

## Description of a New Species of *Stenonema* (Ephemeroptera: Heptageniidae) from Virginia<sup>1</sup>

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### ABSTRACT

Nymphal and adult stages of a new species of *Stenonema* from western Virginia are described. Useful characteristics for determining the new species are sum-

marized. Species of Heptageniidae sympatric with the new species are reported in addition to the known ecology and distribution of the new species.

The *Stenonema* mayflies are among the most abundant insects inhabiting lotic environments in eastern North America. The *Stenonema* are a valuable component in the food web of stream ecosystems and are also useful as indicators of water quality. Traver (1933) established the genus *Stenonema* to include several American species which were formerly placed in *Heptagenia* and *Ecdyonurus*; she divided the genus into 3 species groups which could be distinguished in both nymphal and adult stages. Burks (1953) separated the genus into 7 species groups on the basis of adult characteristics. Jensen (1974) established the genus *Stenacron* for those species formerly placed in the *interpunctatum* group, a designation with which the author is in full agreement. The delineation of species in the genera *Stenonema* and *Stenacron* has been controversial. Lewis (1974) has summarized the synonyms of previous workers, and after a study of nymphs and adults, recognized 31 species and 17 synonyms, 6 of which were considered subspecies.

*Stenonema allegheniense* n.sp. is described from adult specimens which were reared from nymphs by the author. A large series of nymphal and adult specimens preserved in 95% ethanol was also studied to determine the variability of the species. After preservation in ethanol, all significant changes in color were noted. Air trapped in the body cavity of adult specimens preserved in ethanol was removed to reduce the rate of color fading. Some adults were preserved in vials filled with borax. Additional specimens were freeze-dried. Body lengths were measured ventrally from the anterior margin of the head to the posterior margin of the 10th sternum. The male genitalia were placed in a depression slide filled with alcohol and drawn from the image projected with a microslide projector. Slide mounts of the right male penis were repeatedly compressed, until the true length of spines was discernable.

### *Stenonema allegheniense* n. sp.

*Male Imago*.—Body length 9–13 mm, fore wings 10.5–13 mm, caudal filaments 28–30 mm.

*Head*.—Upper portion of compound eyes silver gray during the day becoming dark brown at dusk, lower portion chalky silver gray becoming dark purple, portions divided by a narrow dark band; compound eyes separated dorsally by the width of a lateral ocellus;

face dark orange; ocellar elevations dark green, ringed with lighter green distally, these elevations becoming brown after death, ocelli hyaline; posterior ridge of vertex brown, epicranial suture light orange, a small area between brown of posterior ridge and dark orange of vertex often light orange or translucent; clypeo-frontal ridge light orange becoming light gray behind annular antennal sclerites; clypeus translucent, the mesal 4th including the nasal carina orange, a narrow translucent area lateral to the nasal carina; annular antennal sclerites orange, scapes light orange, pedicels light gray becoming darker distally and often black ringed at apices, flagella gray becoming lighter proximally and distally; posterior surface of head predominantly pea-green becoming white toward posterior margins of compound eyes, the posterior surface also generally with small brown median dashes.

*Thorax*.—Thorax brown dorsally, and whitish laterally with a narrow purplish maroon and dusky orange stripe between fore femora and fore wing bases, and a wider and much less distinct orange-brown band above mesocoxae. Pronotum dark brown dorsally becoming white on lateral expansions; probasisternum yellowish white to gray. Mesoscutum brown, lighter on lateral faces, dark median suture interrupted by a yellowish orange spot, posterior margin yellow medially and laterally; posterior margins of the mesoscutellum dark brown, mesoscutellum becoming translucent anteriorly and whitish laterally; membrane between prescutum and prealar sclerites dusky orange or maroon, remainder of thoracic membranes mostly pale; mesoepisterna dusky orange becoming dusky brown ventrally; mesothoracic spiracles and area surrounding them white; mesoepimera white to light orange with 2 or 3 dark brown areas adjacent to mesocoxae and a purplish streak behind; subalar sclerites dusky orange to light brown; mesobasisternum gray; mesofurcisternum brown, frequently margined and divided by yellowish white. Metathorax predominately dusky brown, hind wing bases and metathoracic spiracles white. Orange and brown of specimens preserved in alcohol often fading to tans.

*Legs*.—Membrane at base of coxae dusky orange; procoxae and trochanters tan with an external purplish maroon stripe, front femora light yellow-brown with median and apical purplish maroon bands and each with a small dark spot at base, front tibiae

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yellow-tan, darker at bases, apex of front tibiae and reversible joints black; basal fore tarsal segment  $\frac{3}{8}$  to  $\frac{1}{2}$  the length of 2nd segment (fore tarsal ratio 2.1-2.6); tarsi 1-4 on all legs light tan with base and apex of each smoky black, last tarsal segments and unguis smoky black; meso- and metacoxae and trochanters brown, mesocoxae with a basal white bar and an apical dark streak; middle and hind femora light yellow-tan with median and apical purplish maroon bands; middle and hind tibiae light yellow-tan with small maroon spots at the distal end of the ventral ridge.

Wings.—Wing membranes hyaline with black dash along the costal braces, longitudinal veins yellowish at bases becoming black distally, crossveins black and thicker than longitudinal veins; crowded crossveins at level of bulla in 1st 6 interspaces (1-3, 2-4, 1-3, 1-3, 1-3, 1-2); stigmatic areas suffused with maroon and often becoming smoky gray toward wing tips; hind wing margins hyaline and veins paler and finer than in fore wings.

Abdomen.—Abdomen predominately red-brown dorsally, but occasionally with the dark brown on each side of the median stripe limited to posterior 4th of the mid-abdominal terga. Terga 1-9 with an uninterrupted reddish brown mid-dorsal stripe more or less divided by a narrow light streak, posterior portion of terga 1-9 reddish brown, terga 1-7 becoming light yellow to translucent anterolaterally, lighter portion most extensive lateral to the mid-dorsal stripe, terga 8 and 9 becoming yellow-orange anteriorly, tergum 10 yellow-orange and often with dark brown dash above cerci; lateral and lower portion of posterior lateral margins of terga 1-7 and partially 8 translucent, terga 2-6 without rudimentary posterolateral spines, lateral margins of terga 8 or 9 to 10 alabaster white; in dark specimens lighter oval areas discernible laterally on terga 1-7, dark spiracular marking absent or obscure. Sterna 1-7 light orange-yellow to light brown with posterior margins somewhat darker, posterior portion of sternum 8 alabaster white, anterior portion of sternum 9 light brown; cerci white to light tan with alternating wide brown and narrow tan articulations, apex of abdomen white.

Genitalia.—Forceps light tan, distal segments somewhat grayish; penes light orange-brown, distinctly "L"-shaped similar in general form to that of the *vicarium* group, each with an acute apical spine as long as the maximum median width of the titillator spines, and a stouter terminal spine  $\frac{3}{4}$  the length of the apical spine with its apex inclined proximally (Fig. 1), either spine occasionally represented by 2 short spines; penes with several setae ventrally at the posterolateral margins, which are as long as the terminal spines.

*Female Imago*.—Body length 10-14 mm, fore wings 12-16 mm, caudal filaments 20-23 mm.

Head.—Upper and lower portions of compound eyes light green, portions divided by a narrow brown line, compound eyes becoming dark brown at dusk; compound eyes separated dorsally by ca. 3 times the width of a lateral ocellus; face similar to male but

with orange color extended to posterior ridge of vertex which is narrowly translucent, frons with a small dark spot laterally between each compound eye and clypeus; annular antennal sclerites brown; remainder of head with color patterns similar to those of male.

Thorax.—Thorax appearing white laterally with a maroon and orange-brown stripe extending between front femora and fore wing bases. Pronotum as in male with brown areas less extensive, remainder of prothorax lighter in color than in male, profurcisterium often light brown or gray ventrally. Dorsum of meso- and metathorax light yellow-orange to tan, lateral faces of mesoscutum lighter, posterior margin of meso- and metascutellum gray; meso- and metathorax lighter laterally, often white, with 3 dark areas adjacent to mesocoxae; mesoepisterna with a lateral light orange area anterior to mesocoxae; mesobasisternum yellow-white to gray with 2 lateral brown areas, remainder of venter yellow-white.

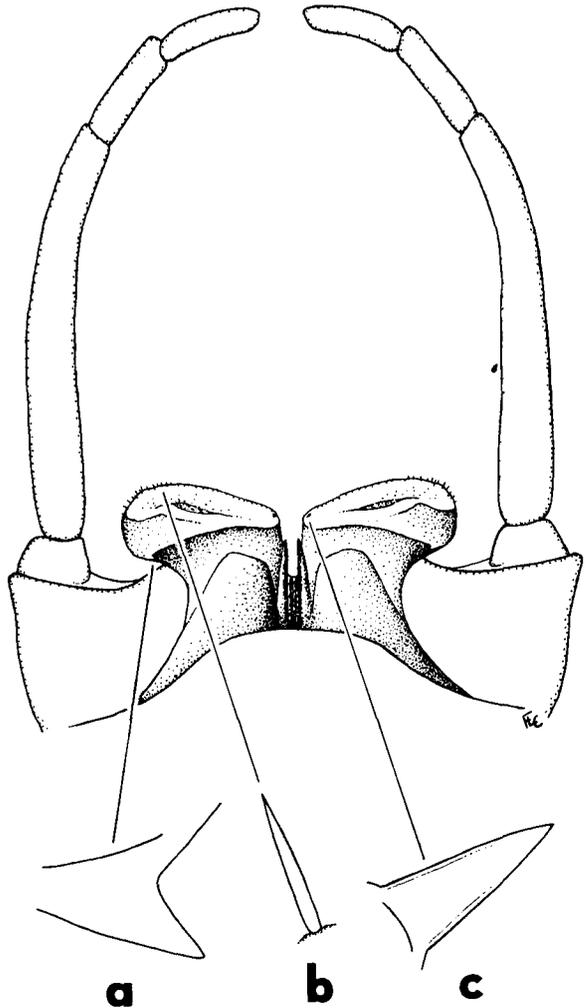


FIG. 1.—*Stenonema allegheniense*—dorsal view of male genitalia, (a) terminal spine, (b) posterolateral setae, (c) apical spine.

Legs.—Color of legs as in male, except with the small maroon spot on tibiae reduced or absent.

Wings.—Wings similar to those of male with longitudinal veins more extensively yellow; crowded crossveins at level of bulla in the 1st 6 interspaces (1-2, 2-3, 2-3, 1-3, 1-3, 1-3); stigmatic areas hyaline or suffused with gray or maroon.

Abdomen.—Mid-dorsal reddish brown stripe continuous, similar to that of male, posterior margin of terga 1-8 or 9 brown, this margin becoming translucent laterally and joining translucent lateral margin of each tergum, terga 1-7 with brown extended anteriorly and becoming yellow-orange on anterior portion, yellow-orange portion most extensive lateral to mid-dorsal stripe, terga 8-10 predominately orange; lateral margins of terga 8 or 9-10 and posterior lateral surface and posterior margin of tergum 10 all white; dark spiracular markings absent, in dark specimens lighter oval areas discernible laterally on terga 1-7. Sterna 1-6 yellowish white or gray with or without small mesal maroon markings; sterna 7-8 light orange-yellow, maroon, or brown; sterna 9-10 predominately white, posterior portion of sternum 8 often white and posterior margin of sternum 10 often gray or brown; as in the male the most consistent color characteristics of the abdomen being the mid-dorsal stripe, and the translucent and white lateral tergal margins.

Nymph.—Body length, male 10-12 mm, female 11-14 mm, caudal filaments 18-20 mm.

Head.—Grayish brown, freckled with pale dots becoming larger and more abundant anteriorly; vertex with posterior median spot along half the coronal suture and larger posterior submedian spots, these spots becoming obscured in mature male nymphs; vertex also generally with small pale area adjacent to compound eye between each lateral ocellus and posterior submedian pale spot; large pale spots lateral to each lateral ocellus and a pale "T"-shaped spot anterior to the median ocellus, a small pale spot on the clypeo-frontal suture on each side of the median "T" spot; area lateral to each compound eye pale and divided by dark band; annular antennal sclerites pale, scapes and pedicels brown, flagella tan; anterior margin of clypeus fringed with long setae; maxillae with 5 short pectinate setae (frequently 4 in immature nymphs) and 20-30 hair setae on crowns; 25-35 lateral lacinial setae (frequently 20-30 in immature nymphs), with proximal 3-5 considerably longer and displaced laterally; 7-9 proximal lacinial setae; mandibles with 9-13 teeth on inner margin of outer canines (frequently 8 in immature nymphs), and 2-6 teeth on inner margin of inner canine.

Thorax.—Pronotum gray-brown with 3 pairs of anterior pale spots, 2nd pair largest with 2 posterior extensions, 3rd pair generally extended posteriorly to meet pale lateral border of pronotum, leaving anterolateral margins of pronotum gray-brown. Mesonotum gray-brown with suggestion of usual "M"-shaped mid-dorsal pale area and also with pale areas at wing bases and at anterolateral margin. Sternum of thorax pale.

Legs.—Legs brown dorsally with 3 irregular pale bands across each femur, the apical 2 pale bands somewhat suffused with maroon, femora also each with a ventral maroon spot, dorsal surface of femora beset with several short stout setae and posterior margins with row of long hair setae paralleled by row of short acute setae ventrally and sparse row of long blunt setae dorsally, tibiae with proximal and subapical brown bands generally evident, each tarsus with a wide brown band, tarsal claws without pectinations (claws occasionally pectinate in immature nymphs).

Abdomen.—Abdominal tergum extremely variable in color pattern, young nymphs with tergum usually gray-brown with tergum 7 mostly pale, mature nymphs with terga 6, 10, and generally 8 and 9 predominately brown, the remaining terga mostly pale; each tergum with minute spines at the dorsal posterior margin which generally alternate long and short. Lamellate gills with 5-8 main tracheae, gills 1-4 slightly emarginate at apex, 5-6 truncate; 7th gill lanceolate, fringed with fine hair and without trachea; fibrillar gills 1-6 with 20-30 tubular fibrils many of which are bifid. Posterior lateral margins of segments 7-9 or occasionally 6-9 extended as spines, relative lengths (0-1, 6-8, 10, 2-3), respectively. Abdominal sternum pale yellow; each sterna 2-8 with a median sinuate transverse dark brown band somewhat resembling the head of a mushroom with turned-up ends on more posterior sterna, the more anterior marks either reduced to median rectangular spots or with median portion lacking, these marks progressively less represented in younger nymphs; sternum 9 with 2 oblique brown bands in immature nymphs which become joined anteriorly in mature nymphs to form an inverted "U." Developing forceps of male brown apically, developing penes pale; caudal filaments yellowish tan with alternating narrow dark and wide pale sections near tip.

Types.—Holotype, male — Spruce Run, Giles County, Va.; reared Apr. 3, 1976; F. Carle; nymphal and subimaginal exuviae in alcohol, adult in alcohol; deposited in U.S. National Museum.

Allotype, female—Va.; same data as for holotype.

Paratypes—Va.; data same as for holotype, 5 males, 8 females. Giles County; Apr. 13, 1976; with net; F. Carle; 6 males, 9 females; in alcohol. Giles County; Apr. 3, 1976; picked from rocks; F. Carle; 213 nymphs in alcohol. Tom's Creek, Montgomery County; Apr. 25, 1976; picked from rocks; F. Carle; 28 nymphs; in alcohol; paratypes deposited in U.S. National Museum, Canadian National Collection, Florida A&M University Collection, Virginia Polytechnic Institute and State University Entomology Collection, and with the U.S. Environmental Protection Agency, Cincinnati.

Additional nymphal and adult specimens in alcohol and not included in the type series are from the following counties—N. C.: Allegheny, Surry, and Wilkes. Va.: Alleghany, Augusta, Bath, Bland, Botetourt, Craig, Franklin, Giles, Highland, Montgomery, Patrick, Pulaski, Roanoke, Rockbridge,

Rockingham, Shenandoah, Wise, and Wythe. W. Va.: Greenbrier, Mercer, Monroe, Pendleton, and Pocahontas.

*Remarks.*—*Stenonema allegheniense* is allied to species of the *vicarium* group, which includes *Stenonema vicarium* (Walker), *S. fuscum* (Clemens), *S. pudicum* (Hagen), and *S. ithaca* (Clemens and Leonard) as defined by Burks (1953). Adult characteristics of *Stenonema allegheniense* which conform to the *vicarium* group include the predominately dark coloration, the geminate reddish brown mid-dorsal abdominal stripe, the relatively small dorsal separation of the compound eyes, the shape and spination of the male penes, and the relatively high fore tarsal ratio. Adults of *S. allegheniense* may be readily separated from other members of the *vicarium* group in lacking a dark reddish brown, purplish, or black lateral streak on each side of the nasal carina, although in preserved specimens the orange of the clypeus may become brownish. More specifically, *S. allegheniense* may also be readily separated from *S. pudicum* in lacking the dark margin of the hind wing, from *S. vicarium* in lacking the reddish or brown tibiae and by a smaller body size, from *S. fuscum* in having a greater abundance of crossveins in the fore wing (2-4 crowded crossveins in the 2nd interspace in region of bulla). *Stenonema allegheniense* may also be separated from those 2 species in lacking rudimentary lateral abdominal spines, and finally from *S. ithaca* in having the lateral margins of tergites 8 or 9-10 and the pleura ventral to the wing bases alabaster white. The apical spines of the male penes are longer than the terminal spines only in *S. vicarium* and *S. allegheniense*, the penes of *S. allegheniense* may be distinguished from that of *S. vicarium* in having the ventral posterolateral setae as long as the terminal spines. The nymphs of *S. allegheniense* resemble nymphs of the *vicarium* group in their relatively large body size, extensive ventral maculation of the abdomen, non-pectinate tarsal claws, and truncate lateral abdominal gills. The nymphs of *S. allegheniense* are similar to those of *S. ithaca* both in ventral color pattern and in the development of lateral abdominal spines, but can be separated from those of *S. ithaca* in having from 20-30 setae on the crown of the maxilla and 9-13 teeth on the inner margin of the outer canine. *Stenonema ithaca* lacks setae on the crown of the maxilla and has from 6-8 teeth on the inner margin of the outer canine. The nymph of *S. allegheniense* may be separated readily from the remaining nymphs of the *vicarium* group in only having the lateral margins of abdominal segments 6 or 7-9 extended as spines.

*Etymology.*—The name refers to the distribution of the species, which is centered about the Allegheny Mountains.

*Ecology and Distribution.*—The nymphs inhabit the riffle areas of small to medium-sized streams, and have been occasionally collected from large rivers.

The species is tentatively rated 4 in Chutter's (1972) Empirical Biotic Index because the species has been occasionally collected from streams slightly enriched by domestic and farm run-off. Emergence in Virginia begins in Mar. and ends in July. The adults become active at sunset and have been captured in tandem up to an hour after activity had begun. Many individuals were observed and collected emerging from Spruce Run, Giles Co., Va., but the subimagos were not attracted to lights after dark, although 5 male imagos were collected at a light in June, 1974. *S. annexum* Traver is the only species of *Stenonema* which has been collected with *S. allegheniense* in Spruce Run. Other species of *Stenonema* which are sympatric with *S. allegheniense* at other locations include *S. tripunctatum* (Banks), *S. rubrum* (McDunnough), *S. pulchellum* (Walsh), *S. pudicum*, and *S. vicarium*. Nymphs of an uncommon species which appears to be *S. ithaca* are also sympatric with *S. allegheniense*, although this is far from its known range as reported by Lewis (1974). *S. ithaca* is found more often in northern Va., where it is most abundant in the slow currents of small rivers. *S. terminatum* (Walsh) and *S. exigum* (Traver) have been collected from the New River near the type locality of *S. allegheniense*. Species of *Stenonema* sympatric with *Stenonema allegheniense* include *Stenonema carolina* (Banks) and various species or subspecies now included with *S. interpunctatum* (Say). Other Heptageniidae sympatric with *Stenonema allegheniense* include *Heptagenia aphrodite* McDunnough, *H. hebe* McDunnough, *H. marginalis* Banks, *Epeorus vitreus* (Walker), and *E. pleuralis* (Banks). The known distribution of *Stenonema allegheniense* includes the Allegheny Mountains of Va., W. Va., and N. C. Additional collecting will probably extend the known range northward into Md. and Pa., and southward into Ky., Tenn., and possibly Ga. and S.C.

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