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To Dr. F. A. Chace, Jr.
With the compliments of
K. Hayashi

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A New Species of Shrimp, *Rhynchocinetes hiatti*
(Crustacea, Decapoda)*

With 2 Text-figures

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(Communicated by S. MIYAKE)

ABSTRACT The present paper describes a new species of the genus *Rhynchocinetes* from the Indo-West Pacific region. The species, *R. hiatti* n. sp., whose name has repeatedly appeared in print as a *nomen nudum*, is closely related to *R. rigens* Gordon from the Atlantic but distinguishable from the latter by the presence of a pterygestomian spine, the peculiar colour pattern and other small differences.

When studying material from Formosa and Okinawa-jima one of the authors (Hayashi) found a species of *Rhynchocinetes* which did not agree with the published descriptions of any of the known species of the genus. Consultation with Holthuis showed that the new species is identical with *Rhynchocinetes hiatti* a species of which the description had not been published, but, through unfortunate circumstances, its name had three times appeared in print as a *nomen nudum*.

Hayashi and Holthuis then decided to combine their data on the new species and give the name *R. hiatti* legal nomenclatural status. The present paper is the result of this decision. The holotype from Formosa and the material from Okinawa-jima have been examined by Hayashi, the other material by Holthuis. The description of the holotype and the illustrations are by Hayashi, the general description by Holthuis. However, both authors are responsible for the entire paper and the species should be known as *Rhynchocinetes hiatti* Holthuis and Hayashi.

The studies on the Formosan and Okinawan material were undertaken by Hayashi at the Zoological Laboratory, Kyushu University, under the guidance of Dr. Sadayoshi Miyake, for whose valuable suggestions and encouragement he wishes to express here his sincere

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gratefulness. This material was kindly donated to the collection of the Zoological Laboratory by Mr. Genjiro Nishi and his colleagues of the Marine Ecological Research Society of Kagoshima University, and Mr. Hisakatsu Minei of the Kyushu University, to whom we extend our best thanks.

Holthuis' studies were made during a year's stay (1952-1953) at the U. S. National Museum, Washington, D. C., when with a grant from the Office of Naval Research, Department of the U. S. Navy, he studied Decapod material collected in the Pacific under the auspices of the Pacific Science Board of the National Research Council, Washington, D. C. He wishes to express his deep gratitude to Drs. Fenner A. Chace, Jr. and Frederick M. Bayer, then both of the Division of Marine Invertebrates, U. S. National Museum for entrusting him with this material and for advice and help. Furthermore we are grateful to Dr. Isabella Gordon of the British Museum (Nat. Hist.), London, for reading the original manuscript.

The holotype from Formosa and the paratype material from Okinawa are preserved in the Zoological Laboratory, Kyushu University (ZLKU), with the exception of one of those paratypes which is in the collection of the Rijksmuseum van Natuurlijke Historie, Leiden (RMNH). The other material is in the collection of the U. S. National Museum, Washington, D. C., with the exception of duplicates which have been donated to the Leiden Museum.

Rhynchocinetes hiatti new species

(Figs. 1, 2)

Rhynchocinetes rigens, Hiatt, 1948, 78 (not *Rhynchocinetes rigens* Gordon, 1936).

Rhynchocinetes hiatti Holthuis, 1953, 54 (*nomen nudum*).

Rhynchocinetes hiatti Morrison, 1954, 18 (*nomen nudum*).

Rhynchocinetes hiatti Wiens, 1962, 255 (*nomen nudum*).

Material examined: Formosa: Kosho Bay, southern extremity of Formosa, 3 or 4 m deep, 20 August 1965, G. Nishi, *holotype* ♂ (ZIKU Cat No. 3269).

Ryukyu Islands: Yona, north west coast of Okinawa-jima, tidal zone, 8 April 1961, H. Minei, 1 ♂ (R. M. N. H. reg. no. Crust. D 23022), 1 ♂, 1 ovigerous ♀ (ZLKU Cat. No. 3286, 3288).

Caroline Islands: Outer reef off middle of Ella Island, Ifalik Atoll, collected by natives, 24 September 1953, R. R. Harry & F. M. Bayer, Sta. 397. -1 specimen.

Kapingamarangi Atoll: Tewawaelal, 1° 4' 27'' N 154° 42' 10'' E, outer reef flat, surge channels and surf zone, 14 July 1954, George Vanderbilt Foundation Expedition Sta. 41. -2 specimens.

Marshall Islands: Eniwetok, 1957, Eniwetok Marine Biological Laboratory.- 1 ♂; lagoon 1 to 0.5 miles off Eniwetok Island, Eniwetok Atoll, surface light at night, 20 May 1946, L. P. Schultz S-4-158, 159. -35 specimens (including 4 ovigerous ♀ ♀); Airy Island, Bikini Atoll, ocean reef, in surf, 16 April 1946, L. P. Schultz S-46-96. -2 juveniles; Namu Island, Bikini Atoll, lagoon reef, 6 August 1947, L. P. Schultz S-46-508. -3 juveniles; N. E. of Enybarbar Island, Rongelap Atoll, ocean reef and high tide channels, 18 June 1946, L. P. Schultz S-46-216. -1 specimen.

Gilbert Islands: Onotoa Atoll, August 1951, A. H. Banner. -3 specimens (1 ovigerous ♀).

Tuamotu Archipelago: N. end of Oneroa Island, Raroia Atoll, from surge channels in outer reef at and beyond Lithothamnion ridge, 6 August 1952,

J. P. E. Morrison no. 2064. -14 specimens; Raroia Atoll, 16° 1' S 142° 26' W, outer reef, surge channels at Lithothamnion ridge, immediately S. of excurrent channel, 17 August 1952, R. R. Rofen, George Vanderbilt Foundation Expedition Sta. 59.-1 specimen.

Description of holotype: The specimen of a male is 45 mm long from the posterior margin of the orbital notch to the distal margin of the telson, being a robust form with inconspicuous vertical striae and the colour pattern as shown in Fig. 1. The carapace is provided with an acute antennal spine continued to the

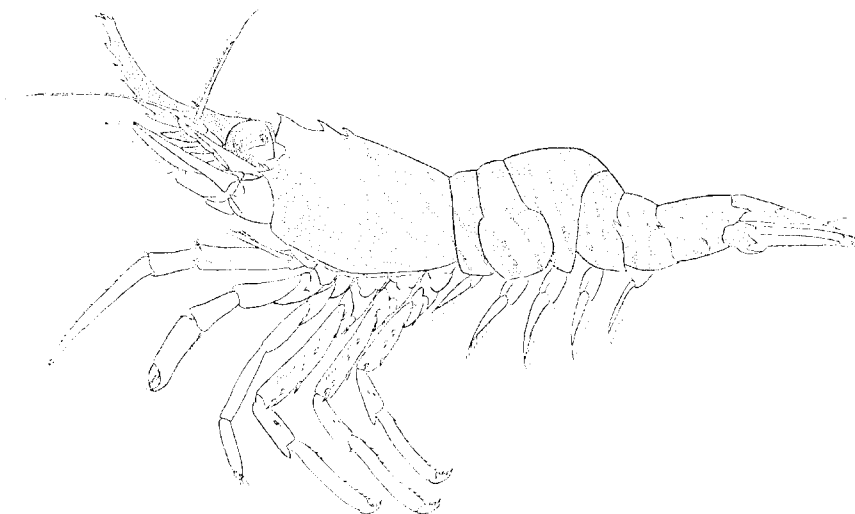


Fig. 1. *Rhynchocinetes hiatti* new species, holotype, showing colour pattern in formalin. $\times 1.6$.

lower limit of the orbit. There is no supraorbital spine, and the pterygostomian angle is curved inward and provided with a minute tooth. There are three teeth on the carapace behind the incomplete articulation of the rostrum, the second of which is nearer to the first one than to the third (Fig. 2, a). The rostrum is slender, strongly curved upward, and is much longer than the carapace; a lateral ridge extends from the proximal part of the rostrum forward to the middle of it; the lower border of the rostrum is provided with 9 teeth gradually decreasing in size toward the distal tooth; on the upper border there are two large teeth, of which the posterior one is broken, on the proximal third, and two small ones are near the apex, which consequently give a trifold appearance.

The length of the abdominal somites including the telson is slightly shorter than the length of the carapace including the rostrum. The large pleuron is separated from the second somite by a fine suture, and also a inconspicuous oblique suture is placed on the pleura of both of the first and third somites. The third somite is prominent, measuring 4.3 times as large as the first one. Both of the fourth and fifth somites bear a large tooth immediately above the posterior margin of the pleura, and the posteroinferior angles of them end in a

sharp point (Fig. 2, b). The sixth somite is about 3 times the length of the first somite. The telson excluding the terminal spines is measured a little shorter than the uropod, and armed with three dorsal teeth on the distal half; the apex terminates in a median point with three spines on either side of it.

The eye is large and nearly globular, the width of the cornea is much greater than that of the stalk, and the greatest diameter is measured $1/3$ times the dorsal length of the carapace.

The antennular peduncle reaches a little beyond the second dorsal tooth on the rostrum, and the stylocerite is apically pointed and extends as far as the distal articulation of the ultimate segment. On the anterior margin of the basal segment near the outer angle there is a triangular tooth ending in a minute spine which does not reach the distal end of the penultimate segment, and the base of the tooth is notched by a small process at the outer side (Fig. 2, c). The outer thicker flagellum reaches to the apex of the rostrum and has setae growing on the proximal two-thirds portion and the distal third becomes fine and thread like.

The scaphocerite is measured 2.5 times as long as wide and exceeds the antennular peduncle. The outer margin of the scaphocerite is almost straight and ends in a strong spine which extends slightly beyond the truncated lamellar tip (Fig. 2, d).

The third maxilliped extends beyond the rostral apex and is provided with both of the epipod and exopod; the ultimate segment armed with five worn spines near the apex is about 2.5 times the length of the penultimate segment.

The first leg reaches the distal end of the antennular peduncle; the chela is 1.5 times the length of the carpus; the palm is nearly 2.5 times as long as wide and bears densely short hairs on the ventral margin of the proximal third. The immovable finger terminates in three long chisel-like claws, and also the movable finger (=dactylus) terminates in 10 similar ones (Fig. 2, e). The second leg is slender and cylindrical, and elongates a little beyond the end of the antennular peduncle; the merus is carinate and subequal to the chela in length, jointing with the ischium to form a very oblique articulation; the carpus is measured approximately $1/3$ longer than the chela and 7 times as long as wide; the immovable finger has three terminal corneous claws, and the movable finger (=dactylus) has about 14 ones. The third leg reaches nearly to the end of the scaphocerite; the merus is 6 times as long as wide and has four spines on the lateral margin and one on the ventral, and moreover, a series of the plumose hairs set near the dorsal median line; both of the ischium and carpus have one spine on the lateral margin, but the former has an additional non-erected spine on the ventral; the propodus is 4 times as long as the dactylus and has about 15 spinules on the ventral margin; the dactylus bears two conspicuous spines on the left side instead of having three on the right side, excluding the terminal claw. The fourth leg is rather slenderer than the third one, having equal to those of the third in number of spines and the pattern of hairs. The fifth leg has close resemblance to the features of the former legs, but it differs from these legs in having the slenderer and shorter form without the plumose hairs and having three spines on the lateral margin of the merus.

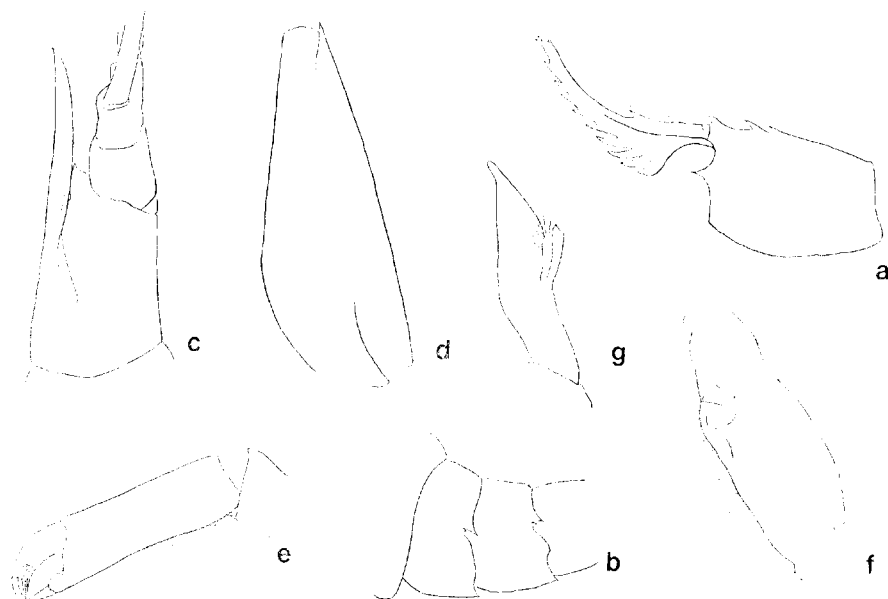


Fig. 2. *Rhynchocinetes hiatti* new species, holotype. a, lateral view of carapace, showing incomplete articulation and rostral ridge; b, teeth on fourth and fifth abdominal somites in lateral view; c, antennular peduncle in dorsal view; d, scaphocerite in dorsal view; e, chela of first pereopod; f, endopod of left first pleopod with appendix interna in posterior view; g, endopod of left second pleopod with appendix interna and appendix masculina in anterior view. (Setae omitted).

The endopod of the first pleopod bears a large appendix interna on the middle of the inner margin (Fig. 2, f). On the endopod of the second pleopod there are both of the appendix interna and appendix masculina (Fig. 2, g). The arthrobranchs corresponding to the fourth and fifth legs and an epipod on the fifth leg are absent.

The specimen collected in a hole or a crevice of the coral reef, together with some spiny lobsters at a depth of three or four meters.

General description: This species is extremely closely related to *Rhynchocinetes rigens* Gordon (1936) from the Atlantic, but shows some differences which, though they are small, seem to be constant.

The shape of the rostrum shows no appreciable differences from that of *R. rigens*. It is longer and slenderer in the males than in the females. In the former it reaches beyond the scaphocerite with almost half of its length, while in the females only about 1/3 of the rostrum projects beyond the scaphocerite. There are always three teeth behind the incomplete articulation between the rostrum and the carapace. Of these three teeth the first two are placed closer together. The upper margin of the rostrum bears two teeth in the proximal part; the distal part is unarmed save for two (seldom three) subapical teeth. The lower margin bears 8 to 11 teeth which decrease in size distally. Usually there are fewer ventral teeth in the female than in the male. The carapace shows distinct transverse striae all over. The antennal spine is well developed and

stands on the lower angle of the orbit. A minute pterygostomial spine is present; this spine is sometimes concealed from view by some hairs which are placed on the anterior margin of the carapace in the pterygostomial region. In all specimens of *R. rigens* examined, no trace of such a pterygostomial spine could be found.

The abdominal somites, like the carapace, show distinct fine striae. In the first two somites these striae are oblique, in the third almost longitudinal and in the last three somites they are placed transversely. The pleura of the first somite are rather narrow and rounded. Those of the second somite are much broader and in the female broadly rounded, in the male the distal margin is slightly concave. The margin of the third pleuron is evenly rounded in the female; in the male the posterolateral angle is rectangularly rounded. The pleuron of the fourth somite is rounded with a minute sharp tooth at the top; that of the fifth somite is acutely pointed. Like in *R. rigens* the fourth and fifth abdominal somites bear a strong, posteriorly directed spine on the posterior margin just above the base of the pleura. The sixth somite is more than 1.5 times as long as the fifth. The pleuron and the posterolateral angle end in regularly tapering sharp points. The telson is somewhat longer than the sixth abdominal somite; in the females it is relatively shorter than in the males. It bears three pairs of dorsal spines. The anterior pair stands about in the middle of the length of the telson. The distance between the first and second pairs is slightly larger than that between the second and third. The third pair lies about midway between the second pair and the posterior margin of the telson. This posterior margin ends in a triangular median point and bears three pairs of spines, the outer of which are very short, the intermediate longest and the inner about $3/4$ of the length of the intermediate.

The eyes are very large. The cornea is very broad and rounded, an ocellus is present.

The stylocerite is very long and reaches beyond the end of the antennular peduncle, thus being distinctly longer than in *R. rigens*, where it does not attain the end of this peduncle. It is sharply pointed and bears an obliquely anteriorly directed dorsal tooth in the basal part. The peduncle strongly resembles that of *R. rigens*. The first segment has the anterolateral angle produced into a spine which reaches slightly beyond the middle of the second segment. The outer margin of the basal segment shows a notch in the distal part. A spine is present on the lower inner margin of the segment. The two flagella are simple. The outer flagellum has the basal segments (about 30 to 40 in number) thickened and provided with ventrally placed hairs. This thickened part is conspicuously shorter in our *R. hiatti* specimens than in material of *R. rigens*. In *R. hiatti* it always falls short of the end of the rostrum (though in adult females it almost reaches the tip), in examined *R. rigens* specimens from Bermuda it far overreaches the rostrum, even in the males. However, in Gordon's figure of the holotype of the latter species, the thickened part of the flagellum is shown as being distinctly shorter than the rostrum.

The scaphocerite is slightly more than 3 times as long as broad. The final tooth is sharp and slender and distinctly overreaches the lamella. The latter narrows anteriorly and ends in a truncate top. The antennal peduncle bears

two sharp teeth near the base of the scaphocerite, one laterally and one dorsally. In *R. rigens* the lateral tooth is present and is sharp, but the dorsal tooth is replaced by a rounded lobe. The antennal peduncle reaches about the middle of the scaphocerite.

In the shape of the mandible no appreciable differences were found with that of *R. rigens* as figured by Gordon. Kubo (1942, Fig. 2) gave figures of the mouthparts of *Rhynchocinetes uritai* Kubo, which agree well with those of *R. hiatti*, the only important difference we can find is that the palp of the first maxilliped in *R. hiatti* is three-segmented and not two-segmented as figured by Kubo for *R. uritai*; the distal segment, however, is very small. In the two sexes the third maxilliped is of a strikingly different shape. In the males it is very long and reaches with about half the length of the last segment (sometimes less, sometimes more than half this length) beyond the scaphocerite. In the females the third maxilliped reaches about the end of the scaphocerite. The last segment of the third maxilliped bears at the top some 4 to 6 dark coloured spines. In the males this segment is very elongate, being about 3.5 times as long as the next segment. In the female the last segment is only about twice as long as the penultimate. The antepenultimate segment bears a strong anterolateral tooth. The distal margin of this segment furthermore bears a tooth in its anterior (—dorsal) part. The posterior (—ventral) surface of this antepenultimate segment has a movable spine in the anterolateral part. The exopod fails to reach the end of the antepenultimate segment. This segment is about 1.5 times as long as the penultimate, in the males generally somewhat more, in the females somewhat less than 1.5 times.

The branchial formula runs as follows:

	Maxillipeds			Pereiopods				
	1	2	3	1	2	3	4	5
Pleurobranchs	—	—	1	1	1	1	1	1
Arthrobranchs	—	—	1	1	1	1	—	—
Podobranchs	—	1	—	—	—	—	—	—
Epipeds	1	1	1	1	1	1	1	—
Exopeds	1	1	1	—	—	—	—	—

The first leg in the male reaches not fully the end of the scaphocerite. In the female it slightly surpasses the end of the antennal peduncle. In the male the first legs are larger and heavier than in the female, while the fingers are more strongly curved and gaping. The dactylus bears 10, the fixed finger three black claws at the top. These claws are more or less movable. The fingers are about half as long as the palm. The carpus is of about the same length as the palm and also is about as long as the merus. It bears no scale on the coxa, only a low tooth is seen there, both in the male and female. The second legs in the male fail to reach as far as the end of the first legs, in the female they overreach the first legs. The dactylus at the top bears 16, the fixed finger three black claws similar to those of the first legs. The palm is about 3 times as long as the fingers, it is elongate and rather narrow. The chela measures about 4/5 of the length of the carpus and is somewhat longer than the merus. The ischium

is slightly shorter than the merus. The third leg reaches with the dactylus and part of the propodus beyond the scaphocerite or just attains the end of that scale. The dactylus is short and ends in a strong black claw; the posterior margin bears two dark additional claws. The propodus is about 4 times as long as the dactylus. It bears a row of spinules on the posterior margin. The carpus is more than half as long as the propodus and bears one or two large movable spines on the outer surface. The merus is twice to more than 2.5 times as long as the carpus. It constantly bears a single spine slightly distally of the middle of the posterior margin. On the outer surface of the merus there are generally 4 or 5 (rarely 3) spines: two (rarely three) in the distal part and two (rarely one or three) in the proximal half. The ischium is short and bears one posterior and one outer spine. There is no spine on the coxa. The fourth and fifth legs are similar to the third leg, but are shorter. The fifth is shorter than the fourth and reaches about to the base of the scaphocerite. From the third to the fifth leg the merus becomes relatively shorter, this is true also for the propodus, but to a lesser degree. The spines on the carpus and the merus in the fourth and fifth legs are much like in the third leg; only in the fifth leg the carpus bears practically constantly only one spine. Furthermore the merus of the fifth leg generally is provided with only one spine in the distal part of the outer surface. In the female the last three legs are somewhat more robust than in the male.

The first pleopod of the male has the endopod broadly leaf-shaped, the appendix interna is rather broad and ends in a rounded tip which bears some small curved hooks. The inner margin of the appendix shows a small tooth which has the tip curved. No appendix is present on the endopod of the first pleopod of the female. The second pleopod of the male has the appendix masculina distinctly shorter than the appendix interna. Appendices internae are present in the second to fifth pleopods of both sexes; they are rather short except in the second pleopod of the male. The protopod of the uropod dorsally ends in a strong and sharp tooth. The exo- and endopods are ovate and of the same length. The outer margin of the exopod ends in a minute tooth which at its inner side bears a strong movable spine. The diaeresis of the exopod is distinct and curved strongly forwards in the median part.

The eggs are numerous and small, they are 0.5 to 0.6 mm in diameter.

The colour pattern in freshly preserved specimens is as follows. The whole of the rostrum is of a reddish colour, with the exception of the tip which is strikingly white. The carapace is reddish in the larger part of its surface. In the posterior part, however, there are at each side two short oblique white bands flanked by dark red bands. Similar red-white-red bands are running transversely over the abdomen: one over the second segment, one over the anterior part of the third, one over the posterior part of the third and the anterior part of the fourth, and one over the fifth segment. A white spot surrounded by dark red is visible on the sixth segment, below this spot a second, much vaguer spot sometimes is visible. A dark red band in an oblique direction crosses the pleura of the first abdominal segment. This colour pattern differs strongly from that of *Rhynchocinetes rigens* Gordon.

The species is most closely related to *Rhynchocinetes rigens* from the Atlantic (Madeira, Bermuda, Bahamas, Florida). In fact, it was identified with that species

by Hiatt (1948, p. 78). The differences between *R. hiatti* and *R. rigens* are the following:

1. *R. hiatti* possesses a pterygostomian spine which lacks in *R. rigens*.
2. The stylocerite in *R. hiatti* surpasses the antennular peduncle, in *R. rigens* it fails to reach the end of that peduncle.
3. The antennal peduncle in *R. hiatti* shows two sharp teeth near the base of the scaphocerite. In *R. rigens* one sharp tooth and a rounded lobe are found there.
4. The last three legs are slenderer in *R. rigens*. The fifth leg reaches about to the end of the antennular peduncle, while it only slightly overreaches the base of the scaphocerite in *R. hiatti*.
5. The merus of the third and fourth leg in *R. rigens* bears two posterior spines, it shows only one spine there in *R. hiatti*.
6. The colour pattern is different in the two species.

Remarks: As pointed out by Gordon (1936) the genus *Rhynchocinetes* may be divided in two natural groups, one with two, the other with three teeth on the dorsal margin of the carapace behind the rostrum. This new species falls in the second category. Apart from *R. hiatti* and *R. rigens* this group also contains *R. hendersoni* Kemp; in all three species the articulation of the rostrum is incomplete. Of two species recently described as new, *R. marshallensis* Edmondson, 1952 and *R. intermedius* Edmondson, 1952, the types could be examined; comparison with an extensive material from the Pacific proved both to belong to *R. hendersoni* Kemp. *R. hendersoni* differs from *R. hiatti* in that (1) the anterolateral tooth of the basal segment of the antennular peduncle ends in a long and slender point, which overreaches the end of the second segment, while in the new species this tooth is short and broad and its narrow point does not attain the end of the second antennular segment, (2) the stylocerite reaches beyond the end of the antennular peduncle in *R. hiatti*, while in *R. hendersoni* it fails to attain the end of the third segment, (3) in *R. hiatti* the antennal peduncle bears two teeth near the base of the scaphocerite, in *R. hendersoni* there is only one, the lower, the upper has become a large rounded lobe, (4) the dactylus of the last three legs of *R. hiatti* bears only 2 teeth on the posterior margin behind the tip, in *R. hendersoni* there are 3 larger and one minute teeth there.

It is a pleasure to name this species for Dr. Robert W. Hiatt, who was the first to discover it.

Distribution: Hiatt's (1948) prediction that the species might be more widely distributed in the Indo-West Pacific region has been fully substantiated by the present material which originates from Formosa, the Ryukyu and Caroline Islands, Kapingamarangi Atoll, the Marshall and Gilbert Islands and the Tuamotu Archipelago. Hiatt's (1948) specimens came from just off the reef on the south shore of Oahu Island, Hawaiian Archipelago, and from off Diamond Head, Oahu. Holthuis (1953) mentioned the species from Onotoa and Raroia Atolls, Morrison (1954) and Wiens (1962) dealt with Raroia specimens already listed by Holthuis.

Habitat: Hiatt (1948) obtained his small specimens at night with the aid of light and a dipnet, his large specimens were taken in a fish trap at 6 fathoms. Morrison (1954) remarked that in Raroia the species was taken "from the surge-channels in the buttress zone just beyond the algal ridge" and was "not seen

in other habitats at Raroia." The George Vanderbilt Expeditions collected the species in this habitat both at Raroia and Kapingamarangi. Schultz during the 1946 Bikini Expedition collected *Rhynchocinetes hiatti* in "high tide channels" at Rongelap and "in surf of the ocean reef" at Bikini. At Eniwetok specimens were taken at night with light. The species inhabits shallow waters; some were taken in the tidal zone, others at the surface. The deepest records are for those of Oahu, Hawaii, where they were taken at 6 fathoms (Hiatt, 1948), while the Formosa specimens were collected between 3 and 4 m deep.

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