

TWO REDISCOVERED SPECIES OF LITTORAL COPEPODS FROM BARBADOS COLLECTIONS

HARRY C. YEATMAN

Department of Biology, University of the South
Sewanee, Tennessee 37375

ABSTRACT

The harpacticoid copepod, *Heterolaophonte hamatus* Jakobi, 1954 and the calanoid copepod, *Pseudocyclops magnus* Esterly, 1911 were found in 1972 collections from turtlegrass, *Thalassia*, in Barbados. This rediscovery enabled more complete descriptions of the females and descriptions of the males for the first time. *Pseudocyclops latens* Gurney, 1927 is considered to be synonymous with *Pseudocyclops magnus*.

INTRODUCTION

In 1911, Calvin O. Esterly described the calanoid copepod, *Pseudocyclops magnus* from a single female taken in a haul at Agar's Island, Bermuda. This description was incomplete and no male was available.

In 1954, Dr. Hans Jakobi described the harpacticoid copepod, *Heterolaophonte hamatus* from collections made at Itapocoroí and Porto Belo-Santa Catarina, Brazil. He had seven females and one male. The description of the females was brief and the male was not described.

These two incompletely described species were recently rediscovered in Barbados collections. Mr. Charles Hollingworth, researching on feeding habits of some marine littoral copepods at the Bellairs Research Institute of McGill University, St. James Barbados, sent his collections to the author for identifications. This material enabled more complete descriptions of the females and descriptions of the males. The author wishes to thank Mr. Hollingworth for the opportunity to use his collections and to thank Dr. Jakobi for notes on *H. hamatus*. Thanks are given to Dr. Thomas E. Bowman, curator of the Division of Crustacea, Smithsonian Institution and to Dr. Auden Fosshagen, Biological Station, Espesgrend, Norway for sending some necessary literature.

PSEUDOCYCLOPS MAGNUS (ESTERLY, 1911)

Specimens Examined. Five adult females and six adult males collected by Mr. Charles Hollingworth from *Thalassia* beds on 6 July 1972 at St. Lawrence, Barbados.

Redescription of female. Body length varies from 0.60 to 0.68 mm. in Barbados specimens. Esterly's single female from Bermuda was 1.10 mm. Body resembles that of a cyclopoid copepod, hence the generic name (Fig. 1). Head and first pedigerous segment are not fused, but the separation joint is not as distinct as the other body joints. Rostrum points ventro-posteriorly and bears two tiny setae (Fig. 3).

Caudal rami are about as long as broad or in some specimens

broader than long (Fig. 4). Unlike typical calanoid copepods, the caudal setae are of unequal lengths as in cyclopoid copepods (Fig. 1). Each caudal ramus bears a short subterminal outer spine, a moderately long outer terminal seta, two long median setae and a fairly long inner terminal seta. There is a short, unjointed spinule at the innermost corner of each ramus (Fig. 4). The long median setae are usually moderately inflated and the longer of these setae terminates in a short whip-like process (Fig. 1). In one specimen otherwise normal, the longest caudal seta is modified into a paddle-shaped appendage (Fig. 5). Abnormal shapes of these setae are not rare in other marine calanoids, such as *Ridgewayia marki* (Esterly), see Yeatman (1969).

First antennae consist of seventeen segments and extend to or just beyond the indistinct posterior border of the first body segment (Fig. 1). I cannot find any blunt aesthetascs, figured on the first antennae of many other species of *Pseudocyclops*. If present, they were broken off in my material. Some of the setae are slightly inflated and some end with tactile, whip-like processes (Fig. 6).

Second antennae consist of one-segmented basipod, two-segmented exopod, and three-segmented endopod, and thus resemble the second antennae of *Pseudocyclops cokeri* (Bowman & Gonzalez, 1961). Many species of *Pseudocyclops* have five-segmented exopods (Fosshagen, 1968). Setation is shown in Fig. 7.

Mouthparts resemble those of *P. cokeri* (Bowman & Gonzalez, 1961).

Exopods and endopods of the swimming legs are three-segmented. Combining spines and setae, the armature formula of the terminal segment of the exopods is seven, eight, nine, nine, and of the terminal segment of the endopods is six, eight, eight, seven (Figs. 8-11). Many of the setae are jointed about a third of the length from the base. *P. bahamensis* Fosshagen (1968) has very similar swimming legs.

The fifth leg is quite different from that of other species, except *P. latens* Gurney (1927), which is discussed below. The exopod is three-segmented. The basal and middle segments each bear an outer spine and the distal segment bears two outer spines, one terminal spine, and one large and one tiny subterminal inner spine. There are no inner border setae or spines on any of these exopod segments, thus *P. magnus* differs from many other species of the genus. The endopod consists of three segments. Esterly (1911) used the term "joint" to mean segment and said this endopod was two-jointed due to "the first and second joints (of the original three) being fused", but his figure shows a three-segmented endopod. Spinules are subterminal and at the borders of the segments. There is a short spine or seta at the end of the endopod (Fig. 12).

Description of male. Esterly found only a single female, no males. The six Barbados males varied from 0.59 mm. to 0.62 mm. The body is cyclopoid in appearance. In some specimens the joint separating the head from the first pedigerous segment is difficult to see except in well-cleared specimens.

As in other species of the genus, the left first antenna is like those of the female and the right one is geniculate, or modified for grasping the female (Fig. 2). Second antennae, mouthparts and swimming legs are like those of the female.

Fifth legs differ from those of other species, but some structures resemble those of *P. mathewsoni* Fosshagen (1968) and

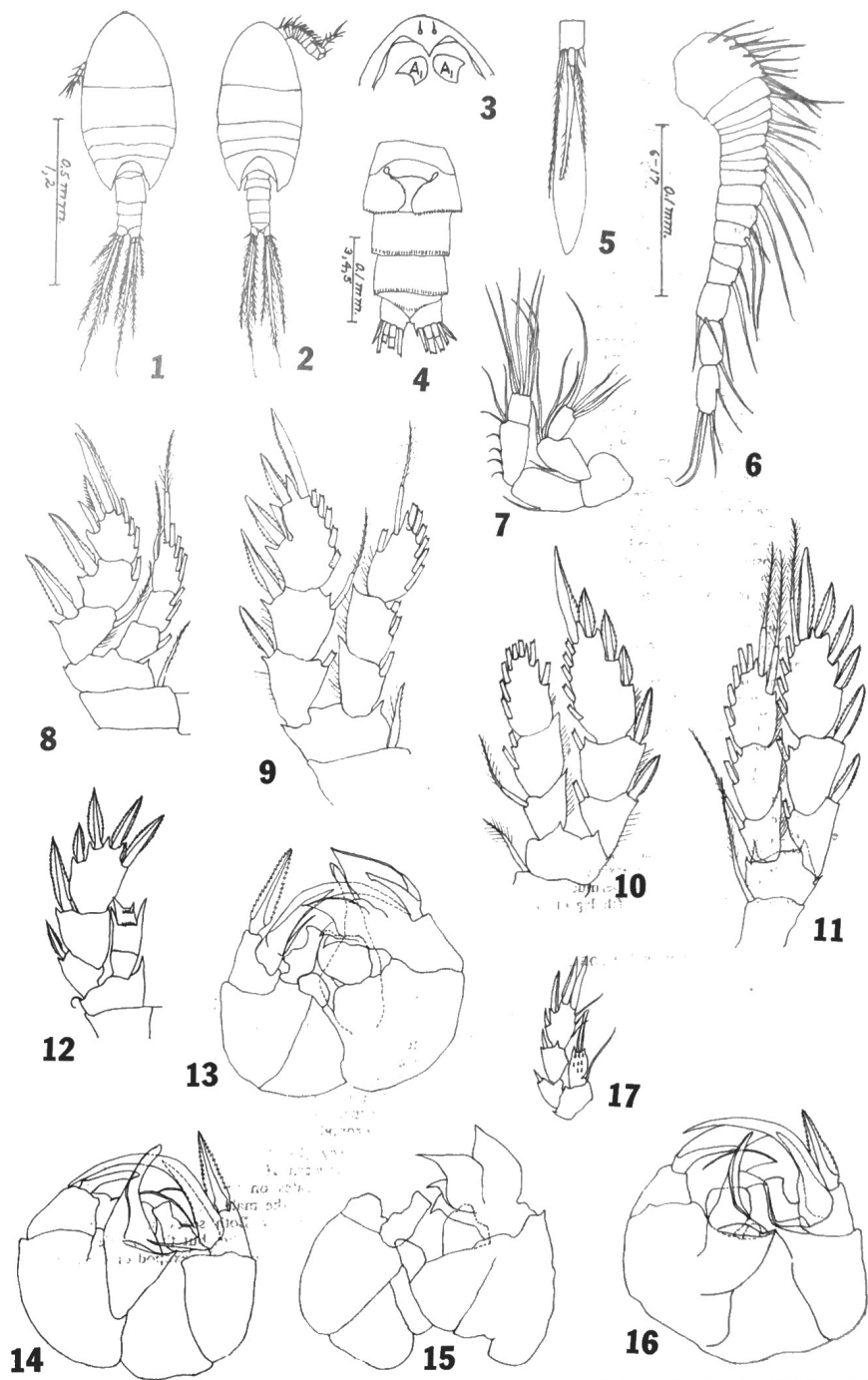


PLATE 1:

Pseudocyclops magnus Esterly. 1. Female, dorsal view. 2. Male, dorsal view. 3. Rostrum ventral view of female. 4. Abdomen, ventral view of female. 5. Caudal ramus with abnormal seta of female. 6. First antenna of female. 7. Second antenna of female. 8. First leg of female. 9. Second leg of female. 10. Third leg of female. 11. Fourth leg of female. 12. Fifth leg of female. 13. Fifth legs of male, posterior view. 14. Fifth legs of male, anterior view. 15. Fifth legs of male, posterior view with spines and claws removed. 16. Fifth legs of male, anterior view. 17. Fifth leg of female.

P. cokeri Bowman & Gonzalez (1961). The right exopod is one-segmented and bears three spines, the largest is clawlike and bears a seta at its base (Figs. 13, 14, 16). The single-segmented right endopod is angulated and squared at its distal end. The left exopod bears an anterior membranous process somewhat like that of *P. mathewsoni*. Distally, the left exopod bears a blunt spine and four leaf-like processes (Figs. 13, 15, 16). The left endopod is short, blunt, and unarmed.

Comments. Except in size, the Barbados specimens agree with Esterly's description and figures of the single female specimen from Bermuda. The Bermuda specimen was either a giant individual or perhaps the water temperature differed in the two environments. Some freshwater cyclopoid copepods, when reared in cool water from early naupliar stages, mature more slowly, but grow to a larger size than those reared in warmer water (Coker, 1933; Aycock, 1942; Yeatman, 1959).

Nicholls (1944a) believed *Pseudocyclops latens* Gurney (1927) to be the same species as *P. magnus*. Vervoort (1964) separated these forms in his key to the species of *Pseudocyclops* on the basis of size (1.1 mm. for *P. magnus* and 0.63 mm. for *P. latens*), number of thoracic segments, and rami of *P. latens* being internally produced. Gurney's figure of the whole mount doesn't show a joint between the head and the first pedigerous segment, but, as pointed out above, this joint is very difficult to see in some specimens that have not been cleared. The Barbados specimens show inner expansions of the caudal rami, although they are not protruding as much as Gurney figured. Gurney's figures and description indicate that his *P. latens* is synonymous with *P. magnus*. Gurney's single female specimen was taken in plankton at night at Ismailia, Egypt.

Both female and male *P. magnus* differ from all other species in the shape and armature of the fifth legs. The inner borders of the exopod segments of the female fifth leg are devoid of spines, or setae in *P. magnus* and the endopod is three-segmented, not two or one-segmented. The two-segmented instead of five-segmented exopod of the second antenna helps distinguish *P. magnus* from many species from the Bahamas.

When seeking specimens of *P. magnus*, the author collected a female specimen of *Pseudocyclops* in a night plankton haul in St. George's Harbor, Bermuda on 11 August 1955. The specimen was somewhat damaged, therefore no attempt was made to describe it. Later (1961), Bowman & Gonzalez described the new species *Pseudocyclops paulus* from Puerto Rico. The specimen from Bermuda is that species, thus increasing its distribution range. The fifth leg of the *P. paulus* from Bermuda is shown in figure 17 for comparison with the female fifth leg of *P. magnus*.

HETEROLAOPHONTE HAMATUS (JAKOBI, 1954)

Specimens examined. Twelve adult females and five adult males collected by Mr. Charles Hollingworth on 1 January 1972 from a *Thalassia* bed in about one meter depths at St. Lawrence Gap on the south coast of Barbados. Water temperature was 27.5°C.

Redescription of female. Body length varies from 0.52-0.62 mm. Body is cylindrical in shape and consists of 10 segments (Fig. 18). A short rostrum is armed with two subterminal setae. All the body segments are fringed with short hairs.

Caudal rami are slightly less than twice as long as broad and are armed with two short lateral seta one short inner seta, one short dorsal seta and two long median setae, that are joined near their bases (Fig. 20). The inner median setae are twice as long as the outer median setae, but are shorter than the copepod body (Fig. 18).

First antennae are seven-segmented and an aesthetasc is

located on the fourth segment (Fig. 21). These antennae are shorter than the first body segment.

Second antennae consist of two large segments and often a tiny exopod bearing two or three setae (Fig. 22). In some specimens the exopod is not distinct and is represented by two or three tiny setae (Fig. 23).

Maxilliped consists of two distinct segments and an apical claw (Fig. 24).

The exopods of the first four legs are three-segmented and the endopods are two-segmented. The basal segment of the endopod of the first leg is much longer than the entire exopod of that leg and the short distal segment of the endopod bears a large claw (Fig. 25). Combined spine and setal formula of the terminal segment of the endopods of the second, third, and fourth legs is four, six, four (Figs. 26-29). The proximal endopod segment is unarmed. Spine and setal formula of the terminal exopod segment of the first four legs is four, six, six, four (Figs. 25-29); which includes an inner seta for the second and third legs, but not the fourth legs. The first two exopod segments of each leg bear an outer spine and, in addition, an inner seta for the second segment of the second, third and fourth legs (Figs. 25-29). The exopods of the first legs are devoid of inner setae on any segment (Fig. 25). The fifth leg exopod is almost oval in shape and bears six setae, of which the third and fifth are longer than the others. The basal segment bears an outer seta and five setae and spines on its inner expansion (Fig. 30).

Description of male. Dr. Hans Jakobi, who described the female *H. hamatus*, wrote me that he has no males available and therefore cannot give a description of this sex. He urged me to describe it.

The body length is about 0.50 mm. The body consists of 10 segments and is shorter than that of the female (Figs. 18 and 19).

The first antennae are geniculate. The first leg is like that of the female. The terminal segment of the exopod of the second leg has four large spines, a short spine at the base of the second spine, a tiny terminal seta, and an inner seta. The endopod of the second leg has three terminal setae and an inner claw inflated at its middle (Figs. 31 and 32). The terminal segment of the exopod of the third leg has four large spines, one small spine, and two small setae. The endopod of the third leg has four terminal setae and an outer thumb-like claw (Fig. 33). The terminal segment of the exopod of the fourth leg has five spines and setae, but none are normally on the inner side (Figs. 34 and 35). The fourth leg endopod is like that of the female. The fifth leg is very rudimentary and variable. The exopod is not distinct from the basal segment. There are two inner setae, an outer seta and three of four middle setae (Figs. 36 and 37). The sixth leg consists of two setae (Figs. 36 and 38). One male had abnormal third and fourth legs. These are shown in figures 39-41, and may indicate an ancestral condition.

Comments. This species is characterized by having two long terminal caudal setae instead of one seta, a three-segmented first leg exopod without any inner setae, a fourth leg exopod terminal segment with two not three outer spines in the female and no inner seta in either sex, and a fifth leg of the female with the inner expansion of the basal segment reaching about the middle of the exopod.

Lang's key (1965) to the *Heterolaophonte* females leads to a choice between *H. variabilis* Lang and *H. hamatus* Jakobi, which he separates on the shape of the fifth leg. The second and third legs of the male *H. variabilis* are quite different from those of *H. hamatus*. Both sexes of *H. manifera* (Wilson) are very much like *H. hamatus*, but that species bears an inner seta on the terminal segment of the exopod of the fourth leg (Wilson, 1932).

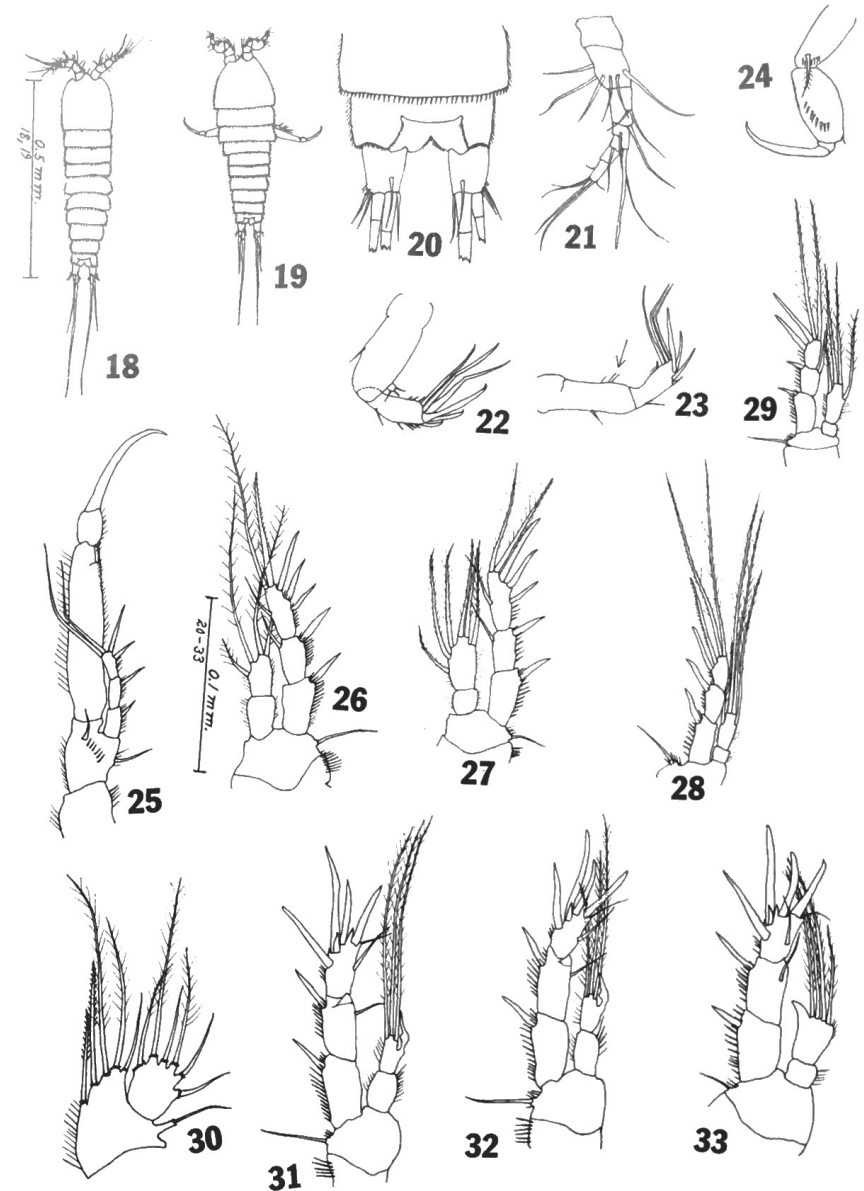


PLATE II:
Heterolaophonte hamatus Jakobi. 18. Female, dorsal view. 19. Male, dorsal view. 20. Caudal rami of female, dorsal view. 21. First antenna of female. 22 & 23. Second antennae of female.

24. Maxilliped of female. 25. First leg of female. 26. Second leg of female. 27. Third leg of female. 28 & 29. Fourth legs of female. 30. Fifth leg of female. 31 & 32. Second legs of male. 33. Third leg of male.

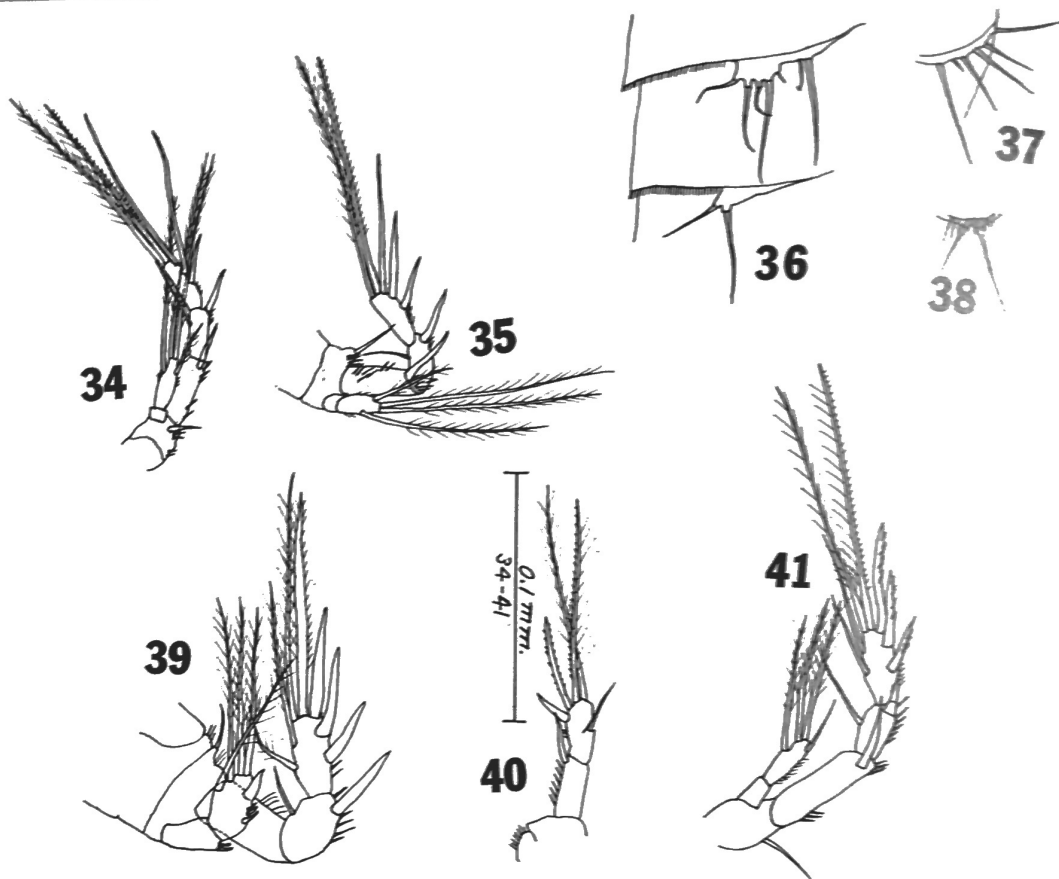


PLATE III:

Heterolaophonte hamatus Jakobi. 34 & 35. Fourth legs of male. 36. Fifth and sixth legs of male. 37. Fifth leg of male. 38.

Sixth leg of male. 39. Abnormal third leg of male. 40. Abnormal exopod of fourth leg of male (terminal segment not separated by joint into 2 segments). 41. Abnormal fourth leg of male.

Dr. Jakobi has written me that the type locality of the species (Itapocaroi and Porto Belo-Santa Catarina, Brazil) has the coastal water temperatures oscillating between 30°C. (January and February) and 20°C. (July and August). The Barbados specimens are the only record of the species other than Brazil. Mr. Hollingworth wrote that males were collected routinely from May to October 1972 at St. Lawrence, Barbados (near St. Lawrence Gap) and that females were collected at both localities in the summers of 1968, 1971, 1972 and Christmas 1971. The species is fairly common at Barbados.

LITERATURE CITED

- Aycock, D. 1942. Influence of temperature on size and form of *Cyclops vernalis* Fischer. Jour. Elisha Mitchell Sci. Soc. 58:84-93.
- Bowman, T. E. and J. G. Gonzalez. 1961. Four new species of *Pseudocyclops* (Copepoda: Calanoida) from Puerto Rico. Proc. U. S. Nat. Mus. 113:37-59.
- Coker, R. E. 1933. Influence of temperature on the size of freshwater copepods (*Cyclops*). Internationale Revue der gesamten Hydrobiologie und Hydrographie 19:406-436.
- Esterly, C. O. 1911. Calanoid copepods from the Bermuda Islands. Proc. Amer. Acad. Arts Sci. 47:219-226.
- Fosshagen, A. 1968. Marine biological investigations in the Bahamas, 4. *Pseudocyclopidae* (Copepoda, Calanoida) from the Bahamas. Sarsia 32:39-62.
- Gurney, R. 1927. Zoological results of the Cambridge Expedition to the Suez Canal, 1924. Report on the Crustacea, Copepoda and Cladocera of the plankton. Trans. Zool. Soc. Lond. 22. 139-172.
- Jakobi, H. 1954. Especies novas de Harpacticoida (Copepoda-Crustacea) encontradas en algas marinhas do litoral Parana-Santa Catarina. Bol. Inst. Ocean. Univ. Sao Paulo. 5:189-199.
- Lang, K. 1965. Copepoda Harpacticoida from the Californian Pacific Coast. Almqvist and Wiksell, Stockholm.
- Nicholls, A. G. 1944 a. Littoral Copepoda from South Australia (II). Calanoida, Cyclopoida, Notodelphyoida, Monstrilloida and Caligoida. Rec. S. Aust. Mus. 8:1-62.
- _____. 1944 b. Littoral Copepoda from the Red Sea. Ann. Mag. Nat. Hist., Ser. 11, 11:487-503.
- Vervoort, W. 1964. Free living Copepoda from Ifaluk Atoll in the Caroline Islands. Bull. U.S. Nat. Mus. 236:1-431.
- Wilson, C. B. 1932. The copepods of the Woods Hole region, Massachusetts. U.S. Nat. Mus. Bull. 158, xix+635 pp., 41 pls.
- Yeatman, H. C. 1959. Some effects of temperature and turbulence on the external morphology of *Cyclops carolinianus*. Jour. Elisha Mitchell Sci. Soc. 75:154-167.
- _____. 1969. A redescription of copepod, *Ridgewayia marki*, with description of an unusual specimen. Jour. Tenn. Acad. Sci. 44:7-10.