

SCIENTIFIC RESULTS OF EXPLORATIONS BY THE U. S.
FISH COMMISSION STEAMER ALBATROSS.

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No. XXXII.—REPORT ON THE CRUSTACEA OF THE ORDER STOMATOPODA
COLLECTED BY THE STEAMER ALBATROSS BETWEEN 1885 AND 1891,
AND ON OTHER SPECIMENS IN THE U. S. NATIONAL MUSEUM.

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THE material which forms the subject of this report is derived from various sources. It consisted at first of the Stomatopoda collected by the *Albatross* on her voyage around to the Pacific during the winter of 1887-'88. This had been referred to Prof. W. K. Brooks for a report, and it was at his request that I undertook the task. Subsequently the later collections of the *Albatross* were turned over to me, including the specimens collected during the expedition of 1891 under the direction of Dr. Alexander Agassiz. The Crustacea of that expedition had been referred to Dr. Walter Faxon, and I am indebted to him for the Stomatopoda. I have had, moreover, free access to the collection of Stomatopoda in the U. S. National Museum, including the earlier collections of the *Albatross*, specimens collected by the U. S. Fish Commission schooner *Grampus*, and specimens sent in by naval officers and others. Many of these specimens had already been identified by Mr. Richard Rathbun. I have been able to make also a small addition to the collection, consisting of four species collected by me in the Bimini Islands, Bahamas, while there, during the summer of 1892, in connection with the marine laboratory of the Johns Hopkins University.

The collection as it now stands before me consists of adults and larvæ, the former representing 34 species, distributed through 5 genera, as follows: *Gonodaetylus*, 2; *Odontodaetylus*, 2; *Pseudosquilla*, 6; *Lysiosquilla*, 5; and *Squilla*, 19. Of all these 14 are new species. They comprise inhabitants of tropical and temperate waters of both hemispheres. The collection of larvæ is large, but it contains nothing like a complete series of stages of any one species and almost no larva that can be referred with any certainty to its adult form. It does con-

tain, however, a few specimens of unusual interest, which will be described in the concluding section of this report.

As it has not been my intention to expand this report into a monograph of the group, I have gone into the matter of classification only so far as seemed necessary to indicate my views as to the relationships of the species with which I have had to deal. I have not used the comparatively recent classification of Gerstaecker (1889), because it does not seem to me at all satisfactory, but have followed Miers and Brooks, avoiding changes unless there appeared to be strong reasons for making them. In a preliminary paper, however (1893a), I pointed out that the species of the genus *Gonodactylus*, as it stood then, fell naturally into two groups, which I ranked provisionally as subgenera, and for one of which I proposed the name *Odontodactylus*. It seems better now to regard them as distinct genera, of which one retains the old name, while the other is described in this report under the new name just mentioned. It is possible that the latter will be found on future investigation to merge into the genus *Coronida*, but they appear to be distinct at present. The genera *Leptosquilla* and *Pterygosquilla* have been inserted in the key to the genera, although there seems to be hardly sufficient ground for separating them from the *Chloridella* section of the genus *Squilla*.

An analytical key is the best form in which to convey a general idea of the distinguishing characters of a group of species, but it can not always be made to show the natural affinities. Nevertheless I have endeavored to do so as far as possible, and with that end in view have rearranged the species of *Lysiosquilla* and *Squilla*. It will be noticed that the principal divisions that I have made in these genera do not correspond with the old divisions into *Lysiosquilla* and *Coronis* on the one hand, nor into *Squilla* and *Chloridella* on the other.

This work has almost all been done in the biological laboratory of the Johns Hopkins University, and I desire to express my thanks to Prof. Brooks for his advice and supervision. I am, however, alone responsible for any errors or omissions that it may contain. I have also to thank Mr. James E. Benedict and Miss Mary J. Rathbun, of the National Museum, for valuable assistance, and Mr. Baldwin for his care in making the greater part of the drawings.

Order STOMATOPODA.

This order may be defined as a group of malacostracous Crustacea in which the stalked eyes and the first pair of antennæ are borne upon distinct movable segments; the rostrum in the adult is separated by a movable joint from the carapace, which is small and does not cover the last four distinct thoracic segments; the first five of the eight pairs of thoracic limbs are not biramous and are adapted to serve as accessory mouth parts, the second pair being strongly developed into the large raptorial

limbs in which, as in the three following pairs, the terminal segment (dactylus) closes upon the next segment (manus) like the blade of a pen-knife; the last three pairs of thoracic limbs are biramous, having a lateral appendage upon the penultimate segment, and are adapted for walking; the abdomen is very strongly developed; tufted gills are carried upon the exopodites of the first five abdominal appendages and the sixth pair (uropods), which act with the telson as a powerful tail fin, are strengthened by a stout process from the basal segment ending in one or two spines.

Family SQUILLIDÆ.

We may regard the *Stomatopoda* as comprising a single family with the characteristics of the order. For the sake of avoiding circumlocution it has been found desirable to use certain technical expressions. They are mainly those already used by Brooks, but it may be well at this point to indicate briefly their meanings. According to our present morphological ideas the thorax of the *Malacostraca* consists of eight somites, and those which are usually left uncovered by the carapace in the Squillidæ are therefore the fifth, sixth, seventh, and eighth, and sometimes the fourth is also exposed (fig. 13). In the posterior half of the carapace there is often an irregular transverse depression, known as the cervical suture, and there is always besides a pair of longitudinal sutures (pl. XXI). In the genus *Squilla* there are often five longitudinal carinæ upon the carapace—an unpaired median one, an intermediate pair, and a lateral pair. The lateral carinæ are often continued into the anterior lateral spines, while the intermediate ones usually extend as marginal carinæ around the edges of the posterior lateral lobes (pl. XXI). The eyes are often flattened and have the corneal portion divided into two lobes. In that case there are two principal axes—the peduncular axis (*ab*, fig. 14), running from the base of the peduncle to the line between the lobes, and the corneal axis (*cd*, fig. 14), coinciding with the greatest diameter of the corneal portion. The three distal segments of the great raptorial limb are known as the carpus, manus, and dactylus (*e*, *m*, and *d*, fig. 7). In the higher species of *Squilla* there are eight principal ridges or carinæ upon the abdominal somites described as submedian, intermediate, lateral, and marginal (fig. 9, *sc*, *ic*, *lc*, and *mc*). The seventh abdominal somite, or telson, usually has a dorsal median carina, that I shall speak of as the crest, and there is sometimes a ventral one that may be called the keel. The projecting points on the margin of the telson fall into two series. The larger ones are the marginal spines, of which there are usually six (figs. 9, 16, *sm*, *im*, and *l*), with sometimes indications of an additional pair (fig. 16, *al*); the smaller ones are the denticles, of which there are six sets (fig. 16, *sd*, *id*, and *ld*). The arrangement of the denticles for each species is often characteristic and may be expressed in a formula. The formula for *Squilla mantis* is 3-4, 4-8, 1; which means that in this

species one may expect to find on each side of the median line of the telson three or four submedian denticles, from four to eight intermediate ones, and one lateral one.

ANALYTICAL KEY TO THE GENERA OF SQUILLIDÆ.

I. Sixth abdominal somite more or less completely fused with the telson.

The dactylus of the raptorial limb dilated at the base and without lateral teeth.
 PROTOSQUILLA, Brooks.

II. Sixth abdominal somite separated from the telson by a flexible joint.

1. Dactylus of the raptorial limb dilated at the base, and the manns without pectinations.

a. Antennary scales and uropods not unusually small.

Hind body strongly convex; raptorial dactyli without lateral teeth.

GONODACTYLUS, Latreille.

Hind body moderately convex; raptorial dactyli armed with lateral teeth..... ODONTODACTYLUS, new genus.

b. Antennary scales and uropods very small; hind body depressed; raptorial dactyli with lateral teeth..... CORONIDA, Brooks.

2. The dactylus of the raptorial limb, as a rule, not dilated at the base (dilated in *Leptosquilla*) and the manns provided with minute pectinations on the inner margin.

a. Telson with 6 marginal spines and never more than 4 denticles between the submedian and intermediate spines.

Body compact and convex; dactylus of raptorial limb not dilated and with not more than 3 lateral teeth or unarmed.

PSEUDOSQUILLA, Guérin.

Body loosely articulated and flattened; dactylus of raptorial limb not dilated and with at least 5 lateral teeth.. LYSIOSQUILLA, Dana.

b. Telson with 6 (rarely 8) marginal spines and, as a rule, with more than 4 intermediate denticles.

* Lateral margins of the first 5 abdominal somites expanded to equal three-fourths of the width of the median portion, measured between articulations.

Raptorial dactylus not dilated, with 10 to 11 teeth; abdomen, except the sixth somite, without submedian carinae.

PTERYGOSQUILLA, Hilgendorf.

** Lateral margins of the abdominal somites not greatly expanded, about one-fourth the width of the median portion.

Ophthalmic segment greatly elongated and prolonged beyond the rostrum for more than half its length; raptorial dactylus dilated at the base; abdomen, except sixth somite, without submedian carinae; eyes cylindrical..... LEPTOSQUILLA, Miers.

Ophthalmic segment not greatly elongated; raptorial dactylus not dilated, or very slightly so..... SQUILLA, Fabricius.

Genus GONODACTYLUS, Latreille.

Gonodactylus, LATREILLE, Encycl. Méth. Hist. Nat., x, p. 473, 1825; Cr. in Cuvier, Règne Anim., IV, p. 109, 1829.—MILNE-EDWARDS, Hist. Nat. Crust., II, p. 528, 1837.—DE HAAN, Siebold's Fauna Japonica, Crust., p. 220, 1849.—DANA, U. S. Expl. Exp., XII, p. 615, 1852.—MIERS, Ann. and Mag. Nat. Hist. (5) V, p. 115, 1880.—BROOKS, Voyage of the *Challenger*, XVI, ii, p. 55, 1886.

Diagnosis.—Stomatopoda having a movable joint between the sixth abdominal segment and the telson; the hind body convex; the dactylus of the raptorial claw enlarged at the base and with a sharp inner

edge that fits into a groove on the manus, and is without lateral teeth; and no pectinations upon the manus.

Remarks.—This genus, as it was defined by Miers (1880), included all those species in which the raptorial claw is without pectinations on the penultimate joint and has the dactylus dilated at the base. From this Brooks (1886) has separated two groups of species. One, the genus *Protosquilla*, includes forms having the dactylus unarmed and the telson fused with the sixth abdominal segment; the other, the genus *Coronida*, is composed of those species having the hind body depressed, the dactylus armed with spines on the inner edge, and possessing very small antennary scales and uropods. The forms that have remained up to this time in the genus *Gonodactylus* fall naturally into two groups, one clustered around the well-known *G. chiragra*, Latreille, and the other around *G. scyllarus*, Linnaeus. These two groups are so distinct that I am convinced that they should be given the rank of distinct genera. The first group forms the genus *Gonodactylus* proper and corresponds exactly to Brooks's definition, while the other, for which I propose the name *Odontodactylus*, would be excluded by his definition, and will be described below.

ANALYTICAL KEY TO THE SPECIES OF GONODACTYLUS.

* Telson with 3 rounded longitudinal prominences on the dorsal side.

Whole dorsal surface of telson beset with fine prickles, only the submedian marginal spines well developed, the other 2 pairs obsolete; sixth abdominal somite with 6 smooth carinae.....SPINOSUS, Bigelow.

Like the above, but with only 4 distinct carinae on the sixth abdominal somite, the whole dorsal surface of which is covered with prickles.

SPINOSISSIMUS, Pfeffer.

Dorsal surface of telson without prickles; two pairs of marginal spines well developed, only the lateral pair obsolete.....CHIRAGRA, Fabricius.

** Telson with more than 3 narrow carinae on the Dorsal side, and all 6 marginal spines developed.

The 5 narrow carinae of the telson grouped together on a hemispherical prominence.....GLABROUS, Brooks.

Seven closely packed dorsal carinae on the telson.....GRAPHURUS, Miers.

GONODACTYLUS SPINOSUS, Bigelow.

Gonodactylus spinosus, BIGELOW, Johns Hopkins Univ. Circ., 106, p. 101, June, 1893.

Diagnosis.—A *Gonodactylus* having cylindrical eyes, a transverse rostrum, with a long median spine and subacute antero-lateral angles; a smooth carapace, nearly oblong, the posterior margin being straight, but the rounded antero-lateral lobes projecting forward; the hind body strongly convex; the lateral margins of the first exposed thoracic segment not produced, of the next three segments rounded; the first five abdominal segments smooth above and with lateral marginal carinae, the sixth segment with six broad and smooth dorsal carinae, each ending in a spine; three high, rounded, longitudinal dorsal prominences on

the telson, the whole dorsal surface beset with numerous minute prickles; two large submedian marginal spines, with minute movable tips, the intermediate and lateral spines being obsolete, and the basal prolongation of the uropod ending in two flattened curved spines, of which the outer is the longer.

General description.—Except for the telson, this species corresponds in structure almost exactly with the well-known *G. chiragra*, Latreille. The telson also resembles that of the last-named species, but it has striking and characteristic differences. The three central dorsal prominences are higher than in *G. chiragra*, broader and more closely pressed together. The vertical diameter of the telson exceeds half the horizontal diameter, which is not the case in the other species. The basal carinae of the submedian and intermediate marginal spines are represented by broad, rounded, longitudinal prominences, separated from each other and from the central ones by narrow grooves. The lateral marginal pair of carinae is inconspicuous. But what is most characteristic is that the whole dorsal surface of the telson, except the bottom of the grooves, is roughened by minute projecting spines. The telson appears at first sight to have but a single large pair of marginal spines. Closer examination, however, reveals two small teeth on each side that are evidently homologous to the intermediate and lateral spines of such a form as *G. graphurus*, for instance. The submedian spines have a large number of minute denticles on their inner margins.

The first antennae are short, the second joint not extending beyond the eyes. The second antennae are nearly as long as the first pair, but the antennary scale is small, not larger than half the short carapace. The basal prolongation of the uropod is broad and flat and the spines are curved inward. The outer one has no tooth on its inner margin. The distal segment of the exopodite is about half as long as the proximal one, which bears nine movable spines.

When I published my preliminary description of this species I had not seen Pfeffer's paper (1889) in which he describes a very similar species from Zanzibar, *G. spinosissimus*. It is possible that the two forms may prove finally to be merely varieties of a single species, but at present they appear to be distinct in spite of the fact that they disagree in very few particulars. The chief differences are in the fifth and sixth abdominal somites. In our specimens there is but a single pair of carinae on the fifth somite, and the sixth bears six prominences with smooth and shining surfaces, the spaces between being somewhat pubescent. Each prominence or carina is tipped with a spine. The outer pair are the longer, the other four are of more nearly the same length, the intermediate pair being smaller and a trifle shorter than the submedian pair. The other form, on the contrary, has, according to Pfeffer, two pairs of carinae on the fifth abdominal somite, and on the sixth there are four rounded knobs, the middle pair near one another and separated from the lateral by a deep furrow. The last-mentioned pair is also

separated by furrows from the lateral portions of the somite, which are hardly at all elevated. Both these lateral portions and the knobs are thickly beset with strong upright independent spinules. In the absence of any intermediate form, *G. spinosus* may be regarded as a distinct species.

Size.—Length of the body, 2 em.

Locality.—Two female specimens, No. 4295, U.S.N.M., were collected by Col. N. Pike at Mauritins.

GONODACTYLUS CHIRAGRA (Fabricius).

Mantis marina barbadensis, PETIVER, Pterigraph, Americ, pl. xx, fig. 10.

Squilla chiragra, FABRICIUS, Ent. Syst., II, p. 513, 1793. Desmarest, Consid. Crust., p. 251, pl. XLIII, 1825.

Cancer (Mantis) chiragra, HERBST, Naturg. Krabben, II, p. 100, 1796.

Gonodactylus chiragra, LATREILLE, Encycl. Méth., x, p. 473, 1825.—MIERS, Ann. and Mag. Nat. Hist. (5), v, p. 118, 1880.—BROOKS, Voyage of the *Challenger*, XVI, ii, p. 56.

Gonodactylus smithii, POCKOCK, Ann. and Mag. Nat. Hist. (6), XII, 1893.

The collections of the U. S. Fish Commission and the National Museum contain a large number of specimens of this species from numerous localities among the Florida Keys, in the Gulf of California and the Abrolhos Islands. One specimen (No. 9493, U.S.N.M.) was collected by the *Albatross* at station 2323, off Havana, Cuba, at a depth of 163 fathoms, and I have added to the collection specimens taken in a foot or two of water on the sand flats in the Bimini Islands, Bahamas. They are common there, hiding among the algæ and under shells and stones. One specimen was found in a red sponge. When disturbed they move from one shelter to another with great rapidity. The coloring is distinctly protective, varying from a mottled green and white to a nearly pure green. I have also to record the occurrence of this species in burrows in the rock at Port Henderson, Jamaica.

In addition to these there is a single small specimen collected by W. L. Abbott in the Indian Ocean (No. 18457, U.S.N.M.) and a number of small specimens collected by Col. N. Pike at Mauritius (No. 2202, U. S. N. M.). These differ from the *G. chiragra* of our coast in that the carinæ of the sixth and terminal abdominal segments are narrow instead of being broadly rounded.

ODONTODACTYLUS, new genus.

Odontodactylus (subgenus), BIGELOW, Johns Hopkins Univ. Circ., 106, p. 100, June, 1893.

Gonodactylus (part), LATREILLE, Encycl. Méth. Hist. Nat., x, p. 473, 1825.—BERTHOLD, Abhandl. k. Gesellsch. Wiss. Göttingen, III, p. 30, 1847.—DE HAAN, Siebold's Fauna Japonica, Crust., p. 225, 1849.—WHITE, Proc. Zool. Soc., 1850, p. 96.—A. MILNE-EDWARDS, Nouv. Archiv. Mus. Hist. Nat., IV, p. 65 (foot-note), 1868.—MIERS, Ann. and Mag. Nat. Hist. (5), v, p. 115, 1880.—VON MARTENS, Sitz.-Ber. Gesel. Naturf., Berlin, 1881, p. 93.—POCKOCK, Ann. and Mag. Nat. Hist. (6), XII, 1893.

Diagnosis.—Stomatopoda having a movable joint between the sixth abdominal somite and the telson; the hind body moderately convex;

the dactylus of the raptorial limb dilated at the base and provided with lateral teeth; the rostrum more or less triangular but not produced into a spine; the telson strongly resembling that of the genus *Pseudo-squilla*, and as a rule with not more than two intermediate denticles.

Remarks.—This genus, which occupies an intermediate position between *Gonodactylus* and *Pseudosquilla*, was described by me in a preliminary paper (1893) as a subgenus of *Gonodactylus*, but it is sufficiently distinct to merit the rank assigned to it here.

ANALYTICAL KEY TO THE SPECIES OF ODONTODACTYLUS.*

- * Dactylus of raptorial limb with 2 lateral teeth.
 Rostrum transverse and subtriangular; median crest of telson elevated. SCYLLARUS, Linnaeus.
 Rostrum enlarged at the base and ending in a point; median crest of the telson lamellate, but much less elevated than in the next. BLEEKERII, A. Milne-Edwards.
 Rostrum quadrilateral; median crest of the telson lamellate and with a vertical height nearly equal to its distance from the lateral margin. CULTRIFER, White.
 Dactylus but little ventricose at the base; rostrum somewhat transverse, not acute; telson as broad as long dorsally, nearly smooth, with an acute ending in a spinule ELEGANS, Miers.
- ** Dactylus with more than 2 lateral teeth.
 Dactylus with 3 teeth; rostrum pentagonal with a short median point. TRACHURUS, von Martens.
 Dactylus with 3 teeth; rostrum ovately convex, its extremity bent downward; eyes very large and globular CARINIFER, Pocock.
 Dactylus with 5 to 7 small serrations on its inner margin; rostrum sinuate at the sides, tip obtuse and strongly incurved JAPONICUS, Berthold.
 Dactylus with 6 small lateral teeth; rostrum not sinuate but transverse and rounded in outline; eyes very large HAVANENSIS, Bigelow.
 Dactylus with 9 teeth; rostrum with evenly convex anterior border and evenly rounded angles; eyes large HANSENI, Pocock.
 Dactylus very little ventricose at base and with about 8 teeth on its inner margin; rostrum transverse BREVIROSTRIS, Miers.

ODONTODACTYLUS SCYLLARUS (Linnaeus).

Squilla arenaria prona, SEBA, Thesaurus, III, p. 5, 1758.

Cancer scyllarus, LINNÆUS, Syst. Nat. (ed. XII), p. 1054, 1766.

Squilla scyllarus, FABRICIUS, Ent. Syst., II, p. 512, 1793. LAMARCK, Hist. Anim. sans Vert., v, 1818, p. 189.

Cancer (Mantis) scyllarus, HERBST, Nat. Krabben, etc., II, p. 99, 1796.

Gonodactylus scyllarus, LATREILLE, Encycl. Méth., x, p. 473, 1825. etc.—MIERS, Ann. and Mag. Nat. Hist. (5), v, p. 115, 1880.

* All of the species in this key, except *havanensis*, have been described previously as species of *Gonodactylus*.

There is a female specimen in the National Museum, collected by A. B. Steinberger, at Samoa (No. 5147, U.S.N.M.).

Length of the body, 14 cm.

ODONTODACTYLUS HAVANENSIS, Bigelow.

Plate xx.

Gonodactylus havanensis, BIGELOW, Johns Hopkins Univ. Circ., 106, p. 101, June, 1893.

Diagnosis.—An *Odontodactylus*, having large, subspherical eyes; large antennal scales; the dactylus of the raptorial claw strongly dilated at the base and provided with six small marginal teeth besides the terminal one; a transverse rostrum without angles; a nearly square carapace with rounded corners; three exposed thoracic segments with rounded margins; six spines on the sixth abdominal segment; a dorsal crest and four other carinae on the telson, six margin 1 spines, the submedian pair with mobile tips, and numerous minute submedian denticles, two intermediate, and one lateral one on each side; rather large uropods with two simple basal spines, the outer one the longer.

General description.—A single specimen of this interesting species was found in a bottle with a young *G. chiragra* both having been collected by the *Albatross* in the Gulf of Mexico, off Havana. The body is short and broad, and is convex on the dorsal side (pl. xx). The sides of the carapace, thoracic segments, and abdomen form nearly a straight line. The width of the carapace at the anterior end equals one-fifth of the length of the body, while the width of the abdomen at the fifth segment equals about one-fourth of it. The rostrum is twice as broad as it is long and is evenly curved in front. The carapace is almost perfectly square. It is a little narrowed in front and the posterior and anterior margins are slightly incurved. Only three thoracic segments are exposed. These have rounded margins and like the carapace and the first five abdominal segments are devoid of carinae. The third, fourth, and fifth abdominal segments have posterior lateral spines. The sixth segment has six carinae ending in spines and two additional tubercles on each side, one between the submedian and intermediate carinae and another between the intermediate and lateral ones. There are no spines at the articulations of the uropods (fig. 1). The telson has a narrow elevated dorsal median crest ending in a

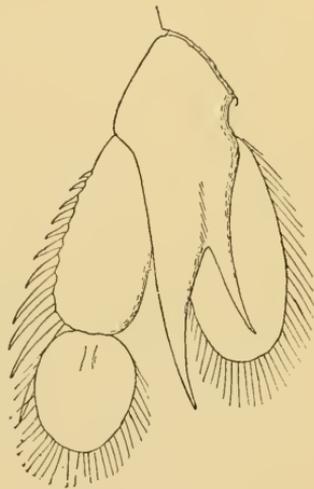


Fig. 1.

RIGHT UROPOD OF ODONTODACTYLUS HAVANENSIS.

Ventral side, five times natural size.

spine. The distance through the posterior part of the crest to the ventral surface of the telson is about equal to one-fourth of the width of the telson. The other four carinae are less elevated. The marginal spines are prominent and the movable tips of the submedian pair are much longer than in *O. scyllarus*. The basal prolongation of the uropod (fig. 1) is continued into two simple spines of which

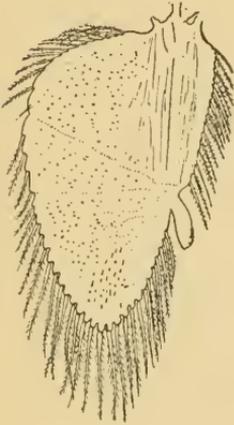


Fig. 2.

ENDOPODITE OF ODONTODACTYLUS HAVANENSIS.

Endopodite from first abdominal limb. Nine times natural size.

the outer one is the longer but is not so long as the exopodite. The distal joint of the latter is about two-thirds as long (measured on the ventral side) as the proximal one, which bears eleven movable spines. The eyes are very large, but are subspherical and not at all triangular. The width of the cornea equals 0.09 of the length of the body. The first antennae are short, the first three segments hardly extending beyond the eyes and almost equaling the flagella in length. The second antennae reach almost as far forward as the first pair. The antennary scales are large, very nearly equaling the carapace in length and half as wide. The raptorial claw is rather small. When folded it only reaches backward to the cervical suture of the carapace, and the dactylus is only three-fourths as long as the manus. The latter is devoid of spines or pectinations of any kind, and is provided with

a simple continuous groove for the reception of the dactylus when closed. The dactylus is strongly dilated at the base, and is provided with six very small and thin teeth on its inner edge. The appendages to the pleopod are linear. A remarkable peculiarity of the specimen before me is that while it is a male it is like a female in having no clasping organs on the exopodites of the first abdominal appendages, which are just like the succeeding ones (fig. 2).

It is probable that this is a very young specimen, and some of its characters may be due to its youth, but a young *G. chiragra* of the same size possesses the clasping organs and exhibits all the adult features.

Color.—The alcoholic specimen has a dark spot on the carapace and black markings on the uropods.

Size.—Length of body, 2 cm.

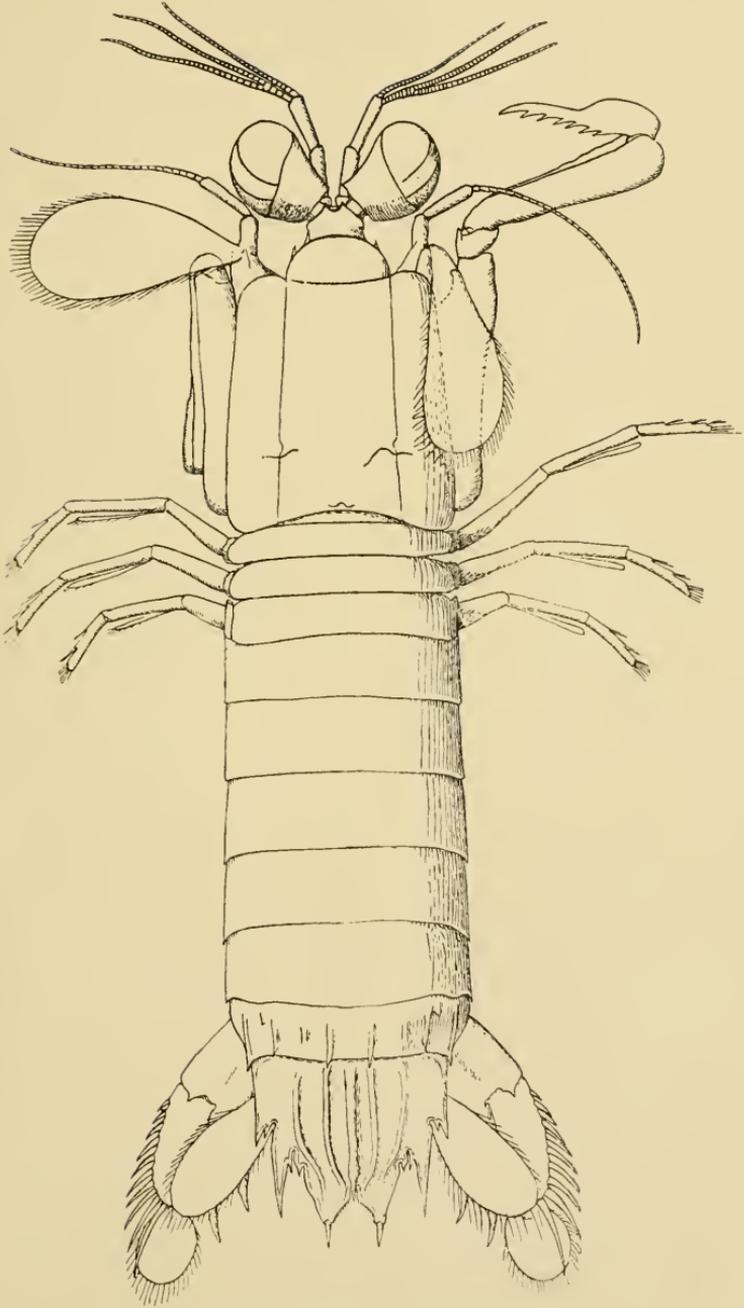
Locality.—The unique specimen was taken by the *Albatross* in 1885 at station 2323 at a depth of 163 fathoms off Havana, Cuba. (No. 17997, U.S.N.M.)

Genus PSEUDOSQUILLA (Guérin).

Squilla trapues, MILNE-EDWARDS, Hist. Nat. Cr. II, p. 525, 1837.

Squilla (sect. iii) *parallela*, DE HAAN, Siebold's Fauna Japonica, Cr., p. 221, 1849.

Pseudosquilla, GUÉRIN (ined.), DANA, U. S. Expl. Exp., XIII, Cr., 1, p. 615, 1852.—MILNE-EDWARDS, Ann. and Mag. Nat. Hist. (5), v, p. 108, 1880.—BROOKS, Voyage of the *Challenger*, XVI, ii, p. 53, 1886.



ODONTODACTYLUS HAVANENSIS.
About six times natural size.



Diagnosis.—Stomatopoda, with the sixth abdominal segment not fused with the telson; the hind body smooth, very convex, and narrow; the dactylus of the raptorial claw not dilated at the base and possessing not more than three lateral teeth, or in some cases none; the submedian spines of the telson long and having movable tips; not more than four intermediate denticles, usually one.

Remarks.—This genus is, as a whole, compact and well defined, but the three species that I have placed under B in the key are of doubtful affinities. *P. monodactyla*, Milne-Edwards, may prove to be an immature form; *P. stylifera*, Milne-Edwards, approaches *Gonodactylus* very closely; and *Gonodactylus ensiger*, Owen, seems to be closely related to the last.

ANALYTICAL KEY TO THE SPECIES OF PSEUDOSQUILLA.

A. *Pseudosquilla*, proper. Hind body narrow and thick; raptorial claw armed with a few marginal spines.

a. Basal prolongation of the uropod ending in 2 spines; dactylus with 3 teeth.

* Telson with crest and 4 other carinae.....? EMPUSA, De Haan.

* * Telson with a crest and 6 other carinae.

Eyes small and cylindrical.....CILIATA, Miers.

Eyes flattened, club-shaped, 2 eye-spots on carapace....ORNATA, Miers.

* * * Telson with crest and 8 other carinae.

Eyes flattened, club-shaped; rostrum with small median spine.

OCULATA, Brullé.

Eyes very large and triangular; rostrum without a spine.

MEGALOPHTHALMA, Bigelow.

b. Basal prolongation of the uropod ending in one long terminal spine having 2 other spines on its inner margin. Telson with crest and 10 other carinae.

* Dactylus with 3 teeth.

Rostrum with a long median and 2 short lateral spines.

LESSONII, Guérin.

Rostrum with prominent median spine but no lateral ones.

CERISII, Roux.

* * Dactylus with 4 teeth; telson wider than long.....PILAENSIS, de Man.

B. *Doubtful position.* Dactylus with a single terminal spine.

Telson smooth except for crest; many very minute submedian denticles; rostrum almost subtriangular, acute.....MONODACTYLA, Milne-Edwards.

Telson with crest and 2 other carinae; rostrum longer than wide, narrowed at the end.....STYLIFERA, Milne-Edwards.

Rostrum trispinose, median spine obsolete.

(? GONODACTYLUS) ENSIGER, Owen.

PSEUDOSQUILLA CILIATA, Miers.

? *Squilla ciliata*, FABRICIUS, Ent. Syst., II, p. 512, 1793.

Squilla stylifera, LAMARCK, Hist. Anim. sans Vert., v, p. 189, 1818.—LATREILLE, Encycl. Méth., x, p. 472, 1825.

Pseudosquilla stylifera, DANA, U. S. Expl. Exp., XIII, Cr., 1, p. 622, 1852.—? VON MARTENS, Archiv. f. Naturg., XXXVIII, p. 146, 1872.

Pseudosquilla ciliata, MIERS, Ann. and Mag. Nat. Hist. (5), v, p. 108, 1880.—BROOKS, Voyage of the *Challenger*, XVI, ii, p. 53.

This species is represented in the National Museum by a large number of specimens from the Florida Keys; one from Bermuda (Dr. F. V. Hamlin) (No. 5136, U.S.N.M.), and another from Honolulu (?) (No. 6584, U.S.N.M.). I found it also in abundance at Bimini, in the Bahamas, associated with *Gonodactylus chiragra* and resembling that species very closely in habits and coloring.

PSEUDOSQUILLA ORNATA, Miers.

? *Pseudosquilla oculata*, HELLER, Reise der Novara, Crust., p. 124, 1865, not BRULLÉ.
Pseudosquilla ornata, MIERS, Ann. and Mag. Nat. Hist. (5), v, p. 111, 1880.

The National Museum contains one specimen of this species, purchased from H. A. Ward (No. 15629, U.S.N.M.).

Locality.—Mauritius.

Length of body, 7.5 cm.

PSEUDOSQUILLA OCULATA (BRULLÉ).

Squilla oculata, BRULLÉ, in WEBB and BARTHELOT, Iles Canaries, Zool. Crust., p. 18, 1836-34.

Pseudosquilla oculata, MIERS, Ann. and Mag. Nat. Hist. (5), v, p. 110, 1880.

There is a small specimen in the National Museum that seems to belong to this species. It was collected by Col. N. Pike, U. S. Consul at Mauritius (No. 5137, U.S.N.M.).

The localities for this species given by Miers are the Canaries and Madeira.

PSEUDOSQUILLA MEGALOPHTHALMA, Bigelow.

Pseudosquilla megalophtalma, BIGELOW, Johns Hopkins Univ. Circ., 106, p. 101, June, 1893.

Diagnosis.—A *Pseudosquilla* with very large triangular eyes, the corneal axis being transverse; a very long, slender dactylus on the raptorial claw, with three teeth; a nearly heart-shaped rostrum without spines; narrow, rounded lateral processes on the first exposed thoracic segment, the lateral margins of the next two segments truncated; posterior lateral spines on the abdominal segments from the second to the fifth, and the usual six spines on the sixth segment, with a smaller additional one on the inner side of each intermediate spine; a crest and eight other carinæ on the telson, six marginal spines, the submedian pair being the longest and mobile; two simple spines on the basal prolongation of the uropod, and ten movable spines on the exopodite.

General description.—In the collection of the U. S. National Museum we have three specimens of *Pseudosquilla* from Mauritius, representing as many species. One of these may be identified as *P. ornata*, Miers, another as *P. oculata*, Brullé, and the third (No. 18003, U.S.N.M.) is a new species related to the other two, perhaps more closely to *oculata* than to the other. It is easily distinguished from both by its large triangular eyes. The conical axis is at right angles to the peduncular

one, which is eight-elevenths as long as the former and equals six one-hundredths of the total length of the body. The carapace is twenty-two one-hundredths of the total length and about two-thirds as wide as it is long. The abdomen is a little wider and the telson a little narrower. Its width is about equal to its length, leaving out the mobile spines, and this is about fourteen one-hundredths of the total length.

The rostrum is of a broad heart shape, truncated at the base. It is therefore intermediate in shape between the rostrum of *P. ornata* and *P. oculata*. The length equals five-sevenths of the width. It covers the ophthalmic segment completely. The carapace is relatively longer than in *P. ornata*, and is perfectly smooth and without angles. The lateral margins of the exposed thoracic segments are rounded and without spines—of the first they are narrow and of the next two broad and truncated. There is a pair of slight projections on the ventral side of the first segment corresponding to the ventral spines in *Squilla*, and there is a similarly placed pair of larger somewhat conical projections on the next segment. The abdominal segments from the first to the fifth have each a stout spine pointing downward and backward on the ventral median line. All but the first of these segments have the posterior lateral angle produced into short spines. The sixth segment has six broad dorsal carinæ ending in stout spines, and there is a small additional spine on the inner side of each of the regular intermediate ones. There is no spine in front of the articulation of the uropod. The telson is most nearly like that of *P. oculata*. It has the same number of carinæ, eight besides the crest, and the basal carinæ of the submedian and intermediate spines, but while in *P. oculata* the carinæ of the pair next the lateral marginal pair are parallel to the axis of the body, and point toward the intermediate spines, in this species they are oblique and continue out to the tips of the lateral spines. The submedian carinæ are serrated. The ventral surface of the telson is perfectly smooth. There are no submedian denticles, two intermediate, and one lateral one. The outer one of the two spines of the basal prolongation of the uropod is the longest, and is very nearly as long as the exopodite, the distal segment of which is larger than in *P. ornata*. The antennæ are much longer than in the other two species. The first three segments of the first pair are three-fourths as long as the carapace, and the flagellæ are also of about this length. The antennary segment bears a truncated collar-like process on each side. The second antennæ are about three-fourths as long as the first.

The antennary scale is three-fifths as long as the carapace. The raptorial claws are very long and slender. When folded the limb reaches from the eyes to the most posterior part of the carapace. The pectinations are confined to the proximal half of the penultimate joint. The appendages to the walking legs are linear.

Size.—Length of the body, 6.8 cm.

Locality.—The single specimen, a male, was purchased from H. A. Ward, and it was collected at Mauritius.

PSEUDOSQUILLA LESSONII (G u é r i n).

- Squilla cerisii*, GUÉRIN, Voy. *Coquille*, Crust., p. 40, 1830 (*S. lessonii* on plate).
Squilla spinifrons, OWEN, Proc. Zool. Soc., p. 6, 1832.
Squilla lessonii, MILNE-EDWARDS, Hist. Nat. Crust., II, p. 527.—WHITE, List Crust. Brit. Mus., p. 84, 1847.
Squilla monoceros, MILNE-EDWARDS, Hist. Nat. Crust., II, p. 526, 1837.—GAY, Hist. Chile Zool., III, Cr., p. 224, 1849.
Pseudosquilla lessonii, DANA, Crust. U.S. Expl. Exped., XIII, i, p. 622, 1852.—MIERS, Ann. and Mag. Nat. Hist. (5), v, p. 113, 1880.
Pseudosquilla marmorata, LOCKINGTON, Proc. Cal. Acad. Sci., p. 33, 1877.

A female individual is in the National Museum, collected by D. S. Jordan at Wilmington, Cal. (No 3081, U.S.N.M.), and several smaller specimens were taken by the *Albatross* with the Tanner combination towing net at the surface at Surface station 29 in S. Lat. 00° 46' 00", and W. Long. 89° 42' 00" (No. 18481, U.S.N.M.).

Length of largest specimen, 13 cm.

PSEUDOSQUILLA STYLIFERA (M i l n e - E d w a r d s).

Figure 3 (p. 505).

- Gonodactylus styliferus*, MILNE-EDWARDS, Hist. Nat. Crust., II, p. 530, 1837.—GAY, Hist. Chile, p. 225, 1849.
Pseudosquilla stylifera, MIERS, Ann. and Mag. Nat. Hist. (5), v, p. 112, 1880.

A specimen undoubtedly belonging to this species is in the possession of the Johns Hopkins University, having been sent by F. W. Simonds. It was caught by a fisherman in a gill net off Dead Man's Island, San Pedro, Cal. This specimen corresponds exactly to Miers's description, except that the telson can hardly be said to have "8 large marginal teeth." It has the usual six marginal spines, the submedian pair having small movable tips, and a broad rounded denticle between the submedian and intermediate spine on each side. (See fig. 3, p. 505.) An additional minute movable spine should appear on the raptorial manus of this figure, and also a minute denticle on the outer edge of the basal prolongation of the uropod.

The color of the living animal, according to Mr. Simonds's memorandum, was violet.

The length of the body is 14.5 cm.

Genus LYSIOSQUILLA, Dana.

- Coronis*, LATREILLE, Encycl. Méth. Hist. Nat., x., p. 474, 1825; Crust. in Cuvier's Règne Anim., IV., p. 109, 1829.—MILNE-EDWARDS, Hist. Nat. Crust., II, p. 530, 1837.—GERSTAECKER, Arthropoda, in Bronn's Klass. und Ord. des Tierreichs, v, ii, p. 743, 1889.
Squilla (♂), MILNE-EDWARDS, Hist. Nat. Crust., II, p. 518, 1837.
Squilla (sect. i, *Maculata*), DE HAAN, Fauna. Japon. Crust., p. 220, 1849.
Lysiosquilla, DANA, Crust. U.S. Expl. Exped., XIII, p. 615, 1852.—MIERS, Ann. and Mag. Nat. Hist. (5), v, p. 5, 1881.—BROOKS, Voyage of the *Challenger*, XVI, ii, p. 44, 1886.

Diagnosis.—Stomatopoda having the sixth abdominal segments separated from the telson by a movable joint; the hind body depressed, loosely articulated, and wide; the dactylus of the raptorial claw without a basal enlargement, but with not less than five marginal teeth; no more than four denticles, and often only one, between the intermediate and submedian marginal spines of the telson, which is usually wider than long; and the outer spines of the basal prolongation of the uropod usually longer than the inner one.

Remarks.—Although the name *Coronis* antedates *Lysiosquilla*, the latter is the proper name for this genus, because the former was used first by Hübner in 1816 for a genus of *Lepidoptera*. The species of *Lysiosquilla* may be separated into two subgroups; one, corresponding to Latreille's genus *Coronis*, includes those in division A and B a of the following key. They all have small eyes and broad appendages to the walking legs. The three species in B a, however, have characters which place them in an intermediate position between A and B b, the latter division corresponding to Dana's genus *Lysiosquilla* proper, which is characterized by the possession of large triangular eyes and linear appendages to the walking legs. Brooks has pointed out the relationship between *Coronis* and the lower forms of *Squilla*.

ANALYTICAL KEY TO THE SPECIES OF LYSIOSQUILLA.

A. Telson with a transverse row of dorsal spines in addition to the marginal ones, eyes as a rule cylindrical.

a. Dactylus of the raptorial limb with 6 or 7 teeth.

* Five dorsal spines on the telson.

Telson with about 12 minute submedian denticles; rostrum quadrate with lateral angles right angles; dactylus with 6 teeth.

ACANTHOCARPUS (Gray) Miers.

The same, but dactylus with 7 teeth.

ACANTHOCARPUS var. SEPTEMSPINOSA, Miers.

Telson with 12 minute submedian denticles; lateral angles of rostrum rounded; dactylus with 6 teeth; transverse markings without eye-spots..... SARACINORUM, F. Müller.

Telson with 6 to 8 submedian denticles; not minute, transverse markings, with eye-spots on carapace and telson; dactylus with 6 teeth.

BIMINIENSIS, Bigelow.

* * Seven dorsal spines on the telson.

Dactylus with 6 teeth..... BRAZIERI, Miers.

Dactylus with 7 teeth..... LATIFRONS, de Haan.

b. Dactylus with 10 or 12 teeth.

Telson with 3 dorsal spines..... SPINOSA, Wood-Mason.

Telson with 8 scarcely discernible dorsal spines..... EUSEBIA, Risso.

[NOTE.—*Squilla indefensa*, Kirk (1879), and *Squilla tridentata*, Thomson (1882), are probably *Lysiosquillae* belonging in this section (Cf. Miers, 1880, p. 125), while *Squilla laris*, Hutton (1879), appears to belong in this section or the next.]

B. Telson without dorsal spines.

a. Eyes small.

* Dactylus with 10 teeth. Eyes small, with cornea oblique and somewhat flattened; telson with 6 marginal spines, the submedian mobile, and on each side 7 to 9 minute submedian denticles, 4 intermediate and 1 lateral..... ARMATA, Smith.

- * * Dactylus with 12 teeth. Eyes nearly globular; telson nearly square, without (?) teeth or spinesSCOLOPENDRA, Latreille.
- * * * Dactylus with 15 to 16 teeth. Eyes cylindrical; telson nearly square, with a pair of mobile submedian spines and 10 submedian denticles.
EXCAVATRIX, Brooks.

b. Eyes large and subtriangular.

- Dactylus with 5 to 7 teeth. Telson smooth, with a slight median elevation and 6 marginal spines, only the lateral pair acute.

GLABRIUSCULA (Lamarck) Meyers.

- * * Dactylus with 9 to 10 strong teeth.

Hind body smooth and telson like the preceding.

MACULATA Fabricius.

Hind body with longitudinal wrinkles; sixth abdominal somite grotesquely sculptured; telson smooth.....MIERSII, De Vis.

Telson roughened with fine granulations on each side of the flattened shield-like crest; 6 strong and acute marginal spines; submedian denticles fused.....SCABRICAUDA, Lamarck.

- * * * Dactylus with 11 teeth. Telson like the preceding, but more spinous.

DESATSSUREI, Stimpson.

- * * * * Dactylus with 20 teeth. Telson nearly as in *maculata*, eyes (?).

POLYDACTYLA, von Martens.

LYSIOSQUILLA BIMINIENSIS, Bigelow.

Lysiosquilla biminiensis, BIGELOW, Johns Hopkins Univ. Circ., 106, p. 102, 1893.

Diagnosis.—A *Lysiosquilla* having cylindrical eyes; 6 teeth on the dactylus of the raptorial claw, the terminal one the strongest; broadly ovate appendages on the first 2 pairs of pleopods and strap-shaped ones on the third pair; a nearly quadrate rostrum with a median spine; a smooth carapace without angles; the angles of the segments of the hind body rounded, except the posterior lateral angles of the sixth abdominal segment, which are produced into spines; a long spine curving backward on the anterior edge of the articulation of the uropod; a transverse row of 5 dorsal spines on the telson, and 6 marginal spines, the submedian pair being mobile; on each side 3 to 4 submedian denticles, not minute, 4 intermediate and 1 lateral one.

General description.—This species from the Bahamas may prove to be identical with the Australian *L. acanthocarpus*, but Miers does not mention the very striking coloring of our species, and the raptorial claw and the telson seem to differ.

The body (fig. 4) is rather flat, generally smooth, and somewhat loosely put together. The carapace and the exposed thoracic region each occupy a little less than one-fifth the total length of the body. The width of the carapace is about seventy-five-ninetieths of its length on the median line, while this is equaled by the greatest width of the abdomen. The length of the telson is three-sevenths its width and one-third the length of the carapace. The eyes are small and cylindrical and their bases are covered by the rostrum. The latter is nearly square and has a sharp median spine that reaches forward to the proximal edge of the corneal parts of the eyes. The carapace has

rounded anterior and posterior lateral lobes. The cervical suture is faintly marked on the outer side of each of the two longitudinal sutures.

The exposed thoracic and first five abdominal segments are devoid of carinae or spines. The sixth abdominal has a short spine at each of its posterior lateral angles and a larger spine curved backward in front of the articulation of each uropod (fig. 5). The telson is perfectly smooth except for a transverse row of five spines on the dorsal side near the posterior margin (figs. 4 and 6). The mobile submedian

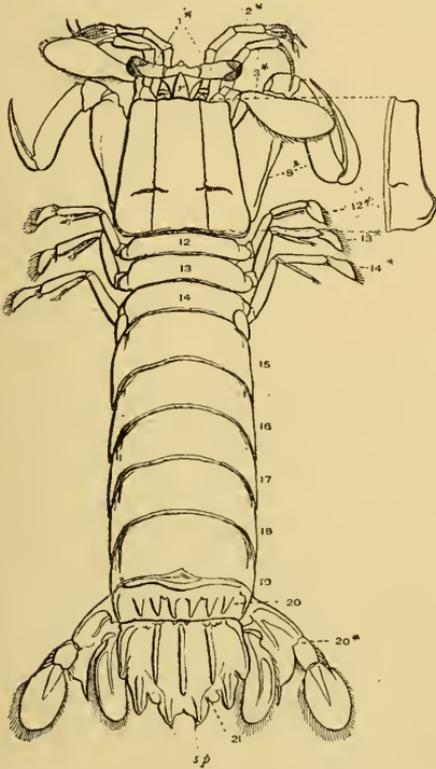


Fig. 3.

PSEUDOSQUILLA STYLIFERA.

Drawn by W. F. Simonds. About half natural size.

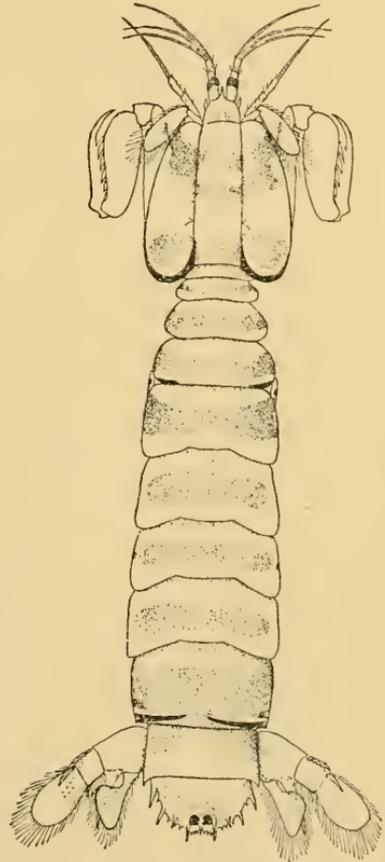


Fig. 4.

LYSIOSQUILLA BIMINIENSIS.

About twice natural size.

pair of marginal spines are placed a little toward the ventral side and are curved upward (figs. 5 and 6). They are not much longer than the adjoining denticles. Judging from Miers's figure, the marginal spines in our species as well as the submedian denticles are considerably larger than in *L. acanthocarpus*, and there appears to be no median sinus in the latter species, while there is a small one in the former. The basal segment of the uropod (fig. 5) bears two stout spines, of which the inner is much the longer. The endopodite is cleaver-shaped.

The distal segment of the exopodite exceeds in length the proximal segment, which bears six movable spines. The antennae of the first pair are about equal to the carapace in length. The three basal seg-

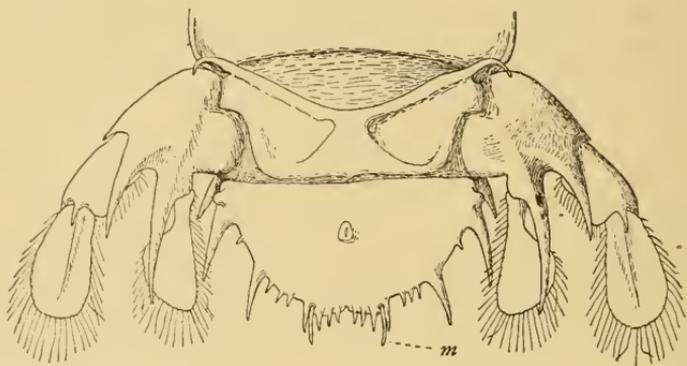


Fig. 5.

TELSON AND UROPODS OF *LYSIOSQUILLA BIMINIENSIS*.

Seen from below. Five times natural size. *m*—Movable spine.

ments do not reach much beyond the eyes. The antennary somite is armed with a pair of sharp lateral spines. The second antennae are about as long as the first. The antennary scale is very small, about one-third as long as the carapace. The raptorial limbs are well developed, but are not very long (fig. 7). The carpus has a simple ridge on its anterior side ending distally in a spine. The manus is stout and bears four movable spines. The dactylus is slender and graceful. The terminal spine is much larger than the other five but the one next to it is not very small, as it is in *L. acanthocarpus*. The appendages to the first two pairs of walking legs are almost circular in outline, while they are strap-shaped on the next pair.

Color.—The coloration of this species is peculiar and characteristic. The ground color is an opaque white and this is marked by transverse bands, one on the

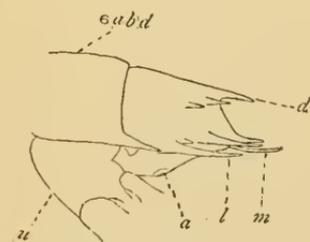


Fig. 6.

SIDE VIEW OF TELSON OF *LYSIOSQUILLA BIMINIENSIS*.

About $4\frac{1}{2}$ times natural size.

- d*.—Dorsal median spine.
m.—Submedian mobile spine.
l.—Lateral spine.
6abd.—Sixth abdominal somite.
a.—Anus.
u.—Uropod.

rostrum, two or three on the carapace, and one on each of the segments posterior to it (fig. 4). On one of my two specimens, a male, these bands were fawn-colored, on the other one, a female, they were pink, and in addition to this fawn color or pink, as the case might be, the band was marked by a fine dark reddish brown stippling. In both specimens

the posterior lateral lobes of the carapace are bordered by a narrow band of deep black, separated from the rest of the carapace by a similar band of bright lemon yellow, forming conspicuous eye-spots. There are also two pairs of yellow and black stripes on the last thoracic and on the fifth abdominal segments bordering the posterior margin for some distance inward from the angle, and the telson has a pair of black eye-spots edged in front with yellow, one on each side of the median line, just in front of the dorsal spines. All except the black markings wash out in alcohol.

Size.—Length of body, 4.8 cm.

Locality.—Two specimens, a male and a female, were found by me in a burrow in the sand at Nixies' Harbor, Bimini Islands, Bahamas (No. 17999, U.S.N.M.).

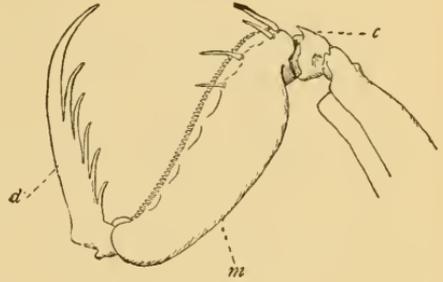


Fig. 7.

LEFT RAPTORIAL CLAW OF FEMALE *LYSIOSQUILLA*
BIMINIENSIS.

About $4\frac{1}{2}$ times natural size.

c. Carpus. m. Manus. d. Dactylus.

LYSIOSQUILLA ARMATA, Smith.

Lysiosquilla armata, SMITH, Proc. U. S. Nat. Mus., III, 1881, p. 413.

The collection contains a female and a mutilated male from the stomach of a flounder. They were dredged by the U. S. Fish Commission steamer *Fish Hawk*, at stations 1247 and 1251, southwest of Gay Head, Martha's Vineyard, at a depth of 27 and 17 fathoms, bottom sand (No. 12787, U.S.N.M.). Although these specimens were identified by Prof. Smith himself, as shown by the label, they differ somewhat from his description. The eyes in both specimens are not large and are only a little more than half as broad as the rostrum. The posterior part of the body of the male is destroyed, but in the female the posterior margins of the fourth, fifth, and six abdominal segments and the lateral margins of the telson in front of the lateral spines are smooth, entirely devoid of the slender spines or spinules described by Smith. It may be that the possession of these spinules is a sexual character of the male. The telson of the female has six well-developed marginal spines, the submedian pair being very slender and mobile. There are seven to nine very small submedian denticles on each side, four intermediate ones, two of them being very large, flattened, and rounded in outline, and two others alternating with them, being very small and acute, and there is one small lateral denticle on each side. The rostrum is tipped with a small spine.

Size.—Length of body, 5.8 cm. Width of rostrum, 3 mm. Length of corneal axis of eye, 2 mm.; peduncular axis, 2.5 mm.

LYSIOSQUILLA GLABRUSCULA, Miers.

? *Squilla glabruscula*, LAMARCK, Hist. Anim. sans Vert., v., p. 188, 1818.—LATREILLE, Encycl. Méth. Hist. Nat., x, p. 470, 1825.—MILNE-EDWARDS, Hist. Nat. Crust., II, p. 519, 1837.

Squilla vittata, MILNE-EDWARDS, Hist. Nat. Crust., II, p. 519, 1837.—WHITE, List Crust. Brit. Mus., p. 83, 1847.—GIBBES, Proc. Amer. Assoc., p. 199, 1850.

Lysiosquilla glabruscula, MIERS, Ann. and Mag. Nat. Hist. (5), v, p. 7, 1880.

There are two specimens of this species in the National Museum, collected by Dr. Whitehurst at Garden Key, Tortugas, Fla. (No. 2052, U. S. N. M.). They are a male and a female; the latter is the larger and is 21.3 cm. long. The dactyli of the raptorial claws of the male have six very long teeth. The female, on the contrary, has but three very short lateral teeth in addition to the long terminal one.

LYSIOSQUILLA MACULATA (Fabricius).

Squilla arenaria, RUMPH, Amboin. Rarit., p. 6, 1705.

Squilla maculata, FABRICIUS, Ent. Syst., II, p. 511, 1793.

Cancer (Mantis) arcuarius, HERBST, Nat. Krabben u. Krebse, II, p. 96, 1796.

Lysiosquilla maculata, MIERS, Proc. Zool. Soc., p. 138, 1877; Ann. and Mag. Nat. Hist. (5), v, p. 5, 1880.—BROOKS, Voy. of the *Challenger*, XVI, II, p. 45, 1886.

This species is represented by three specimens in the National Museum, a male collected by Dr. William H. Jones, U. S. Navy, of the U. S. S. *Wachusett*, at Tawhae, Marquesas, in 1884 (No. 6593, U.S.N.M.), and a female collected by A. B. Steinberger at Samoa (No. 5148, U.S.N.M.). The latter is 30 cm. in length and exhibits the same peculiarity of the raptorial claws that Miers describes. The dactylus has a stout terminal tooth and seven or eight very small lateral teeth. The third specimen (No. 3392, U.S.N.M.), also collected by Steinberger, is the raptorial claw of a male from Samoa and exhibits ten well-developed teeth (including the terminal one) on the dactylus. This is evidently a true case of sexual dimorphism.

LYSIOSQUILLA SCABRICAUDA (Lamarck).

Squilla scabricauda, LAMARCK, Hist. Anim. sans Vert., v, p. 188, 1818.—LATREILLE, Encycl. Méth. Hist. Nat., x, p. 470, 1825.

Squilla hoeveni, HERKLOTS, Addit. Faun. carcin. Afric. occident., p. 17, 1851.

Lysiosquilla inornata, DANA, U. S. Expl. Exped., XIII, Crust., I, p. 616, 1852.

Lysiosquilla scabricauda, MIERS, Ann. and Mag. Nat. Hist. (5), v, p. 7, 1880.

There are two specimens, a female and a young male, in the Museum, collected by Henry Hemphill at Johns Pass, Fla. (No. 6471, U.S.N.M.), one male specimen collected by D. S. Jordan at Key West, Fla. (No. 14112, U.S.N.M.), a female from Galveston, Tex. (M. Wallace, No. 2268, U.S.N.M.), and another from Pensacola, Fla. (Silas Stearns, No. 5150, U.S.N.M.), and a male collected by James D. Dana at Rio de Janeiro (No. 2115, U.S.N.M.). The dactyli of the raptorial claws seem to be a little smaller in the females than in the males, but there is nothing like the difference seen in *L. glabruscula* and *L. maculata*.

Genus *SQUILLA*, Fabricius.

Squilla, FABRICIUS (part), Ent. Syst., II, p. 511, 1798.—LATREILLE (part), Hist. Nat. Crust., VI, p. 271, 1803; Encycl. Méth. Hist. Nat., X, p. 467, 1825.—LAMARCK (part), Hist. Anim. sans Vert., V, p. 186, 1818.—MILNE-EDWARDS (part), Hist. Nat. Crust., II, p. 517, 1837.—DE HAAN (part), Fauna Japon. Crust., p. 220, 1849.—DANA, Crust., U. S. Expl. Exped., XIII, I, p. 615, 1852.—MIERS, Ann. and Mag. Nat. Hist. (5), V, p. 16, 1880.—BROOKS, Voyage of the *Challenger*, XVI, II, p. 23, 1886.—GERSTAECKER, Bronn's Klass. u. Ord. des Thier., V, II, p. 742, 1889.

Chlorida, EYDOUX and SOULEYET, Voy. de la *Bonite*, Zool., I, Crust., p. 264, 1841.

Chloridella, MIERS, Ann. and Mag. Nat. Hist. (5), V, p. 13, 1880.—GERSTAECKER, Bronn's Klass. und Ord. des Thier., V, II, p. 743, 1889.

Diagnosis.—Stomatopoda having the telson attached to the sixth abdominal segment by a movable joint; the hind body depressed and wide; the dactylus of the raptorial claw with usually not more than six teeth; as a rule, more than four intermediate denticles on the telson, which is usually longer than wide; and the inner basal spine of the uropod the longer of the two.

Remarks.—This is by far the largest and most diversified of the genera of Stomatopoda. I have followed Brooks in including within it the old genus *Chloridella* (Eydoux and Souleyet) Miers, the chief characteristic of which is the shape of the eyes. The species that Miers referred to are contained in division B a of the following key, but no sharp line can be drawn between these and those species having the small eyes (e. g., *S. dubia*), which have been placed in different divisions of the genus, where many other characters indicate that they belong.

ANALYTICAL KEY TO THE SPECIES OF *SQUILLA*.

A. Submedian spines of the telson with movable tips.

a. Submedian carinae absent or obsolete on the first five somites of the abdomen.

* Dactylus of the raptorial limb with 4 teeth, including the terminal one.

Lateral process of the fifth thoracic somite very short and acute; no keel on the telson..... QUADRIDENS, Bigelow.

Lateral process of the fifth thoracic somite broad, curved slightly forward, and blunt; telson with a keel..... POLITA, Bigelow.

** Dactylus with 5 teeth. Lateral process of the fifth thoracic somite flattened antero-posteriorly, short, straight, and blunt.

DESMARESTII, Risso.

*** Dactylus with 10 teeth. Telson nearly smooth, with denticles 13, 18, 1.

GRACILIPES, Miers.

b. Submedian carinae present on all abdominal somites, except the telson.

Dactylus with 4 teeth; 5 longitudinal crests on the telson.... MILES, Hess.

Dactylus with 7 to 9 teeth; telson with crest and keel, and curved lines of pits; denticles 0, 10-11, 1..... ARMATA, Milne-Edwards.

B. Submedian spines of the telson with immovable tips.

a. Hind body without submedian carinae except the sixth abdominal somite; eyes small.

a¹. Raptorial dactylus with 4 teeth.

* Anterior lateral angles of the carapace rounded. ROTUNDICAUDA, Miers.

** Anterior lateral angles of the carapace produced into spines.

Rostrum semioval MICROPHITALMA, Milne-Edwards.

Rostrum emarginate LATREILLEI, Eydoux and Souleyet.

*a*ⁱⁱ. Dactylus with 5 teeth.

Rostrum wider than long.

CHLORIDA, Brooks. [= ? DECORATA, Wood-Mason.]

*a*ⁱⁱⁱ. Dactylus with 6 teeth, eyes nearly cylindrical.

Telson with crest and obsolete curved lines of pits; denticles 0, 6-7, 1.

LATA, Brooks.

Telson with 4 or 5 carinae on each side of the crest; denticles 4, 8, 1.

FASCIATA, de Haan.

b. 8 distinct carinae on the first 5 abdominal somites, the dorsal surface of the telson on each side of the crest either smooth or marked by symmetrically curved lines of pits.

b'. Lateral process of the fifth thoracic somite on each side a single spine, a pair of ventral spines also present.

1. Eyes small.

Eye stalk dilated; lateral spine of the fifth thoracic somite prominent, flattened dorso-ventrally, and acute; denticles on telson 1-3, 3-4, 1 DUBIA, Milne-Edwards.

Eyes triangular, stalk not dilated; lateral spine of the fifth thoracic somite short, flattened antero-posteriorly, and blunt; denticles on the telson 3-4, 8, 1 PARVA, Bigelow.

2. Eyes large and triangular.

* Dactylus with 4 teeth. Denticles on the telson 12, 12, 1.

LEPTOSQUILLA, Brooks.

* * Dactylus with 5 teeth.

Lateral spine of the fifth thoracic somite straight and acute.

DUFRESNII (Leach), Miers=PRASINOLINEATA (Dana), Ives.

Lateral spine of the fifth thoracic somite longer and slightly curved PRASINOLINEATA (Dana ?), Miers.

Lateral spine of the fifth thoracic somite strongly falcate and acute SCORPIO, Latreille.

* * * Dactylus with 6 teeth.

Corneal and peduncular axes of the eye at right angles; lateral spine of the fifth thoracic somite short, straight, and acute; denticles on the telson 5-6, 11-12, 1 MANTOIDEA, Bigelow.

Corneal and peduncular axes of the eye nearly at right angles; lateral spine of the fifth thoracic somite curved forward and acute; marginal spines of the telson enormously developed in the males; denticles 3-4, 5-7, 1 ACULEATA, Bigelow.

Corneal and peduncular axes of the eye distinctly oblique to one another; lateral spine of the fifth thoracic somite curved forward and acute; no thickening of the telson in males; denticles 4, 6-8, 1 EMPUSA, Say.

* Lateral spine of the fifth thoracic somite straight and acute, margin of telson slightly thickened in males; denticles 3 or 4, 8-11, 1 MANTIS, Latreille.

Lateral spine of the fifth thoracic somite spatuliform, otherwise like *S. mantis* NEGLECTA, Gibbes.

Lateral spine of the fifth thoracic somite curved forward and acute; margin of the telson much thickened in males, the thickening being interrupted on the outer side of each of the 6 marginal spines; denticles 5, 10-11, 1-2.

PANAMENSIS, Bigelow.

Lateral spine of the fifth thoracic somite very strongly curved forward; marginal thickening on the telson of the males continuous between the intermediate spines; denticles 4-6, 10-13, 1 INTERMEDIA, Bigelow.

- Males with a continuous thickening all around the outer margin of the telson; keel produced into a sharp spine; denticles 5 to 7, 15-19, 1..... BIFORMIS, Bigelow.
- * * * * Dactylus with 8 teeth. Manus of raptorial limb with numerous immobile marginal spines RAPHIDEA, Fabricius.
- b'. Lateral processes of the fifth thoracic somite bilobed; no ventral spines on this somite.
1. Eyes small. Median carina of the carapace deeply bifurcated.
NEPA, Latreille.
 2. Eyes large.
 - * Dactylus with 5 teeth. Lateral processes of the sixth and seventh thoracic somites bilobed..... QUINQUEIDENTATA, Brooks.
 - * * Dactylus with 6 teeth.
 - Lateral processes of the sixth and seventh thoracic somites bilobed..... AFFINIS, Berthold.
 - Lateral processes of the sixth and seventh thoracic somites not bilobed, posterior lateral angles of the carapace simply rounded..... ALBA, Bigelow.
 - Lateral processes of the sixth and seventh thoracic somites not bilobate, posterior lateral angles of the carapace project as rather prominent lobes LEVIS (Hess) de Man.
- c. Eight or more carinae on the first 5 abdominal somites, the dorsal surface of the telson marked by carinae in addition to the median crest and the carinae at the bases of the marginal spines and denticles.
- c'. Eight abdominal carinae.
- * Dactylus with 3 teeth. Telson with 1 carina on each side of the crest..... VERUSSACHI, Ronx.
 - * * Dactylus with 6 teeth. Telson with 10 carinae on each side of the crest..... RUGOSA, Bigelow.
- c''. More than 8 abdominal carinae.
- * Dactylus with 5 teeth.
 - Nine carinae on the hind body SUPPLEX, Wood-Mason.
 - Very many carinae on the hind body; lateral processes of the exposed thoracic somites bilobate..... MULTICARINATA, White.
 - * * Dactylus with 6 teeth. Hind body with 5 median and 6 lateral carinae; lateral processes of the exposed thoracic somites bilobed COSTATA, de Haan.

SQUILLA QUADRIDENS, Bigelow.

Squilla quadridens, BIGELOW, Johns Hopkins Univ. Circ. 106, p. 100, 1893.

Diagnosis.—A *Squilla* with small triangular eyes having the corneal axis slightly shorter than the peduncular and somewhat oblique; dactylus of raptorial claw short, with four teeth; rostrum nearly flat and ovate; carapace without carinae except at the posterior lateral angles, which are rounded, anterior lateral angles nearly right angles and subacute; exposed thoracic segments without submedian carinae, lateral process of the first very short and acute, of the second and of the third broadly rounded; without submedian carinae on abdominal somites except the sixth; telson having a low crest ending in a spine and shallow symmetrically curved furrows on each side, no ventral keel, six marginal spines, the submedian with mobile tips, and between them on each side four to five submedian teeth, six to eight intermediate, and

one lateral; uropod having four to five movable spines on its outer edge; its basal prolongation with six long teeth on its inner edge and a large rounded lobe on the outer edge of the inner spine.

General description.—Unfortunately this species has to be described from a single small specimen. The general form of the body is flattened and rather compact. The greatest width of the abdomen equals the length of the carapace and one-fourth of the total length of the animal, measured from the anterior extremity of the ophthalmic segment to the base of the median marginal sinus of the telson. The greatest width of the carapace equals nine-elevenths of its length. The antero-lateral angles of the carapace are slightly less than right angles and are without spines, while the posterior corners form rather prominent rounded lobes. The only carinae on the carapace are an incompletely circular marginal carina at each posterior lateral lobe and within this a short longitudinal carina representing the posterior portion of the lateral carina of some of the other Squillae. The exposed thoracic segments have well-marked intermediate carinae. The lateral spines on the first segment are compressed antero-posteriorly and are distinct from the ventral ones, which are acuminate and bent slightly forward.

The sixth abdominal segment is the only one that bears a pair of submedian carinae; all the others have well-marked intermediate, lateral, and marginal carinae. All six carinae of the fifth and sixth segments end in spines. There are no spines on the sixth segment in front of the articulations of the uropod.

The width of the telson at its base nearly equals the length of the sixth abdominal segment and the telson taken together. The telson has six prominent marginal spines without a trace of an additional anterior lateral pair. The submedian spines in this specimen do not have movable tips, but microscopical examination shows articulations which indicate that they did possess movable tips, which have been broken off. The marginal teeth are long and sharp. The upper surface of the telson is ornamented by a longitudinal crest ending posteriorly in a spine and about five shallow furrows running from the crest outward and backward to the posterior margin. There are also some irregular furrowings near the lateral margin. There are faintly marked carinae at the bases of the marginal spines, the lateral pair being continued forward along the margin to the base of the telson. The ventral surface is very faintly marked by furrows corresponding to the dorsal ones. The uropod has the two joints of the exopodite of equal length; on the external edge of the first joint there are five movable spines. The remarkable teeth on the inner edge of the prolongation of the basal joint are long and slender.

The eyes of this animal are rather small. The corneal region is elongated and slightly bilobed. The corneal axis nearly equals fourteen fifteenths the peduncular one, and is set somewhat obliquely to it. The peduncle is not dilated and is much narrower at its base than the

corneal region, so that the eye as a whole has a triangular outline. The ophthalmic segment bears a truncated process at the base of each eye.

The antennæ of the first pair are long, equaling about half the length of the body. The marginal spines of the first body segment are acuminate. The second antennæ are about two-fifths as long as the first. The antennary scales of this specimen have been lost. The raptorial claw when folded does not reach to the posterior margin of the carapace. The carpus has no spines. The dactylus is short and its outer margin has a simple curve broken only near the articulation by a small tubercle. It bears four slender teeth, of which the proximal one is much smaller than the others. The appendages of the walking legs are linear.

Color.—The alcoholic specimen is marked by a few dark pigment cells arranged symmetrically on the carapace and hind body.

Size.—Total length, 22 mm.

Locality.—The type specimen was taken by the *Albatross* in 1886, with a trawl at a depth of 26 fathoms, in N. Lat. $26^{\circ} 5' 0''$ and W. Long. $80^{\circ} 15' 0''$, off Key Largo, Fla.; bottom, coral sand. (No. 11547, U.S.N.M.)

Remarks.—It is with considerable hesitation that I found a new species upon this single specimen, which very closely resembles the next species, *S. polita*. I should have placed it in that species if I had not been able to compare it directly with a specimen of the same size.

Such a comparison showed that in this species the eyes are smaller and the thoracic segments much wider, and there is an entire absence of the keel on the telson which the other possesses.

SQUILLA POLITA, Bigelow.

Squilla polita, BIGELOW, Johns Hopkins Univ. Circ., 88, 1891.

Diagnosis.—Eyes of medium size, triangular; dactylus of raptorial claw with four teeth; rostrum ovate without carina; carapace without carina, except on posterior lateral lobes, which are rounded, cervical suture obsolete on the median line, anterior lateral angles acute; lateral spine of the fifth thoracic segment broad, blunt, and curved forward, lateral margins of the next two segments rounded; hind body without submedian carinae except the sixth abdominal segment; telson with a dorsal crest and ventral keel and a few curved lines of pits on each side; six large marginal spines, the submedian pair having movable tips, and on each side of the median sinus two to three submedian denticles, nine to twelve intermediate, and one lateral one.

General description.—This species is closely related to *Squilla desmarestii*, Risso, and has many points of resemblance to *S. armata*. The body is well arched, but somewhat less compact. The carapace is longer than the exposed thoracic segments, and a little less than half as long as the first six abdominal segments and about twice as long as

the telson. The whole dorsal surface of the animal has a highly polished appearance that suggested the name which I have given to the species. The rostrum is ovate, without carinae, and it covers the first antennary segment. The carapace has a polished surface and is devoid of carinae, except on the posterior lateral lobes, where the intermediate and lateral carinae are present. The posterior median tubercle is obsolete. The cervical suture is obliterated for some distance on each side of the median line. The anterior lateral angles are short, acute spines. The posterior lateral lobes are evenly rounded. The distance between the anterior lateral angles equals twice the length and exceeds half the posterior width. The carapace differs from that of *S. armata* chiefly in the disappearance of the cervical suture on the median line and in the small depressed anterior lateral spines.

The exposed thoracic segments have no submedian carinae, but the intermediate carinae are prominent. The ventral spine of the fifth segment is elongated, curved forward, and acute. The lateral process is broadly flattened dorso-ventrally, slightly curved forward, and blunt. The margins of the next two segments are broadly rounded and without spines. Submedian carinae are entirely absent in the abdomen, except on the sixth somite. Intermediate lateral and marginal carinae are well marked and end in spines, except in the first two abdominal somites, where there are no spines.

The telson (fig. 8) is relatively smaller than in *S. desmarestii*, and is much wider than long. There are 6 long and sharp marginal spines, each having at the base a slightly raised carina; the spines of two outer pairs curve somewhat toward the median line. The submedian spines are jointed, and the movable distal part is longer than in *S. desmarestii*. The denticles are long and acute and extend along the outer edge of each submedian spine nearly to the joint. There are no anterior lateral carinae.

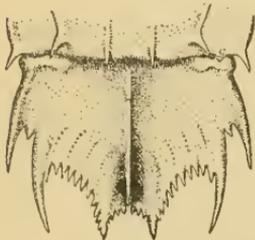


Fig. 8.

TELSON OF *SQUILLA POLITA*.

Three times natural size.

The crest has a sharp edge and rises rather abruptly from the general surface. It is interrupted by a depression near its anterior end, and its posterior end is extended into a long acute spine. The dorsal surface of the telson is polished, as in *S. desmarestii*, but in this species there are distinct symmetrically curved depressed lines and some shallow circular pits, showing in a rudimentary condition the same sculpturing found in *S. mantis* and its allies. The ventral surface is smooth except for obsolete curved depressed lines and a long prominent keel.

The eyes are of moderate size. The corneal portion, which is slightly constricted in the middle, is about equal, not longer, than the interior margin of the eye, and its long axis is at an angle of about 45° to the

long axis of the eye stalk. The anterior process of the segment is acute. The lateral processes are broad, flat, and truncated.

The first antennæ equal in length the distance from the end of the rostrum to the posterior end of the thorax.

The second antennæ reach to about the base of the flagella of the first pair. The exopodite is small.

The distal joints of the raptorial limb are short. The dactylus has four curved teeth and has a well-marked tubercle on the outer edge close to the articulation. The manus bears three movable spines, the middle one being much the smallest. The carpus has one blunt spine on the anterior side.

The prolongation of the basal joint of the uropod is not deeply serrated on the inner edge, but simply undulating. The inner process of the prolongation is not twice as long as the outer one and bears on its outer side at about the middle of its length a very conspicuous rounded tooth. There are five movable spines on the exopodite.

No secondary sexual differences appear.

Color.—An alcoholic specimen is marked in a way very similar to *S. mantis* except on the telson. There is a dark V-shaped spot at the end of the crest of the telson, and lines of pigment cells follow the line of pits.

Size.—The largest specimen is 6.3 cm. in length and the smallest 2.2 cm.

Locality.—All the specimens in the collection were taken by the *Albatross*; two males and one female from Santa Rosa Island, California (No. 18494, U.S.N.M.), one small male from off Abreojos Point, Lower California (No. 18475, U.S.N.M.).

SQUILLA DESMARESTII, Risso.

Squilla desmarestii, Risso, *Crust. de Nice*, p. 114, 1816.—MIERS, *Ann. and Mag. Nat. Hist.* (5) v, p. 28, 1880.

There are two males in the collection from the Channel Islands contributed by Edward Lovett, Esq., of London, England (No. 6542, U.S. N.M.). Miers fails to mention the eyes in his description. They are triangular, but small as compared with a specimen of *S. panamensis*, for example, of the same size.

SQUILLA ARMATA, Milne-Edwards.

Squilla armata, ?MILNE-EDWARDS, *Hist. Nat. Crust.*, II, p. 521, 1837.—?GAY, *Hist. de Chile, Zool.*, III, *Crust.*, p. 223, 1849.—MIERS, *Ann. and Mag. Nat. Hist.* (5) v, p. 26, 1880.—BIGELOW, *Johns Hopkins Univ. Circ.*, 88, 1891.

Diagnosis.—Eyes large, triangular; dactylus of the raptorial limb with seven to nine teeth; rostrum narrowed in front with a slight median elevation; carapace with median carina obsolete or entirely absent, intermediate and lateral carinæ present only on the posterior lateral lobes, anterior lateral angles produced into acute spines; lateral

spines of the fifth thoracic segment narrow, straight, and acute, the lateral processes of the next two segments broadly rounded and produced into spines that point backward; eight carinæ on the abdominal segments; telson with a crest and a keel and a series of curved lines of pits on each side, six marginal spines, the submedian pair with movable tips, no submedian denticles, ten to eleven small intermediate ones, and one lateral one.

General description.—The carapace is twice as wide behind as it is in front. The exposed part of thorax is as long as the carapace; and the abdomen, leaving out the telson, is twice as long. The abdomen is about the same width for its whole length. The telson is about as long as wide.

The rostrum is triangular, a little wider than long. The apex is blunt and rounded. In one specimen the apical margin is indented so

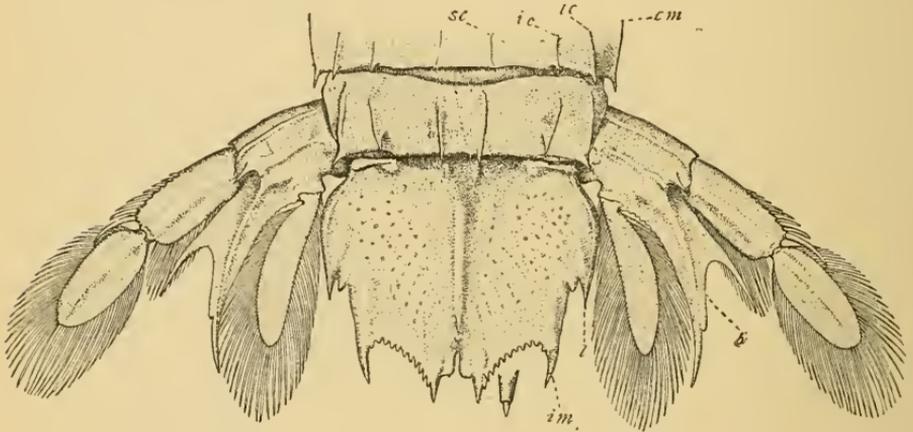


Fig. 9.

TELSON AND UROPODS OF *SQUILLA ARMATA*.

Twice natural size.

b.—Basal prolongation of uropod.

im., l.—Intermediate and lateral marginal spines.

sc., ic., lc., cm.—Submedian, intermediate, lateral, and marginal carinae.

as to have four short teeth. The median and marginal carinae are obsolete or entirely absent, and the dorsal surface is smooth except for a slight roughness in old specimens.

The carapace has generally a smooth, polished appearance. There is a well-marked transverse suture, but it makes only a slight depression across the median line. The posterior lateral lobes are evenly rounded, not angled.

The exposed thoracic segments possess submedian and intermediate carinae. The fifth segment has a pair of short and acute ventral spines and a pair of much longer lateral processes that are straight, evenly tapering, and sharply acute.

On the lateral margins of the next two segments there is no trace of an anterior lobe. The marginal process is evenly rounded to the

posterior lateral edge where it is suddenly produced into a sharp spine directed backward and outward.

The segments of the abdomen, except the sixth, and the telson are all provided with submedian, intermediate, lateral, and marginal carinæ; the latter are absent in the sixth segment. All the carinæ end posteriorly in sharp spines except the submedian ones in the first five segments. In the posterior margin of the fifth segment on each side, half way between the submedian and intermediate carinæ, there are from one to four spines grouped together.

The telson (fig. 9) has little or no indication of an anterior lateral carina or spine. The submedian spines are jointed so that they have each a short and acute movable tip. The ventral surface has a keel which is deepest just posterior to the anus. The rest of the surface is smooth except for an obsolete series of curved lines corresponding with those of the dorsal surface. Between the submedian spines the margin is divided by a deep median sinus into two rounded lobes very much as in *S. lata*, and there are no teeth present except sometimes very minute dentations on the posterior edge. Between a submedian and intermediate spine there are ten or eleven conical teeth and between each intermediate and lateral spine there is one. These are very small elevations at the base of each tooth and spine.

The eyes are triangular, the corneal portion equals in length the distance along the inner edge of the eye from the anterior end of the corneal part to the anterior edge of the hard part of the stalk. The median process of the ocular segment is subacute. The lateral processes are rounded laterally, but the anterior margin of each gives rise to a stout, straight, rounded spine which points forward and slightly outward opposite the inner edge of the eye. The first antennæ are nearly as long as the carapace and exposed thoracic segments taken together. The antennary segment bears a pair of stout lateral processes curved forward and sharply acute.

The flagellum of the second antenna does not reach quite to the base of the flagellum of the first antenna.

The raptorial claw (fig. 10) is stout. The dactylus is armed with seven to nine teeth, rarely six. There are three movable spines and a row of pectinations on the manus as usual. The anterior edge of the carpus has one tooth-like projection.

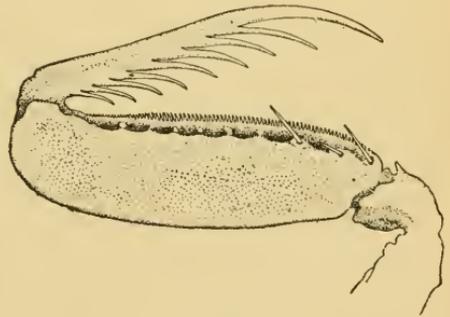


Fig. 10.

RAPTORIAL CLAW OF *SQUILLA ARMATA*.

Nearly three times natural size.

The uropods (fig. 9) are very much as in *S. panamensis*. In general the spines are more conspicuous, except the outer one of the prolongation of the basal joint, which is not half so long as the inner one. The small tooth (large in small specimens) is beyond the middle of the spine. The two joints of the exopodite are equal in length and the first one bears on its outer edge seven movable spines. The endopodite is narrowly spatulate, relatively a little broader than in *S. panamensis*.

There are no secondary sexual differences and no peculiarities of coloring in my specimens.

This species conforms to Miers's description of *S. armata* in every essential point that he covers.

Size.—The largest specimen in the collection is 12.2 cm. in length. Most of the specimens, however, are smaller, about 6 cm. long.

Locality.—This collection of specimens consists of a good number of both sexes from four stations off the coast of Patagonia, viz., station 2769, off the Gulf of St. George (No. 18470, U.S.N.M.); station 2787, off Port Otway (No. 18472, U.S.N.M.); station 2783, off the west coast of Patagonia (No. 18505, U.S.N.M.); and Island Harbor (No. 18471, U.S.N.M.), the depth being from 51 to 122 fathoms.

SQUILLA DUBIA (Milne-Edwards?) Miers.

Squilla mantis, DESMAREST, Consid. Crust., p. 250, 1825.

Squilla dubia,? MILNE-EDWARDS, Hist. Nat. Crust. II, p. 522, 1837.—? GIBBES, Proc. Amer. Assoc., VI, p. 200, 1850.—MIERS, Ann. and Mag. Nat. Hist., (5) v, p. 24, 1880.

? *Squilla rubrolineata*, DANA, Crust., U. S. Expl. Exped., XIII, i, p. 618, 1852.—VON MARTENS, Arch. f. Naturgesch., 37, p. 144, 1872.

The National Museum possesses three specimens of this species, a male collected by Dr. G. H. Macon, at Savannah, Ga. (No. 2524, U.S.N.M.), a young male collected by C. C. Leslie, Charleston, S. C. (No. 3139, U.S.N.M.), and a female found by Dr. W. H. Jones, U. S. Navy, in a salt lake near Guayaquil, Ecuador (No. 14113, U.S.N.M.).

The specimen from Savannah corresponds exactly to Miers's description. The lateral spine of the first exposed thoracic segment is straight in front but rounded behind. In the Charleston specimen it is curved forward a little as in *S. empusa*.

The specimen from Guayaquil is practically identical in form with the one from Savannah, except that there are one or two more denticles on each side of the telson. A character common to these specimens, and not mentioned by Miers, is the shape of the eyes. They are very small. The eye stalk is dilated in the middle and the corneal axis of the eye, while oblique, is shorter than the peduncular one.

SQUILLA PARVA, Bigelow.

Squilla parva, BIGELOW, Johns Hopkins Univ. Circ., 88, 1891.

Diagnosis.—Squillae with narrowly triangular eyes, the corneal part being shorter than the total length; dactylus of the raptorial claw having six teeth; triangular rostrum rounded anteriorly and provided

with median and marginal carinae; five carinae on the carapace, its anterior lateral angles produced into spines and posterior corners evenly rounded; lateral process of the fifth thoracic segment very short, flattened antero-posteriorly and obtuse, of the sixth and seventh without spines and rounded; submedian carinae on all segments of the hind body behind the first exposed thoracic; the telson ornamented dorsally by a crest and curved lines of pits, and having six marginal spines and a pair of anterior lateral carinae, and on each side three to four submedian teeth, eight intermediate, and one lateral.

General description.—All the specimens of this species seen so far are small. The carapace is rather short, being 0.22 of the total length and seventeen-eightieths of the greatest width of the abdomen. The greatest width of the carapace is about 0.77 of its length. The telson on the other hand is relatively large and is broader than long, its length being about 0.16 the total length and 0.92 of its width at the base.

The carinae on the rostrum (fig. 11) are small, but can be made out distinctly with a lens. In the anterior fourth of the carapace the median carina is obsolete or completely lost, but the lateral carinae pass directly into the anterior lateral spines. Each of the four exposed thoracic segments (fig. 12) has four dorsal longitudinal carinae except the first, which has no submedian ones. The lateral process of the fifth segment is drawn out into a very short obtuse spine that is flattened antero-posteriorly and is connected by a ridge with the short acute ventral spine of the same side. The sixth and seventh segments have on each side a broad, evenly rounded, lateral lobe pointing obliquely a little backward. In front of this on the sixth segment there is a slight projection common to most species of *Squilla*, but on the seventh this projection is somewhat larger and flattened and approaches the condition found in *S. nepa*. The eighth segment possesses a similar lobe. The carinae of the abdomen, like those of the thorax, are well developed. None of these end in spines on the first, second, and third abdominal segments, while all but the submedian ones do so on the fourth, and all of them on the fifth and sixth. Besides the six dorsal spines on the sixth segment there is a stout marginal spine in front of each uropod. The telson has a low, sharp crest, ending in a prominent spine and six small carinae at the bases of the six marginal spines, together with a pair of anterior lateral carinae in front of the

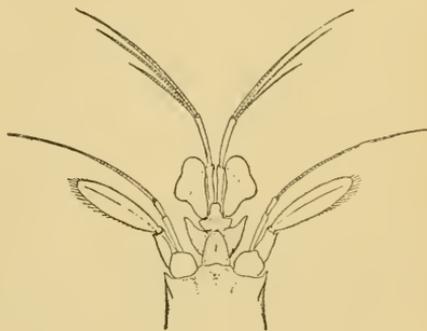


Fig. 11.

CEPHALIC REGION OF SQUILLA PARVA.

Three times natural size.

carinae of the lateral spines. The rest of the dorsal surface is marked by about ten curved rows of fine shallow pits on each side of the crest. The ventral surface is smooth, except for similar but somewhat fainter lines. The six marginal spines are prominent and acute and are immobile. The median sinus is very deep. The submedian teeth are obtuse, while the intermediate ones are acute.

Returning to the anterior part of the body (fig. 11), the eyes immediately strike one as out of keeping with the other characters, for while the corneal part of the eye is flattened and set obliquely to the peduncle, it is relatively small, the corneal axis being only about four-fifths as long as the peduncular one. The ophthalmic segment is emarginate in front. The first antennæ are about half as long as the body, while the second pair are not quite half as long as the first. The antennary scale is about half as long as the carapace. The carpus of the raptorial claw has on its anterior edge a longitudinal crest, the distal extremity of which is an acute angle, and beyond this there is a small blunt tubercle. The outer (posterior) edge of the dactylus is a compound curve, being slightly sinuate near its base, but there is no basal tubercle. The six teeth are well developed and progressively longer toward the distal extremity. The appendages of the walking legs are linear. The first joint of the exopodite of the uropod is much longer than the second, and bears eight or nine movable spines. The inner margin of the basal prolongation of the uropod is serrated, and there is a large rounded lobe on the outer side of the inner spine.

Color.—The alcoholic specimens have the body covered with a mottled pattern of dark pigment cells.

Size.—The length of the largest specimen in the collection is 4.15 cm.

Locality.—The collection contains six males and one female collected by the *Albatross* in March, 1888, from the stations not over 13 miles apart in the Bay of Panama where the depth was from 7 to 16 fathoms, and the bottom green mud (Nos. 18477–18479, U.S.N.M.). There is also one poorly preserved specimen from off Manzanillo, Mexico (No. 18480, U.S.N.M.), that seems to belong to this species although the telson is somewhat different from the Panama specimens.

SQUILLA PRASINOLINEATA (Dana?) Miers.

Squilla prasinolineata, ? DANA, Crust. U. S. Expl. Exped., XIII, p. 620, 1852.—MIERS, Ann. and Mag. Nat. Hist. (5) v, p. 19, 1880.

A specimen in the collection (No. 11290, U.S.N.M.) corresponds pretty closely to Miers's description of a specimen that he doubtfully refers to Dana's species of this name. Unfortunately the source of this

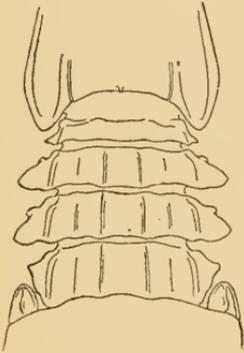


Fig. 12.

EXPOSED THORACIC SEGMENTS OF *SQUILLA PARVA*.

Four times natural size

specimen is not recorded. According to Ives (1891) this species should be described under a new name for he regards *S. prasinolineata*, Dana, as identical with *S. dufresnii* (Leach) Miers, the first name having the priority. He records (1891) a specimen corresponding to Miers's description of *S. dufresnii* from the coast of Yucatan.

SQUILLA MANTOIDEA, Bigelow.

Squilla mantoidea, BIGELOW, Johns Hopkins Univ. Circ. 106, p. 101, 1893.

Diagnosis.—Eyes triangular, but with the corneal axis at right angles to the peduncular one; dactylus of raptorial claw with six teeth, outer margin not sinuate; rostrum subquadrate, carinate; carapace with five carinae, the median one bifurcated, and with strong anterior lateral spines; lateral spine of the fifth thoracic segment short, straight, acute, and flattened obliquely, lateral processes of the next two segments strongly produced and acute; submedian carinae on thoracic and abdominal segments without spines, except the sixth abdominal; telson with a crest and a long ventral keel, twelve or more lines of pits on each side, six marginal spines; denticles 5-6, 11-12, and 1.

General description.—The collection contains but a single specimen of this species, a female from Borneo. Judging only by the published descriptions of *S. mantis* one would refer this specimen to that species, but on comparing it with specimens from the Mediterranean it is seen at once to be specifically distinct.

The body is compact and broad and the carinae are all well marked. The greatest width of the abdomen equals the length of the carapace, which makes up nearly one-fourth of the total length of the body. The telson is one-sixth of the total length, and its width is $1\frac{1}{2}$ times its length. The rostrum is four-fifths as wide as it is long; it is broadly rounded in front, with nearly parallel sides, and has well-marked marginal and median carinae.

The carapace is narrowed anteriorly; its smallest diameter being a little more than half the greater, which is a little less than four-sevenths of its length. The five carinae and the cervical suture are well marked. The median carina incloses a narrow oval area in its anterior quarter. The lateral carinae are continued into prominent spines that are a little way in from the anterior lateral angles. The posterior lateral lobes are prominent, but are not distinctly angled. The lateral spines of the first exposed thoracic segment (fig. 13) resemble those of *S. mantis*, being straight and acute, but they are small and flattened obliquely. The

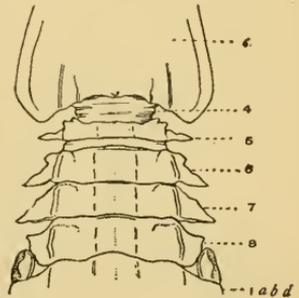


Fig. 13.

EXPOSED THORACIC SEGMENTS
OF *SQUILLA MANTOIDEA*.

Natural size.

4-8—Fourth to eighth thoracic segments.
1 *abd.*—First abdominal segments.
c.—Carapace.

ventral pair are large and triangular. The lateral spines of the next two segments are longer than in *S. mantis* and acute, and on the first one there is a small additional anterior lobe. The submedian carinae are well marked, and the first five abdominal segments have eight carinae, all of which end in spines except the submedian ones and the intermediate of the first two segments. The sixth segment has six carinae ending in spines and a spine on the anterior side of each uropod. The telson is quite different from that of *S. mantis*. The crest is low and narrow, and ends in a spine. The general surface of the telson is smooth except for

eight or ten lines of very small, shallow pits, arranged symmetrically on each side of the median line. It has a rather long ventral keel. There are six marginal spines, rather long and slender, and with basal carinae. The anterior lateral carinae also end in a small projecting angle. There is scarcely any elevation at the bases of the denticles, while in *S. mantis* there is a distinct ridge bordering the telson in both sexes. Another difference of importance between these two species is in the eyes. In *S. mantoidea*, while the corneal axis is longer than the peduncular one (6:5), it is unlike *S. mantis* in being transverse instead of oblique, giving the eye a very different shape (fig. 14). The antennae

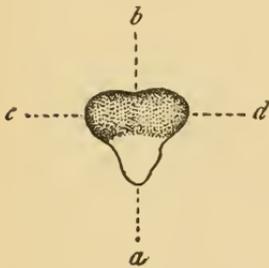


Fig. 14.

EYE OF *SQUILLA MANTOIDEA*.

Twice natural size.
ab.—Peduncular axis.
cd.—Corneal axis.

are rather long, the first three segments equaling the carapace in length. The second antennae only reach a little way beyond the second joint of the first. The antennary scale is a little over six-tenths the length of the carapace. The raptorial claw is long, when folded reaching back as far as the median posterior edge of the carapace, and is more slender than in *S. mantis*. The antepenultimate joint has but one spine, not two. The dactylus is not sinuate on its outer margin, and the distal ones of the six teeth are very long, much longer than the proximal ones, the length decreasing gradually towards the base of the dactylus. The appendages of the walking legs are linear. The inner basal spine of the uropod is twice as long as the outer one, bears a small lobe on its outer margin and is finely serrated on its inner margin. The distal joint of the exopodite is shorter than the proximal one, being tenths of its length when measured on its ventral side, while in *S. mantis* the two joints are equal, measured in the same way. The proximal joint bears eight movable spines.

Color.—The alcoholic specimen shows a dark band on the rostrum, three irregular bands on the carapace, and a band on each segment of the hind body except the sixth abdominal. The posterior half of each uropod is black.

Size.—Length of body, 12 cm.

Locality.—There is in the collection a single female from Borneo, purchased of H. A. Ward, No. 18504. U.S.N.M.

SQUILLA ACULEATA, Bigelow.

Squilla aculeata, BIGELOW, Johns Hopkins Univ. Circ., 106, p. 101, 1893.

Diagnosis.—A species having small but triangular eyes, the corneal axis not exceeding the peduncular and nearly transverse; the dactylus of the raptorial claws very strong, with six teeth; a broad rostrum provided with median and lateral carinae; five carinae upon the carapace, the lateral ones passing into the anterior lateral spines, and the posterior lateral margins angled; the lateral processes of the first exposed thoracic segment curved forward and acute, of the second and third acuminate; submedian carinae present on all the segments of the hind body except the first exposed thoracic, but not ending in spines except on the sixth abdominal, all the other carinae ending in spines on the third, fourth, and fifth segments, and the lateral ones on the first and second; in the male a thickened crest on the telson ending in a small spine, the surface of the telson on each side marked with curved lines of pits, six marginal spines, of which the submedian and intermediate are very large and curved, and, like the lateral ones, have thickened basal carinae, and between these three to four submedian teeth, five to seven intermediate, and one lateral tooth, no trace of a ventral keel; the inner spine on the basal prolongation of the uropod much longer than the outer and with a rounded lobe on the outer side near its base.

General description.—At first sight this species appears to be identical with *S. empusa* except for its smaller eyes and the heightened topography of its telson, but a careful comparison of the specimens reveals many minor points of difference. I shall base the following description upon a large male specimen from Chile and afterward compare with it a small female from Panama.

The body is strongly and compactly put together. The carapace is nearly 0.22 of the total length of the body and 0.97 of the greatest width of the abdomen. The width of the carapace is about 0.83 of its length. The telson takes up 0.17 of the total length of the animal, and its width at the base is 1.06 times its length.

The eyes (fig. 15) are strikingly small, their width (length of the corneal axis) being 0.033 of the length of the body, but this is very nearly equal to the length of the peduncular axis, and the eye is flattened in the usual way and is subtriangular. The ophthalmic segment is rounded and entire in front, and the processes at the bases of the eyes are short and rounded. The processes on the antennary segment are also rounded. The first antennae appear to be about two-fifths the length of the body, while the second pair reach to the end of the third joints of the first pair. The antennary scales are



Fig. 15.

EYE OF
SQUILLA
ACULEATA.

Twice natural
size.

of about the usual size—a little more than half the length of the carapace. The raptorial claws are rather short when folded, only reaching back as far as the angle on the side of the carapace. The carpus has no spines, but is armed with a sharp crest that ends distally in a rounded angle. The outer edge of the dactylus describes a curve which if slightly changed might become either a simple or a compound curve.

The rostrum is nearly as broad at the tip as it is at the base, and the lateral and median carinae are well marked. The median carina

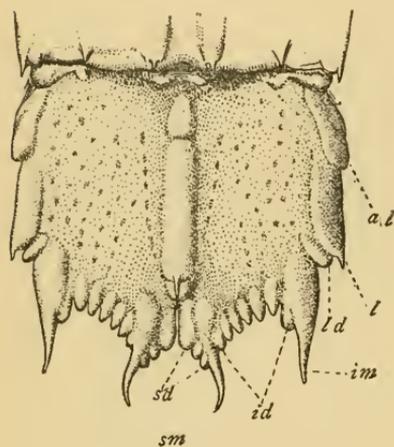


Fig. 16.

TELSON OF SQUILLA ACULEATA.

Male. Two-thirds natural size.

al.—Anterior lateral angle and carina.
l., *im.*, *sm.*—Lateral, intermediate, and submedian spines, each with a basal carina.
id., *id.*, *sd.*—Lateral, intermediate, and submedian denticles.

of the carapace is bifurcated in front but is only faintly marked in this region. The angle on each posterior lobe is well marked. The ventral spines on the first exposed (fifth) thoracic segment are strong, sharp and pointed obliquely forward, and there is a low ridge running from each one to the nearest marginal process. There is a small projection on the second segment in front of each lateral lobe. The submedian carinae are nowhere very prominent, but the others on the abdomen become more and more pronounced toward the telson. The sixth segment has a small spine on the same side in front of the uropod.

The long submedian and intermediate spines, curved like the horns of a cow together with the thickenings at the bases of the spines and teeth, give the telson (fig. 16) a very striking appearance. There is a separate elevation at the margin corresponding to each denticle and spine, and there is also a distinct pair of anterior lateral carinae. The general surface of the telson is unusually smooth, but the pits are unusually well defined. They are arranged in about eight rows. The ventral surface is perfectly smooth except for a corresponding series of pits and a small carina on each side running in a short way from the extreme anterior lateral angle. The denticles are all blunt. The uropods present nothing remarkable except that the lobe on the inner spine of the basal projection is a little nearer the base than usual. The inner margin of the projection is bluntly serrated and the second joint of the exopodite is about two-thirds the length of the first joint. The latter bears eight movable spines.

S. empusa, Say, differs from this specimen in having wider eyes (0.043 times total length); the processes on the antennary segment acute; two small spines on the anterior edge of the carpus of the raptorial

claw; the outer edge of the dactylus, a compound curve, and the median carina of the carapace distinct in front. The lateral processes of the sixth and seventh thoracic segments in *S. empusa* are acute, but hardly acuminate, and the submedian carinae of the fourth and fifth abdominal segments end in spines. The marginal spines of the telson are also not unusually long, and on the ventral surface there is a distinct postanal carina, or keel; while the two joints of the exopodite of the uropod are of equal length, and there is no lobe on the inner spine of the basal projection.

The small female specimen from Panama, referred to above, occupies an intermediate position between the larger specimen I have just described and *S. empusa*. The eyes are the same size as in the latter, relatively to the length of the body, but the ratio of the length of the peduncle to that of the corneal axis is greater than in *S. empusa* and like that of the type specimen. The outer edge of the raptorial dactylus is a compound curve and the dorsal surface and the margin of the telson closely resemble the condition found in *S. empusa*, but in all other respects this specimen agrees with the type. As the females and the young of both sexes are known to differ from the mature males in several species of *Squilla*, I think it most probable that this small specimen represents an immature condition of the larger one.

Color.—The larger specimen has completely faded, but the smaller one has a symmetrical mottled arrangement of dark pigment cells.

Size.—Length of body, 15 cm. and 6.85 cm.

Locality.—The large specimen was collected by W. H. Jones, U. S. Navy, then on board the U. S. S. *Wachusett* at Iquique, Chile (No. 11198, U.S.N.M.). The smaller one was taken at Panama and was purchased from H. A. Ward (No. 15626, U.S.N.M.).

SQUILLA EMPUSA, Say.

Squilla empusa, SAY, Journ. Acad. Nat. Sci. Phila., 1, p. 250, 1818.—MILNE-EDWARDS, Hist. Nat. Crust., II, p. 525, 1837.—DE KAY, New York Fauna, VI, Crust., p. 32, 1844.—MIERS, Ann. and Mag. Nat. Hist. (5) v, p. 23, 1880.—BROOKS, Voyage of the *Challenger*, XVI, p. 25, 1886.

Diagnosis.—Eyes triangular and with oblique corneal axis equal to peduncular axis; six teeth on the dactylus of the raptorial claw, the outer edge of the dactylus sinuate; rostrum variable, generally a little longer than broad, subquadrate or hemiellipsoidal and possessing lateral and median carinae; carapace with five carinae, the median one bifurcated, the lateral ones produced into large anterior lateral spines, the posterior lateral margins angled; the fifth thoracic segment with separate ventral and lateral spines, the latter being slightly curved forward and acute; the lateral processes of the next two segments strongly produced and acute or mucronate; eight carinae on the first five abdominal segments; telson with crest and curved lines of pits, six marginal spines and eight basal carinae and on each side three to four submedian,

six to nine intermediate, and one lateral denticle; the carinae and the elevations at the bases of the denticles always distinct; never any thickening of the margin of the telson or of the abdomen in the males.

Remarks.—Say's description of this species is very brief, and like Gibbes, his conception of *S. mantis* seems to have been derived from a figure given by Herbst that was, I think, intended to represent *S. nepa*, Latreille. His description is colored by this idea. De Kay's figure is very poor, but indicates that the outer edge of the dactylus is sinuate.

Miers pointed out that this species is extremely close to *S. mantis*, but may be recognized by the lateral processes of the first exposed thoracic segment being elongated and curved forward, instead of being straight. Brooks has described and figured the first abdominal appendage of the male. All of these authors, however, neglect characters which separate this from closely related species. In order to compare them we need to start with an adequate definition of *S. empusa*, and it is with the hope of supplying this that I have introduced the above diagnosis, founded upon the study of specimens from Beaufort, N. C., preserved at the Johns Hopkins University, and on others from various localities in the National Museum.

This species is so very near to *S. mantis* that Miers was at first inclined to regard it as a mere variety, and it seems to me that this is probably the correct view. Although very slight, there are, however, differences, which are constant in the specimens that I have examined. As stated above, the lateral spine of the first exposed thoracic segment is more curved than in *S. mantis*. The rostrum in full-grown specimens of *S. empusa* is broader in proportion to its length, and the corneal axis of the eye very nearly equals the peduncular one, while in *S. mantis* the corneal axis is about six-fifths the length of the peduncular one. Large specimens of *S. mantis*, of both sexes, have a slight thickening at the margin of the telson that is almost altogether absent in *S. empusa*.

Size.—Length of body of a large specimen, 18 cm.

Locality.—There are specimens in the National Museum from numerous stations between Woods Holl, Mass., and Pensacola, Fla.

SQUILLA MANTIS, Latreille.

Squilla mante, DE GEER, Mém. pour servir à l'hist. des Insectes, VII, p. 533, 1778.

Squilla mantis, LATREILLE, Hist. Nat. Crust., VI, p. 278, 1802; Encycl. Méth.

Hist. Nat., X, p. 471, 1825.—MIERS, Ann. and Mag. Nat. Hist. (5), V, p. 21, 1880.

Of this species, common in the Mediterranean, the Museum possesses two males collected by Dr. D. S. Jordan at Venice, Italy (No. 5151, U. S. N. M.), and a male and female from Naples, received from Rev. A. M. Norman (No. 14552, U. S. N. M.).

SQUILLA PANAMENSIS, Bigelow.

Squilla panamensis, BIGELOW, Johns Hopkins Univ. Circ., 88, 1891.

Diagnosis.—Squilla with large triangular eyes having a slender stalk; six teeth on the dactylus of the raptorial claw; an ovate or ellip-

soidal rostrum with median and marginal carinae; a carapace having five carinae, very small spines at the anterior lateral angles and angled at the sides posteriorly; the lateral spines of the fifth thoracic segment curved a little forward and acute, the lateral processes of the next two segments obliquely truncated and subacute; eight carinae on the abdominal segments, all on the last three of these segments ending in spines; a crest and curved lines of pits on the telson, a long ventral keel, six or eight marginal spines and five submedian, ten to twelve intermediate and one to two lateral teeth; the crest and margin of the telson as well as the lateral margins of the abdomen thickened in the male, the thickening being greatest at the bases of the marginal spines.

General description.—A female specimen of this species is difficult to distinguish from *S. empusa*, Say, but an adult male is easily recognized by the thickenings of the telson and sides of the abdomen, there being no trace of these sexual characters in *S. empusa*. The typical form exhibits other points of difference from that species, which will be mentioned farther on.

The carapace occupies about two-tenths of the total length of the body and is a little longer than the telson, which is about 0.16 or 0.18 of the total length. The width of the telson at its base nearly equals its length and the greatest width of the carapace. The carapace is narrowed in front so that the distance between the anterior lateral angles only slightly exceeds half of the greatest width. The diameter of the body just behind the carapace is less than half the greatest width of the abdomen.

The rostrum is ovate or subtriangular and faintly marked by median and marginal carina.

The carapace has five longitudinal carinae, the median one being bifurcated at each end, so as to inclose a lozenge-shaped area, and the lateral ones ending in a minute spine at each anterior lateral angle.

All segments of the hind body are provided with submedian carinae, except the fifth thoracic. This segment, fig. 17, has a pair of acute ventral spines, and its lateral spines are acute and slightly curved forward. In my preliminary description of this species (1891) I spoke of the margins of the next two segments as bilobed, which is somewhat misleading, for in the first of them, while there is an anterior lateral process exactly homologous to the one found in *S. nepa*, still it is so small and the posterior process is so much larger, that the term tends to convey a false impression, which I wish to correct. The lateral processes of the second of these segments had better be described as indented or sinuate. In both cases the posterior processes are

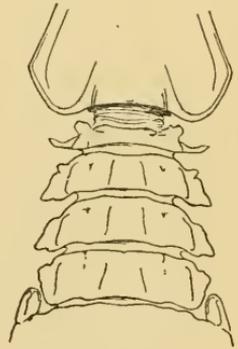


Fig. 17.

THORACIC REGION OF
SQUILLA PANAMENSIS.

Natural size.

rounded and mucronate or subacute in the typical form. All the carinæ on the fourth, fifth and sixth abdominal somites end in spines, and there is a spine in front of the articulation of each uropod. In the first abdominal somite only the marginal carinæ end in spines; the second has spines terminating the lateral carinæ as well as the marginal ones, and the third has also spines on the intermediate ones. There is a very slight median tubercle on all but the first and sixth abdominal segments. In full-grown males the marginal carinæ are thickened. This thickening extends as a broad elevation along the posterior margin and involves the greater part of the lateral carinæ. There is no trace of any such thickening in the females.

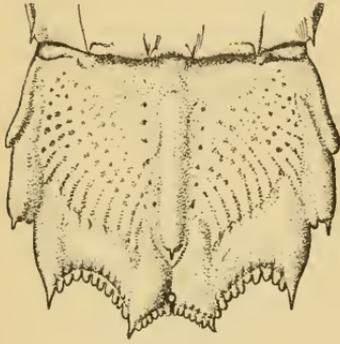


Fig. 18.

TELSON OF *SQUILLA PANAMENSIS*.

Male. Slightly enlarged.

In the female of the typical form the crest of the telson ends in a small spine, and behind it there is a small tubercle. The six marginal spines are slender and acute and have basal carinæ. There is also a distinct anterior lateral pair of carinæ. The denticles are large and rounded and have smaller elevations at their bases. The dorsal surface is marked on each side by a row of shallow pits, running nearly parallel to the crest and a series of about a dozen curved lines of pits, running outward and backward. The ventral surface has an exactly similar arrangement of these sculpturings. There is also a keel extending about half way from the anus to the median sinus, and there is a pair of lateral carinæ. In full-grown males the crest and the dorsal side of the margin of the telson are very much thickened (fig. 18). The basal elevations of the denticles on the medial side of each carina form with it a continuous ridge, while there is a distinct furrow separating the carina from the elevations on its lateral side. The marginal thickening is greatest at the bases of the spines.

The eyes are broadly triangular. The corneal axis is oblique and about one-fifth longer than the peduncular axis, while it is about five one-hundredths of the total length of the body. The spines at the bases of the eyes are erect and truncated. The first three joints of the first antennæ are about equal in length to the carapace. The second antennæ are about as long as this and the antennary scale is very nearly two-thirds as long. The raptorial claw is strongly developed. The carpus has a series of teeth on its anterior margin. The outer margin of the dactylus is not sinuate and has no tubercle or one that is hardly perceptible near the articulation. The appendages on the walking legs are slightly spatulate or sinuate. The basal prolongation of the uropod is finely serrated on the inner side and the inner spine is twice as long as the outer one, and has a minute lobe on the outer side in the

typical form. All the carinæ on the fourth, fifth and sixth abdominal somites end in spines, and there is a spine in front of the articulation of each uropod. In the first abdominal somite only the marginal carinæ end in spines; the second has spines terminating the lateral carinæ as well as the marginal ones, and the third has also spines on the intermediate ones. There is a very slight median tubercle on all but the first and sixth abdominal segments. In full-grown males the marginal carinæ are thickened. This thickening extends as a broad elevation along the posterior margin and involves the greater part of the lateral carinæ. There is no trace of any such thickening in the females.

middle of its length. The terminal joint of the exopodite is about two-thirds the length of the first joint, which bears eight or nine movable spines.

Varieties.—Animals answering to this description appear to be very abundant in the Bay of Panama. There are three other groups of specimens in the collection that are distinct from these, but the differences are so slight that they may all be regarded as varieties of one species. First, there are a number of specimens from off Cape Lobos, Mexico, and from Point San Fermin to Consag Rock, Lower California, that are evidently of the same species as those I have described as *S. panamensis*, but which differ from them in having the lateral spine of the fifth thoracic segment more curved and the anterior lateral carina of the telson produced into short spines, so that there are eight marginal spines on the telson. This form may be designated as *variety A*, the Panama form being taken as the type of the species. *Variety B* is represented by a few specimens from the southeast of Tiburon Island, Mexico. It agrees with the first in that the telson has but six marginal spines, while it differs from this and agrees with the last in having a well-marked tooth upon the outer side of the inner spine of the basal prolongation of the uropod, and it differs from both the others in having the proximal segment of the exopodite not longer than the distal segment. The marginal spine of the fifth thoracic segment is large and curved forward into a strongly sickle-shaped, acute process. The margins of the next two segments are rounded on the anterior side and have their points directed farther backward, and are more sharply acute than in the other varieties. This variety is also very different in its color markings, if we may judge from alcoholic material. It is much less like the type than *variety A*, and it may be found eventually to rank as a separate species, for the only male specimens in the collection are very small and immature, so that until adult males have been found we can not tell whether or not this form possesses the characteristic telson of *S. panamensis*.

It is also with some hesitation that I refer to this species, a single young male specimen from off Cape Frio, Brazil. In the shape of its body, the arrangement of pigmented areas in the integument, and the form of its eyes it resembles *S. panamensis* very much, and the edge of the telson appears to have begun to thicken, so it is probably better to regard it as belonging to this species rather than to *S. empusa*. If this view be accepted this specimen will represent a third variety, *C*. It differs from the type in having the rostrum elongated so that it partly covers the ophthalmic segment. The anterior lateral spines of the carapace are longer. The lateral angles of the second and third exposed thoracic segments are longer and more acute. The first abdominal segment carries lateral spines and the second one has intermediate ones. Moreover, there is a good-sized lobe on the outer side of the inner spine of the basal prolongation of the uropod.

Color.—In alcoholic specimens there is a line of dark pigment following both of the longitudinal sutures of the carapace and bordering its anterior margin, except the middle third. The posterior margin of the carapace and of most of the exposed segments of the body are marked each by a dark line. There is also a very dark triangular spot on each side of the telson near the crest. *Variety B* has in addition a large transverse dark spot on the second and fifth abdominal segments and faintly marked transverse bands on the carapace and other segments.

Size.—The largest specimen measures 14 cm. in length.

Locality.—The specimens of the type-form, of which there are a large number of both sexes and of various sizes, were all taken by the *Albatross* in Panama Bay at a depth of between 26 and 47 fathoms (Nos. 18458–18460, U.S.N.M.). Of *Variety A* about 20 specimens were taken off Cape Lobos, Mexico (Nos. 18461, 18462, U.S.N.M.), 2 off Consag Rock, Lower California (Nos. 18465, 18466, U.S.N.M.), 5 off Diggs' Point, (18467, U.S.N.M.), and 10 off Cape San Fermin (Nos. 18463, 18464, U.S.N.M.). The depth varied from 12 to 76 fathoms. Three females and two young males of *Variety B* were taken in 29 fathoms of water at station 3014 southeast of Tiburon Island, Mexico (No. 18468, U.S.N.M.). A single male specimen of *Variety C* was captured off Cape Frio, Brazil, in 59 fathoms (No. 18469, U.S.N.M.).

SQUILLA INTERMEDIA, Bigelow.

Squilla intermedia, BIGELOW. Johns Hopkins Univ. Circ., 106, p. 102, 1893.

Diagnosis.—A *Squilla* having very large nearly T-shaped eyes; very large and strong raptorial claws, with six teeth upon the dactylus; the rostrum narrowed in front and provided with well-marked median and lateral carinae; five strong carinae on the carapace, the median one bifurcated in front and behind, and the lateral one ending in spines at the anterior lateral angles, posterior lateral margin angled; the lateral margin of the fifth thoracic segment produced into a strongly sickle-shaped acute spine, of the sixth and seventh obliquely truncated and very acute; eight prominent carinae on the abdominal segments all ending in spines except the submedian of the first four segments; a low crest on the telson ending in a small spine, a post-anal keel without a spine, the dorsal and ventral surfaces of the telson marked by numerous curved lines of very fine pits, six marginal spines, and four to six submedian denticles, ten to thirteen intermediate and one lateral one; the crest and dorsal side of the margin of the telson very much thickened in the male, the marginal thickening being continuous between the intermediate spines.

General description.—This species stands in an intermediate position between *S. panamensis* and *S. biformis*. The body is compactly and strongly put together. The exposed thoracic region is about two-thirds the length of the carapace. The latter occupies a little less than one-fourth the total length of the body, while the telson is just one-fifth the total length. The length of the telson is the same as its width at the

base, and also equals the greatest width of the carapace. The greatest width of the abdomen is about one-tenth greater than the length of the carapace. The eyes are of somewhat different proportions in the two specimens before me, for in the female the corneal axis exceeds the peduncular one by 0.43 of its length and is 0.068 times the length of the body, while in the male the corneal axis exceeds the other by only 0.15 and is 0.060 times the length of the body.

The rostrum is narrowed and rounded in front, and besides the marginal carinae has a prominent median carina in its anterior half. The carinae on the carapace are very well marked, and the cervical suture is very distinct. At each of the anterior lateral angles the lateral carina is continued into a strong projecting spine. There is a marked external angle on each posterior lateral lobe. Submedian and lateral carinae are present on all the exposed thoracic segments. The first one has a strong, acute pair of ventral spines, besides the sickle-shaped lateral spines. The lateral processes of the next two segments resemble those of *S. biformis*, but are more acute. The abdominal carinae are very prominent and the spines are strong and sharp. There is a small spine in front of the articulation of the uropod. In the male the marginal carinae are very slightly thickened. The telson of the female is very similar to that of the female *S. biformis*. The crest rises gradually from the general surface, which is smooth except for about a dozen curved lines of very shallow pits, the lines branching at the periphery. The carinae at the bases of the marginal spines are small and low. There is also a pair of anterior lateral carinae separated from the posterior pair by only a slight dorsal notch. There are slight elevations at the bases of the denticles. This specimen differs from a female of *S. biformis* in having fewer and larger denticles on the telson, larger marginal spines, a higher crest, and no spine on the short ventral keel. In the male (fig. 19) the crest and the margin of the telson are much thickened on the dorsal side. But it differs from the male *S. biformis* in having the marginal ridge interrupted in two places on each side. One of these marks the end of the anterior lateral carina, and the other is just behind the lateral denticle. Except for these, the ridge is smooth and continuous and therefore quite different from the condition found in *S. panamensis*.

The basal prolongation of the uropod is finely serrated on its inner margin, and the inner spine has a rounded lobe in the middle of its outer side. The proximal joint of the exopodite is but a little longer than the distal one and bears seven movable spines. The eyes are large

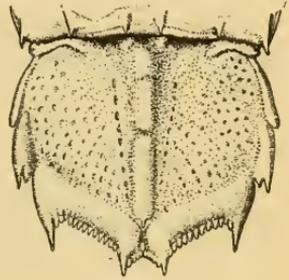


Fig. 19.

TELSON OF *SQUILLA INTERMEDIA*.

Male. Slightly enlarged.

and broadly T-shaped, especially in the female. The male has rounded processes at the bases of the eyes, while in the female they are acute. The ophthalmic segment is emarginate in front. The next segment is completely covered by the rostrum and bears a pair of acute spines. The first three joints of the first antennæ are longer than the carapace. The second antennæ are about as long as the carapace, and the antennary scales are three-fourths as long. The raptorial claw is so long that when folded it extends as far back as the most posterior point of the carapace. There are two short spines on the outer margin of the carpus. The pectinations on the inner margin of the manus have an undulating outline. The dactylus has six strong teeth. It is angled near the articulation, but from the angle to the tip of the terminal tooth its outer edge forms a simple curve. The appendages on the three posterior pairs of thoracic legs are linear or narrowly spatulate.

Size.—Length of the largest specimen, 10.5 cm.

Locality.—There are but two specimens in the collection, both collected by the *Albatross*. One, a male, was taken in 1885 at station 2378, in the Gulf of Mexico, near the delta of the Mississippi (No. 9658, U.S. N.M.). The other, a female, was taken in 1886 at station 2655, in the Atlantic, north of Little Bahama Bank (No. 11543, U.S.N.M.).

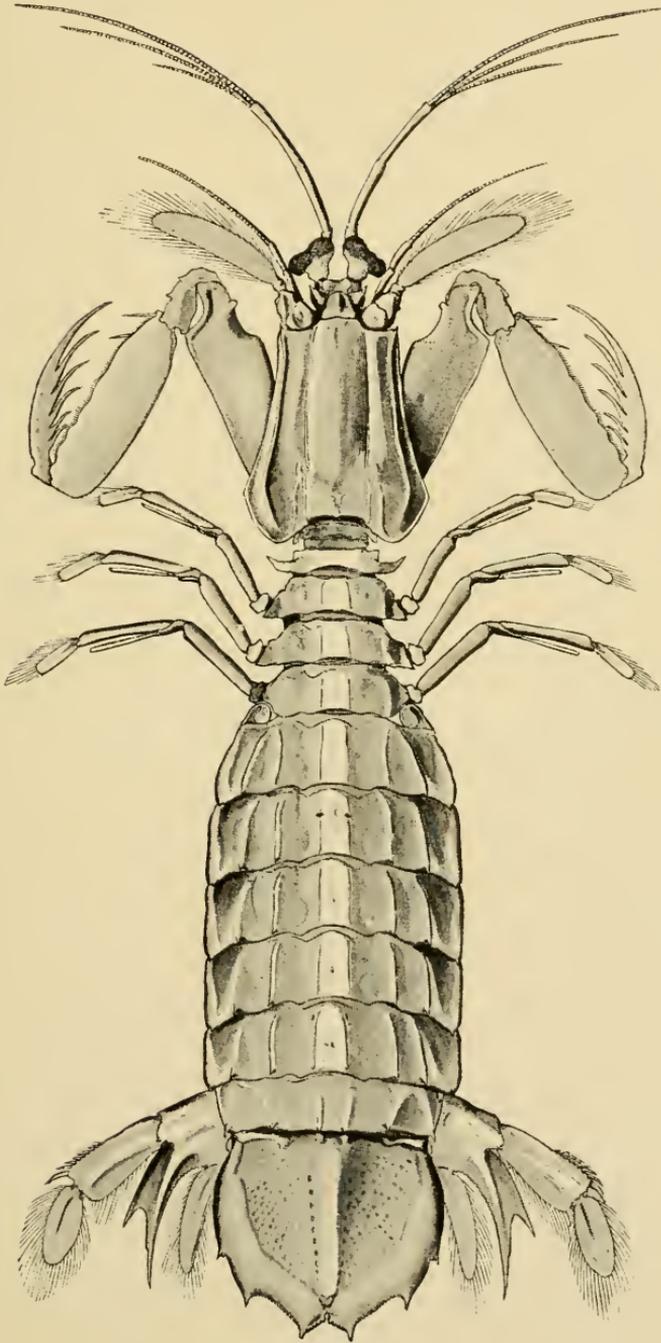
SQUILLA BIFORMIS, Bigelow.

Plate XXI.

Squilla biformis, BIGELOW, Johns Hopkins Univ. Circ., 88, 1891.

Diagnosis.—Eyes large, subtriangular or nearly T-shaped; dactylus of the raptorial claw with six teeth; rostrum ovate, with median and marginal carinæ; carapace provided with five well-marked carinæ, anterior lateral angles produced into small acute spines, posterior lobes angled at the sides; lateral spines of the first exposed thoracic segment strong, well curved forward, and acute, lateral processes of the next two segments obliquely truncated and acute; eight prominent carinæ on the first five abdominal segments; telson with a crest, a short ventral keel produced into a stout spine directed backward, and the general surface marked by many symmetrically curved lines of shallow pits, the dorsal surface in males elevated into a continuous smooth thickening around the entire free border; in females no elevations at the bases of the denticles and very small carinæ at the bases of the six marginal spines; five to seven submedian denticles, 15 to 19 intermediate, and one lateral, all small.

General description.—This is a large species, about 17 cm. long. The carapace (pl. XXI) equals in length the exposed thoracic segments and the telson measured from its base to the tip of the submedian spines, and is somewhat less than half as long as the first six abdominal segments. The body widens gradually from the posterior margin of the



SQUILLA BIFORMIS.

Male. About three-fourths natural size.

carapace to the second abdominal segment, then keeps about the same width back to the telson.

The rostrum is as broad as it is long and is broadly rounded in outline anteriorly. It extends over the first antennary segment. The median and marginal carinae are well marked, the former extending, however, only along the first half of the rostrum. The length of the carapace equals nearly the posterior width and is about twice the width between the anterior lateral angles. All five carinae are well marked. The median is bifurcated fore and aft, and it and the intermediate are interrupted by the transverse suture. There is a median tubercle on the posterior margin. The anterior lateral angles are rounded except at the point of termination of the intermediate carina, where a sharp spine arises abruptly. The posterior lateral lobes are obtusely angled laterally.

The exposed thoracic segments are provided with well-marked submedian and intermediate carinae. The ventral spine of the first exposed segment is obliquely flattened and acuminate, the lateral one is flattened dorso-ventrally, curved forward, and acute. The lateral margins of the next two segments are obliquely truncated and acute.

The first five abdominal segments have submedian, intermediate, lateral, and marginal dorsal carinae. The sixth has all but the latter, and the second, third, fourth, and fifth have double median tubercles. The marginal and lateral carinae of the first abdominal somite end posteriorly in spines. This is true of all but the submedian in the second, third, and fourth, and in the fifth and sixth they all end in spines.

The telson is a little shorter than broad and generally rounded in outline. There are six relatively small marginal spines which in the female (fig. 20) are continued into very slightly elevated carinae. The anterior lateral carinae are distinct, but not prolonged into spines. The submedian spines are divergent. Between each submedian spine and the shallow median sinus there are five or seven blunt teeth.

Between a submedian and an intermediate there are 15 or 17, and there is one between the intermediate and lateral spines. The crest is rather broad and terminates in a very small spine. On the ventral surface there is a short prominent keel, which is drawn out into a stout and sharp spine, pointed directly backward. Both dorsal and ventral surfaces are marked by numerous symmetrical curved lines of shallow pits, and the dorsal surface is slightly roughened between them. In the adult male (pl. XXI) the crest is thickened and whole margin of the telson is very much swollen on the dorsal side, so that all the carinae run together.

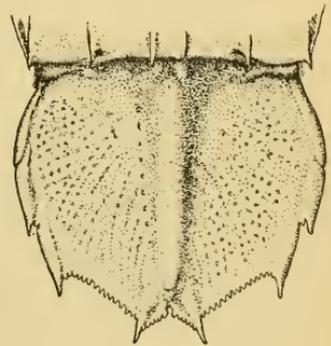


Fig. 20.

TELSON OF *SQUILLA BIFORMIS*.

Female. Slightly enlarged.

The eyes are very large and nearly T-shaped. The corneal part is very prominent, is more than twice as long as the stalk, and is divided into two parts by a slight groove. The anterior process of the ocular segment is emarginate. The lateral processes are flat, broad, and obtuse. The first antennæ are rather long, about the length of the last five abdominal segments. The spines of the corresponding segment are short, straight, and acute. The second antennæ reach a little beyond the base of the flagella of the first pair. The antennary scale is large. The raptorial claw is strong. The dactylus has six long claws. The pectinations on the manus are in a slightly undulating line. The carpus has two or three short processes on the anterior edge. The appendages to the thoracic appendages are linear. The inner spine of the basal prolongation of the uropod is more than twice as long as the outer one, and has a very small tooth on its outer side, about the middle of its length, and the inner edge is serrated. The endopodite has its sides nearly parallel. The terminal joint of the exopodite is nearly three-fourths the length of the first joint. On the outer edge of this joint there are eight to ten movable spines, usually nine. In fully mature specimens the difference between the sexes is very marked. In the adult male, besides the thickening of the crest and the margins of the telson, the marginal carinæ of the other abdominal somites are very broad and thick, and each one is connected along the posterior margin of the somite with the lateral carina, which is a little broader than in the female. The general shape of the abdomen differs in the two sexes, the first, second, and third segments being much wider in the male (pl. XXI).

The young males in the collection (e. g., two 5.4 and 7.4 cm. long, respectively) are in general like mature females, but differ in certain peculiarities of the telson. The crest is sharp and ends in a prominent spine. The marginal spines are relatively much larger than in the adult. Between the submedian spines and the median sinus there are next the spine two or three ordinary teeth, then for the rest of the distance to the sinus it appears as if the teeth were fused and their outer edges produced into a number of very fine teeth. This is most marked in the younger specimens. In a nearly full-grown female the pair of teeth next the sinus were found to possess similarly serrated borders.

Color.—The alcoholic specimens have no characteristic coloring.

Size.—The largest specimen is a male 17 cm. long.

Locality.—The *Albatross*, in 1889, captured three large males, two small ones, and two large females, in the Gulf of California, off La Paz Harbor, at a depth of 112 fathoms (No. 18493, U.S.N.M.). The *Albatross* expedition of 1891, under the direction of Dr. Alexander Agassiz, took 66 specimens of both sexes and various sizes at stations 3389, 3391, 3396, and 3397 (No. 18474, U.S.N.M.), in Panama Bay, the depth varying from 85 to 259 fathoms.

SQUILLA RAPHIDEA, Fabricius.

Squilla arenaria marina, SEBA, Thesaurus, III, p. 50, 1758.

Squilla raphidea, FABRICIUS, Ent. Syst. Suppl., p. 416, 1798.—LATREILLE, Encycl. Méth., x, p. 471, 1825.—MILNE-EDWARDS, Hist. Nat. Crust., II, p. 524, 1837.—WHITE, List Crust. Brit. Mus., p. 84, 1847.—MIERS, Ann. and Mag. Nat. Hist. (5), v, p. 27, 1880.

Squilla mantis, var. *B. major*, LAMARCK, Hist. Anim. sans Vert., v, p. 187, 1818.

Squilla harpax, DE HAAN, Fauna Japon. Crust., p. 222, 1849.

The Museum contains two specimens, one from Hongkong, China, collected by W. Stimpson on the North Pacific Exploring Expedition (No. 2108, U.S.N.M.), the other collected by the U. S. S. *Palos*, no locality given (No. 5146, U.S.N.M.).

SQUILLA NEPA, Latreille.

? *Cancer (mantis) digitalis*, HERBST, Naturg. Krabben und Krebse, p. 93, pl. XXXIII, fig. 1, 1796.

Squilla nepa, LATREILLE, Encycl. Méth. Hist. Nat., x, p. 471, 1825.—MILNE-EDWARDS, Hist. Nat. Crust., II, p. 522, 1837.—BERTHOLD, Abhandl. d. kön. Gesellsch. d. Wiss. Göttingen, III, 1845.—DE HAAN, Siebold's Fauna Japonica, 1850.—BIGELOW, Johns Hopkins Univ. Circ., 106, p. 102, 1893.

? *Squilla nepa*, HELLER, Reise der Novara, Crust., p. 124, 1865.—MIERS, Cat. New Zeal. Crust., p. 89, 1876; Ann. and Mag. Nat. Hist. (5), v, p. 25, 1880.

? *Squilla oratoria*, DANA, Crust. U. S. Expl. Exped., XIII, i, p. 621, 1852.

? *Squilla Edwardsii*, GIEBEL, Zeitschr. f. d. gesammte Naturwiss., XVIII, p. 319, 1861.

? *Squilla Massarensis*, KOSSMANN, Zool. Ergeb. einer Reise in dem Küsteng. des Rothen Meeres, II, p. 99, 1880.

Diagnosis.—A *Squilla* with very small eyes, the corneal axis being about three-fourths the length of the peduncular one and at right angles to it, and 0.029 times the length of the body; the dactylus of each raptorial claw deeply sinuate on its outer margin and provided on its inner margin with six teeth, including the terminal one; an ovate rostrum with marginal carinae and a small median tubercle; five carinae on the carapace, the median one bifurcated for nearly or more than half its length; spines at the anterior lateral angles of the carapace extending farther forward than the suture between the carapace and rostrum, the posterior lateral angles being evenly rounded; no ventral spines on first exposed thoracic segment but instead an additional lateral process, making two on each side, the anterior one being curved forward and acute and the posterior one much smaller, narrow, straight, and blunt; the lateral margins of the next two segments bilobed, the two lobes on the first one being of equal length and rounded or subacute, but the posterior one broader than the other, while on the second one the anterior lobe is very much the smaller; eight submedian carinae on all the segments of the hind body except the first exposed thoracic; a crest and a keel on the telson and symmetrical lines of pits on each side; six marginal spines and eight basal carinae and between the former two to three submedian, eight to ten intermediate, and one lateral denticle.

Locality.—The collection contains two female specimens. One of these is from Singapore (No. 2120, U.S.N.M.), and was collected by J. D. Dana while with the U. S. Exploring Expedition under Wilkes. The original label bears the name "*Squilla rhetorica*, S. & M." The other one is labeled Borneo (No. 15627, U.S.N.M.), and the name of the collector is not given.

Remarks on synonymy.—In the collection of the National Museum I have found two sets of specimens, either of which corresponds perfectly

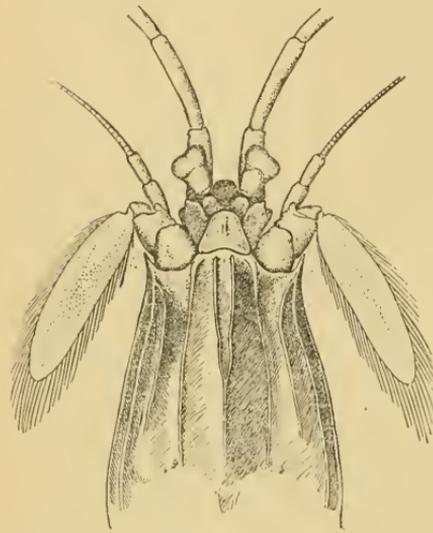


Fig. 21.

CEPHALIC REGION OF *SQUILLA NEPA*.

Slightly enlarged.

with the description of *Squilla nepa*, Latreille, as given by Miers, but which are evidently distinct. The most striking difference is in the eyes. Of one set, these are small and of the *Chloridella* type; of the other, they are large and of the type found in *S. mantis*. Further comparison shows other points of difference. The question immediately presents itself, which of these is the form that was originally described as *Squilla nepa*? and this suggests the further question, is the other form a new species, or has it been described under one of the several names now regarded as synonymous with *nepa*?

Latreille's original description of *Squilla nepa* is based on a single specimen from China, is very short, and applies equally well to either of our forms; but he refers to the figure given by Herbst (1796) of *Squilla digitalis*, and in this the animal is represented as having small eyes, the corneal axis not exceeding the peduncular one. This would indicate that the original *S. nepa* was our small-eyed form. Miers says, to be sure, that this figure seems intended for *S. mantis*, but this does not seem to me to be true. Although Herbst gives *Squilla mantis*, De Geer, etc., as a synonym of his "*Cancer (mantis) digitalis*," it appears to me that he had chiefly in mind the East Indian form, and took it for granted that the Mediterranean one was the same, for in his figure (Tab. 33, fig. 1) the margins of the thoracic segments are bilobed, thus plainly showing the chief characteristic that separates the two species, and in the text he says:

Das Vaterland ist Ostindien; auch findet man ihn häufig im Adriatischen Meere und im Liburnischen Meerbusen, woselbst er Canochia genannt wird.

Except in a few points, however, the description given by Herbst

would apply equally well to any *Squilla* related to *S. mantis*, and it seems to be the general opinion of the zoologists that followed him that his figures are unreliable. We may, therefore, follow the general usage and give to Latreille the credit of first clearly distinguishing the Mediterranean from the Indian species.

Turning now our attention to *S. oratoria*, De Haan, the most prominent synonym of *S. nepa* given by Miers, we find that Heller (1868) separates forms under these two names, but as noted by Miers, does not give his reasons for doing so. Dana (1852) reports this species from Singapore, but his short description contains nothing to distinguish it from *S. nepa*. De Haan's original description (1850) is a short one in Latin and contains nothing that is not also true of *S. nepa*. In his analytical key he separates the two by the difference in the length of the anterior lateral angles of the carapace. So far Miers appears to be right in regarding the two as synonyms, but De Haan's figure differs from the one of Herbst referred to by Latreille in representing the animal as having large triangular eyes. Moreover, De Haan gives *S. affinis*, Berthold, as a synonym of *S. oratoria* and when we refer to Berthold's paper (1845) we find what we were seeking, a clear distinction between the large-eyed and small-eyed forms of *S. nepa*.

Berthold founded his species, *S. affinis*, upon some specimens that he purchased from a ship that had been to China. In his museum he found an old specimen marked *S. digitalis* that corresponded to the descriptions of *S. nepa* given by Latreille and by Milne-Edwards. Comparing the two he found the following differences:

Squilla affinis, BERTHOLD.

The cornea measures obliquely $2\frac{1}{2}'''$.

The upper end of the peduncle reaches nearly to the upper end of the cornea so that the latter is placed obliquely above or below the peduncle.

The rostrum has an upturned outer margin.

The anterior bifurcation of the median carina of the carapace reaches backward only one-fifth of its length.

The anterior lateral angles of the carapace do not extend beyond its anterior frontal border.

The denticles on the telson are swollen and are arranged obliquely anterior posteriorly.

The whole body is thicker, relatively to its length broader and higher.

The last joint of the raptorial claw is slightly bent, but not sinuate.

Squilla nepa, LATREILLE.

Only $1\frac{1}{2}'''$.

The upper end of the peduncle hardly reaches any farther forward than the other, so that the cornea is placed directly in front of the peduncle.

The rostrum has no such upturned border. (See marginal carina shown in fig. 21).

This bifurcation reaches backward nearly half the length of the carapace.

These angles are strongly produced so that they extend beyond this border.

The denticles have no swollen elevation and point directly backward.

The body is more slender, less high and broad.

The last joint of the raptorial claw has the proximal half of its outer margin strongly sinuate.

Both sets of my specimens have rostra with carinated margins, and I fail to find any essential differences between them in the denticles on

the telson or in the general proportions of the body. Otherwise, the distinguishing characters given by Berthold hold for my specimens and I am convinced that they represent two distinct species. As Berthold was the first to separate these species we should undoubtedly follow his nomenclature, regarding the small-eyed form as *S. nepa*, Latreille, and giving his name *S. affinis* to the other. Berthold's description of the latter is very complete, is accompanied by measurements and figures, and was published five years before de Haan's. I can not see that de Haan had any warrant for replacing Berthold's name for this species by one of his own, and the latter should be dropped.

The similarities and differences between these two species as exhibited in the collection before me are expressed briefly in the definition given above and in the one which follows.

SQUILLA AFFINIS, Berthold.

Squilla affinis, BERTHOLD, Abhandl. kön. Gesellsch. Wiss. Göttingen, III, p. 26, 1845.—BIGELOW, Johns Hopkins Univ. Circ., 106, p. 102, 1893.

Squilla oratoria, DE-HAAN, Siebold's Fauna Japon. Crust., p. 223, 1850.

? *Squilla oratoria*, HELLER, Reise der Novara, Crust., p. 124, 1865.

? *Squilla nepa*, MIERS, Ann. and Mag. Nat. Hist. (5), v. p. 25, 1880.

Squilla nepa, BROOKS, Voy. of the *Challenger*, XVI, ii, p. 25, 1886.

Diagnosis.—A *Squilla* with large triangular eyes, the corneal axis being oblique and as long as or usually longer than the peduncular one and 0.05 times the length of the body; the outer margin of the dactylus of the raptorial claw not sinuate or only slightly so; six teeth on the dactylus; the rostrum slightly truncated and provided with marginal carinae and a median tubercle; five carinae on the carapace, the median one not bifurcated for more than one-fourth its length, and the lateral ones continued into the anterior lateral spines, which do not reach as far forward as the suture between the rostrum and carapace, the posterior lateral angles evenly rounded; no ventral spines on the first exposed thoracic segment, its lateral processes and those of the next two segments bilobed as in *S. nepa*; submedian carinae present on all except the first segments of the hind body; crest, keel, and symmetrical lines of pits on the

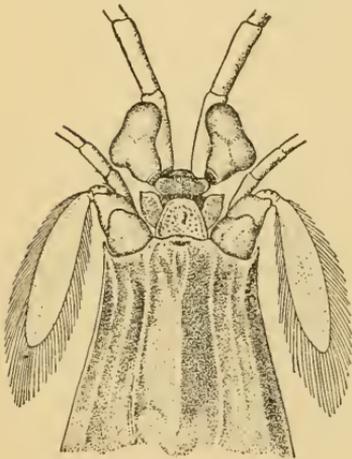


Fig. 22.

CEPHALIC REGION OF SQUILLA AFFINIS.

Slightly enlarged.

telson and six marginal spines, eight basal carinae, and between the former four to five submedian, seven to nine intermediate, and one lateral denticle.*

* See remarks on Synonymy under *S. nepa*.

Locality.—There are in the collection one male and three females, brought by J. B. Bernadon, U. S. Navy, then of the U. S. S. *Alert*, from Nagasaki, Japan, and supposed to be from Korea (No. 14116, U.S. N.M.); two males collected by P. L. Jouy in 1885 at Fusan, Korea (No. 12426, U.S.N.M.); a small female from Japan, purchased of H. A. Ward (No. 15628, U.S.N.M.), and a much smaller one from Yokohama, Japan (No. 9347, U.S.N.M.); two specimens from the U. S. S. *Palos* (No. 5145, U.S.N.M.), and a number collected by R. Hitchcock in Japan (No. 13940, U.S.N.M.), and by W. Stimpson at Hongkong (No. 2004, U.S. N.M.).

SQUILLA ALBA, Bigelow.

Plate XXII.

Squilla alba, BIGELOW, Johns Hopkins Univ. Circ., 106, p. 103, 1893.

Diagnosis.—A species possessing very large triangular eyes, the corneal axis being oblique; a pair of large raptorial claws with six teeth on the dactylus; an ovate rostrum with obsolete carinae; a carapace with five carinae, the median one not bifurcated in front, with the anterior lateral angles produced into spines, and the posterior lateral angles rounded; no ventral spines, but two lateral lobes on each side of the first exposed thoracic segment, the anterior one being large, strongly curved forward and acute, the posterior one short and rounded; rounded lateral margins on the next two segments, not bilobed; eight carinae on the abdominal segments; a nearly smooth telson with a low crest ending in a spine and a few curved lines of confluent pits upon its dorsal surface; six marginal spines and between them five to six submedian, twelve intermediate, and one lateral denticle; a large rounded lobe on the inner tooth of the basal prolongation of each uropod and one in the angle between the two teeth.

General description.—This is a well-marked and striking species. The color of the living specimens at once attracts attention. Except for the corneal region of the eyes, which is yellowish, the whole animal is a pure opaque white, marked by only a few symmetrically and definitely placed minute black spots, the positions of which are shown in pl. XXII. The shape of the animal is also peculiar. The carapace and the exposed portion of the thorax are equal in length and together make up about four-ninths of the total length of the body. The segments in front of the carapace are also elongated so that the rostrum does not completely cover the first antennary segment. Moreover, the eyes are unusually large, so that the whole cephalothoracic region has a drawn-out appearance, not well shown in the figure. The rostrum is ovate and nearly smooth, the median and lateral carinae being only faintly marked.

The general surface of the carapace is smooth and polished; the median carina is not bifurcated in front, but stops short some distance before it reaches the anterior edge of the carapace. The lateral carinae

run forward very close to the edge and pass into the anterior lateral angles. The first exposed thoracic segment has submedian and lateral carinae as well as the rest. Its lateral processes recall the condition found in *S. nepa*. Latreille. There are no ventral spines and there is a strong and sharp lateral one curved until it points directly forward and bearing on its posterior side a flattened rounded lobe. The lateral processes of the next two segments are, however, not bilobed, but are broad and rounded and only slightly emarginate on the anterior side. The small lobe on the fourth segment is rounded.

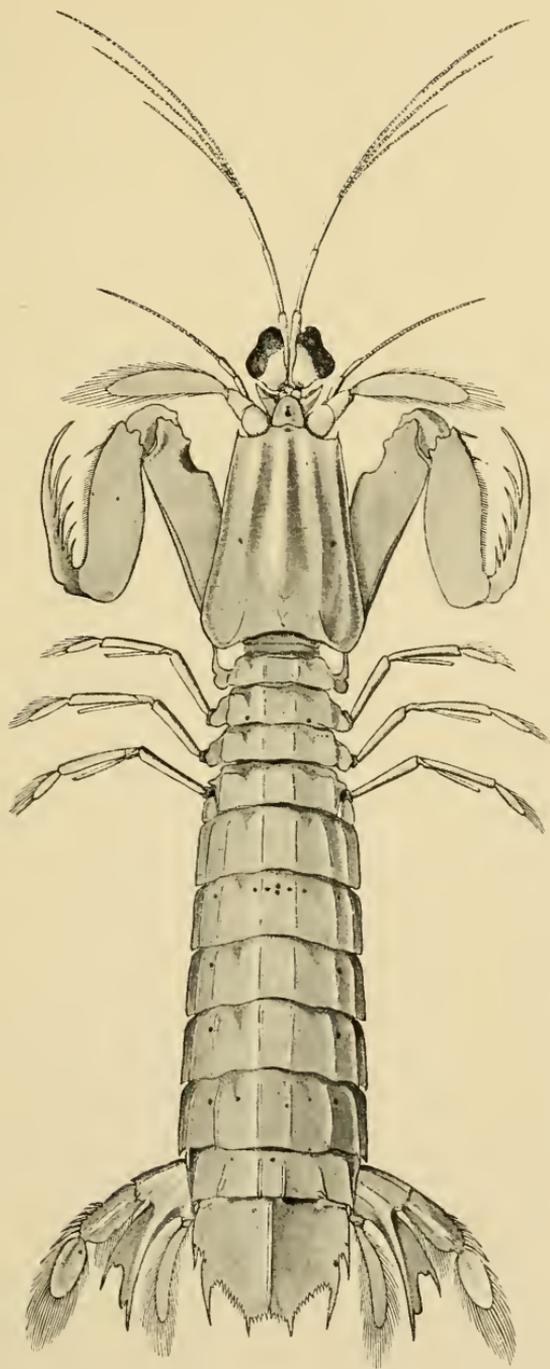
The abdomen is rather compactly put together. Only a small number of carinae end in spines, namely, the usual six on the sixth segment, all but the submedian on the fifth, and the lateral and marginal ones on the fourth. The spine in front of the articulation of the uropod is very minute or absent. The length of the telson is five sixths of its width at the base. It has an acute median crest ending posteriorly in a stout spine. Of the six marginal spines the intermediate pair is much the longest and stoutest. They all have short low carinae at their bases. The anterior lateral carinae form no angles at their posterior ends, but taper off gradually. The lateral denticles are very acute and without elevation at their bases. There are about six oblique, faintly marked rows of confluent pits on the dorsal surface of the telson on each side of the crest, besides the row of pits on each that runs nearly parallel to it. The ventral surface has a corresponding series of obsolete pits and there are faint carinae also on the bases of the submedian and intermediate spines, an unusual feature, otherwise the ventral surface of the telson is perfectly smooth, there being no keel nor lateral carinae.

The basal prolongation of the uropod is serrated along its inner margin, and besides the large rounded lobe in the middle of the outer side of the inner spine there is another similar lobe in the angle between the two spines. The first joint of the exopodite is a little longer than the distal one and bears six movable spines.

The corneal portion of the eyes is unusually large in proportion to the size of the body, and is much greater in bulk than the pedicle. The pedicle is small and inversely conical, while the corneal region is voluminous and reniform. The ophthalmic segment bears a short rounded process at the base of each eye. The lateral processes on the next segment are subacute. The first antennae reach nearly half the length of the body, the first three joints being as long as the carapace. The second antennae are as long as the carapace, and the antennary scale is about half as long. The raptorial claws, when folded, do not reach to the posterior extremity of the carapace. The carpus has merely a slightly elevated ridge on its anterior margin. The dactylus has a minute projection on its outer margin near the articulation.

The appendages of the walking legs are linear.

Color.—The eyes are yellowish, while the rest of the body is opaque



SQUILLA ALBA.

Nearly three times natural size.

white, with a few symmetrically placed black spots. (See pl. XXII.) The same number of spots is not always present.

Size.—The largest of the two specimens is 4.1 cm. in length.

Locality.—Two females were collected by me in Bimini Harbor, Bahamas, where they were found burrowing in the calcareous sand. (No. 18495, U.S.N.M.).

SQUILLA RUGOSA, Bigelow.

Squilla rugosa, BIGELOW. Johns Hopkins Univ. Circ., 106, p. 102, 1893.

Diagnosis.—A *Squilla* having large triangular eyes with oblique cornea; long raptorial claws, their dactyli armed with six teeth; a sub-triangular truncated rostrum, slightly raised at the margin; five longitudinal carinae upon the carapace, the median and intermediate being interrupted by the cervical suture, and the median one not bifurcate in front; the anterior lateral angles of the carapace produced into acute spines, and the posterior angles rounded; six carinae on each of the exposed thoracic segments, the lateral process of the first of these segments being lanceolate and acute, with the second and third rounded in front and produced backward into an acute spine; eight carinae on the first five abdominal segments, all the abdominal carinae ending in spines except the submedian of the first four segments and the intermediate on the first two; three to four teeth on the posterior margin of the fifth and sixth abdominal segments between the submedian and intermediate spines; ten prominent carinae on the dorsal surface of the telson on each side of the crest, which ends in a spine, six marginal spines, and on each side five submedian teeth, ten to twelve intermediate, and one lateral one; the basal prolongation of the uropod with eight to twelve long teeth on its inner margin, and a rounded lobe on the outer side of the inner spine.

General description.—The first impression one receives on handling a specimen of this species is the marked prominence and sharpness of all its carinae and spines. The general proportions of the body are very similar to those of *S. quadridens*. The length of the carapace is very nearly equal to one-quarter of the total length of the body and to the greatest width of the abdomen. The greatest width of the carapace is equal to three-fourths its length. The telson is very nearly as long as it is broad at its base.

It is in the uropod, the telson and the adjoining segments that we find the most striking peculiarities of this species. The most prominent of these is the sculpturing on the dorsal surface of the telson (fig. 23). The median longitudinal crest is high and narrow and ends behind in a very sharp spine pointing directly backward. There is a

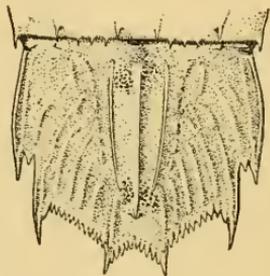


Fig. 23.

TELSON OF SQUILLA RUGOSA.

About twice natural size.

tubercle beneath the spine. On each side of the crest there is a shorter carina running nearly parallel with it. Outside of this there is another carina taking a similar course but extending to the base of the submedian spine, where it ends abruptly. The proximal two-thirds of this carina is repeatedly interrupted, so that this part of it consists of a series of seven or eight elongated tubercles. Then next outside of this one there is a series of six parallel carinae running obliquely outward and backward. The fifth one of these extends on to the intermediate spine and tapers gradually to its tip. Then two more carinae, one beginning at the posterior edge and running along the lateral margin and another parallel one just inside of this. They both taper off on the lateral spine.

The ventral surface of the telson is nearly smooth except for a low keel and two small tubercles, one each side of the anus. The sixth abdominal segment has, besides the usual six dorsal spines, a small marginal spine on each side on the front edge of its articulation with the uropod.

The presence of three or four small teeth on the posterior margin of the fifth and sixth abdominal segments between the submedian and intermediate spines on each side is one of the unusual features of this species. Another one is the presence of from eight to twelve or perhaps more long slender teeth on the inner edge of the basal prolongation of the uropod. The lobe on the inner spine is at about its middle. The proximal joint of the exopodite is but slightly longer than the distal one and it bears from eight to thirteen movable spines; eight is probably the usual number.

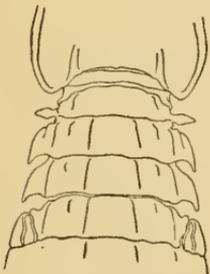


Fig. 24.

EXPOSED THORACIC SEGMENTS OF *SQUILLA RUGOSA*.

About $1\frac{1}{2}$ times natural size.

The rostrum in this species is provided with marginal carinae, but has no median one. The lateral carinae of the carapace are continued into the antero-lateral spines. The lateral spine of the fifth thoracic segment (fig. 24) extends outward prominently at right angles to the body. It is very much compressed dorso-ventrally and is lance-shaped. The ventral spines are distinct and triangular in outline. They are compressed obliquely and are straight. The lateral spines on the next two segments point strongly backward.

The eyes are large and broadly triangular, the corneal axis being ten-sevenths the length of the peduncular one and oblique to it. The ophthalmic segment is not at all covered by the rostrum, is acute in front and only very slightly produced into lobes at the bases of the eyes. The lateral lobes of the first antennary segment are acute. The first antennae are considerably longer than half the length of the body. The second antennae only reach a little beyond the second joints of the first. The antennary scale is a little more than equal to half the length of the carapace. The raptorial claw is long, and when folded reaches

as far back as the most posterior portion of the carapace. The carpus is without spines. The manus has the usual three movable spines, and the marginal pectinations form a slightly undulating line. The dactylus is rather slender and its outer edge is a simple curve except for a scarcely perceptible tubercle near its base. It is armed with six teeth that gradually increase in length from the base outward. The appendages of the walking legs are linear.

Size.—Length of body, 7.7 cm.

Locality.—The single female specimen in the collection was taken by the *Albatross* in 1885 in the Gulf of Mexico off Charlotte Harbor, N. Lat. 26° 18' 30'', W. Long. 83° 8' 45'' at a depth of 27 fathoms (No. 9835, U.S.N.M.).

THE LARVÆ.

The ontogeny of the Stomatopoda includes a remarkable metamorphosis, and the animals while in the larval stage bear so little resemblance to their adult form that it was but natural that the earlier zoologists should suppose them to be adults of another family and should give to them generic and specific names. We are indebted to the researches of Claus (1871), Faxon (1882), and Brooks (1879, 1886, and 1892) for our knowledge of the true relationship of these forms. While they are now only entitled to bear the names of adult species of which they are the immature representatives, it is still convenient in speaking of them to use the old generic names, and Brooks (1886) extended this terminology at the same time that he pointed out distinguishing characters of the representative larval forms of most of the genera, so that now for each one of the principal adult genera we have a corresponding larval type. The ontogeny of *Protosquilla*, *Pterygosquilla*, and *Leptosquilla* is unknown. The chief characteristics of the larval forms of the other genera are displayed in the following:

ANALYTICAL KEY TO THE TYPES OF STOMATOPOD LARVÆ.

I. Eyes sessile; appendages I-X developed and XIV-XVII also budded in older stages..... ERICHTHOIDINA, Claus. (An early stage; adult form unknown).

II. Eyes stalked; appendages I-VII and XIV-XVII, present in earliest stages.

* *Erichthus* Form: Telson usually quadrate or hexagonal in general outline, with never more than 4 intermediate denticles.

† Body elongated; carapace narrow without prominent ventro-lateral angles and with posterior lateral angles near the dorsal surface.

Telson slightly wider than long, and notched on the median line; posterior lateral spines of carapace long; never any trace of lateral teeth upon the raptorial dactylus.

GONERICHTHUS, Brooks. (Larva of GONODACTYLUS).

Like the above, but the dactylus of the raptorial limb showing traces of lateral teeth in the oldest stages.

ODONTERICHTHUS, new type. (? Larva of ODONTODACTYLUS).

Hind body very long; telson longer than wide, sometimes ovate in general outline; carapace narrow and short with short rostrum and short postero-lateral spines:

PSEUDERICHTHUS, Brooks. (Larva of PSEUDOSQUILLA).

†† Body short; carapace large and wide, infolded on the ventral side, with prominent ventral angles, and posterior lateral angles widely separated from the median line.

Hind body wide and flat; telson wider than long.

LYSIOERICHTHUS, Brooks. (Larva of LYSIOSQUILLA).

* * *Alima* Form: Telson usually octagonal in general outline with numerous intermediate denticles.

† Basal spines of each uropod small and equal.

Body short and broad, nearly covered by the carapace, which is folded downward and inward.

ERICHTHALIMA, Brooks. (? Larva of CORONIDA).

†† The inner one of the basal spines on each uropod the longer.

Hind body short and broad; carapace broad, covering all but the last thoracic segment, but not folded in at the sides.

ALIMERICHTHUS, Claus. (? Larva of SQUILLA [CHLORIDELLA]).

Body greatly elongated; carapace flattened, elongated, and narrow (about $\frac{1}{3}$ as wide as long); usually several thoracic segments exposed ALIMA, Leach. (Larva of SQUILLA).

General remarks on the collection.—The collection of larvæ is of considerable size, but it is not worth while for us to linger over it, for it contains but few forms of special interest, no consecutive series, and no stages that can be assigned with certainty to any adult species. The most striking features are the quantity of large *Lysioerichthi* from the Atlantic and the number of very large *Alimæ* from the Bay of Panama. The former resemble the specimen figured by Brooks (1886) in pl. x, fig. 7, and which he regards as the young of *Lysiosquilla maculata*. The latter are of two species, one with a very wide carapace and the other with a narrow one. It seems probable that these will be found to be the larvæ of the two large species of *Squilla* that are common at Panama—*S. panamensis* and *S. biformis*.

The larvæ of stomatopods are sometimes to be found in immense schools. While with the Johns Hopkins University Marine Laboratory at Bimini in the summer of 1892 I found a few stomatopod larvæ of various kinds and stages almost every time that the towing net was used, but after dark on the evenings of July 19, 20, and 21 the towing nets were crowded with an immense number of very small *Gonerichthi*, apparently identical with the form represented by Claus (1871) in his fig. 22 B.

THE ODONTERICHTHUS LARVA.

Two specimens among the larvæ from the Atlantic are of especial interest. They are probably in the last larval stage and exhibit most of the characters of *Gonerichthi* except that lateral teeth are to be seen beneath the larval skin on the dactylus of the raptorial limb. It is evident that they can not be larvæ of *Gonodactylus*, but, if Brooks is right in regard to the relations of the larval forms, the specimens before us must belong to a genus very closely related to *Gonodactylus*. The nearest one is *Odontodactylus*, and it seems probable that these

larvæ belong to two unknown species of that genus. They therefore represent a new larval type for which I propose the name *Odonterichthus*.

One of them (No. 9958, U.S.N.M.) was taken by the *Albatross* October 3, 1883, at station 2101, off Nantucket. It is represented in fig. 25. A comparison of this figure with Brooks' fig. 5, pl. XII, which represents a *Gonerichthus* from St. Vincent, Cape Verde, will show a striking similarity. They both exhibit the form of body, the shape of the carapace, and telson, that Brooks has shown to be characteristic of the *Gonodactylus* larvæ. An examination of fig. 25 will convey a better idea of this interesting form than pages of description. It will be seen that the specimen before us differs from Brooks' in having a somewhat shorter rostrum with five or six small spines on the ventral

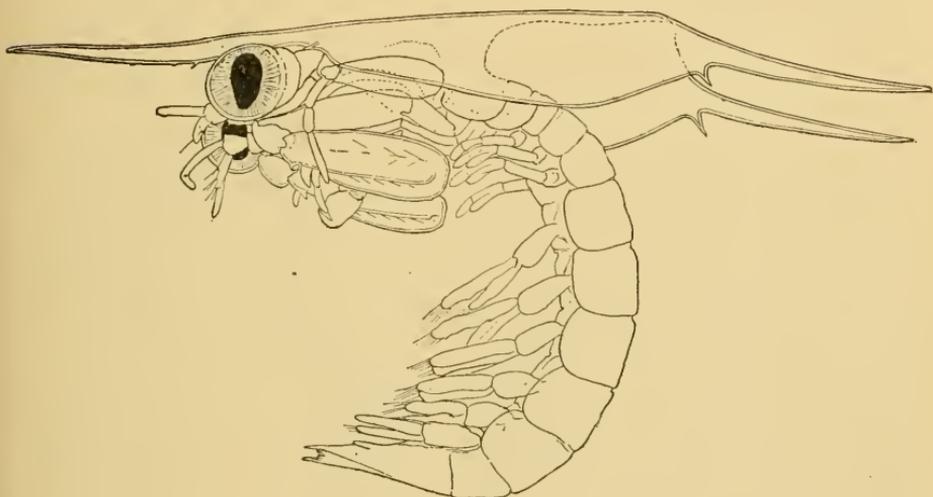


Fig. 25.

ODONTERICHTHUS LARVA.

Two teeth on the rostrum are hidden by the eye. Drawn with a camera lucida $\times 14$.

side, and in having a minute additional secondary spine on the ventral edge of the carapace. The dactylus of the raptorial limb is much more developed and shows five lateral teeth beneath the larval skin. The similarities are so much greater than the differences that the latter may be due merely to a difference in age, the one being an older stage of the other. These forms would appear to belong to a species in which the larvæ can be distinguished from *Gonerichthi* only after the teeth begin to form on the raptorial dactylus.

The other species, however (fig. 26), is not so similar to the *Gonerichthus* type, but approaches the *Pseuderichthus* form, and this is just what we should expect if my view be accepted that this is a larva of *Odontodactylus*, because this genus is distinctly intermediate in some

of its characters between *Gonodactylus* and *Pseudosquilla*. Compare *Odontodactylus havanensis* (pl. XX) with *Gonodactylus chiragra* on the one hand and with *Pseudosquilla ciliatu* on the other, and then compare this larva (fig. 26) with a typical *Gonerichthus* and a typical *Pseuderichthus*, as, for instance, the forms figured by Brooks* on pl. XII, fig. 6, and on pl. XV, fig. 11, respectively. It will be seen that this larva

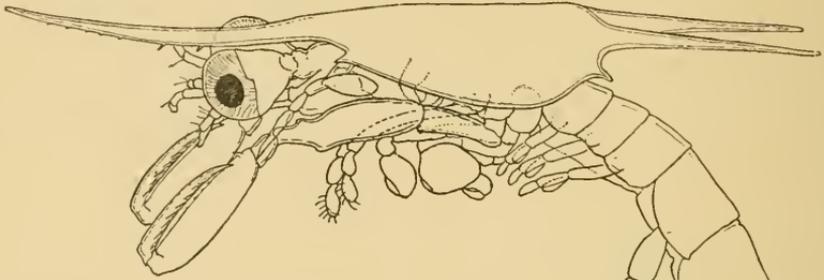


Fig. 26.

ODONTERICHTHUS LARVA.

Drawn with the camera lucida $\times 13$.

(No. 4393, U.S.N.M.), which was taken at Woods Holl, Mass., August 22, 1876, has the elongated body and short carapace of *Pseudosquilla*, but the carapace bears the long rostrum and long postero-lateral spines of a *Gonerichthus*, while the dactylus of the raptorial limb shows traces of seven or eight lateral teeth. It is thus excluded from either of the genera with which we have been comparing it. *Odontodactylus havanensis*, however, has six lateral teeth upon the dactylus and *O. hansenii*, recently described by Pocock (1893) has nine distinct teeth, so that our larva may well belong to this genus. It probably belongs to some West Indian species, was swept north by the Gulf Stream and then driven into Woods Holl by a southerly wind, for such has been the fate of many tropical creatures.

Brooks also found in the *Challenger* collections "larvæ which closely resemble *Pseuderichthus*, although they may be *Gonodactylus* larvæ;" perhaps they are younger stages of *Odonterichthus*.

THE METAMORPHOSIS OF *SQUILLA QUADRIDENS*.

At Bimini on the 7th of July, 1892, several Alimæ were taken in the tow net. The two largest ones appeared to be alike on a superficial examination and were distinguished from the rest by the great elongation of the body in proportion to its width. One of these was preserved

* Voyage of the *Challenger*, XVI, part 45, 1886.

in alcohol and is represented in fig. 27. The other was left in the aquarium, and on July 9 it molted in the form seen in fig. 28. Unfortunately the two larvæ

were not compared carefully before the molt, but I have no doubt that they were identical in form, for there was no difference in general appearance, and a careful comparison of the specimen represented in fig. 27 with the older one in fig. 28 shows so many features in common

that one can hardly doubt that the one form is derived from the other, and this opinion is confirmed by the entire absence of any characters inconsistent with such a view. Of course, these two forms are separated by the critical change from the larval to the adult form, and there is more difference between them than between any other two stages.

The adult form (fig. 28) appears to be identical with *Squilla quadridens*, Bigelow, the type specimen of which was found on the Florida coast not far from where these larvæ were captured. A comparison of the figure with the description of the species (p. 511) will show that it corresponds in all the chief characters, although it probably would not assume its fully matured form and detail of structure until after several more molts. In the passage from the larval to the adult form the body becomes broader and more compact at the expense of its length, so that shortly after the molt it is but 1.1 cm. in length, while before it was 0.5 cm. longer. Another specimen which may have undergone another molt since assuming the adult form was captured by the towing net four days later.

The dactylus of the raptorial limb in the larva (fig. 27) is unarmed, but one can see three lateral teeth in addition to the terminal one lying beneath the larval skin. In this way it corresponds to the adult form, and at the same time recalls Brooks's description (1886, pp. 90-93), of *Squilla* (*Alima*) *bidens*, Claus, but a comparison of this description and the

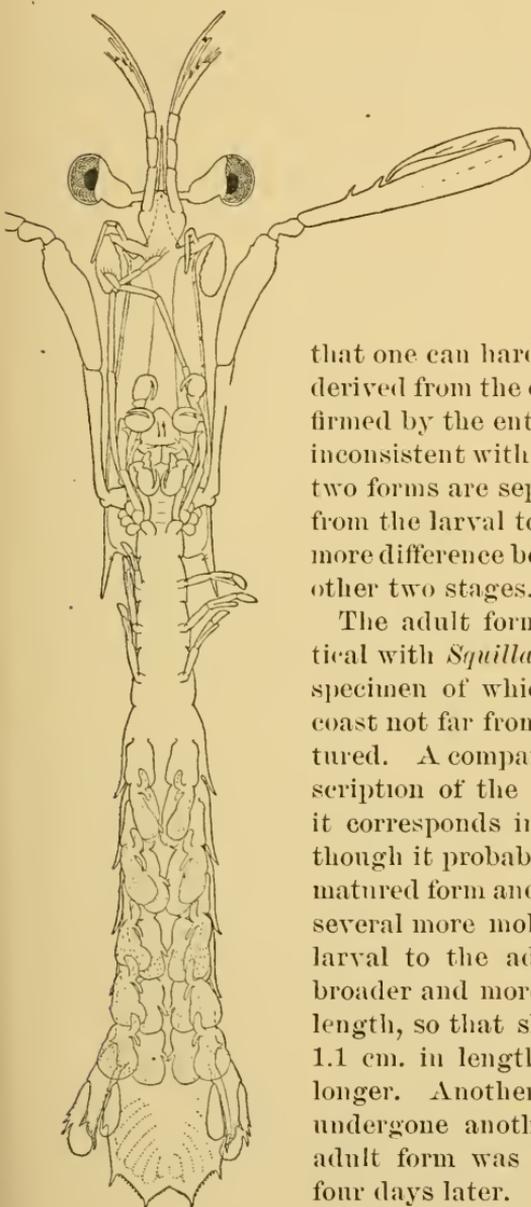


Fig. 27.

LAST ALIMA STAGE OF *SQUILLA*
QUADRIDENS.

Drawn with a camera lucida $\times 8$.

same time recalls Brooks's description (1886, pp. 90-93), of *Squilla* (*Alima*) *bidens*, Claus, but a comparison of this description and the

accompanying figures with our form shows so many differences that the two must be distinct.

Our larva, *Squilla (Alima) quadridens*, is in the first place much smaller than *Alima bidens* at the stage with three lateral teeth on the dactylus, the later being an inch in length while the length of the former is but 1.6 cm.

Then in our form the carapace is relatively shorter and narrower,

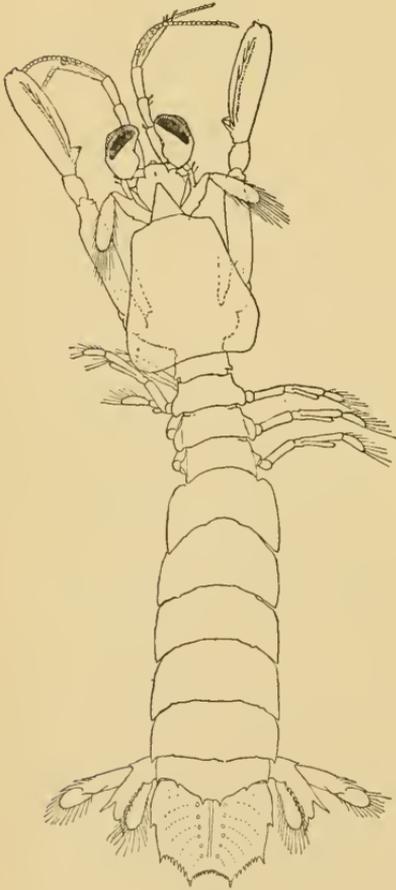


Fig. 28.

FIRST STAGE OF ADULT FORM OF SQUILLA
QUADRIDENS.

Drawn with the camera lucida $\times 8$.

making with the rostrum less than two-fifths of the total length of the body measured along the median line. The rostrum does not extend beyond the shafts of the first antennæ and does not equal half the length of the rest of the carapace. The anterior lateral angles are not so prolonged, and the posterior lateral spines reach only so far as the boundary between the second and third of the four posterior thoracic segments, which are left exposed by a deep incision in the posterior margin of the carapace. There is a single secondary spine at the base of each posterior lateral process and three or four minute ones on the side of the carapace in front of the mouth. The hind body is more elongated than in *Alima bidens* and comprises more than three-fifths of the total length from the tip of the rostrum, but, as in that species, all of the posterior lateral angles of the first five abdominal somites end in acute spines, and there are two submedian spines on the sixth. The shape of the telson is very similar to that of the other species, but it has a different number of secondary denticles, there being on each side fifteen submedian, eight to nine intermediate, and no lateral ones,

while in *A. bidens* they are $20 \pm, 12-13, 0$. The basal prolongation of the uropod shows beneath the larval skin the characteristic form of the adult, including traces of the acute teeth on the inner side. The raptorial claw is more slender than in *A. bidens*, and the manus bears two equally

large curved teeth on its proximal portion instead of 1 large one, and has numerous minute teeth on its distal portion.

A number of Alimæ were found at the same time in earlier stages. They are all of one species which is very similar to or identical with *Alima gracilis*, Milne-Edwards, and they may be the earlier stages of the form that I have just described, but no decision can be reached on this point, as the necessary intermediate stages are wanting.

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