

SHORT COMMUNICATIONS

**THE LARVA OF WILLIAMSONIA FLETCHERI WILLIAMSON
(ANISOPTERA: CORDULIIDAE)**

R.E. CHARLTON^{1,3} and R.A. CANNINGS²

¹ Department of Entomology, Cornell University,
New York State Agricultural Experiment Station, Geneva, New York 14456, United States

² Biology Section, Royal British Columbia Museum,
675 Belleville Street, Victoria, British Columbia V8V 1X4, Canada

Received May 22, 1992 / Revised and Accepted February 1, 1993

The final instar larva is described from specimens collected near Petersham, Massachusetts; Havelock, Ontario; and Masham, Quebec. It closely resembles the larva of *W. lintneri*, the only other member of the genus, but can be distinguished from it by the shorter length of the lateral spines on abdominal segment 9; these spines are about 1/5 the length of the segment including the spine, but 1/4 the length or longer in *W. lintneri*. *W. fletcheri* shares with *W. lintneri* the combined presence of dorsal hooks on abdominal segments 3 through 9 and lateral spines on segment 9 only, characters that are unique among North American corduliid genera. The larval habitat is described and observations of adult behavior and species associations are reported.

INTRODUCTION

Williamsonia fletcheri Williamson is a dragonfly associated with northeastern nearctic peatlands. Adults have been collected in Canada at scattered localities from southern Manitoba to New Brunswick and in Maine, Massachusetts, Michigan, New York, and New Hampshire in the United States. The adults are seldom encountered owing in part to their apparently scarce breeding habitat, inconspicuous nature, and early flight season. The even more elusive larva has been eagerly sought by a number of workers for decades. WALKER & CORBET (1975) "made frequent efforts to discover the nymph of this elusive insect in the pools of the Mer Bleue," a *Sphagnum* bog in eastern Ontario near Ottawa where collectors regularly found adults but never the larvae. On 19 May 1984

³ Present Address: Department of Entomology, Kansas State University, Manhattan, KS 66506-4004, United States

near Havelock, Ontario, R. Lyons found an emerging adult female and collected the exuviae. One year later and some 450 km (280 mi) to the southeast, another larva was found by one of us (REC) near Petersham, Massachusetts at the site where a population of *W. fletcheri* had previously been reported (CHARLTON, 1984). This area harbors a wide variety and expanse of peatland habitats, all potential breeding areas for the dragonfly. Initially, the search focused on small pools in the bog mat, these being the kind of sites where adults have previously been observed (WALKER & CORBET, 1975). No *Williamsonia* larvae were ever found in these pools so attention was turned to the pond itself. Then, on 12 May 1985, after repeatedly dredging a small *Sphagnum*-lined inlet of the pond, and after finding many other odonate larvae, REC collected a larva closely matching the description of *W. lintneri* (Hagen) as reported by WHITE & RAFF (1970). Three days later a female *W. fletcheri* emerged.

It was not long ago that the larva of *W. lintneri*, the only other *Williamsonia* species, was discovered in a bog in eastern Massachusetts and described by WHITE & RAFF (1970). The larva of this species was distinguished from all other North American corduliids by the presence of dorsal hooks on abdominal segments 3-9 and lateral abdominal spines on segment 9 only.

In this paper we describe the larva of *W. fletcheri*, confirm that the generic characters proposed by WHITE & RAFF (1970) and tentatively used by WALKER & CORBET (1975) apply to this species and thus the genus as a whole, and provide characters that distinguish *W. fletcheri* from *W. lintneri*.

MATERIAL EXAMINED

Specimens located in following collections: R.E. Charlton Collection (REC); H.B. White, III Collection (HBW); Royal British Columbia Museum (RBCM); and B. Ménard Collection (BM). The *W. lintneri* specimens provided by H.B. White, III were among those used in the original description of the larva (WHITE & RAFF, 1970).

– *W. fletcheri* – MASSACHUSETTS: Worcester Co., Brooks Pond, near Petersham, 1 ♀ exuviae (associated with emerging adult), 12-V-1985. – ONTARIO: Peterborough Co., Sandy Lake Road x Hwy 46 N of Havelock, 1 ♀ exuviae (associated with emerging adult), 19-V-1984 (RBCM). – QUEBEC: Gatineau Co., Masham Township, peatland near Duncan Lake, 1 ♀ larva, 2 ♀ and 1 ♂ exuviae, 28-V-1989 (BM).

– *W. lintneri* – RHODE ISLAND: Washington Co., Great Swamp Management Area, 1 ♂ larva (final instar), 5-IV-1986, R.E. Charlton (REC); – 3 exuviae (2 ♂, 1 ♀), 23-IV-1986, R.E. Charlton (REC); – 1 ♀ exuviae (associated with emerging adult), 28-IV-1989. – MASSACHUSETTS: Norfolk Co. Ponkapoag Bog, 1 ♂ exuviae (associated with emerging adult), 3-V-1970, H.B. White, III and R.A. Raff (HBW); – 4 exuviae (2 ♂, 2 ♀), 2-V-1970, H.B. White, III and R.A. Raff (HBW).

DESCRIPTION

The final instar larva is shown in Figure 1. Coloration described from exuviae. The larvae are scantily hairy and uniformly medium brown except for a lighter

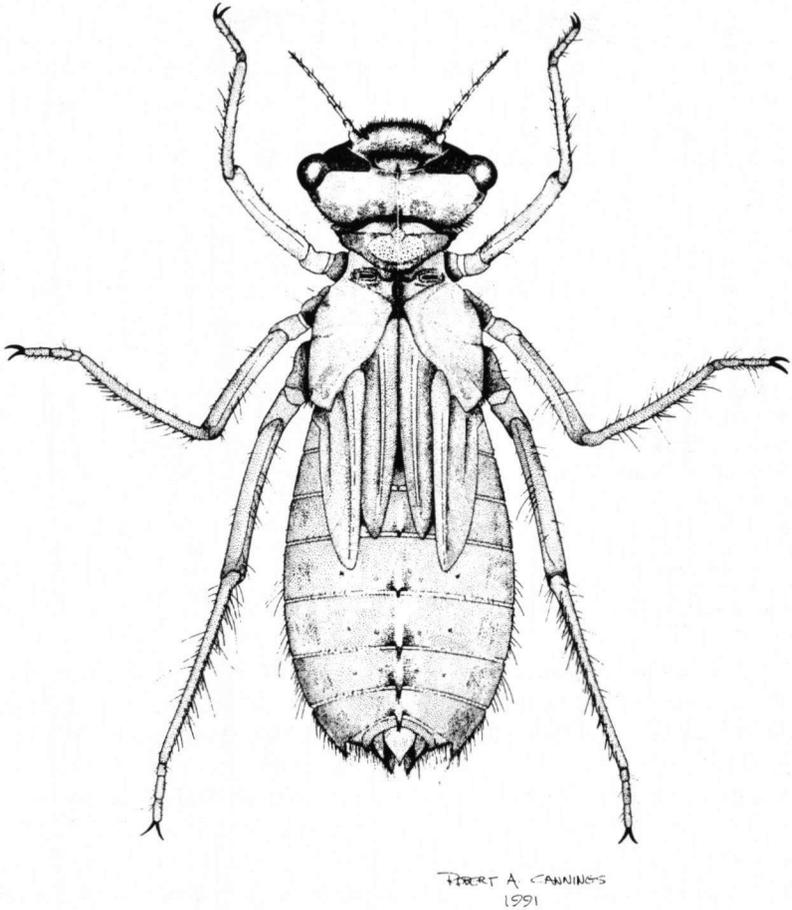


Fig. 1. *Williamsonia fletcheri*, final instar female larva, dorsal view. — [Scale line = 3 mm].

mid-dorsal stripe that extends the length of the abdomen and envelops the dorsal hooks. There are dark markings on the dorsum of abdominal segments 2-9: a mesal row of minute dark spots, and another row of larger, diffuse blotches at the points where the tergo-sternal muscles attach. There is an indistinct dark stripe on the thoracic mesopleuron.

Measurements are summarized in Table I. Head 4.6 mm wide, 2.5 mm (range: 2.4-2.6) long. Antennae nearly bare, 7 segmented and approximately as long as head; mean lengths of segments 1-7: 0.24, 0.32, 0.39, 0.27, 0.36, 0.58, 0.53 mm, respectively. Eyes prominent and convex. Labium large, the folded prementum extending to posterior margin of the mesocoxae; underside of folded labium 3.5

Table I

Morphometric comparisons of *Williamsonia fletcheri* and *W. lintneri* larvae – [All length measurements are in millimeters; – *W. fletcheri*, n=6; *W. lintneri*, n=10 except where indicated]

Character	<i>fletcheri</i>		<i>lintneri</i>	
	$\bar{x} \pm SE$	Range	$\bar{x} \pm SE$	Range
Total length	16.3 \pm 0.3	15.1 - 17.1	7.5 \pm 0.3	15.7 - 18.2
Abdomen length	10.3 \pm 0.1	10.1 - 10.6	11.0 \pm 0.1	10.4 - 11.6
Abdomen width	5.4 \pm 0.1	5.0 - 5.8	5.9 \pm 0.1	5.7 - 6.2
Head width	4.6 \pm 0.1	4.5 - 4.8	4.8 \pm 0.1	4.6 - 5.0
Hindwing length	5.5 \pm 0.1	5.0 - 5.6	5.5 \pm 0.1	5.3 - 5.7
Forewing length	5.8 \pm 0.1	5.4 - 6.0	5.8 \pm 0.04	5.7 - 6.0
Metafemur length	4.3 \pm 0.1	4.0 - 4.5	4.5 \pm 0.03	4.3 - 4.6
Metatibia length	4.7 \pm 0.1	4.3 - 5.0	4.9 \pm 0.03	4.7 - 5.0
Palpal setae ¹	7.8 \pm 0.2	7 - 8	8.0 \pm 0.1	7 - 8
Premental setae ¹	12 \pm 0	12	11.8 \pm 0.2	10 - 13
Lateral spine length	0.38 \pm 0.004	0.37 - 0.40	0.55 \pm 0.01	0.47 - 0.60
Ratio lateral spine/seg 9 ²	0.22	0.21 - 0.24	0.27	0.25 - 0.30
Epiproct length	0.89 \pm 0.02	0.82 - 0.94	0.92 \pm 0.01	0.87 - 0.97
Paraproct length	1.08 \pm 0.03	0.94 - 1.13	1.16 \pm 0.02	1.10 - 1.27
Cercus length	0.69 \pm 0.01	0.63 - 0.73	0.76 \pm 0.02	0.67 - 0.87

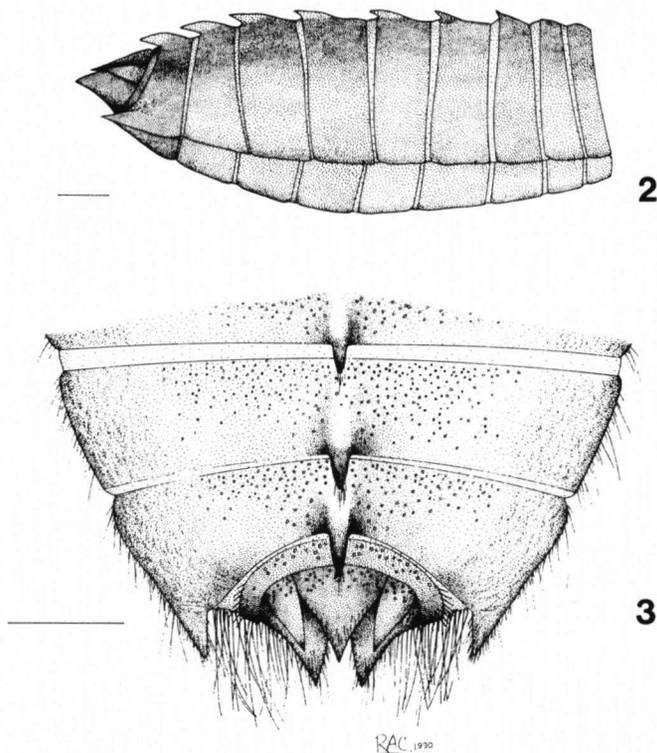
¹ n=12 for *W. fletcheri*; n=20 for *W. lintneri*

² length of lateral edge of segment including spine

mm (3.3-3.7) wide at widest point and 3.9 mm (3.8-4.5) long. Premental setae 12 on each side, the inner 4 distinctly shorter and becoming progressively smaller medially. Labial palps each with 7 or usually 8 setae along lateral margin plus one minute seta near base of each palp; 8-9 deeply rounded crenulations on medial margin of palp, each crenulation except the one nearest the dorsal hook bearing 3-5 short spiniform setae that diminish in size dorsally; the longest of these spines is 1.5 times as long as the crenulation is deep.

Thorax about as wide as head. Angular processes on lateral margins of pronotum fringed with short, wiry brown hairs. Forewings and hindwings extending, respectively, to the anterior margin and middle of the sixth abdominal tergite. Legs of moderate length, the hind femora reaching to the middle of segment 6. Legs sparsely hairy with rows of setae most prominent on the mid and hind tibiae, the longest setae occurring on the dorsal surface.

Abdomen elongate and only modestly ovate, widest (5.4 mm) at segment 7. Dorsal hooks present on segs. 3-9, those on 3 and 4 very small, the following ones increasing in size posteriorly (Fig. 2); each hook with a small tuft of setae at its tip (Fig. 3). Prominent lateral spines on seg. 9 only, fringed on their lateral and medial margins with short brown hairs; tips of spines extending posteriorly to approximately the tips of the epiproct and cerci but noticeably shorter than the paraprocts (Fig. 3). Mean length of the lateral spines 0.38 mm (0.37-0.40) or about one-fifth the lateral length of segment 9 including the spine. Epiproct



Figs 2-3. *Williamsonia fletcheri*: (2) abdomen of female larva, lateral view showing dorsal hooks; – (3) apex of abdomen of female larva, dorsal view. – [Scale line = 1 mm].

about equilateral, 0.90 mm (0.88-0.97) wide, 0.89 mm long, and extending posteriorly beyond the tips of the cerci; both epiproct and cerci markedly shorter than the paraprocts. Posterior margin of seg. 10 fringed with long, wiry hairs, the longest about twice the length of the epiproct (Fig. 3).

COMPARISON WITH *W. LINTNERI*

In most respects the larvae of *W. fletcheri* and *W. lintneri* are nearly identical (Tab. I). However, several characters separate the two species: (1) the lateral spine on segment 9 is shorter in *W. fletcheri* (0.38 ± 0.004 mm) than in *W. lintneri* (0.55 ± 0.01 ; range 0.47-0.60); – (2) the total length of segment 9 measured laterally is shorter in *W. fletcheri* (1.72 ± 0.01 mm; range 1.70-1.75 mm) than in *W. lintneri* (2.08 ± 0.02 ; 2.00-2.22); and – (3) the ratio of the length of the spine to the lateral length of seg. 9 including the spine is smaller in *W. fletcheri*

(0.22 mm; range 0.21-0.24) than in *W. lintneri* (0.27 mm; 0.25-0.30). Another good, but not certain, way to distinguish the two is that in *W. fletcheri* the tips of the lateral spines only extend rearward to about the tips of the cerci; in *W. lintneri* the spines almost always reach beyond the cerci, and in some specimens, beyond the tips of the paraprocts. In just one specimen, the lateral spines only reached the tips of the cerci. Finally, the dorsal abdominal hooks of *W. fletcheri* are more prominent than those of *W. lintneri*. In *W. fletcheri*, the dorsal hooks on segments 8 and 9 are 0.34 (0.30-0.40) and 0.35 mm (0.30-0.40) long, respectively (measurement excludes fringe of hairs); these hooks are shorter in *W. lintneri* - seg. 8; 0.22 ± 0.01 ; range 0.18-0.27; seg 9: 0.22 ± 0.02 ; 0.20-0.23.

WHITE & RAFF (1970) reported that in *W. lintneri* larvae the regular spacing of the palpal setae was interrupted by a wider gap between the third and fourth setae from the proximal end. Because this distance between setae is fairly constant in *W. fletcheri*, we first considered this to be another means by which the two species could be distinguished. However, this is a variable character in *W. lintneri*; only 5 of the 10 larvae examined show this characteristic. In the remaining specimens the spacing is even (both the Massachusetts and the Rhode Island specimens were represented in each category); the mean distance between setae beginning with the most proximal is 0.17; 0.22; 0.25; 0.24; 0.24; 0.22; and 0.20 mm. WHITE & RAFF (1970) also stated that each crenulation on the labial palps usually bore only two spiniform setae, but we found 3-5 of these spines per crenulation, similar to the situation in *W. fletcheri*. The shape of the epiproct of both *W. fletcheri* and *W. lintneri* is sexually dimorphic. In females, the dorsal surface is flat; however, the male epiproct has a prominent antiapical knob dorsally, similar to ones described in some other corduliids (e.g. *Somatochlora tenebrosa* (Say); WALKER & CORBET, 1975, p. 128).

HABITAT AND REPRODUCTIVE BEHAVIORS

Brooks Pond, Massachusetts, known locally as Tom Swamp, is a large pond formed by the damming, in the late 1800's, of a stream that traversed an existing fen. Most of the shoreline is rimmed by *Sphagnum* and at its northern end the pond grades into an extensive *Sphagnum* mat thickly overgrown by ericaceous shrubs, with leatherleaf (*Chamaedaphne calyculata*) and highbush blueberry (*Vaccinium corymbosum*) dominating. At the interface of the pond and the *Sphagnum* mat there are numerous small coves lined with *Sphagnum*; it was near the edge of one of these inlets that the larva was found. The quiet open water of the cove was dotted with *Nymphaea odorata* and *Nuphar variegatum* but on land the plants were, for the most part, characteristic of bogs and poor fens. The underwater layer of *Sphagnum* extended on shore and growing on the cushion there were pitcher plants (*Sarracenia purpurea*), *C. calyculata*, bog rosemary (*Kalmia angustifolia*) and a few swamp candles (*Lysimachia terrestris*); in drier

areas sundew (*Drosera* spp.) and cotton grass (*Eriophorum* spp.) also grew. The larva was found by removing bunches of submerged moss then methodically examining the stems. The larva's color was almost identical to that of dead *Sphagnum* moss and this, coupled with the fact that the larva hardly moved, made it difficult to detect.

The juxtaposition of peatland and marsh vegetation near the spot where the larva was found is also reflected in the dragonfly fauna. In early July *Nehalennia gracilis* Morse (a peatland species) and *N. irene* Hagen (a marsh species) flew nearly side by side. Similar peatland/marsh species pairs flying in the same general area included *Leucorrhinia glacialis* Hagen and *L. intacta* Hagen as well as *Gomphus borealis* Needham and *G. (Arigomphus) furcifer* (Hagen). Other odonates flying with *W. fletcheri* in early June included *Enallagma laterale* Morse, *Chromagrion conditum* (Selys), *Epithea canis* McLachlan, *Cordulia shurtleffi* Scudder, *Libellula julia* Uhler, and *Leucorrhinia hudsonica* (Selys). In July additional species were observed: *E. ebrium* (Hagen), *Lestes inaequalis* Walsh, *Anax junius* (Drury), *Aeshna canadensis* Walker, *Dorocordulia lepida* (Hagen), *D. libera* (Selys), *Libellula incesta* Hagen, and *Leucorrhinia frigida* Hagen.

The Havelock, Ontario site is a peatland over granite bedrock. It is a fen consisting of several small ponds and a few larger, open wetlands with some flowing water. Birch (*Betula papyrifera*) woods surround the wetlands, which are largely dominated by *Sphagnum* moss. Other odonates flying with *W. fletcheri* on 19 May 1984 included *E. canis*, *C. shurtleffi*, and *Leucorrhinia* (probably *hudsonica*).

On 28 May 1989 MÉNARD (1990) found *W. fletcheri* larvae near Duncan Lake, Masham Township, Quebec, just north of Ottawa, and provided an account of where and how he captured them (translated from French): "The habitat can be described as follows: a portion of a large marsh that has become a minerotrophic bog having a floating shore comprised of *Carex* and *Sphagnum* and punctuated by small holes containing water where I collected the undescribed larvae of this species, which is rarely collected in Quebec. At this site I improved my collection with an adult male, two exuviae and three larvae, all of different sizes. Beginning at the end of April it is possible to find these larvae by carefully examining the interwoven strands of *Sphagnum* removed painstakingly from the scattered pools on the floating shore. The most promising pools contain several plant species, including *Sphagnum*, *Carex*, and other aquatics, notably *Calla palustris*".

B. Ménard (pers. comm.) also captured a single, partly grown larva of *W. fletcheri* in May, 1988 at Alfred Bog, Ontario. This is largely a black spruce (*Picea mariana*) and *Sphagnum* bog located near Alfred, Prescott and Russell Co., Ontario. It is mostly forested, with some small open areas containing small, shallow pools and water-filled holes in the moss. Dominant plants also include *Nemopanthus mucrinatus*, *Ledum palustre* and *C. calyculata*. In October, 1982,

RAC tried to find larvae here, but failed. Efforts were focused on the *Sphagnum* pools and holes, but only *Somatochlora franklini* Selys larvae were found. The *W. fletcheri* larva that B. Ménard collected in 1988 was taken from a man-made ditch that lies adjacent to the open area described above.

The mating behavior of *W. fletcheri* remains poorly understood. In fact, larval sites have been difficult to find because adult males do not habitually perch or patrol near the pools where females oviposit. At Brooks Pond, Massachusetts, both sexes (including mating pairs) are frequently found some distance from the water, tending to perch in sunlit areas on or alongside dirt roads or in small forest clearings (CHARLTON, 1984). So too, R. Lyons notes (pers. comm.) that almost all the adults he saw on a visit to the Havelock, Ontario site in May 1988 were perched on the trunks of birch trees, from a few centimeters to over six meters above the ground. Even though mating pairs are often seen well away from water, it remains to be determined if mating normally occurs in these areas or if males capture females near oviposition areas then fly into the surrounding woods. In support of the first scenario, at Brooks Pond, REC watched a male rise from his resting place on a path, then seize a female and fly away in tandem; this encounter occurred about 100 m from the nearest water. On the other hand, S. Dunkle (pers. comm.) observed several males perching at the edge of small pools on hummocks of *Sphagnum* or other low vegetation near a spruce bog in central Maine. Because neither females nor mating were observed near these pools, it is not clear whether the males were territorial or stationed to intercept ovipositing females. WALKER & CORBET (1975), describing adults (of unknown sex) found at Mer Bleue, an extensive peat bog near Ottawa, also noted that "on the few occasions when we have found this inconspicuous species, it was making short flights close to a few small dark pools in the more open part of an alder thicket close to a rocky island, which rises abruptly from the flat green expanse of the bog." Along similar lines, one of us (REC) twice observed male *W. fletcheri* fly to the cove at Brooks Pond where the larva was found. They were, however, quickly chased off by male *Leucorrhinia hudsonica*, several of which had established territories around the perimeter of the cove. Possibly, male *W. fletcheri* will remain near oviposition areas only when more aggressive species are absent.

Oviposition was observed by RAC at Anderson Lake, near Dornoch, Grey Co., Ontario on 2 June 1992. The oviposition site was a shallow pool lying in a depression in the *Carex* and moss (not *Sphagnum*) mat, about 10 m from the wooded margin of the fen. It was about 1 m² in area and 15 cm deep. Pitcher Plant and Buckbean (*Menyanthes trifoliata*) grew in the moss and sedge mat. The female, hovering over the pool at 1640h EDT, dipped her abdomen into the clear water four or five times before moving 20 or 30 cm away in the same pool and repeating the process. No males were seen in the area. A subsequent visit on 1 July, revealed no *Williamsonia*. Although the fen mat remained saturated with water, the surface water of the pool had evaporated despite unseasonable cool,

wet weather.

ACKNOWLEDGEMENTS

We are grateful to R. LYONS for giving us one of the *W. fletcheri* exuviae used in this description and for information and photographs concerning habitat. We would also like to thank H.B. WHITE, III for loaning us his *W. lintneri* specimens and J. TANG and W. CHARLTON for their welcome help in finding and rearing the Massachusetts *W. fletcheri* larva. R. HUTCHINSON, B. MENARD, D.M. WOOD, and D.R. FOSTER generously provided other specimens and information.

REFERENCES

- CHARLTON, R.E., 1984. A colony of *Williamsonia fletcheri* (Odonata: Corduliidae) discovered in Massachusetts. *Ent. News* 96: 201-204.
- MÉNARD, B., 1990. Captures d'odonates dans la vallée de l'Outaouais, dans la Haute-Gatineau, et la région de Port-au-Saumon (Charlevoix-Est) en 1989. *Fabriques* 15(4): 80-89.
- WALKER, E.M. & P.S. CORBET, 1975. *The Odonata of Canada and Alaska*, Vol. 3. Univ. Toronto Press, Toronto.
- WHITE, H.B. & R.A. RAFF, 1970. The nymph of *Williamsonia lintneri* (Hagen) (Odonata: Corduliidae). *Psyche* 77: 252-257.