

**THE EXTERNAL MORPHOLOGY OF SCOLYPOPA AUSTRALIS (WALKER) (HOMOPTERA: RICANIIDAE)**

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**Abstract**

The external morphology of the egg and five nymphal instars of *Scolytopa australis* are described fully for the first time. The adult is redescribed. The morphological features which change from instar to instar are discussed and used in a key to separate the adults and five nymphal instars. Size measurements, as well as the arrangement of sensory pits, and the structure of tarsi, hind legs and abdomen, provide useful characters for separation of instars.

**Introduction**

*Scolytopa australis* (Walker), the passion vine hopper, has had extensive treatment in the literature due to its economic status. The species was originally described by Walker (1851, as *Pochazia australis* sp. n.; 1858, as *Flatoides australis* sp. n.). Additional descriptions were made by Stål (1859, as *S. urbana* sp. n.) and Melichar [1898, as *S. australis* (Walker)]. These were quite full and few details need be added. These additional points are mainly concerned with the lateral plates of the thorax, the mesonotum, the legs and the terminalia. In the adult description below, "anterior" is taken to mean "towards the oral opening".

The nymphs have been mentioned in the literature only twice and the egg not at all. Froggatt (1907) stated that "the larva is a green wedge-shaped little creature clothed at the tip of the abdomen with a bunch of white filaments". Kirkaldy (1908) gave a less detailed description. Nymphs of *S. australis* are mottled brown and white, sometimes with a greenish tinge in later instars. The most obvious characteristic is the fan of abdominal filaments held over the body at all times (Fig. 3). This appears to serve a dual function. Firstly, it disguises a nymph as it feeds on the plant and, secondly, it slows the fall of a nymph which has leapt from the plant. Several nymphs are usually found together on the undersurfaces of a leaf or along a stem.

All stages of the life cycle are described below from material collected on *Aegiceras corniculatum* (L.) (Myrsinaceae), the river mangrove, at Patonga, north of Sydney, N.S.W., during 1975-1976. The egg is described from numerous individuals extracted from oviposition sites. Five individuals were used for the measurements of the first, third, fourth and fifth instar nymphs, and adult males and females. Three individuals, collected on two different dates, were used for the measurements of second instar nymphs.

**Instar separation**

The characteristics which provide the best separation of instars are length of body, breadth of vertex and length of lateral edge of mesonotum. Of these, the first and third are easiest to measure.

Sensory pits are easy to see since they are dark, but it is not easy to count all of the pits on any one part of the body from one direction. The exception is the abdominal sensory pits on abdominal segments 4 and 5; these can be easily counted when the insect is laid on its side.

In addition to the sensory pits, the spination of the hind tibiae and tarsi and the number of tarsal segments on the three pairs of legs are useful in separating instars.

In the following key, the terms "abdominal pit configuration" and "tarsal configuration" are used. The former gives two numbers corresponding to the number of lateral sensory pits on each side of abdominal segments 4 and 5 respectively. The tarsal configuration gives three numbers corresponding to the number of tarsal segments on the first, second and third pairs of legs respectively.

**Key to nymphal instars and adults of *Scolytopa australis***

- 1. Fully winged; body more than 4 mm long; tarsal configuration 3-3-3 .. 2
  - Wings not separated from nota; body less than 4 mm long; tarsal configuration 2-2-2 or 2-2-3 .. .. . 3

- 2. Lateral mesonotum, including wing, more than 7 mm long; apex of abdomen with pair of large, vertically held, triangular plates bearing ventral teeth and toothed ovipositor held within ventral margin .. .. . **Adult female**  
 Lateral mesonotum, including wing, less than 7 mm long; apex of abdomen with pair of vertically held, rectangular plates attached to the sternite, without teeth .. .. . **Adult male**
- 3. Tarsal configuration 2-2-3; hind tarsi with six black-tipped spines at apex of first segment; lateral mesonotum more than 0.4 mm long. .. .. . 4  
 Tarsal configuration 2-2-2; hind tarsi with four or five black-tipped spines at apex of first segment; lateral mesonotum less than 0.4 mm long .. .. . 5
- 4. Fore wing-pads reaching at least to apex of hind wing-pads; lateral mesonotum more than 1.0 mm long; abdominal pit configuration 5-6, with four pits on each side of sternite 7 .. .. . **Fifth instar**  
 Fore wing-pads overlapping front of metanotum only; lateral mesonotum less than 1.0 mm long; abdominal pit configuration 4-5, with two pits on each side of sternite 7 .. .. . **Fourth instar**
- 5. Hind tibiae with three black-tipped spines on shaft and six spines at apex; abdominal pit configuration 3-4; body more than 1.8 mm long .. .. . **Third instar**  
 Hind tibiae with less than three black-tipped spines on shaft and less than six at apex; abdominal pit configuration 2-2 or 2-3; body less than 1.8 mm long .. .. . 6
- 6. Hind tibiae with one black-tipped spine on shaft and five at apex; hind tarsi with five black-tipped spines at apex of proximal segment; abdominal pit configuration 2-3; body more than 1.0 mm long .. .. . **Second instar**  
 Hind tibiae without black-tipped spines on shaft but with four at apex; hind tarsi with four black-tipped spines at apex of proximal segment; abdominal pit configuration 2-2; body less than 1 mm long. .. .. . **First instar**

*Egg* (Fig. 1)

Uniformly translucent immediately after laying, with yolk globules varying from 8 to 26  $\mu\text{m}$  in diameter. Length 770-870  $\mu\text{m}$ , maximum width (at about midlength) 360-380  $\mu\text{m}$ . Dorsal surface slightly more convex than ventral.

Chorion minutely granular, with faint polygonal impressions of follicle cells 17-22  $\mu\text{m}$  across. Anterior third of surface with numerous irregularly scattered, small, rounded projections, largest of which *ca* 4.8  $\mu\text{m}$  high (these projections larger towards anterior pole).

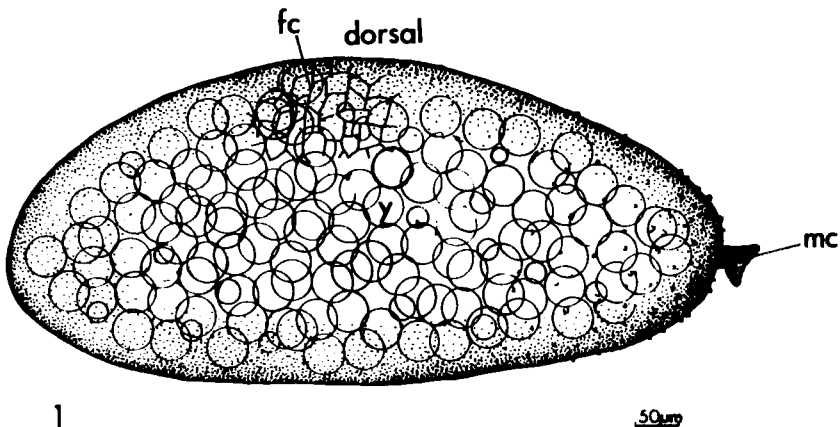


FIG. 1.—Egg of *S. australis*, lateral view (fc, follicle cell impressions; mc, micropylar cap; y, yolk).

Micropylar cap, at anterior pole, a mushroom-shaped projection 35-50  $\mu\text{m}$  high and 27-30  $\mu\text{m}$  wide at point of attachment to egg. Variable in shape at apex, but usually internally funnel-shaped and ragged at edges. Width across top variable, but mostly 43-48  $\mu\text{m}$ . Cap bent ventrally in all eggs so that dorsal side of cap runs nearly parallel to main axis of egg and ventral side lies close to chorion. Cap consisting of outer layer appearing similar to general chorion in structure, and inner section traversed by numerous canals passing the length of cap. These micropylar canals penetrate to membrane beneath chorion. Inner section of cap brittle, most eggs examined having part missing due to its having crumbled during sectioning.

When sectioned and examined under high magnification, chorion seen to be traversed by numerous minute canals arranged in haphazard fashion and appearing to be a product of chorion secretion process. These may be important for water absorption or gas exchange. Vitelline membrane lying beneath and closely associated with chorion.

A layer close beneath chorion appears to be composed of polygonal cells 8-16  $\mu\text{m}$  across their widest diameter, but is, in fact, flat, the "cells" apparently not having contents. It is not known what this layer is, as the eggs were examined before the formation of the blastoderm and a vitelline membrane would not have a cellular appearance.

### *First instar nymph* (Figs 2, 3)

Light brown, with darker brown mottling laterally; sensory pits dark brown. Body robust in outline, with thorax prominent and abdomen small. Body length, excluding abdominal filaments, 0.79-0.94 mm.

*Head*.—Rostrum long, reaching apex of hind coxae. Anteclypeus triangular, with steep sides reaching up to convex central portion. Postclypeus with carinate margins, with disc flat in longitudinal view but evenly curved in lateral view. Three carinae on postclypeal disc, one median longitudinal and two lateral following curve of carinate margins. Postclypeus between lateral carinae and margins at angle to central portion and bearing line of 11-12 dark sensory pits. Antennae with pedicel slightly larger than scape, segment 3 as long as pedicel but narrower, arista 0.20-0.26 mm long. Vertex with posterior, lateral and anterior margins carinate; dorsally flat, without carinae. Hind margin concave and front margin convex, so that vertex is slightly longer in midline than adjacent to eyes. Length in midline 0.06-0.07 mm, breadth between carinate margins 0.23-0.25 mm.

*Thorax*.—Pronotum large, with prominent central portion and lateral portions angled nearly vertically towards side of body. Central portion delineated by lateral carinae extending from convex front margin, nearly continuous with lateral margins of vertex, towards anterolateral corner of mesonotum. Line of seven sensory pits lying inside each lateral carina and extending laterally around posterior end of carina onto lateral portion. Double median carina running longitudinally. Hind margin of pronotum excavate V-shaped. Lateral margins reaching ventrally nearly to base of fore coxae. Propleuron visible between fore coxae, anteclypeus and pronotum. Fore legs with angulate femur and tibia that fold against each other. Angles lined with short pale hairs. Fore tarsi two-segmented, distal segment larger than proximal and bearing two claws apparently attached to large arolium.

Mesonotum broadly triangular due to V-shaped hind margin of pronotum. Hind margins without visible wing-pads. Median longitudinal carina double. Lateral carinae angled slightly outwards and extending from anterior margin of mesonotum towards, but not reaching, hind margin. Mesonotum lateral to carinae continuous with even curve of central portion and bearing four sensory pits on each side, two on posterolateral corner of mesonotum and two midway between these and lateral carina. Mesepisternite a rectangular plate with faint carina reaching from mid coxae to mesonotum. Mesepimeron very small, triangular. Mid legs similar to fore legs.

Metanotum broad, with slightly and evenly convex anterior margin and excavate V-shaped hind margin, shape of V broader than that formed by hind margin of pronotum. Median longitudinal carina double, lateral carinae absent. One sensory pit on each side, situated in posterolateral corner. Metasternum and metapleuron continuous and fused to hind coxae, which are large and carinate. Hind femora angulate, without hairs. Hind tibiae longer than mid or fore tibiae, angulate, slightly curved so that outer margin is concave. Shafts of tibiae without spines. Apices of tibiae with ventral row of four black-tipped spines. Hind tarsi two-segmented, proximal segment with ventral row of four black-tipped spines apically. Distal segment with claws as in fore leg.

*Abdomen* flexed dorsally, small, compact and relatively rigid. Seven segments visible dorsally, seventh concealing remainder. Five segments visible ventrally. Tergite of each segment extending ventrally for some distance so that sternite is quite small. Segments 6-8 bearing openings of glands which secrete "waxy" strands held over body at all times in form of shallow inverted cone. Each bank of wax gland openings with anteriorly situated, posteriorly projecting papilla. Segments 4-5 each bearing two sensory pits on each side lateroventrally on tergite. Segment 6 bearing one sensory pit dorsally on each side of tergite. Anal segments forming small protuberance between gland openings of segment 8. Protuberance with pair of ventral flaps.

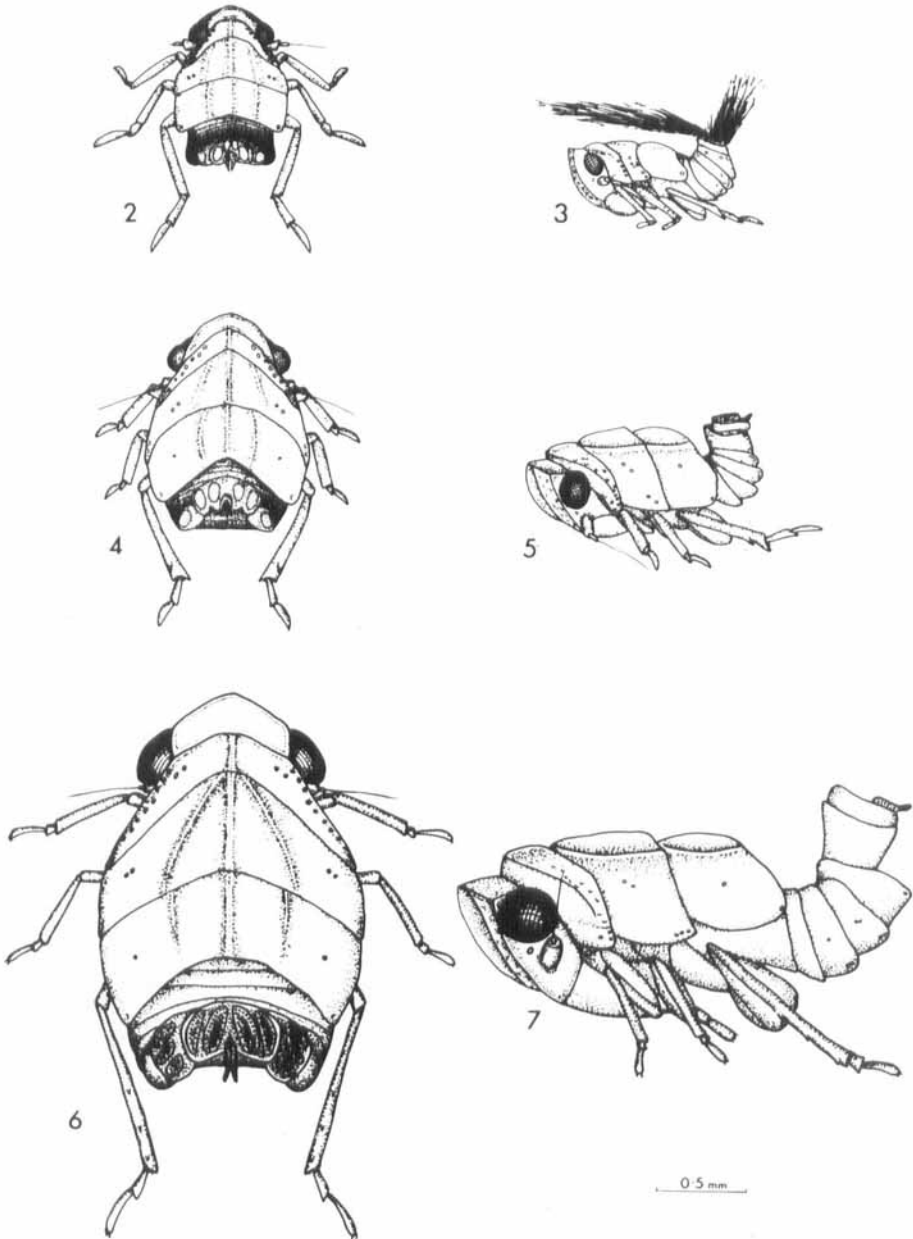
### *Second instar nymph* (Figs 4, 5)

Body coloured as in first instar, robust. Body length, excluding abdominal filaments, 1.24-1.78 mm.

*Head*.—Rostrum long, reaching apex of hind coxae. Anteclypeus triangular, steep-sided; disc evenly convex. Postclypeus as in first instar, with carinate margins and three carinae on disc. A line of 12 dark sensory pits between lateral carinae and margin on each side. Antennae with pedicel larger than scape, covered with sensilla, segment 3 much smaller than scape or pedicel, arista 0.29-0.31 mm long. Vertex carinate at all margins, without carinae on disc. Front margin convex and hind margin concave, so that length in midline is greater than length adjacent to eyes. Length in midline 0.11-0.13 mm, breadth 0.32-0.39 mm.

**Thorax.**—Pronotum wide with central portion at higher level than vertex, pale brown with dark sensory pits. Portions lateral to lateral carina nearly at right angles to central portion. Lateral carinae angled at about  $45^\circ$  to axis of body with line of eight sensory pits visible dorsally, four additional sensory pits present on lateral portion of pronotum. Median longitudinal carina double. Hind margin broadly V-shaped. Laterally, pronotum reaching base of fore coxae. Propleuron an anterior triangular plate. Fore legs as in first instar but claws separate from arolium.

Mesonotum broadly triangular, hind margin curved, without wing-pad development. Pale brown medially, darker brown laterally with pale circular patch at approximate centre of each half. Median longitudinal carina double. Lateral carinae angled as in first instar. Sensory pits four on each side arranged as in first instar. Mesepisternite extending anterior to mid coxae with carina close to hind margin. Mesepimeron large with small, dark, triangular portion marked off by carinae against which head of femur rests. Mid legs as in first instar, claws clearly separate from arolium.



FIGS 2-7—Dorsal and lateral views of *S. australis* nymphs: (2, 3) first instar nymph; (4, 5) second instar nymph; (6, 7) third instar nymph.

Metanotum broad, front margin slightly curved, evenly convex, hind margin broadly V-shaped. Median longitudinal carina double and faint lateral carinae on each side on anterior half of notum. One sensory pit on each side in posterolateral corner and minute sensory pit in centre of each half of metanotum. Metepisternite and metasternum fused, meeting narrow metepimeron at raised carinate ridge against which femur rests. Hind femora angulate posteriorly for reception of tibiae. Hind tibiae with one black-tipped spine on shaft and ventral row of five black-tipped spines across emarginate apices. Hind tarsi two-segmented with ventral row of five black-tipped spines across emarginate apices of proximal segments, two claws on distal segments.

*Abdomen* flexed dorsally, with two sensory pits lateroventrally on tergite 4, three lateroventrally on tergite 5 and one dorsolaterally on tergite 6. Otherwise abdomen as in first instar.

### *Third instar nymph* (Figs 6, 7)

Mottled brown and dark brown with central longitudinal pale stripe along carina. Abdominal tergites pale brown with dark patch on each side. Abdominal tergite 7 also with central dark patch. Body robust, length, excluding abdominal filaments, 1.82-2.30 mm.

*Head*.—Rostrum long, reaching just past base of hind coxae. Anteclypeus swollen, triangular, steep-sided. Postclypeus slightly concave between lateral and median carinae and between carinae and margins. Line of 16 dark sensory pits present between lateral carina and margin on each side. Antennae with pedicel four times as long as scape, segment 3 small, arista 0.34-0.39 mm long. Vertex with carinate margins, longer in midline than adjacent to eyes, flat on disc. Length along midline 0.11-0.14 mm, breadth 0.45-0.49 mm.

*Thorax*.—Pronotum very broadly arrow-shaped, wider than head (including eyes). Lateral portion not visible dorsally. Hind margin broadly V-shaped. Carinae as in second instar. Sixteen sensory pits on pronotum; 10 visible dorsally between hind margin and lateral carina on each side, three on lateral portion and three on ventral portion. Pronotum reaching base of fore coxae, forming broad flap ventrally overlapping propleuron anteriorly. Fore legs as in second instar.

Mesonotum broadly triangular with posterolateral flaps indicating beginning of wing-pad development. Dark brown with central pale stripe, pale patch medially against hind margin, pale patch surrounding pair of dark sensory pits in centre of each half. Second pair of sensory pits occurring on fore wing-pads. Carinae as in first instar. Mesepisternite and mesepimeron dark; junction depressed for reception of mid femur. Mid legs as in second instar.

Metanotum coloration similar to mesonotum, narrower than mesonotum but more extensive posterolaterally due to beginning of development of hind wing-pads. Hind margin straight between lateral carinae with small emargination at end of median carina, laterally curved posteriorly to form anal margins of hind wing-pads. Median longitudinal carina double, each lateral carina curved so that both ends are equidistant from median carina and distinct nearly to hind margin. Sensory pits as in second instar. Metepisternite and metasternum continuous, meeting metepimeron at carinate margins. Metepimeron narrow, raised on one side to form depression into which femur fits. Hind coxae large, carinate, fused to metasternum. Hind femora as in second instar. Hind tibiae angulate with three black-tipped spines along shaft, one minute at about one-third distance from proximal end, one large at about half length of tibia and one large close to apex. Apex of tibiae with ventral row of six black-tipped spines. Hind tarsi two-segmented, proximal segment with apical row of five black-tipped spines ventrally, distal segment with two claws.

*Abdomen* as in second instar except that sensory pits on segments 4, 5 and 6 are 3, 4 and 1 respectively, and apical protuberance of anal segment clearly bifid at tip. Ventral flaps longer than in second instar.

### *Fourth instar nymph* (Figs 8, 9)

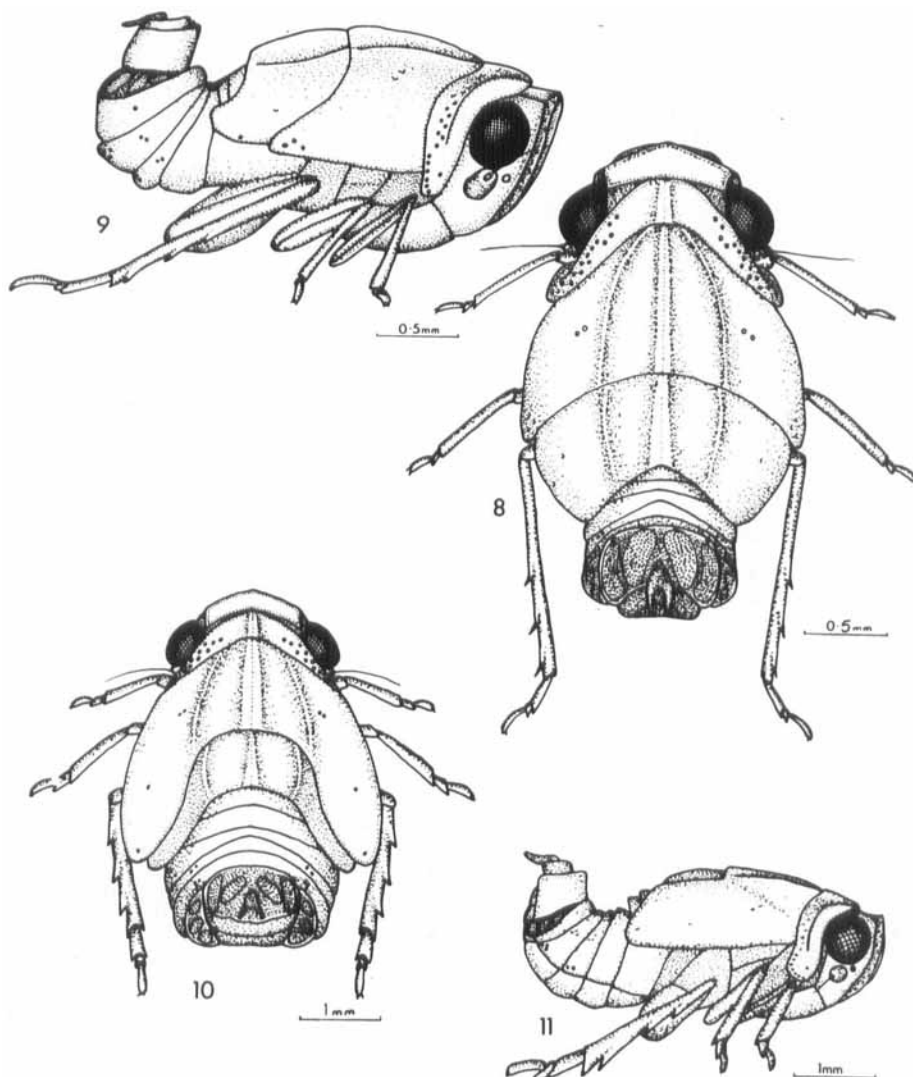
Coloration as in previous instars. Body robust. Length, excluding abdominal filaments, 2.10-2.80 mm.

*Head*.—Rostrum long, reaching past base of hind coxae. Anteclypeus as in third instar. Postclypeus similar to that in third instar, with 16-18 sensory pits. Antennae as in third instar, arista 0.41-0.62 mm long. Vertex longer in midline than adjacent to eyes. Length along midline 0.14-0.20 mm, breadth 0.56-0.62 mm.

*Thorax*.—Pronotum V-shaped, with carinae as in third instar. Sensory pits 21, 14 visible dorsally, and seven on lateral and ventral portions arranged as line of six around posterior margin of lateral portion of pronotum and single pit in centre of ventral portion. Ventral margin of pronotum reaching base of fore coxa on each side, overlapping propleuron which is narrow plate anterior to coxa. Posteriorly pronotum overlapping dorsal part of mesepisternite. Fore legs with femora as in third instar. Fore tibiae four-angled, lined with minute dark hairs. Fore tarsi two-segmented, slightly angulate with dark hairs in longitudinal rows. Distal segment bearing two claws.

Mesonotum broad, with fore wing-pads overlapping front of metanotum and carinae as described for previous instars. Five to seven sensory pits on each side in three groups, variable in number. One group in pale-coloured patch close to, but lateral to, lateral carina on each side, containing two or three pits. Second group closer to lateral margin of mesonotum and containing three or four pits. A single pit against lateral margin of mesonotum. Maximum number of pits on mesonotum of any individual was seven on each side. Mesepisternite and mesepimeron meeting along depressed margin against which femur fits. Mid legs similar to fore legs.

Metanotum dark brown with hind margin broadly excavate between wing-pads; two median carinae separated by white stripe. White patch medially near hind margin and white patches in posterolateral corners and towards centre of each side. Yellowish patch on each side between lateral carina and median carina towards anterior margin of notum. Lateral carinae more distinct than in previous instars, reaching hind



FIGS 8-11—Dorsal and lateral views of *S. australis* nymphs: (8, 9) fourth instar nymph; (10, 11) fifth instar nymph.

margin. Two sensory pits on each side, one against lateral margin midway between front and hind margins and one some distance lateral to white patch near centre of each side. Metepisternite, metepimeron and metasternum as in third instar. Hind coxae and femora as in previous instar. Hind tibiae with three black-tipped spines on shaft, one close to apex, one at midlength and small one at about one-third distance from proximal end. Latter spine occasionally very small in small individuals. Ventral row of six black-tipped spines on apices of tibiae, occasionally very small seventh spine. Hind tarsi three-segmented, proximal segment with apical ventral row of six black-tipped spines, second segment small, third segment bearing two claws.

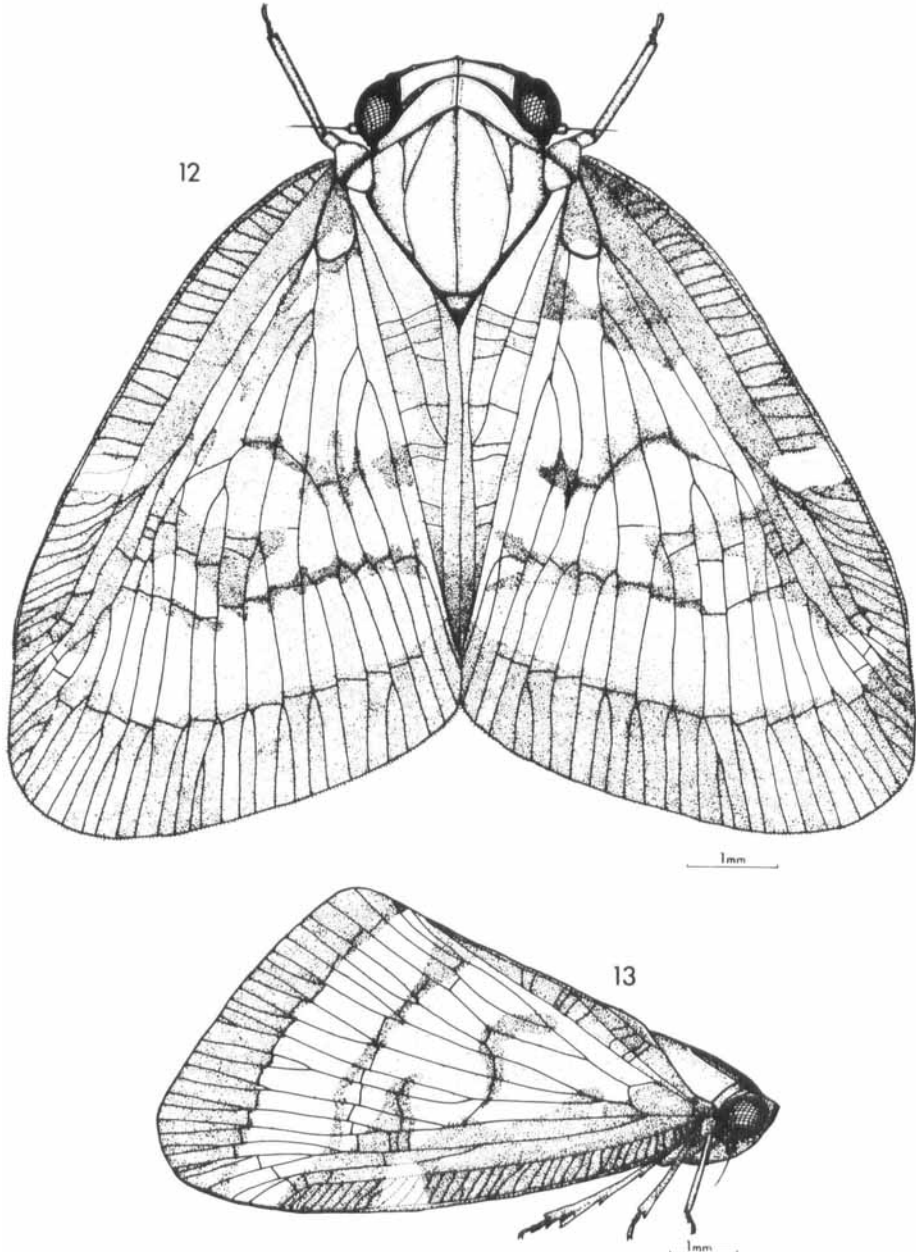
*Abdomen* large, dorsally flexed, with seven segments visible dorsally and five ventrally. Sixth segment with four banks of "wax" gland openings on each side. Large bank of gland openings on each side of segments 7 and 8. Each bank with anteriorly situated, posteriorly projecting papilla. Segment 4 with four and segment 5 with five lateral sensory pits on each side, segment 6 with one dorsal sensory pit on each side and segment 7 with two sensory pits laterally on each side of sternite. Segment 10 forming bifid projection beneath which two dark flaps project posteroventrally from segment 9. No apparent external sexual differentiation.

#### *Fifth instar nymph* (Figs 10, 11)

Brown with white patches, particularly laterally on thorax. Abdominal tergites nearly entirely brown. Body stout, very broad across developing wing-pads. Body length, excluding abdominal filaments, 2.78-3.28 mm.

**Head.**—Rostrum long, reaching to half length of hind coxae. Anteclypeus triangular, with steeply sloping sides and convex disc. Postclypeus nearly circular in outline with carinate lateral margins forming continuous curve with apex when viewed ventrally. Two lateral carinae follow curve of lateral margins. Postclypeus concave between lateral carinae and margins and bearing 22-24 sensory pits, evenly convex between lateral carinae. Antennae with small scape, large pedicel with sensilla around apex, segment 3 small, arista 0.50-0.59 mm long. Vertex as in previous instars, with dark patches laterally. Length of vertex in midline 0.14-0.17 mm, breadth 0.76-0.81 mm.

**Thorax.**—Pronotum as in fourth instar with 20-22 sensory pits. Raised central portion with 13-14 pits visible dorsally, lateroventral portion with row of 6-7 around posterior border and single pit towards anterior border. Ventrally, pronotum covering propleuron almost entirely and overlapping dorsal portion of mesepisternite. Fore legs as in fourth instar.



FIGS 12, 13—Dorsal and lateral views of *S. australis* adult.

Mesonotum very large, fore wing-pads covering hind wing-pads entirely. Furrow between posterior end of lateral carina and anterolateral corner of mesonotum marking base of wing-pad. Carinae as in previous instars. Four sensory pits present on each side, one towards the lateral margin of wing-pad about two-fifths length of mesonotum from anterior margin and group of three between lateral carina and furrow at base of wing-pad. Mesepimeron, mesepisternite and mid legs as in fourth instar.

Metanotum hidden by mesonotum except for dark brown rectangular portion between lateral carinae. Median carina white, double. White patch on either side of median carina near hind margin. Metapleuron and metasternum as in previous instars. Hind femora curved dorsally from trochanters, angulate, with minute hairs along angles. Hind tibiae strongly angulate with three black-tipped spines along shaft, positioned as in fourth instar but more robust. Apex of hind tibiae emarginate with ventral row of six black-tipped spines. Hind tarsi three-segmented with white hairs ventrally on each segment. First segment with ventral row of six black-tipped spines at emarginate apex, second segment small, pointed apically, without spines, third segment with two claws.

*Abdomen* as in fourth instar except for absence of papillae anterior to "wax" gland openings and increase in numbers of sensory pits on each side, segment 4 having five laterally, segment 5 having six laterally, segment 6 having one dorsally and segment 7 having four on each side of sternite. Segment 7 with 10 banks of "wax" gland openings. No apparent external differentiation of sexes. Terminal segments as in fourth instar.

### *Adult* (Figs 12-20)

Body brown, with wing margins and veins brown (Melichar 1898). Length of body 4.8-5.3 mm (males) and 5.9-6.2 mm (females) (6 mm, Melichar 1898).

*Head* (Fig. 14) broad, uniformly light amber. Rostrum extending to base of hind coxae. Anteclypeus triangular (Walker 1851), with lateral margins declivous. Central portion slightly convex. Postclypeus broad, extending laterally to carinate margins which slightly overhang front of eyes. Anterolateral margins between antennae and anteclypeus bent down at right angles to general surface and continuous with lateral margins of anteclypeus. Disc of postclypeus slightly convex, with three longitudinal carinae (Walker 1851) extending from just anterior to junction of postclypeus and vertex to anteclypeus. Central carina straight, lateral ones parallel to curved lateral margins of postclypeus (Walker 1851). Sensory pits absent. Antennae with small scape, enlarged club-shaped pedicel with distal half covered with wart-like sensilla, segment 3 small, arista 0.3-0.64 mm long. Lateral ocelli present between eyes and antennae. Eyes prominent. Vertex narrow, marked off laterally, anteriorly and posteriorly by carinae, wider adjacent to eyes than in midline (Walker 1851), light amber, with darker brown markings laterally. Length in midline 0.09-0.14 mm, breadth 1.05-1.09 mm (males) and 1.18-1.30 mm (females).

*Thorax*.—Pronotum narrow, extending laterally to tegulae, longer in midline than laterally, with longitudinal carina along midline (Walker 1851). No sensory pits. Ventrally, pronotum extending to top of fore coxae and overlapping, as simple flaps, part of mesopleura and mid coxae. Fore coxae elongate, pale yellow, angular. Fore femora and tibiae four-angled, angles lined with dark setulae.

Mesonotum large, convex, diamond-shaped, anterior portion disappearing under hind margin of pronotum. Darker brown markings appearing laterally, with two dark spots against hind margin. The three carinae (Walker 1851) were described correctly by Melichar (1898), who indicated that the lateral pair were forked anteriorly. This fork occurs at midlength of mesonotum. One branch continues as faint carina straight to front margin of mesonotum and other curves towards median carina which it meets at front of mesonotum. Posterolateral margins of mesonotum depressed to allow tegmina to fit against mesonotum. Scutellum light brown, very small, with carinate margins. Mesepimeron and mesepisternite divided in halves by horizontal carinae. Mid legs similar to fore legs, but coxae slightly larger. No sensory pits on mesothorax. Fore wings (Fig. 15) broad, hyaline, with border of brown all around except for clear patch near end of Sc, dark spot posterior to this, and white patch on anterior margin at two-thirds length of Sc. Some transverse brown patches in central portion of wings. Veins brown except in anterior pale patches (Walker 1851). Anterior and distal margins lined with microtrichia (Melichar 1898).

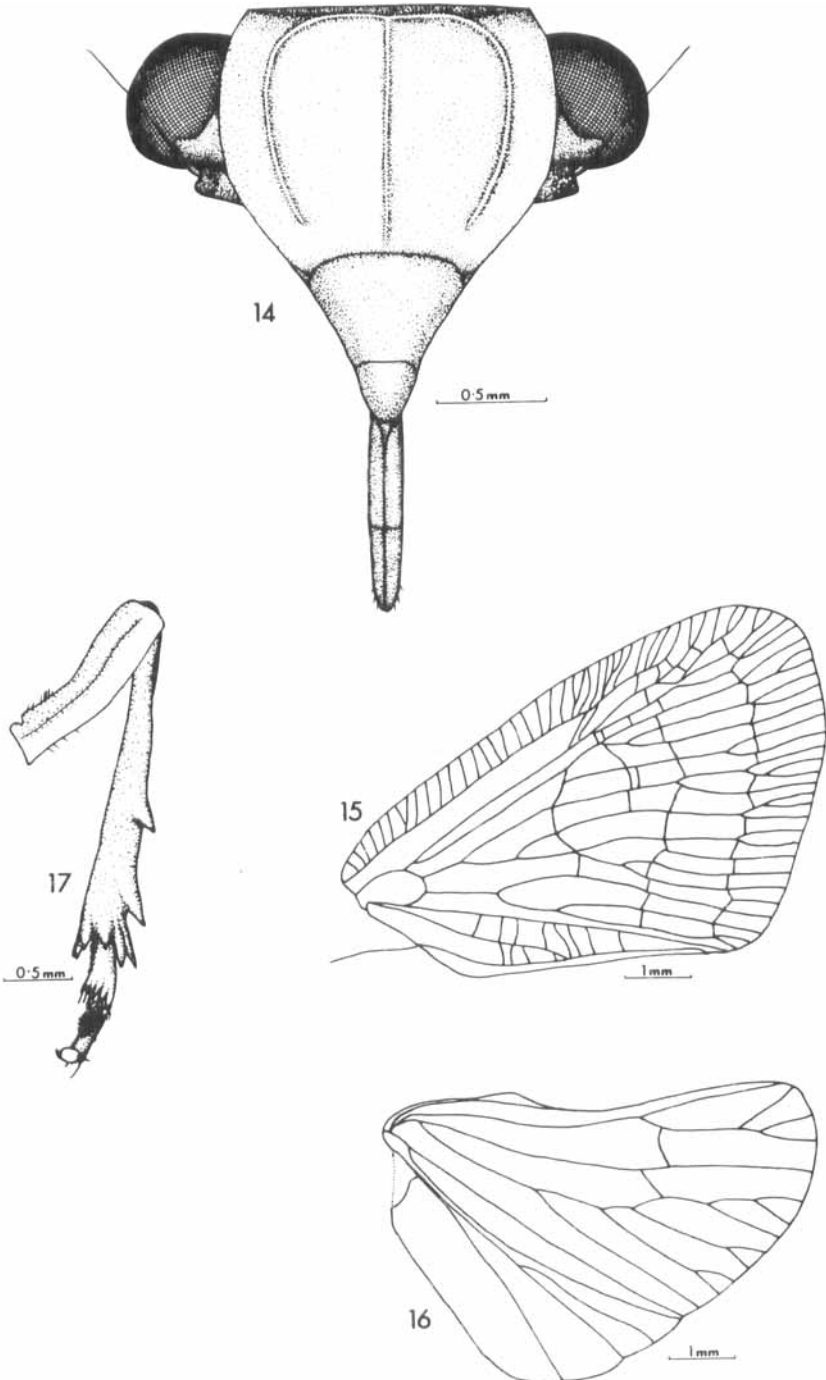
Metanotum narrow, parallel to posterolateral margins of mesonotum. Metapleuron with transverse horizontal carina less distinct than on mesopleuron. No metathoracic sensory pits. Hind coxae broad, membranous in part, fused to metasternum. Femora slightly curved dorsally from trochanters, angular, bare of setulae, yellow, with carinate edges black. Tibiae angular, flattened distally, with two black-tipped spines on anterolateral angle. Apex of tibiae with ventral row of six black-tipped spines in males and six to seven black-tipped spines in females. All tibial margins with setulae. Hind tarsi three-segmented, proximal segment with ventral row of eight black-tipped spines at apex in males and eight to 10 black-tipped spines in females (Fig. 17). Hind wings (Fig. 16) hyaline, with brown veins and smoky distal margins, otherwise unmarked (Walker 1851, Melichar 1898).

*Abdomen*.—*Male* (Fig. 18) with six segments visible before genitalia. Sixth visible sternite (part of segment 7) extended dorsally on either side to form pygofer. Parameres extended dorsally at posterior end. Anal segment overlapping incurved tips of parameres dorsally. Aedeagus (Fig. 19) complex, with two pairs of recurved pointed appendages from apex and two straight appendages extending to mid length of main tube from sides of base. Aedeagus attached by rod to pygofer.

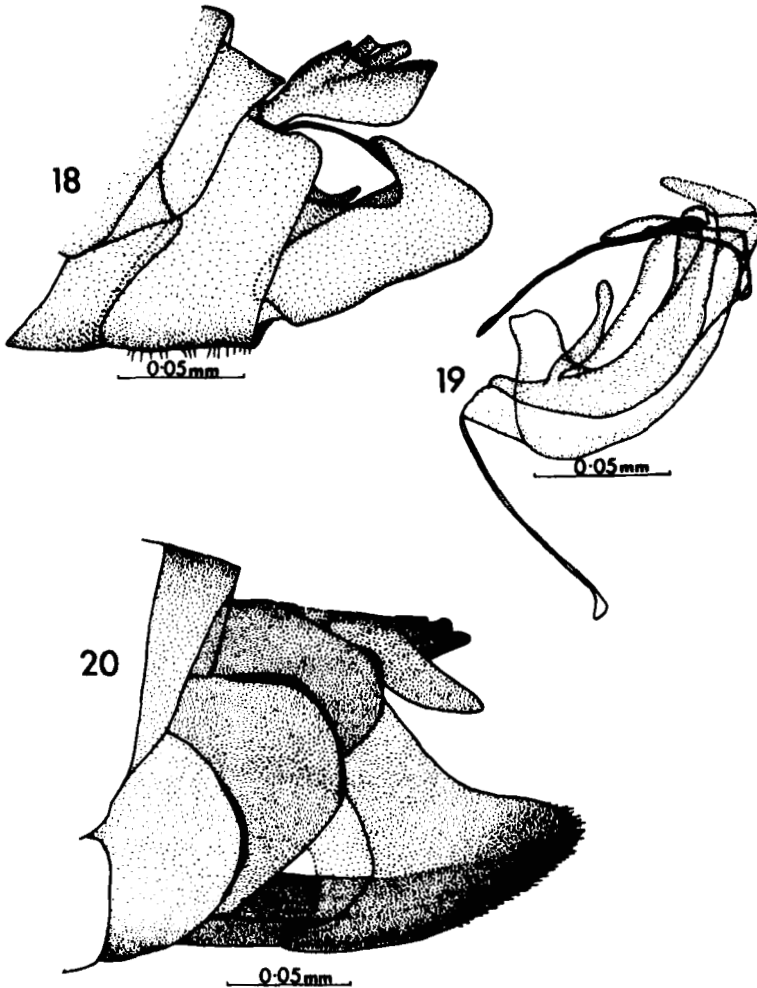
*Female* (Fig. 20) with seven visible segments. Sixth visible sternite emarginate posteriorly and expanded laterally. Lateral borders of sternites 6-7 black. Sternite 7 divided into two lateral expansions. Third ovipositor valves large, roughly triangular lateral plates with hairs along external borders, spines on internal



surfaces and teeth along posteroventral margins. Third valves transparent proximally, but opaque brown distally and around margins. First valves narrow, visible through hyaline area of third valves, lying along ventral internal margins of third valves. Ventral surface and apex of first valves covered with recurved teeth. Second valves lying within first, narrow blades, without teeth. Third valves attached to lateral expansions of tergite 9.



FIGS 14-17—*S. australis* adult: (14) head, facial view; (15) fore wing; (16) hind wing; (17) hind leg.



FIGS 18-20 *S. australis* genitalia: (18) male terminalia, lateral view; (19) aedeagus, left lateral view; (20) female terminalia, lateral view.

### Discussion

Table 1 lists the measurements or values of the diagnostic features of the nymphal instars and adults of *Scolypopa australis*.

#### *Size measurements*

As the insect passes through the instars it does not increase in size at an even rate. The greatest growth occurs between first and second and between fifth and adult, and the smallest between third and fourth (see Table 2). The length of the vertex does not follow this pattern, as the vertex decreases in length from fifth instar to adult. Prior to fourth instar, however, the increases in length of the vertex correspond to the pattern observed in total body length.

The length of the lateral margin of the mesonotum, as expected, increases greatly in the later instars since this measurement incorporates development of the wing-pads.

#### *Counts and structural variations*

*Sensory pits.* The number of sensory pits increases from first to fifth instar on the postclypeus, pronotum and abdominal segments. On the mesonotum there is an

increase in the third instar from four sensory pits to five, and in the fourth instar from five to five to seven. Fifth instars have only four mesonotal sensory pits. On the metanotum the only increase is between first and second instars, and is from one sensory pit to two. Fifth instars have no metanotal sensory pits, presumably since the metanotum is nearly completely covered by the mesonotal wing-pads.

There are no sensory pits on adult males and females.

*Tarsi*.—The number of tarsal segments is two on all legs in all instars except the fourth and fifth, in which the hind legs have three tarsal segments. The adult hopper has three tarsal segments on all legs.

TABLE 1  
DIAGNOSTIC MORPHOLOGICAL CHARACTERS OF NYMPHAL AND ADULT *S. AUSTRALIS*

	First	Second	Third	Fourth	Fifth	Adult ♂	Adult ♀
Body length (mm)	0.79-0.94	1.24-1.78	1.82-2.30	2.10-2.80	2.78-3.28	4.87-5.28	5.96-6.23
Arista length	0.20-0.26	0.29-0.31	0.34-0.39	0.42-0.62	0.50-0.59	0.52-0.64	0.34-0.64
Vertex length	0.06-0.07	0.11-0.13	0.11-0.14	0.14-0.20	0.14-0.17	0.09-0.14	0.10-0.13
Vertex breadth	0.23-0.25	0.32-0.39	0.45-0.49	0.56-0.62	0.76-0.81	1.05-1.09	1.18-1.30
Vertex length/breadth	0.26-0.31	0.29-0.35	0.23-0.30	0.24-0.33	0.17-0.21	0.09-0.13	0.08-0.10
Lateral mesonotum (A)	0.09-0.11	0.18-0.20	0.25-0.34	0.42-0.60	1.48-1.60	5.78-6.33	7.74-8.28
Lateral mesonotum + metanotum (B)	0.22-0.29	0.49-0.61	0.67-0.90	0.84-1.06	1.43-1.54	4.91-5.46	6.14-6.83
A/B	0.37-0.43	0.32-0.38	0.34-0.42	0.50-0.63	1.03-1.04	1.13-1.28	1.18-1.26
Postclypeal sensory pits per side	11-12	12	16	16-18	22-24	0	0
Pronotal sensory pits per side	7	12	16	21	20-22	0	0
Mesonotal sensory pits per side	4	4	5	5-7	4	0	0
Metanotal sensory pits per side	1	2	2	2	0	0	0
Abdominal pit configuration segs 4-5-6-7 per side	2-2-1-0	2-3-1-0	3-4-1-0	4-5-1-2	5-6-1-4	0	0
Tarsal segments	2-2-2	2-2-2	2-2-2	2-2-3	2-2-3	3-3-3	3-3-3
Hind tibial shaft spines	0	1	3	2-3	3	2	2
Hind tibial apical spines	4	5	6	6-7	6	6	6-7
Hind tarsal proximal segment apical spines	4	5	5	6	6	8	8-10

TABLE 2  
PROPORTIONS OF PREVIOUS INSTAR FOR MEASURED CHARACTERS OF *S. AUSTRALIS*

Instars	1-2	2-3	3-4	4-5	5-adult
Body length	1.75	1.36	1.19	1.24	1.84
Arista length	1.30	1.22	1.42	1.05	0.98
Vertex length	1.85	1.04	1.36	0.91	0.74
Vertex breadth	1.48	1.32	1.26	1.33	1.47
Lateral mesonotum	1.90	1.55	1.73	3.02	4.56

*Hind legs.*—The hind legs in *S. australis* (Fig. 17) bear black-tipped spines along the shaft of the tibiae and a row of small black-tipped spines along the apex of the tibiae. In addition to these spines, the proximal tarsal segment bears a row of black-tipped spines, similar to those on the apex of the tibiae. The number of spines in each of these positions varies between instars and, in general, increases from first instar to adult.

On the hind tibiae of first instar nymphs there are no shaft spines. Second instars have only one shaft spine and third, fourth and fifth instars bear three spines on the shaft of the hind tibiae, although one small fourth instar specimen had only two. Adults have only two tibial shaft spines. Each count is for one tibia only and this is duplicated on the other side of the body.

At the apex of the hind tibiae there are four black-tipped spines in the first instar, five in the second instar and six in older instars and in the adult (with an additional small spine in some adult individuals).

The proximal segment of the hind tarsi bears four spines at the apex in the first instar, five in the second and third instars, six in the fourth and fifth instars and eight in the adult, the female adult occasionally bearing one or two extra spines.

*Abdomen.*—The abdomen does not vary significantly in structure through the instars except for the numbers of sensory pits already mentioned.

The structure of the wax gland openings and the structure of the terminal segment appear to vary slightly between instars but there is no externally apparent development of the genitalia. It is only in the adult that the sexes are externally distinguishable.

*Coloration* did not vary sufficiently between the nymphal instars to be used as a distinguishing character.

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