



EIGHT NEW SPECIES OF *AMPHINEMURA* (PLECOPTERA: NEMOURIDAE) FROM VIETNAM

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ABSTRACT

Eight new species of *Amphinemura* are recognized based on specimens collected in Vietnam. New taxa include *A. bifurcata* sp. n., *A. caoae* sp. n., *A. divergens* sp. n., *A. giay* sp. n., *A. meyi* sp. n., *A. sapa* sp. n., *A. tamdao* sp. n. and *A. viet* sp. n. A single male specimen of *A. gressitti* Kawai and a male and female of *A. hainana* Li & Yang are also reported and two species based on unassociated females are described under informal designations. A preliminary key for males of *Amphinemura* known for Vietnam is presented.

Keywords: Plecoptera, Nemouridae, Vietnam, *Amphinemura*, New species

INTRODUCTION

Amphinemura includes more than 130 species according to Li & Yang (2008a), and DeWalt et al. (2009) provides a list of 166 species. Many of these are known from east Asian localities in China, Japan, Indonesia and other nations, and 38 species have been described from China alone since 2002 (Du & Wang 2007; Li & Yang 2005, 2006, 2007, 2008a, 2008b, 2008c, 2008d, 2008e; Li et al. 2005; Wang et al. 2006, 2007; Yang et al. 2004, 2005; Zhu & Yang 2002, 2003). However, only two species, *A. gressitti* Kawai and *A. handschini* (Geijskes), are reported for Vietnam (Kawai 1969), and the latter species was originally described from a Javan population (Geijskes 1937, 1952) and may be misidentified. One unidentified *Amphinemura* female was also reported from Thailand by Kawai (1969).

This study, based on a small sample of *Amphinemura* adults and larvae collected by several colleagues during the 1990's, includes males of ten species, several females which could not be associated and a series of larvae from the Sapa area. The larval series includes three specimens with dark wingpads but the epiprocts are not developed on the

two male specimens. Clearly more than one species is represented in this larval series but no descriptions are presented since they cannot be associated with any of the adult specimens from that locality. Specimens are deposited in the Royal Ontario Museum, Toronto (ROM), the Zoologisch-Museum der Humboldt-Universität, Berlin (ZMB) and the Slovenian Museum of Natural History, Ljubljana (PMSL). The following key is presented to aid in identification of males of the eleven species of *Amphinemura* reported from Vietnam.

RESULTS AND DISCUSSION

Preliminary Key to Males of Vietnamese *Amphinemura*

- 1 Lateral lobes of epiproct in dorsal aspect armed with small, tooth-like spines or serrae (Fig. 7) 2
- 1' Epiproct lateral lobes, if present, not armed with tooth-like spines or serrae 6
- 2 Lateral epiproct lobes diverging strongly from central axis, or curved strongly laterad near tip (Figs. 4, 7) 3
- 2' Lateral epiproct lobes variable, but not strongly

- divergent or apically curved (Fig. 10) 5
- 3 Epiproct apex consists of a pair of slender processes set between prominent lateral lobes (Fig. 7) *divergens*
- 3' Mesoapical section of epiproct consists of a wide, complex process set between lateral lobes (Figs. 4, 19) 4
- 4 Mesoapical section of epiproct more-or-less cylindrical and projecting beyond lateral lobes (Fig. 19) *sapa*
- 4' Mesoapical section of epiproct somewhat fork-shaped and not reaching apex of lateral lobes (Fig. 4) *caoe*
- 5 Projecting mesal section of epiproct extending well beyond tips of lateral lobes (Fig. 21) *tamdao*
- 5' Mesal lobes of epiproct subequal to lateral lobes in length (Fig. 10) *giay*
- 6 Epiproct apex trifurcate, or with a projecting long slender process (Figs. 1, 24) 7
- 6' Epiproct apex notched (Fig. 16) or truncate 9
- 7 Mesal lobes of epiproct slender and much longer than broadly rounded lateral lobes (Fig. 13) 8
- 7' Mesal lobe of epiproct subequal in length and width to slender lateral lobes (Fig. 24) *viet*
- 8 Epiproct apex trifurcate; epiproct bearing several short, stout, ventral spines (Figs. 13, 15) *gressitti*
- 8' Epiproct apex with a long slender, apically notched lobe set between broad, rounded lateral lobes; epiproct without obvious ventral spines (Figs. 1, 3) *bifurcata*
- 9 Posterior margin of tergum 10 divided into a pair of upturned lobes; inner lobe of paraprocts with a small apical notch *hainana*
- 9' Posterior margin of tergum 10 without upturned lobes; inner lobe of paraprocts unnotched 10
- 10 Epiproct apex with mesal V-shaped notch (Fig. 16) *meiyi*
- 10' Epiproct apex truncate *handschini*

***Amphinemura bifurcata* sp. n.**
(Figs. 1-3)

Material examined. Holotype ♂ from Vietnam, Lao Cai, Sapa, large waterfall on road from Sapa to Lai Chau, 7 May 1995, ROM 956015, D. Currie, B. Hubley, J. Swann (ROM). Paratypes: Vietnam: Lao Cai, Sapa, Fan Si Pan Mountains, 25-30 March 1995,

W. Mey, 1♂ (ZMB). Lao Cai, Sapa, Okui-Ho, 1100 m, 24-25 March 1995, W. Mey, 2♂ (ZMB).

Adult habitus. General color pale brown. Head brown, without distinctive pattern. Pronotum with brown rugosities on pale disk. Wings transparent, veins pale amber. Legs pale brown.

Male. Forewing length 5.5-7 mm. Epiproct narrow at base and enlarged at midlength to form an apically bifid bulbous process; protruding from notch is an apically divided, slender fork-like process (the apparent extension of the ventral sclerite) which extends beyond the anterior margin of tergum 10 (Fig. 1); lateral aspect of bulbous portion of epiproct apex without obvious spine row (Fig. 3), but fine spicules occur along midventral margin of projecting mesal processes. Tergum 10 bears a sparse field of fine spinules beneath epiproct tip. Sclerite of tergum 9 strongly narrowed on midline and bearing a few long setae and patches of fine spinules. Paraproct inner lobe a short triangular sclerite (Fig. 2), outer lobe an inconspicuous slender sclerite closely appressed to mesal lobe; mesal lobe broad at apex in caudal aspect, and subdivided into two small lobes, each bearing one or two strong bristles (Fig. 2); in dorsal aspect, the apical section of paraproct mesal lobe bears a pair of apical bristles and a basal sclerotized thumb-like projection. Vesicle very slender.

Female. Unknown.

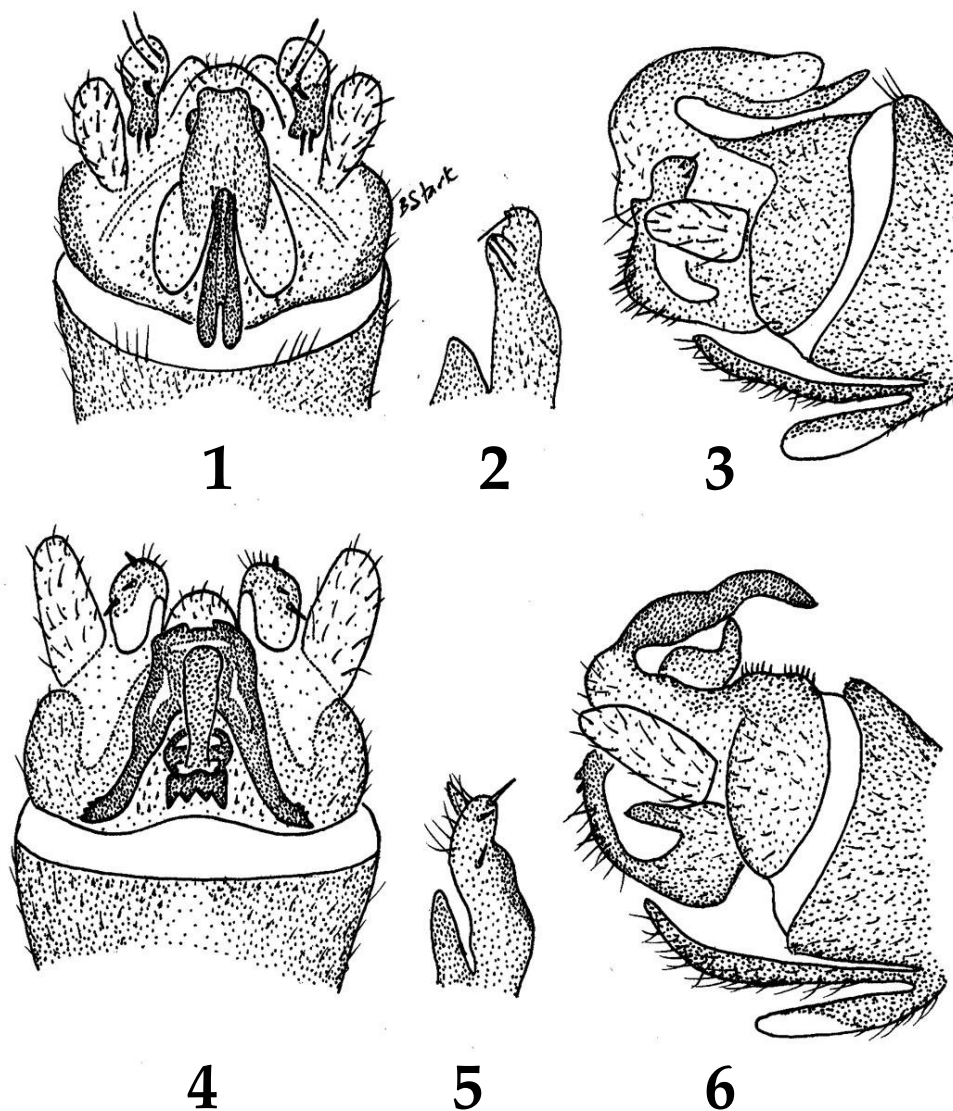
Larva. Unknown.

Etymology. The species name refers to the forked epiproct apex.

Diagnosis. The epiproct of this species is generally similar to that of *A. gressitti* which Kawai (1969) described from a Dalat, Vietnam specimen. In our specimen of *A. gressitti* from Thua Thien-Hue Province, the projecting apical process appears as a single, upwardly curved hook-like structure, although Kawai (1969) shows it as a pair of closely appressed processes. In addition the lateral aspect of the bulbous portion of the epiproct of *A. gressitti* bears a short row of fine spines. The paraprocts of *A. bifurcata* and *A. gressitti* also differ (compare Figs. 2 and 14).

***Amphinemura caoe* sp. n.**
(Figs. 4-6)

Material examined. Holotype ♂ from Vietnam, Lao



Figs. 1-6. *Amphinemura bifurcata* (1-3) and *A. caoae* (4-6). 1. Male terminalia, dorsal. 2. Paraproct, caudal aspect. 3. Male terminalia, lateral. 4. Male terminalia, dorsal. 5. Paraproct, caudal aspect. 6. Male terminalia, lateral.

Cai, Muong Hoa Ho River, 5-12 May 1995, ROM 956007, D. Currie, B. Hubley, J. Swann (ROM). Paratypes: Vietnam: Lao Cai, 12 km along road from Sapa to Lai Chau, 22° 20' 58" N, 103° 46' 15" E, 1-12 May 1999, 1950 m, ROM 992012, B. Hubley, 1♂ (ROM). Lao Cai, Sapa, Okui-Ho, 1100 m, 24-25 March 1995, W. Mey, 1♂ (ZMB). Same location, 25-30 March 1995, W. Mey, 1♂ (ZMB). Lao Cai, Sapa, Fan Si Pang Mountains, 25-30 March 1995, W. Mey, 3♂ (ZMB).

Adult habitus. General color pale brown. Head brown without distinctive pattern. Pronotum pale along midline and darker over most of disk. Wings transparent, veins pale brown. Legs pale.

Male. Forewing length 6-7 mm. Complexly lobed epiproct strongly sclerotized with two large lateral spines, each with small serrae on outer subapical margin (Fig. 4); floor of tergum 10 beneath epiproct bearing a toothed sclerite which a mesal, ventrally

directed strut supports. Dorsoapical aspect of paraproct mesal lobe partially sclerotized and bearing three short, stout spines; inner lobe of paraproct consists of a small triangular sclerite (Fig. 5), outer lobe a slender, inconspicuous sclerite appressed to mesal lobe. Lateral aspect of tergum 10 with a pair of low mounds, each armed with stout spines (Fig. 6). Tergum 9 sclerite completely divided by mesal membrane; inner margins of divided sclerite bearing a low spinulose mound.

Female. Unknown.

Larva. Unknown.

Etymology. The species name honors Cao Thi Kim Thu in recognition of her contributions to the knowledge of Vietnamese Plecoptera.

Diagnosis. The epiproct of this species is generally similar to that of *A. leigong* Wang & Du in sharing the presence of a pair of strongly sclerotized, slender, spine-like lateral sclerites. That species also has a strong, anteriorly directed mesal sclerite with a subapical spine tuft which is absent in *A. caoae*. In addition a distinctive sclerite and a pair of spiny knobs are located on the surface of tergum 10 in *A. caoae* but not in *A. leigong* (Wang et al. 2006). Details of paraproct shape and armature also differ for the two species. The epiproct of this species is also similar to those of *A. divergens*, *A. giay* and *A. viet* (all described below) and several Chinese species identified in the diagnosis for *A. divergens*, but the specific details of the epiproct and paraprocts differ significantly among these species. *Amphinemura caoae* is the only one of these species in which there is a wide, toothed structure lying between the divergent and apically toothed lateral arms of the epiproct. In other species the mesal toothed structure is about as wide as the lateral arms and in some other species the mesal structure, or the lateral arms are without teeth.

Amphinemura divergens sp. n.
(Figs. 7-9)

Material examined. Holotype ♂ and 1♂ paratype from Vietnam, Lao Cai, Sapa, Fan Si Pan Mountains, 25-30 March 1995, W. Mey (ZMB).

Adult habitus. General color dark brown. Head and pronotum dark, antennae and legs uniformly dark brown.

Male. Forewing length 6-7.5 mm. Epiproct bearing a

pair of apically serrate, lateral arms which diverge from the body axis and curve ventrolaterad near the tip (Figs. 7, 9); ventral sclerite armed along much of length with serrae and tip divided into a pair of slender processes nested between longer lateral lobes. Paraprocts armed with 4-6 prominent apical spines on mesal lobe, other lobes unarmed (Fig. 8). Tergum 10 bearing a pair of small patches of thick, midlateral, spine-like setae; tergum 9 strongly constricted mesally by a U-shaped posterior notch; margins of notch bearing patches of short, peg-like sensilla.

Female. Unknown.

Larva. Unknown.

Etymology. The species name refers to the divergent tips of the lateral lobes of the epiproct.

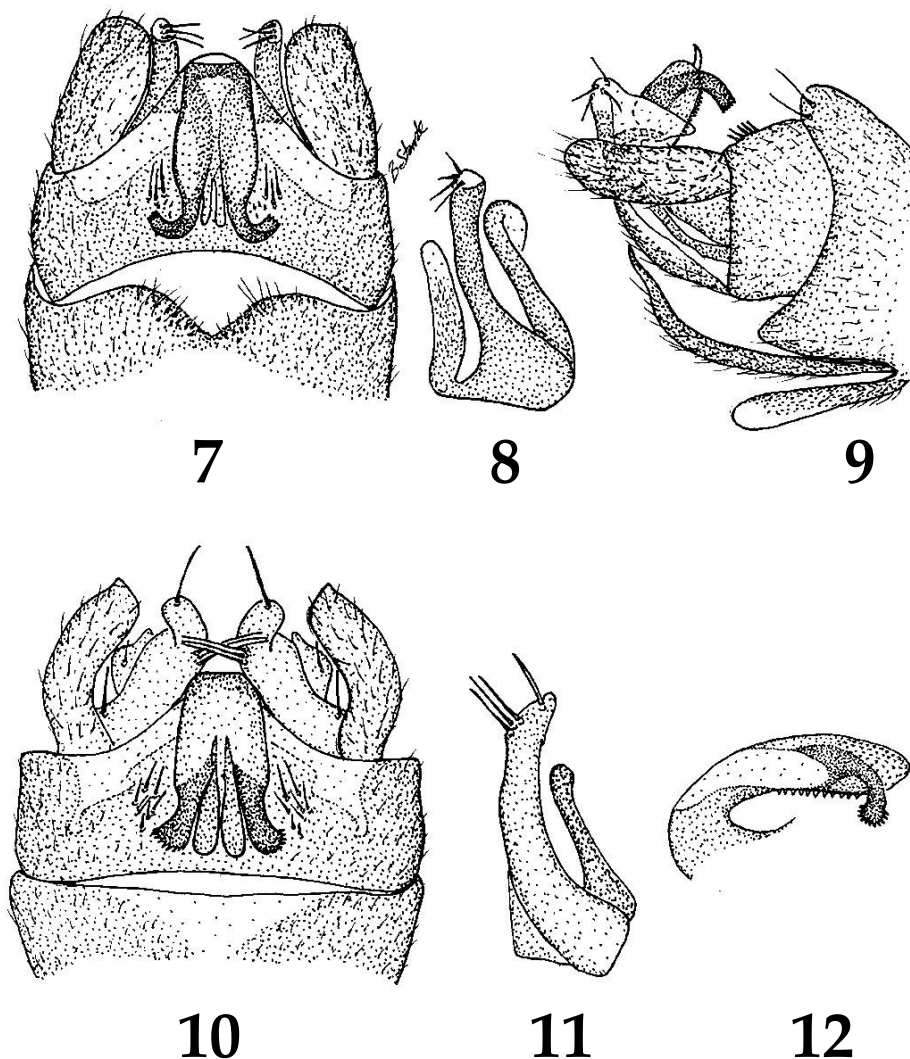
Diagnosis. The epiproct of this species is generally similar to that of *A. caoae*, *A. hamiorinata* Li & Yang, *A. leigong*, *A. nigriritubulata* Li & Yang, *A. viet* and related species in bearing strongly sclerotized lateral processes which diverge somewhat from the body axis (Li & Yang 2008b, 2008e; Wang et al. 2006). In this species the projecting lobes which lie between the lateral arms are divided and unarmed and the lateral aspect of the epiproct reveals a series of small teeth along most of the length of the ventral sclerite.

Amphinemura giay sp. n.
(Figs. 10-12)

Material examined. Holotype ♂ from Vietnam, Lao Cai, Sapa, Fan Si Pan Mountains, 25-30 March 1995, W. Mey (ZMB).

Adult habitus. General color brown to dark brown. Head dark brown, palpi pale, antennae uniformly brown. Pronotum uniformly brown with obscure rugosities. Legs uniformly brown.

Male. Forewing length 7.5 mm. Epiproct bearing a pair of apically serrate, slightly divergent lateral arms, and a median, subequal pair of lobes which lie between lateral arms (Fig. 10); lateral arms curved strongly ventrad near apex; in lateral aspect, a row of tooth-like spines line the ventral sclerite of the epiproct (Fig. 12). Mesal paraproct lobe bearing a small cluster of long thick setae at the apex and another cluster visible in dorsal aspect subapically (Figs. 10-11). Tergum 10 armed with small clusters of long setae on either side of epiproct; tergum 9 without distinctive setal groups.



Figs. 7-12. *Amphinemura divergens* (7-9) and *A. giay* (10-12). 7, Male terminalia, dorsal. 8. Paraproct, caudal aspect. 9. Male terminalia, lateral. 10. Male terminalia, dorsal. 11. Paraproct, caudal aspect. 12. Epiproct, lateral.

Female. Unknown.

Larva. Unknown.

Etymology. The species name, used as a noun in apposition, honors the Giay people of the mountains of northern Vietnam.

Diagnosis. *Amphinemura giay* is similar in epiproct structure to *A. divergens* and related species but it differs from these in having the median and lateral arms of the epiproct subequal in length in dorsal aspect.

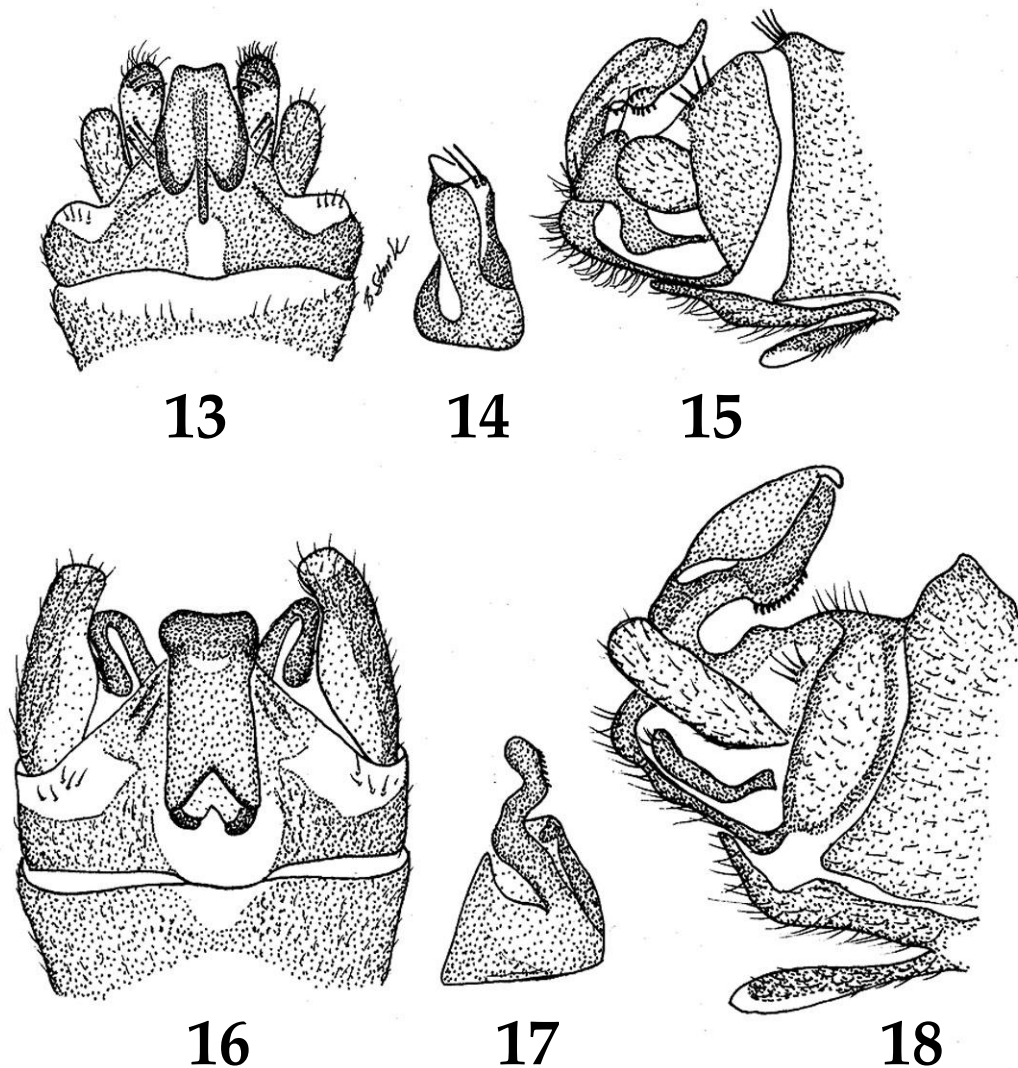
***Amphinemura gressitti* Kawai**
(Figs. 13-15)

Amphinemura gressitti Kawai, 1969:618. Holotype ♂ (Bernice P. Bishop Museum), Dalat, Vietnam

Material examined. Vietnam: Thua Thien-Hue, Bach Ma National Park, Rhododendron trail at junction with summit road, 1200 m, 16° 11' 10" N, 107° 50' 55" E, 12 June 2000, ROM 2000522, B. Hubley, 1 ♂ (ROM).

Remarks. This species was previously known from the holotype male and although there are differences in the genitalia of our specimen and the figures provided by Kawai (1969) they are in essential agreement in head and pronotal pigment pattern, dorsal and lateral epiproct shape and in having at least one very long, dark seta near the paraproct

apex. Kawai shows a pair of fine, parallel processes projecting from the base of the median process of the epiproct, but in our specimen this process appears to be single. The holotype will need to be examined in order to resolve the status of our specimen. We present Figs. 13-15 to help in recognition of this species.



Figs. 13-18. *Amphinemura gressitti* (13-15) and *A. meyi* (16-18). 13. Male terminalia, dorsal. 14. Paraproct, caudal aspect. 15. Male terminalia, lateral. 16. Male terminalia, dorsal. 17. Paraproct, caudal aspect. 18. Male terminalia, lateral.

***Amphinemura hainana* Li & Yang**

Nantianchi, Jianfengling, Ledong, Hainan, China

Amphinemura hainana Li & Yang, 2008c:65. Holotype ♂ (Entomological Museum of China Agricultural University),

Material examined. Vietnam: Tuyen Quang, tributary Gam River, 7 km NE Pac Ban, 24 May 1996,

ROM 963093, D. Currie, D. Darling, 1♂, 1♀ (ROM).

Remarks. This species is one of the most widely distributed Asian members of the genus with populations now reported from Inner Mongolia to Hainan (Li & Yang 2008c) and northern Vietnam. Males are easily recognized by virtue of the notched inner paraproct lobes and especially by the posterior margin of tergum 10 being divided into a pair of upturned, falcate processes. The female has a distinctive, triangular but deeply divided subgenital plate (Li & Yang 2008c).

Amphinemura meyi sp. n.
(Figs. 16-18)

Material examined. Holotype ♂ from Vietnam, Lao Cai, ca. 12 km along road from Sapa to Lai Chau, 1950 m, 22° 20' 58.3" N, 103° 46' 15.7" E, ROM 992002, Malaise trap, 1-12 May 1999, B. Hubley (ROM). Paratypes: Vietnam: Lao Cai, Sapa, Okui-Ho, 1100 m, 24-25 March 1995, W. Mey, 9♂ (ZMB).

Adult habitus. General color brown. Head brown without distinctive pattern; 2nd antennal segment darker than basal segment, flagellum dark brown. Pronotum pale brown with darker rugosities on central disk. Wings brown, veins dark brown. Femora brown, becoming darker on dorsum and near apex; tibiae dark brown.

Male. Forewing length 8.5 mm. Epiproct broad in dorsal aspect with parallel lateral margins; apex with shallow V-shaped notch from which a short, downturned process projects (Fig. 16). Lateral aspect of epiproct bulbous ventrally (Fig. 18) and ventral sclerite bearing a row of prominent median spines. Tergum 10 with a pair of low humps under epiproct and with a large arcuate membranous area near anteromedian margin. Cerci somewhat inflated basally in dorsal aspect. Mesal paraproct lobe slender, elongate and recurved over tip of abdomen; caudal aspect with an outer marginal row of tiny subapical serrae; inner lobe a short triangular sclerite; outer lobe a short club shaped structure in lateral aspect (Fig. 17). Vesicle long and slender.

Female. Unknown

Larva. Unknown.

Etymology. The patronym honors W. Mey for his generosity in providing specimens for this and other studies of Asian stoneflies.

Diagnosis. The general shape of the epiproct of this

species bears some similarity with that of *A. cordiformis* Li & Yang, particularly in lateral aspect where both are abruptly swollen near midlength, and both bear prominent spines along the swollen sclerite. However, *A. meyi* lacks the "...heart-shaped projection on the dorsal sclerite..." mentioned by Li & Yang (2006).

Amphinemura sapa sp. n.
(Figs. 19-20)

Material examined. Holotype ♂ from Vietnam, Lao Cai, Sapa, Okui-Ho, 1100 m, 24-25 March 1995, W. Mey (ZMB).

Adult habitus. General color brown without distinctive pattern.

Male. Forewing length 6 mm. Epiproct with a prominent dorsal hump in lateral aspect (Fig. 20), and bearing a divergent pair of apically spinous, basolateral lobes; lateral lobes relatively broad and somewhat fleshy in appearance, dorsoapical aspect of median lobe broad, terminating in an open, more or less funnel shaped process (Fig. 19); ventral sclerite of epiproct with a row of ca. 6 short, stout spines. Mesal lobe of paraprocts somewhat swollen in apical half and bearing a single long, slender setae near apex; outer lobe with a cluster of thick setae on dorsal surface. Tergum 10 with a median row of small spines under epiproct; tergum 9 bearing a posterior cluster of long setae.

Female. Unknown.

Larva. Unknown.

Etymology. The species name, used as a noun in apposition, refers to the type locality.

Diagnosis. *Amphinemura sapa* does not appear to be closely related to any of the recently described regional species but it is similar to an undescribed form known from Thailand (Sivec unpublished).

Amphinemura tamdao sp. n.
(Figs. 21-23)

Material examined. Holotype ♂ from Vietnam, Vinh Phu, Tam Dao, 1000 m, 10-16 November 1990, Narčuk (PMSL).

Adult habitus. General color brown, head dark brown, palpi and legs pale. Pronotum uniformly brown with obscure rugosities.

Male. Forewing length 6.5 mm. Epiproct bearing a

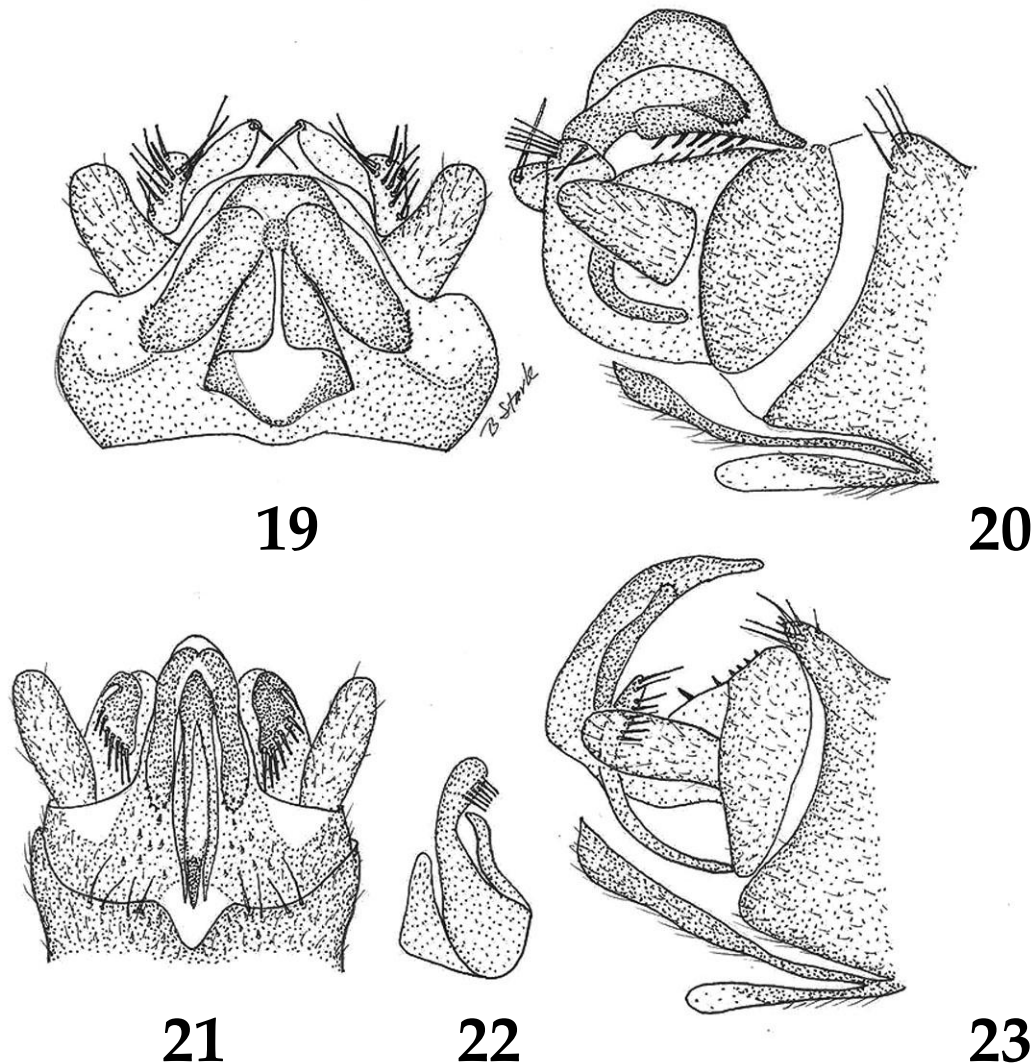
long, slender, apically acute and trifurcate median lobe and a pair of short, apically spinous lateral lobes which reach slightly beyond midlength of the median lobe (Fig. 21); lateral aspect of epiproct without visible spines on ventral sclerite (Fig. 23). Mesal paraproct lobe with an apical, more or less linear cluster of stout spines (Fig. 22). Tergum 10 with a few scattered, short sensilla and tergum 9 with a small cluster of sensilla and long setae along posterior margin.

Female. Unknown.

Larva. Unknown.

Etymology. The species name, used as a noun in apposition, is based on the type locality.

Diagnosis. The epiproct of *Amphinemura tamdao* does not appear to be similar to other regional species. The combination of a long, apically pointed mesal lobe and a pair of short, apically armed lateral lobes of the epiproct is apparently unique to this species.



Figs. 19-23. *Amphinemura sapa* (19-20) and *A. tamdao* (21-23) 19. Male terminalia, dorsal. 20. Male terminalia, lateral. 21. Male terminalia, dorsal. 22. Paraproct, caudal aspect. 23. Male terminalia, lateral.

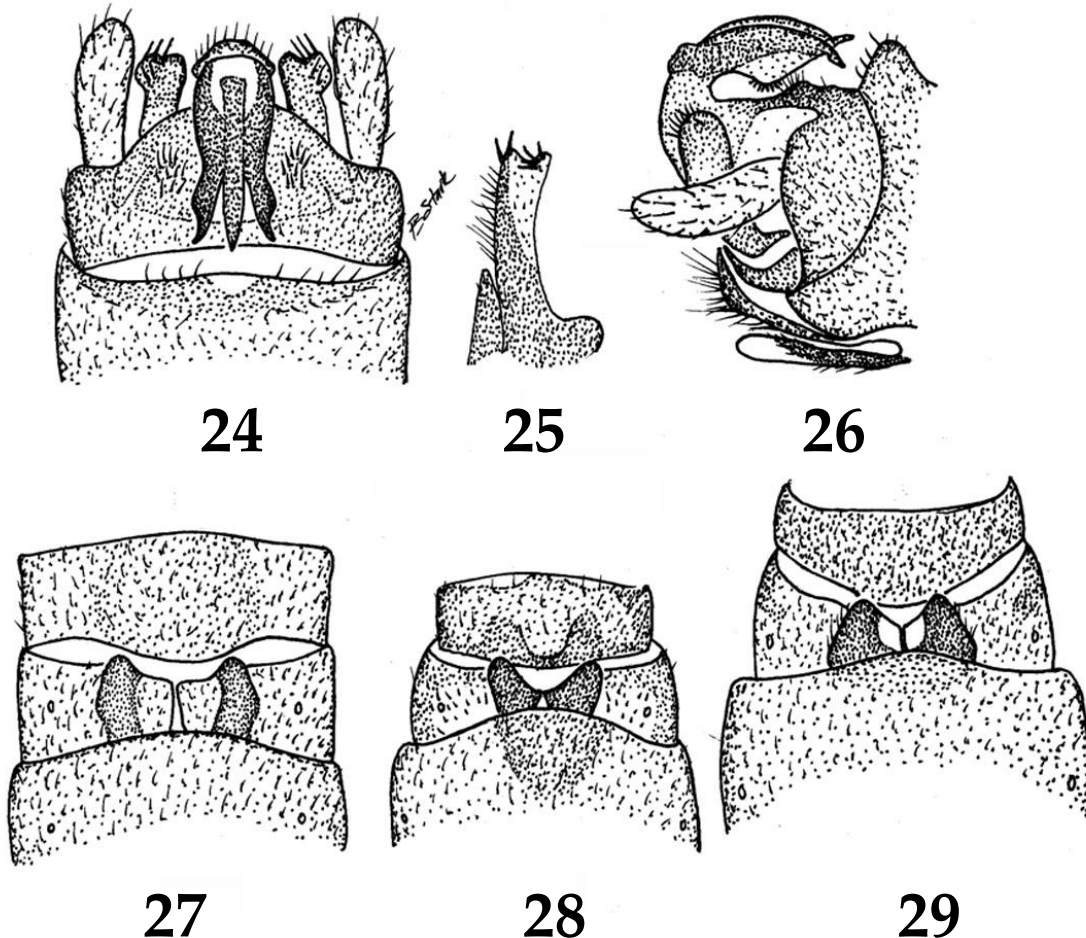
Amphinemura viet sp. n.
(Figs. 24-27)

Material examined. Holotype ♂, 2♂ and 1♀ paratypes from Vietnam, Vinh Phu, Tam Dao Hill Station, lower waterfall of stream flowing through town, 11 May 1996, ROM 961030, B. Humble, D.C. Darling (ROM). Additional Paratypes: Vietnam: Lao Cai, Sapa, Fan Si Pan Mountains, 25-30 March 1995, W. Mey, 3♂, 4♀ (ZMB). Vinh Phu, Tam Dao, 600-900 m, 17-31 May 1995, A.V. Gorohov, 1♂, 1♀ (PMSL). Vinh Phu, Tam Dao, 900 m, 50 km N Hanoi, 23 March 1995, W. Mey, 5♂, 9♀ (ZMB).

Adult habitus. General color pale brown. Head brown without distinctive pattern. Pronotum pale

along median suture and with darker rugosities on central disk. Wings pale with pale amber veins. Legs pale brown.

Male. Forewing length 5.5 mm. Epiproct with three elongate, subequal, slender processes (Fig. 24); lateral processes sinuate and slightly swollen subapically and pointed at the apex; median projection relatively straight and gradually tapered to apex. Epiproct inflated at midlength in lateral aspect, with tips of lateral processes bent ventrad (Fig. 26). Mesal paraproct lobe slightly club-shaped in lateral aspect and armed with several apical spines (Fig. 25); apex emarginate in caudal aspect. Posterior margin of tergum 9 with a prominent hump in lateral aspect; vesicle long and slender.



Figs. 24-29. *Amphinemura viet* (24-27) and *Amphinemura* spp. (28-29) 24. Male terminalia, dorsal. 25. Paraproct, caudal aspect 26. Male terminalia, lateral. 27. Female terminalia, ventral. 28. *Amphinemura* Vn-A, female terminalia, ventral. 29. *Amphinemura* Vn-B, female terminalia, ventral.

Female. Forewing length 6.5 mm. Sclerotized lobes of subgenital plate broadly separated by pale, lightly sclerotized areas on midline (Fig. 27). Subgenital plate base covered by hind margin of sternum 7; mesal area of sternum 9 swollen but posterior margin straight.

Larva. Unknown.

Etymology. The species name honors the indigenous Viet people, and is used as a noun in apposition.

Diagnosis. The epiproct of this species appears generally similar to the deeply divided, trilobed structures of *A. fleurdelia* (Wu), *A. nanlingensis* Yang, Li & Sivec and *A. elongata* Li, Yang & Sivec (Li et al. 2005; Li & Yang 2007; Yang et al. 2005) but this species differs from all these in having the lateral processes of the epiproct subapically swollen.

Amphinemura Vn A
(Fig. 28)

Material examined. Vietnam: Lao Cai, ca. 12 km along road from Sapa to Lai Chau, 1950 m, 22° 20' 58" N, 103° 46' 15" E, 1-12 May 1999, ROM 992012, B. Hubley, 3♀ (ROM).

Adult habitus. General color brown. Head brown with pale transverse line behind ocelli. Pronotum dark except along lateral margins. Wings brown, veins dark brown. Legs brown.

Female. Forewing length 7.5-8.0 mm. Subgenital plate lobes divergent (Fig. 28). Sternum 9 with a large anteromesal hump. Sternum 7 projects over base of subgenital plate.

Remarks The distinctive pronotal color pattern of these specimens has not been found among Vietnamese male specimens. The strongly divergent subgenital plate lobes distinguishes this species from other Vietnamese females.

Amphinemura Vn B
(Fig. 29)

Material examined. Vietnam: Lao Cai, ca. 12 km along road from Sapa to Lai Chau, 1950 m, 22° 20' 58" N, 103° 46' 15" E, 1-12 May 1999, ROM 992012, B. Hubley, 2♀ (ROM).

Adult habitus. General color brown. Head brown with dark areas at base of antennae. Pronotum pale brown over most of disk, paler along median suture. Wings pale brown, veins dark brown. Femora brown,

tibiae dark proximally at knee and pale elsewhere.

Female. Forewing length 7.5 mm. Subgenital plate lobes meet near midline; posterior margins form a broadly U-shaped notch; inner basal margins poorly sclerotized (Fig. 29). Sternum 9 entirely sclerotized; anteromedian margin slightly projecting. Median area of sternum 7 projects over base of subgenital plate.

Remarks. No males with dark spots near the antennal bases were found among our samples. The pale area on the inner basal margin of the subgenital plate lobe appears to be distinctive, at least for the Vietnamese species we have seen.

ACKNOWLEDGMENTS

We thank B. Hubley, W. Mey, A.V. Gorohov and H. Malicky for the loan of specimens used in this study, and we also thank Weihai Li of China Agricultural University for help in obtaining literature.

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