

## AUSTRALIAN WOODBORING COSSIDAE.

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“*Endoxyla macleayi*,” SCOTT; “*E. boisduvalii*,” ROTHs; “*Culama expressa*,” LUCAS; WITH INCIDENTAL REFERENCE TO OTHER SPECIES.

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(PLATE VII.)

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WE are not in a position to offer a systematic classification of the Cossidae,\* but believe this paper will be of value as a contribution thereto; indeed this will be something, for authorities do not agree as to their treatment. Pro tempore, we adopt Rebel's (Iris xi.) subdivision of this group into Cossinae and Zeuzerinae, of which there appear to be some forty-five species in Australia—eleven Cossinae, thirty-four Zeuzerinae, to which may be added three species of Phragmataecinae. The group is entirely without representatives in New Zealand.

We regret exceedingly having been unable to procure ova for examination, but it may be of interest to note that the ovum of *Cossus cossus* (Europe) is ornamented with “crystalline” sculpture on the eggshell; nor have we examined newly-hatched larvae, doubtless the first instar will furnish details of value, but these groups do not differ widely in any stage as to larval structure, according to Dyer† only in the absence in the first instar of the tubercle above the base of the abdominal feet. The material with which we are familiar consists of larvae older than the first instar, and some pupae.

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\* We understand Rothschild is engaged on a revision of the group.

† Dr. Dyer, New York Academy Science, 1894.



It is generally conceded that the earlier lepidopterous larvae were phytophagous, and it is well known that many Hepiali are subterranean feeders. Our previous paper† dealt with "Australasian Woodboring Hepialidae," we cannot, however, separate Hepialidae into two distinct phylogenetic groups—phytophagous and lignivorous—it seems rather that some Hepialidae independently from time to time acquired lignivorous habits, in an evolutionary sense these may be regarded as higher than those of phytophagous habit.

We may note, however, there is little difference in actual habits between phytophagous and lignivorous Hepialidae. Subterranean species burrow more or less vertically into the earth, and pupate without any cocoon in the vertical larva burrow. Woodborers likewise burrow vertically downwards, the only approach to a pupal cocoon being that a prepupal operculum is constructed, which seals up the vertical bore or the horizontal galleries; there is also throughout the larval existence an outer (external) cover.

There was probably little differentiation amongst early Lepidoptera as regards larval habits, differentiation accompanied specialisation, and we may trace the habit of existing Lepidoptera, exposed feeders, case bearers, leaf miners, to progenitors whose habits were similar, living in primeval marshlands, where Neuroptera passed their developmental stages in shallow pools, micropterygid-lepidoptera fed among damp mosses, and Hepialidae derived subsistence from the roots of grasses and ferns. Having acquired the habit of feeding in the interior of reeds, as do existing Phragmataecinae, some Cossid progenitors became lignivorous, and their larvae are now almost exclusively so.

Cossidae larvae burrow indifferently up or down in saplings, branches, or trunks of trees of large growth. At an early age\* the larva commences to bore, and covers the burrow with an external cover (Zeuzera) or with a loose web (Endoxyla) sometimes a prepupal cover is constructed (Endoxyla), some pupate without a cocoon, others construct a pupal cocoon. Zeuzerinae do not leave the larval burrow—like Hepialidae—

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† Trans. Royal Soc., Queensland, Vol. XVI.

\* The very earliest stage of the larva is not passed in the wood, and calls for special investigation, as to what is the exact habit when first hatched.



until the pupa forces its anterior segments out of the burrow for the imago to emerge. Young *Cossus* larvae feed at first beneath the bark of the tree, then burrow into the wood, there to spend, as do *Hepialidae* and *Zeuzerinae* a lengthy existence often of three or four years. The habits of *Cossinae* are not so exclusive as those of *Hepialidae* and *Zeuzerinae*, the external cover is often absent (*Culama*), indeed we have frequently observed the larva of *Cossus cossus* when full fed, expose its whole length to warm sunshine, moreover it will commonly leave its larval burrow to pupate elsewhere, even in the earth away from its ligneous habitat. May it be that a too numerous colony (*Cossus* and *Culama* are gregarious) in the same tree, by breaking in upon each others burrows, always strictly avoided by *Hepialidae*, become a source of irritation, or even danger at the critical time of changes to the pupal condition, and the larva is compelled to pupate elsewhere. The normal habit appears to be that the larva tunnels to the bark which it eats away, leaving however a very thin surface, and it may be noted these larvae frequently fill their burrows with a kind of solidified sawdust (*Hepialidae* scrupulously eject all frass). †A cocoon of silk and chips is constructed within which it pupates, in the immediate vicinity of the exit; finally the pupa forces its anterior segments through the thin outer cover of the burrow and the imago emerges.

Always remembering the limited material at our command, so far as it goes our observations show that *Zeuzerinae* and *Cossinae* may be associated by some identical larval structures. The number of scutellar setae of prothorax, the tubercle arrangement (and spiracle scars) of meso and post thoracic segments, the lateral thoracic intersegmental tubercle; the duplicate remote supraspiracular seta, the position of the basal setae, and the hooks of the abdominal feet. These structures are not peculiar to *Cossidae*, being also observed in other groups (composing Dyer's superfamily *Cossina*), but they sharply and distinctly separate *Cossidae* from *Hepialidae*, which cannot be associated.

Some larval features appear to afford good characters upon which we may separate *Zeuzerinae* from *Cossinae*. The *Zeuzerin* prothoracic scutellum, viewed laterally, slopes upward and backward in dorsal outline, so that the length from front to back

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† Proc. Roy. Soc. Queensland Vol. XIV. (Illidge).



is considerably more than the length of the ventral surface of the prothorax; the produced posterior area of the scutellum is provided with numerous spicules (*Zeuzera*, *Endoxyla*). The prothoracic scutellum of *Cossinae* is smooth, not produced posteriorly, being confined to normal and proper limits, the posterior margin parallel to the anterior margin (*Cossus*, *Culama*).

An important feature in *Zeuzerinae* is the presence on the dorsum of the abdominal segments of minute tubercles (one each side) with seta, in front of the typical anterior trapezoidal tubercles (*Zeuzera*, *Endoxyla*), but which are not observable in *Cossinae*. These tubercles are probably homologous with the thoracic intersegmental tubercles, observed also in *Cossinae*, and in other groups of *Lepidoptera*. Mr. A. Bacot, in a letter some years ago, drew our attention to these (abdominal) tubercles on the larva of *Zeuzera pyri* (Europe), he having also observed those of the thorax in several isolated groups of *Lepidoptera* e.g. *Lycænidae*, *Psychidae*. We have noted such thoracic intersegmental tubercles with setae in newly-hatched and adult *Hepialidae*\*, in *Lysiphragma* (*Tineina*) without seta†; they are also present in *Tortricina* (*Cacaecia*) and others. Bacot believes this to be a once common character, now generally lost in *Lepidoptera*, and had not then detected the setae which are present on the thoracic and abdominal tubercles in question of *Endoxyla*. We have been unable to find whether Dr. Dyer is aware of these extra abdominal tubercles.

We are not inclined to insist upon minor differences; that *Zeuzerin* larvae are circular or nearly so in transverse section; *Cossinae*, being flatter, are barely more than semi-circular; that *Zeuzerinae* have middorsal spiculate abdominal humps, and some other features, as young larvae in either group may be more alike.

A consideration of the pupal structure affords additional support to the conclusions arrived at from larval characters as to the separation of *Hepialidae* from *Cossidae*,‡ and the subdivision of *Cossidae*. The pupae bear a superficial resemblance to each

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\* Trans. Ento. Soc., Lon., 1900 (Quail).

† Trans. New Zealand Institute, 1900 (Quail).

‡ We wish to emphasize that these groups cannot be associated, which, of course, is generally admitted, but are sometimes treated of or referred to as if they were. Their primitive ancestors were probably neither *Hepialid* nor *Cossid*, but had some of the characters now found in each group.



other, but, when examined closely, we find sufficient points of distinction between the groups.

The Hepialid pupa is remarkably cylindrical, Cossidae are not so. Hepialidae have dorsal and ventral segmental spines, Cossidae have the dorsal spines only. The Hepialid antenna is diminutive, reaching only to the "knee" of 2nd leg, in fact that portion of the antenna which extends beyond the pro-mesothoracic suture is half its entire length. The Cossid antenna reaches to fully half the wing margin being some four times the length of the basal portion. The ancestors of these groups had comparatively short pupal antennae, and if Cossidae are derived from progenitors with antennae like those of typical existing Hepialidae, then the latter are lower in the evolutionary scale than Cossidae, which will have specialized in having developed antennae of greater length.

The Lepidopterous pupa has its appendages—legs, wing-cases, etc., extending beyond the thoracic segments downwards, adherent to certain abdominal segments which become incorporated with more or less fixity, so as to lose their individual movement; the terminal (anal) segments likewise become one coherent mass, in varying number, and movement of the pupa is thus confined to the intermediate segments, of which the incisions remain free and functional. Dr. Chapman has pointed out the importance of this structural character, in classification.†

The wing cases of Hepialidae adhere to the abdominal segments 1 and 2, that they have become integral parts of the anterior mass is shown in that the spiracle of 2 is subdorsal, and on dehiscence they (the wing cases) still adhere to those abdominal segments. In Hepialidae the free segments are ♂ 3, 4, 5, 6, 7; ♀ 3, 4, 5, 6.

The Cossid spiracles are normal in position, and on dehiscence the appendages lose their apparent fixity to the abdominal segments, remaining attached only by the inner membrane of 3rd legs and hindwings, the dissection exposing to view the abdominal spiracles (1 and 2) in normal position, until then covered by the wing cases. In Zeuzerinae the free segments are ♂ 3, 4, 5, 6, 7; ♀ 3, 4, 5, 6. In Cossidae the free segments are ♂ 4, 5, 6, 7, ♀ 4, 5, 6. In respect of incorporation of the numbers of abdominal segments into the anterior mass Hepialidae are the lowest, there being a tendency in Zeuzerinae to

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† Trans. Ento. Soc. Lond., 1892.



incorporate segment 3 also, and in Cossinae 3 is so incorporated, but Cossidae—both Zeuzerinae and Cossinae—retain a character relatively more ancient than that of Hepialidae, that is, the freeing by dissection of the appendages from the abdominal segments on dehiscence.

#### ZEUZERINAE—ENDOXYLA.\*

Description of larvae.—The dorsal horns of anal segment may prove a good *generic* character. The arrangement of scutellar spicules is probably a good *specific* character.

*E. boisduvalii*—"Roths." (Plate VII., Fig. 6.)

† The larva at an early age feeds beneath a light-coloured silken web, which falls off subsequently when the larva has burrowed into the wood of the tree; our description is made from a larva 35mm. in length, it has at this stage a very pleasing plumage, being ringed alternately red and yellow, it is in appearance quite an elegant aristocratic larva, but with approaching maturity loses its remarkable coloration.

\* Derived from *endo* and *xulon*.

† The first intimation of the presence of the larva is readily noted by this freshly-formed web of loose silk and gnawed pieces of the bark of the tree, upon raising which the caterpillar may be seen, either partly buried in the bark and young wood or quite entered within the small tunnel it has bored. Later on the bark begins to grow over the opening made into the tree, the web falls off or is blown away by the wind, and a small circular scar is the only indication then left of the insect inside the tree. The larva continues tunnelling towards the centre of the tree, increasing in size, and the bore becoming larger. Having gone as far as the heart of the tree, or nearly so, it curves upwards at right angles to its former course for from 6 to 8 inches, and completes the remainder of its existence by feeding upon the constantly forming young wood and sappy matter, sometimes making two or three short pseudo-bores at the foot of the perpendicular tunnel, which together form a large chamber within the stem of the tree. Having attained full growth within it prepares for its change and exit as an imago or winged insect by gnawing outwardly with its powerful cutting mandibles, and forms a clean cut round hole often nearly an inch and a-half in diameter upon the outside of the tree. This opening is frequently blocked up by triturated fragments of wood loosely spun together with silk. The next process is the retreat of the insect to the perpendicular tunnel, where it first forms a most singular network of a very viscous substance from  $1\frac{1}{2}$  inch to 2 inches in depth, which when first formed is a pure glistening white, but becomes yellow with age. On this it forms its operculum of finely triturated wood closely felted together with silk and saliva. Having completed all its arrangements the larva, now head downwards, and quite filling up the chamber-room left, turns to a pupa (chrysalis), and in the course of a month or six weeks, occasionally longer, the imago emerges in the manner usual to insects of this group.



Head is yellowish brown ; scutellum has the anterior half blackish, except at margin which is yellowish, as is the posterior area ; segmental area of prothorax is yellow ; mesothorax thinly bright red dorsally and subdorsally, yellow below ; postthorax and 1 to 9 abdominal segments are divided transversely, anterior red, posterior yellow, sections, above the spiracles the band is dull red, at and below the spiracles and ventrally it is bright red ; the posterior dorsal humps are brighter red than are the anterior humps ; the anal segment is wholly yellowish brown.

Shape: Viewed dorsally, is uniform, robust ; viewed laterally, the meso and post-thoracic segments are "weaker" than others. Head: Finely striate. Prothorax: Scutellum finely striate anterior, and finely spiculate on posterior area, four larger spicules are arranged in a trapezoidal position, *i.e.*, two in front approximate (with some minute spicules between them) and two posterior remote. On either side of the median line of scutellum are one anterior, two posterior dorsal setae on the unspiculate area of scutellum ; two anterior and one central setae are on a lateral subdivision of the scutellum ; a prespiracular tubercle bears two long setae with a small inner seta near the spiracle. Spiracle is very large, above the legs a tubercle bears two setae. Meso and post thorax : the dorsal and subdorsal setae are duplicate pairs ; lower a more central lateral tubercle bears a single seta, and an anterior tubercle bears also a single seta, between these tubercles a rudimentary spiracle or scar may be detected ; a lower anterior tubercle bears a single seta, and tubercle above legs bears one seta.

Abdominal segments : the dorsal humps are divided transversely, not longitudinally, and are covered with minute spicules, the anterior hump is largest. The trapezoidal tubercles are normal with a single seta each, placed on the segmental area, not on the humps. The supraspiracular tubercle has a single long seta above the large oval spiracle, and there is a remote anterior supra spiracular tubercle with a minute seta. The subspiracular tubercles each have a single seta, the anterior highest in position ; above the legs a tubercle bears one central seta ; the basal setae are three in number, one being above the others, not in line with them. Segment 9 has the anterior trapezoidals remote, posterior trapezoidals inner ; 10 has two small blunt protuberances of red colour representing what in other species are a pair of anal horns, the setae are one anterior, one level with horn, one posterior, one more lateral, three lateral setae



are below the anal flap, and basal setae are on the anal claspers. The abdominal feet have a single row of hooks, the interspace being pear-shape. In addition to the typical tubercles described, the intersegmental area of pro-meso-post-thorax carries two minute setae one below the other, a little below the subdorsal pair of thoracic setae in position. On the abdominal segments a minute seta is placed on the anterior margin longitudinally in line with the posterior trapezoidal tubercle; it appears to be frequently turned under out of sight by contraction of the segments.

*E. macleayi*—"Scott." (Plate VII, figures 1, 2, 3, 4, 5.)

Larvae varying in length from 47 mm. to 67 mm. have been examined, and are identical as regards structure, and we especially noted the scutellar spicules were so. Head brown, scutellum anterior area brown, with middorsal and lateral areas black, general colour of body dirty pale brown, with pinkish lateral flanges, blackish spiracles, brown legs, and abdominal feet.

Shape: Viewed dorsally is robust, uniform except that the subdorsal tubercles of mesothorax protrude conspicuously; viewed laterally meso and post thorax are smaller than abdominal segments, which latter are produced to prominent humps on the middorsal outline (as the preceding species); 8 and 9 are without humps; 10 has a pair of postero dorsal horns—distinct chitinous (not fleshy) processes curved backwards.

Structure: Head freely striate, clypeus with straight sutures having two setae one before other at lower corners; ocelli four, in fairly close crescent, one lower, another near and below antenna; jaws dentate; maxillae short and stout with one palpus developed.

Prothorax: scutellum slopes (as in preceding species) upward and backward from the small caput, the anterior half striate transversely, posterior area covered with chitinous spicules of which *three* of the largest are in line, considerably in front of the others; these spicules are hollow protuberances (shown by dissection of the thorax) as much so as cow's horn, they are somewhat irregular in size, more numerous and more minute towards the outer and posterior edges of scutellum. The larger spicules are invariably blunt at the top, the smaller ones intermixed are sharp pointed. The function of the scutellar spicules is evidently to act as a saw or rasp upon the wood of the tree, thereby assisting the work of



the jaws, such action causing the larger spicules to become blunter, the spicules are directed backwards (*i.e.*, upward).

The tubercles and setae of thoracic and abdominal segments are as described of the preceding species. The prothoracic spiracle is extremely large, earshaped with convex curve posterior. Owing to innumerable number of brown spicules which cover the thoracic and abdominal segments on dorsum, laterally, and ventrally, intersegmental tubercles cannot be detected, nor can the extra abdominal setae, except the small remote supraspiracular.

These larvae grow to a very large size, we have a specimen which is, we believe, this species in its ultimate instar, in length 16.4 cm.; in width, 19 mm.; being so large it offers a good subject to examine for different structures. The colour is dirty whitish yellow, jaws brown, head dark brown shading to yellow at suture of clypeus, scutellum yellow anterior margin with dark brown shading to reddish either side of a V shape median mark yellow in colour which spreads over the whole posterior area of scutellum on which the spicules show distinctly as little brown dots; the abdominal humps are slightly brownish from the numerous brown spicules; the tubercles are little brown areas on the skin, but the spiracles are very dark brown, almost black, raised oval rims, the dorsum of the anal segment is brown with posterior horns of darker brown colour.

In most respects it agrees with the above description as regards structure, but the frontal spicules are *four* in number, the largest of the hinder flanking spicules marking the trapezoid similar to Boisduvali. The skin of the thoracic segments has numerous brown spicules, but the abdominal segments are practically free from spicules except on the humps. The pro-meso-thoracic intersegment carries a dorsal seta (almost hidden by posterior edge of scutellum) just below the dorsal pair of setae in position, and two lateral setae below the subdorsal pair of setae. The meso-post thoracic intersegmental area carries two lateral setae, but cannot detect dorsal setae. The extra dorsal anterior setae of abdominal segments are just below the posterior trapezoidal tubercles in longitudinal position; it seems probable that the minute anterior supraspiracular tubercle is homologous with the lower thoracic intersegmental seta, which it resembles in size, and approximates in position. The extra tubercle of 9th abdominal segment are a little more



dorsal in position than the second (inner) tubercle. Abdominal feet have a single row of hooks.

Pupa of *E. macleayi*, ♂ length 10.4 c.m. (Plate VII., Figs. 13, 14, 15, 16).

Almost unicolorous dark brown in colour, with darker polished areas on pro-meso-thorax, wing and leg cases. The wing cases extend partly over the third abdominal segment, but are not adherent at any rate on dehiscence, they are then detached and connected only by the inner membrane of legs and hind wings to the second abdominal segment, the spiracles of 1st and 2nd abdominal segments may be seen, normal in structure and in position uncovered by the semi-detached wing-cases.

The head on dehiscence carries antennae, eyecovers, etc., as one piece, terminating with an anterior apparatus with a chisel-like organ; between the eyes another, and still lower a pair of similar chisel-like organs.

The abdominal segments have the anterior row of dorsal spines best developed, the posterior row being merely a thin line of spicules, the anterior spines are curious as regards shape, each having at its tip a cuplike hollow; there are no ventral spines, the scars of abdominal feet are very distinct, but are not spinous. Segment 8 has no dorsal spines, but transverse lateral series more strongly developed than are the dorsal spines of other segments—this is so with pupae of *E. affinis*. Segments 9 and 10 are smooth, except for a few spicules which may be related to hooks of anal claspers, the scar of the cloacal aperture is distinctly marked. The sexua' organ extends from 9-10 suture forward to about middle of 8th, being a slightly raised polished surface, where it meets a V and again continues as a thin straight line. The free segments are 3, 4, 5, 6, 7; in ♀ the free segments are 3, 4, 5, 6.

#### COSSINAE—CULAMA.

*C. expressa*—"Lucas."\* (Plate VII. Figs. 7, 7a, 7b, 7c, 7d, 8, 9, 10.)

Of all the internal wood-feeding larvae we have known this is the most gregarious, one piece of branch less than a foot in length containing ten larvae. The burrows may be distinct and run parallel with each other, or may coalesce and in one and the same burrow quite young and older larvae are found. As may

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\* Trans. Linn. Soc. N.S.W., 1902.



be imagined the damage to the tree is proportionately great, the wood (*Aegiceras majus*), however is tough, and despite the removal of the interior by *Culama* larvae, still looks solid, showing no external evidence of the ravages committed, and *Termitidae* could not do their work more effectually than do these larvae.

The larvae under observation were of various sizes 6 to 35 mm. Colour: it recalls the larva of *Cossus cossus*, being bright red and pale pink ventrally, head dark red, jaws brown, scutellum brownish, spiracles, thoracic legs and hooks of abdominal feet brown.

Shape: Very uniform, flat viewed laterally, broad dorsally; the head is small retractile; of the thoracic segments prothorax is longest, mesothorax widest; 1 and 2 abdominal segments are smaller than thoracic segments, the succeeding six (four of which carry abdominal feet) are more robust; 9 and 10, of course, are terminal and smaller.

Structure: Head smooth, ocelli pale, in crescent of five with one forward below antenna; two setae are enclosed by ocelli; jaws curved dentate; maxillae, one palpus developed others minute; labial palpi anterior to spinneret, which is short and stout. No perceptible difference between the organs of caput in this species, and of *Endoxyla*.

Prothorax: Scutellum smooth, anterior transmarginal; setae three each side, two transposterior setae, one mid lateral near edge of scutellum, anterior to the spiracular position. On each side of the scutellum is a depression less definite, but not unlike in position to the scutellar concavity of *Charagia* (*Hepialidae*, *Xyloryctina* also have similar scutellar depressions); also there are three (apparently) rudimentary circular tubercle bases without seta, in arrangement not unlike the scutellar transmedian setae of other *Hepialidae*. We are not sure that these are on the outer surface or inner (showing through) of the scutellar integument, they would most likely be overlooked, unless one had a knowledge of the *Hepialidae*, and being observed on all the *expressa* larvae examined they are at least worth mentioning. Spiracle is oval, large, not extremely posterior. Prespiracular setae, three in number, smallest near spiracle; above the legs a longitudinal tubercle bears two setae; the scutellum of *Culama* differs from that of *Endoxyla*.

Meso and post thoracic segments: the dorsal and subdorsal tubercles are duplicate pairs, a little lower a more central



tubercle and an anterior tubercle; each bear a single seta, with spiracle scar between, but not so distinct as in *Endoxyla*; a lower anterior tubercle bears a single seta. In addition to the typical tubercles, an intersegmental midlateral tubercle bears two setae in position a little lower than the subdorsal pair of setae.

Abdominal segments: have two subsegments, the larger anterior subsegment carries all the tubercles, except the posterior trapezoidals which are on the posterior smaller subsegment. Dorsal elevations form the areas from which rise the trapezoidal setae in normal position; the other tubercles are as in *Endoxyla*. The minute anterior supraspiracular tubercle with seta is present, but the anterior minute dorsal seta cannot be detected. Terminal hooks of abdominal feet are as in *Endoxyla*, consisting of a single row, each hook having a long embedded shaft with a strong free hook. The anal claspers have hooks only on the inner edge. All setae are smooth. The skin of thoracic segments is spinulose only on dorsal area.

Pupa of *Culama expressa*. (Plate VII., figures 11, 12.)

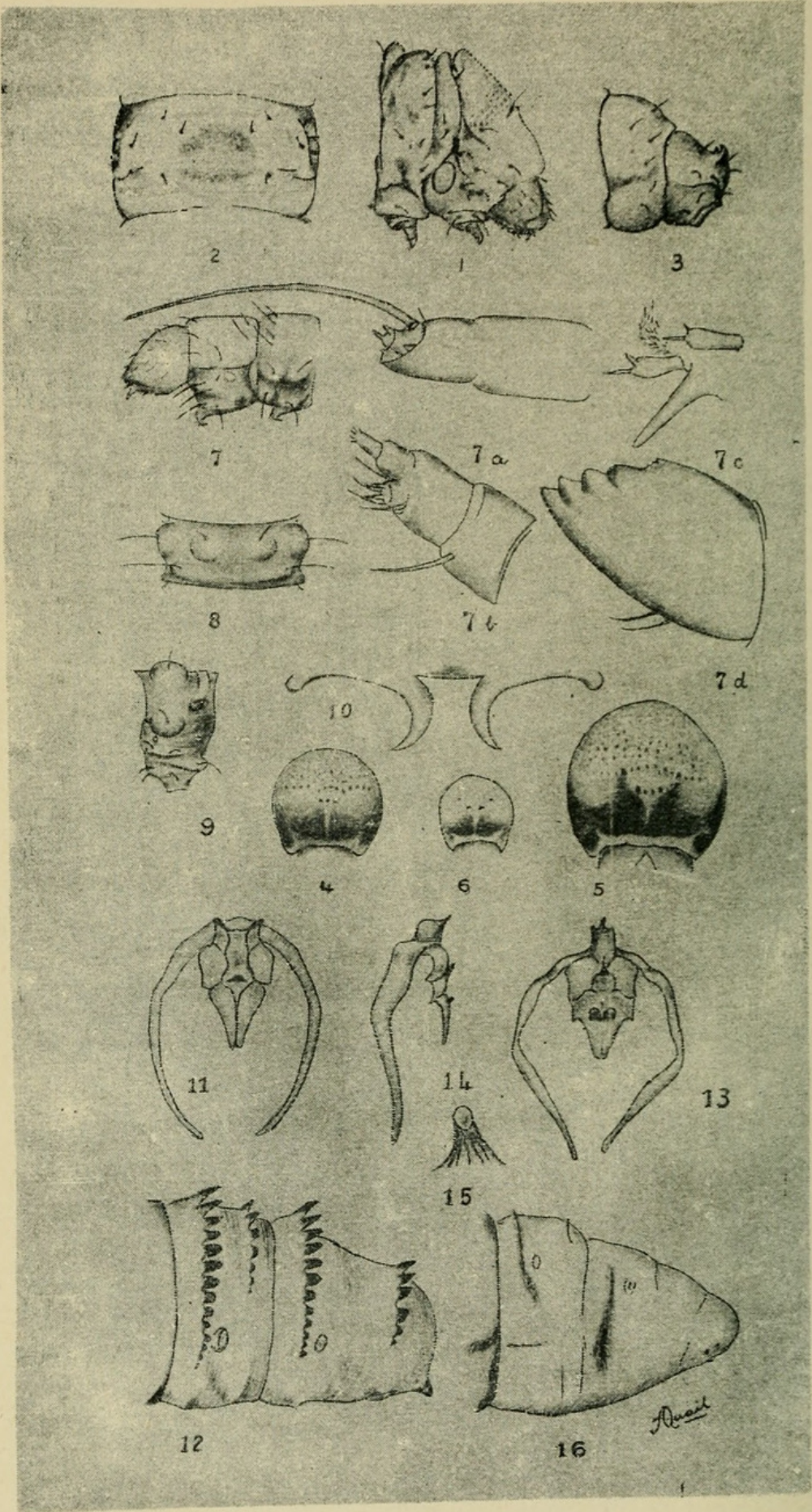
♀ length 21 mm.; greatest width, 8.5 mm.

Almost unicolorous brown, dorsum rather darker, spines still darker brown; probably when alive the wing cases are more or less transparent, as in the case with other wood feeders (*Charagia*); preservation in spirits while hardening the tissues renders them opaque. The dorsum curves definitely from 1 to anal segment, ventrally from 7—10. Meso thorax has distinct lateral "shoulders," prothorax and head abruptly tapering. The anterior (head) apparatus, which in *Endoxyla* is very prominent, is in *Culama expressa* represented by three parallel ridges passing back to suture of prothorax and ventrally to between eyes, where a raised area carries a depression and terminates with a broad chisel-like apparatus. The antennae pass behind the eyes with a very wide curve, and terminate ventrally about the locality of 1-2 abdominal incision, if same could be seen ventrally. The superior wing cases extend from mesothorax to suture 3-4 abdominal segments, rather slightly beyond, but in no way adherent to 4th abdominal. The short maxillae? and mandible?, 1st and 2nd pairs of legs, are between the antennae on ventral surface, tips of 3rd pair of legs show between the apices of the wing cases. The dorsal incisions between 1—7 abdominal segments are distinct, the ventral incisions only between 3—7 are so, segments 7—10 are fused into one coherent











mass, thus 4, 5, 6, are free segments. Abdominal segments 1 to 6 each have posterior and anterior parallel rows of strong spines across the dorsum; 7, 8, 9, have a single row each; 10 has three lateral spines on each side. The scar of the cloacal aperture appears as a postero ventral median line, the sexual organs appear as a median linear depression on the ventral surface of 8—9 segments. The pro-meso-thoracic sutural spiracle opening is rather large, and abdominal spiracles 2 to 7 are in normal position, 8 appears as a rudimentary scar. On dehiscence the head, antennae, and mouth parts (ventral appendages) separate as one piece—corresponding to that of Hepialidae—the legs and wing cases remain attached loosely (divided centrally) to the general body of the pupa. The suture with 1st abdominal opens dorsally to near the tips of wing cases ventrally the wing cases becoming semi-detached throughout.

The ♂ pupa differs from the ♀ in being less robust and in having segments 4, 5, 6, 7, free.

The chisel-like apparatus of the head presents a marked difference from *Endoxyla*.

#### EXPLANATION OF PLATE VII.

Figure 1. *Endoxyla macleayi* larva:—Head, prothorax, mesothorax, nat. size.

2.	„	„	„	Dorsal view abdominal segment, nat. size
3.	„	„	„	Lateral view anal segment showing posterior horns, nat. size
4.	„	„	„	Scutellum showing spicules, nat. size
5.	„	„	„	„ „ „ ultimate instar, nat size
6.	„	<i>boisduvalii</i>	„	Scutellum showing spicules, nat. size
7.	<i>Culama expressa</i>	„	„	Head, prothorax, mesothorax, magnified
7a.	„	„	„	Antenna largely magnified (x250)
7b.	„	„	„	Maxilla „ „ „
7c.	„	„	„	Spinneret and palpi „ „
7d.	„	„	„	Mandible largely „ „
8.	„	„	„	Dorsal view abdominal segment magnified
9.	„	„	„	Lateral view abdominal segment magnified
10.	„	„	„	Hooks of abdominal feet (x250)
11.	„	„	pupa	Head-piece magnified
12.	„	„	„	♂ Segments 7, 8, 9, 10, magnified
13.	<i>Endoxyla macleayi</i>	pupa	„	Head-piece nat. size
14.	„	„	„	„ profile nat. size
15.	„	„	„	Segmental spine largely magnified (x250)
16.	„	„	„	♀ Segments 7, 8, 9, 10, nat. size



## PRESENT DISTRIBUTION OF COSSIDAE.

SPECIES	AUSTRALIAN REGION.	ORIENTAL REGION.	PALAEARCTIC REGION.		ETHIOPIAN REGION.	NEARCTIC REGION.	NEOTROPICAL REGION.
			ASIA.	EUROPE.			
<b>PHRAGMATAECINAE—</b> Phragmataecina, "Newn"	Australia ..	Ceylon, India, Burma ..	Amur, Japan ..	All Europe ..	..	Mexico ..	..
Genus incog ..	..	..	..	..	..	..	..
Pachyphloeobius, "Feld"	Australia ..	..	..	..	..	..	..
Gnira ..	..	..	..	..	..	..	..
<b>ZEUZERINAE—</b> Zeuzera, "Latr" ..	..	Ceylon, India ..	China, Japan ..	All Europe ..	N. Africa ..	U.S.A., N. Am'ca	Texas ..
Xystus, "Grote" ..	..	..	..	..	..	..	..
Paracossus, "Hampson"	..	Ceylon, India ..	..	..	S., E., C. Africa, Natal, Nigeria	Mexico ..	..
Azygophleps, "Hampson"	New Guinea ..	..	..	..	Natal, Madagascar ..	..	..
Duanitus (Butl)=Xyleutes	Tas., Q'land, W. Australia ..	Ceylon, India, Sikkim, Assam, Java, Penang, New Britain, Singapore ..	..	..	..	..	Venezuela, Brazil, Guatemala, Bolivia, W. Indies, Honduras ..
<b>COSSINAE—</b> S.G. Endoxyla ..	Australia ..	..	..	..	..	..	..
Culama, "Walk" ..	Australia ..	India ..	..	..	Algeria ..	..	..
Eremocossus, "Hampson"	..	India ..	..	..	Central Africa ..	..	..
Genus incog ..	..	..	..	..	..	..	..
Stygia, "Iatr" ..	..	..	Altai ..	Europe ..	..	..	..
Endagria, "Boisd" ..	..	..	..	Europe ..	..	..	..
Hypopta, "Hubn" ..	..	..	..	Russia, Hungary ..	..	..	..
Holococerus, "Stgr" ..	..	..	Palestine ..	Russia ..	..	..	..
Cossodes, "White" ..	Australia ..	..	..	..	S. Africa ..	..	..
Rethona, "Walk" ..	..	..	..	..	Natal, S. Africa, Madagascar ..	Colorado, U.S.A., Canada	Chili ..
Cossus, "Fabr" ..	Australia ..	N. India, Thibet, Burma, Sarawak, Borneo ..	Japan, China ..	All Europe ..	..	..	..
Genus Incog ..	..	Singapore ..	..	..	..	Mexico, U.S.A.	Coquimbo, Rio Janerio, Chili
Genus Incog ..	..	..	..	..	..	..	Bahia, W Indies
Genus Incog ..	..	..	..	..	..	..	..
Genus Incog ..	..	..	..	..	Natal ..	..	..
Eutheca, "Grote" ..	..	..	..	..	Natal ..	..	..
Dudgeona, "Hampson"	..	..	..	..	E. Africa ..	N. America ..	Argentina ..
Acritocera, "Butl"	..	..	..	..	W. Africa ..	..	..
Daulia, "Walk" ..	..	..	..	..	..	..	Haiti ..

Based on list compiled from collection British Museum by A. Bacot, F.E.S., with additions by authors.





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