

A NEW SPECIES OF *CAENOCULIS* SOLDÁN FROM CHINA (EPHEMEROPTERA: CAENIDAE)

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Abstract.—*Caenoculis acutalis*, NEW SPECIES, is described from larvae collected from southern China. This new species represents the first record of the genus *Caenoculis* Soldán from China, and the fourth species of this genus worldwide. *Caenoculis acutalis* is relatively similar to *C. bishopi* Soldán from Malaysia and *C. nhahoensis* Soldán from Vietnam with respect to presence of a pronotal longitudinal ridge and the protruding edge of the posterolateral corner of the operculate gill. The new species can be easily distinguished from congeners based on unique morphology associated with the mesonotum with a small triangulate protrusion at the anterolateral corners, the abdominal tergum 1 with a narrow medial cone-shaped protrusion, and posterolateral processes on abdominal segments 3–9. Larval habitat of the new species is discussed and represents the first such data for the genus.

Key Words.—Mayflies, Ephemeroptera, China, Caenidae, *Caenoculis*, NEW SPECIES.

The genus *Caenoculis* (Soldán 1986) was originally based on three species described from the Oriental Region. Larvae are distinct from those of other Caenidae genera because of their unique combination of having ocellar tubercles and three-segmented maxillary and labial palps. The adult stage of the genus remains unknown. Other than that given by Soldán (1986), there have been no additional data published regarding the diversity or distribution of *Caenoculis*. Larval specimens recently collected from Southwestern China (Yunnan Province) represent a new species of *Caenoculis*. The description and diagnosis are presented below.

Caenoculis acutalis Zhou, Sun and McCafferty, NEW SPECIES

Types.—Holotype, mature larva; data: CHINA, YUNNAN PROVINCE, ER-YUAN COUNTY (26.06 N, 99.56 E, Alt 2262 m), Fu-Tian village, Mei-Yuan River, 1996-V-24, J.C. Morse, L.-F. Yang, B.-X. Wang and C.-F. Zhou (deposited in Nanjing Normal University, Nanjing, China). Paratypes, 18 larvae, data and deposition same as holotype; two larvae, data same as holotype (deposited in the Purdue Entomological Research Collection, West Lafayette, Indiana, U.S.A.).

Mature Larva (in alcohol).—Body (Fig. 1) length 4.5–7.0 mm. Caudal filaments length 2.0–4.0 mm. Ratios of length of body: antenna: foreleg: midleg: hindleg—3.6: 1.0: 1.3: 1.5: 1.6. Ratio of body length to mesonotum width—3.2. General coloration dark yellow brown.

Description.—*Head:* yellow brown; occiput stained with irregular-shaped black-brown patterns. Head capsule with dense, short and long, fine setae scattered on frons and occiput, and with anterolateral transverse row of dense, long setae between base of antenna and base of mandible (Figs. 1, 9). Clypeus with transverse row of dense, relatively long setae anteriorly. Branches of epicranial suture forming low, transverse ridge (Fig. 9). Lateral ocellar tubercle triangulate in lateral view (Fig. 9), slightly longer than width at base; anterior margin straight; apex rounded. Middle ocellar tubercle triangulate in dorsal view (Fig. 1) and curving dorsally in lateral view (Fig. 9), slightly shorter than that of lateral ocellar tubercle, and

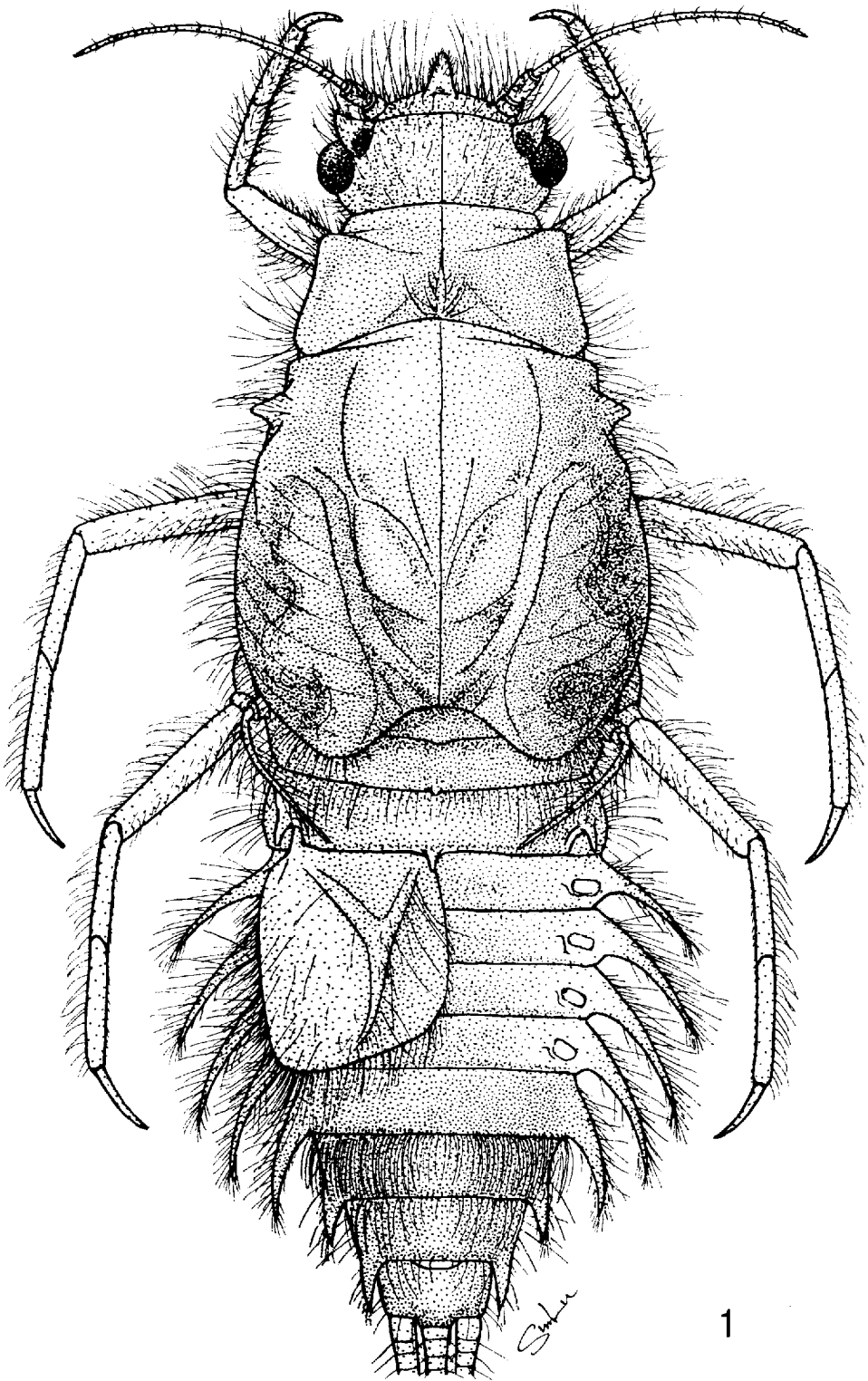
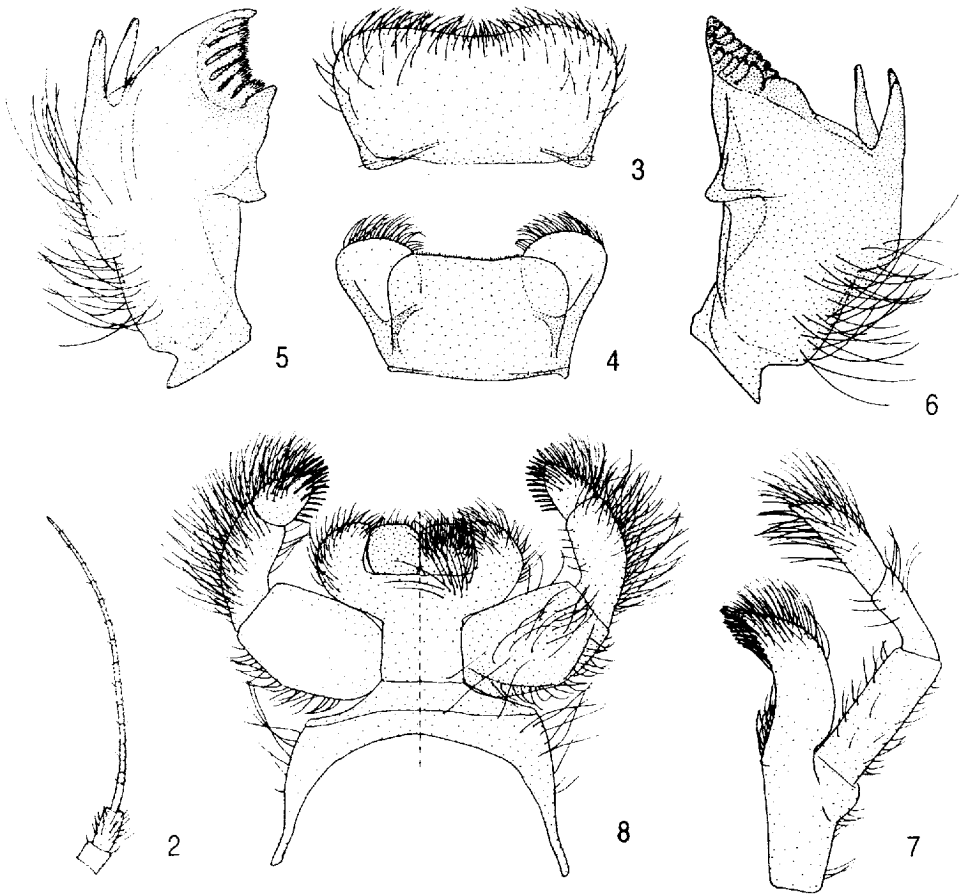


Figure 1. *Caenoculis acutalis* NEW SPECIES, larva habitus.



Figures 2–8. *Caenoculis acutalis* NEW SPECIES, larva. Figure 2. Antenna. Figure 3. Labrum. Figure 4. Hypopharynx. Figures 5 and 6. Mandibles. Figure 7. Maxilla. Figure 8. Labium.

slightly longer than that of basal width; lateral margins straight; apex bluntly pointed. All ocellar tubercles with very short setae at apex (Figs. 1 and 9). Compound eye not strongly produced dorsally or anteriorly (Fig. 9); distance from posterior margin of compound eye to posterior margin of head ca. half of length of compound eye. Antenna (Fig. 2) pale brown, with pedicel $2.0\times$ scape length; pedicel with black apical macula on dorsal surface, and whorled with about 20 stout setae subequal to, or longer than, one-half length of pedicel. Labrum (Fig. 3) nearly trapezoidal; anterolateral margin slightly produced; distal margin slightly concave medially, and with row of dense, stout setae. Mandible (Figs. 5 and 6) with dense, long marginal setae; outer incisor with three denticles; inner incisor with two denticles. Lingua of hypopharynx (Fig. 4) with distal margin slightly concave; superlinguae with lateral margins moderately produced and convex. Maxilla (Fig. 7) with galealacimia length to width ratio—3.1; maxillary palp segments 2 and 3 subequal in length, measuring together $1.5\times$ length of segment 1; segment 1 width $1.5\times$ that of segment 3; segment 2 with three long, stout setae along inner margin and with about eight long, fine setae along outer margin; segment 3 with about 15 long, stout setae along inner margin extending basally from apex, and with numerous long, fine setae at apex and along outer margin. Labial palp (Fig. 8) with dense, long setae along outer margin of segments 2 and 3.

Thorax: Not dark yellow brown; sterna paler. Pronotum (Figs. 1 and 9) trapezoidal, stained with diffused black; anterior margin straight; subanterior transverse ridge distinct; medial line prominent, forming distinctive ridge; lateral margin angulately produced in anterior fourth, and with few long marginal setae. Propleuron not visible in dorsal view, and with few marginal setae. Prosternum with distance between forecoxae subequal to, or slightly greater than half of distance between midcoxae;

median transverse ridge curved, not produced ventrally, and covered with some short setae. Mesonotum (Fig. 1) dark yellow-brown, with small triangulate projection at anterolateral corner directed laterally and bluntly pointed at apex; lateral margin with dense, long setae. Mesosternum anterior margin covered with row of short setae. Mesosternum and metasternum without central processes. Legs pale brown throughout, without maculae. Ratios of length of forefemur: tibia: tarsus: claw—3.0: 1.7: 1.5: 1.0. Ratios of length of hindfemur: tibia: tarsus: claw—3.3: 1.9: 1.9: 1.0. Ratio of hindfemur length to width—4.7: 1.0. Forefemur (Fig. 10) dorsal margin with row of dense, long and short setae; ventral margin with row of relatively long, stout setae and some short setae. Foretibia and foretarsus each with row of about 10 short, stout setae along ventral margin, and with some scattered, relatively long, fine setae on both anterior and posterior surfaces. Midcoxa and hindcoxa (Fig. 11) with pointed, triangulate process on dorsal margin; process of hindcoxa much longer than that of midcoxa. Hindfemur (Fig. 11) dorsal margin with row of long setae interspersed with some short setae; ventral margin with very short setae. Hindtibia and hindtarsus with row of sparse, relatively long, fine setae along dorsal margins and row of short, stout setae along ventral margin. Hindclaw (Fig. 11) adenticulate and nearly straight, with length $5.7 \times$ basal width, and with inner margin smooth.

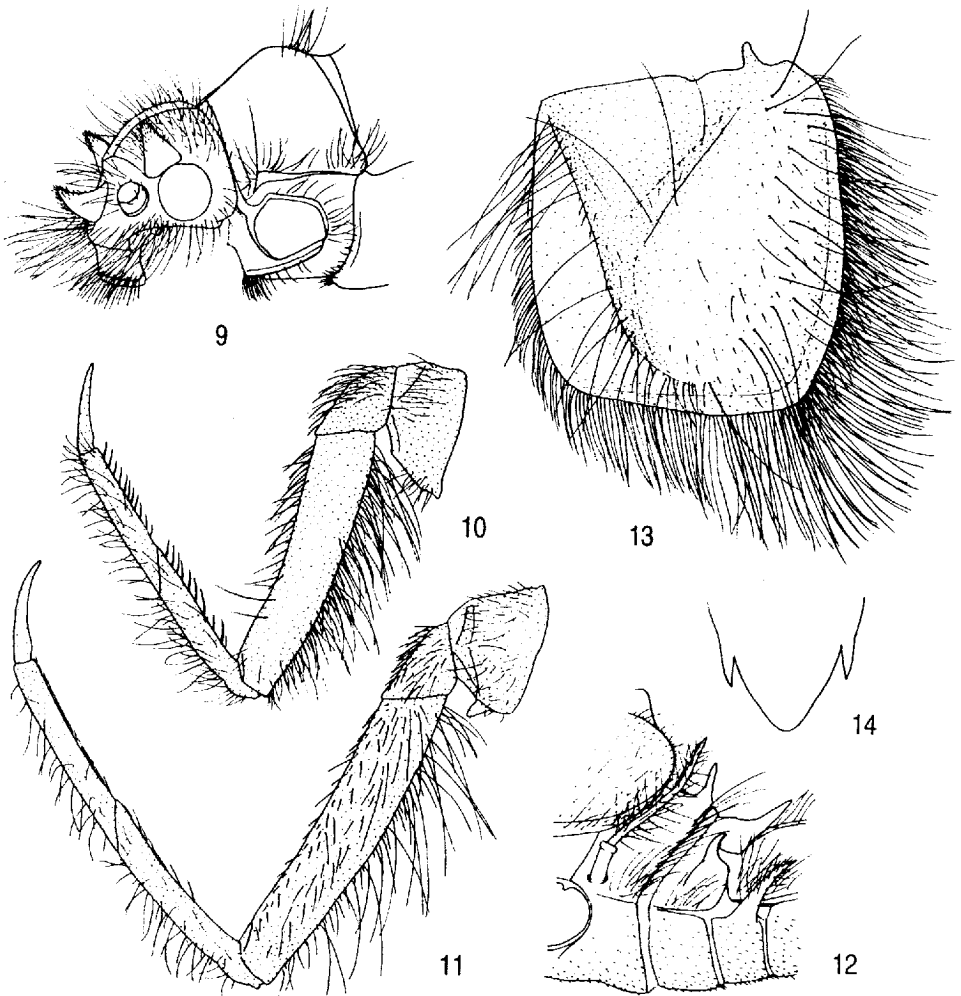
Abdomen: Terga yellow brown, somewhat paler than head and thoracic nota, stained with diffuse black. Tergum 1 (Figs. 1 and 12) with row of long, fine setae along posterior margin; tergum 7 with row of dense, long setae along posterior margin; tergum 8–10 with much fewer setae along posterior margin (Fig. 1). Terga 1 and 2 with narrow medial cone-shaped protrusion on posterior margin; apex pointed and directed dorsally (Figs. 1 and 12). Tergum 2 with claw-shaped, pointed process near base of operculate gill (Figs. 1 and 12). Lateral processes on segments 3–9 (Fig. 1); processes 3–7 slightly curving dorsally; processes 4, 5 and 6 longer than processes 3 and 7 by about one-third; process 8 about half of length of process 7; process 9 slightly shorter than process 8. Sterna paler than terga, flat, with dense, very short setae; sternum 9 (Fig. 14) posterior margin convex. Gill 1 (Figs. 1 and 12) slightly shorter than hindfemur. Operculate gill (Figs. 1, 13, 15, and 16) subquadrate; length $1.1 \times$ width, posterolateral corner with distinct protruding edge; dorsal surface yellow-brown, nearly same color as abdominal terga; few long setae in lateral region; Y ridge of gill strongly developed, with row of long setae; lateral margin and posterolateral corner of gill with row of dense, long setae; posterior margin and posteromedial corner with row of long setae but shorter than those of posterolateral corner; medial margin with row of dense, short setae; ventral surface of gill with submarginal rows of minute, palmate, scale-like outgrowths near outer and posterior margins. Caudal filaments pale brown; cerci length $0.75\text{--}0.80 \times$ that of median caudal filament; segments whorled with setae; setae on apical segments subequal to those of basal segments in length.

Adult.—Unknown.

Diagnosis.—Among the three previously described species, *Caenoculis acutalis* is relatively similar to *C. bishopi* Soldán and *C. nhahoensis* Soldán, in that they share the pronotal longitudinal ridge and the protruding edge of the posterolateral corner of the operculate gill that are not found in *C. dangi* Soldán. Diagnostic features that distinguish *C. acutalis* from *C. bishopi* and *C. nhahoensis* include a mesonotum with a small triangulate pointed protrusion at the anterolateral corners, abdominal tergum 1 with a narrow medial cone-shaped protrusion at the posterior margin, and lateral processes on abdominal segments 3–9. In *C. bishopi* and *C. nhahoensis*, such protrusions on the mesonotum and abdominal tergum 1 are absent. Processes are present on abdominal segments 4–7 in *C. bishopi*, and are present on abdominal segments 4–8 in *C. nhahoensis*.

Discussion.—Soldán (1986) gave a series of larval characteristics for the genus *Caenoculis*, but some of these might not be applicable to *C. acutalis*. For example, in *C. acutalis* the prosternal distance between forecoxae is subequal to, or slightly greater than half of that between midcoxae; whereas Soldán (1986) indicated that the forecoxae were “nearly continuous.” Nevertheless, critical generic characters are shared by the new species and other species of *Caenoculis* and include the presence of ocellar tubercles and three-segmented maxillary and labial palps.

The adult stage of the new species remains unknown. However, pharate male subimago genitalia were dissected from a last instar larva and are shown in Figs. 17 and 18. The penes lobes are subquadrate, with forceps somewhat flattened, bowed, and pointed at apex,



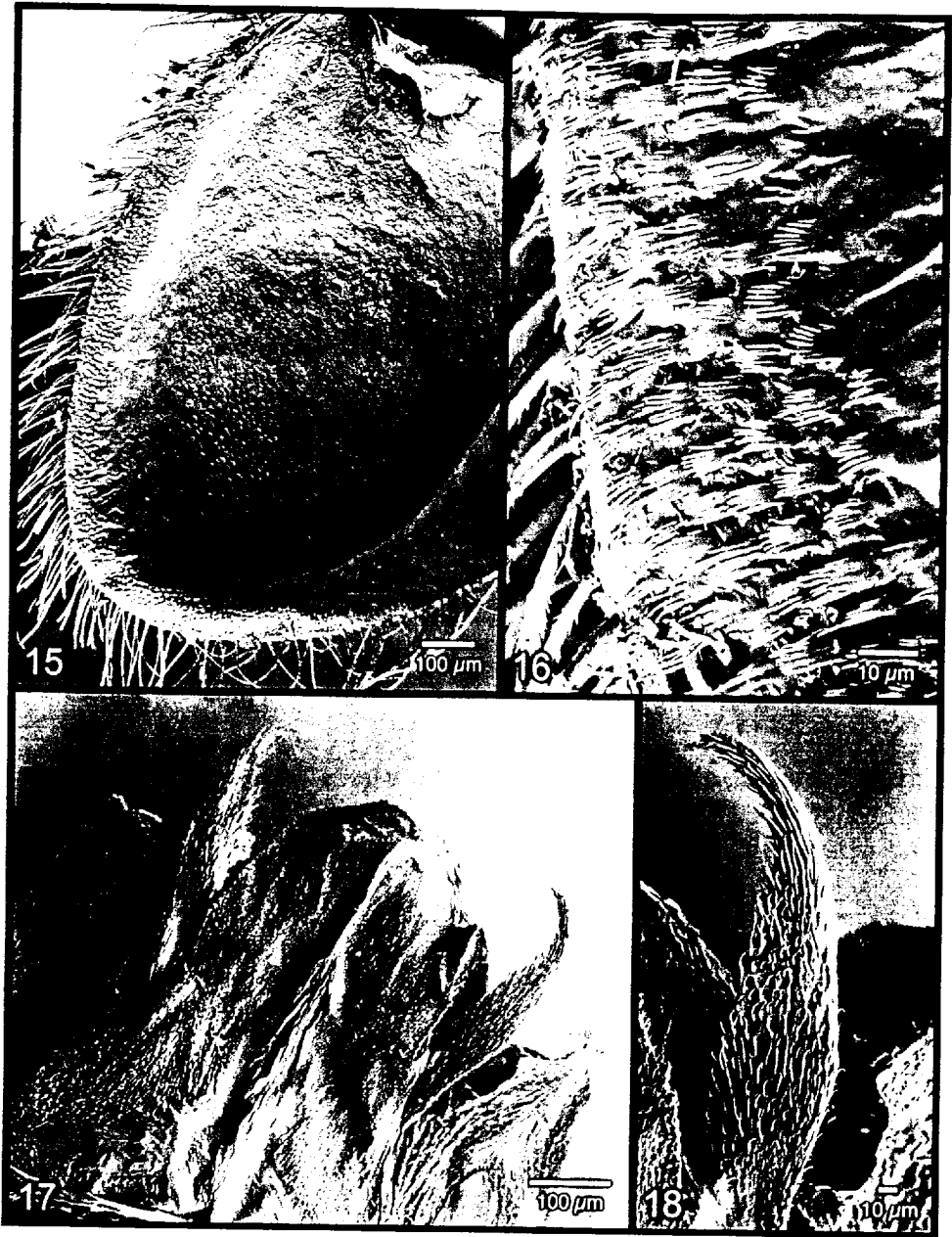
Figures 9–14. *Caenoculis acutalis* NEW SPECIES, larva. Figure 9. Head and pronotum (lateral). Figure 10. Foreleg (anterior). Figure 11. Hindleg (anterior). Figure 12. Abdominal segments 1–3 (lateral). Figure 13. Gill 2 (dorsal). Figure 14. Posterior margin of sternum 9.

and without a longitudinal groove. The forceps are also covered with dense, fine spine-like (unsocketed) outgrowths. Although these characteristics are reminiscent of those associated with male adult *Caenis*, we cannot be sure if there will be much additional developmental transformation of the genitalia expressed in the male adult of *Caenoculis*.

Larvae of *Caenoculis acutalis* were collected in a high-altitude (2262 m) clean-water stream that was 0.5–1.5 m in width. Substrate was mixed and included pockets of sand and silt. Larvae were collected at a depth of ca. 0.3 m, a current speed less than 0.5 m/sec, and a water temperature of 15° C.

Etymology.—The specific epithet is a Latin masculine and feminine adjective meaning pertaining to being pointed or spiny, and is an allusion to the pointed projections on the mesonotum and abdominal terga in the larvae.

Material Examined.—See Types on page 185.



Figures 15-18. *Caenoculis acutalis* NEW SPECIES, larva. Figure 15, Gill 2 (ventral). Figure 16, Setae along outer margin of gill 2 (ventral). Figure 17, genitalia dissected from mature larva (ventral). Figure 18, Forceps dissected from mature larva (ventral).

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