

A new species of the genus *Periclimenes* from Bermuda
(Crustacea, Decapoda, Palaemonidae)¹⁾.

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In the Bermudas Dr. I. EIBL-EIBESFELDT studied some shrimps associated with Actiniaria. On examination by Dr. L. B. HOLTHUIS these shrimps proved to represent a new species which is now described. Data on the ecology are presented.

***Periclimenes (Periclimenes) anthophilus* n. sp.**

Whalebone Bay, Bermuda; near the shore, 2-3 m. deep; on sea-anemones; 20th June 1963; I. EIBL-EIBESFELDT. — 11 specimens (6 ovigerous females).

Description. — The rostrum reaches straight forward, it attains the distal part of the second antennular segment or even reaches to the middle of the third segment. The upper margin is not arched, it bears 6, seldom 7, teeth, of which 1 (in the smaller specimens) or 2 (in the larger) are placed behind the orbit. The teeth are rather regularly spaced, but as a rule the first is separated from the second by a distance larger than that between the other teeth. The lower margin is unarmed but for one to three small, often inconspicuous denticles near the tip; the margin is somewhat convex in its proximal part, practically straight in the rest. The rostrum is rather high in its basal portion, and gradually narrows towards the tip. The midrib lies close to the lower margin. The lower orbital angle is produced as a narrow rounded lobe. The antennal spine is placed on the anterior margin of the carapace some distance below the lower orbital angle. The hepatic spine is stronger than the antennal and placed on a somewhat lower level. No supra-orbital spine is present. The antero-lateral angle of the carapace is rectangularly rounded.

The abdomen has the pleura of all somites rounded; that of the fifth is not posteriorly produced. The third somite has the postero-median part strongly produced; this part is somewhat compressed and forms a distinct hump. The sixth somite is about twice as long as the fifth, and practically of the same length as the telson. The upper surface of the telson bears two pairs of very small spinules; the anterior of these are placed well behind the middle of the telson.

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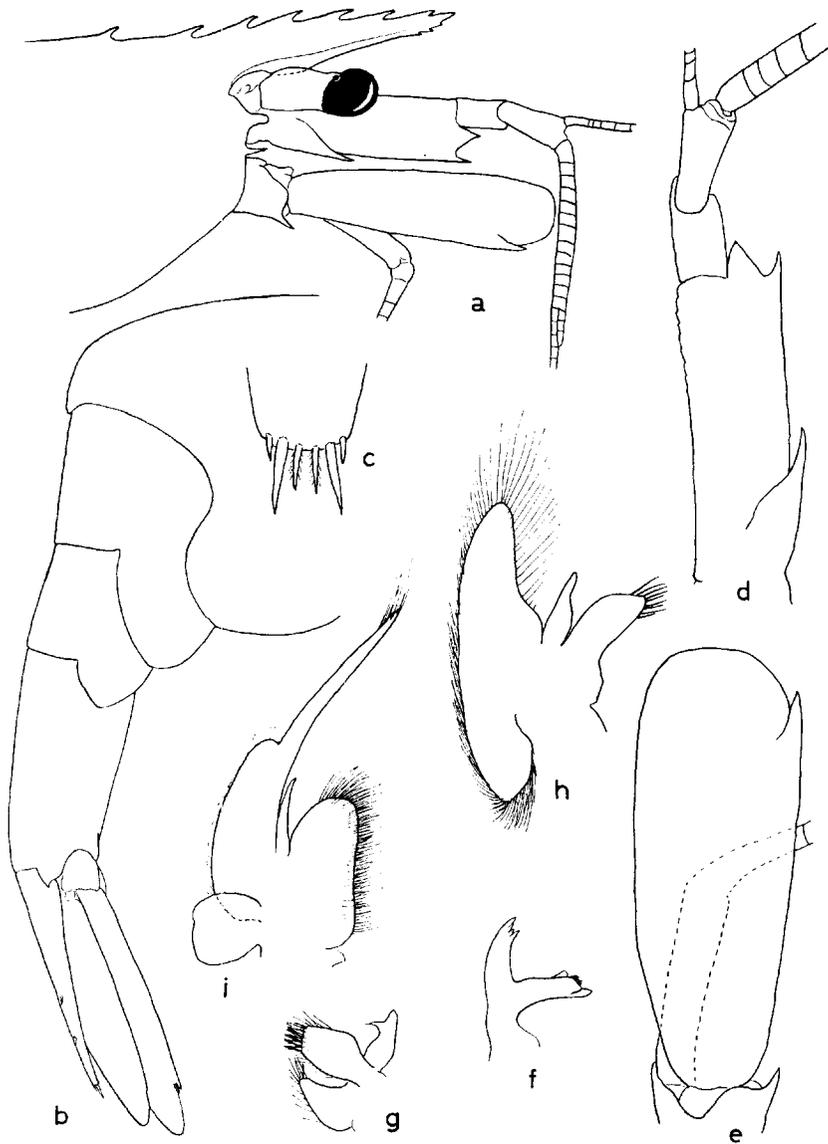


Fig. 1. *Periclimenes (P.) anthophilus* n. sp. a) anterior part of body in lateral view; b) abdomen in lateral view; c) tip of telson in dorsal view; d) antennula; e) scaphocerite; f) mandible; g) maxillula; h) maxilla; i) first maxilliped. a, b, $\times 10$; c, $\times 35$; d, e, $\times 15$; f-i, $\times 20$.

The posterior pair is situated halfway between the anterior pair and the posterior margin of the telson. The posterior margin is rounded, it bears three pairs of spines: the outer are shortest, being much less than half as long as the intermediate; the inner spines are somewhat shorter than the intermediates and are hairy.

The eyes are elongate. The cornea is globular and about half as long as the stalk. A small but distinct ocellus is present.

The antennular somite ends in a blunt anterior spinule which is directed obliquely upward. The basal segment of the antennular peduncle reaches with more than $\frac{1}{4}$ of its length beyond the eye. The stylocerite is slender and pointed, but fails to attain the middle of the segment. The anterior margin of the segment is produced forward into a sharp angle which reaches almost to the middle of the second segment and surpasses the antero-lateral tooth of the basal segment. This antero-lateral tooth is well-developed and sharp. The second segment of the antennular peduncle is slightly shorter than the third; together they are somewhat more than half as long as the first. The two rami of the upper antennular flagellum are fused for 8 to 13 segments (the lower number in the younger specimens), the free part measures $\frac{2}{7}$ to $\frac{1}{4}$ of the length of the fused part and consists of 3 or 4 segments.

The scaphocerite reaches about as far as the end of the antennular peduncle. It is almost three times as long as wide. The tip is broadly rounded and somewhat truncate, it reaches beyond the final tooth. The greatest width of the scaphocerite lies in its distal part. The antennal peduncle almost reaches the middle of the scaphocerite. A strong spine is placed on the antennal peduncle just outside the base of the scaphocerite.

The mouth parts are quite typical. The mandible bears no palp; the incisor process ends in about four teeth, the outer of which are the larger; the molar process shows some blunt knobs and a tuft of hairs. The maxillula has the palp bifid; the lower lacinia is slender; the upper ends in a row of spines. The endite of the maxilla is uncleft, the palp and the scaphognathite are well developed. All maxillipeds have well developed exopods. The endites of coxa and basis of the first maxilliped are not separated; the palp is normal in shape; the caridean lobe of the exopod is distinct; the epipod is slightly bilobed. The second maxilliped is of the usual shape; the epipod is well developed, but bears no podobranch. The third maxilliped reaches with a small part of, or with the entire dactylus beyond the stylocerite. The last segment is about $\frac{3}{4}$ as long as the penultimate. The exopod fails to reach the base of the penultimate segment.

The first pereopod reaches with the fingers beyond the scaphocerite. The fingers are about as long as the palm. The carpus is about 1.2 times as long as the chela and practically as long as the merus. The second legs are strong, they are practically equal in length, but slightly unequal in shape. They reach with part of the carpus beyond the scaphocerite. In the more robust of the two legs the fingers measure about $\frac{3}{4}$ of the length of the palm. The cutting edges of the fingers show a few small and inconspicuous teeth in the extreme proximale part. The dorsal surface of the dactylus is obliquely flattened so that the dactylus is triangular in transverse section. The top of this triangle which is directed downward is formed by the cutting edge, the outer angle of the triangle lies only slightly higher or even slightly lower than the top, while the inner angle is

raised; the upper surface is oblique and slightly convex, the almost horizontal outer surface and the almost vertical inner surface are distinctly concave. The fixed finger has the outer surface somewhat concave. The palm is cylindrical or somewhat swollen in the middle, it is about 1.2 to 1.6 times as long as the carpus. The carpus narrows proximally; its anterior margin is incised externally, but

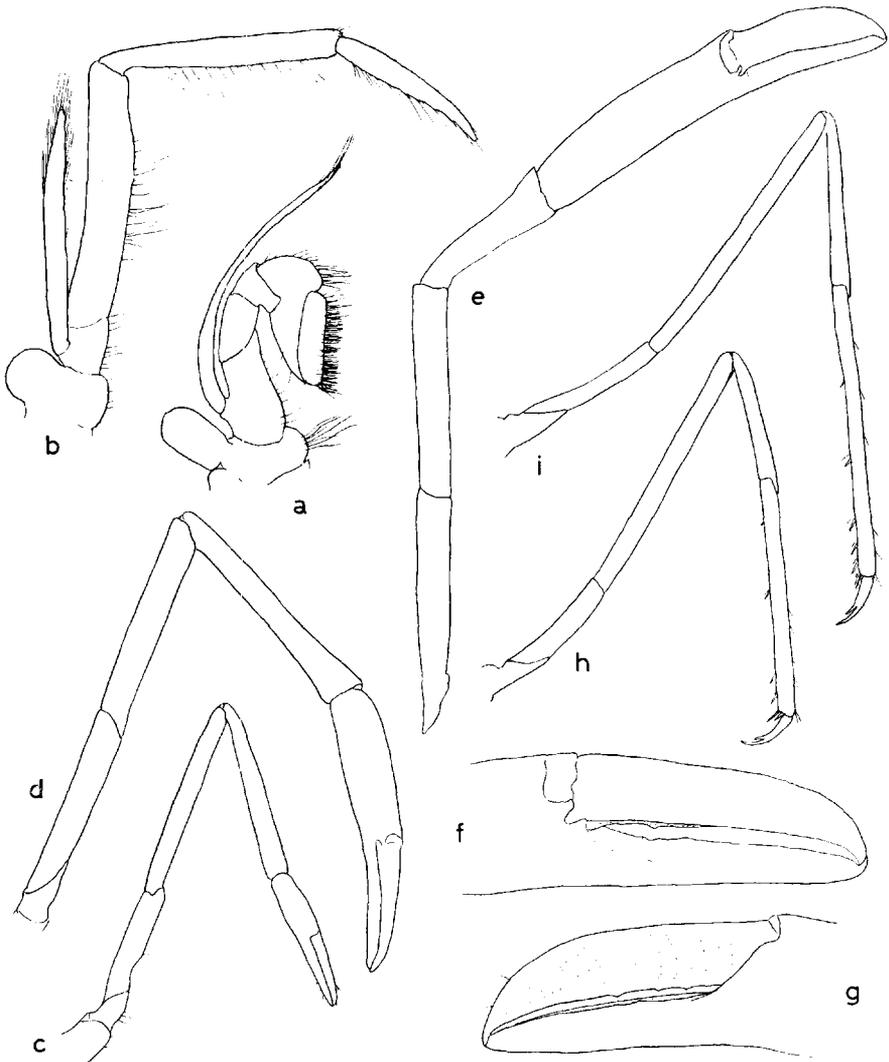


Fig. 2. *Periclimenes (P.) anthophilus* n. sp. a) second maxilliped; b) third maxilliped; c) first pereopod; d) smaller second pereopod; e) larger second pereopod; f) fingers of larger second pereopod, inside view; g) fingers of larger second pereopod, outside view; h) third pereopod; i) fifth pereopod. a, b, f, g, $\times 20$; c-e, h, i, $\times 10$.

bears no teeth. The merus is 1.2 to 1.4 times as long as the carpus. The ischium is a little longer than the merus. There are no spines or teeth on any of the segments. The other second leg is more slender. The fingers are normal in shape, being only slightly concave to the outside of the cutting edge. They are slightly shorter than the palm. The cutting edge of the dactylus bears a very indistinct denticle in the proximal part. The carpus is about 1.5 times as long as the palm, and slightly longer than the merus, which is about as long as the ischium. No spines are present on any of the segments. The third leg reaches with a small part of the propodus beyond the scaphocerite. The dactylus is slender and deeply bifid. It is slightly over $\frac{2}{9}$ of the length of the propodus. The propodus is elongate and bears four or five spines on the posterior margin. The carpus is about 0.6 times as long as the propodus. The merus is practically as long as the propodus. The last two legs are similar to the third.

The pleopods of the females are normal in shape; no males are present in the material examined. The uropods are normal. The outer margin of the exopod ends in a tooth at the inner side of which a movable spinule is present.

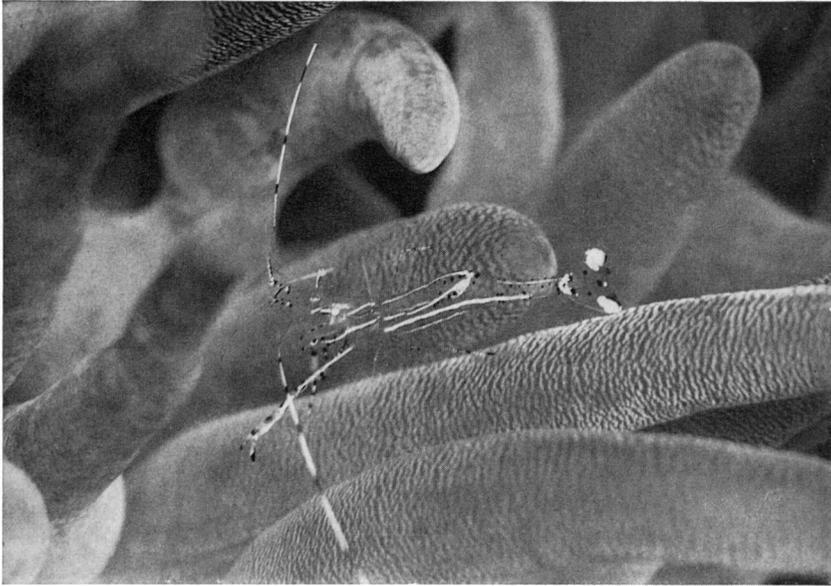
Size. — The specimens are 14 to 24 mm. long, with a carapace length of 4 to 8 mm. The carapace length of the ovigerous females is 5 to 8 mm. The eggs are numerous, they have a diameter of 0.4 to 0.5 mm.

Types. — Holotype ♂ SMF 2608. The paratypes are in the collection of the Natur Museum Senckenberg in Frankfurt am Main (1♀ SMF 2609) and of the Rijksmuseum van Natuurlijke Historie in Leiden (Crust. D. 19485 ♀).

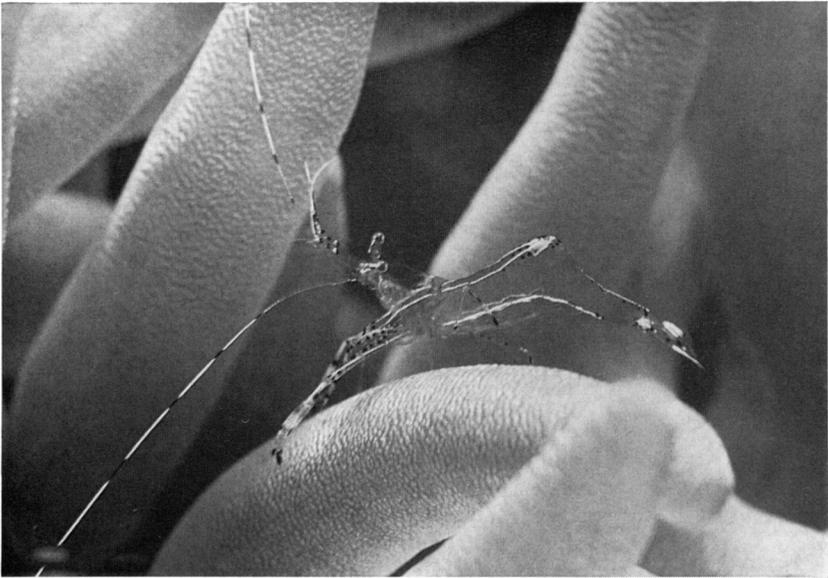
Colour. — In spirit specimens the colour has disappeared entirely, except for a purple band over the middle of the fingers of the chelipeds. A specimen preserved in formaldehyde showed the following remnants of the original colour pattern. Rounded rather large purple spots are visible in the median part of the entire abdomen, with a broad, rather short, anteriorly narrowing streak of purple at each side of the hump of the third somite. A large purple eyespot occupies the entire distal part of the uropodal exopod. Also the base of the tail fan is purple, while furthermore purple spots are visible on the ventral surface of the sixth somite. The third maxilliped has a purple band over the proximal half of the ultimate and penultimate segments. The first pereopod has a purple band over the palm, and two over either carpus, merus and ischium. The second pereopods have a purple band over the fingers, two over the palm, a broad one over the carpus, a broad and a narrow one over the merus, and one or two over the ischium. Some or all of the last three pereopods have a broad purple band over the proximal part of propodus, carpus and merus, and over the middle of the ischium.

Colour of life specimens. — As shown by the photographs (fig. 3a, b) the animals are transparent with conspicuous white markings along the body. In some specimen the antennae are completely white, but in others these white markings are interrupted by reddish violet zones. The third, and sometimes the last, walking leg is transparent and without marking, thus differing from the other leg. The large conspicuous ocelli on the tail fan have whitish anterior borders.

Remarks. — The present new species, as shown by the bifid dactyli of the last three pereopods, belongs to the typical subgenus of the genus *Periclimenes*.



3a



3b

Fig. 3a, b. *Periclimenes (P.) anthophilus* n. sp. on the anemone, lateral and dorsal view. (Photographs: H. KACHER).

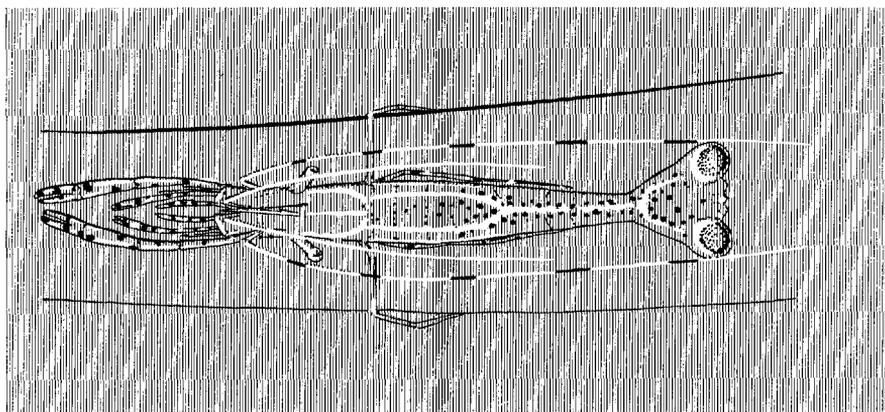


Fig. 4. „Fright“-posture of *Periclimenes anthophilus* n. sp. (Drawing by H. KACHER).

It is most closely related to *Periclimenes yucatanicus* (IVES, 1891), *P. infraspinis* (RATHBUN, 1902), and *P. iridescens* LEBOUR, 1949. It resembles *P. yucatanicus* in the truncated scaphocerite, the shape of the dactyli of the three pereopods and the general shape of the chelipeds. It may immediately be distinguished, however, by the shape of the rostrum which is shorter and has the ventral teeth much smaller, and by the fact that the anterior margin of the basal antennular segment ends in a single sharp tooth and bears no additional spines. In *P. iridescens* and *P. infraspinis* the rostrum has the upper margin more arched, the anterior margin of the basal segment of the antennular peduncle is less sharply pointed, while the scaphocerite is not widened anteriorly and is not truncated, but produced antero-internally. Another species to which the present new form shows some resemblance is *Periclimenes (P.) pedersoni* CHACE, 1958. CHACE's species differs from *P. anthophilus*, however, in having the chelipeds of the second pair more slender, with the carpus almost as long as the chela, while the fingers of the larger second leg are of the normal type. In *P. pedersoni* the hepatic spine is placed at a level with or behind the first dorsal rostral tooth, while in *P. anthophilus* it stands between the first and second rostral teeth.

Like *P. yucatanicus*, the present species is found associated with sea-anemones.

Ecology and behavior. — All the shrimps were collected from anemones living in the shore region of the Bermudas, mostly in depths from 2-3 meters. A pair was most often found on specimen of the two common species *Actinia bermudensis* McMURRICH, 1889, and *Condylactis gigantea* WEINLAND, 1860, and occasionally even several were found on one anemone. None were, however, found on *Bartholomea annulata* (LESUEUR, 1817).

When undisturbed, they fed with the first pair of pincers, while crawling over the surface of the anemone tentacles. When removed from their anemone and released in the water they fled to the ground and hid in crevices. Many were eaten by fishes as they swam to the substrate, those kept in an aquarium fed both on the substrate and on the anemone, to which they retreated in times of danger. In such a situation the animals oriented themselves parallel to one

tentacle. They maintained this position by grasping this tentacle with the third pair of walking legs. All other appendages were held parallel to the body axis (fig. 4). The antennae rested on the back, the pinchers and the first two pairs of walking legs stretched forwards and the last pair stretched backwards. Such a position in which all white markings run parallel to the tentacle results in the animal being inconspicuous. A highly interesting aspect of adaptation is that the only leg that is not held parallel to the body and is used for grasping the tentacle, is transparent.

By analogy insects that imitate sticks adopt similar postures. A peculiar sideways swaying movement of the shrimp is often observed, when in the above described posture, sometimes even, when sitting on the substrate alone. This may be a further analogy to a similar behavior of stick-imitating insects.

When the shrimp walks on the tentacle, the anemone reacts to its presence by slow contraction. This is especially the case when a shrimp is placed on an anemone which was not „inhabited“ for several days. The tentacles, then, attempt to slowly encircle the shrimp. The latter avoids this by moving away. When one tentacle touches the shrimp from above, the latter shake their antennae strongly and the tentacle moves away. Only once was such a shrimp evidently „burned“ since it had to free itself by force. Pistol shrimp (*Alpheus*) that were placed on such an anemone got caught immediately.

The shrimps profit evidently from the protection of the anemone, the latter, however, does not seem to have any advantage. We kept such anemones for months, without shrimps, and the former do well.

According to LIMBAUGH, PEDERSON & CHACE (1961) the closely related *Periclimenes pedersoni* CHACE from the Caribbean, which inhabits the anemone *Bartholomea annulata*, has the habit of cleaning fishes. It attracts the attention of fishes by waving its long antennae. It then climbs over them, picking off parasites. They enter the mouth cavity and crawl under the opercula. Such observations were not recorded in the Bermuda shrimp. Other species of the same genus, living on anemones, are: *Periclimenes brevicarpalis* (SCHENKEL, 1902) (= *P. hermitensis* RATHBUN, 1914), *P. inornatus* KEMP, 1922 both indo-pacific and *P. yucatanicus* from the caribbean. Nothing is known about the mechanism that protects the shrimp from the nematocyst discharge. DAVENPORT (1962) made experiments with *Hyas*, found often on *Tealia felina* (LINNAEUS, 1767), but could not detect the factor protecting the crab from the normal feeding behaviour of the anemone.

Literature.

- DAVENPORT, D. (1962): Physiological notes on Actinians and their associated commensals. — Bull. Inst. oceanogr. Monaco, 59 (1237): 1-15.
 LIMBAUGH, C., PEDERSON, H. & CHACE, F. A. (1961): Shrimps that clean fishes. — Bull. Marine Sci. Gulf and Caribbean, 11 (2): 237-257.