

**TRANSFER OF THE TAIWANESE *PSEUDOPYROCHROA*
UMENOI AND THE JAPANESE *P. AMAMIANA* TO
PSEUDODENDROIDES (COLEOPTERA: PYROCHROIDAE:
PYROCHROINAE)**

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Abstract.—On the basis of salient characters, particularly those associated with the head, eighth abdominal sternite and genitalia of the male, both *Pseudopyrochroa umenoi* Kôno of Taiwan, and *Pseudopyrochroa amamiana* Nakane of Amami-Oshima Island, Japan are transferred from *Pseudopyrochroa* to *Pseudodendroides* where they are hypothesized to represent species closely related to the Japanese *Pseudodendroides niponensis* (Lewis).

Key Words.—Insecta, Coleoptera, Pyrochroidae, *Pseudopyrochroa*, *Pseudodendroides*, generic transfers, phylogeny, confocal microscopy, Japan, Taiwan.

In an effort to redefine *Pseudopyrochroa* Pic (1906) as a monophyletic taxon, part of a larger project on the taxonomy of the genus, several taxonomic changes have become necessary. The body of this paper proposes two changes involving *Pseudopyrochroa* and another pyrochroine genus, *Pseudodendroides* Blair (1914).

Pseudopyrochroa was proposed as a subgenus of *Pyrochroa* Geoffroy for several Southeast Asian pyrochroids previously assigned to the European *Pyrochroa*. *Pseudopyrochroa* was said to differ by having a smaller head, compound eyes, and reduced genae. But even Pic applied the name inconsistently, and the generic use of *Pseudopyrochroa* did not begin to stabilize until Pic (1913) briefly elaborated on his misplacement of several *Pseudopyrochroa* species that he had originally attributed to the circumboreal genus *Schizotus* Newman.

Although the largest genus in the family with approximately 70 species names attributed to it, *Pseudopyrochroa* is among the least known of all pyrochroine genera from both taxonomic and ecological perspectives. Species richness is greatest along the Pacific coast of the Asian continental plate and forested inland montane regions. The only previous attempt to synthesize information on *Pseudopyrochroa* came in the form of Blair's (1914) provisional comments and key. This effort was, according to Blair (1914:318), "intended merely as a temporary measure, in the hope of stimulating further study of the genus. . . ."

Pseudodendroides was proposed for two Indian and two Japanese species previously assigned to *Dendroides* Latreille. Two additional species were added by Pic from China (1938) and the Himalayan regions of Sikkim and Tibet (1955). At the time of its description, *Pseudodendroides* was said by Blair (1914: 314) to differ from *Pseudopyrochroa*, "by the large eyes, approximate above in the male." This is certainly the case in males of the Japanese *P. niponensis* (Lewis), the type species of *Pseudodendroides*. However, this derived character state appears to be homoplasious, having arisen independently several times in both pyrochroine and pediline pyrochroids (Young, unpublished observations), and *Pseudodendroides* as characterized by Blair is, at best, paraphyletic.

Depositories, Procedures, and Abbreviations.—Taxonomic material for this

study came from my personal collection (DYCC), and material borrowed from the collection of Darren Pollock, Winnipeg (DAPC), the Florida State Collection of Arthropods, Gainesville (FSCA), the Naturhistorisches Museum Wien, Wien (NHMV), the Muséum National d'Histoire Naturelle, Paris (PMNH), the Taiwan Agricultural Research Institute (TARI), and the Museum für Naturkunde der Humboldt-Universität, Berlin (ZMHB). The holotype male of *Pseudopyrochroa umenoi* Kôno was also borrowed from the Hokkaido University, Sapporo, Japan (HUSC), as was the holotype female of *Pseudodendroides uraiana* Kôno. Type and other pyrochroid material in The Natural History Museum, London (BMNH) was studied on site.

MATERIALS AND METHODS

As I discuss below, the presence, number and configuration of cranial pits (Young 1975) in several genera of male pyrochroines offer important characters for hypothesizing relationships among genera. Unfortunately, these three-dimensionally complex structures are virtually impossible to draw and for many species, only the type or small type series is known.

Using scanning electron microscopy (SEM) and photomicrography to capture and illustrate features of insect gross anatomy and exoskeletal ultrastructure has become a well established research tool. However, SEM techniques have several unfortunate drawbacks, usually including the necessity of coating the specimen with a thin layer of a heavy metal to prevent electron charging, exposure of the specimen to a high vacuum environment, and the possible need to trim or dissect the specimen to fit the sample holder.

As SEM proved unfeasible for this and related studies, I investigated techniques of laser-scanning confocal microscopy. Standard confocal techniques such as a 3D z-series reconstruction or projection were unsatisfactory because exoskeletal opacity inhibited laser penetration and the full vertical range of the cranial complex could not be imaged. Finally, in a nod to well known SEM "stereo-pair" techniques, images of exoskeletal autofluorescence were collected from a straight vertical view and a tilted view.

A low-magnification lens for the confocal microscope ($3.5\times$) was selected. Its wide field of view permitted imaging of the entire dorsoanterior region of the head, including all of the cranial apparatus, without resorting to making montages of micrographs. The large depth of field (optical section thickness) of the lens allowed the protrusions and concavities to be imaged in a single image frame. Finally, the large working distance of the lens made it possible to image intact beetles, without resorting to perturbation of any kind. Not only could the specimens remain on their pins, point, or card mounts, but it was not even necessary to remove any of the specimen labels.

The 488 nm line of the Kr/Ar laser was utilized to excite the autofluorescence of the exoskeletal material. The standard fluorescein imaging cube was used for detection of the emitted signal.

Preparation of the specimen for imaging was quickly accomplished by inserting the mounting pin into a $7.6 \times 7.6 \times 1.9$ cm ($3'' \times 3'' \times 3/4''$) foam block. This entire assembly was able to be placed under the microscope's objective lens for imaging. After a straight vertical, "head-on" image was taken, fiducial marks were made on the microscope's imaging screen using a felt-tipped marker. Three

standard microscope slides were then placed under one corner of the foam block, thereby effectively tilting the block (and specimen) by approximately 5–7°.

After re-aligning the “live” image with the fiducial marks on the screen, a second image was obtained. When printed side-by-side, these two images form a stereo pair (Figs. 7 and 8). It should be noted that to create the stereo effect, it is generally necessary to view the figures with a stereo viewer.

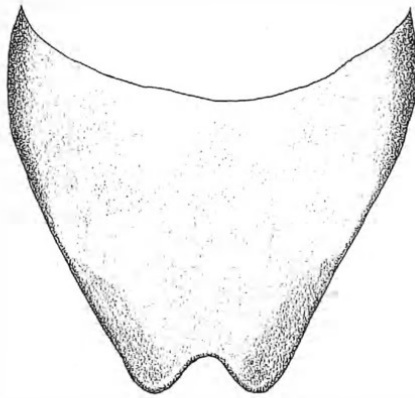
DISCUSSION

The presence of complex, cranial pits in adult males is an important synapomorphy establishing the monophyly of several pyrochroine genera. Pyrochroine genera exhibiting cranial pits, have them located behind the eyes, as in males of *Schizotus*, or between the eyes. In the latter case, the pit may consist of a single, shallow impression, as in the European *Pyrochroa* and Asian *Eupyrochroa* Blair, or pits may be well developed and paired; *Pseudodendroides*, *Phyllocladus* Blair, *Neopyrochroa* Blair and *Pseudopyrochroa*. Using this clade of seven genera for outgroup comparisons, the monophyly of *Pseudopyrochroa* species may be hypothesized by a synapomorphy associated with the external male genitalia. In *Pseudopyrochroa*, the dorsolateral apices of the parameres are bilaterally toothed, with each tooth projecting basally (Fig. 2). In the plesiomorphic character state, the apices of the parameres are rounded. Additionally, in *Pseudopyrochroa* the apex of the penis (Fig. 3) is provided with a dorsomesal, basally recurved hook (= apomorphic). In other pyrochroine genera (e.g., Fig. 6) the apex of the penis is generally rounded and lacking a hook (= plesiomorphic). A similar, apically hooked penis is present in males of *N. flabellata* (Fabricius), from the eastern United States and Canada. However, males of *N. femoralis* (LeConte) and *N. sierraensis* Young lack the modification and its autapomorphic presence in *N. flabellata* is hypothesized to be homoplasious with respect to *Pseudopyrochroa*.

Although exhibiting considerable interspecific variation, the cranial pits of male *Neopyrochroa*, *Phyllocladus* and *Pseudopyrochroa* are paired and typically well excavated. Those of *Pseudodendroides*, as illustrated by *P. niponensis* (Fig. 7) have an additional transverse ridge, making them nearly four-chambered (= apomorphic); very similar to those of both *P. umenoi* (Fig. 8) and *P. amamiana*.

In *Pseudodendroides* the parameres of the male genitalia are short and widely separated for approximately half their length (Fig. 5). This character represents a probable synapomorphy also exhibited by the Asian *Phyllocladus*, *Neopyrochroa*, a genus endemic to North America with two eastern and two western species, and an undescribed genus and species from the Darjeeling District of India. Males of *Pseudodendroides*, *Phyllocladus*, and the undescribed genus and species from Darjeeling also share an apomorphy associated with the eighth sternite: the apical margin is widely emarginate and conspicuously concave (Fig. 4). In males of other pyrochroine genera, including *Pseudopyrochroa*, the eighth sternite (Fig. 1) is tapered distally and narrowly emarginate mesally (= plesiomorphic).

Although there has never been a comprehensive assessment of pyrochroine antennae, the gross anatomy is rich in characters; this is particularly true in the case of males (Young, unpublished observations). In males of *Pseudodendroides*, the scape is long and parallel-sided (= apomorphic); this condition is not seen in *Pseudopyrochroa* or any other pyrochroine genera. Males of both *P. umenoi* and *P. amamiana* have an elongate, parallel-sided antennal scape.



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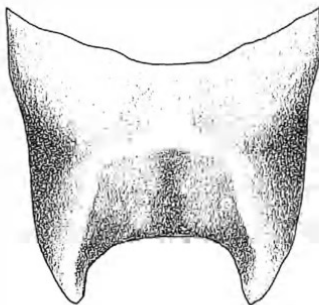
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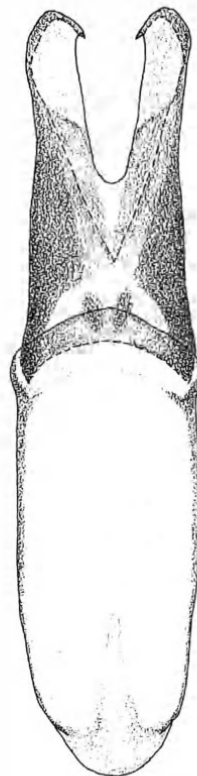
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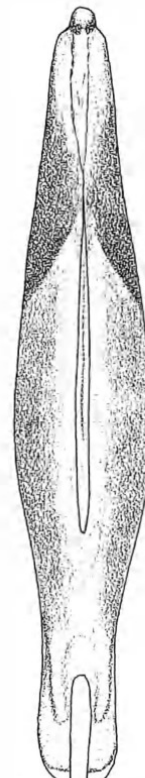
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Employing these criteria, the Taiwanese *Pseudopyrochroa umenoi* Kôno and the Japanese *P. amamiana* Nakane must be transferred to *Pseudodendroides*:

Pseudodendroides umenoi (Kôno), 1936, NEW COMBINATION

Pseudodendroides amamiana (Nakane), 1988, NEW COMBINATION

Pseudodendroides umenoi was originally described under the generic name *Pseudopyrochroa* on the basis of both males and females collected at Numanohira, Taiwan. In 1960, Nakane outlined and briefly discussed the Pyrochroidae of Japan, recording what he understood to be *P. umenoi* from Amami-Oshima Island. In that paper, Nakane also expressed some uncertainty regarding the relationships between *Pseudopyrochroa* and *Pseudodendroides*, noting that *P. umenoi* appeared to lack the retrorsely acuminate processes at the apex of the parameres characteristic of most *Pseudopyrochroa*. This topic was briefly revisited by Ohbayashi (1968). He illustrated the genitalia of *P. umenoi*, noting the "small teeth" at "the apex of male paramera of the species." However, in *P. umenoi* as in *P. niponensis* (Fig. 5), the "teeth" are formed from the excavate inner margins of the distal parameres. The tooth-like paramereal processes characteristic of most *Pseudopyrochroa*—as seen, for example, in *P. harmondi* (Pic) (Fig. 2)—are formed by the splaying and sclerotization of the outer and dorsal distal surfaces of the parameres, which are narrowly and shallowly separated distally.

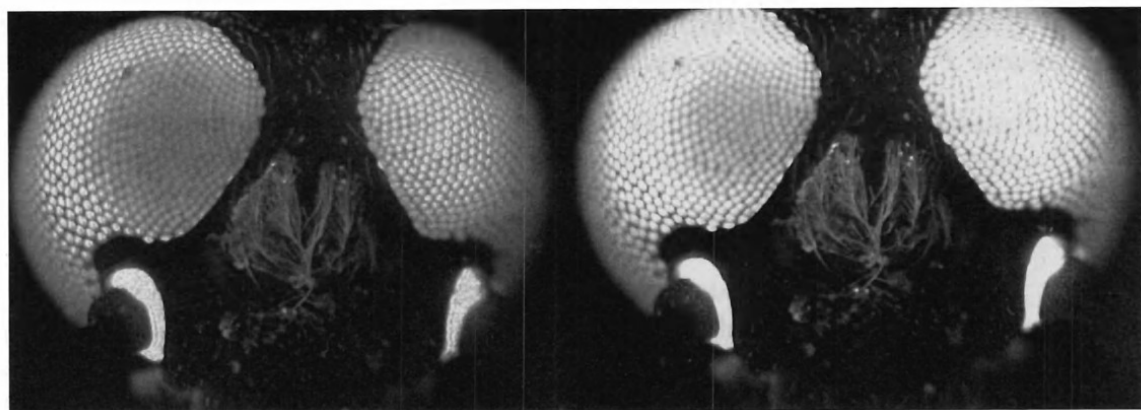
After years of reflecting on the material from Amami-Oshima Island, Nakane (1988) described *Pseudoedendroides amamiana*, under the generic name *Pseudopyrochroa*, stating that it differed consistently from *P. umenoi* in several characters associated with the head, including secondary sexual characteristics of the cranium, prothorax, and male genitalia. No further comments relative to generic relationships were made.

On the basis of the characters discussed above, it is clear that both *Pseudopyrochroa umenoi* Kôno and *Pseudopyrochroa amamiana* Nakane are incorrectly placed in *Pseudopyrochroa*. The evidence suggests that both species belong to *Pseudodendroides*.

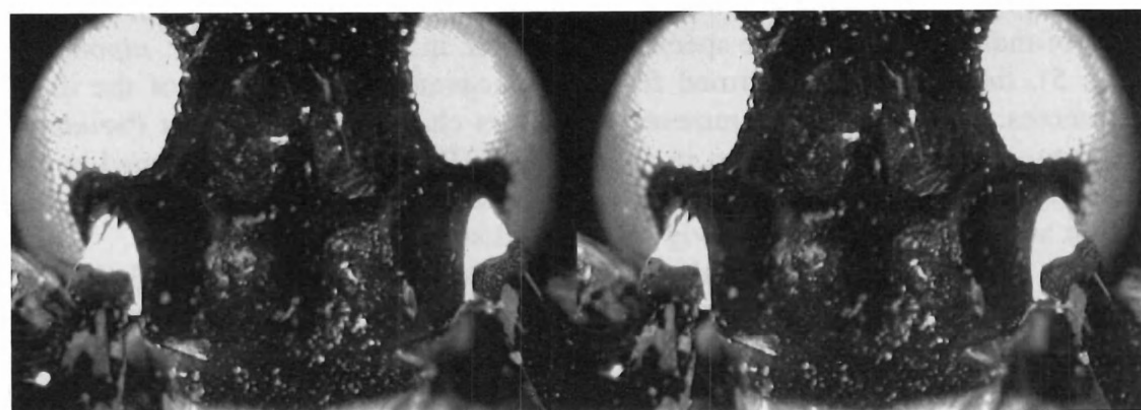
Material Examined.—*Pseudodendroides amamiana*: JAPAN. AMAMI OSHIMA: Hatsumo, 1 Apr 1968, ex Tamanuki, 1♂ (DYCC); 28 Mar 1964, Y. Miyake, 1♀ (DYCC). *Pseudodendroides nipponensis*: JAPAN. [country only] G. Lewis, 2♂♂, 1♀ (BMNH); Kiou-Siou (Kiushiu), Bassin Supérieur de la Sendaigawa, 1906, E. Gallois, 1♂, 4♀♀ (PMNH) KYUSHU: Higo, G. Lewis, 1♂ (BMNH); Higo, 1881, G. Lewis, 1♀ (BMNH); Higo, G. Lewis, 1♀ (BMNH); Kumamoto Pref., Momiki, Izumi v., 6 Jul 1991, T. Ueno, 1♂ (DAPC); HONSHU: Akita [underside of mounting card], Nikko, G. Lewis, 1♂ (BMNH); Akita, G. Lewis, 1♀ (BMNH); Nikko, 29–31 Oct 1880, G. Lewis, 1♀ (BMNH); Miyazoshita, G. Lewis, 1♀ (BMNH); Chiuzenji, 19–24 Aug 1881, G. Lewis, 1♀ (BMNH); Tokio, [G. Lewis material], 1♀ (BMNH); Nagano Pref., Tobira Spa, 31 Jul 1973, S. Hisamatsu, 1♂ (DYCC); Env. de Tokio et Alpes de Nikko, 1901, J. Harmond, 4♀♀ (PMNH); Env. de Tokio, 1906, J. Harmond, 2♀♀ (PMNH); Kofou, 1906, L. Drouard de Lezey, 1♀ (PMNH). *Pseudodendroides umenoi*: TAIWAN. NUMANOHIRA: 19 Jun 1932, Umeno & Taira, No. 21, *Pseudopyrochroa umenoi* Kôno, ♂ [Holo]Type (HUSC); NANTOU HSIEN: Meifeng, 2150 m, 20–22 Jun 1979, K. S. Lin & H. Chen,

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Figures 1–3. *Pseudopyrochroa harmondi* Pic, adult male. Figure 1: Abdominal sternite 8, ventral view. Figure 2: Tegmen (= basal piece + parameres), dorsal view. Figure 3: Penis, dorsal view. Figures 4–6. *Pseudodendroides nipponensis* (Lewis), adult male. Figure 4: Abdominal sternite 8, ventral view. Figure 5: Tegmen (= basal piece + parameres), dorsal view. Figure 6: Penis, dorsal view.



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Figures 7–8. Figure 7: *Pseudodendroides niponensis* (Lewis), adult male, cranium, including cranial pits, stereo-pair, dorsal view. Figure 8: *Pseudodendroides umenoi* (Kôno), adult male, cranium, including cranial pits, stereo-pair, dorsal view.

2♀♀ (TARI); 15 Jul 1982, S. C. Lin & C. N. Lin, 1♀ (TARI); Tsuifeng, 2300 m, 23–25 Jun 1983, K. S. Lin & S. C. Lin, 2♀♀ (TARI); *TAICHUNG HSIEN*: 8 Mar 1977, HOMEOTYPE: *Pseudopyrochroa umenoi* Kôno, Daniel K. Young, Elytra of type a bit lighter, 1♂ (DYCC); Jul 1977, 1♀ (DYCC); Anmashan, 2275 m, 6–9 Jul 1979, L. Y. Chou, 1♀ (TARI); *HSINCHU*: Kwangou, 2000 m, 24 Jun 1985, J. B. Heppner, 1♂ (FSCA). *Pseudodendroides uraiana*: TAIWAN. [Formosa], Urai [underside of label], 24 Apr 1925 [underside of label], T. Kano, *Pseudodendroides uraiana* Kôno, ♀ [Holo]Type, “description based on 1♀, this must be the HOLOTYPE, Daniel K. Young, 1992” (HUSC); *HOOZAN*: [Formosa], Sauter, 2♀♀ (DYCC); [Formosa], Sauter, 2♀♀ (NHMV); Apr 1910, H. Sauter S. G., Zool. Mus. Berlin, 2♂♂ (ZMHB); Apr 1910, H. Sauter S. G., Zool. Mus. Berlin, HOMEOTYPE: *Pseudodendroides uraiana* Kôno, Daniel K. Young, Type is slightly more teneral - lighter pn. etc., 1♀ (ZMHB); [Formosa, (Hoozan) Hosan], Mar 1910, Sauter S., Zool. Mus. Berlin, 1♂, 1♀ (ZMHB); *POLISHA*: [Formosa], Apr 1910, Sauter S., Zool. Mus. Berlin, 1♀ (ZMHB).

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