

Studies of Parydrinae (Diptera:
Ephydriidae), I: A Review of the
Genus *Brachydeutera* Loew from the
Oriental, Australian, and
Oceanian Regions

WAYNE N. MATHIS
and
KUMAR D. GHORPADÉ

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ABSTRACT

Mathis, Wayne N., and Kumar D. Ghorpadé. Studies of Parydrinae (Diptera: Ephydriidae), I: A Review of the Genus *Brachydeutera* Loew from the Oriental, Australian, and Oceanian Regions. *Smithsonian Contributions to Zoology*, number 406, 25 pages, 27 figures, 1985.—Seven species of the genus *Brachydeutera* Loew from the Oriental, Australian, and Oceanian regions are reviewed. A key to species, illustrations, and where appropriate, distribution maps are provided. One species, *B. ibari* Ninomiya, is recognized as the valid name for *B. argentata* of authors, not Walker, from the Old World. The identity of *B. pleuralis* Malloch, a species described from Australian specimens, is clarified. With its identification clearly established, *B. pauliani* Wirth (previously known from Madagascar and South Africa) becomes a junior synonym of *B. pleuralis*. *Brachydeutera pleuralis* is also found to occur in southern India. *Brachydeutera pleuralis* of authors, not Malloch, is named *B. adusta*, new species.

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Wayne N. Mathis
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Introduction

Twenty years ago Wirth (1964) revised the genus *Brachydeutera* Loew on a worldwide basis. Wirth's revision included 14 species, 8 of which were new. Since then additional data have accumulated and are presented here as a review of the genus from the Oriental, Australian, and Oceanian regions.

This study was prompted initially when we collected three species of *Brachydeutera* in southern India and Sri Lanka. No species were recorded previously from Sri Lanka, and only *B. longipes* Hendel was known from southern India. Attempting to identify these species has led to this review.

The history of the genus *Brachydeutera* is both brief and simple. Loew (1862) described the genus, with *B. dimidiata* Loew as the only included species, from specimens collected in Washington, D.C., by Baron Osten Sacken. Nearly a decade

earlier, however, Walker (1853) had described *Notiphila argentata* from specimens collected in the "United States" (the only location data on the label), and Becker (1896) correctly surmised that Walker's name was the senior synonym of *B. dimidiata*. Becker (1903) later discovered a species of *Brachydeutera* that he and subsequent authors interpreted as *B. argentata* (= *B. ibari* Ni-nomiya) in Egypt. Until then the genus was known only from the Western Hemisphere. Becker (1905, 1926) later reported *B. ibari* (as *B. argentata*) from the Canary Islands and Egypt, and that species has since been found to be widespread, ranging from Mediterranean Europe eastward to Japan and Hawaii. Records of *B. argentata* from localities other than North America are based on misidentifications (Mathis, 1983).

Except for brief generic diagnoses, mostly translations of Loew's original description or paraphrased extractions from it (Becker, 1896, 1926), no one treated *Brachydeutera* in a comprehensive manner until Wirth (1964) revised the genus. Wirth's revision more than doubled the number of species and included illustrations of

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the male terminalia, which are necessary to identify some species that are closely related to *B. argentata*. Throughout the present study, Wirth's revision has provided perspective, and we gratefully acknowledge it.

Subsequent work on the genus mostly comprised isolated descriptions of new species. These are summarized as follows: Hendel (1913) described *B. longipes* from specimens H. Sauter collected in Taiwan; Malloch described *B. sydneyensis* (1924) and *B. pleuralis* (1928) from specimens collected in Australia; Cresson (1926) described *B. hebes* from specimens collected in the Hawaiian Islands; and Ninomiya (1929) described *B. ibari* from specimens collected in Japan.

METHODS.—The methods and descriptive format used generally in this study were explained previously by Mathis (1982). The descriptive terminology, with the exception to be noted, follows that published in Volume 1 of the recent *Manual of Nearctic Diptera* (McAlpine, 1981). I have followed Sabrosky (1983) in using "microtomentum" rather than pruinescence or pollinosity for the dustlike vestiture over much of the cuticular surface. The dustlike appearance, however, is the result of cuticular microtrichia at various densities, not a waxy substance, as on a plum (pruinescence), or dust (pollinosity).

There are species treated in this paper with distributions that extend beyond the geographic scope of the monograph. In the pertinent "Distribution" sections data listed first are those pertinent to this study. These data are followed by a semicolon and then by an indication of the wider distribution of the species.

One scutellar and two venational ratios are used commonly in the descriptions and are defined here for the convenience of the user (all ratios are averages of three specimens).

1. Costal vein ratio is the straight line distance between the apices of R_{2+3} and R_{4+5} /distance between the apices of R_1 and R_{2+3} .

2. M vein ratio is the straight line distance along M basad of crossvein dm-cu/distance apicad of crossvein dm-cu.

3. The scutellar ratio is the scutellar length/scutellar width as measured between the two basal scutellar creases.

ACKNOWLEDGMENTS.—Numerous persons and institutions have cooperated to make this study possible. We express our appreciation for their consideration, especially to the curators and their respective institutions, for loaning specimens (an asterisk indicates collections from which type specimens were borrowed).

AM	Australian Museum, Sydney, Australia (Dr. David K. McAlpine)
ANIC	Australian National Insect Collection, Canberra, Australia (Dr. D.H. Colless)
ANSP	Academy of Natural Sciences of Philadelphia, Pennsylvania (Dr. S.S. Roback)
BBM*	Bernice P. Bishop Museum, Honolulu, Hawaii (Mr. Neal Evenhuis)
BM	British Museum (Natural History), London, England (Mr. Brian H. Cogan)
CAS	California Academy of Sciences, San Francisco, California (Dr. Paul H. Arnaud, Jr.)
CIH*	Commonwealth Institute of Health, University of Sydney, Australia (Dr. Margaret Debenham)
BERL	Museum für Naturkunde, Humboldt Universität, Berlin, DDR (Dr. H. Schumann)
HELS	Zoological Museum, University of Helsinki, Helsinki, Finland (Drs. B. Lindeberg and W. Hackman)
HNHM	Hungarian Natural History Museum, Budapest, Hungary (Dr. L. Papp)
KDG	Personal collection of Dr. Kumar D. Ghorpadé, Bangalore, India
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts (Dr. Norman E. Woodley)
MNHN*	Muséum National d'Histoire Naturelle, Paris, France (Mr. Loïc Matile)
NZAC	New Zealand Arthropod Collection, Entomology Division, DSIR, Auckland, New Zealand (Dr. B.A. Holloway)
UHH	University of Hawaii, Honolulu, Hawaii (Dr. D. Elmo Hardy)
USNM*	Former United States National Museum, collections in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.
WIEN*	Naturhistorisches Museum, Wien, Austria (Dr. Ruth Contreras-Lichtenberg)

Hollis B. Williams prepared the distribution

maps and organized the locality data. For reviewing a draft of this paper, we thank Norman E. Woodley and Oliver S. Flint, Jr. The illustrations were carefully prepared by Sally Parker and Young Sohn. We also thank S. Dillon Ripley, Secretary, Smithsonian Institution, for a Fluid Research Grant to conduct field work in India and Sri Lanka.

Genus *Brachydeutera* Loew

Brachydeutera Loew, 1862:162 [type-species: *Brachydeutera dimidiata* Loew (= *Notiphila argentata* Walker), by monotypy].—Malloch, 1924:334; 1928:353.—Williams, 1938:90.—Harrison, 1959:233.—Wirth, 1964:3–12 [revision].—Cogan and Wirth, 1977:337 [Oriental catalog].

DIAGNOSIS.—Small to large shore flies, length 1.45–5.35 mm.

Head: Frons much wider than long, microtomentose, appearing dull, mesofrons not distinguished from remainder of frons; laterocline fronto-orbital bristles 2–3; both inner and outer vertical bristles present; 1 pair of cruciate, interfrontal bristles inserted in front and laterad of anterior ocellus; ocelli arranged to form an isosceles triangle, distance between anterior ocellus and either posterior ocellus less than that between posterior ocelli; ocellar bristles well developed, proclinate and divergent; second antennal segment lacking dorsoapical, prominent bristle; arista conspicuously pectinate, bearing 6–12 dorsally branching rays, longer rays subequal to length of first flagellomere. Face generally bare except for 3–12 setulae laterally; face with prominent, vertical, median carina between antennae, extended from ptilinal suture to epistome; epistomal margin of face broadly emarginate medially, emargination shallowly rounded; clypeus conspicuous within epistomal emargination as a wide, transverse band. Eye bare, large, prominent, slightly oval vertically. Genal bristle lacking or much reduced.

Thorax: Chaetotaxy generally weakly developed; postpronotal, presutural, supra-alar, and prescutellar acrostichal bristles small but usually evident; posterolateral dorsocentral and postalar

bristles better developed; otherwise macrochaetotaxy of scutum reduced; acrostichal and dorsocentral tracks represented by reduced setae; scutellum setose dorsally, with a basal and apical bristle, these not arising from tubercles; notopleural bristles usually 2, anterior bristle weakly developed; anepisternum with 1 bristle; katepisternum usually with 1 bristle, frequently pale, inconspicuous, less well developed than anepisternal bristle; prosternum bare of setulae. Costal vein extended to R_{4+5} ; R_{2+3} short, not extended beyond level of crossvein dm-cu; M apical of crossvein dm-cu evanescent. Legs generally lacking prominent setae; front first tarsomere short, subequal in length to other tarsomeres; middle and hind first tarsomeres longer, about twice length of other tarsomeres; claws with curvature more abrupt apically; pulvilli evident but poorly developed.

Abdomen: Flattened dorsoventrally in female; convex dorsally in male. Male terminalia as follows (Wirth's terminology in parenthesis): fifth tergum elongate, length subequal to basal width; epandrium attenuated dorsally, not extended around cerci to form cercal cavity; surstyli (genital plate) fused medially to form a narrow, ventral plate, posteroventral to cerci; hypandrium (genital processes) attached basally at basal $\frac{1}{3}$ of surstyli, with a pair of digitiform, highly sclerotized processes; aedeagus poorly sclerotized, as conical or keel-shaped, semihyaline lobe or protuberance.

DISTRIBUTION.—Although the genus occurs in all faunal regions its diversity is greatest in the subtropics and tropics, especially those of Africa and Asia. In the Western Hemisphere only three species are known, whereas in Africa and Asia 11 species have been discovered. Presently Africa has the greatest diversity, with six known species (Wirth, 1964).

NATURAL HISTORY.—(Our treatment here is mostly paraphrased from available literature: Scheiring and Foote, 1973; Tenorio, 1980; Thier and Foote, 1980; Williams, 1938.) Adults are accomplished water-skaters and are found most frequently on the surface of small, quiet,

and usually ephemeral bodies of water, such as ponds, rain pools, and puddles. Water that has accumulated in tree holes and discarded containers or other man-made receptacles is not overlooked. Deonier (1965) reported that adults of *B. argentata* were rarely taken on mud-shore habitats in Iowa. Flight is seldom attempted, although the winged imago is quite capable of it. Adults feed on microscopic particles, especially decomposing organic matter, which they skim from the water's surface with their labella.

The aquatic larvae prefer shallow water and feed primarily as scavengers on decaying microscopic plant or animal material. Foote (Scheiring and Foote, 1973) reared larvae of *B. sturtevanti* Wirth on decaying lettuce, as did Thier and Foote (1980) for *B. argentata*. Thier and Foote (1980) summarized the natural history of the latter species as follows: microhabit—small pools; food—algae and detritus; and occurrence—through the warm season. One species, *B. hebes* Cresson, has been reported as a parasitoid of the liver fluke snail, *Lymanaea ollula* Gould, in Hawaii (Davis, 1959).

Johannsen (1935) described and illustrated the third-instar larva and the puparium of *B. argentata* from specimens collected in fish-hatchery ponds at Ithaca, New York. Williams (1938) and Tenorio (1980) gave detailed information on the habits, habitat, life cycle, and immature stages of *B. hebes* Cresson (see species treatment, pp. 10–12).

PHYLOGENY.—*Brachydeutera* is well characterized (see description), and the monophyly of the

genus is confirmed by numerous apomorphies as follows:

1. *Setation of frons*: The interfrontal bristles (cruciate and proclinate) are unique within the subfamily.

2. *Conformation of face*: The prominent facial carina (vertical and between the antennae) is unique among shore flies.

3. *Length of R_{2+3}* : The short R_{2+3} , which meets the costal vein before the level of crossvein dm-cu, is unique in the subfamily.

4. *Extension of costal vein*: Usually this vein extends to M, but in specimens of *Brachydeutera* the costal vein extends only to R_{4+5} .

5. *Development of vein M*: Vein M is well developed throughout its length in most shore flies, but for specimens of *Brachydeutera*, the section apical of crossvein dm-cu is conspicuously weaker or evanescent.

6. *Conformation of surstyli*: Usually the surstyli are evident as two processes at the venter of the epandrium. All *Brachydeutera* species have the surstyli fused medially to form a single, usually broad, ventral projection from the epandrium.

Brachydeutera is a well characterized, monophyletic lineage, as indicated above. Its relationship with other taxa within the subfamily Parydrinae, however, remains unresolved. Although an in-depth analysis of the phylogenetic relationships of taxa within Parydrinae is beyond the purview of this study, we suggest that *Brachydeutera* may be closely related to *Gastrops* Williston and *Beckeriella* Williston. The latter two genera are closely related (Mathis, 1977) and are primarily neotropical in distribution, although there is an undescribed species of *Beckeriella* from the Philippines.

Key to Oriental, Australian, and Oceanian Species of *Brachydeutera*

1. Brown coloration of scutum continued ventrally to about dorsal $\frac{1}{6}$ – $\frac{1}{3}$ of anepisternum, thereafter sharply delimited from pale gray coloration of ventral pleural areas 2
 - Brown coloration of scutum gradually becoming paler laterally, merging with pale gray pleural coloration 4
2. Crossvein dm-cu forming very oblique angle with CuA_1 ; cell r_1 at level of crossvein dm-cu almost twice width of cell r_{2+3} ; face entirely whitish gray to silvery; katepisternal bristle lacking (Oriental) *B. hardyi* Wirth

- Crossvein dm-cu nearly perpendicular with CuA₁; cell r₁ at level of crossvein dm-cu only slightly wider than cell r₂₊₃; face with ridge of facial carina brown; katepisternal bristle present 3
3. Clypeal microtomentum dark brown; wing membrane dark brown (Hawaiian Islands) *B. hebes* Cresson
Clypeal microtomentum silvery white; wing membrane grayish hyaline (temperate Eurasia: Mediterranean countries, eastward to Japan, Taiwan, and Hawaii) *B. ibari* Ninomiya
4. Anterior notopleural bristle absent; abdominal terga 3–4 fasciate anteriorly and posteriorly, fascia narrowly connected medially (Australian) *B. sydneyensis* Malloch
Anterior notopleural bristle present; abdomen either wholly brown or terga 1–3 with brown area medially, not fasciate 5
5. Mesonotum dark brown, at most scutum with faint greenish to grayish stripes; scutal setulae strong and numerous; abdomen subshiny, entirely dark brown dorsally (Australian, Oceanian)
. *B. adusta*, new species
Mesonotum mostly light brown, sometimes mostly gray, at most scutum with dark brown stripes; scutal setulae weak and sparse; abdomen dull, at most partially dark brown 6
6. Scutellar width 1.3 times its length; fused surstyli long, slender, apex rounded (Oriental) *B. longipes* Hendel
Scutellar width 2 times its length; fused surstyli short, wide, apex bifid (Afrotropical, Australian, and Indian) *B. pleuralis* Malloch

Brachydeutera adusta, new species

FIGURES 1–3

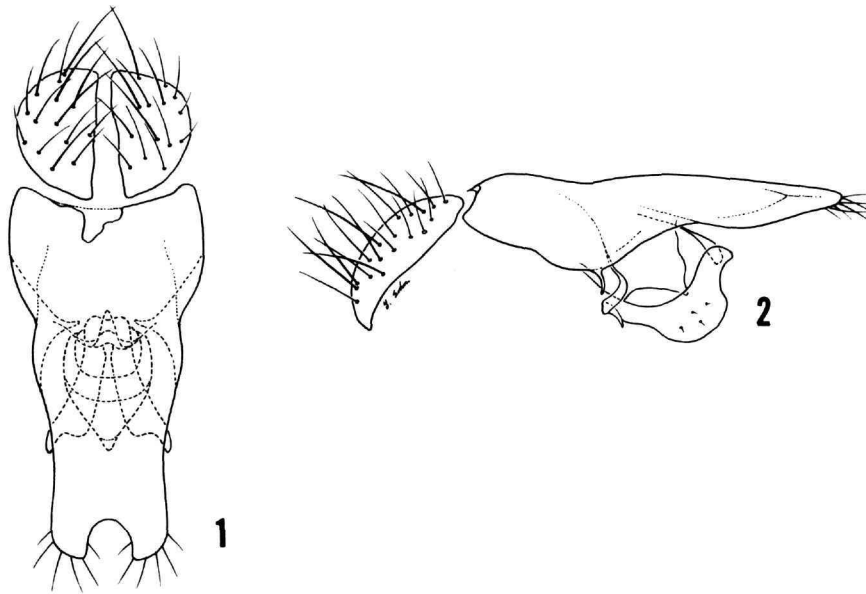
Brachydeutera pleuralis of authors.—Wirth, 1964:9 [in part, revision]. [Not *B. pleuralis* Malloch, 1928.]

Brachydeutera longipes of authors.—Bohart and Gressitt, 1951:88. [Not *B. longipes* Hendel, 1913.]

DIAGNOSIS.—Moderately small to medium-sized shore flies, length 2.20–3.00 mm.

Head: Frons mostly uniformly brown except for olivaceous to greenish area laterad of ocelli; 2 prominent, laterocline fronto-orbital bristles, if third present, usually less than 2/3 length of either posterior 2. Antenna, ventral 1/2 of facial carina, and clypeus brown, concolorous with frons. Arisal branches 10–12. Facial carina moderately sharp ventrally, acutely pointed ventrally, more flattened dorsally. Face, except for ventral 1/2 of carina and clypeus, grayish white to faintly bluish gray. Palpus pale, yellowish.

Thorax: Mesonotal chaetotaxy moderately well developed; bristles generally well developed, setae of main setal tracks larger. Mesonotum mostly brown, stripes, if at all evident, faintly inconspicuous anteriorly, light grayish to olivaceous. Scutellar ratio 0.71; distance between apical bristles subequal to that between basolateral scutellar bristle and apical bristle. Anterior notopleural bristle present, although weaker than posterior one; katepisternal bristle apparently lacking. Brownish coloration of mesonotum continued ventrally but more or less merged with grayish coloration of pleural areas. Femora mostly yellowish basally, apically becoming brownish, especially mid- and hind femur; tibiae brownish; tarsi brown, apical tarsomeres slightly darker; male hind tibia lacking patch of ventral, long setae. Wing hyaline, clear; R₂₊₃ moderately arched; R₄₊₅ slightly arched; costal vein ratio 3.25; M vein ratio 0.58.



FIGURES 1, 2.—*Brachydeutera adusta*: 1, cerci and epandrium (plus fused surstyli?), posterior aspect; 2, cerci, epandrium (plus fused surstyli?), and gonite, lateral aspect.

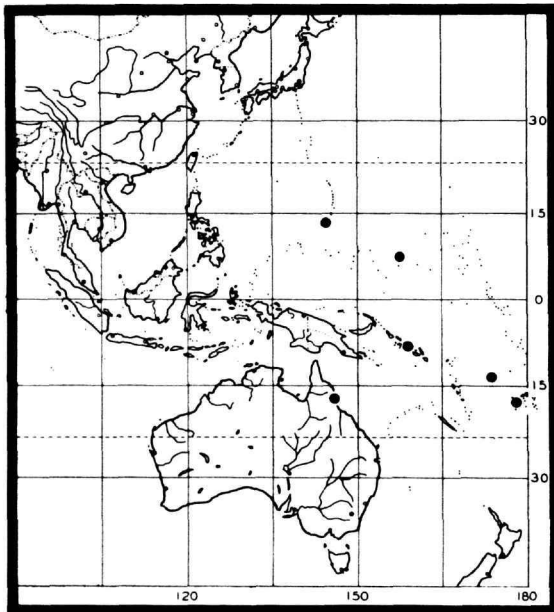


FIGURE 3.—Distribution map of *Brachydeutera adusta*.

Abdomen: Dorsum uniformly dark brown, ventrolateral margins of terga with some grayish coloration, vestiture sparsely microtomentose, slightly subshiny. Male terminalia (Figures 1, 2) as follows: dorsal surface of epandrium shallowly concave; epandrial width at dorsum not much wider than lateral margins of cerci; lateral margins of epandrium generally becoming narrower ventrally and with 2 sinuate emarginations, both shallow; epandrium + surstyli mostly parallel sided, apex with inverted U-shaped, deep emargination which bears setae, in lateral view with anterior surface shallowly sinuate, with slight enlargement about $\frac{1}{2}$ way between apex and epandrial connection; gonite thickly developed and with posteroventral process that is curved and narrowly pointed apically.

PRIMARY TYPE MATERIAL.—The holotype male, allotype female, and paratypes (6♀; BBM, USNM) are labeled "MARIANA IS. Guam, Inarajan X-'57 [Oct 1957], N. Krauss." Other paratypes are as follows: AUSTRALIA. *Queensland*: Cairns,

28 Apr 1957, W.W. Wirth (1♂; USNM). CAROLINE ISLANDS. *Ponape I.*: Kolonia, Aug 1956, M.R. Wheeler (1♀; USNM). FIJI. Suva, 7 mi [11 km] N, Nov 1967, B. McMillan (2♀; BMNH). MARIANA ISLANDS. *Guam, SE coast*: 6 May 1945, caribao hole, G.E. Bohart, J.L. Gressitt (8♀; BBM, CAS, USNM). SAMOA ISLANDS. *American Samoa*: Auasi, Tutuila, 10 Dec 1953, C. Hoyt (1♀; USNM). SOLOMON ISLANDS. *Kolombangara*: 5 Sep 1965 (1♂; BMNH). The holotype is double mounted (glued to a paper triangle), is in good condition (abdomen removed, dissected, and stored in an attached microvial), and is in the USNM collections of the National Museum of Natural History, Smithsonian Institution.

DISTRIBUTION (Figure 3).—Australia (Queensland), Caroline Islands (Ponape Island), Mariana Islands (Guam), Samoa Islands (American Samoa).

REMARKS.—The dark brown coloration of the

mesonotum, which merges more or less gradually with the pleural coloration; the presence of an anterior notopleural bristle; and better developed setae, especially the main setal tracks of the mesonotum, distinguish this species.

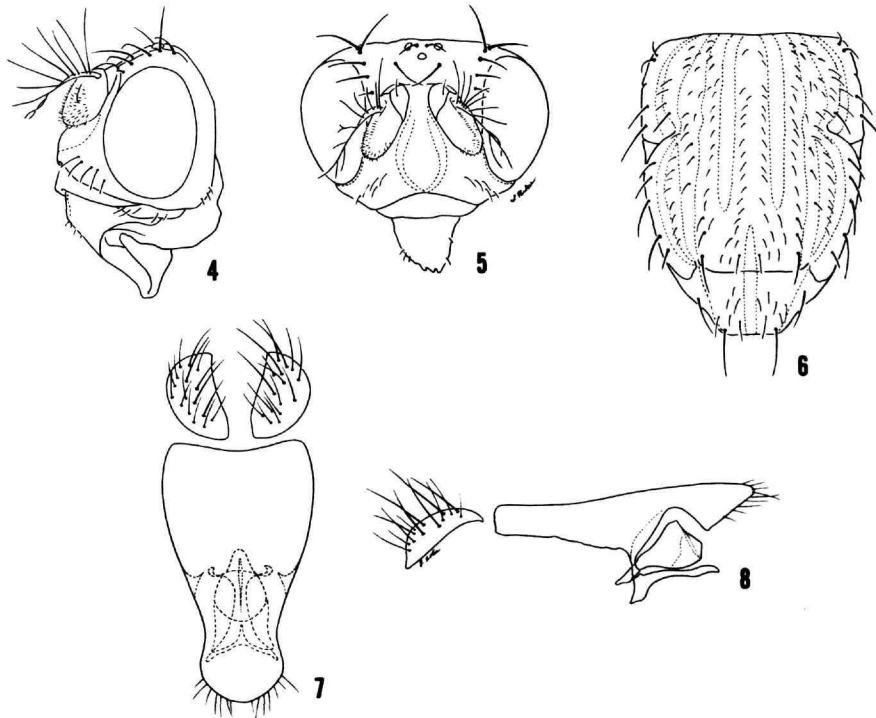
Previously this species had been confused with *B. pleuralis*, largely because the identity of the latter had not been clearly established (see treatment of *B. pleuralis*, p. 18). Now that the identity of *B. pleuralis* is resolved, and as it is distinct from *B. adusta*, the latter is here described.

The specific epithet, *adusta*, is in allusion to the dark brown mesonotum of this species.

Brachydeutera hardyi Wirth

FIGURES 4–9

Brachydeutera hardyi Wirth, 1964:6.—Cogan and Wirth, 1977:337 [Oriental catalog].



FIGURES 4–8.—*Brachydeutera hardyi*: 4, head, lateral aspect; 5, head, anterior aspect; 6, thorax, dorsal aspect; 7, cerci and epandrium (plus fused surstyli?), posterior aspect; 8, cerci, epandrium (plus fused surstyli?), and gonite, lateral aspect.

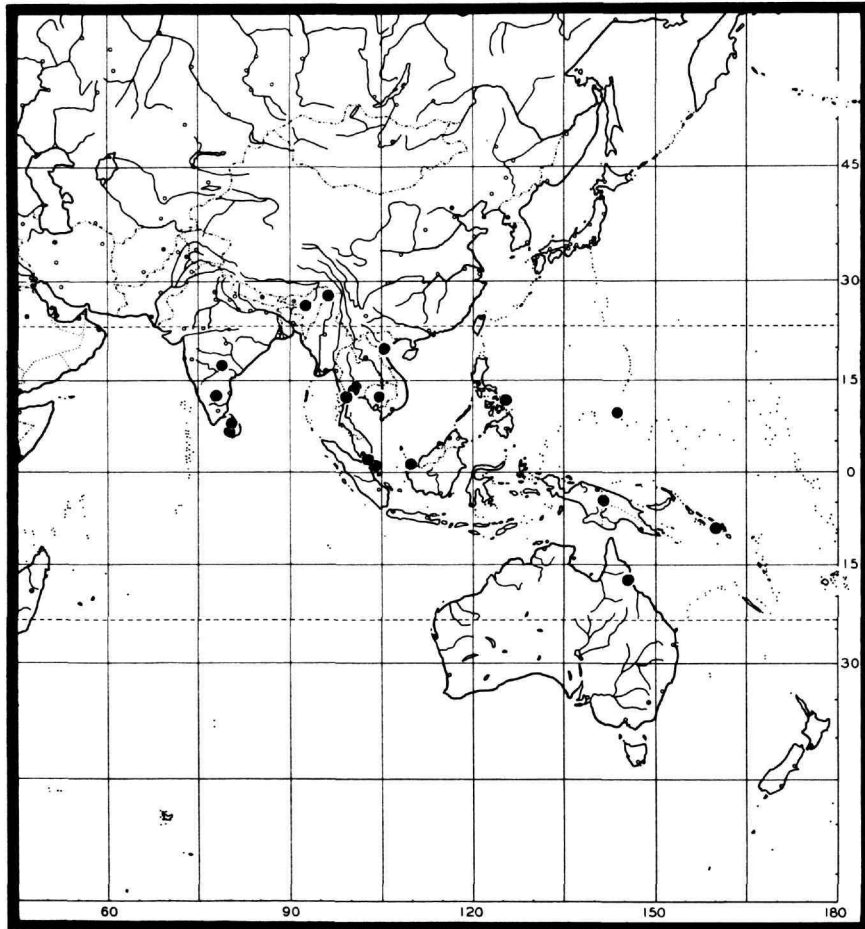


FIGURE 9.—Distribution map of *Brachydeutera hardyi*.

DIAGNOSIS.—Small to moderately small shore flies, length 1.45–2.10 mm.

Head (Figures 4, 5): Frons mostly uniformly brown except for olivaceous to greenish inverted U-shaped figure, with arms immediately laterad of ocelli, extended posteriorly around ocelli and united on occiput just below vertex; prominent, 2 laterocline fronto-orbital bristles. Antenna mostly concolorous with frons, first flagellomere paler, especially basally, slightly yellowish; arisal branches 8–10. Facial carina rather sharp, acutely pointed ventrally, extended from ptilinal suture to oral emargination. Face mostly concol-

orous, gray to grayish or silvery white. Palpus mostly pale, yellowish.

Thorax (Figure 6): Mesonotal chaetotaxy comparatively poorly developed; bristles barely evident, setae of main setal tracks small. Mesonotum mostly brown, but with stripes distinct, grayish to olivaceous blue, on either side of acrostichal track, laterad of dorsocentral track, and a single, median scutellar stripe; lateral margins of mesonotum lighter brown. Scutellum short, scutellar ratio 0.57; distance between apical bristle greater than that between basolateral scutellar bristle and apical one. Anterior notopleural bris-

tle present, although very weakly developed compared to posterior one; katapisternal bristle lacking. Brownish coloration of mesonotum continued ventrally to dorsal $\frac{1}{4}$ – $\frac{1}{6}$ of anepisternum, thereafter abruptly delimited from grayish to silvery white coloration of ventral portion of pleural areas; anepisternum with posterior margin silvery gray. Femora and tibiae mostly pale, yellowish; forefemur lacking sparsely microtomentose area anterodorsally toward base; tarsomeres dark brown; male hind tibia lacking patch of ventral, long setae. Wing hyaline, clear; R_{2+3} conspicuously arched; R_{4+5} very slightly arched, nearly straight; costal vein ratio 4.57; M vein ratio 0.49.

Abdomen: Dorsum mostly uniformly dark brown, posterolateral corners of terga 4–5 grayish, vestiture sparsely microtomentose, slightly subshiny. Male terminalia (Figures 7, 8) as follows: dorsal surface of epandrium in posterior view shallowly and evenly concave, epandrial width at dorsum not extended laterally beyond lateral margins of cerci; lateral margins of epandrium gradually curved inward to fused epandrium + surstyli; epandrium + surstyli broadly spatulate, apex broadly rounded, setose, in lateral view with anterior margin markedly angulate, U-shaped before narrow curvature to epandrial connection; gonite slender, more or less parallel sided, shallowly sinuate.

PRIMARY TYPE MATERIAL.—Holotype male is labeled "Misamari 35 mi [56 km] N W Tezpur Assam India/D E Hardy Jan. 29 [month and day handwritten], [19]44/♂ HOLOTYPE *Brachydeutera hardyi* W.W. Wirth [sex symbol, species name handwritten, red ink]." The holotype is double mounted (glued to a paper point) and is in good condition (antennae missing, some setae of head misdirected; USNM 66451).

OTHER SPECIMENS EXAMINED.—AUSTRALIA. *Queensland:* Kuranda, 23 Dec 1958, D.K. McAlpine (1♂; AM). CAMBODIA. Phnom Penh, 23 May 1967, light trap, M. Delfinado (1♀; USNM). CAROLINE ISLANDS. *Yap Islands:* Yap Island, Weyloy, 15 Jun 1957, C.W. Sabrosky (2♂, 1♀; USNM). INDIA. *Andhra Pradesh:* Hyderabad, 28

Oct–4 Nov 1971, A.C. Pont, J.C. Deeming (1♂; BMNH). *Assam:* Misamari 35 mi [56 km] NW Tezpur, 29 Jan 1944, D.E. Hardy (1♀, paratype; USNM); 10 mi [16 km] N Tinsukia, 29 May 1944, D.E. Hardy (1♀; USNM). *Karnataka:* Bangalore, 916 m, 22 Oct 1979, K.D. Ghorpadé (7♂, 8♀; KDG, USNM). MALAYSIA. *Malacca:* Malacca, Jan 1964, rubber plantation (1♀; BMNH). *Sarawak:* Santubong (1.43°N, 110.19°E), 27 Oct–3 Nov 1976, P.S. Cranston (2♂, 2♀; BMNH). NEW GUINEA. Kandanggei, Sepik River, 2 Mar 1964, D.H. Colless (1♂, 1♀; ANIC); Siutmeri, Sepik River 16 Mar 1964, D.H. Colless (1♀; ANIC); Lower Sepik River, Oct 1959, R. Pullen (1♂, 1♀; ANIC). PHILIPPINES. Samar, Osmena, 23 May 1945, at light, K.L. Knight (1♀; USNM). SINGAPORE. *Singapore Island:* Pasir Panjang Nature Reserve, 11 Jan 1973, A.E. Stubbs (1♂, BMNH). SOLOMON ISLANDS. *Guadalcanal Island:* Lunga River, 16 Sep 1944, J. Laffoon (1♀; USNM). SRILANKA. *Anuradhapura:* Mihintale, 20 Feb 1974, P.J. Chandler, A.E. Stubbs (1♀; BMNH). *Colombo:* Colombo, 14 Apr 1980, W.N. Mathis (1♂; USNM); Yongammulla (3 mi [5 km] E), Yakkala (18 mi [29 km] NE Colombo), 7 Jan 1962, L. Cederholm (1♀; BMNH). *Polonnaruwa:* Polonnaruwa, 5 May 1980, W.N. Mathis, T. Wijesinhe, L. Jayuawickrema (19♂, 11♀; USNM). THAILAND. *Bangkok:* Huai kwang, Aug–Sep 1962, at light, J. Scanlon (5♂, 2♀; USNM); Makasan, 11–12 May 1959, at light, Manop (2♂; USNM); Plukchit, Aug–Sep 1962, at light, J. Scanlon (2♀; USNM); Pratoomvan, 9–10 May, Aug–Sep 1959, at light, Manop, J. Scanlon (1♂, 3♀; USNM); Thonglo, Aug–Sep 1962, at light, J. Scanlon (2♂, 5♀; USNM). *Rat Buri:* Banpong, 26 Dec 1958, Manop (1♀; USNM). Ayudhaya, 2 Jan 1959, Manop (2♀; USNM). Samuthprakan, 22 Dec 1958, Manop (1♂, 1♀; USNM). Thonburi, 23 Dec 1958, Manop (1♀; USNM). Pechaburi, 27 Dec 1958, Manop (3♀; USNM). VIETNAM. Hanoi, 30 Aug–6 Oct 1963, T. Pocs (2♂, 1♀; HNHM).

DISTRIBUTION (Figure 9).—Cambodia, Caroline Islands (Yap Island), India (Assam, Karnataka), Malaysia, New Guinea, Philippines (Sa-

mar), Solomon Islands (Guadalcanal), Sri Lanka, Thailand, and Vietnam.

REMARKS.—This species is distinguished from all congeners by its small size (less than 2.25 mm), wing venation (conspicuously arched R_{2+3} , wide cell r_{2+3}), coloration (striped mesonotum, mostly gray face), and conformation of the male terminalia (see species description and Figures 4–9).

***Brachydeutera hebes* Cresson**

FIGURES 10, 11

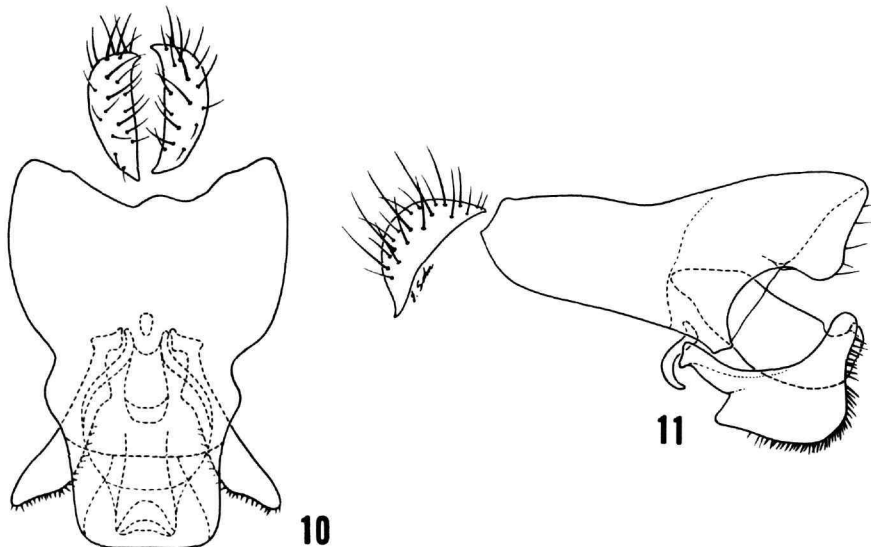
Brachydeutera hebes Cresson, 1926:277.—Williams, 1938:90 [behavior, life history, figures of all stages].—Wirth, 1964:7 [revision].—Tenorio, 1980:293 [revision, figures of thorax, wing, abdomen, male and female terminalia], 338 [description and figures of larvae and puparium].
Brachydeutera argentata of authors.—Howard, 1901:490.—Grimshaw, 1901:49. [Not *B. argentata* Walker, 1853.]

DIAGNOSIS.—Medium-sized to large shore flies, length 3.60–5.35 mm.

Head: Frons mostly uniformly brown except for olivaceous to greenish area immediately laterad of ocelli; prominent, laterocline fronto-

orbital bristles 3, anterior bristle only slightly weaker, about $\frac{3}{4}$ length of posterior 2. Antenna, ridge of facial carina, border of oral emargination, middle of clypeus, and parafacial area, in lateral view, between eye and oral margin brown, concolorous with frons. Aristal branches 10–12. Facial carina rather sharp, acutely pointed ventrally, extended from ptilinal suture to oral emargination. Lateral margins of facial carina grayish to olivaceous; remainder of face, except as noted above, silvery white. Palpus almost entirely pale, yellowish.

Thorax: Mesonotal chaetotaxy comparatively well developed; bristles as indicated in generic description well developed, setae of main setal tracks larger. Mesonotum mostly brown, with some grayish to olivaceous areas as stripes on either side of acrostichal track, laterad of dorso-central track, near dorsal margin of notopleuron and extended posteriorly through supra-alar area. Brownish coloration of mesonotum continued ventrally to dorsal $\frac{1}{4}$ of anepisternum, thereafter abruptly delimited from grayish to bluish gray coloration of ventral portion of pleural areas; anepisternum with brownish coloration



FIGURES 10, 11.—*Brachydeutera hebes*: 10, cerci and epandrium (plus fused surstyli?), posterior aspect; 11, cerci, epandrium (plus fused surstyli?), and gonite, lateral aspect.

continued along posterior margin; anepisternum with dorsomedian circular area silvery white through orientation of microtomentosity. Scutellar ratio 0.73; apical bristles approximate, distance between them less than that between basolateral scutellar bristle and apical one. Anterior notopleural bristle present, nearly as strong as posterior one; katepisternal bristle present. Femora mostly yellowish, apices brownish; forefemur with sparsely microtomentose, extensive blackish area anterodorsally toward base; tibiae mostly brown, yellowish basally, becoming rapidly but gradually darker apically, stramineous to brown; tarsomeres dark brown; male hind tibia lacking patch of ventral, long setae. Wing hyaline, with brownish tinge; R_{2+3} moderately arched; R_{4+5} conspicuously arched; costal vein ratio 2.38; M vein ratio 0.80.

Abdomen: Dorsum uniformly dark brown, sparsely microtomentose, slightly subshiny. Male terminalia (Figures 10, 11) as follows: dorsal surface of epandrium in posterior view irregularly concave; epandrial width at dorsum conspicuously extended beyond lateral margins of cerci, lateral margins of epandrium abruptly sinuate with dorsal half very shallowly arched, more or less parallel, thereafter angled inward rather abruptly, then outward to form a small lateral bump; epandrium + surstyli parallel sided to truncate ventral surface, epandrium + surstyli in lateral view wide, more or less evenly thick, anterodorsal surface rounded to epandrial connection with gonite; gonite thickly developed, posteroventral angle drawn out into narrow process, ventral and anterior surfaces setose.

PRIMARY TYPE MATERIAL.—Holotype male is labeled "Kalihi 2-23 [23 Feb, handwritten] Oahu/E. H. Bryan, Jr Collector/Stagnant water/Kam. School Campus/TYPE 355 Brachydeutera HEBES E.T. Cresson, Jr. [number and species name handwritten, maroon ink]." The holotype is pinned directly, is in good condition, and is in the Bernice P. Bishop Museum.

OTHER SPECIMENS EXAMINED.—HAWAII. *Hawaii:* Hilo, Jul 1900, H.W. Henshaw (1♀; USNM); Hualalae, 19 Oct 1963, D.E. Hardy (1♂, 4♀;

UHH); Laupahoehoe, logging road, 3300 ft [1006 m], 1 Jun 1970, D.E. Hardy (3♂, 12♀; UHH); Oiaa Forest (upper), Aug 1952–Mar 1968, D.E. Hardy, W. Mitchell, J.A. Tenorio (1♂, 3♀; UHH); Paauilo (forest above), 3200 ft [976 m], 6 Aug 1965, D.E. Hardy (6♂; UHH); Puu Waa Waa Halepiula shed, 20 Jan 1970, 4000 ft [1220 m], in water trough, S.L. Montgomery (1♂, 2♀; UHH); Volcano Kiluea, Jun, H.W. Henshaw (2♀; USNM). *Maui:* Hanaula, 9 Jul 1968, 4000 ft [1220 m], J.A. Tenorio (2♀; UHH); Puu Niauniau, Apr 1954, M. Tamashiro (2♂, 2♀; UHH). *Molokai:* Puu Kaeo, Jul 1952, D.E. Hardy, M. Tamashiro (2♂, 1♀; UHH, USNM); Wailau Valley, Jul 1952, E. Dresner (1♂; UHH). *Oahu:* 13 Jul 1945, Block (3♂, 6♀; USNM); 19 Jan 1945, lily pads in pond (1♂, 1♀; USNM); Ewa, 1 Apr 1963, light trap, J.W. Beardsley, (1♂, 2♀; UHH); Honolulu, 20 Dec 1917–23 Feb 1950, M.S. Adachi (1♂; 3♀; UHH, USNM); Kaala Makalawena stream, wet bank, 8 Feb 1970, J.A. Tenorio (2♂; UHH); Kamananui Gulch, 28 Jul 1945, W.W. Wirth (1♂; USNM); Kaneohe, 13 Mar 1946, W.W. Wirth (1♀; USNM); Kuliouou Valley, 26 Jan 1945, W.D. Field (2♂, 8♀; USNM); Makua, Apr 1951, D.E. Hardy (2♂; UHH); Mt. Kaala, 22 Aug 1945, 4000 ft [1220 m], puddles in bog, W.W. Wirth (4♂, 3♀; USNM); Niu Valley, 5 Jun 1970, S.L. Montgomery (1♀; UHH); Palolo, 12 Feb 1922, J.F. Illingworth (1♀; USNM); Poamoho Trail, 9 Nov 1946, W.W. Wirth (1♀; USNM); Pupukea, 4 Feb 1964, D. Gubler (1♂; UHH); Waialae, 6 Feb 1916, O.H. Swezey (1♂, 1♀; USNM).

DISTRIBUTION.—Apparently endemic to the Hawaiian Islands (Oahu, Kauai, Molokai, Maui, Hawaii, and Kahoolawe).

NATURAL HISTORY.—We quote from the excellent treatment by Tenorio (1980:293, 338), who conducted field studies on this species in Hawaii. He also summarized the work of others.

Williams (1938) gave detailed information on the habits, habitats, life cycle, and immature stages of this species. The adult fly is an excellent water-skater, found most abundant in the lowlands occupying great varieties of quiet pools and other small bodies of water whose

bottoms are littered with leaves and other plant parts in various stages of decay. Stagnant pools, some of which have their surfaces covered with scum or algae and which emit a putrid odor, are not uncommon habitats for these flies. At higher elevation, small puddles diverted from streams or those which collect in the rain forests serve commonly as breeding sites for *B. hebes*. It has also been seen in tree holes filled with water and in artificial containers, such as water tanks or discarded oil drums. On one occasion, in Olaa Forest in Hawaii, I found two fully-grown larvae in a discarded aluminum foil container (4 × 6 × 2 in [10 × 15 × 5 cm]) half-filled with water and rotting leaves; these larvae were subsequently reared to adulthood.

Both as adults and as larvae, these flies are scavengers feeding on microscopic organisms and particles of plant and animal material. The adults occupy the surface of the water, while the larvae concentrate beneath the surface.

The larvae of this species, in one case, were reported to be parasitic by Davis (1959). He observed the larvae "attacking and killing local populations of the liverfluke snail, *Lymnaea ollula* Gould." In laboratory studies, Davis observed six larvae in one snail, and out of 10 adult *Lymnaea*, three were "consumed" over a period of three days.

The life cycle of this species, based on Williams' studies (1938), may take as little as 14 days: the egg hatches in one day, the larva matures in eight days, and the pupal stage lasts five days. *B. hebes* is easy to rear in the laboratory from larvae taken in the field.

REMARKS.—Because of its large size, more numerous and strongly developed setae, distinctive color pattern, and generally darker coloration *B. hebes* is easily recognized and is not likely to be confused with its congeners.

The only Hawaiian congener of *B. hebes* is *B. ibari*. *Brachydeutera hebes* can be distinguished by its dark brown clypeal microtomentum, brown wing membrane, and larger size. The characters of the male terminalia of each species are also diagnostic.

Brachydeutera ibari Ninomiya

FIGURES 12–18

Brachydeutera ibari Ninomiya, 1929:190.—Miyagi, 1977:76 [discussion].

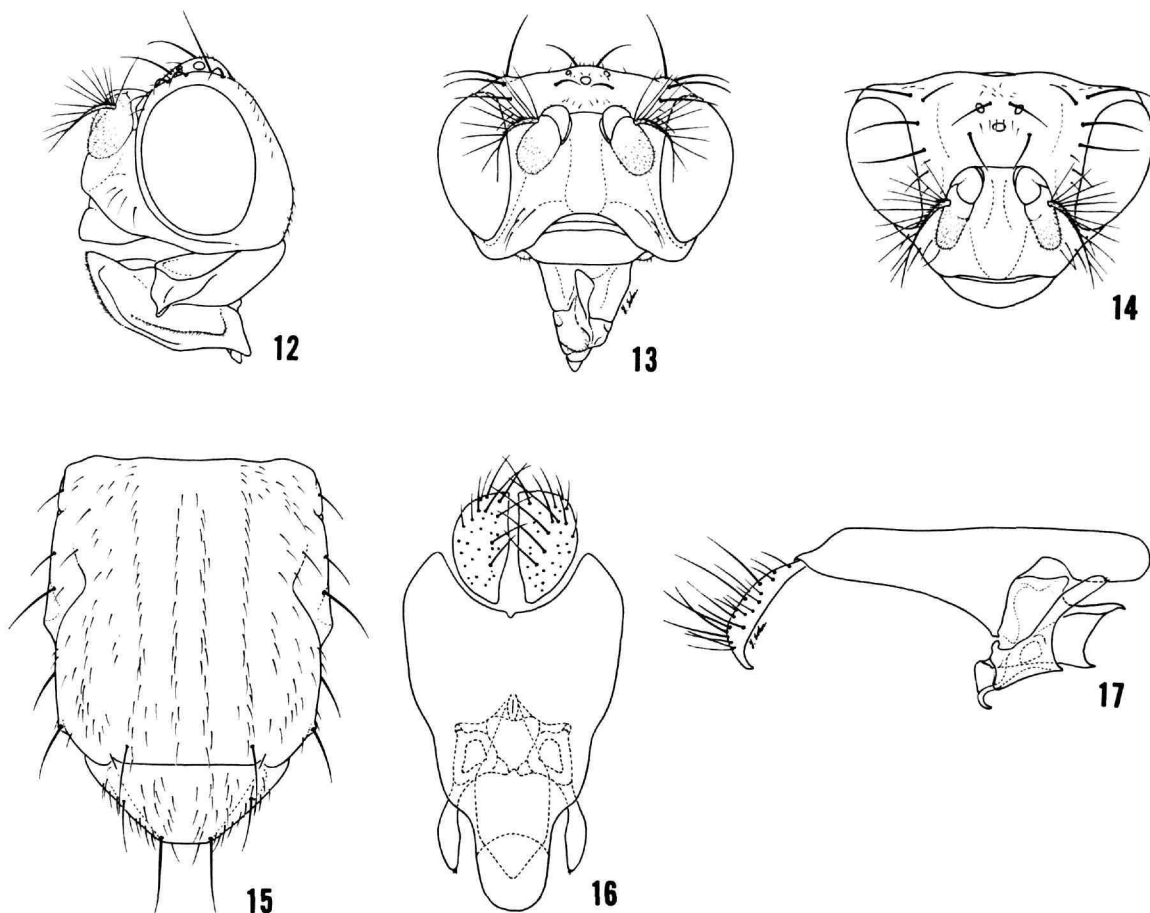
Brachydeutera argentata of authors.—Becker, 1896:201; Wirth, 1964:5 [in part, revision].—Cogan and Wirth, 1977:337 [Oriental catalog].—Miyagi, 1977:75 [in part]. [Not *B. argentata* Walker, 1853.]

DIAGNOSIS.—Moderately small to medium-sized shore flies, length 2.35–3.35 mm.

Head (Figures 12–14): Frons mostly uniformly brown except for olivaceous to greenish area posterolaterad of ocelli; prominent, 3 latero-ocellate fronto-orbital bristles, anterior bristle weaker, about $\frac{1}{2}$ – $\frac{2}{3}$ length of posterior 2. Antenna and ridge of facial carina brown, concolorous with frons. Aristal branches 9–11. Facial carina rather sharp, acutely pointed ventrally, extended from ptilinal suture to oral emargination. Clypeus, face, except for ridge of carina and narrow margin along oral emargination silvery white. Palpus pale, mostly yellowish.

Thorax (Figure 15): Mesonotal chaetotaxy moderately developed; bristles barely evident, setae of main setal tracks small. Mesonotum mostly brown, but with considerable olivaceous coloration, especially as stripes on either side of acrostichal track, laterad of dorsocentral track, near dorsal margin of notopleuron and extended posteriorly through supra-alar area, and at merger of scutum and scutellum. Scutellar ratio 0.74; distance between apical scutellar bristles slightly less than between basolateral scutellar bristle and apical one. Anterior notopleural bristle present, although weaker than posterior one; katepisternal bristle present. Brownish coloration of mesonotum continued ventrally to dorsal $\frac{1}{4}$ – $\frac{1}{6}$ of anepisternum, thereafter abruptly delimited from grayish to silvery white coloration of ventral portion of pleural areas; anepisternum with posterior margin silvery gray. Femora mostly yellowish, forefemur with sparsely microtomentose, gray area anterodorsally toward base; tibiae yellowish basally, becoming gradually darker apically, stramineous to brown; tarsomeres dark brown; male hind tibia lacking patch of ventral, long setae. Wing hyaline, clear; R_{2+3} moderately arched; R_{4+5} conspicuously arched; costal vein ratio 2.95; M vein ratio 0.62.

Abdomen: Dorsum with posterolateral, grayish areas on terga 3–6 of female and 3–5 of male, grayish area progressively larger, extended across entire posterior margin of tergum 6 of female, 5 of male. Male terminalia (Figures 16, 17) as follows: dorsal surface of epandrium in



FIGURES 12-17.—*Brachydeutera ibari*: 12, head, lateral aspect; 13, head, anterior aspect; 14, head, dorsal aspect; 15, thorax, dorsal aspect; 16, cerci and epandrium (plus fused surstyli?), posterior aspect; 17, cerci, epandrium (plus fused surstyli?), and gonite, lateral aspect.

posterior view deeply concave, forming pocket between which cerci lie; epandrial width at dorsum much wider than lateral margins of cerci; dorsal $\frac{1}{4}$ of lateral margin of epandrium slightly flared laterally, thereafter generally narrowed ventrally by 2 parallel sided steps; epandrium + surstyli parallel sided, apex bluntly rounded, in lateral view apex of epandrium + surstyli bluntly rounded and bare, thereafter parallel sided on ventral $\frac{1}{2}$, then forming angulate concavity on anterodorsal surface; gonite with base subrectangular, posteroventral angle drawn into long, slender, more or less parallel sided process, length

subequal to length of basal portion.

PRIMARY TYPE MATERIAL.—Male neotype, herein designated, is labeled "Ogahanto 1, Sept. [19]63 [light yellow]/Japonia Honshu I[chiro]. MIYAGI [light yellow]/NEOTYPE *Brachydeutera ibari* Ninomiya by W. N. Mathis 1984 [handwritten, red ink]." The neotype is double mounted (minute nadel in paper rectangle), is in good condition (the abdomen has been removed, dissected, and is in an attached microvial), and is in the insect collection at Hokkaido University.

The syntypic series, from Japan (Honshu: Tokyo), was lost or destroyed during World War II

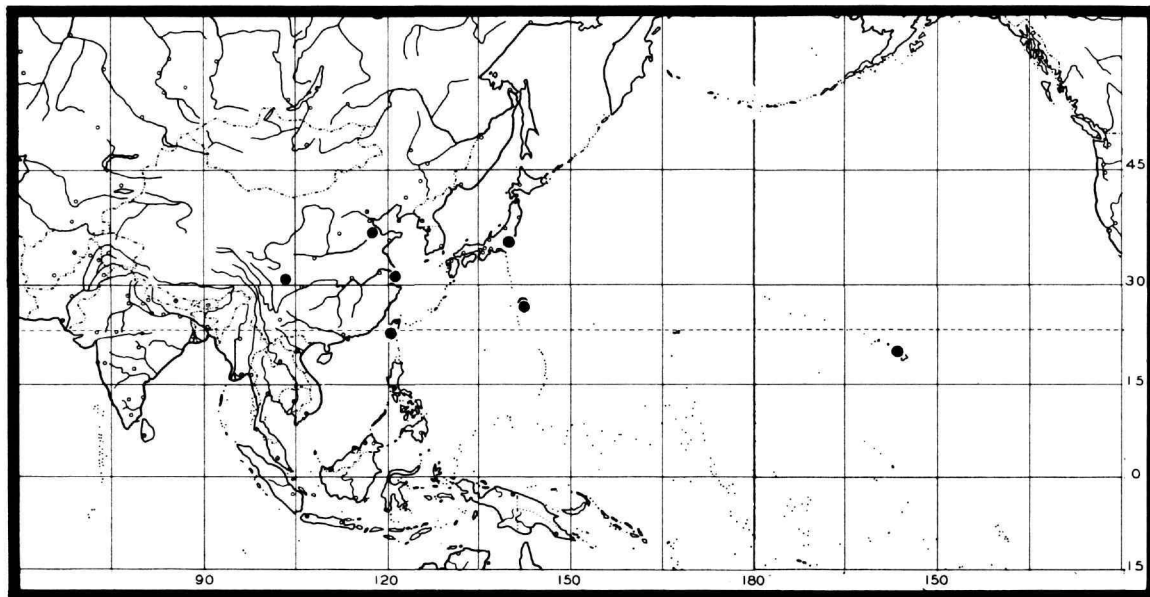


FIGURE 18.—Distribution map of *Brachydeutera ibari*. (The species is also found in the Canary Islands, Mediterranean Europe, and the Middle East.)

(Miyagi, 1977 and in correspondence). In addition to this citation and correspondence we contacted the following people to further verify the loss of the syntypic series: Mr. Yoshihiro Ikezaki, Nagasaki Nishi High School; Dr. Y. Matsumoto, Tokyo University; Dr. N. Fukuhara, National Institute of Agriculture (Tsukuba); and Mr. K. Sumida, Tokyo University. All reported that Ni-nomiya's collection, which was kept in the city of Nagasaki, was destroyed during World War II.

The compelling reason for designating the neotype was not the missing or destroyed syntypic series; zoological issues constituted the key factor. Two species are known to occur in Japan, *B. ibari* and *B. longipes*. Only the former was reported to be common (Miyagi, 1977, as *B. argentata*). During this study we discovered that Japanese specimens of *B. longipes* were not that uncommon (6 of 29 specimens in a recent sample), and furthermore, that the species is widespread in Japan (Honshu, Kyushu, and the Ryukyu Islands). To avoid confusion with the names of these two species, we have designated a neo-

type for *B. ibari* and a lectotype for *B. longipes* (see treatment of that species, pp. 15–18).

SPECIMENS EXAMINED.—**BONIN ISLANDS.** *Chichi-Jima*: Sakai-ura "Bull Beach" Apr. 5–25, 1958, F.M. Snyder (4♂, 8♀; BBM, USNM); Ogiura, 8 Apr–12 May 1958, F.M. Snyder (1♂; BBM); Okumura "Yankee Town," 12 May–9 Jun 1958, F.M. Snyder (1♂, 4♀; BBM); Omura, "Camp Beach," 5 May–9 Jun 1958, F.M. Snyder (1♂, 2♀; BBM, USNM). *North Chichi Jima, Ototo-Jima, SE, beach*, 9 Apr 1958, F.M. Snyder (4♀; BBM, USNM). **CHINA.** *Kiangsu*: Shanghai, 8 May 1906, E. Burnetti (1♀; BMNH). *Shantung*: Tsinan, Oct 1925, E. Hindle (1♂, 2♀; BMNH). *Szechuan*: Chengtu, Crampton collection (1♂, 3♀; MCZ, USNM); Suifu (1♂, 1♀; USNM). **HAWAII.** *Kahoolawe Island*: Hakioawa, stream, 70 m, 26 Apr 1980, S.L. Montgomery (2♂; USNM). **TAIWAN.** Kang-k'ou, 1912, H. Sauter (1♀; USNM). Tainan, 11 Sep, H. Sauter (1♀; WIEN).

DISTRIBUTION (Figure 18).—Canary Islands in the west, eastward through countries of the Mediterranean, Middle East (Egypt, Israel, Iran,

Iraq), and China to Japan, N. Korea, Taiwan, and the Hawaiian Islands. From the study area the species is known from the Bonin Islands (Chichi Jima), China (Szechuan), Hawaiian Islands (Kahoolawe), and Taiwan.

REMARKS.—This species is both related and very similar to *B. argentata* (Walker) of North America and has been confused with it (see Mathis, 1983, for a review of the nearctic species). It is distinguished by the lighter brown coloration of the abdominal dorsum and by the conformation of the male terminalia, especially the fused surstyli (merger of surstyli with the epandrium indicated by an angulate emargination, best seen in lateral view), which bear generally inconspicuous, microscopic setae anteroventrally. From the study area, this species is distinctive (see characters used in the key) and is not likely to be confused with any others.

Brachydeutera longipes Hendel

FIGURES 19–21

Brachydeutera longipes Hendel, 1913:99.—Wirth, 1964:7 [revision].—Ramachandra Rao, 1970:354.—Cogan and Wirth, 1977:337 [Oriental catalog].

DIAGNOSIS.—Moderately small to medium-sized shore flies, length 2.10–3.15 mm.

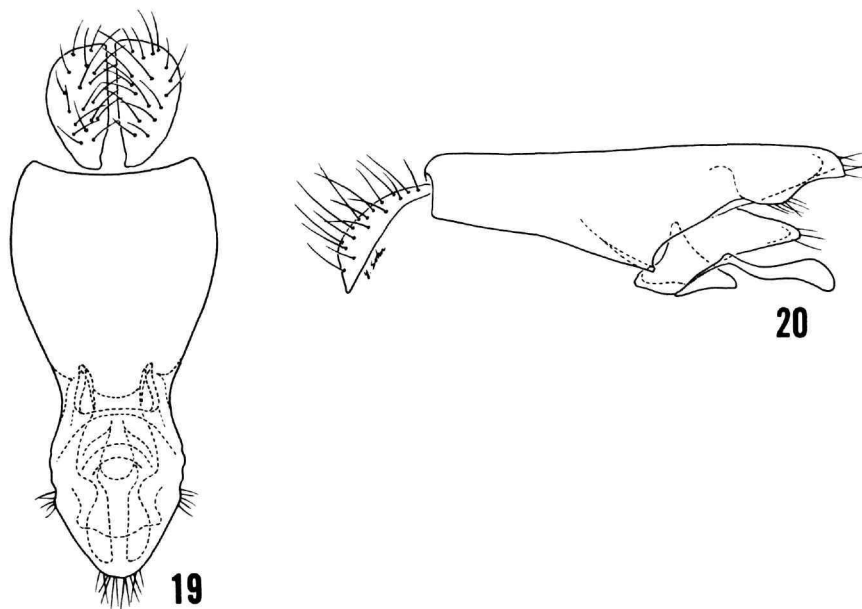
Head: Frons mostly grayish brown to light brown, with faint olivaceous areas posterolaterad of ocelli; prominent, laterocline fronto-orbital bristles 3, anterior bristle weaker, about ½ length of posterior 2. Antenna brown, darker than frons; arisal branches 8–9. Facial carina wide, low, and rounded, weakly developed between antennae. Face, clypeus, and gena concolorous, pearly gray, facial carina and antennal fovea slightly darker, lightly tinged with faint olivaceous to grayish blue, extreme dorsum of facial carina sometimes faintly brownish. Palpus pale, yellowish.

Thorax: Mesonotal chaetotaxy comparatively poorly developed; bristles inconspicuous, setae of main setal tracks small. Mesonotum light brown to olivaceous gray, concolorous with frons, some-

times with darker brown stripes through setal tracks and with areas laterad of setal tracks more olivaceous gray, postpronotum and dorsum of scutellum mostly grayish. Scutellar ratio 0.85; apical bristles approximate, distance between them less than that between basolateral scutellar bristle and apical one. Anterior notopleural bristle present, although weaker than posterior one; katepisternal bristle present but very inconspicuous, pale, whitish. Light brownish coloration of mesonotum gradually merged with grayish coloration of pleural areas, notopleuron mostly light brownish and sometimes dorsolateral portions of anepisternum. Femora and tibiae yellowish, forefemur lacking sparsely microtomentose area anterodorsally toward base; tarsomeres brown to dark brown apically; male hind tibia lacking patch of ventral, long setae. Wing hyaline, clear; R₂₊₃ moderately arched; R₄₊₅ very slightly arched, nearly straight; costal vein ratio 3.10; M vein ratio 0.51.

Abdomen: Dorsum light brown anteriorly and medially, otherwise mostly gray; moderately microtomentose, mostly dull. Male terminalia (Figures 19, 20) as follows: dorsal surface of epandrium in posterior view shallowly concave; epandrial width at dorsum extended laterally slightly beyond lateral margins of cerci; lateral margins of epandrium sinuate and more narrowed ventrally; epandrium + surstyli with lateral margins directed inward, apex narrowly rounded, broadly V-shaped, in lateral view with anteroventral angle sharp, thereafter more or less evenly curved to epandrial connection except for a broad, bluntly rounded, setose process; gonite generally narrow, slightly enlarged apically, spatulate.

PRIMARY TYPE MATERIAL.—The lectotype female, designated herein, is labeled “Kankau (Form.) H.Sauter IX.12 [Sep 1912]/Coll. Hendel/LECTOTYPE ♂ *Brachydeutera longipes* Hendel By W. N. Mathis 1984 [sex, species name, and lectotype designator handwritten, black submarginal border].” One female paralectotype has the same locality and date as the lectotype. The lectotype and paralectotype are



FIGURES 19, 20.—*Brachydeutera longipes*: 19, cerci and epandrium (plus fused surstyli?), posterior aspect; 20, cerci, epandrium (plus fused surstyli?), and gonite, lateral aspect.

the only specimens that bear label data consistent with the data Hendel (1913) mentioned in the original description, viz. "Kankau" and "Sep." In addition to these specimens, I (WNM) have examined several other specimens from Kankau, but they either lack a date or have a date other than September. Both the lectotype and paralectotype are deposited in the Naturhistorisches Museum Wien.

OTHER SPECIMENS EXAMINED.—CAMBODIA. Phnom Penh, 23 May 1967, light trap, M. Del-finado (3♂, 1♀; USNM). CHINA. *Fukien*: Foochow, 16 May 1936, M.S. Yang (3♀; BMNH). HONG KONG. Pig sty, 13 Jun 1973, H.Y. Lee (1♀; BMNH). INDIA. 1927, E. Brunetti (4♀; BMNH). *Andhra Pradesh*: Hyderabad, 28 Oct–4 Nov 1971, A.C. Pont, J.C. Deeming (5♂, 5♀; BMNH). *Assam*: Chabua, 10 Oct 1943, D.E. Hardy (4♂, 11♀; USNM). *Karnataka*: Bangalore, 916 m, 10 Mar–22 Oct from 1974 to 1980, A. Freidberg, K.D. Ghorpadé, W.N. Mathis, M.G. Venkatesh (80♂, 84♀; KDG, USNM). *Maharashtra*: Kanheri National Park, 18 mi [29 km] N Bombay, 1 Jan

1962 (3♂, 7♀; BMNH). *Pondicherry*: Kurumbagaram, Karaikal, Aug 1954, P.S. Nathan (16♂, 24♀; USNM). *Tamil Nadu*: Coimbatore, 23 Apr 1914 (1♀; BMNH); Tondiarpet, Aug 13, open sewage, Fletcher (2♀; BMNH); Tuticorin, 18 Oct 1938 (5♂, 2♀; BMNH). *Uttar Pradesh*: Allahabad, 1961, D. Kaul (1♀; BMNH); Dehra Dun, 2300 ft [701 m], 15 May 1936 (reared from puparia), J.A. Graham (1♂, 2♀; BMNH). *West Bengal*: Calcutta, 14 Apr 1980, A. Freidberg (9♂, 21♀; USNM). INDONESIA. Bogor District, 8 May 1980, K.R. Norris (duck complex)(1♀; ANIC). IRAQ. 'Uman, Masanah, 7 Dec 1929, V.H.W. Dowson (2♀; BMNH). MALAYSIA. *Selangor*: Kuala Lumpur, Jul–Aug 1958, R. Traub (1♂, 2♀; USNM); 18 Aug–11 Sep 1926, C. Dover (2♀; BMNH). PAKISTAN. *North-West Frontier*: Peshawar, Jun 1959, light trap, H. Barnett (2♂, 1♀; USNM). *Punjab*: Lahore, Jul–Aug 1957–59, H. Barnett, J. Maldonado (2♂, 8♀; USNM). PHILIPPINES. *Luzon*: Tarlac, Moncado, Mar 1953, D.C. Blodget (6♂, 4♀; CAS). *Mindanao*: Zamboanga, Oct 1945, at light, J. Laffoon (1♂, 1♀; USNM). *Mindoro*:

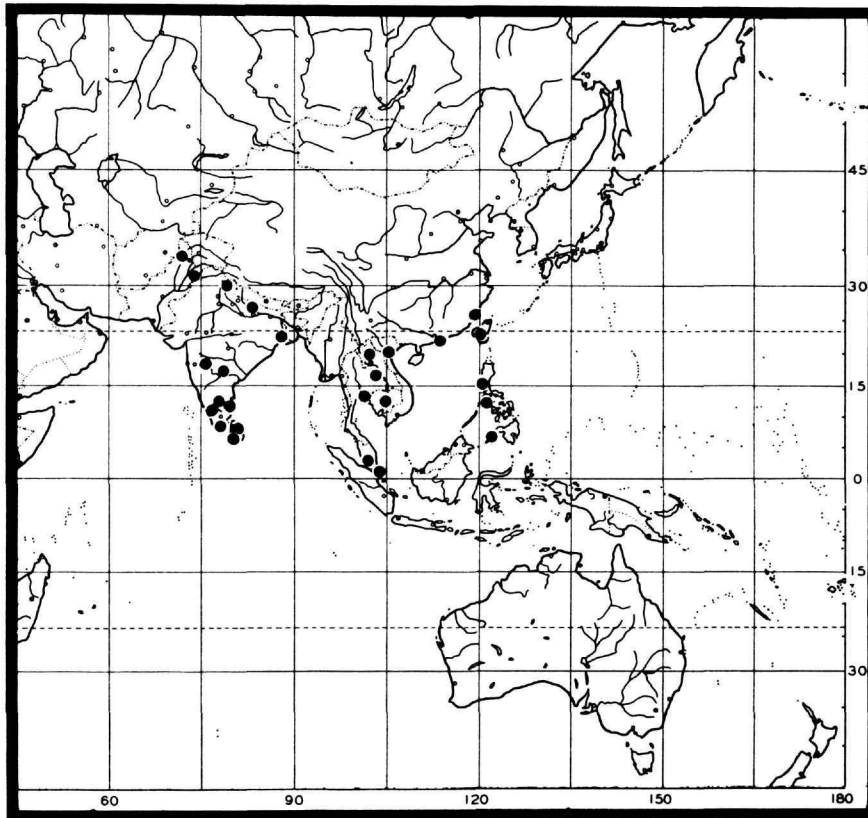


FIGURE 21.—Distribution map of *Brachydeutera longipes*.

San José, Feb–5 Apr 1945, E.S. Ross (3♀; CAS). SINGAPORE. May 1923, surface of stagnant water, J.C. Moulton (1♂, 2♀; BMNH); pig farm, 1975, D.H. Murphy (2♂; BMNH). SRI LANKA. *Colombo*: Colombo, 14 Apr 1980, W.N. Mathis (1♂, 4♀; USNM); Negombo, 7 May 1980, W.N. Mathis, T. Wijesinhe, L. Jayawickrema (18♂, 18 ♀; USNM). *Kalutara*: Beruwala, 25 Jan 1962, swept from grass, coconut plantation, L. Cederholm, H. Andersson, P. Brinck (3♂, 3♀; BMNH). *Polonnaruwa*: Polonnaruwa, 4 May 1980, W.N. Mathis, T. Wijesinhe, L. Jayawickrema (1♂; USNM). *Ratnapura*: Sabaragamuwa, 3 mi [5 km] NE Ratnapura, 20 Feb 1962 (1♀; BMNH). *Trincomalee*: Trincomalee, hot wells, 13 Jul 1890, Yerbury (1♀; BMNH). TAIWAN. Anping, Sep 1908, H. Sauter (3♀; HELS, USNM). Hsiao-i,

Oct 1964, J. Bergner (1♂, 1♀; USNM). Kankau, Aug–Sep 1912, H. Sauter (2♂, 2♀; HELS, HNHM). Kankau, Koshun, Apr–Jun 1912, H. Sauter (4♀; HELS, WIEN). Ma-Kung, Peng-hu, 22 Jan 1954, C.C. Lin (2♂, 8♀; USNM). Mt. Hoozan, May 1910, H. Sauter (1♂, HNHM). Tainan, Jun–11 Sep 1912, H. Sauter (8♂, 18♀; HNHM, WIEN). Takao, 27 Jan 1907, H. Sauter (3♂, 12♀; HNHM, USNM). Yen-Swei, 14 Nov 1953, C.C. Lin, S. Liu, Y.K. Ni (2♀; USNM). THAILAND. *Bangkok*: Bangpo, Aug–Sep 1962, at light, J. Scanlon (3♀; USNM); Huaykwang, Aug–Sep 1962, at light, J. Scanlon (8♂, 3♀; USNM); Makasan, 11–12 May 1959, at light, Manop (3♂, 3♀; USNM); Plukchit, Aug–Sep 1962, at light, J. Scanlon (3♂, 1♀; USNM); Pratoomvan, 9/10 May–Sep 1959–1962, at light, Manop, J. Scanlon

(2♀; USNM); Thonglo, Aug–Sep 1962, at light, J. Scanlon (1♂, 4♀; USNM). *Bangphra*: Chon Buri, Oct 1962, at light, J.E. Scanlon (1♂; USNM). *Banpong*: Rat Buri, 26–27 Dec 1958, at light, Manop (1♂, 1♀; USNM). *Khon Kaen*: Ban Pai, 28–30 May 1959, at light, Manop (1♀; USNM); Choom Pae, 25–27 May 1959, at light, Manop (1♀; USNM); Muang, 20–24 May 1959, at light, Manop (1♂, 3♀; USNM). *Loei*: Dan Sai, 6–7 Jun 1959, at light, Manop (1♂; USNM); Muang, 1–5 Jun 1959, at light, Manop (1♂; USNM); Ta Lee, 8–9 Jun 1959, at light, Manop (2♂, 3♀; USNM). *Nong Khai*: Muang, 10–14 Jun 1959, at light, Manop (2♀; USNM); Ta Bo, 15–16 Jun 1959, at light, Manop (1♂, 1♀; USNM). *Sakhonakhon*: Muang, 25–27 Jun 1959, at light, Manop (1♀; USNM). *Surin*: Surin, Jun–Jul 1976, on swamp buffalo, Surachet (1♂, 7♀; BMNH). *Udorn Thani*: Muang, 17–20 Jun 1959, at light, Manop (2♂, 1♀; USNM); Nong Han, 21–22 Jun 1959, at light, Manop (3♂, 2♀; USNM); Pen, 23–24 Jun 1959, at light, Manop (1♂; USNM). *Nonthaburi*, 20 Dec 1958, at light, Manop (3♀; USNM). VIETNAM. Hanoi, 3 Sep–6 Oct 1963, T. Pocs (9♂, 10♀; HNHM).

DISTRIBUTION (Figure 21).—India (Assam, Karnataka, Tamil Nadu, Uttar Pradesh, West Bengal), Indonesia, Malaysia, Pakistan, Philippines (Luzon, Mindoro, Mindanao), Singapore, Sri Lanka, Taiwan, Thailand; Iraq(?), Japan (Honshu, Kyushu, and the Ryukyu Islands), and Vietnam.

REMARKS.—This is the most widespread species in the Orient, and its distribution extends northward into the Palearctic Region (Japan: Kyoto). The locality from Iraq was not located on a map and is unconfirmed.

The species can be distinguished by its lighter coloration, especially of the mesonotum, and by the presence of an anterior notopleural bristle. The anterior notopleural bristle is weaker than the posterior one but is still quite conspicuous. To distinguish *B. longipes* from *B. pleuralis* it is best to use characters of the male terminalia and perhaps the scutellar ratio.

Brachydeutera pleuralis Malloch

FIGURES 22–24

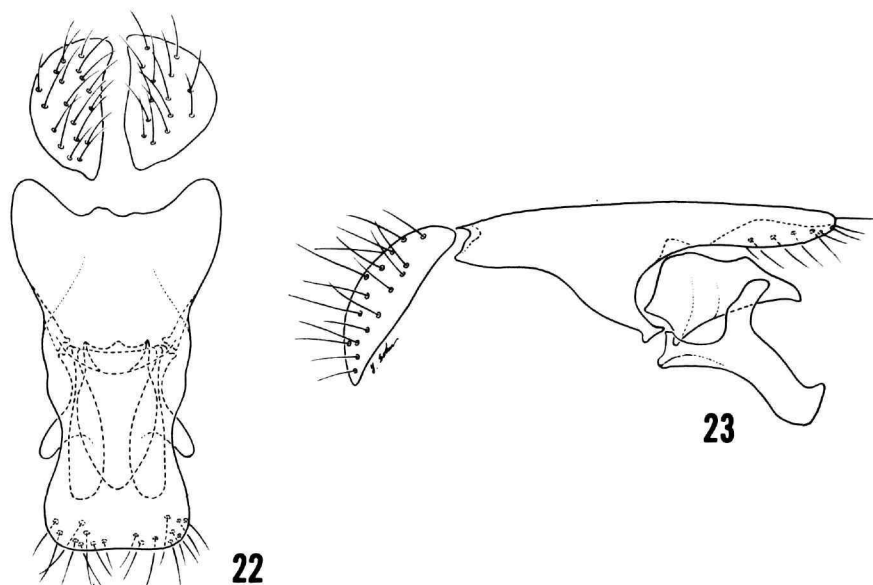
Brachydeutera pleuralis Malloch, 1928:354.—Wirth, 1964:9 [revision].

Brachydeutera pauliani Wirth, 1964:9.—Cogan, 1980:666 [Afrotropical catalog]. [New synonym.]

DIAGNOSIS.—Small to moderately small shore flies, length 1.85–2.65 mm.

Head: Frons mostly grayish brown to light brown, with faint olivaceous areas posterolaterad of ocelli; prominent, laterocline fronto-orbital bristles 3, anterior bristle only slightly weaker, about $\frac{3}{4}$ length of posterior 2. Antenna brown, darker than frons; arisal branches 8–9. Facial carina low and rounded, weakly developed between antennae. Face, clypeus, and gena concolorous, pearly gray, facial carina and antennal fovea slightly darker, lightly tinged with faint olivaceous to grayish blue, extreme dorsum of facial carina sometimes faintly brownish. Palpus pale, yellowish.

Thorax: Mesonotal chaetotaxy comparatively poorly developed; bristles inconspicuous, setae of main setal tracks small. Mesonotum light brown to olivaceous gray, concolorous with frons, sometimes with darker brown stripes through setal tracks and with areas laterad of setal tracks more olivaceous gray, postpronotum and dorsum of scutellum mostly grayish. Scutellar ratio 0.64; apical bristles approximate, distance between them less than that between basolateral scutellar bristle and apical one. Anterior notopleural bristle present, although weaker than posterior one; katepisternal bristle present but inconspicuous, pale, whitish. Light brownish coloration of mesonotum gradually merged ventrolaterally with grayish coloration of pleural areas, notopleuron and sometimes dorsolateral portions of anepisternum mostly light brownish. Femora and tibiae yellowish, forefemur lacking sparsely microtomentose area anterodorsally toward base; tarsomeres brown to dark brown apically; male hind tibia lacking patch of ventral, long setae. Wing hyaline, clear; R_{2+3} moderately arched; R_{4+5}



FIGURES 22-23.—*Brachydeutera pleuralis*: 22, cerci and epandrium (plus fused surstyli?), posterior aspect; 23, cerci, epandrium (plus fused surstyli?), and gonite, lateral aspect.

nearly straight; costal vein ratio 3.60; M vein ratio 0.50.

Abdomen: Dorsum light brown anteriorly and medially, otherwise mostly gray; moderately microtomentose, mostly dull. Male terminalia (Figures 22, 23) as follows: dorsal surface of epandrium irregularly concave; epandrial width at dorsum not much more than lateral margins of cerci; lateral margins of epandrium generally becoming more narrowed ventrally and with 2 emarginate sinuations, epandrium + surstyli broadly formed, apex slightly enlarged, truncate, and with conspicuous setae anteriorly; epandrium + surstyli in lateral view a simple, mostly parallel-sided process, curvature to epandrial connection evenly rounded; gonite with posteroventral and anteroventral processes, the latter thicker and with an apical spur.

PRIMARY TYPE MATERIAL.—The adult holotype of *B. pleuralis* is apparently lost (Lee et al., 1955), probably destroyed. All that remains of the type series are the two puparia, which, according to Malloch, were mounted with the

adults. The puparia are labeled "Townsville [handwritten] QUEENSLAND F.H. TAYLOR larvae lives in water [handwritten]." One of the puparia also bears the following label "Brachydeutera pleuralis Type Det. JR Malloch [black subborder, species name and "Type" handwritten]." Although the adult male holotype and paratype were destroyed, we have studied four topotypical specimens (2♂, 2♀; CIH) from the same series as the holotype that establish the identity of this species and the synonymy with *B. pauliani*. Like the holotype and paratype, the other four specimens have a puparium mounted below each pinned adult.

The holotype male of *B. pauliani* is labeled "Madagascar Centre Station Agric. Alaotra 800m dct Ambatondrazaka 24.XII.57 B. Stuckenberg/♂/♂ HOLOTYPE Brachydeutera pauliani W.W. Wirth [sex symbol, species name handwritten, red]." The holotype is double mounted (minuten wired to main pin), is in good condition, and is in the Muséum National d'Histoire Naturelle, Paris.

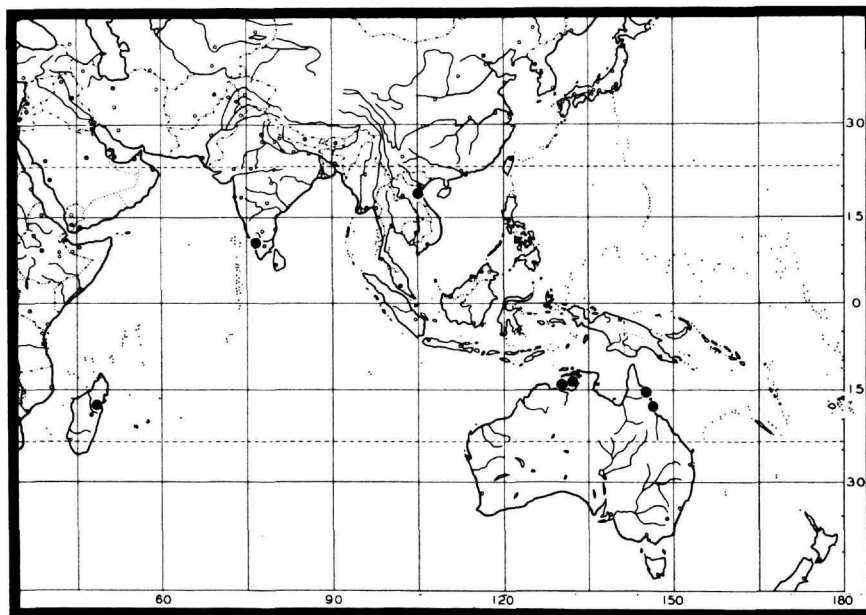


FIGURE 24.—Distribution map of *Brachydeutera pleuralis*.

OTHER SPECIMENS EXAMINED.—AUSTRALIA. *Northern Territory*: Cooper Creek, 19 km E by S Mt. Borradaile, 9 Nov 1972, at light, D.H. Colless (2♂, 2♀; ANIC); Jim Jim Creek, 19 km WSW Mt. Cahill, 24 Oct 1972, at light, D.H. Colless (1♀; ANIC); Magela Creek, 9 km SSE Mudginbarry HS, 6 Nov 1972, at light, D.H. Colless (1♀; ANIC); Mt. Cahill, 15 km E by N, 29 Oct 1972, D.H. Colless (1♀; ANIC); Stuart Highway, Coomalie Creek, 50 m, 24 Oct 1962, E.S. Ross, D.Q. Cavagnaro (2♀; CAS). *Queensland*: Mt. Webb, 3 km NE (15.03S, 145.09E), 1 Oct 1980, at light, D.H. Colless (1♂; ANIC); Townsville, F.H. Taylor (2♂, 2♀; CIH). **INDIA.** *Karnataka*: Mudigere, 900 m, 6 Apr 1980, K.D. Ghorpadé (2♂; KDG, USNM). **VIETNAM.** Cuc Phuong, 17 Oct 1963, T. Pocs (1♂; HNHM).

DISTRIBUTION (Figure 24).—Australia (Northern Territory, Queensland), India (Karnataka), and Vietnam; Cape Verde Islands, Madagascar, Nigeria, South Africa, and Tanzania.

REMARKS.—Discovering the synonymy of *B. pleuralis* with *B. pauliani*, which previously was

known only from Madagascar and South Africa, and collecting specimens from southern India substantially increases the known distribution of this species.

Like *B. longipes*, the lighter coloration of this species, especially the mesonotum, and the presence of an anterior notopleural bristle will distinguish this species from most congeners. From the former, however, accurate identification will usually require reference to characters of the male terminalia.

Brachydeutera sydneyensis Malloch

FIGURES 25–27

Brachydeutera sydneyensis Malloch, 1924:335.—Harrison, 1959:234 [redescription, figures].—Wirth, 1964:11 [revision].

DIAGNOSIS.—Medium-sized shore flies, length 3.10–4.00 mm.

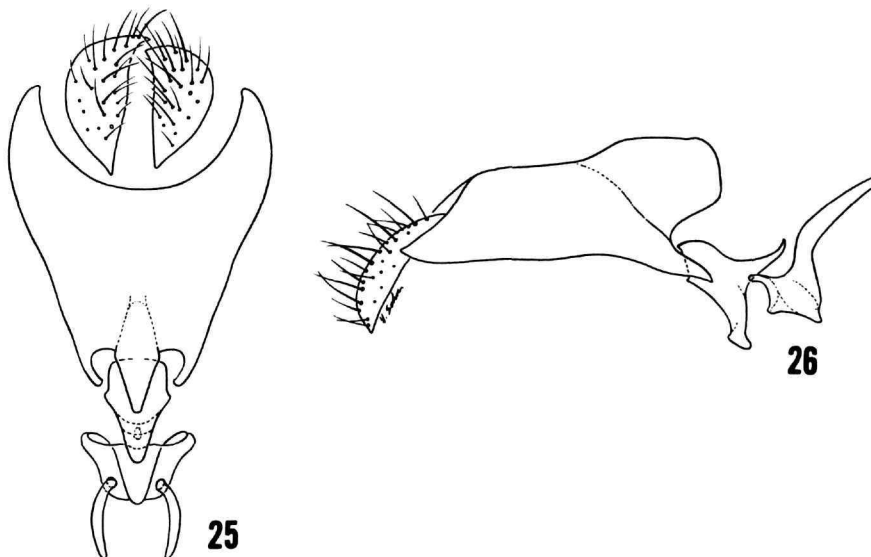
Head: Frons mostly grayish brown to light brown, with faint olivaceous areas posterolaterad

of ocelli and along fronto-orbits; prominent, latero-clinate fronto-orbital bristles 3, anterior bristle only slightly weaker, about $\frac{3}{4}$ length of posterior 2. Antenna brown, darker than frons; arista branches 10–12. Facial carina with ridge brown, lateral surfaces faintly olivaceous to bluish gray, conformation low and bluntly rounded, flattened dorsally between antennae. Face, except for facial carina, clypeus, and gena concolorous, pearly gray. Palpus pale, yellowish.

Thorax: Mesonotal chaetotaxy moderately developed; bristles inconspicuous, setae of main setal tracks small. Mesonotum light brown to olivaceous gray, concolorous with frons, sometimes with extensive gray areas lateral of setal tracks, postpronotum and dorsum of scutellum mostly grayish. Scutellar ratio 0.72; apical scutellar bristles approximately, distance between them about $\frac{1}{2}$ distance between basolateral scutellar bristle and apical one. Anterior notopleural bristle lacking; katepisternal bristle lacking, but with inconspicuous, pale, whitish setae. Light brownish coloration of mesonotum gradually merging with grayish coloration of pleural areas,

notopleuron mostly light brownish and sometimes dorsolateral portions of anepisternum. Femora yellowish; tibiae mostly yellowish except for dark brown annulation apically; tarsomeres brown to dark brown apically; male hind tibia lacking patch of ventral, long setae. Wing hyaline, clear; R_{2+3} slightly arched; R_{4+5} slightly arched; costal vein ratio 2.63; M vein ratio 0.92.

Abdomen: Mostly faintly olivaceous gray but with extensive dark brown markings posteriorly and/or anteriorly as fascia, bigeminate spots, sometimes with median connections. Male terminalia (Figures 25, 26) as follows: dorsal surface of epandrium deeply and evenly concave, forming pocket into which cerci lie; epandrial width at dorsum conspicuously wider than lateral margins of cerci; lateral margins of cerci narrowed evenly ventrally, ventral apex in posterior with 2 lateral, inwardly curved processes and a large, triangular median process, in lateral view the median process is a broad keel with a truncate apex; gonite with small, basal subquadrate structure bearing a long, slender posteroventral process.



FIGURES 25, 26.—*Brachydeutera sydneyensis*: 25, cerci and epandrium (plus fused surstyli?), posterior aspect; 26, cerci, epandrium (plus fused surstyli?), and gonite, lateral aspect.

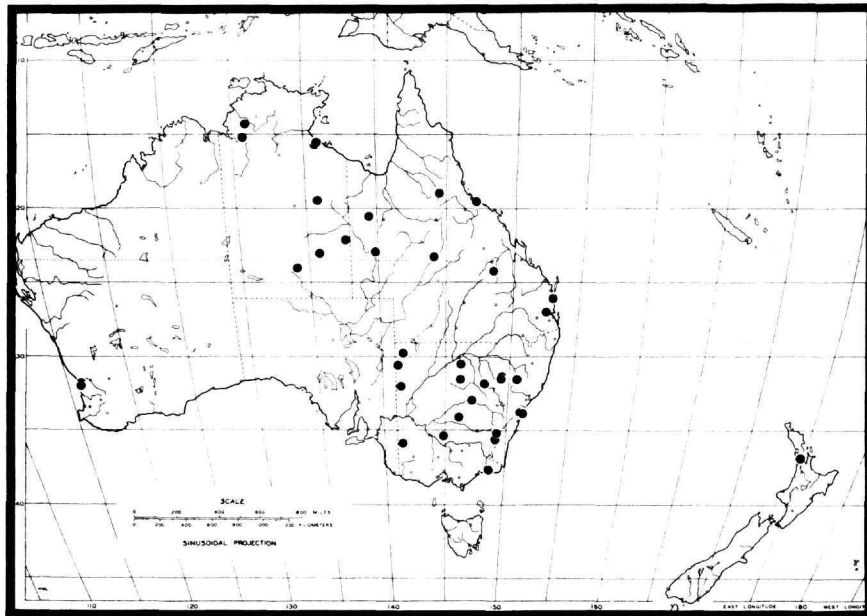


FIGURE 27.—Distribution map of *Brachydeutera sydneyensis*.

PRIMARY TYPE MATERIAL.—Holotype female is labeled "Sydney[,] Collaroy 10.9.[19]21 Health Dept./*Brachydeutera sydneyensis* Det J R Malloch Type [species name and type handwritten; black submarginal border]." The holotype is double mounted, is in good condition [right mid-leg missing], and is in the insect collection of the School of Public Health and Tropical Medicine, University of Sydney. In the original description, Malloch stated that the holotype and single paratype from the type-locality were males. Both specimens are females, however.

OTHER SPECIMENS EXAMINED.—AUSTRALIA. *Australian Capital Territory*: Black Mountain, 2 Jan–30 Apr and 8 Oct–28 Dec from 1930 to 1968, light trap, yellow-tray aphid trap, I.F.B. Common, R.D. Hughes, A.L. Tonnoir (9♂, 31♀; ANIC, USNM); Blundell's, 1 mi [2 km] S, 2 Mar 1955, I.F.B. Common (2♀; ANIC); Canberra, 4 Dec 1963, D.H. Colless (1♀; ANIC); Lake Burley Griffin, Canberra, 2 Feb 1964, D.H. Colless (reared from puparia found floating among grass)(2♂, 7♀, 5 puparia; ANIC); Narrabundah, 24 Nov 1961, light trap, P.W. Geier (91♀;

ANIC). *New South Wales*: Belaringar, 9 Sep 1923 (2♂, 5♀, 5 are paratypes; CIH, USNM); Broken Hill, Dam number 2, 20 Nov 1943, C.E. Chadwick (2♂, 9♀; AM); Billabong Creek, Conargo, 23–30 Apr 1978, Z.Liepa (1♂; ANIC); Broken Hill, Umberumberka, 1 Oct 1944, C.E. Chadwick (3♀; AM); Byrock, 23 km SE by S, 5 Apr 1976, at light, D.H. Colless (2♀; ANIC); Cabbage Tree Creek, Clyde Mountain, 22 Nov 1964, Z. Liepa (2♀; ANIC); Calumet, 26 mi [42 km] NE Binnaway, Nov 1931, A. Musgrave (1♂, 19♀; AM); Condobolin, 17 Oct 1902; W.W. Froggatt (2♀; USNM); Condobolin, 37 km NW, Cobarr Road, 27 Dec 1976, Z. Liepa (1♂, 1♀; ANIC); Deniliquin, 1 May 1978, at light, Z. Liepa (1♀; ANIC); Griffith, 16 Nov 1956, W.W. Wirth (1♀; USNM); McCan's Creek, Terry Hills, 21 May 1958, K. English (1♂, 3♀; AM); McCarrs creek, 20 Sep 1956, W.W. Wirth (1♀; USNM); Mendooran, 5 mi [8 km] S, 13 Sep 1975, G. Daniels (6♂, 11♀; AM); Mt. Boppy, 25 Nov 1949, S.J. Paramonov (8♀; ANIC, USNM); Oxford Falls, 22 Apr 1956, D.K. McAlpine (3♂, 6♀; AM); Packsaddle, 111 mi [178 km] N Broken Hill 23–

24 Nov 1969, H.E. Evans (14♀; ANIC); Quandong, 53 km NE Broken Hill, 26 Sep 1975, Z. Liepa (2♀; ANIC); Royal National Park, 28 Dec 1970, D.K. McAlpine (1♂; AM); Sydney, Collaroy, 10 Sep 1921 (2♀, holotype and paratype; CIH); Tibooburra, Cobham Lake, 17 Nov 1949, S.J. Paramonov (1♂, 8♀; ANIC, USNM); Upper Allyn River, 1500 ft [457 m], 9 Nov 1960, I.F.B. Common, M.S. Upton (2♀; ANIC); Warrarah, 1920, W.W. Froggatt (9♀; ANIC). *Northern Territory*: Alice Springs, 41 km S by E, 4 Oct 1978, at light, D.H. Colless (1♂, 1♀; ANIC); Alroy Downs, 12 km SW, 10 Apr 1976, D.H. Colless (1♂; ANIC); Bukalara Plateau, 46 km SSW Borrooloola, 23 Apr 1976, at light, D.H. Colless (2♀; ANIC); Caranbirini, 33 mi [53 km] SW Borrooloola, 21 Apr 1976, at light, D.H. Colless (2♀; ANIC); Coolibah H. S. 4 mi [6 km] W, 17 Sep 1968, M. Mendum (1♀; ANIC); Entire Creek, 155 km NE by E Alice Springs, 13 Oct 1978, at light, D.H. Colless (2♀; ANIC); Goose Lagoon, 11 km SW Borrooloola, 17 Apr 1976, at light, D.H. Colless (3♀; ANIC); Illungnarra, 90 km SW by S Urandangi (Queensland), 15 Oct 1978, at light, D.H. Colless (3♀; ANIC); McArthur River, 2 km SSE Borrooloola, 20 Apr 1976, Malaise trap, D.H. Colless (1♂; ANIC); McArthur River, 14 km S by W Cape Crawford, 11 Apr 1976, at light, D.H. Colless (1♀; ANIC); Plenty Highway, 268 km ENE Alice Springs, 14 Oct 1978, D.H. Colless (1♂, 1♀; ANIC); Roe Creek, 12 km SW by W, Alice Springs, 9 Oct 1978, at light, D.H. Colless (6♀; ANIC). *Queensland*: Boulia, 62 km W by S, 17 Oct 1978, at light, D.H. Colless (1♀; ANIC); Burpengary, 1904, T.L. Bandroft (1♂, 3♀; BMNH); Camp Milo (26.00S, 153.05E), Cooloolia National Park, 16–20 Oct 1978, D.C.F. Rentz, J. Balderson (1♀; ANIC); Clare, 26 Aug

1982, I. Kay (1♂, 1♀; BMNH); Darr River, 31 km NW by N Longreach, 7 Apr 1976, at light D.H. Colless (1♀; ANIC); Einasleigh, 24 mi [38 km] SE, 500 m, 4 Nov 1962, E.S. Ross, D.Q. Cavagnaro (1♀; CAS); Esdivol, 1924, Bancroft (2♂, 3♀, 2♀; CIH, USNM); Mt. Isa, 66 km NW, 9 Apr 1976, at light, D.H. Colless (1♀; ANIC); Springsure, 19 Apr 1955, I.F.B. Common, K.R. Norris (1♀; ANIC). *Victoria*: Little Desert, 13 mi [21 km] S Kiata, 6 Nov 1966, I.F.B. Common, M.S. Upton (2♂; ANIC); Orbost, 15 mi [24 km] NNE, 5 Nov 1969, I.F.B. Common (1♀; ANIC). *Western Australia*: Cannington, 30 Jan 1935, K.R. Norris (2♂, 3♀; ANIC, USNM); Carson Escarpment (14.49S, 126.49E), 9–15 Aug 1975, I.F.B. Common, M.S. Upton (1♂, 2♀; ANIC); Crawley, 11 Feb 1934, K.R. Norris (2♀; ANIC); Guildford, 29 Sep 1936, K.R. Norris (4♀; ANIC, USNM). *NEW ZEALAND*. *North Island, Auckland*: Mangere, Owairaka, R.A. Harrison (1♂, 1♀; NZAC).

DISTRIBUTION (Figure 27).—Australia, where it is widespread (Australian Capital Territory, New South Wales, Northern Territory, Queensland, Victoria, Western Australia), and New Zealand.

REMARKS.—The lack of an anterior notopleural bristle; the lighter brown coloration of the mesonotum, which gradually merges with the pleural coloration; and the fasciate, abdominal terga distinguish this species from all congeners. The characters just enumerated plus those of the male terminalia make this structurally the most divergent species of the genus.

This species is apparently attracted to lights at night, as evidenced by numerous specimens that were collected in light traps.

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