ARTHUR G. HUMES
and JU-SHEY HO

Cyclopoid Copepods of the Genus Pseudanthessius Associated with Crinoids in Madagascar

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • 1970 NUMBER 54

SERIAL PUBLICATIONS OF THE SMITHSONIAN INSTITUTION

The emphasis upon publications as a means of diffusing knowledge was expressed by the first Secretary of the Smithsonian Institution. In his formal plan for the Institution, Joseph Henry articulated a program that included the following statement: "It is proposed to publish a series of reports, giving an account of the new discoveries in science, and of the changes made from year to year in all branches of knowledge not strictly professional." This keynote of basic research has been adhered to over the years in the issuance of thousands of titles in serial publications under the Smithsonian imprint, commencing with *Smithsonian Contributions to Knowledge* in 1848 and continuing with the following active series:

Smithsonian Annals of Flight
Smithsonian Contributions to Anthropology
Smithsonian Contributions to Astrophysics
Smithsonian Contributions to Botany
Smithsonian Contributions to the Earth Sciences
Smithsonian Contributions to Paleobiology
Smithsonian Contributions to Zoology
Smithsonian Studies in History and Technology

In these series, the Institution publishes original articles and monographs dealing with the research and collections of its several museums and offices and of professional colleagues at other institutions of learning. These papers report newly acquired facts, synoptic interpretations of data, or original theory in specialized fields. Each publication is distributed by mailing lists to libraries, laboratories, institutes, and interested specialists throughout the world. Individual copies may be obtained from the Smithsonian Institution Press as long as stocks are available.

S. DILLON RIPLEY
Secretary
Smithsonian Institution

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY

NUMBER 54

Arthur G. Humes
and Ju-Shey Ho

Cyclopoid Copepods of the Genus Pseudanthessius Associated with Crinoids in Madagascar

SMITHSONIAN INSTITUTION PRESS
CITY OF WASHINGTON
1970

ABSTRACT

Humes, Arthur G., and Ju-Shey Ho. Cyclopoid Copepods of the Genus *Pseudanthessius* Associated with Crinoids in Madagascar. *Smithsonian Contributions to Zoology*, 54:1–20. 1970.—At Nosy Bé, Madagascar, five species of cyclopoid copepods belonging to the genus *Pseudanthessius* occur on various crinoids. Three of these species, *P. madrasensis* Reddiah, 1966, *P. major* Stock, 1967, and *P. minor* Stock, 1967, are redescribed. Two species are described as new: *P. angularis* new species, and *P. rostellatus*, new species.

Official publication date is handstamped in a limited number of initial copies and is recorded in the Institution's annual report, Smithsonian Year.

UNITED STATES GOVERNMENT PRINTING OFFICE
WASHINGTON : 1970

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price 35 cents (paper cover)

Arthur G. Humes and Ju-Shey Ho

Cyclopoid Copepods of the Genus Pseudanthessius Associated with Crinoids in Madagascar

Three species of the genus *Pseudanthessius* are known to be associated with crinoids. At Madras, India, Reddiah (1966) found *P. madrasensis* Reddiah, 1966, on unidentified crinoids. In the Gulf of Aqaba, Stock (1967) recovered *P. minor* Stock, 1967, from *Lamprometra klunzingeri* (Hartlaub) and *P. major* Stock, 1967, from *Heterometra savignyi* (J. Müller) and *L. klunzingeri*. In the vicinity of Nosy Bé, in northwestern Madagascar, all three of these copepods have been found, in addition to the two new species described below.

The copepods were collected by the first author during field work made possible as follows: in 1960 during an expedition of the Academy of Natural Sciences of Philadelphia, in 1963–1964 as part of the United States Program in Biology of the International Indian Ocean Expedition, and in 1967 supported by a grant (GB–5838) from the National Science Foundation. The study of the copepods has been aided by another grant from the National Science Foundation (GB–8381X).

All figures have been drawn with the aid of a camera lucida. The letter after the explanation of each figure refers to the scale at which it was drawn. The following abbreviations are used: A_1, first antenna; A_2, second antenna; MXPD, maxilliped; and P_1, leg 1.

All measurements of the body lengths have been made from specimens in lactic acid and do not include the setae on the caudal rami. The lengths of the segments of the first antenna have been measured along their posterior nonsetiferous margins.

Arthur G. Humes and Ju-Shey Ho, Department of Biology, Boston University, Boston, Massachusetts, 02215.

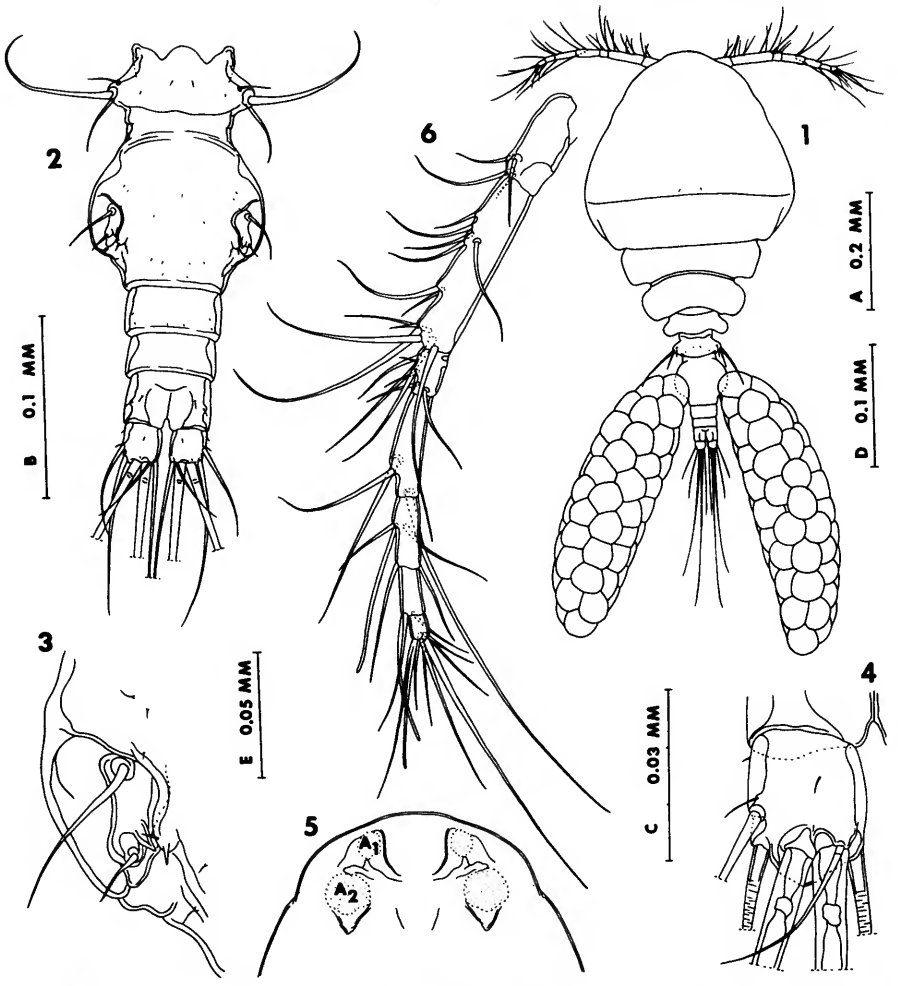
We are greatly indebted to Miss Ailsa M. Clark of the British Museum (Natural History), London, for the identifications of the crinoid hosts.

This paper comprises the following: (1) a redescription of *Pseudanthessius madrasensis* Reddiah, 1966, from *Tropiometra carinata* (Lamarck); (2) descriptive notes on *Pseudanthessius major* Stock, 1967, from *Cenometra emendatrix* (Bell), *Heterometra africana* (A. H. Clark), *Stephanometra indica* (Smith), *Lamprometra klunzingeri* (Hartlaub), *Liparometra*? sp., and *Dichrometra* sp.? *afra* A. H. Clark; (3) descriptive notes on *Pseudanthessius minor* Stock, 1967, from *Heterometra africana*, *Lamprometra kluzingeri*, *Liparometra*? sp., and *Dichrometra* sp.? *afra;* (4) a description of *Pseudanthessius angularis*, new species, from *Stephanometra indica* and *Dichrometra* sp.? *afra;* and (5) a description of *Pseudanthessius rostellatus*, new species, from *Comaster* sp.? nov. aff. *distinctus* (P. H. Carpenter).

Pseudanthessius madrasensis Reddiah, 1966

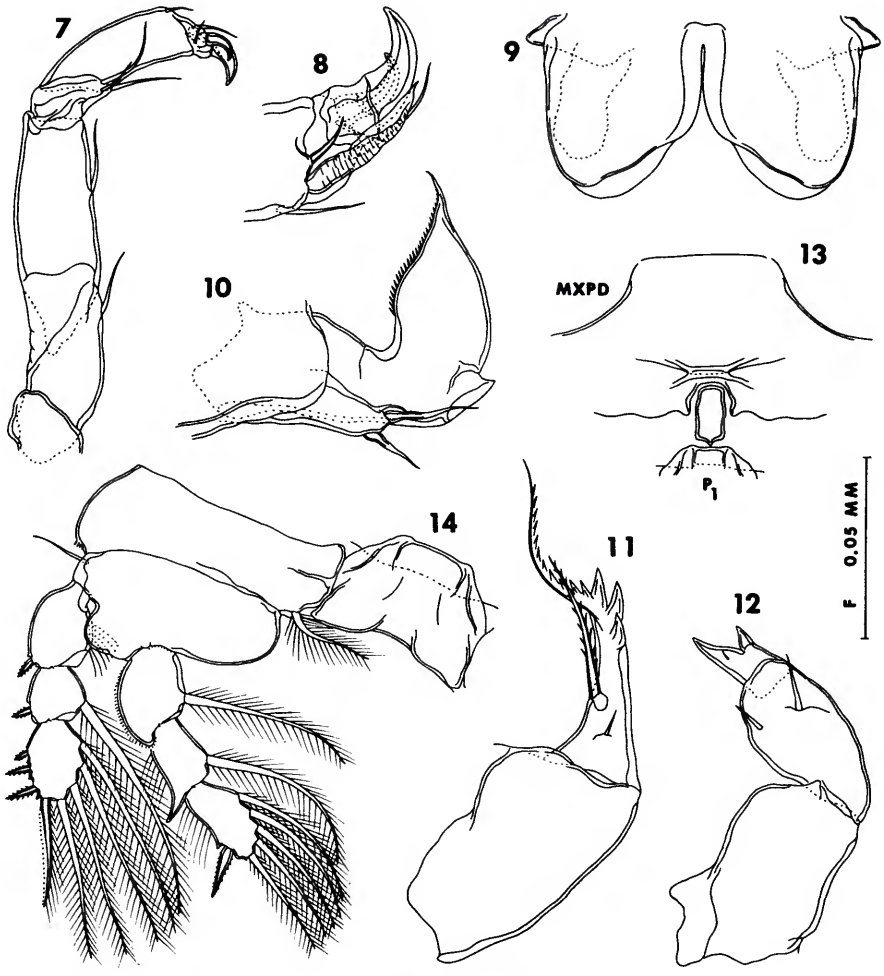
FIGURES 1–28

Collections in Madagascar comprised approximately 440 individuals from *Tropiometra carinata* (Lamarck), as follows: 39 ♀♀, 17 ♂♂, and 1 copepodid from 26 hosts, in 2 m, under dead *Acropora*, Pte. Ambarionaomby, Nosy Komba, near Nosy Bé, 18 August to 12 October 1960; 2 ♀♀, 9 ♂♂, and 2



FIGURES 1–6.—*Pseudanthessius madrasensis* Reddiah, 1966, female: 1, dorsal (A); 2, urosome, dorsal (B); 3, area of attachment of egg sac, dorsal (C); 4, caudal ramus, dorsal (C); 5, rostrum, ventral (D); 6, first antenna, dorsal (E).

copepodids from 6 hosts, in 1 m, Nosy N'Tangam, a small island on the western coast of Nosy Bé, 25 August 1960; 19 ♀♀, 6 ♂♂, and 5 copepodids from 4 hosts, in 1 m, Pte. Mahatsinjo, Nosy Bé, 18 and 26 October 1960; 4 ♀♀ and 7 ♂♂ from 3 hosts, in 1.5 m, Nosy N'Tangam, 20 October 1960; 16 ♀♀, 3 ♂♂, and 2 copepodids from 2 hosts, in 2 m, Antsamantsara, north of Madirokely, Nosy Bé, 31 October 1960; 15 ♀♀, 10 ♂♂, and 1 copepodid from 13 hosts, in 0.5 m, under dead *Acropora*, Pte. Ambarionaomby, 24 June 1963; 9 ♀♀ from 3 hosts, in 1 m, Pte. Ambarionaomby, 3 July 1963; 38 ♀♀, 13 ♂♂, and 3 copepodids from 19 hosts, in 1 m, Pte. Ambarionaomby, 3 September 1963; 25 ♀♀, 5 ♂♂, and 3 copepodids from 30 hosts, in 1 m, Pte. Ambarionaomby, 30 October 1963; 33 ♀♀, 34 ♂♂, and 4 copepodids from 17 hosts, in 1 m, Pte. Ambarionaomby, 28 November 1963; 8 ♀♀ and 8 ♂♂ from 1 host, in 2 m, Ambato Rano, a small island southeast of Nosy Komba, 13°30′45″S, 48°22′55″E, 2 October 1964; 19 ♀♀, 5 ♂♂, and 1 copepodid from 16 hosts, in 1 m, under dead *Acropora*, Pte. Ambarionaomby, 8 June 1967; 29 ♀♀ and 13 ♂♂ from 25 hosts, in 1 m, Pte. Ambarionaomby, 26 June 1967; 1 ♀ from 1 host, in 3 m, Pte. Mahatsinjo, Nosy Bé, 7 June 1967; 13 ♀♀ from 1



FIGURES 7–14.—*Pseudanthessius madrasensis* Reddiah, 1966, female: 7, second antenna, posterior (E); 8, tip of second antenna, anterior (C); 9, labrum, with paragnaths indicated by dashed lines, ventral (C); 10, mandible and first maxilla, posterior (C); 11, second maxilla, posterior (C); 12, maxilliped, inner (C); 13, area between maxillipeds and first pair of legs, ventral (E); 14, leg 1 and intercoxal plate, anterior (F).

host, in 1 m, Ambatoloaka, Nosy Bé, 23 June 1967; and 4 ♀♀ and 7 ♂♂ from 1 host, in 15 m, Banc du Touareg, south of Nosy Bé, 13°32′05″S, 48°15′20″E, 1 September 1967.

Specimens have been deposited in the United States National Museum and in the Zoölogisch Museum, Amsterdam.

The following redescription supplements Reddiah's brief diagnosis, in which certain appendages were left undescribed.

FEMALE.—Body (Figure 1) with a broad subtriangular cephalosome. Length 0.68 mm (0.63–0.73 mm) and greatest width 0.36 mm (0.32–0.39 mm), based on 10 specimens. Ratio of length to width of prosome, 1.37:1. Ratio of length of prosome to that of urosome, 2.55:1.

Segment of leg 5 (Figure 2) 55 × 83μ. Between this segment and genital segment a weakly defined ventral intersegmental sclerite. Genital segment 83 × 100μ. Areas of attachment of egg sacs situated dorsolaterally just behind middle of segment. Each area (Figure 3) bearing two naked setae, 13μ and

33μ long, with a spiniform process between them. Three postgenital segments, 26 × 55μ, 24 × 51μ, and 29 × 50μ, from anterior to posterior. Posteroventral margin of anal segment naked.

Caudal ramus (Figure 4) 25 × 22μ in greatest dimensions, length including terminal ventral flap. Outer lateral seta 55μ, dorsal seta 28μ, outermost terminal seta 104μ, innermost terminal seta 130μ, and two median terminal setae (242μ, outer, and 350μ, inner). All setae naked.

Dorsal surface of prosome and dorsal and ventral surfaces of urosome ornamented with only a few small hairs (sensilla).

Egg sac (Figure 1) elongated (528 × 154μ), extending a little beyond tips of longest ramal setae, and containing approximately 55–65 eggs, each about 56μ in diameter.

Rostrum (Figure 5) weakly developed, and lacking a distinct posteroventral margin.

First antenna (Figure 6) 232μ long. Lengths of its seven segments: 25 (39μ along its anterior margin), 72, 20, 41, 30, 19, and 11μ, respectively. Formula for armature: 4, 13, 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. All setae naked.

Second antenna (Figure 7) with formula 1, 1, 3, II + 1 + 4. Fourth segment 81μ along outer edge, 51μ along inner edge, and 21μ wide. This segment bearing terminally two unequal claws (17μ and 25μ), a stout annulated seta with a unilateral lamella (Figure 8), and four slender setae. Appendage lacking fine ornamentation, and all its setae naked.

Labrum (Figure 9) with two nondivergent posteroventral lobes.

Mandible (Figure 10) bearing on its convex margin a scalelike process and on its concave margin a row of small spinules. Lash short and naked. Paragnath (Figure 9) an elongated lobe ornamented distally with a few hairs. First maxilla (Figure 10) bearing three setae. Second maxilla (Figure 11) with an unarmed first segment. Second segment produced to form a unilaterally spinose lash, and bearing a dorsal surficial barbed seta and a posterior proximal setule. Maxilliped (Figure 12) with two naked setae on second segment; third segment bearing a short spine, a minute setule, and produced to form a spiniform tip.

Ventral area between maxillipeds and first pair of legs not protuberant. A fine line connecting bases of maxillipeds (Figure 13).

Legs 1–4 (Figures 14–17) with 3-segmented rami except for endopod of leg 4 which consists of a single segment. Armature of legs as follows (Roman numerals indicate spines; Arabic numerals, setae):

P_1	coxa	0–1	basis	1–0	exp	I–0;	I–1;	III, I, 4
					enp	0–1;	0–1;	I, 5
P_2	coxa	0–1	basis	1–0	exp	I–0;	I–1;	III, I, 5
					enp	0–1;	0–2;	I, II, 3
P_3	coxa	0–1	basis	1–0	exp	I–0;	I–1;	III, I, 5
					enp	0–1;	0–2;	I, II, 2
P_4	coxa	0–1	basis	1–0	exp	I–0;	I–1;	II, I, 5
					enp	1, I		

Inner seta on coxa of legs 1–3 long and plumose, but in leg 4 this seta minute (3μ) and naked. Inner margin of basis of all four legs naked. In leg 1 proximalmost outer spine on third segment of exopod unusually short (4μ) in relation to adjacent distal spine (8μ). First segment of endopod of legs 1–3 with a spinulose fringe along its outer edge (in leg 3 with short proximal row of hairs also) and distal outer angle of this segment rounded. Last segment of endopod of leg 2, 24μ long and its spines 10, 11, and 18μ, respectively. Last segment of endopod of leg 3, 28μ, and its spines 13, 23, and 50μ. In leg 4, exopod 107μ long. Endopod 62 × 14μ, terminally with its naked seta 48μ and its inner barbed spine 58μ. Inner row of hairs and a few small spinules near insertion of terminal elements.

Leg 5 (Figure 18) consisting of a large spiniform seta (77μ), a slender seta (39μ), and a dorsal seta (22μ), all three setae naked.

Leg 6 probably represented by two setae near attachment of each egg sac (Figure 3).

Color in life in transmitted light translucid, intestine reddish brown, eye red, egg sacs opaque gray.

MALE.—Body (Figure 19) with a less-broadened and triangular cephalosome than in female. Length 0.48 mm (0.44–0.58 mm) and greatest width 0.19 mm (0.18–0.23 mm), based on ten specimens. Ratio of length to width of prosome, 1.67:1. Ratio of length of prosome to that of urosome, 1.73:1.

Segment of leg 5 (Figure 20) 22 × 52μ. Between this segment and genital segment only a trace of a ventral intersegmental sclerite. Genital segment 84 × 84μ in dorsal view, tapered anteriorly and broadended posteriorly. Four postgenital segments, 21 × 38μ, 19 × 38μ, 16 × 36μ, and 18 × 35μ from anterior to posterior.

Caudal ramus similar to that of female, but smaller (18.5 × 16.5μ).

Surface of body bearing only a few hairs as in female.

Rostrum similar to that of female.

First antenna like that of female, but an aesthete added on segment 2, as in *P. major* and *P. minor*. Second antenna, labrum, mandible, paragnath, first maxilla, and second maxilla resembling those of female. Maxilliped (Figure 21) 4-segmented, assuming that proximal part of claw represents fourth segment. Second segment bearing two naked setae and a single row of spines. Claw in some specimens bent (94μ along its axis) as in Figure 21, but in others evenly arched (60μ along its axis) as in Figure 22; bearing usual two unequal proximal setae.

Area between maxillipeds and first pair of legs like that of female.

Legs 1–4 with same spine and setal formula as in female. In leg 1 (Figure 23) proximalmost outer spine longer (7μ) in relation to adjacent distal spine (11μ) than in female. In legs 1–3 distal outer angle of first segment of endopod forming a spiniform process rather than being rounded as in female. Last segment of endopod in legs 1–3 showing sexual dimorphism in nature of armature. In leg 1, two outer setae stout and somewhat spiniform. In a male with a bent claw on maxilliped the segment in leg 2 (Figure 24) 30μ long and its three spines 13, 18, and 38μ; segment in leg 3 (Figure 26) 36μ long, with its spines 18, 31, and 50μ, with longest spine recurved. In a male with an evenly arched claw on maxilliped, last segment in leg 2 (Figure 25) 20μ and its spines 9, 12, and 24μ; segment in leg 3 (Figure 27) 22μ, with its spines 12, 21, and 38μ, longest spine straight.

In leg 5 two elements ventral to dorsal seta about 37μ and naked (Figure 20).

Leg 6 (Figure 26) consisting of a posteroventral flap on genital segment, bearing two naked setae (20μ and 35μ), and a rather long and slender spiniform process (12μ).

Spermatophore not observed.

Color in life resembling that of female.

REMARKS.—Through the kindness of Mr. B. K. Tikader, Zoological Survey of India, Calcutta, we have been able to dissect one paratypic female of *Pseudanthessius madrasensis* Reddiah, 1966. A detailed study of this paratype has shown no significant differences from the Madagascan material.

Reddiah's description and figures contain certain errors. The armature of the first antenna and the spine and setal formula of legs 1–4 are as given in the description above, not as Reddiah has shown them. Reddiah described a row of denticles on the first two segments of the exopod of leg 2, but there are no such denticles in the paratype or in the specimens from Madagascar. The position of these supposed denticles lies along a prominent striated muscle, whose striations may have been misinterpreted as ornamentation. The outer articulated spine on the second segment of the endopod of leg 3, shown in Reddiah's figure 2L, is only an unarticulated spiniform process.

Although we have not had available for study a paratypic male, we have concluded on the basis of the identical features of the paratypic female of *P. madrasensis* and the females from Madagascar that our material from *Tropiometra carinata* is indeed *Pseudan. thessius madrasensis*.

The type-specimens of *P. madrasensis* were collected from unidentified crinoids in the harbor of Madras, India. *Tropiometra carinata*, the host crinoid in Madagascar, has been found in Madras harbor (A. H. Clark, 1947, p. 286), where it has been recognized as the subspecies *T. carinata clarki* Gislén. This may perhaps have been the host of Reddiah's specimens.

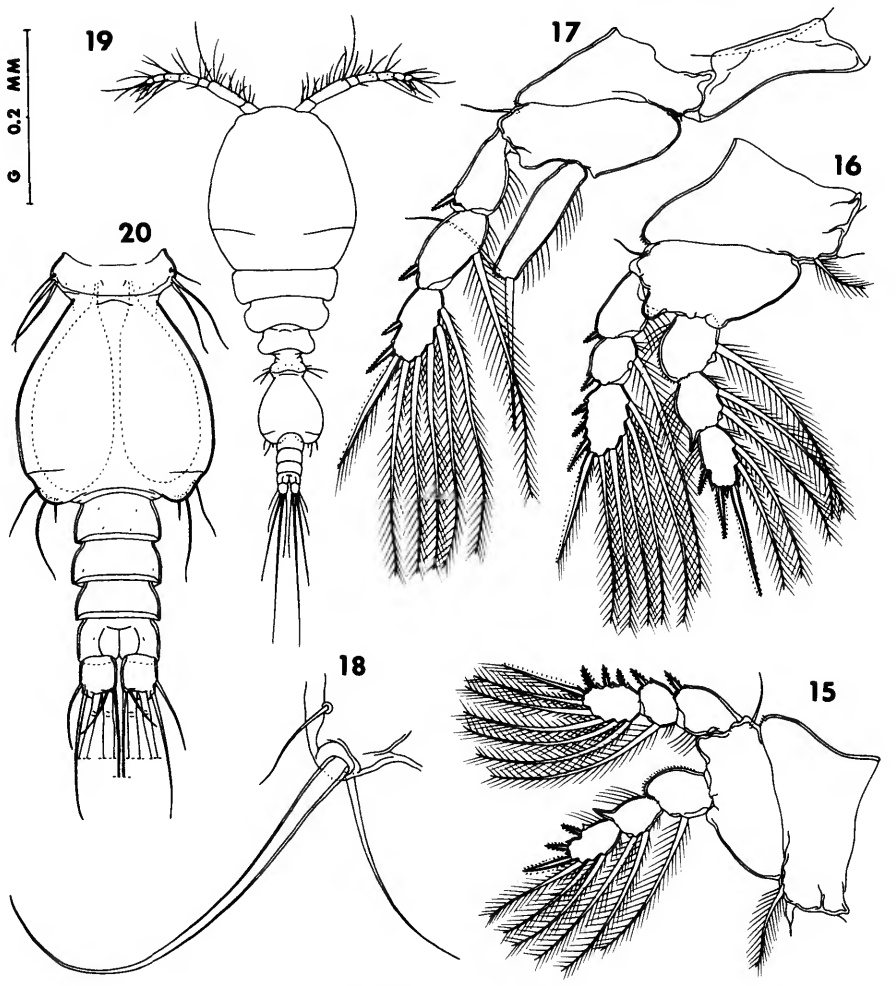
Pseudanthessius major Stock, 1967

FIGURES 29–44

Nearly 900 specimens of this copepod, thus far known only from the Red Sea, have been collected in Madagascar from six different crinoids, as follows:

From *Cenometra emendatrix* (Bell): 43 ♀ ♀, 42 ♂ ♂, and 23 copepodids from 5 hosts, in 20 m, south of Tany Kely, a small island to the south of Nosy Bé, 10 September 1963; 49 ♀ ♀, 24 ♂ ♂, and 13 copepodids from 6 hosts, in 20 m, south of Tany Kely, 11 October 1963; 23 ♀ ♀, 6 ♂ ♂, and 1 copepodid from 2 hosts, in 20 m, south of Tany Kely, 12 October 1963; 19 ♀ ♀, 12 ♂ ♂ from 2 hosts, in 10 m, northwestern coast of Nosy Ovy (=Berafia), Isles Radama, 13°59′00″S, 47°46′30″E, 1 October 1964; and 66 ♀ ♀, 33 ♂ ♂, and 1 copepodid from 11 hosts, in 20 m, Banc de Dzamandzar, western coast of Nosy Bé, 30 August 1967.

From *Heterometra africana* (A. H. Clark): 4 ♀ ♀, 8 ♂ ♂, and 4 copepodids from 1 host, on sand in 18 m, in pass between Nosy Bé and Nosy Komba at Pte. Lokobe, 14 July 1967; 48 ♀ ♀, 32 ♂ ♂, and 17 copepodids from 1 host, on shell fragment on sandy bottom in 34 m, 1 km south of crater near Ambatoloaka, Nosy Bé, 24 July 1967; 7 ♀ ♀ from 1 host, in 25 m, trawl 13°29′30″S, 48°02′00″E to 13°28′00″S,

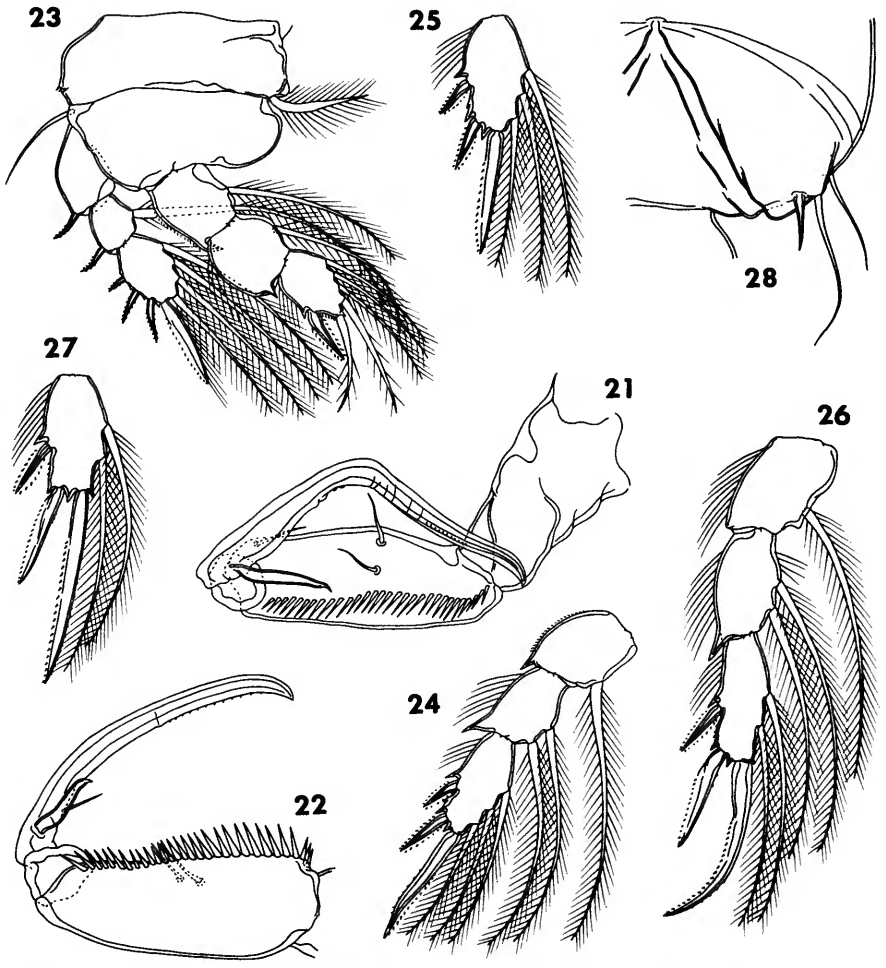


FIGURES 15–20.—*Pseudanthessius madrasensis* Reddiah, 1966. 15–18, female: 15, leg 2, anterior (E); 16, leg 3, anterior (E); 17, leg 4 and intercoxal plate, anterior (E); 18, leg 5, dorsal (C). 19, 20, male: 19, dorsal (G); 20, urosome, dorsal (E).

48°02′30″E, southwest of Nosy Bé, 11 August 1967; 1 ♀, 2 ♂ ♂ from 1 host, on sand in 17 m, in pass off Pte. Lokobe, 15 August 1967; 13 ♀ ♀, 20 ♂ ♂, and 73 copepodids from 1 host, on octocoral on sandy bottom in 29 m, 1 km south of crater near Ambatoloaka, 21 August 1967; 2 ♀ ♀, 1 ♂ from 1 host, on sand in 17 m, in pass between Nosy Bé and Nosy Komba, 16 August 1967; 46 ♀ ♀, 18 ♂ ♂ from 1 host, in 17 m, in pass off Pte. Lokobe, 23 August 1967; 24 ♀ ♀, 14 ♂ ♂, and 5 copepodids from 3 hosts, on sand in 17 m, in pass off Pte. Lokobe, 27 August 1967; and 47 ♀ ♀, 20 ♂ ♂, and 10 copepodids from 4 hosts, in 18 m, near black buoy north of Nosy Varona, a small island almost between Nosy Bé and Nosy Komba, 30 August 1967.

From *Stephanometra indica* (Smith): 1 ♀, 2 ♂ ♂ from 1 host, in 2 m, Antsiabe, on southern shore of Nosy Komba, 8 July 1967; 20 ♀ ♀, 17 ♂ ♂ from 1 host, in 17 m, in pass off Pte. Lokobe, 16 August 1967; and 2 ♂ ♂ from 1 host, on sand in 13 m, opposite Antisabe, 2 September 1967.

From *Lamprometra klunzingeri* (Hartlaub): 2 ♀ ♀, 1 ♂ from 1 host, in 1 m, Pte. Ambarionaomby, Nosy Komba, 3 September 1963; and 1 ♀, 4 ♂ ♂, and 2 copepodids from 1 host, on sand in 13 m, opposite Antsiabe, 2 September 1967.



FIGURES 21–28.—*Pseudanthessius madrasensis* Reddiah, 1966, male: 21, maxilliped, inner (F); 22 maxilliped, postero-inner (C); 23, leg 1, anterior (F); 24, endopod of leg 2, anterior (F); 25, third segment of endopod of leg 2, anterior (C); 26, endopod of leg 3, anterior (F); 27, third segment of endopod of leg 3, anterior (C); 28, leg 6, ventral (C).

From *Liparometra*? sp.: 4 ♀♀, 1 ♂ from 1 host, on sand in 15 m, in pass off Pte. Lokobe, 13 June 1967; 3 ♀♀, 1 ♂ from 1 host, in 27–23 m, trawl 13°29′S, 48°09′E to 13°28.5′S, 48°11.5′E, south of Nosy Bé, 11 August 1967; and 3 ♀♀, 1 ♂ from 1 host, in 35m, trawl 13°26.1′S, 48°11.7′E to 13°25.5′S, 48°11′E, south of Nosy Bé, 24 August 1967.

From *Dichrometra* sp.? *afra* A. H. Clark: 3 ♀♀, 1 ♂ from 1 host, in 2 m, Pte. Lokobe, 2 September 1960; 13 ♀♀, 3 ♂♂ from 1 host, in 1 m, west of Pte. Mahatsinjo, Nosy Bé, 2 November 1960; 4 ♀♀, 3 ♂♂ from 1 host, in 6 m, Ambariobe, a small island almost between Nosy Bé and Nosy Komba, 28 December 1963; and 16 ♀♀, 13 ♂♂ from 1 host, in 2 m, Ambariotelo, a small island near Ambariobe, 24 May 1964.

Specimens have been deposited in the United States National Museum and in the Zoölogisch Museum, Amsterdam.

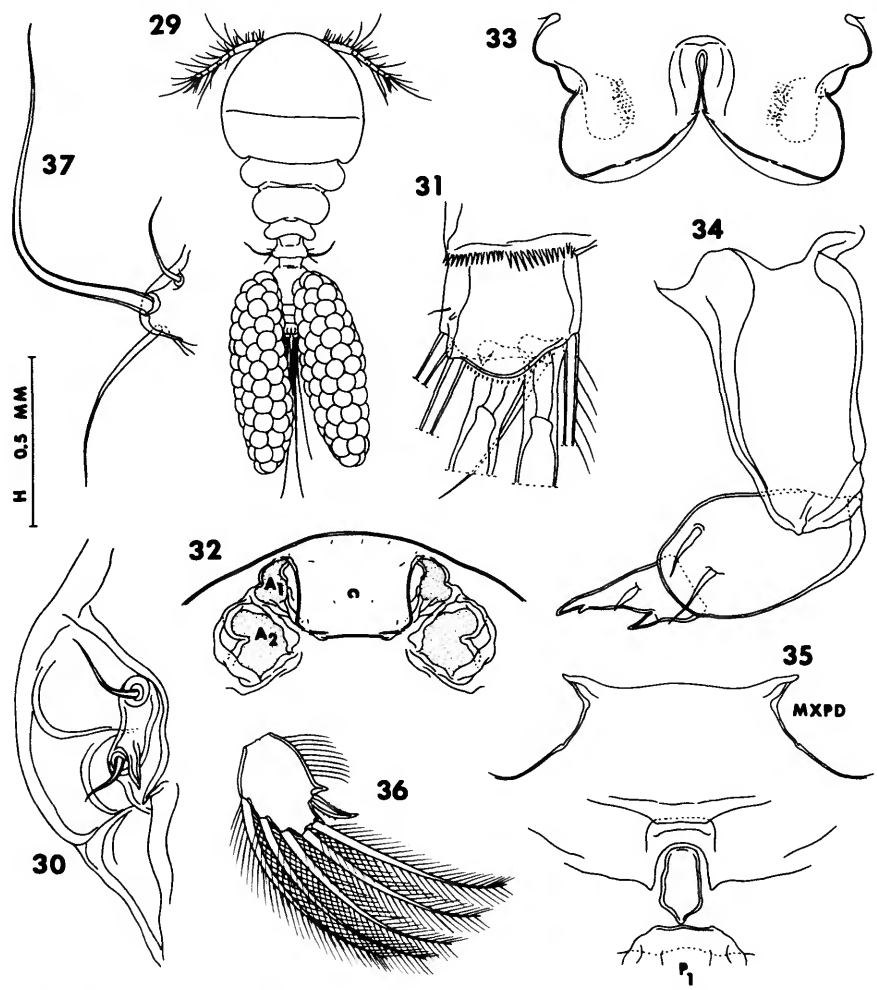
Although the Madasgascan specimens are readily determinable from Stock's original description, we take this opportunity to add certain information, based upon specimens from *Cenometra emendatrix* unless otherwise noted. Structures not mentioned may be assumed to be essentially as described by Stock.

375-844 O - 70 - 2

FEMALE.—Length of body (Figure 29) 0.85 mm (0.79–0.88 mm) and greatest width 0.45 mm (0.43–0.47 mm), based on ten specimens. Ratio of length to width of prosome, 1.43:1. Ratio of length of prosome to that of urosome, 2:1.

Segment of leg 5, 60 × 96μ. Between this segment and genital segment a short and rather weak ventral intersegmental sclerite. Genital segment 112 × 122μ, with its shape in all specimens like that shown in Stock's figure 7a rather than like that in his figure 7b. Attachment area of each egg sac bearing two naked setae (18μ and 13μ long) and a spiniform process (Figure 30). Three postgenital segments, 34 × 69μ, 28 × 62μ, and 30 × 58μ, from anterior to posterior.

Caudal ramus (Figure 31) 22 × 20μ, including terminal ventral flange which bears a row of minute spinules. Outer lateral seta 45μ, dorsal seta 25μ, and outermost terminal seta 74μ, all three of them naked. Innermost terminal seta 110μ, with spinules along its inner edge. Two median terminal setae (275μ, outer, and 400μ, inner), both with lateral spinules.



FIGURES 29–37.—*Pseudanthessius major* Stock, 1967, female: 29, dorsal (H); 30, area of attachment of egg sac, dorsal (C); 31, caudal ramus, ventral (C); 32, rostrum, ventral (D); 33, labrum, with paragnaths indicated by dashed lines, ventral (C); 34, maxilliped, inner (C); 35, area between maxillipeds and first pair of legs, ventral (E); 36, third segment of endopod of leg 1, anterior (F); 37, leg 5, dorsal (F).

Egg sac (Figure 29) elongated (in specimen drawn, 638 × 187μ) and having about 90 eggs, each approximately 62μ in diameter. In a female from *Liparometra*, each sac containing about 55 eggs; and in one from *Stephanometra*, about 40 eggs.

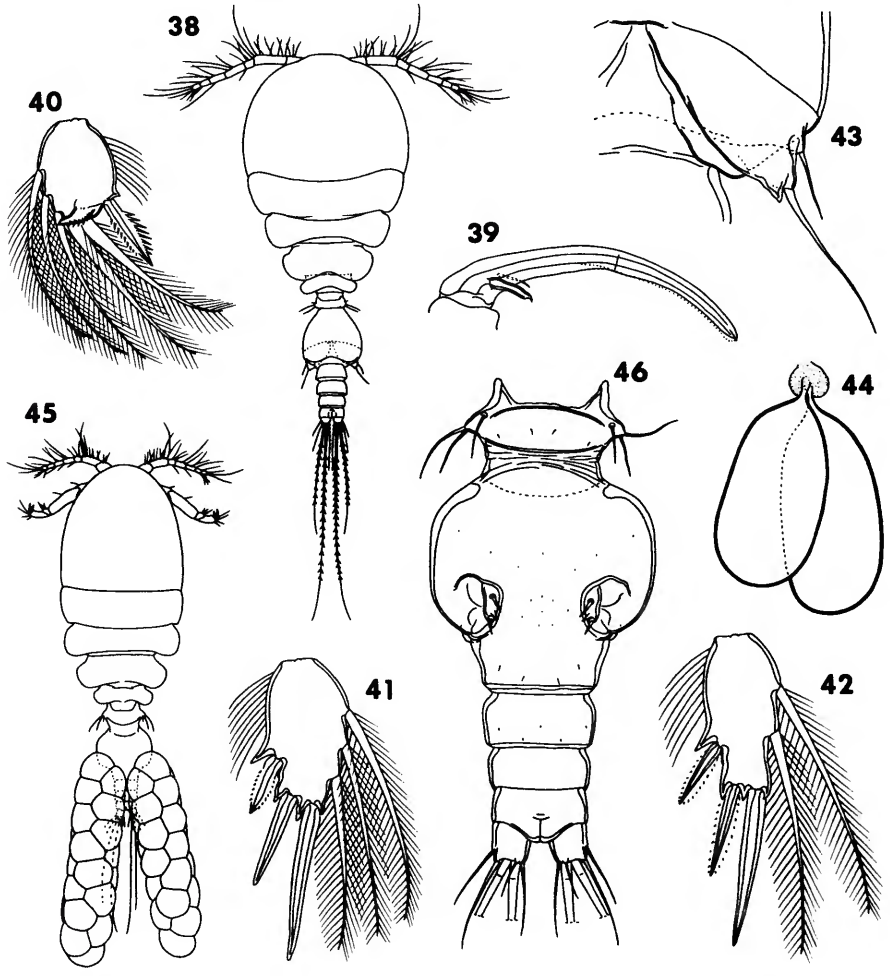
Rostrum (Figure 32) weakly developed and often showing, to varying degrees, a small median sclerotized knoblike area.

First antenna 250μ long, lengths of its segments being 28 (50μ along its anterior margin), 64, 20, 42, 38, 23, and 13μ, respectively. Third segment with six setae (rather than five as described by Stock). All setae naked.

Last segment of second antenna 44μ along inner edge, 75μ along outer edge, and 19μ wide. Terminal claws 28μ and 19μ, measured along their axes.

Labrum (Figure 33) with two divergent posteroventral lobes.

Mandible having on its convex edge a scale more prominent than that illustrated by Stock in his figure 8b, and more like mandible of *P. madrasensis* shown in our Figure 10. Paragnath a small lobe with a few



FIGURES 38–46.—38–44, *Pseudanthessius major* Stock, 1967, male: 38, dorsal (A); 39, claw of maxilliped, inner (F); 40, third segment of endopod of leg 1, anterior (F); 41, third segment of endopod of leg 2, anterior (F); 42, third segment of endopod of leg 3, anterior (F); 43, leg 6, ventral (F); 44, spermatophores, attached to female, ventral (E). 45, 46, *Pseudanthessius minor* Stock, 1967, female: 45, dorsal (A); 46, urosome, dorsal (E).

hairs. Maxilliped (Figure 34) with two setae on second segment, and number of denticles on spine and on spiniform prolongation of third segment varying from none to four.

Ventral area between maxillipeds and first pair of legs (Figure 35) only slightly protuberant. A fine line connecting bases of maxillipeds.

Curved spine on last segment of endopod of leg 1 (Figure 36) finely barbed. Exopod of leg 4, 130μ long, and endopod 60μ (including terminal spiniform process) $\times$ 18μ, with its two terminal elements 47μ (outer) and 71μ (inner).

Leg 5 (Figure 37) with a dorsal seta (30μ) and two unequal posterolateral setae, one stout and 108μ, the other more slender and 44μ. All three setae naked.

Color in life in transmitted light translucent to slightly opaque, eye red, egg sacs gray.

MALE.—Length of body (Figure 38) 0.67 mm (0.65–0.70 mm) and greatest width 0.30 mm (0.29–0.31 mm), based on ten specimens. Ratio of length to width of prosome, 1.45:1. Ratio of length of prosome to that of urosome, 1.79:1.

Segment of leg 5, 25 $\times$ 47μ. Between this segment and genital segment no distinct ventral intersegmental sclerite. Genital segment 88 $\times$ 79μ. Four postgenital segments, 27 $\times$ 43μ, 20 $\times$ 40μ, 15.5 $\times$ 36μ and 17.5 $\times$ 36μ, from anterior to posterior. Anal segment as in female bearing on each side a posteroventral row of spinules (more than four in number as in Stock's description).

Caudal ramus 17 $\times$ 16.5μ and similar to that of female.

Claw of maxilliped (Figure 39) 90μ along its axis, weakly divided near its middle, bearing two unequal setae proximally.

Last segment of endopod of leg 1 (Figure 40) showing fairly strong sexual dimorphism. Outer spine 22μ and prominently barbed. Length of segment, 26.5μ, with ratio of spine to segment 1:1.2. Two outermost setae stouter than other three; near their insertions an antero-inwardly directed spinous process bearing spinules. In specimens from *Dichrometra*, *Stephanometra*, *Heterometra*, *Lamprometra*, and *Liparometra* outer spine 14μ with much smaller barbules, and length of segment 24μ, with ratio 1:1.7.

Last segment of endopod of leg 2 usually a with naked outer proximal spine, but in a male from *Cenometra* this spine barbed in right leg (Figure 41) but smooth in left leg. Length of this segment 40μ and three spines 17, 28, and 46μ from proximal to distal.

Last segment of endopod of leg 3 (Figure 42) with a naked inner terminal spine in all specimens except in a male (from *Dichrometra*) where it is very slightly barbed.

Leg 5 like that of female except that two posterolateral setae are more equal.

Leg 6 (Figure 43) consisting of a posteroventral flap on genital segment, bearing two naked setae (15μ and 36μ) and a small spinous process.

Spermatophore (Figure 44) attached to female in pairs, about 85 $\times$ 42μ, not including neck.

Color in life similar to that of female.

REMARKS.—Although our specimens from Madagascar conform closely to Stock's original description, there are several small differences. These may be noted by comparing the above account with Stock's description. None of the differences is greater than might be expected as a result of technique of observation or possibly as an expression of variability related to host preference.

In the Gulf of Aqaba, Stock (1967) found *P. major* on *Heterometra savignyi* (J. Müller) and *Lamprometra klunzingeri* (Hartlaub). In Madagascar it occurred on *L. klunzingeri* and on the five other crinoids listed above. The numbers of hosts and their copepods are shown in Table 1.

TABLE 1.—*Host crinoids and incidence of* Pseudanthessius major

Species of crinoid	Number of hosts	Number of *P. major*	Average number of *P. major* per host
Heterometra africana	14	416	29.7
Cenometra emendatrix	21	355	17.0
Stephanometra indica	3	42	14.0
Lamprometra klunzingeri	2	10	5.0
Liparometra? sp.	3	13	4.3
Dichrometra sp.? *afra*	4	56	14.0
Totals	47	892	

In Madagascar *Heterometra africana* and *Cenometra emendatrix* appear to be hosts favored by *P. major*. One specimen of *H. africana*, collected in 29 m on 21 August 1967, had 106 copepods; and another, collected in 34 m on 24 July 1967, had 97. The numbers

collected of the other four species of crinoids are relatively small, and the average numbers of copepods per host are not as significant.

Pseudanthessius minor Stock, 1967

FIGURES 45–51.

Approximately 170 specimens were collected in Madagascar from four species of crinoids, as follows:

From *Heterometra africana* (A. H. Clark): 10 ♀♀, 1 ♂ from 2 hosts, in 18 m, near black buoy north of Nosy Varona, a small island almost between Nosy Bé and Nosy Komba, 30 August 1967.

From *Lamprometra klunzingeri* (Hartlaub): 2 ♂♂ from 1 host, on sand in 13 m, opposite Antsiabe, southern shore of Nosy Komba, 2 September 1967.

From *Liparometra*? sp.: 12 ♀♀, 1 ♂, and 4 copepodids from 1 host, on sand in 15 m, in pass off Pte. Lokobe between Nosy Bé and Nosy Komba, 13 June 1967; 79 ♀♀, 7 ♂♂ from 1 host, in 27–23 m, trawl 13°29′S, 48°09′E to 13°28.5′S, 48°11.5′E, south of Nosy Bé, 11 August 1967; and 15 ♀♀ from 1 host, in 35 m, trawl 13°26.1′S, 48°11.7′E to 13°25.5′S, 48°11′E, south of Nosy Bé, 24 August 1967.

From *Dichrometra* sp.? *afra* A. H. Clark: 24 ♀♀, 14 ♂♂, and 2 copepodids from 1 host, in 2 m, Pte. Lokobe, Nosy Bé, 2 September 1960.

Specimens have been deposited in the United States National Museum.

Structures not mentioned in the brief notes which follow may be regarded as conforming to Stock's original description. The text and figures are based on specimens from *Dichrometra* sp.? *afra* unless otherwise stated.

FEMALE.—Length of body (Figure 45) 0.59 mm (0.55–0.64 mm) and greatest width 0.21 mm (0.21–0.22 mm), based on ten specimens. Ratio of length to width of prosome, 1.96:1. Ratio of length of prosome to that of urosome, 2.24:1.

Segment of leg 5 (Figure 46) 41 × 67μ. Between this segment and genital segment a short weak ventral intersegmental sclerite. Genital segment 88 × 96μ. (In some specimens lateral borders of this segment in dorsal view more rounded than shown in the figure.) Attachment area of each egg sac bearing two naked setae (11μ and 7μ), with a spiniform process between them. Three postgenital segments, 24 × 47μ, 18 × 42μ, and 18 × 40μ, from anterior to posterior.

Caudal ramus 20 × 15.5μ (length including terminal ventral flange). Outer lateral seta 28μ, dorsal seta 15μ, outermost terminal seta 39μ, innermost terminal seta 30μ, and two long median terminal setae (125μ, outer, and 240μ, inner).

Egg sac (Figure 45) elongated and slender (400 × 100μ), with about 23–28 eggs, each approximately 60μ in diameter, though of irregular dimensions.

Rostrum (Figure 47) with a conspicuous median sclerotized knob, but weakly defined posteroventrally.

First antenna 125μ long. Lengths of its segments: 13 (29μ along its anterior edge), 22, 12, 16.5, 20, 14, and 10μ respectively. Third segment with six setae. All setae naked.

Last segment of second antenna 21μ along inner edge, 40μ along outer edge, and 17μ wide. Two claws, 19μ and 11μ (measured along their axes).

Labrum and paragnath like those of *P. major*. First maxilla with three elements. Maxilliped shown in Figure 48.

Ventral area between maxillipeds and first pair of legs similar to that in *P. major*.

Spine on third segment of endopod of leg 1 with very small barbules in one female from *Liparomtera*? sp.

Exopod of leg 4, 69μ long; endopod 34 × 10μ, with outer terminal element 18μ and inner 32μ.

MALE.—Length of body (Figure 49) 0.52 mm (0.51–0.53 mm) and greatest width 0.19 mm (0.19–0.20 mm), based on ten specimens. Ratio of length to width of prosome, 1.54:1. Ratio of length of prosome to that of urosome, 1.45:1.

Segment of leg 5, 29 × 48μ. Between this segment and genital segment no distinct ventral intersegmental sclerite. Genital segment 99 × 92μ. Four postgenital segments 25 × 40μ, 25 × 39μ, 17.5 × 36μ, and 15.5 × 35μ from anterior to posterior.

Caudal ramus 17.5 × 14.5μ.

Rostrum smooth, without knob seen in female.

Claw of maxilliped 62μ along its axis and bearing proximally two unequal elements.

Last segment of endopod of leg 1 (Figure 50) showing sexual dimorphism. Outer spine 13.5μ and segment 23μ (not including pointed terminal hyaline process); ratio of spine to segment, 1:1.70. As in two previous species, two outer setae stouter than others.

Leg 6 (Figure 51) bearing two naked setae (16μ and 26μ) and a slender spiniform process.

Spermatophore, attached to females in pairs, 75 × 14μ, not including neck, and resembling that of *P. major*.

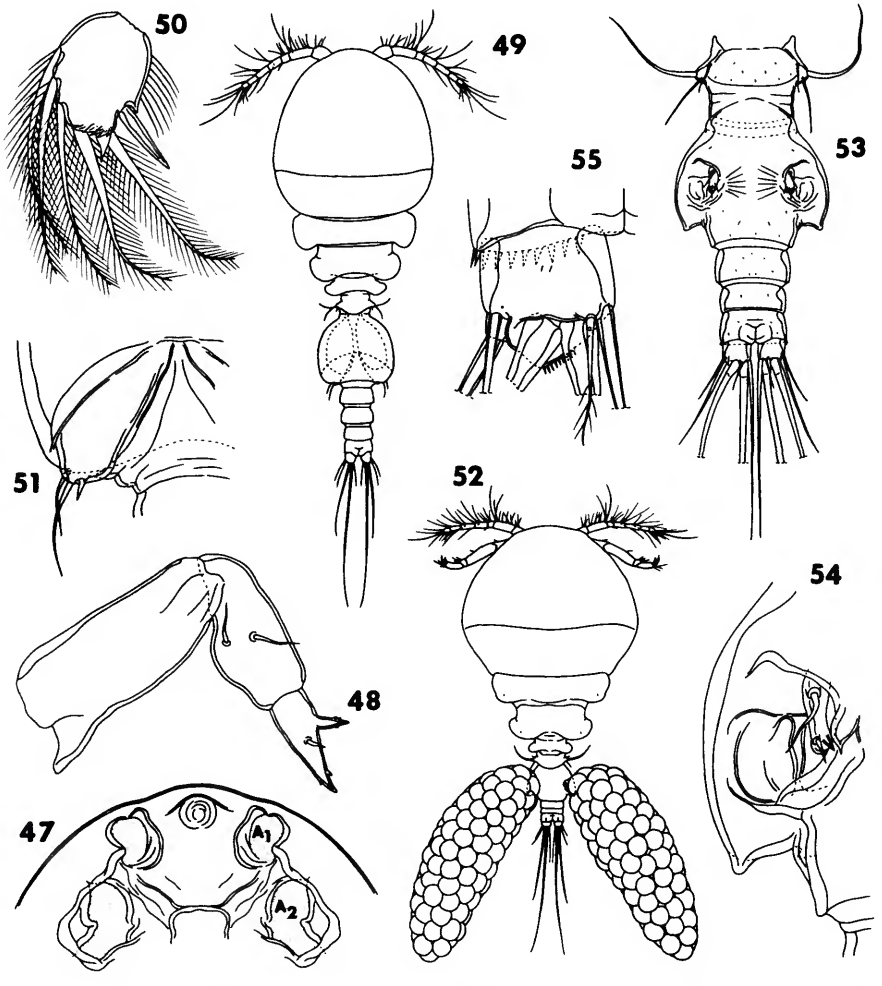
REMARKS.—Although each time that *P. minor* was collected it was in company with *P. major*, the separation of the two species was relatively easy. In addition to the interspecific differences listed by Stock (1967), *P. minor* may be distinguished from *P. major* by the number of eggs and the shape of the egg sac, by the prominent rostral knob in the female, and by the nature of the third segment of the endopod of leg 1 in the male.

In the Gulf of Aqaba Stock (1967) found *P. minor* on *Lamprometra klunzingeri* (Hartlaub). In Madagascar it occurred in only one instance on that host; more commonly it was found on *Liparometra*? sp., *Dichrometra* sp.? *afra* A. H. Clark, and *Heterometra africana* (A. H. Clark).

Pseudanthessius angularis, new species

FIGURES 52–66

TYPE MATERIAL.—4 ♀♀, 2 ♂♂ from one *Stephanometra indica* (Smith), in 2 m, Antsiabe, southern shore of Nosy Komba, near Nosy Bé, Madagascar, 8 July



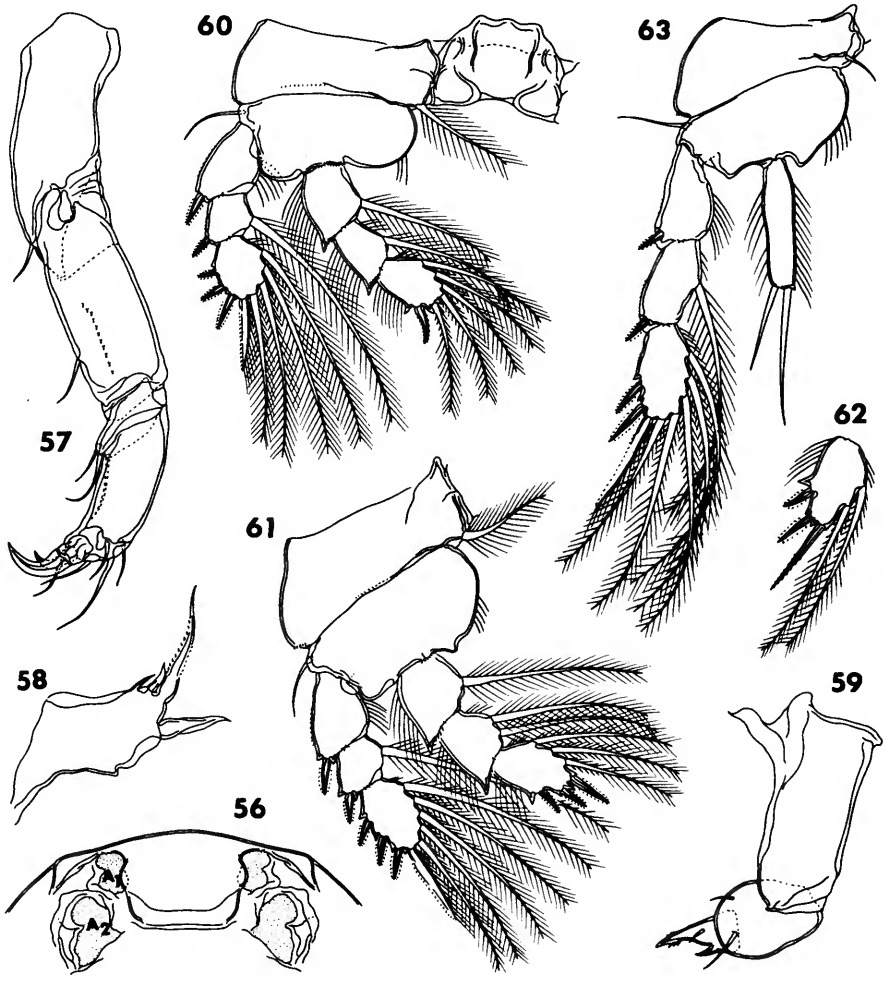
FIGURES 47–55.—47–51, *Pseudanthessius minor* Stock, 1967: 47, 48, female: 47, rostrum, ventral (E); 48, maxilliped, inner (G); 49–51, male: 49, dorsal (G); 50, third segment of endopod of leg 1, anterior (G); 51, leg 6, ventral (F). *Pseudanthessius angularis*, new species, female: 52, dorsal (H); 53, urosome, dorsal (D); 54, area of attachment of egg sac, dorsal (F); 55, caudal ramus, dorsal (G).

1967. Holotype ♀ and allotype deposited in the United States National Museum; the three paratypes (dissected) in the collection of A. G. Humes.

OTHER SPECIMENS.—From *Stephanometra indica:* 2 ♀♀, 1 ♂ from 1 host, in 6 m, east of Pte. Ambarionaomby, Nosy Komba, 21 September 1964. From *Dichrometra* sp.? *afra* A. H. Clark: 1 ♀ from 2 hosts, in 1 m, west of Pte. Ambarionaomby, 19 August 1960, and 2 ♀♀, 1 ♂ from 1 host, in 1 m, Ambariobe, a small island almost between Nosy Bé and Nosy Komba, 3 November 1960.

FEMALE.—Body (Figure 52) with a broad prosome. Length 0.85 mm (0.79–0.89 mm) and greatest width 0.46 mm (0.40–0.50 mm), based on nine specimens. Segment of leg 1 set off from head by a dorsal transverse furrow. Ratio of length to width of prosome, 1.20:1. Ratio of length of prosome to that of urosome, 2.37:1.

Segment of leg 5 (Figure 53) 65 × 96μ. Between this segment and genital segment a weakly sclerotized ventral intersegmental sclerite. Genital segment 117 × 113μ in greatest dimensions as seen in dorsal view, expanded laterally except in its posterior fifth. The abrupt junction between these two areas with two



FIGURES 56–63.—*Pseudanthessius angularis*, new species, female: 56, rostrum, ventral (D); 57, second antenna, anterior (E); 58, first maxilla, anterior (C); 59, maxilliped, inner (F); 60, leg 1 and intercoxal plate, anterior (E); 61, leg 2, anterior (E); 62, third segment of endopod of leg 3, anterior (E); 63, leg 4, anterior (E).

acute posterolateral angles. Areas of attachment of egg sacs located dorsally at about middle of segment. Each area (Figure 54) bearing two naked setae (22μ and 8μ), with a spiniform process between them. Three postgenital segments, 31 × 62μ, 22 × 56μ, and 24 × 57μ, from anterior to posterior. Posteroventral margin of anal segment on both sides bearing a row of small spines.

Caudal ramus (Figure 55) nearly quadrate, 28 × 25μ in greatest dimensions, length including terminal ventral flange. Outer lateral seta 44μ, dorsal seta 24μ, outermost terminal seta 99μ, innermost terminal seta 180μ, and two long median terminal setae (320μ, outer, and 400μ, inner). All setae naked except dorsal seta, which is lightly plumose. Four terminal setae inserted dorsally to a subtriangular terminal flange bearing marginal spinules.

Dorsal surface of prosome and dorsal and ventral surfaces of urosome sparsely ornamented with small hairs.

Egg sac (Figure 52) elongated, 600–650 × 220μ, extending a little beyond tips of ramal setae, and containing many eggs, each about 56μ in diameter.

Rostrum (Figure 56) weakly developed.

First antenna 252μ long, similar in form and armature to that of *P. madrasensis*. Lengths of its seven segments: 24 (50μ along its anterior margin), 75, 20, 36, 35, 23, and 13μ, respectively. All setae naked.

Second antenna (Figure 57) with formula 1, 1, 3, and II + 5. Fourth segment 68μ along outer edge, 39μ along inner edge, and 24μ wide. Segment bearing terminally two claws (28μ and 17μ) and five slender setae. Second segment with an axial row of small spinules on posterior surface. All setae naked.

Labrum resembling that of *P. major*. Mandible like that of *P. madrasensis*. Paragnath similar to that in *P. major*. First maxilla (Figure 58) with four elements. Second maxilla like that of *P. major*. Maxilliped shown in Figure 59.

Ventral area between maxillipeds and first pair of legs resembling that of *P. major*.

Legs 1–4 (Figures 60–63) with same segmentation and armature as in *P. madrasensis* except that endopod of leg 4 bears two setae instead of a spine and a seta as in that species. Inner coxal seta of legs 1–3 long and plumose, but in leg 4 this seta much shorter (18μ) and naked. Inner margin of basis of all four legs bearing a few hairs. In leg 4, exopod 120μ long; endopod 55 × 15μ, with both lateral margins bearing a row of coarse hairs and with two terminal naked setae (39μ, outer, and 70μ, inner).

Leg 5 like that of *P. madrasensis*.

Leg 6 probably represented by two setae near attachment of each egg sac (Figure 54).

Color in life in transmitted light translucid, eye brownish red, egg sacs light gray.

MALE.—Body (Figure 64) with a much less broadened prosome than in female. Length 0.58 mm (0.56–0.62 mm) and greatest width 0.24 mm (0.24–0.25 mm), based on three specimens. Ratio of length to width of prosome, 1.47:1. Ratio of length of prosome to that of urosome, 1.85:1.

Segment of leg 5 (Figure 65) 27 × 52μ. Between this segment and genital segment no ventral intersegmental sclerite. Genital segment 88 × 92μ, broadest in its posterior half. Four postgenital segments 25 × 41μ, 22 × 39μ, 13 × 36μ, and 17 × 35μ, from anterior to posterior.

Caudal ramus like that of female, but smaller (18 × 17μ).

Surface of body sparsely ornamented with hairs as in female.

Rostrum resembling that of female.

First antenna similar to that of female, but an aesthete added on segment 2 (as in males of three preceding species). Second antenna also like that of female, but axial row of spinules on second segment absent.

Labrum, mandible, paragnath, first maxilla, and second maxilla like those of female. Maxilliped closely resembling that of *P. major*. Claw 77μ along its axis.

Ventral area between maxillipeds and first pair of legs like that of female.

Legs 1–4 with same spine and setal formula as in female. Sexual dimorphism occurring in endopod of leg 1 (Figure 66), where spine is straight rather than recurved, and where two terminal spiniform processes of female are replaced by two rows of prominent spinules across end of segment. Two outermost setae stouter than others. Legs 2–4 like those of female.

Leg 5 like that of *P. madrasensis*.

Leg 6 similar to that in *P. major*.

Spermatophore not observed.

Color in life resembling that of female.

ETYMOLOGY.—The specific name *angularis* (Latin, having corners or angles) refers to the posterolateral angles on the genital segment of the female.

REMARKS.—The new species may be readily distinguished from 22 species of *Pseudanthessius* in which the caudal ramus is distinctly longer than wide (at least 1.5:1): *P. aestheticus* Stock, Humes, and Gooding, 1963; *P. assimilis* G. O. Sars, 1917; *P. concinnus* Thompson and A. Scott, 1903; *P. deficiens* Stock, Humes, and Gooding, 1963; *P. dubius* G. O. Sars, 1918; *P. ferox* Humes and Ho, 1967; *P. gracilioides* Sewell, 1949; *P. gracilis* Claus, 1889; *P. latus* Illg, 1950; *P. liber* (Brady, 1880); *P. luculentus* Humes and Cressey, 1961; *P. mucronatus* Gurney, 1927; *P. nemertophilus* Gallien, 1935; *P. obscurus* A. Scott, 1909; *P. procurrens* Humes, 1966; *P. pusillus* Humes, 1969; *P. sauvagei* Canu, 1892; *P. spinifer* Lindberg, 1945; *P. tenuis* Nicholls, 1944; *P. thorelli* (Brady, 1880); *P. tortuosus* Stock, Humes, and Gooding, 1963; and *P. weberi* A. Scott, 1909.

Pseudanthessius angularis differs from nine species in which the caudal ramus is quadrate (or very nearly so) by its having acute posterolateral angles on the genital segment of the female. These species are *P. anormalus* Ummerkutty, 1966; *P. brevicauda* Ummerkutty, 1966; *P. foliatus* Stock, 1967; *P. madrasensis* Reddiah, 1966; *P. major* Stock, 1967; *P. minor* Stock, 1967; *P. minutus* Reddiah, 1966; *P. notabilis* Humes and Cressey, 1961; and *P. pectinifer* Stock, Humes, and Gooding, 1963.

In *P. liber* sensu Sewell, 1949, the caudal ramus was not described or figured. This form, probably representing a new species (see Humes and Cressey, 1961, p. 81, and Stock, Humes, and Gooding, 1963, p. 10), is unlike *P. angularis* in having two very long elements on the first segment of the first antenna (the longer of the two being more than half the length of the appendage) and in its much longer fourth segment of the second antenna (longer than either of the first two segments).

Pseudanthessius rostellatus, new species

FIGURES 67–90

TYPE MATERIAL.—30 ♀♀, 52 ♂♂, and 9 copepodids from 7 *Comaster* sp.? nov. aff. *distinctus* (P. H. Carpenter), on sponge in 47 m, 13°29′S, 48°06′E, southwest of Nosy Bé, Madagascar, 21 August 1967. Holotype ♀, allotype, and 68 paratypes (23 ♀♀, 45 ♂♂) deposited in the United States National Museum; the remaining paratypes in the collection of A. G. Humes.

FEMALE.—Body (Figure 67) with moderately slender prosome. Length 0.77 mm (0.72–0.80 mm) and greatest width 0.35 mm (0.34–0.36 mm), based on ten specimens. Ratio of length to width of prosome, 1.50:1. Ratio of length of prosome to that of urosome, 2.48:1.

Segment of leg 5 (Figure 68) 60 × 93μ. Between this segment and genital segment a very weakly defined ventral intersegmental sclerite. Genital segment (Figures 68, 70) 99 × 101μ in greatest dimensions in dorsal view. Areas of attachment of egg sacs located dorsolaterally near middle of segment. Each area (Figure 69) bearing two naked setae (33μ and 18μ), with a small spiniform process between them. Adjacent and medial to this area a conspicuous spine (12μ). Three postgenital segments, 24 × 64μ, 19 × 55μ, and 27 × 51μ, from anterior to posterior. Posterior margin of anal segment bearing a row of small spines.

Caudal ramus (Figure 71) 26 × 22μ in greatest dimensions, including terminal ventral flange. Outer lateral seta 105μ and naked, dorsal seta 34μ and naked, outermost terminal seta 135μ with inner spinules, innermost terminal seta 237μ with spinules, and two long median terminal setae (375μ, outer, and 500μ, inner), both with spinules. Terminal ventral flange bearing a row of marginal spinules.

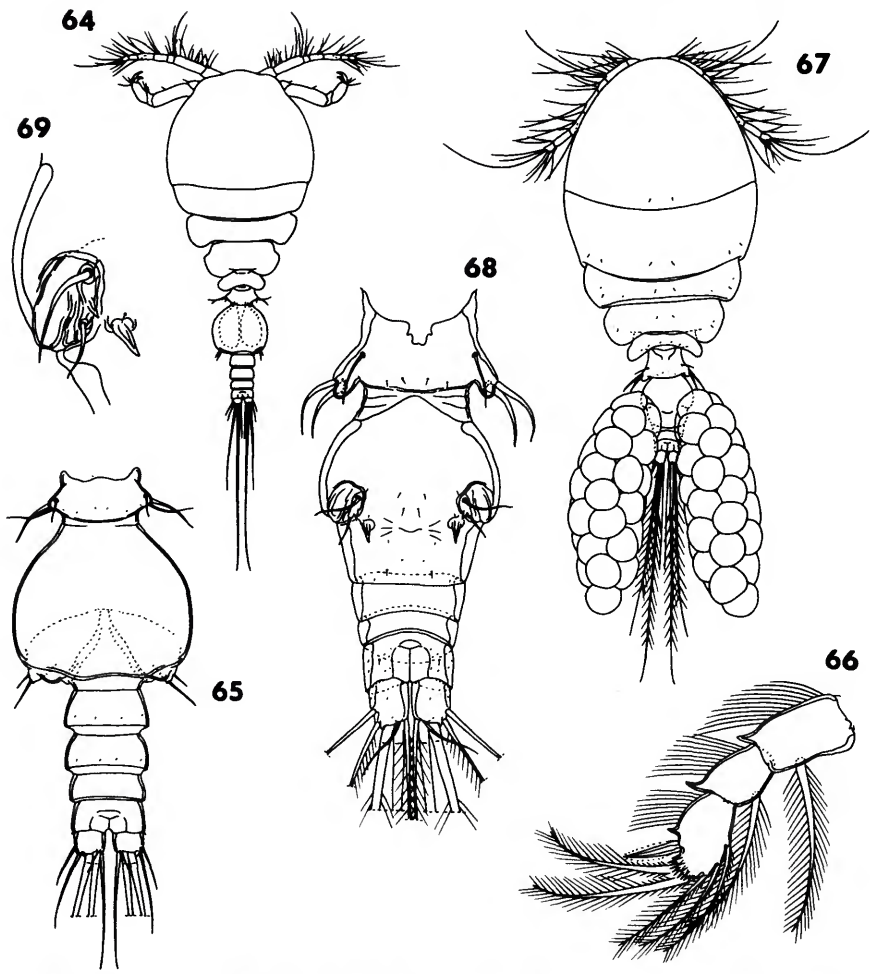
Dorsal surface of prosome and dorsal and ventral surfaces of urosome ornamented with small hairs.

Egg sac (Figure 67) elongated (418 × 143μ) and containing about 30 eggs, each approximately 62μ in diameter.

Rostrum (Figures 72, 73) well developed and forming a somewhat triangular snoutlike process directed posteroventrally.

First antenna (Figure 74) 272μ long. Lengths of its seven segments: 22 (47μ along its anterior margin), 50, 18, 46, 52, 40, and 19μ, respectively. Formula for armature same as in four previous species. All setae naked.

Second antenna (Figure 75) 225μ long and unusually slender. Formula: 1, 1, 3, and II + 2 + 3. Fourth segment 85μ along outer edge, 55μ along inner edge, and 15μ wide. Terminally with two claws (24μ and 22μ), two long, weakly jointed setae, and three shorter simple setae. Fine ornamentation of appendage consisting of a row of small spinules along outer margin of second and fourth segments, and an angular row of spines on anterior surface of fourth segment near insertions of claws.

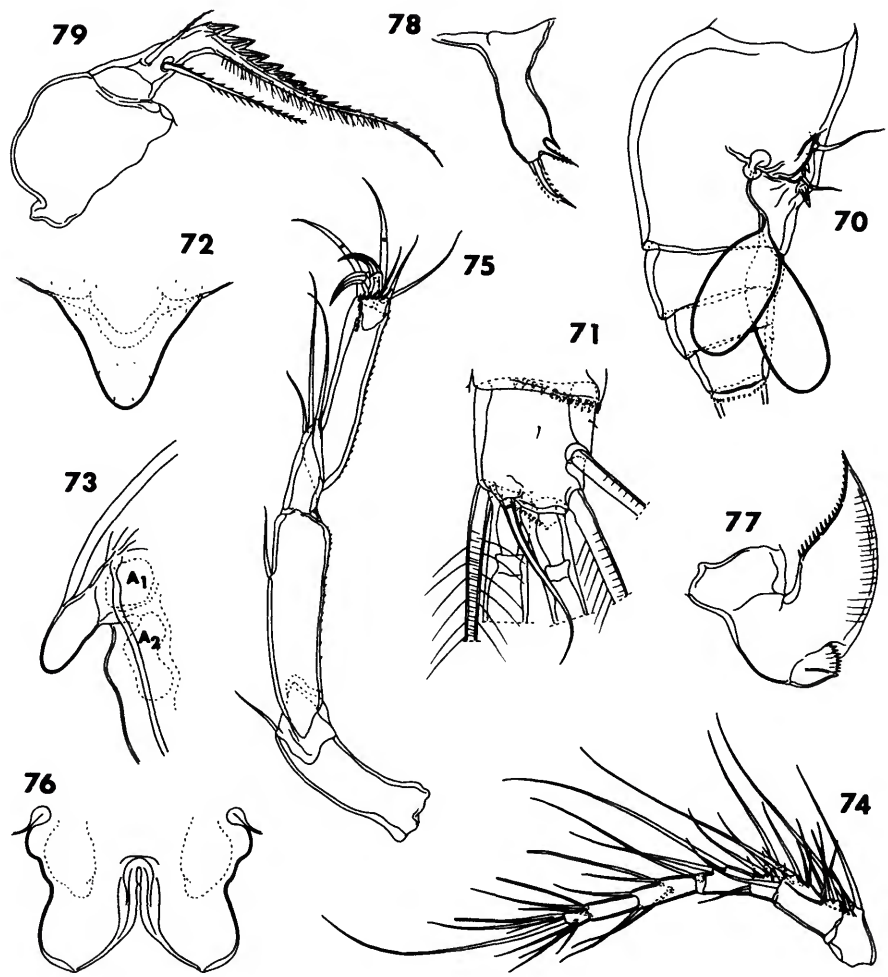


FIGURES 64–69.—64–66, *Pseudanthessius angularis*, new species, male: 64, dorsal (A); 65, urosome: dorsal (B); 66, endopod of leg 1, anterior (F). 67–69, *Pseudanthessius rostellatus*, new species, female, 67, dorsal (A); 68, urosome, dorsal (B); 69, area of attachment of egg sac, dorsal (F).

Labrum (Figure 76) with two rather slender and slightly pointed posteroventral lobes. Mandible (Figure 77) with a row of prominent spinules across distal end of scalelike process on its convex margin and spinules along its concave margin. Lash extremely short and practically indistinguishable from blade. Paragnath (Figure 76) an elongated lobe without hairs. First maxilla (Figure 78) with three elements. Elongated second segment of second maxilla (Figure 79) bearing a barbed seta and a seta barbed along one edge and haired along the other, and produced to form a long lash spinose along one edge but with rows of hairs along the other. Maxilliped (Figure 80) having two elements on second segment, one slightly spiniform and naked and the other setiform and finely barbed. Attenuated tip of third segment with a few minute barbules.

Ventral area between maxillipeds and first pair of legs similar to that in *P. major*.

Legs 1–4 (Figures 81–84) having same segmentation and armature as in *P. madrasensis*, except that endopod of leg 4 bears two spines instead of a spine and a seta as in that species. Inner coxal seta of leg 4 short (6μ) and naked, instead of being long and plumose as in legs 1–3. Inner margin of basis of leg 4 naked. In leg 4, exopod 135μ long; endopod 66 $\times$ 16μ, with



FIGURES 70–79.—*Pseudanthessius rostellatus*, new species, female: 70, genital and postgenital segments, lateral (E); 71, caudal ramus, dorsal (C); 72, rostrum, anteroventral (E); 73, rostrum, lateral (E); 74, first antenna, dorsal (D); 75, second antenna, anterior (E); 76, labrum, with paragnaths indicated by dashed lines, ventral (F); 77, mandible, posterior (F); 78, first maxilla, posterior (F); 79, second maxilla, posterior (F).

both lateral margins haired and with two terminal fringed spines (52μ, outer, and 63μ, inner).

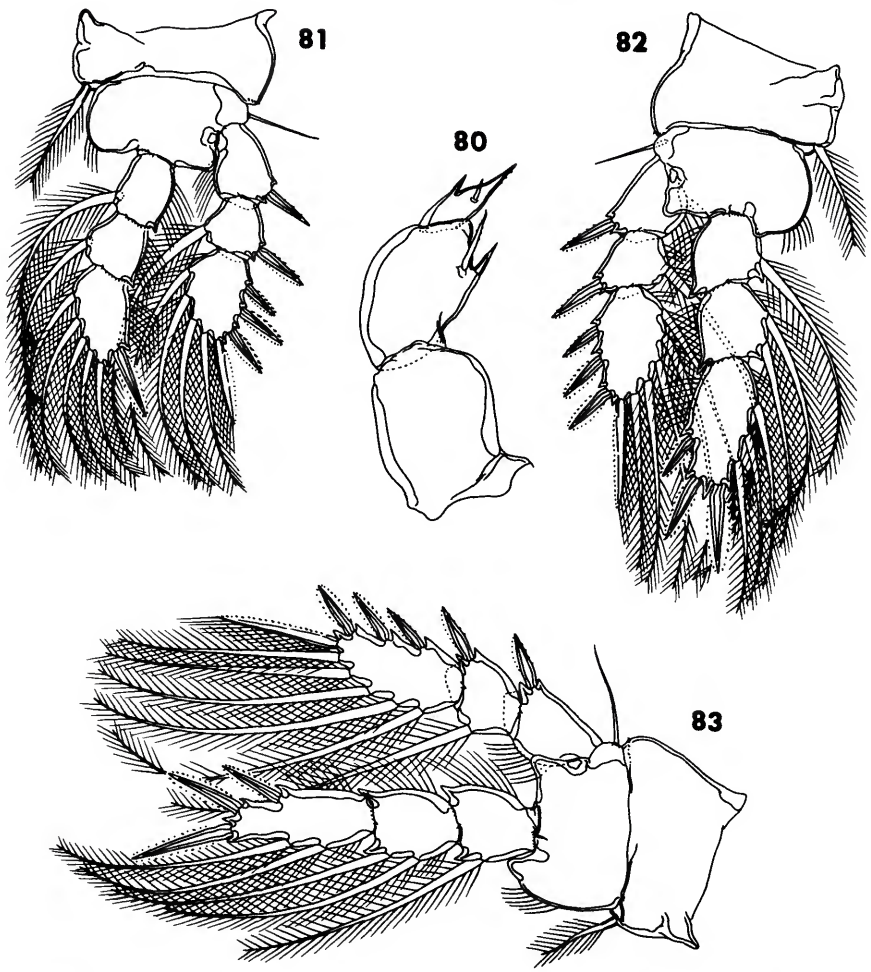
Leg 5 (Figure 85) having a dorsal seta (34μ) and two posterolateral setae, one 53μ and naked, the other 46μ, basally stouter, and with a few minute barbules. Edge of segment forming a distinct lobe dorsal to stouter seta.

Leg 6 probably represented by two setae near attachment of each egg sac (Figure 69).

Color in life in transmitted light translucid, eye red, egg sacs light gray.

MALE.—Body (Figure 86) similar in general form to that of female. Length 0.57 mm (0.53–0.61 mm) and greatest width 0.23 mm (0.22–0.23 mm), based on ten specimens. Ratio of length to width of prosome, 1.67:1. Ratio of length of prosome to that of urosome, 1.86:1.

Segment of leg 5 (Figure 87) 41 × 55μ. Between this segment and genital segment no ventral intersegmental sclerite. Genital segment 86 × 75μ. Four postgenital segments, 23 × 43μ, 18 × 43μ, 9 × 42μ, and 17 × 41μ, from anterior to posterior.



FIGURES 80–83.—*Pseudanthessius rostellatus*, new species, female: 80, maxilliped, inner (F); 81, leg 1, anterior (E); 82, leg 2, anterior (E); 83, leg 3, anterior (E).

Caudal ramus like that of female, but smaller (21 × 19μ).

Surface of body ornamented with hairs as in female.

Rostrum, first antenna (without an aesthete added), second antenna, labrum, mandible, paragnath, first maxilla, and second maxilla resembling those of female. Maxilliped (Figure 88) with a slender claw 105μ along its axis.

Ventral area between maxillipeds and first pair of legs like that of female.

Legs 1–4 having same spine and setal formula as in female. Sexual dimorphism occurring in last segment of endopod of leg 1 (Figure 89), where two terminal spiniform processes of female are replaced by two diagonal rows of spinules converging in an inwardly directed spiniform process. Two outermost setae not stouter than others, and not spiniform. Legs 2–4 like those in female.

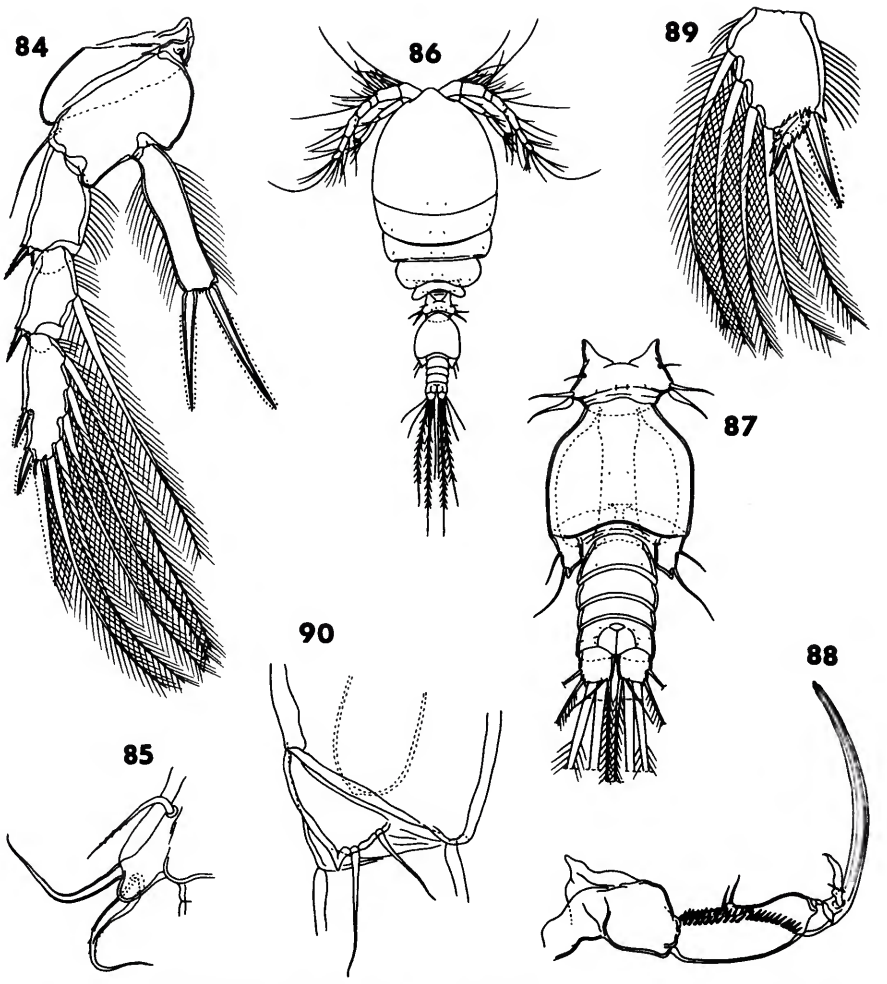
Leg 5 (Figure 87) resembling that of female, but lacking posterodorsal lobe. Two posterolateral setae about 35μ long.

Leg 6 (Figure 90) consisting of usual posteroventral flap on genital segment, bearing two naked setae (44μ and 29μ) and a small spiniform process.

Spermatophore (Figure 70), attached to female in pairs, 65 × 27μ, not including neck.

Color in life resembling that of female.

ETYMOLOGY.—The specific name, *rostellatus* (from



FIGURES 84–90.—*Pseudanthessius rostellatus*, new species. 84, 85, female: 84, leg 4, anterior (E); 85, leg 5, dorsal (F); 86–90, male: 86, dorsal (A); 87, urosome, dorsal (B); 88, maxilliped, inner (E); 89, third segment of endopod of leg 1, anterior (C); 90, leg 6, lateral (F).

the Latin *rostellum*, having a small snout), alludes to the well-developed snoutlike rostrum.

REMARKS.—The snoutlike rostrum in both sexes and the pair of spines on the dorsal surface of the genital segment of the female are distinctive. These two features, however, are not useful for comparison with many species since in more than half the species in the genus the rostrum and the detailed ornamentation of the genital segment are unknown.

Pseudanthessius rostellatus may be separated from 22 species in which the caudal ramus is distinctly longer than wide (at least 1.5:1). These species are listed above, under the remarks on *P. angularis*.

It remains to distinguish the new species from the ten species in which the caudal ramus is quadrate or very nearly so. Six of these have a much less developed rostrum, and in the female lack the pair of spines on the dorsal surface of the genital segment (*P. angularis*, *P. madrasensis*, *P. major*, *P. minor*, *P. notabilis*, and *P. pectinifer*). In three (*P. anormalus*, *P. brevicauda*, and *P. minutus*), the fourth segment of the second antenna is relatively shorter (distinctly shorter than the second segment) and stouter than in the new species. *Pseudanthessius foliatus* differs by having two jointed dentate claws on the second antenna and by one of the elements on leg 5 being a flattened denticulated spine.

In *P. liber* sensu Sewell, 1949 (see above), the fourth segment of the second antenna is nearly twice the length of the second segment, while in *P. rostellatus* these segments are nearly equal in length.

Literature Cited

Brady, G. S.
1880. *A Monograph of the Free and Semi-Parasitic Copepoda of the British Islands*. Volume 3, pages 1–83. Ray Society, London.

Canu, E.
1892. Les Copépodes du Boulonnais, morphologie, embryologie, taxonomie. *Travaux du Laboratoire de Zoologie Maritime de Wimereux-Ambleteuse (Pas-de-Calais)*, 6:1–354.

Clark, A. H.
1947. A Monograph of the Existing Crinoids. Volume 1. The Comatulids. Part 4b.—Superfamily Mariametrida (Concluded—the Family Colobometridae) and Superfamily Tropiometrida (Except the Families Thalassometridae and Charitometridae). *United States National Museum Bulletin*, 82:1–473.

Claus, C.
1889. Über neue oder wenig bekannte halbparasitische Copepoden, insbesondere der Lichomolgiden- und Ascomyzontiden-Gruppe. *Arbeiten aus dem Zoologischen Institute der Universität Wien und der Zoologischen Station in Triest*, 8(3):327–370.

Gallien, L.
1935. *Pseudanthessius nemertophilus* nov. sp., copépode commensal de *Lineus longissimus* Sowerby. *Bulletin de la Société Zoologique de France*, 60(5):451–459.

Gurney, R.
1927. Zoological Results of the Cambridge Expedition to the Suez Canal, 1924. XXXIII. Report on the Crustacea:—Copepoda (Littoral and Semi-Parasitic). *Transactions of the Zoological Society of London*, 22(4): 451–577.

Humes, A. G.
1966. *Pseudanthessius procurrens* n. sp., a Cyclopoid Copepod Associated with a Cidarid Echinoid in Madagascar. *Breviora*, 246:1–14.
1969. *Pseudanthessuis pusillus* n. sp., a Cyclopoid Copepod Associated with a Clypeastroid Echinoid in Madagascar. *Zoologischer Anzeiger*, 183(3/4):268–277.

Humes, A. G. and R. F. Cressey
1961. Deux nouvelles espéces de *Pseudanthessius* (Copepoda, Cyclopoida) parasites des oursins à Madagascar. *Mémoires de l'Institut Scientifique de Madagascar*, series F, 1959, 3:67–82.

Humes, A. G. and J.-S. Ho
1967. New Cyclopoid Copepods Associated with Polychaete Annelids in Madagascar. *Bulletin of the Museum of Comparative Zoology, Harvard University*, 135(7): 377–413.

Illg, P. L.
1950. A New Copepod, *Pseudanthessius latus* (Cyclopoida: Lichomolgidae) Commensal with a Marine Flatworm. *Journal of the Washington Academy of Sciences*, 40(4): 129–133.

Lindberg, K.
1945. Un nouveau copépode poecilostome de l'Inde de la famille des Lichomolgidae; *Pseudanthessius spinifer*, n. sp. *Bulletin de la Société Zoologique de France*, 70(3): 81–84.

Nicholls, A. G.
1944. Littoral Copepods from South Australia (II). Calanoida, Cyclopoida, Notodelphyoida, Monstrilloida and Caligoida. *Records of the South Australian Museum*, 8(1):1–62.

Reddiah, K.
1966. Two New *Pseudanthessius* Species (Copepoda-Lichomolgidae) from the Madras Harbour. *Journal of the Marine Biological Association of India*, 8(2):320–328.

Sars, G. O.
1917. *An account of the Crustacea of Norway with Short Descriptions and Figures of All the Species. Volume 6. Copepoda, Cyclopoida, Parts 11 and 12, Clausidiidae, Lichomolgidae (Part)*. Pages 141–172. Bergen Museum, Bergen.
1918. *An Account of the Crustacea of Norway with Short Descriptions and Figures of All the species. Volume 6. Copepoda, Cyclopoida, Parts 13 and 14, Lichomolgidae (concluded), Oncaeidae, Corycaeidae, Ergasilidae, Clausiidae, Eunicicolidae*. Supplement, pages 173–225. Bergen Museum, Bergen.

Scott, A.
1909. The Copepoda of the Siboga Expedition. Part I. Free-Swimming, Littoral and Semi-Parasitic Copepoda. *Siboga Expedition*, 29a:1–323.

Sewell, R. B. S.
1949. The Littoral and Semi-Parasitic Cyclopoida, the Monstrilloida and Notodelphyoida. *John Murray Expedition 1933–34, Scientific Reports*, 9(2):17–199.

Stock, J.H.
1967. Copepoda Associated with Invertebrates from the Gulf of Aqaba. 3. The Genus *Pseudanthessius* Claus, 1889 (Cyclopoida, Lichomolgidae). *Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen*, Amsterdam, series c, 70(2):232–248.

Stock, J. H.; A. G. Humes; and R. U. Gooding
1963. Copepoda Associated with West Indian Invertebrates. IV. The Genera *Octopicola*, *Pseudanthessius* and *Meomicola* (Cyclopoida, Lichomolgidae). *Studies on the Fauna of Curaçao and other Caribbean Islands*, 18(77): 1–74.

Thompson, I. C., and A. Scott
1903. Report on the Copepoda Collected by Professor Herdman, at Ceylon, in 1902. *Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Manaar*, part I, supplementary report number 7, pages 227–307.

Ummerkutty, A. N. P.
1966. Description of Two Species of Cyclopoid Copepods, *Pseudanthessius anormalus* n. sp. and *P. brevicauda* n. sp. *Proceedings of the Symposium on Crustacea, Ernakulam*, part 1, pages 107–113.

U.S. GOVERNMENT PRINTING OFFICE: 1970 O—375-844

Publication in *Smithsonian Contributions to Zoology*

Manuscripts for serial publications are accepted by the Smithsonian Institution Press, subject to substantive review, only through departments of the various Smithsonian museums. Non-Smithsonian authors should address inquiries to the appropriate department. If submission is invited, the following format requirements of the Press will govern the preparation of copy. (An instruction sheet for the preparation of illustrations is available from the Press on request.)

Copy must be typewritten, double-spaced, on one side of standard white bond paper, with 1½" top and left margins, submitted in ribbon copy with a carbon or duplicate, and accompanied by the original artwork. Duplicate copies of all material, including illustrations, should be retained by the author. There may be several paragraphs to a page, but each page should begin with a new paragraph. Number consecutively all pages, including title page, abstract, text, literature cited, legends, and tables. The minimum length is 30 pages of typescript and illustrations.

The *title* should be complete and clear for easy indexing by abstracting services. Taxonomic titles will carry a final line indicating the higher categories to which the taxon is referable: "(Hymenoptera: Sphecidae)." Include an *abstract* as an introductory part of the text. Identify the *author* on the first page of text with an unnumbered footnote that includes his professional mailing address. A *table of contents* is optional. An *index,* if required, may be supplied by the author when he returns page proof.

Two *headings* are used: (1) text heads (boldface in print) for major sections and chapters and (2) paragraph sideheads (caps and small caps in print) for subdivisions. Further headings may be worked out with the editor.

In *taxonomic keys,* number only the first item of each couplet; if there is only one couplet, omit the number. For easy reference, number also the taxa and their corresponding headings throughout the text; do not incorporate page references in the key.

In *synonymy,* use the short form (taxon, author, date, page) with a full reference at the end of the paper under "Literature Cited." Begin each taxon at the left margin with subsequent lines indented about three spaces. Within a taxon, use a period-dash (.—) to separate each reference. Enclose with square brackets any annotation in or at the end of the taxon. For *references within the text,* use the author-date system: "(Jones, 1910)" or "Jones (1910)." If the reference is expanded, abbreviate the data: "Jones (1910, p. 122, pl. 20: fig. 1)."

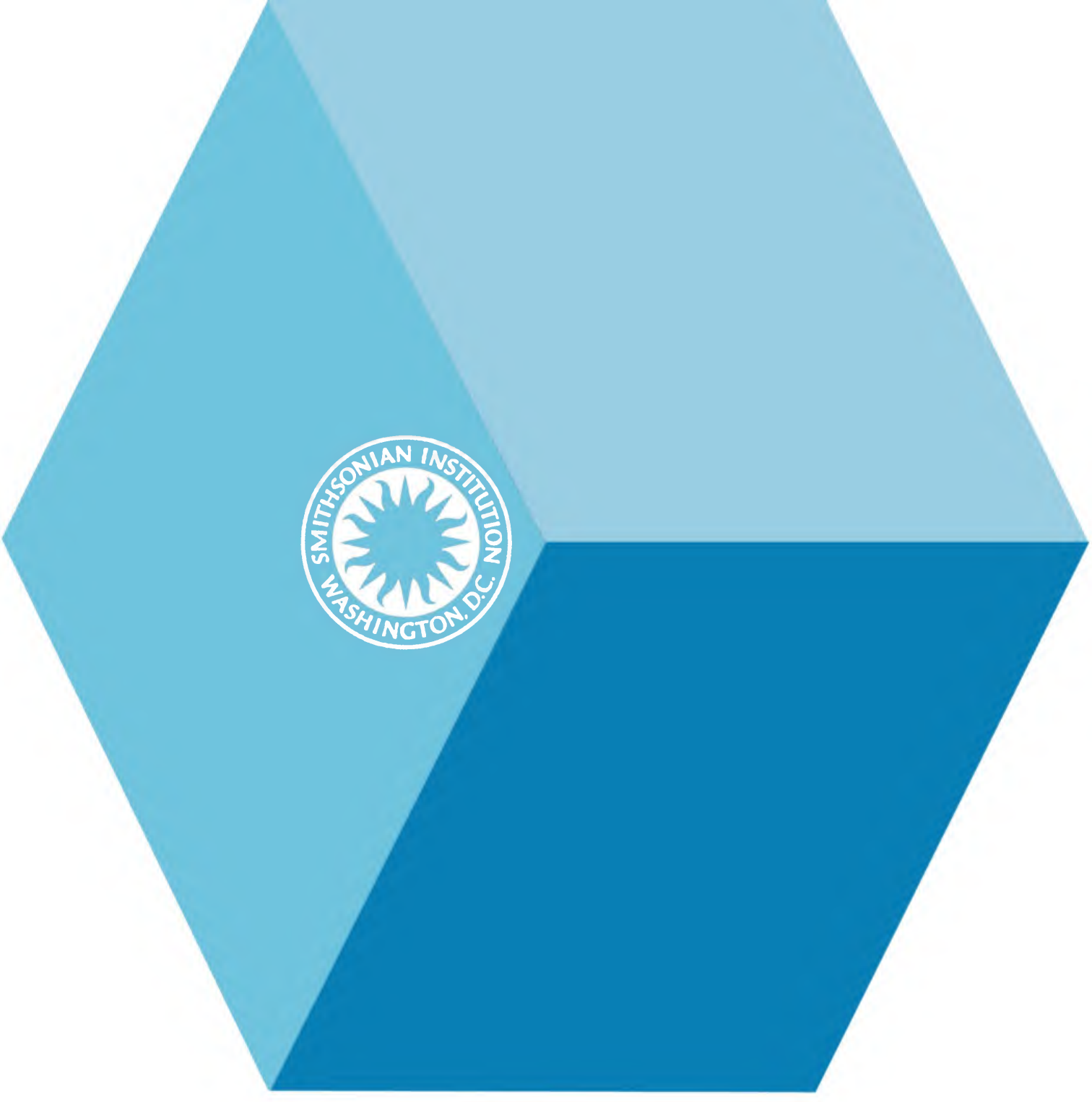
Simple *tabulations* in the text (e.g., columns of data) may carry headings or not, but they should not contain rules. Formal *tables* must be submitted as pages separate from the text, and each table, no matter how large, should be pasted up as a single sheet of copy.

For *measurements and weights,* use the metric system instead of (or in addition to) the English system.

Illustrations (line drawings, maps, photographs, shaded drawings) can be intermixed throughout the printed text. They will be termed *Figures* and should be numbered consecutively; however, if a group of figures is treated as a single figure, the individual components should be indicated by lowercase italic letters on the illustration, in the legend, and in text references: "Figure 9*b*." If illustrations (usually tone photographs) are printed separately from the text as full pages on a different stock of paper, they will be termed *Plates,* and individual components should be lettered (Plate 9*b*) but may be numbered (Plate 9: figure 2). Never combine the numbering system of text illustrations with that of plate illustrations. Submit all legends on pages separate from the text and not attached to the artwork.

In the *bibliography* (usually called "Literature Cited"), spell out book, journal, and article titles, using initial caps with all words except minor terms such as "and, of, the." (For capitalization of titles in foreign languages, follow the national practice of each language.) Underscore (for italics) book and journal titles. Use the colon-parentheses system for volume, number, and page citations: "10(2):5–9." Spell out such words as "figures" and "plates" (or "pages" when used alone).

For *free copies* of his own paper, a Smithsonian author should indicate his requirements on "Form 36" (submitted to the Press with the manuscript). A non-Smithsonian author will receive 50 free copies; order forms for quantities above this amount with instructions for payment will be supplied when page proof is forwarded.


SMITHSONIAN INSTITUTION
WASHINGTON, D.C.