

KOMBIA ANGULATA N. GEN., N. SP. (COPEPODA, CYCLOPOIDA)
PARASITIC IN A CORAL IN MADAGASCAR

BY

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To the growing list of copepods associated with coelenterates is now to be added the new genus and species described below. The specimens were collected while the author was the leader of an expedition to Madagascar sponsored by the Academy of Natural Sciences of Philadelphia. Financial aid for this study has been received from the Academy and from the National Science Foundation of the United States. The facilities of the Station Océanographique at Nossi Bé were generously made available by the Institut de Recherches Scientifiques de Madagascar.

For the identification of the coral hosts I am indebted to Dr. Donald F. Squires of the American Museum of Natural History in New York. I also wish to thank Mr. Richard U. Gooding who has examined type specimens and offered valuable suggestions.

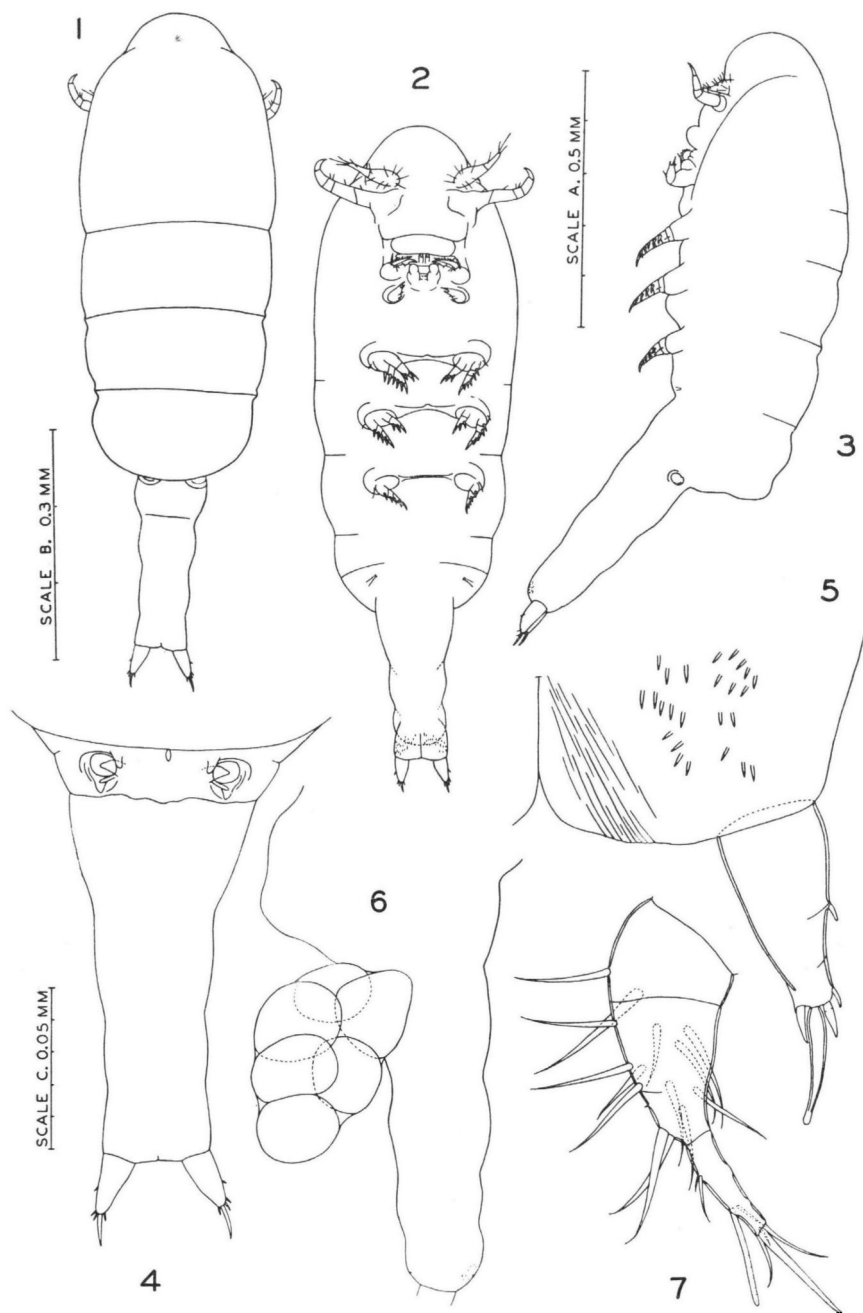
All figures were drawn with the aid of a camera lucida. In the explanation of the figures the letter after each figure refers to the scale at which it was drawn.

Kombia n. gen.

FEMALE. Body elongated, prosome moderately stout, urosome more slender. Segment of leg 1 fused with the head region. Segment following that of leg 3 and the segment bearing leg 5 partially fused. Abdomen 3-segmented. Two egg sacs, with the eggs arranged in a cluster. First antenna short, with indications of possibly 6 segments, though the joints are sometimes obscure. Second antenna 4-segmented, prehensile, with a terminal claw. Mandible lichomolgic, terminating in a minute serrated blade. Two lobes possibly representing paragnaths present. First maxilla a minute lobe bearing 3 setae. Second maxilla 2-segmented, bearing a terminal denticulate spine. Maxilliped weakly 3-segmented, with 2 terminal processes.

Legs 1 and 2 with 3-segmented exopods and 2-segmented endopods. Leg 3 uniramous and 3-segmented. Leg 4 absent. Leg 5 reduced to 2 setae.

MALE. Body with the prosome somewhat narrower than in the female. Segmentation similar to the female, but the abdomen 4-segmented. Head appendages, legs 1 to 3, and the caudal ramus resembling those of the female. Maxilliped larger, prehensile, and apparently 3-segmented. Leg 4 absent. Leg 5 as in the female. Leg 6 represented by 2 setae.



Figs. 1-7. *Kombia angulata* n. gen., n. sp., female. 1, dorsal (A); 2, ventral (A); 3, lateral (A); 4, urosome, dorsal (B); 5, caudal ramus and part of adjacent abdominal segment, ventral (C); 6, posterior part of body with egg sac, lateral (B); 7, first antenna (C).

TYPE SPECIES. *Kombia angulata*, n. sp.

The generic name is derived from Nossi Komba, the island off whose shore the type specimens were found.

***Kombia angulata* n. sp. (figs. 1-38)**

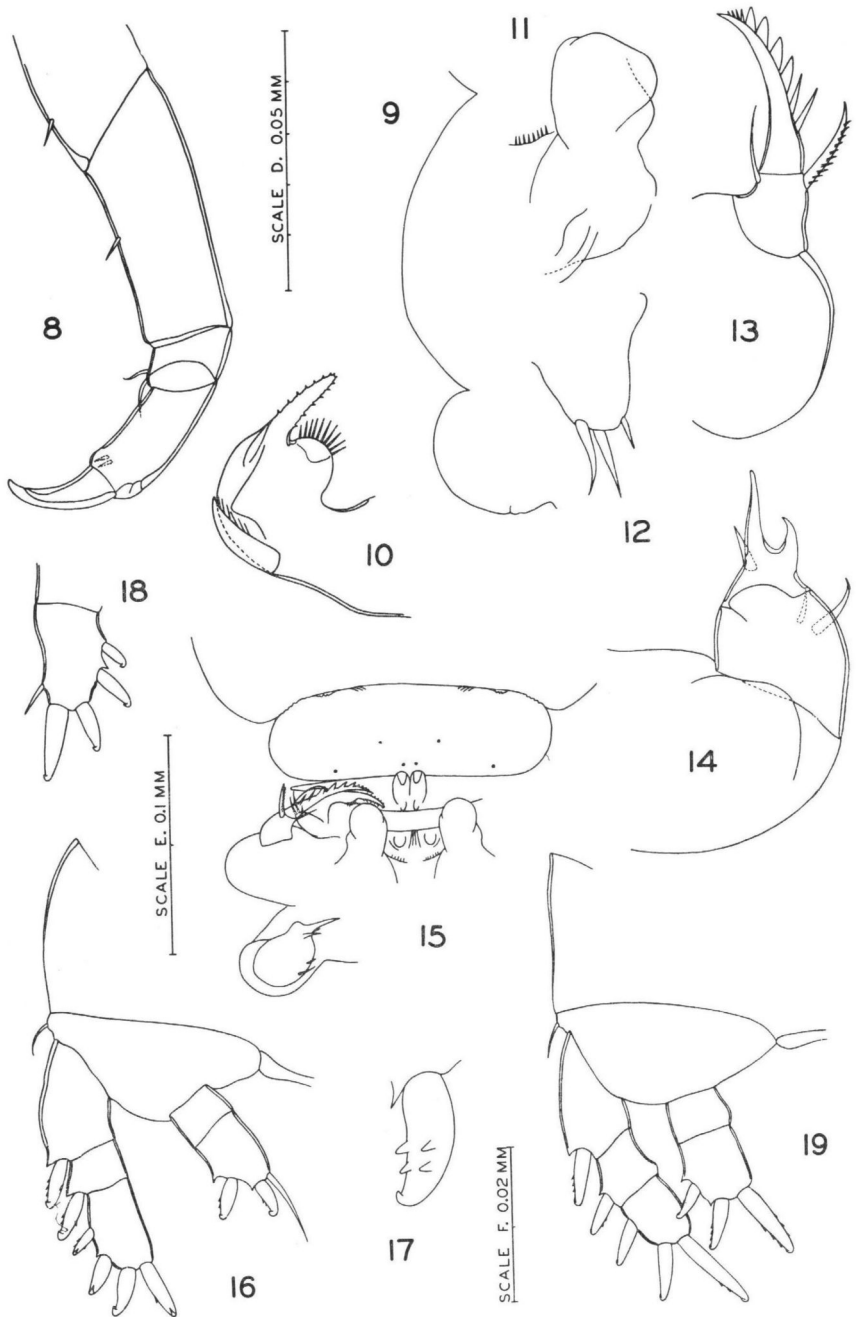
TYPE MATERIAL. 28 females and 62 males from washings of a hard coral, *Psammocora* sp., taken from 3 meters depth at low tide west of Pointe Ambarionaomby, on the northern tip of Nossi Komba, near Nossi Bé, Madagascar, October 2, 1960. Holotype, allotype, and 21 paratypes (6 females and 15 males) deposited in the Muséum National d'Histoire Naturelle at Paris, the same number of paratypes in the United States National Museum at Washington, the Academy of Natural Sciences at Philadelphia, and the remaining paratypes in the author's collection.

OTHER SPECIMENS. 4 females and 12 males from washings of *Psammocora* sp. in 3 meters at Pointe de Tafondro, on the southeast corner of Nossi Bé, Madagascar, August 29, 1960. This point is 4 km north and slightly east of the type locality.

FEMALE. Body elongated (figs. 1 and 2), the prosome wider than the urosome and with its sides nearly parallel. In side view (fig. 3) the prosome stout and abruptly truncate above the beginning of the urosome. Length of body (including the caudal rami) 1.40 mm (1.28-1.48 mm), length of prosome 0.93 mm (0.86-0.99 mm), greatest width at level of first legs 0.41 mm (0.38-0.45 mm), based on 10 specimens. Segmentation sometimes rather weakly defined. Segment bearing leg 1 fused with the head. Segment which would normally bear the fourth legs partially fused with the segment bearing leg 5. Genital segment much more slender than the preceding segments (fig. 4), with its body wall sclerotized in the region of the dorsolateral oviducal openings but very hyaline posterior to this. Abdomen (fig. 4) 3-segmented, the segments of about equal length and sometimes indicated only by slight swellings. Last abdominal segment ventrally on each side with a patch of spinules and an inner faintly striated area. Caudal ramus (fig. 5) elongate, 60 μ long and 31 μ wide at the base, tapering distally, with a short blunt hyaline seta on its middle outer margin, a short subterminal outer seta, and 3 terminal setae, the middle one 36 μ long (about 3 times longer than the other two) and more strongly sclerotized, with a rather blunt hyaline tip.

Two egg sacs, each about 300 μ long, with 6 to 8 eggs arranged in a cluster (fig. 6).

Rostral area broadly rounded and somewhat set off from the rest of the head. First antenna (fig. 7) small, 109 μ long (not including the setae), shorter than the second antenna, with indications of 6 segments, though the division between the second and third is only weakly suggested and the last 3 segments (more slender than the preceding 3) are indicated only by breaks in the sclerotization of the wall. With numerous naked setae and 2 aesthetes (one terminal, the other on the penultimate segment). Second antenna (fig. 8) about 160 μ long, 4-segmented, prehensile, bearing a few small setae as indicated in the figure and



Figs. 8-19. *Kobia angulata* n. gen., n. sp., female. 8, second antenna (C); 9, outline of labrum and region between bases of second antennae, lateral (C); 10, mandible (D); 11, lobe probably representing paragnath, ventral (D); 12, first maxilla (D); 13, second maxilla (D); 14, maxilliped (D); 15, portion of oral area, pressed, with posterior part of labrum bent forward, ventral (E); 16, leg 1 (C); 17, outer distal spine of first exopod segment of leg 1 (F); 18, third segment of exopod of leg 1 (C); 19, leg 2 (C).

having a terminal claw 31μ long. Labrum projecting in lateral view (fig. 9); in ventral view appearing in 2 parts, the anterior one a broad transverse plate with a few refractile dots on its surface, the posterior one a hemispherical area covering the mandibles, most of the first maxillae, and the terminal spines of the second maxillae (figs. 2 and 15, and see also fig. 32). Median posterior area of the labrum showing 2 sclerotized elements closely appressed and protruding as a hyaline knob (compare figs. 15 and 32).

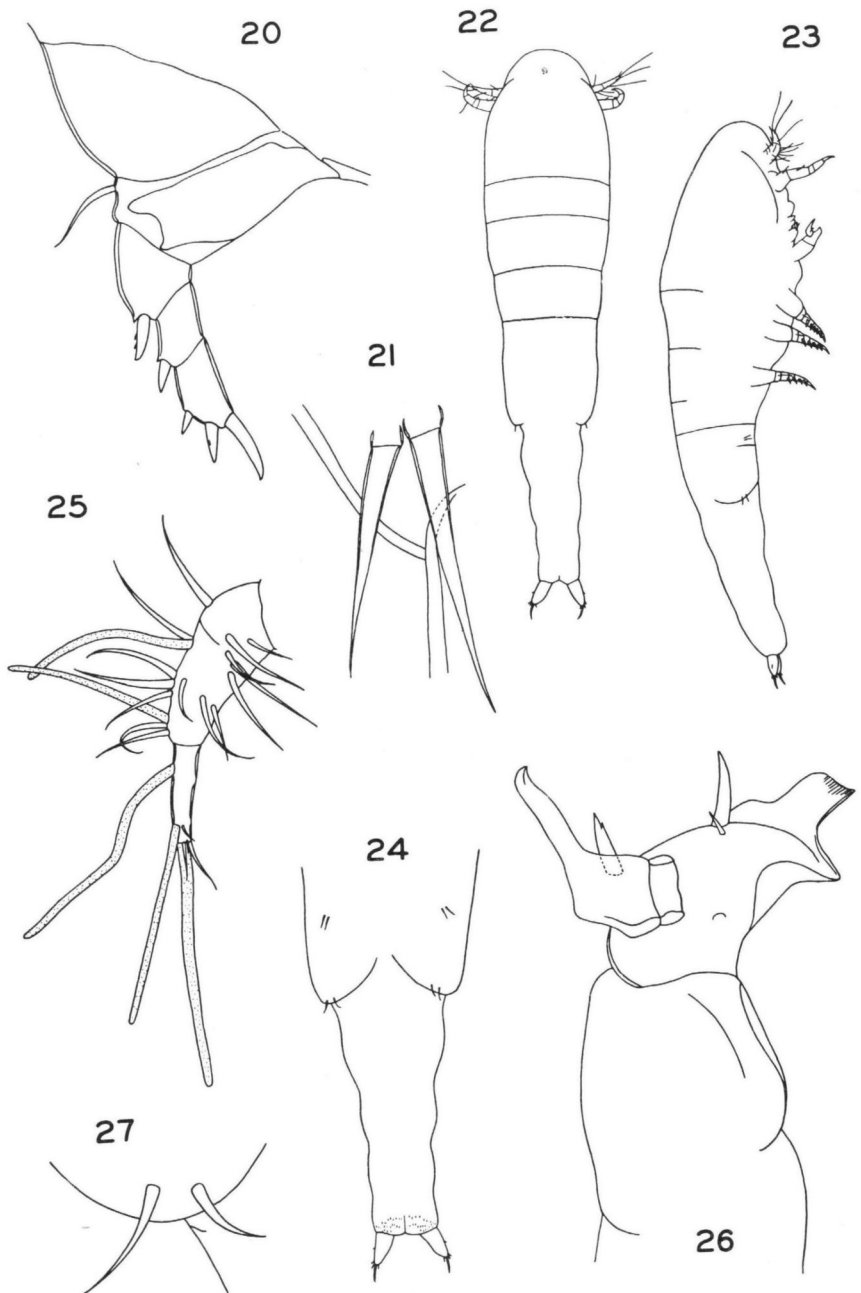
Mandible (fig. 10) small, having an outer scale-like process and an inner lobe bearing a row of fine spinules, and terminating in an elongate blade with serrate edges. Margin of the mandible between the insertion of the scale and the origin of the blade hyaline and membranous. Paragnath probably represented by an irregular lobe (figs. 11 and 15) projecting ventrally just behind the mandibular blade and on a level with the base of the first maxilla. A very short row of minute spinules medial to but apparently not on the paragnath. First maxilla (fig. 12) a simple lobe with 3 setae. Second maxilla (fig. 13) 2-segmented, the small second segment armed with 2 setae and a large terminal spine which is dentate along its medial edge. Maxilliped (fig. 14) probably to be considered 3-segmented, the separation between the second and third segments indicated by breaks in the sclerotization of the body wall. Second segment with 2 setae; third with a sub-terminal seta and 2 unequal terminal processes. Oral area as shown in fig. 15 (compare also fig. 32).

Leg 1 (fig. 16) biramous. Basipod with a minute outer seta. Exopod 3-segmented, the first two segments each with a strong outer distal spine (fig. 17), the last segment with 4 spines and in some specimens a slender hyaline subterminal seta on the inner margin (fig. 18). Endopod 2-segmented, the first segment unarmed, the second with 2 spines and a slender seta. Leg 2 (fig. 19) biramous, similar to leg 1, except that the number of spines on the last exopod segment varies from 3 to 4 (sometimes varying on opposite legs in the same female), that the hyaline seta on this segment is uniformly absent, and that the last endopod segment bears 3 spines. Leg 3 (fig. 20) uniramous, with a 3-segmented exopod, but the endopod being absent. Last exopod segment with usually 3 spines, but occasionally only 2. Leg 4 absent.

Spine and setal formula of legs 1 to 3 as follows (Roman numerals indicating spines, Arabic numerals setae):

	leg 1		leg 2		leg 3	
	exp	enp	exp	enp	exp	enp
1st segment	I : 0	0 : 0	I : 0	0 : 0	I : 0	
2nd segment	I : 0	II, 1	I : 0	III	I : 0	
3rd segment	IV or IV, 1		III or IV		II or III	

Leg 5 (fig. 21) apparently represented only by 2 setae, 32 and 36μ in length, situated on the ventrolateral areas where the fifth legs would be expected to arise.



Figs. 20-21. *Kombia angulata* n. gen., n. sp., female. 20, leg 3 (C); 21, leg 5 (F).
 Figs. 22-27. *Kombia angulata* n. gen., n. sp., male. 22, dorsal (A); 23, lateral (A); 24, posterior part of body, ventral (B); 25, first antenna (C); 26, maxilliped (F); 27, leg 6 (F).

These setae have been interpreted here as the fifth legs because of the presence of a delicate transverse fold separating this segment from the non-pedigerous segment preceding it. Furthermore, it may be noted that while legs 1 to 3 arise far forward on their segments, the setae of leg 5 arise about in the middle of the segment, thus supporting the interpretation of these setae as leg 5 rather than as leg 4.

Color in life transparent, eye red.

MALE. Body (fig. 22) elongated as in the female, but less expanded in the thoracic region. In lateral view (fig. 23) the posterior thoracic segments not conspicuously wider than the urosome. Length of body (including the caudal rami) 0.97 mm (0.93-1.02 mm), width 0.20 mm (0.18-0.22 mm), based on 10 specimens. Segmentation as in the female, but the abdomen (fig. 24) 4-segmented, the segments sometimes indicated only by slight swellings as in the female. Last abdominal segment ventrally with 2 patches of spinules and striations as in the female. Caudal ramus like that of the female.

Rostrum, second antenna, labrum, mandible, first maxilla, and second maxilla like those of the female. First antenna (fig. 25) small, 82 μ long, segmented as in the female; with 5 long aesthetes, one on each segment except the first, the terminal aesthete 70 μ long. Paragnath probably represented as in the female by a small lobe. Maxilliped (fig. 26) 3-segmented, the first segment large and unarmed, the second bearing 2 setae and expanded inwardly to form 2 processes, one somewhat truncate with a striated distal margin, the other bluntly rounded and without striations. Third segment very short and bearing a fairly long angulate claw (apparently derived from one of the terminal processes of the female maxilliped) with a single seta.

Legs 1 to 3 as in the female, but the terminal claws on both rami tending to be a little longer. Leg 4 absent. Leg 5 as in the female. Leg 6 (fig. 27) represented by 2 small setae located on the posterolateral areas of the genital segment.

Spermatophore not seen.

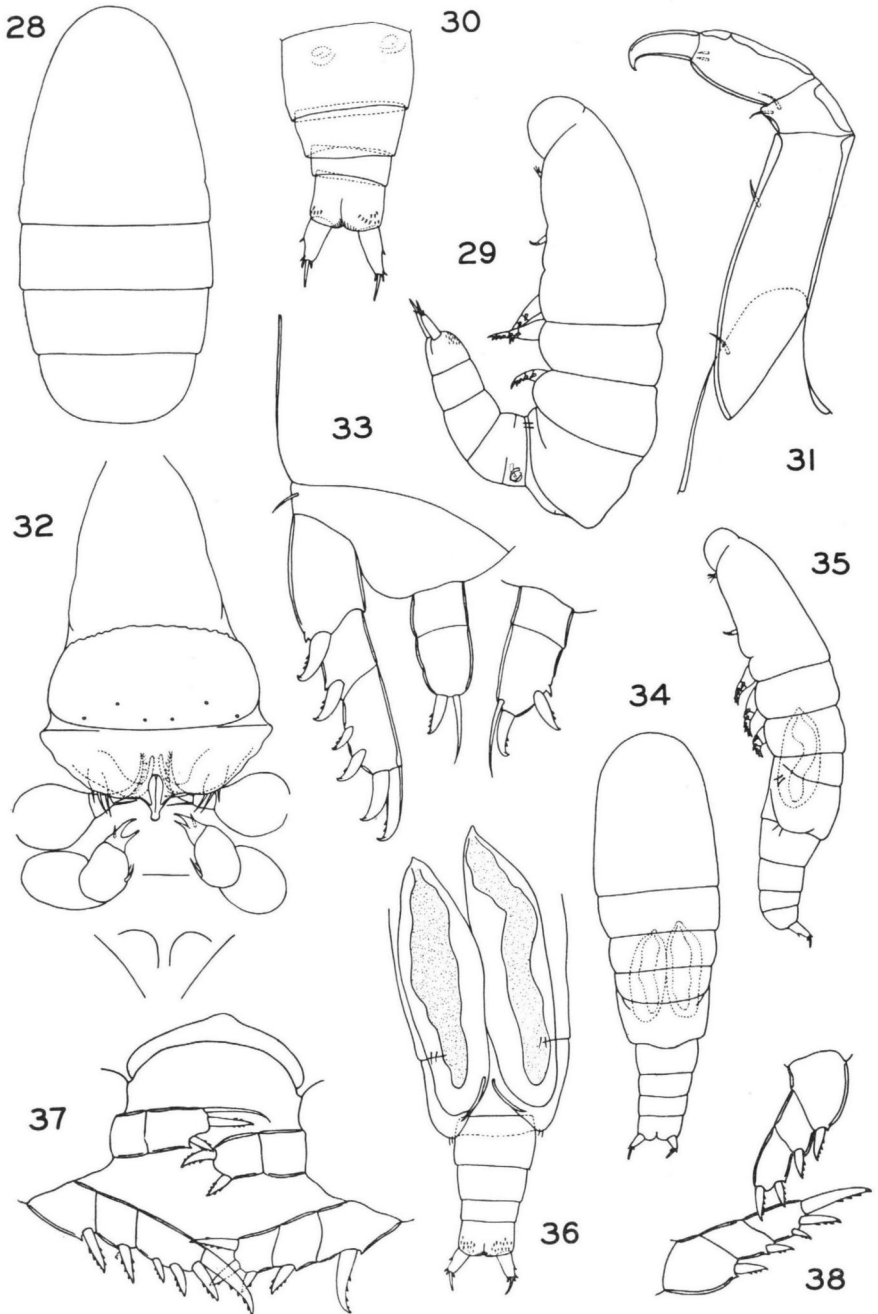
Color as in the female.

The specific name *angulata*, having angles, refers to the abrupt angle of the posterior dorsal part of the prosome in the female and to the angulate claw on the male maxilliped.

NOTES ON SPECIMENS OF KOMBIA ANGULATA FROM POINTE DE TAFONDRO

These 16 copepods (mentioned above) are probably from the same species of *Psammocora* as the type specimens, but this is based upon field identification only, no specimens of the coral having been preserved. The copepods show certain variations which warrant brief mention here.

FEMALE. Body slightly smaller than in the type specimens, with the ventral surface of the prosome somewhat flattened. Total length 1.15 mm, length of prosome 0.83 mm, length of urosome 0.31 mm, averages based on 2 individuals. Segmentation more distinct (figs. 28, 29, and 30). Urosome bent ventrally in all



Figs. 28-33. *Kambia angulata* n. gen., n. sp., female (drawn from Pointe de Tafondro specimens, not types). 28, dorsal, urosome concealed underneath (A); 29, lateral (A); 30, urosome, ventral (B); 31, second antenna (C); 32, oral area, including region between bases of second antennae, drawn without pressure and hence posterior part of labrum in its normal position, ventral (E); 33, leg 1 plus endopod of leg on opposite side (C).

Figs. 34-38. *Kambia angulata* n. gen., n. sp., male. 34, dorsal (A); 35, lateral (A); 36, posterior part of body, ventral (B); 37, first pair of legs (C); 38, rami of third pair of legs (C).

4 females seen. (Such differences may be relative to the method of fixation, that is, whether dead or alive at the time. Differences in total length should be treated with caution, since the urosome is somewhat contractile in life).

Claw on end of second antenna (fig. 31) slightly more recurved. Oral area as in fig. 32. In this specimen the posterior part of the labrum being in its normal position, shielding the mandibles, first maxillae, and terminal spines of the second maxillae; compare with fig. 15 where this part of the labrum is bent forward because of pressure during preparation of the specimen.

Endopod of leg 1 having on the second segment I, 1 or II, 1 (fig. 33). Leg 5 with shorter setae, about 22 μ long.

MALE. Body shorter than in the type specimens, 0.81 \times 0.25 mm, based on a single individual. Segmentation more obvious (figs. 34, 35, and 36).

Leg 1 (fig. 37) with the second endopod segment II, 1 or II. Leg 3 (fig. 38) with the formula I : 0, I : 0, II or III.

In other respects these specimens appear to be identical with the type specimens. Such differences as have been noted are considered to be well within the limits of intraspecific variation.

DISCUSSION

The recovery of these copepods from the corals presents some difficulty. When the coral is crushed with a hammer and the whole mass washed in alcoholized sea water, a few copepods may be found in the sediment. This method, however, is very time-consuming, since there is so much fine debris and mucus to examine. A more satisfactory method is to let the fresh corals remain without crushing in alcoholized sea water (about 5% ethyl alcohol) for 7 to 10 hours. The copepods then tend to move out of the polyps and may easily be recovered from the relatively small amount of debris and mucus.

The living copepods move the abdomen with a worm-like motion, contracting and extending it freely. When isolated in a dish of sea water the females frequently rest with the abdomen bent under the body. The copepods cling to debris with the spines on the legs and the setae on the caudal rami, and are unable to swim.

The new genus *Kombia* seems to be related to the genus *Xarifia* Humes, 1960, and should probably be placed with it in the family Xarifiidae Humes, 1960. A revised diagnosis of *Xarifia* and keys to the 10 known species are presented in the paper by Humes, 1962. Similarities between the two genera are to be found in the elongate body, the moderately stout prosome in relation to the slender urosome, the first and second antenna, the blade-like tip of the mandible, the first maxilla, and the maxilliped in both sexes. Marked differences exist, however, in the second maxilla, in the structure and armature of legs 1 to 4 (in *Kombia* leg 4 being absent and leg 3 having only the exopod), and in the reduction of leg 5 to two setae. The inclusion of *Kombia* in the Xarifiidae along with *Xarifia* makes a discussion of the characteristics of the family desirable, but it seems premature at this time to

attempt such a diagnosis, since the limits of variation in this genus are as yet based on only one known species.

RÉSUMÉ

Description de *Kombia angulata*, nouveau genre et nouvelle espèce de Copépode cyclopoïde parasite d'un corail, *Psammocora* sp., à Madagascar. Ce copépode se place probablement dans la famille des Xarifiidae, à côté du genre *Xarifia*.

REFERENCES

- HUMES, A. G., 1960. New Copepods from madreporarian corals. *Kieler Meeresforsch.*, **16**: 229-235.
—, 1962. Eight new species of *Xarifia* (Copepoda, Cyclopoida), parasites of corals in Madagascar. *Bull. Mus. Comp. Zoöl. Harvard Coll.* (in press).