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THE ATLANTIC SHRIMPS OF THE DEEP-SEA GENUS
GLYPHOCRANGON A. MILNE EDWARDS, 1881¹

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ABSTRACT

An enumeration is given of the 12 known Atlantic species of the genus *Glyphocrangon* (Crustacea, Decapoda, Caridea), with a key for their identification. Two species are described as new, while of others additional details are provided. The geographic distribution of each species is discussed.

INTRODUCTION

During the cruises of the research vessels GERDA and JOHN ELLIOTT PILLSBURY of the University of Miami, important collections of deep-sea decapod Crustacea have been brought together. The GERDA collections originate largely from the Straits of Florida and adjacent waters, while R/V PILLSBURY explored West African waters (1964, 1965) and the Atlantic offshore waters of Yucatan (1968), Honduras (1967, 1968), Panama (1966), Colombia (1966, 1968), Venezuela (1968), the Guianas (1968), the West Indian islands from Trinidad to Puerto Rico (1969), and from Puerto Rico to Jamaica (1970), and also made a collecting trip to Bermuda (1964). The material of the deep-sea genus *Glyphocrangon* obtained during these cruises proved to be so extensive and so important that it could well serve as the basis for a revision of the Atlantic representatives of the genus. As a participant in seven of the PILLSBURY cruises and one of the GERDA, I was able to make colour notes and colour sketches of fresh material of a number of species, which helped me considerably towards a better understanding of their true taxonomic status. The material of these cruises is preserved in the collections of the museum of the Rosenstiel School of Marine and Atmospheric Sciences of the University of Miami (UMML), and the Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands (RMNH); some duplicates are in the U. S. National Museum, Washington, D. C., and the Allan Hancock Foundation, University of Southern California, Los Angeles, California.

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In the present paper an enumeration is given of all the species and subspecies known from the Atlantic, and a key for their identification is provided, as well as descriptions and figures where needed. As no uniformity existed in the indication of the various ridges, grooves, and other structures of the carapace, which are of great systematic importance, a terminology is now proposed in order to facilitate a reference to them.

I am greatly indebted to Drs. Gilbert L. Voss and Frederick M. Bayer for permitting me to take part in various PILLSBURY and GERDA cruises and for placing the facilities of the Rosenstiel School of Marine and Atmospheric Sciences at my disposal, thus enabling me to finish the present study. The University of Miami made it financially possible for me to partake in the expeditions and to stay for several periods at the School of Marine and Atmospheric Sciences.

Type-specimens and other Atlantic material of *Glyphocrangon* have been kindly placed at my disposal by the U. S. National Museum, Washington, D. C. (USNM); the Museum of Comparative Zoology of Harvard University, Cambridge, Massachusetts (MCZ); the British Museum (Natural History), London (BM); the Muséum National d'Histoire Naturelle, Paris (MP); the Universitetets Zoologiske Museum, Copenhagen (MC); and the Centre Océanologique de Bretagne at Plouzané, France (COB). This additional material greatly helped to arrive at conclusions concerning the status of several species and often also considerably extended our knowledge of the range of the species. I wish to tender my very best thanks to Drs. Fenner A. Chace, Jr., and Raymond B. Manning of the U. S. National Museum; Drs. William A. Newman and Herbert Levi of the Museum of Comparative Zoology; Drs. Isabella Gordon, Anthony L. Rice, and R. W. Ingle of the British Museum; Dr. J. Forest of the Paris Museum; Dr. Torben Wolff of the Copenhagen Museum; and M. M. l'Herroux of the Centre Océanologique for their most cordial help.

The greater part of the drawings illustrating this paper were made by Mrs. Constance Stolen McSweeney, staff artist of the Rosenstiel School of Marine and Atmospheric Sciences. Through the kindness of Dr. Raymond B. Manning, it is possible to reproduce here the original drawings of *Glyphocrangon* species first published by S. I. Smith in 1882 and 1886. These drawings, made by J. H. Emerton, are now preserved in the Division of Crustacea, U. S. National Museum, Washington, D. C. They are of such high quality that it was thought worthwhile to republish them here, the more so as their reproduction in Smith's paper (1886) leaves much to be desired.

The abbreviation cl. denotes the carapace length (inclusive of the rostrum). The above-mentioned institutions are usually indicated with the abbreviations given in parentheses after their names.

Glyphocrangon A. Milne Edwards, 1881

Thalascaris Bate, 1878: Ann. Mag. nat. Hist., (5) 2: 282. A genus originally described without included nominal species. Type-species, by present designation: *Glyphocrangon rimapes* Bate, 1888, Rep. Voy. Challenger, Zool., 24: 523. Gender: feminine.

Glyphocrangon A. Milne Edwards, 1881: Anns Sci. nat., Zool., (6) 11 (4): 3. Type-species, by original designation: *Glyphocrangon spinicauda* A. Milne Edwards, 1881, Anns Sci. nat. Zool., (6) 11 (4): 3. Gender: feminine.

Rhachocaris S. I. Smith, 1882, Bull. Mus. comp. Zool. Harv., 10: 41. Type-species, selected by Fowler (1912, Ann. Rep. New Jersey State Mus., 1911: 556): *Rhachocaris agassizii* S. I. Smith, 1882, Bull. Mus. comp. Zool. Harv., 10: 43. Gender: feminine.

Glyptocrangon Norman, 1886, Mus. Normanianum, (Ed. 1), 3: 8. Erroneous spelling for *Glyphocrangon* A. Milne Edwards, 1881.

Plastocrangon Alcock, 1901, Descr. Cat. Indian Deep Sea Crust. Macr. Anom.: 125, 133. Type-species, selected by Fowler (1912, Ann. Rep. New Jersey State Mus., 1911: 556): *Glyphocrangon caecescens* Wood-Mason & Alcock, 1891, Ann. Mag. nat. Hist., (6) 8: 357. Gender: feminine.

The genus *Glyphocrangon* is represented in the Atlantic by 12 known species. Material of all the Atlantic species was available for study.

Description.—The integument of the body is very firm. The rostrum is well developed, dorsoventrally depressed, and somewhat hollowed in the basal part. The lateral margin of the rostrum bears two or three teeth in the species dealt with here (this number is higher in some species from the Indo-West Pacific and East Pacific regions). A dorsomedian carina as a rule is present on the rostrum. The carapace shows a complicated array of grooves, ridges, spines, and tubercles. In order to facilitate a comparison of these features in the various species, the following names are now proposed for them (see also Figure 1).

GROOVES:

a. Cervical groove. A transverse groove in the median part of the posterior third of the carapace. It ends at about the antennal ridge (No. 3, see below); a side branch connects it with groove b.

b. Lateral groove. This groove runs from below the rostrum posteriorly and ventrally to the posterior part of the lateral margin of the carapace, where it usually stops short against the submarginal ridge (No. 6). It traverses practically the full length and breadth of the lateral surface of the carapace.

c. Anterior groove. This groove cuts across the base of the rostrum, curves backward laterally and stops against the anterior intermediate ridge (No. 2a).

d. Posteromarginal groove. This groove runs along the posterior margin of the carapace, from one posterolateral angle to the other.

e. Lateromarginal groove. This groove runs to the inside of the anterior half of the marginal ridge (No. 7). It starts at the base of the branchiostegal spine and follows the marginal ridge (No. 7) to the point where the marginal and submarginal (No. 6) ridges fuse.

RIDGES: Most ridges of the carapace are bisected by either the cervical or the lateral grooves. The two components of each bisected ridge are indicated here as anterior and posterior and are indicated with the letters a and b, respectively. Sometimes the homology of the two components is not very clear, and mistakes may have been made here.

1. Submedian carina (1a, anterior; 1b, posterior). This runs along either side of the dorsomedian line of the carapace, extending from the rostral base to the posterior margin of the carapace. It is divided in two by the cervical groove (a).

2. Intermediate carina (2a, anterior; 2b, posterior). This extends below and to the outside of the submedian carina (No. 1), and runs parallel to it. It reaches from just below the anterior groove (c) to the posteromarginal groove (d), and is divided into two parts by the cervical groove (a).

3. Antennal carina (3a, anterior; 3b, posterior). This carina extends from the antennal spine on the anterior margin of the carapace to the posteromarginal groove (d), being more or less parallel to the intermediate carina (No. 2). It is bisected by the lateral groove (b). Sometimes the anterior antennal carina (No. 3a) is reduced to a mere line of tubercles, or is entirely absent; only in *G. neglecta* is it present as a distinct ridge.

4. Lateral carinae (4a, anterior; 4b, posterior). This ridge lies below the antennal carina (No. 3) and is about parallel to it. It starts either at the branchiostegal spine (in *G. neglecta*), or above it and closer to the antennal spine, and continues backward as far as the posteromarginal groove (d). The anterior lateral carina (No. 4a) is always present and often shows one or two large, winglike, widened teeth. It is bisected by the lateral groove (b).

5. Sublateral carina (5a, anterior; 5b, posterior). This rather short carina lies below the lateral carina (No. 4) and is about parallel with it. It starts at some distance behind the anterior part of the lateromarginal groove (e) and somewhat below and behind the branchiostegal spine. As a rule, it does not reach the posteromarginal groove. It is bisected by the lateral groove (b). The posterior sublateral carina (No. 5b) is rather irregular in shape. The anterior sublateral carina is low, but is always present.

6. Submarginal carina. This ridge starts in the anterior part of the

carapace in front of the lateral groove (b) and extends backward to slightly beyond the posterolateral angle of the carapace. Sometimes it is partly coalesced with the marginal carina (No. 7), and sometimes it is broken up.

7. Marginal carina. A narrow and sharp ridge just above the lateral margin of the carapace. It extends from the branchiostegal spine along the lateral and posterior margins of the carapace.

SPINES, TEETH, AND OTHER FEATURES: The following spines and teeth can be recognized:

α . Lateral rostral teeth (α_1 , anterior; α_2 , posterior). The teeth on the lateral margin of the rostrum. As a rule, they are placed in the basal half and are two in number on either side; only in one Atlantic species, *G. rimapes*, are there three pairs.

β . Antennal spine. A spine placed on the anterior margin of the carapace at the lower orbital angle.

γ . Branchiostegal spine. A spine placed on the anterior margin of the carapace at some distance below the antennal spine.

Spines and tubercles may also be found on the various ridges. The posterolateral angle of the carapace (p.a.) is a spot in the posterior part of the marginal carina where this carina is bluntly triangularly produced. The lateral margin of the carapace in its posterior part lies very close to the marginal carina (No. 7), being separated by a short distance from it in the anterior part. The margin closely hugs the bases of the pereopods; both before the third maxilliped and before the first pereopod a process extends from the lateral margin inward and fits behind a process directed up from the anterior part of the base of either appendage. This peculiar formation was already observed and discussed by Smith (1882).

The abdominal somites are provided with numerous longitudinal ridges and spines or tubercles. A median carina is found on all or part of the somites. This carina on the first somite ends in a strong anteriorly directed spine, and in somites 2 to 6 it is bisected transversally. In somites 2 and 3, the tubercles forming the carina usually are so low and inconspicuous that the carina is hardly, if at all, noticeable there, and only becomes distinct in the middle of the fourth somite. The first somite also shows in each half a strong, anteriorly directed tooth, which forms a continuation of the intermediate carina of the carapace. The pleura of the second to sixth somites end in one or more strong teeth. The telson is elongate triangular and gradually tapers to a long and slender sharp point. The articulations between the abdominal somites 1 and 2, 2 and 3, and 3 and 4 are of the normal type. Those between somites 4 and 5, 5 and 6, and 6 and the telson are aberrant, insofar as each of the two articulating points between two consecutive somites possesses a locking mechanism. The posterior margin of the somite in front of each articulating point forms a

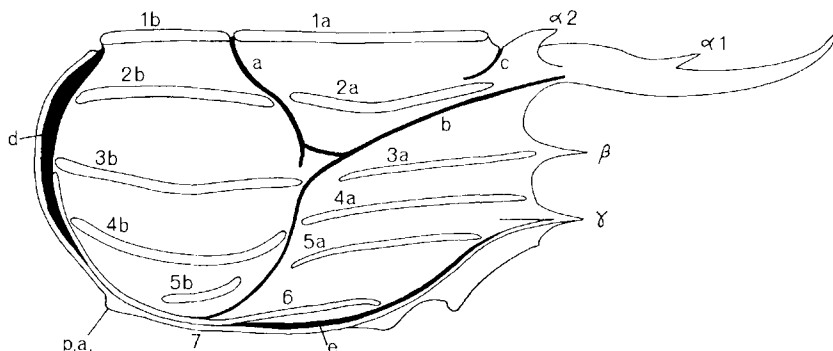


FIGURE 1. Schematic drawing, in lateral view, of the carapace of *Glyphocrangon*, showing ridges, grooves, teeth, and spines, with the nomenclature used here for these. 1a, 1b, anterior and posterior submedian carinae; 2a, 2b, anterior and posterior intermediate carinae; 3a, 3b, anterior and posterior antennal carinae; 4a, 4b, anterior and posterior lateral carinae; 5a, 5b, anterior and posterior sub-lateral carinae; 6, submarginal carina; 7, marginal carina; a, cervical groove; b, lateral groove; c, anterior groove; d, posteromarginal groove; e, lateromarginal groove; p.a., posterolateral angle; α 1, α 2, lateral rostral teeth; β , antennal spine; γ , branchiostegal spine.

process just below the articulation, which process curves up and around the center of the articulating point. This process moves in a semicircular groove, the anterior margin of which is formed by the tubercle of the articulating point, and the posterior margin of which is a sharp ridge on the somite behind the articulation. This latter ridge lies immediately against the posterior margin of the process. The exact nature of the locking mechanism is unknown to me, but it makes it possible for the last three abdominal somites and the telson to form a fixed, rigid unit. The three pairs of locking devices work independently from one another. The locking is such that the posterior somite of two consecutive somites forming the mechanism can move upward relative to the anterior member of the pair, but not downward; when the posterior member of the pair reaches its highest upward-directed position, the locking is complete. When all three pairs of locking devices are completely locked, the posterior end of the abdomen is strongly curved upward. A. Milne Edwards (1881), in the original description of the genus, remarked that the sixth abdominal somite and the telson are fused. He was probably led to this conclusion because, in his material, the locking device between the sixth somite and the telson made any movement between these somites impossible. As Smith (1882) perfectly correctly understood the condition, and also pointed to the locking mechanisms in the last abdominal somites, he thought that his material might possibly represent a genus different from A. Milne Edwards's *Glypho-*

crangon, and used the name *Rhachocaris* for it. After Milne Edwards, in 1883, published a figure of his *Glyphocrangon* species to supplement his rather meagre descriptions, Smith (1884) recognized the synonymy of *Glyphocrangon* and *Rhachocaris* and dropped the latter name.

The eyes are either large and well developed (subgenus *Glyphocrangon*) or reduced (subgenus *Plastocrangon*).

The antennulae have two flagella, the inner of which is slender; the outer has the larger proximal part thickened.

The scaphocerite is well developed and oval. A tooth may be visible on the outer margin.

The mandible possesses no incisor process and no palp. The molar process is slender, curved, and widened at the end, where it bears several blunt teeth. The maxillula has the palp well developed; the lower lacinia is slender and oval; the upper lacinia is distally widened and bears a row of spinules on the distal margin. The maxilla has the inner lacinia strongly reduced; the palp is well developed and ends in some spiniferous hairs; the scaphognathite is large. All maxillipeds are provided with exopods that end in articulate flagella. The upper endite of the first maxilliped is distinct, the lower is practically nonexistent; the palp is well developed; the exopod has a distinct caridean lobe; the epipod is large and bilobed. The last segment of the second maxilliped is narrow and applied to the penultimate segment with its longer side. The third maxilliped is a large appendage, the ultimate two segments of which form an oval blade that bears strong spines along its margin and on the inner surface.

The branchial formula runs as follows:

	Maxillipeds			Pereiopods				
	1	2	3	1	2	3	4	5
Pleurobranchs	—	—	—	1	1	1	1	1
Arthrobranchs	—	—	2	1	1	1	1	—
Podobbranchs	—	—	—	—	—	—	—	—
Epipods	1	1	—	—	—	—	—	—
Exopods	1	1	1	—	—	—	—	—

The subgenus *Plastocrangon* (see discussion, p. 294) should differ from *Glyphocrangon* s.s. in the absence of arthrobranchs at the first pereiopods. Whether or not this is a reliable character still has to be ascertained. In the Atlantic species *Glyphocrangon atlantica* Chace, which originally was placed in the subgenus *Plastocrangon*, the branchial formula in the specimens examined by me proved to be of the normal *Glyphocrangon* type. On the other hand, Kemp (1910: 170) reported in a juvenile specimen of *G. longirostris* the absence of arthrobranchs from the first two pereiopods, while in material of the same species examined by me these arthrobranchs

were present (see p. 341). The value of this character still needs an extensive study.

The first pereopod is strong and subchelate. The ischium bears a strong anteroventral tooth. The second leg is also subchelate; it is very slender and has the carpus subdivided in numerous articles. The left and right second legs usually are slightly unequal, the right is then longer and more slender with a higher number of articles in the carpus. The following three pairs of pereopods are simple and strongly resemble each other. The dactylus of the third leg is shorter and more conical than those of the fourth and fifth legs, which are more flattened. In females of *G. sculpta* and *G. rimapes*, the dactylus of the fifth leg is bifid. The propodus of the fourth and fifth legs bears a large terminal tuft of hairs surrounding the base of the dactylus; this tuft is absent in the third leg.

The first pleopod of the female has the endopod short and narrow, without any appendix; in the male it is short and broad, with a distinct *appendix interna*. The second to fifth pleopods of the female and the third to fifth of the male have the endopod well developed, with a slender *appendix interna*. The endopod of the second pleopod of the male bears, in addition to the *appendix interna*, an *appendix masculina*. The uropods are of the usual shape. The endopod is oval; the exopod bears a tooth on the external margin at the diaeresis, which is not very distinct, and which extends as far as the median carina of the exopod.

Distribution.—The genus *Glyphocrangon* is benthic and inhabits the deep sea of the Atlantic, Pacific, and Indian Ocean areas. The Atlantic species have been found at depths between roughly 135 and 3480 fathoms (= 250 and 6370 m). The depth range of the various species is more restricted; the data found so far are as follows:

	Total range (m)	Range of optimal occurrence (m)
<i>G. longleyi</i>	300– 837	300– 638
<i>G. haematonotus</i>	247– 966	329– 749
<i>G. neglecta</i>	365–1050	365– 730
<i>G. aurantiaca</i>	410– 733	410– 733
<i>G. spinicauda</i>	256– 692	458– 660
<i>G. alispina</i>	548–1865	548– 914
<i>G. aculeata</i>	707–1760	1100–1280
<i>G. nobilis</i>	410–2150	1280–1460
<i>G. longirostris</i>	1280–2500	1920–2290
<i>G. sculpta</i>	1645–3219	2200–2400
<i>G. rimapes</i>	2510	2510
<i>G. atlantica</i>	3885–6364	3885–6364

As to the horizontal distribution of the Atlantic species, eight (*G. spinicauda*, *G. aurantiaca*, *G. longleyi*, *G. haematonotus*, *G. neglecta*, *G. aculeata*, *G. nobilis*, and *G. alispina*) are known only from the western Atlantic, and three (*G. sculpta*, *G. atlantica*, and *G. longirostris*) have been found in both the western and eastern Atlantic, while the twelfth (*G. rimapes*) inhabits the Pacific (Japan and Juan Fernandez) and is known from a single specimen taken in the South Atlantic near Tristan da Cunha. No species is restricted to the eastern Atlantic. It is interesting to note that exactly the four species that inhabit the greatest depths (i.e., those that have not been found in depths of less than 1200 m) have the widest geographical distribution; these species occur either at both sides of the Atlantic Ocean or are found in both the Atlantic and the Pacific oceans. Two of the three amphi-Atlantic species have also the most extensive north-south distribution of all Atlantic species of *Glyphocrangon*: *G. sculpta* ranges from Iceland to the West Indies and South Africa, and *G. longirostris* from New England to the West Indies and from Ireland to South Africa. None of the other species goes this far north or south (only *G. rimapes* is found at about the same southernmost latitude). The third amphi-Atlantic species, *G. atlantica*, is known from only three specimens, so that little can be said about its actual range.

Of the eight species that seem to be confined to the western Atlantic, six (*G. spinicauda*, *G. longleyi*, *G. haematonotus*, *G. aculeata*, *G. nobilis*, and *G. alispina*) have a known range which extends from the southeast coast of the United States (North Carolina, South Carolina, or Florida) to the West Indies (the first three of these species), or to the north coast of South America (the last three). The two remaining species seem to have a more restricted area of distribution: *G. neglecta* has been found in the southern Caribbean and along the north coast of South America, while *G. aurantiaca* is known only from a small area covering Tobago and the north coast of the Guianas.

These general remarks have, of course, to be considered with much reserve, as a very great part of the deep and very deep waters of the Atlantic Ocean remain to be explored. Actually, the only area that has been consistently and intensively investigated for a period extending over many years is the Straits of Florida, which has been thoroughly covered by R/V GERDA. R/V PILLSBURY has systematically explored a great part of the West Indian region and continues this work. Also the BLAKE, ALBATROSS, and OREGON did valuable work in the West Indian region, but outside that area, large parts of the Atlantic Ocean are still terra incognita. Any definite conclusions can therefore not be drawn from the data at hand.

A comparison of the western Atlantic species of *Glyphocrangon* with the five species of the genus that are known from the East Pacific area (*Glyphocrangon alata* Faxon, 1893; *G. loricata* Faxon, 1895; *G. sicaria* Faxon,

1893; *G. spinulosa* Faxon, 1893; *G. vicaria* Faxon, 1896) shows no striking similarities. Except for *G. vicaria*, none of the East Pacific species can be considered as having a counterpart in the Atlantic Ocean. *Glyphocrangon vicaria* at first was identified by Faxon with *G. nobilis*, and later was elevated to the rank of a distinct species. According to Faxon (1896: 159, footnote), although it resembles *G. nobilis*, it is "even more closely related to *G. longirostris* Smith, which it represents on the Pacific side of the American continent."

Remarks.—A. Milne Edwards (1881) was incorrect in assigning the neuter gender to the generic name *Glyphocrangon*; the gender of the Greek word κρᾶγγον, krangon, is feminine. Therefore, instead of *G. aculeatum* and *G. nobile* one should write *G. aculeata* and *G. nobilis*.

Bate (1878: 282), in a preliminary paper dealing with material of *Willemoesia* collected by the CHALLENGER, remarked: "That the depauperized state of the organs of vision is not due to the loss of light from the great depth at which *Willemoesia* is taken is evident from the fact that *Thalascaris*, n.g. (Crangonidae), is taken at depths equally great, and is remarkable for the large size of its eyes." As far as I know, the generic name *Thalascaris* since that time has not been mentioned again, either by Bate (1888) in the CHALLENGER report, or by any other author. It is very likely that Bate intended to propose the name *Thalascaris* for *Glyphocrangon*, which in 1878 was still undescribed. The only species of Crangonidae mentioned in Bate's CHALLENGER report from the depth range from which he reported *Willemoesia* in 1878 (1375 and 1900 fm) are *Pontophilus gracilis* Bate (1100-2150 fm) and *P. profundus* Bate (2600 fm). Of *P. gracilis*, Bate (1888: 489) remarked: "The ophthalmopoda are not large, being well hidden within the orbital cavity," while in *P. profundus* "The ophthalmi are ovate and tolerably large and prominent" (Bate, 1888: 490). It is not likely that Bate based his *Thalascaris* on either of these species. Of *Glyphocrangon*, however, Bate (1888: 505) remarked in the generic description: "The ophthalmopoda are short and support large and globular ophthalmi." Furthermore, the specimens of *Glyphocrangon* obtained by the CHALLENGER were found at depths between 200 and 1875 fathoms. The final, and most important, indication that Bate's early use of *Thalascaris* refers to *Glyphocrangon* is found by comparing his above-quoted remark of 1878 with what he said in 1888 (p. 525) about *Glyphocrangon rimapes* Bate: "The type of this species was brought up by the trawl in the same locality in the South Atlantic (Station 133) at which *Willemoesia leptodactyla* was obtained, and it is worthy of remark that while in this last-named genus the organs of vision are reduced to a rudimentary condition, those of *Glyphocrangon* are unusually large." *Glyphocrangon rimapes* Bate, 1888, thus should be considered the type-species of the genus *Thalascaris* Bate, 1878.

The International Commission on Zoological Nomenclature has been asked to suppress the generic name *Thalascaris* Bate, 1878, for the following reasons:

1. The genus was proposed in a most haphazard way, and its identity can be made clear only by the use of circumstantial evidence.
2. The generic name *Thalascaris*, as far as I have been able to find out, has never been used or cited after its original publication. Even its own author ignored it, and it is not found in Neaves's *Nomenclator Zoologicus*.
3. Although the genus is rather rare and the literature concerning it is very limited, the name *Glyphocrangon* has been consistently used for it for the last 80 years.
4. The generic name *Glyphocrangon* has been placed on the Official List of Generic Names by the International Commission on Zoological Nomenclature in their Opinion 470 (1957, Opin. Decl. Int. Comm. Zool. Nomencl., 16 [9]: 136) as name No. 1120.
5. The generic name *Thalascaris* is so similar to *Thalassocaris* (also for a genus of Caridean shrimps) that it would be good not to have to use these names side by side.

Pending the decision by the Commission, the name *Glyphocrangon* is provisionally adopted here for the genus.

The 12 Atlantic species of *Glyphocrangon* can be distinguished according to the following key.

KEY TO THE ATLANTIC SPECIES OF *Glyphocrangon*

- | | | |
|---|---|--------------------------|
| 1. Anterior lateral carina of the carapace with two distinct teeth behind the branchiostegal spine | 2 | |
| 1. Anterior lateral carina of the carapace with one tooth or without teeth behind the branchiostegal spine | 8 | |
| 2. Pleuron of fifth abdominal somite ending in three distinct teeth | | <i>G. sculpta</i> p. 279 |
| 2. Pleuron of fifth abdominal somite ending in two distinct teeth | 3 | |
| 3. Rostrum with three lateral teeth on each side. Dactylus of the fifth pereopod, at least in the female, broad and bifid ... | | <i>G. rimapes</i> p. 287 |
| 3. Rostrum with two lateral teeth on each side. Dactylus of fifth pereopod oval, not bifid | 4 | |
| 4. Anterior antennal carina formed of a row of tubercles. First abdominal somite with two transverse rows of tubercles between the intermediate carinae | 5 | |

4. Anterior antennal carina absent. First abdominal somite usually with only a single transverse row of tubercles, viz., along the posterior margin 6
5. Eyes with the cornea white. Body naked or with a very inconspicuous pubescence. The margins of the rostrum and the basal part of the carinae on the telson are serrated or crenulated. Posterior antennal carina distinctly serrated, between it and the posterior lateral carina many tubercles. Basal part of outer margin of scaphocerite without a fringe of setae proximally of the outer tooth *G. atlantica*
5. Eyes with the cornea pigmented. Body with a short, but dense pubescence. The margins of the rostrum (apart from the 2 pairs of rostral teeth) not serrated, straight. Posterior antennal carina (apart from 2 blunt posterior teeth) straight, not serrated; between it and the posterior lateral carina the surface of the carapace is smooth. Outer margin of scaphocerite ciliated for its entire length *G. spinicauda*
p. 288
6. Posterior antennal carina usually rounded anteriorly, not ending in a spine. Antennal spine directed strongly outward, far more strongly diverging than the branchiostegal spine *G. aurantiaca*
6. Posterior antennal carina usually ending anteriorly in a spine or sharp angle. Antennal spine not more strongly diverging than the branchiostegal *G. spinicauda*
p. 295
7. Anterior intermediate carina not ending in a spine. Posterior antennal and posterior lateral carinae bearing several blunt tubercles or teeth. Anterior of the two teeth on the anterior lateral carina behind the pterygostomial spine reaching to or beyond the orbital margin *G. longleyi*
7. Anterior intermediate carina ending in a sharp spine. Posterior antennal and posterior lateral carinae straight, without tubercles or teeth. Anterior tooth of anterior lateral carina not reaching the level of the posterior margin of the orbit *G. haematonotus*
p. 309
8. Anterior antennal carina strong, forming with the antennal spine a single sharply pointed winglike expansion. Anterior lateral carina ending in the branchiostegal spine *G. neglecta*
8. Anterior antennal carina absent or at most indicated by a few small tubercles. Antennal spine isolated on anterior margin of carapace, not winglike expanded posteriorly. Lateral ridge ending between antennal and branchiostegal spines 9

- | | | | |
|-----|--|------------------------|--------|
| 9. | Posterior antennal carina ending anteriorly in a large winglike expanded spine. Tooth at anterior end of anterior lateral carina large and winglike, much wider than antennal spine | <i>G. aculeata</i> | p. 323 |
| 9. | Posterior antennal carina anteriorly blunt or ending in a small spinule, which is not at all winglike. Tooth at anterior end of anterior lateral carina, although distinct, much shorter and less wide than antennal spine | | 10 |
| 10. | Upper surface of rostrum corrugated at either side of the median carina | <i>G. longirostris</i> | p. 330 |
| 10. | Upper surface of rostrum at either side of the median carina smooth | | 11 |
| 11. | Antennal spine hardly more divergent than the branchiostegal. Posterior antennal carina ending anteriorly in a low right angle | <i>G. nobilis</i> | p. 341 |
| 11. | Antennal spine usually far more strongly diverging than the branchiostegal. Posterior antennal carina ending in a distinct spine | <i>G. alispina</i> | p. 347 |

The best account of *Glyphocrangon* is undoubtedly that by Sidney I. Smith (1882: 41-53), who gave an excellent description of the genus and three of its species, and provided very accurate illustrations. Smith proposed the new name *Rhachocaris* for the genus, although he realized that there was a possibility that it might be identical with *Glyphocrangon*. A. Milne Edwards, proposed a year earlier; A. Milne Edwards's preliminary description was insufficient to make this fully certain. Later the identity of the two genera was definitely established. In 1901, Alcock erected a new subgenus for species with reduced eyes collected in Indian waters; this subgenus *Plastocrangon*, which later was reported also from Atlantic waters, is of very doubtful standing (see p. 294).

Glyphocrangon sculpta (S. I. Smith, 1882)

Figs. 2, 3

Rhachocaris sculpta Smith, 1882, Bull. Mus. comp. Zool. Harv., 10: 49, pl. 5, fig. 3; pl. 6, fig. 3-3d.

Glyphocrangon sculptus Smith, 1884, Rep. U. S. Commnr Fish, 10: 365 (p.p.).—Verrill, 1885, Rep. U. S. Commnr Fish, 11: 555, pl. 35, fig. 154.—Smith, 1886, Rep. U. S. Commnr Fish, 13: 608, 655, pl. 8, fig. 3; pl. 9, figs. 1, 2.—Hansen, 1908, Dan. Ingolf-Exped., 3 (2): 55.—Stebbing, 1908, Ann. S. Afr. Mus., 6: 37; 1910, Ann. S. Afr. Mus., 6: 387.—Fowler, 1912, Ann. Rep. New Jersey State Mus., 1911: 557.—Stephensen, 1913, Meddr Grønland, 22: 21.—De Man, 1920, Siboga Exped. Mon., 39(a3): 215, 218.—Nierstrasz & Brender à Brandis, 1923, Siboga Exped. Mon., 32f: 86.—Heegaard, 1941, Meddr Grønland, 126(6): 34, fig. 13.—Barnard, 1950,

Ann. S. Afr. Mus., 38: 719, fig. 134a-d.—Marshall, 1954, Aspects Deep Sea Biol.: 329.—Kensley, 1968, Ann. S. Afr. Mus., 50(12): 318.

Glyptocrangon sculptus Norman, 1886, Mus. Normanianum, (Ed. 1) Pt. 3: 8; 1905, Mus. Normanianum, (Ed. 2) Pt. 3: 9.—Williamson, 1915, Nord. Plankt., 6: 392.

Material Examined.—WESTERN ATLANTIC: E of New Jersey, U. S. A.: ALBATROSS sta. 2035, 1 female (USNM), 1 ovigerous female (A. M. Norman coll., BM); sta. 2095, 2 males (USNM); sta. 2102, 1 male (USNM); sta. 2196, 1 female (USNM); sta. 2534, 1 female (USNM); sta. 2571, 1 male (USNM).—Off Delaware, U. S. A.: BLAKE sta. 339, 1 ovigerous female holotype (MCZ).—E of Virginia, U. S. A.: ALBATROSS sta. 2105, 1 male (USNM).—E of North Carolina, U. S. A.: ALBATROSS sta. 2725, 2 specimens (USNM).—Mouth of Exuma Sound, Bahama Islands: ALBATROSS sta. 2629, 1 ovigerous female (USNM).—St. Croix Basin, Virgin Islands: PILLSBURY sta. 1304, 4 specimens.—NE of Tobago: PILLSBURY sta. 844, 2 ovigerous females.

EASTERN ATLANTIC: Bay of Biscay off Santander, Spain: Centre Océanologique de Bretagne, Sta. CHO4-BO15-Put 109, 1 male (COB).—SE of Lagos, Nigeria, West Africa: PILLSBURY sta. 314, 2 specimens.

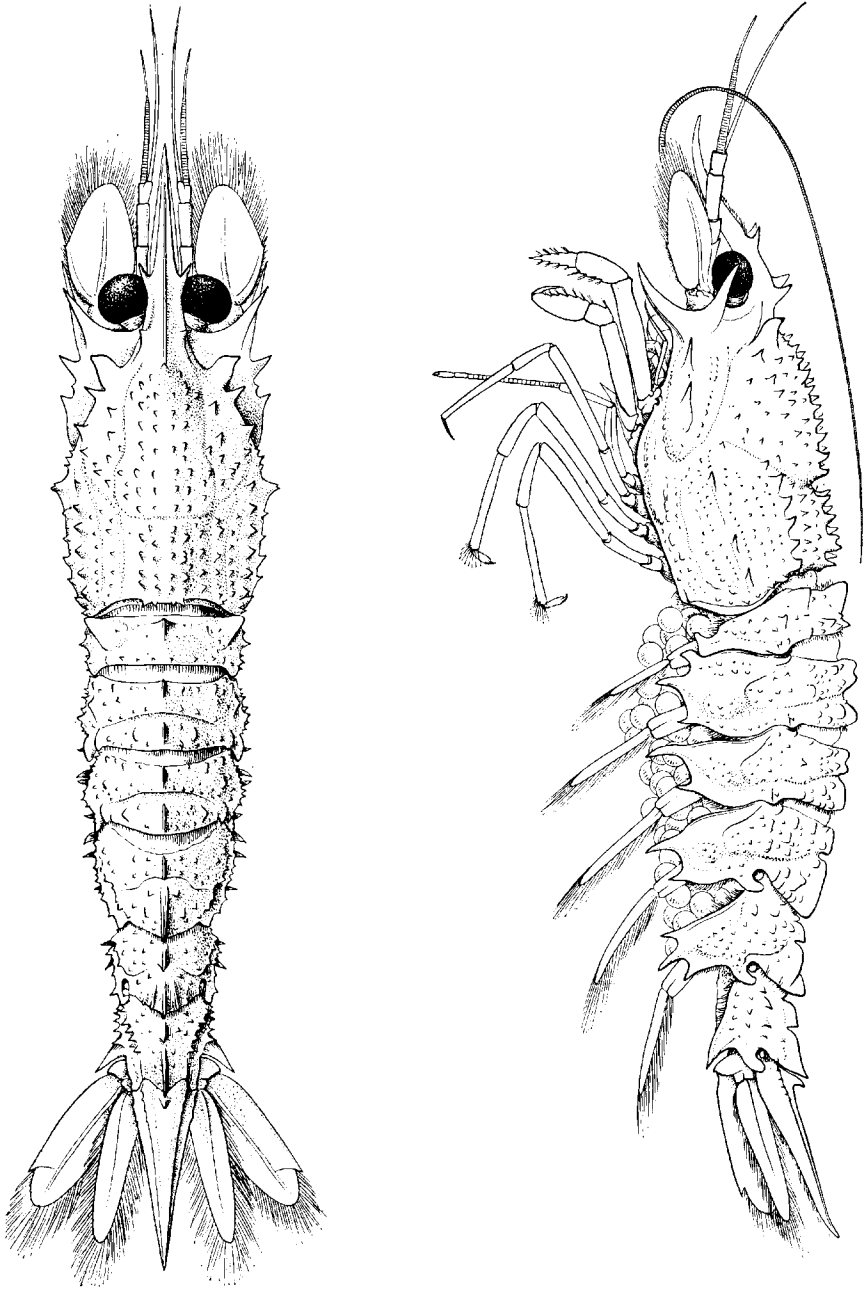
Description.—The carapace is glabrous and slightly pitted; there is no pubescence or a widely scattered one of short, inconspicuous hairs. The rostrum reaches with $\frac{1}{2}$ or $\frac{1}{4}$ of its length beyond the scaphocerite. The distance between the two pairs of lateral rostral teeth is somewhat shorter than, to almost half as long as, the distance between the anterior pair and the apex of the rostrum, which is again somewhat shorter than the distance dorsally between the anterior and the cervical grooves. The median rostral carina reaches to the base of the rostrum; sometimes it shows some tubercles or denticles in its basal part. The upper surface of the rostrum is concave, except for the distal fourth. A rounded carina connects the anterior and posterior lateral teeth.

The antennal spine is placed on the lower angle of the orbit; it is rather strong and directed somewhat upward and outward. The branchiostegal spine is stronger and is directed more downward. From the upper surface of the branchiostegal spine a carina extends to the anterior end of the anterior lateral carina; a shorter, similar carina is placed just below it.

The anterior submedian carinae of the carapace carry six to nine spiniform tubercles; between the two carinae there are scattered spinules; laterally of each carina there is an irregular row of about eight spinules. The carina ends anteriorly in a distinct spine. The posterior submedian carinae

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FIGURE 2. *Glyptocrangon sculpta* (Smith), holotype female from BLAKE sta. 339, in dorsal and lateral views, $\times 1.4$. (After Smith, 1882.)



bear four or five sharp toothlike spines; a few spinules are found both to the outside and to the inside of the carinae. A row of about seven toothlike spines and a few scattered spinules are placed between the posterior submedian and the posterior intermediate carinae. The anterior intermediate carina has five spines, the anterior of which is largest; it is larger than the posterior rostrolateral teeth and is immediately followed by a much smaller spine; the distance between the first and second spines is much smaller than that between the second and third. To the inner side of the anterior intermediate carina there is a row of about five smaller teeth; a few spinules are placed to the outside of it. The posterior intermediate carina bears six or seven large toothlike spines; some spinules are placed to the outside of the carina. The posterior antennal carina is smooth, but irregular, and often has indications of several teeth, e.g., one in the middle and one in the basal part; the carina ends in a usually distinct, but blunt, triangular tooth. Between the anterior end of this ridge and that of the anterior intermediate there is a row of three or four spines placed along the posterior margin of the lateral groove; behind these three or four spines there are many spiniform tubercles more or less clearly arranged in longitudinal rows. The anterior antennal carina is indicated by a row of five to seven sharp spines, below and above which there may be small tubercles. The posterior lateral carina is rather irregularly toothed; the teeth are low and not very conspicuous. Between the posterior antennal and posterior lateral carinae there is a longitudinal row of about six to nine spinules, often with several tubercles above and below it; more to the rear, along the posteromarginal groove, there are two oblique rows of, respectively, one or two and three or four spinules. The anterior lateral carina bears two large, triangular, outwardly directed pointed teeth, in addition to which there is a third, much smaller, often inconspicuous, tooth either behind the first or the second of the larger teeth. The anterior and posterior sublateral carinae are distinct and without teeth. Between the posterior ends of the anterior lateral and sublateral carinae, there may be a very short additional carina just before the lateral groove. Behind the lateral groove, at about the same level there is an indication of a blunt tubercle followed by some others. The anterior submarginal carina is distinct and is sometimes connected with the posterior, which is short and not fused with the marginal carina. The lateromarginal groove merges uninterruptedly with the posteromarginal. The marginal carina is somewhat widened at the posterolateral angle. A sharp, or blunt, rather large tooth is placed at the posterolateral angle to the inner side of the marginal groove, this perhaps is to be considered a remnant of the posterior part of the submarginal carina. Sometimes one or two spines are placed before it.

The abdomen has the tubercles rather spiny. The three large dorsal teeth on the first somite are triangular and sharp. The tubercles are conical

and pointed, and very numerous. The median carinae on the second to sixth somites are widely interrupted in the middle (somites 2 and 3), or before the middle (somites 4 to 6). In the fifth somite, the two components of the median carina are rather short and sharply pointed; the submedian carinae are long and reach almost to the end of the somite, sloping down in the posterior third. The two components of the median carina of the sixth somite both end in an acute tooth. The pleuron of the first somite ends in an obliquely anteriorly directed blunt tooth; the anterior margin is somewhat concave, the posterior strongly convex. The pleuron of the second somite ends in three teeth of which the middle one is the longest. The pleura of the third and fourth somites end in two teeth, the anterior of which is longer than the posterior. The pleuron of the fifth abdominal somite ends in three sharp teeth, the middle one being longest. The lateral surface of the sixth somite has a longitudinal row of four or five sharply pointed teeth over the middle, with three to five smaller spines above it and about three below it. A longitudinal row of about six to eight small and rather closely placed spinules extends over the base of the pleuron. The basal tooth of the telson is large and triangular. The proximal part of the dorsal submedian carina is serrate.

The eyes are large, the cornea is globular; a small tubercle is placed in the distal part of the inner margin of the peduncle.

The scaphocerite is about $\frac{2}{3}$ as wide as long. The antennal peduncle reaches to the end of the scaphocerite. Even in the adult specimen, an indication of a tooth is present slightly below the middle of the outer margin.

The third maxilliped reaches to the end of the scaphocerite. The distal two segments are of the same length and bordered by slender spines, which also are found on the inner surface. The first pereopod reaches with the end of the propodus about to the end of the first segment of the antennular peduncle. The second legs are slightly unequal. The right is the longer and the more slender; it fails to reach the end of the scaphocerite, or just reaches beyond it. The carpus contains 20 to 23 segments. The left leg is shorter and wider. Its carpus is divided into 17 segments. The third leg reaches with the dactylus or a small part of the propodus beyond the scaphocerite. The dactylus measures about $\frac{1}{3}$ of the length of the propodus. It is oval and pointed, with a longitudinal groove in the distal part of the dorsal surface. There is no brush of hair at the end of the propodus. The carpus is half, or less than half, as long as the propodus. The merus measures slightly less than the combined length of carpus and propodus. The fourth leg reaches with almost the entire dactylus beyond the scaphocerite. The dactylus measures $\frac{2}{3}$ of the length of the propodus; it is oval in shape, but in the female it ends in two points, the outer of which is smaller than the inner; the upper surface shows a short distal groove between the two

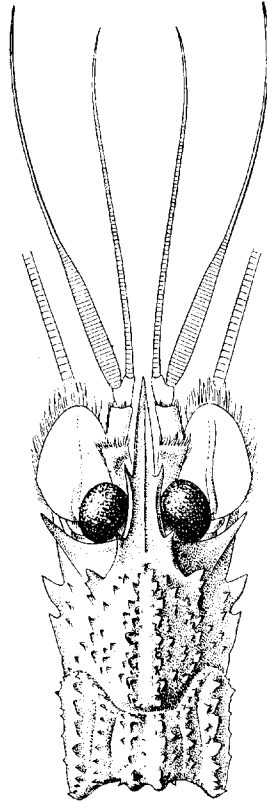


FIGURE 3. *Glyphocrangon sculpta* (Smith), male from ALBATROSS sta. 2051, anterior part of body in dorsal view, $\times 1.4$. (After Smith, 1886.)

teeth. In the male it ends in a single point with at most a slight swelling on one side. The carpus measures $\frac{2}{3}$ of the length of the propodus. The propodus bears distally a large tuft of hairs, which is slightly less than half as long as the dactylus. The merus is about twice as long as the carpus. The fifth leg distinctly fails to reach the end of the scaphocerite. It has about the same shape as the fourth; here, too, the sexual difference in the shape of the dactylus is noticeable.

The present species can easily be recognized and distinguished from the other Atlantic species of the genus by the fact that the pleura of the fifth abdominal somite end in three, instead of two, sharp teeth and by the two-pointed dactyli at the fourth and fifth pereopods in the females.

Size.—The holotype specimen, a female, has cl. 44 mm. The examined female from the ALBATROSS Expedition has cl. 45 mm. The male from northern Spain has cl. 34 mm. The two ovigerous females collected by the PILLSBURY in 1969 have cl. 31 and 32 mm, and the two West African specimens 28 and 40 mm. The smaller and larger diameter of the eggs are, respectively, 2.0 to 2.6 mm and 3.0 to 3.4 mm. The total lengths of South African specimens, recorded by Stebbing (1908), were between 75 and 88 mm. Kensley (1968) reported for his South African material carapace lengths of 15.6 to 22.8 for the males and 19.3 to 26.0 mm for the females; in ovigerous females the carapace lengths ranged from 24.0 to 26.0 mm. Evidently Kensley did not include the rostrum in his carapace length.

Colour.—The description is based on recently preserved material from PILLSBURY sta. 844 and fresh material from PILLSBURY sta. 1304. The rostrum is red. Also red is the anterior part of the carapace before the anterior and cervical grooves, inclusive of the antennal and branchiostegal spines. The red colour also extends onto the anterior part of the anterior submedian carinae and the anterior tooth of the anterior intermediate carinae. A few tubercles of the anterior and posterior intermediate and lateral carinae may be pinkish, as also the anterior tooth of the posterior antennal carina. The rest of the carapace is uncoloured.

The abdomen is entirely uncoloured, but for the three large teeth of the first somite, the lateral teeth of the pleura, and the tip of the telson, all of which are pale orange, or reddish.

The antennulae and antennae are entirely orange red, except for an uncoloured spot in the basal part of the scaphocerite.

The mouthparts and the first three pereopods are red. The fourth and fifth legs have the ischium red and the rest uncoloured or very pale orange; sometimes the articulations of the legs are reddish.

The pleopods are uncoloured.

Parasites.—Stebbing (1908) mentioned the presence of the bopyrid isopod *Bathygyge grandis* Hansen in the right branchial chamber of one of the South African specimens. This species was originally described from *Glyphocrangon spinulosa* Faxon from off the west coast of Mexico.

Horizontal Distribution.—The species has an extensive distribution in the Atlantic Ocean, reaching from Iceland to the West Indies, the Gulf of Guinea and South Africa. The records in the literature are: Between Iceland and Greenland: 64°34'N, 31°12'W (1300 fm = 2380 m) (Hansen, 1908; Stephensen, 1913; Heegaard, 1941). Off the east coast of the United States between Massachusetts and Delaware: 39°41'00"N, 69°20'20"W (1106 fm), 39°40'05"N, 69°21'25"W (1098 fm), 39°29'00"N, 70°58'40"W (1342 fm), 39°26'16"N, 70°02'37"W (1362 fm), 38°44'00"N, 72°38'00"W

(1209 fm), 37°50'00"N, 73°03'50"W (1395 fm) (Smith, 1884). Off New Jersey: 39°35'N, 69°44'W (1230 fm) (Smith, 1886). Off Delaware: 38°16'45"N, 73°10'30"W (1186 fm) (type-locality; Smith, 1882). Cape Point NE by E ¼ E, 40 miles and Cape Point N 70°E, 40 miles, South Africa (1463-1645 m) (Stebbing, 1908, 1910; Barnard, 1950). W of Cape of Good Hope, South Africa: 33°26'S, 16°33'E (2268 m), 33°45.5'S, 16°23.5'E (2707 m), 33°49'S, 16°30'E (2743 m), 33°52'S, 16°51'E (2835 m), 34°05'S, 16°58'E (2707 m), 34°36'S, 17°00'E (3219 m) (Kensley, 1968). The present material extends the known distribution of the species in the eastern Atlantic from South Africa north to West Africa and the Bay of Biscay, and in the western Atlantic from the east coast of the United States south to the West Indies. *G. sculpta* was, compared to the other species of the genus, very poorly represented in the PILLSBURY catches.

Vertical Distribution.—The depths from which *Glyphocrangon sculpta* is reported range from 900 to 1760 fathoms (= 1645 to 3219 m). It was found on bottoms described as: gray ooze (ALBATROSS sta. 2534), *Globigerina* ooze (ALBATROSS stas. 2035, 2052, 2095, 2102, 2105; BLAKE sta. 339), gray *Globigerina* ooze (ALBATROSS sta. 2571), gray ooze and Foraminifera (ALBATROSS sta. 2725), blue mud and *Globigerina* ooze (ALBATROSS sta. 2051), green mud (ALBATROSS sta. 2196), and coral sand (ALBATROSS sta. 2629).

Type-Material.—The holotype, an ovigerous female, originates from off Delaware, 38°16'45"N, 73°10'30"W. It is preserved in the collection of the Museum of Comparative Zoology at Harvard University, Cambridge, Massachusetts, U. S. A. (No. 3236).

Remarks.—In the original description, Smith described the dactyli of the third and fourth pereopods as bifid. It was Barnard (1950: 721, fig. 134b) who pointed out correctly that this feature is only shown by the females, while in the males the dactyli are of the usual oval shape, at most with a slight additional hump in the distal part of one lateral margin.

The specimen from ALBATROSS sta. 3825, referred to by Smith (1884) as belonging to the present species, is preserved in the Museum of Comparative Zoology in Cambridge, Mass., and upon examination proved to belong to *G. longirostris*. The sample contained the original identification by Smith and a label in another handwriting giving the correct identity. The material from ALBATROSS stations 2035, 2095, 2102, and 2105 reported upon by Smith (1884) as *G. sculptus* were also examined and proved to be correctly identified. Smith's (1884) material from ALBATROSS stations 2051 and 2052 was not available for examination.

Glyphocrangon rimapes Bate, 1888

Fig. 4

Thalascaris Bate, 1878, Ann. Mag. nat. Hist., (5), 2: 282.

Glyphocrangon rimapes Bate, 1888, Rep. Voy. Challenger, Zool., 24: 523, pl. 94, fig. 4.—Murray, 1896, Trans. R. Soc. Edinburgh, 38: 387, 394, 400, 453.—Thompson, 1899, Proc. R. Soc. Edinburgh, 22: 328.—De Man, 1920, Siboga Exped. Mon., 39 (a3): 215, 218.—Holthuis, 1952, Lunds Univ. Årsskr., N. Ser. (2) 47 (10): 77.—Anon., 1954, Illustr. Encycl. Fauna Japan, (Rev. Ed.): 764, fig. 2203.—Bahamonde, 1963, Noticiario mens. Mus. Nac. Hist. nat., Santiago Chile, 7 (81): [4].—Zarenkov, 1964, Faun. zoogeogr. notes decapod Crustacea Antarctic: 8.—Kubo, 1965, New Illustr. Encycl. Fauna Japan, 2: 624, fig. 1011.

The status of this species is somewhat uncertain. Bate (1888) based it on four specimens, one from Japan, two from near Juan Fernandez, and one from the South Atlantic. Since that time no additional specimens have been found, and it is not even quite certain that all of Bate's specimens belong to a single species. For completeness' sake, it is included in the present list.

Glyphocrangon rimapes differs from all other Atlantic species of the genus in that the rostrum has three, instead of two, lateral teeth on either side. It agrees with *G. sculpta*, but differs from the other species, in that the dactylus of the fifth leg in the female is distinctly bifid. As no males of *G. rimapes* are known, we do not know whether there is any sexual difference here.

Size.—The specimen from the South Atlantic, an ovigerous female, was reported by Bate to have a total length of 87 mm.

Horizontal Distribution.—The four types, which so far are the only known specimens, were taken in Japan (near Yokohama, 34°37'N, 140°32'E), near Juan Fernandez (33°42'S, 78°18'W), and between Buenos Aires and Tristan da Cunha (37°47'S, 30°20'W).

Vertical Distribution.—The four known specimens were taken in 1375 fm (Juan Fernandez), 1715 fm (South Atlantic), and 1875 fm (Japan), on bottoms of *Globigerina* ooze (Juan Fernandez and South Atlantic) and blue mud (Japan).

Type-Material.—Bate (1888: 525) indicated the specimen from "the South Atlantic (Station 133)" as "the type of this species," and therefore this specimen from near Tristan da Cunha has to be considered the holotype. The figures of *G. rimapes* given by Bate (1888: pl. 94, fig. 4; reproduced in the present paper as Fig. 4) and also the greater part of his description are based on the larger of the two specimens from Station 300 (near Juan Fernandez; see Bate, 1888: 524).

Glyphocrangon atlantica Chace, 1939

Fig. 5

Glyphocrangon (Plastocrangon) caecescens atlantica Chace, 1939, Mem. Soc. cub. Hist. nat., 13: 40.

Material Examined.—WESTERN ATLANTIC: NW of Swan Island, N of Honduras: PILLSBURY sta. 575, 1 ovigerous female (UMML).—South of Santa Clara Province, Cuba: ATLANTIS sta. 2966, 1 female holotype (MCZ, No. 10242).

EASTERN ATLANTIC: Bay of Biscay, France: Centre Océanologique de Bretagne, sta. CHO4-BO17-Put 115, 1 female (COB).

Description.—The body is naked, without any obvious pubescence. The rostrum reaches with about $\frac{1}{3}$ of its length beyond the scaphocerite. The distance between the two pairs of rostral teeth is slightly less than half the distance between the anterior pair and the apex. The rostral teeth are small compared to those of the other species; the anterior pair is directed more outwards than the posterior. The lateral margin of the rostrum in the PILLSBURY specimen shows three or four inconspicuous elevations between the lateral teeth, and one of these elevations in this specimen is enlarged to a minute tooth; before the anterior teeth a few faint irregularities may also be observed on the rostral carinae. In the French specimen and in the type these elevations are absent. Behind the posterior rostral tooth, the rostral carina is somewhat serrated or crenulated in all three specimens. The tip of the rostrum (i.e., the part distally of the anterior rostral teeth) is slightly longer than the distance between the anterior and cervical grooves measured dorsally. The median carina extends over the full length of the rostrum, it is nowhere very high, and it ends in the median tooth at the base of the rostrum. This median tooth is very distinct in the West Indian specimens, inconspicuous in the French. Between the anterior rostral teeth the rostrum is rather flat; farther backwards it becomes more concave. There is no distinct swollen ridge between the two pairs of teeth.

The antennal spine is placed on the lower angle of the orbit; it is much smaller than the branchiostegal spine and directed somewhat upward and forward. In the PILLSBURY specimen the carina behind the antennal spine is angularly produced, in the French specimen and in the type it is practically smooth. The branchiostegal spine is directed obliquely forward.

The anterior submedian carinae of the carapace are built of seven or eight small but distinct tubercles, which are conical with a blunt top. At the inner side of the carina there are about seven to nine smaller tubercles, arranged in an irregular longitudinal row; to the outside, a row of about eight similar irregularly arranged tubercles can be seen. The posterior submedian carina consists of four or five tubercles, with a few smaller ones on both the inner and outer sides. Apart from the small median tubercle at

the base of the rostrum just before the anterior groove, there is a larger median tubercle just behind the groove.

The anterior intermediate carina bears a row of four pairs of fairly large tubercles; the tubercles of each pair are placed one laterally of the other. Apart from these eight tubercles, each intermediate carina shows several smaller tubercles, above and below the larger ones; sometimes they are placed in longitudinal rows, sometimes there is no clear pattern. The posterior intermediate carina consists of an interrupted ridge formed by seven or eight teeth. Between it and the posterior submedian carina about three longitudinal rows of five to eight small tubercles are present.

The anterior antennal carina consists of a row of four or five tubercles, the anterior of which is ridgelike; one or two very small tubercles may be seen either above or below the antennal carina. The posterior antennal carina is irregularly serrated. It ends in a rather low tooth at some distance behind the cervical groove, and one or two small tubercles stand between it and the cervical groove. Between the posterior antennal carina and the posterior intermediate carina there are about three longitudinal rows of eight to twelve small tubercles each.

The anterior lateral carina has two large, but not very high, teeth with blunt tops. The carina itself is in places irregular, so that one or two faint serrations may be visible between or behind the teeth. The anterior tooth does not attain the posterior limit of the orbit. The carina ends at the base of the branchiostegal spine. The posterior lateral carina is low but distinct; it is bluntly serrated. These serrations are most distinct and placed closest together in the posterior half. Anteriorly the carina ends bluntly. Between the posterior lateral and posterior antennal carinae there are two or three longitudinal rows of four to ten very small tubercles.

In the West Indian specimens the anterior sublateral carina is rather distinct, although it is rather irregular; above it, and sometimes also below, is a row of four irregular tubercles. The carina and tubercles are hardly noticeable at all in the French specimen. The posterior sublateral carina consists of a row of ten to fourteen tubercles below the posterior lateral carina. The submarginal carina is indistinct and consists of an area of reticulated grooves. The lateral groove is interrupted there. The marginal carina forms a distinct rounded tooth at the posterolateral angle.

In the French specimen, the sculpture of the carapace is far less distinct than in the PILLSBURY specimen, on which the above description is based for the larger part.

The tubercles on the abdomen are small and blunt, but quite distinct. There is no, or hardly any, pubescence. The first abdominal somite carries the usual three large, pointed, triangular teeth. Between these teeth there is a row of distinct tubercles along the anterior margin, in addition to the row that extends along the posterior margin of the tergum. All somites

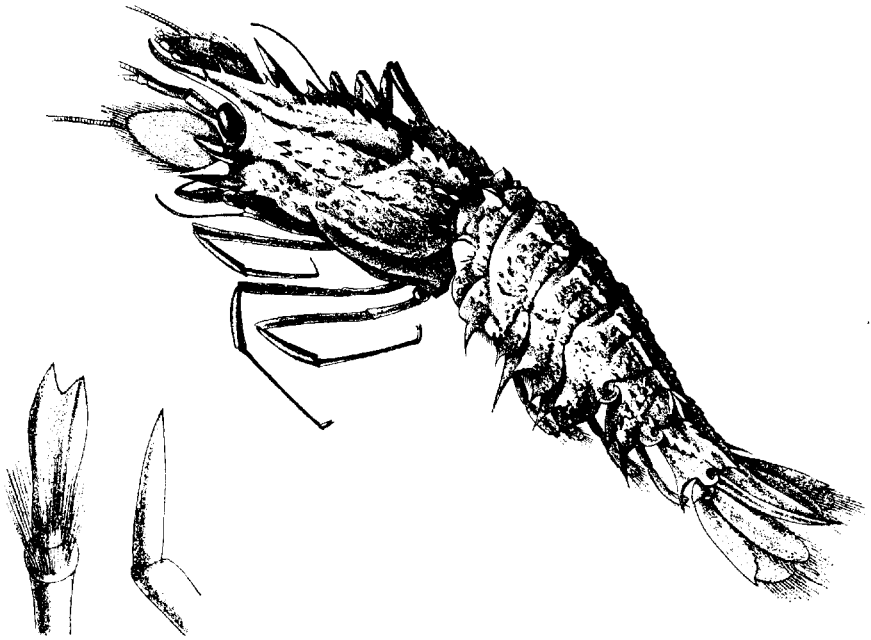


FIGURE 4. *Glyphocrangon rimapes* Bate, paratype female from CHALLENGER sta. 300: Top, dorsolateral view; bottom, left, dactyl of fifth pereopod; bottom, right, dactyl of third pereopod; $\times 1.8$. (After Bate, 1888.)

have a median longitudinal carina. That of the first is formed by the above-mentioned large, median, triangular tooth and a short ridge behind it. Those of the second and third are low and interrupted by the transverse grooves of each somite. That of the fourth shows a slight notch in the middle. The fifth somite shows only the carina in the anterior half and in the extreme distal posterior part; in the posterior half of the somite there are two posteriorly diverging submedian carinae, which are rather high and do not reach the posterior margin of the somite. The median carina of the sixth somite is high, shows a notch just before the middle, and ends in a triangular tooth. The rest of the terga and pleura of the somites are provided, both before and behind the transverse grooves, with various tubercles which are arranged in longitudinal rows or placed irregularly. The tip of the pleuron of abdominal somite 1 is truncate laterally, with the anterolateral angle produced forward. The pleuron of the second somite is almost circular, with a distinct, sharp tooth at the apex and an indistinct, low, rounded tooth on the margin before and behind the apex. The third, fourth, and fifth somites end in two teeth each; in the third and fourth, the anterior

of these teeth is by far the larger and is directed distally, while the posterior is very small. In the fifth, the posterior tooth is markedly larger than the anterior. The pleuron of the sixth somite is formed by a large and sharp triangular tooth, the apex of which is directed posteriorly. The lateral surface of the sixth somite bears a longitudinal row of about four or five ridge-like tubercles over its middle, extending from the articulation with the fifth somite to that with the telson. One to four blunt tubercles are placed below this row. Two very short ridges are placed at the posterior margin, one just over and one just below the articulation with the telson. Above the upper of these a small tubercle is visible. Along the anterior half of the lower margin of the sixth somite and over the base of the pleuron there is a row of about five tubercles. The marginal as well as the submedian carinae of the telson are denticulated in their proximal half; this is especially distinct in the basal part of the marginal ridge. The basal median dorsal tooth of the telson is ridgelike and high.

The eyes are large; the cornea is globular and far wider than the eyestalk. However, no pigment is present. The cornea is milky white, both in the living and the preserved animal. A small, pointed tubercle is placed on the inner margin of the eyestalk near the base of the cornea.

The scaphocerite is elongate oval; it is slightly more than twice as long as broad. A distinct, although blunt, tooth is placed in the middle of the outer margin. The inner margin of the scaphocerite shows a shallow notch or dent in the distal part. The antennal peduncle reaches as far as the end of the scaphocerite.

The third maxilliped reaches with the dactylus to the end of the scaphocerite, or somewhat beyond.

The first pereopod reaches somewhat beyond the middle of the scaphocerite. The second legs are definitely unequal. The right is the longer; it reaches to the end of the scaphocerite in the larger specimen, less far in the smaller. The fixed finger of the chela is so strongly reduced that the latter has practically become a subchela. The carpus consists of 19 and 20 segments in the larger specimens, 16 in the smaller; the last segment is the longest, being about as long as the subchela. The merus is less than half as long as the carpus and slightly shorter than the ischium. The left second leg fails to reach the end of the scaphocerite. The carpus consists of 15 segments in the larger specimens, and of 13 in the specimen from France. The merus is about half as long as the carpus. The third leg reaches with half the propodus beyond the scaphocerite in the larger specimen, overreaching it with the dactylus in the smaller. The dactylus is only slightly flattened and measures almost $\frac{1}{3}$ of the length of the propodus. It ends in a single slender point and has a longitudinal groove on the upper (= anterior) surface. The propodus does not bear a distal tuft of hairs. The

carpus is more than half as long as the propodus and less than half as long as the merus. The fourth leg reaches about to the tip of the rostrum in the larger specimens, to the end of the scaphocerite in the smaller. The dactylus is somewhat less than $\frac{1}{3}$ of the length of the propodus; it ends in a slender, simple point. The propodus bears a distal tuft of long hairs, which hides the basal part of the dactylus from view. The fifth leg is almost as long as the fourth. Its dactylus is shorter, being about $\frac{1}{4}$ of the length of the propodus. Otherwise, the two legs resemble each other very much. The sternum is smooth.

The uropodal protopod ends dorsally in two rounded lobes over the bases of the exopod and endopod. The outer margin of the exopod is somewhat curved and ends in a distinct tooth. The diaeresis is very obscure; it can be seen only very close to the outer tooth.

Size.—The type-specimen has cl. 43.4 mm; the other specimens, the second and third known, have cl. 37 and 47 mm; all are females. The eggs have a diameter of 3×4 mm.

Colour.—The colour of the living specimen from the PILLSBURY Expedition was noted to be "pale orange with yellow eggs." The cornea was white. Also in the French specimen, which was examined 6 months after capture, the cornea was entirely white.

Horizontal Distribution.—Until now, the species was known only from the type-specimen, from south of Santa Clara Province, Cuba, $20^{\circ}47'N$, $80^{\circ}24'W$ (2125 fathoms = 3885 m) (Chace, 1939). The largest specimen reported upon in the present paper was taken not too far from the type-locality; the smaller, however, originates from the eastern Atlantic, having been collected off the Atlantic coast of France.

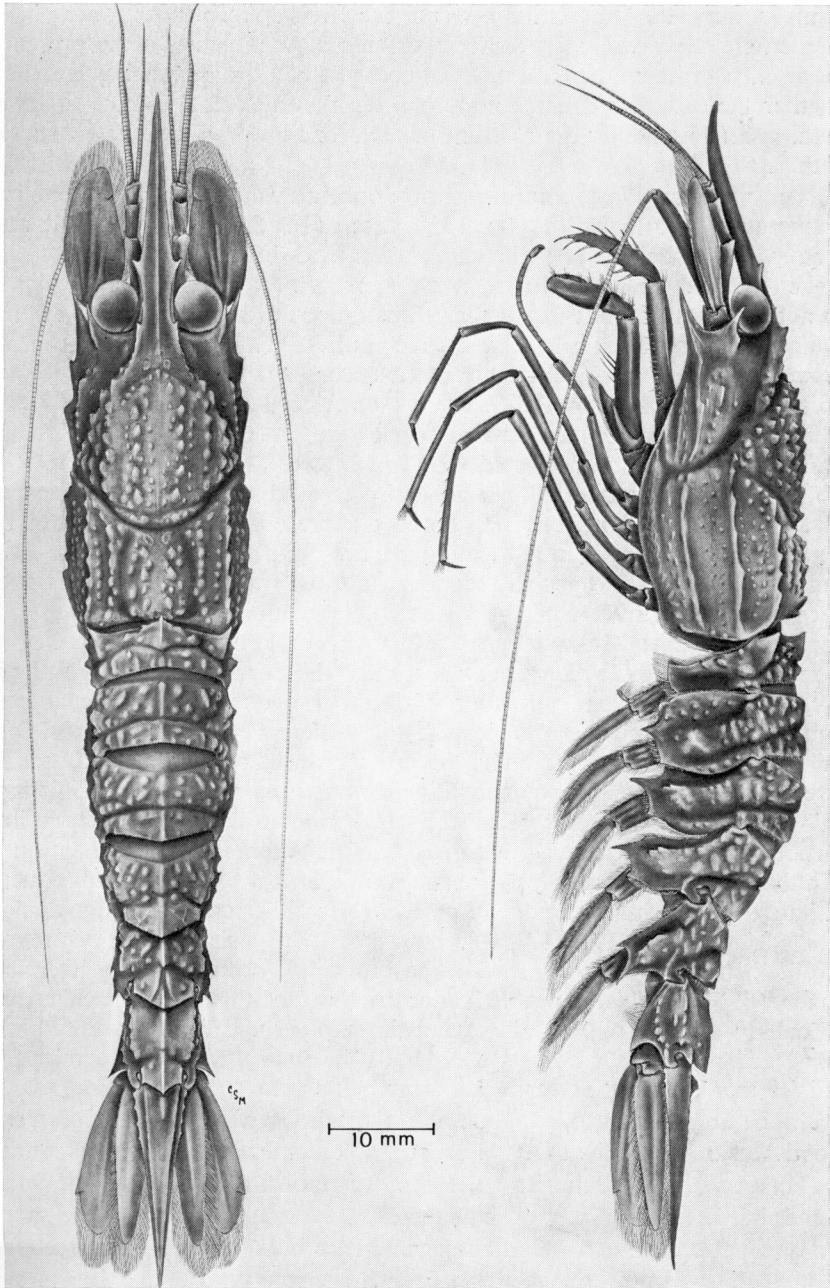
Vertical Distribution.—The type was taken at 3885 m depth, the other specimens at 6364 to 6373 m and 4665 m. Compared to the other Atlantic species, *G. atlantica* is one of those occurring deepest. The bottom at PILLSBURY Sta. 575 was noted to consist of clay.

Type-Material.—The holotype, a female with cl. 43.4 mm, was collected south of Santa Clara Province, Cuba, $20^{\circ}47'N$, $80^{\circ}24'W$ at 2125 fathoms, at ATLANTIS sta. 2966. It is now preserved in the Museum of Comparative Zoology, Harvard University, Cambridge, Mass., under reg. no. 10243.

Remarks.—Chace (1939) considered this form to be the Atlantic subspecies of *Glyphocrangon caecescens* Wood-Mason from the Bay of Bengal.

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FIGURE 5. *Glyphocrangon atlantica* Chace, female from PILLSBURY sta. 575, in dorsal and lateral views.



In my opinion the differences between the two forms, part of which have been enumerated by Chace, are of a specific nature, e.g., (1) the presence or absence of the tubercles that define the anterior antennal ridge, (2) whether the fifth abdominal somite has the pleura ending in two or three teeth, and (3) whether the rostrum has two or three well-developed lateral teeth.

The subgenus *Plastocrangon* is of doubtful validity. The differences enumerated by Alcock (1901: 133) are: (1) the eyes are small and opaque yellow-ochre, (2) the submedian and intermediate carinae are broken up into lines of tubercles, and (3) the first and second pereopod do not have arthrobranchs. In their Illustrations of the Zoology of the Investigator, Wood-Mason & Alcock (1894, pl. 7, fig. 1) showed the eyes of *G. caeca* as quite small, but those of *G. caecescens* (pl. 7, fig. 2) are distinctly larger, as are those of *G. cerea* (see Alcock & Anderson, 1895: pl. 9, fig. 6). The eyes of the present species are not much, if at all, smaller than those of normal species of *Glyphocrangon*. As to the colour of the eye, this seems to be variable, at least in preserved specimens of some species. Thus, in *G. longirostris* the eyes (in preserved specimens) can be almost white, but specimens with dark eyes and intermediates are also found. Pale eyes are especially found in juvenile specimens. It is possible, of course, that in living specimens the colour of the eye is more constant. The submedian and intermediate carinae are broken up into tubercles in so many species of *Glyphocrangon* s. s. that this character is of very little, if any, value for the characterization of *Plastocrangon*. The third character seems to be of great importance, viz., the difference in the branchial formula. In *Plastocrangon*, namely, the arthrobranchs of the first and second pereopods, which are present in *Glyphocrangon* s. s., should be missing. This important character, which, if constant, might even be of generic importance, has been curiously ignored by most authors. Alcock mentioned it in the original description of the subgenus *Plastocrangon*, but subsequent authors dealing with species of *Plastocrangon* neither confirmed nor denied it. De Man (1920: 241-247), who described two species of *Plastocrangon*, one of them new, did not mention the branchial formula, and neither did Chace (1939). This is probably due to the fact that the branchiae are difficult to observe without damaging the carapace. In the present specimens, arthrobranchs are present on both the first and second pereopods and for that reason the species certainly belongs to *Glyphocrangon* s. s. It would be interesting to examine the typical *Glyphocrangon caecescens* Wood-Mason, as this is the type-species of the subgenus *Plastocrangon*.

The specimen from the Bay of Biscay resembles the one from off Swan Island, but has the sculpture decidedly less accentuated. Many of the sharp and distinct tubercles of the latter specimen are blunt or very inconspicuous in the former. Also the legs of the French specimen are relatively shorter.

But in all important characters there is a close resemblance, and I do not hesitate to assign both to the same species. Some of the differences may be due to the fact that the specimen from the eastern Atlantic is younger than the others.

Glyphocrangon spinicauda A. Milne Edwards, 1881

Figs. 6, 7

Glyphocrangon spinicauda A. Milne Edwards, 1881, *Anns Sci. nat. Zool.*, (6) 11 (4): 3; 1883, *Rec. Fig. Crust. nouv. peu conn.*: pl. [40], fig. 1, 1a.—Faxon, 1896, *Bull. Mus. comp. Zool. Harv.*, 30: 158.—Young, 1900, *Stalk-eyed Crust. Brit. Guiana*: 458.—De Man, 1920, *Siboga Exped. Mon.*, 39 (a3): 215, 219.—Glassell, 1934, *Trans. S. Diego Soc. nat. Hist.*, 7: 454.—Holthuis, 1955a, *Zool. Verhand. Leiden*, 26: 130; 1955b, *Bull. zool. Nom.*, 11: 211.—Hemming, 1957, *Opin. Decl. Int. Comm. zool. Nomencl.*, 16: 136.—Anderson & Bullis, 1970, *Sea Frontiers*, 16 (2): 116.

Glyphocrangon aculeata Boone, 1927, *Bull. Bingham oceanogr. Coll.*, 1 (2): 121, fig. 27; (p. p.) 1930, *Bull. Vanderbilt mar. Mus.*, 3: 179, pl. 66 (not pl. 67).—Glassell, 1934, *Trans. S. Diego Soc. nat. Hist.*, 7: 454 (not *Glyphocrangon aculeata* A. Milne Edwards, 1881).

Glyphocrangon cf. *spinicauda* Burkenroad, 1942, *Am. Nat.*, 76: 421.

Glyphocrangon (*Glyphocrangon*) *spinicauda* Springer & Bullis, 1956, *Spec. Scient. Rep. U. S. Fish Wildl. Serv., Fisheries*, 196: 13.—Bullis & Thompson, 1965, *Spec. Scient. Rep. U. S. Fish Wildl. Serv., Fisheries*, 510: 8 (p.p.).

Glyphocrangon spinicauda "Form A" Dobkin, 1965, *Bull. Mar. Sci.*, 15: 872, 874, figs. la, b, d, e, 2-5.

Material Examined.—Straits of Florida, U. S. A.: GERDA sta. 142, 1 ovigerous female; sta. 154, 11 males, 7 females (3 ovigerous); sta. 158, 8 males, 11 females (2 ovigerous); sta. 161, 2 males; sta. 169, 1 male; sta. 170, 1 juvenile; sta. 175, 1 female; sta. 179, 15 females (8 ovigerous); sta. 180, 1 male; sta. 247, 1 ovigerous female; sta. 299, 36 males, 4 females, 1 juvenile; sta. 300, 4 males; sta. 301, 20 specimens; sta. 302, 9 juveniles; sta. 386, 1 specimen; sta. 646, 2 specimens; sta. 666, 2 ovigerous females; sta. 671, 1 specimen; sta. 715, 23 specimens (18 ovigerous); sta. 716, 2 specimens (1 ovigerous); sta. 806, 5 specimens (1 ovigerous); COMBAT sta. 447, 1 ovigerous female (USNM); sta. 450, 8 specimens (1 ovigerous) (USNM); PELICAN sta. 17, 1 specimen (USNM); SILVER BAY sta. 441, 18 specimens (6 ovigerous) (USNM).—Santaren Channel, N of Cuba: GERDA sta. 815, 3 specimens; sta. 816, 1 specimen; sta. 817, 1 specimen; sta. 818, 7 ovigerous females; sta. 1012, 1 specimen; sta. 1016, 7 males, 4 females (2 ovigerous); sta. 1017, 1 specimen; sta. 1018, 1 specimen; PILLSBURY sta. 1171, 49 specimens (20 ovigerous).—N of Cuba: OREGON sta. 1342, 1 male, 1 ovigerous female (USNM).—W of Key West, Florida, U. S. A.: OREGON sta. 1321, 1 male, 7 ovigerous females (USNM).—NW of Cuba: PILLSBURY sta. 584, 1 specimen.—Off Yucatan, Mexico: ALBATROSS sta. 2358, 35 specimens (18 ovigerous) (USNM); sta. 2359, 19

specimens (7 ovigerous) (USNM); PILLSBURY sta. 600, 4 specimens; sta. 601, 1 specimen; sta. 602, 11 specimens.—S of Jamaica: PILLSBURY sta. 1225, 13 specimens.—Between Jamaica and Honduras: OREGON sta. 1885, 7 specimens (2 ovigerous) (USNM).—Off Nicaragua: OREGON sta. 1916, 1 ovigerous female (USNM); sta. 1919, 1 specimen (USNM); sta. 1921, 3 specimens (1 ovigerous) (USNM); sta. 1933, 2 specimens (1 ovigerous) (USNM).—N of Hispaniola: PILLSBURY sta. 1160, 2 specimens.—Off St. Kitts (= St. Christopher): BLAKE sta. 147, 1 male holotype (MCZ); sta. 148, 2 specimens (MCZ).—Off Guadeloupe: PILLSBURY sta. 918, 1 specimen; sta. 923, 2 specimens; sta. 936, 41 specimens (5 ovigerous).—Off Dominica: PILLSBURY sta. 929, 4 specimens.—Off St. Lucia: PILLSBURY sta. 889, 1 ovigerous female.—Off Barbados: BLAKE sta. 274, 12 specimens (MCZ); sta. 275, 5 specimens (2 ovigerous) (MCZ); sta. 281, 7 specimens (MCZ).—Off the mouth of the Amazon River: OREGON sta. 2081, 4 ovigerous females (USNM).

Description.—The dorsal surface of the body is covered with a very short pubescence between the carinae and tubercles. The rostrum is rather slender, with the tip curved upward. In the adults the tip (i.e., the part before the anterior lateral rostral teeth) is about as long as the basal part (i.e., the part between the anterior pair of rostral teeth and the anterior groove of the carapace), and somewhat shorter than the distance between the anterior and cervical grooves. In juveniles, the tip is distinctly longer than either the basal part or the distance between the two grooves. There are two pairs of lateral rostral teeth; the posterior pair is situated in the basal sixth of the rostrum. The upper surface of the rostrum is rather deeply hollowed in the basal half and flattened distally; it is not, or hardly, channeled between the anterior teeth. The lateral margin between the two pairs of lateral teeth is not widened. The distal part carries a longitudinal median carina which extends backward about halfway the distance between the two pairs of lateral teeth. A transverse row of setae is placed across the base of the rostrum.

The anterior submedian carinae of the carapace are distinct, with six or seven blunt teeth. At the inner side of each of these ridges there is a row of nine to fifteen smaller tubercles. On the outer side one of five to nine tubercles. In some specimens these additional tubercles are about as large as those of the submedian carinae proper; in very small specimens they are often very inconspicuous. The posterior submedian carinae consist of four or five blunt teeth, the last of which protrudes posteriorly over the posterior groove. At their inner side there is a row of three to five small tubercles; on the outer side, between it and the posterior intermediate carina, there are several smaller and larger tubercles scattered: generally a row of two to four small tubercles along the submedian carina, a row of three to five larger tubercles in the middle and a row of two to seven along

the inner side of the posterior intermediate carina. The rows are often not distinct, or are double, so that the impression of scattered tubercles is obtained. The anterior intermediate row consists of three or four blunt teeth flanked by an upper and a lower additional row each of three to five tubercles. The posterior intermediate carina bears six or seven blunt tubercles. A lower additional row consists of two to nine small tubercles. The posterior antennal carina is smooth and anteriorly rounded without a trace of a spine; in its posterior half it shows some indistinct concavities. Anteriorly, the carina is continued obliquely upward by a row of about three tubercles along the posterior margin of the lateral groove. The anterior antennal carina is represented by a longitudinal row of about five to eight distinct tubercles extending behind the antennal spine. One or two pearly tubercles are present dorsally of the base of this row. The posterior lateral carina is straight and ends in a small, almost rectangular tooth. The anterior lateral carina lies in one line with the posterior lateral carina; it ends in the branchiostegal spine. The anterior of these teeth fails to reach the level of the posterior margin of the orbit; it is somewhat appressed and is much less conspicuous than the one in *G. longleyi*. The posterior (= lateral) margins of the two teeth lie approximately in one line. The anterior and posterior sublateral carinae are distinct. The anterior part of the submarginal carina ends near the end of the lateral groove. However, there is a distinct high and sharp, though rather short, carina between the posterolateral angle of the carapace and the posterior end of the posterior lateral carina; this short carina is distinctly removed from the marginal carina and evidently represents the posterior part of the submarginal carina; it is continued to the posterior end of the posterior antennal carina as a row of three or four separate tubercles. The posteromarginal and lateral grooves are in contact with each other.

The antennal and branchiostegal spines are strong and much resemble those of *Glyphocrangon haematonotus*.

The abdomen is more tubercular than that of *Glyphocrangon haematonotus*. Between the median and intermediate carinae of the first somite there are two transverse rows of three or four distinct tubercles each, one along the anterior and one along the posterior margin. In *G. haematonotus*, the anterior row is absent. The shape and the size of the pleural spines is about the same in the two species. The dorsal submedian ridges of the fifth abdominal somite resemble those of *G. haematonotus*, in that they are continued almost up to the posterior margin of the segment as narrow sharp ridges; in *G. haematonotus*, however, they reach farther backward than in *G. spinicauda*. As in *G. haematonotus*, the median carina of the sixth somite is deeply incised in the basal part. On the sixth abdominal somite, instead of the two longer longitudinal carinae on the middle of the lateral surface as found in *G. haematonotus*, there are three to five much shorter

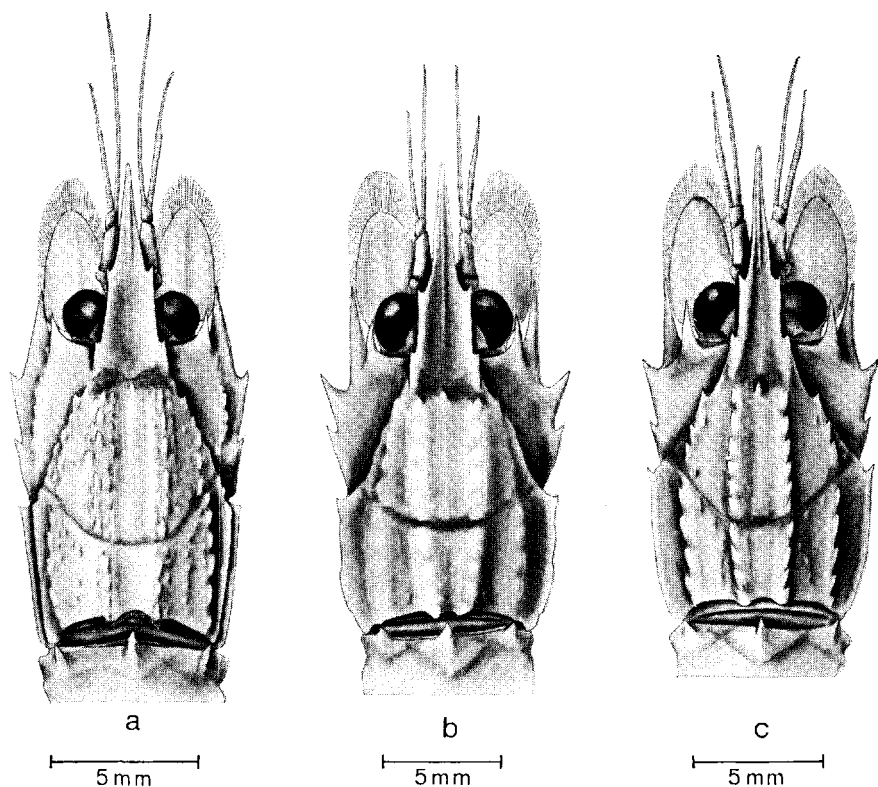


FIGURE 6. Dorsal view of anterior part of body: a, *Glyphocrangon spinicauda* A. Milne Edwards, from GERDA sta. 247; b, *Glyphocrangon longleyi* Schmitt, from GERDA sta. 197; c, *Glyphocrangon haematonotus*, new species, from GERDA sta. 222.

carinae. Also, the carina ending in the posterolateral tooth of the somite is broken up in small parts.

The tailfan resembles that of *G. haematonotus*, but is perhaps slightly less slender.

The eyes are large, but smaller than in *Glyphocrangon longleyi*, and about the size of those in *G. haematonotus*. The cornea is large, swollen, and provided with dark pigment. A small, but distinct, tubercle is placed on the inner margin of the ocular peduncle near the base of the cornea.

The scaphocerite is rather narrow, as in *G. haematonotus*, and much less broad than in *G. longleyi*. It is slightly more triangular and less oval than in *G. haematonotus*. The antennal peduncle reaches almost to the end of the scaphocerite.

No differences could be found between this species and *G. haematonotus*, as far as the oral and thoracic appendages are concerned.

No spine is found on the fifth thoracic sternum of either males or females, but in juveniles a median tubercle may be present there.

The spine on the outer margin of the scaphocerite, which in *G. haematonotus* is visible only in the younger specimens and is entirely absent in ovigerous females, in the present species is still present in females carrying eggs and in males with carapace lengths of up to 31 mm.

Size.—The smallest specimen examined is a juvenile with a carapace length of 13 mm. Males had the carapace length up to 44 mm and females up to 43 mm. The ovigerous females examined had the carapace length between 30 and 43 mm. The diameter of the eggs is 2 to 2.5 mm.

Colour.—The general colour impression is that of a red-backed shrimp with a red spot below the eye and with pale legs. The rostrum is whitish. The distal part (from the distal lateral teeth forward) is pink; the extreme tip in some specimens is white, in others it is red. The lateral margins of the distal part of the rostrum are somewhat darker red than the rest. The basal lateral rostral teeth are red, and the distal teeth are either pink (like the rest of the rostrum there) or red. The tubercles of the submedian and intermediate carinae (especially of the anterior carinae) are red. The additional tubercles between these carinae and below the intermediate are either red or pink. The posterior submedian and posterior intermediate carinae usually are lighter than the anterior, sometimes being whitish; usually the last tubercles of the posterior submedian carinae are red. Red chromatophores are scattered between the carinae in an area behind the anterior and upper lateral grooves and above the posterior antennal carina. The outline of this area is often quite distinct. Below it, the carapace and the carinae are uncoloured. The extreme anterior part of the posterior antennal carina may carry a red spot. The antennal spine and the area just behind the anterior margin of the carapace above the spine are dark red, as is also the basal part of the branchiostegal spine, and sometimes also the tip of the anterior tooth of the anterior lateral carina and the tubercles of the anterior antennal carina.

All the tubercles and carinae of the tergum and the upper part of the pleura of the abdomen are red. The distal part of the pleura is uncoloured, except for the tip of that of the sixth somite, which is red. The area between the red tubercles of the abdomen bears scattered red chromatophores. The tailfan is pink or whitish, with red carinae and tubercles.

The antennula, both peduncle and flagellum, is pink; the basal segment is not darker than the rest, but of the various segments the distal end may be somewhat darker than the proximal part. The antenna is pink with a

red band over the base of the scaphocerite and the adjoining area; sometimes also the extreme distal part of the peduncle is red.

The mouthparts, pereopods, and pleopods are uncoloured, in striking contrast to most other species of the genus.

The eggs are blue, with a slightly greenish tinge, or pale greenish.

Horizontal Distribution.—The species is known from the western Atlantic from the east coast of Florida south to Barbados and into the Caribbean area as far west as Yucatan, Honduras, and Nicaragua. The records in the literature are: Off the east coast of Florida: off Daytona Beach (Anderson & Bullis, 1970). Straits of Florida: 27°41'N, 79°11'W to 27°51'N, 79°14'W (300-310 fm), 25°45'N, 80°00'W (140 fm) (Dobkin, 1965); 25°07'N, 79°15'W (300 fm), 23°59'N, 79°43'W (350 fm) (Bullis & Thompson, 1965); off Miami, 1100 fm (Boone, 1930). N of Cuba: 23°10'N, 79°33'W (280 fm) (Springer & Bullis, 1956). Gulf of Mexico, W of Dry Tortugas: 24°49'N, 84°06'W (170-200 fm) (Springer & Bullis, 1956). Off St. Kitts (= St. Christopher), West Indies: 17°19'27"N, 62°50'30"W (250 fm) (type-locality: A. Milne Edwards, 1881, 1883; Young, 1900), 17°17'12"N, 62°46'43"W (208 fm) (Faxon, 1896). Off Barbados, West Indies: 13°00'50"N, 59°36'20"W (209 fm), 12°58'33"N 59°36'45"W (218 fm), and 12°54'48"N, 59°36'30"W (288 fm) (Faxon, 1896). Off British Honduras: N of Glover Reef (366, 484, and 486 fm) (Boone, 1927). Off Honduras: 16°54'N, 81°18'W (250 fm) (Bullis & Thompson, 1965). Off Nicaragua: 13°30'N, 82°00'W (275-300 fm), 13°18'N, 82°12'W (350 fm) (Bullis & Thompson, 1965).

The present new records of the species from the east coast of Florida, the Straits of Florida, the Santaren Channel, northwest of Cuba, off Yucatan Peninsula, south of Jamaica, north of Hispaniola, off Guadeloupe, off Dominica, off St. Lucia, and off the mouth of the Amazon fit well into the range shown by the records from the literature, and extend the known range to the southeast.

Vertical Distribution.—The species has been collected between 140 and 378 fathoms (= 256 and 692 m); most of the specimens have come from between 250 and 360 fm (= 458 and 660 m). Boone (1927) reported her material from 366, 484, and 486 fm; it is not certain, however, whether all of it belongs to the present species. The same author (Boone, 1930) reported upon material collected off Miami in 1100 fm, which record seems very unlikely (see Remarks). The bottom on which the animals were caught is indicated as: gray mud (PELICAN sta. 17); fine gray sand, ooze (BLAKE sta. 147); fine gray sand, black specks (BLAKE sta. 148); fine sand (BLAKE sta. 274); fine brown sand (BLAKE sta. 275); broken shell (BLAKE sta. 281); coral (OREGON stas. 1885, 1916); coral sand (COMBAT sta. 447; SILVER BAY sta. 441); fine white coral (ALBATROSS sta. 2358); white

coral (ALBATROSS sta. 2359); fine mud, broken shell, dead coral, broken sea-urchin tests (PILLSBURY sta. 1171); very clean bottom with pumice stone rubble (PILLSBURY sta. 929); rock (OREGON sta. 2081). The species evidently prefers a sandy or rather coarse bottom over a pure muddy one.

Habits.—So far as I know, only once a species of *Glyphocrangon* has been observed in its natural surroundings, viz., by Anderson & Bullis (1970: 116), who describe the present species, which they watched from an Aluminat submarine at a depth of about 250 fm off Daytona Beach, Florida: "The shrimp were almost always in a strange position, with head and tail-fan touching, or dug into the bottom with the middle of the body arched. These shrimp jumped and swam more often than other shrimp species as the lighted area of the submarine approached. The swimming actions were relatively weak—one tailflip moved the animal about 1 inch, and the forward movements were very slow."

Larval Development.—Burkenroad (1942) reported upon a late embryo of a species of *Glyphocrangon* which he thought to be probably this species. Dobkin (1965) dealt extensively with the development of the present species, which he indicated as *Glyphocrangon spinicauda* "Form A."

Type-Material.—The holotype is a male specimen (cl. 44 mm) from St. Kitts (17°19'27"N, 62°50'30"W, 250 fm, fine gray sand and ooze), collected by the BLAKE at sta. 147 (14 January 1879), and now preserved in the collection of the Museum of Comparative Zoology, Cambridge, Mass., where I have been able to examine it, and to establish its identity with the present form.

Remarks.—This species, *G. longleyi*, and *G. haematonotus* resemble each other very closely, and have been confused in the literature. The differences, both in morphological and in colour characters, are so constant, however, that there can be little doubt that the three forms are distinct species.

The original description of *Glyphocrangon spinicauda* is insufficient for a positive identification of the species. A. Milne Edwards's (1883) figure of the holotype, however, makes its identity with the present species clear; furthermore, this was confirmed by the examination of the holotype.

Boone (1927) described and figured what she thought to be *Glyphocrangon aculeata* from north of Glover Reef, where it was taken at depths of 366, 484, and 486 fathoms. The specimen figured by Boone is definitely not *G. aculeata*, but *G. spinicauda* instead. It is not certain, however, whether all of Boone's material actually belongs to *G. spinicauda*. She commented, namely, on the great variation within her material, and described old specimens which were "much more heavily tuberculated and

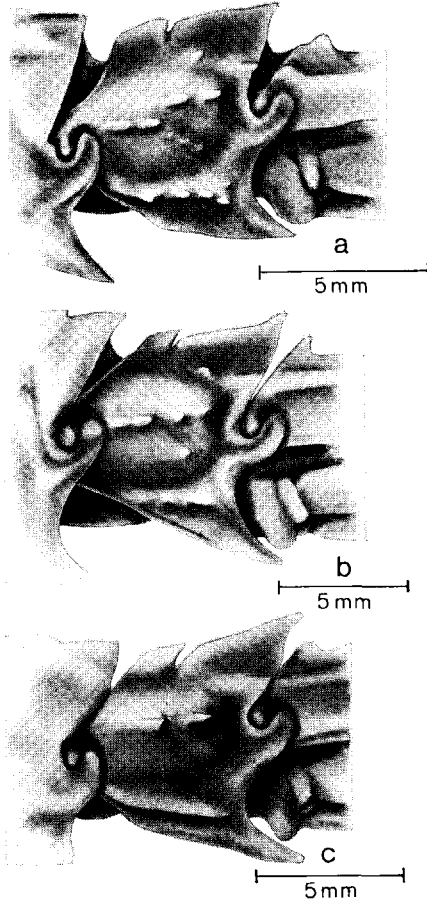


FIGURE 7. Sixth abdominal somite in lateral view: a, *Glyphocrangon spinicauda* A. Milne Edwards, from GERDA sta. 247; b, *Glyphocrangon longleyi* Schmitt, from GERDA sta. 197; c, *Glyphocrangon haematonotus*, new species, from GERDA sta. 222.

rugose," while others (equally large adults) had "weak tubercles" or were "nearly smooth." Without examination of Boone's material, no certain identification is possible. Glassell (1934) has already referred Boone's material to the present species. In her 1930 paper, Boone again reported upon *Glyphocrangon aculeata*; her illustrations show that she had (at least) two species confused under that name. Boone herself distinguished two forms in her material. One of these, represented by three specimens and

figured on her Pl. 67, is clearly true *G. aculeata*. The other form, to which she brought ten specimens, one of which is figured on Pl. 66, is *G. spinicauda*, judging by this figure. All 13 specimens were reported by Boone to be "dredged in 1100 fathoms, off Miami, Florida." This record must be erroneous, as no such great depths are found anywhere near Miami.

Part of the material brought by Bullis & Thompson (1965) to the present species is now preserved in the collection of the U. S. National Museum, and could be examined there. The specimens from OREGON stas. 1324, 1908, 1915, part of 1916, part of 1919, and 1923, from COMBAT sta. 120, and from PELICAN sta. 54 proved to belong to *Glyphocrangon longleyi*; those from COMBAT sta. 445 belong to *G. haematonotus*; while those from OREGON stas. 1885, 1916 (*partim*), and 1919 (*partim*), as well as those from COMBAT stas. 447 and 450, proved to be true *G. spinicauda*.

***Glyphocrangon aurantiaca*, new species**

Fig. 8

Material Examined.—Off Tobago: PILLSBURY sta. 847, 1 male holotype (USNM No. 134647), 2 female paratypes.—Off Surinam: OREGON sta. 2007, 1 ovigerous female paratype (USNM); sta. 2009, 1 male, 1 ovigerous female paratype (USNM); sta. 4300, 1 ovigerous female paratype.—Off French Guiana: OREGON sta. 4293, 1 female paratype; sta. 4294, 1 female paratype.

Description.—The body is covered with a dense short pubescence, through which the carinae and tubercles protrude. The rostrum reaches with more than $\frac{1}{3}$ of its length beyond the scaphocerite in the holotype, and in the smallest specimen with almost half its length. The distance between the two pairs of lateral rostral teeth is less than half the distance between the distal pair and the rostral apex, and about half the distance between the anterior and cervical grooves measured dorsally. The median rostral carina extends from the tip of the rostrum backward to the anterior pair of rostral teeth and becomes indistinct soon after. In its anterior part the carina is high and sharp. The upper surface of the rostrum between the anterior rostral teeth is rather flat, becoming concave more posteriorly; it is entirely covered with a tomentum of short and soft hairs. The anterior rostral teeth are slightly larger than the posterior and point obliquely sideways and forward. The posterior spines are more erect and point forward and upward. There is no distinct ridge between the teeth.

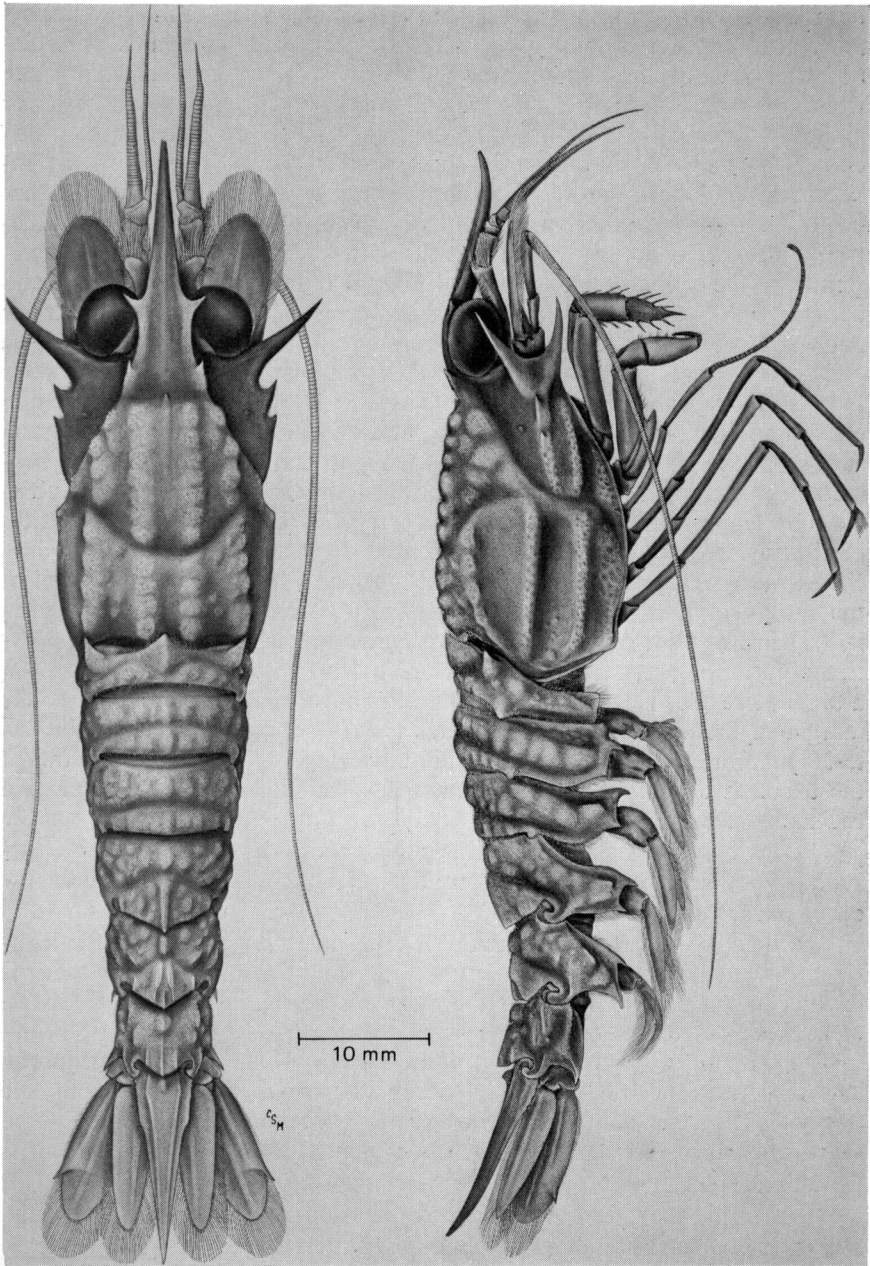
The submedian carinae of the carapace are broad and flattened. The anterior bear six or seven wide, low, blunt teeth which show a reticulate pattern of ridges dorsally. A few small tubercles stand to the inside of the carina. The posterior submedian carinae have four or five such broad teeth. A distinct, pointed, median tubercle is placed in the anterior groove

at the base of the rostrum. The anterior intermediate carina is replaced by a row of three or four very wide, low tubercles similar to, but larger than, those of the submedian carinae. These tubercles are flanked at each side by one to three small ones. The posterior intermediate carina is formed by a row of about six tubercles similar to, but smaller than, those of the submedian carinae. A row of about six small tubercles extends along the inner side of the posterior intermediate carina, while an additional tubercle is placed between the posterior intermediate and submedian carinae just behind the cervical groove, and two tubercles in the posterior half of the space between these carinae. The posterior antennal carina shows no teeth or tubercles, but has the reticulate pattern throughout; the anterior end of the carina is bluntly rounded. Obliquely above the end of the carina, a blunt tubercle is placed behind the anterior groove. There is no anterior antennal carina, although a small tubercle is found some distance above the anterior lateral carina. The posterior lateral carina, like the posterior antennal, is straight with a reticulate pattern of ridges; like all the other ridges, it does not end in a spine. There are a few tubercles in the posterior part of the space between the posterior antennal and lateral carinae. The anterior lateral carina bears two rather small teeth. The anterior is somewhat larger than the posterior, and both are directed obliquely forward and outward. The distance between the anterior tooth and the antennal spine is about as long as the tooth itself. The carina ends about between the antennal and branchiostegal spines. The antennal spine is very strong and long, being almost as long as the scaphocerite; it is directed strongly outward, making an angle of more than 60° with the branchiostegal spine, which is also very strong, although less so than the antennal spine. The anterior and posterior sublateral carinae are distinct and reticulate; they bear no spines. The submarginal is distinct and not connected with any other carina. The lateral groove merges uninterruptedly with the posterior groove. The marginal carina is not, or hardly at all, widened at the posterolateral angle. Between the tubercles and ridges, the carapace is covered with a very short and soft pubescence.

The tubercles on the abdomen, like those of the carapace, are low, wide, and blunt, but are without a reticular pattern of ridges; between them, the integument carries a very short and soft pubescence. The first abdominal somite carries the usual three large, pointed, anteriorly directed dorsal teeth; there is a transverse row of distinct tubercles along the posterior, but not along the anterior, margin of the somite. The second and third somites do not show a median carina. The fourth somite shows one in the pos-

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FIGURE 8. *Glyphocrangon aurantiaca*, new species, male holotype from PILLSBURY sta. 847, in dorsal and lateral views.



terior half. The fifth somite has a very short median carina in the anteriormost part, and an equally very short one in the posteriormost part; the posterior half of the somite shows two rather long, submedian carinae which diverge slightly, posteriorly, and reach practically to the posterior margin. The sixth somite has a median carina over its full length, which ends in a slightly upward-directed sharp tooth. The carina is narrowly incised slightly before the middle. The pleuron of the first somite is rather narrow, its top is somewhat forward produced; it is rounded in the holotype, and more acute in the smallest specimen. The pleuron of the second somite in the holotype has the distal margin bluntly angular in front and behind, with a distinct tooth in the middle; in the juvenile, the posterior angle is more acute and toothlike. The pleura of the third to fifth somites end in two teeth, the anterior being longer than the posterior in somites three and four, shorter in somite five. The lateral margin of the sixth somite ends in a strong and sharply pointed, posteriorly directed tooth. The lateral surface of the sixth somite bears the following carinae: (a) a short, submedian carina in the extreme posterior part, which is preceded by a tubercle, (b) a short, longitudinal carina of irregular shape in about the center of the surface, (c) just below this central carina, a longitudinal, slightly sinuous ridge extends from the anterior margin of the somite to the level of the anterior part of the central carina, and a tubercle is found just behind it, (d) in line with carina c and the tubercle, a carina is found in the extreme posterior part of the somite, reaching the posterior margin, and (e) a broad, irregular ridge extends somewhat above, and parallel to, the lower margin of the somite. A short groove is furthermore found near the anterior margin of the somite somewhat above ridge (c). The basal tooth of the telson is distinct and triangular, with a rounded top. The submedian carinae of the telson are smooth.

The eyes are large; the cornea is globular and far wider than the eye-stalk. The latter carries a very prominent, though small, tubercle in the distal part of the inner margin.

The scaphocerite is broadly oval. It does not carry a tooth in the holotype, but in the smallest specimens (cl. 20 and 26 mm) such a tooth is distinct in the proximal part of the outer margin. The antennal peduncle reaches almost to the end of the scaphocerite.

The third maxilliped reaches beyond the end of the antennal peduncle. The distal segment is triangular, ending in a sharp spiniform tooth; the upper margin bears four, the lower three, long movable spines, while about seven such spines are placed in two oblique rows on the inner surface. The penultimate segment bears two movable spines in the distal part of the upper margin, and three on the lower. The inner surface bears one movable spine somewhat behind the middle of the anterior margin. A dense field of hairs is present in the upper half of the inner surface. The antepen-

ultimate segment is almost as long as the two distal combined; its lower margin bears two small spines in the distal part.

The first pereiopod reaches beyond the end of the eyes; it is similar in shape to those of the other species of the genus. The second legs are unequal. The right is longer and more slender than the left; when stretched forward it reaches beyond the end of the scaphocerite. The chela is small, with the dactylus rather high and the fixed finger triangular, being about half as long as the palm. The carpus consists of about 30 articulations, of which the first and the last are longer than the others. The left leg is shorter and more robust than the right; its carpus consists of 20 to 25 articulations. The third leg reaches beyond the end of the scaphocerite. The dactylus is only slightly flattened and measures about $\frac{1}{3}$ of the length of the propodus; it ends in a single slender point. The propodus does not have a terminal brush of setae. The carpus is somewhat longer than half the propodus, and slightly shorter than half the merus. The fourth leg reaches with part of the dactylus beyond the scaphocerite. The dactylus is more than half as long as the propodus; it is distinctly flattened and even slightly concave dorsally; it ends in a single slender point. The carpus is a little more than half as long as the propodus and a little less than half as long as the merus. The fifth leg reaches as far forwards as the fourth, and is similar in structure, the only difference being found in the shorter dactylus, which measures about $\frac{1}{2}$ the length of the propodus. In the juvenile (cl. 20 mm), the dactylus of the last pereiopod is relatively somewhat longer. The thoracic sternum in the holotype is smooth, but for the fifth sternite, which shows a small, but distinct, median spinule. This spinule is absent in the large female, but present, be it small, in the juvenile.

The first pleopod of the holotype has a well-developed *appendix interna* on the endopod. The second pleopod has the *appendix masculina* longer than the *appendix interna* and for more than the distal half beset with long, rather stiff setae. In the females, the endopod of the first pleopod is oval without an appendix; on the other pleopods, only the *appendix interna* is present.

The uropodal protopodite has a rounded lobe over the base of the endo- and of the exopodite. The exopodite has the outer margin straight, or slightly sinuous, and ending in a distinct tooth. The diaeresis starts inwards from this tooth, but stops at the dorsal median longitudinal carina of the exopod. A second carina is visible to the outside of the median; it stops before reaching the diaeresis. The endopod is elongately oval and has a single, longitudinal median carina.

Size.—The carapace length of the male holotype is 36 mm, those of the female paratypes range from 20 to 41 mm; in the ovigerous female it is 40 mm. The eggs are about spherical, with a diameter of about 2.4 mm.

Colour.—The following colour description was made from the holotype immediately after capture. The general impression is that of an orange animal that has the carapace somewhat lighter than the abdomen, and white spots on the scaphocerite. The rostrum and the antennal and branchiostegal spines are uniformly orange. The tubercles of the submedian and intermediate carinae of the carapace are orange; the branchial area of the carapace is light orange. The abdomen is orange, with the tubercles and carinae of the tergum darker than the rest. Each somite shows a band of darker orange along the posterior margin, but this is not very striking. The tips of the pleura also are darker orange than the rest. The telson and the uropods are plain orange, only the carinae on the telson being darker. The antennular peduncle and flagella are orange, with a white spot dorsally on the last peduncular segment. The antenna is entirely reddish orange, with a white spot near the basis of the scaphocerite and on the middle and the basis of the scaphocerite itself. The mouthparts and the legs are uniformly red to reddish orange, the legs being orange, the mouthparts more red. The pleopods are uniformly orange. In the juvenile specimen the legs and uropods show more white.

Horizontal Distribution.—So far the species has been found only in a restricted area off the north coast of South America between Tobago and French Guiana.

Vertical Distribution.—*Glyphocrangon aurantiaca* has been found in depths ranging from 225 to at least 403 fathoms (= 410 to 733 m); the deepest station (PILLSBURY sta. 847) was between 403 and 700 fm (= 733 and 1280 m), so that it is likely that the depth range of the species exceeds 403 fm. In only two instances (OREGON stas. 2007 and 2009) the nature of the bottom was noted; in both cases it was blue mud.

Type-Material.—Holotype is the male specimen from PILLSBURY sta. 847, off Tobago, 11°37.3'N, 60°59.4'W to 11°41'N, 61°01.3'W, 400-700 fm, 2 July 1969. It is preserved in the U. S. National Museum under catalog number 134647. The paratypes are in the Museum of the Rosenstiel School of Marine and Atmospheric Sciences, Miami, Florida; the U. S. National Museum; and the Rijksmuseum van Natuurlijke Historie, Leiden.

Remarks.—The new species belongs to the group of *Glyphocrangon spinicauda*, *G. longleyi*, and *G. haematonotus*, characterized by having two distinct teeth on the anterior lateral carina, and two teeth at the end of the pleuron of the fifth abdominal somite. It differs from all three species in the long and widely divergent antennal spines, in the small teeth on the anterior lateral carina, in the lack of a sharp tooth at the end of any of the other carinae of the carapace, in the arrangement of the carinae on the sixth abdominal somite, and in the colour pattern. The species differs