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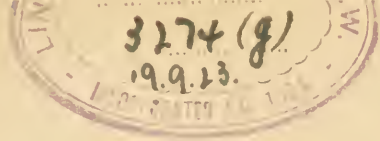
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Wood Moths.

- | | |
|-------------------------------------|------------------------------------|
| 1. <i>Charaya splendens</i> (male). | 3. <i>Charaya lignivora</i> (male) |
| 1a. " " (female). | 3a. " " , dark variety (female). |
| 2. <i>Charaya eximus</i> (male). | 3b. " " , green variety (female). |
| 2a. " " (female). | 4. <i>Culama rubiginosa</i> (male) |



FOREST INSECTS OF AUSTRALIA.

By

WALTER W. FROGGATT, F.L.S.,

Government Entomologist, New South Wales.

Member of the Linnean Society of London, The Association of Economic Entomologists of U. S. America, Corresponding Member Entomologiska Foreningen of Stockholm, Vice-President of the Linnean Society of New South Wales, Vice-President of the Royal Zoological Society of New South Wales, Vice-President of the Wild Life Preservation Society, Vice-President of the Gould League of Bird Lovers, Vice-President of the Field Naturalists' Society, President Wattle Day League.

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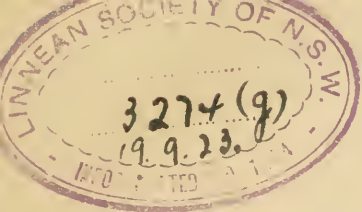


PREFACE.

As a worker in the field of Entomology, Mr. Walter W. Froggatt needs no introduction, and his compilation of this little volume on the "Forest Insects of Australia" is not the least valuable of his contributions to Science during the past thirty years. In this work will be found a fund of information regarding white ants, timber borers, and forest insect pests, which is of both practical and scientific value, and embodying, as it does, the results of many years' careful investigation, it may be accepted as a text and reference book of value by those interested in Forestry, Architecture, or industries in which wood as a material is employed.

The extent of injury done to timber by insect pests is hardly realised, and if the economic loss could be estimated, it would arouse the public mind from its apathy in regard to both the introduction of borer and other pests from abroad, and to the urgent need for protective and remedial measures. The matter is one which demands the serious attention of our legislators, and, in writing this introduction, it is in the hope that this publication may serve to throw light upon it, and to materially assist in its better consideration.

W. E. WEARNE,
Minister for Forests.



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3b. ,, ,, Green variety (female)
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WALTER W. FROGGATT, F.L.S., F.E.S.,
GOVERNMENT ENTOMOLOGIST.

INTRODUCTION.

THERE has been, comparatively speaking, very little systematic research work done upon the insects that damage the forest trees of Australia. Nothing has been observed dealing exclusively with forest insects; but incidentally a number of forest insects have been described and identified in dealing with plants on which they feed. The following pages are written for the information of all those persons who are interested in the preservation of our forests, or in the study of their insect pests. The greater part of this work will be original matter, illustrated with new plates; but the writer has also collected other information which has been previously recorded, both by himself and other naturalists, and has included it in this work.

Among our pioneer entomologists, John W. Lewin ranks first, for he described and figured in colours the insects that he found in the vicinity of Sydney in 1805. In his "Natural History of Lepidopterus Insects of New South Wales" he included a number of forest moths. Schrader, in 1862, contributed a paper to the "Transactions of the Entomological Society of New South Wales," in which he described the remarkable gall-making coccids of the sub-family Brachyscelinæ that are true forest insects, and which abort the tissue of the eucalypts and other native trees into galls. Scott, in 1864, included a number of our wood-boring moths in his "Australian Lepidoptera and their Transformations," the letterpress being accompanied with fine coloured plates of the moths and their life-histories. Professor McCoy, in the twenty decades of his "Podromus of the Zoology of Victoria" between 1878 and 1890, also dealt with forest insects. Mr. D. Best published a series of notes on the Longicorn beetles of Victoria, and listed forty-six species of these forest beetles in the pages of the "Southern Science Record," now merged into the "Victorian Naturalist."

In the miscellaneous collection of insects figured and described as pests in C. French's "Handbook of the Destructive Insects of Victoria," parts I to V, the author has included many typical forest insects. The writer has also done something toward the study of wood-boring or forest insects, both in the "Proceedings of the Linnean Society of New South Wales" and in the *Agricultural Gazette* of New South Wales.

Australian forest trees are no more immune from insect infestation than the forest flora of other parts of the world. In fact, our native trees are more open to attack, because we have no efficient feathered allies, such as the woodpeckers of Europe and America, who wage constant war upon all wood-boring beetles, moths, and their larvæ.

The writer has now gathered together all previous information dealing with forest insects, including his own observations noted in "Australian Insects" and in papers in the *Agricultural Gazette* of New South Wales. These forest insects, like their food plants, are peculiar to Australia; and they differ from similar insects in other portions of the globe on account

of the dominance of the two large groups, eucalyptus and acacia, and by the absence of oaks, chestnut, poplars, and the indigenous wild fruit-trees of the Old World.

When we study the more stunted trees of our western spaces, such as the kurrajong, casuarina, wilga, quandong, and rosewood trees, we shall find that each group has its own particular insect fauna. It is interesting to note also that when a particular species of eucalyptus, acacia, or other robust native tree is grown under artificial conditions, it is much more liable to insect attack, and it suffers much more severely from coccids, borers, and foliage-eating insects than when grown under natural conditions.

Wattle scrub that springs up on our coastal flats after a forest fire, or which has germinated from naturally dispersed seed, is usually free from mealy bugs and other scale insects; whereas, in the same localities, we find these pests attacking planted trees or plants grown from cultivated seed. The life of many of our coastal wattles is limited to, say, ten or twelve years, because, as soon as they have reached this age, the bark of the trunk hardens and cracks, giving easy entry to wood-eating beetles and moth grubs which finally cause the old trees to die.

In the western lands of the interior, however, the more slow-growing hardy scrub trees are apparently very long-lived; and some of the giant redgums on the banks of our main inland rivers are probably many hundred years old, and maybe can rival in age the historic oaks of Great Britain. When the main limbs of these gnarled old gums have been snapped off they put out fresh growth, and grow up from the side of the stump. Speaking of the age of the wattles in the west, there are many eucalypt and boree trees on the Riverina Plains that are very old, storm-beaten old warriors; they are often half recumbent, but are still vigorous, and probably can reach back for a century. In the swamps of Riverina and of North-West Victoria many great redgum trees, gaunt and dead, can be found; these grew up and reached maturity when, under normal conditions, the water dried up every summer. When the water became permanent, however, after the advent of the settler caused the damming up of the creeks and the swamp mud was puddled with the sheep, these trees could not then live because their roots became waterlogged.

In many low-lying areas in the west, which in abnormal seasons are subject to floods, and the heavy soil retains the water for considerable periods after the floods subside, one's attention is often called to the thousands of dead trees, chiefly wattles, which, standing bleached and leafless, have been lifeless for years, and yet show no marks of fire or of ring-barking. These have been killed after they had reached maturity by a cycle of wet years and waterlogged soil. Wattles and other western scrub trees seldom or never die from drought. Throughout the ages, living under semi-desert, arid conditions, they have evolved a root system that collects and stores up every drop of rain or dew, and the close, hard bark and stiff leaves waste no moisture. The Rev. Dr. Wools, in a paper entitled "The Destruction of Eucalyptus," published in the *Victorian Naturalist* (vol. viii, 1892, p. 75), gives some interesting examples of the destruction of forest gums through excessive moisture and floods. Such a cycle of wet seasons and excessive rain is more disastrous to the western wattles and other dry-land flora of that type than the longest drought can ever be.

At Depot Glen, Grey Ranges, in the driest corner of the north-west of New South Wales, I camped near Poole's grave in 1881, under the beef-wood tree (*Greivillia sp.*) that Captain Sturt marked in 1845. This tree was

as vigorous and the date as distinct as the day on which it was cut. I saw a sketch of this historic tree taken a year or two ago, and it showed that it had not altered in the least.

Wattles and many other scrub trees can protect themselves in the land of grass fires in which they thrive (another instance of adaptation to surroundings); because in these parts of Australia no grass grows right under the tree, and the rapid grass fires of the plains and downs pass them by, hardly scorching the bark of the trunk or even singeing the leaves. In fact a bush fire, even in the coastal districts, promotes the growth of the young wattle plantations, for the heat generated cracks the hard enveloping integument of the fallen seeds, and so enables them to germinate. The gum-trees growing in our coastal scrubs after a bush fire has passed over the ranges may at first sight appear killed; yet very soon afterwards, with the first rains, they put forth a fresh growth of foliage, bursting out from the scorched bark of the larger tree trunks, while young saplings spring up from the stems of the smaller timber. The stout trunks of many of our gum trees and other hardy shrub trees have evidently fire-resisting bark. We are often told that we are foolish to advocate the planting of wattles in our gardens or parks for ornamental purposes because they are such short-lived trees. Well this is true to a certain extent, yet this is counterbalanced by the rapidity with which they grow and the ease with which they can be replaced.

Many of our wattles and other trees and their attendant insects have quite a limited range; others are found in every quarter of our continent.

In many of the early Australian maps the waste places of the interior are marked out with letterpress, giving some idea of the dominant flora met with by the explorers in their overland expeditions. We find "apple gum flat," "dense whip-stick scrub," "clumps of desert cypress," and so on.

In a paper dealing with the "Forests of New South Wales," written by Mr. J. H. Maiden in the *Agricultural Gazette of New South Wales*, 1901, there is appended a forest map based on the geological formation, and it is marked out in divisions showing the dominant flora of each division.

In 1914 I published a booklet on the "Insects of New South Wales" for the use of the members of the British Association for the Advancement of Science. In this I divided our State into four main divisions to localise the typical insects; and this defines the range of many of the wattle insects. The first division was the coastal region south of Sydney extending to the bleak tablelands on the Victorian border, the home of the black wattles; the second comprised the semi-tropical or rain forests from the Queensland boundary south to the Hawkesbury River, with their "sallys" and long-leaved wattles. The third division contained the typical Hawkesbury sandstone, where there is a blending of the northern and southern acacia flora with many more dwarfed forms peculiar to the sandstone country. The fourth division held the western area, where the hardy dry land wattles, such as the mulga, gidya, boree, and brigalow predominate.

Naturally, the distinctive species are responsible for the range and distribution of the insects peculiar to each wattle; and particularly for those insects that are known as "borers," and which attack the stems, branches, and roots. Yet when we study the leaf or flower-haunting insects we find many of them that range over the greater part of Australia.

In the summer months, when the western wattles are in bloom, the entomologist with a sweeping net can obtain a rich harvest of wasps, bees, flies, leaf hoppers, plant bugs, and small beetles attracted to the pollen.

CHAPTER I.

PLANT GALLS.

A plant gall has been briefly described as the morbid enlargement of the affected part of a plant by parasitic agency, which may be insect or fungus. Besides the many curious galls formed by insects, some of our trees, such as the black wattle (*Acacia decurrens*) are often badly infested with rust galls which are of fungus origin. The most characteristic is *Uromycladium tepperianum*, which, as they increase in size, cover the branchlets with woody excrescences, rusty red in colour and variable in form; these in turn become the home of insects that are living upon this aborted tissue, or else are parasites upon the plant-eating larvæ.

All kinds of insects are bred out of these mature rust galls; but it must be remembered that they are only inquilines or visitors and did not produce the galls in the first instance. The kurrajong is also infested with large fleshy galls upon its branchlets; these galls are irregularly rounded, and range from the size of a walnut to one's closed fist. They have been considered rust galls, though my botanical friends have been unable to find any traces of rust spores upon them. These galls are considered later on when dealing with the insect pests of the kurrajong, for they are the home of beetle and hymenopterous larvæ.

A great deal has been written about the plant galls of Europe; Connold has written a fine work, "British Vegetable Galls, 1901," illustrated with hundreds of photographs of the species described; a list of fifty-four species is given of those peculiar to the oaks (*Quercus*).

As a number of insects belonging to different orders produce galls, and as gall insects are very numerous in Australia, I propose to deal with them as a whole, and then simply refer to each species when describing their habits and food plants.

Insect galls are formed of aborted plant tissue produced upon the stems, branchlets, leaves, or flowers by the action of different insects. The local injury is caused by the ovipositor of an insect, or the secretion injected when the ovipositor is inserted, or by the presence of the egg, and later by the larvæ sucking or gnawing the surrounding tissue.

A typical gall is an oval or rounded mass of more or less soft plant tissue surrounding a central cell or cells containing the insect larva. When fully fed the larva pupates, later on the insect emerges from the pupal skin, and cuts its way out through the side of the gall. When galls are formed upon buds or embryo seed pods they are frequently aborted into a mass or bundle of irregular tubes; a typical example are those formed by the gall gnat (*Cecidomyia acacia-longifoliae*) when it punctures the flowers of the long-leaved acacia. Another gall gnat causes the leaf buds of a coastal Melaleuca to form oval brown galls composed of many leaf-like bracts. In another Dipterous family (TRYPETINÆ), containing a number of small richly-coloured flies, allied to the destructive fruit-flies, we find them usually forming typical rounded galls on the branchlets. The greater number of the micro-hymenoptera are parasites, and though these are often bred out of excrescences, they are usually parasites devouring the original gall-makers. Still, however, there are quite a number of such phytophagus species that are true gall-makers. Most of these galls are oval or rounded; but others are



Insect Galls.

1. Male and Female Galls of *Brachysectis pilata*, Schrader.
2. Female Galls of *Opisthoscelis subrotunda*, Schrader.
3. Galls of *Cecidomyia acacia-longifoliae*, Skuse.

slender and horn-shaped. In one remarkable group (*Trichilogaster*) that infests our wattles and gums and forms rounded fleshy galls there are usually two eggs deposited, and a male and female wasp emerge from each gall. In an allied species (*Eurytoma binotata*) the galls are long, slender, green or red, spindle-shaped structures forming bunches upon the branchlets of young eucalypts. Members of the order THYSANOPTERA, which are popularly known as "black fly" or "thrips," free-living plant pests in other parts of the world, are responsible for some of the most curious leaf galls in Australia. Some of these are bract-like processes on the leaf buds, others attack the leaf on either side and cause each edge to roll up towards the mid-rib. Sometimes, particularly on wattles, they puncture the leaf from the underside, and an oval, flattened, or rugose gall forms into which the greater part of the leaf is absorbed, the stalk and the tip of the leaf only remaining intact on each side of the gall. These galls are apparently the work of an adult female thrips, which finally becomes a prisoner in the cavity where she lays her eggs, and under the protection of which the baby thrips develop, escaping when full grown when the scar on the underside of the leaf cracks as the gall matures. I have recently found another species: a rounded woolly gall on the branches of the belar (*Casuarina*); this is intersected beneath the covering bark with transverse galleries in which large communities of thrips were living until by the same process the bark cracked and liberated them.

We have no gall-making aphids in Australia like those so common on the forest trees of the United States; yet a number of our lerp insects (family PSYLLIDÆ) produce somewhat similar leaf galls. Some are thin and hollow with the opening on the underside of the gum leaf ("bubble galls"); others are stout and almost solid, and in the first instance were commenced by the larva puncturing the under surface of the leaf, but they have to mature, split, and open on the apical surface before the perfect insect can escape from her cell.

The most remarkable galls in the world, however, and those with the most complicated structure, are produced by our gall-making Coccidæ. In the most typical genus (*Apiomorpha*), the tiny yellow larvæ, hatched in the gall chamber, emerge through the apical opening on the tip of the female gall. Hundreds of these tiny creatures, encircled by fine cilia, with mouth, legs, antennæ, and eyes, scatter over the foliage of the food plant. Some settle down on the foliage, others on the twigs, and each sex produces a distinct form of gall. The male galls are generally much more numerous on the foliage, the female galls upon the twigs. Here they all settle down and in some mysterious manner cause the plant tissue to swell up round them. The female larva changes into an elongate turbinate yellow grub-like creature without any apparent mouth, with aborted antennæ and legs, and with the tip of the abdomen produced into two horny tails; the body segments are clothed with rows of fine spines, hairs, and floury secretion. The galls become hard, oval, ribbed, or rounded boxes, with a central cavity fitting round the enclosed coccid, who is standing on her head with the horny tails towards the tiny apical opening in the gall. A number of these galls are furnished with curled horns or braets at the apical margins characteristic of the species. *Apiomorpha duplex*, with its pair of long leaf-like appendages, is the giant among them, sometimes measuring over a foot in length.

The male larva, resting on the leaf, produces a short cylindrical hollow gall standing erect upon the leaf with the apex often dilated. Enclosed in this woody tube the tiny red elongated male coccid, also standing on his head, develops and emerges later a perfect two-winged active coccid.

The female entombed in her solid gall finally becomes a sac of eggs, and after she has deposited them she withers up and dies.

Sometimes the whole of the foliage and twigs of a eucalypt are covered and aborted with these galls.

Other gall coccids produce even more remarkable community galls, in which both male and female live together; these are chiefly confined to the Casuarina, Melaleuca, and Leptospermum trees.

The reader will find most of these galls figured and briefly described in my "Descriptive Catalogue of the Scale Insects (Coccidæ) of Australia," Science Bulletins Nos. 14, 18, and 19, Department of Agriculture, New South Wales, 1915-21.

Among the most obscure galls are those produced by the mites belonging to the family ERIOPHYIDÆ. These are minute cylindrical mites with two pairs of legs close behind the head, and long hairs on the tip of the body. Some, like the pear mite, and the vine-leaf mite, are well-known orchard pests. Many of our native trees and plants are infested by unique species; and there is a rich field for investigation for the naturalist who takes up the study of our leaf mites. I have collected a number of different species in our bush. Some cover the surface of the leaves of different species of eucalypts with multitudes of tiny bright-red bladder-like blisters, each containing a mite. Another species produces little red bladders upon the foliage of *Euphorbia drummondii*. A western species covers the leaves of the western rosewood tree (*Heterodendrum hamastoma oleaefolium*) with rugose raised blisters. Sometimes they attack the bark, and the stems of the scribbly gums (*Eucalyptus hamastoma*) growing upon the Cordeaux water conservation area have rounded, raised blisters upon their bark, each containing a colony of tiny crimson mites.

The Economic Value of Birds in Forests.

The bird-life of the Australian forest is as remarkable as the plants and insects. As in other parts of the world, we have many small birds that feed upon the insects which shelter under the dead bark, and other birds that constantly hunt over the foliage. Yet we have very few birds that are able to capture insects when once the insects have penetrated the bark of a tree, and so they fail to destroy the true wood-borers of the forest.

In the Old World and North America there is a large group of birds belonging to the family PICIDÆ, which are popularly known as woodpeckers. These birds have a stout, powerful, pointed beak with which they can cut into any infested wood, and so they can abstract the wood-boring grub or larva. In Central Europe alone there are eight species of woodpeckers, and there are many more species in North American forests.

The question whether woodpeckers are protective or injurious to forest plantations is, however, a vexed question among European forest experts; and some writers claim that these birds, by drilling holes into sound trees, eating forest seeds, and girdling healthy trees, do more damage than they do good in keeping down destructive insects. The latest investigations in Europe and in North America tend to prove, however, that the police work in the forest carried out by the woodpeckers as a whole outbalances the damage sustained by the tree.

In Australia we have no birds allied to the woodpeckers that hunt and destroy the wood-boring larvæ of moths and beetles. The only birds that can peck out the wood grubs are the black cockatoos (*Calyptorhynchus*

funereus). These cockatoos frequent the forest lands, and are provided with a very powerful beak, capable of tearing off quite large limbs of the gum-trees when searching for wood-grubs.

In Britain the wood-pigeons are not only considered serious pests by the farmers because of the enormous quantities of peas and other field crops they eat, but also because in the forest, when numerous, they destroy a great number of valuable seeds of forest trees.

I have frequently noticed the bronzewing pigeons congregating in the wattle scrub at seeding-time to feed upon the falling seeds, in spite of their hard integument.

There are a number of ground-hunting birds in the scrubs and cedar brushes that feed upon insects and land snails, which otherwise might become a serious menace to the foliage and stems of the forest trees.

Several species of lerp insects (*Psyllidæ*) cover the leaves of the gum-trees so thickly with their manna-like tests that they almost defoliate the trees. Several species of the little brush-tongued parrakeets, and some of the honey-eaters, feed upon these sugary lerp scales; and as these parrots usually congregate in large flocks they must play an important part in cleaning up the sugar lerps. Though birds are frequently credited with spreading scale insects in orchard and forest, by frequenting scale-infested trees and thence flying on clean trees with the larval scales upon their legs, yet some are well-known scale-eaters.

Mr. E. A. Kitson published a note in the *Victorian Naturalist* (vol. xiv, p. 106, 1897) in which he records that the rosella parrots (*Platycercus eximus*) were noticed that season in some of the Melbourne parks, and that they were eating out the glassy oak scale (*Asterolecanium quercicola*) which infests the tips of the branchlets of the oak trees. It is very probable that parrots and other birds play an important part in the reduction of mealy bugs and other scale insects upon forest trees over the whole of our vast continent.

Insects generally in their relation to forest trees.

Insects damage trees in many different ways. Sometimes they eat the foliage; in other cases they suck up the sap from the leaves, and cause them to be discoloured, wither, and fall off. Others again web leaves together with silken strands and cause them to decay.

All foliage is destroyed chiefly by the caterpillars of moths and butterflies, or else by foliage-eating beetles, chiefly those belonging to the Lamellicornæ and Chrysomalids. In the CHRYSOMALIDÆ both the larvæ and the beetles feed upon the foliage. The legless larvæ of some of the snout beetles or weevils (CURCULIONIDÆ) destroy foliage, and quite a number of the adult beetles attack the opening leaf-buds. These under normal conditions are forest insects, and should be watched in forest plantations. A number under altered conditions have found their way out of the bush into the orchards, and have developed into very serious pests.

In the family TENTHREDINIDÆ, the sawflies have typical phytophagus larvæ, which often appear in great numbers; they mass together on the foliage, and when abundant defoliate the trees.

At Roma, Queensland, one species of the genus *Pterogopherus* appears sometimes in countless millions, stripping off every leaf on the ironbark gums; and when full-fed they congregate at the base of the tree. The grazing cattle have learnt to eat these sawfly grubs, and numbers die from this abnormal appetite.

All the members of the family PHASMIDÆ, containing the leaf and stick insects, are foliage-eating insects all through their lives; but most of the species are solitary in their habits and are comparatively rare insects. One gregarious species (*Podacanthus wilkinsoni*) frequently appears in immense armies in the eucalyptus forests east of Walcha and Glen Innes, and, marching along a broad track, they take every leaf off all the gum-trees in their track.

The habit of webbing the foliage together with loose silken strands or closely-woven silken bags is confined to several groups of the bag-shelter and leaf-rolling moths.

The destruction of all the leaves by the infestation of sucking insects is generally caused by members of the orders THYSANOPTERA (thrips) or HEMIPTERA (plant bugs). The larvæ and adult free-living thrips damage the epidermis of the leaf.

All the members of the order HEMIPTERA are provided with a sucking, tubular mouth known as the rostrum. They are popularly known as plant bugs, scale insects, froghoppers, aphids, lerp insects, and snowflies. Among the most serious of all these enemies to vegetation are the scale insects (COCCIDÆ). They suck up the sap of leaves, twigs, stems, and even the fruits; and they destroy much valuable timber by stunting the growth, even if they do not actually kill the tree. Many wattle trees are killed by different species of the armoured scales.

We have few, if any, indigenous aphids on our forest trees. One dark-winged, hairy species recently appeared in the cypress pine forests in the Dubbo district. A few introduced species have turned their attention to our pine plantations. The place of aphids is taken by the typical lerp insects. These tiny homopterous insects belonging to the PSYLLIDÆ are well-defined in Australia under the popular name of "lerp insects," in reference to the remarkable little structures that the larvæ of many species produce from the surplus sap they suck up, discharge from the anal segment, and spin into protective shields with their hind legs. Moving about under the lerp scale, they feed upon the sap until full-grown, when they usually crawl from under the shelter and rest on the surface of the leaf, while the pupal skin splits down the back, and the perfect, minute, winged, cicada-like insect emerges.

When these insects are numerous, large areas of forest, particularly eucalypts, are so badly infested that all the foliage becomes discoloured through the sap being sucked up; the leaves dry up and fall, and thousands of trees become defoliated, and look in a very unhealthy condition, or as if they had been ringbarked. If suitable climatic conditions carry on the successive generations of lerp insects through several years, this constant infestation causes the tops of the gum-trees to die back, and the forest rangers state that the timber becomes of an inferior quality to that of uninfested trees. Generally, however, these insects come and go; and I doubt if an occasional infestation does much harm to the trees, as under normal conditions they shed the damaged leaves, and a fresh growth of foliage appears without the growth of the timber being affected.

Unlike the scale insects, both male and female lerp insects in the adult state have two pair of well-developed wings, and are active little creatures that can fly well; and, being provided with thickened processes upon the thighs of the hind legs, they can spring a considerable distance.

The lerp insects are well represented in Australia, and besides those feeding upon the different species of wattles and gum-trees, many of our native shrubs are infested with their own distinctive species. Some of these form leaf galls; others cover themselves with woolly filaments, shelter under viscid sâp, or are naked and unprotected. Suited to Australian conditions, they have adapted themselves to our distinctive flora, and appear to take the place of the Aphidæ that are so common and destructive in other parts of the world, but are very poorly represented by indigenous species on our flora.

The timber-boring insects of the forest which attack healthy trees are chiefly confined to the order LEPIDOPTERA, moth and butterfly caterpillars, and the grubs of beetles COLEOPTERA. They may lay their eggs upon the surface of the bark; but in the case of beetles that puncture the bark the resultant larvæ bore into through the bark, and frequently they feed in the earlier stages between the bark and sap-wood before they bore into the harder wood and pupate. Sometimes the larvæ feed down the centre of the smaller branches for a considerable distance. Others encircle the wood just beneath the bark and cause the branchlet to snap off; the larvæ feed and pupate on the fallen portion. In several groups of the longicorn beetles, the female, when depositing her egg, girdles, or ringbarks, the infested stem, and provides the larva with suitable withering food. The larvæ of all longicorn beetles are timber-feeders; and, though many undergo their metamorphoses within a year, others may take several years before completing their life-cycle. The longicorns, unlike most of the other beetles, lay their eggs upon vigorous healthy trees as well as those that are sick or injured, and thus they cause a great deal of injury to valuable timber trees.

The weevils or snout beetles (*Curculonidæ*) deposit their eggs in a similar manner to the longicorn beetles; but they usually cut into the bark and push the egg into the cavity. They are often gregarious, and a number of eggs may be deposited in one spot. The legless larvæ usually pack the chewed wood behind them as they tunnel; and they frequently return down this bore when they are perfect beetles, eating their way out through the original opening. Other weevils lay their eggs in dead trees, and are often much more prolific than the previous group of beetles.

There are a number of other wood-boring beetles, such as the ambrosia beetles, shot-hole borers, auger beetles, and powder-post beetles, that confine their attention to dead or drying timber; but they are dealt with in a separate section.

The timber or wood boring moths are well represented in Australian forests, and many of the smaller forest and scrub trees are killed by their larvæ. The moths deposit their eggs upon perfectly sound, healthy trees. Some, like the *Cryptophagina*, of which the cherry-tree borer is an example, simply make a hole in the stem and a short, vertical burrow below, webbing the bark in front, and coming out at night to feed. Thus they gradually eat off all the bark surrounding the bore before they pupate, and thus kill large branches. Others, like the wattle-borers, feed down the centre of the stems, and are true timber feeders, ready when full-fed to pupate at the end



Lerp Scales of Australian Psyllidae—Lerp Insects.

- | | |
|---|---|
| 1. <i>Cardiaspis bunneus</i> (Froggatt). | 12. <i>Rhinocola mollis</i> , n.sp. |
| 2. " <i>tetrix</i> (Froggatt). | 13. <i>Cardiaspis actifex</i> (Swartz). |
| 3. " <i>spiniferus</i> , n.sp. | 14. <i>Spondylaspis eucalypti</i> (Dobson). |
| 4. <i>Lasiopsylla rotundipennis</i> (Froggatt). | 15. " <i>rufya</i> , n.sp. |
| 5. " <i>striatus</i> , n.sp. | 16. <i>Cremis longipennis</i> . |
| 6. " <i>falcatus</i> , n.sp. | 17. <i>Eucalyptolyua maideni</i> (Froggatt). |
| 7. <i>Rhinocola pennaeformis</i> (Froggatt). | 18. <i>Lasiopsylla pellucida</i> , n.sp. |
| 8. <i>Spondylaspis mannafera</i> (Froggatt). | 19. <i>Rhinocola nigra</i> , n.sp. |
| 9. <i>Rhinocola costatus</i> , n.sp. | 20. " <i>cuniculatus</i> (Froggatt). |
| 10. " <i>liturata</i> (Froggatt). | 21. <i>Cardiaspis plicatuloides</i> (Froggatt). |
| 11. <i>Penapsylla alba</i> , n.sp. | |





Dead Trunk of *Pinus insignis*.
Showing the pupa cases of the Pine Weevil (*Aesiotus leucurus* Pasc.).

of the burrow, which comes so close to the outer bark near the pupal cell that on emergence the moth can push her way quite easily through the outer bark.

The third division (PIELIDÆ) feed upon the outer surface of the roots of the trees, and, when full-grown, pupate, and work their way to the surface of the soil, so that the moth has no difficulty in escaping; their empty pupal cases are frequently noticed sticking a few inches out of the soil at the base of the tree. This group is one of those that are often infected with the spores of the curious fungus *Cordiceps*. The larvæ, feeding upon the infected wood, becomes spore infected; the whole body turns into a hard woody substance and sends up a small rush-like fruiting spore-stem that attached to the dead caterpillar shoots above the ground. These are known as vegetable caterpillars.

It is a well-known fact that all trees that are not thriving either on account of unfavourable climatic conditions, unsuitable soil, or defective root formation are at the mercy of all bark-eating beetles; and, frequently without any apparent proof, these insects are credited with effecting the death of the trees, whereas they are only the secondary cause. On investigation, both in orchard and forest, it will always be found that the trees are already dying, and this is the real reason of the appearance of the borers, who are attracted by the withering bark and stagnant plant tissue. Such trees, dead trees, and fallen timber that has been cut up, should not be allowed to decay in the timber plantations; and, if not of sufficient commercial value to be removed and milled, they should be burnt or otherwise destroyed. In such material we often find immense quantities of injurious insect larvæ in all stages of development, which later on emerge and spread through the forest, and find freshly-fallen timber suitable for their larvæ.

If a bush fire runs through a forest or scrub, the entomologist knows that in a few days later the trees upon the fire-swept area will yield upon examination a rich harvest of phytophagous beetles, and other carnivorous beetles that feed upon them.

It is only a naturalist who has studied this question who can realise the important part that carnivorous or parasitic insects play in forest entomology. His knowledge of the life-history of a large series of some such timber pest enables him to show the percentage of the pest destroyed in the egg, larvæ, or pupal state in this manner, and thus he can estimate the enormous value of the parasites.

The introduction of timber pests into a new country and the reason of their excessive destructiveness is another important problem. We have quite a number of examples of how a comparatively harmless insect in its native land can become a very serious pest when accidentally introduced into another country without the control of its natural enemies. The importation of large numbers of railway sleepers from Australia to South Africa some years ago led to accidental introduction, and later the establishment, of one of our common longicorn beetles (*Phoracantha recurva*) in that country. The Forestry Department were forming large plantations of eucalypts in this district, and found these beetles attacking the healthy trees, where they at the present time damage a good deal of valuable timber. Whereas in Australia, controlled by numerous parasites (described later on), these beetles only lay their eggs in fallen timber or dying trees.

Another introduction into South Africa is a weevil beetle (*Gonipterous reticulatus*). Its native home is Tasmania, where it is a comparatively rare insect, yet in South Africa it is swarming over the foliage of the young blue-gums (*Eucalyptus globulus*). The curious, legless, slug-like larvæ eat the surface off the leaves, stunting and destroying the plantations.

In New Zealand, where extensive plantations of eucalyptus trees have been established, our "White egg scale" (*Eriococcus coriaceus*) was accidentally introduced. Without its attendant parasites, ladybird beetles and small moth larvæ, which in our native forests keep it well in hand, this scale increased in such numbers that they have to constantly spray to keep the scale down and give the trees a chance to grow.

Even at home, in our irrigation areas and gardens, we find examples of our indigenous insect pests which increase abnormally because the trees are planted out under new conditions and away from the natural surroundings of the native forest. The sugar-gums in such situations have been just as badly infested with *Eriococcus coriaceus* as the blue-gums in New Zealand. Here it will probably be only a matter of time for the native parasites (of which there are many) to find their enemies in these new plantations, and then the balance of nature will right itself.

Insect parasites, varying in size from the large Ichnumon wasps and the large Clerid beetles to the tiny, microscopic chalcid wasps, are ever at work in the forest. It is safe to say that a very small proportion (probably not 5 per cent.) of the hundreds of thousands of eggs of the wood-moths deposited in the tree-trunks ever reach maturity. The same applies to the longicorn beetles. The larvæ of all wood-borers have many dangers to pass through before the perfect insects emerge.

CHAPTER II.

TERMITIDÆ—White Ants.

Termites are widely distributed over the warmer parts of the earth's surface, and are well represented in Australia by many interesting species. Among these are several species that annually destroy many thousands of pounds' worth of valuable timber in our forests; and it is almost impossible to estimate the monetary value of the enormous damage they do to the woodwork of our houses all over Australia.

In regard to seasoned timber in buildings, most of the methods to be adopted are essentially preventive measures. *First*, the wood used in construction should be made distasteful to the termites, either by soaking it in wood oil, tar, or creosote mixture, or by painting the outer surface with some similar repellent preparation. *Second*, all floors should be built well



Domed Nest.



Domed Nest with outer wall removed.

up from the ground, so that there will be a perfect ventilation, and so that the timber can be examined from beneath from time to time. *Third*, cutting off all connection with the ground beneath by the use of metal caps on the wooden or brick piers beneath the floor. Defective ventilation, followed by damp condition or dry rot, frequently attracts the termites to the wood.

In forest areas termites flourish where there is plenty of dead or dying timber. During the dry season or in times of an extended drought the termites disappear getting down to moist earth or wood; but as soon as the wet season appears they reappear as if by magic, and within a few days every log, bit of wood upon the ground, and even the cow dung, is swarming with termite workers and soldiers. The most effective method to be adopted

by the forester in keeping down the termites is the destruction or removal of all dead timber, for, as a rule, they do not attack healthy, vigorous trees. The termite that is responsible for nearly all the damage to houses in Australia is the Milk termite (*Coptotermes lacteus*), which is described and figured here with its life-history.

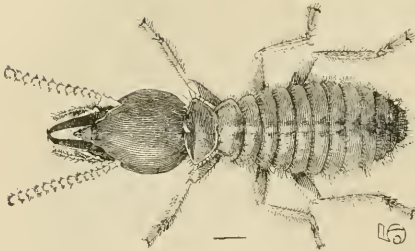
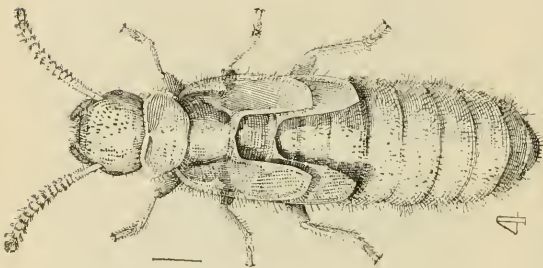
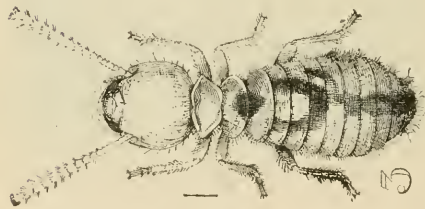
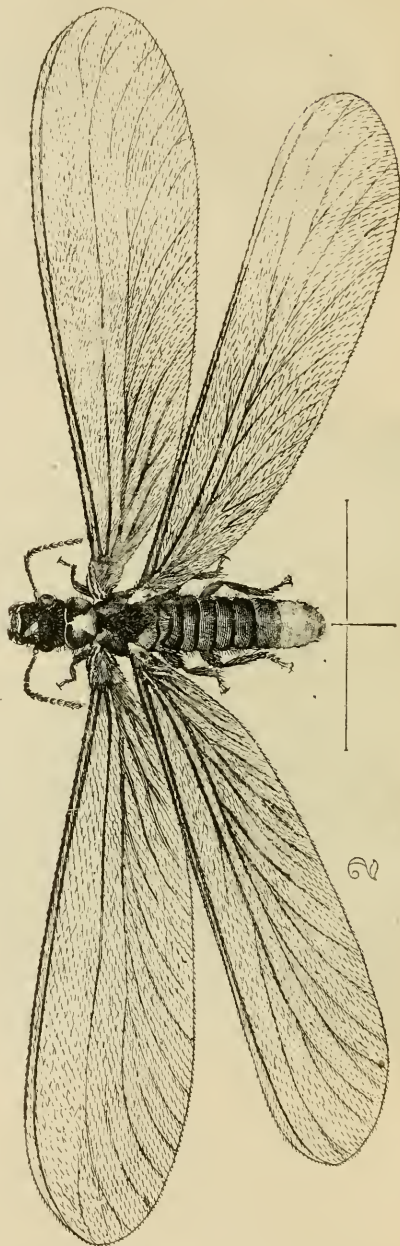
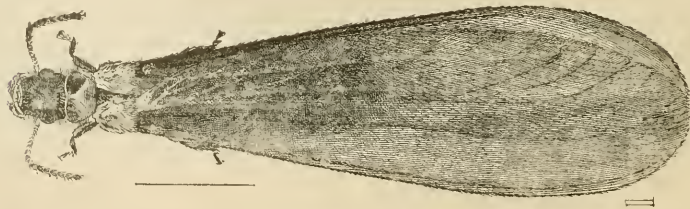
Two other species belonging to the genus *Eutermes* are small, dark-coloured termites, in which the soldier caste have the front of the head produced into a snout or awl-like process, from which they are known as "nasuti," they are common in the forests, and they often damage fences. *Eutermes fumipennis* and *E. fumigatus* live in large communities under dead bark or logs, and also form rounded termitaria or nests of woody matter on the branches of trees. From their shape and dark colour they are popularly known as "Negro Head" nests.

Others live in small communities on stumps, logs, or cavities in the trunks of trees, and form no definite termitarium; and, with one or two exceptions, they seldom get into the timbers of buildings.

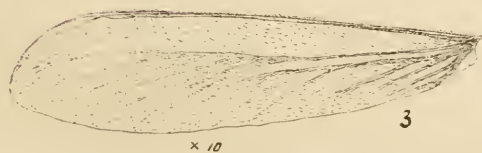
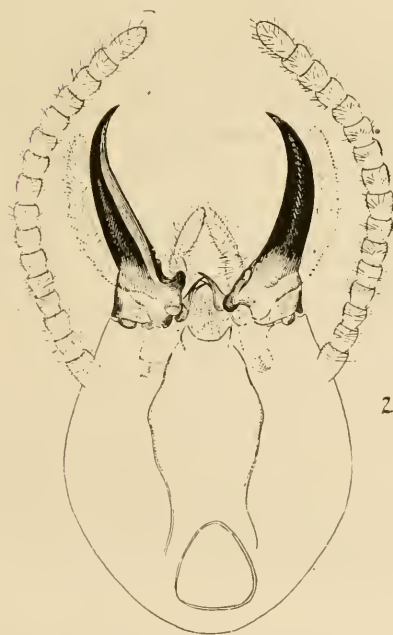
The Milk White Ant (*Coptotermes* [*Termes*] *lacteus*, Froggatt).

This species was first described under the name of *Termes lactis* by me in the *Agricultural Gazette* of New South Wales, p. 297, with plate, in May, 1897, and later on in the same year a technical description was given in the "Proceedings of the Linnean Society of New South Wales."

It is the common species in Australia that is responsible for nearly all the damage done to houses; I have never found any other species of this genus in houses, but one or two species of the allied *Eutermes* often get into fences and outside woodwork in the bush. It is rather curious that while the nests of this species are not found about the neighbourhood of Sydney, where they simply form colonies in old stumps, under logs and houses, that they build such characteristic domed nests in other districts. The large termite nest met with along the South Coast, the scrubby country of Colo Vale, Moss Vale, and up into Southern Queensland, is the home of this species. It measures up to 6 feet in height, broadest at the base, tapering very little on the sides, and broadly rounded on the summit. The outer clay covering is very thick and compact, without any opening on the surface except when the workers cut galleries through the walls in November to let out the winged males and females, and as soon as they have emerged the holes are filled up with fresh clay. Enfolded in this clay covering is an irregular mass of granulated, honeycombed, woody matter, which has at one time been wood, but has been chewed up and voided by the insects and produced into a regular papier-maché-like substance; it is seldom in contact with the clay except at the base, and fits to the outward form of the termitarium. The base of the nest, which consists of a regular network of galleries, generally extends about a foot below the surrounding surface of the ground, from beneath which several large galleries lead away into the soil and are the main roads out of the nest to the surrounding forest. Above the network portion of the base of the nest, which is easily detached from the ground, the structure of the galleries becomes more solid, and the royal chamber nearly in the centre of the mass is surrounded with terrace-like solid sheets of a lighter colour, the central chamber being a convex cavity on a level floor about the size of an ordinary saucer; just below on the side will be found more open galleries containing piles of eggs, like semi-transparent grains of sugar, which are removed by the workers from the royal chamber. There are several openings leading off from the floor by which the attendant



White Ants. 1 and 2. Male and Female Winged White Ants. 3. Worker. 4. Nymph. 5. Soldier.



White Ants (*Coptotermes* [*Termes*] *lacteus*).

1. Head of Worker 2. Head of Soldier. 3. Wing of Perfect Insect.

workers can come in and out, but they are not large enough for the queen, if she is able to move freely (which she is not usually able to do), to get out of her cell. It is noticeable that the egg chambers and queen cell are always situated well above the ground level, so that even if the ground was flooded they are out of danger. Above the queen is a mass of very fine laminated material as thin as brown paper, folding up into fine galleries, curving round into an irregularly rounded ball as big as a man's head, in which the tiny larvæ swarm, and which has been termed the "nursery." The rest of the termitarium consists of more or less solid masses of material, full of chambers and galleries, through which the workers and soldiers are mixed up in no regular order. Sometimes the clay walls contain short galleries in which workers and soldiers are found, but this is not usually the case. In November, on the Shoalhaven, where I opened a number of nests, several were found with keyhole-like slits in the walls, with a cluster of soldiers at the outer opening, with their jaws facing out, standing guard, while behind them the galleries were packed with the winged ones ready to emerge at the appointed time when the soldiers would give free exit, which turned out to be just before sunset.

The winged forms are almost black in colour, with no very distinct character from several other species; but both the soldiers and workers are very white, with the head pale yellow. The soldier has a somewhat pear-shaped head, with 16-jointed antennæ, large, untoothed, curved, sabre-shaped jaws, usually meeting or crossed at the tip, and a tubular opening in front above the labrum, through which, when touched, he can discharge a globule of white, sticky fluid, by which the species is easily distinguished from any other found about Sydney. It is met with in all sorts of situations, under logs and stones, under dead bark on tree trunks, in the roots or stems of old or damaged fruit trees, and in the woodwork of houses. When disturbed, the workers always hurry away, but the soldiers only retreat to the entrance of the galleries leading downwards, where they stand with their jaws just projecting and their antennæ moving sideways. If the gap is in the wall of a regular nest, the soldiers remain there until the workers return with grains of earth which they place on the fracture, then turn round, void a drop of what looks like liquid mud, hurry off, while the next one steps in front of the soldiers and places its load on the top of the other, treats it in the same manner, and is followed by another until the opening is soon closed up, and the last one sees is the antennæ of the soldiers waving behind the barricade. The rebuilding of the broken wall, if the damage is serious, is only of a temporary character over the galleries leading to the nest; they seem to understand that they cannot replace the mass of clay that has been broken out at once, but this is gradually filled in by nocturnal workers, who, in a very few days, will replace the gap and level the surface down to its original shape.

Preventatives and Methods of dealing with White Ants.

Termites are individually very delicate creatures that can be easily destroyed by any contact poison if once found, and their whereabouts noticed in time; so that it is not difficult to check or drive them away in the first instance.

The food of these insects is wood or vegetable matter of all kinds, and the wonderful instinct or sense of smell that enables them to find their way upwards through feet of clay or brickwork to the wood above is very remarkable.

Therefore, as prevention is better than cure, the more perfectly the house being built is isolated from the ground beneath the better chance there is of keeping out the white ants. The first thing to do before building any kind of house in a district where white ants are known to be troublesome is to thoroughly examine the proposed site for all stumps, roots, or dead wood, and remove everything found: if it is practical to remove all the surface earth that is being built over for a depth of 6 inches or more, so much the better; some foreign authority recently advised deeply ploughing the site first, and claimed that he had never had a house infested with white ants where this practice had been followed.

All floors should be raised above the surrounding level, so high that a man could crawl everywhere under the building and have access to the woodwork. In many of the cases where houses are badly damaged by white ants the floor joists will be frequently found resting upon or only a few inches off the ground.

In country houses where timber supports or piles are used, they should be charred or tarred, and if half a lb. of salt be placed in each hole beneath the post it would be a great preventive; on the top of each a tin or zinc cap should be placed, for, though not everlasting, they help to keep the pests out of all upper woodwork.

Where bricks can be used it is much better to build all supports with them, as they do not attract the termites. The floor joists after they are laid should be thoroughly dressed with wood-preserving oil, to which has been added 1 lb. of arsenic to 4 gallons of oil. If equal parts of washing soda and arsenic are boiled together, the latter will be dissolved and can then be mixed with the oil. This is the basis of all "anti-ant paint" and "white ant exterminators" that are placed upon the market: they can be just as easily compounded at home for less than one quarter the cost. Sometimes after the floor is laid upon the joists the oil will ascend through the nail holes, but this does not harm, but is rather a proof that the work has been well done.*

Of course, it is difficult to perfectly isolate a house from the ground, for often after all the care taken someone may build a flight of steps up to the front without any precautions, furnishing an ideal roadway for the termite: or else someone leans a beam against the wall and gives them another means of ingress. In the country where wood is chiefly used for fuel, and is carted in and stacked close to the house, it is quite evident that logs infested with small colonies of white ants can be easily introduced, which, under favourable conditions, might emerge and find a lodgment elsewhere, and thus get into the house timbers. In North Queensland many of the houses are built upon 11-foot piles, so that there is plenty of room beneath, and in such houses it is seldom that the termites get into the woodwork.

When once the white ants have gained an entrance into a building, the first thing is to find where they started work and the extent and area affected by their depredations. When this has been ascertained, the outer woodwork can be removed, and the damaged timber, where not too far gone, painted with corrosive sublimate (bi-chloride of mercury) which has been dissolved in spirits of wine or water. Sugar or treacle, to which arsenic has been blended, if placed in the excavations they are working, will kill off large numbers, for they feed off it readily, and even eat the dead ones that have first succumbed to the poison, so that it soon reduces their numbers.

* See Note (Appendix I, p. 21).

There have been many suggestions made as to the possibility of injecting steam, the fumes of carbonic acid, &c., into the infested timber, but none have been of any practical value. Sometimes the white ants get into a house, and after doing a certain amount of damage, disappear without going any further into the timber. Again, white ants may attack a building and remain in it for many years, and during that time it appears to be more or less immune and protected from any serious damage. Under the floors of the old Naval Dépôt, 140 George-street, Sydney, there is quite a large nest, which has contained a more or less active colony for many years, yet they never seem to have spread from the large beam where they raised their clay galleries.

In the Philippine *Agricultural Review* (December, 1911), Mr. D. B. Mackie, Agricultural Inspector, writes upon the method of fumigation with a mixture of white arsenic and sulphur.

This is adopted when the termites have been located in the woodwork of a building where they can be reached, or in the destruction of their nests. The apparatus is simply a small force pump attached to an air-tight iron box by a flexible tube, with another tube furnished with a sharp-pointed nozzle which can be forced into the damaged timber.

The mixture used is 1 oz. of white arsenic and 3 oz. of sulphur, well mixed, and placed in the iron box, which is heated from beneath until the mixture becomes vapourised, when the operator works the pump, forcing the fumes out of the chamber into the tube leading into the damaged woodwork. These deadly fumes kill all the termites in the galleries, at the same time depositing a coating of poison upon the surfaces of their workings.

An outfit, after the style of Plant's Universal Ant Destroyer, which has been used in Pretoria, South Africa, to destroy ants' nests and termites, would be suitable for this work.

This fumigation can be used when the termites have been discovered at an early stage of their invasion, but in many cases it is better to remove an infested beam or board, and replace it with one that has been treated with preservative kerosene or wood oil, in which some arsenical poison has been mixed.

In cases where the termites have come up from below into the flooring-boards and followed down between two boards, as is often the case, the writer has found that it is sometimes better, instead of tearing up the floor, to open out the damaged portions, remove them, and then soak the surrounding wood with kerosene, packing all the cavities with stiff putty into which a quantity of Paris green has been worked. This can be pressed in with a knife-blade, and, if necessary, a strip of zinc or tin can be tacked along on the under-surface of the floor; the whole surface should then be smoothed down level with the surrounding wood, and when dry stained to match the surrounding wood.

The question of white-ant-resisting or distasteful timber is often raised, and though the hardness or otherwise of wood seems to have little influence on the steel-like jaws of the workers, for they will tunnel through some of our driest, dead, hard eucalyptus tree trunks with the greatest ease, there is not the least doubt they much prefer some timbers. I have frequently seen red pine boards, round which the white ants have passed, hardly scratched upon the surface, when a clear pine board behind it has been reduced to ribbons. Some of our native woods are much more liable to their attacks, among them sawn stringybark timber. Jarrah is said to resist their attacks, but I have seen a board from West Australia much damaged by them. Desert cypress they are certainly not fond of when sawn up, but

in the fallen trees, logs, or telegraph poles they are very often found hard at work. There is room for valuable experimental work in testing the different timbers as regards their resistant properties to white ants in Australia; something of this kind has been done in other countries. An interesting account is given by H. W. Bates, "On the prevention of the destruction of Timbers by Termites," in the Transactions of the Entomological Society (London), 1864, Vol. 1, page 185. In "The Technologist" (London), 1865, Vol. V, page 453, the Rev. M. J. Berkeley published an account of termites and remedies based upon a report issued by the Committee of Inquiry into the ravages of the white ants at St. Helena and the means of dealing with them.

In Crichton's History of Arabia, Ancient and Modern (Edinburgh), 1833, an account of the termites destroying live trees is given, which the Arabs protect by plastering the stems with sheep dung. I have been informed by one of my western correspondents that sheep dung has been used in the Hay district to protect trees and timber with very good results. Bossavia states, in an article in "The Technologist" (Vol. V, page 237), that in the gaol at Lucknow, India, a plaster of clay or cowdung mixed with the pulp of the common American aloe was found very serviceable in keeping termites out of the timber.

APPENDIX I. *Formula for making solution to treat timber.*—For dressing timber add 2 lb. of hard soap boiled in 4 gallons of water to the 4 gallons of oil. Dissolve 2 lb. of white arsenic by boiling with 1 lb. 7 oz. of washing soda or 6½ oz. of caustic soda in 2 gallons of water. Pour the soap and water while hot backwards and forwards into the oil until thoroughly emulsified. Then when the arsenic solution has cooled down a little pour it into the oil, soap, and water mixture. When cold this will form a thin jelly, and if not used at time of making can be warmed up by the addition of a gallon of boiling water.

White Ants attacking Australian Railway Sleepers in India.

During last year a Committee appointed by the Indian Railway Board made an exhaustive inspection of Australian sleepers on Indian railways, particularly the southern section of the North-Western railway, whence reports had been received of serious damage by white ants. They also obtained reports from the various Railway administrations throughout India, as to the extent of damage suffered from white ants attacking Australian sleepers.

The Committee found that it was only in one section of the North-Western railway that the attacks were really serious. This section is an almost rainless belt of sandy desert. In all other parts of India, all Australian timbers used were found liable to attack by white ants, but the damage was not in any case serious, even after the sleepers had lain for six or seven years in the road.

There is considerable uncertainty as to the exact species of timber used for many of the sleepers, but the Committee satisfied themselves that the sleepers examined and reported upon were Australian wood. They also found no difficulty in distinguishing jarrah and karri from the timbers of Queensland, New South Wales, and Tasmania.

On the North-Western railway, none of the Australian sleepers were immune from white ant attack, but white ants prefer jarrah sleepers to other species of Australian woods, with the possible exceptions of Tasmanian stringybark and blue gum, and New South Wales turpentine. With regard to New South Wales timbers, grey gum appears to withstand the attacks best, but very few sleepers of this timber was seen. Blackbutt appears very

liable to split, thus affording easy access to the white ants. The timbers mentioned were amongst those which the Committee were able to identify from the Government brands stamped on the ends of the sleepers.

Tasmanian sleepers are definitely pronounced as unsuitable to India, either for dry or wet zones, as they appear very liable to rot and split, in addition to being liable to the attack of white ants.

Creosoted pine sleepers, even in the badly affected districts, showed practically no trace of white ants. Deodar sleepers were attacked in comparatively few cases, and then always in the sapwood. White ants seem only to attack them when very old.

The Chief Commissioner, Forestry Commission, N.S.W. (Mr. R. D. Hay), extracted the following information from the "Indian Forester" regarding the Australian timber trees that are not seriously affected by white ants:—

In a useful article written by Kanehira, of Formosa, Japan, and reproduced in the "Indian Forester" for January, 1914, the following information on timbers which resist the attack of termites is taken.

The writer, after carefully collecting his information from reliable authorities in various tropical and sub-tropical countries, furnishes a list of the principal trees, the timbers of which are "termite proof," that is, not liable to the ravages of white ants; and in a summary he furnishes some interesting conclusions which are well worth quoting.

From Mr. Kanehira's list the following timbers indigenous to this State are more or less not liable to the ravages of white ants, or "termite proof":—

<i>Sterculia acerifolia</i>	..	A. Cunn	..	Plane tree.
<i>Aurthulia diversifolia</i>	..	G. Donn	..	Kurrajong.
<i>Elaeocarpus grandis</i>	..	F.v.M. . .	..	Mountain Ash.
<i>Cedrela australis</i>	..	F. Muell	..	Red cedar.
<i>Dysoxylon Fraserianum</i>	..	Benth . .	..	Rosewood.
<i>Flindersia australis</i>	..	R. Br. . .	..	Native teak.
<i>Flindersia Oxleyania</i>	..	F.v.M. . .	..	Long Jack or Light Yellow Wood.
<i>Euc. corymbosa</i>	..	Sm . .	..	Bloodwood.
<i>Euc. crebra</i>	..	F.v.M. . .	..	Narrow leaf ironbark.
<i>Euc. longifolia</i>	..	Link . .	..	Woollybutt.
<i>Euc. microtheca</i>	..	F.v.M. . .	..	Coolabah.
<i>Euc. resinifera</i>	..	Sm . .	..	Red mahogany.
<i>Euc. rostrata</i>	..	Schlecht	..	Red or flooded gum.
<i>Melaleuca leucadendron</i>	..	L. . .	..	Broad leaf tea tree.
<i>Syncarpia laurifolia</i>	..	Ten . .	..	Turpentine.
<i>Doryphora sassafras</i>	..	Endl . .	..	Sassafras.
<i>Grevillea robusta</i>	..	A. Cunn	..	Silky oak. .
<i>Casuarina Glauca</i>	..	Sieb . .	..	Swamp oak.
<i>Callitris (various species)</i>				Cypress pine.
<i>Podocarpus elata</i>	..			Brown pine.

The author concludes from the information gathered that of timber which is liable to the attack of termites, softwood is most liable, and particularly softwood which does not have any strong smell or taste; and that the reasons which make timber termite proof are:—

The presence in the wood of some substance which has a strong smell or taste which insects do not like.

The presence of some substance which is poisonous to insects.

The extreme hardness of the wood rendering it too hard to attack.

Notes from "Indian Forester."

In a note attached to Mr. Kauchira's contribution, the Forest Zoologist, Dehra Dun, states that the increased attention that the study of termites has received of late has established the fact that the habits of the insect are by no means uniform, and that economically the points of difference are of considerable importance.

In addition to the true wood-eating termite, there are at least two more well-marked groups, viz., the mound-building termites which do not normally attack wood and are very rarely destructive, and the harmless termite which never touch timber. The first group consists of the genera destructive to manufactured timber.

It must be remembered that the durable timbers, while possessing a relative immunity from white ant attack, are, under certain conditions, readily eaten by the destructive species.

In no case, as far as I am aware, has absolute immunity from the attack of wood-eating genera been established by experiment over any species of untreated timber.

CHAPTER III.

WOOD-BORING BEETLES THAT DAMAGE TIMBER TREES,
CHIEFLY HARDWOOD.

It has been considered advisable to include a number of the wood-boring beetles in this section, though some of them do not confine their attention to the hardwoods.

The Powder-post Beetle (*Lyctus brunneus*).

The members of the family *Cioidæ*, to which the powder-post beetle (*Lyctus brunneus*) belongs, are all small insects with short antennæ, the terminal joints of which thicken to a club. They have short feet composed of four joints, middle and hind pair of legs with coxæ small and oval, and flexible abdominal segments. The larvæ are small, semi-transparent, slightly hairy grubs. The eggs are deposited in the sapwood of dead timber, or in fungi growing upon decaying timber. The typical genus *Cis* contains over a hundred species of tiny oval beetles breeding in fungi, and one of these, *Cis boleti*, is found all over Europe. Out of forty-two species of this family described from Hawaii, according to Perkins, twenty-nine belong to this genus, and are chiefly collected in the large fungi growing externally on trees or on dead bark, under which there are usually many small fungus growths.

The family is poorly represented in Australia. In Gemminger and Deharold's great "Catalogue of the Coleoptera," published in 1869, no species is recorded from Australia, and in Masters' "Catalogue of the Described Coleoptera of Australia" only one—our common powder-post beetle—is listed.

The members of the genus *Lyctus* differ considerably in general form from the fungus-infesting species, being elongate, flattened on the dorsal surface, with the thorax larger and squarer, and the divisions between the abdomen, thorax, and head well defined. The adult beetles vary in colour from black to reddish-brown, most of them being about $\frac{3}{8}$ of an inch long.

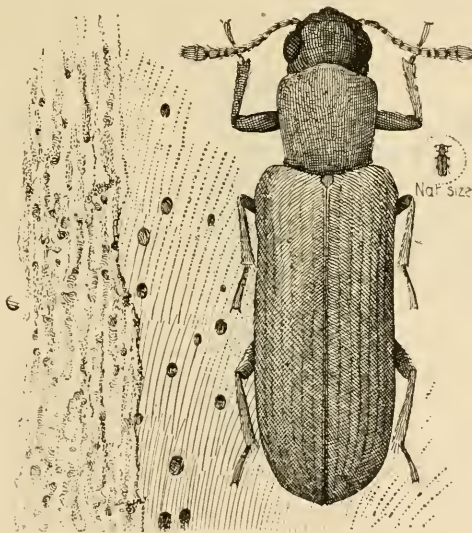
Timber Infested at an Early Stage.

The female probably deposits her eggs in the outer surface or sapwood when the tree has been cut down and the bark is drying. This may happen in the forest if the logs remain there for any length of time, or when exposed in the mill yard. There is no question that the eggs or young larvæ are in the sapwood when the timber is sawn up and used for building purposes, though usually there is no evidence of their presence until about twelve months after the house has been erected. Then the householder notices little dabs of wood dust on the floor. If the boards along the skirting or wainscote are infested, these heaps will be very noticeable, and the little pinholes from which the wood dust has fallen will be well defined. Sometimes this will end in a year, and there will be no further damage, the adult beetles emerging through the pinhole and dying outside. At other times generation after generation of active grubs are hatched out of eggs, evidently deposited by the adult females before they emerge from the infested timber or furniture, and after a series of years the infested wood is simply reduced to a mass of wood dust, held together by an outer thin skin of wood perforated with fine holes. The larvæ of these beetles may be found in the timber in any part of a house where unseasoned wood (or sapwood) has been worked up in hard woods.

It is not uncommon to find other species in furniture, and some species frequently feed on the rattan and cane chairs, &c., imported from the East, reinfesting it for years until the whole structure is reduced to a shell, and finally falls to pieces.

When sapwood has been used in making furniture, the entire piece is stained and varnished to a uniform tint, but on turning it upside down one may often find the band of light-coloured sapwood riddled with fine pinholes, caused by the presence of these beetles. Large numbers of the wooden handles of picks, hammers, and axes are often found by storekeepers to be wasting away to dust, being often so far gone that there is nothing to be done but to remove and burn them.

In most cases the adult beetles die when they emerge from the infested wood, but they have sometimes been found boring into new timber upon which they have flown or fallen. Borers were discovered at the great hall of



The Powder-post Beetle (*Lyctus brunneus*).

Also some damaged woodwork.

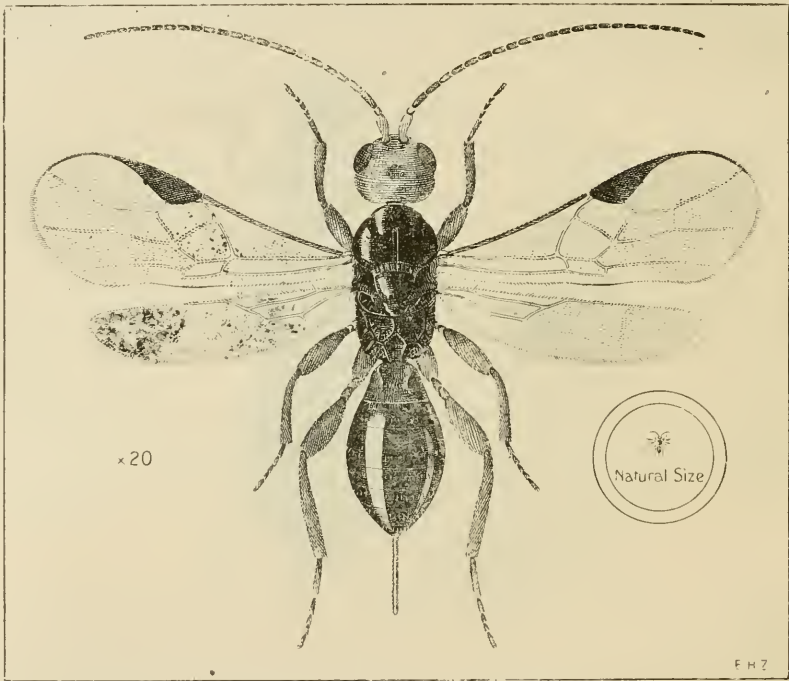
the Fisher Library at the Sydney University soon after it was finished, and some fell on the varnished reading-desks below and bored their way into them.* In this instance the powder-post beetles died out without doing any serious damage. In a large bonded store in Sydney, where the large beams under the floor were rounded joists, the outer sapwood began to fall away in flakes, and the owners found the beetles on the floors. When, at our suggestion, the sapwood was adzed away, and the rest treated with crude oil, the damage did not extend into the remaining timber.

Range and Description of the Beetle.

Among the members of the genus *Lyctus* that have been recorded as powder-post beetles, *Lyctus unipunctatus* is stated to be the most common and destructive species in the United States. *Lyctus striatus*, another North American beetle, did considerable damage to the red oak floors of Michigan College, while *Lyctus opaculus* bores into the stems and canes of the grape vines in some parts of the United States.

* NOTE.—These were probably not powder-post beetles, but furniture beetles, *anobium punctatum*.

Though our powder-post beetle (*Lyctus brunneus*) was described at a very early date from specimens in England, and again under the synonyms of *L. cobydioides* Dejeen, and *L. glycyrrhizæ* Cheverolet, from specimens in France, and from Woodlark Island by Montrozier under the name of *Lyctus rugulosus*, it was not until 1876 that it was recorded and identified from Australia. In a note in the *Entomologist's Monthly Magazine* of that year, J. W. Douglas contributed a note as follows: "In the year 1862, on a small log of wood with the bark on, imported into the London Docks from Swan River as a sample, I found five beetles of a species which has recently been identified as *Lyctus brunneus* by Dr. Sharp, who informs me that he has specimens of it from New Zealand, Britain, and France, and it is recorded from Woodlark Island."



Braconid parasite of the Powder-post Beetle.

This beetle probably has a very wide range over the East, and has been casually introduced in most of these outside countries in timber or furniture. It may not even be a native of Australia, though it is well established here at the present time. It may be described as follows:—

General colour reddish-brown, sometimes dark brown; general form elongate, with the divisions between the head, thorax, and body well defined. Head not as broad as the thorax; jaws stout, turned down; eyes large, rounded, and projecting from the sides of the head; antennae with the terminal joints forming a club. The thorax is rather flattened on the dorsal surface, a little more long than broad, rounded on both the hind and front margins, and with sides straight, but sloping slightly to the hind margin, the whole surface being finely granulated. The wing covers are long and narrow, their front margin straight with tips rounded, and the surface finely granulated with fine parallel striae. The hind pair of wings is well developed, for this little beetle can fly well. The legs are long, with slender tibiae and long tarsi. Length, $\frac{1}{8}$ of an inch.

A Parasite on the Powder-post Beetle.

There has been no record, as far as the writer knows, of a parasite attacking or checking the increase of this very serious wood-destroying beetle; but early in 1919 a badly-infested board of "blue fig" was sent to this office from southern Queensland. It was full of fine pin-holes from which powdered wood dust was falling. The board remained under observation for several months, when several adult beetles emerged, which proved to be the well-known *Lyctus brunneus*. The beetles first appeared on the surface of the board in May, and it was toward the end of the month, while collecting specimens of them, that their hymenopterous parasite was first noticed coming out of the holes in the board.

This Braconid wasp measures 4 mm. in length. The head is reddish-brown, and the antennæ (except the basal joints, which are reddish-brown), eyes, and area round the ocelli black. The dorsal surface of the thorax, the abdomen, and ovipositor are black, with a slight reddish-brown mottle on the thorax in some specimens, and the under surface lighter coloured. The legs are a yellowish-brown, wings hyaline, and the costal nervure and stigma black, with inner veins of a lighter colour.

Suggestions and Remedies.

The general use of unseasoned timber and sap-wood in buildings in Sydney and suburbs during this last few years has led to the spread and increase of this serious timber pest; and for this reason during the next few years thousands of feet of hardwood floor joists and battens will have to be removed.

The sapwood of spotted gum and tallow wood seem to be among the worst species affected; but this may be because so much of these timbers are milled. This species at the present time infests the sapwood of most of our hardwoods, belonging to the Genus *Eucalyptus*.

The only royal way is for all people having contracts with architects and builders to stipulate that all wood used is free from sapwood. When infested sapwood is found in floors, battens, or in joists, it should be treated with kerosene or creosote mixture, if it cannot be cut away. When the floors are damaged, the sapwood should be followed along and kerosene poured over the infested area and brushed in. When in the roof battens or upright timber kerosene should be brushed in with a stiff sash brush. The more oil that can be made to penetrate the better the deadly action on the larvæ and beetles in the wood.

The Shot-hole Borer (*Platypus omnivorus*, Lea).

There are a number of small beetles which damage timber, and which are popularly known as "borers." They attack it in various ways. Thus, the powder-post beetle (*Lyctus brunneus*), previously dealt with in the *Agricultural Gazette* (page 273, 1920) reduces the sapwood of many Australian timbers to dust, while a second group of beetles, represented in Australia by *Anobium domesticum*, also remain in the infested timber for years, burrowing through and through it in successive generations until there remains nothing but a shell covering a honeycombed mass, somewhat like wood that has been ravaged by white ants. I have had timber under observation in a building for over ten years, and the *Anobium* beetles and their larvæ can still be found at work in the originally infested boards. Mr. C. French, junior, in a paper, "Furniture and Timber Boring Insects" (*Journal of Agriculture of*

Victoria, 1918), calls *Anobium domesticum* the "pin-hole borer," but I would limit the popular name pin-hole borer to the beetles that cut direct burrows through the timber they attack and that do not reinfest it over and over again, as does *Anobium domesticum*.

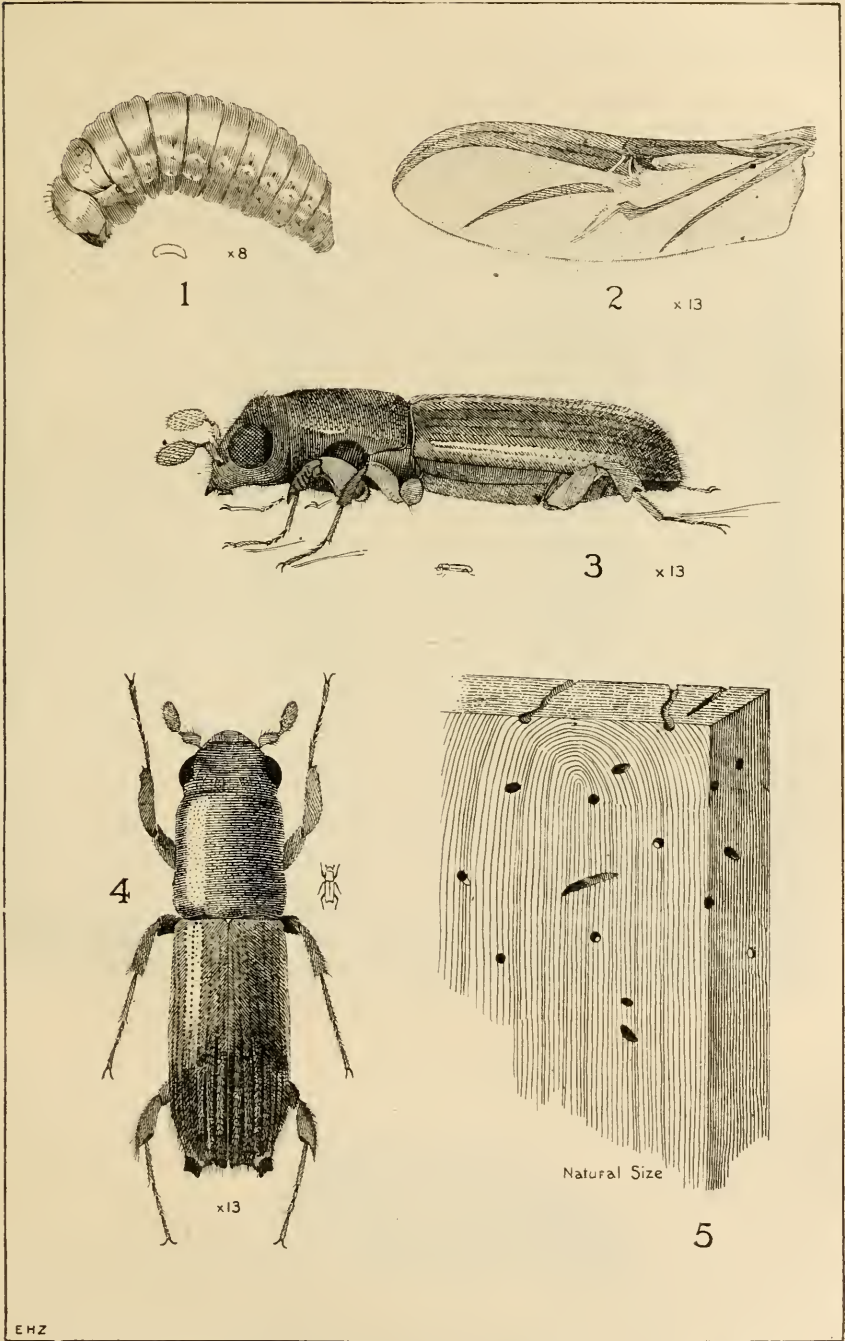
Under the ordinary conditions of forest life, when a tree is damaged it sickens and dies in the scrub, or it is cut down by the timber-getter. The decay or fermentation of the sap of the bark attracts all the wood-boring beetles in the vicinity. Some come simply for food and eat the surface, others to both feed and lay their eggs upon it, while many beetles themselves bore directly into the trunk.

There are a number of small wood borers that can aptly be called shot-hole borers; they bore circular burrows straight into the timber through the bark, and of these *Platypus omnivorus* is a typical example. The infestation of the timber by the true shot-hole borers may take place in the forest or brush before the fallen tree is hauled to the sawmill, or while the logs are lying in the sawmill yards previous to being cut up, or even after they have been sawn up and while the boards are seasoning in the stacks under the sheds.

The genus *Platypus* was formed by Herbest in 1793, for some European wood borers, and all the species of the genus were described and figured by the French entomologist Chapuis in his "Monograph of the Family *Platypedeæ*" in 1865. These beetles are widely distributed over the forest areas of the world, but they are most numerous in the forests of North and South America and in the Malay Archipelago. One species has been recorded from New Zealand, and three from Australia. The species now discussed was described by Lea from Tasmania, and I understand from him that this is the first record of it from the mainland. French has described and figured a Malayan species (*Platypus corpulentus*) obtained from timber in a Melbourne timber yard ("Handbook of Destructive Insects of Victoria," pt. v, p. 81, pl. 80); but so far as I know it has not become established in Australia.

Our common shot-hole borer (*Platypus omnivorus*) is widely distributed through the New South Wales coastal forests, commonly known as "brushes" or "cedar brushes." My observations on its habits and life history were carried out last summer at a sawmill where large quantities of brush timber trees are cut up in boards and lengths for the manufacture of furniture in Sydney factories. The principal timbers damaged by these beetles are beech (*Trochocarpa laurina*), blackwood (*Acacia melanoxylon*), corkwood (*Schizomeria ovala*), sassafras (*Doryphora sassafras*), and coachwood (*Ceratopetalum apetalum*).

These beetles are not noticeable during the winter months, but are very active in December, January, and February. They not only penetrate the sap-wood, but bore into the solid material of the logs for some distance. They also attack the newly-sawn boards while they are drying, but when after exposure for a month or so, the sap has dried out, the timber loses all its attractive properties and the borers leave them alone. When I visited the sawmill in the middle of February there was a stack of damaged boards drying in the shed; these were just in the condition attractive to shot-hole borers and there were numbers of beetles in burrows formed in the wood. On some of the boards the beetles were busy laying their semi-transparent rounded eggs in the ends of burrows in contact with neighbouring boards, and on other boards we found the active larvæ, while the outside of the stack was showing signs of attack by beetles that had made their way in



The Shot-hole Borer (*Platypus omnivorus*, Lea).

1. Larva. 2. Hind wing. 3. Side view of the perfect beetle. 4. Dorsal view.
5. Timber, showing the damage caused by the borer.

from the surrounding forest. We soon made a large collection of the beetles by taking each board and pushing a dry grass stem into some of the burrows, thus forcing the inmates out into the killing tube.

The beetle is a typical cylindrical borer, of a general dark reddish brown tint. The front of the head and prothorax are almost black, the legs reddish brown, the apex of the wing covers clothed with stiff yellow hairs, curiously serrate at the tips, as shown in the figure. The beetle measures a little over 4 mm. in length. The whole structure of the beetle—its cylindrical form, the head flattened in front, the curious shape of the shovel-like tibia of the fore legs, and the brush of coarse hairs on the extremity of the wing covers—is adapted to its mode of living, by boring through the timber and brushing out the waste dust as it excavates its burrow.

Forest entomologists in Europe and North America have studied the habits of a number of species found in these parts of the world, where an immense amount of damage is often caused to timber in the pine forests. The general experience of these investigators is that preventive measures are the only ones that have met with any success; such measures consist of the removal of all dead and dying trees from the forest areas, and their destruction before the beetles develop and emerge from the infested wood. I. M. Swaine has written some important monographs on Canadian bark-beetles (Dept. Agriculture, Ottawa, 1917-18), and in these he points out that forest fires provide much material for beetle infestation. W. J. Chamberlin, of the Forest Branch of the Oregon Agricultural College, has carried out and published records of some very interesting observations on the pine bark-beetle (*Dendroctonus brevicornis*) in the great pine forests of that State. M. W. Blackman, of the New York State College of Forestry, has studied the habits of *Pityogenes hopkensi* and other allied species that attack the larch; and Dr. A. D. Hopkins, of the U.S. Department of Agriculture, has published many papers and monographs dealing with the shot-hole borers of the United States.

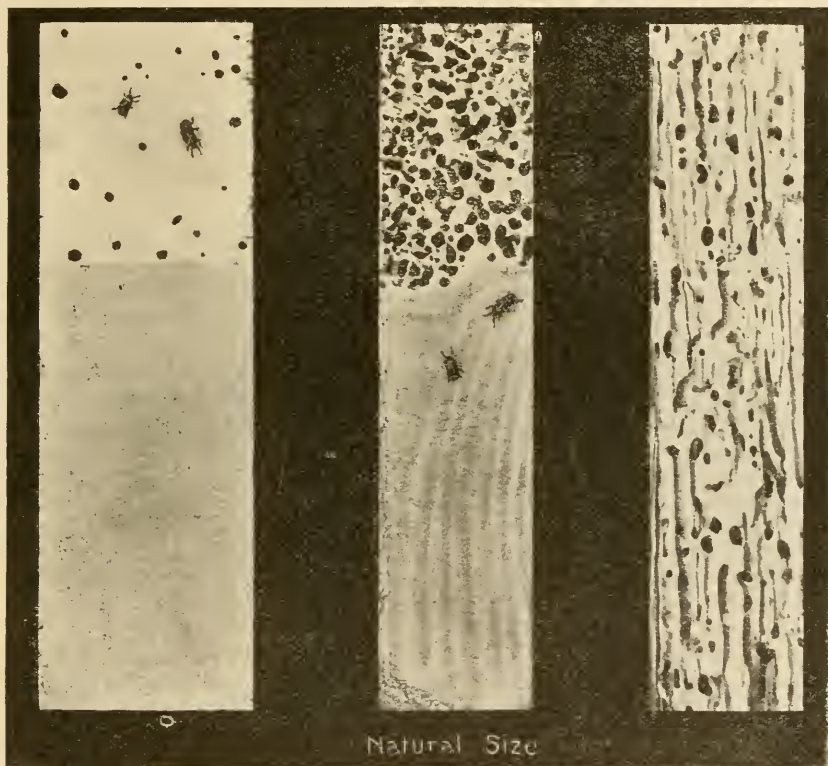
When timber has been cut and is stacked, it is still liable to infestation until it is quite dry. The beetles can, however, be kept away by the use of carbolic acid sprinkled beneath the stack and between the layers of boards and battens as they are stacked. A 5 per cent. solution of water and carbolic acid is mixed into a bucket of sawdust, and the moist sawdust is freely sprinkled over the timber. A sawmiller to whom I recommended this treatment of sawn seasoning timber informs me that he has had no timber damaged after it has been treated in this manner.

The Anobium Beetle Borer (*Anobium (domesticum) punctatum*).

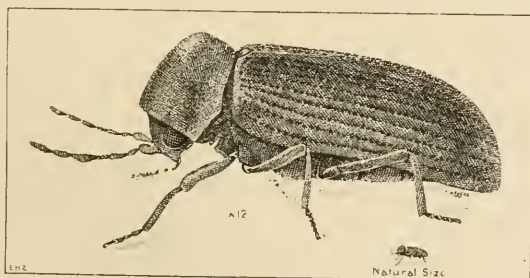
Though this beetle was probably introduced into Australia at a very early date in imported timber or furniture from Europe, it was not until this last ten years that it attracted much notice in New South Wales as a pest in house-timber.

In the latest catalogue (Junk's Coleopterorum Catalogus, 1912), M. Pic has gone into the synonymy of this beetle; and he finds that *Anobium punctatum*, described by Dr. Geer in 1774, is identical with what Geoffery described as *Anobium domesticum* in 1785, so the first name has priority. This beetle's range is given as Europe and America; but it probably has a much wider distribution, because it is well established in Australia; and is one of the most serious timber pests in New Zealand, according to Messrs. Speight and Cockayne.

The full-grown beetle is of a uniform dark reddish brown colour, but has a greyish tint on account of the fine coating of hairs clothing both the upper and under surfaces. It measures up to one-fifth of an inch in length, but varies considerably in size. Its general form is elongate and rounded, with the head when at rest tucked in and quite hidden beneath the cowl-like thorax, but viewed from the side, the eyes and tips of the antennæ, with the three thickened terminal segments, are usually visible. The thorax



Maryborough Pine Flooring Boards damaged by the Furniture Beetle.



Anobium (domesticum) punctatum.

is rounded and narrower in front, and broader but not quite as broad as the shoulders; the central portion is raised up in a regular hump and slopes down to the wing covers. It is finely punctured, and clothed with short hairs. The wing covers and body are rounded, with the former pressing in on the sides and covering the tip of the abdomen. They are deeply striated with impressed parallel lines, bearing rows of punctures, and the whole clothed with fine hairs. On the legs and under-surface the colouration is lighter, and the heavy coating is much finer than on the dorsal surface.

They lay their eggs on the surface of the timber; and the little white grubs, with three pair of legs, rounded head, swollen thoracic segments and tapering body, bore into the wood. The life cycle from the egg to the emergence of the perfect beetle, though it has never been satisfactorily worked out, is supposed to be about a year.

As can be seen from the drawing, the boring differs from the previous groups in that it is made in long straight parallel tunnels side by side in badly-infested wood, so that the whole infested area is quite honeycombed and open, not closely packed as when infested by powder post beetle.

Speight in a contribution to the *New Zealand Journal of Science and Technology*, 1918, gives a list of the timbers and their resistance to this borer. Some are immune; others are infested in the sap-wood and the heart-wood is not attacked. Cockayne, in the following year, in the same journal wrote a note, "The wood-borer and its control"; in this he states that when white pine and kauri are infested, the heart-wood is usually damaged, while in other timbers they confine their attention to the sap-wood only. Cockayne advises spraying infested timber with arsenate of lead 1 lb. to 28 gallons of water. Also to spray with a mixture of 5 parts benzine to 1 part creosote; or $\frac{1}{2}$ lb. of naphthalene dissolved in half a pint of benzine.

In Sydney most of the colonial pine timbers, Maryborough pine, and kauri, are infested both in the sap-wood and heart-wood; and the anobium, like the powder post beetle, will reinfest the same timber year after year. I have had them under observation in kauri timber for over ten years. In the city and suburbs they are nearly always found in floors. In floors, when the timber is not too far gone, we advise brushing and soaking in as much kerosene oil as the wood will take up, and where it penetrates well, to add half a pound of Paris green to each gallon and to keep it well stirred up when using. Spraying infested timber is of little value as far as our experience goes; and fumigation with any gas is ineffective.

In England this beetle is known as the "Common Furniture beetle"; and in the Economic Series Bulletin, No. 11, published by the British Natural History Museum, 1920, Gahan has issued an account of this beetle as a furniture pest. His suggestion of control measures are therefore considered when dealing with wormy furniture. He states that if dry heat can be safely applied and forced to the heart of the wood up to 55° C. or 131° F., the eggs, larvæ, and beetles will be destroyed. He also advises the use of hydrocyanic acid gas; but my experience is that it would be very difficult to fill any fumigating chamber with penetrative gas long enough to reach the entombed larvæ. The vapour of benzine, carbon disulphide, and carbon tetrachloride are also recommended as penetrative fumigants.

Beetle Borers on Pine Floors.

Householders are often seriously alarmed by finding boat-shaped metallic-tinted beetles, about $\frac{1}{2}$ inch in length, emerging from their floors.

On examination they find a clean-cut hole through the linoleum or carpet, and on turning it back they find a corresponding hole in the flooring board beneath. Usually only one or two beetles appear at the same time, but now and then four or five such borers are found, and the householder wonders where the damage is going to end, and if the whole floor will be destroyed.

The holes are eaten out by the larvæ of several different species of beetles belonging to the family BUPRESTIDÆ. They are popularly known as "Round-headed Borers," because the larvæ have the thoracic segments behind the head very broad and rounded on the sides, very much larger than the abdominal segments. These larvæ in the earlier stages of their existence have penetrated into the log while it was lying and seasoning in the forest or sawmill yard, and long before the log was sawn up into flooring boards. They generally feed in the interior of the board for a year or more after it has been placed in position; they pupate there in the wood, and then, when mature, the perfect beetles cut their way out to daylight. When once these beetles have cut their way out they do no further damage. They do not lay their eggs or reinfest the wood. If they cannot find their way out of the room in which they have emerged they will die within a few days. These beetles have short heads with large eyes. The head fits close into the front of the thorax, which is rounded on the sides and rests against the wing covers; and the wing covers slope round on the sides to the tip of the body. The thorax is usually impressed with fine punctures; the wing covers are marked with fine parallel lines.

The Yellow-spotted Borer (*Prospheres aurantipicta*) is a shining black buprestid beetle. The head and thorax are finely punctured; the wing covers are rounded on the sides and toothed at the tips, and bear finely-punctured parallel striæ, and are ornamented with four transverse rows of irregular golden-yellow spots, the first, second, and fourth of two, and the third four spots. Length slightly over $\frac{1}{2}$ inch. This species has been bred out of pine floors on several occasions in houses in the Sydney suburbs. This beetle was described and figured by Castelnau and Gory in their monograph of the family in 1835. A second species comes from New Caledonia.

The Shining Black Borer (*Buprestis mæstis*) is a larger beetle of similar form, but more elongate and with an impressed furrow down the centre of the thorax. It is of a uniform blue-black colour with metallic reflections, with the wing covers ribbed and finely punctured. This is one of the commonest species that we find coming out of floors.

It is well known that a number of wood-infesting beetles remain for a considerable period in the larvæ and pupal state long after the tree trunks have been cut up and shipped to foreign countries. Thus, through the importation of timber, the range of such beetles may become cosmopolitan. A brilliant little metallic-green buprestid was recently exhibited in Sydney, captured in this State, which is a native of North America, but now common in the Hawaiian Islands, where it has been introduced in timber from the mainland.

The Introduction of Foreign Species of Borers with Imported Timber.

The danger of the establishment of beetle borers that are easily introduced from foreign countries, and which may become very serious pests to our native timber trees, is a problem that requires serious consideration. We are frequently breeding out borers at the Entomological Branch in all kinds of wooden boxes and packing enclosing merchandise from the East: tea chests, hat boxes, and softwood packing are often received riddled with borers in all stages of development. As, however, these boxes and containers are usually destroyed in the port of entry in the warehouses, they are only a minor source of danger. The great source of infection is from the undressed timber logs that are being imported from the East Indies, the Malay Peninsula, Borneo, and the Philippines, as well as from shipments of new and little-known timber from the Pacific Islands.

A great deal of this timber shows signs of borers, and many of the large unbarked logs, particularly those from the Pacific Islands and Borneo (where there is a considerable trade done with Australia), are very badly infested with beetle borers and their larvæ in all stages of development. As these logs are infested in their native forests as soon as they are fallen, the treatment of the logs would have to be undertaken there. This is only a matter of expense. If the timber cut by these large companies has a good market value for export it should pay the managers to adopt methods of protecting the timber until shipment, when the danger is past.

This is a serious question: should our timber merchants be allowed to import foreign timber logs, containing dangerous wood-destroying insects, without any supervision? This is a question for the Forestry Commissioners.

CHAPTER IV.

INSECTS OF THE EUCALYPTUS.

The Blue Gum (*Eucalyptus globulus*).

This fine gum tree is confined to Tasmania, Victoria, and the south-eastern parts of New South Wales. Under natural conditions it is a rapid-growing tree, and the timber is considered a very valuable hardwood. It has been extensively cultivated and planted in many parts of the world, both as a timber and shade tree. It is one of the most hardy of our gum trees, and can thrive under the most varied climatic conditions of heat or cold. In his "Select Extra-Tropical Plants" Baron von Mueller says (p. 151) that this tree is attacked by the wood-boring larva of *Eudoxyla eucalypti*, and the larvæ of two beetles, *Hapatesus hirtus* and *Phoracantha tricuspis*. The wood moth (*Zeuzera eucalypti*), however, confines its attention to the black wattle (*Acacia decurrens*) and other allied species. It is the much larger larvæ of *Zeuzera macleari* that damages the blue gum and other gum trees. With regard to *Hapatesus hirtus*, this is a member of the family ELATERIDÆ, commonly known as "Click beetles," and the larvæ are popularly called "wire-worms." They live in the soil and often damage the roots of plants. I think there must have been some mistake in the identification of this species, and I can find no record elsewhere of its being a forest pest.

Quite a number of the species of the genus *Phoracantha* attack the blue gum and other species of eucalypts. I am placing *Phoracantha recurva* under the blue gum pests, chiefly because it is the particular species that does so much damage to the blue gum in South Africa, but it also infests the timber of many other eucalypts.

Among the Australian longicorn beetles that exist upon the timber of the gum trees (*Eucalyptus*), the most numerous and characteristic are the members of the genus *Phoracantha*, with a few closely allied species in the genera *Coptocercus*, *Epithora* and *Allotesis*. The life-histories and general habits of this group of longicorn beetles are almost identical, and they are found in all stages of development in the dying or dead timber of a large number of the eucalypts, which are the most typical trees of the Australian flora.

The perfect beetles hide in the daytime under the strips of dead bark, resting on the surface bark of the tree trunks, but are very active when disturbed, and when captured produce a sharp rasping sound, caused by rubbing the hind edge of the thorax against the front margin of the wing-covers. At night they come out from their shelter, fly about, and are often attracted to lighted lamps.

The genus *Phoracantha* comprises a number of handsome longicorns of large or medium size, of a general shiny black or reddish colour, often mottled or blotched with pale yellow. The upper surface of the thorax and wing covers is rugose and usually deeply pitted. The general form of these beetles is rather elongate, the antennæ are long and stout, with the first joint thickened, the second very small, and the succeeding ones long, fringed with very fine hairs: the apex of the inner margin is produced into a stout spine on the third, fourth and fifth joints, with smaller spines on some of the preceding joints. The upper surface of the thorax is roughened, corrugated and slightly flattened, with a blunt spine on the sides. The tips of the wing covers are deeply scalloped with a fine projecting spine on either side of each scallop.

The Yellow Longicorn (*Phoracantha recurva*).

Newman's *Entomologist*, vol. i, p. 4. 1840.

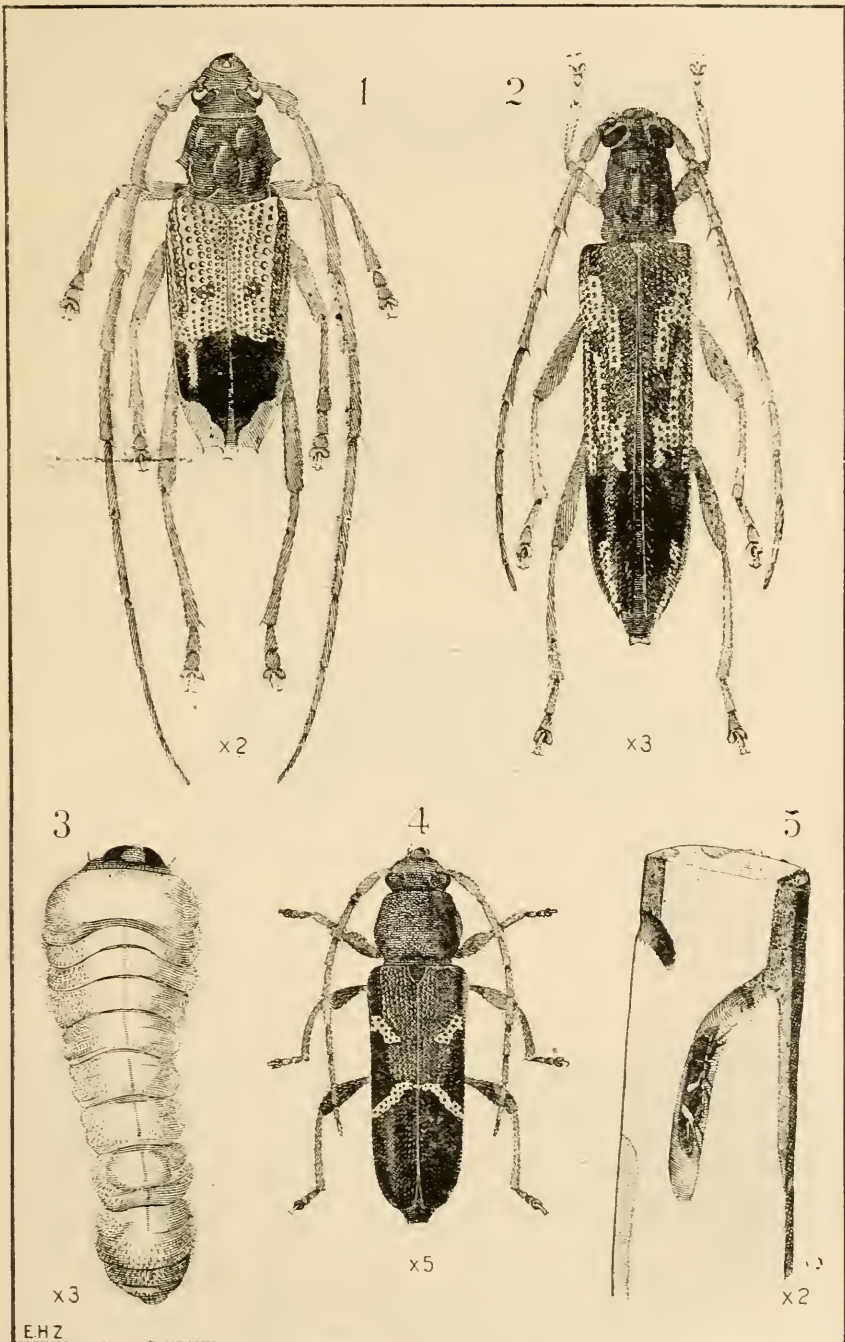
Germer, *Linnaea Entomologica*, vol. 3, p. 226. 1848.

This beetle was described by Newman in the first volume of his journal, known as Newman's *Entomologist*, where he says, speaking about this beetle, "Inhabits New Holland. This beautiful insect is common in all our collections under the name of *Stenocorus semipunctatus*." This confusion of names came about because Boisduval identified it as the species under that name, which Donovan had figured in his "Insects of New Holland" in 1805, whereas it was another species.

This is the commonest and most widely distributed species of the genus, and does not confine its attention to any particular species or group of the eucalypts, for while it was so common at Uralla, New South Wales, on the rough-barked peppermint gums (*Eucalyptus novae-angliae*), we found them busy laying their eggs upon and boring under the bark of the red gums (*Eucalyptus rostrata*) on the Murrumbidgee, near Hay.

During the writer's visits to the Experiment Stations at Uralla and Hay, he has had many opportunities of studying the life-history of this beetle, and the many parasites that keep it in check under natural conditions.

At Wooloondool Experiment Station, near Hay, on the banks of the Murrumbidgee River, these beetles were observed in the month of February depositing their eggs upon the drying bark of fallen red gum branches within a fortnight of their fall. The eggs are usually deposited by the beetles beneath the thin dry strips of bark loosely attached to the smooth green bark on the trunk or main branches. Each is deposited separately in irregular rows, forming a patch of about sixty eggs. They are pale yellow, elongate spindle-shaped in form, but flattened on the upper and lower surface when deposited (as is usually the case) in a shallow depression between the dry scaly and green bark. They are composed of a soft, gelatinous matter without any definite structure or skin, and a very large percentage appear to be infertile, or shrivelled up by the heat without any larvæ emerging. The average length of each egg is about $\frac{1}{10}$ of an inch. Before the emergence of the larvæ the eggs swell out and are almost cylindrical in form. The little larva as soon as it hatches out begins to bore its way through the bark, and is similar in form to the full-fed grub ready to pupate. A number of such freshly-emerging larvæ were under observation on the 8th March, but eggs had been noticed about six weeks earlier. When the larvæ have worked their way through the bark, they remain for some months (from six to seven) feeding upon the under-surface of the bark and the upper surface of the sap-wood. They make regular excavations or tunnels, feeding straight ahead and packing the sawdust behind them in a compact mass as they move forward. Sometimes these burrows run for several feet in an almost straight line, in others they twist and turn at all angles, until the whole surface of the bark and sap-wood is covered with scroll-like markings. A short time before they are full-fed, the larvæ cut a shaft through the sap-wood, and after feeding in the inner wood for a short time, pupate in the solid wood several inches beneath the outer surface, where they spent most of their lives. They never pupate under the bark, which, by the time they are ready to undergo their metamorphosis, is usually weather-worn and ready to peel off or become detached from the trunk, and would thus afford them very poor protection.



1. The Yellow Longicorn (*Phoracantha recurva*). 2. The Variegated Longicorn (*Coptocercus cubripes*).
 3. Larva of *Bethelium munda*. 4. Adult Beetle (*Bethelium munda*). 5. Adult Beetle (*Bethelium munda*) in branch damaged by the larva.

E.H.Z.

The full grown larvæ measure up to an inch and a quarter in length and are of the usual elongate legless grub form of the typical longicorn beetle. The jaws are short and stout, buried in the small head, with the thoracic segments behind broader than the abdominal segments, which are slightly corrugated, flattened on the dorsal and ventral surface, and broadly rounded at the anal extremity. The pupa fits closely into the end of the cavity where the larva stopped feeding, and is enveloped in the usual delicate skin.

If these beetles had no insect parasite enemies they would increase to an enormous extent, and probably be a very serious timber pest; but nature has provided a natural check, and the habits of the larvæ in remaining during the greater part of its existence between the bark and the sap-wood has enabled these attendant parasites to get in touch with them, and destroy probably 70 per cent. of them in the larval stage before they reach the pupating stage.

Some years ago these beetles were accidentally introduced into South Africa in timber from Australia in their pupal state, and free from their parasites. Without these checks this longicorn has spread in several states in South Africa and attacked the eucalypts that have been extensively planted for shade and timber in many parts of Africa.

Parasites of *Phoracantha recurva*.

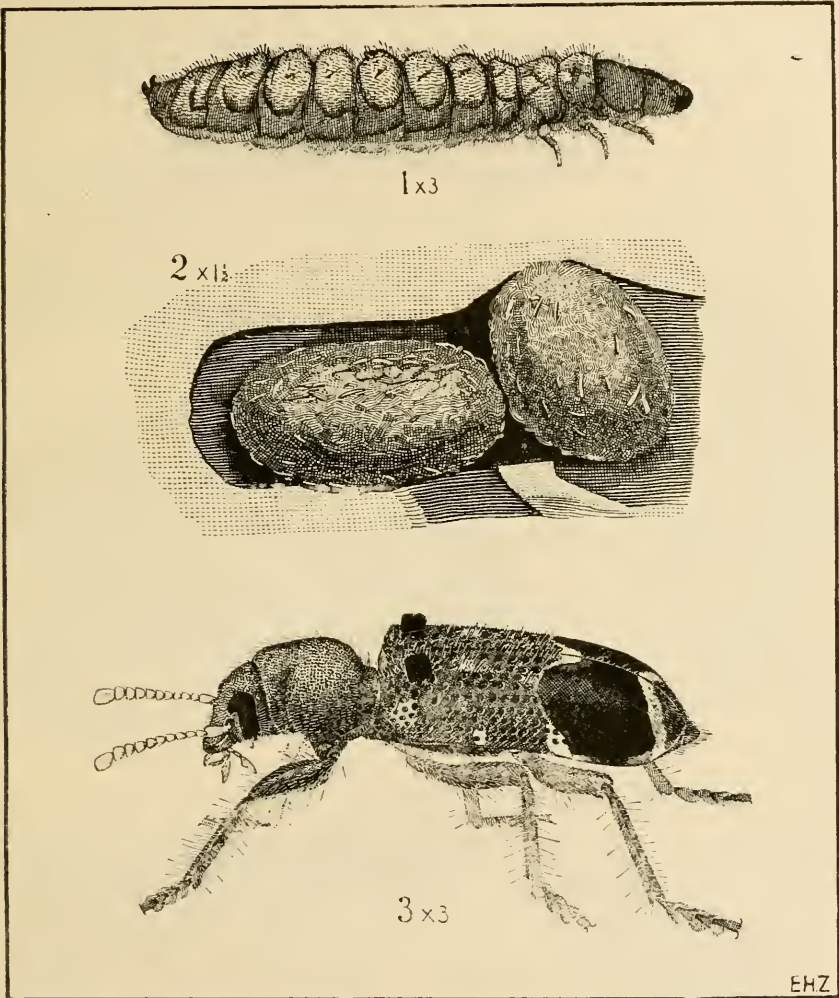
The following insects are among the most important that keep down the undue increase of these bark longicorns. A number of small hymenoptera were also noted in different stages of development, belonging to the family *Chalcididae*, and also some small carnivorous beetles, but they were probably feeding upon the small dipterous and other larvæ that are common in decaying bark and damp wood.

(1) The Yellow Horned Clerid (*Trogodendron fasciculatum*).

This handsome beetle was figured and described by Dr. Schreiber, an Austrian entomologist, in the *Transactions of the Linnean Society of London*, in 1802 (p. 195, plate 20, fig. 6), and has been monographed and figured in several other publications.

It has a wide range over Australia, and is often met with, as it has the rather uncommon habit, for a beetle, of flying about in the daytime, resting on a branch or post, with its bright yellow antennæ moving backwards and forwards. It is very easily recognised, and though fearless and easily caught, if handled carelessly it will bury its stout jaws in one's finger with a bulldog-like grip, and sometimes lets one pull its head from the body sooner than loosen its hold. It is very variable in size, measuring from three-quarters of an inch to an inch in length. It is of a uniform shiny black tint, clothed with fine scattered hairs; those upon the legs grey, while the ones of the thorax are grey and black. The wing covers are very finely punctured with a curious raised tuft of black hairs on each shoulder, and the apical third clothed with a saddle-shaped patch of blue black pile, fringed on the outer margins with fine white hairs. The head is short, turned down in front of the short rounded thorax, and the stout, bright yellow antennæ curled round on each side are composed of rounded bead-like segments thickened towards the tips.

The egg-laying was not observed, but the beetle probably lays her eggs upon the surface of the cracked bark, the emerging larvæ working their way beneath the surface. The larvæ in all stages of development were found



1, 2, 3. Life History of *Trogodendron fasciculatum*. 1. Larva. 2. Pupal cocoons in cavity of bark. 3. Perfect beetle. 4. Under-surface of bark stripped from the stem of a Peppermint Gum, showing the burrowings of the larvae of *Phoracantha recurva* and *Coptocercus rubripes*.

enveloped in wood dust between the bark and the sapwood, working their way along the galleries tenanted by the longicorn grubs. As many as a dozen could often be found in an afternoon when stripping the bark off a single small tree trunk.

The larva measures up to an inch in length, and is of a general light pink tint, with the margins lighter coloured, clothed with rather long fine dull yellow hairs, thickest on the thoracic segments and the outer margins of the abdominal segments. The dorsal surface of the head and jaws is dark reddish brown, with the thoracic plate black; the legs are slender, yellow, with the terminal claws of the first and second pair black. The anal plate on the last abdominal segment is a shiny reddish brown, bearing a pair of short curved black spines at the tip.

They are active creatures, contracting and extending their segments as they crawl about in the burrows, and if two or three are left in a box, the largest one soon eats up the smaller ones. When full grown they form a regular oval or rounded cocoon of bits of bark and gnawed wood cemented together into a stiff shell, within which they pupate. The beetles emerge in October and November, and can be taken flying about all through the summer months.

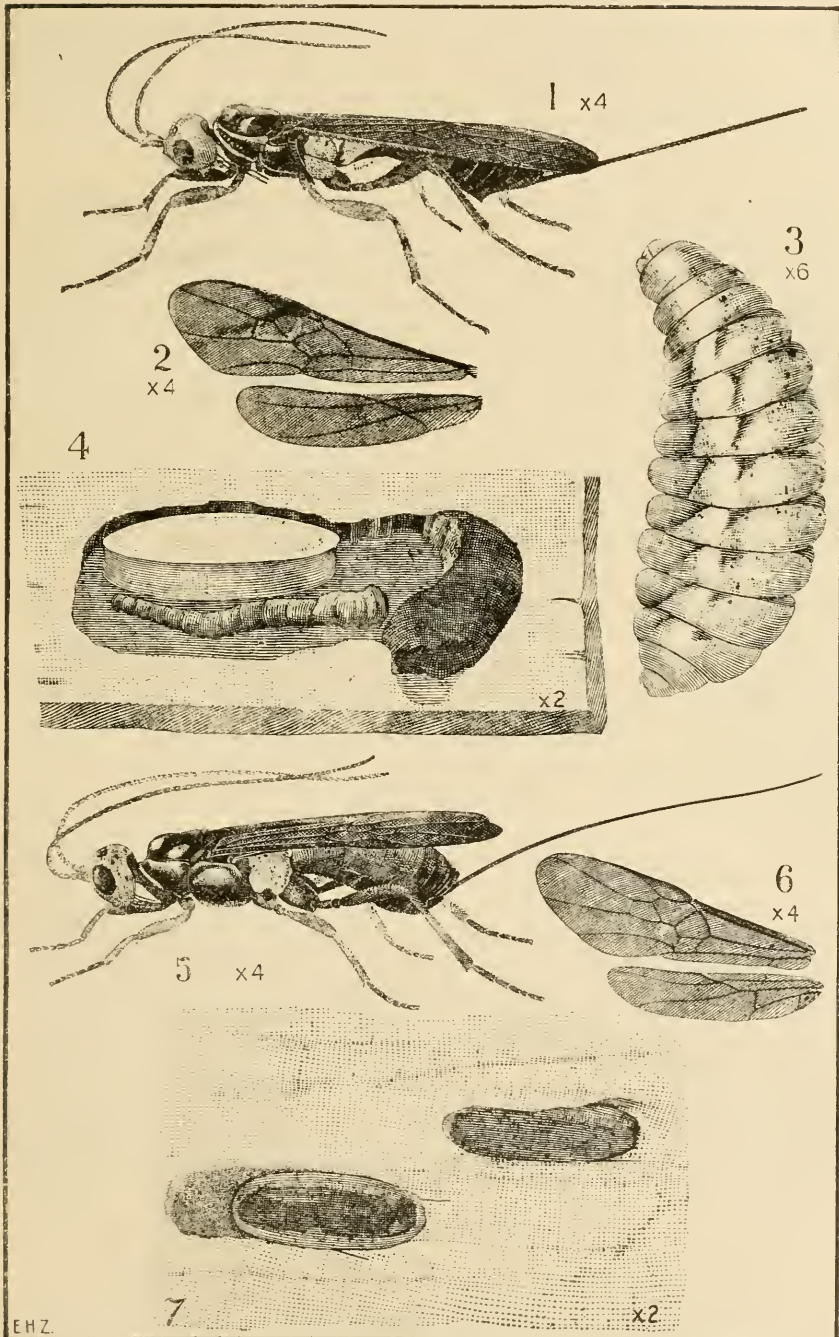
Though this beetle is recorded in "Australian Insects" as a parasite of some of the wood moths in their pupal state, this is the first account of its life history, and the first record of the important part it plays in the destruction of the larvæ of the wood-boring longicorns.

The Red-headed Braconid (*Iphiaulax rubriceps*, Froggatt.)*

The adult female braconid wasp is shiny black, with the exception of the head, which is bright red, and the under-surface of the prothorax from the junction of the head to the base of the fore legs, which are a duller reddish brown. The long slender antennæ, large circular eyes, and the area encircling the ocelli, are all black. The large wings are dull smoky black, lightest on the inner margin of the base of the hind wings. The basal joints of the thorax are elongate, abdomen blotched with white on the under-surface, which extends round the sides and shows well up to the dorsal surface, the hind margins of the following segment transversely banded with creamy white; the slender long ovipositor reddish brown, standing straight out behind as long as the whole abdomen. The head is short and broad, rounded in front, arcuate behind. The thorax is narrow in front, convex above, smooth, shining and very lightly clothed with fine hairs on the sides and more thickly on the under-surface at the base of the legs. The legs are

* NOTE.—The author is indebted to Mr. Claude Morley, of the British Museum of Natural History, for the determination of the genus to which the three braconid wasps belong, and has great pleasure in dedicating one to this well-known authority on parasitic hymenoptera. Mr. Morley states that to the best of his knowledge they are all undescribed species.

The Genus *Iphiaulax* is a very large and cosmopolitan one, containing a great number of described species, of which six have been previously described from Australia.—W. W. F.



1, Perfect Insect; 2, Wings; and 3, Larva of the Red-headed Braconid *Iphiaulax rubriceps*, n.sp. 4, Showing cocoon of pupa in cavity under the bark, with remains of beetle larva. 5, Perfect Insect; and 6, Wings of the Silver Braconid *Iphiaulax phorceanthus*, n.sp. 7, Showing rounded pupal cocoon in a cavity in the bark.

long, slender, with the femur somewhat thickened, particularly on the hind pair, clothed with fine scattered grey hairs and the tip of the tibia furnished with a fine spine. Length from the front of the head to the tip of the abdomen slightly over half an inch, ovipositor one-third of an inch, and the antennæ nearly half an inch. The expanse of the large wings is about an inch.

This braconid has a wide range over Australia, probably as wide as its beetle host, and a closely allied if not identical species is found in Tasmania. The maggots were often found in the cavities under the bark with the remains of a longicorn larva upon which they were feeding, and were of the typical wasp form, dull white, oval, tapering to both extremities, showing thirteen segmental divisions. When full fed they formed a remarkable oval flattened handbox-like cocoon attached on the under-surface to the bottom of the cavity with the sides quite vertical and the top quite flat. This is composed of a dense dull brown silk, and is about one-third of an inch in length, longer than broad.

When the fully developed braconid is ready to emerge it cuts a hole through the side of the silken cocoon, but a large number appear to die before reaching maturity and perish in the cocoon.

The Silvery Braconid (*Iphiaulax phoracantha*, Froggatt).

The general colour is shining black with a bright red head, the large eyes, rounded area containing the shining brown ocelli, and the long slender antennæ black. The short broad head is rounded in front with the basal joint of the antennæ springing out from a depression situated between the eyes in the front of the face, and the hind margin truncated, joined to the prothorax by a short neck. The prothorax is narrow, with lobes behind, and the hind portion of the rest of the thorax is of a uniform width truncated at the hind margin. The wings are large, smoky brown, with the nervures black. The legs are long, mottled slightly with brown and covered with fine silvery pubescence. The abdomen is small, elongate, oval, with the slender reddish brown ovipositor nearly as long as the whole insect. The whole of the upper surface of the apical portion of the thorax and the abdominal segments is densely clothed with fine shining white hairs, giving it a beautiful silvery pubescence; silvery hairs are more lightly scattered over the under-surface. Length from the front of the head to the tip of the abdomen, not including antennæ or ovipositor, slightly under half an inch. Expanse of wings 1 inch.

These braconid wasps were bred out in considerable numbers from cocoons made in an elongate oval form of pale brownish yellow, semi-opaque, silk, parchment-like cocoons. These cocoons were found in the chambers where the larval *Phoracantha* had been feeding, with the chitinous remains of the grub.

The Variegated Braconid (*Iphiaulax morleyi*, Froggatt).

This handsome braconid was bred from pupæ like that of the typical form under the bark of the peppermint gums at Uralla, but was a much rarer species than the previous ones described. In immature ones the abdominal

segments are often coloured with reddish brown, but in mature specimens only the first two basal segments are light coloured, all the posterior ones being black.

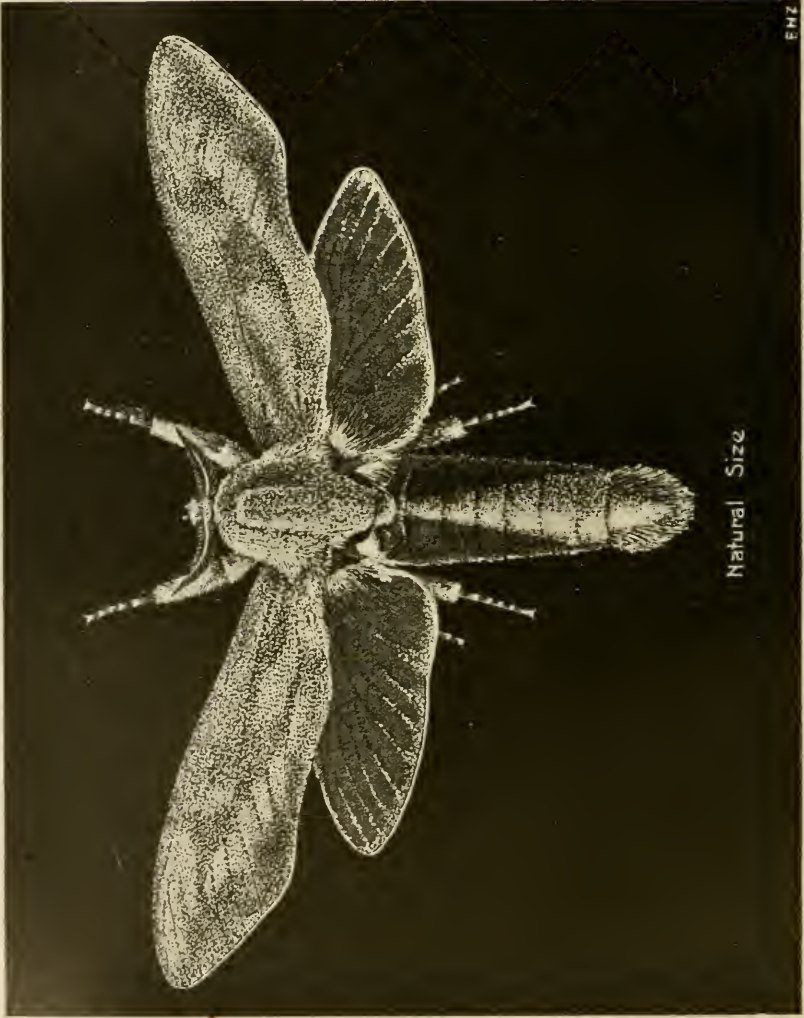
It has a similar red head with black antennæ, eyes, and area surrounding the ocelli, and the wings are smoky, like the Red-headed Braconid, but is otherwise very distinct. Head red, clothed in front with scattered reddish hairs, arcuate behind, eyes large, rounded, projecting. Thorax black, dorsal surface shining, a striated area in line with the base of the wings with a reddish spot behind, lightly clothed on the sides and ventral surface with short grey and black hairs. Prothorax narrow at junction with the head, contracted on the hind margin; mesothorax broadest at the insertion of the wings, rounded behind; metathorax reddish brown in the centre, saddle-shaped rounded above and thickly clothed with fine silvery hairs, narrowed and meeting on the ventral surface at the insertion of the hind legs. The legs are variegated yellow and black; in the front pair the apex of the femur and the basal half of the tibia black, in the middle and hind pair the whole of the legs are black except the central portion of the femora, the apex of the tibia and the tarsi which are yellow. The trochanters are short and thickened and the central portion of the femora of all the legs swollen and rounded, those of the hind legs much more than the front pair. The wings have the basal portion and nervures reddish brown with the rest smoky black. The abdomen is slightly stalked by the first segment bending sharply down to the lower edge of the thorax; this segment is finely striated, and with the greater part of the broader second segment reddish brown; the following ones are black, rounded, tapering to the extremity, lightly clothed with scattered silvery hairs all over the body and legs, and forming regular bands across the dorsal surface at the base of each segment, with a corresponding short stripe on either side, five in number. Ovipositor reddish brown, about a quarter of an inch in length. Length of braconid from front of head to tip of abdomen slightly over half an inch; expanse of wings one inch.

The Giant Wood Moth (*Zeuzera macleayi*, Scott).

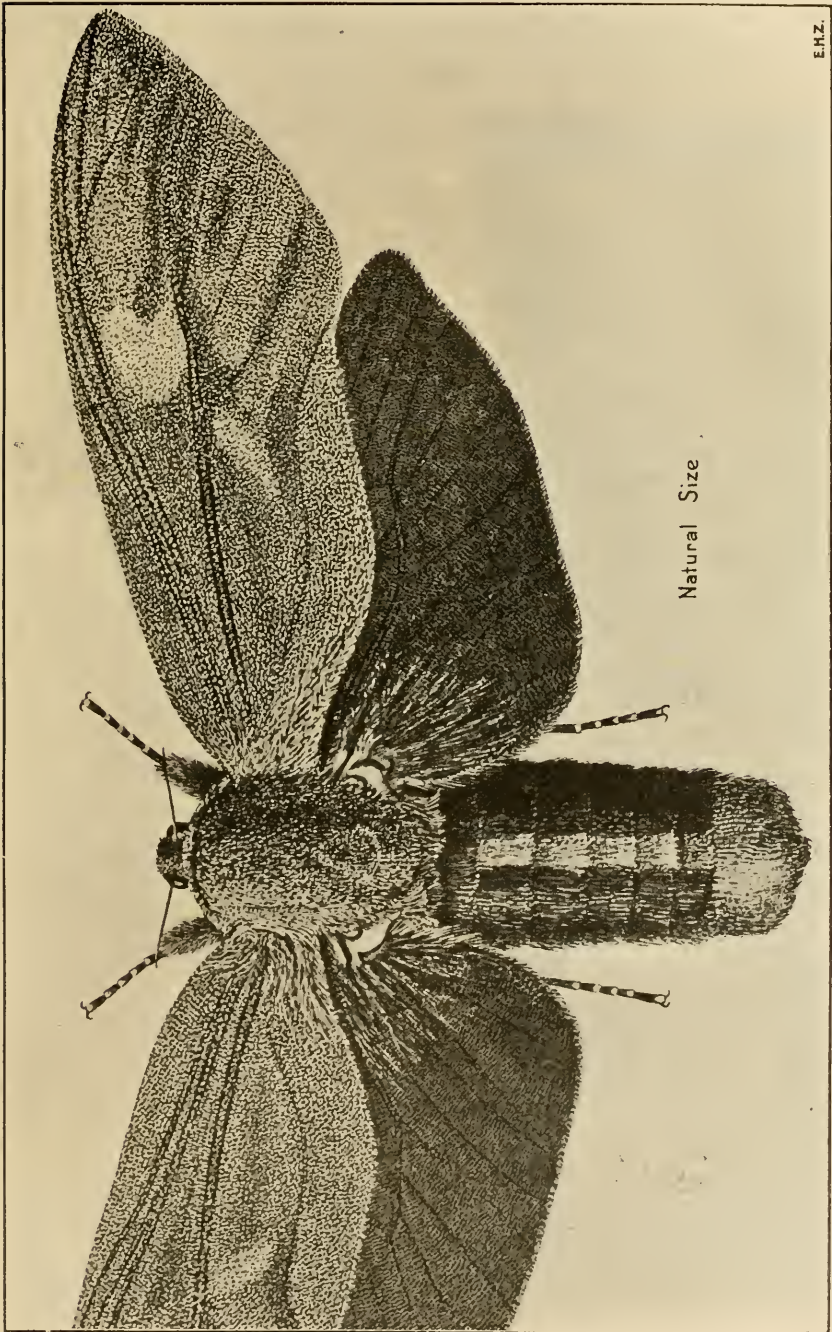
This is one of the largest of our wood-borers. The great white grub bores tunnels in the trunks of a number of different species of eucalypts and thus damages valuable timber. These moths sometimes lay their eggs upon the trunks of various street shade trees, and in such case the damage caused by the larvæ is very noticeable.

The sexes vary much in size and colouration. In consequence of this fact, among the many scientific descriptions of our wood moth (*Zeuzeridae*) there remains a great deal of doubt as to the original and correct name of several of our common species. This one named by Scott after Macleay is probably identical with the one that Herriek-Schafer named *Eudoxyla boisduvalli*.

The smaller male measures about 5 inches across the wings and the length of the body up to 3 inches, and on an average the female measures 8 inches across the wings, with a large swollen body containing many thousands of small shot-like eggs; but we have records of them measuring up to 10 inches across the outspread wings. The male has short, reddish-brown feather-like antennæ, rounded brown eyes, and very fluffy forelegs usually extended in front when clinging to the bark after emergence from the tree trunk. The wings are large and broad, folded round the large cylindrical body, which, in the male, is more slender and flattened to the tip. The



Zeuzera maculayi. Male.



E.H.Z.

Natural Size

Zenzera macleani. Female.

ground colour of the wings are chocolate brown, but the whole of the rounded thorax, forewings, and the lower half of the body and stripe running back to the base of the thorax, thickly covered with white scales and downy hairs,

so that it has a uniform greyish-brown colouration. The hind wings and sides of body are clothed with light chocolate-red scales, with a few scattered white scales on the margins of the hind wings.

The large female differs in having a thinner coat of grey scales over the front pair of wings, the whole of the large swollen body covered with shaggy light chocolate-brown hairs, except at the tip, with a dusting of greyish ones down the centre, forming an indistinct dorsal stripe. The hind wings of a uniform light chocolate-brown tint. The whole of the under-surface thickly clothed with shaggy white hairs and scales.

The larva is a typical white grub, with powerful black jaws, corrugated horny plated prothorax covered with stiff thorn-like processes, with similar ones forming plates on the dorsal surface of the body segment, which with the short legs and well developed prolegs enable them to move very easily up and down their burrows during their long caterpillar or larval life. In the Newcastle district Thornton stated that these larvæ live for four years in the trunk of the white mahogany (*Eucalyptus acmenioides*). They pupate in the vertical shaft which is above the transverse bore. Unlike the members of the Genus *Charaga* they do not form a web or bag in front of the opening, but before pupating it plugs the opening with a wad of silken material. Later on this

wad is pushed out by the maturing pupa which has the power of moving up and down the vertical shaft. The eggs, oval in form, black in



Larva viewed from the side.

Zeuzera Macleayi.

Front view of head.

colour, and enclosed in a smooth shining shell, measure about 2 mm. in length, and are deposited in masses upon the bark. The greater number of these eggs or the tiny larvæ must have many active parasites, otherwise the countless number of caterpillars would destroy whole forests of eucalyptus.

The Smaller Green Wood Moth (*Uharaga lignivora*, Lewin).*

This moth has recently been found damaging the young blue gum trees in a forest plantation at Wyong; and a fine series have been bred from infested stems sent by Mr. McPherson. The eggs are deposited on the bark in the early part of the year; the moths emerged in the insectarium at the end of December. The larva bores into the centre of the stem, then turns down and bores a vertical shaft 2 to 2½ inches in depth, in which it lives, coming out and feeding upon the surface of the bark surrounding the lateral opening. Over this and right round the branch the active larva constructs a felted covering of silken web and fine fragments of gnawed wood; the whole forms a light-brown paper-bag-like covering up to 3 inches in length, and broad in proportion to the size of the stem encircled. This is attached at the extremities to the bark of the encircled stem. In some of the large stems the final action of the caterpillar infestation causes the stem to swell out with a large depression on the side; then the larva only forms a felted covering immediately over the opening and the surrounding depression. If this covering is damaged, the larva mends it during the night. Under this covering the larva often makes its position more secure by filling the opening in the stem with a wad of silk and wood dust. The caterpillar is a naked light biscuit-brown coloured larva, with slender, smooth, shining cylindrical body, and with a double fold at the apex of each of the well-defined abdominal segments. The head is dark reddish brown, black at the jaws, and is very hard and horny. The thoracic segments are uniform with the following ones, and each bears a pair of short stout legs. Length up to 1½ inches. It is a very active creature, moving about quickly, and clinging with its legs and anal claspers to the sides of its bore when the wood is split open. The pupa is cylindrical in form, and 1¾ inches in length. It fits closely into the burrow in which it finally rests, with its head level with the top of the vertical shaft. The upper surface of the head and first two thoracic segments are black and armour-plated, with finely corrugated impressed chiton which must be admirably adapted to protect the otherwise helpless pupa from the depredations of other carnivorous insect enemies. The male moth measures 2 inches across the outspread wings, and is a very dainty little creature when resting on the bark after emergence. The fore wings are deep green with a light whitish stripe along the front margin, with a fine silvery white line crossing at an angle towards the tips and with another similar line forming a V near the base. The hind wings are silvery grey. The head is small, with two large dark brown eyes with shaggy grey hairs below; and with slender dark yellow antennæ. The thorax is clothed with white and green downy hairs; and the abdominal segments have rose pink and green pubescence and fine scales.

* See *Frontispiece* coloured plate this moth, male and female. Figs. 3, 3a, and 3b.

The larger female measures about $2\frac{1}{2}$ inches across the outspread wings; and the slender abdomen including the head is about $1\frac{1}{2}$ inches in length. She differs considerably in colouration from the smaller male. The outer half of the fore wings is clothed with fine red scales, and has a triangular patch of green in the centre; the base of the wing is tinted below with reddish brown and deep yellow. The hind wings are clothed with reddish scales and rose pink downy hairs, thickest towards the body. The head and thorax are covered with dense buff and yellow down. The abdomen has the basal portion rose pink, with the apical portion yellow; but it is almost bare of pubescence or scales. The larvæ of this moth feed upon the stems of a number of other shrubs besides gum tree saplings. They girdle the stems of *Leptospermum*, *Melaleuca*, and *Tristania*. French records them in his "Handbook of the Destructive Insects of Victoria" (Part iv, 1909, p. 77, pl. lxxii) as infesting an apple orchard, where they damaged a number of apple trees.

The Blue Gum Leaf Moth (*Mnesampela plicata*, Gn.).

The caterpillars of this moth infest the tips of the branchlets of the blue gum saplings growing in Victoria. On the low bush on the hills in the vicinity of Bendigo, I can remember as a boy thousands of bushes being infested in summer time. The rather handsome mottled and striped green caterpillars draw the leaves together, webbing them only along the edges and thus they form an irregular-rounded bag in which they shelter. They skeletonise the lower leaves and eat up the edges. I have no record of this caterpillar appearing in any of our New South Wales blue gum plantations; but there is always the danger of such a pest appearing in cultivated areas.

French gives a coloured plate of the life history of this web moth, and a brief description, in his Handbook "Destructive Insects of Victoria," part iii, 1900, p. 53, pl. xii.

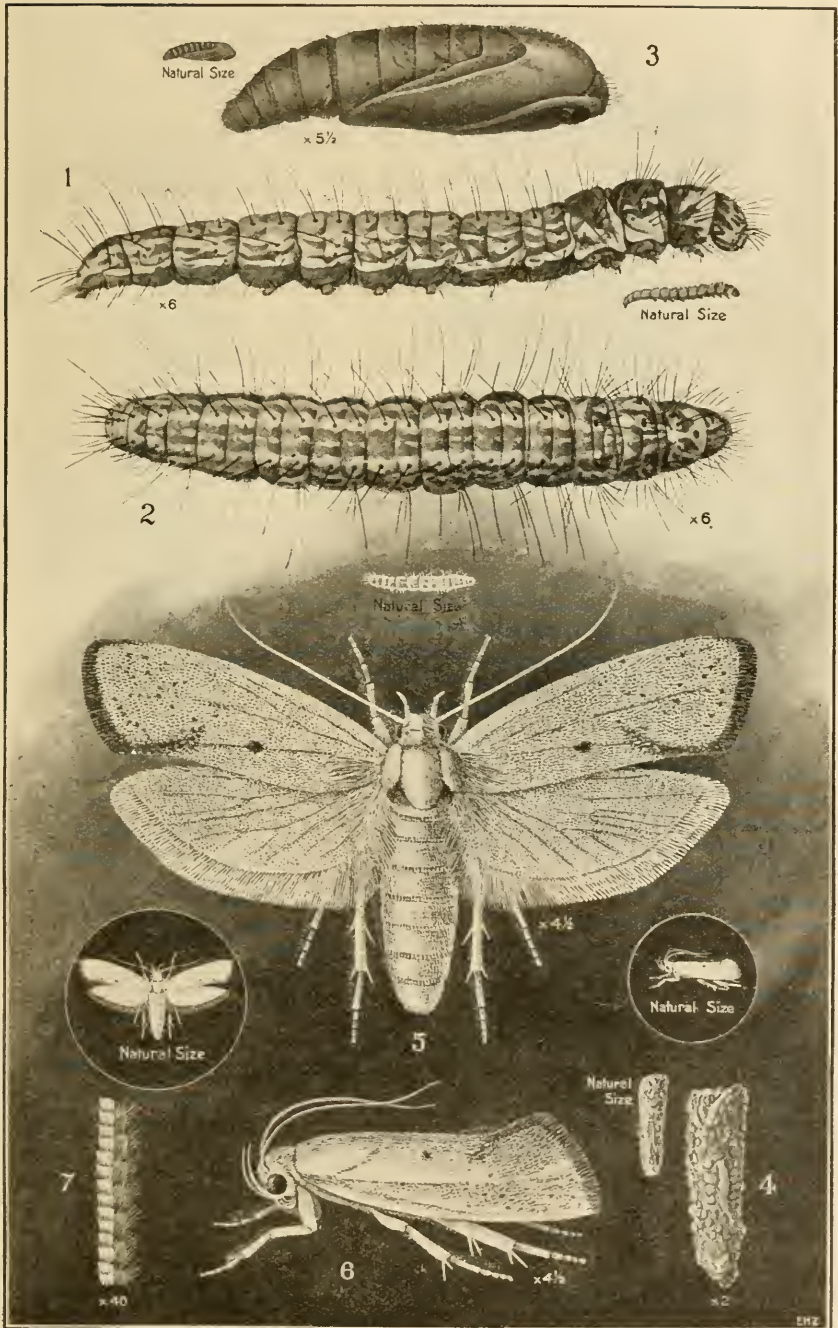
In a plantation it would not be a difficult matter to cut off all infested tips containing the caterpillars, and to destroy them before pupation.

The perfect moth measures $1\frac{1}{2}$ inches across the outspread wings, and $\frac{1}{2}$ inch from the tip of the abdomen to the front of the head. It is of a general dark brown tint, with a greyish blotch towards the tips of the fore wings, which are recurved at the tips. The hind wings are of a uniform lighter tint than the fore pair.

The Brown Leaf Moth (*Roesilia lugens*, Walker).

This moth until recently was known under the name of *Nola lugens*, and was figured and briefly described by French under the name of the "Gum-tree moth" ("Handbook of the Destructive Insects of Victoria," part v, 1911, p. 119, pl. cxxii). He states that the blue gums suffer severely from this caterpillar. "In some parts of the State the tops of these eucalypts appear at a distance as though a fire had passed through them."

The caterpillar is a typical "woolly bear," about an inch in length, reddish brown, and clothed with long grey hairs thickest on the margins. It feeds upon the surface of the leaves of the blue gum and other eucalypts.



Silver Leaf-rolling Moth.

eating off the whole of the epidermis and skeletonising each leaf. I have bred moths from caterpillars collected on gum trees at Mittagong, New South Wales.

The moth has a somewhat thick-set body, and is of a general uniform light brown tint. The whole of the upper surface of the wings, head, and body are covered with fine whitish scales interspersed among the darker ones, giving the whole moth a distinctly grey tint. The fore wings have three irregular broken bands of black scales crossing the centre, with other scattered black scales over the inner portion. The hind wings are browner than the fore pair, and are fringed with long downy scales. Length, $1\frac{1}{2}$ inches across the outspread wings.

Gumleaf-rolling Moth (*Heliocausta hemitelis*).

The foliage of many different species of gum trees are, at times, very badly infested by leaf-rolling moths. The eggs are laid upon the foliage; the tiny caterpillars feed upon the surface of the leaves, and matt the foliage together with silken strands until it becomes a protective mass among which they feed and finally pupate. The plate figures the life history of an *undetermined species* that has this habit of leaf-rolling. The life history of the "Mottled Yellow Leaf-roller (*Heliocausta hemitelis*) which is common all over the coastal districts of Victoria and New South Wales is identical; and a large mass of rolled leaves often produces a number of fine moths when the leaves are placed in the breeding cage.

It is a handsome canary yellow coloured moth, with the thorax and body blotched with dark brown; the fore-wings are blotched dull claret colour, and also have a rounded blotch on the hind margin; the wrinkled hind wings are dull brownish, and are fringed on the outer and inner margin with long hair-like scales. It measures just under an inch in length. Its life history is identical with that of the undetermined species figured.

The Blue Gum Psylla (*Rhinocola eucalypti*, Maskell).

This tiny little lerp insect lays her eggs on the tips of the foliage of young seedlings and small trees. The larvæ are pale yellow, mottled with grey and brown. They congregate at the base of the leaflets and envelop themselves in white woolly filaments while feeding. Maskell first recorded them from New Zealand upon blue gums and suggested that the insects might be Australian. I have found that nearly all the blue gum seedlings grown in the plant nurseries in the vicinity of Sydney are infested by this little grey psyllid, which can be easily recognised by the silky white filaments on the young foliage. A description and drawings of this insect will be found in Maskell's paper in the *Transactions of the New Zealand Institute*, 1889. In the *Proceedings of the Linnean Society of New South Wales*, 1890, I note this species in my Monograph of the Australian Psyllidæ.

This infestation by these sap-sucking larvæ does not seem to have any serious effect upon the seedlings or young trees, and where excessive they can be easily controlled by the application of soap and tobacco wash.



Eriococcus coriaceus.
Female (immature).



Eriococcus coriaceus. Female (mature).
x 4.

The White Egg Scale (*Eriococcus coriaceus*, Maskell).

This is one of the most common species of the genus, and they attach themselves to the young stems, branchlets, and leaves of a number of different species of our eucalypts. The adult female scale insects are oval, wrinkled, bluish brown to reddish brown in colour. They are completely enveloped in a thin tough white to reddish brown sac, fitting all round the edges on the bark or leaf, with a small circular orifice at the tip of the anal segment. Massed together on a twig they sometimes cover an inch or more of the whole surface. This scale was described by Maskell in the *Transactions of the New Zealand Institute* in 1892. Kirk has recorded it as very destructive to young trees in the blue gum plantations in New Zealand, where it had been accidentally introduced some years previously from Australia. It is frequently sent in to the Entomologist for report from the irrigation areas, and from stations and homesteads gardens thickly infesting sugar gums. When the gum trees are growing under natural conditions in the native bush the numerous parasites keep this scale in check and clean up the trees every season. Among these parasites are two or three species of ladybird beetles (*Rhizobius* sp.) and the larvæ of the scale-eating moth (*Thalpochares coccophaga*).

CHAPTER V.

INSECTS ATTACKING VARIOUS SPECIES OF EUCALYPTUS,
SOME MORE THAN ONE SPECIES.Branch-cutting Longicorn (*Bethelium munda*, Blackburn).

(Plate, p. 37.)

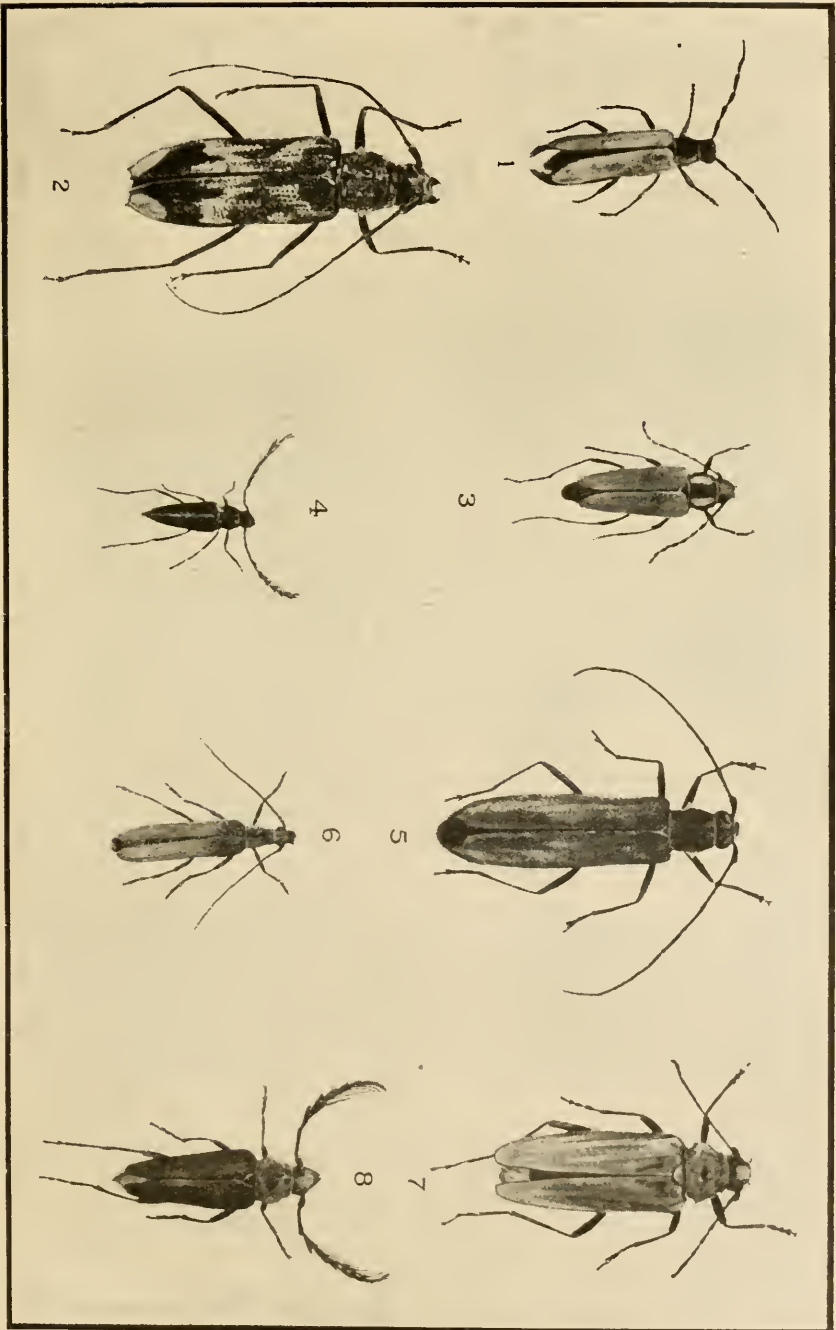
This handsome little beetle was described by Blackburn, and is allied to Newman's species *Bethelium signiferum*, which has a very wide range over Tasmania and Australia. A third species comes from Queensland.

Early in June, 1914, when I visited Salisbury Court, near Uralla, to select a site for the Government Sheep-fly Experiment Station, Mr. Hugh Croft called my attention to the enormous number of small branchlets that were strewn all over the paddocks under the peppermint gums (*Eucalyptus novae-angliae*). This, he informed me, was caused by a small grub. On examination every branchlet, many of which were as thick as a man's finger, was found to be cut clean off from the main branch, and every gust of wind brought down a fresh shower of detached branchlets. Frequently when longicorn larvæ girdle branches they remain below the cut in the main branch, but in this case the grubs bored right into the centre of the fallen branches and usually made for the first dead knot. The baby larva was a short dull yellow grub with a small black head, the body short and rounded.

No beetles could be found while these branchlets were falling, but a large number of the infested twigs were collected and placed in the breeding cages for later investigation. All through the following year, though the larvæ were busy at work feeding on the wood and the boxes were full of wood dust, no beetles emerged in the summer. However, in the following season, almost within a few days of the time when the branches of the peppermint gums had begun to fall the previous year, the same infestation occurred all over the New England district wherever there were peppermint gums. On my return from Uralla to Sydney I examined the boxes of infested twigs and found the adult beetles were just beginning to emerge, and were trying to escape, while many other fully developed beetles were still in the pupal cavity ready to make their way out.

This handsome little beetle measures under one-third of an inch in length, and is of a general reddish-brown colour, mottled with black on the thorax and wing covers with two irregular transverse stripes of dull white on each side of the wing covers which do not extend to the margin on either edge. The whole of the upper surface is finely punctate, deepest on the thorax and basal part of the wing covers and lightly clothed with fine reddish hairs. The head is turned down in front with the eyes, arcuate on the inner margin where the thickened basal joints of the rather long antennæ are situated. The thorax is irregularly oval, longer than broad, and the well-developed legs have the apical half of the femur thickened and swollen into an oval mass. The wing covers are more black than red, the apical third shining black, and about twice the length of the head and thorax.

The residents of the New England district say that during the last ten years since this pruning of the peppermint gum by these beetle larvæ has become a yearly event, many of the isolated clumps of these trees have died out, and attribute it, rightly or wrongly, to this beetle infestation.



Eucalyptus longicornis.

- | | |
|--|---|
| 1. <i>Bimia bicolor.</i> | 5. <i>Trypocharia mastersi.</i> |
| 2. <i>Phoracantha tricuspis.</i> | 6. <i>Scolecobrotus westwoodi.</i> |
| 3. <i>Distichocera maculicollis</i> ♀ female | 7. <i>Distichochochera macleayi</i> ♀ female. |
| 1. " " ♂ male. | 8. " " ♂ male. |

Where timber for shelter is valuable it would be quite possible to reduce the numbers of the beetles by collecting the fallen branchlets while they are so noticeable with their dead brown leaves from the other dead wood, and burning them in heaps, for every one I examined contained a grub which in the following season would be a perfect beetle ready to commence the egg infestation of the branches. Of course, where the fallen timber is thickly strewn over the ground in the open forest, a bush fire often accounts for the destruction of enormous quantities of these beetles.

The Dark Brown Phoracantha (*Phoracantha tricuspis*, Newman).

This is the largest species of the genus; it measures up to $1\frac{3}{4}$ inches in length; but like many of the longicorn beetles it is variable in size and in shades of colouration. The ground colour varies from almost black to dark reddish brown. The head, thorax, and base of the wing covers are black, with the remainder of the wing covers dark reddish brown, variegated in the central portion with light reddish yellow and an oval patch of lighter tint on the apical portion of each wing cover.

The larva attacks the dead or dying timber of several species of Eucalypts. After feeding under the bark for some time it penetrates into the centre of the stem, gnawing out large flat chambers several inches in diameter. In these it remains for several years. The larva is a typical white stout longicorn grub, with a broad head, small legs, and regular abdominal segments rounded to the tip. The beetles are usually found under the dried loose bark on the tree trunks. I used to collect specimens when a boy on the stacks of ironbark wood used for firewood at the gold-crushing plants in Bendigo, Victoria.

French calls it the "Yellow Box Borer," and states that it chiefly breeds in the timber of *Eucalyptus viminalis*, locally known as the "Yellow Box."

The Rough-shouldered Longicorn (*Scolecobrotus westwoodi*, Hope).

This fine longicorn beetle was described and figured by Hope in 1835 (*Transactions of the Zoological Society*, p. 109). I gave an account of its food plant and life history in 1894 (*Proceedings Linnean Society, New South Wales*, p. 113). This is much more slender in form than the previous species; it measures $1\frac{1}{2}$ inches in length. It has a ground colour of reddish brown, but the whole beetle is so densely clothed with fine buff pubescence, that the reddish brown only shows through the pubescence on the deeply pitted shoulders. The head is slender, the prothorax cylindrical, broadest at the base of the wing covers, and very deeply marked with transverse corrugations. The body is rounded and slender. The wing covers taper to but do not cover the tip of the abdomen; both of the wing covers are arcuate at the tips and are produced into a fine spine on each side.

The pale yellow larva is slender, with the segments deeply and widely constricted. About Sydney it feeds in the main stem of the small bloodwoods (*Eucalyptus corymbosa*); but I have also bred specimens from stems of the Whip Stick or mallee gum (*Eucalyptus gracilis*) collected at Bendigo, Victoria. The larva enters the stem of the Bloodwood about a foot above the ground; it bores its way upward, hollows out the branches, then works downward, and gnaws right round the top of the stem just where it first entered. It thus kills the bush, which, when touched, snaps off at the gnawed ring. The larva, having fed downward through the centre below the fractured top usually pupates in the bottom of the burrow situated just a few inches above the ground.

Master's Longicorn (*Trypocharini marstersi*, Pascoe).

I have never bred this beetle, though it is recorded from New South Wales; but French states that it is a very serious pest in the neighbourhood of Melbourne, Victoria (Handbook, part iv, p. 99, 1909).

Pascoe named this beetle in 1875, in the "Annals of Natural History," p. 61. According to French it is particularly destructive to the young saplings of the peppermint gum (*Eucalyptus amygdalina*); and also was the final cause of the death of a number of blue gums (*E. globulus*) in the Melbourne Public Gardens.

The larva works round and round the trunk under the bark; it then bores into the top portion of the stem, above which the stem eventually snaps off, carrying the entombed larva with it. It pupates in the snapped off stem; and the perfect beetles emerge early in the summer. The adult insect is a large bright reddish brown beetle, measuring nearly 2 inches in length. The upper surface of the prothorax is very roughly corrugated with a blunt spine on either side, and the long antennæ are spined at the segments. The wing covers are very thickly and coarsely punctured, and the central portions are biscuit brown.

Macleay's Longicorn (*Distichocera macleayi*, Newman).

This is one of the flower-hunting longicorns. The beetles are found in the early summer upon the flowers of the angophoras and eucalypts, where they feed upon the honey. There are several handsome beetles in the genus, which are remarkable for the difference in size, colour, and form of the sexes. This fine species was described by Newman in 1851 in the *Proceedings of the Zoological Society of London*. I have never bred this species, but French in his work previously quoted (Part v, p. 97, 19) records and figures it as a borer in the Yellow box (*Eucalyptus stuartiana*) in Victoria under the name of the "Feather-horned Yellow-box Borer."

The smaller male measures 1 inch in length; the larger female 1½ inches, and is much broader in proportion. The male is of a general blackish brown tint, with white hairs on the sides of the prothorax and all over the under-surface; the wing covers are flattened and fluted with parallel ridges tapering to the tips, with a stripe of white down on inner edges. The antennæ, however, are the most remarkable part of their structure. The first joint is simple, the second long, with a short finger pointing outward at each side on the apex; the following joints have these fingers increasing in length forming a V, the stalk springs from the bottom of the V; the last segment has three long fingers.

The prothorax of the female is black, wing covers are reddish brown, the under-surface of the body and legs are covered with fine white hairs or down. On the upper surface the front of the head between the base of the antennæ, and two broad strips on the sides of the prothorax, are ornamented with dark orange yellow downy scales. The whole of the wing covers are so thickly covered with dark orange yellow scale-like hairs that it hides the deeper reddish-brown ground colour. So this beetle can be briefly described as a dark orange-coloured beetle, with a black band in the centre of the prothorax. In the female, the antennæ are quite different from those of the

male. The basal segments are rounded, broadest at the apex, and the apical segments are shorter, broader, and are shield-shaped: the outer margins of the upper edges are slightly toothed.

Several other species of this genus are to be found about Sydney on the flowering shrubs such as angophora and leptospermum in the early summer. I noted the life history of *Distichocera maculicolles* (*Proceedings Linnean Society, New South Wales, 1893*). This I bred from larvæ in the stems of the "Tick Bush" (*Kunzia capitata*). Commencing just under the bark, the larva traversed the stem in every direction, boring several long parallel chambers backwards and forwards to the centre of the stem.

The larva is a stout, thick-set white grub, with a broad square head, and the body is lightly clothed with short hairs.

The *Bimia Longicorn* (*Bimia bicolor*, White).

This handsome longicorn beetle was figured and described by White in the *Proceedings of the Zoological Society, 1850*. A second species was described and figured by Saunders in the *Transactions of the Entomological Society of London* in 1850, under the name of *Bimia femoralis*. French gives a coloured plate of the latter species in his *Handbook, Part V, pl. III, 1911*, which he states is a serious pest to the apple gum (*Eucalyptus stuartiana*) in the Gembrook district, Victoria.

The typical *Bimia bicolor* has the body, flying wings, antennæ, eyes, space on top of head behind the antennæ, broad oval blotch in the centre of the prothorax and scutellum, shining black. The rest of the head, thorax and wing covers are dull yellow, with fine yellow hairs on the head and thorax, and black ones on the antennæ and under-surface of the body. The front two pair of legs are yellow on the thighs, the whole of the hind pair black.

The beetle has a somewhat small head with the prothorax rugose, and produced into a blunt spine on either side. The wing covers are lighter yellow than the head, and thorax are narrow and usually opened out at the tips. It is somewhat variable in size, but averages about 1 inch in length.

The second species, *Bimia femoralis*, differs from the typical form in being slightly larger and also in the colouration of the head and thorax, the latter being only marked with black down the centre. I have several other specimens: one has two faint spots on the prothorax and half the scutellum black; another has the prothorax unspotted, and the scutellum only marked with black.

Blackburn writing upon the genus (*Transactions of the Royal Society of S. Australia, 1888*), says in regard to *Bimia femoralis*: "There is little doubt that this is a variety of *B. bicolor*, from which it is said to differ in having no black mark on the head, a narrow instead of wide black bar on the prothorax, and the middle femora yellow instead of black. A short series before me varies in all these respects, no two specimens being coloured quite exactly as either of the species named."

Besides being so variable in colouration, these beetles have a wide range over Australia.

The distinctly variegated species figured by French is evidently not *Bimia bicolor*, but the species described from Victoria in 1886 by Van de Poll (in *Notes Leyden Museum, Vol. VIII*), under the name of *B. maculicollis*.

CHAPTER VI.

STICK INSECTS, MOTHS, SAWFLIES, AND HOMOPTEROUS
INSECTS ATTACKING EUCALYPTUS.The Gregarious *Phasma* or "Ringbarker"

(*Podacanthus wilkinsoni*, Macleay).

The leaf or stick insects are well represented in Australia by many large and handsome species, but in most cases they are solitary and comparatively rare insects. So although they are all foliage eaters, still they cannot be called pests.

In this species we have a phasmid that ranges over a considerable area of our northern coast forest lands, while odd specimens have been found as far west as the Jenolan Caves in the Blue Mountains.

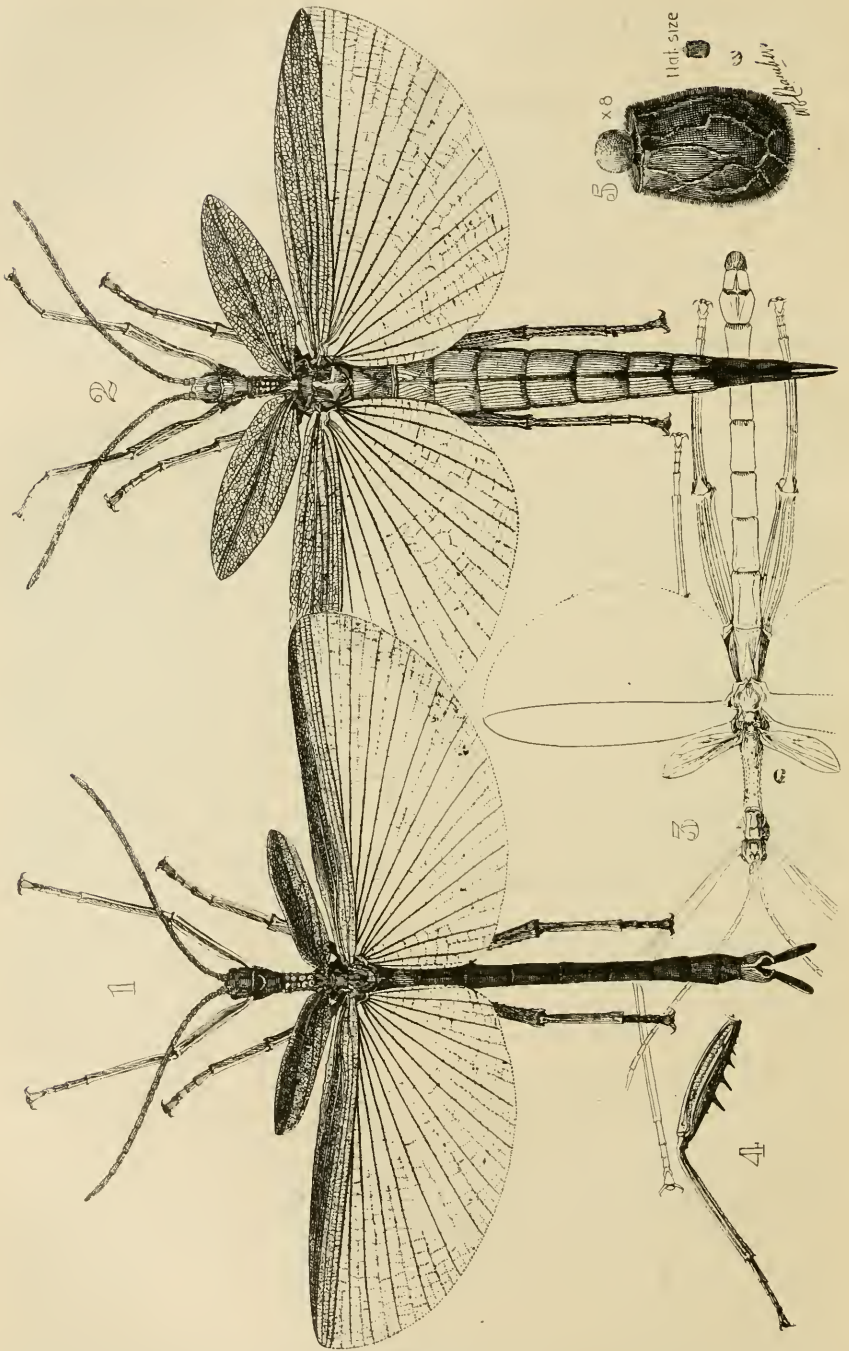
They appear at irregular intervals in such countless millions, either walking or flying through the forests, that every leaf is stripped off the gum trees in their path. In 1891 Olliff stated (*Agricultural Gazette of New South Wales*) that the infested area was about 50 miles long, comprising a strip of thick forest including what is known as Murphy's Creek near Walcha, through the scrub to Upper Tia and Nowendoc Station to the "Gulf" a depression in the mountains towards the Manning River. In this district they were known as "Ringbarkers," and "Lowrie's Flying Gang," on account of the leaf stripped forest looking after they had passed through as if all the trees had been killed by ringbarking. The type specimens were collected by the late Mr. C. S. Wilkinson; he handed them to Sir William Macleay who described them in the Proceedings of the Linnean Society of New South Wales in 1889. Macleay commenting on Wilkinson's notes said; "It was probable that in many cases where the trees were found to be dying out, from no apparent cause, that it might be brought about by the infestation of this or other allied species of plant eating phasuids."

In February, 1905, I visited the Nowendoc district when the whole forest was alive with these active creatures, and collected a very large series; afterwards publishing a paper in the *Agricultural Gazette* entitled "Stick or Leaf Insects". Some years later I investigated the damage caused by a still larger army about 20 miles east of Glen Innes. I visited a small sawmilling plant in their direct line of march, the owner of which informed me that thousands crawling over the boiler had been scorched to death, and the engineer had to shovel them off the top of the portable engine.

The foliage of all species of eucalyptus was devoured but no other forest trees were molested; the native cherry, wattles, river oaks, and other under brush were fully foliated among the leafless gum trees.

There is no doubt that the action of the insects defoliating these trees, even at irregular intervals, is a set-back to their growth, and causes the tops to die back and form many dead branches, thus reducing the value of many valuable timber trees.

The adult females, when their bodies are distended with eggs, cannot fly; and while crawling and feeding among the foliage they drop their hard oval seed-like eggs one by one into the soil beneath. We do not know how long



Stick Insects.

- 1. Ringbarker (*Podacanthus wilkinsoni*). Male.
- 2. " " Female.
- 3. Immature male. " 4. Hind leg of immature male.
- 5. Egg, showing plug or lid.

these eggs can remain fertile on the dry ground ; but the egg stage may be six months or more ; and for several months the tiny baby phasmids would not be noticeable among the foliage.

Probably the most effective way, where practical, of getting rid of these insects, would be to fire the underbrush and burn the eggs and young phasmids before they have moved on up into the tree tops.

The adult insects are handsome creatures. The smaller male measures about $3\frac{1}{2}$ inches from the front of the head to the tip of the tail, and has a wing expanse of about 4 inches. The general colour is dull green with brownish legs, the small fore wings edged with white on the outer edge. The large hind wings are pink shaded with purple, striped on the front margin with green and orange yellow at the base. The larger and more bulky female differs from the male in having the hind wings a deep rich purple colour.

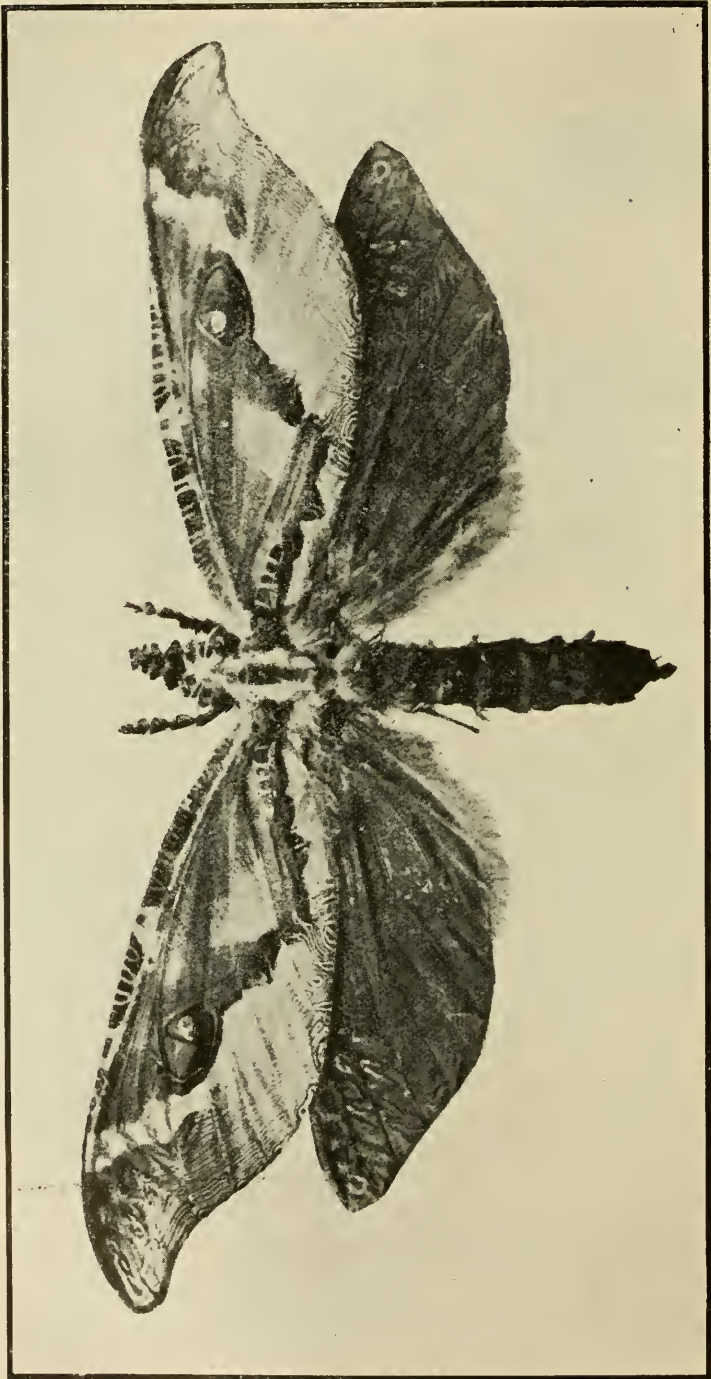
The members of the family *Phasmidae* have no means of protection against their many enemies, except that of exuding a drop of offensive smelling fluid from the mouth which may be objectionable to predaceous insects and birds. Their structural peculiarities and colouration are so adapted to their surroundings that, until they move, they are very difficult to find. This is known to naturalists as protective mimicry.

The Bent Wing Moth (*Leto staceyi*, Scott).

This is one of the most remarkable and beautiful moths in Australia, both in regard to size, form, and colouration. It was originally described under the name of *Zelotypia staceyi* by Scott ; and a variety was described by Olliff in the Proceedings of the Linnean Society of New South Wales in 1887, under the same name ; but Meyrick's investigation proved that it should come in the African genus *Leto*.

Skuse gives a photograph of this moth with its wings closed resting on a tree trunk (Records of the Australian Museum). He likened it to the head of a small monitor lizard, claiming it was a case of Protective Mimicry. A very fine plate is given of the male moth in "Australian Insects," published in 1907. The male and female differ in size and colouration. The male is much the smaller. The female measures $6\frac{3}{4}$ inches across the outspread fore wings, which are narrow and curved in behind the tips. The whole surface of the wings is daintily covered with crenulated ripples, and has a raised eye spot in the centre. The pale buff, yellow, and creamy shades and markings over the fore wings are very difficult to describe. The hind wings are of a uniform deep yellow buff. The female measures 8 inches across the wings, which are flatter than those of the male, and usually are not so brightly tinted. The head is small ; the thorax is rounded, bearing shaggy, reddish hairs on the sides ; the abdomen is long and somewhat slender and cylindrical.

At one time a profitable trade was carried on by several bush naturalists in the Newcastle district. They used to mark the infested trees, and later they either cut out the section containing the pupa and take it home, or else watch the critical time when it emerged, and capture it resting on the tree trunk. It has since been bred from trees in the Gosford district, but its range seems to be limited. It feeds in the stems of the grey gum *Eucalyptus*



Bent Wing Wood Moth (*Leta Staceyi*).

punctata. The larvæ, after boring through the bark to the centre of the trunk, covers the opening with silken threads, matted with chewed up wood, and the vertical shaft is always turned downwards. Thornton claimed that it took six years to complete its life history; but this wants more careful verification. When well grown the stout cylindrical larvæ, provided with the fine, thorn-like spines on the segments (which are also found on several other of our wood-borers) moves up and down the vertical shaft. Before pupating, this larva eats the web off the orifice in the stem, and closes up the lateral bore with a stout wad of silk. Changing into the pupal stage in December, the moth emerges in March. The pupa for some days before it is ready to emerge is quite active; it pushes the wad out of the opening and moves up and down the vertical bore, and will rest in it with its head level with the top of this vertical shaft.

Lewin's Processional Caterpillar Moth (*Ocinara lewinæ*, Lewin).

This woolly-coated little fawn-coloured moth was figured in colours and described by John Lewin. He called it the "Hook Tip Moth" on account of the arcuate curve on the outer margin of the fore wings; and he writes: "The larvæ feed upon the stringybark. A large number of these larvae had spun themselves on a large white web at the root of a stringybark, in which they lie during the day inactive, not venturing to feed until the sun had set, when they swarmed up the trunk, spreading all over the tree as they feed, and as the sun rose they regularly returned. The larvæ changed 22nd January, 1803. Emerged 21st February, 1803."

These Processional caterpillars have a wide range through the coastal forests; and they are well known from the habit they have of raising regular blisters when they come in contact with the skin through the action of their stinging hairs.

In 1903 these caterpillars were very numerous on the south coast forest areas, where they stripped all the leaves off thousands of eucalypts in the vicinity of Bateman's Bay and Bega.

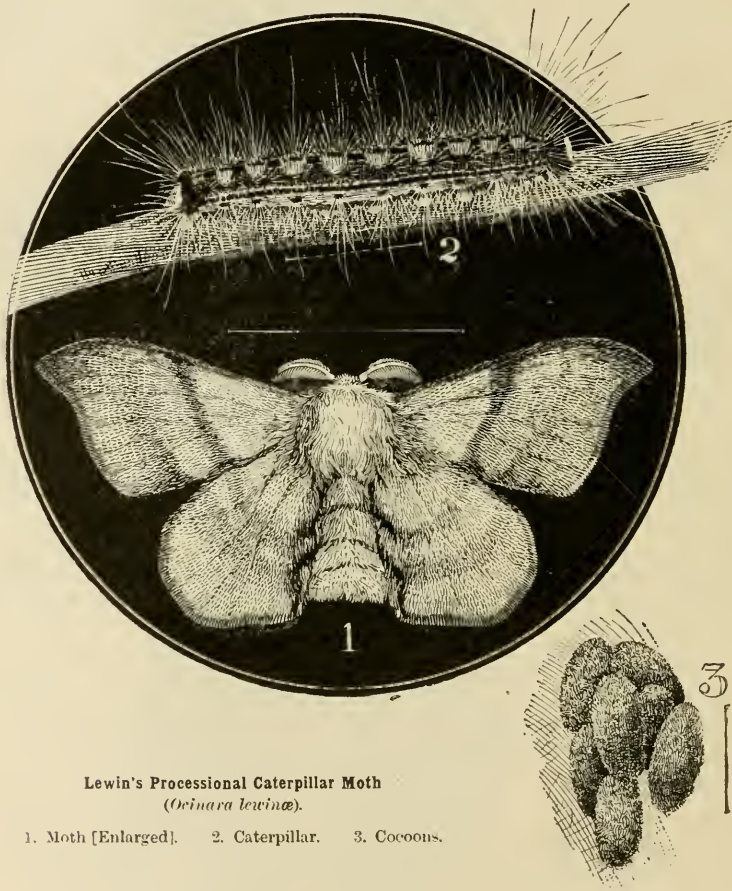
In 1911 they swarmed all through the Gilgai district and Bundarra. Here they stripped all the eucalypts and swarmed into some of the houses; the grass became so thickly covered with their scattered hairs and cast skins that numbers of stock feeding over the infected pastures got them embedded in their jaws, their mouths became ulcerated, and a number of stock died.

In June, 1921, a number of specimens of these caterpillars were sent me from Bindumgo Station, near Roma, Queensland, with the information that they were doing similar damage to the forest areas and also affecting horses and cattle in the same manner.

From Gilgai Mr. W. C. Fraser wrote: "These grubs are locally known as 'Hairy Grubs' or 'Itehy caterpillars.' At present there is a plague of them in this neighbourhood; trees for miles around are covered with their webs in hundreds and the grubs in millions. They have eaten nearly all the leaves off the trees, giving the appearance of wholesale ringbarking. At first they attacked the wild apple tree (*Angophora subretutina*), but they soon destroyed all their foliage and then went for all sorts of bush trees. When the grubs grew to about 1½ inches in length, they left the nests and came down the

trunks of the trees in millions, getting on the grass; and where the stock picked them up when grazing and were affected in the manner previously noted.

The larvæ are slender caterpillars clothed with scattered long hairs; and they have a very characteristic pad of short hairs on each side of all the segments. They do not go into the ground, but pupate among the leaves of



Lewin's Processional Caterpillar Moth
(*Ocinara lewinæ*).

1. Moth [Enlarged]. 2. Caterpillar. 3. Cocoons.

their bag shelter sometimes with hardly a distinct silken cocoon. When fed in the breeding cages they pupate outside the "bag shelter," forming regular cocoons from the hairs upon their bodies. Under natural conditions the caterpillars form their cocoons in the furrows in the tree trunks. The moth measures about $1\frac{1}{2}$ inches across the outspread wings. It is of a uniform awn or buff colour, with reddish brown tints forming a transverse bar across

the fore wings. The wings, thorax, and body are covered with fine downy scales, longest on the dorsal surface of the thorax segments and the tip of the abdomen.

The White Stemmed Gum Moth (*Chelepteryx collesi*, Gray).

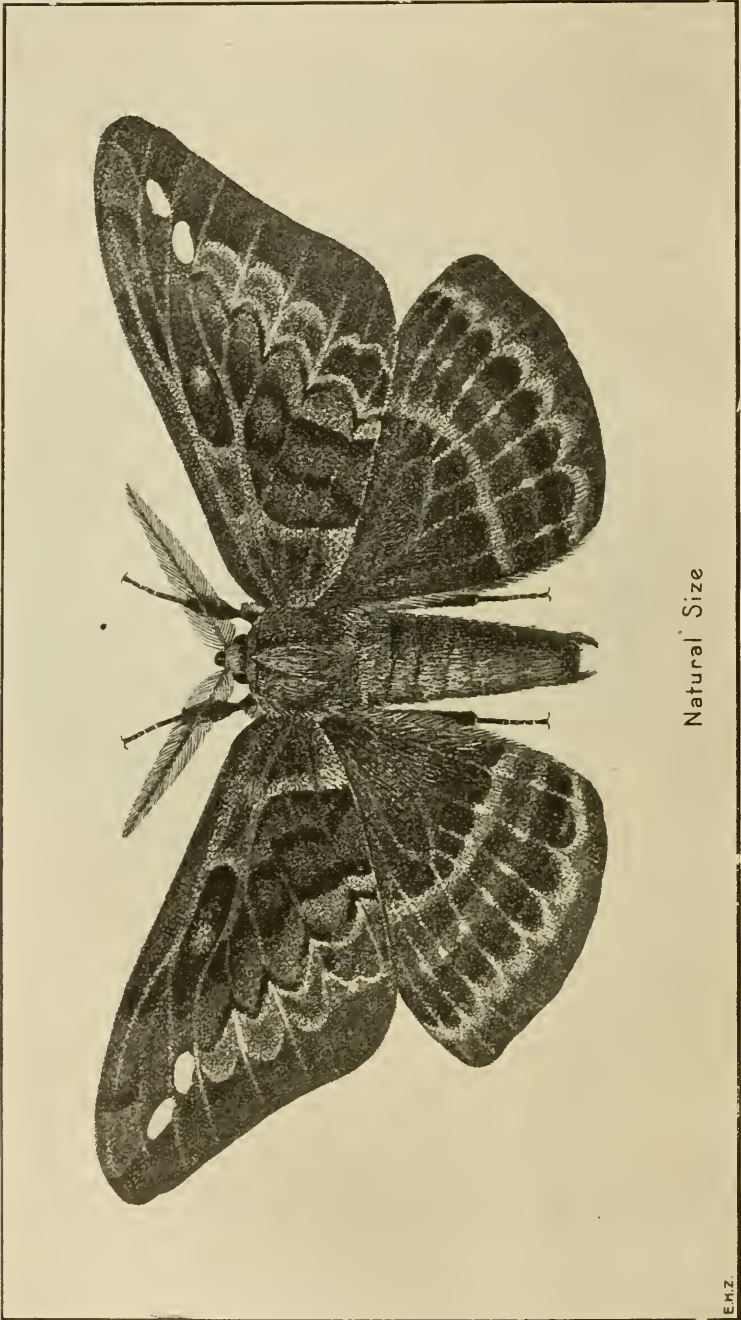
This handsome moth used to be common even in the vicinity of Sydney a few years ago, and in the summer months was often noticeable flapping round the street lamps in the evening. But with the destruction of its food plant, the foliage of the white stemmed gums (*Eucalyptus hæmastoma*), it is now comparatively scarce. I have often seen half-a-dozen of its large cocoons attached to the undersurface of an overhanging rock on the shores of Mosman Bay. Now one has to go further afield for specimens. When large arc lights were erected at the Cordeaux Water Conservation area, these moths were attracted by the powerful electric light; and numbers were obtained towards the middle of March resting upon the poles in the early morning. The moth lays her eggs upon the bark of the white gum, the larvæ feeding upon the foliage.

The full grown caterpillar is over 4 inches in length. It is elongate and rounded on the sides. It has a small head and well defined segments. It has three pair of legs with four pair of well developed claspers or pro legs and powerful anal claspers. The general ground colour is reddish brown mottled and variegated with yellow. From behind the head each segment is ornamented with a pair of raised yellow tubercles, divided from each other by a dorsal stripe, and it also has a larger reddish brown tubercle on each side of each segment. The dorsal surface is clothed with patches of white hairs and feather like scales, and beneath them are still finer reddish brown hairs with longer reddish hairs forming an irregular pattern. Both the dorsal and lateral tubercles are covered with long stout, stiff, reddish spines that stand out all over the body. The under surface is banded with a dull reddish stripe running from the head between the legs to the tip of the abdomen. The legs, claspers and undersurface are mottled with yellow and clothed with patches of white and reddish brown hairs.

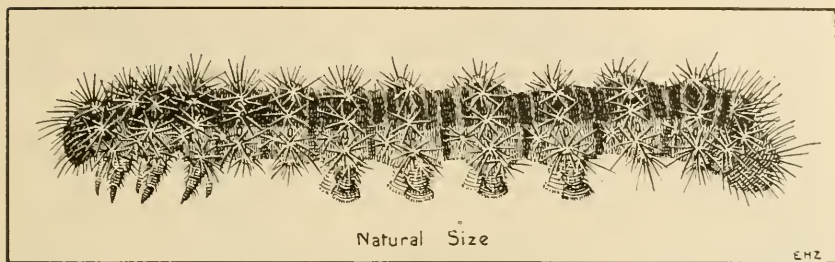
When full fed and ready to pupate, this large spiny caterpillar crawls on to the trunk of the tree or the undersurface of an overhanging rock, and spins a long oval cocoon of fine lightish brown silken strands. When finishing it, it forces all the spines off its body through the enveloping silken cocoon, so that it is as prickly as a cactus, and the fine spines are just as irritating if the cocoon is carelessly handled.

The moth is of a uniform rich chocolate brown tint. It has two oval tale-like spots on the tip of the forewings with variegated zigzag bands forming lunate patterns round the outer half of both pairs of wings. The whole surface is thickly coated with grey scales and hairs which are interspersed with lighter brown scales and delicate yellow hair and feather like scales forming the pattern of the wings. The antennæ are very large, and beautifully feathered. A large female moth measures 6 inches across the outspread wings. This moth was originally described by Gray in the Transactions of the Entomological Society of London, vol. i, page 122, 1834.

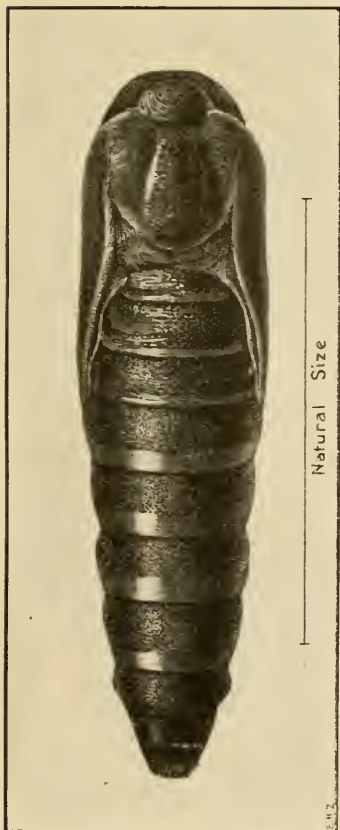
In his revision of Australian Lepidoptera *Hypsiidæ* and *Anthelidæ* Dr. Turner gives a technical description of *Chelepteryx collesi* published in the Proceedings of the Linnean Society of New South Wales, vol. xlvi, page 187, 1921.



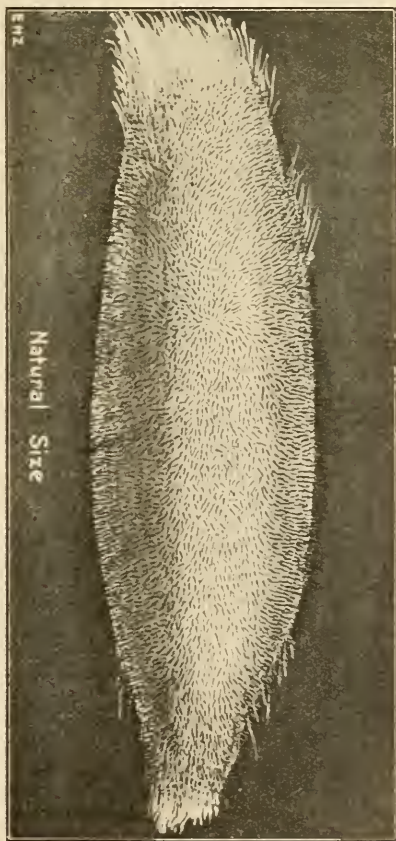
The White Gum Moth (*Chelepteryx collesi*).



Larva White Gum Moth (*Chelepteryx collesi*).



Pupa of White Gum Moth (*Chelepteryx collesi*).



Spiny cocoon of (*Chelepteryx collesi*).

Australian Goat Moth (*Culama caliginosa*, Walker).*

Two species of goat moths were described from Australia by Walker in the Seventh Part of the British Museum Catalogue of Lepidoptera, published in 1856. He described this species from Tasmania, and then a second species under the name of *Cossus longicornis* from the neighbourhood of Sydney.

Our species is closely allied in form and coloration to the European goat moth (*Cossus ligniperda*) which is responsible for a great deal of damage to timber in British forests, infesting a number of different trees. Theobald says as many as 200 larvæ have been found in a single tree.

Some years ago, early in the season, I found a "cabbage gum" (*Augophora lanceolata*) at Mosman Bay, with the trunk badly damaged by some unknown moth larvæ. I cut out the infested section and found it contained a number of smooth, reddish, naked caterpillars with stout black jaws, which were feeding under the bark and boring into the timber beneath. These larvæ later on formed cocoons at the end of the galleries, from which these fine moths emerged early in March. These, like many other moths, are readily attracted to electric lights. A fine series were obtained last March, 1921, at the large arc lights at the Cordeaux Water Conservation Works.

The sexes vary much in size, the larger female averaging 4 inches, and the male from 2 to 2 $\frac{3}{4}$ inches across the outspread wings. The whole of the upper surface of the moth is thickly coated with light brown hairs and scales, and shot with other white scales; these give it a delicate greyish tint thus forming an indistinct pattern across the fore wings. The antennæ of the male form remarkable serrate feathers tapering to the tips and measuring $\frac{3}{4}$ of an inch in length. In the females the antennæ are even longer, but slender, the filaments fringing the margins. With the growth of forestry plantations in this State, this moth might easily increase in such numbers as to do considerable damage. It is worth watching.

The Seedling-gum Moth (*Nola metallopa*, Walker).

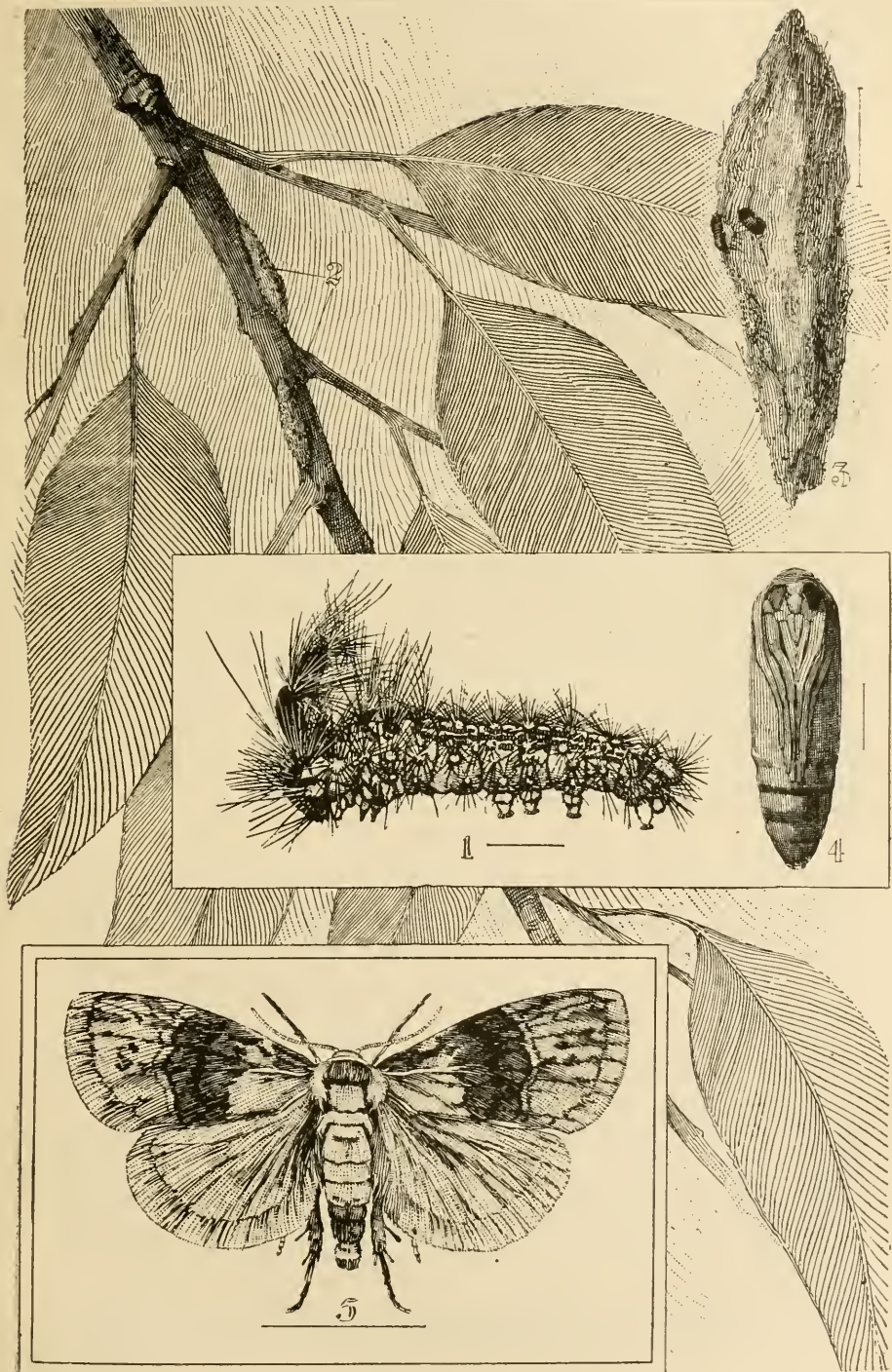
In 1899, when visiting a plant nursery at Botany in the early part of the year, the foliage of a number of seedlings of the West Australian Crimson-flower Gum (*Eucalyptus ficifolia*) were found by the writer to be badly infested with small hairy caterpillars.

The man in charge of the seed-beds said they were a very serious pest, spoiling large numbers of the young trees by stripping off all the foliage. In writing up the life history of this curious little caterpillar, figured and described in this Gazette (vol. xi, p. 647, 1900), the writer stated that it was a comparatively rare moth in collections, though described many years ago from Australia. The genus *Nola* contains a number of different species of small moths confined to forest lands. Three species are common in Great Britain, four are found in Ceylon; Hampson described twelve species from India, and others attacking the oak, willow, and witch-hazel are peculiar to North America.

Since the date of the previous publication (1900) only odd specimens have been sent in on two or three occasions, and reported to be damaging young gum trees. Through the observations of the Forestry Commission we have now a record of the moth caterpillar doing very extensive damage to the red gum (*Eucalyptus rostrata*) in the Deniliquin district. Mr. P. J. McCormick, forest guard, reported:—

I was on part of Koondrook State Forest No. 622, Parish of Tittil and Danberry, County Wakool, yesterday, and noted that a large area of *Eucalyptus rostrata* is affected, apparently with insects or disease. Scarcely any of the trees have any green leaves left.

* See frontispiece coloured plate. Fig. 4.



The Seedling-gum Moth (*Nota metalopa*).

1. Caterpillar, showing cast skins of previous moults attached to the hairs on the head.
2. Cocoon of pupa on branchlet. 3. Cocoon (enlarged). 4. Pupa. 5. Moth.

on them, and the small branches and twigs are sapless and mostly dead. Some of the leaves are partly eaten away, in some instances leaving little more than the mid-ribs, and in others the outline of the leaf is complete, but the fleshy green part is eaten and the network of veins is left. On many of the trees large reddish-brown irregular patches appear, caused by the outer thin layer of green bark being eaten off. The bark is quite tight on the trees, and there appears to be a shortage of sap.

There is a small, cream-coloured hairy caterpillar very numerous on the trees this season. I have never noticed this caterpillar before, and I am quite certain that these have something to do with the damage of the trees, but whether they are the sole cause, or whether there is some other insect or disease assisting, I am unable to say.

The area affected extends from the northern boundary near Portion 27, Parish Danberry, southward to the Crooked Creek and nearly to the Barham Station telephone line in "The Reeds." I am not able to say how far it extends towards The Mylock; it extends at least a mile east to the north to south break which Overseer Walker cleared last year, but I know that from 6,000 to 7,000 acres are affected. I was unable to get eastward towards The Mylock, as there was too much water and the swamps boggy, but I will know its eastward limits in a day or two.

Old trees are not affected and others only slightly, but these do not represent more than 5 per cent. of the forest, and trees of all sizes are attacked, both in the swamps and on the higher ground.

It is too early to estimate what percentage, if any, will die, but it seems to me that some will certainly die. Much depends on whether it is the caterpillars that are solely responsible for destroying the leaves, and if so, whether the trunks and larger branches will retain sufficient vitality to make a fresh growth, or whether they are only a secondary consideration and that it is some disease like the Lerp, which is attacking the ironbark in the coastal districts.

The District Forester, Mr. J. S. Parry, in forwarding Mr. McCormick's report, says that "100,000 acres, and probably much more, look as if a bush fire had swept through the red gum forest, and in places there is little or no shade or cover; I do not know if this insect by an occasional visit would do much damage, but if they are going to be an annual pest they must seriously affect the growth of the red gum." With the experience of what leaf-eating moth caterpillars can do in this and other countries when unchecked, all such forest insects should be kept under close observation. It is, however, probable that this pest, being a native insect, will be soon overtaken by its natural enemies, or run itself out in a year or two.

General Description.

The Caterpillar is about half an inch in length, the colours in the immature specimens varying from almond white to pale yellow, but in the full-grown larvæ much darker. The general form is slender, the sides and ventral surface pale yellow, with lines of alternate black and grey running from behind the head to the anal tip of the former portion, the dorsal surface grey. The head is rounded, with the eyes black and surrounded with pale yellow, out of which spring a number of black hairs; on the summit of the head rises a regular pyramid, apparently formed of the successive moulted skins of the head, which, becoming attached to the hairs upon either side, are not cast off with the rest of the skin, but remain one above the other like an ornamental head-dress. The sides of each segment bear two rounded tubercles, clothed with long grey hairs forming a regular rosette; the dorsal surface of each segment with a light creamy grey tubercle on either side of the dorsal stripe, surmounted with similar grey hairs, which are shorter than those on the sides; the apical segments of the abdomen narrower; the anal one rather truncated, bearing seven small rounded tubercles.

The Pupa.—When the larva is full-grown it crawls on to the stem of the tree, and attaching itself to the bark makes a tent-like cocoon of silken sheet attached to the bark all round the edges, of an elongate oval form,

covered with bits of bark, and so exactly of the same colour as the bark to which it is attached, and sloping down so naturally at the extremities, that it requires a very careful examination to detect them if there are several on the same stem, as they appear at first sight to be simply swellings of the bark.

The enclosed chrysalid measures about $4\frac{1}{2}$ lines in length. General colour pale reddish brown, slender and cylindrical in form. Viewed from the upper surface it is rounded at the apex of the head, contracted behind where it joins the thorax, the first four abdominal segments enclosed with the wing-cases are small, the others larger, and the one rounded to a conical tip. Viewed from below the eyes are very large, wing-covers long and ample, reaching to the apex of the fifth abdominal segment, legs and antennæ folded straight down in front.

The Moth.—The first moth came out in the middle of February and several came out during the week. The length across the outstretched wings was just under an inch; the length from the front of the head to the tip of the body $3\frac{1}{2}$ lines. The general colour of the upper surface of the wings is silvery grey, with the fore wings transversely banded with a small barb of metallic coppery brown near the shoulder, and a much larger one of the same colour near the centre of the wing, tapering to its hind margin, with the outer edges also slightly mottled. The head is small, with long palpi, small eyes, and long antennæ. The thorax is ornamented, with a fine grey band across the apex, below a broad band of copper-tinted scales. The hind wings are of a uniform greyish-brown colour.

The Steel Blue Sawfly (*Perga dorsalis*. Leach).

Among a number of handsome sawflies more or less common in our native forests, the above species is the largest and most abundant in the caterpillar state upon several species of gum trees (*Eucalyptus*) growing in our coastal districts.

They feed upon the foliage, often eating off all the leaves of the young trees; and in planted forest areas with abundance of food supplies might very readily become a serious forest pest. Under natural conditions they are fortunately infested by a number of hymenopterous and dipterous parasites that keep them in bounds.

The wasp is a large thickset winged insect, of a general deep shining steel blue colour with yellow markings on the face, thorax, sides, legs and antennæ. The wings are short, rounded, and thickened with stout nervures of a deep yellow tint. The antennæ are clubbed, like all the members of the Genus.

The female, which has the larger, body, is furnished on the under surface of the abdomen with a fine saw-like ovipositor. With this she cuts the upper skin of the leaf, and pushes her eggs beneath the epidermis; the egg mass form a little blister.

The tiny black larvae hatch out, and crawling on to the edge of the leaf mass together. They feed in this close formation for some days; then they crawl up the main stem of the tree, and clustering together form an oval mass. They rest in this manner during the day; and at nightfall scatter over the branches to feed, returning at dawn to the same situation; they do this until the whole of the foliage is stripped off, or until they are full fed and ready to pupate. They are large elongated black caterpillars, with three pairs of stout legs well adapted for clinging to the twigs. The head is rounded and smooth: the thorax and abdomen wrinkled, and clothed with short scattered white hairs. When disturbed while resting, they exude a viscid yellow matter from the mouth, smelling strongly of eucalyptus; they



Life History of the Steel Blue Saw-fly (*Terga dorsalis*, Leach).

1. Young larvæ feeding.
2. First pupal state.
3. Adult larvæ resting in the day time.
4. Cocoon of pupa.
5. Second stage of pupa.
6. Final pupa stage.
7. Eggs inserted in leaf (natural size and enlarged).
8. Young larvæ feeding.

keep curving the body and rapping it down on the leaves; evidently this is a protective measure to save them from insectivorous birds or other enemies. When full grown they crawl to the ground and, massed together, wander over the surface until they find a suitable place to pupate. Usually this is at the butt of a tree; and they then burrow in the soil to a depth of several inches, and there form their black paper-maché-like cocoons piled in rows on the top of each other. Within these cocoons they undergo their somewhat complicated metamorphoses. This handsome insect (a true hymenopteron though popularly called a "sawfly") has been noticed by several of our earlier naturalists, originally described by Dr. Leach in 1815. It was again figured and described by Messrs. Bennett and Scott under the name of *Perga eucalypti*. Proceedings of the Zoological Society, London, p. 209, 1859. I also figured and gave some account of its life history in the Proceedings of the Linnean Society of New South Wales, 1890, and in the pages of the *Agricultural Gazette* of New South Wales, 1901.

The Ironbark Sawfly (*Pterygophorus analis*, Costa).

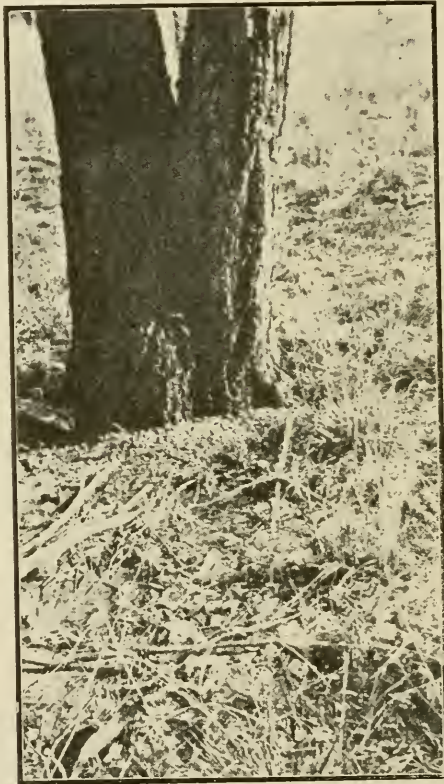
The members of the Genus *Pterygophorus* are much smaller sawflies than those belonging to the Genus *Perga*. Their wings are usually clouded, and they are either bright reddish yellow and black or iridescent blue and black



Trees stripped of foliage by Sawflies.

upon the head and thorax. The smaller male has delicate feather-like antennæ, the female has them composed of simple rounded segments. She deposits her eggs in the tissue of the leaf. The tiny slender tailed larvæ at first feed in a row along the edge of the leaf, but as they develop they scatter all over the foliage and feed during the day. When full grown most species cut their way into dead wood, forming small oval chambers in which they pupate; but *Pterygophorus analis* buries itself in the loose soil and makes a slight earthen cocoon.

Most species are comparatively rare and cannot be considered pests, but the Ironbark sawfly is an exception and completely defoliates the gum trees

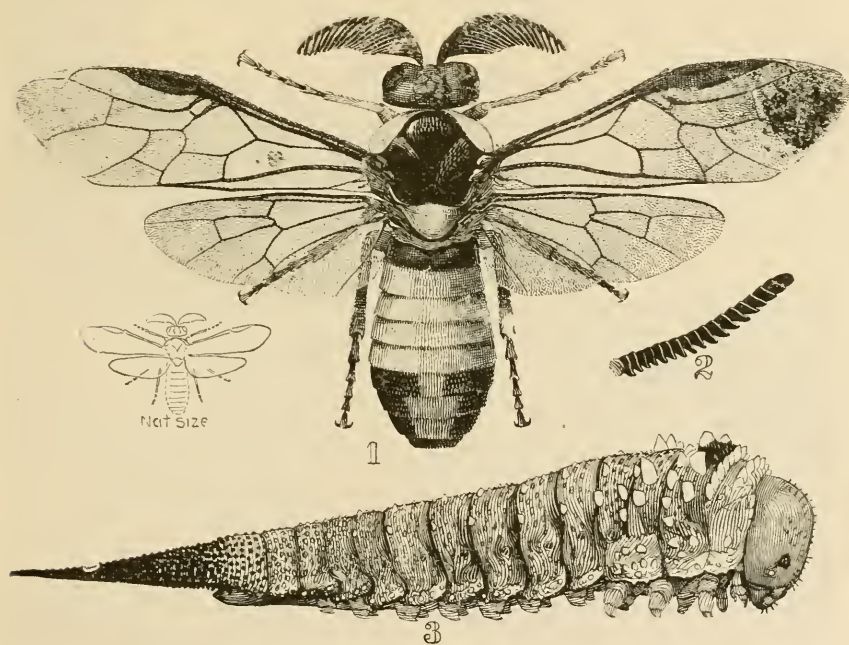


Sawfly larvæ at base of trunk.

over a large area of south-western Queensland. In the Roma and Mitchell districts these sawflies appear in great numbers about April. They confine their attention to this particular eucalypt and deposit their eggs in the tissue of the leaves. The larvæ hatch out in a few days, they feed all through the winter months and are full fed in August, by which time every leaf has been stripped off the infested trees. They then crawl down the tree trunks and mass together near the base, forming a squirming mass for some days before they pupate. The cattle grazing in these paddocks find these larvæ and eat

them, and numbers of cattle die from indulging in this abnormal food, the larvae causing acute internal irritation. The numbers of valuable cattle dying from this cause is so great that the landowners are considering the question of ringbarking all the ironbark gum trees in their paddocks so as to get rid of the pest.

Pterygophorus analis is half an-inch in length with a broad thorax and somewhat flattened body. The head, antennæ, thorax, and tip of the abdomen are a rich metallic blue colour, the rest of the abdomen and legs are yellow.



The Ironbark Sawfly (*Pterygophorus analis*).

The Ironbark Psylla (*Eucalyptolyma maideni*, Froggatt).*

This tiny lerp insect was described by me from specimens collected in the Botanic Gardens, Sydney, upon the foliage of an undetermined Eucalyptus, in the Proceedings of the Linnean Society of New South Wales, 1901 (p. 262). Lea afterwards sent me specimens from Tasmania.

Towards the end of 1912, the District Forester at Taree, New South Wales, reported that the ironbark trees along the North Coast were being seriously damaged. The leaves of the trees were covered with small white scales, and inside these were minute insects. It was stated that the insects were attacking the young trees as well as those fully developed; and

* See No. 17 coloured plate Lerp insects, p. 6.

beekeepers were said to be losers by the pest as the ironbark trees had become practically useless from the standpoint of honey production. It was also claimed that the action of this lerp insect in defoliating the trees caused the trees to become stunted; and where the pest had infested the foilage for several consecutive seasons the timber deteriorated and was useless for telegraph poles and other purposes. I visited these forests later in the year and found considerable areas where every leaf of the ironbark was smothered with these curious lace like lerp. But it was hard to definitely state what damage was actually caused to the timber by the action of the insects upon the foilage. These insects appeared for several years in succession, but for the last few years altered climatic conditions or parasites have kept them under control.

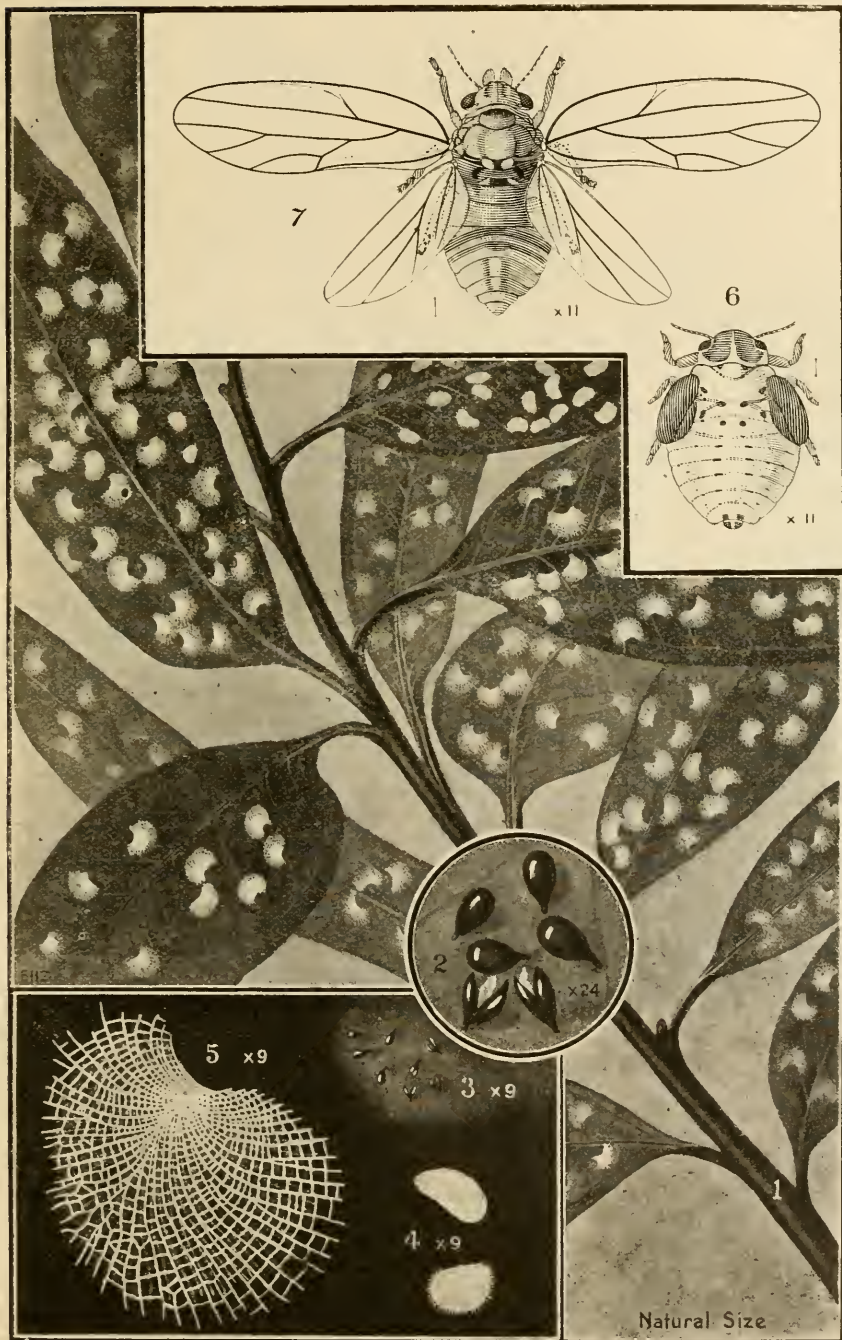
The tiny yellow larvæ live under the shelter of these angulated horn-like lerp. These structures are composed of brittle, white, sugary secretion, and are attached to the surface of the leaf from the tip to the broader base which is open, the summit is flattened and the margins serrate with filaments along both sides. It measures up to half an inch in length and one-tenth of an inch across the apex, but varies both in size and structure. The perfect psyllids are delicate bright green insects, variegated with yellow and light brown, they have clear transparent wings. They can fly and jump well when disturbed. They lay their eggs upon the surface of the leaves.

The Lace Lerp (*Cardiaspis vittiformis* n.sp.).

This beautiful lerp has a wide range over New South Wales. It is not uncommon upon several species of Eucalypts in the vicinity of Sydney. Some years ago it appeared in enormous numbers upon the foilage of the ironbark gums at Wingham, New South Wales, and was reported to be destroying the forest foilage over a large area in that district. Though still to be found in that district, it is not, as far as I know, doing much damage.

The snow-white fan-shaped lerp, depressed and convex at the base, spreads out flattened round the edges, to the surface of the leaf. It is composed of delicate white crystalline threads radiating from the base, where over the chamber containing the larvæ they are close together. The whole structure is crossed with similar threads forming a fine network of cells, and it resembles a bit of delicate lace. They are sometimes sparsely scattered over the surface of the leaf; at other times the whole surface of the leaf is covered and the leaf dries up from the action of the lerp and drops off. The foilage remaining on an infested tree is often so discoloured that it looks as if the tree has been singed by a bush fire. Width of a well formed lerp is one-third of an inch. The larva is bright red, is of the usual short thick-set form, is variegated on the upper surface, spotted and barred with black, with a creamy-white dorsal stripe running from the head between the wing covers to the tip of the body.

The perfect little lerp insect is of a uniform dull orange-yellow colour, with the upper surface marked and blotched with black. The face lobes are yellow, the ocelli deep red, the eyes dark brown, and the antennæ blackish brown. The delicate wings are transparent, with pale yellow nervures. Length, one-sixth of an inch from the front of the head to the tips of the folded wings.



White Lace Lerp (*Carliaspis rittafornis*, n.sp.).

- | | |
|---|--|
| 1. Showing infested leaves of Eucalyptus. | 5. Lerp scale (enlarged). |
| 2. Cluster of eggs. | 6. Full-grown lerp larva. |
| 3. Eggs (natural size). | 7. Adult <i>Carliaspis rittafornis</i> . |
| 4. Lerp scale (natural size). | |

CHAPTER VII.

INSECTS OF THE SUGAR GUM (*Eucalyptus cladocalyx*).

This South Australian gum tree has been extensively planted as a shade tree in the irrigation areas at Lecton and other parts of the Riverina. It is used in the avenues at Trangie Experiment Farm, and many station-owners are also planting it about their homesteads.

It seems to adapt itself to the new conditions, and grows a luxuriant mass of foliage that is very attractive to forest insects.

Among the scale insects that attack it is *Eriococcus coriaceus*, which has been previously described and noted as a blue-gum pest.

The White Ribbed Case Moth (*Thyridopteryx herrichii*, Westwood).

This case moth is one of the few that does not cover the outside of its cocoon with bits of sticks, leaves or other protective material so commonly used by most of the bag or case moth larvæ. It was originally described by Westwood in 1854 (Proceedings of the Zoological Society), from specimens sent from Adelaide, South Australia.

It has a wide range over Australia: and it confines its attention to the different species of eucalypts. Under normal conditions it is rather a rare insect in the native bush; but during the last few years large numbers of Sugar gums, *Eucalyptus cladocalyx*, have been planted out all over the irrigation areas in the Riverina, and also planted as ornamental shade trees in parks and gardens, and this case moth has been attracted to these trees.

At the avenue from the Experiment Farm at Trangie to the main road, I found a well grown sugar gum, about 10 feet in height, that had been so badly infested that every leaf had been stripped off, and the tree was dead. The adult case moth caterpillars had crawled down and fixed themselves upon the main stems, and these were thickly encrusted with hundreds of empty cocoons. On other trees in the same locality I found thousands of tiny larvæ hidden in the caps, gnawing the surface of the leaves early in February.

The white closely felted silken bag-like cocoons vary much in size. The cocoons of the females are twice the size of those containing the males. They have at the apex a rather long silken neck attached to the branchlet; when full fed, the oval six-sided cocoon swells out from the base of this neck, and tapers to the tip which terminates in a little tail. It measures $2\frac{1}{2}$ inches in length; and a central measurement gives a diameter of about $\frac{3}{4}$ of an inch. Like most Case moths, in spite of their stout covering, this species is very subject to attacks from dipterous and hymenopterous parasites. The larvæ is a stout thick set smooth caterpillar. It has three pairs of short reddish brown legs. The rounded head and thoracic segments are creamy white, mottled with dark chocolate brown; the head and the following segment are lightly spotted; the second and third thoracic segments are more deeply banded. The abdominal segments are all black.

The male moth is a very active little creature. As soon as he emerges through the bottom of the cocoon he dashes about, and soon damages his wings in a breeding cage. He measures an inch across the outspread wings.



White Ribbed Case Moth (*Thyridopteryx herrichii*, Westw.).

1. Male moth (*Thyridopteryx herrichii*),
2. Antennæ male moth.
3. Cocoon and pupa case of male
4. Cocoons of male and female moth (natural size); one with fema'e holding on to leaf stem.

He has a short broad thorax, and a rounded body tapering to the apex. The head is small, almost hidden by the surrounding dark brown fine downy hairs; and these hairs, interspersed with white above the eyes and the base of the antennæ, cover the whole of the thorax. The antennæ are short, broad, and deeply pectinate. The wings are transparent with a pale blue sheen; the nervures are light brown. The abdomen is black and shining, with black down along the sides and tip; and the anal appendages are yellow.

The female, which never emerges from the cocoon in which she undergoes her last moult, has no wings and only rudimentary legs and antennæ. She is covered with downy scales, and is simply a moribund bag of eggs in the last period of her existence. As the larvæ hatch out and drop through the opening at the bottom of the cocoon she withers to a dried skin.

The Buff Coloured Gum Moth (*Pinara despecta*, Walker).

This moth has a wide range over Australia. This curious slender caterpillar feeds upon the foliage of several species of eucalypts, usually preferring the young growth. I have collected them about Mosman Bay upon *Eucalyptus haemastoma*. Recently I took several specimens in February at the Trarigon Experiment Farm feeding upon the sugar gums (*E. cladocalyx*). The caterpillar is a very elongate creature of a uniform thickness from the head to the anal segment, with the upper surface rounded, flattened on the ventral surface; and when at rest it fits close against the branch. It measures about $2\frac{1}{2}$ inches in length. The head is dark and lobed, with a dark transverse line between the thorax and abdominal segments, and two finger-like spines in the centre of the back. The whole of the upper surface is densely clothed with buff-coloured spoon-shaped (spatulate) scales standing erect; on the sides they are long and stalked, and are mingled with longer buff and brown hair-like scales, forming a thick close fringe on both sides from the head to the tip of the abdomen. Two specimens, which were collected on the 2nd February, spun their cocoons the next day; and the perfect moths emerged on the 18th of the same month.

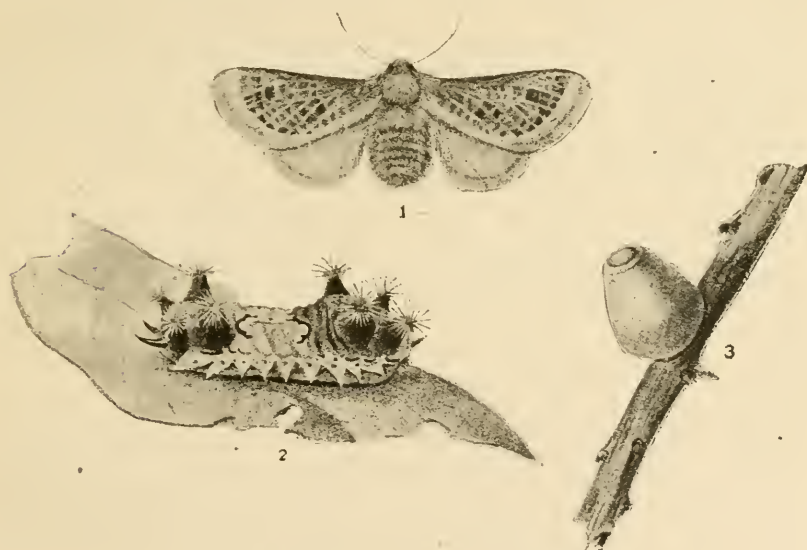
The stout white silken cocoon is oval, elongate, and irregularly round at the extremities. It is usually spun between two leaves, which are attached at the sides. It measures just under $2\frac{1}{4}$ inches in length, and about $\frac{1}{2}$ inch in diameter.

The male moth measures $2\frac{1}{4}$ inches across the outspread wings. The head is small, with the palpi forming a pointed snout between the round black eyes; the basal portions of the antennæ are fringed on both sides with filaments forming a bell-shaped feather; the apical portion is blackish, slender, and serrate on both sides, tapering to the tip. The whole of the head, thorax and body are densely clothed with pale biscuit brown or light buff downy hairs. The upper surface of the fore wings are of the same tint, but sometimes are diffused with reddish brown; the under surface is flushed with pink and light brown to the tips. The upper surface of the head and the wings are each reddish yellow, clothed with long hair-like scales. The under surface is pale buff like the body, with a narrow dark lunate mark in the centre of the front margin.

The female has the same general colouration but is larger, measuring $2\frac{1}{2}$ inches across the wings. The body is short and broader; and the antennæ are long, slender, and finely toothed along both sides. Both sexes, however, are variable in the size and colouration, although the colouration and the long downy hairs covering the hind wings are constant.

The Mottled Cup Moth (*Doratifera vulnerans*, Lewin).

The members of this group of moths have various popular names by which they may be identified. They have attracted considerable attention on account of the beauty of their caterpillars. They are known as "Slug Moth Caterpillars" from the way they crawl over the foliage by contracting and extending the under surface of their bodies, because they have no legs. They are called "Stinging Caterpillars" because their backs are ornamented with little rosettes or tufts of brightly coloured hollow spines; these they can erect or retract in sacks on the back at will. If these spines come in contact with the soft skin of the arm or body they produce a stinging sensation like the touch of a nettle leaf. Sometimes they are called "Saddle-backed Caterpillars," because each extremity of the dorsal surface is raised, and the central portion is hollowed down like a saddle. Again, we



The Mottled Cup Moth (*Doratifera vulnerans*).

1. Moth. 2. Caterpillar. 3. Cocoon.

call them "Cup Moths" on account of the curious cup-like cocoons many of them construct. This cocoon is made of a thin paper-maché-like material; its apex forms a cup-like lid which is easily pushed off by the escaping adult moth.

This moth is figured with its life history in Scott's "Australian Lepidoptera and Their Transformations." I described it in the *Agricultural Gazette* of New South Wales in 1897 under the name of the "Mottled Cup Moth," when noting it as a forest moth that had become an orchard or garden pest. The moth frequently comes into the orchard and lays her eggs upon the foliage of apricot trees. The moths are very prolific, and at times large areas of eucalyptus forest are so thickly infested with these caterpillars that every leaf is damaged before they crawl into the next tree in their line of march.

At Pitt Town, near Windsor, two years ago, they were in such numbers in the bush land that the residents became alarmed lest they treat their orchards in the same manner. French records (Handbook, Pt. V, 1909) that in Victoria the water in an open channel passing through some gum forest became so discoloured that the water reserve men had to investigate the matter, and, on examination, found that the discoloration was caused by the droppings of countless swarms of these slug caterpillars feeding upon the gum forest fringing the water channel.

The moths vary somewhat in size, the female being the largest. The male measures an inch across the wings, the female $1\frac{1}{4}$ inches and is much larger in proportion to the male. The sexes have the same coloration. The head, thorax and abdomen thickly clothed with fine buff-coloured hair-like scales. Fore wings beautifully mottled with reddish chocolate and silvery-white scales, the latter forming a fringe round the hind margin; hind wings light brown, fringed in a similar manner. The male has the antennæ thicker at the base and finely toothed; those of the female are simple and annular.

The oval greyish-brown cocoons are attached to the twigs of the food plant at the base, slightly contracted at the apex. This forms a distinct lid or cap which is detached and pushed off when the moth is ready to emerge. They are formed of a paper machie like material; without any definite structure, but thin and papery. They measure half an inch in height and slightly over a quarter an inch in diameter.

A large series of cocoons were collected at Trangie Experiment Farm on the 3rd February, many of which emerged in the middle of the month. Immature and adult caterpillars were found on the sugar gums at the same time, so some of the moths must have emerged about the middle of January.

The larvæ of *Doratifera vulnerans* is a typical "slug" caterpillar of a rich creamy-white colour with a light-blue tint. The dorsal surface is ornamented with black spots and an irregular bar, and is furnished with two pairs of light-red tubercles on each extremity, terminating in a bundle or rosette of pale yellow cactus-like spines which can be contracted and folded down, or erected and expanded, as the caterpillar moves over the leaf. The front and outer margins are fringed, with pairs of fleshy slightly roughened tubercles, the anal ones forming a pair of tails. When first hatched out they mass together and eat off the epidermis of the leaf; when more developed they scatter over the foliage and devour the whole leaf.

CHAPTER VIII.

INSECTS OF THE KURRAJONGS (*Brachychiton populneum*).

Strictly speaking the various species of the Genus *Brachychiton*, popularly known as Kurrajongs, and included in the great family *Sterculiaceae*, have no commercial value as timber trees. They are not studied by the forester from that standpoint, but they are well known as fine shade trees and are often used for street planting, and grown in our parks and avenues.

From the pastoralist's point of view, however, they are one of the most important groups of the Australian flora; and the time is not far distant when great areas of our western lands and Central Australia will be planted with millions of these valuable fodder trees as a standby in times of drought.

Brachychiton populneum is one of our most typical species, ranging over the greater part of the eastern half of Australia. The young trees, erect in stem, and crowned with delicate glossy green leaves, grow both upon the rugged ranges and through the open scrub on the plains. Under suitable soil conditions they often grow into large branching trees. The bark is fine and close, covering a stem composed of soft fibrous tissue which cuts very easily and rots very quickly. They are easily grown from seed, and quite large saplings can be easily transplanted if carefully handled. When full grown the trees will stand heavy lopping and put out a fresh growth of leaves again and again. Stock will not only feed upon this foliage but the cattle will chew up the twigs and branchlets, and do well on this leafage during drought conditions.

The insect fauna of the Kurrajong is very interesting, and in 1905 I published a paper in the Agricultural Gazette of New South Wales entitled the "Insects of the Kurrajong," most of which, with additional information, is now republished.

The Mimic Bark Weevil (*Axionicus insignis*, Pascoe).

This fine weevil was described and figured in the Journal of the Linnean Society of London, vol. X, 1869, p. 455, t. 18, f. 8, the localities given being Gayandah, Queensland, and Wagga, New South Wales. I have found this beetle at all seasons of the year upon the trunk of the kurrajong in all parts of this State, and its range is probably as wide as that of the tree. With its head turned down in front and the legs folded together under the body, it remains in the daytime half hidden in the cracks in the bark, the brown and grey back resembling the mottled slightly roughened surface of the trunk, so that in spite of its size it takes a trained eye to detect it even when numerous. It is one of the finest examples of protective colouration that I know of among our coleoptera.

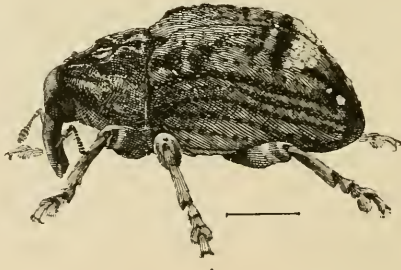


The beetle, variable in size, measures up to half an inch in length, the general ground colour black, but so thickly clothed with white and light brown scales that the surface is quite obliterated. The white scales scattered all over the body form two distinct irregular white blotches, one at the basal part of the thorax, and the second on the apical half of the wing covers. The thorax narrow in front, swelling out behind, very rugose, with a slight parallel ridge; wing covers, deeply impressed with parallel striæ coming into rugose points in the centre, but on the sides the punctures follow the striæ, but the whole of the rugosities are much down and hidden within the clothing of scales.

The eggs are laid in any damaged or dying branch. The larvæ are typical, stout, white, legless grubs with small reddish brown heads. They honeycomb the decayed wood with circular bores and pupate in the end of the chamber. The wood, after the emergence, is riddled with large holes through which the adult beetles have escaped. In Kurrajong country one can find specimens of this fine beetle all the year round, tucked away in the holes in the bark of the trunk. I have never seen one moving about either on the bark or on the foliage in the daytime; so, like many other of the weevil family, they are probably nocturnal in their habits.

The Seed Weevil (*Tepperia sterculiæ*, Lea).

This is another weevil which has a range probably as wide as that of its food plant, and is so destructive to the seeds of the kurrajong that it must have a great deal to do in limiting the spread and number of young plants. It was originally described by Lea in the Proceedings of the Linnean Society of New South Wales, 1903, p. 660, from specimens collected at Yass, New South Wales. I have bred numbers from the large fleshy galls or abnormal growths common on the twigs of the tree, and sometimes bigger than one's fist, but they chiefly develop in the seed-pods, the female boring into the side of the pod and depositing her eggs, often four or five larvæ being found



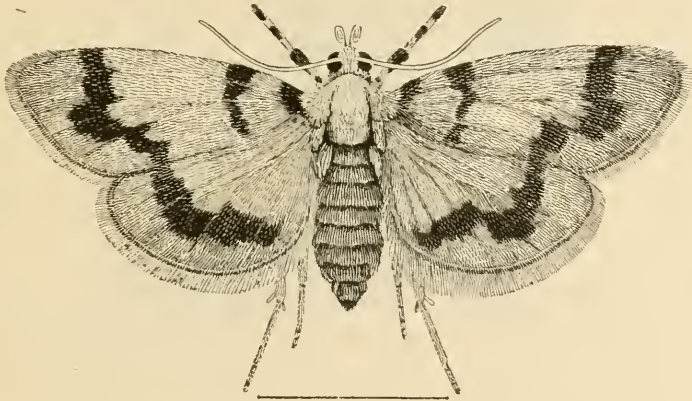
in each pod; they are of the usual short wrinkled form, about $2\frac{1}{2}$ lines in length, dull white, with reddish-brown head, and when full grown pupate in the empty shell of the seed, the pupæ developing into beetles early in June, but not emerging until the spring.

The beetle measures about one-third of an inch in length, and its ground colour is black, but so thickly clothed like the bark weevil with similar rounded grey and brown scales that the dorsal surface is of a general light brown colour with a well-defined grey patch in the centre of the elytron, while the undersurface, except the legs, are more grey than brown. The general form of the beetle is short and broad, the head turned down in front,

the thorax narrow and rounded in front and broad behind, the body broader behind than the thorax, rounded and turned down at the tip. The head, thorax, and undersurface finely punctured, the scales on the front of the thorax forming wavy ridges, and on the wing covers, which are deeply striated, regular little tufts that are densest on the back. In the summer this beetle is also to be collected on the tree trunk, with which its tints harmonise almost as much as in the former species; but it has a habit of crawling into every deep crevice in the bark, so that you have to dig it out of its hiding-place.

The Kurrajong Leaf Roller (*Notarcha clytalis*, Walker).

The larvæ of this moth are gregarious in their habits, feeding upon the foliage which they roll and mat together with silken strands forming an irregular cylindrical mass of closely rolled twigs, leaves, or silken strands 8 or 9 inches in length, feeding upon the enclosed foliage; among the remains of which they each draw the sides of a leaf together, forming an irregular chamber about $\frac{3}{4}$ of an inch in length in which they pupate. The pupa measured $\frac{1}{2}$ an inch in length, was of an uniform dark green tint, with the black spots of the larva still present, and most of them emerged three weeks after they have pupated, in February.



The larva measures slightly over an inch in length, slender in form, general colour dull green, darkest down the back, the head mottled with irregular parallel bars of light brown, the first thoracic segment thickly marked with black spots, each of the following ones with two pair of dark olive-green marks (the first pair largest) with a corresponding one on either side below; from each spot springs out a fine bristle-like hair, and finer ones fringing the tips of the abdomen. The head is small, deeply lobed, mouth parts projecting, legs slender, semi-transparent abdomen furnished with four pair of prolegs and stout anal claspers.

The moth measures 1 inch across the outspread wings, and is of a uniform bright yellow, with an irregular wavy line of black running round towards the outer edges of the wings, with two short transverse bands of the same colour on the front of the fore wing near the sides of the body; the outer margins of the wings fringed with fine scales.

The photograph was taken of specimens from Berowra on some cultivated Kurrajongs. They are frequently very destructive on the street trees; and at Moree every season the Kurrajongs in the streets had their foliage matted together, the damaged foliage finally dropping off before the fresh growth appeared.



Nest of Larvae of *Notanoha clytalis*.
Half natural size.

The Star Psylla (*Tyora sterculia*, Froggatt).

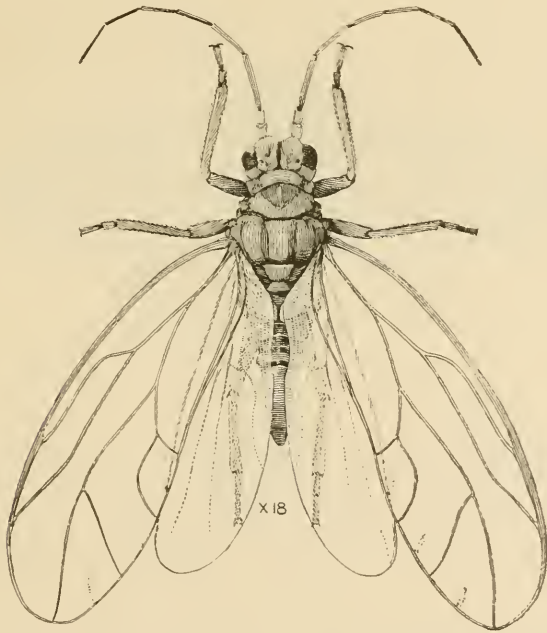
It was originally described by the writer in the Proceedings of the Linnean Society of New South Wales, 1901, p. 289, from specimens obtained at Forbes, New South Wales.

The horn-coloured eggs are laid upon the upper surface of the leaves in patches of from thirty to forty in number; the tiny larvæ, when they first emerge, are semi-transparent, with red markings on the eyes, centre of the thorax and abdomen, with the tip of the latter clothed with the tuft of white filaments. As they reach the pupal form they change to a deep green in the centre with the margins of a lighter green, with a fine red dorsal stripe from the front of the head to the tip of the abdomen. The thorax is broader than the head, with the wing pads short, and the legs stout; the abdomen flattened, swelling out at the base, broadest in the centre, but slightly arcuate on the sides near the tip, from which a number of thick, woolly filaments, from two to five in number, trail out on the sides and

extremity, fully $\frac{1}{4}$ of an inch in length. When a cluster of these larvæ are on the leaf, the white filaments spread out on all sides, giving them a star-like appearance, and each family makes a large white blotch on the infested leaf.

The perfect insect might be easily taken for an ordinary green aphid from its delicate structure, long slender antennæ, and transparent fragile wings. Its general colour is pale green, with red eyes, yellow ocelli, and the segments of the body marked with black. They cluster together on the leaves at first like the larvæ, but afterwards scatter about like all the members of the family, jump a considerable distance when touched.

This psylla has a very wide range, from Queensland to the south of this State, and sometimes the foliage of the young trees grown in the gardens and parks are covered with larvæ.

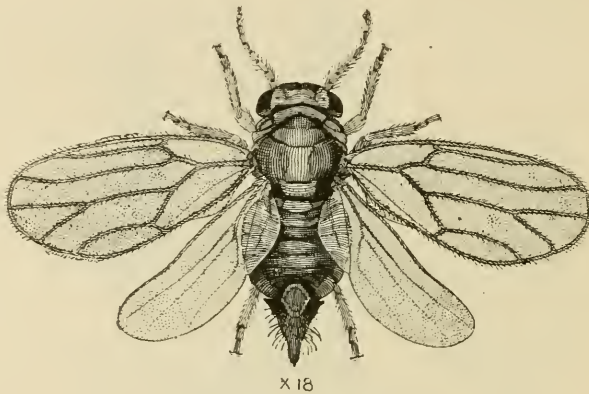


The Twig Psylla (*Psylla sterculiæ*, Froggatt).

Towards the end of April the tips of the kurrajong twigs are thickly encrusted with bright yellow eggs. The egg is semi-transparent, with two pink eye spots showing through the shell just before the larva emerges. When exposed to the light and heat the yellow larvæ soon puts on a mottled brown tint, and cluster all over the twigs; they suck up the sap with their pointed tubular beaks. Like many of the other larval forms of hemiptera they exude a large amount of honey dew, but this species do not produce any lerp scales such as other of the psyllids form on the foliage of their host plants. Their presence on the twigs is always very noticeable because of the swarms of mound ants running over the infested twigs and sipping up the honey dew that these little creatures discharge from the tips of their abdomens.

The larva has the head and thorax dull yellow, marked with light brown, and the abdomen is also mottled on the upper surface with a reddish tint. It undergoes a series of moults, changing to a darker tint each moult, the antennæ increasing in length and the wing pads more developed; the dorsal surface becoming clothed with fine hairs.

The perfect psylla is a tiny little creature only $\frac{1}{12}$ of an inch in length, of a general ochreous tint, shaded with reddish-brown, marked with black and chestnut brown, with short rounded light-brown semi-opaque wings. They, like the larvæ, cluster along the twigs with the wings sticking out, sometimes almost covering the surface of the twigs like aphids, so that eggs, larvæ—in all stages of development—and the perfect insect will be found upon the same twig.



When I described this species, I considered it rare, as I had only found it on a single kurra'ong near Wagga, but since then specimens have been obtained from half-a-dozen widely-separated localities, and specimens were sent to me from a garden where they were said to have been damaging the young shoots, by their immense numbers; the trees had been sprayed to destroy them.

They probably have many predaceous enemies, for it is only on the twigs of cultivated trees in gardens that we find them causing the branchlets to die back from the tips.

FLESHY LUMP GALLS.

Towards the end of the year the branchlets of the Kurrajong trees are often covered with irregularly rounded fleshy galls or masses of soft tissue. They vary in size from a marble to a man's closed fist; and cut like a yam or potato. They are reddish brown in colour, pitted, rough and corrugated; and are usually found upon the tips of the twigs. I was originally under the impression that they were in the first instance rust galls allied to those upon the wattles but enlarged by the action of phytophagous insects, but my botanical friends could not find any trace of rust or fungus origin in samples collected and forwarded to them in all stages of development.

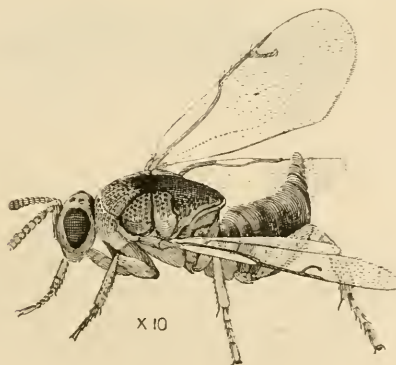
During a visit to Dubbo last November (1921) when examining some Kurrajong trees growing in the Park, I found a number of leaves with the leaf stalk formed into a button-like fleshy gall. Each gall contained a Chalcid wasp larva in the centre. The perfect wasp was bred out later. It proved to be identical with the "Thickset chalcid" bred out previously from the large lump galls. It is therefore probable that this is the insect responsible for the growth of all these galls.

A number of curious insects have been bred from these galls. They are briefly noted below. Some of them are true plant eaters, the larvæ feeding upon the gall tissue; others are parasites upon the gall-making larvæ.

The Thickset Chalcid (*Decatomoherax gallicola*, Ashmead).

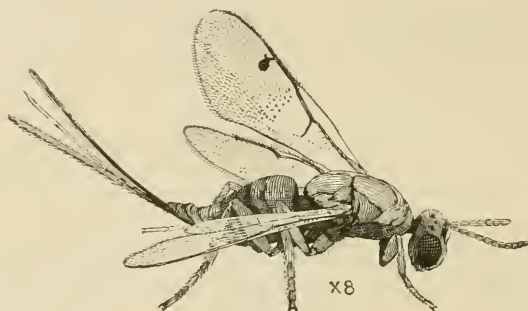
This thickset dull chalcid can always be bred out in numbers from these lump galls. The semi-transparent maggots, rounded and tapering to both extremities, form an oval cell in the soft tissue.

Head and antennæ brownish yellow, darkest on the summit; with bright red ocelli, black eyes, the elbowed cylindrical antennæ consisting of nine segments. Upper surface of the broad thorax finely pitted and marked with brown in centre. Abdomen elongate, oval, coming to a point at the tip and transversely banded with brown. Length $2\frac{1}{4}$ lines.



The Long-tailed Chalcid (*Megastigmus brachychitoni*, Froggatt).

This handsome chalcid wasp was figured and described in the paper previously noted; and is also found feeding upon the plant tissue in the larval form like the previous species. Both sexes are of a general dark dull yellow tint marked with a reddish brown. The abdomen barred with pale yellow, and the ovipositor of the larger female black. The female measures 4 lines in length including the long extended ovipositor. The smaller male has a similar form and colouration, but the abdomen is cylindrical, rounded at the extremity and dark coloured. There are probably several undescribed species of this genus among the chalcids bred out from these galls.



The Green Striped Chalcid (*Coelocyba viridilineata*, Froggatt).

This brilliantly coloured little wasp is closely allied to the species that Ashmead described, under the name of *Coelocyba nigrocincta*, from soft fleshy galls upon the foliage of the Bloodwood (*Eucalyptus corymbosa*). It is of a uniform bright canary yellow colour, with the darker markings bright metallic green. Large numbers of these microscopic wasps were bred from these galls in company with the previous species, upon some of which, if they are not inqualines they are probably parasitic.



GALLS IN KURRAJONG FLOWERS.

In December, 1904, Mr. C. T. Musson found the flowers of the Kurrajongs, growing at Richmond, New South Wales, with button-like galls. He sent me down a fine series and from these I bred two different species of minute chalcid wasps. These were sent for determination to Cameron, who described them in a paper published in the Proceedings of the Linnean Society of New South Wales in 1911.

Xantheurytoma flava, Cameron, Vol. 36, 1911, p. 651.

Megastigmus subcicollis, Cameron, Vol. 36, 1911, p. 644.

CHAPTER IX.

INSECTS OF THE BUMBLE TREE OR WILD POMEGRANATE

(*Capparis mitchelli*).

All through the western portion of New South Wales and in similar country in Victoria, South Australia, Queensland, and North Australia, this hardy, prickly, shrubby tree thrives. It was originally described by Lindley from specimens collected by Major Mitchell, when crossing from the Darling to the Bogan River, 17th August, 1833.

He writes: "To-day I fell in with a tree; it bore a yellow flower and a fruit resembling a small pomegranate on a hooked stalk. I had unfortunately omitted to gather specimens of it when seen by me in flower in 1831, and now I could not procure any of the seeds, every rind being hollow, and the interior destroyed apparently by insects."

Sixteen native species of the genus *Capparis* are recorded from Australia; four of these are found in New South Wales, of which this very thorny one is the most common.

Besides the interesting insects which do more or less damage to the very hard wood and small oval leaves of this tree, large numbers of insects, chiefly flies and wasps, are attracted to the large honey-bearing flowers. Among the most striking is the native bee *Anthophora preissi* var. *froggatti* identified and named by Cockerill from specimens collected near Brewarrina, New South Wales. This bee has the uncommon habit of coming to the blooms only at twilight. As the large mound ants (*Leptomyrmex detectus*) swarm over these flowers during the day time, it is evident that these bees have taken on this crepuscular habit to avoid the ants.

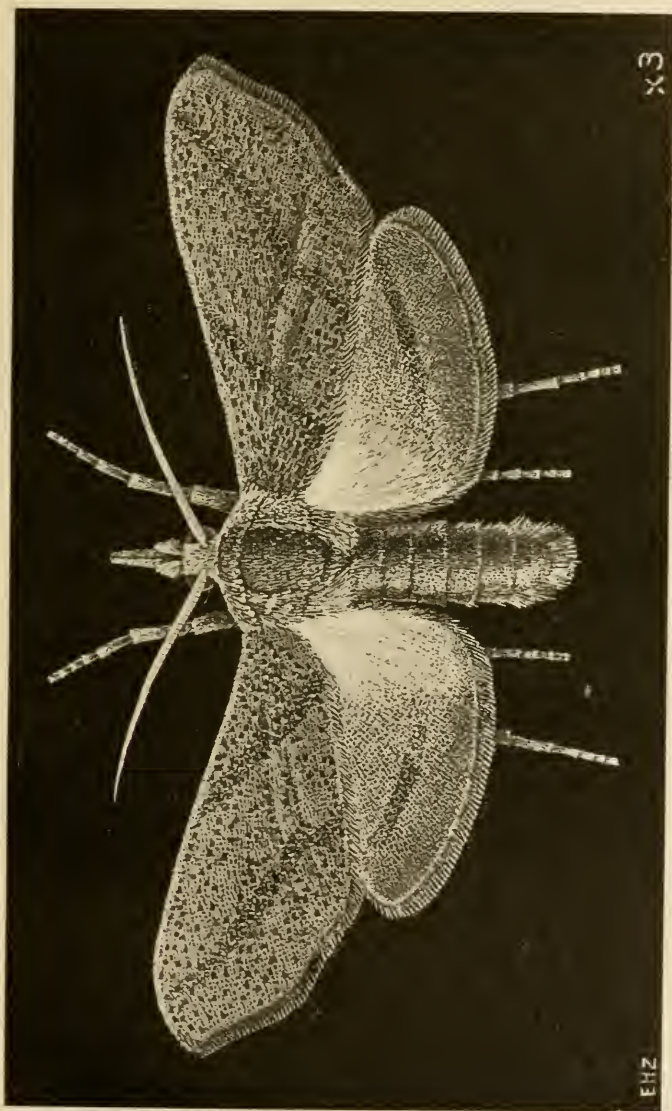
The Bumble Tree Moth (*Styplelepis agenor*, Turner).

This remarkable moth was described by Dr. Jefferies Turner (Pro. Royal Society, Queensland, p. 31, 1915) from specimens bred and sent to him by the writer. While carrying out Sheep Maggot Fly investigations in 1914 in the Brewarrina district, a number of dead trees were noticed in the scrub on the edge of the sandhills. These, on examination, proved to be Wild Pomegranate or Bumble trees (*Capparis mitchelli*). The main stems, up to 8 inches in diameter, were thickly riddled with irregularly rounded bores, covered with frass and sawdust at each opening. On cutting a stem it was found that the whole of it was honey-combed by countless bores running to the centre, and all parallel to each other. Since then the writer has received several infested stems from Mr. Woodburn, of Gunnedah, and from these a fine series of moths emerged in the early part of November. On examination, the wood was found to contain at this date many pupæ about ready to emerge, and also a number of active caterpillars; so that there are apparently two broods.

The eggs are evidently laid upon the surface of the rough bark. The adult caterpillar is a dull brownish yellow grub, with a smaller dark head, and rounded eyes; a body of uniform thickness, rounded, and about three-quarters of an inch in length; it is furnished with three pairs of small legs and stout anal claspers, the apex irregularly rounded. The life cycle is about a year. The pupæ are of a uniform shining yellowish brown tint, with the



Section of Trunk of Bumble Tree (*Capparis mitchelli*)
Attack by gregarious larvæ.



Bumble Tree Moth (*Styphlepis aeneor*).

cephalic portion and infolded wings darker brown: general form slender, cylindrical, just under an inch in length, with the apical segments well defined, and a peg-like process at the anal extremity.

The moth measures just over two inches across the outspread wings. The dorsal surface of the head, thorax, and fore wings is greyish brown, the latter slightly marked with fine darker wavy lines. Under a lens the wing surface shows a number of black spade-shaped scales scattered over the very fine silver-grey scales. The inner margin of the hind wings fringed with fine downy white hairs; the inner portion clothed with bright deep yellow hairs, or downy scales, the outer edge greyish brown. The antennæ, long, slender, yellow, with silvery pubescence. The abdomen clothed with greyish-brown scales on the dorsal surface, and silvery white on the sides. The under surface of the body and wings pearly white.

The range of this moth is probably the same as that of its food plant all over the inland and central scrubs of Australia.

The Common White Butterfly. (*Belenois java*, Sparrman).

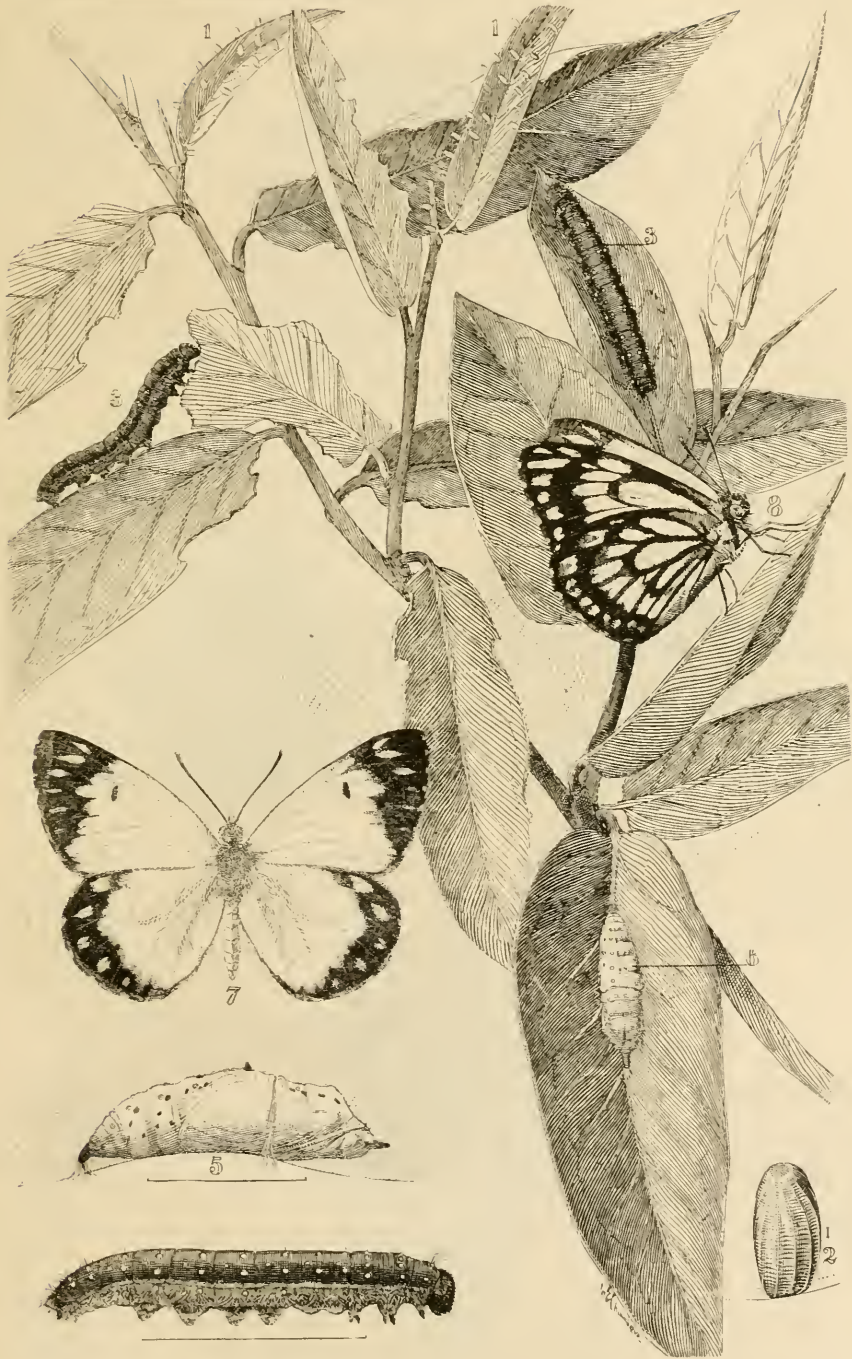
This typical member of the Family *Pieridæ* is found all over Australia where its food plants thrive. Its tastes are not limited to the members of the Genus *Capparis*; and in Western New South Wales it feeds and pupates upon the Warrior Bush *Apophyllum anomulum*.

It was known until recent years under the name of *Pieris tentonia* under which name Fabricius described it in 1775; but it has now been determined as the same species as that previously described from Timor by Sparrman. But a further change has now taken place, and our common butterfly is now placed in Hubner's Genus *Anaphalis*.

As far as I can learn, nothing had been written about its life history until 1890, when Henry Edwards gave a very complete account of its life history and food plant in the pages of the Victorian Naturalist. In November, 1921, every bush in the Trangie district was covered with the slender smooth olive green caterpillars, or the delicate white pupæ attached to the slender twigs. Thousands of the mottled white butterflies were flitting about or resting upon the foliage and depositing their yellow eggs upon the food plant. Sometimes in the early morning, so many pupæ have hatched out during the night that many bushes at this time of the year are literally draped with white.

This is the species that at irregular intervals gather together on their breeding grounds, and, massing together in countless millions, fly eastward to the coast and even reach the Sydney gardens.

The butterfly measures up to 2½ inches across the outspread wings. The male is larger than the female. The general colour of the upper surface is white, with the outer portions of the wings clouded with black; the density and amount of black being very variable. Sometimes more than half the wings are black, in others only the outer margins. The under surface is black, but thickly mottled with lunate spots and patches of creamy white diffused with yellow. The undersurface is also very variable in the marking and colouration. The life history of this butterfly will be found in the pages of the *Agricultural Gazette* of New South Wales, vol. x., 1899, p. 74, in a paper written by me entitled "The Common White Butterfly," where the previous papers written are recorded, illustrated with the plate now reproduced.



The Common White Butterfly (*Belenois jara*).

1. Eggs (natural size) on leaves.
2. Egg magnified.
3. Caterpillar on leaf (enlarged).

- 5-6. Pupa and pupa on leaf.
7. Dorsal view of butterfly.
8. Wings folded showing undersurface.

The Painted Capparis Bug (*Stenozygum personatum*, Walker).

This pretty little shield bug has a wide range over the eastern portion of Australia. Walker described it from Australia in his British Museum Catalogue, Hemiptera, in 1867. Distant described it from Queensland in 1881. It is common in the scrubs on the Tweed River, and ranges out west to Moree and Nyngan in New South Wales.

Towards the end of January the writer found them in all stages of development among the foliage of the "Wild Pomegranate" or "Bumble Tree" (*Capparis Mitchellii*), growing on the banks of a creek near Moree. A little later, specimens were received from Mr. A. Lucas (Stock Inspector in the Nyngan District), that had been taken upon an orange tree where they had been doing considerable damage.

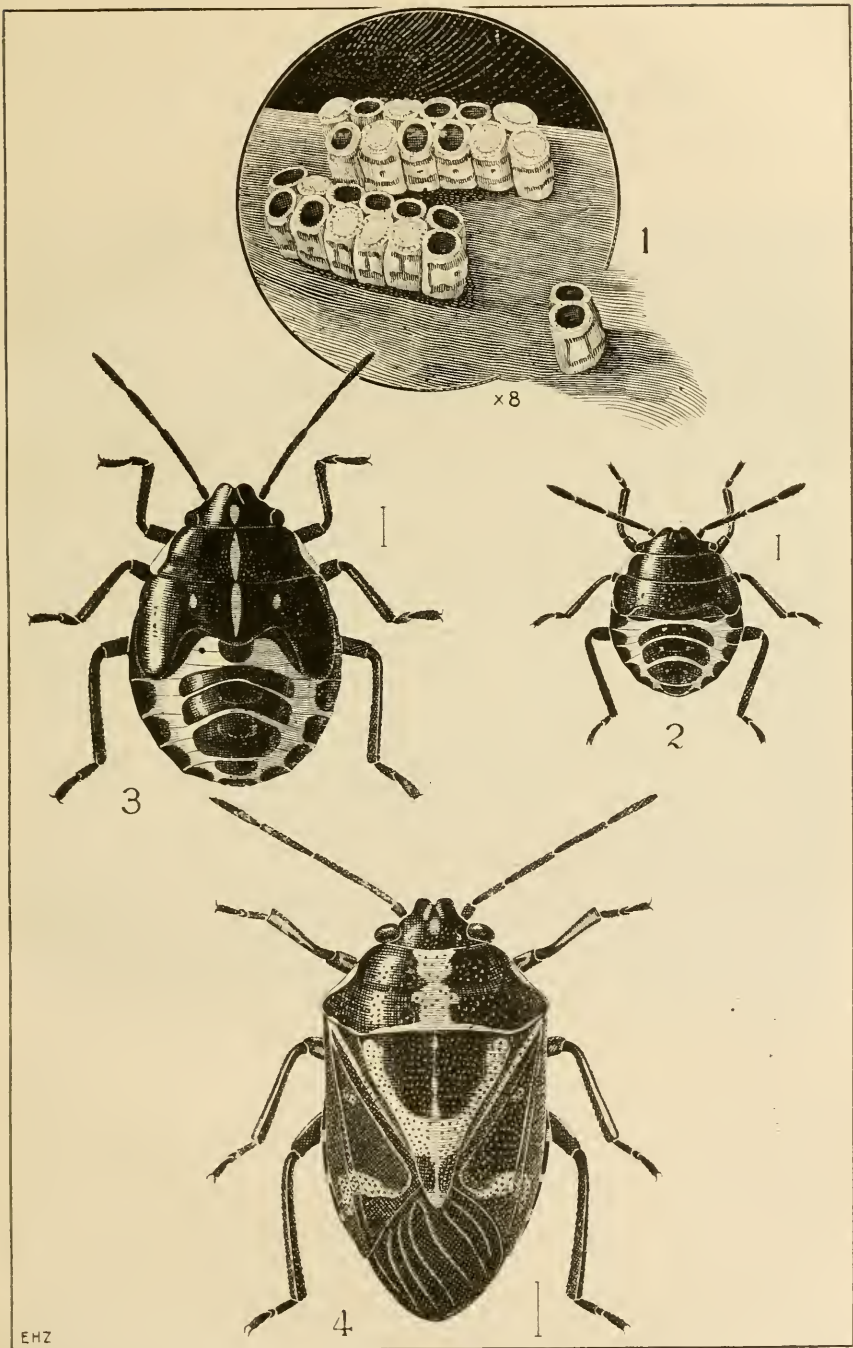
The perfect insect measures slightly over $\frac{1}{4}$ of an inch in length, but is longer than broad, with the prothorax angular in front, sloping down to the head, the sides of the wing covers straight to the centre of the scutellum, and then forming a rounded tip. The surface is dark bronzy brown, richly mottled with yellow and pink markings. These form an elongate stripe down the centre of the head, with a transverse patch below the eyes, and finer lines on the sides in front of the head. The outer margin of the thorax is touched with yellow, with a broader transverse band through the centre shaded with pink; the scutellum is mottled with yellow and pink, but these markings are variable. The elytra are barred with five parallel lines of yellow blotched with pink, with smoky brown hind wings. The under-surface is yellow, spotted along the sides, and the legs are variegated yellow and brown. The eggs are deposited upon the foliage in little clusters; they are greyish brown, circular boxes, covered with a slightly concave close-fitting lid, like a saucer, and can be better understood by reference to the plate than described.

In their development from the eggs the little bugs vary considerably in colour after each moult, as is in a measure indicated in the accompanying plate illustrating their life history. They are very active little creatures, running about among the foliage and dropping to the ground when disturbed.

The Black Lecanium (*Lecanium Cappari*, Froggatt).

This destructive lecanid scale was described in Part 11 of my Catalogue of the Scale Insects (Coccidæ) of Australia, Science Bulletin 18, Department of Agriculture, 1921 (page 29). The original specimens were found upon the Bumble tree at Warren, New South Wales, but it has as wide a range probably as its food plant. In November, 1921, at Nyngan, several large trees were found so thickly infested with this scale that the leaves were falling off in large quantities.

When immature the scales are soft and of a dull green tint; but as they mature they become more convex, then reddish brown, and finally are almost uniform black. The adult female scale measures one-sixth of an inch in length and is very convex, oval in form, with the outer margins finely corrugated.



E.H.Z.

Life History of "Painted Capparid Bug" (*Stenozygum personatum*).

1. Eggs upon leaf of *Capparis Mitchellii*. 2. First stage of bug. 3. Half-grown bug. 4. Perfect bug.

CHAPTER X.

INSECTS OF THE WILD LIME (*Atlantia glauca*).

This article is taken from the pages of the *Agricultural Gazette*, of New South Wales, April, 1919.

Among the many interesting trees peculiar to our western scrubs—a flora where the struggle for existence is so keen—is that sturdy shrub known to the bushmen as the “Native Lime,” and to the botanist as *Atlantia glauca*. It is interesting to the economic botanist from the fact that it is one of the very few indigenous plants related to the citrus family; and from the United States, where the field investigators of their Department of Agriculture are always on the lookout for useful plants, the writer has had several requests for seeds. The seeds were wanted for cultivation to see if the stock of our wild lime would be suitable as stock on which to graft the more delicate cultivated oranges and lemons. These shrubs generally grow in small clumps of about a dozen, and range from 1 to 8 feet in height, their dark green tint showing up on the edge of the scrub intersecting the level plains of north-western New South Wales.

In the early stages of their growth the wild limes are almost leafless; the erect shrubby stems and branchlets covered with long slender needle-like spines render them very awkward plants to handle, and protect them in a wonderful way from plant-eating animals. The old trees, growing up on a single stem as all the surrounding branchlets die back, often reach a height of 15 feet, the spines are then so reduced in size as to be hardly noticeable, and are replaced by a luxuriant growth of small dark green leaves.

Early in December the twigs are covered with small rounded soft green-skinned fruits, enclosing a grape-stone-like seed, embedded in the fruit pulp, but a large number of them are seedless. When full grown these fruits turn to a golden yellow. These fruits have a distinctly acid lime flavour, and crushed in water, to which sugar has been added, make a refreshing drink.

The Native Lime-tree Borer (*Citriphaga mista*, Lea).

The wild lime grows plentifully in the Moree district; and while collecting insects the writer discovered that a large number of the half-grown trees were badly damaged by borers. During the last summer a number of infested branches were cut out containing the active larvæ, which were kept under observation while the life history of the beetle was investigated, and from them a fine series of the perfect beetles was bred out in the Insectarium.

The eggs are deposited in the bark a few inches above the ground; the feeding stage of the active larva can be estimated as about ten months, and the pupal state as lasting from a month to six weeks. The larva works up the centre of the stem, forming a large open bore often straight ahead for 4 or 5 feet; but where, as is sometimes the case, there are several larvæ at work, they form parallel burrows and riddle the whole stem. The action of the larvæ causes a considerable gumming of the damaged wood: often large clear lumps of gum are found on the side of the stem, and even running in a liquid state down the excavated bore in the centre of the branch.

In 1892, when a number of orange orchards were planted out in the Tweed River district, a borer appeared in the trees, and a number were seriously damaged. The trouble was carefully investigated by the late Mr. A. Sidney Olliff, who bred a large longicorn from the infested stems; this was described and figured in this *Gazette* (vol. III, 1902) under the name of *Uracanthus*

cryptophaga. Further investigation proved that this beetle had emigrated from the native finger lemon (*Citrus australasica*), its natural food plant, growing in the brush near the orange trees. It is therefore not at all unlikely that the species figured in this article may develop a similar propensity, and appear some day in the citrus trees in the squatters' gardens in the north-west.



Fig. 1.—Branch of Native Lime, showing first stage of growth before the leaves appear.

General Description.

The larva measures up to $1\frac{1}{4}$ inches in length and is of the usual elongated form of a longicorn beetle. It is of a uniform dull yellow tint, with head dark chocolate brown: the prothoracic segment large, dull white, blotched on the lower margin and sides with dull red, flattened and lobed behind; the second and third thoracic segments are very narrow and constricted; and each of the three segments is furnished with a pair of small but well developed legs, terminating in a fine point. The first seven abdominal segments are of a uniform size, with deep corrugations between; both dorsal and ventral surfaces of each segment bear a pair of large rounded tubercles occupying the whole surface of back and underside, each rounded and corrugated on the apex; the last two abdominal segments are small, irregularly rounded, and telescopic.

The pupa is of a general reddish-yellow tint, with nothing very characteristic about it that requires description to supplement the drawing of the life history of the beetle.

The beetle is very variable in size—the largest of those bred out is $1\frac{1}{4}$ inches in length, and it is broad in proportion; the smallest measures only $\frac{3}{4}$ of an inch. The true ground colour is dark shining brown, but the whole surface is so thickly clothed with buff-coloured pubescence and fine white hairs that it has a general greyish-brown tint. The pubescence on the antennae is very fine, and almost golden on the terminal joints. The under-surface of the whole body is also covered with grey hairs, with still finer ones on the legs. The antennae are long, composed of eleven joints; the third to the tenth narrow at the base, flattened and widened to the apex, furnished with a long spine on the inner extremity, and a smaller one and a few stiff hairs on



Fig 2.—Branch of Native Lime, showing the foliage at the second stage of growth.

the outer edge. The terminal joints taper off with reduced spines, to the elongate slender last joint. The thorax is rather short, roughly rounded, with a blunt spine on the sides. The wing covers show a regular pattern of snow-white patches of fine hairs, of which six (the two upper ones largest) stand out distinctly on the lower half; the extremities of the wing covers are arcuate with a fine spine on either side.

This beautiful longicorn beetle was not represented in any of our collections, so the writer forwarded it to Mr. A. M. Lea, of the Adelaide Museum, for identification. He reports that it is a new and undescribed species that will not fit into any established genus, and has therefore formed the above genus (*Citriphaga*) for its reception, and has sent his technical description of the new species—here appended—for inclusion in this paper.

CITRIPHAGA, n.g.

Head of moderate size. Eyes large, coarsely faceted, emargination fairly deep, upper lobe small. Mandibles short. Palpi small. Antennæ about the length of body, third to tenth joints each produced at inner apex, third to eighth each with a small spine at outer apex, eleventh about one and one-half the length of tenth. *Prothorax* not much wider than long, sides rounded and each with a small conical tubercle in middle. *Elytra* long, parallel-sided, each with two small acute spines at apex. *Legs* long and thin, front coxal cavities open posteriorly.

A curious genus in some respects, near *Opsidota*, but with each elytron bispinose and prothorax armed at the sides; in catalogues it should be placed near *Aphanasium* and *Didymocantha*, which have armed prothorax but unarmed antennæ and elytra. The tarsi are apparently four-jointed, but the true fourth joint may be seen as a very small basal attachment to the claw-joint.

Citriphaga mixta, n.sp.

Black, some parts of derm of an obscure dark brown. Rather densely clothed with short, depressed, yellowish pubescence, mixed with a few white hairs: elytra with irregularly distributed white spots.

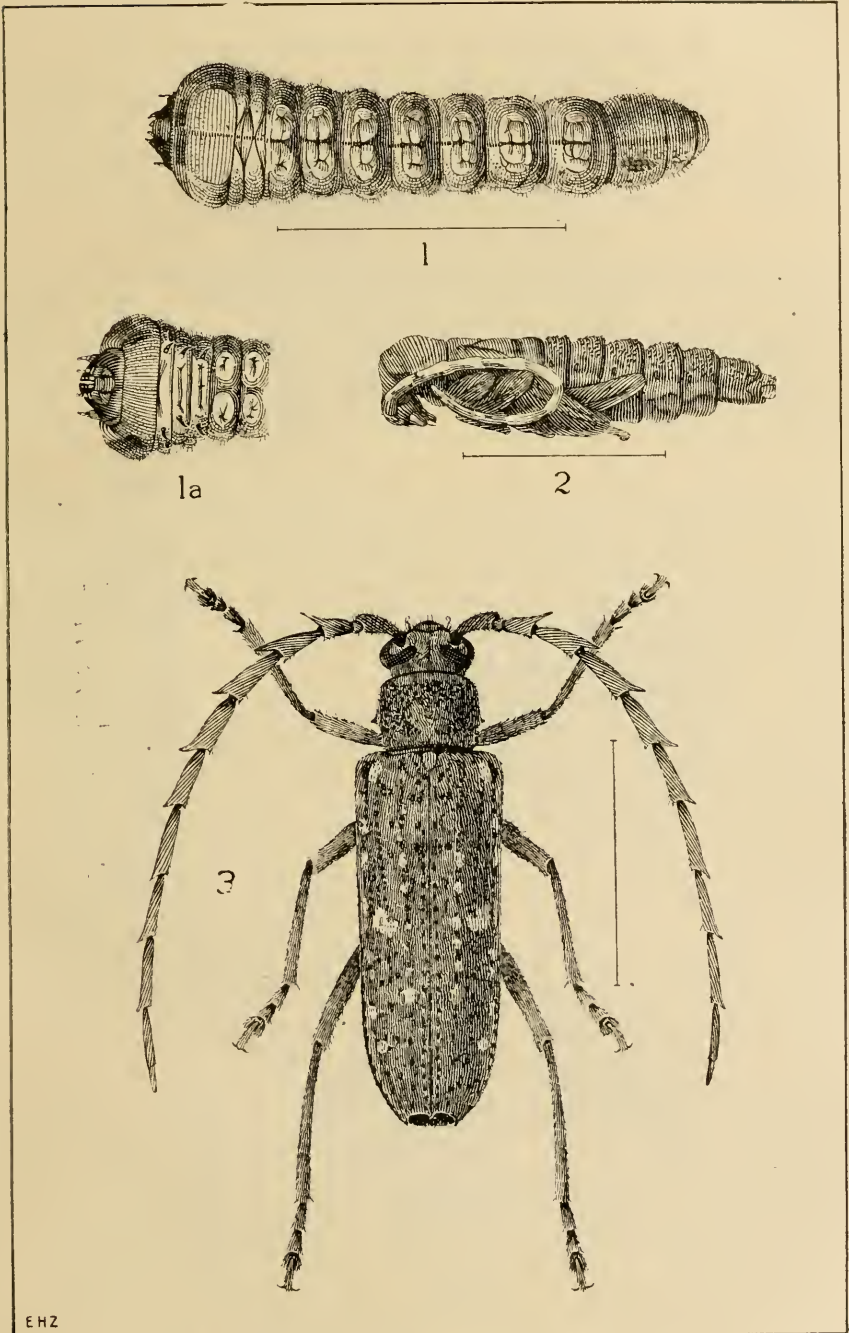
♂ *Head* with small, dense, partially concealed punctures: a strong ridge between eyes divided along middle; clypeal suture deep. Mandibles smooth about apex, but granulate elsewhere. Antennæ long, first joint stout and with dense punctures, second very short, third acutely produced at inner apex and with an acute outer spine, fourth to eighth gradually increasing in length, with the produced part at inner apex and the outer spine of each joint gradually becoming smaller, ninth and tenth feebly produced at inner apex and non-spinose, eleventh longer and thinner than tenth. *Prothorax* across median spines slightly wider than head across eyes, narrowly impressed across base and apex; with crowded, more or less concealed punctures and granules. *Scutellum* semicircular; with small concealed punctures. *Elytra* about thrice the length of head and prothorax combined, slightly wider than prothorax across spines, and much wider than base; each with two acute spines at apex, of which one is sutural; with crowded minute punctures about base, with numerous fairly large round ones, becoming smaller and sparser posteriorly. *Abdomen* rather wide and flat, first segment considerably longer than second, the others gradually decreasing in length. *Legs* long and thin, the hind ones conspicuously longer than the others; hind femora just passing fourth segment of abdomen. Length, 21 mm.

Hab.—New South Wales: Moree, reared from wild lime (W. W. Froggatt). Type (unique), I. 10,664, in South Australian Museum.

The white spots of clothing on the elytra are mostly small and sublateral, but there is a fairly large one extending about half-way across each elytron about the middle; there is an appearance as of numerous small dark spots on the elytra and legs, due principally to the absence of pubescence from the larger punctures, but on the abdomen a similar appearance is due to small glabrous spaces; on the under-surface and legs the pubescence is rather longer and (except on the prosternum) paler than on the upper surface; on the antennæ the pubescence is very short and sericeous, but each joint (except the apical one) has a few apical hairs or setæ; each femur has a streak of yellow glandular pubescence along the under-surface, as in the males of *Uracanthus*, *Didymocantha*, *Aphanasium*, and allied genera. On the type there is a feeble notch and oblique suture on the eleventh joint of antennæ at about one-third from the apex, as if a twelfth joint was indicated, but this may be an individual variation as in many species of *Uracanthus*. Its first abdominal segment has a narrow impression across the apical third, but it curves round so that on each side it ends on the apical margin; as a result there appears, on a first glance, to be six segments, of which the second is much shorter than the first or third.



Fig 3.—Stem of Native Lime, showing the damage caused by Longicorn beetle.



EHZ

Fig. 4.—Life history of the Native Lime-tree Borer (*Citriphaga mixta*).

1. Larva—dorsal view. 1a. Ventral view of head and thorax, showing the legs. 2. Pupa.
 3. Perfect beetle.

The Green Spined Orange Bug (*Biprorulus bibax*).

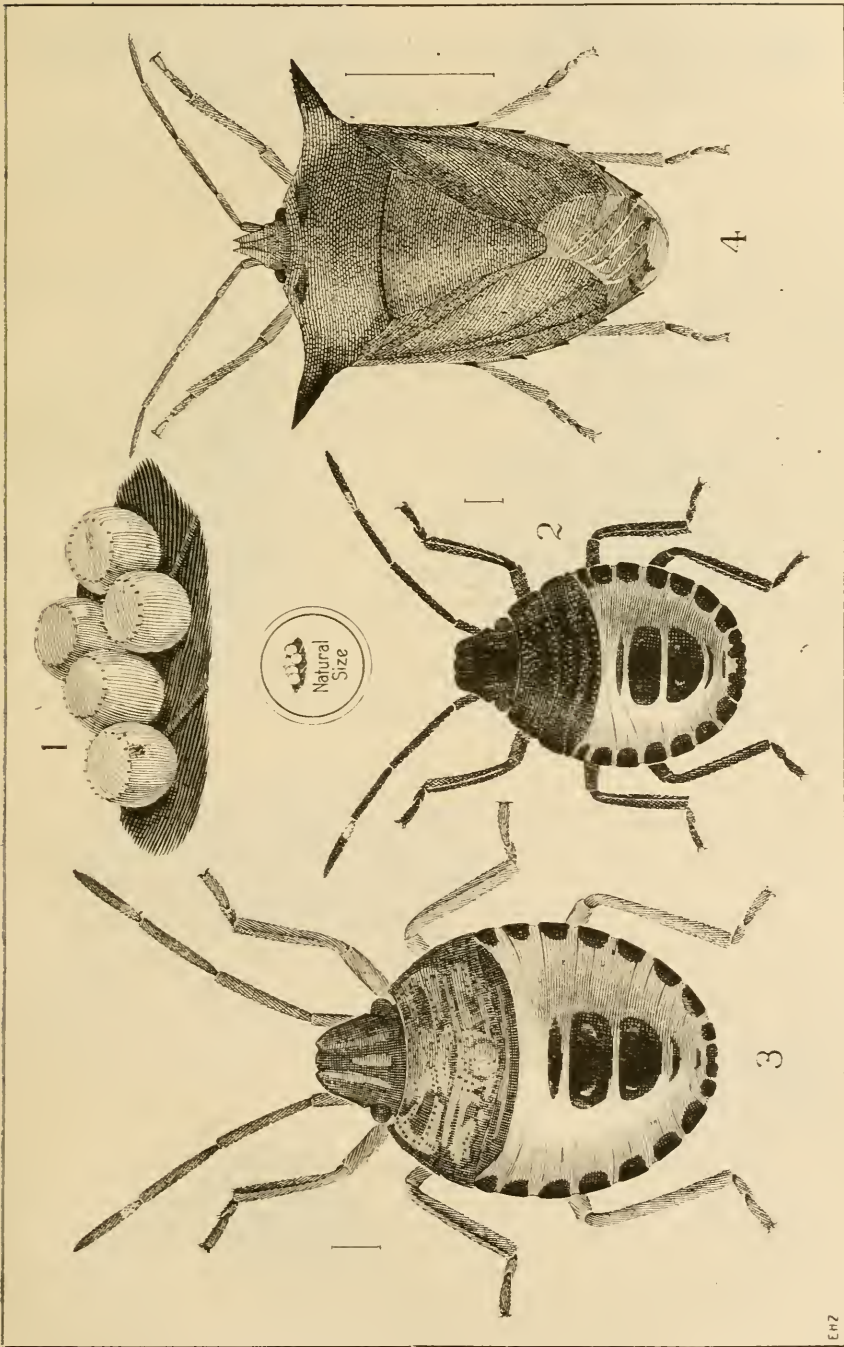
This large bug was described as an orange-tree pest in "Insects and Fungus Diseases of Fruit trees," published in this Gazette in 1899 under the name of *Rhynchocorus* sp. In 1901, under the identification of *Biprorulus bibax*, it was figured in colours and described in Part 1, "Notes on Australian Hemiptera," and is also noted on paged 330 in "Australian Insects."

This is a typical, broad-shouldered shield bug, with long legs and antennæ, measuring about $\frac{3}{4}$ of an inch from the front of the head to the tip of the abdomen, and about the same width across the shoulders from the base of the prothoracic spines. The prothorax is turned down in front to the pointed head, swelling out on the sides, which are produced into stout pointed spines; the outer margin behind the spines and the body rounded to the apex. General colour bright green, with the extremities of the spines tipped with reddish brown.

They are very active creatures, and when disturbed fly readily: in cover they appear to trust to their remarkable protective coloration harmonising with the foliage and do not move. The eggs are deposited in clusters of about a dozen side by side upon the upper surface of the leaf, or sometimes upon the side of a fruit. They are glassy, semi-transparent, hemispherical, and covered on the top with a flattened star-ribbed lid. The young ones are dull green, more elongated than the adults, and barred with brownish black.

These insects have a wide range. They were first recorded as pests from the citrus orchards of the Northern Rivers; and as the "Finger Lime" *Citrus australasica* is a native of the coastal scrub, it is probably their host-plant in the north of New South Wales. Later on they were recognised in the citrus orchards in the Gosford district, and in other parts of the Hawkesbury River; and for several years they have been invading the home-station orchards of the north-west, from Moree northwards to Garah, thence south to Coonamble, and in most cases they show a marked preference for the lemon trees. Early in December Mr. George Smith, of Budgeree, Garah, sent me several clusters of eggs from his garden. None of these produced a bug, as they were all infested by a minute chalcid wasp parasite, which came out in the observation jar. The presence of this parasite evidently accounts for them not becoming a more serious pest in the orchards in the north-west.

In working out the life histories of local insects in the Moree district, those upon the "Native Lime" (*Atlantia glauca*) were investigated. Early in December numbers of the "Spined Orange Bug" were found resting among the spiny branchlets, and were sucking the juice out of the small, rounded, ripening fruits. This is evidently, in the north-west, their natural food plant, from whence they have found their way into the station gardens and discovered the cultivated citrus trees. On their native food plant they represent a striking case of protective mimicry, not only in form, but also in coloration, for the slender shoulder spines are tipped with reddish brown, just like the long spines on the wild lime. The bugs seem to know their mimic powers; for, enveloped among the thorny branchlets, they cling to the twigs and do not drop to the ground as they do when found among the more open foliage of the cultivated lemon trees.



Life History of the "Green Spined Orange Bug" (*Biprenodus labac*).
1. Eggs on orange leaf. 2. Young bug on emergence from egg. 3. Half-grown bug. 4. Adult Green Spined Orange Bug.

CHAPTER XI.

INSECTS OF THE WATTLES (Genus—*Acacia*).

IN dealing with the insects of the wattles it is necessary to take them collectively instead of individually, because a number of insects that feed upon them are found upon more than one species of wattle. I therefore propose to take the insects in order, and to list the different wattles upon which a particular insect may feed.

In Mueller's "Systematic Census of Australian Plants," published in 1889, he catalogues 340 different species of the genus *Acacia*, and since that date a number of new species have been named and described.

Wattles vary from very small shrubby plants a foot or two in height in the sandstone country to great forest trees in suitable deep, rich soil. They are found growing in every part of Australia, and have many popular names. The "bushman's wattles" of the western lands, spreading over large areas of the interior of Australia, are well known as "Mulga, Gidgee." Myall, Boree, Brigalow, and other popular names.

The cultivation of wattle for their bark has been carried on for many years in Australia, and wattle bark stripping is extensively carried on in our coastal districts. Other species are planted in our gardens, parks, and streets, as ornamental flowering shrubs.

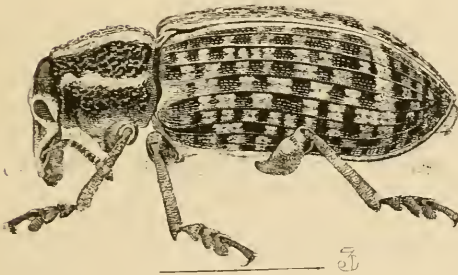
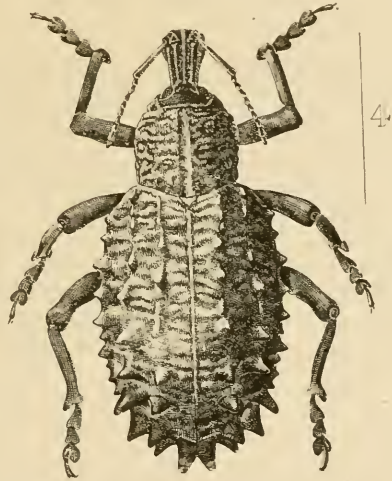
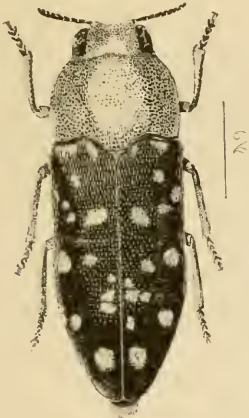
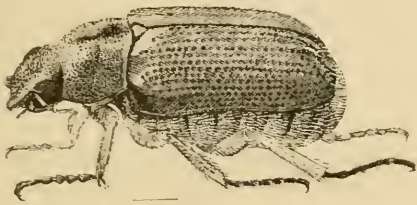
Many species of Australian *Acacias* have been introduced and largely planted in other parts of the world for their tanning bark, for firewood, on account of their rapid growth, as sand-breaks on the sea-coast, and for their beauty as flowering shrubs.

The Metallic Green Foliage Beetle (*Diphucephala auralenta*, Kirby).

This beetle was described by Kirby in the "Transactions of the Linnean Society of London," in 1818, but no information was given of its habits or food plant. In the early summer the beetles are often very numerous upon the foliage of the Black wattle, *Acacia decurrens*. In Tasmania this, or a closely allied species, deserts its natural food plant and migrates to the adjacent apple orchards, and does considerable damage to the crop by eating the skin of the crown of the immature apples. It is of a rich metallic green colour; the thorax very rugose, and the wing covers coarsely and thickly punctured; the under surface is finely clothed with buff hairs, longest upon the thoratic surface. Length, $4\frac{1}{2}$ lines.

The Small Cockchafer (*Anoplognathus flavipennis*, Boisduval).

This beetle was originally described by Boisduval, in the records of the "Voyage de l'Astrolabe." It is another of the foliage-eating beetles that are sometimes very numerous upon the foliage of the Black wattle. This is one of the smaller cockchafers, measuring about 9 lines in length; a dark metallic head and thorax; light yellowish-brown wing covers; under surface rich metallic reddish-brown, with coppery reflections, and lightly clothed with grey hairs. This species is common about the Blue Mountains and Maitland district.



INSECTS WHICH ATTACK WATTLE-TREES.

Fig. 1. *Diphucephala arcuata*, Kirby.

Fig. 2. *Cissris leucosticta*, Kirby.

Fig. 3. *Chrysolophus spectabilis*, Fab.

Fig. 4. *Leptops tribulus*, Fab.

Fig. 5. *Rhinotia haemoptera*, Kirby.

Fig. 6. *Myrmacielus formicarius*, Chev.

Fig. 7. *Doticus pestilens*, Olliff.

Small Black and Gold Flower Beetle (*Cisseis cyanipes*, Saund).

This beetle was described by Saunders in the "Transactions of the Entomological Society of London" in 1868. It is one of the smaller Buprestid beetles which are plentiful upon the foliage of the Black wattles (*Acacia decurrens*) and the allied varieties. In the early summer I found it very prolific in the Mittagong district of New South Wales, but it has a wide range over our coastal districts in the wattle lands. It measures about a quarter of an inch in length; it is boat-shaped and broad in proportion to its length; general colour rich coppery red, with the centre of the wing covers clouded with black; legs metallic green. If disturbed when feeding upon the foliage in the daytime it releases its legs and drops to the ground.

The White-spotted Flower Beetle (*Cisseis leucosticta*, Kirby).

This beetle has a wide distribution over Australia. It feeds upon the foliage of a number of different wattles, from Victoria and South Australia to Queensland. Like the previous species it feeds upon the foliage of the Black wattle in the neighbourhood of Sydney, and drops to the ground when disturbed.

It measures slightly over half an inch in length. The upper surface of the head and thorax is deep metallic green, thickly and finely punctured; the wing covers rich metallic red, closely punctured and lightly clothed with irregular small white spots. The under surface is of a dull green tint; the legs much brighter; the outer margin of the abdominal segments blotched with grey pubescence. The colouration in the male beetle differs in the head and thorax, being coppery red, and the wing covers merging into dark purple.

The Grey-striped Agrilus (*Agrilus australasie*, Laporte and Gory).

This is another small foliage-eating buprestid beetle, which can be obtained in numbers in the early summer in the black wattle brush in the Mittagong district, by shaking the branches into a net when the insects are feeding. It is slender in form, measuring just under half an inch in length. It is of a general dull metallic bronzy tint; the sides of the thorax, a stripe along the sides of the abdominal segments, and both sides of the under surface are all of a reddish metallic tint. The wing covers are narrow, contracted about the middle on the sides, and rounded at the tips.

Metallic Buprestid Beetles.

(*Melobasis iridescens*, Laporte and Gory; *Melobasis splendida*, Donovan).

Both these handsome little buprestid beetles have been bred out of infested twigs of the Long-leaved wattle, *Acacia longifolia*, growing in the neighbourhood of Sydney.

As both have similar larvæ and habits I have taken them together. The larvæ are slender flattened grubs; the thoracic segments between the small head and the abdominal portion are broad and rounded, with the smaller abdominal segments tapering to the rounded tip. They feed between the bark and the sapwood until nearly full grown, then they cut an oval burrow into the stem beneath, and after feeding on it, they pupate at the end of the excavation. Both these beetles are about the same size, one-third of an inch in length. They are ornamented with rich metallic tints.

The first, *Melobasis iridescens*, is rich metallic green. The head and thorax are finely punctured; the wing covers are irregularly striated, with the striae and ridges between them finely punctured; the apical edges of the wing covers are finely toothed.

The second, *Melobasis splendida*, is also bright metallic green, but there are two parallel bands of dark purple across the thorax, and a central band of similar rich coppery purple down the centre of the wing covers, with two transverse ones towards the tips.

The Vine Cane Weevil (*Orthorrhinus klugi*, Boheman).

The larvæ of this beetle feed on the dead branches of the Black wattle. They bore down the centre of the branchlets, and pupate when full fed in the end of the burrow. I noted its life history in the Proceedings of the Linnean Society of New South Wales in 1894. The specimens were obtained from dead branches collected in the vicinity of Sydney. These beetles have the curious habit of laying their eggs in the canes of grape vines in the Parramatta and Fairfield districts. The grubs feed down the soft centre of the canes and damage the vines. The beetle is a typical long-legged weevil, about one-third of an inch in length. It is of a general reddish-brown colour, produced by an external coat of fine bronzy scales. It is ornamented with two conical projections in front of the thorax; and a double row of three more on either side of the wing covers.

The Broad-back Weevil (*Leptops tribulus*, Fab.).

This fine snout beetle is the representative of a large genus of weevils found all over Australia, one of which, *Leptops hopei*, is a very serious pest in the larval state upon the roots of the apple trees. Nothing is known about the larva of this species, but it is probably a naked, soft, legless underground grub like that of the well-known apple pest; and it most probably lives on the roots of the wattles. The adult beetles are found feeding upon the foliage of the Black wattle growing about Sydney. This weevil is called the "Wattle Pig" by the school children. The larger female measures about an inch in length. The body is nearly double the size of the male. The whole insect is black, with a dusty reddish tint on the upper surface; the snout is short, stout, and rigid; the thorax short, small, rounded in front, coarsely rugose, with three parallel rows of short stout spines down either side of the wing covers. On account of this rough spiny exterior it was redescribed by Macleay under the name *Leptops echidna*.

The Botany Bay Diamond Beetle (*Chrysolophus spectabilis*, Fab.).

This large and handsome weevil was described in a few lines by Fabricius in his System Entomologica, p. 155; and since that date has been described and figured by several of our earliest entomologists. Donovan, in his Insects of New Holland, 1805, gives a very good coloured figure of the beetle, to which he affixes the popular but somewhat unwieldy name used by me at the heading.

The beetle varies in size from an inch to 8 lines in length, and is also variable in colour; those taken in the earlier part of the season are much more brightly tinted with green than later, as the scales are more or less

rubbed off the beetles. Their general colour is black, with the sides of the snout, under surface of the head, and three parallel bands down the thorax, rich metallic green. The wing covers are richly mottled with the same tint, forming irregular markings, blending together on the sides and under surface of the body, which is almost completely sheathed in these scales. The thorax is deeply punctured, and the wing covers regularly striated.

The female, when laying her eggs, generally attacks the stem of the tree just above the surface of the ground, where she gnaws the bark into little roughened spots, under each of which is deposited an egg. Where there have been a number of eggs deposited the bark has the appearance of having had a charge of shot fired into it. The larva, when hatched out, feeds down into the main roots, which, as it increases in size, it completely hollows out, packing up the chamber behind with the castings as it works along. When full grown the larva is a short, thick, fleshy, much wrinkled white grub, with three pairs of stout legs covered with short reddish hairs, a shining ferruginous head armed with stout black jaws. The life history is completed in the year, under ordinary conditions, though some belated individuals may come out later in the season. This beautiful weevil has a wide range over Australia, and is common upon the foliage of the Black wattle.

I have also bred it out of the roots of five other acacias growing in the neighbourhood of Sydney. At certain seasons this beetle is very plentiful about the bush, and dozens can be taken in the course of an afternoon where there is a plentiful growth of young wattles.

The Slender Weevil (*Belus sparsus*, Germ.).

This beetle was originally described from South Australia; but it is plentiful upon the foliage of wattles in the Bathurst district, and has a wide range over the State of New South Wales. It is about half an inch in length; slender in form, with the tips of the wing covers pointed. It is reddish brown in colour. The wing covers are strongly ridged on either side, and in freshly-emerged specimens are finely punctuated with a double row of fine pubescent spots on either side of the elytron; but in older specimens these are frequently rubbed and indistinct. On the under surface the segments, from beneath the head to the tip of the abdomen, are clothed with fine white pubescence, densest on the sides. This beetle is found upon the different varieties of the Black wattle.

The Rugose Weevil (*Belus edentulus*, Lea).

This beetle was described by Lea in the Proceedings of the Linnean Society of New South Wales, from specimens taken upon Black wattle scrub in the Braidwood district; but it has a wide range north and south along the coastal wattle belt of New South Wales. It is a slender, dark, pitchy-brown beetle, with reddish-brown antennæ and legs. It measures under half an inch in length; and the body is somewhat cylindrical. The upper surface is very thickly and finely punctured and lightly mottled with greyish pubescence down the centre of the elytra. The elytra come to a point at the apex, and by means of lens, show a fringe of fine hairs along the outer margin of the tips. The outer margin of the eyes are lightly fringed; and the sides of the head, thorax, and abdominal segments are thickly clothed with silvery-grey pubescence.

The Tailed Weevil (*Belus phanicopterus*, Germ.).

This is one of the largest members of the genus *Belus*; it measures three-quarters of an inch in length, without including the slender snout. It is of a uniform dark chocolate brown on the upper surface; with the sides of the under surface of the head, thorax, and abdomen clothed with fine white hairs. The legs, antennae, and inner portion of the under surface are reddish brown. The thorax is broad with the surface roughly punctured, and furrowed with a medium suture. The wing covers are thickly punctured, with the extremities produced into slender tails.

This species was originally described from South Australia, but it is found upon wattle scrub in many parts of New South Wales.

The Spotted Weevil (*Belus semipunctata*, Fab.).

This species has a wide range from Victoria over New South Wales. It is rather a common species about Bathurst, Mittagong, and other wattle country. It is much more variable in size than any of the preceding species, measuring from 5 to 7 lines in length. The general colour is dark reddish-brown, with the antennae much lighter coloured; thorax broad, angular, and rugose; a raised parallel ridge on either side of the medium suture of the wing covers, with another somewhat more indistinct one on the outer edge, and produced into slender points on either side at the tips. The whole of the wing covers are mottled with yellowish grey hairs that, forming small spots; produce double parallel lines of spots on either side. The under surface is similarly clothed with grey hairs, as that of the preceding species.

The Slender Red Weevil (*Rhinotia hæmoptera*, Kirby).

This handsome weevil was described and figured by Kirby in a paper entitled "A Century of Insects, including several new genera described from my cabinet." Among these insects there are a number of Australian beetles.

This beetle varies considerably in size, measuring from 8 to 10 lines in length, without including the stout turned-down snout. The general colour is rich, shining black, with a stripe on either side of the eyes, a slender one in the centre of the thorax, another broad blotch on either side; and the whole of the wing covers deep rich orange red. The general form is slender and somewhat cylindrical, broadening out beyond the centre, and rounded at the tips; the whole of the elytron is very finely striated and granulated.

The beetle lays its eggs in a scar on the bark of a branch not much thicker than one's finger, and the tiny larva, when hatched, bores into the centre, burrowing down through the middle for some inches, causing the bright green bark to turn yellow. The larva is a rather curious-looking creature, of a dull, light yellow colour, with a small head, and the thoracic segments swelling out and forming a prominent forehead or ridge, tapering down to the jaws; the abdominal segments of a uniform size, slender, rounded with the anal segment, broad, truncate, and shining.

I have cut them out of *Acacia decurrens* and *A. pubescens*, but their common food plant is *Acacia suaveolens*, about the Sydney scrub. I have taken both larvæ and beetles out of the stems in May, and, as they are seldom met with on the foliage until October, the fully-developed beetle must remain a considerable time in its chamber before it gnaws its way out. The beetles feed upon the foliage of a number of different scrub wattles besides *Acacia decurrens*.

The Ant-shaped Weevil (*Myrmacielus formicarius*, Chev.).

This small shining black weevil was described by Chevrolat in the Annals of the Entomological Society of France, in 1883. It is a queer-looking ant-shaped weevil that crawls about on the trunks and foliage of the wattle, and is often taken in the net when shaking a bush. It only measures 2 lines in length to the front of the head, but the stout turned-down snout measures another half-line. It is of a uniform black colour, smooth, and shining, with the head and snout broad; the thorax oval, very narrow at the junction with the body, which swells out into an elongate oval; the legs long, with the thighs thickened in the centre.

The Jumping Anthribid (*Doticus pestilans*, Olliff).

There are a number of wattles, particularly the Black wattles, which are attacked by a rust fungus. It usually starts on the branchlets and gradually causes the growth of aborted tissue into large irregularly rounded rusty-red galls as large as a man's fist. These often appear in such numbers that they finally kill the infested trees. These woody excrescences attract moths and beetles, which lay their eggs in or upon the tissue; and they thus form suitable food for a number of different insect larvæ. Among the most plentiful are the larvæ of the abovenamed beetle. This beetle measures about a quarter of an inch in length; it is of a general dark-brown colour, covered with greyish down. The fore legs are very long in proportion to the hind pairs, and they are furnished with abnormally large tarsi. It jumps in a very peculiar manner when touched. The larva or grub is pale yellow, clothed with fine hairs; it measures slightly over one-sixth of an inch in length. The head is small, almost hidden in the thorax, and it is furnished with small, hard jaws, tipped with two pointed teeth.

This beetle was originally bred from dead dried apples taken from the orchard when the trees were pruned. They were first found in Victoria, and Mr. French sent them to New South Wales, where Mr. Olliff described the beetle as a new species. We frequently have dried fruits of different kinds sent into the office, gathered in the orchards in wattle districts, and all are full of these grubs feeding upon the dry tissue.

CHAPTER XII.

LONGICORN BEETLES OF THE WATTLES—OTHER WATTLE INSECTS.

The Metallic Violet Longicorn (*Iotherium metallicum*, Newman).

This beetle was described in Newman's Entomological Magazine in 1838. This richly-tinted beetle has a wide range, as it has been recorded from Tasmania, Victoria, and New South Wales. I have taken it in several localities upon wattle foliage in New South Wales. The smaller male was described by Pascoe under the name of *Phaolus macleayi*, from a collection sent to him from Australia by Macleay. The sexes vary considerably in size. The male is slightly over one-third of an inch, and the female is often nearly twice that length. The general colour is deep metallic violet, with more coppery tints upon the wing covers. The head is broad, furnished with short, somewhat thickened antennæ; the thorax slopes out on either side, with a stout spine in the centre; the abdomen is broad, rounded to the tip.

The Silvery Brown Longicorn (*Pachydissus sericus*, Newman).

This beetle was named in the same journal as the previous species. Next to the wattle goat-moth, this beetle does most serious damage to several species of wattles, particularly when they have reached maturity and are beginning to die back. The eggs are laid in the bark; and the resultant larvæ bore through the sapwood, where they feed. The larvæ, as they increase in size, burrow deep into the solid wood. The long-leaved wattles, once so plentiful about Sydney, were killed off by these borers; and they also breed in numbers in the stems of the black wattles. The typical flattened larvæ measures up to 2 inches in length. It is of the usual dull-yellow colour; has a horny plated thorax, and has solid black jaws.

The beetle is a handsome, light chocolate coloured insect, clothed with a fine pubescence, which gives it a rich, silvery sheen. The antennæ are very noticeable, for the second and third segments are much swollen out at the apex. The thorax is stout and roughened, and the tips of the wing covers are sharply cut out, forming two fine spines on either side. The beetle measures up to 1½ inches in length. It has a wide range over Australia.

The Slender Grey Longicorn (*Didymocantha obliqua*, Newm.).

This beetle was described in a paper entitled "New Species of Cerambycidae from New Holland and Van Dieman's Land," in which Newman described twenty-five new species of our Longicorn beetles. In the same year (1840) Hope contributed a paper to the Proceedings of the Zoological Society of London, in which he named this beetle *Strongylurus varicornis*.

This beetle is common on the black wattle in Southern Queensland and the northern rivers of New South Wales; but I have taken it upon wattle foliage in the Maitland district. It has the curious habit when disturbed of letting its long antennæ droop down on either side in a most comical manner, and then it stretches out its legs, ready to drop to the ground if further startled. It measures three-quarters of an inch in length, with its long, slender antennæ nearly twice the length of its body. The general colour is chestnut-brown, with the apex of the second, third, and fourth joints of the antennæ black; the scutellum white. The wing covers are marked with dark, indistinct brown lines on either side. The thorax is narrow, hairy, and armed with a spike on either side; legs long, slender, and hairy.

The Slender, Grey-haired Longicorn (*Lygesis mendica*, Pascoe).

A number of specimens of this longicorn were bred from the infested twigs of a black wattle, cut off a tree at Carlingford, near Sydney, some emerging in August, but the remainder towards the middle of November, in the infested timber.

The beetle measures under half an inch in length, of a uniform reddish-brown colour, with a slender head and long cylindrical thorax. The wing-covers rounded at the tips, and the whole insect clothed with stout white hairs, and the legs swollen on the lower portion of the thighs.

The Slender-lined Longicorn (*Syllitus grammicus*, Newm.).

This pretty longicorn beetle is slightly over one-third of an inch in length, and is very slender in form. It is of a general light reddish-brown colour, with the head and thorax darkest. The wing covers are daintily marked with six white parallel ribbed lines, running from the shoulder to the tip of the abdomen. The slender yellow larvæ bores narrow, irregular chambers along the smaller branches of the black wattle, and is common in the dead wood up to the middle of December. They are plentiful in the Tweed River district upon the foliage; and can easily be collected by shaking the branches over a net. This beetle was noted by me in the Proceedings of the Linnean Society of New South Wales in 1894.

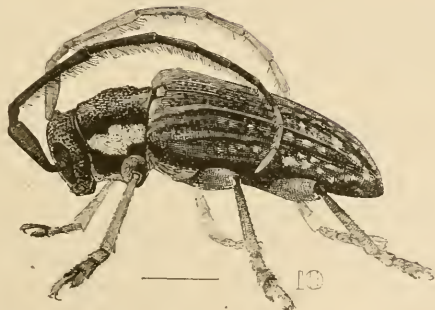
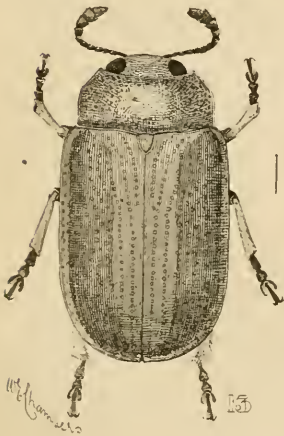
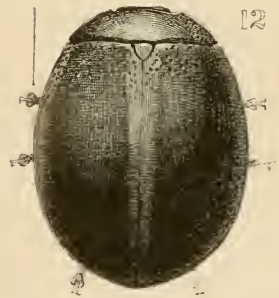
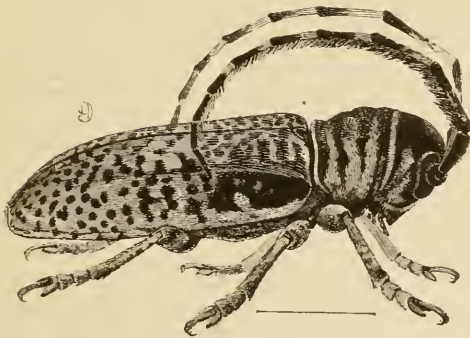
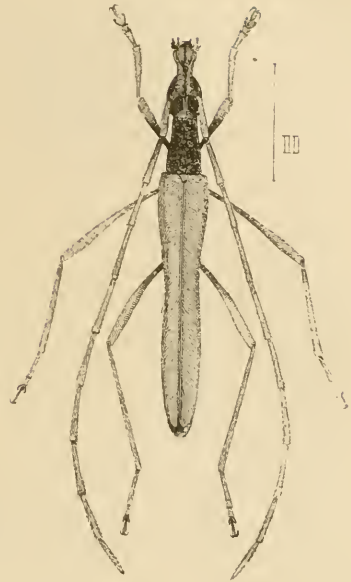
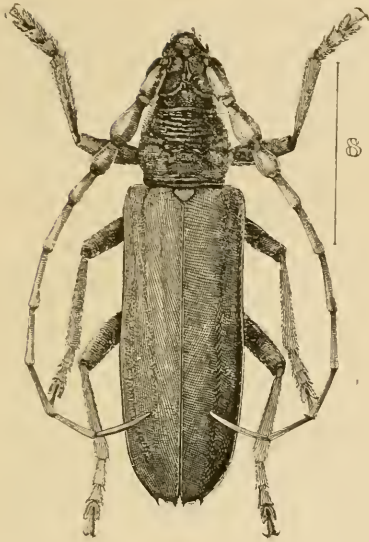
The Triangular-marked Longicorn (*Uracanthus triangularis*, Hope).

The life-history of this fine longicorn was first recorded by Mr. D. Best in a paper published in the *Southern Science Record*, 1880, entitled "Longicorn Beetles of Victoria," in which forty-six species are listed. He states that its larvæ feed chiefly upon *Acacia decurrens*, but it is also found feeding in the stems of *Banksia integrifolia* (Honeysuckle) and *Acacia longifolia*, so that French has given it the name of "Triangular-marked Banksia Beetle." I have bred a considerable number about Sydney from the stems of *Eriostemon lanceolatus* and *Boronia pinnata*, but have also had infested wood of the black wattle from Mr. J. H. Maiden which contained this beetle.

The larva is of a bright yellow colour, long and somewhat cylindrical, but deeply corrugated at the segmental divisions, each segment being rounded and lightly clothed with reddish hairs; an impressed line runs down the dorsal surface that causes the segments to form a rounded lump on either side, the anal extremity rounded with five short spines at the apex. They feed down through the centre of the branchlet, hollowing it out as they go, and sometimes eating through the sides, finally pupating at the end of the chamber.

The beetles are not at large until November, though I have cut them out of a branch perfectly formed as early as June. It has a wide range over New South Wales; I have specimens from Sydney, Newcastle, and Wilcannia.

It is the most distinctive species of the genus, measuring up to 1½ inches in length, slender and cylindrical in form, with an elongated thorax tapering to the head. The general colour is reddish-brown, but the head, thorax, and shoulders are so thickly clothed with buff-coloured—and the apical portion with grey-coloured—hairs that it has a much darker appearance: on either side of the outer margin of the wing covers is an elongated angular space, smooth and shining, and not clothed with hairs.



INSECTS WHICH ATTACK WATTLE-TREES.

Fig. 8. *Pachylissus sericus*, Newm.

9. *Synophyctes restigialis*, Pasc.

10. *Hebeceus marginicollis*, Boisd.

Fig. 11. *Lygesis mendica*, Pasc.

12. *Paropsis immaculata*, Marsh.

13. *Calomea paralis*, Lea.

The White-cheeked Longicorn (*Hebecerus marginicollis*, Boisd.).

This and the two following species are very plentiful upon the foliage of the wattle in the early summer, where they cling to the small branchlets and feed upon the bark. The larvæ of the three are very similar in appearance and habits; the eggs are laid in the bark on the smaller branches in the dead or dying wood; the young larvæ when hatched out feed in the sapwood, in which they tunnel in an irregular manner, finally pupating in a small oval chamber at the end of the cavity.

The larva is of the usual semi-transparent colour, slightly brownish, fringed with fine hairs on the margins; head large, rounded in front, with stout ferruginous jaws, black at the tips; the last two segments of the abdomen smooth, cylindrical, rounded at the apex.

The beetle measures up to 7 lines in length, and is stout and thick-set in proportion, with the thorax broad and the tip of the abdomen rounded. The general colour is very dark brown, the antennæ clothed with fine black hairs along the inner margin; sides of thorax finely punctured, lightly clothed with dark hairs, and a broad distinctive stripe of pale yellow pubescence on either side in a line with the base of the antennæ. The wing covers are both striated, and more coarsely punctured than the thorax, and lightly clothed with spots of the same dull yellow pubescence, which is much thicker on the under surface of the abdominal segments.

This species was described in "Dejean's Catalogue" (third edition) on page 362, under the name of *Acanthocinus marginicollis*, and was re-described by Boisduval, the French naturalist attached to the scientific expedition which sailed round the world in the "Astrolabe" in 1830. This ship stopped at a number of places along the Australian coast, collecting and buying specimens, so that quite a number of Australian insects are described and figured in Zoological Monographs published by the French Government. It is common about Sydney, Bathurst, Mittagong, &c., and has a wide distribution over Australia.

Illidge records it as common on the wattles in the vicinity of Brisbane.

The Dark-grey Longicorn (*Hebecerus australis*, Boisd.)

This is the largest of these species infesting the wattles. It measures over half an inch in length, and is stouter in build than the previous species. The general colour is darker, the antennæ fringed with longer hairs, head and thorax very finely and thickly punctured, the latter being produced into a stout spine on the sides; the dorsal surface of the elytra thickly and coarsely punctured and lightly clothed with grey and buff pubescence.

This beetle is often found upon the trunks of wattle trees, as well as upon the branches, and is not as plentiful as the smaller species; its colouration is so close to that of the wattle bark that when at rest it needs a sharp eye to detect it. I have collected it all over the country, and it ranges into the other States.

The Small Grey Longicorn (*Hebecerus erocogaster*, Boisd.).

This is the smallest of the three well defined species. It measures only slightly over a quarter of an inch in length. Its ground colour is a uniform dark brown, with the thorax very finely granulated, and the wing covers thickly and coarsely punctured with a slight clothing of dull yellow pubescence. The antennæ are very distinctive, being very long and stout and clothed with hairs variegated in grey and black, each band of the latter colour forming a rounded mass in the centre.

The larva of this typical species feeds and pupates in the dead branches of the black wattle and other allied species growing about Sydney. It has a wide range over the wattle districts. Some of the larvæ remain over two years in the infested wood; though probably their life cycle under normal conditions is about twelve months. The emerging beetles feed upon the young branchlets, and are often plentiful in the early summer months.

The Buff-coated Longicorn (*Symphyletes vestigalis*, Pascoe).

This species was described in the Journal of Entomology in 1864. In the early summer months the freshly emerged beetles can be found clinging tightly to the young branchlets. It is a handsome, medium-sized beetle measuring about three-quarters of an inch in length. It is of the usual cylindrical form with the abdomen rounded at the apex. The ground colour is black or very dark brown; but it is so thickly clothed with rich buff-coloured hairs or pubescence, and also clouded with white on the edge of the wing covers, that the whole of the back has a mottled appearance. The antennæ are large; and commencing at the second joint are banded black and white; the whole clothed with fine black hairs fringing the inner margin. This beetle probably lays her eggs in the bark and girdles the twig like most of the members of this genus, who are typical stem girdlers. The larvæ has never been identified from the wattle stems.

The Feather-horned Longicorn (*Piesarthrius marginellus*, Hope).

This handsome longicorn beetle was originally described by Hope in the Proceedings of the Zoological Society in 1848. I recorded its life history and food plant in the Proceedings of the Linnean Society of New South Wales in 1893.

The somewhat slender, dull whitish larva is furnished with three pairs of small, reddish-brown legs; with its powerful jaws it feeds in the centre of the stems of several species of our coastal wattles, cutting off the branches where the stem is entered by the larva, when it hatches out of the egg in the bark. I used to breed them in numbers from the infested branches of the slender-leaved wattle (*Acacia longifolia*) growing upon the flats at Rose Bay and Botany, New South Wales. I have also bred specimens from the wood of the Black wattle (*Acacia decurrens*). Mr. French has informed me that it is not an uncommon pest in the stems of the black wattle in the Victorian scrub near Melbourne. Mr. Illidge writes ("Queensland Naturalist," 1922): "The larva of this beetle in Queensland cuts off the branch as if with a keen knife, just above the burrow. Occasionally it makes a mistake and cuts itself off below, and hence falls to the ground." Under natural conditions, as soon as the perfect beetles emerge from the timber they crawl up to the topmost branches of the wattles, where they remain during the day clinging tightly to the twigs, so that when collecting insects one seldom finds this fine beetle in the bush.

The male and female differ considerably in size, the larger female measuring an inch in length; she differs only in form from the male in having simple antennæ, while he has each joint laminated along the inner margin, giving the antennæ a feather-like appearance. The ground colour of both sexes is a uniform creamy-white or very pale yellow, marked with dull, reddish-brown, longitudinal stripes; the head, thorax and basal portion of the wing covers are rugose and reddish-brown, with a few hairs on the side of the head and thorax.

The damage caused by these beetles would probably be much more serious if it were not for the hymenopterous parasites that destroy them before they reach maturity. The chief parasite is *Aulacus apicalis* (Family *Evaniidae*), the maggots eating up the larval beetles and replacing them with their close-packed silken cocoons.

The Grey Ringbarker (*Symphyletes neglectus*, Pascoe).

This longicorn beetle was described by Pascoe in the Transactions of the Entomological Society in 1863 from New South Wales. I gave an account of its life-history in the Proceedings of the Linnean Society of New South Wales in 1893.

This beetle is plentiful in December about Sydney harbour. It is usually found clinging to the branchlet and feeding upon the bark; it girdles the branch with several deep rings, above which it gnaws several circular little flaps of bark in a horseshoe shape without detaching it, and then deposits an egg under each flap. If, however, the beetle finds a decaying or broken branch she dispenses with the girdling process and lays her eggs at once.

The larva feeds in the stems of *Acacia longifolia* eating out the wood in irregular tunnels; it pupates in the end of the last one. It is of the usual elongate form, with regular rounded segments; it has a somewhat broad, angular head, with ferruginous mouth parts, stout black jaws, and a few shallow scattered punctures across the centre. Length, 1 inch. The colouration of the beetle is dull brown, but it is so thickly covered with grey pubescence and short hairs that it is only in old, rubbed specimens that the ground colour is exposed. On either side of the wing covers, just below the shoulders, is a well-defined, crescent-shaped mark, by which this species is easily identified. It measures just under an inch in length. This beetle has a wide range over New South Wales and Queensland.

The Green-striped Longicorn (*Symphyletes nigrovirens*, Donovan).

This is one of the insects that Donovan figured in his Insects of New Holland, published in 1805. I gave an account of its life-history in the Journal previously noted in 1893.

Though the slender white larvæ feed and pupate in the stems of the small, prickly wattle (*Acacia juniperina*), the perfect beetles are found feeding upon the bark of the young shoots of the long-leaved wattle (*Acacia longifolia*) in the neighbourhood of Sydney. Best records it feeding upon the black wattle (*A. decurrens*) in Victoria, and it extends its range into Queensland. It is one of the smallest members of the genus, measuring a little over an inch in length. The face, legs, and a broad parallel stripe on the outer margin of the wing covers white, with the centre of wing covers deep green; a heart-shaped patch of buff-coloured pubescence between the shoulders.

A second species (*Symphyletes albocinctus*, Guerin), is about the same size, and similarly striped with white on the sides, but with the central portion of the wing covers of uniform reddish-brown. It is also found feeding upon *Acacia longifolia*, but the larvæ feed on the stems of *Viminaria denudata*, the stems of which are previously ringbarked by the beetles. It also ranges over New South Wales and Queensland.

Other Longicorn Beetles bred out of Wattle Twigs of minor importance.

Neissa inconspicua, Pascoe.—One of the smallest wattle beetles, only one-sixth of an inch in length. It breeds in the twigs of *Acacia longifolia*, and emerges in November in the neighbourhood of Sydney.

Lygysis mendica, Pascoe. A reddish-brown beetle, clothed with fine, white hairs; under half an inch in length. It breeds in the dead twigs of *Acacia decurrens*, in the vicinity of Sydney, and emerges in November.

Pentacosma scoparia, Newman.—A dark-brown longicorn, clothed with greyish-buff pubescence; it measures about a quarter of an inch in length. It is easily identified by the form of the antennæ, which have the first joint thickened and the third joint ornamented with a little black ball of fine hairs; the other segments are fringed on both sides with black hairs. The larvæ feed under the bark of the branches of *Acacia longifolia* in the neighbourhood of Sydney. This beetle has a wide distribution over Australia.

Sybra acuta, Pascoe.—Another small longicorn of a general greyish-brown colour. It is under a quarter of an inch in length. The wing covers are finely and closely punctured and produced into a sharp arcuate tooth on either side of the tips. The larvæ feeds on the twigs of *Acacia longifolia* about Sydney; the beetles emerge towards the end of December.

Stephananops nasuta, Newman.—A very slender longicorn, half an inch in length. The head is greatly produced, and has large eyes. General colour, reddish-brown, clothed with fine, greyish pubescence. The beetles emerge from the stems of *Acacia longifolia* towards the end of November.

Syllilus gremmicus, Newman.—Another slender, reddish-brown longicorn, slightly over one-third of an inch in length. The wing covers are marked with six pale-white, parallel lines from the shoulders to the apex. The larvæ feed in the centre of the dead twigs of *Acacia decurrens*.

Other Wattle Beetles.

Mr. R. Illidge has contributed a paper to the "Queensland Naturalist" (Vol. 111, No. 3, p. 61, 1922) entitled "Insects of the Wattle Trees," in which he lists the following additional insects from Queensland:—

Sceleocantha glabricollis, Newm.—This is a stout, thick-set, dark-reddish, brown Prionid longicorn, measuring about $1\frac{1}{2}$ inches in length. It has a small head, the prothorax slope on the sides, and bears a fine-pointed spine on either side; the body is short, broad, and rounded at the tip. This beetle has a wide range along the coast of New South Wales. Illidge records it as rare about Brisbane. His specimens were bred out of the base of the trunk of *Acacia Cunninghamii*.

Aystrocera virescens, Newm.—This species ranges from Victoria round the coast of New South Wales to Queensland. This is rather a distinctive looking beetle, with a greenish sheen on the wings and a very small spine on either side of the prothorax; the antennæ light coloured. The sexes differ in size, with the apex of each segment dark brown. The larger female measures up to one-quarter inch in length. It is most abundant, according to Illidge, in the stems of the creek-side wattle, *Acacia linifolia*, and in the black wattle, *A. decurrens*; but it has also been bred from the introduced Cootamundra wattle, *A. baileyana*.

Probatodes piliger, W. S. Macleay.—This beetle has an extended range from South Australia, through Tasmania, Victoria, and New South Wales to Queensland. No specific wattle is noted as the host-plant of the larvæ of this longicorn.

Hebecerus nipponoides, Pascoe.—This is a native of Southern Queensland; three other species, two of which are also recorded from Queensland, have been here previously listed.

Symphyletes pulcrulentus, Boisd.—This longicorn beetle ranges from Victoria to Queensland. It is a medium-sized beetle, measuring well over an inch in length. It is a uniform dark, brownish-grey colour. I have taken it on the branchlets of the long-leaved wattle growing at Botany. Illidge records it from the vicinity of Brisbane.

Symphyletes variolosus, Pascoe; *vicarius*, Pascoe.—The first has a wide distribution over Australia; the second is recorded from New South Wales and Queensland.

Pentha pardalis, Newm.—The second is only recorded from Tasmania, in Master's catalogue, but this Queensland record greatly extends its range.

Pentha solida, Pascoe.—Is a handsome, dark-brown beetle marked with fine, grey scales. It measures just an inch in length. It ranges over the northern parts of New South Wales and southern Queensland.

Rhytiphora rubeta, Pascoe.—Ranges from South Australia right round the coast to southern Queensland.

Rhytiphora polymita, Pascoe.—This beetle is found in New South Wales and Queensland.

Ropica exocentroides, Pascoe.—Ranges over New South Wales and Queensland.

Ameipsis marginicollis, Pascoe.—Recorded from southern Queensland.

The Dark-green Calomela (*Calomela curtisi*, Kirby).

This beetle was figured and described by Kirby in the Transactions of the Linnean Society in 1818, and again by Boisduval in the Zoology of the Voyage de l'Astrolabe, 1832. The larvæ are very plentiful at times upon the foliage of the wattle. They are short, thick-set, dull-green grubs, with the head, thorax, and legs black. The head is small; the thorax narrow, and the abdomen large globular. When full fed they, like most Chrysomalids, crawl or drop to the ground and pupate just under the surface of the soil.

The adult beetle measures just under a quarter of an inch in length, and it is broadly rounded. The head, eyes, antennæ, thorax, and legs are orange-yellow; the legs are mottled with dark blue; and a small transverse line of the same colour lies in the centre of the thorax. The wing covers are dark metallic-blue thickly covered with fine punctures.

A second species described by Lea under the name of *Calomela paralis* is also common upon the black wattle in the same localities. It is about the same size and is of a general dark, orange-yellow colour, with a broad parallel band of rich, metallic-green on either side, occupying the centre of each wing cover, and tapering out at the extremities. The wing covers are deeply and finely punctured.

The Red Wattle Paropsis (*Paropsis immaculata*, Marsham).

In a lengthy paper on the genus *Noctolia* (from which *Paropsis* was separated by Hubner), Marsham described and figured eighteen new species from Australia, and though his descriptions are clear, if brief, the figures are poor. This is one of the commonest beetles on the wattles all over the country, and has a very wide distribution.

The beetle measures 6 lines, and is broadly rounded, its diameter being $4\frac{1}{2}$ lines; general colour deep, reddish-brown, the margin of the wing covers much lighter than the portion of the dorsal surface, which often shows also as a pale stripe down the centre of the back when the insect is alive; but in dead specimens the general tint is dull black, with the stripes broad, and thorax reddish-brown. The lower portion of the thorax in line with the eyes deeply punctured, upper portion smooth and shining; the wing covers lightly marked with fine punctures, thickest on the sides, the whole otherwise smooth and shining.

The larva feeds upon the foliage, and is a stout, short grub, broadly rounded on the dorsal surface, with the apex of the abdomen somewhat pointed. Its general colour is yellow-tinted with green, the upper surface of the head and first thoracic segment are striped with black, and the whole of upper surface of the remaining segments curiously mottled with round black dots; on the second and third thoracic segment and the first two or three abdominal ones these dots are thickest, but taper off on the sides to the apex.

The Fire-blight Beetle (*Paropsis orphana*, Erichson).

This was first described by Chapuis in the Annals of the Society Entomologica of Belgium, 1877; and though originally described from specimens collected in Tasmania, is common in Victoria and New South Wales. Though one of the smallest members of this large genus of plant-eating beetles, it is one of the most destructive in the grub state, when it appears in any numbers. Some years ago (1890) the larvæ appeared in such immense numbers in many wattle plantations in Victoria that the trees were defoliated. As nobody had noticed the larvæ, it was looked upon as a new disease, and popularly called "Fire-blight," until the Government Entomologist (Mr. French) investigated the matter, and found the trees swarming with small, dirty green grubs.

Specimens of these which were forwarded by Mr. French were exhibited by me at a meeting of the Linnean Society, New South Wales, and until I bred out the beetles I was under the impression that they were the larvæ of an undetermined sawfly.

The larvæ is a slender caterpillar, quite unlike most of those of the common species of *Paropsis*, varying from dull-brown to green in colour, with two pale, parallel lines running down the dorsal surface from behind the head to the tip of the abdomen; and as they assimilate both in colour and shape to the twigs and foliage among which they are feeding, they very easily escape notice.

The Golden-haired Leaf-beetle (*Elaphodes tigrinus*, Chapuis).

This pretty little beetle is very plentiful in the early summer months upon the foliage of the black wattle all over the coastal district. It measures under one-sixth of an inch in length. It is oval in form, with the head turned in under the thorax. The head and thorax are chestnut-brown, with the wing covers lighter reddish-brown, mottled with darker brown, and lightly clothed with short, golden hairs, which also extend over the face and under-surface.

CHAPTER XIII.

LEPIDOPTERA OF THE WATTLES.

The Tailed Emperor (*Charaxes sempronius*, Linn.).

The curious caterpillar of this handsome butterfly feeds upon the foliage of the Black wattle. It has a wide range round the Australian coast from Sydney to Derby, North-West Australia.

The caterpillar is of a uniform dark-green tint, somewhat elongate in form, rounded on the back, and tapering slightly towards the apex. The front of the head is flattened, forming a horny shield produced into four flattened horns varying in length on the top: these give it a most comical appearance. The butterfly is a large handsome creature measuring nearly 3 inches across the outspread wings. The upper surface of the fore wings is creamy white towards the body, with the outer half towards the tips black, interspersed with an out row of white spots, and a white blotch in the inner margin. The slightly crenulated hind wings are produced into a pair of angular tails, with an arcuate area between them; the colouration is somewhat similar to the forewings, but the outer marginal band of black is narrower, and there are also two rows of white spots and markings, with an orange patch on inner apex. The under surface of the wings are variegated with white, black, and orange brown. It is a very rapid, active-flier, and takes some catching with a net when on the wing.

In Waterhouse and Lyell's "Butterflies of Australia," this butterfly is placed in Moore's genus, *Eulipsis*.

The Imperial Blue Butterfly (*Ialmenus evagorus*, Donovan).

This handsome little butterfly was figured in Donovan's "Insects of New Holland," published in 1805.

Olliff, in his pamphlet, "Australian Butterflies," called it by the above popular name, which, for want of a better, I have used, though among the "Blues" there are some much more imperially-coloured butterflies. This is one of the commonest species of the family *Lycenidæ* on the wattle scrubs along the eastern coast; and large numbers of trees are defoliated by their caterpillars.

These larvæ are gregarious, thickset, legless caterpillars. They vary from olive green to brown in colour, and are covered with a slimy secretion which attracts the mound ants, who come to feed upon this secretion. In return, the presence of the ants probably protects them from predatory insects and insectivorous birds.

The full-fed caterpillars pupate upon the twigs of the wattle, sometimes in great clusters. The empty pupal skins, after the butterflies have emerged, remain hung up like bunches of berries. Under normal conditions they remain in the chrysalid state for about a week in the summer time. The butterflies are most numerous in January and February.

The butterfly measures $1\frac{3}{4}$ inches across the outspread wings. On the upper surface the ground colour is black, with the centre of both pairs of wings delicate metallic blue. The extremities of the hind wings are produced into slender scalloped tails, three in number, the central one longest;



INSECTS WHICH ATTACK WATTLE-TREES.

Fig. 14. *Ialomenus iclinus*, Hew.
 15. " *eragorus*, Don.
 16. *Enchloris submissaria*, Walk.

Fig. 17. *Dactylopius albizzia*, Mask.
 17a. " *Enlarged Female*.
 18. *Levanium baccatum*, Mask.

at the base of these tails are spots of rich orange red. The under surface of the wings is delicate greyish-brown, finely edged with black, followed with an inner one of salmon pink, which is shaded by dark brown, all merged into the reddish spot at the base of the tails on the hind wings; the inner portion of the wings marbled with irregular parallel narrow black bands or bars and smaller dots. This butterfly has a wide range over South Australia, Victoria, New South Wales, to Queensland.

The Paler Blue Butterfly (*Ialmenus iclinus*, Hewitson).

Away from the coast this species takes the place of the Imperial Blue. I have collected it upon the Black wattles about Mittagong. Its natural home, however, appears to be in the interior, and it is particularly partial to the foliage of the Weeping Myall, or Boree (*Acacia pendula*), and it has a wide range from Victoria to North Queensland. In its habits it is identical with the previous species, and has similar-looking larvæ.

The butterfly differs from the coastal species in having the upper surface of the wings dark-brown, the blue coloration in the centre of the wings smaller, without the whitish tint; the under surface of the wings yellowish brown, and the dark markings much more delicate.

The Wattle Goat Moth (*Zeuzera (Eudoxyla) eucalypti*, Boisd.).

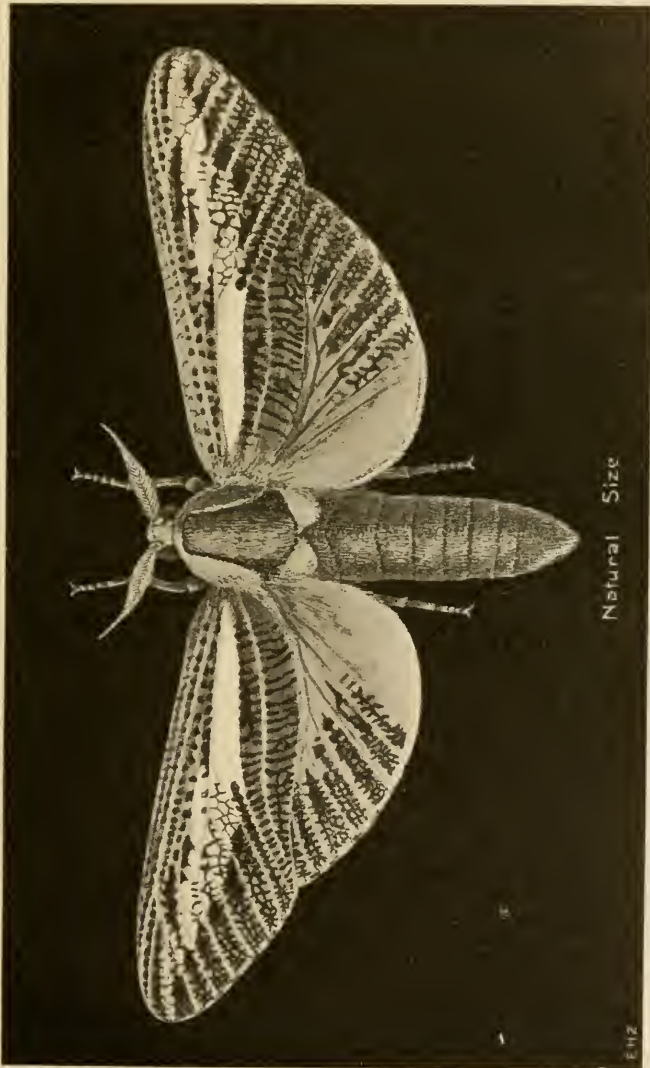
Writing in 1879, Professor McCoy (Podromus of the Zoology of Victoria), says, "Considering the great importance attached lately by the Government to the preservation and cultivation of the wattle trees or *Acacia* of Australia, and the great and increasing money value of the bark, it is important for bark-strippers and persons employed by the Government to foster the growth of the wattles, to know the appearance of the insect represented in the plate as the greatest destroyers of these trees, so that attention may be given to killing the perfect moth; the large abdomen of the female, which is distended with millions of eggs, each of which will produce a voracious grub as thick as the thumb and 5 or 6 inches long, eating the timber for years."

In the coastal districts of New South Wales this destructive moth is just as plentiful, its larvæ is just as voracious as in Victoria, and an enormous number of Black wattles are annually destroyed through the damage they cause to the trunks and main branches.

Early in the year the adult moths emerge from the pupæ cases, which are left just sticking out from the end of the tunnel in the bark. The moths flying about at night deposit countless numbers of tiny shot-like eggs. If every egg was fertile or produced a larva, there would be no wattles left in Australia, but nature provides for this superabundance with many parasites, and only a very small percentage mature and enter the stems. I have cut both larvæ and pupæ out of infested trunks of *Acacia longifolia*, *A. pycnantha*, and *A. decurrens*, growing in the neighbourhood of Sydney. The moth is very easily bred from the infested timber if the pupæ are carefully collected at the proper season of the year.

The eggs are laid upon the surface of the bark, through which the little caterpillar gnaws its way into the centre of the stem or branch, having formed, when nearly full grown, a tunnel as large as one's finger, in which it finally pupates, lining with a thin silken skin inside the base of the chamber. But the chamber is always so constructed that the head of the

chrysalid is almost touching the outside bark, which dries, and is simply pushed off at the opening when the moth is ready to emerge. At first the larva is a pinkish tinted grub, but as it reaches maturity it becomes almost white. In the larger trees the grub commences its attack from the stem



1.

1. The Wattle Goat Moth (*Zeuzera eucalypti*. Male).

close to the ground, and generally works upwards; when, however, it works downward, it sometimes comes out and forms its silken cocoon against the trunk of the tree, just under the surface of the earth. The larval covering is always found projecting from the chamber after the moth has escaped.

Where a tree is badly infested with these large grubs, if it does not die, it is so weakened by their actions that it is frequently blown over or broken down by the wind.



2.

2. Dorsal view Head and Prothorax of Larva (*Zeuzera eucalypti*).

3.

3. Side View of Larva of *Zeuzera eucalypti*.

In old times these grubs were much sought out by the blacks, who looked upon them as tit-bits, and from their size they make a nice mouthful. Many bushmen also look upon them as a dainty dish, quite as good as a large fat oyster. It was asserted that the larva of an allied species of goat-moth, known as *Cossus*, formed a favourite dish at the banquets of the Roman epicures, but the *Cossus* of ancient writers is now said to have been the larva of a wood-boring beetle.

The moth is very variable in its markings, and there is a considerable difference in the size of the sexes, the female being the larger. The male measures about $2\frac{1}{2}$ inches from the front of the head to the tip of the abdomen, and has a wing expanse of about 5 inches. The general colour is greyish-white, mottled and variegated with irregular blotches and bands of white, grey, reddish-brown, and black, the abdomen thickly clothed with brown hairs, and the antennæ beautifully pectinate, but that of the female simple and thread-like.

McCoy, in his "Podromus of the Zoology of Victoria," has figured and described the habits of this moth in that State, where it is said to almost confine its attacks to the black wattle. I have also noted it in my account of "Wood Moths; with some account of their Life Histories," in the *Proceedings of the Linnean Society, N.S.W.*, 1894. French has recently included it in his "Handbook of Destructive Insects of Victoria," p. III, 1900; and many notices of it have appeared in the writings of travellers in Australia.

There is some doubt about the correctness of this name; some lepidopterists state that this is *Zeuzera d'Urvillei* of Herrick-Schafer, and that the smaller, lighter-coloured species, not so common about Sydney as it is further south, but also a wattle moth with similar habits, is the true *Zeuzera Eucalypti*.

The Waitle-stem or Cherry-tree Borer (*Cryptophaga unipunctata*, Don.).

This moth was among the first insects figured from Australia by Donovan, in 1805; and, on account of its size and curious habits, it has been noticed by many writers.

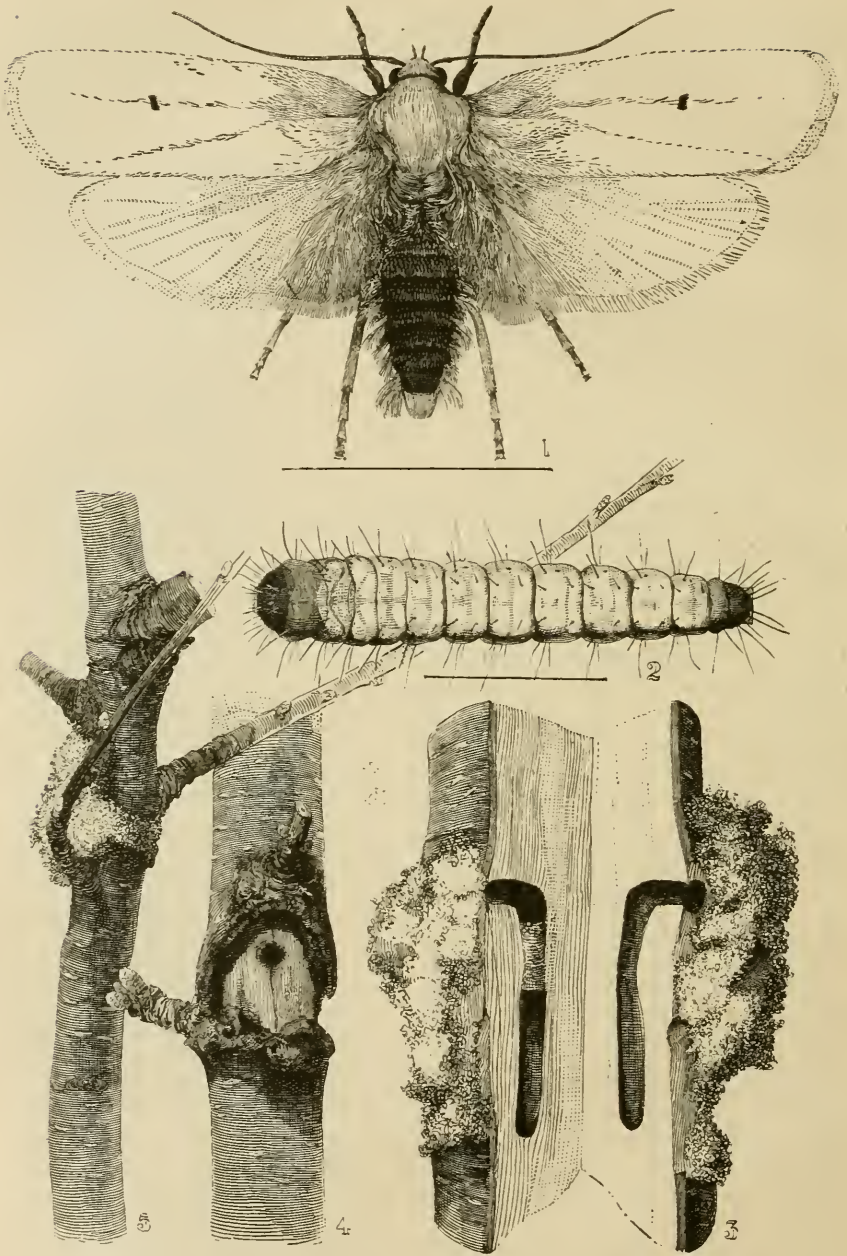
Henry Edwards, the well-known American entomologist, contributed a paper to the Proceedings of the Linnean Society of New South Wales in 1890, entitled "Notes on the habits and earlier stages of the *Cryptophaga unipunctata*." In this paper he stated that he had studied and bred this fine moth as far back as 1858, when it confined its attention to the stems of the black wattle (*Acacia decurrens*). Returning to Australia in 1890, he found that the moth had during the interval turned its attention to the softer woods of the cultivated fruit trees, plums, peaches, and particularly cherry trees, so that it is now popularly known to orchardists as the "Cherry tree borer."

In 1892 Olliff recorded it as an orchard pest in the Blue Mountains (*Agricultural Gazette*, vol. 3).

In 1899 I gave a general account of this moth as an orchard pest, accompanied by fine drawing illustrating its life-history. The life-history of this group of moths is very interesting, for, though they are not timber borers in the strict sense of the term, they do a considerable amount of damage in forests and orchards by killing out large branches of infested trees. Besides the black wattle, it has also been bred out of the stems of the Coastal Honey-suckle (*Banksia serrata*); and French, in his Handbook of the Destructive Insects of Victoria (Part I, page 18), calls it the "Cherry Borer," which, though correct, is a somewhat misleading name, for its true host plants are wattles.

The moth measures slightly over $1\frac{1}{2}$ inch across the outspread wings. The antennæ, palpi, eyes, and forelegs all black; the head, thorax, and wings are of a beautiful white satiny colour, with a single tiny black spot in the centre of the fore wings; the upper surface of the abdomen is black, fringed and marked with rich orange down, forming a thick tuft at the extremity. The medium and hind legs are armed with stout black spines at the base of the tibiæ, and with another spine in the centre of the tibiæ of the hind pair; they are clothed with rich orange yellow down to the tarsi.

The moth deposits her eggs upon the surface of the bark of the branches of the selected tree. The tiny larva at first feeds upon the surface of the bark, and sometimes forms a slight web; then it bores a lateral tunnel into the centre of the stem and turns downwards; it eats out a vertical shaft up to a couple of inches in depth; keeping both these shafts open by gnawing their surfaces. They also come out and feed upon the surface of the bark surrounding the opening. They cover this opening with a mass of frass or gnawed wood and silken strands, forming a regular matted protective covering, and sometimes extending half-way round the infested branch. At night, as they increase in size, they come out and feed both on the bark and foliage; sometimes they drag a leaf down into the shelter of the burrow, and leave the tip sticking out through the web. Edwards says: "It was not unusual to find specimens in the very early morning, (*i.e.*, at 5 or 6 a.m.) at rest on the leaves of the wattles, but later in the day they hid themselves from the sunlight and were very rarely met with." I have noticed that later in the morning they are always just behind the web; if this web is torn off quickly they are exposed before they can scurry into the chamber behind.



The Cherry-tree Borer. (*Cryptophaga unipunctata*, Don.)

1. Perfect Moth (*Cryptophaga unipunctata*).
2. Larva.
3. Cherry stem split to show cavity.
4. " " with external damage exposed.
5. " " covered with web.

The larva, when full grown, measures about $1\frac{1}{2}$ inches in length. It is of a general dull reddish-brown colour, and is smooth and naked, with the exception of a few scattered hairs along the sides of the segments. It is provided with three pairs of small legs, and a pair of prolegs on the last three and segments. The anal tip is produced into a stout pair of claspers. When full fed the caterpillars pupate in the vertical shaft, often plugging up the top with a wad of silken web and chewed wood. This larva has apparently become almost omnivorous in its tastes under altered conditions, because, besides wattles, honeysuckles, and orchard trees, it also attacks street trees, such as elms and willows; and some years ago it did a great deal of damage to the willows growing in the streets of Bathurst.

Remedies. If noticed in time, these larvæ can be killed very easily in the burrow before they pupate, by clearing away the webs round the lateral opening, and squirting a few drops of kerosene down into the vertical shaft with a sewing machine oil-can. The active caterpillar immediately crawls out and can be destroyed, and the hole can be filled up with grafting wax. The insertion of a bit of copper wire is also effective if it is twisted round in the burrow.

The Boree or Bag-shelter Moth (*Teara contraria*, Walker).

This is one of the most widely-spread and destructive foliage insects in our western scrub forests. In the coastal districts the caterpillars often feed upon the foliage of gum trees; but inland they turn their attention to different species of the acacias, and in particular to the graceful "Boree" or "Weeping Myall" (*Acacia pendula*). This is one of the most characteristic and handsome of our western acacias, growing in clumps on the open plains or scattered through the scrub. Wherever land is enclosed and protected from stock, these acacia seedlings spring up in such numbers as to form regular thickets, and the homestead and horse paddocks are usually ornamented with groups of these trees on all the western stations.



The Boree or Bag-shelter Moth (*Teara contraria*).
Acacias at Belltrees defoliated by the caterpillars.

Among the many edible scrub trees, the foliage of this acacia is one of the most valuable. In times of drought the lopped branches have furnished food for thousands of starving stock. Some landowners are so careful of these trees that they do not even lop the branches, but they flog the leaves off the trees with a wire whip, and thus save the branchlets.

The partiality that these caterpillars show for the leaves of this tree has, however, made a considerable difference in its value as a standby in time of drought. Just at the time when the leaves are wanted, when the grass is gone, where the caterpillars are abundant there is not a leaf on the trees.

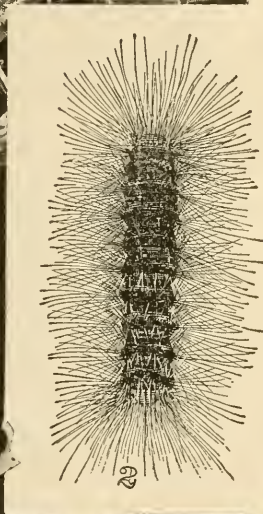
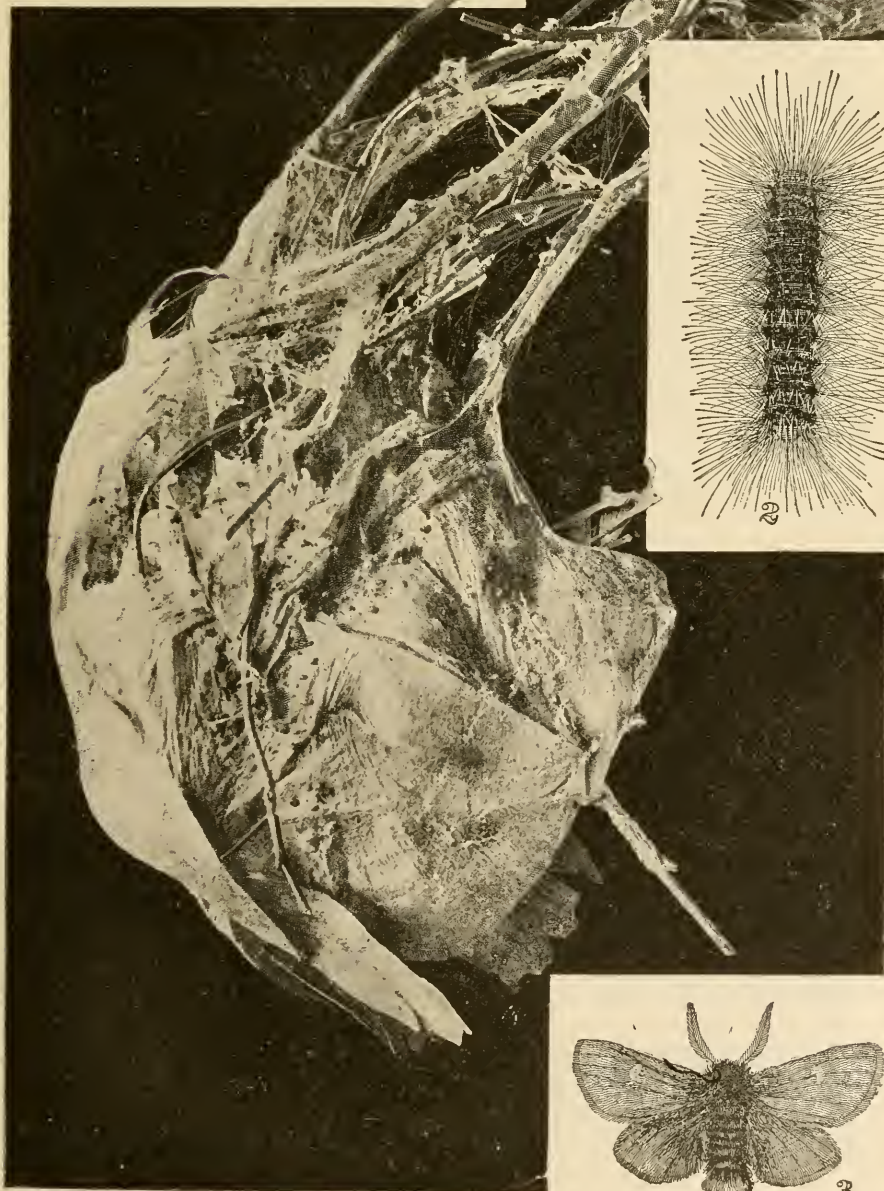
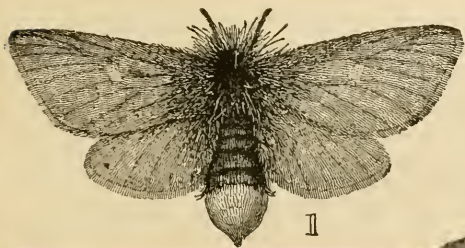
Many squatters, recognising this, undertake the destruction of these caterpillars by cutting out their bag-shelters and destroying them before the trees are defoliated. This can be very easily done, even on a comparatively large acacia, if the operator be furnished with a cutter at the end of a light pole, such as is used by the foresters and gardeners in Europe. Care, however, should be exercised in handling these bag-shelters, for they are all full of fine stiff spines and hairs cast from the bodies of the caterpillars. If these fall upon the hands and arms they may enter the skin, and sometimes cause a very painful and serious rash.

A settler near Nevertire, in the course of conversation, when I was collecting among the weeping myalls, warned me of the unpleasant consequences of handling these bag-shelters. He said that once when cutting them off some trees while on horseback he let one drop upon the horse's back behind the saddle, and the contents were scattered; and shortly afterwards the horse seemed to go almost mad from these tiny hairs getting into the skin.

I might note that the employees of the Gypsy Moth Commission, at Boston, when going through the somewhat similar nests of that moth, were well aware of the stinging properties of the hairs, and always wore long gauntlet gloves to protect their hands and arms.

Mr. H. L. White, of Belltrees, sent me the following information, accompanied by a series of photographs of the bag-shelter moths. He wrote: "These grubs, which I think are known as 'Processional caterpillars,' are doing great damage to the wattle trees about here, and I shall be glad to hear of any practical method for their destruction. Originally this part of the Upper Hunter contained many large clumps of the Yarran (*Acacia hemalophylla*), which with one exception have all died out, owing in my opinion to the ravages of these caterpillars. The exception referred to is a clump of about 10 acres close to Belltrees woolshed. I have practically protected these trees for the last ten years, but the caterpillars have now beaten me, and this beautiful patch of timber is doomed, these hairy grubs having again stripped off half the leaves this autumn (1916). Their nests are a wonderful sight, many as large as small buckets. When I first started I put on three men to cut out and burn these nests; but the contents, excrement, cast skins, and fine hairs fell upon them in such quantities that two of them became affected with itch in such a bad form that they had to attend the local hospital. For many years I expended hundreds of shot cartridges shooting the nests down, then I tried spraying with paris green, but without satisfactory results; but even with an effective mixture it would require a special spraying outfit to reach the topmost branches of the acacia."

The moths appear early in November in the Riverina district. They lay their egg clusters upon the branchlets enveloped in the buff-coloured downy scales stripped from the body of the moth. This rounded matted mass



Bag-shelter Caterpillars (*Teana contraria*, Walk.).

1 Female M.o.h.

2. Larva.

3. Male Moth.

4. Bag shelter, or nest in which the Caterpillars live.

contains upwards of 200 smooth shining light brown eggs, and there are frequently as many as a dozen of these egg masses upon a single tree. The tiny brown larvæ, thickly clothed with thick hairs, hatch out early in January.

These gregarious caterpillars have the habit, common to a number of species of the family *Liparidæ*, of forming "bag-shelters." A branchlet of twigs and leaves are drawn together with silken strands, and are finally enclosed in a stout yellowish-brown silken bag, which is usually rounded and narrow at the base where it encircles the stem, and broadest and often open at the apex. Within this shelter the caterpillars cluster together, enveloped in the contents of excrement and cast skins during the daytime, crawling out of the shelter-bags at night and feeding upon the surrounding foliage, until in a badly infested tree every leaf has been devoured.

The full-grown caterpillar measures about 2 inches in length. Head reddish brown; body of uniform thickness thickly clothed with stiff reddish brown hairs. Thorax and abdominal segmental divisions barred with black, each bearing a central band of raised tubercles with shorter white and reddish-brown hairs.

When touched they curl up into a ball, and remain motionless for some time. When full-fed they crawl out of their bag-shelters and burrow into the soil beneath the tree: here they construct loose felted oval cocoons with the hairs of their bodies, and here they pupate.

The perfect moths vary in size. The male has a wing expanse of about 2 inches; that of the female a third larger. They are of a uniform dark brown tint. The wings are thickly covered with soft brown hairs, and have an oval white spot in the centre of each fore wing, and a smaller and indistinct one in the centre of each hind wing. The head and thorax are thickly clothed with long brown hairs with bright yellow lance-shaped tips. The thick rounded body is covered with bright reddish orange down, barred with black at the apex of each segment, the tip lighter coloured.

PARASITES AND NATURAL ENEMIES.

No natural enemy was known to infest the Bag-shelter moth in any stage of its development until two years ago. Towards the end of 1919 Mr. F. Campbell, of Cooinbil Station, discovered a moth parasite laying her eggs in the egg masses of this moth on the Boree trees. He wrote: "I yesterday made what I think may be a remarkable discovery. I found on a Boree tree about twenty hairless caterpillars in the egg clusters of the Boree moth, about half an inch in length, instead of the Boree moth eggs. It therefore appears to me that they were parasites eating the eggs and so repress the cause." Mr. Campbell sent the live parasitic caterpillars down to me, and I bred out several moths, which Dr. Jeffries Turner says are *Titanoceros themoptera*. I made arrangements to visit Cooinbil at the end of the year when the moths were depositing their eggs upon the acacias, and with the manager, Mr. Reid, I obtained some hundreds of egg masses. (December, 1920.) But in spite of the most careful investigation I only found one egg mass with the eggs of the parasite, and these proved to be infertile. So that there is not much hope of this remarkable parasite being effective.

A Chalcid Wasp Parasite.—While the egg masses thus obtained were under observation in glass-topper boxes, a few metallic chalcid wasps bred out. These chalcid wasps were evidently egg parasites, but the percentage was very small compared with the thousands of tiny moth caterpillars that emerged from the egg masses.

The Reddish Buff Wattle Moth (*Entometa australaia*, Lewin).

This moth is of a uniform yellowish buff colour diffused with red, most prominent upon the hind wings. The front of the head is produced into a pointed snout projecting in front; the round black eyes are half buried at the base, and the finely serrate antennæ stand out above the head. In the centre of the fore wings is a tiny raised spot, with a few very indistinct dots of darker tint crossing the tips. The moths are somewhat variable in size, and in shades of colour form reddish to yellowish buff. They average about 2 inches across the outspread wings.

The moths deposit their eggs upon the foliage of the black wattle. The resultant larva rests along the twigs and feeds at night; the marginal hairs rest against the twigs, and even when the larva is full grown render such a wonderful protective colouration and shape that, unless it moves, it is very difficult to detect upon the bark.

Mr. Luke Gallard, to whom I am indebted for specimens of the larva, says that when full grown it measures up to $1\frac{1}{2}$ inches in length, and that it is greenish-grey in colour. The larva has two transverse black bars across the thorax, which only show out when the caterpillar is crawling about. Its upper surface is rounded, and is lightly clothed with fine grey hairs which form a thick fringe along the sides, head, and anal extremity. The head is small; the under-surface flattened; it has three pairs of small legs, four pairs of prolegs, and large anal claspers. When full grown it spins a compact white silken cocoon attached to the foliage of its food plant. Mr. Gallard says: "I took six of these caterpillars off a black wattle growing at Narara, New South Wales, in October, on the 8th of the month they pupated, spinning themselves up in closely woven white silken cocoons; on the last day of the month the first moths bred out, and the last emerged on November 11th."

This moth has a wide range along our coastal area. French has figured it as "The Pinara grub of the apple," *Pinara nana*, Handbook of the Destructive Insects of Victoria, Pl. IV, 1909. He says it attacks the foliage of the apple in Victoria. Gallard says: "I see them occasionally on fruit trees, and rose bushes, but these are only strays."

The Green Looper Moth (*Euchloris submissaria*, Walker).

There are a number of the delicate brightly tinted moths belonging to the family *Geometridæ*, whose larvæ feed upon the foliage of the different species of wattles. This is one of the commonest species, the larvæ of which is frequently taken in the early summer months when beating the wattle foliage over an umbrella.

It is of the usual slender cylindrical form. It is of a dull buff or light brown tint. Though it remains perfectly erect and motionless when resting on the branchlet, it is very active when disturbed. The moth is a very delicate insect, with the wings tinted a rich deep green colour. The antennæ, front margin of the fore wings, and the outer edge of both pairs, a stripe down the centre of the thorax and body, and the legs are creamy white to buff. There is also a delicate indistinct wavy pattern across the centre of the wings. The perfect moth measures about $1\frac{1}{2}$ inches across the outspread wings.

CHAPTER XIV.

OTHER INSECTS OF THE WATTLE.

Wattle Gall-fly (*Cecidomyia acaciæ-longifolia*, Skuse).

The members of the dipterous family Cecidomyiæ are known as gall gnats, because a number of species deposit their eggs in the flowers or leaf tissue of different plants, and abort the plant tissue in all kinds of curious forms. These delicate two-winged flies are remarkable for their beautiful bead like jointed antennæ clothed with fine hairs. The above species attacks the minute seed-pods of the long-leaved wattle (*Acacia longifolia*), and deposits her eggs in the ovaries. She thus causes each one to become a twisted tube, so that each bunch of seed-pods becomes a mass of contorted swollen brown tubes, and in each tube is concealed the tiny reddish larva of the gall gnat. This seed infestation is very common upon the long-leaved wattles growing on the foreshores of Sydney Harbour, and is also found all along our coast where these wattles are to be found.

Another undescribed species attacks the seed-pods of the weeping myall (*Acacia pendula*), in the western scrub.

The Green Membracid (*Sextius virescens*, Fairm.).

This wattle froghopper is a typical form of the family *Membracidae*, the members of which are well represented in Australia, and are found on a number of our forest trees. All the *Membracidae* are remarkable for the abnormal structure of the prothorax which is produced in front and on the sides into spines or clubbed processes, and with the hind portion extending right down over the centre of the back. Several species of the genus *Sextius* are peculiar to different species of wattle, and are often very numerous. This is one of the commonest species upon the young wattles, where they are much sought after by several species of ants that come to obtain the sugary secretion, popularly known as "honey dew," that they discharge from the abdominal glands.

The female slits the bark with her ovipositer, and lays the eggs in rows; the young larvæ and pupæ, as well as the perfect insects, being found clustering along the branchlets; but as soon as disturbed they crawl round the twig away from their enemies, and when touched they spring from the hind legs and jump for a considerable distance.

It is of the usual wedge-shape, broadest above the face, and tapering to a point at the tip of the wing, and its general colour is green shaded with yellow, the legs of the latter colour, and the under surface covered with floury secretion. The head is small, flattened in front, with large eyes on either side; the thoracic shield, forming an angular point on either side tipped with brown, turns over the back forming a slender curved keel, coming a sabre-like point above the tip of the semi-opaque wings.

The Black Wattle Psylla (*Psylla acaciæ-decurrentis*, Froggatt).

These dainty little insects sometimes smother the branchlets of this wattle with their eggs, larvæ, and pupæ, so that at first sight it looks as if the tree were infested with aphid. They form no lerp or covering, but lay the bright reddish-yellow eggs in regular rows round the twig; the young larvæ as they hatch out crawl lower down, and as they increase in numbers the perfect insects, and the others in all stages of development may be found on the same branch.

The larvae are bright orange-yellow mottled with brown, flattened little creatures, which, when they reach the pupal moult, are of a bright reddish-brown colour, mottled with a darker tint, with little rounded wing-pads on the sides of the thorax, short stout legs, and broad flattened body, clothed with short spiny hairs.

The perfect insect is a delicate four-winged creature, with long slender antennae, and dark mottled brown wings; it measures about 2 lines in length, with head and thorax brown, and the abdomen banded with red and black.

I have collected it on the wattles about the Wagga and Richmond districts.

The White Wax Psylla (*Psylla candida*, Froggatt).

The larvae of this lerp insect feed upon the extreme tips of the foliage of the black wattles all along our coastal areas. They mat the leaflets together with a mass of white waxy secretion which forms a protective covering, under the shelter of which the immature insects feed and develop into the perfect insects. In the Gosford district hundreds of young wattles frequently have the tips of the young foliage covered in this manner. The tiny larvae are yellow, of the usual flattened form, with broad wing-pads, short stout legs, and a somewhat elongated oval green abdomen.

The perfect insects leave the matted foliage and run about on the branchlets; but they are never very numerous or clustered together in numbers like some of the other species. The little psylla measures under one-sixth of an inch in length. It is a general dull yellow colour, with a bright green body, and light brown wings.

The Black Mealy Bug (*Dactylopius albizziae*, Maskell).

This scale was described by Maskell from specimens sent him from Victoria upon the foliage of *Albizzia lophantha*, an introduced tree from Western Australia, but it is a very common wattle scale in this State, being found upon *Acacia discolor*, *A. baileyana*, and about Gosford, smothering all the old black-wattle trees, and apparently helping the other insect pests to kill them a little faster than usual.

The female coccid is under two lines in length, a little longer than broad, with the upper surface convex and the under surface flattened; its outward colour is black; when crushed it gives a purplish stain. It forms no true test or scale, but all the undersurface is enveloped in white, woolly secretion that folds round the outer edges, while two, and sometimes three, transverse bands of the same white substance cross over the dorsal surface, so that an infested tree looks as if the branches had been whitewashed.

The Fluted Cottony Cushion Scale (*Icerya purchasi*, Maskell).

This is a typical wattle mealy bug, common upon several of our wattles, particularly the black wattle and the Cootamundra wattle, when they are cultivated in parks and gardens. It has a curious habit of infesting roses and several creepers when grown in the vicinity of wattle trees.

It has a world-wide reputation on account of its remarkable spread over New Zealand, California, and South Africa; and at one time did an enormous amount of damage to the citrus orchards of California. It is said to have been introduced into North America about the year 1868 on

an *Acacia* from Australia. Though so destructive to vegetation in countries into which it has been accidentally introduced, it is not a serious pest in Australia, because it is heavily parasitised by a number of natural enemies.

The mature female coccid, with her distinctive fluted ovisac of cottony secretion, may measure up to half an inch in length, and they are sometimes thickly massed all over the branchlets, where the little red and black larvæ and delicate two-winged males can also be found.

The Brown Berry Scale Insect (*Cryptes (Lecanium) baccatum*, Maskell).

This remarkable scale insect was originally described by Maskell among the *Lecaniums*, but it is now placed in a new genus. It has a very wide range over the coastal districts on *Acacia decurrens*, *A. linifolia*, and several other slender-leaved varieties. In the western scrubs of the interior of Australia it is common on a number of different wattles, and I have had records of *Acacia pendula* being seriously damaged, and even killed,



Cryptes baccatum (young females).



Cryptes baccatum. Adult females and male puparia (white).

by this pest. All the branchlets were thickly infested with the adult female coccids, which are large, rounded, biscuit-brown creatures—simply a shell covering a mass of larvæ. In the different stages of development they vary from creamy white to pale blue and dull blue to brown, and when full-grown are as large as a pea. The male tests formed of whitish paper-like secretion, massed together on other branchlets.

CHAPTER XV.

INSECTS OF THE RED CEDAR.

The Red Cedar (*Cedrela australis*, Muller).

THIS valuable timber tree ranges from Gosford up the eastern portion of Australia through Queensland to Cape York. It is confined to the patches of semi-tropical scrub that are found at irregular intervals along the coastal valleys, and even into the Liverpool Ranges, which, in consequence, at a very early date, were known to the timber-getters as "Cedar Brushes." They culminate in the truly tropical forests of Cairns and Atherton, North Queensland, which Dr. Mjoberg, the Swedish naturalist, has called "Rain Forests."

This species, closely allied to the species found in Ceylon and India (*Cedrela toona*), is naturally subject to several similar insect pests, and the Red Cedar-tip Moth, found in New South Wales, appears to be identical with the Indian pest.

The Red Cedar Moth.

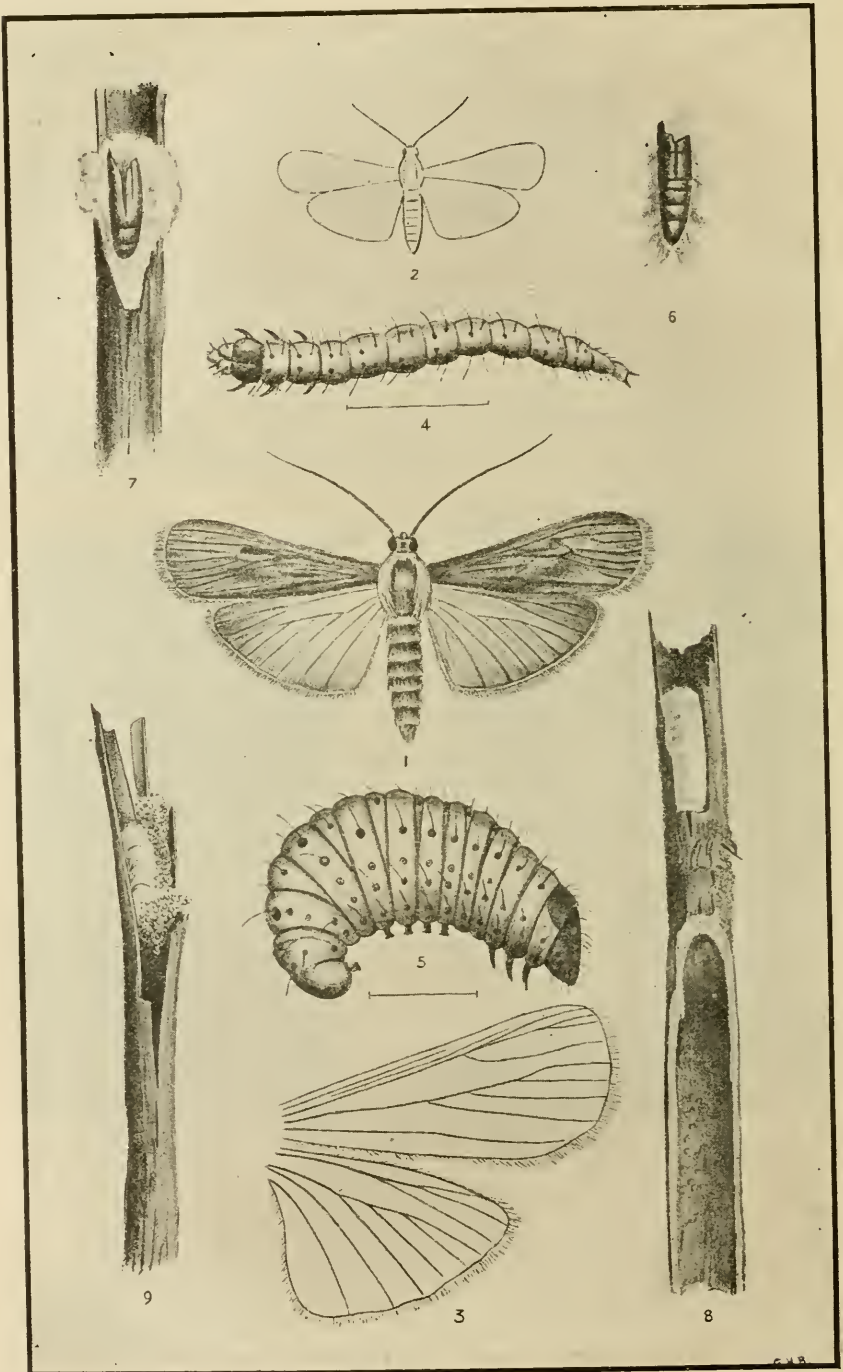
(*Hypsiphla robusta*, Moore; *Epicrocis terebrans*, Olliff).

In 1889 the young cedar trees (*Cedrela toona*), which had been planted at the Gosford State Nursery, were attacked by a moth caterpillar. The eggs were evidently deposited in the tips of the terminal branchlets, the caterpillars boring their way in, and feeding in the centre. The overseer of the State nursery set to work, and cut out the damaged leaders, and burnt a great number of them. Specimens of the infested wood were sent to the Australian Museum for identification; and Mr. Olliff bred out a fine series of the moths. He paid a special visit to the infested plantation at Gosford, and later on published the result of his investigations. This report, together with a plate illustrating its life history, was published in the *Agricultural Gazette of New South Wales*, vol. 5, p. 513, 1894; it was entitled, "On a Species of Moth (*Epicrocis terebrans*) Destructive to Red Cedar and other Timber trees of New South Wales." He identified it as a new species of Zeller's genus *Epicrocis*, in the family *Phycitidae*.

Though not so plentiful in the Gosford district at the present time, this moth has a wide range through our coastal brushes; and we have recently bred a fine series of moths from caterpillar-infested twigs sent by Mr. James Taylor, Public School, Wingham district, which pupated towards the end of June, and emerged as perfect moths in the middle of July.

Further investigations show that Olliff's species is evidently identical with the Cedar-tip moth of India upon the "Toon," *Cedrela toona*, where the caterpillars bore into the tips of the young shoots of this tree in a similar manner. These caterpillars also damage the mahogany forests in India and Ceylon. Moore described this moth under the name of *Hypsiphla robusta* (family *Pyratidea*), in his "Lepidoptera of Ceylon," vol. III.

In vol. I of the *Indian Museum Notes*, 1889, this moth is described and figured (p. 35, plate iii). In the 5th volume of the same Journal (1903), in an article on "Insect Pests of Forest Trees," p. 104, a great deal of information is given regarding the habits and life history of this forest moth.



Red Cedar Moth (*Epicrocis terebraus*, Olliff).

1. The Red Cedar Moth.
2. Outline of same, showing natural size.
3. Venation of same.
4. Larva about two-thirds grown.
5. Full-grown larva.
6. Pupa, and portion of cocoon.
- 7, 8, and 9. Damaged stems, showing boring of larva; cocoon, and pupa.

In "Indian Insect Life," p. 514, Lefroy and Howlett state—"The damage is extremely characteristic, each shoot dying back from the tip, and the pest is a serious obstacle to the growth of this shade tree in some places."

The forest areas of the coast of Queensland are infested with this moth, and Mr. Walter D. Dodd informs me that in the Cairns district this moth is very plentiful. He writes: "The cedars are very hardy trees, and I do not know of one instance of a tree being killed, but the growth of the tree is retarded year after year; it is, therefore, difficult to produce trees which will develop good timber values. Young trees are attacked when several feet in height and suffer until they reach a height of 20 feet. Young cedars growing in clearings are much more liable to attack than those in the scrub."

Here the eggs are laid mostly under the leaves, and the larvæ entering the tips of the shoots excavate the whole of the centre, pith and wood, to a distance of about a foot. It is a common thing to see otherwise healthy trees of 12 to 15 feet in height with all the shoots dead or dying. The pest increased during the summer months and was very active in January.

The caterpillar when full grown is rather a thick-set, rounded grub about an inch in length. It varies in colour from bright green to dull purple, sometimes having a greyish tint, with a salmon-coloured stripe along the sides. The head and upper surface of the first thoracic segment and transverse rows of tubercles on all the segments shining black, each of the tubercles ornamented with a slender black hair. Legs well developed, four pair of pro-legs, and anal claspers. When full fed the caterpillars appear to be more slender, and is a much duller creature. It is often greyish-brown with only a faint greenish tint. The habits of the larvæ when pupating vary considerably, sometimes the cocoon is only a flimsy affair, at other times when at the bottom of the burrow in the cedar shoot it is an elongate, stout cocoon composed of coarse, tough grey silk. The moth varies in size; the larger female measure up to $1\frac{1}{2}$ inches across the out-spread wings, and the male somewhat less. The moth is of a uniform dull reddish-brown tint, mottled with fine silvery grey scales that form a delicate pattern on the fore wings. The hind pair are silvery grey with a delicate pinkish tint beneath, the fine grey hairs covering the upper surface; the outer margins are darkest.

Leaf-eating Cedar Moth (*Leptocneria reducta*).

On the 30th March, 1922, a number of hairy caterpillars were received from Mr. Collins, of Stroud, New South Wales, with the information that for the last few years, at this time of the season, a Red cedar growing in his garden had been infested by these pests and the foliage destroyed.

The hairy, rusty brown caterpillars are elongate in form, and measure about $1\frac{1}{2}$ inches in length. The ground colour is dark-brown; the head yellow, clouded with black in front; the eyes small, rounded, and standing out on the sides. Legs and claspers dull yellow. Dorsal surface of segments bearing dull reddish tubercles; each covered with long stiff, spiny grey hairs, interspersed with longer finer black hairs which form a regular coat over the whole dorsal surface of the caterpillar, shorter and more rusty red on the abdominal segments; the slender black hairs extending nearly half an inch beyond the tip of the anal segment. Pupæ.—When pupating they spin a flimsy open web of silken strands in the corner of the breeding cage. They

now cast off the larval skin and the long hairs, but they retain the short hairs upon the tubercles which now cover the chocolate-brown chrysalis. These fine hairs cover the dorsal surface of the head and thorax and encircle the abdominal segments right to the apex. The head, antennæ, and legs are folded down in front, and the wing pads are deeply ridged. Length, $\frac{3}{4}$ inch.

The moths emerged on the 22nd May. They measure $1\frac{1}{4}$ inch across the outspread wings. The general colour is light chocolate brown, the delicate pectinate antennæ yellowish brown. Head and thorax densely clothed with long downy hair like scales, some with a greyish tint. Body segments covered with close pearly-white scales and fine greyish-brown hairs, the skin beneath showing black spots beneath the scales on the anterior segments. The fore wings thickly covered with silvery-staked spade-shaped scales, interspersed with fine brownish ones; those on the margins are plume-shaped. In the centre of each wing, towards the upper margin are a pair of irregular-shaped oval eye spots, formed of a patch of black scales surrounded with a ring of dull yellow scales. Hind wings uniformly clothed with similar brown and silvery scales to those on the fore pair.

The Queensland Elephant Beetle (*Xylotrupes australicus*, Thom).

This is one of the largest lamellicorn beetles in Australia. She deposits her eggs in decaying vegetable matter, such as dead logs and tree stumps. In old days they used to breed in large numbers from the heaps of megass rotting in the vicinity of the sugar mills in North Queensland. The members of this genus are large black beetles remarkable for the difference in the sexes. The female has the head small and the thorax round in front like other beetles. The male has a stout curved horn standing out and turning upward from the head; the prothorax is swollen and is produced in front into a great curved horn forked at the tip turning over above the head.

A large allied species (*Xylotrupes nimrod*) is a well-known pest in the coconut plantations in the Pacific Islands. It damages the young palms.

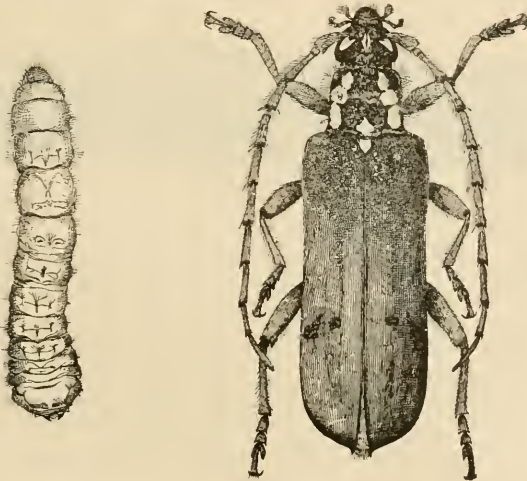
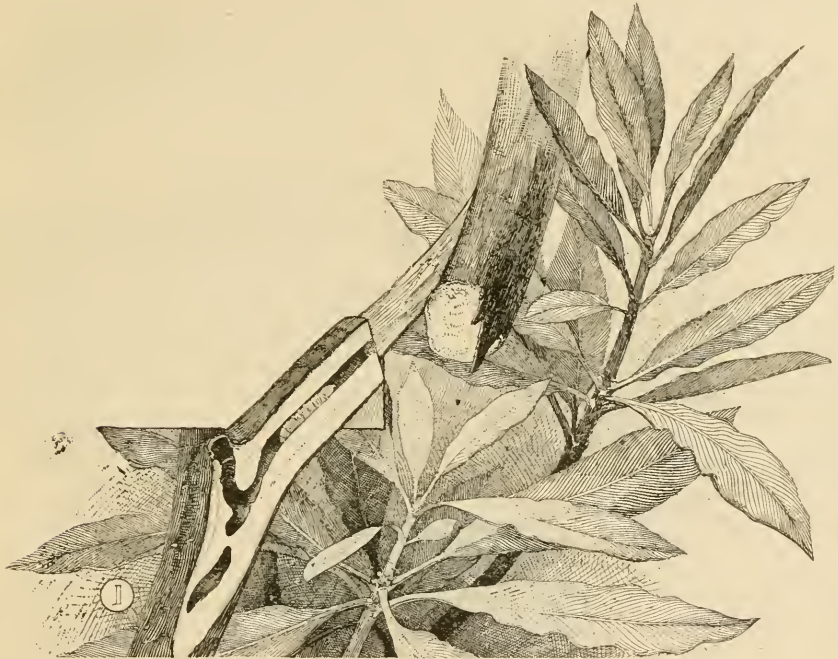
The adult beetles in North Queensland used to congregate for mating purposes on the branches of the Jacaranda trees growing about the home-steads and feed upon the soft bark.

Mr. C. E. Wood, now Director of Agriculture at Tonga, says in correspondence that when he was manager of the Kamarunga State Nursery at Cairns, North Queensland, he noticed these beetles damaging the Red cedar. "When walking past a small Red cedar (*Cedrela toona*) I happened to look up and saw about a couple of dozen elephant beetles on a branch about 3 inches in diameter. I climbed up and found they were tearing off the bark. After collecting the beetles I found the branch looked as if it had been hacked about with a blunt saw, while large patches of bark on the upper surface of the branch had been entirely torn or chewed off." This was not an isolated case. He found them carrying on the same work when visiting another district, Malandra, 2,000 feet above sea-level.

My friend, Mr. W. D. Dodd, writing from Cairns about the "Cedar-tip moth," says: "Regarding other pests of the Red cedar, the Queensland elephant beetle makes a nuisance of itself by grooving the bark of the young cedars." In the Solomon Islands a reward is given to the native labourers for every elephant beetle brought in to the manager. It might be worth while following this example in a cedar plantation.

Pittosporum Longicorn (*Strongylurus thoracicus*, Pascoe).

This handsome longicorn beetle was described by Pascoe in the "Transactions of the Entomological Society, 1857." I gave an account of the damage it caused to pittosporum hedges in a paper entitled "Some Garden Pests" published in the *Agricultural Gazette* in 1902. It usually confines its attention to the large-leaved pittosporum (*P. eugenoides*); but it sometimes damages the branches of the White Cedar in the same manner.

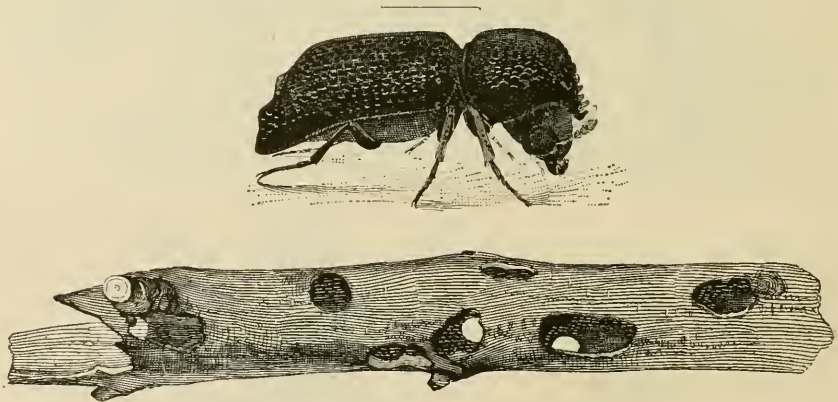


The beetle deposits her egg in the bark of the branch. The larva eats its way into the centre of the stem, but it usually eats round in a circle under the bark before it turns downwards; it then tunnels down the centre of the branch for a distance of several feet. As the wood dries, the branch snaps off at the circular cut, and it is a common thing to see most of the larger shrubs with their leading branches pruned off in this manner. While at work, this elongate dull yellow larva often comes through the surface; and a little stream of dust (gnawed wood) trickles down to the ground. When full fed the larva pupates at the end of the bore.

The perfect insect is a handsome biscuit-brown beetle, with the back of the darker head and the sides of the thorax daintily marked with white. The centre of the wing covers are crossed with an irregular bar of dark-brown markings. The antennæ and legs are long. The beetle measures about an inch in length.

The Auger Beetle (*Bostrychopsis jesuita*, Fabr.).

This is one of the largest wood-boring beetles of the family *Bostrychidae* found in Australia. It has a wide range over the inland parts of the continent, where it bores into the branches of many of our scrub trees. It was first recorded as a pest in the *Agricultural Gazette of New South Wales* by Mr. Olliff in 1891 as "A wood-boring beetle in Pepper and White Cedar trees" growing at Cobar, New South Wales. Mr. French obtained a large number from an orchard at Mildura where they were boring into the dead stumps of orange trees. I obtained the specimen of the damaged branch of the orange tree here figured from the Government Experiment Farm at Moree, New South Wales.



It has received the popular name of "Auger beetle" on account of the clear-cut hole the beetle makes into the side of the dead branch attacked. Several sometimes infest the same branch, boring their tunnels straight down side by side; the branch simply becomes a wooden tube before they abandon it. The short, thick-set white larvæ feed and pupate in the dead wood. The shining, black, cylindrical-shaped beetle measures slightly over half-an-inch in length. The tubular head is turned downwards beneath the projecting cowl-like prothoracic segment. There is a brush of light yellow hairs above the jaws; and the rounded eyes and thickened antennæ stand out on the sides of the head.

CHAPTER XVI.

INSECTS OF THE FIG TREES.

The Moreton Bay Fig (*Ficus macrophylla*, Desfontaines).

Though the members of the genus *Ficus* can be hardly called timber trees, or their wood be considered of any market value, yet they and the insects inhabiting them should be included in any work on forest insects. Their importance lies in their value as shade trees in our parks, gardens, and avenues; and in the early days large numbers of the Moreton Bay fig were planted about Sydney Harbour.

Queensland coastal forests are particularly rich in giant fig trees; and Mueller lists forty species from the whole of Australia. The insect fauna of the fig trees is very interesting. A number of different species feed upon the foliage, and wood-borers live in the timber; but it is when a giant fig tree is blown down in the forest and starts to die that it becomes a centre of infection for many different wood and bark feeding insects.

The remarkable fig insects *Blastophaginae*, minute hymenoptera that live and breed in the ripening fruit, are responsible for the caprification of the cultivated figs in the Capri figs of the Mediterranean region. These are represented by many curious forms in Australia. Three at least are found in the fruit of the Moreton Bay fig, and nearly all our wild figs have some internal wasp of the same type.

The Hawaiian Forestry Department consider the Moreton Bay fig such a suitable tree to broadcast over their islands to protect the denuded areas from soil erosion that last year they sent Mr. Pemberton, one of their economic entomologists, to New South Wales.

He not only collected large quantities of the seeds for propagation purposes, but also the fig insect (*Blastophaginae*) so that they could fertilize the fruits of the fig trees, previously planted, and render their seeds fertile.

The Fig Tree Longicorn (*Batocera boisduvili*, Hope).

This great longicorn beetle has been bred in the stems of the fig trees in the forests of our northern rivers and southern Queensland. It is our representative of the genus *Batocera*, which contains a number of large handsome longicorns, ranging into the tropical scrubs of New Guinea and the Malay Peninsula. They are nearly all fig beetles. Their great white larva, several inches in length, cuts tunnels through the wood in all directions, and finally pupate in the end of the last one.

French figures this species in Part V of his Handbook of the "Destructive Insects of Victoria, 1911," but he quotes Illidge as his authority regarding its life history. The latter states that he bred these beetles from larvæ taken from the stems of *Ficus macrophylla* and *F. australis*.

This beetle measures $2\frac{1}{2}$ inches in length and is broad in proportion. It has very stout antennæ, turned down along its sides, that measure 4 inches in length. The prothorax is produced into a spined boss on either side. The general ground colour is dark slate grey to bluish black marbled with black and it is mottled along the outer half of the wing covers with creamy white.

This beetle was described by Hope in the magazine of "Natural History" in 1839. Four other species have been described from Queensland.

Buff-coloured Fig Longicorn (*Monohammus fistulator*, Montrouz).

Most of the beetles belonging to this genus are sub-tropical in their distribution. Over a hundred species of the genus *Monohammus* have been described, chiefly from America, Africa, Asia, Malay Archipelago, and Australia. This species has a very wide distribution; German described the type from Java in 1824; Pascoe, redescriving it many years later, added six other localities in the Malay Archipelago, India, and Ceylon, and he first recorded it from Queensland.

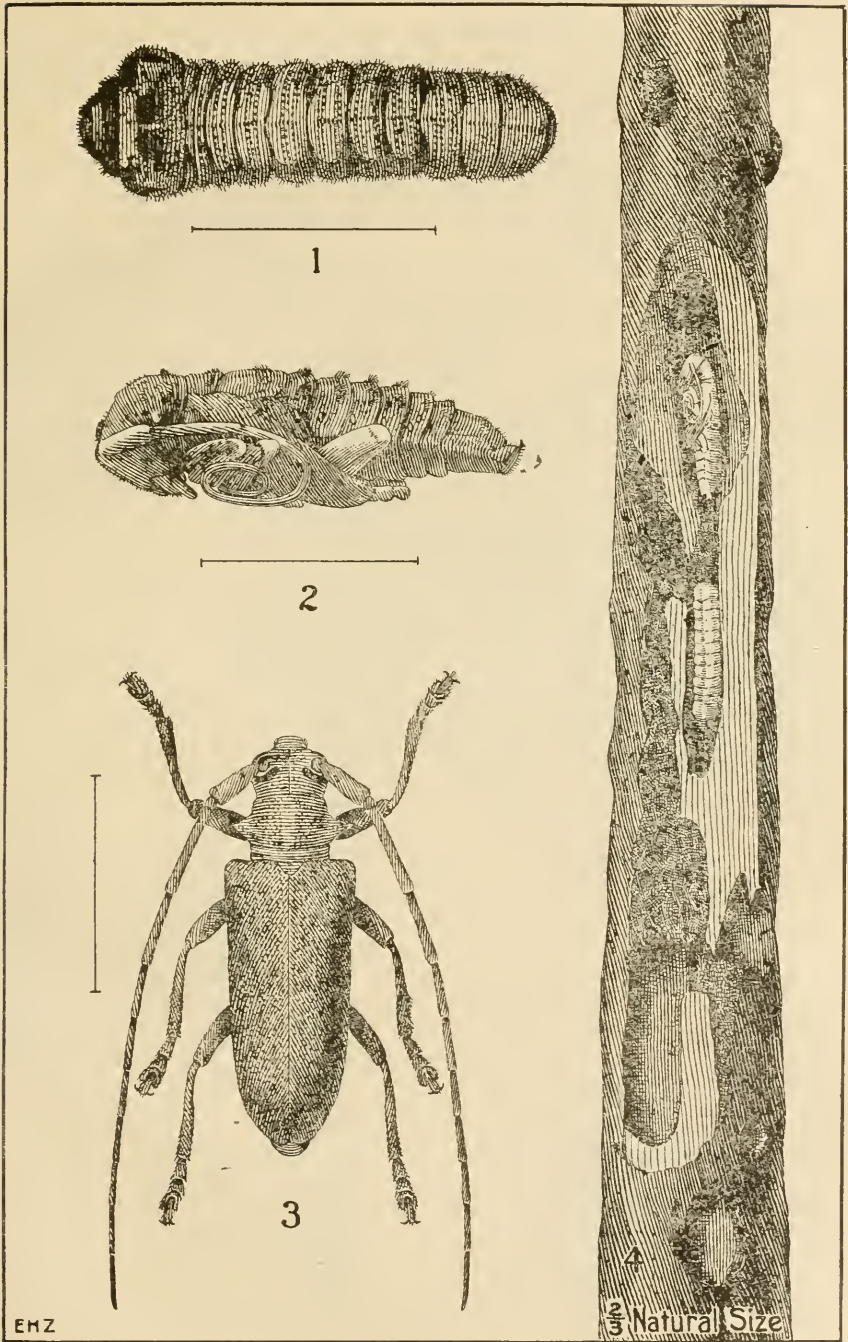
In Master's Catalogue it is listed from Queensland, Victoria, and New South Wales. Mr. A. M. Lea tells me he has specimens from Kangaroo Island, South Australia; and Mr. C. French, junior, informs me that it is not uncommon in southern Victoria. I have bred it from fig stems in Sydney gardens and also from old passion vine stems and from grape vines. The natural food of most of the forest species are the stems of fig trees.

All the members of the genus *Monohammus* are handsome dark-coloured beetles, thickly clothed with very fine hairs or pubescence. They are somewhat elongate in form; have long, smooth, slender antennæ; the prothorax is produced on either side into a stout, short, conical spine. They are related to the giant longicorns of the genus *Batocera* previously described.

The larva is shining dull white in colour, with the head dark chocolate brown, furnished with stout black jaws. Length, $1\frac{1}{2}$ inches. The first thoracic segment is large, flattened on the dorsal surface, marked on the sides with light brown, the central portion finely graulated with minute reddish dots; the second and third thoracic, and the following abdominal segments, except the eighth and ninth, deeply constricted, and each bearing an elongate oval patch of raised warts, forming four rounded ridges on the upper surface, with a corresponding patch on the under side, which is formed of two lines swelling into a rounded lobe at the extremities; the last two (eighth and ninth) segments rounded without any markings. Some larvæ, evidently in a much later stage, which did pupate, and were either undeveloped or in an unhealthy condition, were much darker coloured and more flattened and flanged along the sides than the typical form.

The pupa is dull white, flattened and broad across the centre; the head small, turned down in front, with scattered reddish hairs on the face; the antennæ thickened and turned downward. The dorsal surface of the thoracic segments are flattened; the first two small, clothed with a double patch of stiff reddish-brown hairs. The first six abdominal segments are ornamented with similar patches of hairs; on the seventh the hairs form a narrow transverse band; the anal segment slightly cleft at the tip.

The beetle has a groundwork of pitchy-brown colour, but the whole insect is so thickly covered with a yellowish-grey pubescence that the dark ground tints are only visible through the number of fine punctures in the upper surface. These impressed black pits form patches on the head and thorax, but are thickly and somewhat irregularly scattered all over the slightly-crenulated wing covers. Average length 1 inch, but sometimes a third longer. The long slender antennæ dark on the two basal joints are with the following ones yellowish-brown, all clothed with fine buff pubescence. It measures $2\frac{1}{4}$ inches in length



Buff-coloured Fig Longicorn Beetle (*Monohammus fistulator*).

1. Larva of beetle. 2. Pupa. 3. Dorsal view of beetle. 4. Showing damage caused to a stem of a passion vine by the larvæ.

EMZ

$\frac{2}{3}$ Natural Size

The Fig-branch Borer (*Hylesinus fici*, Lea).

This beetle belongs to the family *Scolytidæ*, the members of which are well-known forest insects. In Europe and North America a great deal of damage is caused by their ravages.

Ratzenber, in his work on "Forest Insects, 1836," describes a species of this family, *Scolytes pygmaeus*, that destroyed thousands of young oak trees in the Bois de Vincennes, France. The pine forests of Germany are constantly devastated by the larvæ of *Tomicus typographagus*. Packard enumerates twenty-three species attacking pine trees in the United States.

Thirteen species of the genus *Hylesinus* were described in Chapuis' Monograph "Synopsis de Scolytides," published in the Memoirs of the Societe Royale de Sciences de Liege. Eight came from Europe, three from America, one from Ceylon, and this one from Australia.

I have found this beetle very plentiful in the terminal branches of a wild fig growing on the ridges near Gunnedah, New South Wales. It probably infests the stems of our small yellow fig, *Ficus rubiginosa*, growing among the rocks about Sydney Harbour; for we have on several occasions obtained it in the stems of cultivated garden figs doing a considerable amount of damage.

The adult beetle is black, but varies from that colour to various shades of reddish-brown while undergoing its development while feeding in the centre of the fig branch. It is a short thick-set beetle, measuring one-sixth of an inch in length. The head is turned down in front, and has five jointed pectinate antennæ. The head and thorax are slightly rugose, and lightly clothed with fine hairs. The wing covers are impressed with fine parallel lines (striæ), and are clothed with short hairs. The legs are short, and toothed on the inner edges of the tibræ, and all the under-surfaces are finely pubescent. The perfect beetles, as well as the short, stout, white larvæ, can be found feeding in the burrows down the centre of the fig branches.

The Fig-leaf Beetle (*Galeruca semipullata*, Clark).

The spindle-shaped eggs of this chrysomalid beetle are laid in little clusters on the surface of the leaves of the Moreton Bay figs, particularly those of young trees when planted out in parks or street avenues. The dull yellowish-green caterpillars feed upon the surface of the stout leaves, and completely skeletonize them; the leaves curl up, dry, and fall off soon after the grubs are fully fed. When full grown these grubs crawl down the trunk of the tree, and bury themselves just under the surface of the soil; here they pupate. Within a very short time, particularly if the first infestation appears in the early part of the summer, a fresh crop of beetles emerge.

These beetle larvæ exude some secretion that protects them from nearly all insectivorous birds. A handful of the grubs thrown into the fowl yard has no attraction whatever for the chickens. The adult beetle measures under half an inch in length. It is of a uniform dull reddish-brown colour; with the antennæ, legs, sides of the head and antennæ shading into dark-brown. The eleven jointed antennæ are somewhat thickened. The prothorax is corrugated. The surface of the broad rounded wing covers are finely granulated.

This beetle has a wide range over New South Wales. For some years it has turned its attention to the cultivated figs in our gardens; if neglected it does a great deal of damage to the trees, so that it has now become more a garden than a forest tree pest.



The Fig-branch Borer (*Hylesinus fici*, Lea).

Some years ago this beetle defoliated a number of Moreton Bay fig trees planted in a street in Kogarah, near Sydney. When infesting young trees, they are easily destroyed in the larval state by spraying or dusting them with arsenical mixtures.



No. 1.—Larva of Fig-leaf Beetle (*Galeruca semi-pullata*, Clark).



No. 2.—Pupa of Fig-leaf Beetle (*Galeruca semi-pullata*, Clark).



No. 3.—The Fig-leaf Beetle (*Galeruca semipullata*, Clark).

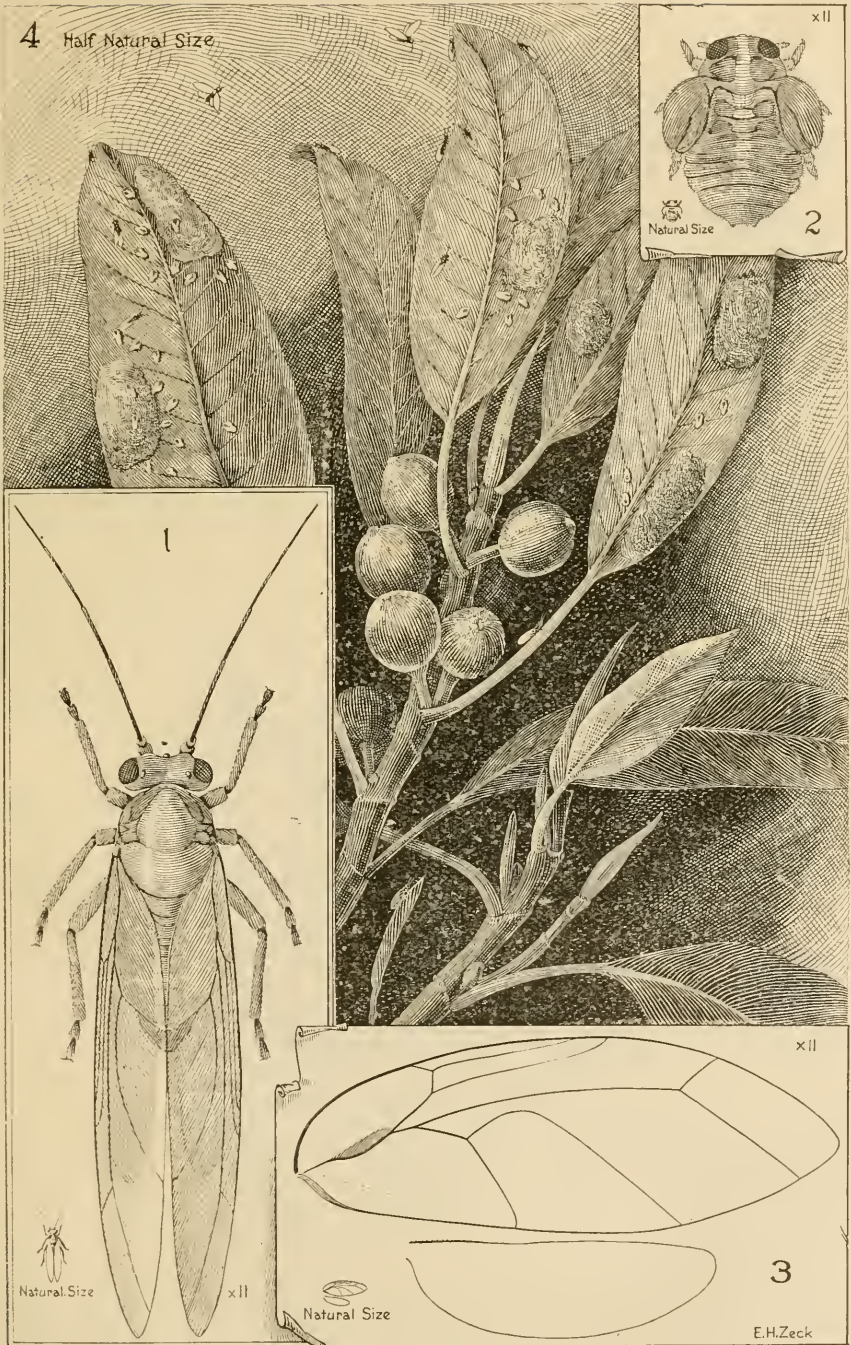
The Moreton Bay Fig Psylla (*Mycopsylla ficis*, Tryon).

This large lerp insect has a wide range along the coast from New South Wales to Queensland, where it infests the foliage of the Moreton Bay fig (*Ficus macrophylla*). It was first noted by Tryon; he, however, only described the eggs and larvæ in a paper he contributed to the pages of the Transactions of the Natural History Society of Queensland, 1892-94, in a paper entitled "Two Insect Pests of the Moreton Bay Fig." I published a detailed description of this and an allied species in my Monograph of the Psyllidæ of Australia in the Proceedings of the Linnean Society of New South Wales in 1901.

The female deposits her dark reddish-brown eggs in patches of about fifty on the under-surface of the leaves. The tiny pale yellow larvæ pierce the upper surface of the leaf and cause the sap to flow out in little buttons; these drops coagulate into regular folds and run together into a sticky viscid mass which covers a score or more of these feeding larvæ. When fully fed the semi-pupæ crawl out of their protective secretion; and, resting on the surface of the leaf, the pupal skin splits along the back, and the perfect-winged Psylla emerges and rests among the foliage. The pupa, when resting on the leaf preparatory to its final transformation, is a very curious squat rounded creature, with broad head, a pair of short horn-like antennæ, rounded wing pads, short legs, and a rounded body; it is mottled with yellow and brown, and looks like a little insect frog with its swollen greenish body.

The perfect Psylla is of a delicate ochreous yellow tint; the long antennæ, margin of head, thorax, and abdominal segments are clouded with darker brown; and the thorax blends into orange. The eyes are red and the ocelli bright orange. The large transparent wings are oval, pointed towards the extremity, and extend a considerable distance beyond the tip of the abdomen.

The infestation of the foliage by these lerp insects causes a large number of the leaves to wilt and prematurely fall in the summer. These leaves fall upon the paths, roadways, and grass, and stick to everything that touches them; they make a great mess wherever an avenue of this large tree is planted.



The Moreton Bay Fig Psylla (*Mycopsylla fic*).

1. Adult insect.
2. Larva.
3. Outline of wings showing venation.
4. Infested foliage showing eggs, and lumps of exuding sap under which the larva live.

E.H.Zeck

CHAPTER XVII.

INSECTS OF THE CASUARINAS.

The She-oaks (*Casuarinas*).

The remarkable-looking group of Australian trees belonging to the Genus *Casuarina*, popularly known under the names of "Bull-oaks," "She-oaks," "River oaks," and "Belars," are found all over the great continent. They grow in all sorts of situations, from the sea coast, swampy flats, and river courses, to the western scrubs and granite ranges. The branchlets of the she-oaks are infested with a number of different species of scale insects (*Coccide*), and among them some remarkable gall-making species that do a certain amount of damage, but the moth and beetle infestation of these trees is not very serious. In Southern Florida many thousands of *Casuarina equisetifolia* have been planted along the roads and avenues on reclaimed swamp land, along the sea-shore, and as wind-breaks for fruit trees. They are known as "Australian pine" in the United States. This species has also been introduced throughout the West Indies and other tropical regions of North and South America.

The Gall Buprestid Beetle (*Paracephala cyaneipennis*, Blackb.).

This little beetle was described by Blackburn in XVII volume of the Transactions of the Royal Society of South Australia. I recorded its curious life history in the Proceedings of the Linnean Society of New South Wales, 1894.

The beetles deposit their eggs in the branches of the dwarfed she-oak, *Casuarina distyla*, growing on the coast in the vicinity of Sydney. The resultant larvæ, by their action in the wood, cause regular rounded galls to swell out from the infested branchlet; and in the centre of this gall the legless dull white larvæ feed and pupate. They cut their way out through the side of the gall when ready to emerge. The beetle, slender in form, measures a third of an inch in length. It is of a deep metallic tint; the head and thorax are dull metallic bronze, the latter very much corrugated. The wing covers are rich metallic green, and are finely rugose. The legs and underside are dull metallic copper colour. In Florida the "Mangrove borer" has turned its attention to the introduced she-oaks.

She-oak Root Buprestid (*Stigmodera heros*, Gehin).

This fine flower beetle is confined to the she-oak forests of South and Western Australia. French illustrated the life history of this beetle in Part V of his Handbook of the Destructive Insects of Victoria, 1911; he describes it as feeding and pupating in the roots of these trees; he called it the "She-oak Root borer." This is one of the large flower beetles, measuring up to $2\frac{1}{2}$ inches in length and 1 inch across the middle of the back. The small deep-set head is metallic green between the red eyes; the whole of the thorax and wing covers are deep orange red. The thorax is roughened; and the wing covers are deeply marked with irregular parallel striæ and irregular punctures. Legs and under surface are bronzy black.

The Brown Cryptophaga (*Cryptophaga ir orata*, Linn.).

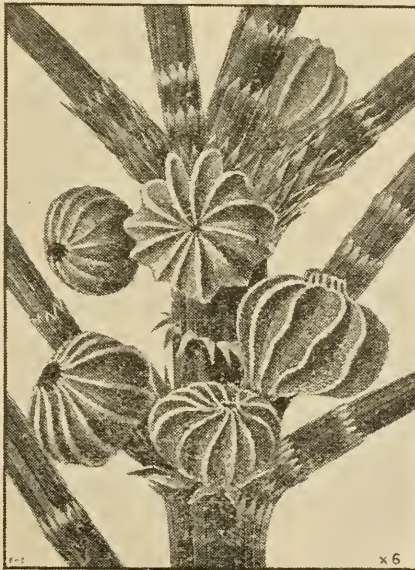
This moth lays her eggs upon the bark of many different species of she-oaks, and has a very wide range over Australia.

The larva has the same structure and habits as the cherry tree borer (*C. unipunctata*), but if the eggs are laid upon the stems of young she-oaks the larvæ sometimes nibble quite a large area of the bark, covering it with a fine web, holding a mat of eaten-up wood dust. The larva frequently forms its chamber in the fork of two branches of the tree.

The moth measures 2 inches across the outspread wings. The fore wings are elongate, of an almost uniform width, and slightly rounded at the tips. They are of a slightly mottled greyish-brown colour. The lens shows that the ground-work of silvery white scales are interspersed with black, brown, and yellow scales; the outer margins are fringed with greyish-brown spatulate scales. The hind wings are light chocolate brown, fringed with silvery white scales of the same spatulate form. The under-surfaces are light chocolate brown, shot with silvery white.

The Calyx Gall (*Spharococcus leaü*, Fuller).

The branchlets of several species of Casuarinas are infested with a number of bract-shaped galls, among which the above have a wonderful resemblance to a tiny pine cone. The round top-shaped galls are usually produced on the branchlets in small clusters, each with a short basal stalk. The expanding gall is composed of a number of sections; these are solid and united on the inner surface of the basal cavity, and the opening is at the apex.



Spharococcus leaü.

They might be easily mistaken for tiny aborted seed cones of the she-oak. Each gall contains a globular pink female coccid and several pupal male coccids. This remarkable gall was originally described by Fuller from Western Australia in the Transactions of the Entomological Society of London, 1899. I have recently found that it is a common gall on *Casuarina cambagei*, the Belar of the western scrub lands of New South Wales.

CHAPTER XVIII.

INSECTS OF THE BANKSIAS.

The Banksias or Honeysuckle Trees (*Banksia serrata*).

This is one of the most typical Australian trees growing along the coast; it sometimes attains a height of 30 feet. The Banksias, together with the *Leptospermums* and *Melaleucas* scrub growing along our coast, form valuable shelter belts which check the sand drifts.

Forty-six species of the Genus *Banksia* are given as Australian species in Mueller's list; the bulk of these are peculiar to Western Australia, ten are natives of New South Wales; and *Banksia serrata* has an extended range from Tasmania and Victoria through New South Wales.

On account of the stiff, hard foliage it is not subject to insect attacks except in the trunk. The young trees are sometimes infested by the Cherry tree borer (*Cryptophaga unipunctata*), which is noted previously as a wattle pest. White ants also destroy some of the old trees.

The Banksia Longicorn (*Paroptites australis*, Erichson).

This large Prionid longicorn was described by Erichson, from specimens obtained in Tasmania, under the name of *Cnemoplites australis* in 1842. It was redescribed by Pascoe under the name of *Macrotoma servilis* in 1863; but the latter is now a synonym of *C. australis*, which has now been placed in the genus *Paroptites*. All the members of the Prionid group of the longicorn beetles are large, broad, dark, reddish-brown insects; and several species live in the trunks of eucalypts and other forest trees.

This is the commonest species in our coastal districts; and it is responsible for the final destruction of a great number of the honeysuckle trees, particularly *Banksia serrata*. All the old trees are tunnelled through the trunk and main branches; and in heavy wind storms the fallen stems show how they are honeycombed by the large white larvæ. Nearly all the older trees are infested with the larvæ; and a honeysuckle tree trunk obtained from the Botanic Gardens yielded over thirty specimens of the perfect beetles the following summer.

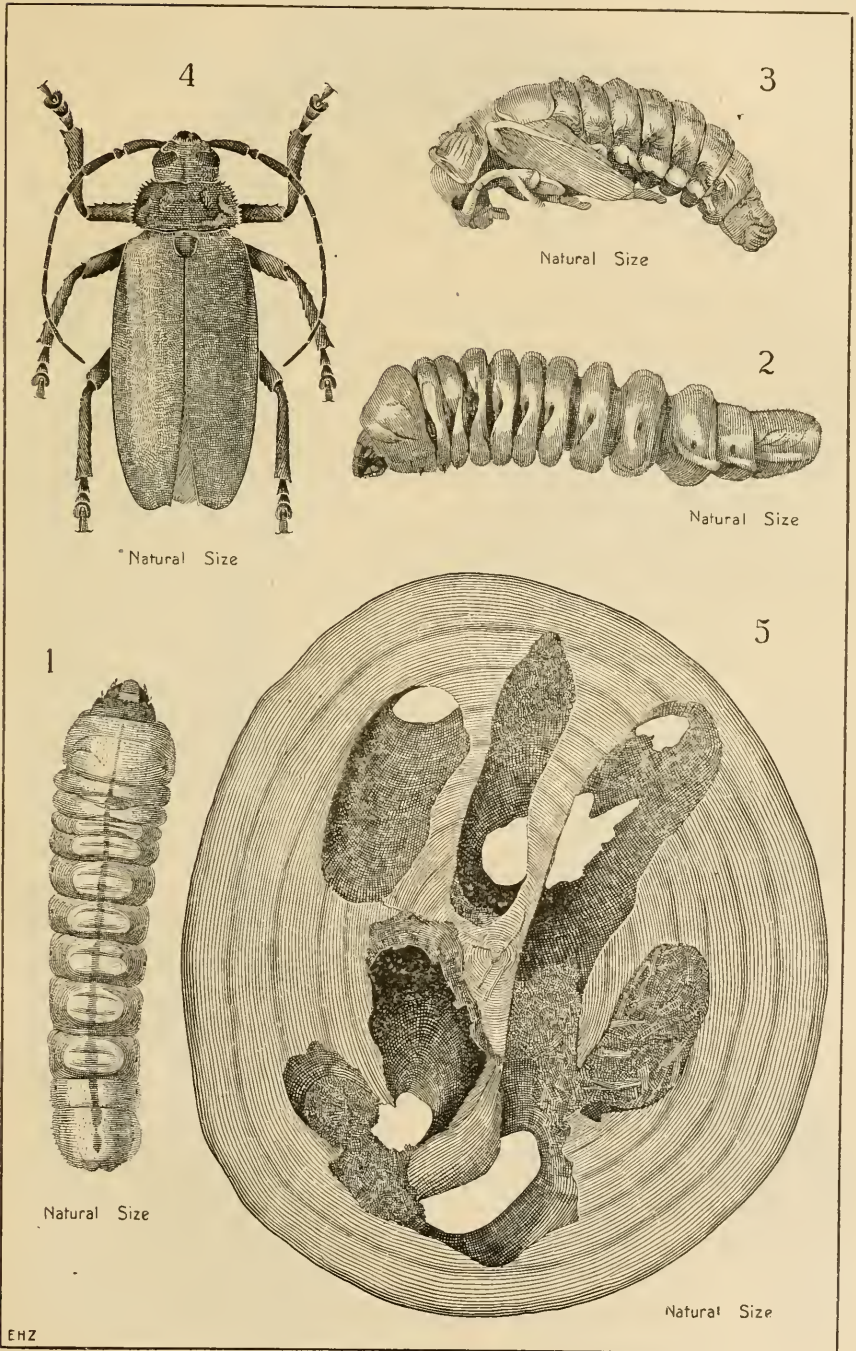
At times these beetles turn their attention to cultivated shade trees. We have had specimens from cork, elms, and willow trees. At Bathurst some years ago a large number of street trees, particularly willows, were badly damaged through infestation by these beetles.

The larva is a stout, thick-set, dull yellow to white grub, with a small horny head and powerful jaws. The thoracic segments fold over in front on the upper surface; and the abdominal segments are deeply corrugated, with the terminal ones rounded. As they bore through the wood they pack the chamber behind them with the chewed wood; and they pupate in the end of the final burrow.

The beetle is of a uniform dark reddish-brown colour. It measures up to 2 inches in length. It has thickened rather short antennæ; a stout head; and the rugose somewhat flattened prothorax is finely toothed on the outer margins. The wing covers are broad, slightly flattened, and broadly rounded to the apex, which have a fine tooth on the inner edges.

The beetles are usually found by the collector sheltering under the dead bark on the tree stems after they have emerged from the tree trunks.

The destruction of all fallen and dying trees would soon reduce the numbers of these beetles.



EHZ

Life History of the Honeysuckle Longicorn (*Paroplites australis*, Erich.).

- 1. Larva of beetle.
- 2. Side view of larva.
- 3. Pupa.
- 4. Adult beetle.
- 5. Cross section of stem showing damage caused by larvæ.

CHAPTER XIX.

INSECTS OF THE *PINUS INSIGNIS*.Common Pine (*Pinus insignis*).

This pine, so popular as a street tree, is planted all over parks and along orchard boundaries for a break-wind; it is a native of California. Under suitable conditions it attains a height of 100 feet, and a stem diameter of 8 feet.

On account of its rapid growth it has been extensively planted and greatly recommended in Australia as a timber tree. Baron von Mueller many years ago strongly advocated its planting as a shade tree in streets and parks, as it is able to withstand both extremes of heat and cold, and also from the fact that it causes less litter in the streets from falling pine needles than any other pine tree.

Pinus insignis is, however, very subject to insect attack; both native and introduced species infest them, and countless trees are stunted and killed out by insects upon their foliage. This timber, when drying after being felled, attracts various wood-boring beetles. Mueller says, in his "Select Extra Tropical Plants," that this pine is seriously damaged in Victoria by the European Pine Bark Beetle (*Hylurgus piniperda*). It is very doubtful, however, whether this species is found in Australia.

The Mottled Pine Weevil (*Aesotes leucurus*, Pascoe).

This handsome beetle attacks any unbarked pine-tree logs, or fallen trunks in our forest areas; and interesting observations were made last November (1921) in the Gosford State Forest Nursery. Numbers of logs of *Pinus insignis* had been cut out some eight months previously, and these were found to be thickly infested with the larvæ, pupæ, and beetles in all stages of development. A section of this timber is illustrated in the introduction of this work.

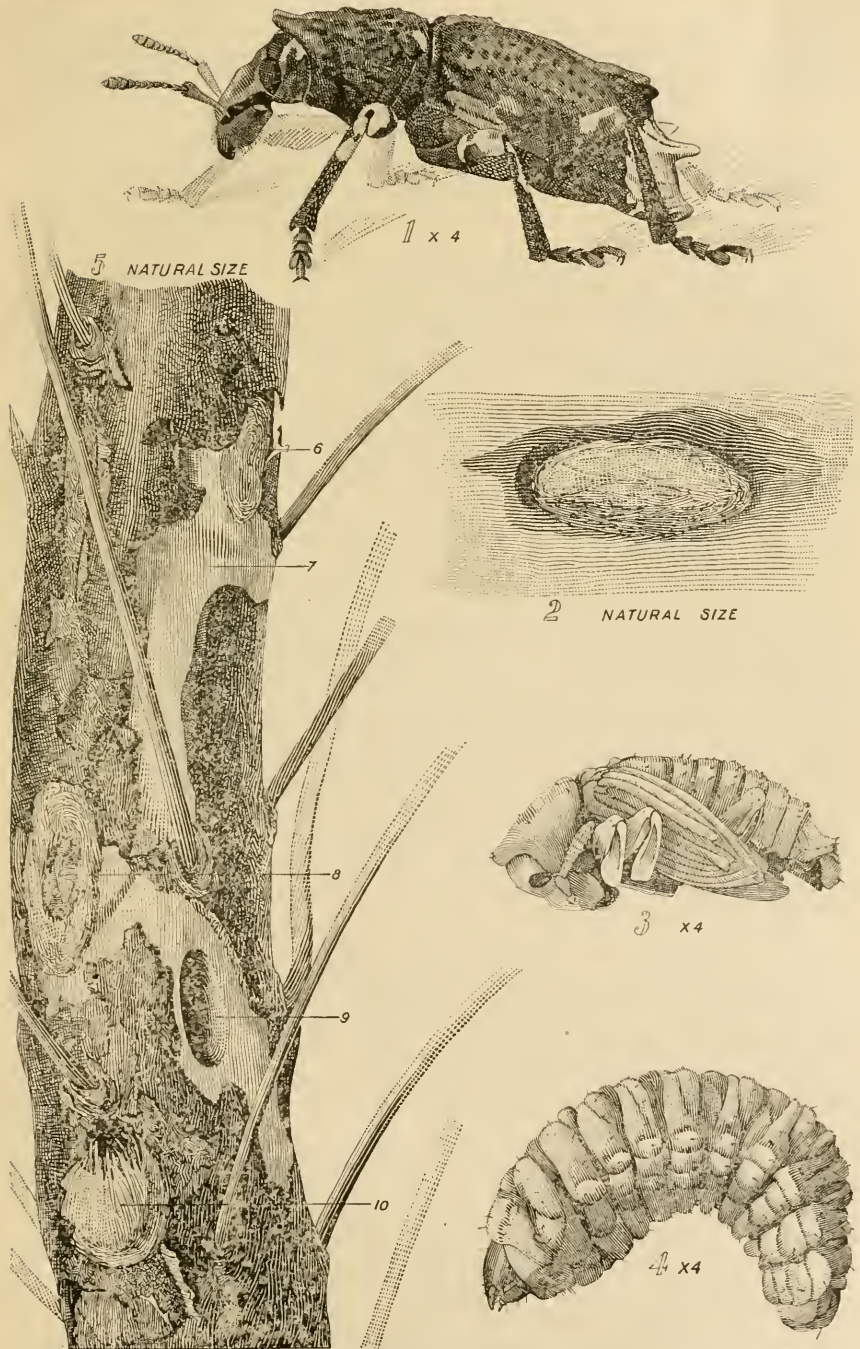
The life history had been previously worked out and published in the pages of the *Agricultural Gazette* of New South Wales when these beetles were found destroying a fine avenue of *Pinus halepensis* at Strathfield, near Sydney. Forty well-grown pine-trees had been planted eight years previously, and had become so badly infested that they had to be cut down and destroyed.

It is quite probable that the original infestation was caused by beetles bred out of logs of *Pinus insignis* which had been cut up and allowed to dry on some adjacent area, and that the trees in the avenue, being in an unhealthy or stunted condition, attracted the beetles which were responsible for the larvæ that then destroyed the trees.

This beetle was described by Pascoe in 1873 (*Annals and Magazine of Natural History*, vol. xii) from specimens sent by Masters from Sydney, with a note that they were "very destructive to introduced conifers."

The eggs are deposited upon or just in the surface of the bark, where the rather large, legless, naked grubs feed between it and the sapwood. When full grown they eat a shallow cavity in the sapwood, and form a regular and very neat elongate oval cocoon out of shreds of sapwood, as shown in the plate.

The beetle, which measures slightly over half an inch in length, is of a general dull chocolate-brown tint, mottled with fine white scales, forming spots on the head and blotches on the legs and under-surface of the body,



Weevil destructive to Pine-trees (*Pinus halepensis*).

1. Adult Weevil (*Esiotex leucurus*, Pasc.).
2. Cocoon.
3. Pupa (magnified four times).
4. Larva which does the damage by boring (magnified four times).
5. Pine branch showing damage by weevil.

with the apical extremity of the wing covers almost pure white. The curious and distinct colouration, with the hood-like projection of the prothorax over the head, and the two stout blunt spines projecting from the white area on the extremity of the body, give this fine weevil a very striking appearance.

The genus to which it belongs, *Æsiotes*, was created by Pascoe for a species (*Æsiotes notabilis*) described by him from the Pine Mountains, Southern Queensland, in 1865 (Journal of Entomology, vol. II, p. 422). French figures this beetle in his Handbook of Destructive Insects of Victoria, Part V, 1911. It was bred from some logs of *Grevillea robusta* and Kauri pine imported from Queensland. A third species *Æsiotes morosus* Pascoe was obtained by Mr. C. French upon some young gum trees (*Eucalyptus viminalis*) near Melbourne. This species is somewhat larger; and also differs from the other two in having a narrow crest-shaped protuberance on the middle of the rostrum, and in the different form of the apex of the thorax.

All pine logs should be barked and stacked or placed where they can be dried rapidly. They should not be allowed to rest on the ground, where they become a breeding ground for beetles. Logs could probably be sprayed with an oil or creosote mixture that would be repellent to the beetles, and so would prevent them from laying their eggs on the drying timber.

The Leaf Bag Moth (*Thyridopteryx hubneri*, Westwood).

This is the commonest and most variable case or bag builder among all our members of the Family *Psychidae*. The enclosed larvæ feed upon many different shrubs. They cover the outer surface of their silken cases with the remains of the foliage of their food plant. When feeding upon a gum tree they ornament it with irregularly gnawed pieces of gum-leaves; and the sack might be likened to a rag mat. Others use the finer leaves of the leptospermum or ti-tree; and when feeding upon pine-trees the cases are neatly coated with pine needles. This is the species that does so much damage to *Pinus insignis*. Often it infests large trees, and when numerous it almost strips them of their foliage. At Gosford they are a very serious pest on young trees, and stunt and retard their growth if they do not actually kill them.

The tiny dark-brown grubs drop on a thread out of the opening in the bottom of the cocoon, and it takes several months from then until they have completed their full-sized cocoon. Feeding under shelter of the bag when crawling about, only the head and feet and two abdominal segments are extended beyond the rim of the bag; the hind pair of legs is used to cling to the inner silken surface of the bag. The bag, when the caterpillar is full fed, is about 2½ inches in length; it is broad in proportion in the centre, tapering and open both top and bottom; but when finally attached to the twig by a stout silken band, the basal opening is closed up. The male caterpillar, before it pupates, turns round with its head at the apical opening; and before the moth emerges the head portion of the chrysolid is pushed well out through the opening before the active moth comes forth. He is a pretty little creature with reddish-brown pectinate antennæ; the body is thickly clothed with black down; the wings have very few scales, are almost transparent, and have a slight blotch in the centre of the hind pair.

The female moth undergoes an incomplete metamorphosis, and remains head upward in the bag with aborted simple legs, no wings, and the whole-body clothed with short close down. She is simply a round sack full of tiny

larvæ, which, as they are born, drop through the hole in the bottom of the bag through which the active male has previously impregnated the stationary female. When all the larvæ have escaped, the female is simply a shrivelled-up skin inside the cocoon. This case moth was originally described by Westwood, in the "Proceedings of the Zoological Society," in 1854.

Olliff in one of the first volumes of the *Agricultural Gazette* described this Leaf-case Moth under the name of the Pine-case Moth on account of its partiality for the foliage of this pine-tree.

The Painted Acacia Moth (*Teia anartoiles*, Walker).

The caterpillars of this little moth have a wide range over Victoria and New South Wales. In their native state they feed upon the foliage of a number of our common wattles, such as *Acacia decurrens* and *Acacia pubescens*. But it has turned its attention to orchards and gardens, and is now almost omnivorous in its choice of food plants. At Armidale it was recorded upon the cherry tree foliage; at the Hawkesbury College orchard it defoliated the apple trees; and in suburban gardens it is often found upon roses and pelargoniums.

Upon emerging from the eggs the caterpillars are almost black, but by the time that they have grown a quarter of an inch in length they begin to assume a browner tint, chiefly from a number of grey tubercles or warts appearing along the sides of the body.

They are now thickly clothed with long hairs, with two curious round red-coloured appendages projecting from the back near the tail. When full grown the caterpillar measures about $1\frac{1}{4}$ inch in length, and is rather slender in shape, with the legs and claspers reddish yellow. The head is dull, reddish brown, lightly covered with long greyish hairs, with a slender tuft projecting from each shoulder beyond the head, the tip of each of these long hairs forming a swollen lance-shaped point. Along the centre of the back, from the centre of the first four abdominal segments there is a thick, erect, brush-like bunch of greyish brown hairs, the thoracic segments in front of these tufts being marked with yellow, and the whole of the upper surface of the caterpillar is covered with long brown hairs, and patches of shorter grey hairs along the sides, a large projecting plume being formed on either side towards the tip of the abdomen. All these hairs are very finely feathered, which gives them a downy appearance.

When full grown they crawl into any corner and spin a loose, light brown silken cocoon of a very flimsy character, through which the pupæ can be plainly seen, and it will be noticed that more than half of them are fully twice the size of the others, the larger being the females. In the summer time they do not remain in the pupal state longer than a fortnight, but in the winter broods not only do the larvæ feed much longer, but the pupal stage lasts until the summer months come round.

The male moth measures about an inch across its outspread wings, of which the fore pair are dark brown, marbled with yellow and grey markings, with a very black transverse band across the tip, and a patch of the same colour at the base of the wings. The hind wings are bright orange yellow in the centre, with a broad black band encircling them, fringed along the outer edge with yellow. The body is rather pointed towards the tip, while the thorax is stout; the antennæ short, broad, and beautifully feathered. When the moth is at rest, it clings to the branch or wall with the wings pressed down on either side forming an angle broadest at the base.



The Painted Acacia Mot. (*Teia anartoides*).

The female moths are short, rounded creatures destitute of wings, with the antennæ and legs rudimentary, but thickly clothed all over with short brown down. Their life work is very limited, for they simply crawl out of their shelter, lay their eggs upon the top of it and die.

The eggs are dull white, hemispherical in shape, and showing a beautiful fascetted structure under a lens. They are rather large for the size of the moth, and generally matted together with the down from the moth's body. Each moth lays on an average about 700 eggs, so it is easily seen how rapidly a family of these moths can increase, particularly as they have several broods in the year.

Since the original article was contributed to the *Agricultural Gazette*, 1897, this moth has been found more omnivorous in its food plants. At the Veterinary Experiment Station at Glenfield it has attacked a number of young *Pinus insignis*, doing considerable damage by badly infesting the trees and webbing the foliage together with their loose cocoon. We have several records of these caterpillars attacking pine-trees in the Gosford district. This shows that with such an omnivorous pest it is sometimes a mistake to attach the name of a food plant to its popular name. This caterpillar would probably be a much more serious pest if its increase was not greatly reduced by parasitic enemies.

The Common Pine-aphis (*Chermis pin*, Koch).

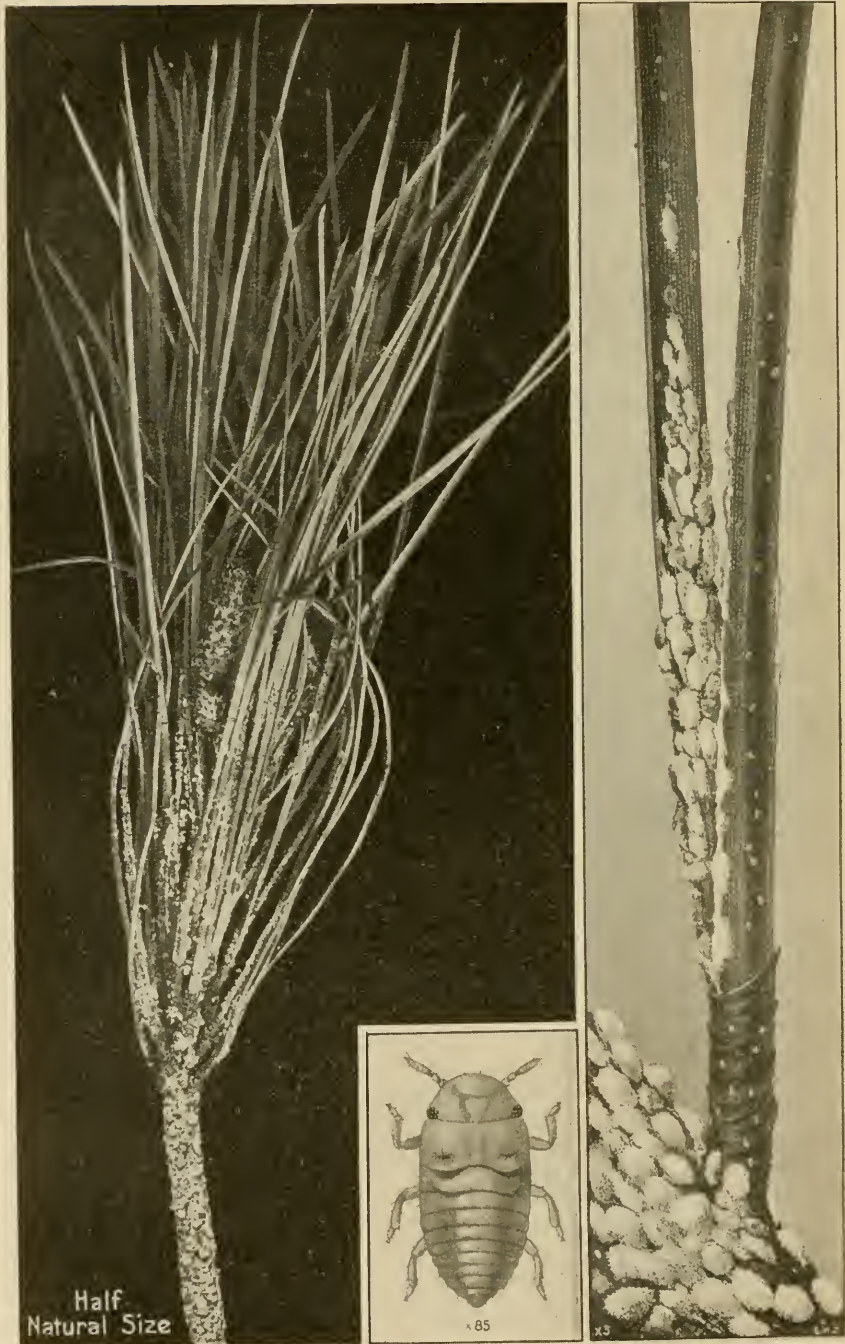
This is the most serious pest that infests our common cultivated pine-tree (*Pinus insignis*). In the plant nurseries it is quite an ordinary occurrence to see the young shrubs in the pots covered with the woolly filaments of this aphis. It is from these nurseries that this pest is frequently distributed. In the country and in our parks and gardens many pines, even when they have attained a fair height, become infested with aphis and put on a rugged, unhealthy, stunted appearance in consequence. When planted for break-winds or shelter purposes in unsuitable localities or in poor soil, large numbers die if they become infested with this insect.

These tiny dark-brown aphids crawl down to the base of the pine needles and puncture the bark of the branchlet. They suck up the sap and envelop themselves in fine white silken filaments produced from their body pores; and in this way they somewhat resemble the woolly aphis of the apple tree.

This aphis was first described and named by Koch in 1854; he found them at the Botanic Gardens at Erlangen. Buckton in his "Monograph of British Aphidæ," 1882, says that they were first noticed in the greenhouses on a variety of the Scotch fir (*Pinus siberica*), but that they soon spread beyond the greenhouses on to other species, among them *Pinus insignis*.

The following is Buckton's description of the wingless oviparus female:—"Coccus-like in form. Dark brown, plentifully furnished with long silky filaments which take a corkscrew form as they issue from the body pores. When denuded the insect shows the body deeply ringed with spots of varying size down the back and sides. The antennæ are very small and are usually inconspicuously folded under the head; they are very rudimentary in form and only contain from three to four joints. The Queen aphis found in England in May and June is surrounded with her pedunculated eggs which are yellow or brown, and well covered from the weather by cottony secretion."

The preventative measures to check this pest should be started in the plant nurseries where the pine seedlings are raised. When packing the plants every pine should be dipped overhead in kerosene emulsion, and afterwards rinsed in clean water before sending out. After planting out, pines up to 10 feet in height could be easily sprayed with kerosene emulsion.



Common Pine Aphid (*Chermes pini*).

1. Infested spray of *Pinus insignis*.
2. Adult female (*Chermes pini*).
3. Opened spray showing aphids.

CHAPTER XX.

INSECTS OF THE CYPRESS PINES.

(*Callitris glauca* and *C. calcarata*).

The first of these two hardy trees is popularly known as the "Desert" or "White Pine," but in the inland portions of North-western Victoria and in the Riverina it is locally known as the "Murray" pine. It has a wide distribution through the western scrubs of New South Wales, and is very noticeable where it stands out against the skyline on the edge of the great plains.

The second species, with nearly as wide a distribution, is known under the popular names of "Black," "Red," or "Mountain Pine." It grows in similar localities, but prefers rising ground. It is the species that is generally found growing on the low ranges and sand-blown ridges. Most of the pioneer settlers built their homesteads of cypress pine on account of the hard, firm structure of its timber, and the ease with which it can be split and worked in the green state; its well-known immunity from the attacks of white ants also renders it a valuable asset to our country, and the day should soon come when thousands of these trees will be grown along the roadsides of the Riverina and other districts in order to assist our timber supplies.

Eighteen species of the genus *Callitris* are described in Messrs. Baker and Smith's "Pines of Australia," Technological Museum, 1910. The insect fauna is very closely allied in all of them, but with the exception of the "Flat-headed borers" of the genus *Diadoxus*, none of the insect pests seem to do any serious injury.

The Cypress Pine Girdler (*Diadoxus erythrus*, White).

This handsome beetle has a wide range over the southern half of Australia, and will be probably found in the whole of the area in which our "Desert" cypress grows. It was originally described and figured in "Stoke's Voyage" by White in 1846; and again described and figured by Saunders in the "Transactions of the Entomological Society in London," in 1868.

The dense pine scrub that over-ran the Laechlan district between 1863 and 1883 was attacked in 1885 by this beetle, which laid her eggs in the main stem of the young cypress trees. The slender flattened larva fed beneath the bark, and finally girdled the tree before it burrowed into the sapwood to pupate. Baron R. von Lindenfeld, the well-known zoologist, who was working in the Australian Museum, was commissioned by the Mines Department to visit the infested area and write a report upon the pine scrub destruction. This was published under the title, "Recent Changes of the Forest Flora of the Interior of New South Wales," 1885.

As this pine scrub had developed into almost impenetrable thickets, the writer considered that the beetles should be considered useful insects in helping to clear the scrub land.

This beetle and the larger closely allied species, *Diadoxus scalaris*, have turned their attention to Lambert's cypress *Cupressus lambertiana*, one of the popular hedge trees about Melbourne and one often planted by squatters about their homesteads. French, in the 5th Part of his handbook of the "Destructive Insects of Victoria," 1911, figures these beetles, and gives several instances of their having destroyed the cypress hedges in the vicinity of Melbourne. We have a number of records from western squatters, who have planted Lambert's cypress about their gardens adjacent to the native

cypress also known as "Murray" pine and which have been badly damaged by these beetles. Landowners have been strongly advised not to plant this cypress in the land of the native cypress.

Diadoxus Erythrurus is a slender almost cylindrical beetle, measuring about two-thirds of an inch in length. It has, when alive, a greenish-yellow tint which fades into dull yellow after death. The upper surface of the thorax is brownish-black with a yellow stripe down the centre; the wing covers are of a similar dark tint, with an elongate oval blotch followed by three smaller irregularly round yellow spots down the centre of each wing cover.

The typical flattened, dull white larva has a small head; the three thoracic segments swell out and form a flattened disc; the narrow abdominal segments taper at the apex.

Diadoxus Scularis has a similar form, but is broader and longer, measuring up to an inch in length. The thorax is short and broad, and the ground colour of thorax and wing covers is light reddish brown; the thorax is striped with yellow in the centre with lateral stripes blacker and broader than in the previous species. It has a wide range over Australia from Sydney to Kalgoorlie, Western Australia. Its life history and habits are similar to those of the smaller Cypress pine girdler.

The Cypress Pine Saw-fly (*Zenarge turneri*, Rohwer).

The caterpillars of this sawfly were first collected by the writer feeding upon the foliage of the Cypress pines growing on the hills at the Wagga Experiment Farm. They are found afterwards in a garden at Killara, North Sydney, feeding upon a cultivated Cypress hedge. Their natural food plant is probably *Callitris muelleri*, a small species that grows in the sandstone gullies in that district. It was from specimens obtained in the last locality by Turner that the type specimens were described by Rohwer (*Annals and Magazine of Natural History* (Vol. II, series 9, 1918)). The larvæ are slender green caterpillars with black heads and legs, and they are so like the foliage in colour that they easily escape detection.

The male wasp measures about three-quarters of an inch in length. It is somewhat slender in form; is black mottled with yellow on the front of the head; the dark wings are semi-transparent with reddish nervures; the body and legs are reddish-brown, the former spotted with black, and the tibiæ and tarsi of the latter darkest. The black antennæ consist of two small basal joints and a large cylindrical third joint, very characteristic of the genus. The female is slightly larger than the male, but of similar colouration, except that the legs are more mottled. This sawfly could become a serious pest upon our Cypress pines. There are several known foreign species that are pine forest pests. Our species probably has natural enemies that keep it in check.

The Cypress Gall-gnat (*Diplosis frenelae*, Skuse).

This gall gnat was bred and described by Skuse in the "Proceedings of the Linnean Society of New South Wales" in 1890 (vol. 5, p. 375, pl. xvi, f. 2). These remarkable galls upon the foliage of the Cypress look exactly like small seed capsules, hemispherical in form and consisting of six sections fitting close together. Each alternate section is marked with a raised edge, and the leaflets form a calyx at the base, and the apex has a rounded depression in the centre. The galls are light brown in colour; and when fully developed they dry and split open along the sections from the apex. They are about the size of a small pea, and may be scattered all over a branchlet.

Each capsule-like gall contains a small cecidomyia larva. Skuse says: "It is not known whether the larva undergoes its transformation within the gall, or drops to the ground on the splitting of the valves; the latter is probably the case."

The type specimens were collected in the Wagga district upon the foliage of *Callitris endlicheri*, but they are not uncommon on several other species of the desert Cyresses, and have a wide range over our western scrub and sandhill lands.

The genus *Diplosis* contains a number of small dull-coloured flies with delicate wings and slender antennæ. Skuse described fifty-three species. The life histories of several gall-making species have been worked out, but nothing is known about the life histories of the remainder.

The Native Cypress Lac Insect (*Tachardia decorella*, Maskell).

This beautiful form of lac insect was originally described by Maskell in 1892. It has a wide range over Australia and is found on a number of different kinds of trees, among them the Water gum (*Eugenia smithii*), *Monotoca elliptica*, *Myrica cerifera*; and on the north coast of New South Wales and in Southern Queensland in sometimes appears on orchard trees. Though considered an indigenous species this lac insect has been found upon



Fig. 31.—*Tachardia decorella*.

native trees in India. I have, on a number of occasions, found it in the west, at Dubbo, Wagga, and elsewhere encrusting the small stems and branchlets of the Desert cypress, *Callitris*, with its waxy tests; though, like most of the lac coccids, it does not seem to do much damage to its host plant. The tests are usually somewhat larger and more symmetrical than that on the coastal trees, but I find no difference in the enclosed coccids.

The lac test of the adult female coccid is formed of hard greyish-blue coloured lac, and it measures one-sixth of an inch in diameter. It is circular in form, is deeply and regularly ribbed right round with the summit flattened and the tiny larval test forming a spot in the centre. It might be likened to the flattened ribbed seed capsule of the Marsh mallow. Sometimes they are scattered singly over the branch when the form is perfect and regular, but when clustered together in test become confluent, and the regular form is lost in the mass of lac. It is figured and described in Part iii, p. 28 of my "Described Coccidæ of Australia." The male lac scales have a different structure. They are small, elongate, and might be compared to a dainty lady's slipper. The tiny larvæ as soon as they crawl from the mother's lac scale cover themselves with a reddish-brown lac.

The size and regularity of form of this coccid upon our Desert cypress are so clear that it almost deserves varietal, if not specific, rank as a new species.

Cypress Pine Mealy Bug (*Llaveia callitri*, n.sp.).

This fine mealy bug was found in the middle of November in considerable numbers upon the bark of the young branchlets of the Cypress pines (*Callitris glauca*) growing near Corinbil homestead, near Carrathool, New South Wales. The mealy bugs were nearly all full grown, each thickly enveloped in a mass of loose cotton wool secretion so that only the tips of the black tarsi were visible. Enveloped in this material they measured half an inch in diameter and were very lightly attached to the bark on which they were resting. Removed from the flocculent covering, they were bright orange yellow; the antennæ, eyes, and legs black; several dots along the apex of the abdomen apparently encircled openings that exuded the woolly filaments. General form of body oval, narrowest in front, with the upper surface rounded and the under-surface flattened. Length one-quarter of an inch, slightly longer than broad. Antennæ eleven jointed lightly clothed with hairs. Legs long, stout, with stout tarsal claws, and fringed along the inner margin with fine hairs. Epidermis clothed with fine scattered hairs and bearing many circular orifices, sometimes scattered, but also in groups. Cephalic portion fringed with long hairs. Band of short spines crossing the body behind the hind legs.

The active little red larvæ are shield-shaped, flattened on the upper surface with the whole of the outer margin fringed with fine hairs, longest at the tip of the body.

The infestation of these pine trees by this mealy bug did not seem to be affecting the trees, and under natural conditions ladybird beetles and neuropterous insects would probably keep them in check.

Pulvinaria Daveyi, n. sp.—This distinct species was collected near Bright, Victoria, by Mr. H. W. Davey upon the foliage of the cypress pine (*Callitris* sp.).

The adult female coccid is light chocolate-brown. The dorsal surface is covered with thin crystalline plates, and the outer margins with glassy rods. Elongate, oval in form; antennæ eight jointed, legs stout. Ovisac composed of closely-felted white filaments. Length of coccid 4 mm. Ovisac 10 mm. in length.

Cypress Pine Aphis.

Early in August, 1921, Mr. W. T. Blakely, of the Botanic Gardens, sent me some sprays of *Callitris verrucosa*, collected in the Narrabri district. They were covered with a dark-brown aphis, which he said was very numerous in the pine forest and doing a considerable amount of damage to the tress. About the middle of September reports were received from the Forestry Branch at Dubbo. Many of the pine trees in the surrounding forest were being damaged by swarms of small brown insects, and the infestation was recorded over a large area of pine country both west and south. A few weeks later I visited the Dubbo district. The cypress pines were very thickly infested with the same kind of brown aphis that I had previously received from Narrabri. At this time the aphids had deserted many of the large trees and were swarming over the young trees, massing together on the young stems and branchlets and completely covering the surface for a foot or more in length. Many of the infested trees had a wilted appearance, and the tips of the branchlets were brown. The stems were sticky from the exuding sap caused by the presence of the aphids. However, on the bark on the trunks of all the larger trees large numbers of the black-spotted Ladybird beetle (*Leis conformis*) were found in all stages of development, these adult beetles, emerging from the pupæ on the bark, were spreading over the more recently infested trees. Subsequent observations proved that these ladybird beetles eventually obtained the upper hand, and the infested pine trees have recovered from the visitation.

The adult winged aphids measure a quarter of an inch in length, and are of a general brown tint mottled with yellowish-brown and black, with the whole surface of the body, legs, and antennæ clothed with fine brownish hairs. The semi-transparent wings are clouded along the costal margin, and the nervure with dull yellow, the nervures and surface of the wings covered with tiny pointed erect scales. Eyes reddish-brown; antennæ composed of six segments, first short, second longer, rounded at the apex, third longer or as long as the four-six combined. Rostrum large, extending, when folded, down beyond the base of the hind legs. Prothorax forming a narrow ring behind the head; centre of thorax in line with base of wings, large, lobed on the sides. Legs long, femora stout, contracted at base; tibiæ of uniform length, tarsal claws large; wings long, elongate, rounded at the tips. Abdomen short, broadly rounded; segmental divisions very well defined, sipuncles very short, truncate at tips.

CHAPTER XXI.

INSECTS OF THE KAURI PINES.

(*Araucaria cunninghami* and *A. bidwilli*).

These two species of the genus *Araucaria* are found in Queensland. The first is known under the popular name of "Moreton Bay Pine"; it ranges along the coast into the highlands of New Guinea. The second is known as "Bunya Bunya Pine," and is confined to Southern Queensland. Growing under the same conditions, they are infested by the same insects, both upon the bark and in the timber. The cultivated Norfolk Island Pine, *Araucaria excelsa*, is also attacked by the same mealy bug when grown in our parks and gardens.

The Great Pine Weevil (*Eurhamphus fasciculatus*, Shuckard).

This is one of the most remarkable-looking snout beetles in Australia, both on account of its size and its structure. It was described by Shuckard in 1838 from a specimen said to have come from New Zealand, and the writer said he had seen a second specimen in the Curtis collection from Van Dieman's Land. Both these localities are incorrect; for, though we know very little about its life history, we know that it ranges from the Richmond River, New South Wales, to the Pine Mountains in Queensland. I believe that this beetle undergoes its metamorphosis in the timber of the *Araucaria* pines. I have had perforated samples of Moreton Bay pine timber showing circular bores of considerable size that were caused, I think, by this large weevil.

Mr. Masters, who did a great deal of collecting in southern Queensland, told me that he once came across a dead pine tree in the Pine Mountains, on the trunk of which were scores of beetles which had evidently just emerged.

This beetle measures about $2\frac{1}{2}$ inches in length from the tip of its slender cylindrical snout to the apex of the abdomen, the snout three-quarters of an inch; and the middle of the body half an inch across. The head behind the snout is small, with large oval black eyes; the prothorax fits close against it, tapering and broadly rounded to the broad wing covers, which are rounded at the tip of the abdomen. The legs are long, and the extremities of the tibræ are provided with a pair of stout claws, which are admirably adapted for clinging to the bark. The ground colour of the whole integument is black and rugose; but the whole beetle is thickly clothed with fine, soft, reddish-brown, buff, and creamy scales. These are interspersed on the upper surface of the thorax and back with tufts of reddish-brown and whitish buff feathery scales that look like clusters of spines.

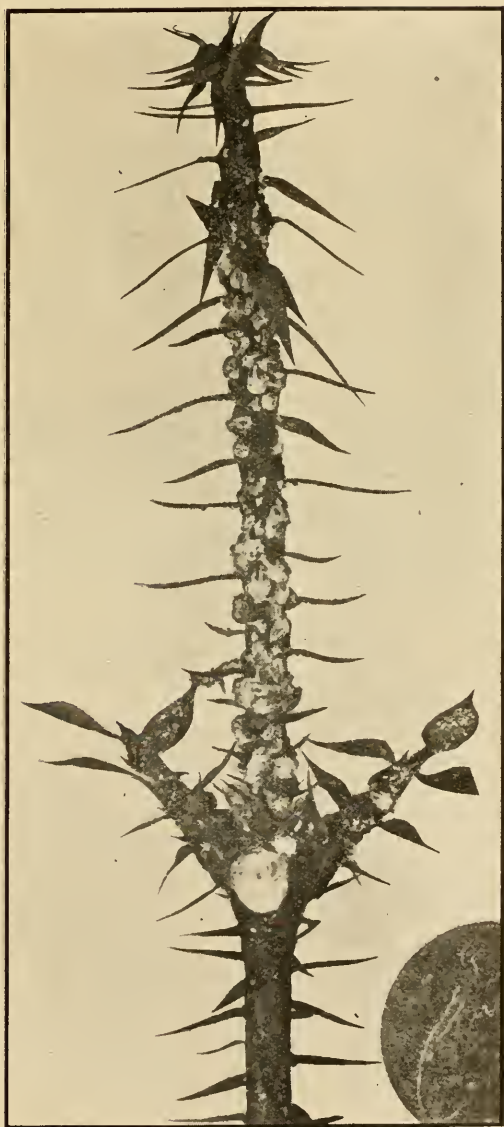
The Yellow-banded Mealy Bug (*Dactylopius aurilanatus*, Mask.)

This distinctive mealy bug was described by Maskell in the Transactions of the New Zealand Institute in 1889. It is figured and described in my Descriptive Catalogue of the Scale Insects (Coccidæ) of Australia, 1921.

This mealy bug infests the bark of all the different *Araucarias*; and when it obtains a footing among neglected nursery stock it soon kills the young pines. When infesting the full-grown pine trees it appears to do little or



Dactylopius aurilanatus on trunk
of tree.



Dactylopius aurilanatus on a seedling pine killed
by the scale.

no damage, though it usually covers the bark of the trunk and branches with its woolly secretions. The chief reason of this immunity is the fact that many efficient parasites feast upon it and keep it in check. The chief one is the well-known ladybird beetle, *Cryptolaemus montrouzieri*, whose larva also has the curious habit of completely covering its body with woolly filaments, under cover of which it crawls about among the scale, feeding upon them, and then pupating on the rough bark among their remains. When full grown these larvæ often drop from the pine trees, or wander about and attach themselves to any handy object.

Several years ago they were very numerous on the Norfolk Island pines on the Manly foreshore. Numbers crawled over the seats under these trees, and ladies sitting upon the seats found their white dresses stained with yellow blotches where they had crushed a ladybird larva.

On several occasions gardeners finding their pine trees covered with white mealy secretion have sprayed or brushed them down with emulsion, thinking they were the scale insects, and unknowingly killed thousands of these useful mealy bug parasites.

The mealy bug is about one-tenth of an inch in length. It is of a general deep black colour, but so thickly-covered with white mealy secretion that the whole insect is hidden. The greater part of the mealy bug secretion is white, but there is always a quantity of pale golden yellow meal round the margins, from which it takes its popular name. This mealy bug was probably a native of New Zealand, but it was accidentally introduced into Australia and other parts of the world with nursery stock.

The Marbled Longicorn (*Dystheta anomala*, Pascoe).

Nothing is known about the earlier stages of the life history of this handsome longicorn beetle; but a number of specimens emerged from the floor of a house in Sydney which was composed of Maryborough Pine. The adult beetle measures just under an inch in length. It has a small head deeply cleft between the base of the antennæ; oval blackish eyes; the first joint of the antennæ swollen, but the following ones slender. The prothorax is narrow and short, with a pointed boss on the dorsal surface, and a smaller one below on each side. The wing covers are crenulated on the shoulder, hollowed in the centre; and irregularly ribbed. The general colour is dull yellow, mottled with ferruginous yellow, but the whole surface is clothed with golden scales and clouded with reddish dark-brown and silvery white scales. The reddish-brown scales form a row of four arrow-shaped marks on each wing cover, which are also marked with a diagonal stripe of silvery white. The whole giving the beetle a handsome dorsal pattern. This beetle was figured and described by Pascoe, from Queensland and Northern New South Wales, in the Transactions of the Entomological Society, in 1863.

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