Sylvicola cinctus (Fabricius), the Hawaiian Wood Gnat, with Notes on the Family (Diptera: Anisopodidae)

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ABSTRACT. The Hawaiian Wood Gnat is identified as *Sylvicola cinctus* (Fabricius). The family Anisopodidae is reviewed, and key to World genera is presented. Male and female genitalia of *S. cinctus, S. fenestralis* and *Anisopus fuscatus* (two other species likely to occur in Hawaii) are figured.

For a number of years a species of Anisopodidae has been known from the Hawaiian Islands (Hardy 1983; Joyce 1959, 1983). The initial specimens (all females) were sent to Thompson who identified them as possibly *Sylvicola fenestralis* (Scopoli). When males were available this identification was changed to *Sylvicola* species, possibly new, but definitely not any of the Nearctic species nor any other Oriental or Australian species known to him. As Rogers had just begun a world revision of the family, the specimens were referred to him. Due to continued requests by Evenhuis and Hardy, who needed a name for their faunistic and catalog work, Thompson recently reviewed the matter and identified the species as European! We here report the name, redescribe the species, validate the name, figure the male genitalia and wing pattern, and present our preliminary views on the classification of *Sylvicola* of authors, as they confirm those already reported by Pratt and Pratt (1980). This treatment is enlarged, as other species of Anisopodidae are likely to be found in Hawaii (one specimen of what was probably *Sylvicola fenestralis* was recently collected in containers used to ship Christmas trees from the Pacific Northwest (Nakahara, 1989)). We have provided a key to the genera of Anisopodidae and references to all major works on the family.

The present accepted classification of Anisopodidae is that of Edwards (1928), except two additional genera have been added (Correa 1947, Colless 1990). European workers, however, separate the aberrant genus *Mycetobia* (Edwards 1916, Knab 1916) as a distinct family (Rohdendorf 1964, 1974, Hennig 1973, Mamaev 1969, 1988, Krivosheina 1969, 1986, Kovalev 1983, Mamaev & Krivosheina 1988, Baylac & Matile 1988). Beyond the work of Edwards, little has been done on the family, and most of that merely was review of previous work (Peterson 1981) or consideration of the placement of the family within the higher classification of Diptera (Tuomikoski 1961, Wood & Borkent 1989). Stone (1965) changed the name of the type genus (*Anisopus* Meigen), as all previous authors had either overlooked or con-

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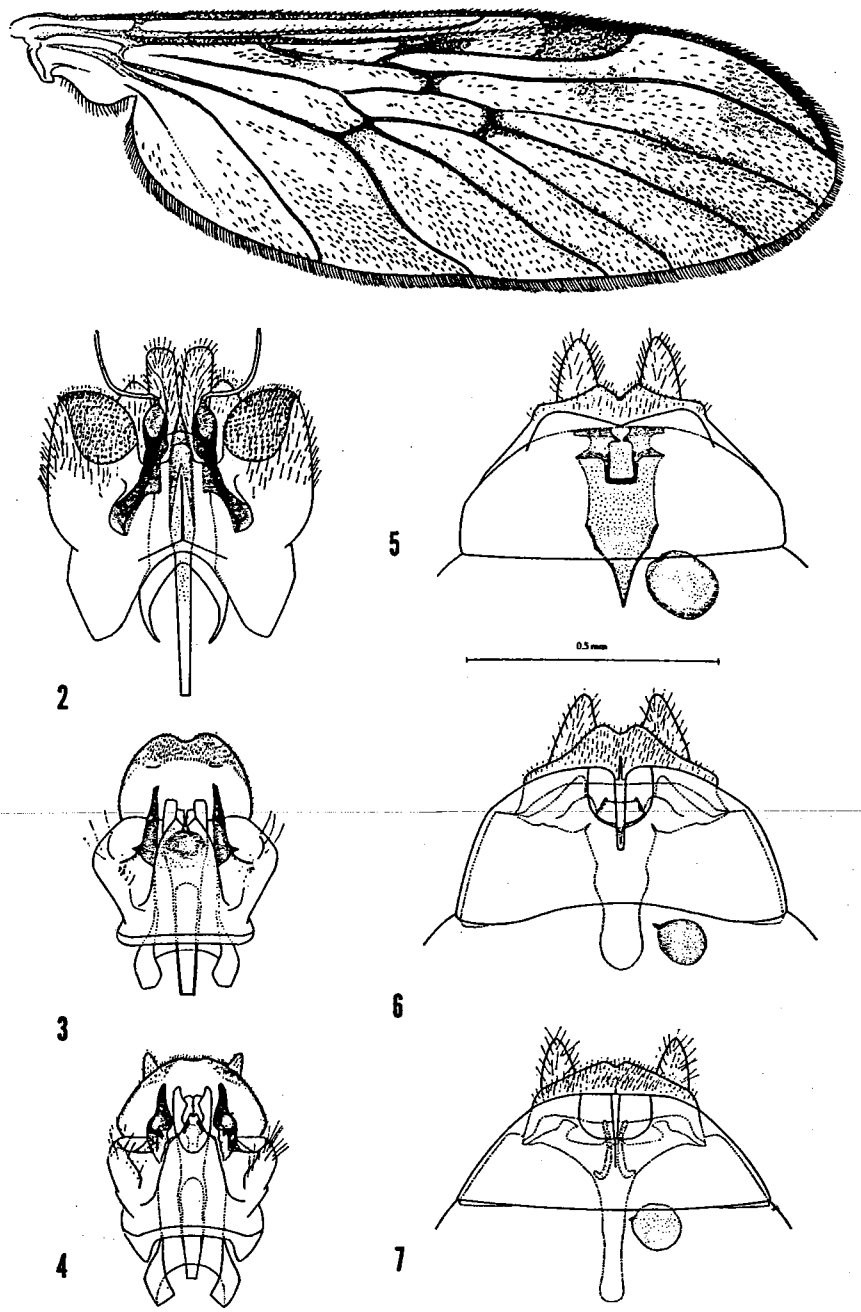

FIGURES 1-7. 1. Wing of *Sylvicola cinctus*. 2-4. Male genitalia. 2. *Anisopus punctatus*, 3. *Sylvicola fenestralis*, 4. *S. cinctus;* 5-7. Female genitalia. 5. *A. punctatus*, 6. *Sylvicola fenestralis*, 7. *S. cinctus*.

sidered invalid (Knab 1912, Edwards 1919) Coquillett's (1910) designation of *brevis* Harris as the type of *Sylvicola* Harris. Most authors had accepted *Sylvicola* as a junior synonym of *Rhagio* Fabricius because *brevis* Harris was considered by Harris himself to be atypical of his genus; all the other originally included species being *Rhagio*. The nomenclatural change, however, has become established through usage in the various regional Diptera catalogs (Alexander 1965; Stone 1973; Papavero 1967; Hutson 1980; Krivosheina 1986; Peterson 1989), leaving the awkward situation of a valid family group name being based on a junior synonym. This situation need not persist! A major, but overlooked, paper on the classification of these flies was published by Pratt and Pratt (1980), in which they demonstrate that there are two well supported groups among the Nearctic, and perhaps, world species of *Sylvicola* of authors. Our work confirms their findings on a world basis; hence, these two groups, which they ranked as only subgenera, are here recognized as genera. Their ranking was rather conservative, especially considering that the distinctions outlined below are of a greater magnitude than those separating many families of Schizophora! The world *Sylvicola* species, however, do not divide into just these two genera, as, for example, endemic South Temperate and most Neotropical species form another distinctive genus.

KEY TO THE GENERA OF ANISOPODIDAE

1. Cell m1 (discal) present; media three branched 2
– Cell m1 absent; media two branched 6
2. Wing with macrotrichia, at least apically; hind tibia with apical comb; mid tibia with 1 apical spur 5
– Wing without macrotrichia; hind tibia without comb; mid tibia with 2 apical spurs 3
3. Eye and katepisternum densely pilose ..... *Lobogaster* Philippi
– Eye and katepisternum sparsely pilose or bare 4
4. Crossvein m connecting with M 1+2 basally; stigmal area hyaline; mesonotal pile short, thick; katepisternum pilose, pollinose ..... *Carreraia* Correra
– Crossvein m connecting with M 2 distally; stigmal area dark; mesonotal pile long, fine; katepisternum bare, shiny ..... *Olbiogaster* Osten Sacken
5. Cell m1 acute basally; m crossvein connecting with M 1+2 basally (fig. 1); male genitalia with basal ring deeply concave ventrally; gonostylus slender, sinuate; sternum 10 deeply notched apically, appearing as 1 fingerlike lobe, partially fused basally ..... *Anisopus* Meigen
– Cell m1 truncate basally; m crossvein connecting with M 2 distally; male genitalia with basal ring not deeply concave ventrally; gonostylus clawlike or rodlike; sternum 10 broad apically, hoodlike ..... *Sylvicola* Harris

6. R 2+3 ending in C 7
– R 2+3 ending in R 1 ..... *Mesochria* Enderlein
7. M 1 and M 2 arising from common stem vein (M 1+2) (see Grimaldi 1991:25, fig. 34) ..... *Mycetobia* Meigen
– M 1 and M 2 separate, without a common stem, arising directly from basal cell (see Grimaldi 1991:7, fig. 18) ..... *Valeseguya* Colless

Genus *Anisopus* Meigen

Phryne Meigen, 1800:16. Type species, *Tipula fuscata* Fabricius designated by Coquillett (1910:589). Suppressed by ICZN, 1963:339.

Anisopus Meigen, 1803:264. Type species, *Anisopus fuscus* Meigen [= *Tipula fuscata* Fabricius] designated by Coquillett (1910:507). *Anisopus* was proposed without named species. Coquillett's designation was from the first two species included by Meigen (1804).

DISTRIBUTION: Restricted to the North Temperate Region.

INCLUDED SPECIES: *fuscatus* Fabricius, *notialis* Stone, *punctatus* Fabricius, *separatus* Edwards.

The available data on immature stages and biology suggest that there may be additional differences between *Sylvicola* and *Anisopus: Anisopus* being strictly coprophagous and having the larval anal segment divided into two parts; *Sylvicola* usually saprophagous and having the anal segment divided into 4 or 5 parts.

Genus *Sylvicola* Harris

Sylvicola Harris, 1776:100. Type species, *Sylvicola brevis* Harris [= *Tipula fenestralis* Scopoli] designated by Coquillett (1910:610).

Rhyphus Latreille, 1804:188. Type species, *Tipula fenestralis* Scopoli by monotypy.

DISTRIBUTION: North Temperate, with limited extensions into the Orient and Neotropics.

INCLUDED SPECIES: *andinus* Edwards, *alternata* Say, *cinctus* Fabricius, *divisus* Brunetti, *fenestralis* Scopoli, *japonicus* Matsumura, *matsumurai* Okada, *oceana* Frey, *phillippinus* Edwards, *suzukii* Okada, *limpidus* Edwards, *zetterstedti* Edwards.

Sylvicola cinctus (Fabricius)

Rhagio cinctus Fabricius, 1787:333. Type-locality: Germany, Kiel. Type ? UZMC, Zimsen 1964:453 (only wings remain in Fabrician Collection). Fabricius 1794:275 (cit.); Meigen 1804:308 (cit., questions placement).

Sciara cincta: Fabricius 1805:60 (comb.).

Rhyphus cinctus: Zetterstedt 1850:3437 (descr., Sweden), 1852:4342 (Norway); Walker 1856:341 (descr., syn., Britain); Schiner 1864:495 (diagn., Austria); Siebke 1877:191 (Norway); Sintenis 1886:287 (Estonia); Kowarz 1894:7 (Bohemia); Strobl 1898a:278 (Austria), 1898b:602, 1900:105 (Yugoslavia); Thalhammer 1899:16 (Hungary); Kertész 1902:304, 1903:167 (cat. cit.); Wahlgren 1905:154 (Sweden); Frey 1945:8 (Azores).

Anisopus cinctus: Edwards 1923:476 (diag., distr.), 1928:16 (key ref., cit.); Keilin & Tate 1940:46 (larval antenna); Freeman, 1950:72 (Great Britain, diag., distr.).

Phryne cincta: Lindner 1930:5 (syn., descr., distr.); Soós 1940:124 (Hungary).

Sylvicola cinctus: Pedersen 1968:230 (Denmark, descr., fig. MG); Stackelberg 1969:443, 1988:682 (European USSR, key ref., fig. MG); Hutson 1976:28 (England), 1977:28 (St. Helene), 1980:212 (Afrotropical distr.); Hackman 1980:30 (Finland).

Musca succinctus Gmelin, 1790:2866. New name for *Rhagio cinctus* Fabricius.

Anisopus sp.: Joyce, 1959:15 (Hawaiian records).

Sylvicola sp.: Hardy, 1983:176; Joyce, 1983:176 (Hawaiian records).

Anisopus fenestralis (in part): Meigen 1818:323 [1851:251] (descr., syn.).

Head. Mouthparts dark brown, with brown setae. Face tan, pollinose. Frons dark gray, pollinose, with a few scattered, short, weak, brown setae ventrad of ocellar tubercle. Antenna dark brown, with numerous short, strong dark brown setae. Scape widest at apex. Pedicel rounded. Flagellum tapering gradually to apex. Ocellar tubercle prominent, extending as low ridge across occiput, with several strong brown setae of varying length. Occiput dark gray, pollinose, with scattered short brown setae posterior to ocellar tubercle. This area separated by narrow bare vitta laterally, remainder of occiput with scattered long brown setae.

Thorax. Scutum with long strong setae in dorsocentral, supra-alar, and postalar rows; with abundant scattered short weak setae also present. Scutum pollinose, usually with tree dark brown longitudinal vittae as follows: acrostichal vitta from anterior edge, extending 0.7 length of scutum, tapering posteriorly; pair of dorsocentral vittae begin 0.2 from anterior margin and extend to posterior margin, with inner margin emarginate at a point level with posterior margin of acrostichal vitta. Scutum otherwise or rarely entirely grayish brown. Scutellum light brown, with pair of long, strong, dark brown setae and numerous short, weak, scattered, dark brown setae. Postnotum dark brown, sparsely pollinose. Pleura light brown, sparsely pollinose, with anepisternum and meron somewhat darker. Postspiracular setae short, weak, light brown. Anepimeral setae present along posterior margin. Wing: Hyaline, with brown maculae. Costal cell clear; subcostal cell clear except for small area at apex; cell r1 infuscated medially, with pterostigma at apex; cell r2+3 infuscated basally, in small area posterior to pterostigma, and on distal 0.2 of cell; basal radial cell infuscated medially and apically; cell r4+5 infuscate basally, in small area posterior to pterostigma and another area on distal 0.2, with both these areas restricted

to anterior half of cell; basal medial cell slightly infuscated apically; discal cell infuscated on distal 0.1; cells m1 and m2 slightly infuscated basally; cell m3 clear; anterior cubital cell infuscated basally; posterior cubital cell and anal lobe clear. Macrotrichia abundant, providing somewhat darker hue on hyaline areas of wing. Halter: Stem and knob yellow. Legs: Coxae yellow; trochanter yellow except narrowly black apically; fore femur yellow; mid-femur yellow, with narrow brown annulus apically; hind femur yellow, with indistinct dark brown annuli medially and apically; tibiae yellow; tarsi pale, darker brown apically.

Abdomen. Tergum I light brown; terga II-VII darker brown at base, becoming lighter distally and laterally, with narrow light brown fascia on apical margin; setae short, weak, present on all segments; sternum I light brown; sterna II-VII dark brown. Genitalia: Aedeagal guide broad basally, tapering apically, with broad apical notch; gonocoxites fused; gonostylus horn-shaped, with small lobe basally; 10th sternum forming broad plate, with margin rounded, emarginate medially; with a tubercle dorsad to each gonostylus; cercus extending slightly beyond 10th sternum.

DISTRIBUTION: Europe (Scandinavia southward); North Africa, Azores, St. Helena, Hawaiian Islands.

HAWAIIAN DISTRIBUTION: Molokai, Puu Kolekole, 3,700 ft., 14 Jan. 83 (S.L. Montgomery) 2 females reared ex decaying bark of *Clermontia* (Lobeliaceae); same data except 1 mile NW of (1 male, 3 females). Maui, Kipahulu Valley, 6,000 ft., 18 Aug. 83 (S.L. Montgomery) 3 females reared ex rotten *Ilex* bark. Hawaii, Hualalai, 4,600 ft., 29 Aug. 80 (K.Y. Kaneshiro), 2 males, 2 females; Ahumoa, Mauna Kea, 7,000 ft., 9 June 80 (Val Giddings) female on *Myoporum* slime flux; Honomaimo, Hoopuloa quad., South Kona, 2,000 ft., 9 Sep. 81 (S.L. Montgomery) male reared ex bark *Charpentiera,* another with same data but reared ex bark *Canavalia.* The Hawaiian population probably came from the Azores. It definitely did not come from the New World as the species is absent there.

As it is the only anisopodid known from the islands, there should be no problem recognizing *S. cinctus.* However, other species may be introduced, such as *S. fenestralis* or *Anisopus punctatus,* the two most common and widespread species in North America. These species are best distinguished by the terminalia. The excellent figures of Pederson (1968) are here republished.

Unravelling the identity of early names can be difficult, especially if types or voucher specimens are not available. Such is the case with the name *Rhagio cinctus* Fabricius. The concept Fabricius intended to represent by the name *cinctus* is difficult to interpret today as we use more and different characters than those used by Fabricius. The concept of Fabricius is today documented only by his original description and the remains of what may be a type specimen. Fabricius described *cinctus* as follows: Stature of *Rhagio longicornis* Fabricius [= *Macrocera,* n. comb]; head globose, testaceous; antenna filiform, black, half length of body; thorax testaceous, immaculate; abdomen testaceous, with segments black basally; legs testaceous, with black knees; wings hyaline, with many small scattered black maculae [literal

translation of original description]. Fabricius placed *cinctus* in his genus *Rhagio,* which was originally (Fabricius 1775) equivalent to *Rhagio, sensu lato;* that is, a group of large flies with maculate wings and short antennae (= brachycerous flies). Later (1787, 1794) he started adding flies with similarly maculate wings, but with longer antennae (= nematocerous flies). *S. cinctus* was in this latter group of species. Fabricius, in his last attempt at Diptera classification, transferred all these nematocerous species of *Rhagio* to *Sciara.* Meigen in his first major work on flies (1804) did not recognize *cinctus,* which he suggested probably did not belong in *Rhagio.* Later in his definitive work on flies, Meigen (1818) transferred *cinctus* to *Rhyphus* as a synonym of *fenestralis* Scopoli. Subsequent authors followed him until Zetterstedt (1852) separated these "species" by the presence or absence of dark mesonotal vittae. This concept was maintained until Edwards. Edwards (1923:476) confirmed that there were two species involved, but he noted that the mesonotal vittae character did not distinguish them. In females of both species the vittae are present, but the vittae were usually (but not always) absent in males of *cinctus.* Edwards redefined these species on the basis of male terminalia characters. As only one species is occasionally "immaculate" [=absence of mesonotal vittae], he assigned the name *cinctus* to it, and used *fenestralis* for the other. Again, subsequent authors have accepted Edwards' interpretation of these names. Our interpretation follows Edwards. There are no characters mentioned in the original description that contradict this interpretation, and what remains of the type material, only a wing, also agree with it.

There remains only one question related to the validity of the name *Rhagio cinctus* Fabricius. When Gmelin (1790) compiled the 13th edition of Linnaeus' *Systema Naturae,* he placed all the species that had been described subsequently back into Linnaeus' classification. This brought many species described in genera such as *Rhagio* Fabricius, together in *Musca* Linnaeus, creating numerous secondary homonyms which Gmelin renamed. Many of these Gmelin names, such as *Musca succincta,* were never used again except to be listed as synonyms. Under the present *Code,* "a junior secondary homonym replaced before 1961 is permanently invalid" (ICZN, 1985:111, Art. 59b). There is, however, a "catch 22", that is, if the replacement name, here *succincta* Gmelin, "is a cause of confusion," then a case is to be submitted to ICZN (Art. 59b(i)). We believe the use of these Gmelin replacement names in most cases, especially for *cinctus,* are a source of confusion (see Thompson 1981:15-16). Hence, we here maintain the use of *Rhagio cinctus* Fabricius, pending an application to ICZN for general suppression of the unused Gmelin replacement names.

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REFERENCES CITED

Alexander, C.P. 1965. Family Anisopodidae. Pp. 190-191. In Stone, A, et alia (eds.), A catalog of the Diptera of America north of Mexico. Agric. Handb. 276. Washington, D.C.

Baylac, M. and L. Matile. 1988. Diptéres Anisopodoidea Mycetobiidae de Nouvelle-Calédonia. In: Tillier, S. (ed.), Zoologica Neocaledonica. Vol. 1. Mém. Mus. Natn. Hist. Nat. (A) 142:83-87.

Colless, D.H. 1990. *Valeseguya rieki,* a new genus and species of dipteran from Australia (Nematocera: Anisopodidae). Annls Soc. Entomol. France (N.S.) 26:351-353.

Coquillett, D.W. 1910. The type-species of the North American genera of Diptera. Proc. U.S. Natn. Mus. 37:499-647.

Correra, Renato R. 1947. Sobre alguns Anisopodidas da America do Sul descricao de *Carreraia,* n. gen. (Dipt. Anisopodidae). Papeis Avulsos, Dept. Zool., Secr. Agric., Sao Paulo 8:97-107.

Edwards, F.W. 1916. On the Systematic Position of the Genus *Mycetobia,* Mg. (Diptera Nematocera). Ann. Mag. Nat. Hist. (8) 17:108-116.

_____. **1919.** Dipteres. Nematoceres. Mission Arc Meridien Equat. 10(2):143-162.

_____. **1923.** Notes on the Dipterous family Anisopodidae. Ann. Mag. Nat. Hist. (9) 12:475-493.

_____. **1928.** Diptera. Fam. Protorhyphidae, Anisopodidae, Pachyneuridae, Trichoceridae. Genera Insectorum 190, 41 pp., 2 pls.

Fabricius, J.C. 1775. Systema entomologiae, sisten insectorum classes, ordines, genera, species adiectis synonymis, locis descriptionibus, observationibus. Flensburgi et Lipsiae 832 pp.

_____. **1781.** Species insectorum exhibentes eorum differentias specificas, synonyma, auctorum, loca natalia, metamorphosin. Hamburgi et Kilonii 2, 517 pp.

_____. **1787.** Mantissa insectorum sistens species nuper detectas. Hafniae 2, 382 pp.

_____. **1794.** Entomologia systematica emendata et aucta. Hafniae 4, 472 pp.

_____. **1805.** Systema antliatorum secundum ordines, genera, species. Brunsviage 30 + 373 pp.

Freeman, P. 1950. Anisopodidae, pp. 70-72 in Coe, R.L., P. Freeman & P.F. Mattingly, Diptera: Nematocera (part). Handb. ident. Brit. Ins. 9(2), 216 pp.

Frey, R. 1945. Tiergeographische Studien über die Dipterenfauna der Azoren. I. Verzeichnis der bisher von den Azoren bekannte Dipteren. Soc. Sci. Fenn., Commentat. biol. 8(10), 114 pp.

Gmelin, J.F. 1790. Caroli a Linne, Systema naturae per regna tria naturae, Ed. 13. Lipsiae 1:2225-3020, pt. 5.

Grimaldi, D.A. 1991. Mycetobiine Woodgnats (Diptera: Anisopodidae) from the Oligo-Miocene Amber of the Dominican Republic, and Old World Affinities. Amer. Mus. Novitates 3014, 27 pp.

Hackman, W. 1980. A checklist of the Finish Diptera. I. Nematocera and Brachycera (s. str.). Notul. Entomol. 60:17-48.

Hardy, D.E. 1983. *Sylvicola (Sylvicola)* sp. near *fenestralis* (Scopoli). Proc. Hawaii. Entomol. Soc. 24:176.

Harris, M. 1776-[1780]. An exposition of English insects with curious observations and remarks wherein each insect is particularly described, its parts and properties considered, the different sexes distinguished, and the natural history faithfully related. Decad I, pp. 1-40, 2 pls. + pls. 1-10, 1776; Decad II, pp. 41-72, pls. 11-20 [?1776]; Decads III-V, pp. 73-166, pls. 21-50 + 1 pl. [?1780].

Hennig, W. 1973. Ordnung Diptera (Zweiflügler). Handb. Zool. 4(2) 2/31 (Lfg. 20), 337 pp.

Hutson, A.M. 1976. 12. Anisopodidae. P. 22, in Kloet & Hincks (eds), A checklist of British insects, 2nd ed. Part 5: Diptera and Siphonaptera. Handbk Ident. Br. Insects 11(5), ix + 139 pp.

_____. **1977.** 2. Fam. Anisopodidae. Pp. 28-29, *in* Basilewsky, P. (ed.), La faune terrestre de l'ile de Sainte-Helene. Trisieme partie. 11. — Insectes (suite et fin). Annls Mus. r. Afr. cent., ser. 8vo (Zool.) 215 [1976], 533 pp.

_____. **1980.** Family Anisopodidae. [Chapter 13], pp. 211-212, *in* Crosskey, R.W. (ed.), Catalogue of the Diptera of the afrotropical Region, British Museum (Natural History), London, 1437 pp.

ICZN [International Commission on Zoological Nomenclature] **1963.** Opinion 678. The suppression under the Plenary Powers of the pamphlet published by Meigen, 1800. Bull. zoolog. Nomencl. 20:339-342.

_____. **1985.** International code of zoological nomenclature. Third edition. xx + 338 pp.

Joyce, C.R. 1959. *Anisopus* sp. Proc. Hawaii. Entomol. Soc. 17:15.

_____. **1983.** Editors note re *Sylvicola* above. Proc. Hawaii. Entomol. Soc. 24:176.

Keilin, D. and **P. Tate. 1940.** The early stages of the families Trichoceridae and Anisopodidae (Rhyphidae). Trans. R. Entomol. Soc. London 90:39-62.

Kertész, K. 1902. Catalogus Dipteroum hucusque descriptorum. Vol. 1, [iv] + 339 pp. Leipzig.

_____. **1903.** Orthorrhapha Nematocera. Bd. 1, 383 pp. *In* Becker, T., M. Bezzi, K. Kertész & P. Stein (eds.), Katalog der paläarktischen Dipteren, Vol. 1, iii + 383 pp. Budapest.

Knab, F. 1912. New species of Anisopodidae (Rhyphidae) from Tropical America. [Diptera: Nemocera.] Proc. Biol. Soc. Washington 25:111-114.

_____. **1916.** *Mycetobia* and the Classification of the Diptera. Entomol. News 27:259-262.

Kovalev, V.G. 1983. A new family of fossil Diptera from Australian Triassic deposits and its presumed descendants (Diptera: Crosaphididae, fam. nov., Mycetobiidae). Ent. Obzor. 62:800-805 [Ent. Rev. 62:130-136. translation].

Kowarz, F. 1894. II. Fliegen (Diptera) Böhmens. iv + 42 pp. *In* Catalogus insectorum faunae bohemicae. Verzeichniss der Insekten Böhmen. Gesell. Physikratie Böhmen. [A Czechoslovakian version also exists.]

Krivosheina, N.P. 1969. Ontogenez i evolucija dvukrylykh nasekomykh. Moskva. 291 pp.

_____. **1986.** Family Anisopodidae. Pp. 330-332. In Soós, A. & L. Papp (eds.), Catalogue of Palaearctic Diptera. Vol. 4, Budapest.

Latreille, P.A. 1804. Tableau methodique des Insectes. Pp. 129-200. In Societe de Naturalistes et d'Agriculturs, Nouveau dictionnaire d'histoire naturelle, applique aux arts, principalement a l'agriculture et a l'economie rurale et domestique. Vol. 24: Tableaux methodique d'histoire naturelle. Pp. 1-238.

Lindner, E. 1930. 1a. Phryneidae (Anisopodidae, Rhyphidae). Pp. 1-10, *in his* Die Fliegen der Palaearktischen Region. 2(2). Stuttgart.

Mamaev, B.M. 1969. [23. Fam. Mycetobiidae.] Pp. 265. *In* Bei-Bienko (ed.), [Keys to the insects of the European part of U.S.S.R.] 5(1). Leningrad [in Russian].

_____. **1988.** 23. Fam. Mycetobiidae. Pp. 402-403. *In* Bei-Bienko (ed.), Keys to the insects of the European part of U.S.S.R. 5(1). Washington. [English translation of 1969.]

Mamaev, B.M. and **N.P. Krivosheina. 1988.** Family Mycetobiidae. Pp. 218-219. In Soós, A. & L. Papp (eds.), Catalogue of Palaearctic Diptera. Vol. 3, Budapest.

Meigen, J.W. 1800. Nouvelle classification des mouches à deux ailes (Diptera L.) d'après un plan tout nouveau. 40 pp. Paris.

_____. **1803.** Versuch einer neuen Gattungseintheilung der europäischen zweiflügeligen Insekten. Magazin für Insektenkunde (Illiger) 2:259-281.

_____. **1804.** Klassifikazion und Beschreibung der europäischen zweiflügeligen Insekten (Diptera Linn.). Erster Band. Abt. 1, pp. i-xxviii + 1-152, pls. 1-8; Abt. II, pp. i-vi + 153-314, pls. 9-15.

_____. **1818.** Systematische Beschreibung der bekannten europäischen zweiflügeligen Insekten. Vol. 1, xxxvi + 333 pp., pls. 1-11. Aachen.

_____. **1851.** Reprint of Meigen 1818 (*v.s.*). xxiv + 259 pp., pls. 1-11. Halle.

Nakahara, L. M. 1989. [Assessment of Insects collected in Hawaii from containerized Christmas trees from the Northwest. A memorandum of Plant Quarantine Branch, Dept. Agric., State of Hawaii, dated 17 Feb. 1989].

Osten Sacken, C.R. 1886. Diptera, Vol. 1 [part]. Pp. 1-24, 25-48, 49-72, 73-104, 105-128, pls. 1-2. *In* Godman, F.D. and O. Salvin (eds.), Biologia Centrali-Americana. Zoologia-Insecta-Diptera. Vol. 1, 378 pp., 6 pls. London.

Papavero, Nelson. 1967. Family Anisopodidae. In [Papavero, N. (ed.)], A Catalogue of the Diptera of the Americas south of the United States, Fasc. 17, 9 pp.

Pedersen, B.V. 1968. Studies on the Danish Anisopodidae (Diptera Nematocera). Entomol. Med. 36:225-231.

Peterson, B.V. 1981. Anisopodidae. Pp. 305-312. In McAlpine, J.F. (ed.), *Manual of Nearctic Diptera.* Vol. 1 vi + pp. 1-674. Res. Br., Agric. Canada Monogr. 27.

_____. **1989.** 16. Family Anisopodidae. Pp. 180-181. In Evenhuis, N.L. (ed.), Catalog of the Diptera of the Australasian and Oceanian Regions, 1,156 pp. Bishop Museum Press & E.J. Brill, Honolulu. 1989.

Philippi, R.A. 1865. Aufzählung der chilenischen Dipteren. Verhandl. K.-k. Zool.-Bot. Gesell. Wein 25(Abhandl.):595-782, 7 pls.

Pratt, G.K. and H.D. Pratt. 1980. Notes on Nearctic *Sylvicola* (Diptera: Anisopodidae). Proc. Entomol. Soc. Washington 82:86-98.

Rohdendorf, B.B. 1964. [Historic development of Diptera.] 311 pp. Moscow [In Russian, translated as 1974].

_____. **1974.** The historic development of Diptera. xv + 360 pp. Edmonton, Alberta. [Translation by Moore, J.E. & I. Thiele.]

Schiner, J.R. 1862-1864. Fauna Austriaca. Die Fliegen (Diptera). Vol. 2, 1864. xxxii + 658 pp. H. 8, pp. 1-80 (1862). H. 9/10, pp. 81-288 (1863). H. 11/12, pp. 289-480; H. 13/14, pp. 481-658 + i-xxxii (1864). Wien.

Siebke, H. 1877. Enumeratio insectorum norvegicorum. Fasciculum IV, Catalogum Dipterorum continentem. (Schneider, J.S. ed.) xiv +255 pp., 1 map. Christianiae.

Sintenis, F. 1886. Neu gefundene Tipuliden. Sitzber. Naturf. Ges. Dorpat [1884] 7:287-290.

Soós, Á. 1940. Die Phryneiden Ungarns (Dipt.). Fragmenta Faunistica Hungarica 3(4):123-124.

Stackelberg, A.A. 1969. [32. Fam. Anisopodidae (Rhyphidae, Phryneidae).] Pp. 442-443. *In* Bei-Bienko (ed.), [Keys to the insects of the European part of the U.S.S.R.] 5(1). Leningrad [in Russian].

_____. **1988.** 32. Fam. Anisopodidae (Rhyphidae, Phryneidae). Pp. 681-682. *In* Bei-Bienko (ed.), Keys to the insects of the European part of U.S.S.R. 5(1). Washington. [English translation of 1969.]

Stone, A. 1965. Notes on Nearctic *Sylvicola* species (Diptera, Anisopodidae). Proc. Entomol. Soc. Washington 67:149-151.

_____. **1973.** Family Anisopodidae (Rhyphidae, Phryneidae, Sylvicolidae). Pp. 431-433 in Delfinado, M.D. & D.E. Hardy (eds.), A catalog of the Diptera of the Oriental region. Vol. 1. Suborder Nematocera. Honolulu, Hawaii.

Strobl, P.G. 1898a. Die Dipteren von Steiermark. IV. Theil: Nachträge. Mitt. Naturwis. Ver. Steiermark 1897 (Abh.):192-298.

_____. **1898b.** [Diptera Fauna of Bosnia, Hercegovina and Dalmatia.] Glasnik zemalj. Mus. Bosni & Hercegovina 10:387-466, 561-616. [In Serbian.]

_____. **1900.** Dipterenfauna von Bosnien, Hercegovina und Dalmatien. Wiss. Mitt. Bosni & Hercegovina 7:552-670.

Thalhammer, J. 1899. III. Arthropoda, Insecta. Ordo. Diptera. 76 pp. *In* Fauna Regni Hungariae, Animalium hungariae hucusque cognitorum enumeratio systematica. Editit regia societas scientiarum naturalium hungarica. — A magyar birodalom allatvilaga. A magyar birodalom bol eddig ismert allatok rendszere lajstroma. Kiadta A. K. M. Termeszettudomanyi tarsulat. Budapest.

Thompson F.C. 1981. The flower flies of the West Indies (Diptera: Syrphidae). Mem. Entomol. Soc. Washington 9, 200 pp.

Tuomikoski, R. 1961. Zur Systematik der Bibionomorpha (Dipt.). I. Anisopodidae und Protorhypidae. Ann. Entomol. Fenn. 27:65-69.

Wahlgren, E. 1905. Diptera. 1. Förs ta Underordningen. Orthorapha. Förs ta Gruppen. Myggor. Nemocera. Fam. 1-9. Entomol. Tidskr. 26:91-154. [Also published separately in Svensk Insektfauna.]

Walker, F. 1856. Diptera. Vol. 3, xxiv + 352 pp., pls. 21-30. In (Walker, F., H.T. Stainton & S.J. Wilkinson), Insecta Britannica. London.

Wood, D.M. and **A. Borkent. 1989.** Phylogeny and classification of Nematocera. Pp. 1333-1370. In McAlpine, J.F. (ed.), Manual of Nearctic Diptera. Vol. 3, vi + pp. 1333-1581. Res. Br., Agric. Canada Monogr. 32.

Zetterstedt, J.W. 1842-1860. Diptera Scandinaviae. Disposita et descripta. Vol. 1, pp. iii-xvi + 1-440 (1842); vol. 2, pp. 441-894 (1843); vol. 3, pp. 895-1280 (1844); vol. 4, pp. 1281-1738 (1845); vol. 5, pp. 1739-2161 (1846); vol. 6, pp. 2163-2580 (1847); vol. 7, pp. 2581-2934 (1848); vol. 8, pp. 2935-3366 (1849); vol. 9, pp. 3367-3710 (1850); vol. 10, pp. 3711-4090 (1851); vol. 11, pp. v-xii + 4091-4546 (1852); vol. 12: Sup. 3, pp. v-xx + 4547-4942 (1855); vol. 13: Sup. 4, pp. v-xvi + 4943-6190 (1859); vol. 14, pp. 6191-6609 (1860). Lundae [=Lund].

Zimsen, E. 1964. The type material of I.C. Fabricius. 656 pp. Copenhagen.