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A New Species of *Stenonema* (Ephemeroptera: Heptageniidae) from Eastern North America¹

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ABSTRACT

Adults and nymphs of *Stenonema meririvulanum* n. sp. are described. Adults are characterized by large dark spiracular dots, gray margined hind wings, and very long banded caudal filaments. Nymphs are characterized by "V"-shaped pale areas on abdominal terga

7-9, posterolateral spines on abdominal segments 6 or 7-9, and an unmarked abdominal venter. The species has been collected from small pristine streams in the Appalachian Mountains.

Stenonema meririvulanum n. sp. is described from specimens reared by the senior author. Additional material from Georgia, Pennsylvania, North Carolina, Tennessee, Virginia, and West Virginia was studied to determine geographical variability. 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 discernible. We follow Knox's (1935) interpretation of thoracic sclerites.

Stenonema meririvulanum n. sp.

Male Imago.—Body length 9.5–12 mm, fore wings 11–14 mm, caudal filaments 45–48 mm.

Head.—Compound eyes light green, often dark brown in alcohol, separated dorsally by ca. 3 times width of lateral ocellus; vertex and frons yellowish white, brownish orange in older specimens; vertex with median and lateral pale areas, posterior ridge of vertex translucent; ocellar elevations green, often dark brown in alcohol, ocelli hyaline; area lateral to lateral ocelli and area anterior to median ocellus pale; annular antennal sclerites pale, scapes dark purple basally, pedicels pale, flagella purplish; clypeus and nasal carina translucent, faint dash on clypeus lateral to nasal carina; posterior surface of head pale, white near compound eyes.

Thorax.—Yellowish white, marked with dark purple, pale areas grayish brown in older specimens. Cervical membrane dark purple dorsally, pronotum diffuse brown, pale on lateral expansions, posterior-

ly with submedian purple spots; each pleural membrane with an oblique dark purple stripe extended distally to base of each front femur; probasisternum pale and white, median ridge brown; profurcisternum tan. Membrane between prothorax and mesothorax dark purple dorsally; mesoscutum tan to brown, much lighter on lateral faces, often pale; apex of mesoscutellum white, lateral portions translucent; postscutellum brown; membranes between prescutum and pre-alar sclerites white, remainder of mesothorax mostly pale or white laterally with subalar sclerites, areas above coxal processes, and mesoepisterna tan to brown; mesocoxal membranes with dark purple areas anterior and posterior to coxae; mesobasisternum gray to brown, mesofurcisternum tan to brown margined and often widely divided by white. Metascutum white, brown laterally; metascutellum white, translucent posteriorly; postscutellum brown; metathorax mostly tan to brown laterally, membranes pale, area between metathoracic spiracle and hind wing bases white; metacoxal membranes with dark purple areas anterior and posterior to coxae; metabasisternum pale; metafurcisternum tan to brown.

Legs.—Procoxae and trochanters pale, marked with white, with external dark purple stripe; front legs grayish brown, front femora with median and poorly developed apical purple bands, purple spots externally at base; apices of front tibiae and reversible joints dark brown; basal fore tarsal segment ca. 0.5 the length of the 2nd tarsal segment (fore tarsal ratio 1.8–2.2); tarsi 1–4 with apices brown, last tarsal segments and unguis smoky black; meso- and metacoxae, and trochanters pale marked with white; middle and hind femora pale with median and apical purple bands; middle and hind tibiae pale, brown

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at apices, tarsi 1-4 dusky brown, apices brown; last tarsal segments and ungues dark brown.

Wings.—Fore wing membranes hyaline with brown dash along the costal braces (Fig. 1); costal and subcostal crossveins, and subcostal bullae margined with brown, these crossveins much darker and thicker than remaining crossveins; longitudinal veins yellowish brown basally, brown distally; crossveins at level of bullae in 1st 6 interspaces (1-2, 1-3, 1-3, 1-2, 1-2, 1-2); *stigmatic areas suffused with pinkish orange*, generally white toward wing tips. Hind wings hyaline, *hind margins narrowly gray*, veins pale.

Abdomen.—Segments 1-7 translucent, *terga 1-7 with posterior purplish black bands and with large purplish black spiracular dots*, spiracular dots often confluent with posterior bands on terga 1-4 or 5, segments 8-10 white, tergum 8 with diffuse posterior band, terga 1-9 faintly grayish brown laterally, tergum 10 often shaded with brown above caudal filaments; caudal filaments grayish with alternating wide and narrow brown articulations.

Genitalia.—Styliger plate, forceps, and penes pale shaded with brown; penes distinctly "L"-shaped with posteromesal angle rounded (Fig. 2); each penis with acute apical spine ca. 0.6 as wide as long; *distal spines in discal position*, generally slightly shorter than apical spines, at least as wide as long, distal spines occasionally reduced or absent; penes with several stout setae on posterior ventral portions, these setae longest at posterior lateral angles, longest setae ca. 0.7 length of apical spine.

Female Imago.—Body length 12-15 mm, fore wings 14-17.5 mm, caudal filaments 31-37 mm. Color patterns of female similar to those of male with exceptions as follows:

Head.—Compound eyes separated dorsally by 4.0-4.7 times maximum width of lateral ocellus; vertex with small purple spot near each compound eye, and often obscure purple dash mesal to each purple spot; frons with small purple spot laterally between each compound eye and clypeus.

Legs.—Middle and apical purple bands of femora occasionally obscure.

Wings.—Crossveins at level of bullae in 1st 6 interspaces (1-2, 2-4, 2-4, 1-2, 1-3, 1-3).

Abdomen.—Sterna 7-9 often brown; subgenital plate often smoky black, angled ventrally at 20°-40°, and with wide cleft at apex.

Nymph.—Body length male 10.5-13 mm, female 13-16 mm, caudal filaments male 20-23 mm, female 22-25 mm.

Head.—Light brown, freckled with faint pale dots over frons and clypeus, vertex with posterior median spot along half coronal sulcus, pale areas lateral to each lateral ocellus and anterior to median ocellus; area lateral to each compound eye light brown frequently pale posteriorly, this area also with pale spot anterior to frontal sulcus; annular antennal sclerites and scapes pale, pedicels and flagella tan; posterior margin of head slightly emarginate, *area lateral to compound eyes expanded*, this area nearly as wide

as compound eye in female nymphs; anterior margin of clypeus fringed with hair setae; pectinate setae on crown of each maxilla (Fig. 3) 7-9 male, 8-10 female; *crowns of maxillae without hair setae*; lateral maxillary setae 30-37 male, 35-50 female; proximal 3-6 lateral setae usually separated from main row; 8-10 proximal lacinial setae; base of each maxilla with 12-16 long setae scattered over lateral portion; teeth on inner margin of each apical mandibular canine (Fig. 4) 9-12 male, 10-16 female; teeth on inner margin of left subapical canine 7-8, apical 3-4 teeth blunt.

Thorax.—Pronotum brown with 3 pairs of anterior pale spots, median pair often connected medially, lateral margins of pronotum predominantly pale with only anterolateral margins brown; mesonotum brown with suggestion of usual "M"-shaped pale area, pale areas also along wing bases and at anterolateral margins; thoracic venter pale.

Legs.—Coxae and trochanters tan usually with purplish markings of adult evident; femora tan with irregular pale median and apical bands and basal pale area, femora pale ventrally with slight continuation of dorsal dark areas, dorsal surface of femora with numerous scale-like setae, setae acute near femoral margins, dorsal surface also with numerous minute spine-like setae and smaller number of long hair setae; posterior margins of femora with row of hair setae paralleled dorsally and ventrally by row of stout acute setae; tibiae pale with basal and sub-apical brown bands; each tarsus with wide median band; tarsal claws without pectinations.

Abdomen.—Abdominal terga variable in color pattern (Fig. 5); each tergum with submedian pale areas, those pale areas on terga 1-4 ♂r 5, 6, 9, and 10 generally reduced to spots and *those on 5 and 7-8 or 9 confluent posteriorly to form pale "V"-shaped areas*; sublateral pale areas also present on terga 1-7 or 8, lateral margins and lateral spines of tergum 8 pale; each tergum with minute dorso-posterior spines; abdominal venter entirely pale, faintly brown between sterna and along sutures; lamellate gills with 5-8 main tracheae, gills 1-4 truncate at apex, 5-6 slightly rounded; 7th gill lanceolate, fringed with fine hair and without tracheae; fibrillar gills 1-6 with 20-30 tubular fibrils, many bifid; posterior lateral margins of segments 6 or 7-9 extended as spines, relative lengths (0-1, 5-6, 10, 6-7), respectively; developing forceps of male brown apically, developing penes pale, caudal filaments yellowish tan becoming darker distally; circle of strong spines at joints, row of long setae on each side of median filament and on mesal margins of lateral filaments.

Types.—Holotype, male—Little Stony Creek, Giles Co., Va.; reared May 3, 1977; F. Carle; nymphal and subimaginal exuviae, and adult in alcohol; deposited U.S. National Museum of Natural History. Allotype, female—Va.; same data as holotype. Paratypes—Va.; same data as holotype; reared May 3, 1977; F. Carle; 3 males, 4 females. Reared Apr. 5-7, 1977; F. Carle; 13 males, 19 females. Apr. 5, 1977;

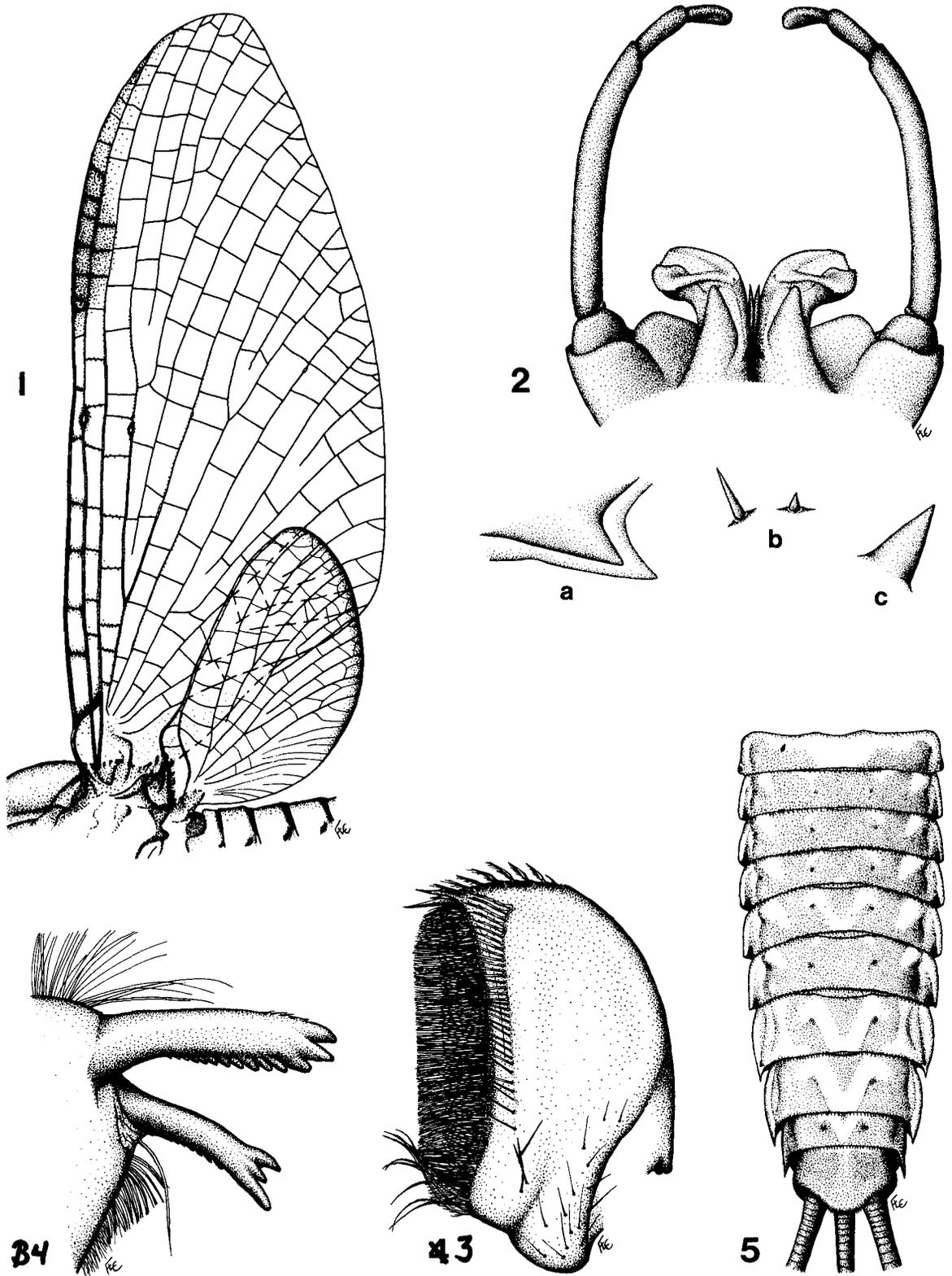


FIG. 1-5.—*Stenonema meririvulanum*, 1 and 2 adult male, 3-5 male nymph. 1. wings; 2. male genitalia, (a) variation of distal spine, (b) posterolateral setae, (c) apical spine; 3. ventral view of left maxilla; 4. dorsal view of left mandible; 5. dorsal view of abdomen.

with kicknet; F. Carle; 87 nymphs in alcohol. Apr. 29, 1977; with kicknet; F. Carle; 34 nymphs in alcohol. Paratypes deposited U.S. National Museum of Natural History, Canadian National Collection, Florida A&M University Collection, and in Virginia Polytechnic Institute and State University Collection.

Additional nymphal and adult material in alcohol and not included in the type series are from the following states and counties: Ga.—White; Penn.—Chester; N.C.—Macon, Swain; Tenn.—Maury, Polk; Va.—Alleghany, Bath, Craig, Fauquier, Floyd, Giles, Grayson, Highland, Montgomery, Page, Patrick, and Roanoke; W. Va.—Pocahontas.

Remarks.—The extremely long caudal filaments will apparently separate adult *Stenonema meririvul-anum* from all other *Stenonema*. Adults have been confused with *S. smithae* Traver and *S. quinquespinum* Lewis. These species may be distinguished from *S. meririvul-anum* in the following ways: *S. smithae*, smaller body size, and distal spines of the male penes in the terminal position; *S. quinquespinum*, smaller body size, compound eyes of male gray, and stigmatic area of fore wings reddish brown. The nymph of *S. meririvul-anum* has previously been confused with *S. carlsoni* Lewis, from which it can be readily separated by having "V"-shaped dorsal pale areas on terga 7–9, and by the lateral margins of only abdominal segments 6, or 7–9 extended as spines.

Etymology.—*S. meririvul-anum* [me ri ri vu lă' num] (L. adj. *merus* "pure" and L. noun *rivulus* "a small brook" plus L. suffix *-anus* "belonging to" N.L. adj. *meririvul-anum* "belonging to small pristine brooks").

Ecology and Distribution.—*Stenonema meririvul-anum* is an uncommon species that inhabits the riffles and pools of very small spring-fed streams, and has been found in larger streams only near the mouth of small tributaries. Nymphs are abundant in the headwaters of Little Stony Creek, which arises from a spruce bog and flows partially underground before reaching the type locality at 3600 feet. Although the stream may partially dry up in summer, water temperature varies only between 9° and 14°C. The nymphs have never been collected from streams disturbed by man's activities and are therefore rated a 0 in Lewis's (1973) modification of Chutter's (1972) Empirical Biotic Index. The only other Ephemeroptera collected at the type locality are an undescribed species of *Ameletus* and an occasional *Stenacron carolina* (Banks). Species of Heptageniidae collected with *S. meririvul-anum* at other localities are *S. allegheniense* Carle, *S. pudicum* (Hagen), *Stenacron carolina* (Banks), *Epeorus pleuralis* (Banks), and *Heptagenia hebe* McDun-nough. The known distribution of *S. meririvul-anum* extends along the Appalachian Mountains from Pennsylvania to Georgia.

The following observations of behavior were made by the senior author in a home aquarium and at the type locality. Nymphs can often be seen on the upper surface of stones which lie across the bottom

of small shaded pools. They walk stilt-like over the substrate while feeding and exhibit a drift and swimming response when disturbed, unlike the clinging response of many Heptageniidae. Before emerging, the nymphs become buoyant and drift or swim to an area of low current velocity, where they attach to the substrate. Nymphs then move toward the water surface, first touching the surface with the clypeus, and then backing down ca. 10 mm (observed variation in depth at emergence was 5–50 mm). Splitting of the nymphal skin then occurs within 1–30 min, when the subimago will usually drown if the prothoracic legs are not freed within 30 sec. The subimago then runs rapidly toward the water surface, occasionally running laterally for as much as 10 cm. The uninflated wings and long legs of the mayfly make it appear as an adult caddisfly beneath the water. The wings expand instantly as the subimago breaks the water surface. The maiden flight can be long, observed flights being from 2–40 m. The subimago stage lasts from 36–48 h.

The senior author observed the following adult behavior on June 4 near Back Creek, Highland Co., Va. At sunset, females began descending from surrounding vegetation to oviposit in a very small spring-fed rill no more than 30 cm wide. Several females were thereafter observed hovering 5–10 cm above the water. Every minute or so, females would drop to the surface of the water or damp stones for 1–5 sec and then rise to hover in the same place. One female was observed to do this 11 times before she flew up and rested on vegetation ca. 1 m above the rill. Males were observed swarming in a nearby clearing at 5–7 m; this activity ended ca. 1 h after sunset.

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