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Apochrysinae (Neuroptera: Chrysopidae): New Larval Description and Subfamilial Comparisons

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Abstract

Although Apochrysinae is considered an important, ancient clade of Chrysopidae, its immature stages are very poorly known. Larvae are rarely seen, and descriptions are limited to the third instar of only one species in the genus *Apochrysa*. Herein, the larvae (all instars) of a second species, *Apochrysa voeltzkowi* (Weele), are described, and the features of the two *Apochrysa* species are compared with those of other chrysopids. The results provide support (one potential synapomorphy) for a phylogenetic relationship between Apochrysinae and Nothochrysinae and additional support for two synapomorphies previously proposed for Nothochrysinae. Diagnostic larval characteristics are proposed for the genus *Apochrysa*, and species-specific features are identified for the two known *Apochrysa* larvae.

Key words: Apochrysinae, larval morphology, Nothochrysinae

Introduction

The green lacewing subfamily Apochrysinae is a small but distinctive group of 25 species in six genera (Winterton & Brooks 2002). Molecular data and evidence from adult morphology indicate that Apochrysinae is a largely monophyletic grouping that falls at or near the base of the chrysopid phylogenetic tree (Brooks 1997, Winterton & Brooks 2002, Winterton & Freitas 2006, Haruyama *et al.* 2008). Nevertheless, relationships among the basal taxa are far from well understood, and future analyses of chrysopid phylogeny would benefit from incorporating a broad range of diverse taxa and an expanded range of characters, including those from larval morphology (e.g., see Tauber *et al.* 2014).

Larvae of the subfamily Apochrysinae are poorly known; indeed, only three specimens have been reported previously, and all three were from the genus *Apochrysa*. Tsukaguchi (1995) described the third instar of *Apochrysa matsumurae* (Okamoto) (as *Nacaura*) and proposed a set of features that might distinguish the subfamily. A photo of this species (by Yusei Hara) shows a third instar carrying white, fluffy flocculence and material from male "cocoons" of the coccoidan *Drosicha corpulenta* (Kywana) (also shown in Tauber *et al.* 2014). Aspöck & Aspöck (2007) published P. Duelli's photo of a third instar *Apochrysa voeltzkowi* (Weele); this larva too was carrying white sternorrhynchan flocculence (P. Duelli, personal communication).

Later, P. Duelli made his *A. voeltzkowi* specimens available for morphological study, and based on these additional specimens, I describe the first and third *A. voeltzkowi* instars and compare their features with those of the *A. matsumurae* third instar.

Material and methods

The specimens [two third instars, one second instar (premolt), and one first instar] were reared from a female collected by P. Duelli in the Republic of South Africa, Tsitsikamma National Park and identified by H. Hölzel. All descriptions, figures, and images here are based on these specimens. For the descriptive work, the specimens first

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were photographed and their external gross features were noted. Then, one third instar and the first instar were cleared in KOH and transferred to glycerine for examination of fine structures and setation. Because the second instar was very near molting, its head and body were slightly distorted; thus it was not cleared or measured. The two uncleared specimens (L2, L3) will be returned to P. Duelli, Swiss Federal Research Institute WSL, Birmensdorf/Zurich, Switzerland; the two cleared specimens (L1, L3) remain in the Tauber Research Collection, Davis CA.

Morphological terminology and chaeotaxy followed the usage of Rousset (1966), Tsukaguchi (1995), Tauber *et al.* (2000), and Monserrat & Díaz-Aranda (2012). Measurements were made with NIH Image-J 1.46r.

Distinguishing larval features of subfamily Apochrysinae

Based on the third instar (L3) of the single Apochrysinae species available to him (*A. matsumurae*), Tsukaguchi (1995) proposed a suite of larval morphological features that he considered characteristic of the subfamily. However, he stated that he did not find any specific or unique larval features that distinguish the subfamily. His proposed set of features is shared by *A. voeltzkowi*; together they provide a comparative basis for recognizing larvae in the genus *Apochrysa* (see below).

It is now known that genera within both of the chrysopid subfamilies Nothochrysinae and Chrysopinae express a broad range of variation in their larval morphology and behavior (see Tauber *et al.* 2014). Moreover, larval synapomorphies have been identified for only one of the chrysopid subfamilies [the relatively small Nothochrysinae (eight genera)]. Although larval synapomorphies are recognized for three of the four tribes within Chrysopinae, none are known for the subfamily itself. Thus, there is a relatively small, albeit interesting, dataset of larval characters for comparison at the subfamilial level.

Three larval features have been proposed as distinctive (synapomorphic) for one of the purportedly basal chrysopid subfamilies, Nothochrysinae (Díaz-Aranda & Monserrat 1995, Monserrat & Díaz-Aranda 2012, Tauber *et al.* 2014, Tauber 2014). As a result, two questions come to mind: Are any of these features also expressed by the *Apochrysa* larvae? What is the *Apochrysa* character state with regard to each of these features? In short, as shown below, information from the current study supports two of the features (#1, #2, below) that have been proposed as synapomorphic for Nothochrysinae, and one of the features (#3, below) is now demonstrated to be shared by Nothochrysinae and *Apochrysa.* Moreover, one of the three features (#1) can differentiate the currently known larvae of all three chrysopid subfamilies.

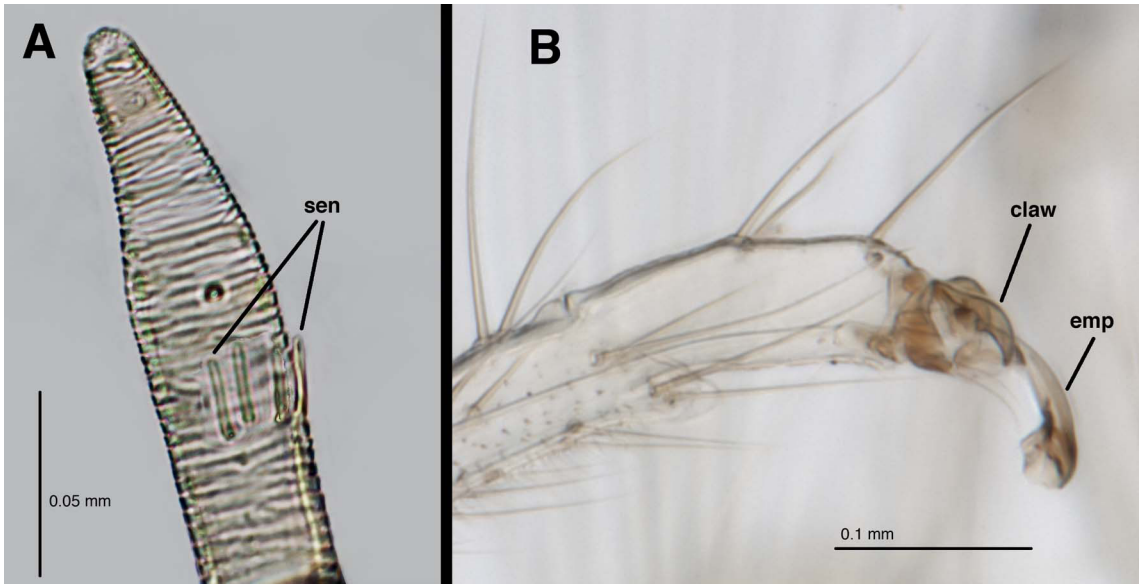

FIGURE 1. *Apochrysa voeltzkowi* (Weele) third instar. A. Terminal segment of labial palpus (distal section) bearing four sensilla. B. Prothoracic tarsus and empodium. Both structures cleared, mounted in glycerin. Abbrevations: emp, empodium; sen, sensilla.

1. Length of larval flagellum. In the Nothochrysinae, the larval flagellum is short, approximately 0.10–0.15x the length of the pedicel, whereas in Chrysopinae it ranges from ~0.20–0.35x the pedicel length (see Toschi 1965, Díaz-Aranda & Monserrat 1995, Monserrat & Díaz-Aranda 2012, Tauber 2014, Tauber *et al.* 2014). Interestingly, in the two known species of *Apochrysa* the flagellum is unusually long, from ~0.45x (L3) to ~0.75x (L1) the length of the pedicel (Figs 2C, 2D, 3A, 7A). Thus, a very short larval flagellum (relative to the pedicel) remains synapomorphic for Nothochrysinae, and an intermediate length flagellum typifies Chrysopinae. Thus, it is possible that a very long flagellum may support Apochrysinae as a monophyletic group separate from both Nothochrysinae and Chrysopinae.

2. Terminus of larval flagellum. In Nothochrysinae, the terminus of the flagellum has several very small apical setae or bristles (see Toschi 1965, Díaz-Aranda & Monserrat 1995, Monserrat & Díaz-Aranda 2012, Tauber 2014, Tauber *et al.* 2014). In contrast, the two known species of *Apochrysa* have a single elongate bristle (Tsukaguchi 1995; Figs 2C, 7A here), a characteristic that is shared with larvae in Chrysopinae. Thus, the presence of small bristles on the apex of the flagellum remains synapomorphic for Nothochrysinae.

3. Sensilla on larval labial palpus. In Nothochrysinae, the terminal segment of the labial palp bears a lateral patch of four or more bacilliform (or baculiform) sensilla. The study here demonstrates that *A. voeltzkowi* also expresses this feature (Fig. 1) [Note: Tsukaguchi 1995 did not report the character state for *A. matsumurae,* nor did he illustrate it on his drawings.]. Larvae of Chrysopinae have, at most, three lateral sensilla on the terminal segment of the labial palp (e.g., see Tauber & deLeon 2001, Tauber 2003, Díaz-Aranda & Monserrat 1995, Monserrat & Díaz-Aranda 2012). Thus, this character is excluded as a synapomorphy for Nothochrysinae; but it may represent a shared character state that distinguishes (Nothochrysinae + Apochrysinae) from Chrysopinae.

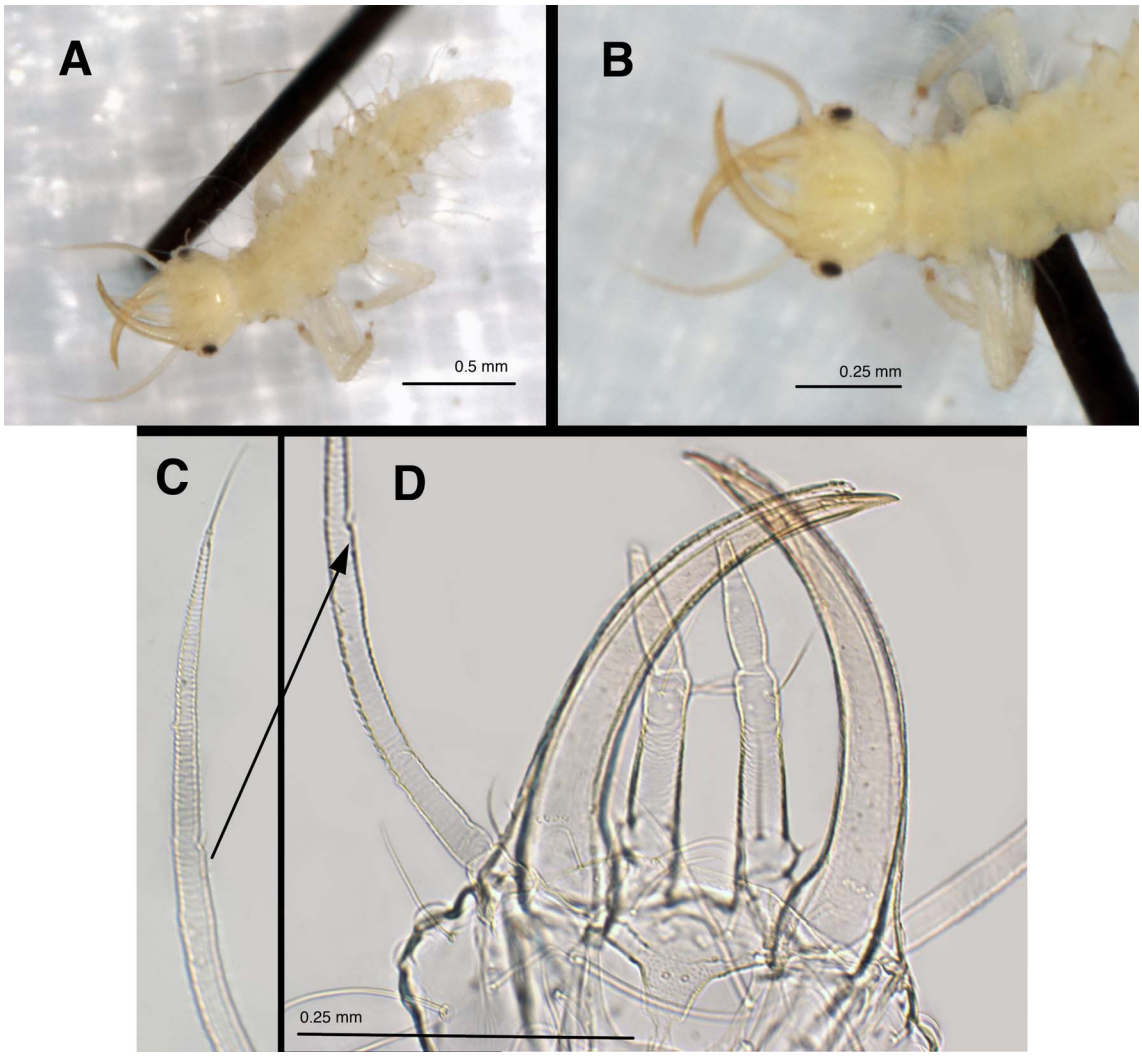

FIGURE 2. *Apochrysa voeltzkowi* (Weele) first instar. A. Body, dorsal. B. Head, dorsal. C, D. Cephalic appendages, dorsal (cleared, mounted in glycerin). C. Flagellum. D. Mouthparts, base of antenna. Arrow indicates tip of pedicel (connection).

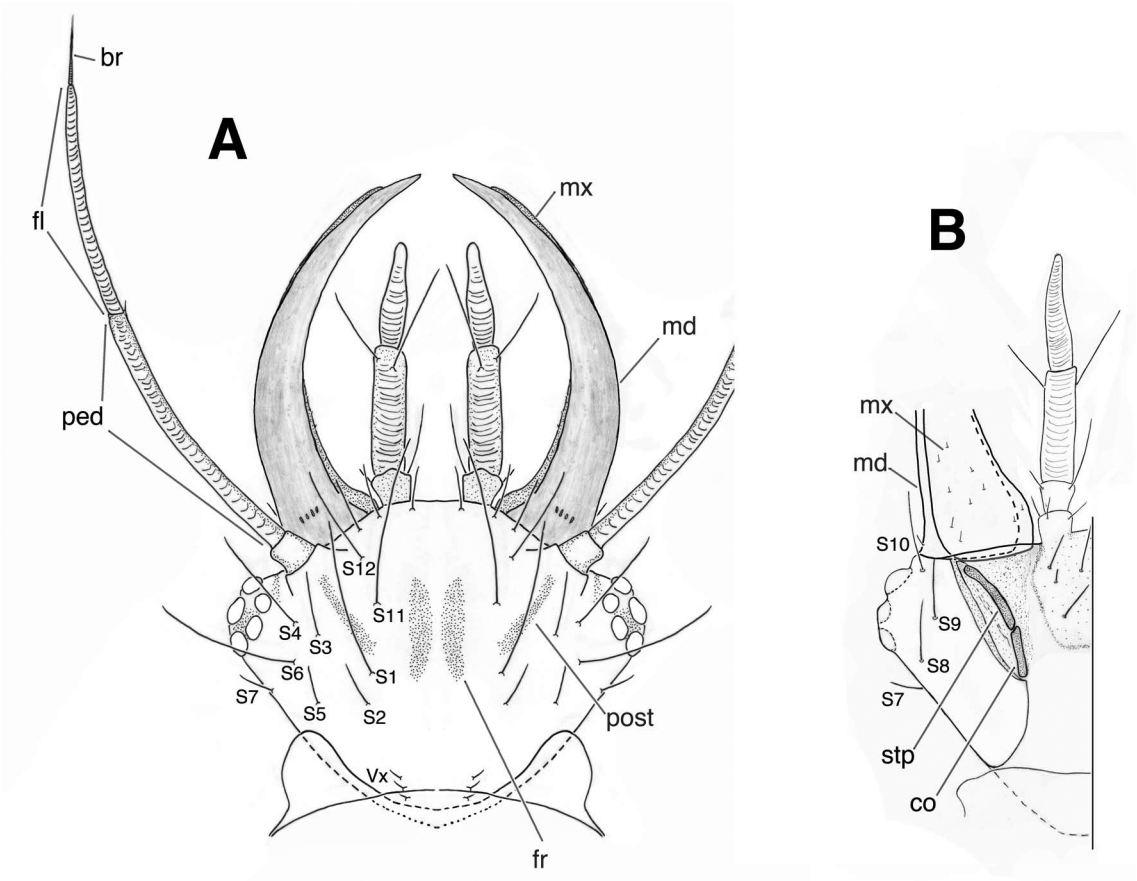

FIGURE 3. *Apochrysa voeltzkowi* (Weele) first instar. A. Head, dorsal. B, Ventral. Abbreviations: br, bristle; co, cardo; fl, flagellum; fr, frontal marking; md, mandible; mx, maxilla; ped, pedicel; post, postfrontal marking; stp, stipes; Sx, primary cephalic seta number; Vx, Vx setae.

Apochrysa generic characteristics

Based on the *A. voeltzkowi* specimen described here (Figs 3, 4, 7, 8,), along with the description and illustrations of the third instar *A. matsumurae* by Tsukaguchi (1995: 139, 142, Figs 106r–106u), the following combination of larval features appears to characterize the genus *Apochrysa*:

General Characteristics (all instars)

Body: elongate, abdomen slightly thickened, cream-colored, with no or few markings.

Debris packet: large, dense (both known species reported to carry flocculence of Sternorrhyncha) (photo by P. Duelli in Aspock & Aspöck 2007, photo by Yusei Hara in Tauber *et al.* 2014).

Eye: Anterior two stemmata large; posterior four slightly reduced in size (*A. voeltzkowi*: Figs 3, 7 here; not reported for A. *matsumurae*).

Mandibles: slender, elongate, ~1.5x length of head capsule.

Antenna: flagellum long (approximately 0.75x (L1) to 0.45x (L3) length of pedicel).

Cranial setation: All primary cranial setae present, smooth and acute, including S12 and three frontoclypeal setae; Vx setae in longitudinal row beneath cervical membrane.

Thorax: Lateral tubercles (LTs) well developed, but not large; prothoracic LTs not reaching the region of the head.

Thoracic setation: All setae smooth; setae (LS) on lateral tubercles elongate, tapering to very fine, acute or lightly hooked tip; dorsal setae shorter, less tapered, with acute tips. Mesonotum, metanotum each with two (L1) or three (L3) transverse rows of setae.

Abdomen: A1–A7 with laterodorsal tubercles (LDTs) bearing robust setae.

Semaphoront A (first instar*)* [based on *A. voeltzkowi* only]

Thoracic lateral tubercles: Prothoracic LTs each with two LS; mesothoracic and metathoracic LTs each with three LS.

Thoracic setation: Prothorax with primary setae S1, S3, S4, S5, S1Sc1, and S2Sc1 present (S2, S1Sc2 apparently absent). Mesothorax with primary setae S1Sc1, S2Sc1 present, SSp absent; posterior region with transverse row of four setae. Metathorax with primary setae S1Sc1, S2Sc1, S3Sc1 present; posterior region with transverse row of four long setae arising from robust chalazae.

Abdominal tubercles: A1 with small LT bearing single long LS; LDT with single elongate, slightly hooked LDS and one very small lateral seta. A2–A7 with well developed LTs, each bearing two elongate LS.

Abdominal setation: Each segment with anterior transverse row of four acutely tipped or slightly hooked setae, two submedian setae (SMS) arising from large chalazae between LDTs.

Semaphoront B (third instar)

Head: Secondary setae present in patch near S1, S3, S11.

Thorax: LTs broadly cylindrical, tapered distally (especially on T2 and T3), longer than those on abdomen, extending dorsolaterally (prothorax) or laterally (mesothorax, metathorax); prothoracic LTs slightly smaller than those on mesothorax or metathorax.

Thoracic sclerites: Prothoracic primary sclerites (Sc1, Sc2) large, rounded, associated setae not distinguished; mesothoracic sclerites Sc2, Sc3 distinct, with associated setae S1Sc2, S2Sc2, and S1Sc3 present; metathoracic sclerite Sc3 distinct, with associated seta S1Sc3 present.

Thoracic setation: Setae on LTs numerous, elongate; dorsal setae numerous, smooth, short to medium-length, tips acute; most primary setae not distinguishable; posterior subsegment of metathorax with transverse row of ~12–15 slightly more robust setae than elsewhere on thorax.

Abdomen: LTs papilliform (A2–A5, A8) to slightly cylindrical (A6–A7); well sclerotized LDTs (A1–A7), each with two to four elongate setae and several shorter setae.

Abdominal setation: LS, LDS elongate but shorter than those on thoracic tuberlces, with tips weakly hooked or acute; submedian setae (SMS) of A1–A6 moderately hooked; dorsal setae of A7–A10 with acute tips; SMS (A2–A6) numerous, in three transverse rows.

Apochrysa voeltzkowi Larvae

Descriptions. First instar (neonate). *Body* (Fig. 2A) length ~1.6 mm (measured in lateral view through spiracles), depth not measured. Dorsal surface of preserved specimens cream-colored, without markings; lateral tubercles (LTs) of thorax, abdomen, laterodorsal tubercles (LDTs) of abdomen with light brown tinge distally; large abdominal chalazae (A1–A5) light brown. All setae smooth, pale, of various lengths and robustness; thoracic setae with acute tips; most abdominal setae (submedian setae, SMS) with small terminal hook.

Head (Figs 2B–D) cream-colored, with very light brown dorsal markings as in Fig. 2B; eyes with stemmata clear (tissue beneath black); integument surrounding margins of anterior stemmata light brown, integment surrounding margins of ventral, posterior and posterodorsal stremmata clear; cranium rounded posteriorly; width (across eyes) ~0.42 mm, length (dorsum) ~0.32 mm, depth not measured; cranial base exposed to slightly withdrawn into cervix. Anterior margin of cranium straight between mandibles, tapering posteriorly from mesal margin of mandibles to eyes; labrum recurved ventrally. Eyes protruding laterally; stemmata clustered tightly on anterior and lateral surfaces of protrusion; anterior two stemmata large, globose, posterior three and central stemmata smaller, less prominent.

Cephalic appendages (Figs 2C, 2D, 3A, 3B) relatively elongate, slender. Mandible long, thin, length (along curve) ~0.47 mm, length (straight line) ~0.37–0.39 mm, width ~0.06–0.07 mm; ratio mandible length (curved) to head width = 1.17–1.24; ratio mandible length (curved) to head length (dorsal) = ~1.5. Mandible with three short, acute basolateral setae; terminus with very small teeth, sharply acute tip. Antennal length 0.57–0.58 mm, ~1.8x length of cranium; width ~0.03 mm (at widest part of pedicel); scape with straight sides, setae apparently absent; pedicel, flagellum long, slender; pedicel with small mesal seta distally; flagellum about 0.76–0.79x length of pedicel, tapering gradually from pedicel; terminus almost 0.1 mm long, ~0.33–0.38x length of flagellum, with single long, tapering bristle. Labial palp long, wider than antenna, ~0.7–0.8x length of mandible (straight line); basal segment with one long, distolateral seta; middle segment long, annulate throughout, with two long, robust

setae distally, one mesal, one lateral; terminal subsegment elongate, ~one-third length of middle segment, slightly tapered distally, with transverse striations throughout, without visible sensillae, setae or terminal bristles, with cluster of microsetae terminally; palpiger approximately same size as basal segment of palpus, with one mesal seta, one lateral seta anteriorly; mentum with two pairs of long, anterior setae, two pairs of lateral setae – one short, one long; stipes elongate, narrow, diverging mesally from cranial margin; cardo shorter, angled posteriorly. *Cervix* small, with one pair of small setae anterolaterally; sclerites not discerned. Venter with row of three short setae (R1) laterally.

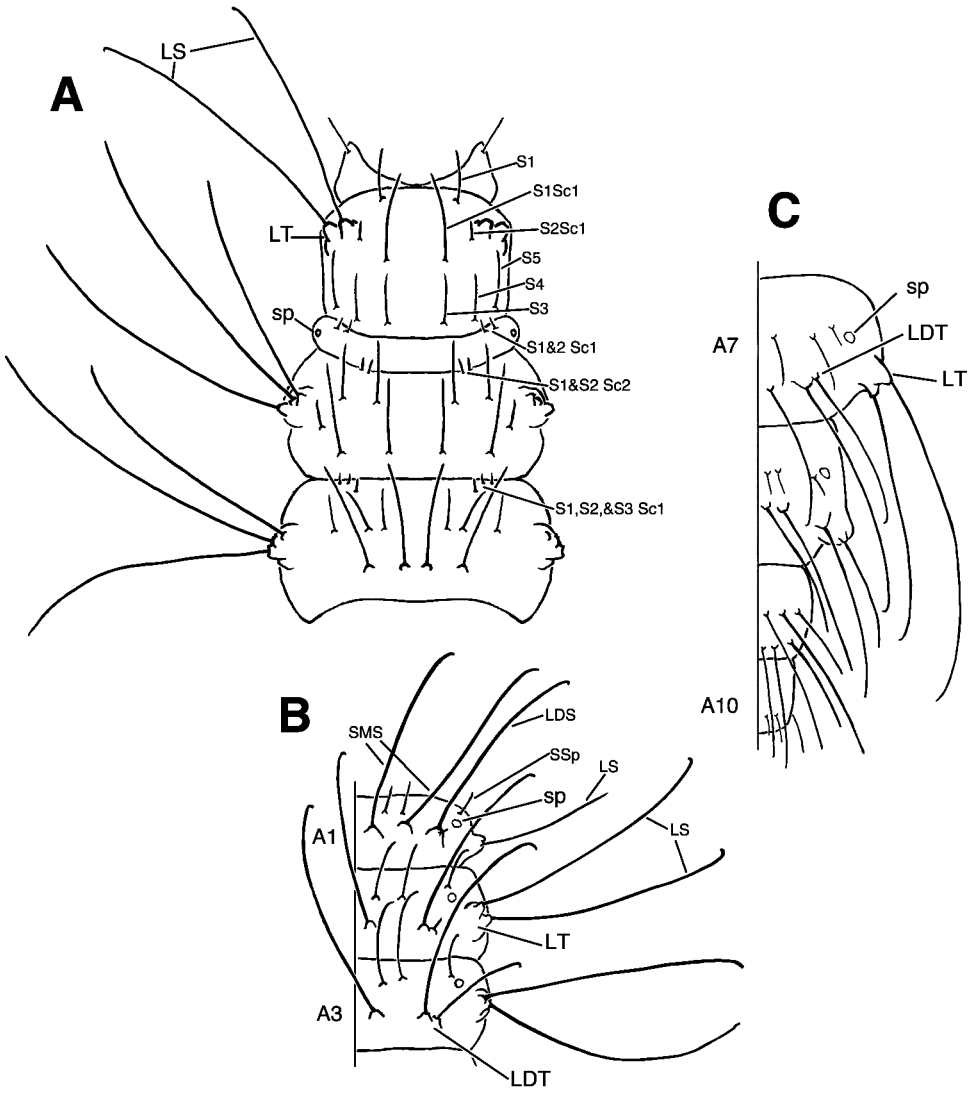

FIGURE 4. *Apochrysa voeltzkowi* (Weele) first instar. A. Thorax. B. First to third abdominal segments. C. Seventh to tenth abdominal segments. Abbreviations: Ax, abdominal segment number; LDS, primary seta on LDT; LDT, laterodorsal tubercle; LS, primary seta on LT; LT, lateral tubercle; sp, spiracle; Sx, primary seta number; SxScx, seta associated with sclerite, numbers; SMS, submedian seta; SSp, seta associated with spiracle.

Thorax (Figs 2A, 4A) with sclerites not distinguished from membranous integument; each segment with pair of lateral tubercles (LTs), each bearing two (prothorax) or three (mesothorax, metathorax) elongate setae (LS); prothoracic LT without small seta between two large LS. LTs well developed, but not large; LS with tapered, acute or very finely hooked tips. *Legs* setose, cream-colored, without markings except at coxal base, tarsal tip; claw, empodium light brown.

Prothorax (T1) with pair of medium-length setae (S1) anteromesal to LTs, small seta (probably S2Sc1) at mesal base of each LT, pair of long setae submesally (probably S1Sc1), three pairs of setae (S3, S4, S5) posterolaterally; S2 apparently missing. Venter (posterior region) with pair of medium-length, submesal setae.

Mesothorax (T2) with anterior subsegment bearing two pairs of small setae (probably S1Sc1, S2Sc1) on anterior margin, bearing spiracles laterally; spiracles simple, sessile, circular, with small atrium, without associated seta. Posterior subsegment with two pairs of very small setae (probably S1Sc2, S2Sc2) on anterior margin, two pairs of medium-length setae between LTs, pair of short setae at base of LTs, two pairs of setae posteriorly, slightly longer than two anterior setae. Venter apparently without setae.

Metathorax (T3) with three pairs of very small setae (probably S1Sc1, S2Sc1, S3Sc1) on anterior margin, transverse row of three pairs of medium-length setae mesal to LTs, two pairs of elongate setae from robust chalazae posteriorly. Venter apparently without setae.

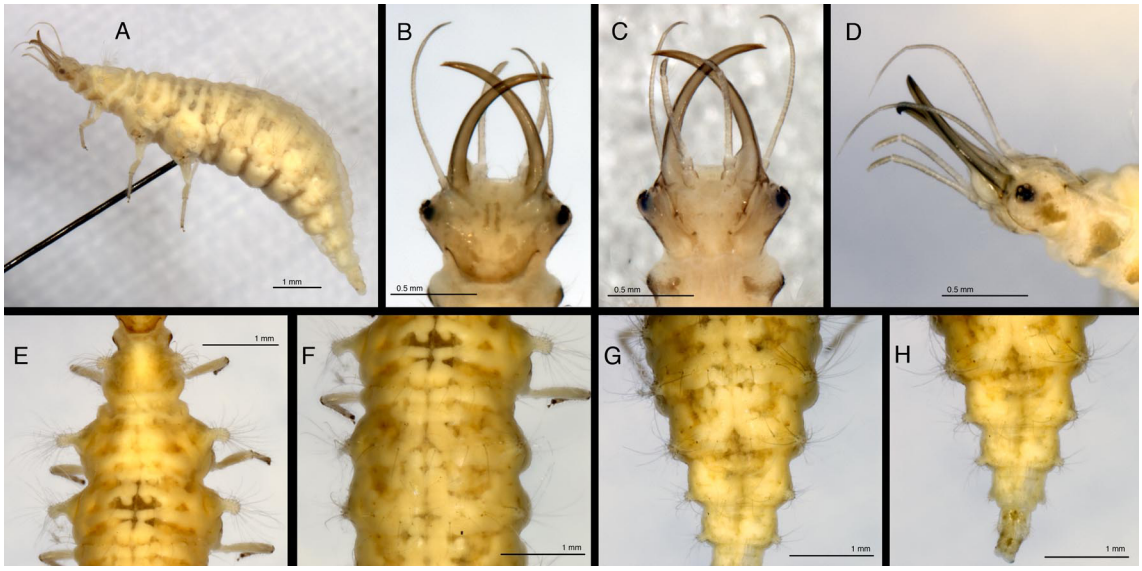

FIGURE 5. *Apochrysa voeltzkowi* (Weele) third instar. A. Body, lateral. B. Head, dorsal. C, Head, ventral. D. Head, lateral. E. Thorax, dorsal. F. First to third abdominal segments. G. Fourth to seventh abdominal segments. H. Sixth to tenth (terminal) abdominal segments.

FIGURE 6. *Apochrysa voeltzkowi* (Weele) third instar. A. Prothoracic lateral tubercle. B. Metathoracic lateral tubercle. C. Lateral tubercle of second abdominal segment. All cleared, mounted in glycerine.

Abdomen (Figs 2A, 4B, 4C) with LTs, LDTs present on A1–A7; LT on A1 with one LS; LTs on A2–A7 each with two LS, without small seta between LS. Spiracles circular, sessile, with small, simple atrium, each with small, acute-tipped (A1–A3, A6–A8) or medium-length, lightly hooked (A4, A5) associated seta (SSp). A1: LS long, acute; LDT with one long, hooked LDS, one very small LDS; dorsum with anterior transverse row of four small setae with acute tips, posterior row with four elongate, lightly hooked SMS from large chalazae. Venter with single pair of submesal setae. A2–A7: LS elongate, lightly hooked to acute; LDTs each with two LDS, one elongate, lightly hooked, one short, acute (A2), medium-length, lightly hooked (A3–A4), or elongate, lightly hooked (A5–A7). Dorsum with anterior transverse row of four medium-length setae—acute (A2) to hooked, blunt, or spatulate (A3–A7); one pair of elongate, hooked SMS on large chalazae between LDTs. Venter with one pair of small to medium-length submesal setae anteriorly, two pairs of submesal setae posteriorly, lateral ones long. A8: LTs short, broad, with relatively short LS, with two pairs of small setae in transverse row between spiracles; two pairs of large, acute-tipped SMS between LTs. Venter with transverse posterior band of approximately eight short

to medium-length setae. A9: Cylindrical; dorsum with two transverse rows of long setae arising from chalazae. Venter with transverse posterior band of approximately eight short to medium-length setae. A10: Dorsum largely without setae, except for two pairs of small, terminal setae. Venter with two pairs of small setae near terminus; terminus with small patch of microsetae.

Second and third instar. *Body* (Fig. 5A) length ~7.3–8.9 mm (measured in lateral view through spiracles), depth ~1.7–2.0 mm (thickest section of abdomen). Coloration of living specimens pure white with thin, greyish median line and abdominal spots; mandibles, tips of legs light brownish to amber [Photo by P. Duelli, Fig. 129 in Aspöck & Aspöck 2007]. Dorsal surface of preserved specimens cream-colored, with sclerites, markings light brown. All setae smooth, pale, of various lengths and robustness, most thoracic setae with acute tips, some elongate setae on lateral tubercles with hooked tips. Most abdominal setae (submedian setae, SMS) with small terminal hook.

Head with light brown to brown markings as in Figs 5B (dorsal), 5C (ventral); 5D (lateral); eyes with stemmata clear; integument surrounding margins of anterior stemmata brown, integment surrounding margins of ventral, posterior and posterodorsal stemmata clear (tissue beneath black); cranium tapered posteriorly, angular ventrally, dorsal surface quadrate posteriorly; width (across eyes) ~0.93–0.95 mm, length (dorsum) ~0.72 mm, depth (midregion, to top of eye) ~0.23–0.24 mm; cranial base exposed to slightly withdrawn into cervix. Anterior margin of cranium straight between mandibles, tapering posteriorly from mesal margin of mandibles to eyes; labrum recurved ventrally. Eyes protruding laterally; stemmata clustered tightly on anterior and lateral surfaces of protrusion; anterior two stemmata large, globose, posterior three and central stemmata smaller, less raised.

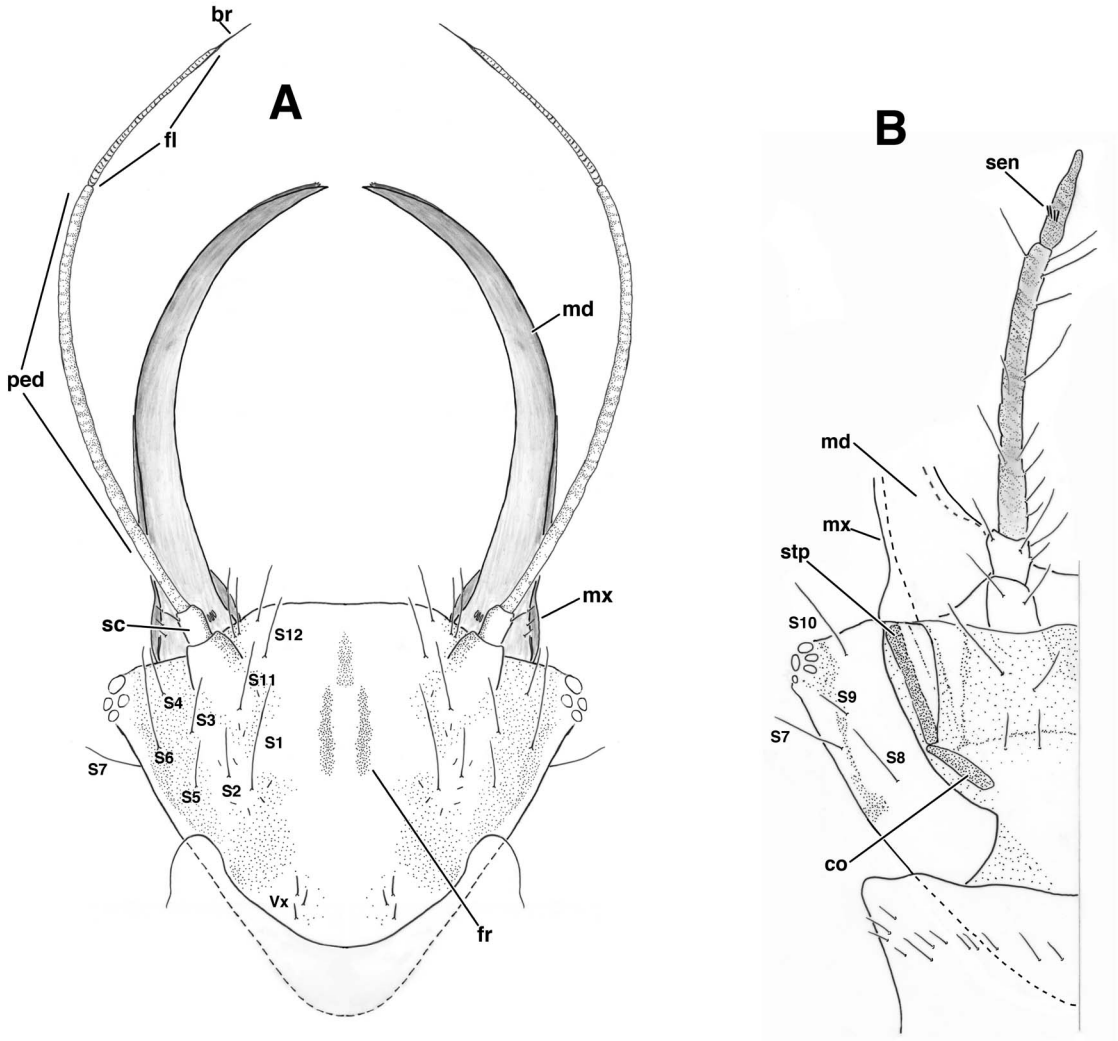

FIGURE 7. *Apochrysa voeltzkowi* (Weele) third instar. A. Head, dorsal. B, Ventral. Abbreviations: br, bristle; co, cardo; fl, flagellum; fr, frontal marking; md, mandible; mx, maxilla; ped, pedicel; sc, scape; sen, sensilla; stp, stipes; Sx, primary cephalic seta number; Vx, Vx setae.

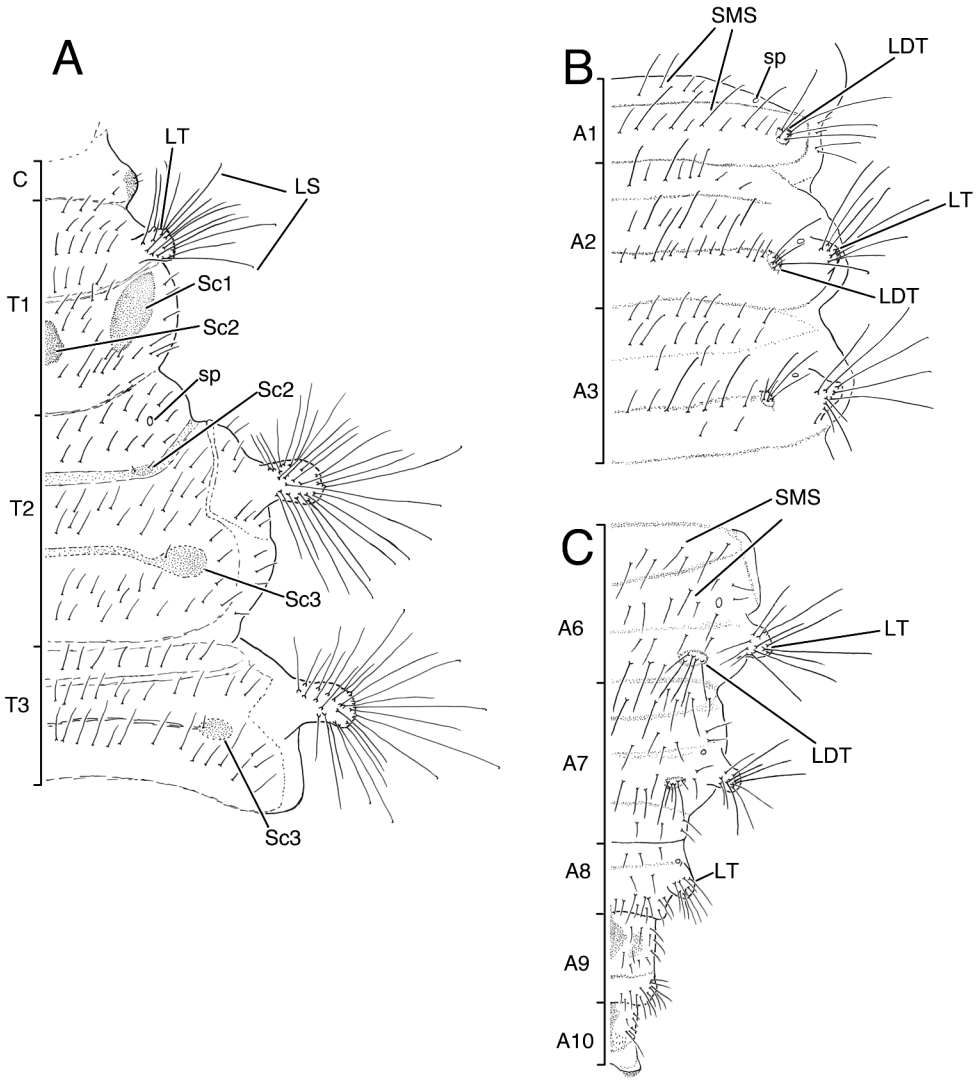

FIGURE 8. *Apochrysa voeltzkowi* (Weele) third instar. A. Thorax. B. First to third abdominal segments. C. Sixth to tenth abdominal segments. Abbreviations: Ax, number of abdominal segment; LDT, laterodorsal tubercle; LS, primary seta on LT; LT, lateral tubercle; sp, spiracle; Scx, primary sclerite number; SMS, submedian seta; Tx, thoracic segment number.

Cephalic appendages (Figs 1A, 5B, 5C, 7A, 7B) relatively elongate, slender. Mandible long, thin, length (along curve) ~1.06–1.15 mm, length (straight line) ~0.84–0.93 mm, width ~0.06–0.07 mm; ratio mandible length (curved) to head width = 1.17–1.24; ratio mandible length (curved) to head length (dorsal) = ~1.5–1.6. Mandible with single acute basolateral seta; terminus with very small teeth, sharply acute tip. Antennal length 1.3 mm, ~1.6x length of cranium; width ~0.04 mm (at widest part of pedicel); scape with straight sides, single pair of short, distolateral setae; pedicel long, slender; flagellum long, slender, about 0.45x length of pedicel, tapering gradually from pedicel; basal flagellomere without mesal seta, terminus with single long bristle. Labial palp long, slender, ~0.9x length of mandible (straight line); basal segment with one long, distolateral seta, ~ three long distomesal setae; middle segment long, annulated throughout, with basal region bearing approximatley seven long setae, mostly mesal, distal region with four long, robust setae, three mesal, one lateral; terminal subsegment elongate, ~one-third length of middle segment, slightly tapered distally, with transverse striations throughout, with four lateral-ventrolateral sensillae, without setae or terminal bristles; palpiger erect, with slightly rounded sides, one mesal seta, one lateral seta; mentum with leathery plate mesal to stipes, with four pairs of long setae; stipes elongate, narrow, angled approximately parallel to cranial margin; cardo shorter, angled mesally, with small dark brown spot at posterior tip. *Cervix* collar-like, with band of setae ventrally, laterally, with few or no setae dorsally, with pair of brown sclerites laterally.

Thorax (Figs 5E, 6A, 6B, 8A) with each segment bearing relatively dense covering of medium-length dorsal setae. *Legs* highly setose, cream-colored, without markings except at coxal base, tarsal tip; claw, empodium brown (Fig. 1B).

Prothorax (T1) with two subsegments separated by shallow fold. Sc1 light brown, oblong, extending almost full length of second subsegment; Sc2 large, approximately pear-shaped. Venter with pair of large setae anteriorly, rows of smaller setae mesally, posteriorly.

Mesothorax (T2) with three, well delineated subsegments separated from each other by two distinct, smooth transverse folds; Sc2 small, embedded in first fold, with minute seta; Sc3 large, round, light brown, at lateral terminus of second fold. Venter with ~50 short, scattered setae, one pair of long to medium-length setae posteriorly.

Metathorax (T3) with three subsegments separated by two small folds. Sc2 large, light brown, round; posterior subsegment with transverse row of approximately 15 setae slightly longer than those elsewhere on thorax. Venter with two transverse bands of approximately eight short to medium-length setae.

Abdomen (Figs 5F–H, 6C, 8B, 8C) with laterodorsal tubercles smooth, each with 2–4 elongate robust setae (LDS), several shorter LDS. Spiracles circular, sessile, with small, simple atrium. A1: Segment with two subsegments separated by small fold. Anterior subsegment small, spindle shaped, with spiracle on lateral margin. Posterior subsegment longer, broader than first, with distinct LDT laterally. Dorsum of each subsegment with transverse bands of numerous elongate to short SMS; venter with single transverse band of ~12–15 short to medium-length setae. A2–A7: Segment with three subsegments separated by small folds. Subsegments roughly of similar size, each extending to margin of segment; dorsum of anterior subsegment with transverse band of 8–10 SMS; middle subsegment bearing spiracle laterally, transverse band of 10–12 SMS; posterior subsegment with pair of distinct, smooth LDTs laterally. Venter with two to three transverse bands of short to medium-length setae; each segment with posterior pair of long, prominent setae submesally. A8: LTs short, broad, with relatively short LS; spiracle at anterior base of LDT; anterior, middle subsegments each with transverse row of ~four SMS; posterior subsegment with ~12 SMS. Venter with posterior band of four robust setae, several shorter setae. A9: Cylindrical, brown marking anteromesally, with numerous short setae, especially robust laterally, dense posterolaterally. A10: Dorsum with longitudinal brown marking mesally, with scattered small setae laterally, with inflated, bilobed membrane terminally.

Larval diagnosis. Based on the description above and that of Tsukaguchi (1995) for *A. matsumurae*, it appears that the third instars of the two species are very similar morphologically. Thus they can be distinguished from known larvae in other chrysopid subfamilies by their elongate flagellar segments. The main differences between the two *Apochrysa* species are in the head and body markings. Tsukaguchi reported that his specimens of *A. matusumurae* were without markings, whereas our specimens of *A. voeltzkowi* (L3) have distinct, although light, brown head and body markings (Figs 5B–5H, 7A). First instars of *A. matusumurae* are not described, but the first instar of *A. voeltzkowi* also has faint head markings that may be distinctive (Figs 2B, 3A).

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