COMMENTARY ON *DRUNELLA TUBERCULATA* AND *PROCLOEON PENNULATUM* (EPHEMEROPTERA: EPHEMERELLIDAE; BAETIDAE) IN NORTH CAROLINA[1]

W. P. McCafferty[2]

ABSTRACT: A new larval variant of *Drunella tuberculata* (Morgan) (Ephemerellidae) was discovered in streams in North Carolina. It possesses morphological characteristics intermediate between *D. tuberculata* and *D. conestee* (Traver). *Drunella conestee* is shown to be a southern clinal variant of *D. tuberculata*, and thus a synonym: *D. tuberculata* [= *D. conestee*, n. syn.]. All larval variants of *D. tuberculata* are distinguished by a distinct posterior marginal ridge dorsally on the forefemora. Larvae of *Procloeon pennulatum* (Eaton) were also discovered from North Carolina. This Holarctic species previously was known in North America only from central and western Canada, where, for the greater part of this century, it was known only as female adults called *Centroptilum infrequens* McDunnough.

Diligent identification and monitoring of freshwater macroinvertebrates, as part of water resources assessment and conservation programs, will predictably lead to the recognition of taxonomic discoveries and anomalies. For example, aquatic biologists with the Kentucky Nature Preserves Commission, the Missouri Department of Conservation, and the North Carolina Department of Natural Resources, Division of Environmental Management, have all found stream samples of macroinvertebrates that could not be keyed to species and which, upon further investigation by a taxonomic specialist, proved to be new species important to understanding North American faunistics (McCafferty 1981a, 1990). Any synergistic relationship between such field workers and taxonomists can be most productive in this respect and must be encouraged because of the invaluable data potentially rendered and because of the mutual benefit that can be derived.

Certain recent samples of larval Ephemeroptera taken in North Carolina stream surveys by the North Carolina Division of Environmental Management could not be identified to species, not even to family in one case, with the use of presently available North American diagnostic keys. My study of this material has revealed notable new data, reported below, regarding two species, *Drunella tuberculata* (Morgan) and *Procloeon pennulatum* (Eaton).

[1] Received April 3,1993. Accepted May 3,1993.

[2] Department of Entomology, Purdue University, West Lafayette, IN 47907

Drunella tuberculata (Ephemerellidae)

This is an essentially Appalachian species ranging in eastern North Armerica from Quebec and Ontario to North Carolina and Tennessee. It was most recently treated (as *Ephemerella* Walsh) by Allen and Edmunds (1962). They provided a key to the larvae and adults of species of North American *Ephemerella* (subgenus *Drunella* Needham) and showed that, on the basis of larval intraspecific variability, *Ephemerella cherokee* Traver (known only from North Carolina) was a junior synonym of *D. tuberculata.*

Certain larvae of *Drunella* taken from streams in North Carolina will not key to any known species when using the Allen and Edmunds key. They tentatively appear to be either *D. tuberculata* or *D. conestee* (Traver) (known only from adjacent areas of North Carolina and Tennessee), having a mixture of characteristics previously applied to one or the other of these species (see Allen and Edmunds 1962) or the former concept of *E. cherokee* (see Traver 1937).

With reference to this new larval material: occipital tubercles of the head are intermediate between the shorter ones shown for *D. conestee* and the highly developed ones described for *D. tuberculata.* The shapes of the clypeus and the lateral frontoclypeal projections are similar to those shown for *D. tuberculata;* however, the genal projections are truncate, as shown for *D. conestee.* Dorsal thoracic tubercles are mainly similar to those described for *D. tuberculata* and *E. cherokee.* There are no anterior submarginal projections on the mesothorax, as is the case in *D. conestee,* and in younger larvae, dorsal thoracic tubercles are not developed or are extremely difficult to detect, similar to the condition described for *D. conestee.* The ventral marginal tubercles of the forefemora match those described for all of these species, but the dorsal femoral warts are intermediate between those shown for *D. conestee* and *D. tuberculata.* The foretibial spine extends only about one-third of the foretarsus length as described for *E. cherokee.* Paired submedian tubercles are present on dorsal abdominal segments 3-7, as described for *D. conestee* and *E. cherokee,* with no sign of small tubercles on segment 2, as described for *D. tuberculata.*

Allen and Edmunds (1962) indicated that *E. cherokee* represented a southern variant of *D. tuberculata* with regard to several characteristics that were clinal in going from north to south within the range of *D. tuberculata.* The newly studied North Carolina material not only matches much of the extreme southern clinal characteristics that have thus been associated with *D. tuberculata,* and particularly *E. cherokee,* but also possesses characteristics that have been associated with *D. conestee,* and some that are intermediate between the two. The lesser tuberculation of *D. conestee,* for example,

appears simply to represent further clinal variation of characteristics associated with southern populations of *D. tuberculata.* Traditional concepts of *D. tuberculata, E. cherokee,* and *D. conestee,* as well as the newly studied material, apparently represent variations of one species. Therefore, I am synonymyzing *D. conestee* with *D. tuberculata: D. tuberculata* (Morgan) [= *D. conestee* (Traver), n. syn.].

At couplet 11 in the Allen and Edmunds (1962) key to the larvae of *Drunella,* one could go either to couplet 12 or 13, depending on the variant of *D. tuberculata* that was being keyed. However, all variants of *D. tuberculata* have a distinctly developed ridge at the posterior margin of the dorsal flat surface of the forefemora. This diagnostic ridge begins submarginally at about one-third the distance from the base of the femora, it then gradually curves to the posterior margin at about one-half the distance from the base of the femora, and it then dissipates at about two-thirds the distance from the base of the femora along the posterior margin [see Figs. 43 and 45 in Allen and Edmunds (1962)]. Traver (1932) indicated that in life some larvae of *D. tuberculata* have a prominent whitish stripe down the back. This is not a true stripe, but there is enough unpigmented area in the medial area, especially of abdominal tergites, that at a distance a pale longitudinal region medially is visible in many individuals, including the newly discovered variant of *D. tuberculata.* This may be a fairly reliable field characteristic, but should not be depended upon for identification of the species. Little can be said about variation or diagnostic features of the adults of *D. tuberculata* because no adults are known of *D. conestee* s. auctt. or the newly discovered variant.

Material Examined (intermediate variant): Two mature larvae, North Carolina, Macon Co., Overflow Creek, 10 July, 1991. Two immature larvae, North Carolina, Stokes Co., Dan River, May, 1982.

Procloeon pennulatum (Baetidae)

This species, which was described by Eaton in 1870, has been known in Europe for over a century as *Centroptilum pennulatum.* Recently, Keffermüller and Sowa (1984) considered it in the genus *Pseudocentroptilum* Bogoescu. In the Palearctic, it is currently known throughout Europe east to the Ural Mountains of Russia. I have recently examined material also from Turkey.

In North America, this species traditionally has been known as *Centroptilum infrequens* McDunnough. Recently, when male and female adults were associated and the larvae were finally reared and described by Lowen and Flannagan (1990a) in Manitoba, it became apparent that *C. infrequens* was a synonym of the European species, and Lowen and Flannagan (1990b) formally considered it as such. McCafferty and Waltz (1990) transferred the species to the genus *Procloeon* Bengtsson, where the majority of species in

North America that were previously placed in *Centroptilum* and *Cloeon* Leach are now included. In the Nearctic, it has been known only from western and central Canada.

Larval specimens of this species were collected in North Carolina, but could not be clearly placed to either the family Siphlonuridae or Baetidae when using available keys because of their relatively short antennae (see McCafferty 1981b). Also, this species has double gill lamellae and although this might be confused with the double gill of *Siphlonurus* Eaton, gills of the two are actually very different in size and shape and degree of development of the second lamella. No adequate keys to the genera of Baetidae in North America have been published to date. All structural characteristics of the species are found in the North Carolina material, and the dorsal color pattern is similar to that shown in a photograph of a larva from Switzerland [Photo XII in Studemann *et al.* (1992)]. The drawing of the dorsal color pattern of the species shown in Fig. 8 of Lowen and Flannagan (1990a) is overly contrasting, although it does show relative development of the pattern correctly.

The discovery of this species in North Carolina represents a considerable southward extension of its known range in North America. This perhaps is not too surprising when one considers that, in Europe, it is known from Spain and Italy at only slightly more northern latitudes than those of North Carolina. Moreover, now that the larval stage is recognizable in North America, I predict that it eventually will be found to be much more widespread in the conterminous United States. Further discoveries of this species will be facilitated to a large degree once adequate generic keys to the baetid genera are made available by Waltz and McCafferty (in ms). There may also prove to be additional synonyms of *P. pennulatum* in North America. Lowen and Flannagan (1990a) found the larvae to be abundant in cool spring-fed streams in Manitoba, and Macan (1979) indicated that larvae of this species are found in slow sandy bottomed streams in England.

Material Examined: Two mature larvae, North Carolina, Caldwell Co., Wilson Creek at St. Rd. 1358.

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U.S. Army, and a former student at the University of Delaware, spent two years based in Nairobi, Kenya researching leishmaniasis. His informative presentation gave Society members a glimpse in the immense problems fighting arbodiseases in an area beset with overpopulation, poverty and regional instability.

Sleeping sickness, an arbodisease readily associated in entomologists' minds with East Africa, is confined mainly to one valley and considered primarily a veterinarian problem. Dr. Johnson stated that simple tabanid traps are effective in preventing spread of the tsetse-fly vector (*Glossina pallidipes* Austen), and recent work has shown that the flies avoid zebras or even "striped" cattle! Malaria, mostly caused by *Plasmodium falciparum*, by contrast, is a severe human health problem, killing worldwide over two million people every year. Control approaches use both high and low technology. Dr. Johnson states that there is no vaccine as yet, and even if available, the prevalence of malaria in Kenya would probably not allow it to be effective. Molecular techniques are being used to sort out the malaria vectors in the *Anopheles gambiae* complex, as some of these cryptic species are better transmitters than others. Impregnating bed nets and rafter screens with pyrethrins is a simple method preventing mosquito transmission.

As mentioned, Dr. Johnson's main research in Kenya dealt with the four species of *Leishmania* causing leishmaniasis and their vectors, the phlebotomine sand flies. Severity ranges from visceral leishmaniasis, which is fatal and destroys the liver and pancreas, to *Leishmania major* which is never fatal. Control techniques run the gamut from vaccine

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