little or no change in size of the specimen which molted through several stages.

DESCRIPTION: The rather stout appearance of the first zoea is exaggerated in Figure 5 because of swelling of the carapace. Nevertheless, it is a rather heavy larva with much yolk. The exceptionally great size relative to the adult is one of the most remarkable features of this species. The larva hatches in a very advanced state of development; the leg buds and pereiopod buds can be seen through the very delicate cuticles. Other features relating to abbreviated development include the setose exopodite of the third maxilliped, the lack of terminal setae on the endopodite of the antenna, and the presence of two rami on the antennule. Other features related to the rapid molting, short larval life, and lack of feeding include reduction of the mandible (it could hardly be distinguished in the first zoea) and endopodites of the maxillipeds (Fig. 6, top row).

In species with normal development the exopodites of the maxillipeds are used in swimming and the endopodites assist in feeding. In the first stage of this species, however, only the locomotory exopodites appeared to be functional but either they are not efficient or the larva was debilitated, as none of the specimens was able to get off the bottom of the container. The later stages did not show any better development of the maxillipeds, indicating that the zoeal stages do not feed.

Zoea II.—Unfortunately, little could be saved of the second-stage exuvia, but scarcely any differences between first and second zoea were noted. There seemed to be segmentation of the endopodites of the maxillipeds and of the antennal endopodite but no other changes of significance (Fig. 6, middle row). The freeing of the eyes from the carapace, which normally takes place in other species at the molt from Zoea I to Zoea II, could not be confirmed in this instance.

Zoea III.—The third zoea did show a number of very interesting changes from the preceding stages. As in most other hermit crabs, the third stage is characterized by the appearance of uropods. In the single specimen obtained, the uropods were very reduced and even the exopodites, normally setose, bore no setae. The form of the telson was little changed except that the posterior margin was a little more indented. The unusual telson armature of the first zoea was retained to this stage. The fusion of the fourth telson process with the margin of the telson appears for the first time in the third stage of other species but was already evident in the first zoea of this species (Fig. 7).

Although the maxillipeds show little change, the other appendages have been modified from the form in the first zoea. The antennule, always biramous, now shows signs of peduncular segmentation. The antennal flagellum is very clearly segmented, with the terminal segment bearing

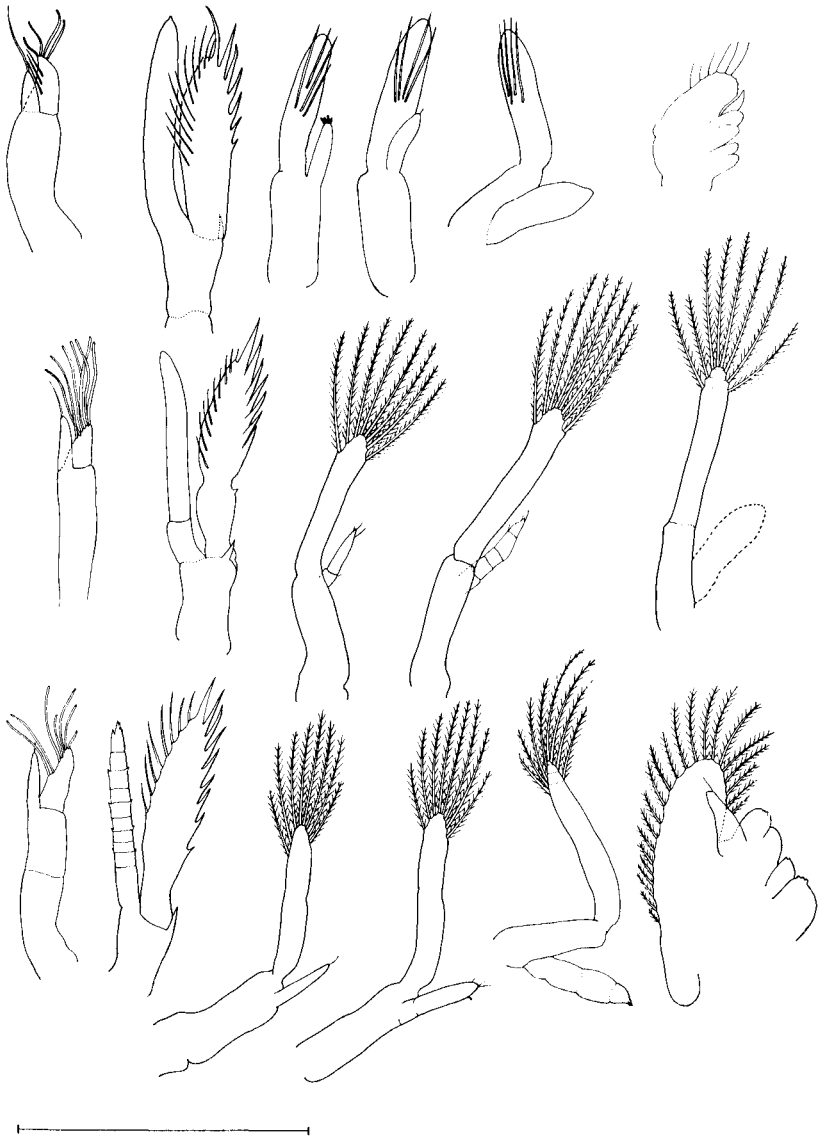

FIGURE 6. *Lithopagurus yucatanicus*, sp. n. Top row, left to right, antennule, antenna, first, second, third maxillipeds, maxilla of first zoea. Second row, same appendages of second zoea, with exception of maxilla. Third row, same appendages of third zoea. Scale represents 0.67 mm for maxillae, 1.0 mm for all other appendages.

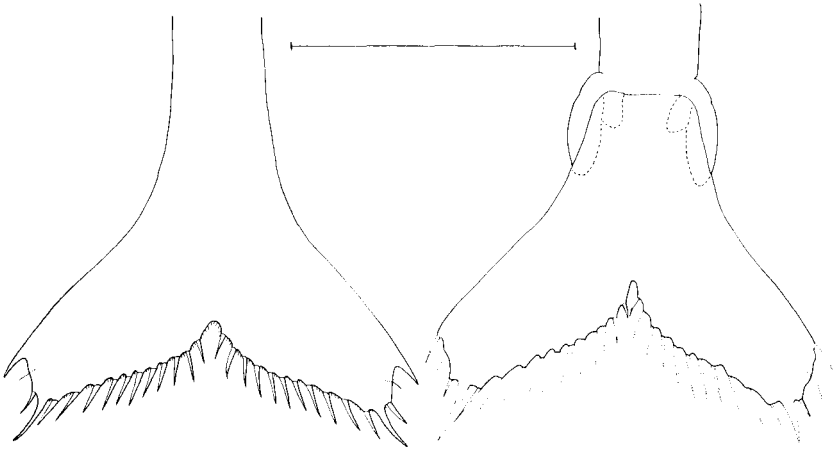

FIGURE 7. *Lithopagurus yucatanicus,* sp. n. Left, telson of first zoea; right, telson of third zoea.

short, spinelike structures and with very short spines representing setae on alternate flagellar segments. The maxilla shows clearly a well-developed scaphognathite bearing setae, but the medial lobes are still unarmed. Pereiopod buds now show segmentation and are so well developed that it is highly probable that the next molt would have produced a glaucothoë. These appendages, though in poor condition, have been illustrated as they show some similarity to corresponding appendages of the adult (Fig. 8).

SYSTEMATIC SIGNIFICANCE OF THE LARVA

Abbreviated development is known in some genera of hermit crabs such as *Cancellus* and *Paguristes* of the family Diogenidae. It has not been reported previously for any species of the Paguridae, although some genera and species are known to have rather large eggs and probably do hatch advanced larvae. Features in our species which are clearly related to the phenomenon of abbreviated development are of no phylogenetic importance. These include the presence of a single terminal process rather than plumose setae on the antennal endopodite, the reduction of mouthparts, and the probably reduced number of stages. The peculiar telson formation, the very high number of telson processes, and the presence of a fused fourth telson process prior to the appearance of the uropods also may be related to abbreviated larval history.

The telson of our larva bears some resemblance to that of *Parapagurus pilosimanus* Smith in advanced stages (see figures of the larvae attributed to *P. pilosimanus* by de Saint Laurent-Dechancé [1964] and by Williamson

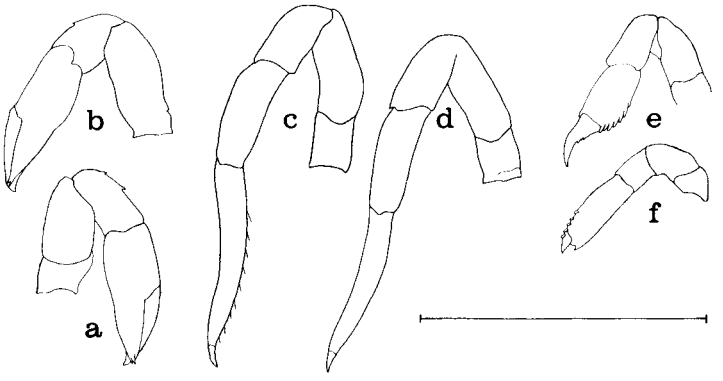

FIGURE 8. *Lithopagurus yucatanicus*, sp. n. Pereiopods dissected from buds of third zoea. a, lateral view of right cheliped; b, lateral view of left cheliped; c-f, second, third, fourth, and fifth pereiopods, respectively.

& von Levetzow [1967]), but the larvae as well as the adults are otherwise so distinct that this resemblance must be of no phylogenetic significance. In fact, the genus *Parapagurus* differs in many ways from other genera of hermit crabs; on the basis of morphology of the adults and larvae, that genus and several closely related to it probably will be separated from the rest of the Paguridae as a new family (de Saint Laurent-Dechancé, 1966: 258).

The only way in which our larva resembles the larvae of the Diogenidae while also differing from all described pagurid larvae is in the lack of posterior marginal carapace spines. It is possible that this feature too may be related to the abbreviation of the zoeal development.

The larva of our new genus differs from all previously described larvae of Paguridae (as well as from those of other families) in the nature of the antennal scale. Representatives of only a few genera of Paguridae have had larvae described previously (*Anapagurus,* several spp.; *Catapaguroides timidus*; *Orthopagurus schmitti*; *Pagurus*, many spp.; and *Spiropagurus elegans*), all of them very similar to each other in many characters. All these described pagurid larvae have a terminal spine on the antennal scale and lack armature on the lateral margin. Some diogenid larvae have a similar terminal spine, some lack it, but none has the lateral margin armed with stout spines as in our larva. It is not likely that this character is related to the abbreviation of development.

SYSTEMATIC POSITION OF THE GENUS

De Saint Laurent-Dechancé (1966) summarized the various characters of recognized value in classification of the Paguridae. At that time she suggested that the described genera of Paguridae *sensu stricto* can be divided

TABLE 1

COMPARISON OF SOME CHARACTERS OF *Tomopaguroides* AND *Lithopagurus*
(Data for *Tomopaguroides valdiviae* taken from Balss [1912] and de Saint Laurent [*in litt.*].)

	Tomopaguroides valdiviae	*Lithopagurus yucatanicus*
Unpaired pleopods in male	3	0
Unpaired pleopods in female	4	3
Abdomen	narrow	bulbous
Rostrum	shorter than front	in advance of front
Ocular scales	broad	narrow
Antennal scale	exceeding cornea by ¾ scale length	reaching only to proximal margin of cornea
Telson margin	with median notch, lobes spined	no median notch, armed with setae only
Carpus of minor cheliped, and of P_2 and P_3	without dorsal spines	with 2 or 3 dorsal spines
Size	CL 9 mm, major manus similar in length to CL	CL 3 mm, major manus longer than CL
Distribution	Western Indian Ocean (off E. Africa), 1079 m (Balss); Pacific, 564-1270 m (de Saint Laurent)	Western Atlantic, 143 (?) to 350 m

into three major groups based on number of gills, presence or absence of an accessory tooth on the ischium of the third maxilliped (lateral to the *crista dentata*), presence or absence of sexual tubes of the fifth coxae of males, and the complement of abdominal pleopods and gonopods. Genera in one of these groups, termed by that author the *Pylopaguropsis*-group, share the following: 13 pairs of gills, not 10 or 11 pairs; no sexual tubes in males, but gonopods usually present in one sex at least; and presence of an accessory tooth on the ischium of the third maxilliped. The group includes *Pylopaguropsis* Alcock, 1905, *Tomopaguroides* Balss, 1912, *Tomopaguropsis* Alcock, 1905, *Munidopagurus* A. Milne-Edwards & Bouvier, 1893, and *Xylopagurus* A. Milne-Edwards, 1880. All of these genera except *Tomopaguroides* have representatives in the western Atlantic Ocean. Larvae are not known for any of them.

On the basis of the characters listed above, our new genus apparently is allied to the *Pylopaguropsis*-group rather than to other described genera of Paguridae. A comparison of the genera in this group shows that they are very different from each other in general morphology. One of the characters uniting them (gonopods in one sex) has been consistently used

as a primary generic character for hermit crabs by all workers. No thorough evaluation of this and some other "generic" features has been published in recent years but a study of such characters and their usefulness in phylogeny is currently in progress (de Saint Laurent, *in litt.*). A detailed discussion of the systematic position of our new genus within the family must await additional knowledge.

New genera of pagurids remain to be described and, although some of them may prove to be more closely allied to our new genus, at present it is possible to say only that the closest known relative appears to be an Indo-West Pacific form, *Tomopaguroides valdiviae* (Balss, 1912), of the *Pylopaguropsis*-group. The two species, while sharing a number of gross features, differ in many ways. Some of the differences between them are listed in Table 1. Additional differences may be discovered when a detailed comparison with specimens of *T. valdiviae* can be made.

In the key which follows, *Tomopaguropsis problematica* males are placed twice, as there is apparently considerable variation in the size at which gonopods appear. The type, which has a shield length of 3.7 mm has only minute buds representing gonopods. Other males examined by me and having shield lengths of 3.8 mm, 4.3 mm, and 5.1 mm, show no evidence of gonopods, but one specimen (shield length, 4.1 mm), having one gonopore in the female position in addition to the normal male gonopores, does bear a pair of well-developed gonopods.

Characters given for males of *Munidopagurus macrocheles* and for females of *Tomopaguroides* have not been previously published and are based on observations by me and by Dr. de Saint Laurent, respectively.

A Key to the Genera and Western Atlantic Species of the "*Pylopaguropsis*-group" of the Paguridae

(The members of this group all have 13 pairs of gills and an accessory tooth on the ischium of the third maxilliped.)

Males

1. Male with one pair of gonopods 2
1. Male with two pairs of gonopods, or none 4

2. Male with no unpaired pleopods ..... *Lithopagurus yucatanicus,* sp. n.
2. Male with unpaired pleopods 3

3. Male with three unpaired pleopods ..... *Tomopaguroides* (Indo-Pacific)
3. Male with four unpaired pleopods ..... *Tomopaguropsis problematica* (A. Milne-Edwards & Bouvier, 1893)

4. Male with two pairs of gonopods, no unpaired pleopods ..... *Xylopagurus rectus* A. Milne-Edwards, 1880
4. Male without gonopods 5

5. Male without unpaired pleopods ..... *Munidopagurus macrocheles* A. Milne-Edwards, 1880
5. Male with unpaired pleopods 6
6. Male with three unpaired pleopods ..... *Pylopaguropsis atlantica* Wass, 1963
6. Male with four unpaired pleopods ..... *Tomopaguropsis problematica* (A. Milne-Edwards & Bouvier, 1893)

Females

1. Female with one pair of gonopods, even if rudimentary 2
1. Female without gonopods 3
2. Female with three unpaired pleopods ..... *Munidopagurus macrocheles*
2. Female with four unpaired pleopods 4
3. Female with three unpaired pleopods 5
3. Female with four unpaired pleopods ..... *Tomopaguropsis problematica*
4. Female with gonopods well developed ..... *Pylopaguropsis atlantica*
4. Female with gonopods rudimentary ..... *Tomopaguroides* (Indo-Pacific)
5. Dorsal surface of major manus obscured by short thick setae, no large spine or projection arising proximal to movable dactylus; calcified sixth abdominal plate convex; inhabits burrows in rock or rocklike sponge ..... *Lithopagurus yucatanicus*
5. Dorsal surface of major manus not obscured, a large projection on medial margin proximal to movable dactylus; calcified sixth abdominal plate concave; inhabits tubes usually of wood ..... *Xylopagurus rectus*

Sumario

Lithopagurus yucatanicus, Nuevo Genero y Especie de Cangrejo Hermitaño con una Larva Caracteristica

El John Elliott Pillsbury, barco de investigación de la Universidad de Miami, colectó frente a la Península de Yucatán, México, (146-350 m) tres ejemplares de un nuevo género y especie de cangrejo hermitaño, *Lithopagurus yucatanicus,* que vive en huecos de las rocas o en esponjas de aspecto rocoso.

El nuevo género, como otros cinco llamados por un investigador el "grupo-*Pylopaguropsis,*" tiene trece pares de agallas, un diente accesorio en el ischium del tercer maxilípedo y gonópodos en un sexo. Difiere de estos otros géneros en que el macho tiene un par de gonópodos pero no otros pleópodos, mientras que la hembra no tiene gonópodos, pero tiene tres pleópodos impares. La especie conocida más próxima a ésta parece ser *Tomopaguroides valdiviae* (Balss, 1912) del Indo-Pacífico occidental. Se da una tabla de diferencias de caracteres entre estas dos formas. Se

provee una clave, por sexo, para los géneros y especies del grupo-*Pylopaguropsis* del Atlántico occidental.

Los ejemplares se mantuvieron vivos en el laboratorio por lo menos durante cinco meses. Una de las hembras llevaba unos pocos huevos muy grandes, algunos de los cuales incubaron una larva que difiere en algunos caracteres de cualquiera previamente conocida de los otros géneros de cangrejo hermitaño. La larva tiene las piezas bucales reducidas y no se alimenta durante los estados de zoea, que sólo duran unos pocos días. Algunas de las peculiaridades de la larva están relacionadas con el acortamiento del período de desarrollo, pero la presencia de espinas laterales en la escama de la antena parece ser un carácter único y tiene valor taxonómico.

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