They can both fly and jump very well, but trust to the latter method to escape from their enemies. They and the members of allied families can be easily collected by shaking or beating low scrub over an open umbrella; or can be bred from larval forms on the food plant.

Very little attention had been paid to our tree-hoppers until a few years ago when Goding published his "Check List of the Membracidae described from Tasmania and Australia" (Pro. Linn. Soc. N.S.W. 1898); in this he gives many notes and lists 22 species, chiefly described by Walker (Brit. Museum Cat. Homoptera 1851), Fairmaire, in his

Review of the family in 1846, and Stal in 1869. In 1903 Goding, in the same Journal, published a "Monograph of the Australian Membracidae." In this he re-describes all the known, and adds a number of new species to our fauna, bringing the list up to a total of 32 described species, comprised in 14 genera, grouped in 6 sub-families, based chiefly upon the shape and structure of the prothorax.

The Genus *Sextius* contains five species, in which the prothorax is ridged in the centre and produced on either side into a rather short acute horn standing out on either side, and with the apical portion produced into a keeled spine extending to the tip of the abdomen. *Sextius virescens*, our commonest species, is of a delicate green colour, and feeds upon the sap of the black wattle and other species of Acacia. In early summer it may be found among the foliage in all stages of development; the trees they frequent are frequently infested with ants which come to obtain the honey dew. The female slits the bark with her ovipositor, and lays the eggs in rows. *S. depressus*, about the same size, slightly over ¼ of an inch in length, ranges from Western Australia to Queensland: at Kempsey, N.S.W., I obtained specimens on a slender leafed Acacia. It is of similar green colour to *S. virescens*, with the front of the thorax of a lighter tint, but the projecting horns are shorter and depressed, and the venation of the elytra is much finer. *S. australis* is about the same size, and of a uniform black tint with a patch of bright silvery pubescence on the sides of the thorax, which is rounded in front and has very short blunt horns. It lives upon the branchlets of a prickly Hakea growing about Sydney.

Lubra spinicornis is a slightly smaller insect, of a

general dull brown tint: it has the prothorax produced into two almost erect clubbed horns. Specimens have been obtained from Brisbane, Queensland, and the northern rivers of New South Wales. *Daunus tasmaniae* is of the same chocolate brown colour; is more robust in proportion. The prothorax forms a regular hood swelling out on either side at the base of the tegmina, and the projecting horns are curved and deeply ridged, and are chisel-shaped at the tips. It is one of the commonest species in Tasmania, and is recorded over a wide area of the eastern mainland as far North as Brisbane.

Eufroggattia tuberculata is a rare insect usually found resting on a twig of a eucalyptus sapling, and is shaped very much like some of the small plant bugs belonging to the Genus *Testrica*; it is short and broad in form, with the head exposed; the thorax has short blunt horns; and the abdomen is broadly rounded at the apex.

Family 4. Lantern-flies.

FULGORIDAE.

This is a very difficult family to satisfactorily define, as their members are very diverse in general shape and structure, with points of resemblance that bring some of the genera very close to the Cercopidae (from which however they differ in the shape of the head), while they somewhat resemble the Jassidae in the structure of the legs.

The typical forms have the front of the head either produced into a lance-shaped structure, or the face and vertex either rounded in front or forming an acute angle. The eyes are large and stand out on the

sides of the head; the ocelli, usually two in number, are situated below or near the eyes and are placed in the cavities on the cheeks; in a few species there are three ocelli, while in others they are wanting. The antennae, situated beneath the eyes, and often very peculiar in structure, consist of two short joints surmounted with a bristle.

Many are large handsome insects with bright coloured tegmina and wings; others are of delicate green and grey tints, quite moth-like in form, but can be easily distinguished by the way they rest with their stiff roof-like wings, and by their active jumping habits. The legs are often long, and the hind pair are furnished with a few stout spines on the tibae, but never thickly spined as in the Jassidae. Many of our larger species are found both in the larval and perfect state, on tree trunks. A few species are well-known pests and have an extended range beyond Australia.

Donovan described and figured several species (Insects of New Holland, 1815); Westwood figured and described two in his “Monograph of the Genus Fulgora” (Trans. Linn. Soc. 1837): but the majority of our species are described by Walker (Brit. Mus. Cat. Homoptera, 1851), and he also named others in “Insecta Saundersiana, Homoptera,” 1858, which describes the insects in W. W. Saunders’ great collection.

Siphanta acuta, better known under the name of *Cromna acuta*, is one of our commonest fulgorids, moth-like in appearance, of a pale green colour, with broad square-cut fore wings and a short pointed head. It measures about an inch across the outspread wings. It has a wide range in Australia; and its pale green fluffy larvae feed upon the sap of many plants,

and readily jump when touched. It is also well known in Hawaii, Sandwich Islands, where it is called the "torpedo-bug" from the way it jumps; and it is said to be a pest on the coffee plants (Smith Annual Report, Hawaii 1904). A number of species of these moth-like forms are described by Walker from Australia and Tasmania, and placed in the Genus *Bythoscopus*, which genus, when further studied, will probably be much subdivided.

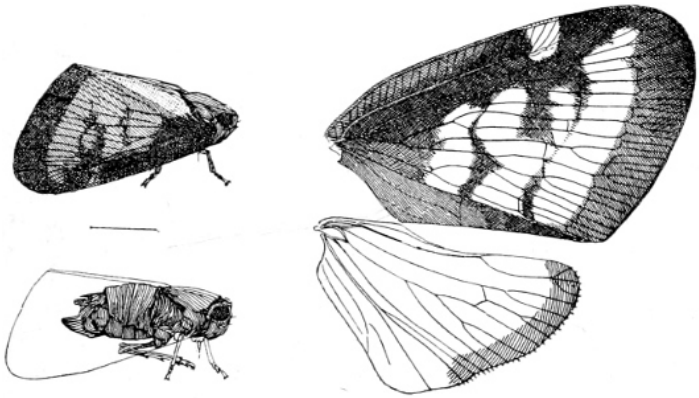


Fig. 159.—*Scolypopa (Pochazia) australis.*

The Common Passion-vine Hopper.

Pochazia australis measures about ¾ of an inch across the short broad fore wings, which are margined and irregularly barred with chocolate brown; the head is short and rounded in front. Melichar, in his "Monographie der Ricaniiden, Wien," 1898, places *P. australis* in the Genus *Scolypopa*. The larva is a green wedge-shaped little creature clothed at the tip of the abdomen with a bunch of white filaments. It is a very common insect with a wide range. Sometimes it is a pest on passion vines; the eggs are laid in the slender tendrils, and the larvae suck up the sap of the stalks. Another species is common among the foliage of the silky oak

(*Grevillia robusta*) in Southern Queensland.

Achilus flammeus has the body and wings of a bright red colour, with the small head showing prominently in front: the broadly rounded opaque elytra and wings cover the short body. It measures about an inch across the outspread wings. Nothing is known about its habits or life history, but in the summer evenings it sometimes comes flying towards the light, and can be found on the windows.

The Genus *Poeciloptera* contains a number of small, short broad-winged forms. Donovan figures *Poeciloptera modesta*, which has pink fore wings, each marked with two small red spots, and the hind wings have a pale bluish tint.

Prolepta dilatata is a typical, dull reddish-brown fulgorid, measuring nearly an inch from the tip of the long slender head to the extremities of the folded tegmina which are broadest across the tips: and the slender prolonged forehead is over two lines in length. This insect was described from W. Australia, but it has a wide range and can be collected about Sydney. *P. obscurata* is about the same size, more rugose in structure, and with markings of dark brown; the markings on the somewhat opaque wings are more distinct, striated and irregular than in *P. dilatata*: it can also be easily recognised by the shorter and thicker process on the forehead. It has a wide range over Australia.

The Genus *Eurybrachys* contains a number of short, dark brown insects with broad rounded heads; they run about on the trunks of trees, jumping at the least alarm. *Eurybrachys leucostigma* is a very stout, broad, dull brown insect, about ¾ of an inch across the outspread wings. Some 16 species are described from all parts of Australia. The members of the

Genera *Ledra* and *Stenocotis* are broad elongate insects with the front of the head spade-shaped, and the convex body tapers to a sharp point. Their larvae are almost as flat as a bit of paper. *Stenocotis australis* is about ¾ of an inch in length, and of a dull brown tint.

Family 5. Leaf-Hoppers.

JASSIDAE.

These insects are minute froghopper-like forms with the head rounded in front, and with the body tapering towards the tips of the tegmina. The head is large, with the oval or rounded eyes projecting on the sides, and with a pair of ocelli situated on the front margin. The antennae, bristle-like, of considerable length, are each composed of two short cylindrical basal joints with a thread-like terminal portion, and are placed in front and below the eyes. The legs are long, well adapted for jumping (their chief means of progression); and the tibiae of the hind pair are thickly clothed with stout spines.

Though these insects are very small, many species appear upon crops and herbage in such immense numbers that they often do a great deal of damage, and are very interesting from an economic standpoint. In Japan, for instance, there are several species very serious pests in the rice fields; while in North America *Erythroneura vitis* is a well-known pest upon the foliage of vines.

They are abundant on the low scrub and grass lands in this country in favourable localities, and may be easily collected with a sweeping net, or by shaking the bushes over an open umbrella; yet, probably on account of their small size and retiring

habits, few specimens are to be found even in our Museum collections.

The sugar-cane hopper, *Perkinsiella saccharicida*, a native of Queensland, is a dull brownish yellow hopper with a dark parallel stripe down the centre of the basal portions of the tegmina; it measures a ¼ of an inch in length. Kirkaldy described it from Hawaii, where it has been introduced, and is a serious pest to the sugar-cane.

A very pretty little unidentified species, bright red and yellow, with the fore wings marked with dark brown, is common upon the broad soft leaves of *Eucalyptus robusta*, where the curious little larvae rest in families of three or four; each is enveloped in white filaments which proceed from round the tip of the abdomen. The larvae of another species have been observed to form large colonies on the surface of the leaves of low eucalyptus bushes on the hills near Capertee N.S.W. They suck up the sap, discolouring the centre of the leaves; each exudes a globule of liquid from the tip of the abdomen, which they drag out into thin threads with their hind legs, to form a spider-web-like covering over their bodies, and this web dries soon after the leaves are gathered.

Family 6. Lerp Insects.
PSYLLIDAE.

These are small homoptera, in appearance suggesting miniature cicadas. The head is generally broader than long, sometimes deflected and with large eyes; the ocelli are three in number, the lateral ones situated on the summit of the head close to the hind margins of the eyes, and the central one at the apex of the median suture. The antennae are each

composed of ten joints, the first two shorter and thicker than the following ones, and the terminal joint surmounted with two short bristles. The thorax is broad, with well developed tegmina and wings, and like the aphids both pairs might properly be called wings. The venation is simple, constant, and useful in the work of classification. They are formed for jumping, with a spine-like process on the coxa of each hind leg, and the apex of the tibiae of the hind legs furnished with a row of short fine spines. The tarsi are two jointed, terminating in a pair of large claws.

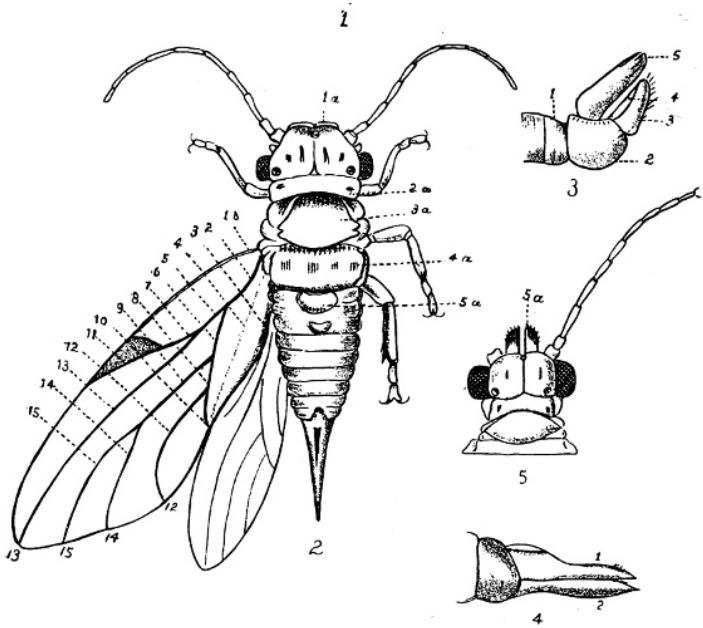


Fig. 160.—Diagram of Psylla (*Thea opaca*) ♀.

Showing the structure and venation of the wings.

1*a*, Face lobes; 2*a*, prothorax; 3*a*, mesanotum; 4*a*, dorsulum; 5*a*, scutellum, tegmina; 1*b*, costal nervure; 2*b*, primary stalk; 3*b*, clavus; 4*b*, clavical suture; 5*b*, stalk of sub-costa; 6*a*, stalk of cubitus; 7*b*, sub-costa;

8*b*, lower branch of cubitus; 9*b*, upper branch of cubitus; 10*b*, lower fork of lower cubitus; 11*b*, stigma; 12*b*, upper fork of the lower branch of cubitus; 13*b*, radius; 14*b*, lower fork of upper cubitus; 15*b*, upper fork of upper cubitus.

3, Genitalia ♂; 4, Genitalia ♀; 5, Head of *Spondyliaspis eucalypti*, showing face lobes.

(Pro. Linn. Soc. N.S.W.)

The female lays her eggs in clusters on the twigs or foliage, from which the curious, little, large-headed larvae emerge, and, after undergoing a series of moults during which they develop large wing-pads on the shoulders and more joints in the antennae, they finally come forth, perfect four-winged insects. They take their family name from *Psylla*, a flea, given them by Linnaeus in reference to their jumping powers, and their popular name of "Lerp Insects," from the habit of the larvae of many species of forming "lerp scales," shell-like protective coverings formed from exudations from the insects. Other species cover themselves with flocculent matter after the manner of mealy bugs; and yet another group form regular oval or rounded galls on the foliage. They are found in most of the warmer parts of the world, and are very numerous in Australia, where they seem to take the place of the APHIDAE to a certain extent; they are readily collected in all stages of growth upon their food plant, and can be easily bred.

The Sugar lerp, *Psylla eucalypti*, whose larvae cover the leaves of several species of gum trees with their white woolly shells, was described by Dobson from Tasmania (Pro. Royal Soc. Van Diemen's Land, 1851). It is a slender little green creature with very long face lobes, and, when crawling about, turns the

tip of its body upwards, so that it looks as if it were walking on its head. It is now placed in the Genus *Spondyliaspis*.

In the same year (1851) Walker published his Homoptera (Cat. Brit. Museum) in which he recorded 5 species, all from Tasmania; and it was not until 1898 that they were again noticed when Maskell described 3 species from Australia (Trans. N. Zealand Inst.); and Schwarz defined another (Pro. Ent. Soc. Washington) in 1897. Between the years 1900 and 1903 I contributed three papers (Pro. Linn. Soc. N.S.W.) monographing our species, in which 64 new species are added to our fauna. I followed Low in the classification of the sub-families, adding Scott's fifth division for those with small heads and no face lobes.

In the LIVIINAE, the front of the head is not produced into face lobes; the stalk of the cubitus is either shorter, as long as, or longer than the lower branch of the cubitus. *Crewiis longipennis* is of a general bright red tint, and is ¼ of an inch in length; it ranges from Tasmania to the North of New South Wales. The larva forms a rounded pale yellow lerp covered with fine woolly filaments upon the leaves of gum trees. *Lasiopsylla rotundipennis* forms a large, flattened, irregularly rounded white scale on the foliage of *Eucalyptus melliodora*, under which the flattened, pale green larva hides.

The Sub-family APHALARINAE contains a number of small species, and the head is produced in front into face lobes, with the stalk of the cubitus as long as or longer than the stalk of the sub-costa. They usually form lerp scales; but some are naked, or clothed with soft white woolly filaments.

Several species of the Genus *Spondyliaspis* belong to this group; all of them form "sugar lerp scales,"

often encrusting all the foliage of the young gum trees, and are so abundant that in the Mallee scrub country in Victoria and S. Australia the blacks used to collect and eat it in quantities, and had a regular "manna harvest." *Cardiaspis artifex* is a short, reddish yellow insect, the larvae of which form beautiful barred shell-like lerps, marked with red and yellow to look like delicate fretwork, upon the leaves of *Eucalyptus robusta*. *C. tetrix* is a pretty pink and grey species found in the Adelong district, N.S.W. The larva constructs a most remarkable cage of fine red bars, not unlike a lady's hair net, beneath which the larva crawls about freely like a bird in a cage. *Rhinocola corniculata* often covers the leaves of different eucalypts with its elongate, opaque, horny, yellow lerps. The test is not unlike that of a large *Mytilaspis* scale, but is open at the broad end through which the little larva can creep in and out. It ranges from New South Wales to Western Australia. *R. eucalypti* is a very tiny, little, dark brown psylla, the larvae of which cluster at the tips of the foliage of young blue gums (*Eucalyptus globulus*), and cover themselves with threads of white flocculent matter. It was described by Maskell from New Zealand, but is common both in Tasmania and Australia: it has also been introduced into Africa on the same eucalypt.

The larvae of the Genus *Thea* are curious, broad, flattened creatures, with hard integument. They hide under the dead bark on the trunks of the white stemmed gums, spreading their white woolly secretion around them; the ants look after them, and probably protect them from many enemies in return for the "honey dew," of which secretion the ants are very fond. *Thea opaca* is of a general reddish pink colour mottled with brown and black; the wings are transparent, with a dark stigma on the fore wing.

The members of the Sub-family PSYLLINAE have the same well-defined conical face lobes, but the stalk of the cubitus is shorter than the stalk of the sub-costa. The larvae may be quite naked, but most of them produce woolly filaments more or less covering them, and form no true lerp scales or galls. The typical Genus *Psylla* comprises a number of usually small and somewhat stouter insects, many of which cluster in swarms like aphids upon the foliage of wattles and other trees. The eggs, larvae, pupae, and perfect insects may be found on the same twigs. *Psylla acaciae-decurrentis* is a slender, dark-winged insect remarkable for the length of its slender antennae; it is common upon the black wattle in early summer. *P. acaciae-baileyanae* is a much smaller yellow species with mottled wings that often swarms over the cultivated "Cootamundra wattle," and is reported to have destroyed all the flower-buds of this wattle in the neighbourhood of Melbourne in 1905. *P. capparis* is a mottled winged species that frequents the foliage of *Capparis mitchelli* in the western scrubs: *P. schizoneurodes* infests the twigs of the allied "Warrior Bush"; the larvae are covered with flocculent matter and have a globule of liquid substance at the tip of the abdomen; when massed together they look much like "woolly blight" on the apple trees. *P. sterculiae* is a small brownish species, found upon the twigs of the Kurrajong, and has a wide range over New South Wales.

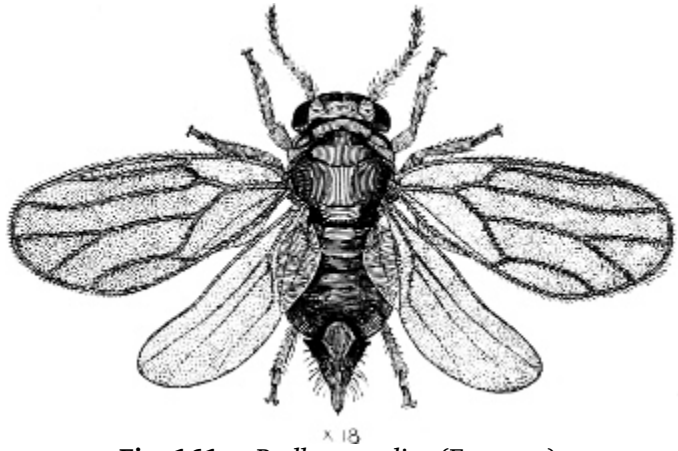


Fig. 161.—*Psylla sterculiae* (Froggatt).

The Kurrajong Twig Psylla.

("Agricultural Gazette," N.S.W.)

Two very curious species are found upon the thick fleshy leaves of our native figs, and one, *Mycopsylla fici*, lays her eggs upon the foliage, the squat grey larvae burying their beaks in the leaf cause a flow of milky sap, under which they hide in small colonies, and when ready to emerge crawl from beneath the viscid mass. Where numerous, they cover the foliage with these sticky patches, and cause the leaves to fall. The perfect psylla is a handsome, dark-coloured insect with long antennae and ample transparent wings.

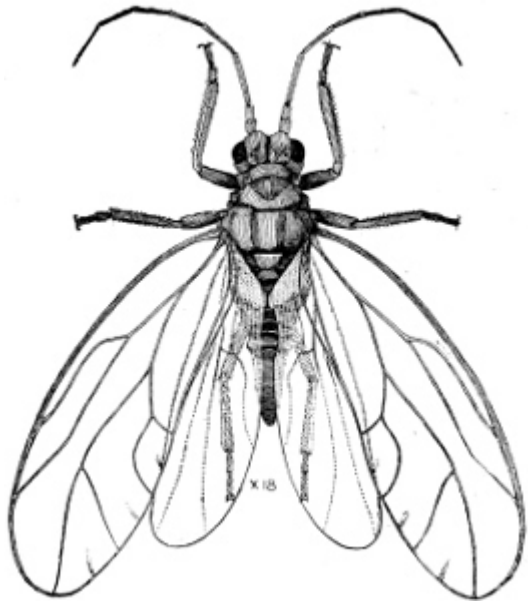


Fig. 162.—*Tyora sterculiae* (Froggatt).

The Star-psylla found on the surface of the leaves of the Kurrajong.

("Agricultural Gazette," N.S.W.)

Sub-family TRIOZINAE. The cubitus of the wing has no stalk, the veins forking directly from its junction with the sub-costa. All our species, with one exception, come into the typical Genus *Trioza*: many of them are gall makers in the larval state, others are naked and cling to the under surface of twigs and leaves. The larvae of the gall-makers are broad, oval, flattened creatures, covered with a mealy secretion, the outer margin of the dorsal shield in each case being fringed with fine regular ciliae. Most of the perfect insects are thickset; they range from chestnut brown to reddish yellow; and have clear transparent wings. *Trioza carnosa* makes a large, oval, fleshy, brightly tinted gall with an irregular opening at the

summit, often covering and aborting the foliage of eucalypts about Sydney. The larva of *T. eucalypti* forms a rounded, hard, woody gall upon the leaves, without any opening on either side until the gall contracts and splits open, when the full grown pupa emerges. *T. casuarinae* is a very pretty little psylla with dark-barred wings, and its curious naked fish-like larva clings to the slender foliage of the she-oak (*Casuarina*). *T. banksiae* has a tiny, naked, yellow larva covered with silvery down; it is a rare insect found on the under surface of the honeysuckle leaves. Nearly all these species have been collected within a day's journey from Sydney, but have a wide range on the eastern coast.

The Sub-family PRIONOCNEMINAE was formed by Scott for Walker's Genus *Tyora*, in which I have placed two species. *Tyora sterculiae* is a pale green, aphid-like psylla, with long antennae and large transparent wings. The larvae cluster together on the leaves of the Kurrajong, forming white patches over the foliage, and each larva throws out slender white threads, fringing the tip of the abdomen and radiating about the body. *T. hibisci* is a delicate pale green insect which has been taken on the foliage of *Hisbiscus tiliaceus*, about Brisbane, Queensland, and also on a creeper on the Tweed River, New South Wales.

Family 7. Aphids or Plant Lice.

APHIDAE.

These destructive little creatures are well known to gardeners under different names, such as "smother or green-fly," "plant lice," or "blight." This family contains one of the most destructive and widespread

pests that ever attacked cultivated plants, namely the vine louse (*Phylloxera vastatrix*), which has destroyed millions of pounds' worth of vines, and has followed its host all over the world. Aphids are all small soft-bodied creatures, green, black, or yellow in colour; and at least ten introduced species are to be commonly found in our gardens and fields; but as far as I know, no indigenous aphid is recorded in Australia.

The life history of these insects is very complex; the winter eggs or larvae lie dormant during the cold season in crevices on the trunks, or hidden underground on the roots of their host plants; but as the warm weather approaches they crawl up the trunks, cluster round the opening leaf buds, and sticking their sharp beaks into the tissue, suck up the sap. These give birth to living larvae which grow very rapidly, and in turn (though virgin females) bring forth fresh broods of live larvae that in the course of several generations develop two pairs of large transparent wings, and consist usually of both sexes, though in some species the males are wanting. The last generation fly away in swarms but before dying deposit eggs which carry on the cycle of their life into the next summer.

The wingless forms are short, stout, rounded creatures with small, slightly lobed heads, and rather stout 3 to 7 jointed antennae; the legs are well-developed with two-jointed feet. The abdomen often swells out into a flask-like shape; it is furnished on the 5th segment with a pair of cylindrical tubes called siphons, through which it discharges a sweet secretion known as "honey dew"; this liquid is often ejected in such quantities on aphis-infested plants that it covers the foliage, and attracts the ants, which

come and lick up the globules of honey-dew on the tips of the siphons, and even caress the aphis with their antennae; and therefore in popular works these insects are often described as “ants’ cows.”

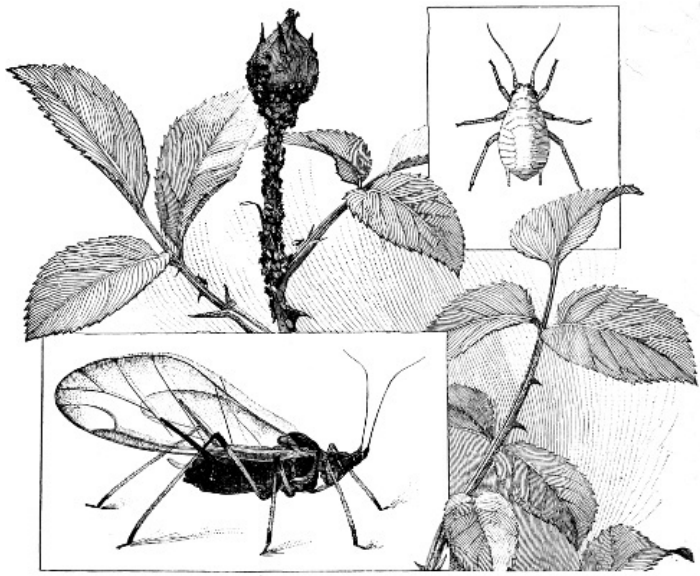


Fig. 163.—*Siphonophora rosae* (Linn.).

The Rose Aphis of the garden.

1, Rose buds infested with aphis; 2, larva; 3, winged female aphis.

(“Agricultural Gazette,” N.S.W.)

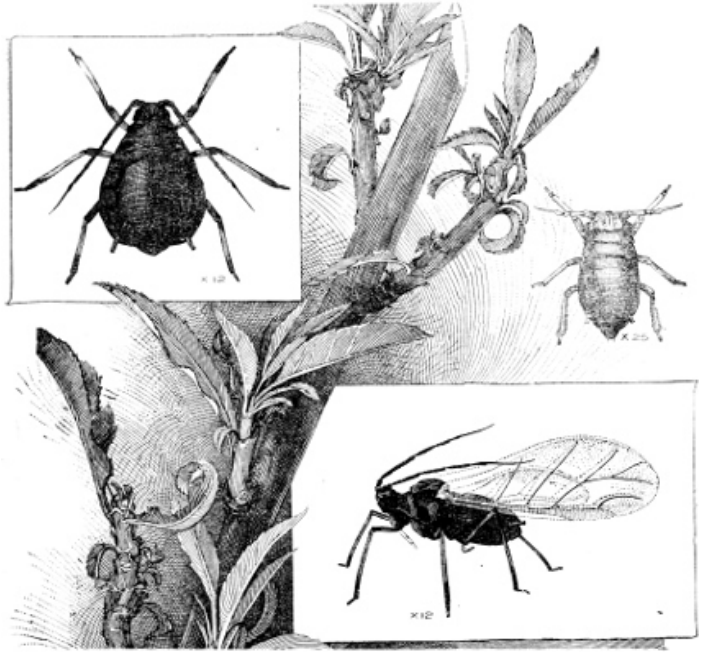


Fig. 164.—*Aphis persicae-niger* (Smith).

The American Peach Aphis (introduced).

("Agricultural Gazette," N.S.W.)

Among the introduced species common in Australia is the Cabbage Aphis, *Aphis brassicae*, a dull green insect covered with a floury exudation; it is one of the greatest pests that the cabbage-growers have to deal with, and is always most troublesome in dry weather. The Rose Aphis, *Siphonophora rosae*, is a pale green species appearing in the spring on the young buds of the roses, but seldom doing very serious damage. The Woolly Aphis, *Schizoneura lanigera*, common both on the roots and branches of apple trees, is found in most of our old orchards; the dull blue aphids cluster together in colonies with their beaks buried deeply in the bark, and the clusters become covered with a mass of soft white

flocculent exudation, hiding them from view. From the irritation to the plant tissue caused by their presence large galls or excrescences appear all over the branches. The Peach Aphis, *A. persicae-niger*, is another common orchard pest which winters on the roots of the peach trees: in early summer they commence to spread, and if neglected do a great deal of damage to the leaf and flower buds.

The chief work dealing with the systematic classification of plant lice is Buckton's "Monograph of the British Aphidae," published by the Roy. Society, London 1881. A number of new species have been described since by American entomologists in bulletins on Economic Zoology.

Family 8. Snow-Flies.

ALEURODIDAE.

These are all very small delicate creatures; both sexes are furnished with two pairs of broad rounded wings with simple parallel veins, and are usually thickly covered with a mealy white dust from which they take their popular name of "Snow-Flies." The head is broad, furnished with a three-jointed beak enclosing setae; seven-jointed antennae; and large reniform eyes, with an ocellus on either side above the eyes. The thorax is broad and the abdomen soft and rounded. The tarsi are two-jointed terminating in two claws at the extremities.

The female lays her eggs in clusters on the under surface of the leaves, where the young larvae later on form regular oval, glassy tests of various colours, enclosed in which they feed and finally pupate. The adult insects have their short broad wings slightly expanded, and cluster together in threes and fours:

but the moment their food plant is touched they fly out in a little cloud. They can, like the scale insects, be very easily introduced into a new country with their food plant, and several species, like *Aleurodes vaporariorum* described by Westwood from Europe, have a wide range over America and this continent.

The snow-flies are well represented in Australia, and several species do a considerable amount of damage to native shrubs, but on account of their delicate structure and small size they are difficult to collect, and harder to preserve when collected; if mounted on card they dry up, with nothing to determine them from but the wings, which have very few distinctive characters. The most satisfactory method of preserving them, is to drop the live insects into oil of cloves on a micro slip, when they usually open their wings and legs, and then make, with a little care, very fine objects when mounted in balsam; at times, however, the floury covering floats off the wings and body and sometimes clouds the mount.

Maskell has described 8 species from Australia (Trans. N. Zealand Inst. 1896); most of these descriptions, however, were based upon the larval tests or scales (and not the adult insects) which had been sent to him under the idea that they were scale insects; so that whoever takes up the study of snow-flies will have to breed them out, to be sure of the identity of his species. *Aleurodes styphelia* forms a flattened, oval, black test fringed with white waxy tubes almost as long as the encircled larva, scattered about over the leaves of *Styphelia richei*, a common scrub bush about Sydney. *Aleurodes t-signata* forms a spiny black test; and with a second undetermined pale yellow species without a marginal fringe, is

found about Sydney on the foliage of *Acacia longifolia*. Another species, *A. banksiae*, is found upon both the honeysuckle (*Banksia*) and the bottle brush (*Callistemon*).

In Maskell's paper, which is an important contribution to the study of these small but very interesting insects, he lists 65 known species belonging to the typical Genus *Aleurodes*; some have since been described from America, of which a few have been placed in the Genus *Aleurodicus*, formed by Douglas for those with a distal and basal branch on both wings.

Family 9. Scale Insects.
COCCIDAE.

These insects take their popular name of scale insects from the habit that many of the typical species have of protecting themselves, after they have settled down on their food plant, by forming a shield or scale over their backs under which they feed and produce their eggs or living larvae. To form the scale the moulted larval skin, called the pellicle, becomes a nucleus in the first place, round which exudations are added until the scale insect ceases growing.

The larvae are pale yellow, pink, or dull-red coloured little creatures, oval or shield-shape in form, usually fringed round the margins of the body with fine filaments, which are often long upon the somewhat thickened irregularly-jointed antennae and form longer setae upon the tip of the abdomen. They have distinct black eyes, well-developed legs; the mouth is pointed and beak-like. At this stage of their existence the sexes do not differ in outward

appearance, but when they attach themselves to their food plant the males and females of the same species often construct scales of very dissimilar form; while in others the male scales are simply more elongate than those of the female.

The male coccid is a delicate fragile little creature, usually microscopic in size, so that, unless bred out in confinement from scale-infested foliage, they are seldom seen. He has a well defined head rounded behind, furnished with moderately long antennae composed of thickened irregularly-jointed segments fringed and surmounted with fine filaments. The globular black eyes stand out on the sides of the head, but the mouth is aborted so that it cannot feed. The thorax, lobed on the dorsal surface, is furnished with a pair of rounded wings each with a simple central nervure, but he can fly well in spite of their delicate structure. The slender legs are simple, terminating in rudimentary hooks; the elongated abdomen is distinctly segmented and furnished at the extremity with a pair of long slender white filaments. This period of his existence is short: thousands of them perish very soon after they leave their scale, and the survivors as soon as they have impregnated the female die.

The female coccid as soon as she settles down to suck up the sap develops under her protective shield (which, unlike the male, she never leaves) into an oval or rounded yellow mass: her legs, antennae, and even head become aborted though the segments of the abdomen are well defined in most species, and finally she becomes simply a sack of eggs. She deposits her eggs under the protection of the shield, in other cases the larvae develop within her shrunken dead skin.

The larvae swarm out and spread over plants when, owing to their immense numbers sucking up the sap with their sharp beaks, they soon injure the tissue and often kill the food plant. Thus from an economic point of view the scale insects are one of the most important groups of the insect-world that man has to deal with, and thousands of pounds are spent in spraying and fumigating cultivated trees to destroy these pests. Many species are cosmopolitan in their range and choice of food plants, having been introduced all over the world, but Australia has a great number of indigenous species, many remarkable for their curious habits, particularly those forming solid woody galls on the eucalypts.

The classification of the scale insects is based chiefly upon the structure of the adult female coccid, viz.:—Of the spinnerets, abdominal cleft, lobes, spines, and anal ring of the abdomen, and the structure and number of joints of the antennae. The shape and structure of the puparium or scale, or other secretions are used to separate them into the larger sub-divisions.

The greater number of our species were described by Maskell in the "Transactions of the New Zealand Institute between the years 1878–1898," in which period he added over 100 new species to our list: Green (Pro. Linn. Soc. N.S.W. 1900) has described some others; and in the same Journal (1882–1898) I dealt with the gall-making coccids belonging to the sub-family BRACHYSCELINAE. In 1894 Maskell issued a "Synoptical List of the Coccidae reported from Australia and the Pacific Islands," in which 180 species were credited to Australia. To this Maskell added later a number of new forms; and Fuller others from Western Australia (Trans. Ent. Soc. London

1899). In Mrs. Fernald's "Catalogue of the Coccidae of the World" (Hatch Experiment Station Bulletin 88, 1903) over 328 species are listed, from this country, but there are a considerable number of doubtful species among them.

The COCCIDAE have been divided into a number of sub-families: I follow Green (Coccidae of Ceylon, 1896), though Mrs. Fernald in following Cockerell reverses the families and starts with the mealy bugs; I also retain most of the well-known generic names unless there is a very valid reason for discarding them, which does not appear to be the case in many of Cockerell's amendments.

The Sub-family DIASPINAE are known as armoured scales and embrace most of the forms which cover themselves with stout horny shields (puparia). When adult the female is almost legless, with rudimentary antennae, and incapable of movement. The members of the Genus *Aspidiotus* form round scales, and among them are some of our worst orchard pests. The introduced species *Aspidiotus auranti*, the Red scale of citrus trees, is now found on many garden shrubs. The puparium of the adult female is dull reddish yellow with the centre lighter coloured, and the twigs, leaves and fruit of neglected trees are often covered with these scales in all stages of growth. *A. perniciosus*, the notorious San José Scale, that attacks deciduous fruit-trees in the same manner, is a dull brown circular scale; its original home is somewhat doubtful, and though it was first recorded as a pest in California, is said to have come from China. The scales are much darker than those of the red scale, and infest the branches and twigs so thickly that they destroy the bark, and whenever they attach themselves to the fruit produce a red

spot. *A. hederi* (better known under the name of *A. nerii*), is a pure white scale with a yellow centre; it has a world-wide range, and its range extends far out into our western scrubs, sometimes covering the whole of a large tree. *A. rossi* is a very distinct, round, black scale, partial to *Euonymus* in the garden, and to grass trees in the bush. *A. ficus* is often known as the "Round Scale" from its size and regular shape; it is deep chocolate brown in colour, common upon palms, and is sometimes found upon oranges coming from the Pacific Islands.

Fiorinia acaciae covers the stems and twigs of *Acacia longifolia* with its narrow white ribbed scale; it is much longer than broad, and is truncate at the extremities; this gives it a very distinctive character.

The Genus *Diaspis* contains a number of delicate, more elongated scales, among which is the well known white rose scale *Diaspis rosae*, common in the garden. *Poliaspis exocarpi* is another white scale infesting *Oxylobium*, *Dillwynia*, and other bush shrubs; the male scales are long, slender, and loosely attached to the smaller twigs.

The Genus *Chionaspis*, containing a number of cosmopolitan and indigenous species, has the base of the scale narrow, elongate, but broadly rounded at the extremity. *Chionaspis xerotides* is white, common upon the blades of the sedge growing along the sea shore at Botany, N.S.W., and has a wide range. *C. eugeniae* is a larger broader scale, variable in size and shape; it infests several native shrubs, and a very large form is found on the waratah.

Mytilaspis is another world-wide genus, in which the scales are attenuated at the base and are oyster-like in shape; *Mytilaspis pomorum* is the common "Mussel" or "Oyster" scale of the apple tree found all

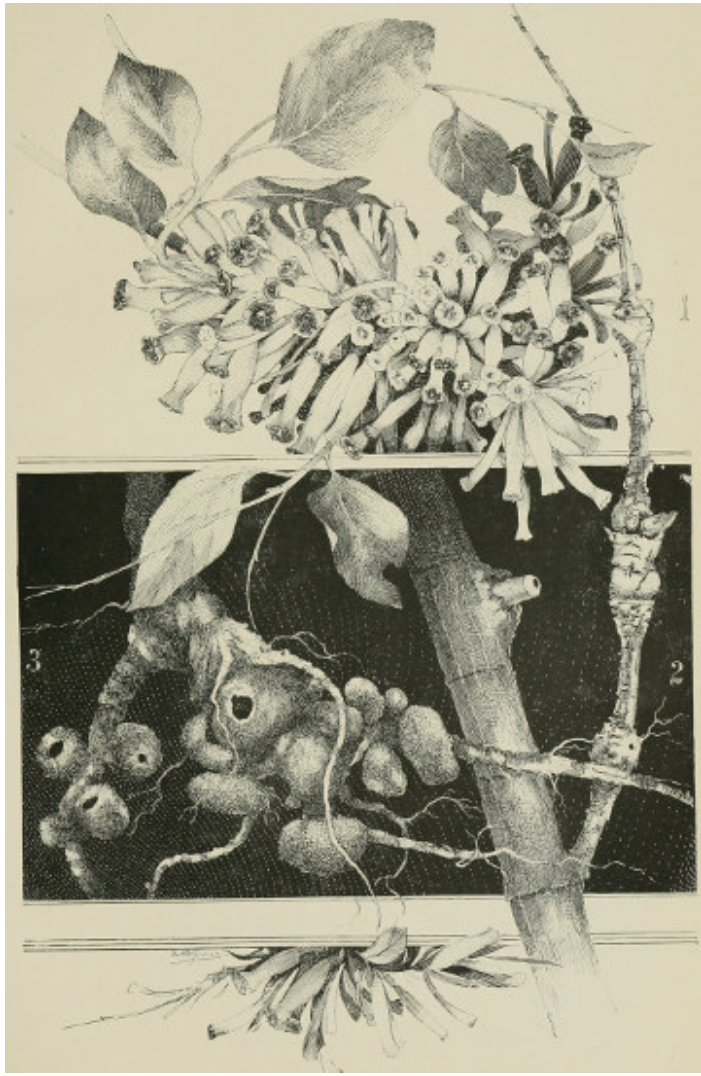
over the world. *M. spinifera* is a handsome, broad, white scale common on the weeping myall (*Acacia pendula*), growing in the interior. *M. striata* is a very slender form of scale that has had to adapt its shape to the slender foliage of the Casuarina which it infests. *M. acaciae* is a grey species that clusters thickly together in masses like the apple scale, covering the stems of several different species of Acacias in the bush with its stout irregular scales.

Plate XXXIV.—HOMOPTERA.

Family **Coccidae**.

1. *Apiomorpha urnalis* (Tepper).
2. *Frenchia semiocculta* (Mask.).
4. *Frenchia casuarinae* (Mask.).
3. Galls of Buprestid beetles (*Ethon corpulentum*, Bohem.).

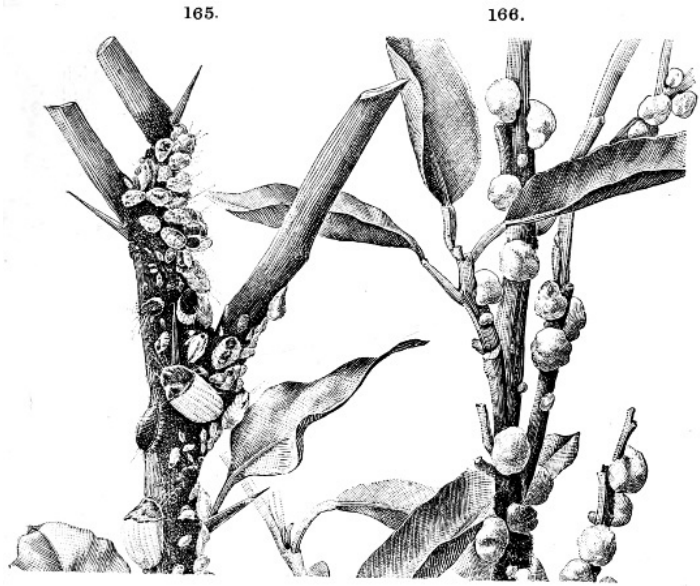
Plate XXXIV.—HOMOPTERA.



In the Sub-family LECANIINAE the female coccids are active or stationary; naked or covered with some secretion; sometimes without legs; the abdomen marked with a median cleft and furnished with two dorsal lobes. Several species of the tropical Genus

Ceroplastes are found about Sydney, where they were introduced into the gardens at a very early date, and have since spread into the orchards and bush. The Indian wax-scale, *Ceroplastes ceriferus*, covers orchard trees, and bush and garden shrubs with its irregular rounded masses of greasy white matter that protect the liver-coloured coccids beneath. *C. rubens* is a smaller and more regularly rounded dull red scale, the enveloping material forming a hard waxy shell.

The members of the Genus *Ctenochiton* are chiefly confined to New Zealand, but two fine species have been described from Australia. *Ctenochiton eucalypti* comes from the Newcastle district, N.S.W., where it infests the leaves of gum saplings. The scales of the sexes differ very much; those of the male are slender, white, and glassy, while those of the female are broad and dark coloured. *C. rhizophorae* comes from Queensland, where it is found upon the mangrove. The beautiful, brittle, glass-like scales of *Inglisia foraminifer* and *I. fossilis*, are often very plentiful in the interior on low scrub trees.



Figs. 165 and **166**.—Scale Insects.

165. *Icerya purchasi* (Maskell).

The Cottony-cushion or Fluted Scale of the orange tree.

166. *Ceroplastus ceriferus* (Anderson).

The introduced Indian Wax Scale of citrus trees, etc.

In the Genus *Ceronema*, the males form delicate angulated scales, but the females are clothed with a woolly secretion. *Ceronema banksiae* is a somewhat rare scale found on the foliage of the banksia; it has the secretion upon the dorsal surface, formed into a distinct rib down the centre. *C. caudata* is a large species with a white woolly covering, a large filament towards the apex forming a large loop rising above the back like a handle. It has a wide range from the South Coast of N.S.W. to North Queensland, and about Bulli, N.S.W., is found on gum trees.

The Genus *Lecanium* (which has been cut up into a number of new genera) contains many distinct

species peculiar to our fauna. *Lecanium tesselatum*, a flattened species with crenulated margins, and common on palms in the gardens, and *L. oleae*, known as "black bug" or "olive scale" by the orchardists, are both introduced species: *L. patersoni* is a slender form found upon the foliage of *Patersonia glabrata* growing about Sydney. *L. scrobiculata* is a bright, shining, convex, dark brown scale infesting several species of acacias; and *L. mirificum*, one of the largest, is found in the interior upon *Acacia pendula*. The curious coccid, *Cryptes (Lecanium) baccatum*, covers the twigs of several acacias, among them the common black wattle in the vicinity of Sydney. At first dull white, they swell out into rounded bead-shaped, blue sacks, so close together that they encrust the whole of the infested twig; when adult they turn dull brown.

The Sub-family DACTYLOPINAE contains most of the well-known "mealy bugs"; they are soft bodied creatures in the earlier stages of their existence, and many species are able to move about until their latter days; instead of forming a separate scale like the first group, they cover themselves with white, woolly, mealy, cottony, or waxy secretions.

The members of the Genus *Asterolecanium* are represented in Australia by the introduced "oak scale" *Asterolecanium quercicola*, a typical form which, half buried in the infested bark at the tips of the branches, is covered with a waxy, greenish yellow, rounded scale; when numerous it causes the tips of the branches to die back. *A. acaciae*, when numerous, aborts the bark and twigs of *Acacia longifolia* and is covered with dull brown and white shields; and with *A. stypheliae*, with its raised, shining, oval, bright yellow tests, found on a number

of different shrubs, are both native species with a very wide range over Australia.

The Genus *Rhizococcus* is represented by 8 species, found chiefly upon the twigs of wattles (*Acacia*) and she-oaks (*Casuarina*); and the cosmopolitan Genus *Eriococcus* by 17 species. Several species of *Eriococcus* enclosed in their egg-shaped, white-felted sacks are very common in the forest, clustering over and often killing the young trees. *Eriococcus coriaceous* varies from white to yellow in colour; the sacs are oval, with a distinct anal opening on the summit; they infest the foliage and twigs of many young Eucalypts. *E. paradoxus* is a somewhat larger, sticky insect; they mass together in regular lumps on the twigs of the same trees: while *E. eucalypti*, as far as my experience goes, is never found on gum trees, as its name implies, but upon the prickly twigs of *Bursaria spinosa*, and its sacs are more depressed and have a browner tint.

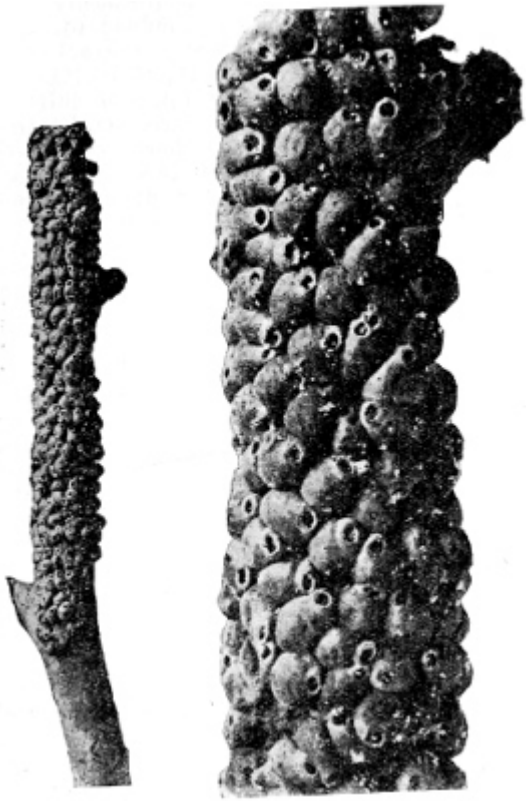


Fig. 167.—*Eriococcus coriaceous* (Maskell).
The Eucalyptus scale. Natural size and enlarged.
(Original photo. T. Kirk).

The typical *Dactylopius* are free-moving insects, often crawling about until their final stage, when they become covered or surrounded with flocculent woolly matter. *Dactylopius albizziae* is common on the black wattle, and is sometimes a pest in wattle plantations; it is a blackish-blue berry-shaped coccid surrounded with and lightly clothed on portions of the dorsal surface with white mealy and woolly filaments. *D. aurilanatus* is chiefly confined to the

branchlets of *Araucaria bidwilli*, or "Bunya Bunya." It is very abundant at times on these trees in the Sydney gardens, and is easily recognised by the broad lines of sulphur-yellow meal or down across the dorsal surface. *D. lobulatus* is an oval coccid, hiding under loose bark on the trunks of the blue gum, *Eucalyptus globulus*; it is so thickly clothed with white mealy secretion forming filaments round the edges that its form and colour are quite hidden.

In the Genus *Ripersia* the species have a world-wide range; they are curious wrinkled naked coccids, but are sometimes more or less enveloped in a white covering; they lead an underground existence on the roots of grass and plants: a single species is recorded by Maskell from S. Australia on the roots of a *Leptospermum*. The curious *Antonina australis* is an underground coccid which infests the roots of the Nut-grass, *Cyperus rotundus*, and was described by Green (Pro. Linn. Soc. N.S.W. 1904) from specimens obtained in the Hunter River district, N.S.W., where it was so plentiful that in the dry seasons it killed a great deal of this sedge. The adult female is a rounded black smooth shining creature about ⅛ of an inch in diameter, enveloped in a coat of white woolly secretion, from which it can be easily removed. The legs and antennae are aborted, but the segmental divisions of the abdomen remain, and the tip is produced into two irregular roughened tubercles, joined at the base with a tuft of stout bristle-like hairs.

Plate XXXVI.—HOMOPTERA.

Family COCCIDAE.

1. *Tachardia australis* (Froggatt). On Melaleuca.
2. *Tachardia australis* (Froggatt). Male and female

tests.
3. *Tachardia australis* (Froggatt). Female coccid.
4. *Tachardia decorella* (Maskell). On Eucalyptus.
5. *Tachardia decorella* (Maskell). Female in test.
6. *Tachardia decorella* (Maskell). Female exposed.
7. *Tachardia decorella* (Maskell). Larva.

Plate XXXVI.—HOMOPTERA.



The Sub-family TACHARDIINAE contains a number of remarkable species, some of considerable commercial value on account of the resinous secretion they encrust themselves with; this secretion is known as lac, and is used for making varnish. The

typical female is an irregular wrinkled fleshy mass with a pair of tubular appendages on the back. These appendages were supposed at one time to be used for producing the lac, but Green considers them to be breathing structures. Five species are described from Australia, of which *Tachardia australis* is so thickly encrusted with reddish brown lac, that it might be of some commercial value in the future; it is very plentiful upon Melaleuca bushes near Maryborough, Queensland, but was described by me from specimens obtained on a small shrub, *Beyeria viscosa*, at Gunnedah, N.S.W. *T. decorella* is enclosed in a very dainty, flattened, ribbed, cushion-like mass of dull slate-coloured lac; it is found on a number of different trees, among them the water gums (*Eugenia smithii*); and I have also found it on the desert cypress (*Callitris*) in the interior.

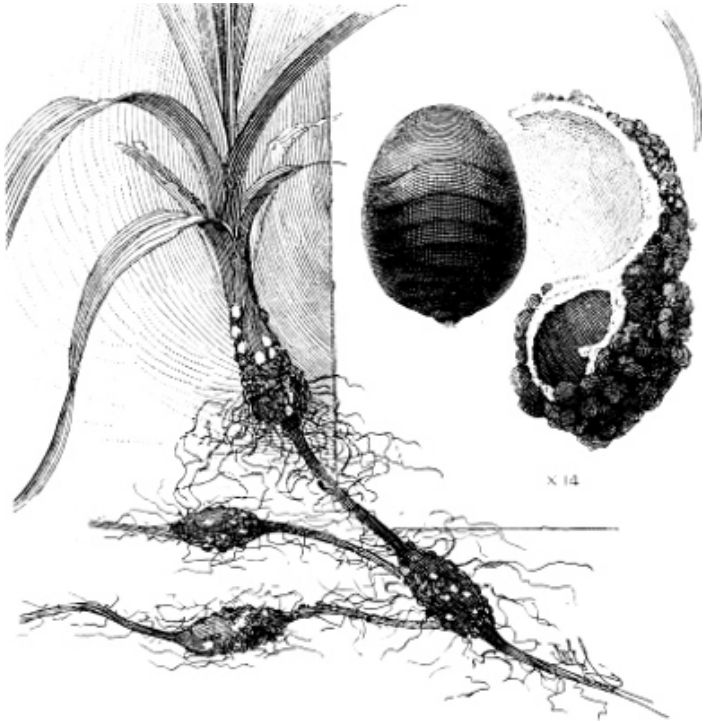


Fig. 168.—*Antonina australis* (Green).

The Nut-grass Coccid.

1. Nut-grass showing coccid upon the roots.
2. Adult female coccid removed from enveloping cover (enlarged).

The Sub-family IDIOCOCCIINAE comprises a number of very curious coccids, some of which are naked; some form waxy tests; while others are enveloped in woody galls. Maskell, who created this division, says they are separated from the MONOPHLEBIINAE by the absence of anal tubercles and the antennae, and from the BRACHYSCELIINAE by the absence of anal appendages. The members of the Genus *Sphaerococcus* number 21 described species, all but two of which are peculiar to

Australia; some form galls, others waxy tests. *Sphaerococcus pirogallus* cover the whole of the tips of the bushes of *Leptospermum flavescens* with its curious little pear-shaped galls. At first pink or red, these galls are dull brown when full grown, and have an aperture on the side of the stalk, and the coccid within is attached to a saucer-like rim on the roof of the apex. This is one of the commonest galls about Sydney; acres of these low bushes often have the whole of their foliage covered with masses of these small galls. *S. melaleucae* does not form a gall, but surrounds itself with a dark waxy secretion like the lac insect; both scales and twigs are often blackened with smut or fumagine. *L. leptospermi* forms a swelling in the twig which looks as if the tissue had risen over it like a blister and then split down the middle, exposing the dorsal surface. *S. froggatti* is very common on the tips of Melaleuca bushes growing about Sydney; the dull red coccid is clothed with white secretion resting in an excrescence fringed with slender, reddish brown finger-like processes curling over in an irregular protective gall. *S. socialis* produces a very curious greyish globular gall with no opening on the outside, and measures up to ½ an inch in diameter. Maskell says: "The outer surface is formed of very closely imbracted scales, which are apparently aborted and coalesced leaves of the tree"; the interior is of a loose structure containing several female coccids, and a few males. It was collected by Lea near Geraldton, W. Australia.

The Genus *Cylindrococcus* contains 3 species which form curious cone-like galls upon the twigs of the She-oak, *Casuarina*. *Cylindrococcus spiniferus* varies much in size and shape. They are often very numerous, covering the whole of the bush with their curious, rough, bracteate galls, which are rounded at

the base and taper to the extremity. The female, a cylindrical, dull red creature, is enclosed in an elongate, thin tube, which occupies the centre of the gall; this tube is attached at the base of the gall and is surrounded with the bracts. Some of the typical forms might be easily mistaken for seed cones. *C. amplior*, which is a more solitary species, forms a solid seed-shaped gall with the base set in a bract like the calyx of a flower, and the whole might be likened to an unopened bud. It is found in South Australia and the north-western parts of Victoria.

Plate XXXV.—HOMOPTERA.

Family COCCIDAE.

1. *Apiomorpha duplex* (Schr.). ♀ Gall.
2. *Sphaerococcus leptospermi* (Mask.). ♀ Galls.
3. *Cylindrococcus spiniferus* (Mask.). ♀ Galls.

Plate XXXV.—HOMOPTERA.



The Sub-family BRACHYSCELIINAE contains some of the most remarkable insects in our fauna. They were first noticed by Schrader (Trans. Ent. Soc. N.S.W. 1862), who described and figured a number of our commonest species and their galls; to these I

have added a number of new species (Pro. Linn. Soc. N.S.W. 1892–1898). They are all gall makers; the beautiful little larva born in the gall is usually yellow, oval, flattened, and fringed round the margin with short glassy filaments. In most species the full-grown female has antennae and legs aborted, and becomes simply a sac of eggs and liquid matter enclosed in a leathery skin, and is furnished with horny tail appendages.

The Genus *Frenchia* was formed by Maskell for a species, *Frenchia casuarinae*, which forms a gall like a stout blunt thorn; it is about the thickness of a slate pencil and has a small opening at the apex. These twig-like galls spring directly from the branch of the infested *Casuarina*, while the aborted tissue at the base swells out like a blister. The slender, attenuated, red female coccid rests head downward with the tail reaching up to the apical orifice of the gall. A second species, *F. semiocculta*, forms a raised swelling on the twigs of *Casuarina*, with a cleft in the centre, thus forming two lobes. The first is common in Tasmania, Victoria, and N.S. Wales; the latter was collected at Manly, near Sydney.

Schrader called the next Genus *Brachyscelis*, but Rubasmann finding the name preoccupied changed it to *Apiomorpha*; over 30 species are given in Mrs. Fernald's Catalogue, but there are several species described both by Rubasmann and Tepper that were described from variable or aborted galls that may prove to be synonyms. The female is remarkable for forming a stout woody gall, sometimes sessile, sometimes springing from a stalk; it encloses an oval cell with a circular or transverse aperture at the apex of the gall, through which the male impregnates her by means of his long slender abdomen. The young

larvae are hatched within its shelter, and crawl out to reach their food plant. The female is a top-shaped (turbinate) creature encased in a leathery skin, more or less clothed with fine hairs, enveloped in a mealy secretion, with rows of fine spines on the dorsal surface of the abdominal segments, and the body terminating in two horny tails (anal appendages). The head is merged into the thoracic portion, and has the ventral surface wrinkled and bearing a rudimentary mouth; the antennae and legs are aborted. The only distinct specific characters are the dorsal spines and the form of the anal appendages. The males are delicate two-winged insects, with long antennae, slender legs, and the body very long and attenuated, ornamented with two fine filaments. They either form single short tubular galls on the leaves, or form masses of the same tubular galls; or they are placed in rows enfolded in a hood growing from the side of the female gall like a small cockscomb. All the members of this genus are confined to the eucalypts.

Apiomorpha duplex is the largest insect-gall in the world. Springing directly from the twig, it swells out into a stout four-sided gall, 1½ inches in diameter, 3 inches in length; beyond this the apex of the gall is produced into two stout flattened appendages extending another 9 inches. The enclosed female coccid measures up to 1½ inches. *A. munita* forms an angulated gall rounded at the base, with each angle on the apex furnished with a slender curled horn, but it is very variable both in form and size. *A. pileata* is an egg-shaped gall, with the apex truncate and forming two lips, the apical orifice forming a keyhole-like slit between them. We have two varieties of this gall, which in their immature state have a membranous tailed cap covering the apex

which dries and falls off as the gall matures, leaving the apical orifice exposed. *A. pomiformis* is shaped like and about the size and shape of a small apple, with the apical orifice situated in a depression in the centre. It is a North Australian form, and is also found on stunted gums in the interior. Specimens of a large gall received from Tennant's Creek, Central Australia, with the enclosed coccid, show that the structure of the coccid is very different from the *Apiomorpha* the anal extremity being thimble-shaped, fitting against the apical orifice, so it will require to be placed in a new genus. *A. dipsaciformis* is an oval gall covered with curled filaments like a "teasel." In the group in which the male galls are formed on the side of the oval female gall, *A. pharatrata* is a typical form; the female gall is oval, overshadowed with the mushroom-shaped mass of coalesced tubular galls growing out near the apex.

The female coccids of the Genus *Opisthoscelis*, as they change from the larval stage, lose almost every vestige of the first two pairs of legs, while the hind pair are produced into long attenuated appendages, which in some species (when enclosed in the gall) curve round over the back like hairs; the whole insect is rounded or top-shaped, with a peg-shaped anal appendage. Thirteen species are described, all of which produce galls upon different species of eucalypts. *Opisthoscelis subrotunda* is our commonest species; the solid fleshy galls, about the size of a pea, often cover and abort much of the foliage of the infested tree. The short rounded coccid fits tightly to the cavity, and the opening, closed by the tip of the anal peg, is on the under side of the leaf. Schrader has described the male galls of this species, which are probably very rare, and I have never been able to discover them.

The short, slender, reddish, tubular galls of *O. spinosa* are as plentiful as the curious thorn-shaped female galls, which latter have the opening at the tip, and are common on the foliage of the large-leaved ironbark, *Eucalyptus siderophloia*, growing around Sydney. The female coccid, in this and several of the other gall-making coccids with the spine or thorn-shaped structure, is firmly attached to the sides and base of the cavity, and is difficult to remove without damage. The galls of the Genus *Ascelis* are often dissimilar in form; that of *Ascelis praemollis* is rounded, with the opening on the under side of the leaf, and except for the shape of the scar and larger size might without close examination be taken for that of *Opisthoscelis subrotunda*; but the enclosed insect is a very different looking creature; it is simply an irregular jelly-like mass, with a short peg-like structure rising from what looks to be the back, but is the tip of the abdomen; this structure is produced into three finger-like projections, which, holding a lump of gummy substance, plug up the basal opening in the gall. *A. schraderi*, which forms a circular, flattened, blister-like gall in the tissue of the leaves of *Eucalyptus corymbosa*, is more flattened, with the anal tail truncate at the apex, without the curious finger-like appendages, and the anal aperture as fine as a pin prick is on the upper surface of the leaf.

I have gone somewhat extensively into the description of these gall-making coccids, owing to the fact that they form such remarkable structures, and differ from all other solid galls in the fact that they are formed by the larvae and are not the result of eggs deposited beneath the plant tissue. Specialists in the study of vegetable growths may find some key to the mystery of gall development in this fact.

The MONOPHLEBIINAE comprises a number of large "mealy bugs," so called because they form no protective scale, but are simply clothed with a mealy secretion, fine filaments or masses of felted wool. The females are often of considerable size, and during the greater part of their existence are capable of crawling about, but when adult and about to lay their eggs they often become fixed to the food plant. The males are of the usual two-winged type with long antennae and the tip of the abdomen fringed with fine filaments. This division has been cut up into a number of sub-families by Cockerell, and these divisions are given in Mrs. Fernald's Catalogue, but here I propose to place them together under the one sub-family.

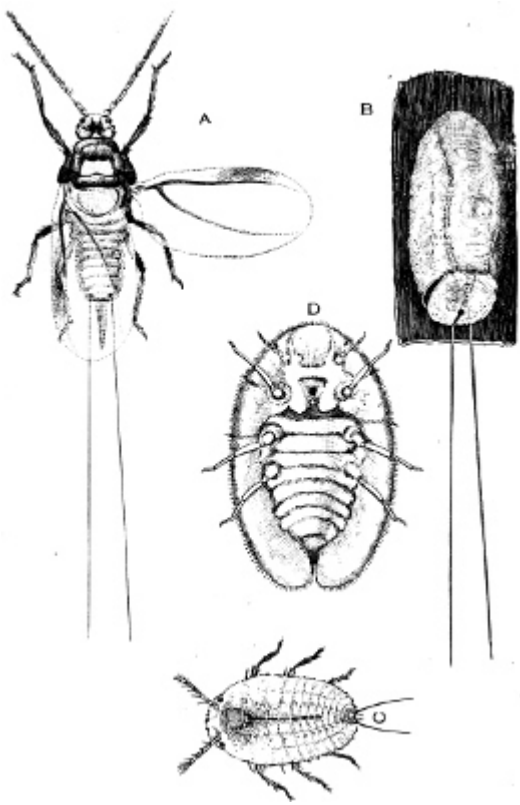


Fig. 169.—*Pulvinaria maskelli* (Olliff).

The Saltbush Mealy Bug of the interior.

a, Male; *b*, Showing the male enclosed in pupal test; *c*, Larva; *d*, Ventral view of adult female.

("Agricultural Gazette," N.S.W.)

Monophlebus crawfordi is one of our largest species; the female measures about 1 inch in length and is broad in proportion; she is dull orange yellow marked with parallel bars of purple, and fringed round the edges with fine hairs; and is of a general flattened, broad, oval form, with the dorsal surface distinctly segmented. She is generally found clinging

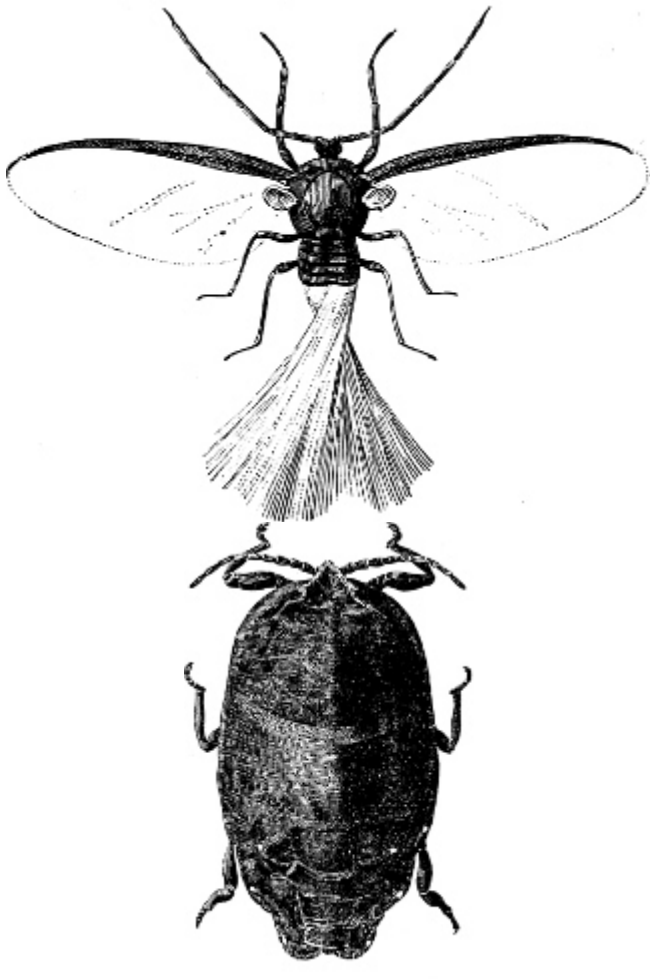
to the stem of a smooth-barked eucalyptus tree, sometimes half hidden under a bit of loose bark and surrounded with white mealy secretion. When egg-laying she sometimes produces a great quantity of fine curled cottony filaments forming a mass much larger than the original size of her body, under which the eggs are deposited.

The Genus *Callipappus* contains 6 Australian species; the females are flattened, oval, irregularly segmented coccids of a dull brown to purplish red tint, which are usually found crawling about on tree trunks. *Callipappus australe* was described by Maskell (Pro. Linn. Soc. N.S.W. 1890) under the generic name of *Coelostoma*, a group confined to N. Zealand. The male is a beautiful two-winged insect of a general deep red colour, the wings rose-pink, and the tip of the abdomen clothed with a large bunch of silky white filaments like a tuft of spun glass; from this latter character it has received the fanciful but rather appropriate name of the "Bird of Paradise Fly." The female is of an oval, flattened form about an inch in length; the body is irregularly segmented and lightly clothed with flakes of a mealy secretion. When depositing her eggs, generally on the trunk of a tree, she becomes attached to the bark with a patch of silk on the ventral surface of the body; the body swells irregularly, the extremities of the abdomen shrink and turn upwards, the whole body later becoming simply a dry shell. Guérin described a species, *C. westwoodi*, from West Australia; and Fuller a few years ago re-described this and named two new species.

Icerya purchasi, known as the "Fluted or Cottony Cushion Scale," was first described from New Zealand, but had been a well-known pest to the

citrus orchards in California many years before it was discovered in New Zealand. The adult female is a very distinctive red coccid with black legs and antennae, and a dull red body with the thoracic portion flattened and fringed with hairs. She produces a quantity of felted woolly filaments forming a mass completely covering the abdomen, which is marked with well-defined parallel furrows and ridges; under this secretion the eggs are deposited. This scale is found upon several species of wattles (*Acacia*) in the neighbourhood of Sydney, and on the roses in the gardens. It does little or no harm in Australia, as it is very much affected by different species of parasites. Several other species placed by Maskell in this Genus have been removed. *Palaeococcus nudata* is one that he described from Australia on verbenas and cosmos. I found it to be very abundant on red clover in the Lismore district, N.S. Wales; it is a smaller oval species uniformly clothed with mealy secretion. *P. rosae*, described by Riley as *Icerya rosae*, the "Floridian Scale," is a convex dull brown shining coccid with the outer margin fringed with short white tufts. Though originally described as a rose pest in Florida it is found upon *Hakea* and *Grevillea* bushes in the vicinity of Sydney.

170.



171.



172.

Figs. 170–172.—Mealy Bugs.

170. *Callipappus (Coelostoma) australe* (Maskell). ♂.

The "Bird of Paradise Fly."

171. *Callipappus australe.* ♀.

172. *Callipappus australe.* ♀. After egg laying.



173.

173. *Monophlebus crawfordi* (Maskell). ♀.



174.

174. *Monophlebus crawfordi*, when she is laying her eggs, which she covers with felted fluted wool.

("Agricultural Gazette," N.S.W.)

Sub-Order III. ANOPLURA.

Sucking Lice.

These insects are wingless, with a more or less thin integument. The rather complicated sucking mouth is furnished with hooks; the thoracic segments are indistinctly divided, and the foot terminates in a single stout claw. They were usually placed at the end of the HEMIPTERA in the Order PARASITA; but later investigators consider them so very closely allied to the true bugs that they are here placed as a Sub-Order. Burmeister called them PEDICULINA.

Family 1. Sucking Lice.

PEDICULIDAE.

These are purely parasitic upon animals, and derive their food from the blood of their hosts, which

they obtain by puncturing the skin with their tubular sucking mouth. It is not an extensive family, containing only about 40 described species included in 6 genera, and they are widely distributed over the world.

Three species are known to live upon the clothes and skin of unclean men, the eggs of which, known as nits, are attached to the hairs of the animal or man infested. From their repulsive habits lice are not popular insects even for entomologists to take up. Nothing is known about those infesting the natives of Australia, though it is believed that the different races of man, particularly savage tribes, are infested with distinct species of these parasites.

The common head louse, *Pediculus capitis*, is confined to the fine hairs of the head, seldom or never going on the coarser hair of the body; the pale-coloured eggs are glued to the hairs, from which emerge larvae closely resembling the adults. *Pediculus vestimenti* lives in the clothes of unclean persons, only coming on the skin to suck up blood; it differs merely in being darker and broader in general appearance. The Crab-louse, *Phthirius inguinalis*, is a very short-bodied creature which clings with its large claws to the stouter hairs of the body. In ancient times all these were very common, and a loathsome disease called *Phthiriasis* was said to be due to them. The domestic animals, hogs, cattle, horses, &c., are infested with distinct species.

Sub-Order IV. MALLOPHAGA.

Biting Lice.

The classification in which this group should be placed is not yet definitely settled; Sharp places them

in the Order NEUROPTERA between the PSOCIDAE and the TERMITIDAE: Cholodkovsky combines them with the sucking lice and creates a new Order, PSEUDORHYNCHOTA (Zool. Anz. xxvii. 1903); while Kellogg has given them the rank of an Order under the group name MALLOPHAGA.

They are certainly not lace-wings in the strict sense of the word; and their habits are so similar to those of the preceding division that I propose to place them as the fourth group of the Order HEMIPTERA.

They consist of biting lice infesting animals and birds, and feed chiefly upon the hair, feathers, scales, or excretions of their hosts by means of stout biting jaws, but are also said to be furnished with an apparatus enabling them sometimes to suck up the blood. They all have flattened bodies encased in horny integument, lightly clothed with stout hairs; the antenna contains from 3 to 5 short joints, and the eyes when visible are situated behind the antennae; the thorax is narrow, apparently composed of two divisions; the short stout legs are provided with 1 or 2 fine claws well adapted to their parasitic habits. The wings are wanting, and the oval abdomen contains from 9 to 10 segments. They attach their eggs to the hairs or feathers of their hosts, and the larvae develop upon the body.

Though some members of the group might be confounded with the ANOPLURA, they are easily distinguished from them by the structure of the mouth, and the different shaped claws at the extremity of the tarsi. While the sucking lice are always confined to a particular host, the biting lice are not so exclusive, for the same species may be found upon several dissimilar birds or animals, and it

is not uncommon for several distinct species to infest the same host.

A number of European writers have studied and described these parasitic creatures; Denny (Monographia Anoplurorum Britanniae 1842) described all the British species, which he illustrated with coloured plates: Piaget's "Le Pediculines," Leyden 1880, is a more important work, and was followed by a supplement in 1885; the first contains a description of all the species known up to that date, and the second adds 100 new species which he had examined. Taschenberg in 1882 published a fine Monograph, which however was never completed.

In America the chief writers have been Osborn and Kellogg; the first in Bulletin 7, Division of Entomology U.S. 1891, dealing with "Insects affecting domestic animals, Chapter v., Mallophaga," figures and describes a large number, among them some new species. Kellogg describes a great many new species (New Mallophaga i., ii., iii., 1886–89, Proceedings California Academy of Sciences, Vol. vi.), and also gives a great deal of information about the structure and classification of these insects. He says: "I propose therefore, in the light of the present position of the Mallophaga as an independent order of insects, to rank the Nitzschian families as sub-orders, the Nitzschian genera as families, and the Nitzschian sub-genera, the genera of the present day writers, as genera."

In this classification two sub-orders are created, ISCHNOCERA, containing two families, viz.: TRICHODECTIDAE, in which the members have 3 jointed antennae and tarsi with one claw, and found upon animals; and PHILOPTERIDAE, lice with five jointed antennae and two tarsal claws, which infest

birds. The second sub-order, AMBLYCERA, also comprises two families, viz.: GYROPIDAE, with four jointed antennae and one tarsal claw, infesting animals; and second the LIOTHEIDAE, with four jointed antennae and two tarsal claws, chiefly found upon birds, but in Australia also found upon marsupials.

There are about 1,000 species of these lice described from all parts of the world, but the genera are few in number. Very little work has been done in Australia on the Mallophaga: Piaget described a species on the wombat for which he created the Genus *Boopia*, naming it *B. tarsata* (1880). In his Supplement (1885) he described a second on the red kangaroo as *Boopia grandis*; and others on Australian birds, among them *Menopon infumatum* on the "Laughing Jackass," and *Menopon pallipes* on the "Swamp Quail."

In 1902 (Victorian Naturalist) Messrs. Le Souëf and Buller published two papers dealing with these parasites; the first entitled "Descriptions of some Mallophaga on Australian Birds," and a second "Descriptions of some new Mallophaga from Marsupials," illustrated with drawings. They describe the kangaroo louse, *Heterodoxus macropus*, as common upon wallabies and kangaroos in most parts of Australia. The female is a pale chestnut-coloured insect about 1½ lines in length, with the typical conical blunt head, 4-jointed antenna, and elongate oval abdomen fringed with hairs, and barred with black between the segments. The Genus *Boopia* contains the wombat louse described by Piaget, and three other species found on wallabies. A fifth species, *Latumcephalum macropus*, is also parasitic upon wallabies. The Native Companion or Australian

Crane is infested by a species described by these writers under the name of *Lipeurus giganteum*; it is of a uniform dull white colour, with an angular head, and measures ¼ of an inch in length. Three species are found upon the Lyre-bird, namely: *Lipeurus menura*, *Nirmus menura*, and *Menopon menura*. The white ibis has a distinct species, and another is found upon the sulphur-crested cockatoo. The emu is the host of an elongate dark-coloured species measuring up to 2 lines in length; the "Apostle Bird" and the "Rosella" parrot have each a distinct parasite.

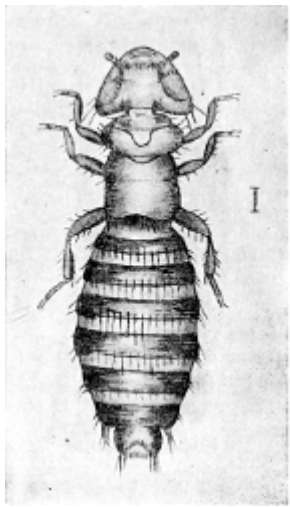


Fig. 175.—The Kangaroo Louse.

Heterodoxus macropus (Le Souëf and Bullen).

(Drawn from the type W.W.F.)

When these insects are carefully collected probably our fauna will be found to be rich in curious and interesting forms, judging from the number of undetermined species in my own collections. They can be very easily collected in small spirit tubes as soon as the animal or bird is shot, but like the "Louse-flies" they soon leave the dead body,

and all sportsmen know this to their cost when carrying their game any distance.

Order IX.—THYSANOPTERA.

These insects are often called PHYSAPODA in allusion to their bladder-shaped feet; but though some are wingless, the name THYSANOPTERA seems much more suitable, for all the typical forms have both pairs of wings beautifully fringed with hair-like filaments, hence the name "fringe-wings."

Thrips have few affinities with any of the other orders, and their exact position in any system of classification has puzzled most entomologists. The remarkable structure of the mouth, which has been studied by Messrs. Jordan and Garman, appears to consist of a compound of biting jaws and a sucking style. Uzel has figured it in his "Monographie der Ordnung Thysanoptera" 1905, but the exact manner in which they take their food is not yet clearly understood. The integument is very thick and opaque, and the head comes to a cone-shaped point at the mouth adjacent, to the ventral surface of the sternum, so that the complicated structure of the mouth is difficult to study. The eggs are laid upon the food plant, and the young undergoing a series of moults resemble the adult in general form, and the distinction between the larval and pupal forms, though noticeable, is very slight.

The members of this Order sometimes appear in immense swarms and do a great amount of damage to cultivated plants and field crops. They are widely distributed over the world, and many species are cosmopolitan, having been spread with the introduction of their food plants. The group is well represented in Australia by many remarkable and

striking species, some of which form distinct galls. This Order contains the single family THRIPIDAE.

Family 1. Thrips.

THRIPIDAE.

These are elongate, black, or brown, with 6 to 9 jointed antennae standing out in front of the head; large eyes; with ocelli (usually absent in the wingless forms). The elongate head comes to a cone-shaped point at the extremity; the mouth consists of a pair of jaws with a pointed style between them. The thorax, as broad or slightly broader than the body, is elongate, and furnished in the typical forms with two pairs of delicate oar-shaped wings with a simple medium parallel vein in the centre of each fore wing, and both pairs fringed with delicate feather-like filaments; both pairs are attached at the base to the dorsal surface of the thorax, and when at rest are folded down the centre of the back. The legs are short and simple, but sometimes the thighs of the front pair are thickened; the tarsi consist of two short simple joints, the last bladder-shaped. The abdomen is slender and is rounded at the extremity, and in one division ends in a slender tubular process. Most of them are minute creatures; the giant among them comes from Australia, but this only measures ½ an inch in length. Though most species are vegetarian in their habits, feeding upon the surface of plants or the pollen of flowers, a few are said to devour mites and other tiny creatures.

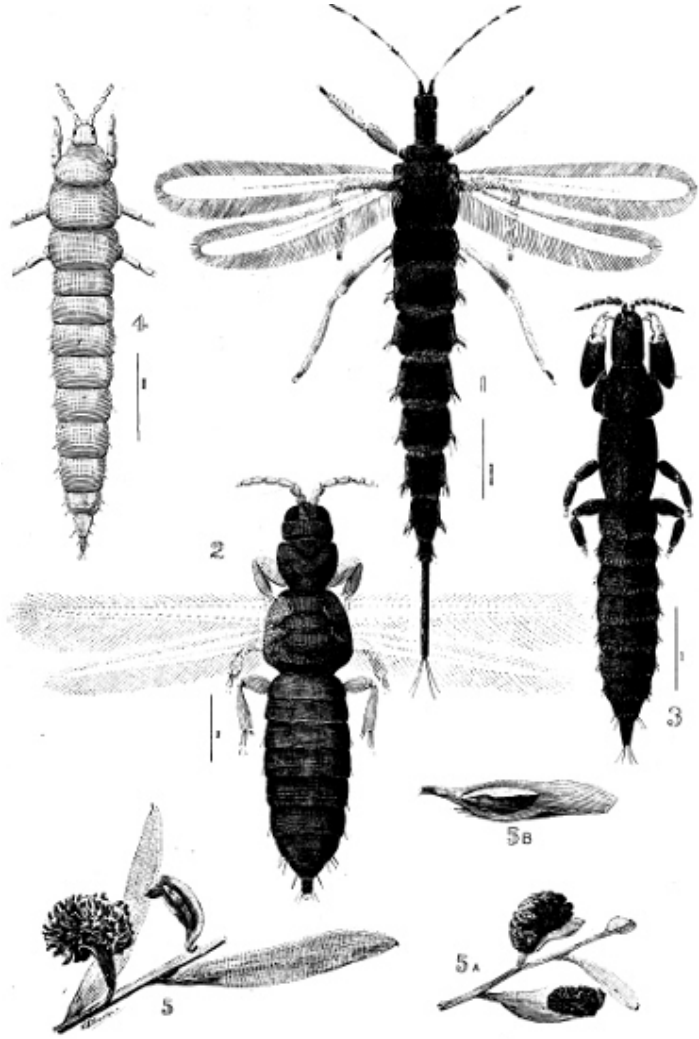
Plate XXXVII.—THYSANOPTERA.

Family THRIPIDAE.

1. *Idolothrips spectrum* (Haliday). Giant thrips.

2. *Thrips tabaci* (Lindeman). Rose and Onion thrips.
3. *Kladothrips rugosus* (Froggatt). Gall thrips.
4. *Kladothrips rugosus* (Froggatt). Larva.
5. 5*a*. 5*b*. Various stages of galls (*K. rugosus*) on Acacia foliage.

Plate XXXVII.—THYSANOPTERA.



In Uzel's Monograph only 135 species are catalogued, half of which are European. Haliday (Entomological Magazine 1836) divided all the known species into two groups or sub-families, viz.: *Terebrantia*, in which the females have an external toothed ovipositor (including all the typical European forms); and the *Tubulifera*, in which the ovipositor is hidden and the tip of the abdomen is produced into an elongated tubular process (most of our indigenous species fall into this latter group).

Heliothrips haemorrphoidalis, an introduced species, is our commonest thrips, and is world-wide in its range. It measures about $^{1}/_{16}$ of an inch in length, is stout in proportion; has the head and thorax rugose, and is of a uniform black tint with very light-coloured wings. It not only infests and damages a great number of garden plants, but is spreading to our native bushes, for I have taken them on young eucalypts far away from any gardens. The Giant Thrips, *Idolothrips spectrum*, was described by Haliday from specimens collected by Charles Darwin in 1836; he described the sexes as different species; and a smaller dark variety was given a third specific name. It is a very common insect in Eastern N.S.W., hiding among the foliage of dead eucalypts; when disturbed it runs about with its wings and elongated body turned upward in the manner of a small "rove beetle." It has an extended range from Tasmania to Southern Queensland. I recorded its life-history (Pro. Linn. Soc. N.S.W. 1904), where the different stages of development are figured. Its large size, long antennae, elongated neck-like prothorax, and red spined abdominal segments and tubular appendage are very distinctive characters.

The most remarkable THRIPIDAE however are

those that infest many of our forest shrubs, such as *Acacia*, *Hakea*, *Callistemon*, and other scrub trees in Central Australia. These live in galls which they produce by puncturing the edges of the young leaves and causing them to curl over; or by attacking the leaf buds and aborting the tips of the twigs into irregular masses of thin woody galls; or again, the leaf is pierced from the under side by the female thrips, causing the leaf to blister on the upper surface, which gradually expands into an oval or rounded gall as large as a small marble, and into which most of the leaf is often absorbed, leaving only the leaf stalk and the tip, which forms a short tail curving up from the basal scar. Many of these galls are closely packed with small semitransparent larvae and pupae in all stages of development, the offspring of the single female thrips that first caused the gall. Noting this remarkable habit of Australian thrips, so different from that of all other known species, I forwarded specimens and galls to Dr. Sharp, who notes the fact in the Cambridge Nat. Hist.: Insects. It seems apparently to be a case of the survival of the fittest, for in the dry intense summer heat of the interior these delicate insects could not live on the outer surface of the foliage, while, enclosed in these galls, they can survive the hottest and driest season. Species of gall-making thrips have been recorded recently from Java. Uzel described one of these gall-making species, *Phloeothrips tepperi* (Acta Societatis Entomologicae Bohemiae 1905) from specimens obtained in S. Australia by Tepper, and which form oval galls upon the "Mulga," *Acacia aneura*. This species is also common in the western parts of N.S. Wales upon the same tree, which also bears two other distinct thrips galls.

I have figured a remarkable rugose gall, obtained

near Tamworth, N.S. Wales, upon a short-leaved acacia (Agricultural Gazette N.S.W. 1906); the maker of this gall will not fit into any known genus, and therefore I propose for it the name of *Kladothrips rugosus*. It has an elongate rounded head, with the thighs of the fore-legs greatly thickened and the apex of the tibia produced into two blunt claws.

THE COLLECTION AND PRESERVATION OF INSECTS.

A collector's outfit will vary considerably in different kinds of country, and depend to a certain extent upon the particular group of insects he is interested in. But there are some things he will require on every tramp through the bush. For general collecting the first thing needed is a strong leather bag; a large-sized school bag that can be slung over the shoulder is preferred by some entomologists, as it leaves their hands free; others carry a hand-bag; but a combination of both, with handle and also swivels to which a shoulder strap can be attached, is sometimes used, so that it can be carried either way. I prefer the hand-bag, though it has its disadvantages, and one is that when shaking or sweeping the scrub it is apt to be left behind, and time spent in returning for it; and if the scrub is thick, may have to be searched for. The bag should not be too big, for in a long day's tramp it becomes a burden, and if string and paper be carried, galls, infested twigs, and foliage can always be made up into a bundle and attached to the bag when an extra good find has been made. Some collectors have the bag divided into compartments or pockets, which are very handy at times for bottles and tubes, but it must be borne in mind that every piece of leather adds weight.

With regard to nets, they must be adapted for the work they are to do; and first in importance comes the butterfly net. If one is in camp a simple net can be constructed with a ring of stout fencing wire, fashioned into a circle with the two ends bent down for about six inches, and tightly lashed to a straight

sapling about eight feet in length; round the ring is sewn a strip of stout calico, to which is attached a mosquito net bag about 18 inches long, tapering to a rounded tip, and about 15 inches in diameter; this net is however a fixture and cannot be taken to pieces and folded up for travelling. Where nets can be obtained from dealers' shops, there are some very neat and handy ones for packing up in small compass, such as the three fold net. The handle, like an ordinary light walking stick, is fitted at the end with a tubular Y; the base of the Y fits on to the handle, and the arm on either side receives the ends of the cane ring; the cane is shod with brass and jointed in three places, and there is a sheath to draw over each joint to form the ring; the net is then slipped on. A short stick is handy for many things; but when necessary a long sapling can be cut for a net-stick.

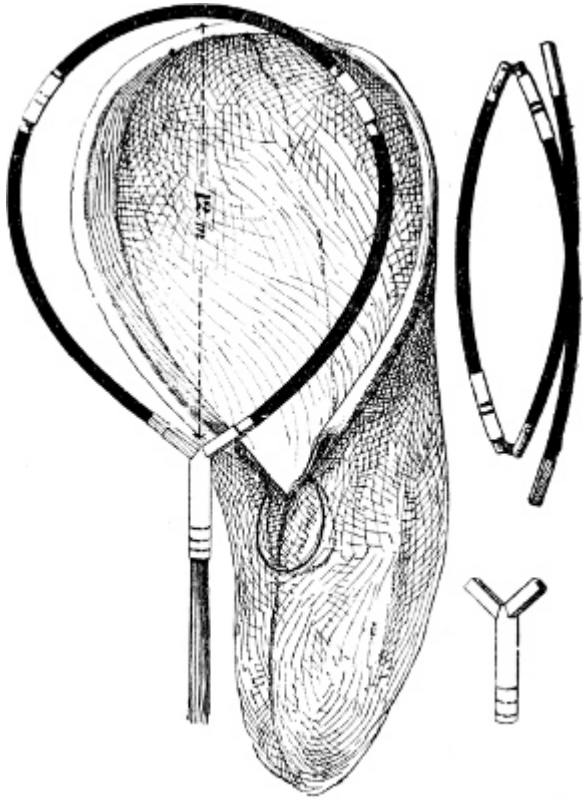


Fig. 176.—Collecting Net for Butterflies showing the ring fitted into ferrule; and folded up.

For catching wasps, flies, and other small insects a little hand-net about nine inches in diameter, made of mosquito net and a bit of fencing wire, is much more handy than the large butterfly net. When dragging water-holes or creeks a bag of cheese-cloth placed on the butterfly net ring will be found very serviceable, and will stand much rough use. A stout umbrella will be found one of the most useful collecting appliances when hunting in scrub or forest country. If the bushes are beaten or shaken with one hand while holding the open umbrella below them,

the collector will be surprised at the number of fine things, large and small, that come tumbling down into the umbrella, including many that he would never see otherwise. In the dry western scrubs I find the early hours of morning between daylight and eight o'clock to be the best time for beating and shaking, as everything that falls then is more or less torpid; later in the day they begin to get very active and fly off when disturbed. Some collectors go to the trouble of having a special umbrella made of white material or lined with calico, so that the fallen insects can be more easily noticed, but the advantage is slight. Mr. Masters suggests the use of a sheet spread under the bushes, and the whole tree beaten and shaken. This method in suitable country has its advantages.

The killing bottles come next in importance, and the first and most commonly used is the cyanide bottle. An empty 1 oz. quinine bottle makes one of a very serviceable size, but any other light wide-mouthed bottle will answer the purpose. Place a piece of cyanide of potassium about 1½ inches square and ½ an inch in thickness at the bottom of the bottle, and then pour in enough liquid plaster of Paris to embed and cover it; drain off any surplus moisture with blotting paper; and when the plaster is set hard, close the bottle with a tight-fitting cork. It is an advantage to coat the top of the cork with red sealing-wax, so that if it is dropped or left behind, the bright cork will make it more conspicuous. Young collectors may get the insects covered with particles of damp plaster and perhaps spoilt; to prevent this, the plaster should be covered with scraps of paper, moss, dry grass, or some such material, to absorb the moisture and keep the specimens clean. The dead insects should always be

turned out of the cyanide killing bottle on returning from a day's hunt, for if kept long in the bottle they will often become more or less discoloured.

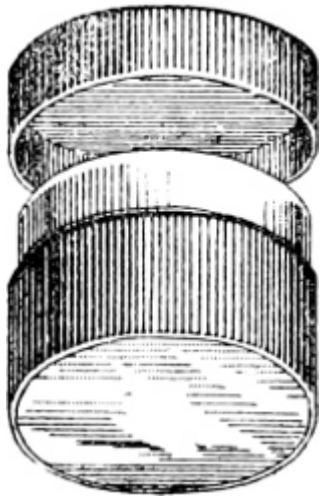


Fig. 177.—Glass-bottomed Box, handy for catching small moths.

A killing bottle favoured by museum and professional collectors is a similar bottle, but, instead of using cyanide, a pad of cotton wool is placed in the bottom, on to which some chloroform is poured to charge the bottle. But when collecting is brisk and the cork constantly being taken out for fresh captures, the chloroform evaporates, and the bottle must be re-charged at intervals. When one is collecting different kinds of small specimens it is advisable to carry several small tubes charged with chloroform, and if a circular pad of blotting paper be carefully cut and pressed down on the wadding, the little creatures will not get their legs and antennae tangled in the fibre of the cotton. If delicate winged insects remain long in the moist atmosphere of the tube, their wings stick to the sides or curl up, so that

it is wise to turn them out every now and then into pill boxes carried for the purpose, and any special treasures should be rolled up in soft paper. At one time most English entomologists used chopped laurel leaves in the bottle instead of cyanide; this foliage gives off a certain amount of hydrocyanic acid vapour, sufficient to kill insects, at the same time keeping them clean and relaxed so that they are easily mounted.

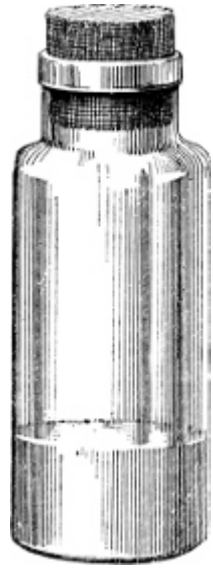


Fig. 178.—Killing Bottle

In which a piece of cyanide of potassium is placed, and then covered with plaster of Paris.

The collector's bag should contain several empty tins of all shapes and sizes, to carry the hundred and one things found in a day's collecting, such as live larvae, cocoons, galls, eggs, &c. When hunting for small moths the lepidopterist always carries a pocket full of small glass-bottomed boxes; the glassed portion is used to slip over the resting moth, which,

when disturbed, at once flies upward to the glass, and the lid of the box is slipped under. These delicate little creatures are taken home alive, and can be killed in a jar and mounted while quite fresh. A stock of small tubes containing methylated spirit can be packed in one of the empty tins; these are very necessary to keep separate from one another specimens of ants, termites, or other insects taken direct from their nests. On a long trip one also wants a larger bottle or jar of spirit in which scorpions, millepedes, centipedes, and such-like creatures can be stored.

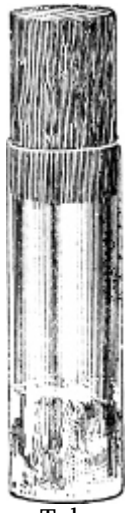


Fig. 179.—Chloroform Tube, used for killing small, delicate insects.

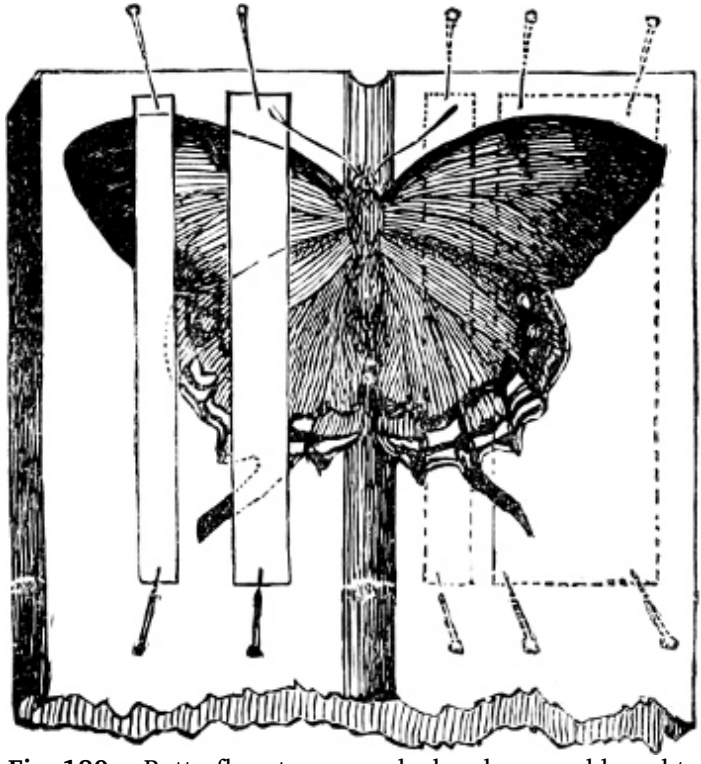


Fig. 180.—Butterfly set upon corked and grooved board to show the process of mounting.

When timber is found infested with beetle or moth larvae, it should be secured and brought home, where it can be placed in a tin trunk, glass jar, or proper breeding cage and the perfect insects bred out. When engaged at this very profitable work a small hatchet and hand saw are needed to cut the branches. At all times a stout old butcher's-knife should be among the kit, as it is useful for digging round the roots of trees and under logs, tearing bark off tree trunks, and if it be jagged on one edge will make a rough saw. A newspaper or two is handy for many things, among others to make envelopes in which to place butterflies.

Specimens collected in camp must be kept in good condition until they can be properly mounted at home; in a dry country this is not difficult, but in the wet season in a semi-tropical climate both botanical and entomological specimens are very liable to damage.

Most collectors put all the hard-bodied insects such as beetles into a wide-mouthed jar of methylated spirits, where they will keep indefinitely, but any beetles that are clothed with fine hairs or floury pubescence should be carefully pinned in a box, and, unless very large, will dry quickly. Some entomologists place their captures of this kind in clear carbolised sawdust in tins or jars: I have packed small specimens in circular tins in the following manner:—First a layer of camphor covered with a circular sheet of blotting paper fitting close into the tin, then the insects fresh from the killing tubes, and after sprinkling the insects with camphor a layer of blotting paper, and so on. Thus many thousands of micro-coleoptera, hemiptera, &c., could be securely packed and added to day by day until the tin was full, when a wad of cotton wool was placed on the last sheet of paper, and the tin put aside or posted to its destination.

With regard to butterflies, the collector can generally see whether they are good or damaged specimens as soon as they are taken out of the net; if the latter, he should let them go (unless unique or rare forms), for an imperfect or rubbed butterfly is comparatively valueless. If it be a perfect specimen, the wings should be folded together over the back, and a sharp nip on the thorax between the fingers will kill it in a moment. Each specimen should be placed in a folded paper envelope, made by

crossfolding an oblong piece of soft paper in the shape of a triangle and folding down the overlapping edges. Packed side by side, a square tin will hold hundreds of these paper envelopes, which can be stored in this manner indefinitely or till the collector is ready to relax and set them. Thousands of butterflies are sent in these papers from all parts of the world to London for sale, and are usually disposed of at so much per hundred.

Moths cannot well be treated in this manner on account of the thickness of their bodies and the looseness of the scales upon their wings; they have therefore to be pinned in a corklined box as they are collected, but later on can be relaxed and their wings set as with the butterflies. When we come to the tiny moths known as MICRO-LEPIDOPTERA, we find they require special treatment, and most lepidopterists take a box fitted with narrow setting boards, when out for a few days, and set their captures every evening before they become stiff, for otherwise many make very unsatisfactory specimens.

In collecting HYMENOPTERA the different groups need special treatment; and where there are several sexes dissimilar in size and structure they should be carefully kept together. Ants are always best collected from their nest, and a number of specimens of the different sexes secured and placed in a tube of methylated spirits. The locality and date should be written with a hard lead pencil upon a slip of paper and placed in the tube with them. A series can afterwards be sorted out and mounted, the large ones on pins and the smaller on gummed card. Wasps should be pinned, and when the forms with wingless females (Thynnidae and Mutillidae) are obtained *in copula*, a very common state in midsummer, they

should be captured and killed together and the paired insects mounted with a check mark on each pin beside the locality and date label, so that no mistake can be made as to their identity.

The bulk of the HEMIPTERA will with their hard integument carry well in spirit or carbolised sawdust. Some of the more delicate of the HOMOPTERA, such as the Psyllidae, Aphidae, and Coccidae (Scale insects), should be collected with their food plant. They can be obtained in various stages of their development; the perfect insects can be bred in confinement upon their food plants. They should be mounted on card when fresh, but, if not, can be placed in the camphor tin or even a dry tube plugged with cotton wool, but if the tube be corked they will spoil, owing to the moisture generated within the tube. In the case of scale insects, portions of the leaves, bark, or twigs infested with the tests of the injects can be cut to a uniform size and mounted with gum or small pin on card, and if mounted carefully make very neat specimens. Many of the larger HOMOPTERA, such as cicadas, fulgorids and frog-hoppers, can be mounted, with the wings outspread, but should not go into spirits.

ORTHOPTERA, particularly the large phasmids, are very unsatisfactory creatures to deal with when captured; often too large to go into a killing bottle, they have to be brought into camp alive. If a female, it may be kept a while to lay its eggs, as they are very interesting objects. The eggs can be mounted on card or placed in a small pill box and pinned beside the insect in the box. These insects, as well as all large grasshoppers, should be cut down the abdomen on the under side and the contents removed with forceps; a little paris green should then be sprinkled

inside or some weak corrosive sublimate applied with a brush; then a wad of cotton wool should be pushed into the cavity to give shape to the empty body when it dries. In the case of the larger cockroaches, which are often very brittle when cleaned and dried, a bit of sheet cork instead of cotton wool can be shaped for a false body, coated with gum and slipped in; when pinned through the cork it makes a very firm specimen. Some collectors mount their grasshoppers and other orthoptera with the wings outspread, and as show specimens they look best, but take up a great deal of room; others mount the wings on one side, and leave the others folded down in their natural condition in repose, so that some idea is given of the natural form, and the outspread wings can also be examined for specific differences. In collecting phasmids and stick insects for transmission by post or packing in small space, the best plan is to get a slender stick and lay the insect along it with outstretched legs and folded wings, and then wind soft worsted thread round it from end to end; it can be unwound and mounted properly when received at its destination. Orthoptera should not be put into spirit with other specimens, as they lose their colour, become soft, and break up easily; they will however travel well in a 5 per cent. solution of formalin; this has a hardening effect and only alters the colour slightly unless the insects are kept in it for a considerable time. If kept in formalin for say a week and then packed in sawdust they will not rot or spoil as they often do when killed and packed before they are dried.

NEUROPTERA are delicate creatures, and many of them keep best if killed and placed in papers as in the case of butterflies, unless there is room to pin them in a store box. The bodies of the dragon-flies

rot very quickly and break off very easily; if carefully handled they can be placed *alive* in papers with their wings folded over their backs, and will remain alive for several days, long enough to travel a considerable distance by post when dispatched direct to a specialist, who will then receive them with their natural colours. If kept in the store box it is advisable to impale the slender body with a bristle or grass stem, inserting it at the front of the thorax and pushing it through to the tip of the abdomen, but not far enough to injure the anal appendages. Many specimens can be pinned in the store boxes with the wings closed, and relaxed and mounted with outspread wings months afterwards.

DIPTERA is another group that requires delicate manipulation, particularly such species as "daddy-long-legs" (*Tipulidae*), mosquitoes (*Culicidae*), &c. When Skuse was collecting he always carried a pocket-box containing pinned card slips of various lengths, and a tube of gum, and, after killing the insects in a chloroform tube, he mounted them at once while they were flexible and the legs not detached. Theobald mounts his mosquitoes on fine pins, which are pushed from beneath through a circular piece of cardboard (these circular cards are stamped out with a wad-cutter); the legs are spread out and an ordinary pin pushed through the circle to pin them in a cabinet. The larger flies are pinned dry in the ordinary manner, and the smaller ones are carded.

ANIMAL PARASITES, which belong to quite a number of groups, are obtained on the live birds or

mammals as soon as they are shot. When the animals are dead the parasites leave the bodies as soon as they begin to get cold. They should be transferred at once to small spirit tubes, in which should also be placed a slip of paper upon which is written in lead pencil the name of the mammal or bird upon which it was taken, the date of capture, and the locality.

LAMP AND NIGHT COLLECTING.—In suitable localities a great haul of insects can often be obtained on a warm sultry summer night by laying a sheet on the ground with a powerful lamp on it and hanging another sheet behind the lamp; the insects are attracted to the light, and falling on the sheet are then easily captured. In camp many fine insects may be obtained round the lamp or camp fire; and during the wet seasons in North Queensland and the north coast of Australia I have taken many rare insects in this manner.

SUGARING is greatly practised in Europe; a suitable spot in a forest being chosen, a mixture of sugar and beer that have been boiled together is smeared upon the tree trunks and fences; at night-fall the ground is visited with a bull's-eye lantern, and the insects (moths chiefly) that come to feed are captured, sometimes in great numbers. This has been tried by our collectors in Australia; but I have never had any success myself nor heard of anyone here who has had better fortune.

TRAPPING.—When settled down in a fixed collecting camp many beetles and other insects can be obtained by trapping. If in brush or forest land a number of empty jam or milk tins with the tops cut

neatly off are buried, with the edges level with the surface of the ground, many carnivorous ground beetles tumble in, and will be found there on going round in the morning. If a bone or bit of meat be placed at the bottom of the trap, it often attracts certain beetles that feed on such food. In the same manner a dead bird or small animal half buried in the ground, or placed under a sheet of bark or log, will prove an attractive bait for the burying beetles and other curious and often rare species; a dead animal should therefore be always investigated by the beetle hunter, as it often hides entomological treasures.

Fallen timber always has a great attraction for all bark-feeding weevils, longicorns, and other small wood-borers that come to it as soon as the bark begins to wither. Here also come Cleridae, Antribidae and other carnivorous beetles to feed upon the smaller wood-borers, and many an hour can be profitably spent over a large fallen tree or bit of brush a few days after it has been chopped down, particularly in the tropical scrubs. Slicing the bark of living trees that exude any sap, and letting the bark hang down, attracts insects that feed on the sap or take shelter under loose bark; a number of such blazed tree trunks round a camp is a great source of revenue, particularly in the summer.

There are many other devices that the collector will only gain by experience in the field, which will enable him to obtain many curious specimens that a novice would never find.

MOUNTING, SETTING, AND STORING.—Having collected specimens, the next question is the storage of the insects. All entomological specimens (other than those kept in spirit tubes) must be preserved in

close-fitting boxes lined with cork, linoleum, or other suitable substance, and the lining covered with clean white paper pasted over it. Many different kinds of store boxes are used by entomologists who cannot afford the luxury of cabinets; most of them are made of deal, with hinges in the centre; the two sides of the box fold together, fitting closely over a rim along the inner edge of one half; and they are fastened with two hooks on the outside. These English boxes made of light pine can be obtained in Sydney; they fit beautifully and are much lighter than the local ones made of kauri, but are slightly dearer. To make a useful store box, nail down the lid of a large-sized cigar box (cleaning, sandpapering, and varnishing it); cut the box through the centre with a fine saw, and then fit a projecting rim into one half with wood from another cigar box, so that the two halves fit close together over the rim without needing catches. This is handy only for a temporary store box, as it is rather difficult to get the two halves to fit accurately, and when made is rather small and deep.

Specimens should be pinned or mounted on cards on a uniform plan; nothing looks worse than insects mounted in different styles. Except the smaller specimens, beetles and other insects should be pinned, and the most serviceable pins are perhaps Kirby, Beard and Co.'s Nos. 1 and 5, though there are several useful intermediate sizes. When an insect is too delicate to pin with either of these, mount it on card, for more insects are lost or damaged through mounting with slender pins that refuse to stick into the cork, and curl up or buckle in the middle, than in any other manner. There are however many professional naturalists who always use the soft, slender, very fine, Continental pins, but they require very delicate handling, and are not suitable for the

general collector. There is a great difference of opinion as to how insects should be set and pinned; many, particularly English naturalists, advocate low setting, while most of our collectors set all insects high, as the insects when thus pinned are raised well above the bottom of the box, and their legs and antennae are not so liable to get broken; all mites, dust and dirt will be noticed at once; and the name affixed beneath can be read without removing the insect. In the case of low setting, the insects are resting on the floor of the box; they are liable to damage with the least bump; anthrenus and mites can feed away under cover without being seen until the remains of the infested specimen fall apart; the insect has to be lifted up every time to see its name; while the locality and date-label is always liable to fall off. My standard height (first suggested to me by Mr. Masters to use when working in the Macleay Museum, Sydney) is the lid of a wax matchbox, which is about ¾ of an inch. A small hole is pierced through the centre of the lid; the beetle is placed on the top of the lid, and the pin pressed through it and the hole in the lid until the point touches the table beneath. The pin, in the case of a beetle, should be pushed through the upper half of the elytron (wing cover) on the right-hand side when the head is facing the same way as the person mounting, the pin coming out on the under surface between the middle and hind legs. The antennae and legs may be arranged with pins, but, during the season in Australia, insects are so plentiful that there is not always time to more than roughly open them out.

In the case of insects too small to pin, they are carded. Sheets of the best white cardboard (little thicker than that of a visiting card) are cut into neat strips of uniform width and length for different

specimens. No. 1 pins are run through the cards at one end to bring the under side of the card the same height up the pin as the under surface of the directly pinned insect. To give the little card mounts a finished appearance the card used in my collections is ruled with a double line of red ink, the first thick and the inner line fine; each strip of card is cut along the thick red line, and the pin is pushed through the red band. Where one has more than a single specimen, two or more can be mounted side by side on the same card, with their legs and antennae neatly set out, one with the dorsal surface uppermost, and the second one gummed with the reverse side upward, so that the specific characters of both sides of the insect can be examined without having to remove the specimen from the card.

Moths, butterflies, cicadas, lace-wings and other large winged insects when fresh, or after they have been relaxed, are pinned down on setting boards; the body should rest in the parallel groove down the centre of the board, and the wings should be opened out and strapped down on either side with braces of paper or cardboard. The wings should be expanded in a natural manner, and so that the whole of the venation and beauty of the wings are shown. A setting board is simply a strip of soft pine wood with two sheets of cork gummed on the upper surface, with a groove between them to receive the body; fine white paper is pasted over the whole of the board. They are made of various sizes to suit both large and small moths. Most of the old setting boards had the cork rounded so that the wings drooped downwards; afterwards many used them with the outer side turning upward so that the wings were raised at the extremities; those in general use now are perfectly flat.

All these insects are easily relaxed by placing them between damp blotting paper on the top of some wet sand in a plate, and covering them over with a bell glass or similar vessel; within twenty-four hours they are limp enough to be pinned and their wings opened out without any danger.

NUMBERING AND LABELLING.—Every specimen, as soon as it is mounted, should have a small label attached to the pin; this can be written with a fine-pointed pen on small slips of paper as distinctly as possible, with the exact locality in which the insect was collected, the date of capture, the name or initials of the collector, and the food plant when known. It is however sometimes better to pin a second slip below for the food plant and a distinctive catalogue number. Every young naturalist starting a collection should have consecutive numbers on each series of specimens he collects, and keep a note-book or stock register, in which to enter any information about the insect bearing the number. These notes in the course of time will become more and more valuable, and give an added value to the collection. Many young naturalists may think of labels only as a record of the collector's name, but the locality and food plant are the important points, and to the working entomologist a collection of Australian insects without any such records have lost half their value. The label is placed on the top of the matchbox lid, and the pin bearing the specimen is pushed through to bring the label about halfway between the specimen and the point of the pin, which allows of the label being easily read, and when uniformly placed adds to the neat appearance of the collection. I have mentioned a matchbox lid as a standard height for mounting specimens, but when constantly at work something more solid is required. Take a

small block of soft deal wood about 4 inches in length by 2 in width, and just under ¾ of an inch in height; bore two or three holes through it at one end, tack a sheet of white cardboard over the top, and above this at one end tack a slip of cork 1½ inches in width; then make holes through the cardboard above the holes bored in the deal block, and you have an excellent mounting table to work upon.

An entomologist does not require much apparatus after his boxes and setting boards, but one indispensable article is a pair of strong entomological forceps with curved tips; the curved extremities allow of the pin being gripped below the insect when fixing it in or lifting it out of the box. These in the hands of an expert are as good as an extra pair of fingers, both for moving about specimens and picking up pins. A second fine-pointed pair of forceps is useful for handling specimens when mounting, or for picking up small active insects under logs and stones. Two needles mounted in pen handles are invaluable for arranging the legs and antennae when being set. Fine-pointed paint brushes for cleaning dust and dirt from the insects are used; and a pair of pointed scissors are necessary for opening the large-bodied insects, cutting mounting cards, labels and such-like. A pocket lens should be always at hand, for without it one loses half the beauty and details of structure, and it would often be difficult to classify the specimens. Later on, the entomologist will find a dissecting microscope, which leaves both hands free to work, an indispensable part of his outfit. A bottle of gum is another requisite, and different recipes are given in manuals on the subject; at one time a mixture of tragacanth gum was generally used, but the great objection to its use is that, though very fine and transparent, it is very difficult to remove from

the specimen when necessary to remount or to detach it for examination. The mixture now generally used is made of clean lumps of gum arabic dissolved in water to the consistency of thin honey, with a little ground lump sugar added; a few drops of carbolic acid are added, which, though apt to discolour it if much is used, will keep the mixture sweet, and prevents mould getting on the specimens. The gum should always be kept corked to prevent dust being introduced, which would show very readily on the mount.

CARE OF COLLECTIONS.—After the collections are formed, the insects pinned, labelled, and placed in their natural groups, one's work is by no means finished; thousands of valuable specimens, and even types, have been irretrievably damaged or completely destroyed from want of a little care in preserving them from mites and museum beetles (*Anthrenus*). The specimens may be perfectly clean and stored in close-fitting boxes, and yet later may become infested, by the addition of specimens that have been in an infested collection. It is advisable to keep a receiving box in which to place exchanged specimens for some time before setting out in the collections; as a general rule a collector eagerly adds any new specimen to his collections, and so at the same time may introduce *Anthrenus*, often in the egg state, whose little hairy larvae will rapidly destroy his insects. Some collectors contend that they can preserve their specimens from the attacks of museum pests by dipping them in a very weak solution of corrosive sublimate in spirits of wine; but this can only be effectively done in the case of beetles and

other hard-bodied creatures, for it must be remembered that this chemical is apt to affect the metallic and bright-coloured tints of the specimens, and will even corrode the pins. Camphor and napthaline kept in a muslin bag or cell in the corner of the insect box will poison the air and certainly kill all mites, and will keep some pests out; but *Anthrenus* are able to live in this poisoned atmosphere, and will still carry on the work of destruction. Having once found *Anthrenus* among the specimens, no time should be lost before destroying them: a wad of cotton wool should be pinned in the corner of the box, and chloroform or bisulphide of carbon poured over it, and the box kept closed for about twenty-four hours, when it should be again opened, all dead *Anthrenus* shaken out, the remains of damaged insects removed, and the most injured specimens (if common) burnt. Another method when *Anthrenus* are found is, to hold the open box or drawer in front of the fire for a few moments, when the pests, even if feeding within the insects, will wriggle out and can be destroyed. When once a box has been infested it will require constant attention for months after.

MOULD is also difficult to get rid of when once it appears in a box. If all insects are well dried before they are placed in the boxes, and the boxes kept in a dry place, there should be no mould among the contents, but if a few damp or mould-infested insects be placed in a clean box the mould may spread and eventually affect the whole collection, especially if the room is inclined to be damp. When mould appears, the affected insects should be cleaned with a brush dipped in benzine, and a few drops of carbolic acid should be poured on a piece of cotton wool in the box.

GREASE is often a great trouble to the collector. Many of the large wood-moths, particularly the bodies, sometimes get into a very bad state if not cleaned out thoroughly; and also on old specimens of beetles the grease develops verdigris, corroding the pins. Soaking all such specimens in benzine will soften the grease so that it can be rubbed off with a soft brush.

MUSEUM COLLECTIONS AND TYPES.

The type of a species is the actual specimen from which the published description has been drawn up by the entomologist; and the care and safe custody of such types should be the aim of every naturalist and museum curator. In the case of insects, they are often such delicate creatures that the type is very easily destroyed or damaged, either by careless handling, bad storage, or from the attacks of museum mites and pests; and at the present time, since many insect types have been thus lost or destroyed, often doubt exists as to which particular insect in the group is the species defined by the author, especially where the written description, as in many cases, is brief or incomplete. Many large private collections have been made by entomologists in which there are numbers of types either described by the owner, or of specimens he has obtained and submitted to specialists. Some of these collections have afterwards been broken up, sold, and distributed, so that it is now very difficult to trace the whereabouts of many types that do exist. Every year brings more independent entomologists into the ranks of the describers, so that our insects are being described in all parts of the world; and though the importance of types is much better understood than it used to be, the ultimate resting place of many of these types is very uncertain.

The proper place for every type is in the cabinet of some accredited museum, though unfortunately there are some museums where the collections of insects are no safer than they are in private hands, either from want of proper storage or the lack of a

special curator. Yet if it were an understood thing that the types of each specialist would be placed in the museum of his country, there would be some hope of them being available for the use of future students.

The drawbacks to such a disposal of types are that most entomologists when they monograph a group intend to follow up the work as new material comes to hand, which occurs when through their publications collectors begin to forward specimens for identification; so that the types are often required by entomologists for supplementary papers.

Again, each insect as soon as it becomes a type has a certain commercial value, and as most naturalists are poor men, this enhanced value is a consideration, and it would be hardly fair to expect them to give away valuable assets. The best way to get over the difficulty would be for each museum to have a sum of money put aside to purchase all types at a certain fixed rate, and with an understanding that no types go out of their native country before they have been submitted to the museum authorities.

It is very unfortunate that many of the early and most prolific writers never definitely marked their type-specimen when it was described, simply returning it to the cabinet with the new name either on the pin or below it; and where there has been a series of the same species, and some assistant affixed the names, the recognised type may be a co-type. Co-types are very valuable when they are determined by the describer from the same species, but some writers have the bad habit of treating co-types as types, which leads to much distrust and confusion.

Every type should if pinned have a second label

besides the ordinary label placed well up on the pin, and bearing the word “type,” with the date, initials of the author, and name of the insect on the reverse side, so that as long as the specimen is in existence there can be no doubt as to it being a type.

I therefore propose in the following pages to give some brief notes upon our Museum Collections, with reference to the types they contain; and also to refer to those types in private collections. To work out the location of the Australian type-specimens and collections in British and foreign museums would require a book to itself, but the destination of a few types of the more important collections can be indicated.

Through the kindness of the Curators of the different Australian Museums and many interested friends, I have been enabled to gather much valuable information about the early collections made in Australia, and their final destinations.

THE MACLEAY MUSEUM, Sydney, contains the finest general collection of Australian insects that exists, and is rich in types; it also contains a large series of insects from all parts of the world, among which are some historical specimens. Unfortunately here also the types of many species cannot be distinguished from their co-types, as they bear no distinctive type-labels. The entomological collections of the Macleay Museum are the accumulated gatherings of three distinguished naturalists. It was originally commenced by Alexander Macleay, who, when he left England to come to Sydney in 1825, had one of the finest and most extensive collections of insects at that time in the possession of any private individual. He added to this many Australian species, some of which still bear his labels. His son,

William Sharp Macleay, inherited this collection on the death of his father in 1848, and added to it, bequeathing it to his cousin, Sir William Macleay, on his death in 1865. Sir William Macleay, to whom the foundation of the Macleay Museum as a general zoological museum is due, began to accumulate insects in 1861, when Mr. Masters went to Port Denison, Queensland, to collect for him; Masters afterwards went on several extended collecting expeditions in Queensland, South and Western Australia, and the specimens collected by him were chiefly described by Macleay, though the actual types of many of the insects were in the early days placed in the Australian Museum, Sydney. The types of those collected by me at Cairns, N. Queensland, in 1886, and at King's Sound, N.W. Australia, 1887–8, are in the Macleay Museum, also the other Macleay types described in the Proceedings of the Linnean Society of N.S.W., except a few that are said to be in the Brisbane Museum. Mr. Lea informs me that some of Bates' types of the *Tenebrionidae* are in the Macleay Collections. The types of all the *Staphylinidae* loaned for description to Olliff are in this Museum; the others described by Olliff are in the Australian Museum. In the Macleay Museum are also Skuse's types of Australian *Diptera*, as described in the Proceedings of the Linnean Society of N.S.W., and which are distinctly marked and mounted, and in a fine state of preservation. Lea's type-specimens of *Coleoptera*, described from unique specimens in this museum on loan, are in this museum; while all his other types, with the exception of a few in the National Museum in Melbourne, are in his own collections. Dr. Jefferis Turner informs me that a few of Meyrick's type of *Micro-lepidoptera* are in the Macleay Museum; but Mr. Masters and I examined a

number that Meyrick named for Macleay, and there is nothing to indicate that there are any types among the specimens.

Two specimens of Sawflies (*Tenthredinidae*) described by me, and most of the types of the *Cicadidae* described by Dr. Goding and myself (with the exception of those types derived from specimens loaned from the Victorian and Adelaide Museums and returned thereto) are in this museum collection; also Marsham's types of *Notoclea* (*Paropsis*), containing many of our commonest species as described in the Proceedings of the Linnean Society of London in 1818, are in this collection, and also, it is said, some of Boisduval's types.

THE AUSTRALIAN MUSEUM, Sydney, was founded in 1836 and incorporated by Act of Council in 1853. The first collection of insects was made by Mr. Roach of Petty's Hotel about 1835, who presented it to the Government; they were exhibited in the "Round House" near Circular Quay, where they were placed in charge of W. S. Wall, afterwards the first Curator of the Australian Museum.

The types now in the collections contain Macleay's Gayndah Collection obtained by G. Masters, and described by Sir William Macleay in the Transactions of the Entomological Society of N.S. Wales. Some of Macleay's *Coleoptera* from Port Denison, and South and West Australian specimens also collected by Masters are said to be in the Australian Museum, but a number of the latter are said by Mr. Masters to be in the Macleay Museum.

Macleay never affixed a type-label to his specimen, and if there were a series of the same species he never indicated the type, so that it is only where there was a single specimen that we can be

positive which specimen is the type; and further confusion arises as he presented many specimens to the Australian Museum from his own collections. Scott's Lepidoptera (still kept as a separate collection) comprise the types described by him, and are the identical butterflies and moths figured in his work, "Australian Lepidoptera," 1864.

Olliff's types of *Coleoptera* and *Lepidoptera* described while he was the museum entomologist are in the museum collections, with the exception of the *Staphylinidae* previously mentioned and a few others described from Macleay Museum specimens, one or two types that went to Jansen, London, in whose collection they are now said to be, and two butterfly types said to be in South Africa.

King's types of *Coleoptera*, collected by himself, and which he described in the Transactions of the Entomological Society of N.S.W., were purchased by the Trustees of this museum after his death. Many of the smaller ones are mounted in balsam on glass slips; others are pinned and carded; and though some of the types have vanished owing to insect pests, they are on the whole in fairly good condition.

Types of all the specimens described by both Skuse and Rainbow in the Records of the Australian Museum are in the collections; and also one of G. A. Waterhouse's types (*Lepidoptera*) and a number of Sloane's type *Carabidae*.

THE NATIONAL MUSEUM, Melbourne, was formed early in 1854, and temporarily housed in the Melbourne University buildings in August, 1856, under the charge of the late Director, Professor (afterwards) Sir Frederick McCoy. The old museum situated in the University grounds was completed early in 1864, and the collections placed in it in

March of that year.

The Entomological Collection was commenced about 1861 by the late William Kershaw, under whose charge it was placed with other of the zoological collections until his retirement in August, 1891. He was succeeded by his son, J. A. Kershaw, who is the present Curator of the Zoological Collections.

In the formation of the entomological collections no professional collectors were engaged, but specimens were obtained by purchase, exchange and donation from various sources. By the latter the Messrs. Kershaw were probably the largest contributors.

The collection of general entomological specimens from all parts of the world is an extensive one occupying 31 cabinets. It contains several well-known collections, of which the most important is the "Curtis Collection of British Insects," which was purchased by the National Museum authorities in 1863. It occupies 5 large mahogany cabinets, four of which contain British Insects of all orders, among them many of Curtis' types (described in his work on British Insects); and the fifth cabinet of 50 drawers contains a general collection of exotic insects. Nothing has been removed from this collection, which is in an excellent state of preservation, and remains exactly as Curtis left it 45 years ago. Curtis' MS. Register or Catalogue of this collection, comprising 4 quarto volumes, is also the property of the National Museum. Some interesting notes on the Curtis Collection were published by J. J. Walker, R.N., in the Entomological Monthly Magazine, 1904.

The "Howett Collection" made by Dr. Howett, consisting of Australian Coleoptera, was bequeathed

to the Melbourne University by its founder, with a condition that it must be kept intact, and nothing added to, or taken from it. It was handed over to the National Museum by the University authorities in April, 1904, on loan, together with Dr. Howett's library of entomological works. This collection is contained in 10 cabinets, and includes a large number of types of Australian insects, principally those of Count Castelnau, in whose handwriting many of the labels attached to the insects are written.

Another large and valuable collection is that of the late Count Castelnau, embracing his general collection of Coleoptera. It occupies 5 large cabinets containing about 200 drawers. The specimens are all mounted on uniformly sized pieces of papered cork, and in a great many instances a species not in the collection is represented by a carded figure.

THE SOUTH AUSTRALIAN MUSEUM, Adelaide.—Mr. F. Waterhouse was the first Curator. It contains the following: Messrs. Kreusler and Odewahn's joint collection of Coleoptera, named by Pascoe, and Mr. E. Guest's *Micro-lepidoptera* named by Meyrick; these were both purchased for the museum, but the types in these collections are not noted by any special reference.

A large portion of Tepper's original collection before 1883, and some of F. Waterhouse's specimens, were also added to the collection.

A comparatively large number, but a small proportion of the whole of the Rev. Thos. Blackburn's types of *Coleoptera*, are in this museum. A number of Mr. O. Lower's types of *Lepidoptera* are also deposited here; and also all or nearly all of Mr.

Tepper's types, described chiefly in the Transactions of the Royal Society of S. Australia.

The Kreusler and Odewahn Collection was formed between the years 1855 and 1875, and consists chiefly of Coleoptera collected about Gawler and Blanchtown, on the Murray River, S.A. Messrs. Schulz, Bathurst, Jung and O. and P. Tepper collected about Lyndoch, South Para River, and P. Tepper later on about the Lower Murray plains, Ardrossan, Yorke's Peninsula and the Mount Lofty Ranges. Messrs. C. A. and G. M. Wilson also collected extensively in the early days. All these collectors exchanged specimens and forwarded S. Australian insects to Europe and England, while the Messrs. Tepper sold to Berlin a large collection chiefly of *Coleoptera* in 1868.

THE QUEENSLAND MUSEUM, Brisbane, is not rich in types, but contains a large collection of Queensland and New Guinea insects of considerable value; but the specimens, from want of funds and a special custodian, are stowed away, and not arranged in any particular order.

The types contained in the large collection of Miskin's Lepidoptera, purchased some years ago by the museum authorities; a few types created by Dr. Jefferis Turner; and others by Lower, are all in this collection. I understand that there are also in this collection some Australian and New Guinea types created by Mr. Tryon.

The following notes on the Australian types that are to be found in British and other collections, furnished by Mr. J. J. Walker, R.N., of Oxford, and Dr. D. Sharp, of Cambridge, are very interesting. Mr. Walker says: "The Hope Collection (made by the Rev. F. W. Hope and bequeathed to the University of

Oxford at his decease about 1861), in combination with that of the late Prof. J. O. Westwood, forms the basis of the now very extensive collections of insects in the University Museum. You may safely assume that *all* Hope's Australian types, and the majority of those described by Westwood, are at Oxford. We have no fewer than 55 types of the Genus *Stigmodera* alone described by Hope. We also have a large number of insects from the collection of the late W. W. Saunders, chiefly *Lepidoptera*, *Heterocera*, *Hymenoptera*, *Orthoptera*, &c., and these include many types described by F. Smith, Walker, and others. The majority of Walker's types (such as they are) are in the National Collection, which in 1896 was enriched by the purchase of Pascoe's collection of Coleoptera, including at least 2,000 type-specimens, with a large number of Australian species among them."

Dr. Sharp says: "We have no Australian types in the Cambridge Museum, and my own collection, containing the types of many species of Australian Coleoptera, was transferred to the British Museum a few weeks ago. The rest of my collections are also there except the Lamellicorns; these were sold by me many years ago to Mr. Rene Oberthier, of Rennes, and the types of the Australian Lamellicorns I described are consequently with him. Though Westwood's collections are at Oxford, many things that he described from the British Museum Collections are in the British Museum. Most of Newman's types are I believe in the British Museum. Castelnau's Collection was sent from Australia to Paris about 40 years ago and sold there; the Carabidae were purchased by the Genoa Museum, and they have the types. The Lamellicorns were purchased by Von Lansberg, and subsequently sold

by him to R. Oberthier. The Stapylinidae and Dytiscidae I bought and are now with the rest at the British Museum. R. Oberthier also possesses the Thomson types. The Cetoniidae of Janson are still in his possession. Edward Saunders' collection of Buprestidae was purchased by the British Museum, and they have also acquired the Kerremans' Collection of Buprestidae."

Among the many collections of Australian insects that contain types, the following might be noticed:—

BLACKBURN.—Coleoptera; a very large collection containing many types created and described by the Rev. T. Blackburn, of Adelaide, S. Australia, who informs me that "A few of the types are in Mr. C. French's collection, a comparatively large number (but small in proportion to the whole) are in the South Australian Museum." The rest are in his own collections.

LEA.—Coleoptera: Another extensive collection from all parts of Australia and Tasmania is that of Mr. A. M. Lea, Hobart, containing a great number of the owner's type specimens. A few of Mr. Lea's types are in the Macleay and National Museums; one or two in Mr. A. Simson's collection in Launceston; and others are in Mr. French's collection in Melbourne.

SLOANE.—Coleoptera: This collection consists chiefly of Cicindelidae and Carabidae, and contains nearly all the types created and described by the owner, Mr. T. G. Sloane, Moorila, N.S. Wales. Some of his types however are in the Lea Collection; others in French's; one in Mr. F. Taylor's (Sydney), and a few, as

previously mentioned, are in the Australian Museum collections.

FRENCH.—Coleoptera: The owner, Mr. C. French, Melbourne, has never described any species himself; but his present collection, of which the Scaritidae is a very important part, contains many types described by other entomologists. During the last twenty years French made and bought several large collections of beetles, which he informs me have been dispersed in the following manner. "My first collection went to Leyden purchased by Count Lansberg. My second collection also to Leyden purchased by Van de Poll." Among the collections he purchased were Atwell's W. Australian beetles, the Diggles Collection, and the last of the Du Boulay's Coleoptera.

LYELL.—Lepidoptera: The owner, Mr. G. Lyell, Gisborne, Victoria, has one of the finest general collections of Lepidoptera in Australia; it contains a number of types of both Messrs. Lower and Turner, and also one of his own types.

LOWER.—Lepidoptera: This contains the majority of the types created by the owner, Mr. O. Lower, Broken Hill, New South Wales.

LUCAS.—Lepidoptera: This is a general collection containing most of the types created by the owner, Dr. Lucas, Brisbane, Queensland.

MEYRICK.—Lepidoptera: This is an immense collection of Micro-lepidoptera chiefly, containing many thousands of types created by Mr. E. Meyrick, Wilts., England.

TURNER.—Lepidoptera: This collection is located in Brisbane, Queensland, and is the property of Dr. Jefferis Turner. It contains most of the owner's types, but some of his types are in the Lyell, Illidge, and Retter collections, and the Queensland Museum.

WATERHOUSE.—Lepidoptera: This collection comprises a very extensive series of Australian butterflies, in which are nearly all the types of the owner, Mr. G. A. Waterhouse, Sydney.

FROGGATT.—Miscellaneous: It contains all the owner's types of Psyllidae, Termitidae, Neuroptera, most of the Coccidae, and a few of Hymenoptera and Diptera. It also contains many co-types of Prof. Forel's Formicidae, Dr. Andre's Mutillidae, and Dr. Horvath's Hemiptera.

ILLIDGE.—Miscellaneous: I do not think that Mr. Illidge, of Brisbane, Queensland, has created any types, but his collection contains types, chiefly of Lepidoptera, described by Dr. Lucas and Dr. Turner.

CARTER.—Coleoptera: This is one of the latest collections of Australian beetles, and belongs to Mr. H. J. Carter, Sydney. He has described a few Tenebrionidae, the types of which are in this collection.

MASKELL.—Coccidae: This collection (Coccidae, Psyllidae and Aleurodidae), made by the late Mr. W. M. Maskell, New Zealand, contains a very valuable series of his types of Coccidae, Psyllidae and Aleurodidae from Australia. It was, on the owner's death, sold to the New Zealand Government.

PUBLICATIONS DEALING WITH AUSTRALIAN ENTOMOLOGY.

In making out a bibliography of books and the more important papers on our insects, it is impossible to notice the hundreds of scientific papers scattered through English and foreign proceedings and transactions of learned Societies. There are, however, a number of books describing Australian insects which do not come under this category that an Australian entomologist may yet want to know something about. Like all such lists, this must be more or less incomplete, but it may give the student some idea of where and what to look for.

"Agricultural Gazette of New South Wales."

Commenced in 1890 on the creation of the Department of Agriculture, it contains many papers on Australian Entomology, with descriptions of new species by Messrs. Olliff, Fuller, and Froggatt.

Anderson, E. and Spry, F. P.

Victorian Butterflies, and how to collect them, Part I., complete with index, Melbourne 1893. Victorian Butterflies, Part II., 1894. A useful little work published in pamphlet form, 130 pages, illustrated with a number of very good wood-cuts.

Australian Museum, Records of.

Commenced in 1890–91, Vols. I.-VI. (1905), Sydney; issued in numbered pamphlet form at irregular intervals. Among other scientific descriptions are papers on entomology by both

Messrs. Skuse and Rainbow.

BENNETT, DR. G.

"Gatherings of a Naturalist in Australia," London 1860. Among general natural history there is a considerable amount of information on our insects.

BRENCHLEY, J. L.

"Jottings during the Cruise of H.M.S. Curaçoa among the South Sea Islands in 1865," London 1873. Natural History Notes, Insects, p. 456. Among the insects described and figured in colours are Australian Hymenoptera and Lepidoptera.

DONOVAN, E.

Insects of New Holland, London 1825.

This rare work contains the original descriptions, accompanied by very fine coloured plates, of a number of our common insects of all orders. The specimens from which the drawings were made were chiefly collected by Sir Joseph Banks. A copy of this book is in the library of the Linnean Society of N.S. Wales, and another in the Public Library, Sydney.

ENTOMOLOGICAL SOCIETY OF N.S. WALES (TRANSACTIONS).

Vols. I.-II., 1866–1873, Sydney.

These Transactions contain a number of papers by Macleay, Scott, King and Schrader, with original descriptions of new species.

FABRICIUS, J. C.

Systema Entomologiae, 1775.

He described a number of Australian insects from

the Banksian Cabinet. These had been collected by Sir Joseph Banks and Dr. Solander during Cook's voyages. The collections were afterwards presented to the British Museum.

FRENCH, C.

Handbook of the Destructive Insects of Victoria.

Part I., 1891; Part II., 1893; Part III., 1900; Melbourne. Each part is complete in itself, containing many coloured plates and popular descriptions of injurious insects.

GRAY, G. R.

The Entomology of Australia, Part I. Monograph of the Family Phasmidae, 1833; British Museum.

This contains coloured plates and descriptions of all our known species up to that date.

GRIFFITHS, EDWARD.

The Animal Kingdom. Insecta, Vol. I., 1832; Vol. II., 1844. With supplementary additions to each order by Griffiths and Pidgeon, and notices of new genera and species by Gray, with 132 plates. A number of Australian species are described, and some figured.

HORN EXPEDITION (edited by Prof. Baldwin Spencer).

Part II., Zoology, 1896.

In this are a number of papers on the insects collected by the members of the Horn Exploring Expedition in Central Australia. Blackburn and Sloane described Coleoptera; Lower, Lepidoptera; Tepper, Orthoptera; Kirby and Froggatt,

Hymenoptera.

KIRBY, W.

"Descriptions of several new species of Insects collected in New Holland by Robert Brown." (Linnean Transactions, Vol. XII., 1818.)

These insects were collected during Flinders' voyage. Thirty-three species are described, and thirteen figured on plate 23.

KIRBY, W.

"A Century of Insects." (Linnean Transactions, Vol. XII., 1818.)

In this paper he described 17 new species, and made 4 new genera.

LEACH, DR. W. E.

"Zoological Miscellanies." "Being descriptions of new and interesting animals, illustrated with coloured figures drawn from Nature by R. P. Noddes." 3 Vols., London. Vol. I., 1814; Vol. II., 1815; Vol. III., 1817.

A number of Australian insects are figured and described for the first time in these volumes.

LEWIN, JOHN W.

"Podromus, etc. Natural History of Lepidopterous Insects of N.S. Wales. Collected, engraved, and faithfully painted by J. W. Lewin." London 1805.

A manuscript copy of this work with the original coloured drawings by Lewin entitled "Insects of Australia," 1803, is in the library of the Linnean Society of N.S. Wales.

LINNEAN SOCIETY OF N.S. WALES, PROCEEDINGS.

Commencing in 1871, an annual volume of four parts has been published every year since. These proceedings contain a great number of entomological papers by the leading entomologists of Australasia, among which are Messrs. Macleay, Meyrick, Olliff, Blackburn, Sloane, Skuse, Masters, Froggatt, Lea, Lower, Turner, and Waterhouse.

MACLEAY, W. S.

"Catalogue of Insects collected by Captain King, R.N.; 192 species of Annulosa; (188 insects and 4 arachnida) pages 438–469." Eighty-one of the species are new. This is an appendix to Captain Phillip King's "Narrative of a Survey of the Intertropical and Western Coasts of Australia performed between the years 1818 and 1822." 2 Vols., London, 1827.

MARSHAM, THOS.

"Description of Notoclea, a new genus of Coleopterous Insects from New Holland." (Transactions Linnean Society, Vol. IX., p. 283, pls. 24–25, 1818.) These insects are now placed in the Genus *Paropsis*. They were probably collected in the vicinity of Sydney.

MCCOY, F.

"Podromus of Zoology of Victoria," Decade I.-XX., 1878–1890. In these memoirs of the National Museum of Victoria, McCoy figured and described a number of Australian insects.

MASTERS, G.

"Catalogue of the Described Coleoptera of

Australia," Parts I.-VII. (Proceedings of the Linnean Society N.S. Wales, Vol. X., 1885; Vol. II., new series, 1887.) Though this originally appeared in the proceedings of this Society, so many sets of reprints have been sold that it may be classed as a separate work. Two supplements have since been published (Pro. Linn. Soc. N.S.W.), but they only deal with the first families.

MISKIN, W. H.

"Synonymical Catalogue of the Lepidoptera, Rhopalocera (Butterflies) of Australia, with full Bibliographical references, including descriptions of new species." Annals of the Queensland Museum, No. 1, Brisbane 1891.

NEW ZEALAND INSTITUTE, TRANSACTIONS.

The publication of the Transactions of this Society commenced in 1867, and are published annually.

The most important articles dealing with Australian entomology are those of the late W. M. Maskell on Australian Coccidae, which commenced in 1889 and continued till his death in 1898.

OLLIFF, A. SIDNEY.

"Australian Butterflies. A brief account of the native families, with a chapter on collecting and preserving insects, with numerous wood-cuts."

A pamphlet published by the Natural History Association of N.S. Wales; Sydney 1889. This is now offered for sale by the N.S.W. Naturalists' Club, Sydney.

ROYAL SOCIETY OF SOUTH AUSTRALIA, TRANSACTIONS.

The Transactions commenced in 1878, and are published annually.

They contain a number of entomological papers by Blackburn and by Lea (Coleoptera), Tepper (Orthoptera), Lower (Lepidoptera), and other writers.

SCOTT, A. W.

"Australian Lepidoptera and their transformations," Vol. I., published by the author; London, 1864; 9 plates; Vol. II., Parts 1–2. Edited and revised by A. S. Olliff and Mrs. Forde. This was published by the Trustees of the Australian Museum, who purchased the drawings and MS. from the Scott family. There is still a considerable amount of unpublished MS. and drawings in the possession of the Trustees.

SCHREIBERS, C.

"Descriptions of some singular Coleopterous Insects." (Linnean Transactions, Vol. VI., p. 185, pls. 19–21, 1802.) Among these are a number of large showy Australian beetles. Their exact localities are not known.

TRYON, H.

"Report on Insect and Fungus Pests." (Queensland Department of Agriculture, Report I., 1889.) In this important report on injurious insects a few new species are described, and the habits and life histories of many well-known species given.

"VICTORIAN NATURALIST, THE."

The Journal and Magazine of the Field Naturalists' Club of Victoria. The first volume was issued in 1884–85. A number of original descriptions of

insects, catalogues, and notes in general are given in the pages of this Journal by Messrs. Kershaw, Lower, Lyell, Billinghurst, and others.

WESTWOOD, PROF. J. O.

"Thesaurus Entomologicus Oxoniensis," Oxford, 1875. "Illustrations of new, rare, or interesting insects for the most part contained in the Collections presented to the University of Oxford by the Rev. T. W. Hope. With 40 coloured plates and with drawings by the author." Among these are some original descriptions of Australian species.

"Arcana Entomologica," London 1841–5, 2 vols. Among other exotic forms this describes a number of Australian species and some are illustrated by means of coloured plates.

WATERHOUSE, G. A.

"Catalogue of the Rhopalocera of Australia." "Memoirs of the New South Wales Naturalists' Club," No. I., 1903. This pamphlet brings the list of Australian butterflies up to date.

WHITE, ADAM.

"Notes on some Insects from King George's Sound." This is an appendix to Captain Gray's "Travels in N.W. and West Australia," Vol. II., 1841. This contains the original descriptions of a number of insects collected by Captain Gray and numerous wood-cuts.

ZOOLOGICAL RECORD.

Commencing in 1864, the Insecta was edited at first by Dallas, afterwards by Rye, and is now edited by Sharp. Contains a list of all genera and species of

insects described during each year. All the Australian species described since 1864 are listed.

ADDENDA.

The following books and papers dealing with Australian insects have been overlooked, or have appeared since this book has been in course of preparation.

(1) A Synonymic Catalogue of Orthoptera, Vol. II. Orthoptera Saltatoria, Part I. Achetidae and Phascognuridae 1906. W. F. Kirby.

This is the second volume of the Catalogue already noticed on page 14, and deals with crickets and long-horned grasshoppers. A few alterations are made, viz.: *Gryllus servillei*, Sauss., is a synonym of *Gryllus commodus*, Walker; and the species of Ephippitytha 32-guttata figured by me in the Agricultural Gazette, N.S.W., 1904, is, Kirby says, a new species which he calls *E. froggatti*.

(2) "A Revision of the Cicindelidae (Coleoptera) of Australia," by T. G. Sloane (Pro. Linn. Soc. N.S.W. 1906). In this paper all the species formerly placed in the Genus *Tetracha* are now placed in the Genus *Megacephala*. In a supplementary paper in the same volume Sloane records *Tricondyla aptera*, Oliver, a tree hunting tiger beetle described from New Guinea as also a native of Cape York, North Queensland.

(3) "Notes on the Genus Leptops, with descriptions of new species," by A. M. Lea (Annales Soc. Ent. Belg. 1906). This is a typical group of Australian weevils. The author notices all the described species, and describes 27 new ones.

(4) "A list of the Libellulidae (Dragon Flies) of Australia," by J. G. O. Tepper (Trans. Roy. Soc. S. Aust. 1899). This paper, based upon a collection of dragon flies sent to France to Rene Martin, for identification, gives a quantity of information about the names and distribution of Australian species.

(5) "Les Odonates du Continent Australien," by Rene Martin (Memoires Soc. Zool. France, 1901). This is a very fine paper on the dragon flies recorded from Australia.

(6) Descriptions of new dragon flies. In the Proceedings of the Linnean Society N.S.W. 1906, R. J. Tillyard has contributed four papers, in which a number of described species are identified and recorded for the first time from Australia; while a number of new species have been figured and described.

(7) "A Revision of the Thynnidae," by Roland C. Turner (Pro. Linn. Soc. N.S.W. 1907). This is part I. of an important Monograph of these remarkable flower wasps peculiar in having wingless females. The author in this paper deals with the Sub-family *Diamminae* and part of the Sub-family *Thynninae*, describing a number of new species.

(8) On page 382 a very large gall is mentioned formed by a coccid obtained from Tennant's Creek, Central Australia. This insect will probably come in the Genus Cystococcus formed by Fuller (Trans. Ent. Soc. London 1899), for the reception of a species he called *Cystococcus echiniformis*.

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