

INSECTS OF MICRONESIA

Neuroptera: Hemerobiidae*

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INTRODUCTION

This account is based mainly on about 150 specimens of Hemerobiidae from Micronesia. All of this material was placed at my disposal through the courtesy of Dr. J. L. Gressitt, to whom I am indebted for the opportunity of making this study. The United States Office of Naval Research, the Pacific Science Board (National Research Council), the National Science Foundation, and Bernice P. Bishop Museum have made this survey and publication of the results possible. Field research was aided by a contract between the Office of Naval Research, Department of the Navy, and the National Academy of Sciences, NR 160-175.

In the course of this study I have made much use of specimens in the Museum of Comparative Zoölogy and I have been helped to an inestimable extent by my examination of a type of *Micromus navigatorum* Brauer, sent to me by Dr. Beier of the Naturhistorisches Museum in Vienna.

Specimens are deposited at the following institutions: Bernice P. Bishop Museum (BISHOP), United States National Museum (US), and Museum of Comparative Zoölogy, Harvard University (MCZ).

Only three species are represented in this Micronesian collection, two in *Annandalia* and the third in *Micromus*. The third species, *M. navigatorum*, has now acquired a very wide distribution, in part, at least, through the agency of man. The two species of *Annandalia* are, so far as now known, endemic to Micronesia.

Annandalia and *Micromus* are only distantly related within the family Hemerobiidae and they can readily be distinguished: *Annandalia* has a broad costal area basally, with a well developed recurrent vein; *Micromus* has a narrow costal area basally and lacks entirely the recurrent vein.

* This represents, in small part, Results of Professor T. Esaki's Micronesian Expeditions (1936-1940), No. 110.

SYSTEMATICS

Genus *Annandalia* Needham

Annandalia Needham, 1909, Indian Mus., Rec. 3: 208.

Annandalia, Banks, 1932, Psyche 39: 104.

Genotype: *Annandalia curta* Needham.

Needham established the genus *Annandalia* for *curta* without knowing of Banks' genus *Notiobiella*, which was named only two months previously. Banks subsequently (1910, Ent. News 21: 389-390) placed *Annandalia* in synonymy with *Notiobiella*, but much later, after reviewing all known species of *Notiobiella*, he reerected *Annandalia* to receive 10 species in addition to *curta*. From my examination of all available material now at hand, including the types of eight species, I agree that the genus should be accepted. As Banks noted, in the fore wing of *Annandalia*, the subcosta and radius are widely separated, with two or three prominent crossveins between them. In *Notiobiella*, these two longitudinal veins are virtually contiguous, without connecting crossveins. Comparable generic differences also exist in body structures, including the male genitalia, which were unknown to Banks.

Thirteen species, already described, belong to *Annandalia*. They are widely distributed over numerous parts of the Old World (data taken from type specimens only) as follows. Africa: *antennata* Kimmins, Belgian Congo; *jeanneli* (Navas), Kenya; *capensis* Kimmins, South Africa. Indian Region: *iniquus* Hagen, Ceylon; *curta* Needham, Calcutta; *hageni* Banks, Ceylon. Australia (Queensland): *externa* (Banks), *obliqua* (Banks), *frazeni* (Banks). East Indies: *pretiosa* (Banks), Fiji Islands; *minima* (Banks), Borneo. Japan: *galloisi* (Navas). Philippine Islands: *affinis* (Banks), Luzon.

Specimens of several of these species have been recorded in the literature from Formosa, Malay Peninsula, and the New Hebrides, although there is uncertainty about their specific identities. The genus has not previously been recorded from Micronesia.

In the course of study of the specimens from Micronesia, I have examined the material in the Museum of Comparative Zoölogy from other regions, including the types of Banks' species. Since the latter were inadequately described for our present needs, I have prepared redescriptions of them with figures of the male genitalia of the type specimens; these will be published in a separate paper elsewhere. The following two new species of *Annandalia* are contained in the Micronesian collection.

1. *Annandalia maculosa* Carpenter, n. sp. (figs. 1, a; 2).

Fore wing: length, 4.5 mm.; width, 2 mm.; hind wing: length, 3.5 mm.; width, 1.5 mm. Body, in general, including antennae and legs, pale fulvous; palpi, dorsal parts of thorax, and abdominal segments brown to dark brown; two dark-brown streaks on each gena, from the compound eye to base of mandible. Fore wing: Membrane pale brown with

diffuse but distinct darker maculations, especially at several of the gradates; wing oval; costal area broad; subradial crossvein at fork of R2 and R3 or distal to the fork, i.e., joining R1 to R2, not the stem of R2+3; six gradate veins (not including the crossvein in subcostal area); gradates 2 and 3 (numbered from anterior to posterior) closely aligned, and gradates 5 and 6 nearly as closely aligned; gradate 4 not aligned with the others and shorter and weaker.

Male genitalia: Ninth tergite with conspicuous median notch on posterior border; ectoprocts in form of a pair of large lobes which, in the case of a distended abdomen, extend dorsally in a nearly perpendicular position with respect to the rest of abdomen; ventral margin of each ectoproct appearing as sclerotized strip (much as in *A. capensis* Kimmins) and terminating in tuft of setae; pair of lateroprocesses arising from ninth tergite, these being somewhat stouter and shorter than the processes of *A. capensis*; tenth sternite in form of pair of slender, curved and weakly sclerotized straps; parameres well developed, fused, with single median, dorsal tooth.

Female similar to male except for usual abdominal differences.

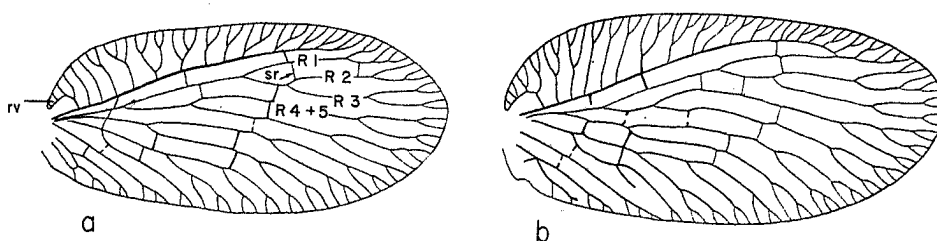


FIGURE 1.—a, fore wing of *Anmandalia maculosa* (specimen taken on Palau, Dec. 20, 1947); b, fore wing of *A. irregularis* (holotype). Abbreviations: rv = recurrent vein; sr = subradial vein; R1 = radius; R2, R3, R4+5 = branches of radial sector.

Holotype, male (US 65380), Ulimang, Babelthuap, Palau Islands, Dec. 9, 1947, Dybas; allotype, female, same data.

The following are paratypes, all Palau Is. Babelthuap: Female, Iwang, 8 m., Dec. 19, 1952, Gressitt; male, East Ngatpang, 65 m., Dec. 10, 1952, Gressitt; male, Ulimang, Dec. 9, 1947, Dybas; female, wooded valley west of Ulimang, Dec. 21, 1947, Dybas. Koror: Three females, July 11, 1953, female, May 30, 1953, male, Feb. 7, 1954, all Beardsley; two males, Nov. 19, 30, 1947, Dybas; male, limestone ridge north of inlet, Jan. 16, 1948, Dybas. Ulebsehel (Aurapushekaru): Male, female, Jan. 13, 1948, Dybas. Ngurukdabel (northeast Urukthapel): Female, Ngaremediu (Ngeremdin), 180 m., Dec. 5, 1952, Gressitt. Peleliu: Two females, northeast coast, Jan. 24, 1948, Dybas; two males, two females, north end of limestone ridge, Jan. 29, 1948, Dybas. Angaur: Male, Feb. 5, 1948, Dybas.

The following are additional specimens, all Palau Is. Babelthuap: East Ngatpang, 65 m., Dec. 10, 1952, Gressitt; wooded peak southwest of Ulimang, Dec. 1947, Dybas. Ngurukdabel (northeast Urukthapel): Ngaremediu (Ngeremdin), Dec. 1952, Gressitt. Ngeremeyaoas (Ngiramaous): Nov. 1947, Dybas. Angaur: Feb. 1948, Dybas.

DISTRIBUTION: Palau Is. (Babelthuap, Koror, Ulebsehel, Nguruk-dabel, Ngeremeyaoas, Peleliu, and Angaur).

This species differs from those previously described in the genus in a number of respects, the most obvious of which is the position of the crossvein (sr) between R1 and the radial sector. In the 24 specimens of *Annandalia maculosa* which I have seen, the crossvein joins the radial sector at the fork of R2+3 or distad of the fork. In all other described species, this crossvein joins R2+3 a considerable distance basad of the fork. In view of the relatively good series of specimens examined, I believe the position of the crossvein is a useful specific characteristic. It is interesting to note that the homologous crossvein is equally useful in the specific determination within *Symphherobius* [Carpenter, 1940, Am. Acad. Arts and Sciences, Proc. 74 (7) : 227-228].

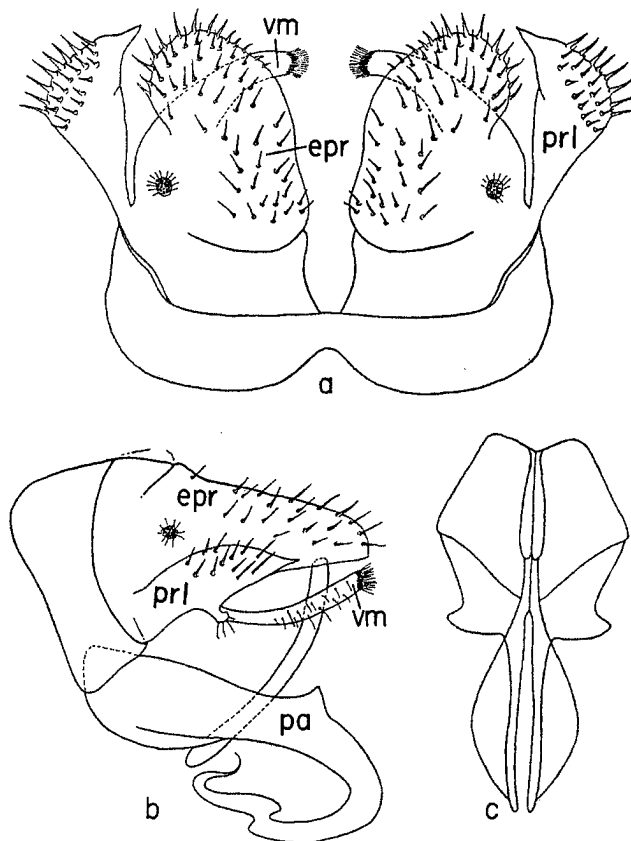


FIGURE 2.—*Annandalia maculosa*: a, terminal abdominal segments, dorsal view; b, same, lateral view; c, parameres, dorsal view. Abbreviations: epr = ectoproct; prl = lateroproduct of ninth tergite; vm = ventral margin of ectoproct; pa = paramere.

From the other known species of the genus, the male of this species also differs in the structure of the ninth tergite and its lateral processes, as well as of the ectoprocts. The male genitalia appear to be nearer to those of *Annandalia capensis* Kimmins than to those of other described species whose genital structures are known to me. In *A. capensis*, however, the lateral processes extend well beyond the ectoprocts, which is not so in *A. maculosa*.

2. *Annandalia irregularis* Carpenter, n. sp. (fig. 1, b).

Fore wing: length 4.5 mm.; width 2.5 mm.; hind wing: length 3.5 mm.; width 1.3 mm. Body in general, including antennae, palpi, and legs, pale fulvous; dorsal parts of thorax and abdominal segments brown; only a single dark-brown streak on each gena, from compound eye to base of mandibles. Fore wing: Membrane pale brown virtually without markings; costal area broad; crossvein sr at fork of R2 and R3 or distal to the fork, as in *A. maculosa*; six gradate veins (not including crossvein in subcostal area); line of gradates broken by gradate 2, which is far proximal of gradates 1 and 3. Male unknown.

Holotype, female (US 65381), Wena (Moen), Truk, Caroline Is., Oct. 22, 1952, Beardsley.

DISTRIBUTION: Caroline Is. (Truk).

This species agrees with *A. maculosa* in having the crossvein sr joined to R2; the position of sr is assumed to be constant in this species as in other species of the genus. It differs from *A. maculosa* in such obvious features as the absence of maculations and particularly in the arrangement of the gradate crossveins, as shown in the illustrations.

Genus *Micromus* Rambur

Micromus Rambur, 1842, Hist. Nat. Ins. Neuropt., 416.

Micromus, Killington, 1936, Monogr. Brit. Neuropt. 1: 250.

As Zimmerman has correctly pointed out, the generic classification of the Hemerobiidae on a worldwide basis is most unsatisfactory. Many genera have been established in studies of local species without regard for the characteristics of genera of other regions; others have been made on very limited series of specimens, inadequate to give a satisfactory idea of specific or individual variation. As a result, specimens of one species may fit into two different genera, and, in some cases, the right wings of a single specimen may have a characteristic of one genus although the left wings may fit another genus.

The genus *Micromus* has presented unusual difficulties. Efforts have been made by several workers (notably Krüger in 1922) to divide this large and cosmopolitan group into several genera. A discussion of some of these, involving Nearctic species, has already been published [Carpenter, 1940, Am. Acad. Arts and Sciences, Proc. 74 (7): 197-198]. *Archaeomicromus* Krüger (1922, Stett. Ent. Zeitung 83: 154) has been synonymized with *Eumicromus* Nakahara [1915, Annot. Zool. Japon. 9 (1): 11], by Killington (1936, Monogr. Brit. Neuropt. 1: 257), and by Zimmerman (1957, Insects of Hawaii 6: 32).

Krüger apparently was unaware of Nakahara's paper. In 1940 [Am. Acad. Arts and Sciences, Proc. 74 (7) : 246] I synonymized *Eumicromus* Nakahara with *Micromus*, pointing out that the proposed differences between these two genera simply do not hold for the Nearctic species. Zimmerman (1957, op. cit.) concludes that *Eumicromus* Nakahara (1915, op. cit.) cannot be maintained as separate from *Nesomicromus* Perkins [1899, Fauna Hawaiiensis 2 (2) : 37]. A study of the Micronesian material now at hand, with the aid of the cosmopolitan collections in the Museum of Comparative Zoölogy, convinces me that *Nesomicromus*, like *Eumicromus*, is not separable from *Micromus* itself. The

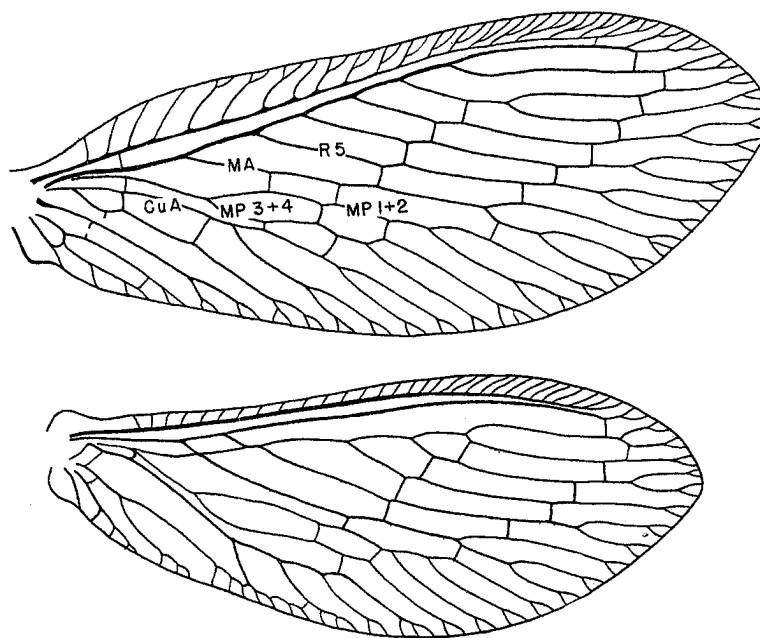


FIGURE 3.—*Micromus navigatorum*, fore and hind wings (specimen taken on Palau, Jan. 1953). Abbreviations: R5 = fifth branch of radial sector; MA = anterior media; MP1+2 and MP3+4 = branches of posterior media; CuA = anterior cubitus.

length of the maxillary palpi, mentioned by Perkins in his account of *Nesomicromus*, shows a marked variation within species, there being an obvious range of intermediate conditions. This character simply does not hold and it has not been used, so far as I am aware, as a point of difference between *Micromus* and *Nesomicromus* since Perkins' account of the latter genus.

So far as I have been able to determine, only one species of Hemerobiidae from Micronesia has been mentioned in the literature. This is the species discussed below as *Micromus navigatorum* Brauer, although it was referred to by Banks as *M. pusillus* Gerstaecker.

3. *Micromus navigatorum* Brauer (figs. 3, 4).

Micromus navigatorum Brauer, 1867, Zool.-Bot. Ges. Wien, Verh. 17: 508.

Archaeomicromus navigatorum, Esben-Petersen, 1928, Insects of Samoa 7 (3): 93, pl. 2, fig. 3.

Nesomicromus navigatorum, Zimmerman, 1957, Insects of Hawaii 6: 63-65, figs. 11; 14, a; 16; 32.

Eumicromus pusillus (Gerstaecker), Banks, 1942, B. P. Bishop Mus., Bull. 172: 29.

Face light brown or yellow; vertex darker brown; antennae pale yellow; eyes dark green; thoracic nota brown, with dark brown on mesonotum near wing bases; legs pale yellow, occasionally with faint brown spot; abdomen light brown. Fore wing: length 6 mm., width 2.2 mm. (average); oval, with rounded apex; membrane light brown; veins dark brown; four to six branches of Rs (not including MA), usually five; two series of

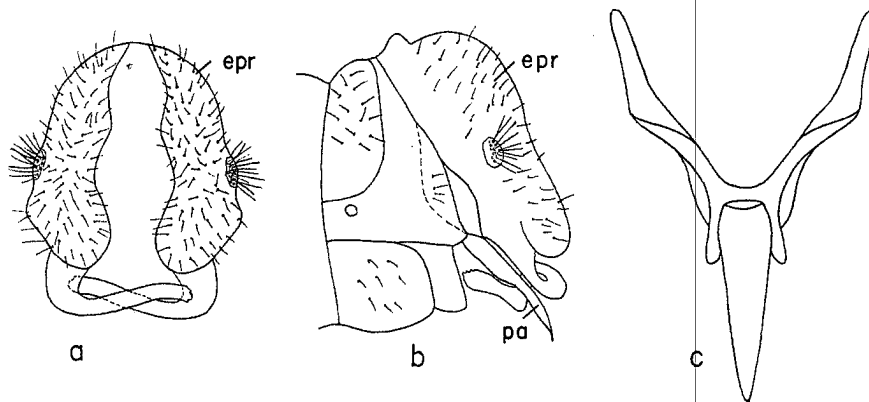


FIGURE 4.—*Micromus navigatorum*: a, ninth tergite, posterior view; b, terminal abdominal segments, lateral view; c, parameres, dorsal view. Abbreviations: epr = ectoproct; pa = paramere.

gradate veins, usually seven in the inner, and eight in the outer (fig. 3); M and Cul are not coalesced in either fore or hind wing. Male genital structures shown in figure 4. Ventral processes of tenth tergite rigid and curved abruptly to extend transversely across end of abdomen; aedeagus extending somewhat beyond processes of tenth tergite; tenth sternite bearing two short distal arms just above aedeagus; parameres small and distal end forked.

DISTRIBUTION: Reported by Zimmerman (1957, op. cit.) from eastern Australia to New Guinea, New Caledonia, New Hebrides, Fiji, Samoa, and west to Malaya, India, and "possibly Africa"; in Micronesia, Bonin, Caroline, Mariana, and Volcano Islands.

BONIN IS. CHICHI JIMA: Two, July 1951, Bohart; 1931, Motoike and Ise; four, Futami-ko, May 1956, Clagg; Omura, July 1949, Mead.

VOLCANO IS. IWO JIMA: Dec. 1945, Bertram.

S. MARIANA IS. AGRIHAN: July 1949, Mead. **SAIPAN:** Jan. 1945,

Hagen; Donni-Sadog Tasi, May 1940, Yasumatsu and Yoshimura. GUAM: May 1945, Bohart and Gressitt; no date, Fullaway, two, Feb. 1954, Liming; two, Pago, May 1945, Bohart and Gressitt; three, Pt. Oca, May 1945, Bohart and Gressitt; Pilgo River, May 1945, Bohart and Gressitt; Talofotofo, June 1946, Townes.

PALAU IS. BABELTHUAP: Imeliik (Aimeliik), Aug. 1953, Ngiwal, Sept. 1951, Gressitt; Ulimang, Dec. 1947, Dybas. KOROR: Feb. 1938, Esaki; five, Dec. 1952-Jan. 1954, Beardsley; Dec. 1956, McDaniel; Arabaketsu, Apr. 1938, Miyake.

YAP. RUMUNG: Oct. 1952, Krauss. GAGIL-TOMIL: Gachapar, June 1957, Sabrosky. YAP: Hill behind Yaptown, Nov. 1952, Gressitt; two, Mt. Madaade (Matade), 60 m., Dec. 1952, Gressitt; Weloy, June 1957, Sabrosky; Yaptown, July 1946, Townes.

CAROLINE ATOLLS. ULITHI: Falalop I., Sept. 1946, McDaniel. WO-LEAI: Utagal I., Feb. 1953, Beardsley. FARAULEP: Faraulep I., Sept. 1952, Krauss; two, Feb. 1953, Beardsley. PINGELAP: July 1949, Owen; Jan. 1953, Gressitt.

TRUK. WENA (Moen): July 1946, Townes; four, Civ. Admin. Area, Mar.-Apr. 1949, Potts. TONOAS (Dublon): May 1946, Townes; Feb. 1948, Maehler. TON (Tol): Jan. 1938, Esaki; two, Mt. Unibot, Dec. 1952-Jan. 1953, Gressitt.

PONAPE. Two, Jan. 1953, Gressitt, Clarke; six, Agric. Exper. Sta., June-Sept. 1950, Adams; Colonia, Mar. 1948, Dybas; Colonia, Jan. 1953, Clarke; two, Colonia, July 1939, Esaki; 34, Mt. Kupwurisio, Mar. 1948, Dybas; Mt. Temwetemwensekir, Mar. 1948, Dybas; four, Mt. Tolotom, June-Sept. 1950, Adams.

KUSAIE. Funaunpes, 1 m., Jan. 1953, Clarke; Hill 541, 165 m., Mar. 1953, Clarke; four, Lele I., Aug. 1946, Oakley; Lele I., Mar. 1953, Clarke; Lele I., Dec. 1937, Esaki; Malem River, 90 m., Apr. 1953, Clarke; Mutunlik (Yepan), Jan. 1953, Gressitt; eight, Mutunlik, Jan.-Apr. 1953, Clarke.

The Micronesian collection sent to me by the Pacific Science Board contains 120 specimens of this species.

As an active predator on plant life, *navigatorum* was intentionally introduced from Queensland into the Hawaiian Islands by F. X. Williams in 1919 (Williams, 1931, *Insects and Other Invertebrates of Hawaiian Sugar Cane Fields*, p. 128). The life history of this insect (under the name of *vinaceus*) in the Hawaiian Islands has been worked out by Williams (1927, *Hawaiian Planters' Rec.* 31: 246, 249).

The foregoing description is based upon preserved specimens (alcoholic and dried). Living specimens are, of course, lighter and more brilliantly colored. Zimmerman (1957, *Insects of Hawaii* 6: 64) states that in living Hawaiian adults the eyes are a gleaming, dark metallic green and the wings intensely iridescent in certain light. An excellent photograph of the wing of *navigatorum*,

as well as drawings of the genital structures of Hawaiian specimens, are also contained in Zimmerman's account.

The determination of this Micronesian *Micromus* as *navigatorum* was made with some difficulty and became definite only after the examination of one of Brauer's types of this insect. The species was described by Brauer from two specimens, one from Fiji (Ovalau) and the other from Samoa (Upolu). The latter specimen, a female, was kindly sent to me by Dr. Beier at the Naturhistorisches Museum in Vienna; it was collected, as indicated by Brauer's description, in 1867 by Graffé. The wing venation and markings agree in all respects with those of the Micronesian specimens at hand. The structure of its terminal abdominal segments also agrees with that of the Micronesian material, including the presence of a short, lateral papilla on the tergite. [This is indicated in Zimmerman's figure 14, a (1957, op. cit.) by a somewhat irregular protuberance.] Since there seem to be no specific differences between this type of *navigatorum* and the Micronesian species, I consider them identical. In this connection, it is significant that *navigatorum* has already been reported from many Pacific islands.

The specimens from Guam which Banks identified (1942, B. P. Bishop Mus., Bull. 172: 29) as *Eumicromus pusillus* and which are contained in the collection of the Museum of Comparative Zoölogy appear to be inseparable from *Micromus navigatorum*. This does not necessarily mean that *pusillus* is a synonym of *navigatorum*, since Banks presumably did not see Gerstaecker's type of *pusillus*. Dr. D. Winkler, of the Zoologisches Museum at Humboldt Universität in Berlin has informed me that the type of *pusillus* is not in the Berlin Museum, and he further states that he does not know of its location. *M. vinaceus* Gerstaecker, which was originally described from Rockhampton, Australia, has been generally regarded as a synonym of *navigatorum* [Esben-Petersen, 1928, Insects of Samoa 7 (3): 93], although the basis for this synonymy has not been given; specimens from Australia in the Museum of Comparative Zoölogy and labeled *vinaceus* appear to be *navigatorum* in all respects.