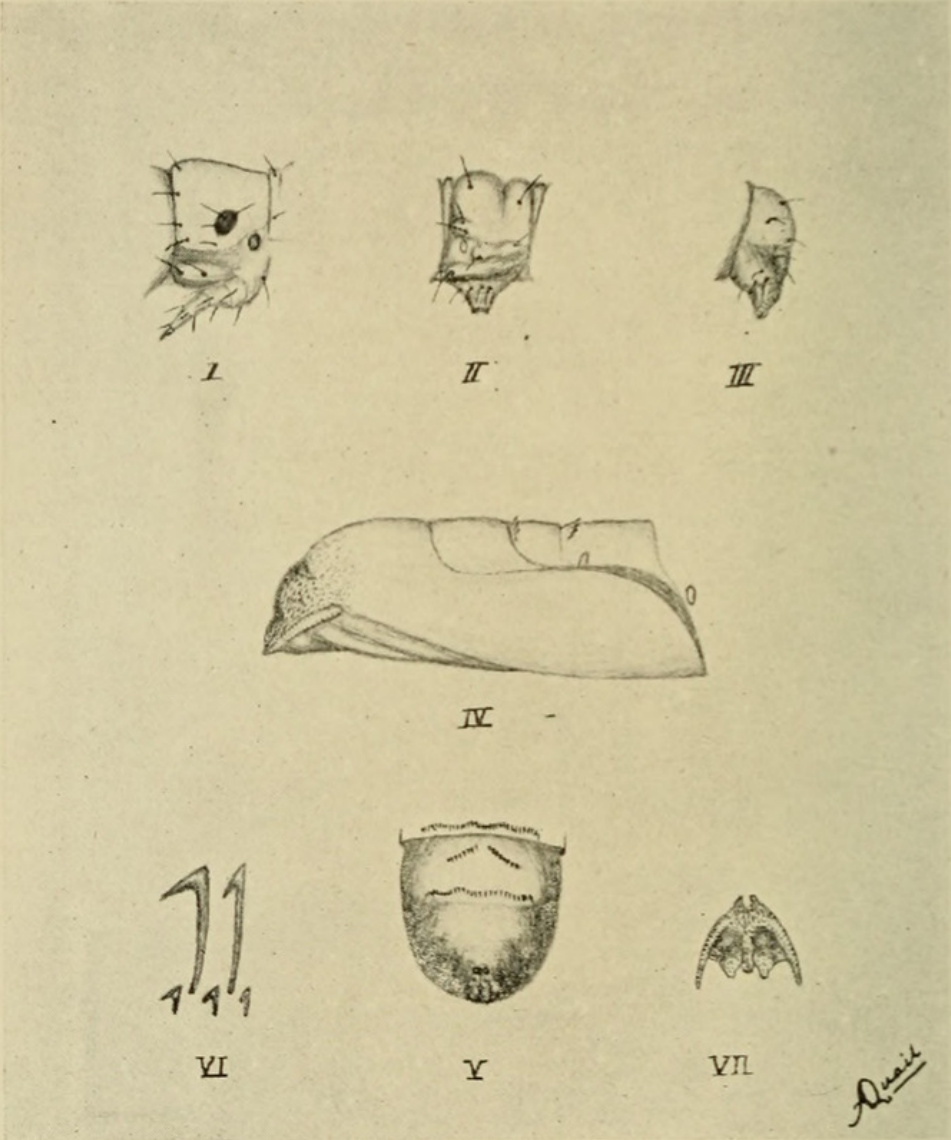




AUSTRALASIAN WOODBORING HEPIALIDAE.

Charagia daphnandra "Lucas," *C. eximia* "Scott," *C. ramsayi*
"Scott," *C. Virescens* "Dbld."

(PLATE IX.)

By **R. ILLIDGE**

AND

AMBROSE QUAIL, F.E.S. (London.)

[Read before the Royal Society of Queensland, December 8th, 1900.]

It has been a very great pleasure to the writer to examine the living larvæ, pupæ, &c., of three species of this interesting group of lepidoptera, viz., *C. daphnandra*, *C. eximia*, *C. ramsayi*, from Queensland, as we have also been making enquiry into the life history of *C. virescens*, a New Zealand species of similar habits and closely allied to the above. Mr. Illidge attached descriptive labels to the sticks of wood which contained the larvæ, and furnished notes from time to time on the habits of the several species under observation.

While unpacking one of these parcels, a Maori saw the larvæ and exclaimed "they are very sweet food," and when informed that they were from Australia, he said they were very like the New Zealand grubs which are in "white pine" and the "houhere" — (thousand jacket), the former — a Longicorne Coleopteron, he said they eat raw, but the latter — *Charagia virescens*, cannot be eaten raw, but is very nice food when roasted. "Houhere" is the *Hoheria populnea*—"Cunn," in which we have found *C. virescens* larvæ.

OVA.

We obtained imagines of *C. virescens* plentifully during the month of September this year, by searching tree trunks in the bush where they were known to be. They emerge half an hour or so before dark, and the males take flight within half an hour after dark. In consequence of the wings being limp when first taken they were placed in a rather large breeding cage, having gauze sides, so that though for some time a dozen of each sex were in this cage together, none were observed to copulate. This was rather a surprise as we thought the close proximity of the sexes would induce copulation. The females commenced to deposit ova immediately after dark, and in a short time there were countless numbers of ova at the bottom of the cage.

One pair were kept together until they died, ♂ on the third day ♀ on the fourth, they were never seen in copulation, but the female deposited ova every evening. The abdomen of the female was opened after it died, and the space within was at the thoracic end, the pressure of the remaining ova being towards the anal extremity of the abdomen.

The ova within the abdomen are connected by a continuous thread-like tissue, and are yellowish in colour, they are extruded automatically at random, and must in a state of nature fall to the ground about the roots of the trees upon which the females probably rest while depositing. The ova of *C. virescens* are spherical and smooth, when first extruded they are yellowish, but in a few hours become black in colour. A female *C. eximia* which emerged during the journey from Queensland, commenced to deposit ova freely the first evening after its release from durance vile. The ova of *C. eximia* are very much smaller than those of *C. virescens*, they are spherical, smooth, yellowish at first, and afterwards become black in colour.

Hitherto we believe there is no record of the colour change in ova of *C. virescens*: Hudson says* "The female lays an enormous number of small, round, yellowish eggs." With regard to the Australian *Charagia*, the eggs "are of a pale yellow colour, but soon turn to a slaty gray hue" (Illidge), there is a grayish hue on the ova of *C. eximia*, which we have also observed on the ova of *C. virescens*, and of some *Porina*, but cannot detect it under the microscope. It is important to note this colour change which we suspect is characteristic of the whole group, and the real colour of the eggshell is black

* New Zealand Macro Lepidoptera.

and remains so after exclusion of the larva in *Hepialus*, *Charagia*, and *Porina*.

The ova obtained were all infertile.

LARVÆ.

These insects live throughout the larval and pupal existence within the branches and trunks of trees. *C. daphnandræ* in *Eugenia*, *Daphnandra*, *Tristania*, *Eucalyptus*, &c. (Illidge), *C. eximia* in *Melaleuca*, &c. (Illidge), *C. virescens* we have taken commonly in *Hoheria*, which is stated to be restricted to New Zealand, but Hudson gives also *Olea*, *Aristotelia*, *Leptospermum*, and *Melicope*, which include Australia in their range of geographical distribution. It has been noted elsewhere* (Illidge) that the food of these larvæ consists largely of the sap of the tree. We have often observed that if wood containing larvæ of *C. virescens* is turned upside down, the fluid contents, undoubtedly sap, will run out of the inverted burrows.

The burrows of *Charagia* are horizontal in the first part, and then perpendicularly downwards; the entrance is wider than the continuation, and has an external cover from the first constructed of silk with particles of bark worked in, making it inconspicuous.

(I.) *C. daphnandræ* constructs a very loose external cover much exceeding the size of the burrow entrance; just prior to the pupal stage an inner operculum is constructed horizontally covering the perpendicular shaft. The length of burrow varied from four to nine inches (Illidge).

(II.) *C. eximia* forms an extremely stout external cover, and the prepupal operculum is inner to the external cover not horizontal as in the other species. Length of burrow, one to three feet or more (Illidge).

(III.) *C. ramsayi* also forms a stout external cover, but instead of an operculum as in the preceding species, spins a web of pure glistening silk around and over the opening, as do also *C. splendens*, *C. lewinii*, and *C. lignivora*. It is worthy of note that these four species which spin the silken web inner to the external protecting cover before pupating should be all strongly adorned with silvery markings, whereas those which form the operculum are either devoid of such or have only traces of them. They thus seem to fall naturally into two groups.

(IV.) *C. virescens* constructs a compact close-fitting external cover, and the prepupal operculum is horizontal to the

* Proc. Roy. Soc. Q'land, Vol. xiv.

perpendicular shaft as in *C. daphnandræ*. Length of burrow, about one foot.

The larvæ of each species can hang by a thread of silk, and we have noticed that the perpendicular shaft of *C. virescens* is thinly lined with silk threads. Unfortunately, we have no description of the newly-hatched larvæ of either species. Apart from the interesting habits of these insects, we hope a description of their structure will have a scientific value. It is hardly necessary to mention that these larvæ are bilaterally symmetrical, and the segments are as follows:—Head, Pro-Meso, Postthorax, each with a pair of legs, and ten abdominal segments, some of which have feet.*

(I.) *C. daphnandræ* larvæ live nearly two years (Illidge); at six months the length is about $\frac{3}{4}$ inch. Colour: Head, dark reddish brown; Prothorax, pale brown scutellum; remaining segments, cream colour. Spiracles are brown with outer rims. Thoracic legs, brown. Abdominal feet and claspers, cream colour with dark brown terminal hooks. Setæ are brown with minute blunt thorns. The skin is comparatively smooth. The head is larger than succeeding segments, larva tapers to anus.

Head: striated, setæ numerous; ocelli, six in number on each lobe, arranged in two rows of three each, they are yellow with a black area on inner side; antennæ are immediately anterior to the two lowest ocelli; spinneret is long and slender.

Prothorax: anterior edge of scutellum darker with a marginal series of setæ equidistant; a midlateral concavity or scutellum is apparently lined with soft down-like hairs, within the concavity are three setæ, and below it one seta. The spiracle is immediately posterior, below the scutellum, and about twice the size of the abdominal spiracles; anterior to the legs a tubercle bears two setæ, on base of legs are two anterior and one posterior hairs, and at the lower end of each joint there are several hairs.

Mesothorax: a small anterior subsegment bears the dorsal (trapezoidal?) tubercles with one seta, and a small lateral tubercle with one seta. The larger subsegment bears on either side a marginal series of three equidistant setæ, and one posterior lateral seta all on one well defined area.

* Abdominal feet proposed by Dr. Sharp to be used instead of the older term prolegs, pro being usually the term for anterior, whereas in larvæ the thoracic legs—identical with imaginal legs, are the anterior legs. The term abdominal feet seems more appropriate.

(equivalent to the prothoracic scutellum), below are a central and a lower anterior tubercle each with one seta.

Postthorax corresponds with Mesothorax but has a less distinct scutellum like area.

Abdominal segments 1 to 8 have spiracles, 4 to 6 have abdominal feet, and 10 has claspers. Segmental incisions are composed of two minor subsegments without tubercles or setæ, the large middle subsegments bear all tubercles. Anterior (dorsal) trapezoidal bears one seta, posterior (subdorsal) tubercle one seta, suprspiracular (lateral) tubercle bears one long one short setæ, it is below the anterior trapezoidal; the spiracle is slightly anterior below the suprspiracular tubercle; a little lower are the two subspiracular tubercles posterior to the spiracle, almost in line, each bearing a remote seta; a lower anterior tubercle bears one seta, and a subventral tubercle bears two setæ. The abdominal feet bear four anterior setæ on base (these correspond to the subventral tubercle with two setæ and two ventral setæ). Segment 9 has anterior and post dorsal tubercles each with one seta; anterior and post subdorsal tubercles each with one seta; two tubercles each with a single seta, one below other on posterior edge of segment; a subventral tubercle with two setæ. Segment 10 has two dorsal tubercles, two lateral tubercles, each with one seta; immediately posterior to the anal flap there is a tubercle with one seta on either side. There are four setæ on the base of claspers.

Ventrally anterior to each prothoracic leg there is one seta; posterior to each thoracic leg one seta, these can be observed also on the inner side at the base of the abdominal feet. On abdomen 1, 2, there are two tubercles with one seta each (already mentioned), outer to the leg seta on 7, 8, there is only one tubercle outer to the leg tubercle, and on 9 there is only the leg tubercle with one seta. Terminal hooks of the abdominal feet are one central row of strong hooks and one outer row of smaller hooks, the circle is incomplete on the outer side; the claspers have two rows of similar hooks but only on the inner side of claspers.

C. daphnandræ at twelve months length is about $1\frac{3}{16}$ inch. Head not noticeably larger than other segments, which are uniform to about 7 abdominal; 8, 9, 10 taper somewhat smaller. The principal subsegments are swollen in appearance and the incisions very pronounced. Colour similar to early

stage but with a reddish tinge and a thin mid dorsal line. Head is very dark brown. In every detail of structure it corresponds with younger larva.

C. daphnandræ full fed at nearly two years; length about 2 inches. Head smaller than Prothorax, abdominal segments 4 to 7 are slightly larger than anterior or posterior segments. Head very dark brown; prothoracic scutellum pale brown; thoracic and abdominal segments dirty yellowish white; anal segment reddish colour. A slight mid dorsal line of brownish colour, and segmental incisions are reddish. The structure as preceeding, black concavity of scutellum has three setæ; terminal hooks of abdominal feet are incomplete on outer side, claspers likewise as before described. Setæ retain minute blunt thorns.

(II.) *C. eximia* larvæ live (?) two years, at nearly twelve months length is $1\frac{1}{8}$ inch. Colour: Head mahogany red; Prothorax light brown; thoracic and abdominal segments cream colour, with greenish mid dorsal line and incisions. Tapers from head to anus. As regards structure, the position of tubercles and number of setæ exactly corresponds with *C. daphnandræ*. Black concavity of scutellum contains three setæ and one below. The spiracles of abdominal segments are well forward on anterior edge of principle subsegment. Circle of terminal hooks is complete on abdominal feet, but the claspers have only the inner rows of hooks. Setæ are almost smooth but have a few minute thorns near base. Head of larva very much smoother than *C. daphnandræ* and it is shining.

C. eximia full fed at nearly two years, length about 2 inches. Colour: Head red brown; Prothorax pale brown; thoracic and abdominal segments are cream with pinkish tinge. All segments about same size, except 9, 10 abdominal, which are smaller. Can only distinguish one seta within the black concavity of scutellum. Terminal hooks, two very distinct rows encircling extremity of abdominal feet, of claspers as before described.

(III.) *C. ramsayi* (?) two years, length 2 inches. Colour: Head dark brown, striated; Prothorax scutellum, pale brown with rosy tinge; thoracic and abdominal segments yellowish, thin darker mid dorsal line. Segments apparently uniform in size to 9, 10. Terminal hooks of abdominal feet complete, of anal claspers like a figure 3 without hooks, posteriorily as in *C. virescens*. Tubercle setæ smooth. Skin smooth.

C. ramsayi full fed length 3 inches. Colour: Head reddish brown; Prothorax, very pale brown; thoracic and abdominal segments, yellowish. Head smaller than Prothorax, abdominal segments 3 to 7 are larger than the anterior and posterior segments. Prothorax scutellum has within the black concavity three setæ. Terminal hooks of abdominal feet complete, anal claspers as before described. Tubercle setæ smooth. Skin smooth.

(IV.) *C. virescens* live (?) three years, there is a great difference between the larvæ which may be regarded as full fed, some about 3 inches, some about 4 inches, it is not improbable that the larvæ which produce female imagines, live a year longer than those which produce males. The larvæ of *C. virescens* are described elsewhere,* but it may be worth noting that the black concavity of scutellum contains three setæ in young larvæ, but one only in adult larvæ, likewise in young larvæ the terminal hooks of abdominal feet are incomplete, but in full fed larvæ they completely encircle the extremity of the abdominal feet. It might also be worth mention that these larvæ, and probably the other species also, vary in colour much in accord with the colour of the sap wood in which they feed.

PUPÆ.

The pupal stage is of short duration, "from six weeks to occasionally as long as three months (Illidge).

(1.) *C. daphnandræ* pupa. Colour: Head and prothorax very dark brown, remaining segments are yellowish brown with reddish shading on posterior edge of segments, spines and spiracles are dark brown.

Head dorsally and ventrally, dorsum of Prothorax, and anterior dorsal area of Mesothorax are deeply pitted and striated in a manner resembling that of the larval caput. The wing cases extend to the anterior edge of abdominal 3; antennæ extend only to base of wing cases of which the second pair of legs forms the costal margins, the first pair of legs are inner to the second. Margin of hind wing cases show a little at the outer margin of the fore wing cases. Abdominal segment 1 is dorsal, small and without spiracles; 2 has spiracles subdorsal and apparently partly covered by edge of wing cases; 3 to 6 have normal spiracles in lateral position, these segments also have setæ—small but definite, which correspond in number and position to the larval tubercle setæ; 7, 8, have scars of spiracles, the four terminal segments are fused together.

* Proc. Roy. Soc. Q'land, Vol. xv, and Trans. Entom. Soc. London, 1900.

Dorsal spines commence on the posterior edge of Meso and Postthoracic segments, abdominal 1, 2, have an anterior ridge of spines; 3 to 7 have anterior and posterior series, the spines of anterior series being strongest, and of 7 more so than the others.

Ventral spines, a few posterior on segment 3, a strong undulating series posterior on 4, 5, 6, an anterior disconnected series and a posterior series on 7, the latter not so strong as those of other segments; 8 to 10 are smooth.

(II.) *C. eximia* pupa appears to correspond in all details of structure with *C. daphnandræ*.

(IV.) *C. virescens* pupa compared with *C. daphnandræ* has a smaller dorsal segment 1, the spines of the abdominal segments are also stronger in the former, this may be associated with the greater length of the burrows.

When the time for emergence of the imago arrives, the pupa "by alternately extending and contracting the segments" (Illidge) aided by the spines, forces its way up the perpendicular shaft, through the prepupal operculum and external cover (when the latter has not been removed prior to pupation). The species with short horizontal burrows extend the anterior pupal segments beyond; *C. virescens* which usually has long horizontal burrows, remains wholly within the entrance.

On dehiscence the pupa ruptures longitudinally from the dorsal posterior edge of Mesothorax to the ventral extremity of wing cases, and the sutures of the Pro-meso, and meso-post thoracic segments become partially split, the ventral head piece with antennal case becomes wholly detached, but the leg cases appear to remain intact, though I am not sure that in some instances the cases of first pair of legs become partially severed from the second pair.

The remarkable identity of structure in all stages is a clear indication of very close relationship between *Charagia daphnandræ*, *C. eximia*, *C. ramsayi*, and *C. virescens*.

EXPLANATION OF PLATE.

- | | | |
|------|----------------------|--------------------------------------|
| I. | <i>C. daphnandræ</i> | prothorax 1st year (x 4). |
| II. | " | 3rd abdominal segment (x 4). |
| III. | " | 10th " " |
| IV. | " | anterior pupal segments (x 4). |
| V. | " | posterior " " (x 4). |
| VI. | " | Terminal hooks of abdominal feet |
| VII. | <i>C. eximia</i> | Dehiscid pupal headpiece (nat. size) |



Illidge, Rowland and Quail, Ambrose. 1901. "Australasian Woodboring Hepialidae." *The Proceedings of the Royal Society of Queensland* 16, 65–72.
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