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A REDESCRIPTION OF *OITHONA DISSIMILIS* LINDBERG 1940
WITH A COMPARISON TO *OITHONA HEBES* GIESBRECHT 1891
(CRUSTACEA: COPEPODA: CYCLOPOIDA)

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Surface zooplankton samples were collected between 1400 & 1900 h on 9 & 18 April 1974 in Pago Pago Harbor, Tutuila Island, American Samoa. Pago Pago Harbor is shaped like an inverted "L". The upright column of the "L" comprises the harbor mouth on the southern coast and is 1.5 km wide at this point. The column runs north 3 km where it is joined on its west side by the narrower, shallower base of the "L," about 1 km long. In addition to detrital laden runoff entering the harbor from several streams, a tuna processing plant on the north shore, toward the head of the harbor, disposes wastes into this area. These consist of blood, oil, and entrails of the processed fish. *Oithona dissimilis* Lindberg 1940 was the most abundant animal in the samples taken near the surface at the head of the harbor with an open conical net (mesh width 60 μ m). Adult males and females with egg sacs, as well as many copepodid stages were present. Very few specimens were present in samples from the mouth of the harbor and outside of the harbor.

Oithona dissimilis Lindberg 1940

Figs. 1-3B

Oithona dissimilis Lindberg, 1940:520, fig. 2; 1950:274 (key); 1955:467 (key).

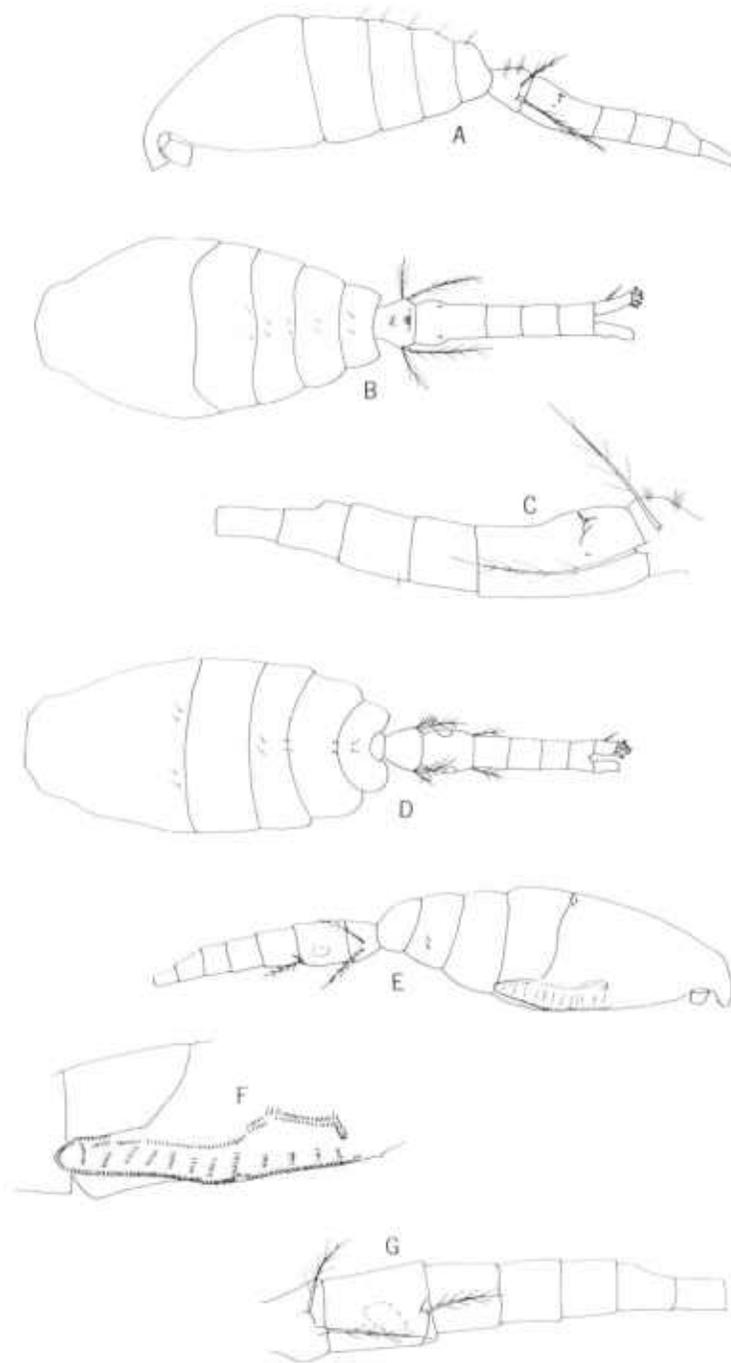
Oithona dissimilis oceanica Lindberg, 1947:52, fig. 2.

Oithona hebes Giesbrecht 1891.—Wellershaus, 1969:276, figs. 88-102.

Diagnosis.—Female length 0.61-0.70 mm (based on 30 specimens); Pr 1.3 \times Ur; cephalosome distinctly constricted dorsally and truncated anteriorly; laterally attaining a small acute point which extends ventrally between first antennae. Greatest width at posterior end of cephalosome; width of metasome segments decreasing posteriorly. Metasome segments 1, 3, 4 each with a pair of dorsal sensory hairs, segment 2 with 2 pairs. As seen dorsally, with one group of sensory hairs in the middle of Ur1 and a second group toward the posterior margin. Caudal ramus (Fig. 2A) 3 \times as long as wide, equal in length to anal segment. A1 reaching posterior mar-

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Fig. 1. *Oithona dissimilis*. A-C, Female: A, Lateral; B, Dorsal; C, Ur, lateral. D-F, Male: D, Dorsal; E, Lateral; F, Cephalosome, ventrolateral; F, Ur, ventral.

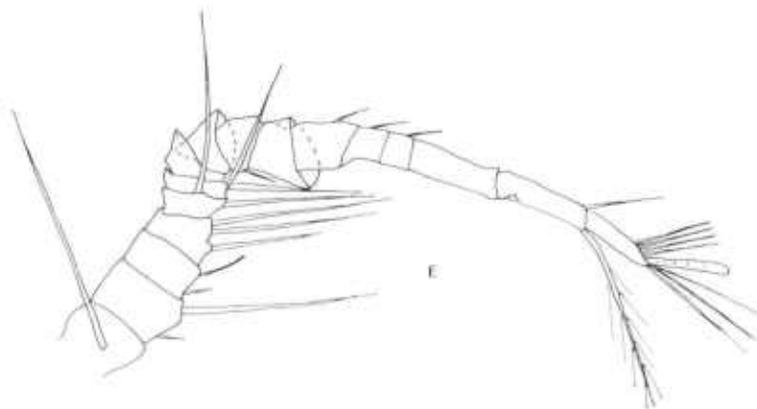
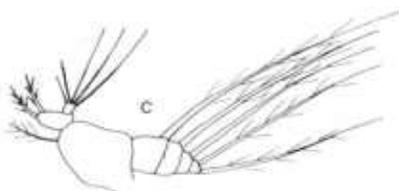
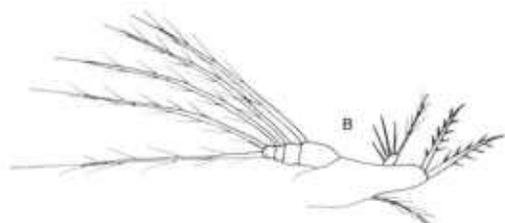


gin of metasome segment 3. Bspd2 of Md (Fig. 2B) with 2 similar, slender curved spines armed with denticles; Ri with 5 setae, ultimate with setules. Large spines of Mx2 (Fig. 3A) with notch on dorsal margin and small denticles on distal fourth of ventral margin. Excluding terminal spine, Re P1-4 with 1-1-3, 1-1-3, 1-1-3, 1-1-2 external spines and 1-1-4, 1-1-5, 1-1-5, 1-1-5 internal setae; Ri P1-4 with 0-0-1, 0-0-1, 0-0-1, 0-0-1 external setae and 1-1-5, 1-2-5, 1-2-5, 1-2-4 internal setae. External spines and terminal spine of Re P1 distinctly attenuated beyond hyaline membrane. Three internal setae of Ri P4 modified (Fig. 3B); proximal seta of Ri2 with tiny membranous flange on medial edge of tip; distal seta slightly curved with larger membranous flange; proximal seta of Ri3 P4 toward its distal end strongly curved, with a very large membranous flange medially. These setae are poorly developed in copepodid V. Internal setae of Re1 P1-4 reduced. P5 with 2 setae, one each on a small lobe dorsally and on larger lobe ventrally. Caudal ramus, external apical seta $\frac{1}{2}\times$ as long as internal apical seta, equal in length to external seta. Genital opening with 2 spines, ventral one larger; a slight prominence ventral to area of opening.

Male length 0.64-0.72 mm (based on 30 specimens); Pr $1.3\times$ Ur; cephalosome, in dorsal view distinctly constricted anteriorly, relatively wider than female; laterally anterior margin of cephalosome rounded, not as angular as female. Greatest width at posterior edge of cephalosome; width of first 2 metasome segments subequal; width of last 2 decreasing. Pr dorsally with slightly different arrangement of sensory hairs (Fig. 1D). Pr laterally (Fig. 1F) with a very complex group of integumental organs in an area comprising posteroventral part of cephalosome and posterior extension or flap of cephalosome overlapping following segment. These organs apparently composed of thickened base and thinner long hair, the latter usually broken. They adorn posterior and ventral edges of flap and continue anteriorly along ventral edge of cephalosome for half its length; dorsally along this length are 12 vertical rows; dorsal to these rows on flap 2 transverse rows, and on cephalosome a more or less longitudinal row, continuing anteriorly as a more curved, double row. Length of caudal ramus (Fig. 2D) $2\times$ width, equal to length of anal segment. Bspd2 of Md with 2 curved spines, relatively shorter than female, armed with thinner denticles; Ri with 5 setae. Re and Ri P1-4 armed as female; all internal setae of Ri P4 unmodified. P5 with 2 setae laterally; genital flap with 1 small naked seta and ventrally a larger setuled one. Dorsal seta of caudal ramus reduced, external apical seta longer than external seta.

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Fig. 2. *Oithona dissimilis*. A-B, Female: A, Caudal ramus, ventral; B, Md. C-E, Male: C, Md; D, Caudal ramus, ventral; E, A1.



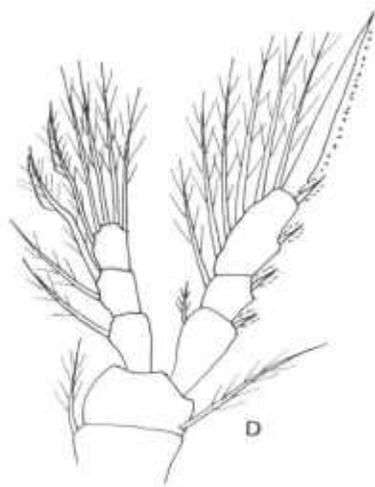
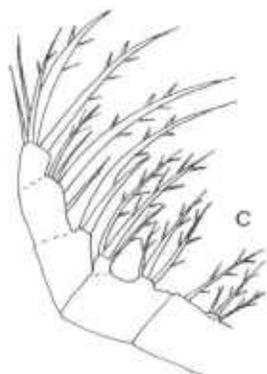
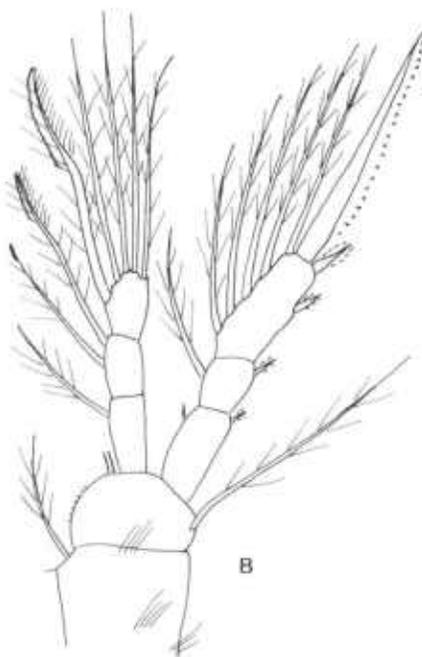
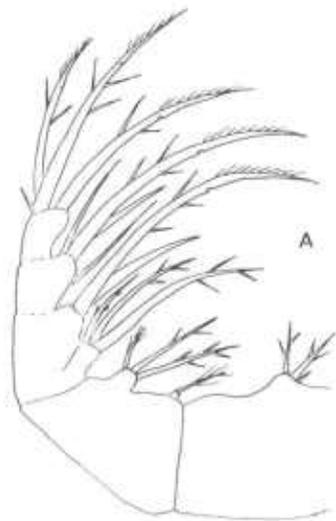
Discussion

Lindberg (1940) illustrated and briefly described *Oithona dissimilis* from the nearshore waters of Pondichery, India. In the description he overlooked an external spine on Re3 P1, but corrected this omission when he (1947) provided a more complete description of a subspecies, *O. dissimilis oceanica*, from Ratnaguri, India. Lindberg remarked that the basis for the establishment of this subspecies was a difference in habitat. *O. dissimilis* was collected from the muddy brackish waters of the littoral zone of lagoons whereas *O. dissimilis oceanica* was found in the pelagic waters of the open sea. Lindberg had at his disposal only 3 females and 2 males of *O. dissimilis oceanica*. Based on records of specimens at my disposal and the co-occurrence of males, gravid females and copepodids, I concur with Lindberg's original observation that *O. dissimilis* is an inhabitant of the brackish, muddy waters of bays and estuaries probably throughout the tropical Indo-Pacific region. Thus, the few representatives of the subspecies were probably members of a local inshore population swept out into the neritic zone. The apparent habitat difference alone should not be used as a basis for establishing this subspecies.

Except for the mistake in the number of external spines of Re P1, Lindberg's (1940) discussion and illustrations fit the Pago Pago Harbor specimens. By a lapsus Lindberg labeled Re P4 as Ri P4. Differences do occur in Lindberg's (1947) later more careful observations. There he stated that *O. dissimilis oceanica* lacks a seta on Re1 P1, possesses a short, strong seta on Re1 P2, a rudimentary one on Re1 P3 and a more developed one on Re1 P4; only P2 is illustrated. The genital flap of the male is illustrated with only 1 large seta and ventrally 3 small points. Although I have been unable to obtain specimens from Pondichery or Ratnaguri, I have assumed a continuous distribution throughout the nearshore coastal area of India for *O. dissimilis*. I have had the opportunity of examining a collection of plankton samples from the Cochin Backwater of India taken by Dr. Thomas E. Bowman on 22 November 1968. In a sample collected in water of 27.3‰, a number of specimens of *O. dissimilis* were found which agree with those from Pago Pago Harbor, including Ri P4, genital opening of the female, and A1 and genital flap of the male. The development of the flap on the cephalosome and the general arrangement of the integumental organs in the male are identical. I feel that the discrepancies between the absence or development of setae on Re1 P1-4 and the male genital flap are too slight to warrant separation of the populations from Pago Pago Harbor and

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Fig. 3. A-B, *Oithona dissimilis*, Female: A, Mx2; B, P4, anterior. C-D, *Oithona hebes*, Female: C, Mx2; D, P4, anterior.



Coehin from the populations described by Lindberg. Of these characters only the morphology of the genital flap has any systematic value and this difference could represent simply an error in observation.

Wellershaus (1969) described and illustrated as *Oithona hebes* Giesbrecht 1891, a species from Cochin Backwater, India. There are obviously awkward zoogeographic complications in finding a species originally described from the Bay of Guayaquil, Ecuador, and probably indigenous to the western tropical coast of the Americas, across the East Pacific Barrier in the Indo-Pacific region. Dr. Bowman has also made available to me plankton samples from the Bay of Guayaquil, Ecuador, collected in February, 1963. In these plankton samples from the type-locality of *O. hebes*, I have found numerous females and eight males of this species which agree with the descriptions of Giesbrecht (1892) and Kiefer (1936). González and Bowman (1965) have briefly discussed differences between *O. hebes* specimens from the type-locality and Lindberg's (1940) description of *O. dissimilis* and their observations are included in the following description.

Oithona hebes Giesbrecht 1891

Figs. 3C-5

Oithona hebes Giesbrecht 1891:475; 1892:538, 549, pl. 34, figs. 8-9.—Grandori, 1912:15.—Farran, 1913:191 (key).—Rosendorn, 1917:44.—Pesta, 1921:551, fig. G5.—Kiefer, 1929:9; 1936:320, figs. 1-5.—Rose, 1933:280, fig. 354.—Lindberg, 1950:274 (key); 1955:467, (key).—Löffler, 1963:209.—González & Bowman, 1965:269, fig. 19a-l, fig. 20a-b.—Bacon, 1971:85.—Santos, 1973:430, 432.

Oithona minuta T. Scott 1894.—Coker & González, 1960:8.

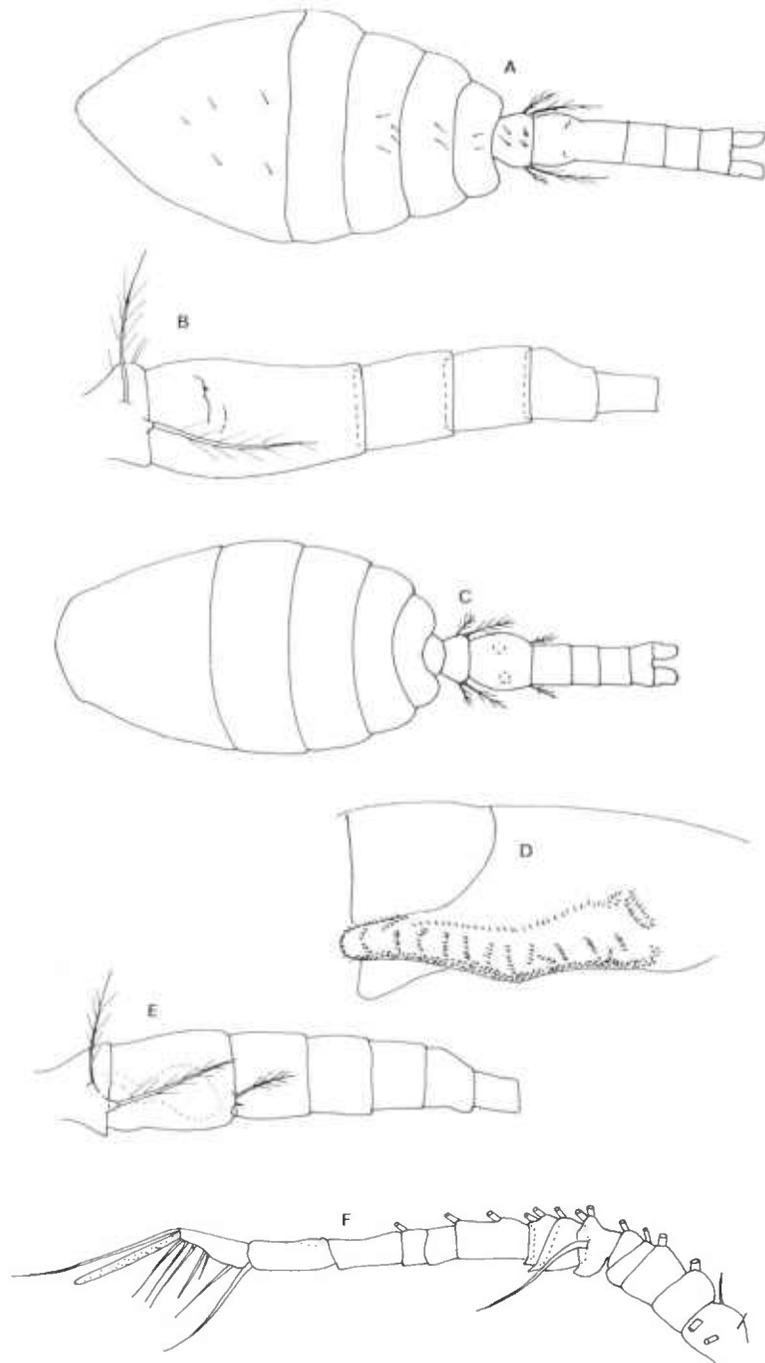
(not) *Oithona hebes* Giesbrecht 1891.—Wilson, 1942:196.

(not) *Oithona hebes* Giesbrecht 1891.—Wellershaus, 1969:276, figs. 88-102.

Diagnosis.—Female 0.49-0.58 mm (based on 30 specimens). Pr 1.5× Ur; dorsally, cephalosome pointed anteriorly; dorsally, Ur1 with 6-8 sensory hairs in 2 rows along midline. Ri of Md (Fig. 5B) with 4 setae, ultimate with setules; Bspd2 with 2 thick spines armed with numerous fine denticles. Mx2 (Fig. 3C) without notch or denticles on large spines. Ri P4 (Fig. 3D) with 2 modified setae; distal seta of Ri2 thicker and more strongly curved than proximal seta of Ri3 which is thinner and only slightly curved; both have membranous flange medially. Genital opening with a small point. Male 0.47-0.50 mm (based on 8 specimens). Integumental organs

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Fig. 4. *Oithona hebes*. A-B, Female: A, Dorsal; B, Ur, lateral. C-F, Male: C, Dorsal; D, Cephalosome, ventrolateral; E, Ur, lateral; F, AI.



of cephalosome (Fig. 4D) in dorsal longitudinal row doubled only toward anterior end; ventral to this 11 vertical rows and 1 oblique row between third and fourth vertical rows. Ri of Md (Fig. 5D) with 4 setae; distal 2 spines of Bspd reduced, only one armed with denticles. Genital flap with 1 large seta with setules and smaller seta ventrally.

Recently, Dr. Stefan Wellershaus of the Institut für Meeresforschung, Bremerhaven, kindly sent me an aliquot of a sample collected on 31 May 1966 from the Cochin Backwater. From this I have removed and identified males and females of *O. dissimilis* which agree in all respects with those populations described above from Cochin and Pago Pago Harbor.

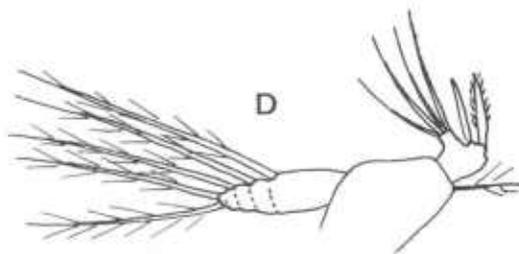
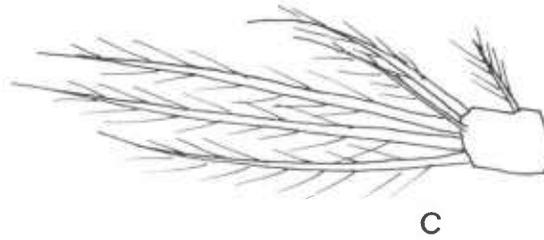
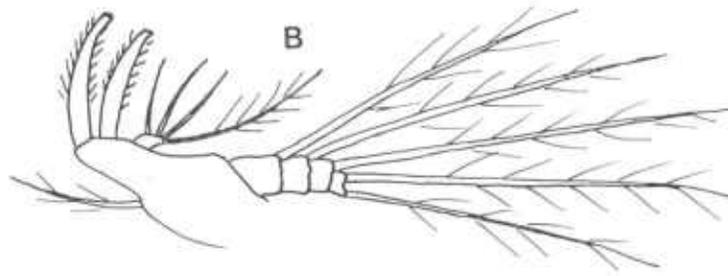
Comments

I have notes on five species of *Oithona* s.s. with modified setae on Ri P4. There are then the proximal inner seta on Ri3 P4 in *O. brevicornis* Giesbrecht (1891), noted and illustrated by Wellershaus (1969), the distal seta of Ri2 and proximal seta of Ri3 P4 in *O. hebes* Giesbrecht (1891) and *O. colcarva* Bowman (1975), and both setae of Ri2 and the proximal seta of Ri3 P4 in *O. dissimilis* Lindberg (1940) and *O. plumifera* Baird (1843), the latter noted and illustrated by Giesbrecht (1892). In each case, the number of setae modified and the extent of modification are specific for the species. The significance of these modified setae may be explained in this way. In the most diverse of the free-swimming copepods, the calanoids, many species exhibit various modifications of both male fifth legs and one of the first antennae. These appendages function to grasp and hold the female and help position the male during copulation. The spermatophore is probably transferred by the left fifth leg which has modified spines or, more often, ciliated parts of the distal segments of the limb to facilitate the handling of this delicate structure (for example, see fig. 22 of Vervoort, 1963). Lee (1972) has given a more complete discussion of the appendage modifications and inferred copulatory behavior of the Centropagidae.

In the males of *Oithona* the first antennae are symmetrical and digeniculate. A proximal series of segments can be rotated up to 270° in some species while the ultimate and penultimate together can be folded 180° back onto the 3 segments proximal to them. Except for these appendages, located far from the genital segment, the males do not possess other appendages modified to hold and transfer the spermatophore. It is possible that the female takes a much more active role in copulatory behavior, using her fourth legs and their modified setae to help transfer the spermatophore.

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Fig. 5. *Oithona hebes*. A-B, Female: A, Caudal ramus, ventral; B, Md. C-D, Male: C, Caudal ramus, dorsal; D, Md.



Fleminger (1973) presented a general discussion of integumental organs in calanoid copepods and demonstrated the systematic value of the pore signature patterns for the genus *Eucalanus*. As yet I have been unable to describe the exact morphology of these organs in the *Oithona* males using a light microscope. However, I hope that use of a scanning electron microscope will clarify many points. I have examined males of *O. plumifera*, *O. nana*, and *O. simplex* from American Samoa. These animals exhibit numerous interspecific differences not only in the pattern and number of integumental organs, but also in the degree of development of the flap on the cephalosome.

Fleminger (1973 & 1975) and Fleminger & Hulsemann (1973) have pointed the importance of prezygotic mating barriers in the selection process for several free-living calanoid genera. If this concept can be extended to *Oithona*, then the systematic value of the modified setae of the fourth legs of the female and the first antenna and integumental organs of the male becomes more apparent.

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