INSECTS OF MICRONESIA
Crustacea: Amphipoda
(Strand and Terrestrial Talitridae)

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INTRODUCTION

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The following symbols indicate the museums in which specimens are stored: US (United States National Museum) and BISHOP (Bernice P. Bishop Museum).

Prior to this paper, terrestrial amphipods have not been reported from Micronesia. All of the known terrestrial crustaceans belonging to the Amphipoda are confined to the family Talitridae, many species of which are known familiarly as "sand-hoppers." Other species of the family are strictly marine in occurrence and a number of additional species are restricted to warm, moist terrestrial environments, particularly to leaf-molds and mosses. Some exotic species have been transported to herbaria, gardens, and greenhouses in Europe and North America, where they were first described.

Indo-Pacific terrestrial and strand talitrids number 62 species and forms in three genera [Stephensen, 1935, B. P. Bishop Mus., Occ. Papers **10** (23): 1-20, and subsequent literature]. Very few of these have been described adequately and with the exception of three species, none in the present collections can be identified with known species. Rearrangement of genera was the recent concern of Hurley [1954, Roy. Soc. New Zealand, Trans. **81** (4): 563-577] and the rearrangement of genera into subfamilies was made by Bulycheva (1957, Akad. Nauk. SSSR, Opred. po faune SSSR **65**: 1-185).

Terrestrial talitrids are among the most difficult of amphipods to study and identify. They are difficult to preserve; many are small, frail, and appear

monotonously similar, even to the trained observer. Care should be taken to collect large series of specimens and they should be preserved carefully while alive, first in 4 percent formalin, then transferred to 70 percent alcohol within a week. The pleopods are the most important feature for quick separation of the species. Pleopods occur on the first three segments of the abdomen, following the last pair of walking legs. When well developed, the pleopods project ventrally below the lateral shields or epimera; when vestigial, they are hidden and care must be taken to fold back the epimera for proper inspection.

Collections of the animals are so infrequent that many species are based on a few specimens and incomplete records of sexual differentiation which is of major importance in the taxonomy of amphipods. Consequently, the study of terrestrial amphipods has been poorly organized and has usually fallen to marine carcinologists, each of whom writes one or a few sketchy papers on a small, often incidental, collection of the animals. [An exception is Hurley, 1950, Roy. Soc. New Zealand, Trans. **84** (2) : 359-389.] This paper is also based on small collections, often unique lots, gathered from widespread parts of the Pacific Ocean; much of the material is from outside the limits of Micronesia. However, it represents the first collections from this large area and also indicates the need for special collecting efforts and ecological studies to establish certain population peculiarities.

Terrestrial amphipods are an important group of animals for a study of evolutionary experimentation within a limited morphological framework, because they belong to a widespread marine family, some members of which have preadapted to living on land. They are very close to their marine ancestors, and the basic morphology of the sea-dwellers remains. However, this line of evolution has been a blind alley; the radiation onto land is confined to a small, poorly diversified group of organisms lacking a mutable genosome capable of providing any range of terrestrial adaptations as seen in insects. Thus, a different point of view must be taken when studying terrestrial insular crustaceans than when studying insular insects. The insects on islands have evolved from precursors already highly successful in a terrestrial environment, many of them from continental sources. The amphipods, on the other hand, are likely to exist in the places where their primary evolution onto land occurred. Evidence for this conclusion is that nearly all known terrestrial amphipods are from islands in the Indo-Pacific, close to the sea in warm moist environments, where competition from other organisms may not be so great as on continents.

Although there is no evidence that the group of terrestrial amphipods or a group similar to it in the past has given rise to any other major group, nevertheless there is evidence that a variable interspecific, and even intraspecific, genosome does exist. Potential kinds of mutations or recombinations appear to be available which may be expressed when parent species are carried to new islands or environments. Examples of this are seen in the variability of

populations of *Orchestia floresiana* at Fiji, of *Talitrus toli* at Truk, and *T. nesius* at Ponape; the two latter species may be descendants of a parent species, *T. hortulanus* Calman.

The present collections of amphipods indicate that considerable effort should be expended in the collecting of more materials from all Indo-Pacific areas. All possible instances of microevolution should be recorded so that parent species can be recognized. These studies should be correlated with ethnological studies of human population movements, since it is probable that these animals were easily transportable in the foods and plants carried by migrating peoples. The results should be examined in the light of bird populations and migrations since Segerstrale [1956, Soc. Sci. Fenn., Comment. Biol. **15** (1) : 69] shows that some amphipod species have a positive aviatropy, attaching themselves to the feathers of birds and surviving for reasonable periods of time. In this way we may be able to determine the length of time required for the successful evolution of genetically distinct populations in natural environments.

Table 1.—Distribution of Micronesian and Fijian Amphipoda

	Micronesian Island Groups								Other Localities
	Caroline								
	Palau	Yap	Caroline Atolls	Truk	Ponape	Kusaie	Marshall	Gilbert	
1. Talitrus hortulanus	×			×					Samoa, New Hebrides
2. T. toli*				×					
3. T. nesius*					×				
4. T. trukana*				×					
5. Talorchestia spinipalma		×	×			×	×		Queensland, New Caledonia, Samoa, Bismarck Archipelago, Philippine Is.
6. Orchestia floresiana	×	×	×			×		×	Flores, Marquesas, Seychelles, New Britain, Thailand, Fiji
7. O. f. vitilevana*									Fiji
8. O. ponapensis*					×				

* Described as new.

mens of Calman and of Stephensen (7-8 mm.) and reflect their small size in the two to three articles of the first antennal flagellum compared with the six to seven of earlier collections. The pleopods of the present specimens are also less well developed; the third pair is less setose and the first pair has rami

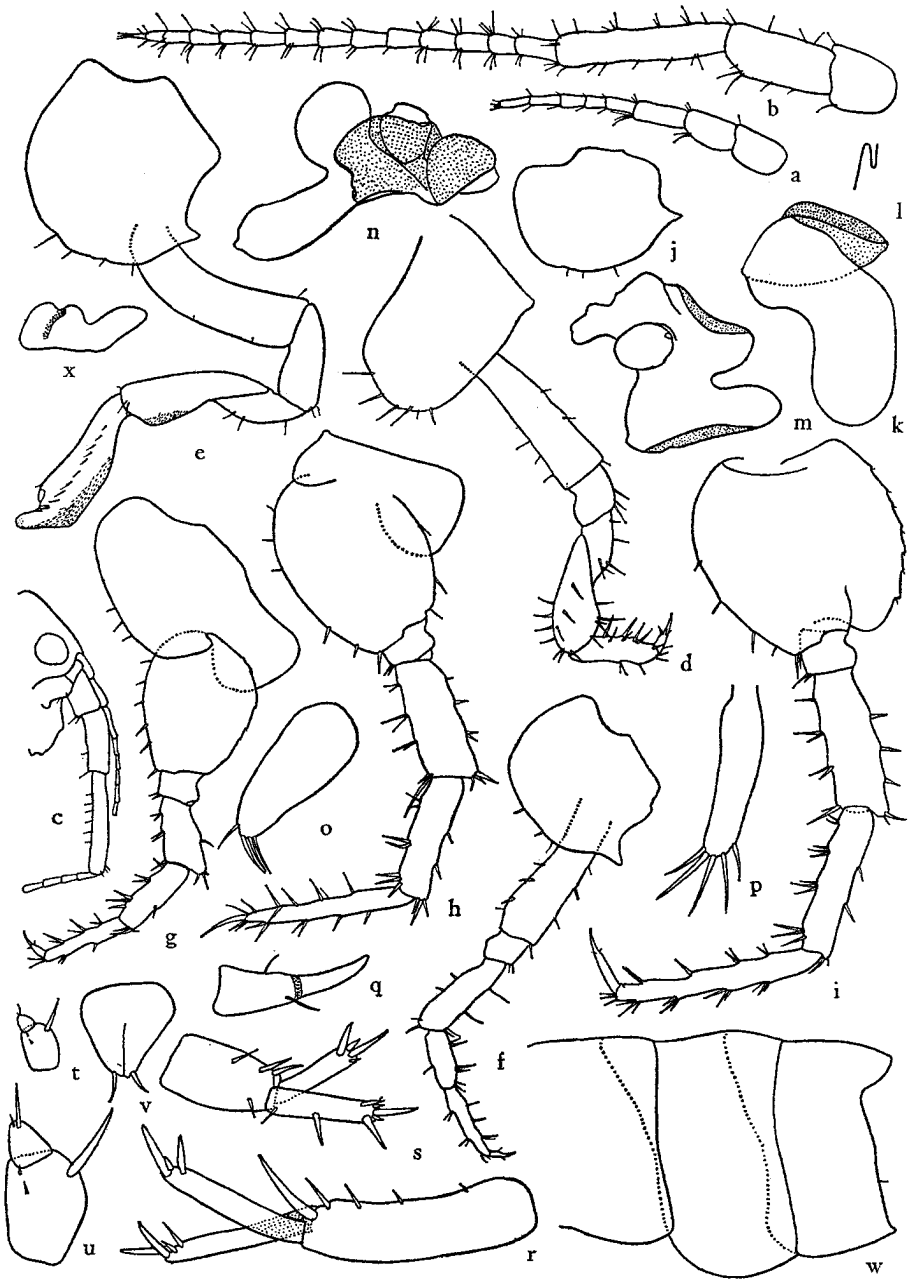

FIGURE 2.—*Talitrus toli,* female, 8 mm., Ton I., Truk: **a, b,** antennae 1, 2; **c,** head; **d, e,** gnathopods 1, 2; **f, g, h, i,** peraeopods 1, 3, 4, 5; **j,** coxa 4; **k,** gill of gnathopod 2; **l,** cross-sectional shape of gill of gnathopod 2; **m,** gill of peraeopod 3; **n,** gill of peraeopod 4; **o, p,** brood plates of peraeopods 2, 4; **q,** article 7 of peraeopod 1; **r, s,** uropods 1, 2; **t, u,** uropod 3; **v,** telson; **w,** pleon segments 1-3; **x,** gill of gnathopod 2, another specimen.

The distinctive feature of this species is the shortened and stubby rami of the third pleopods (not uropods). In figure 1, notice the shorter rami of pleopods 1 and 2 in the Peleliu specimens, compared with those from Truk.

2. **Talitrus toli** Barnard, n. sp. (figs. 2, 3, 4).

Maxillipedal palp poorly spinose; flagellar segments of antenna 2 smooth, untoothed; interramal spine of uropod 1 simple; peduncle of uropod 3 with one spine; rami of pleopod

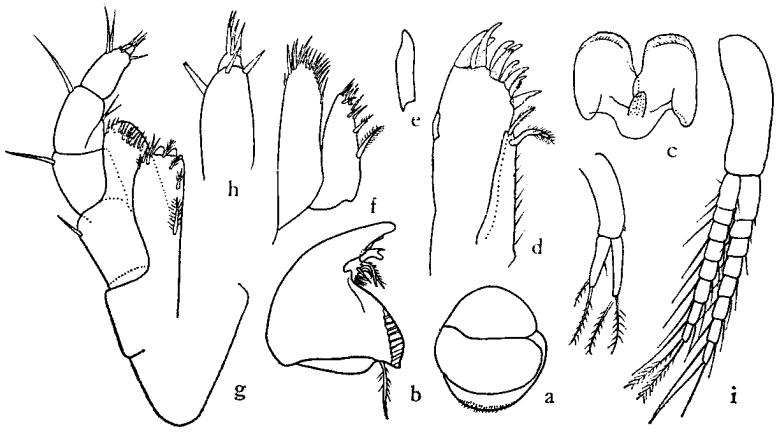

FIGURE 3.—*Talitrus toli:* **a**, upper lip; **b**, mandible; **c**, lower lip; **d**, maxilla 1; **e**, palp of maxilla 1; **f**, maxilla 2; **g**, maxilliped; **h**, maxillipedal palp; **i**, pleopod 2.

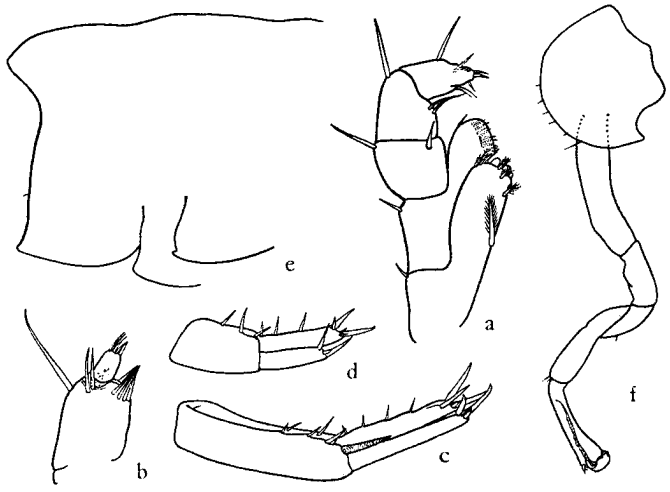

FIGURE 4.—*Talitrus toli,* another female, 8 mm., Ton I., Truk: **a**, maxilliped; **b**, maxillipedal palp; **c**, **d**, uropods 1, 2; **e**, pleon segments 3-1; **f**, gnathopod 2.

3 small, uniarticulate, inner ramus more than one-half length of peduncle; article 6 of gnathopod 1 linear; posterior edges of epimeral plates smooth, sigmoid.

Holotype, female (BISHOP 2910), 5.5 mm., Mt. Unibot, Ton I., Truk, Jan. 21, 1953, Gressitt. Other specimens: Female, seven juveniles, same data as for holotype; two, Mt. Unibot, Ton, Truk, Jan. 1953, Gressitt; female, juvenile, Mt. Unibot, Ton, Truk, Feb. 1953, Gressitt.

DISTRIBUTION: Caroline Is. (Truk).

This species is closely related to *Talitrus hortulanus* Calman and occurs with it on Ton Island, Truk. The peculiar occurrence of the two species suggests that they are of the same population but the new species differs in the following ways, which from our present knowledge of talitrid speciation prevent fusion of the two kinds: The slender rami of pleopod 3; the long and multiarticulate rami of pleopods 1 and 2; the better developed posterior cusp of coxa 2; the different shape of article 6, gnathopod 2; the double-folded and apically rounded gill of gnathopod 2. This species is related to *T. gulliveri* Miers and *T. tasmaniae* Ruffo but can be distinguished easily by the use of the key to the genus in Hurley [1955, Pacific Science 9 (2) : 147].

The aberrant specimen shown in figure 4 is evidence of the variable genosome of the species. Gnathopod 2 is either badly preserved or quite aberrant and the first pleonal epimeron has a tooth as in *T. hortulanus*. On some specimens, such as one seen in figure 2, *r*, the inner ramus of uropod 1 lacks the usual spine.

Although I have not identified a male of the species, the general facies, reduced pleopod 3, and shape of maxillipedal palp lend assurance that it has been placed in the proper genus.

3. **Talitrus nesius** Barnard, n. sp. (fig. 5).

Maxillipedal palp poorly spinose; flagellar segments of antenna 2 smooth, untoothed; interramal spine of uropod 1 with a projecting terminal capillary and terminal cap, peduncle of uropod 3 with one spine; rami of pleopod 3 small, about one-half as long as peduncle and 2-3 articulate; rami of pleopods 1-2 less than one-half as long as peduncle; article 6 of gnathopod 1 linear; posterior edges of epimeral plates smooth, sigmoid.

Holotype, male (BISHOP 2911), 7.5 mm., Ponape, Mt. Temwetemwensekir, 180 m., in dead giant African land snail, Jan. 19, 1953, Gressitt. Other specimens: Female, juvenile, same data as for holotype.

DISTRIBUTION: Caroline Is. (Ponape).

This species differs from *Talitrus toli* by the 2-3 articulate third pleopodal rami, instead of uniarticulate, and the short rami of pleopods 1 and 2 (like *T. hortulanus*).

The new species differs from *T. hortulanus* by the slender and 2-3 articulate third pleopodal rami and the interramal spine of uropod 1, which is simple in *T. hortulanus*.

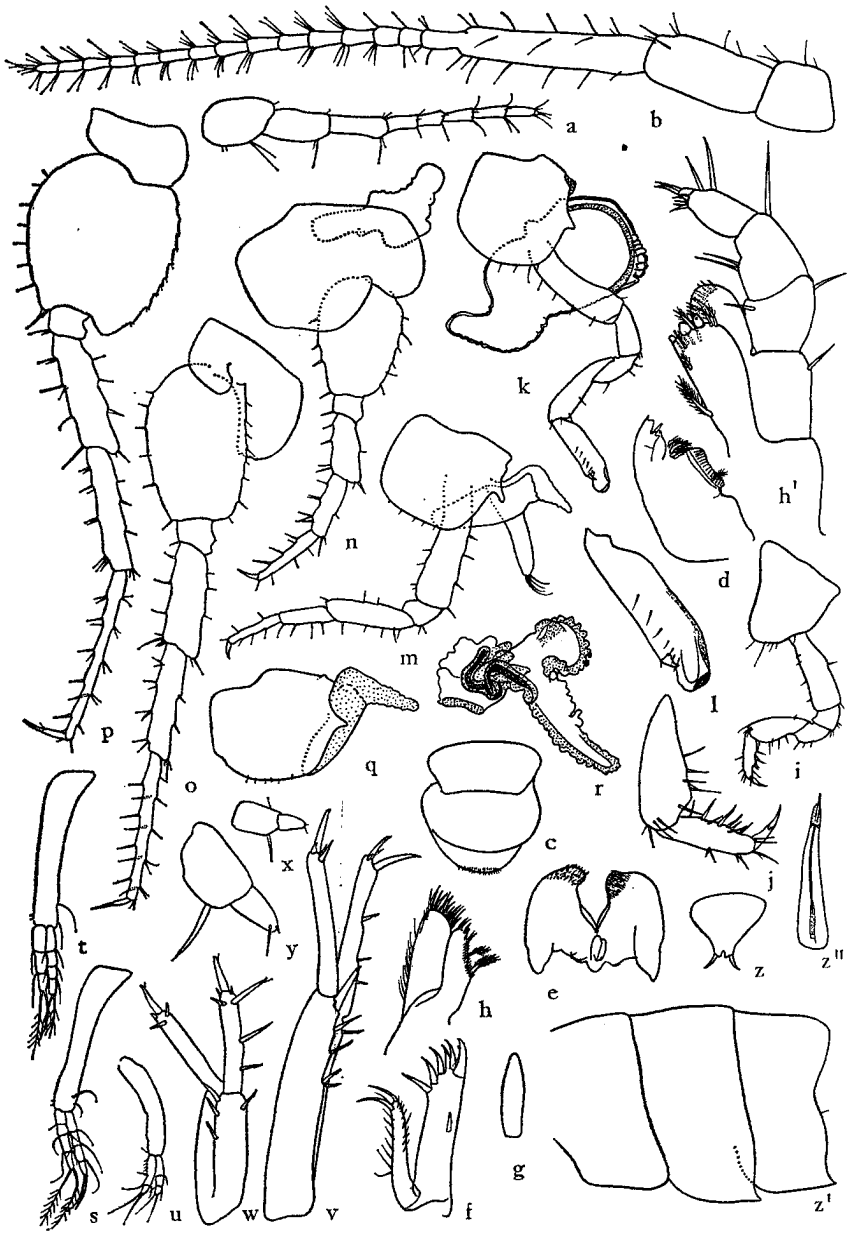

FIGURE 5.—*Talitrus nesius,* female, 9 mm., Ponape: **a, b,** antennae 1, 2; **c,** upper lip; **d,** mandible; **e,** lower lip; **f,** maxilla 1; **g,** palp of maxilla 1; **h,** maxilla 2; **h',** maxilliped; **i, j,** gnathopod 1; **k, l,** gnathopod 2; **m, n, o, p,** peraeopods 1, 3, 4, 5; **q,** coxa 4; **r,** gill of peraeopod 4 (black spots are protozoans); **s, t, u,** pleopods 1, 2, 3; **v, w,** uropods 1, 2; **x, y,** uropod 3; **z,** telson; **z',** pleon segments 1-3; **z'',** interramal spine of uropod 1.

4. Talitrus (?) **trukana** Barnard, n. sp. (fig. 6).

Maxillipedal palp moderately spinose, rather stout; flagellar segments of antenna 2 smooth; interramal spine of uropod 1 apparently absent; peduncle of uropod 3 with one spine; rami of pleopod 3 scarcely shorter than those of pleopods 1 and 2, more than half as long as peduncle; article 6 of gnathopod 1 linear; posterior edges of epimeral plates smooth, slightly sigmoid.

Holotype, sex? (BISHOP 2912), 4.5 mm., Truk, Ton I., Mt. Unibot,

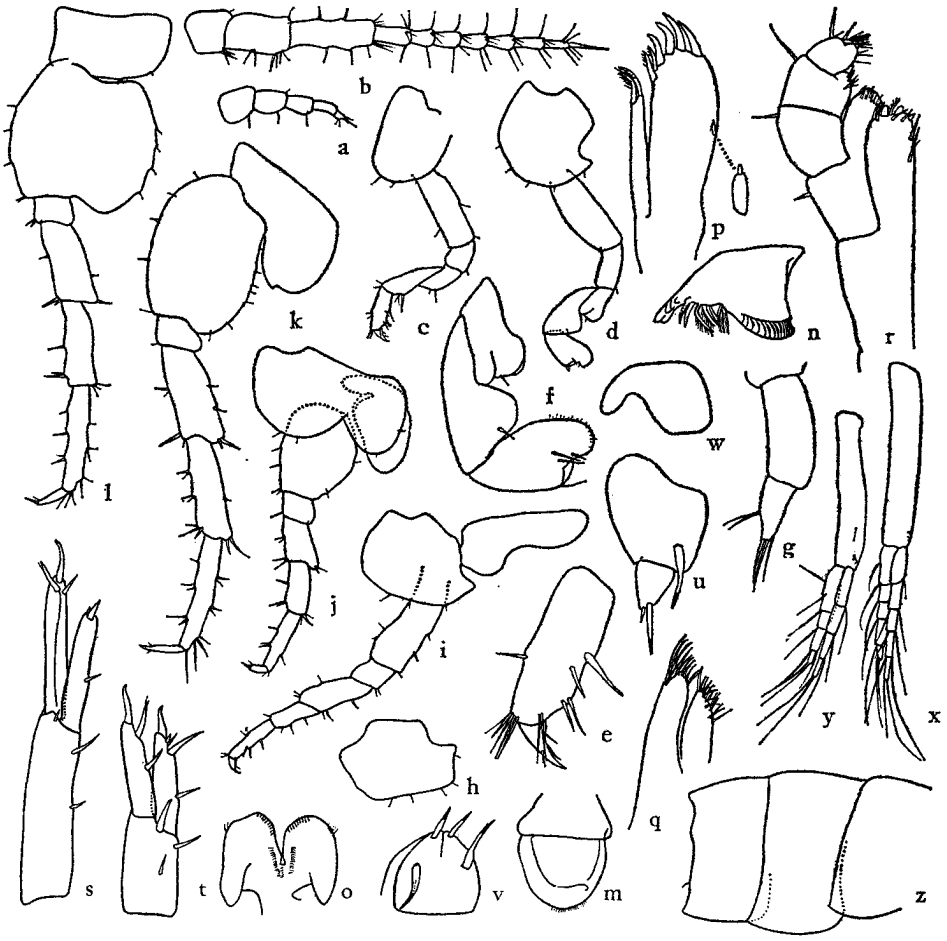

FIGURE 6.—*Talitrus trukana,* male, 4.5 mm., Ton I., Truk: **a, b,** antennae 1, 2; **c, d,** gnathopods 1, 2; **e, f,** gnathopods 1, 2, enlarged; **g,** end of antenna 1; **h,** coxa 3; **i, j, k, l,** peraeopods 2, 3, 4, 5; **m,** upper lip; **n,** mandible; **o,** lower lip; **p,** maxilla 1 and palp, enlarged; **q,** maxilla 2; **r,** maxilliped; **s, t, u,** uropods 1, 2, 3; **v,** telson; **w,** gill of gnathopod 2; **x, y,** pleopods 2 (same morphology as pleopod 1) and 3; **z,** pleon segments 3-1.

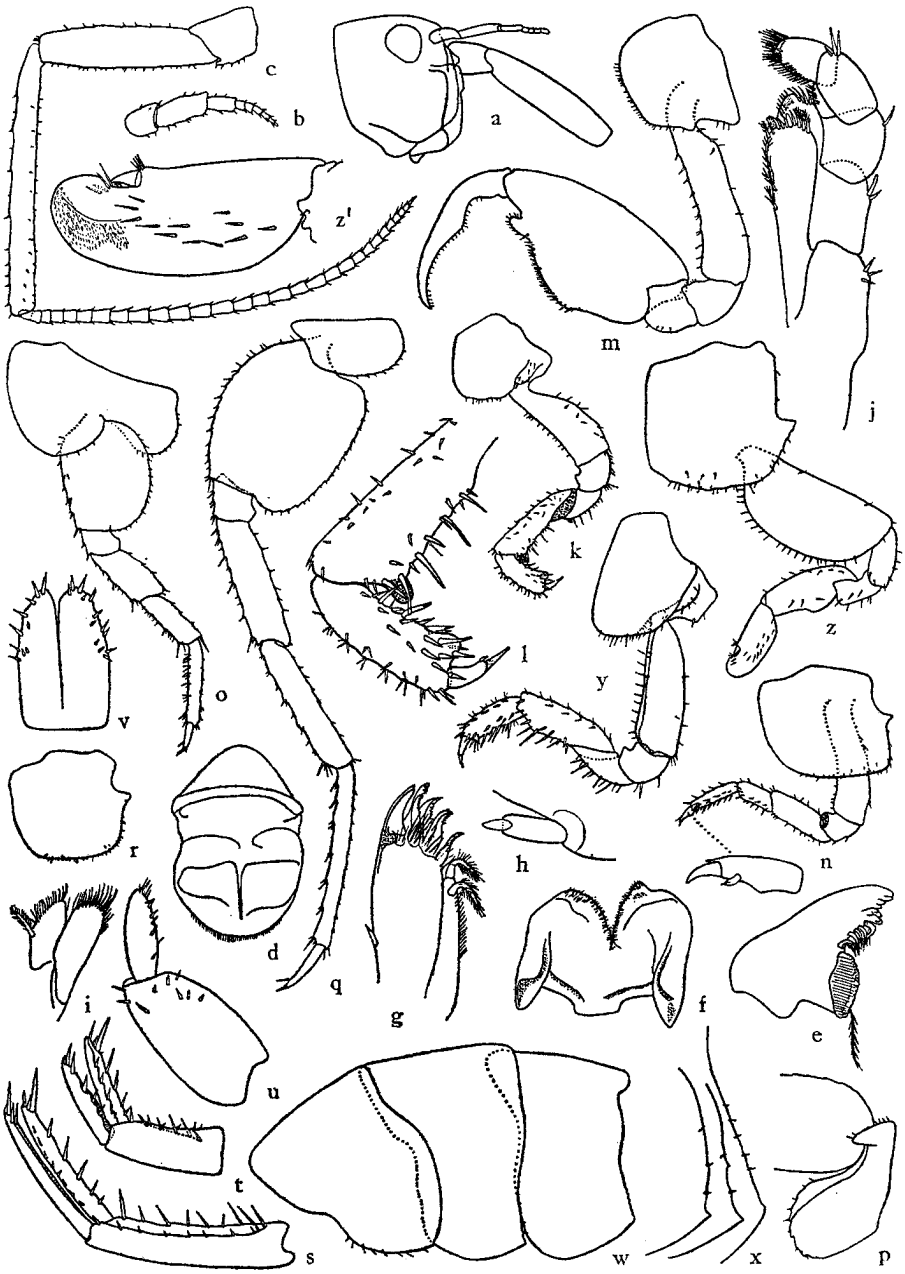

FIGURE 7.—*Talorchestia spinipalma.* **a-x,** male, 13 mm., Kusaie; *a,* head; *b, c,* antennae 1, 2; *d,* upper lip; *e,* mandible; *f,* lower lip; *g,* maxilla 1; *h,* palp of maxilla 1; *i,* maxilla 2; *j,* maxilliped; *k, l,* gnathopod 1; *m,* gnathopod 2; *n, o, p, q,* peraeopods 2, 3, 4, 5; *r,* coxa 3; *s, t, u,* uropods 1, 2, 3; *v,* telson; *w, x,* pleon segments 1-3. **y-z',** female 10 mm.: *y,* gnathopod 1; *z, z',* gnathopod 2.

10 m., Jan. 3, 1953, Gressitt. Other specimens: Two juveniles, 10 m., two juveniles, rotting banana stalk, both same data as for holotype.

DISTRIBUTION: Caroline Is. (Truk).

The very short, 2-articulate flagellum of antenna 1 is rather distinctive, as is the poorly serrate and quite broad second article of peraeopod 5. If this species had a known male with large second gnathopods, it would more than likely be placed in the genus *Orchestia,* even though the first gnathopod of the female lacks a palm. The generally poorly spinose appendages (compared with those of *Talorchestia spinipalma*) would seem to restrict it from *Talorchestia.*

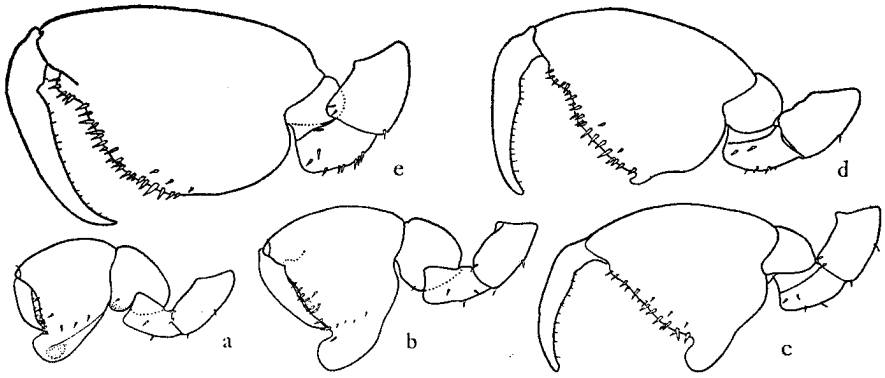

FIGURE 8.—*Talorchestia spinipalma,* progressive development of male gnathopod 2: **a,** 6.0 mm.; **b,** 7.5 mm.; **c,** 7.0 mm.; **d,** 8.2 mm.; **e,** 9.5 mm.

Because of the poor spination and lack of a palm on gnathopod 1 and the absence of a known male, the species has been relegated provisionally to *Talitrus.* As such, it fits none of the known species in Hurley's key [1955, Pacific Science **9** (2): 144-157].

The species occurs on Truk along with *T. toli.* It is quite distinct from that species, especially by the configuration of gnathopod 2.

5. Talorchestia spinipalma (Dana). (Figures 7, 8.)

Orchestia spinipalma Dana, 1853, U. S. Expl. Exped. **14**: 875, pl. 59, fig. 4, *a-e.*

Talorchestia spinipalma, Stephensen, 1935, B. P. Bishop Mus., Occ. Papers **10** (23): 12.—Schellenberg, 1938, K. Sven. Vet.-Akad., Handl. III, **16** (6): 66.

DISTRIBUTION: Queensland, New Caledonia, Tongatabu Group, Bismarck Archipelago, Philippine Is., Caroline Is., Marshall Is.

YAP. MAP: Seven, Aug. 1950, Goss.

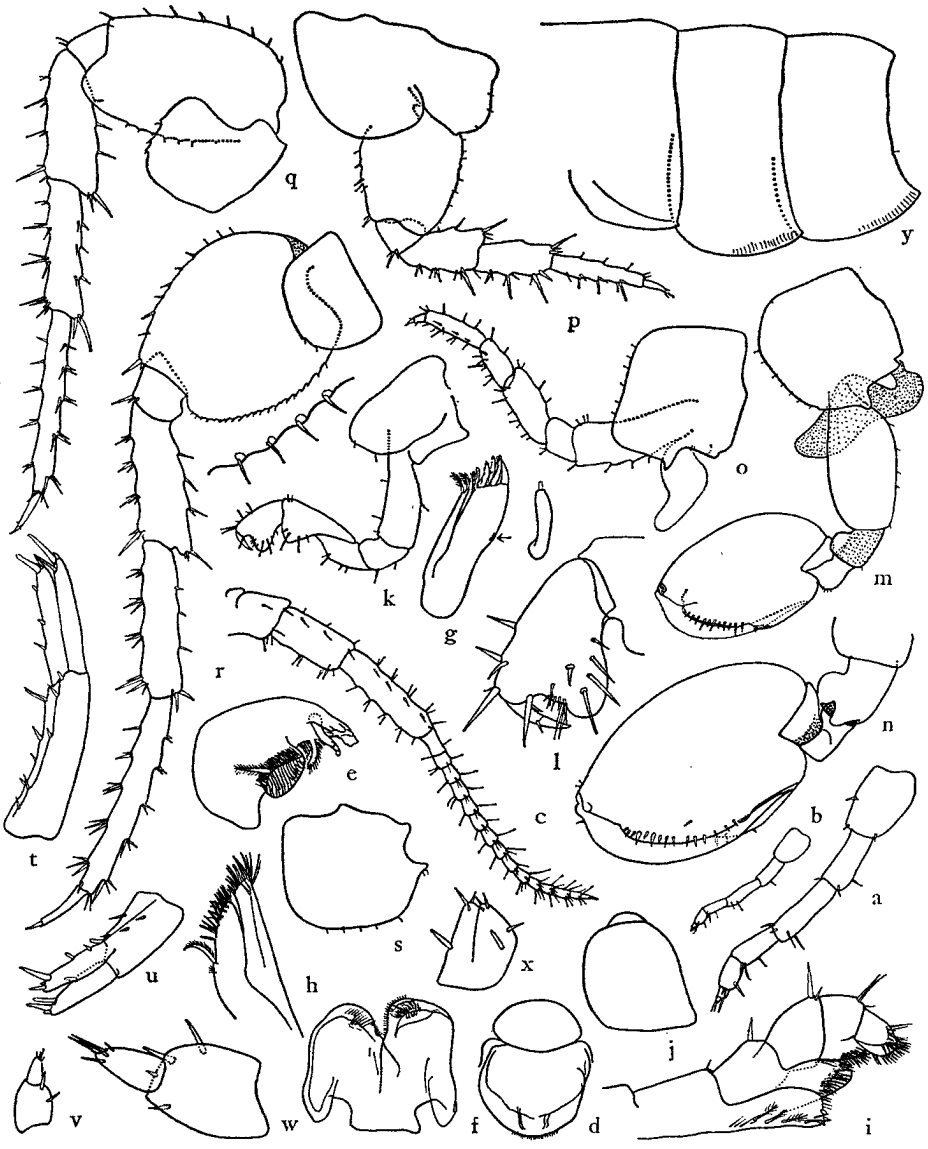

FIGURE 9.—*Orchestia floresiana,* typical, male, 7 mm., East Map I., Yap: **a**, **b**, antenna 1; **c**, antenna 2; **d**, upper lip; **e**, mandible; **f**, lower lip; **g**, maxilla 1 and palp; **h**, maxilla 2; **i**, maxilliped; **j**, palp of maxilliped; **k**, **l**, gnathopod 1; **m**, **n**, gnathopod 2; **o**, **p**, **q**, **r**, peraeopods 1, 3, 4, 5; **s**, coxa 4; **t**, **u**, uropods 1, 2; **v**, **w**, uropod 3; **x**, telson; **y**, pleon segments 1-3.

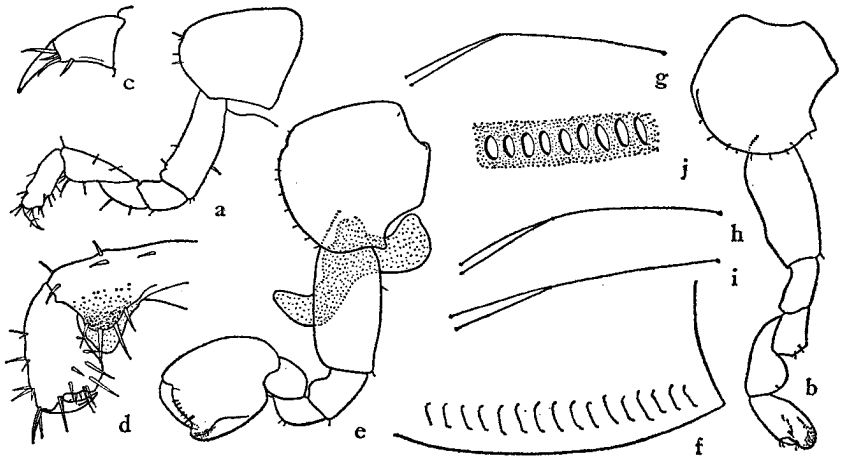

FIGURE 10.—*Orchestia floresiana,* typical, female, 6 mm., Kusaie: **a, b,** gnathopods 1, 2; **c,** article 7 of gnathopod 1 (young male, 7 mm., Sonsorol); **d, e,** gnathopods 1, 2; **f,** lower edge of pleon segment 3; **g, h, i,** pleopods 1, 2, 3, relative lengths of peduncle and two rami; **j,** detail of lower edge of pleon segment 3 (male, 7 mm., Yap).

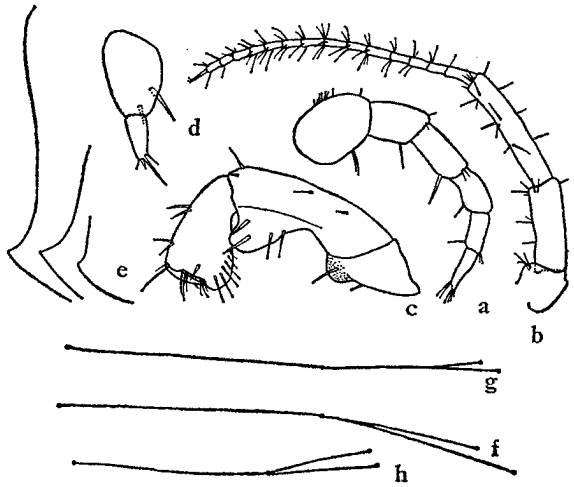

FIGURE 11.—*Orchestia floresiana,* atypical, male, 9 mm., Vitilevu, Fiji: **a, b,** antennae 1, 2; **c,** gnathopod 1; **d,** uropod 3; **e,** pleon segments 3, 2, 1, lower posterior corners of epimera; **f, g, h,** pleopods 1, 2, 3, relative lengths of peduncle and two rami.

CAROLINE ATOLLS. IFALUK: One, Sept. 1952, Krauss.

KUSAIE. 34, Mutunlik, 22 m., Jan. 1953, Clarke.

MARSHALL IS. ENIWETOK: Seven, July 1956, Reish. MAJURO: Four, July 1956, Reish.

This shore-living, sand-burrowing species is easily recognizable but has never been properly illustrated. Included in figure 8 are some of the pre-adult male second gnathopods.

6. Orchestia floresiana Weber (figs. 9, 10, 11).

Orchestia floresiana Weber, Stephensen, 1935, B. P. Bishop Mus., Bull. 142: 24, figs. 4-6.

DISTRIBUTION: Flores, Marquesas, Seychelles, New Britain, Gulf of Thailand, shore to 1,220 m., Fiji, Caroline Is., Gilbert Is.

PALAU. BABELTHUAP: One, Ulimang, Dec. 1947, Dybas.

YAP. MAP: 29, East Map, Aug. 1950, Goss. RUMUNG: One, Aug. 1950, Goss.

CAROLINE ATOLLS. SONSOROL: One, Sept. 1952, Krauss. KAPINGAMARANGI: One, Touhou I., July 1954, Niering.

KUSAIE. One, Lele I., 1 m., Mar. 1953, Clarke.

GILBERT IS. ONOTOA: One, Buiartun I., July 1951, Moul.

FIJI. Two, Vitilevu, Nandarivatu, Sept. 1938, 915-1,132 m., Zimmerman.

The original description of the species from Flores was poor and Stephensen's later description was based on specimens half an ocean away at the Marquesas. Materials similar to the Marquesan specimens were collected at Yap and adequately represent all of the specimens from Micronesia. Minor differences of this material are shown in table 2.

Additional specimens were collected at Fiji, outside Micronesia. Minor differences of the Fijian specimens from the Yap and Marquesan specimens are seen in table 2 and figure 11. The interesting thing about the Fijian specimens is the fact that the subspecies to follow appears to have been derived from *O. floresiana*. The intermediate condition of the Fijian *O. f. floresiana* between the Marquesan-Yap specimens and the new subspecies is seen in table 2. In the final analysis, the new subspecies may be simply a phenotype.

7. Orchestia floresiana vitilevana Barnard, n. subsp. (fig. 12).

Like the typical subspecies, but lacking the slits on the lower edges of the second and third pleonal epimera.

Holotype, male (BISHOP 2906), 9 mm., Nandarivatu, Vitilevu, Fiji, 1,132 m., Sept. 10, 1938, Zimmerman. Other specimens: 45, 915-1,132 m., same locality as for holotype, Sept. 1938, Zimmerman; one, west side Navai Trail, Tholo North, Vitilevu, 915-1,039 m., Sept. 1938, Zimmerman; one, Mt. Victoria, Vitilevu, 915-1,220 m., Sept. 1938, Zimmerman.

DISTRIBUTION: Fiji.

Table 2.—Variation in Several Populations of Orchestia floresiana

	f. floresiana MARQUESAS (93-1,235 m.)	f. floresiana YAP ?	f. floresiana FIJI Nandarivatu (915-1,132 m.)	f. vitilevana FIJI Nandarivatu (915-1,132 m.)	f. vitilevana FIJI Mt. Victoria (915-1,220 m.)
Size in mm.	10-12	6-7	9	13	9
Pleonal slits	yes	yes	yes	no	no
Pleopod 3 short	no	no	yes	yes	yes
Peraeopod 5 serrations	35	20	20	8	4
Gnathopod 2, female, bump on article 4	no	no	yes	yes	yes
Gnathopod 1, male, bump on article 4	slight	no	yes	no	yes

Peraeopod 5 with posterior edge of article 2 minutely crenulate along middle margin. Pleopods well developed, rami multiarticulate, decreasing in length posteriorly so that pleopod 3 is two-thirds as long as pleopod 1.

Uropod 1, outer ramus unarmed marginally; uropod 2 damaged on both sides, uropod 3, peduncle with two large and one small spines, ramus short, slender, with three apical spines. Telson with two large basal spines, apex slightly cleft, each lobe with two spines.

Pleon segment 2 slightly enlarged and its epimeron prolonged posteriorly into a broad tooth. Pleon segment 3 with epimeron smooth posteriorly and prolonged into a smaller tooth.

Holotype, female? (US 103705), 6 mm., Ponape, Mt. Nahnalaud, over 610 m., Mar. 18, 1948, Dybas.

DISTRIBUTION: Caroline Is. (Ponape).

If this is a male animal, then this species must be placed in a different genus. The gnathopods represent the female morphology but, with a distinct palm on gnathopod 1, the species cannot be referred to *Talitrus*.

This species is related to *Orchestia sarasini* Chevreux [1915, IN Sarasin and Roux, Nova Caledonia, Zool. 2 (1): 1-14], which has a normal male, but differs by the short flagellum of antenna 1, the longer article 5 of gnathopod 1, and the unprolonged article 6 of gnathopod 2.

The peculiar shape of gnathopod 2 is like that of *O. pusilla* Chevreux (1915, *op cit.*), which also has a normal male, but the species differs by the first antennae and first gnathopods in the same ways cited above for *O. sarasini.*

This species is related to *O. malayensis* Tattersall [1922, Asiatic Soc. Bengal, Mem. 6 (8): 435-459] but has less numerous serrations on article 2 of peraeopod 5 and the gnathopods are quite different.