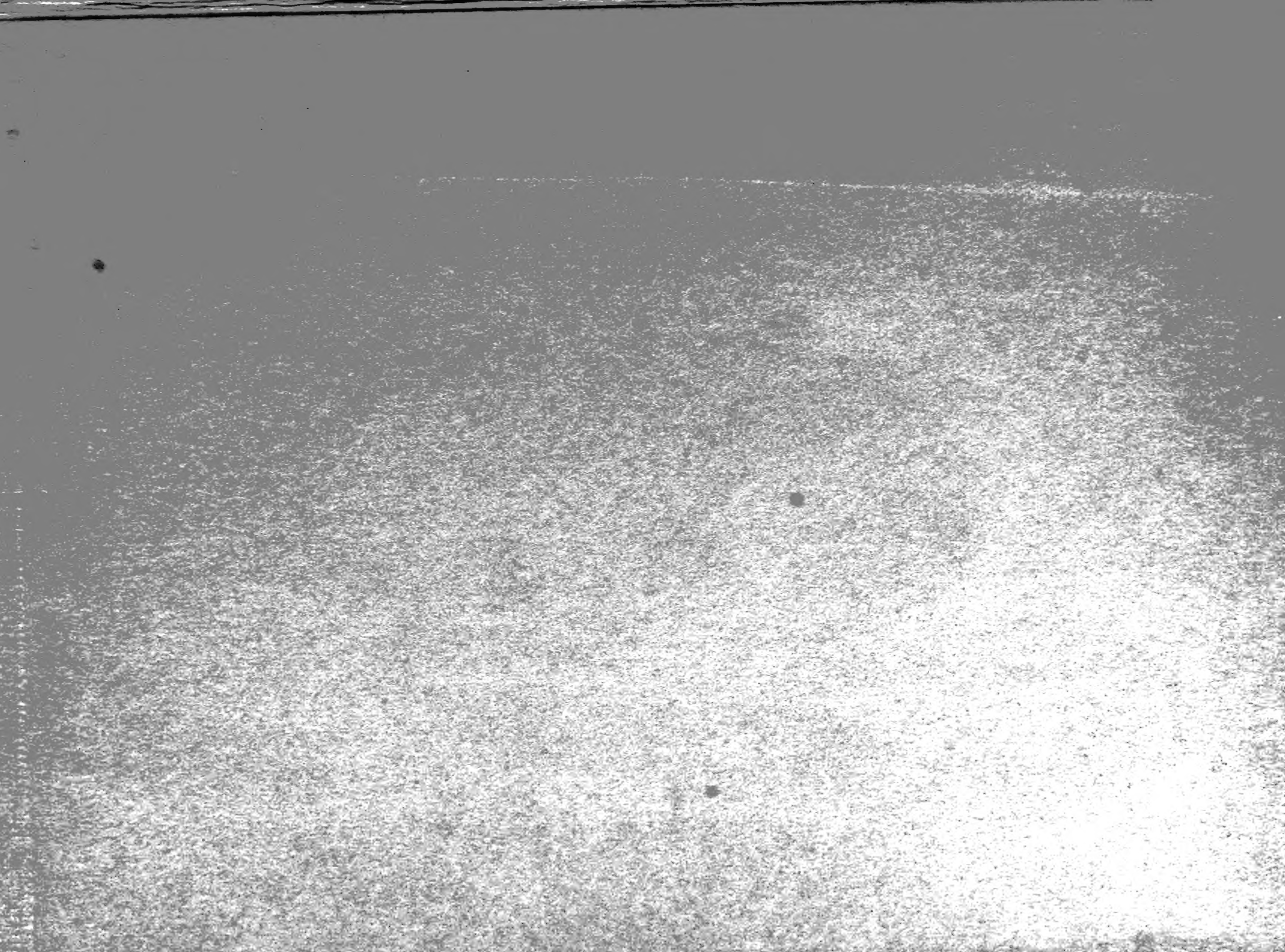

MEMOIRS

of the

INDIAN MUSEUM

Vol. IV, No. 1.

An Account of the

CRUSTACEA STOMATOPODA OF THE INDO-PACIFIC REGION

based on

THE COLLECTION IN THE INDIAN MUSEUM.

By

STANLEY KEMP, B.A.,

Assistant Superintendent, Indian Museum,

with which are issued

ILLUSTRATIONS of the ZOOLOGY of the R.I.M.S.S. 'INVESTIGATOR'

under the command of

Commander C. S. HICKMAN, R.I.M.

Crustacea Stomatopoda, Plates I—X.

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Assistant Superintendent, Indian Museum.

Plates I—X.

CONTENTS.

INTRODUCTION.

The history of the collection of Stomatopoda in the Indian Museum dates from some twenty years ago when the late Mr. J. Wood-Mason, at the expenditure of much time and energy, devoted himself to the acquisition of a representative series of Indo-pacific species To the small nucleus collection then existing he was able to add numbers of known and unknown forms, not only from the coasts of India, but from New Zealand, Australia, Hongkong, Singapore and Mauritius.

Mr. Wood-Mason died in 1893, just after completing the arrangement and classification of a large part of the collection. It was hoped that among his papers material for a full account of the species would be found, but this unfortunately did not prove to be the case. A number of figures accompanied by a few rough laboratory notes alone were available and although his successor, Col. Alcock, was able to edit from these an account of nine species, no connected report on the whole collection has hitherto appeared. Since 1895, when Wood-Mason's descriptions were

published, very considerable additions have been made, largely owing to the painstaking efforts of succeeding Surgeon-Naturalists on the R.I.M.S.S. 'Investigator.'

As may be imagined the task of writing an account of this collection, already to a large extent arranged and classified by Wood-Mason, was one of no especial difficulty: the manuscript names with which many of the species were supplied have been a fruitful source of guidance. It was my original intention to restrict the present paper to an account of the Indian species, but it soon became apparent that the collection was sufficiently representative to justify work on more ambitious lines, and I have consequently attempted to give a descriptive catalogue of all adult Stomatopoda from Indo-pacific waters, indicating as far as a study of the literature enables me, the chief points of those species which I have not been able to examine myself. Owing perhaps to their peculiar habits many species of Stomatopoda are so rare that it is only by abstraction from the work of previous writers that a concise account of the forms occurring in a given area can be prepared.

Under the somewhat loose term " Indo-pacific " I include all localities from Suez and S. Africa to Australia, New Zealand, Oceania and Japan. The Pacific Coast of America is omitted; for the species of Stomatopoda known from this region show little affinity with those of the area defined above and have, moreover, already been fully dealt with by Bigelow.

It is not necessary to treat the history of our knowledge of the recent Stomatopoda at any considerable length. H. Milne-Edwards in 1837 gave an account of the few species known in his day, and this was succeeded in 1849 by De Haan's admirable chapter on the Japanese species in Siebold's Fauna Japonica. After the latter work our knowledge did not increase very rapidly; in 1880 Miers was able to comprise within the limits of two short papers descriptions of all the forms then known and up to the present day this revision has remained the principal work of reference to the Indo-pacific forms. Since 1880 a great number of papers dealing with Stomatopoda have appeared, scattered through numerous scientific periodicals, and among these important contributions to our knowledge of the Indo-pacific species are to be found in the writings of Brooks, de Man, Henderson, Nobili, Hansen, Müller, Borradaile, Tattersall and Fukuda.

Of publications not dealing directly with Indo-pacific species Bigelow's valuable systematic account of the American forms (1894) and Giesbrecht's very complete monograph of those found in the Mediterranean (1910) will be found indispensable to all working at this group of Crustacea.

At the present day the following one hundred and thirty-nine species and varieties of adult Stomatopoda are known.[1] The names of those which have not been found in the Indo-pacific region are printed in italics; an asterisk (*) indicates that examples have been available for examination and a dagger (†) implies that the type specimens have been seen.

[1] Not including *Squilla minor*, Jurich, and *Leptosquilla schmeltzii*, A. Milne-Edwards, which are based on very immature specimens.

SQUILLA.

aculeata, Bigelow.
alba, Bigelow.
† *annandalei, Kemp.
*armata, Milne-Edwards.
**biformis*, Bigelow.
† *boops, Kemp.
chlorida, Brooks.
*costata, De Haan.
† *decorata, Wood-Mason.
**desmaresti*, Risso.
**dubia*, Milne-Edwards.
**empusa*, Say.
fasciata, De Haan.
† *foveolata, Wood-Mason.
† *gibba, Nobili.
† *gilesi, Wood-Mason, MS.
† *gonypetes, Wood-Mason, MS.
gracilipes, Miers.
† *hieroglyphica, Kemp.
† *holoschista, Wood-Mason, MS.
intermedia, Bigelow.
† *interrupta, Wood-Mason, MS.
† *investigatoris, Lloyd.
*laevis, Hess.
*lata, Brooks.
*latreillei (Eydoux and Souleyet).
*leptosquilla, Brooks.
**mantis*, Latreille.
mantoidea, Bigelow.
*massavensis Kossmann.
*microphthalma, H. Milne-Edwards.
miles, Hess.
*multicarinata, White.
neglecta, Gibbes.
*nepa, Latreille.
*oratoria, De Haan.
† * *do.* var. perpensa, Kemp.
pallida, Giesbrecht.
**panamensis*, Bigelow.
parva, Bigelow.
**polita*, Bigelow.
**prasinolineata*, Dana (Ives) [1].
prasinolineata, Miers [1].
quadridens, Bigelow.
*quinquedentata, Brooks.
*raphidea, Fabricius.
rotundicauda, Miers.
**rugosa*, Bigelow.
*scorpio, Latreille.
† * *do.* var. immaculata, Wood-Mason, MS.
† *stridulans, Wood-Mason.
† *supplex, Wood-Mason.
† *tenuispinis, Wood-Mason.
† *wood-masoni, Kemp.

PSEUDOSQUILLA.

cerisii (Roux).
*ciliata (Fabricius).
dofleini, Balss.
empusa (De Haan).
ferussaci (Roux).
lessoni (Guérin).
megalophthalma, Bigelow.
*oculata (Brullé).
*ornata, Miers.
oxyrhyncha, Borradaile.
*pilaensis, de Man.
*stylifera (H. Milne-Edwards).

[1] See p. 201.

LYSIOSQUILLA.

*acanthocarpus, Miers.
armata, Smith.
biminiensis, Bigelow.
do. var. pacificus, Borradaile.
capensis, Hansen.
crassispinosa, Fukuda.
decemspinosa, Rathbun.
desaussurei, Stimpson.
digueti, Coutière.
eusebia, Risso.
excavatrix, Brooks.
glabriuscula, Lamarck.
† *insignis, Kemp.
latifrons, De Haan.
*maculata (Fabricius).
† * *do.* var. sulcirostris, Kemp.
maiaguesensis, Bigelow.
miersi, De Vis.
† *multifasciata, Wood-Mason.
occulta, Giesbrecht.
plumata, Bigelow.
polydactyla, v. Martens.
scabricauda (Lamarck).
scolopendra (Latreille).
septemspinosa, Miers.
† *spinosa (Wood-Mason).
† *tigrina, Nobili.
vicina, Nobili.

CORONIDA.

bradyi (A. Milne-Edwards).
† *multituberculata (Borradaile).
*trachura (v. Martens).

ODONTODACTYLUS.

*brevirostris (Miers).
carinifer (Pocock).
cultrifer (White).
elegans (Miers).
hanseni (Pocock).
havanensis, Bigelow.
*japonicus (De Haan).
latirostris, Borradaile.
*scyllarus (Linnaeus).
† *southwelli, Kemp.

GONODACTYLUS.

*acanthurus, Tattersall.
acutirostris, de Man.
brevisquamatus, Paulson.
brooksi (de Man).
*chiragra (Fabricius).
† * *do.* var. platysoma, Wood-Mason.
*demani, Henderson.
do. var. espinosus, Borradaile.
* *do.* var. spinosus, Bigelow.
drepanophorus, de Man.
ectypus (Müller).
*excavatus, Miers.
festae, Nobili.
fimbriatus, Lenz.
folini, A. Milne-Edwards.
† *furcicaudatus, Miers.
*glaber (Lenz).
*glabrous, Brooks.
*graphurus, Miers.
† *glyptocercus, Wood-Mason.
guerini, White.
*herdmani, Tattersall.
hystrix (Nobili).
† *nefandus, Kemp.
**oerstedi*, Hansen.
*pulchellus, Miers.

*spinosissimus, Pfeffer.
spinoso-carinatus, Fukuda.
stoliurus (Müller).
tanensis (Fukuda).
trispinosus, Dana.
tuberosus, Pocock.

The species known from the Atlantic and Mediterranean and from the Pacific Coast of America are separately listed at the end of this paper with a few of the more important references and synonyms (p. 200).

The exact relations of the Stomatopoda with other groups of Crustacea present a difficult problem. The existing forms show a high degree of specialization coupled with several features that at first sight seem primitive. Of the latter the most striking is the freely movable ophthalmic and antennular somites, but this is now regarded as a secondary character and must also be taken as evidence of specialization. With the views which Calman has expressed on the affinities of the group I am in entire agreement and his conclusion (1909, p. 331) that it seems most probable that " the Stomatopoda are a lateral offshoot from the main stem of the Malacostraca, of which, in the absence of connecting links, it is as yet impossible to determine the exact relations," will, I believe, meet with general acceptance.

The oldest known fossil Stomatopoda have been found in the Jurassic beds of the Solenhofen and have been referred to the genus *Sculda*. Little information of the really satisfactory nature is available concerning these forms; but there is, I believe, enough to warrant the creation of a separate family for their reception (see p. 15). The species are for the most part ornamented with an elaborate sculpture in no respect less remarkable than that of some of the existing forms of *Squilla* and *Gonodactylus*, though of an entirely different type, and it is clear that they also must have attained a high degree of specialization. It is to be hoped that specimens will soon be found which will provide satisfactory material for a study of the appendages. In particular, information regarding the form of the second thoracic appendage, which attains such a monstrous development in the Squillidae, would be most valuable. This limb has been found in an excellent state of preservation in fossil examples of *Squilla*, but it has never been satisfactorily demonstrated in *Sculda*. Seeing that in the former genus it appears to be well adapted for preservation in stratified rocks it is difficult, on the view that it possesses a similar development, to explain its absence in the latter.

Species of *Squilla* have been obtained in the Cretaceous and in the London Clay and other tertiary deposits, and in all structural details which have been studied they appear to bear a close resemblance to existing representatives of the genus.

Brooks held that the forms which he included under the genus *Protosquilla* (here regarded merely as a section of *Gonodactylus*) were the most primitive that persist; but this view has been severely criticized by Hansen and is not now generally accepted. My own observations lead me to conclude that it is among the species of *Squilla* that the most primitive forms are to be sought; but the precise relationships of the several genera are by no means easily traced.

The genera fall without difficulty into two groups, the one comprising *Squilla*,

Pseudosquilla, *Lysiosquilla* and *Coronida*, while the other includes *Odontodactylus* and *Gonodactylus*. The condition of the 'ischio-meral' articulation of the second maxillipede or raptorial claw is the character on which this primary division is based. This character, indeed, appears to me to possess an importance which has not hitherto been appreciated and it shows that the affinities of *Coronida*, usually regarded as a close ally of *Gonodactylus*, have been to a great extent misunderstood.

In the attempt to frame diagnoses of the four genera comprised in the first section of the family considerable difficulties are encountered, for although each genus has indeed a very distinct facies, several isolated forms exist which differ widely from the more typical members in structures that are either aberrant or annectant. A careful examination of species belonging to these four genera has not yielded me material for making any improvement in the classification hitherto adopted. The system employed is certainly unsatisfactory, but the groups are for the most part so readily distinguished that, even in the absence of good morphological characters, I cannot believe that their separation is unwarranted.

The existing species of Stomatopoda are for the most part restricted to the warmer waters of the globe, but a few forms, such as *Squilla mantis* and *S. desmaresti*, have been found as far north as the British coasts, while others, such as *Pseudosquilla stylifera*, *Squilla aculeata*, *S. gracilipes* and *S. armata*, penetrate as far south as Chili and Patagonia, the last being also known from S. Africa and from New Zealand.

Stomatopoda are exclusively marine, but one form, *Squilla scorpio* var. *immaculata*, extends for a considerable distance up the Ganges delta and must at times be brought in contact with water of quite low salinity.

The large majority of the species are littoral or inhabit moderate depths; only the following eleven have been found below the 100 fathom line:—

Squilla armata.
Squilla biformis.
Squilla gilesi.[1]
Squilla investigatoris.
Squilla leptosquilla.
Squilla massavensis.
Squilla stridulans.
Squilla tenuispinis.
Lysiosquilla insignis.
Lysiosquilla maiaguesensis.
Odontodactylus havanensis.

The greatest depth at which any Stomatopod has been found is 370—419 fms. (*S. leptosquilla*—'Investigator').

Stomatopods are essentially burrowing animals and many of the characteristic features of the order are adaptations for this purpose; but they are not fossorial in the sense in which this term is generally used among the Decapoda. The curious form and geniculation of the second maxillipedes must be admirably suited to an animal which lies in wait for its prey at the mouth of a burrow, while the small carapace and loose segmentation of the body-somites enables it to reverse its position in a narrow tunnel without difficulty. The peculiarly modified branchial system is

[1] Caught in a trawl fished between depths of 80 and 110 fathoms.

also in all probability an adaptation to this special mode of life, and it may be noticed that among the Decapoda the attachment of the branchial plumes to the swimmerets is known in one aberrant genus, *Callianidea*, the species of which also appear to make burrows.

It is to be regretted that so little is yet known of the habits of the Indo-pacific Stomatopoda. Brooks' brilliant researches on a few Atlantic species and Giesbrecht's more recent investigations of the Mediterranean forms have supplied information of great value, but no complete account of the life-history of any Indo-pacific species has yet appeared. While it is probable that most of the Squillidae have their own specific idiosyncrasies, it seems almost certain that there are certain broad distinctions in habits between at least some of the different genera of the family. *Squilla* appears to prefer a bottom of mud, sand, or sand and shells, and though it evidently constructs burrows it must often wander from them, for it is constantly captured in the light nets used by fishermen on different parts of the Indian coast. *Lysiosquilla* on the other hand is in my experience very rarely found, though in reality it may perhaps be quite abundant. The species of this genus seem to live in deep burrows which they leave only on rare occasions, and to this fact may be attributed the scarcity of specimens in collections and the large number of forms which are known only from single individuals. The species of the genera *Pseudosquilla*, *Odontodactylus* and *Gonodactylus* seem for the most part to inhabit rough ground; they are often found in abundance on oyster-beds and on coral reefs. Brooks has observed that the Atlantic *Gonodactylus oerstedi* burrows into solid coral or limestone rock and it is probable that the same is the case with the Indo-pacific species of the genus.[1] The members of the genera *Pseudosquilla* and *Odontodactylus* possibly have similar habits, but of this nothing is known.

It is only in very rare instances that other living organisms are found attached to Stomatopoda, but five different forms, recently identified and recorded by Dr. N. Annandale and Mr. H. B. Preston, have been discovered on material in the Indian Museum.

Squilla holoschista.—Several small undeterminable *Balani* were found attached to the dorsal surface of the carapace (*Annandale, Rec. Ind. Mus.*, vii, 1912, p. 124).

Squilla sp.[2]—A few immature barnacles of the genus *Dichelaspis* (probably *D. warwickii*) were found attached to the pleopods (*Annandale, loc. cit.*, p. 124).

Squilla investigatoris.—On the telsons of two of the type specimens of this species colonies of *Platypolyzoon investigatoris*, a new genus and species of Polyzoon, were obtained (*Annandale, loc. cit.*, pp. 124—126, *text-fig.*).

Squilla fasciata.—On the carapace, raptorial claws and telson of a specimen 'ent us by Prof. K. Kishinouye, colonies of the Polyzoon *Triticella korenii*, G. O. Sars, were found (*Annandale, loc. cit.*, p. 124).

[1] See addendum, p. 197.

[2] The specimen was laid aside, prior to identification, and could not subsequently be discovered.

Gonodactylus chiragra.—Two individuals of this species bore on the under surface of the thorax and between the pleopods examples of *Epistethe gonodactyli*, a hitherto unknown genus and species of Gastropod Mollusc (*Preston*, *Rec. Ind. Mus.*, vii, 1912, pp. 126, 127, *text-figs.*).

Coutière (1905) gives an interesting account of *Lysiosquilla digueti*, a species which lives commensally along with a Polynoïd in the burrows of *Balanoglossus*.

The natives of Bengal for the most part classify marine animals according to the estimation in which they are held as articles of diet. For this purpose they consider Stomatopods worthless; they term them *chingri-poká* (prawn-insects) or *dariá-poká* (sea-insects) in contradistinction to *chingri-muchli* (prawn-fish), *i.e.* Penaeidae and Palaemonidae. It is, however, possible that they are used for food in some parts of the Indian Empire: in the Museum collection is a large example of *Squilla raphidea* which was purchased in the market at Akyab in Arakan.

Of the one hundred and thirty-nine species and varieties of Stomatopoda which are known ninety-seven have been found within the limits of the area dealt with in this paper, while fifty-four have been taken on the coasts of the Indian Empire and of Ceylon.

The tables[1] on pages 10 and 11 will give a general idea of the known distribution of the species in the Indo-pacific area.

Only a very few forms found in this region have been discovered also in the Atlantic or on the West Coast of America :—

Squilla armata	..	Chili and Patagonia.
Pseudosquilla ciliata	..	Florida, Bermuda, Porto Rico.
Pseudosquilla oculata	..	Canaries, Madeira.
Pseudosquilla stylifera	..	California.
Lysiosquilla maculata	..	West Indies.

In addition *Lysiosquilla biminiensis*, represented in the Indo-pacific by the form *pacificus*, is found at the Bimini Islands, Bahamas, and the Atlantic *Gonodactylus oerstedi* is so closely allied to the Indo-pacific *G. chiragra* that some will perhaps prefer to regard it merely as a subspecies.

The figures on page 12 are intended to elucidate some of the terms employed in this memoir which might otherwise prove confusing. In such matters as the nomenclature of the various carinae of the carapace, abdomen and telson no exact uniformity is to be found in the literature and I have consequently adopted those which appear to be most suitable.

The form of the eye is often of great importance in systematic work. The relation of the corneal and peduncular axes, whether at right angles or oblique, affords a valuable criterion and scarcely calls for any explanation (see Bigelow, 1894, text-fig. 14, p. 522). In certain species, more particularly in the case of the closely

[1] It will be noticed that the divisions into which the Indo-pacific area has been grouped for the purposes of this table are by no means equal. But the majority of the specimens comprised in the collection under examination are from Indian localities and it has been thought best to give the distribution on these coasts in somewhat fuller detail.

allied forms belonging to the *oratoria* section of the genus *Squilla*, the precise size of the cornea is of great importance; but inasmuch as its breadth becomes proportionately less as the animal increases in size, the character must be used with caution. The number of times in which the breadth of the cornea is contained in the median length of the carapace affords a ready means of comparing the size of the eye in allied species, and the figure so obtained I have designated the "corneal index."

The mandibular palp, by the number of segments which compose it and by its presence or absence, affords useful taxonomic indications; but there is reason to believe that the importance of the character is by no means equal in the different genera.[1] In *Squilla*, for instance, its value is purely specific, in *Gonodactylus* it is of considerable assistance in breaking the genus into groups, while in the case of *Pseudosquilla stylifera* it seems likely that geographical races can be separated by its means. The mandibular palp may easily be examined without dissection by deflecting one of the great raptorial claws. The palp will then be seen directed forwards and lying close up against the side-wall of the carapace (text-fig. 5, p. 12).

The precise relations which the six segments that compose the thoracic limbs of the Stomatopoda bear with the seven (or eight) recognized in other Malacostraca are as yet unknown. I have used the familiar terms ischium, merus, carpus, propodus and dactylus purely for the sake of convenience: it must not be thought that by such application any homology with the Decapod limb is intended.

In descriptions of species of *Squilla* it has been found convenient to note the presence or absence of the terminal spines on the abdominal carinae in tabular form. *Squilla nepa*, for instance, has the following spine-formula:—

Carinae.	*Abdominal somites.*
Submedian	4, 5, 6.
Intermediate	(2), 3, 4, 5, 6.
Lateral	(1), 2, 3, 4, 5.
Marginal	1, 2, 3, 4, 5.

By this it is to be understood that the submedian carinae of the last three somites terminate in spines. The intermediate carinae of the last four somites and the lateral carinae of the last five also have a spinous ending, while, in addition, the intermediate carinae of the second somite and the lateral carinae of the first somite (figures enclosed in brackets) end in spines in some, but not in all, of the specimens examined. All the marginal carinae are produced as spines: the marginal carina of the last somite does not exist in any species of Stomatopod and the spine which is found at the postero-lateral angle of that somite is a continuation of the lateral carina.

Brooks considered that the form of the processes on the endopodite of the first abdominal appendage of the male would be found to yield much assistance in the taxonomic treatment of the group. In my experience, however, this is not the case and I have consequently omitted reference to this appendage in the systematic account of the species.

(*Cont. on p.* 14.)

[1] Further reference will be found under the separate generic headings.

Species.	Red Sea.	East Coast of Africa.	Madagascar, Mauritius, Seychelles.	Persian Gulf.	Arabian Sea.	Ceylon.	Bay of Bengal, West Coast.	Bay of Bengal, East Coast.	Andamans and Nicobars.	Malaysia.	China.	Japan.	Australia.	Oceania.	New Zealand.
SQUILLA.															
S. latreillei ..	..	..	..	x	..	..	x	..	.	x					
S. decorata ..	..	..	..	..	..	..	..	x	x						
S. gibba ..	..		..	..	.	.	..		..	x					
S. microphthalma	..	x	..	..	x		x		..	..	..	..	?		
S. chlorida ..	..	.	..	..	.	..	..	..	.	x					
S. rotundicauda ..	..	..	..	..	.	.			..	..	x				
S. fasciata ..	.	..	.	..	.	..	..	x	x	..	x	x			
S. miles ..	..	..	..	..	..	..		..	..	..	..	..	x		
S. lata ..	..	..	..	.	..	..	..	x	..	x					
S. gilesi ..	..	..	..	x	..	..	x								
S. armata ..	..	..	..	..	..	..	..	..	..	..	..	..	x	..	x
S. scorpio ..	..		..	..	x	..	x	..	..	x	..	..	x		
do., var. *immaculata*	..	..	..	..	x		x	x							
S. mantoidea ..	.	..	..	..	..	..	..	..	..	x					
S. leptosquilla	..	..	..	..	..	..	..	..	x	x					
S. tenuispinis ..	..	..		..	..	..	x	x	x						
S. laevis ..	..	..	..	..	..	..	..	..	..	..	..	..	x		
S. quinquedentata	..	..		..	..	x	x	..	..	x					
S. gonypetes ..	..	..	..	..	x	..	x	x	x	..	x				
S. boops ..	..	..	..	.	..	..	..	x	.	..		x			
S. foveolata ..	..	..	..	..	..	..	..	x	..	..	x				
S. nepa ..	..	..	?	..	..	x	x	..	.	x	x	..	..	?	
S. holoschista ..	..	..	.	..	..	x	x								
S. oratoria ..	..	..	.	?	..	..	.	..	..	x	x	x	..	x	
do., var. *perpensa*	..	..	..	..	x	..		x	x	x	x	x	..	x	
S. interrupta ..	..	..	..	..	x	x	..	x	x	x	x	x			
S. wood-masoni ..	..	..	x	..	x	?	..	x	..	..	x	x	..	x	
S. massavensis ..	..	x	..	..	x										
S. stridulans ..	..	..	.	..	..	..	x	..	..	..	..	x			
S. investigatoris	..	..	..	..	x	x									
S. supplex ..	..		..	.	..	x	..	x							
S. costata ..	..	..	..	..	.	..	..	x	..	..	.	x			
S. multicarinata ..	..	..	..	..	..	..	..	x	x	..	x	x	x		
S. raphidea ..	..	.	x	..	x	x	x	x	x	x	x	x	x		
S. annandalei ..	..		..	.	.	..	..		x						
PSEUDOSQUILLA.															
P. ciliata ..	..	x	x	x	x	..	x	x	..	x	x	x	x	x	x
P. ornata ..	..	..	..	x	..	..	..	..	..	..	x	..	x	..	x
P. oxyrhyncha ..	..	.		..	..		..	.	..	..	..	..	..	..	x
P. oculata ..	..	..	..	x	..		..		.	.	..	x	..	..	x
P. megalophthalma	..	x	..	x											
P. empusa ..	..	.	..	.	..	..	..	..	..	..	..	..	x		
P. dofleini ..	..	..		..	..	.	..	.	..	..	..	..	x		
P. pilaensis ..	..	x	..	..	..	..	..	..	x						
P. stylifera ..	..	..	.		..	..	..	..	..		..	..	.	x	
LYSIOSQUILLA.															
L. maculata ..	..	.	x	x	..	..	x	x	..	x	x	..	x	..	x
do., var. *sulcirostris*	..		..			.			..	x					
L. miersi ..	..			..	..	..	..	.	..	..	..	..	.	x	
L. capensis ..	..	..	x												
L. crassispinosa	..	..	..		..	..	..	..	..	.	..	..	x		

Species.	Red Sea.	East Coast of Africa.	Madagascar, Mauritius, Seychelles.	Persian Gulf.	Arabian Sea.	Ceylon.	Bay of Bengal, West Coast.	Bay of Bengal, East Coast.	Andamans and Nicobars.	Malaysia.	China.	Japan.	Australia.	Oceania.	New Zealand.
L. spinosa									X	X					X
L. acanthocarpus					X	X	X		X	X	X		X		
L. multifasciata	?				X					?	X				
L. biminiensis subsp. *pacificus*														X	
L. tigrina										X					
L. vicina	X														
L. insignis									X						
L. latifrons												X	X		X
CORONIDA.															
C. trachura	X		X											X	
C. multituberculata														X	
ODONTODACTYLUS.															
O. scyllarus		X	X			X				X		X		X	
O. cultrifer										X	X				
O. carinifer											X				
O. elegans			X												
O. japonicus			X								X	X			
O. hanseni											X				
O. latirostris			X												
O. southwelli						X			X						
O. brevirostris			X			X			X						
GONODACTYLUS.															
G. chiragra	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
do., var. *platysoma*		?	X		?				X					X	
G. acutirostris								X							
G. demani	X	X		X	X		X			X					
do., var. *spinosus*	X		X			X									
do., var. *espinosus*														X	
G. glabrous	X	X	X	X	X	X	X	X	X	X		X	X	X	
G. graphurus		?								X	X		X	X	
G. herdmani						X									
G. drepanophorus										X					
G. brevisquamatus	X														
G. fimbriatus		X	X												
G. spinoso-carinatus												X			
G. furcicaudatus														X	
G. pulchellus		X		X	X	X									
G. nefandus								X	X	X					
G. trispinosus													X	X	?
G. tuberosus											X				
G. glaber		X				X			X						
G. tanensis												X			
G. stoliurus										X			X		
G. ectypus			X			X									
G. glyptocercus								X	X	X		X		X	
G. excavatus									X		X				
G. brooksi										X		X			
G. hystrix										X					
G. spinosissimus	X	X				X									
G. guerini														X	
G. acanthurus						X									

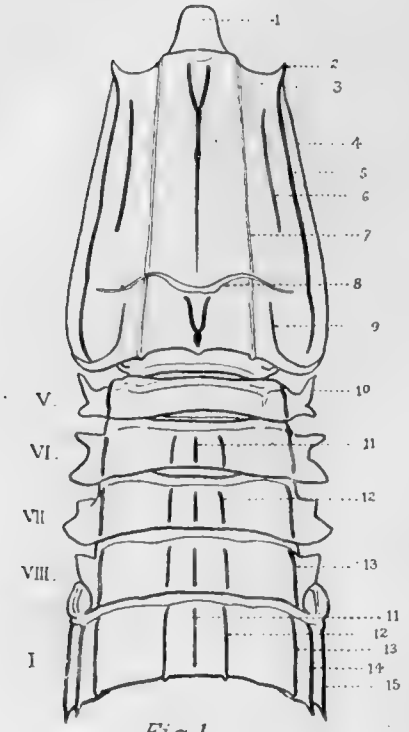

Fig 1.

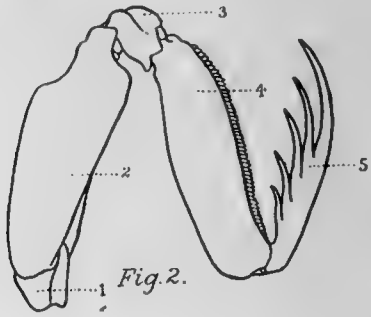

Fig.2.

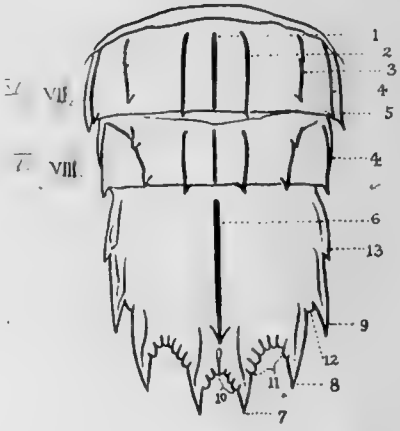

Fig.3.

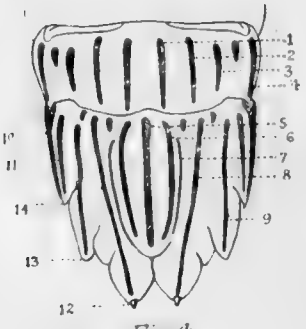

Fig.4.

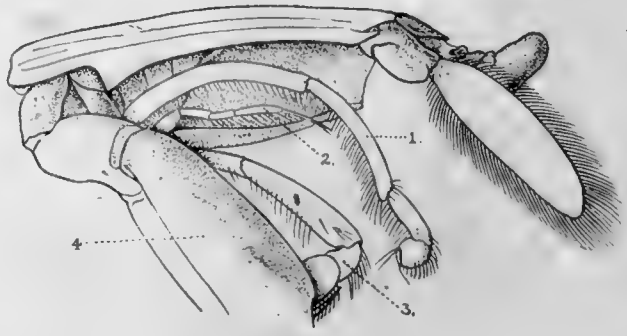

Fig.5.

EXPLANATION OF TEXT FIGURES.

Fig. 1. Rostrum, carapace, exposed thoracic somites and first abdominal somite (*Squilla*).

V-VIII. Fifth to eighth thoracic somites.
I. First abdominal somite.

1. Rostrum.
2. Antero-lateral angle of carapace.
3. Anterior bifurcated portion of median carina.
4. Marginal
5. Lateral } carinae of carapace.
6. Intermediate
7. Gastric groove.
8. Cervical groove.
9. Posterior reflected part of marginal carina.
10. Lateral processes of 5th thoracic somite.
11. Median
12. Submedian } carinae of thoracic and abdominal somites.
13. Intermediate
14. Lateral
15. Marginal } carinae of abdominal somites.

Fig. 2. Raptorial claw or second thoracic appendage (*Squilla*).

1. Ischium.
2. Merus.
3. Carpus.
4. Propodus.
5. Dactylus.

Fig. 3. Last two abdominal somites and telson (*Squilla*).

VII, VIII. Seventh and eighth abdominal somites.

1. Median
2. Submedian
3. Intermediate } carinae of abdominal somites.
4. Lateral
5. Marginal
6. Median carina of telson.
7. Submedian
8. Intermediate } teeth of telson.
9. Lateral
10. Submedian
11. Intermediate } denticles of telson.
12. Lateral
13. Prae-lateral lobe or denticle of telson.

Fig. 4. Last abdominal somite and telson (*Odontodactylus*).

1. Submedian
2. First intermediate } carinae of last abdominal somite.
3. Second intermediate
4. Lateral
5. Median
6. Submedian } carinae of telson.
7. Second submedian
8. Intermediate
9. First lateral } carinae of telson.
10. Marginal
11. Second lateral
12. Submedian
13. Intermediate } teeth of telson.
14. Lateral

Fig. 5. Lateral view of carapace, raptorial claw deflected (*Squilla*).

1. First thoracic appendage.
2. Mandibular palp.
3. Third thoracic appendage.
4. Base of raptorial claw.

Keys have been provided to facilitate the determination of the species. Those of *Pseudosquilla*, *Coronida*, *Odontodactylus* and *Gonodactylus* embrace all species hitherto known, but those of *Squilla* and *Lysiosquilla* have reference only to the Indo-pacific forms.

In the course of the preparation of this report I have received much assistance from museums and institutions in other countries. Through the good offices of Dr. W. T. Calman I have obtained from the Trustees of the British Museum the loan of a most valuable series of *Squilla* belonging to the *S. nepa* and *S. oratoria* groups. In many other matters also I am under a great debt of obligation to Dr. Calman; he has always been ready to place his very special knowledge of Crustacea at my disposal and he has spared neither time nor trouble in obtaining for me particular items of information from the collections in his charge. To Mr. J. C. Moulton I am indebted for the loan of a small but very valuable collection from the Sarawak Museum. Mr. T. Southwell has kindly presented us with a fine series of Stomatopoda from the Ceylon pearl banks, and I wish also to thank Dr. Pearson for sending me, on loan, the entire collection in this group from the Colombo Museum.

It is probable that before this paper is published Mr. Patience's account of the Stomatopoda collected in Portuguese E. Africa and the Mergui Archipelago by Messrs. Simpson and Rudmose Brown, will have appeared. Mr. Patience has kindly sent me examples of nearly all the species of the order which he had in his hands, and in so doing he was good enough to give me permission to make any reference to them that I desired. In addition I have received specimens of several scarce and interesting species from Prof. Kishinouye, Dr. Chilton, Mr. David Stead and Mr. Alan Owston and, through the kindness of Mr. Doncaster, I have been enabled to examine the type specimens of *Coronida* (*Squilla*) *multituberculata*.

In India itself I have been fortunate in obtaining the co-operation of the Bombay Natural History Society, which, in past years, has been instrumental in acquiring for us many species of crustacea from the west coast of India, and, in addition to the members of the staff of the Indian Museum, Mr. J. Hornell at Tuticorin and Mr. T. H. Hill at Cuddalore and Porto Novo have both made special collections on my behalf.

The plates illustrating this memoir are issued as "Illustrations of the Zoology of R.I.M.S.S. 'Investigator.'" The figures were all drawn under my supervision by Babu S. C. Mondul, Artist to the Marine Survey. The care which he has taken in this work and the fidelity of his delineation has, I feel, added materially to the value of the report.

Unless otherwise stated the type specimens are preserved in the Indian Museum.

SYSTEMATIC PART.

STOMATOPODA.

The Stomatopoda belong to the sub-class Malacostraca and constitute the only order of the last of the four divisions into which the second series of the sub-class is divided. This division is known by the name Hoplocarida, and is defined by Calman (1909) in the following terms :—

"Carapace leaving at least four of the thoracic somites distinct; two movable segments are separated from the anterior part of the head, bearing respectively the pedunculate eyes and the antennules; protopodite of antenna of two segments; mandible without lacinia mobilis; posterior thoracic limbs with protopodite of three segments (the relation of the segments of the anterior thoracic limbs to those of the limbs in the other divisions is doubtful); an appendix interna on pleopods; hepatic caeca much ramified; heart much elongated, extending through thoracic and abdominal regions; spermatozoa spherical; development with metamorphosis, a free-swimming nauplius stage is not certainly known."

Since the time when it was discovered that the forms classed as Erichthidae were nothing more than larval stages, the order Stomatopoda has been held to comprise only a single family, the Squillidae. It seems, however, that the species belonging to the fossil genus *Sculda*, Münster, are distinguished from the recent forms by features sufficiently important to entitle them to separate family rank and it may be expected that, with the acquisition of more perfect specimens, other characteristic differences will be disclosed. In the present state of our knowledge the families may be separated from one another as follows :—

I. Exopodite of uropod composed of a single segment	SCULDIDAE (fossil).
II. Exopodite of uropod composed of two quite distinct segments ..	SQUILLIDAE (fossil and recent).

In the Sculdidae the spines on the margin of the telson appear to have all been movable and in this respect differ from those of recent Stomatopoda, while from the figures which Kunth gives (1870) it seems that only three thoracic segments are left uncovered by the carapace. The form of the raptorial claw is unfortunately unknown,[1] but that the limb is far less conspicuous than in the Squillidae may be surmised from the fact that, though no trace of it can be discovered in *Sculda*, it has been found in the much scarcer fossil *Squilla*.[2]

[1] Kunth (1870) is of the opinion that the raptorial claw is traceable in one of his specimens of *Sculda pennata* in which the under surface is shown, but in his figure (pl. xvii, fig. 2) this is far from obvious; it seems more probable that the part referred to is merely a portion of the reflexed lateral margin of the carapace.

[2] *Squilla lewisi*, Woodward, Q. J. Geol. Soc., xxxv, 1879, pl. xxvi, fig. 4.

Family SQUILLIDAE.

To this family all recent Stomatopoda are referred, along with a few fossil species from the London clay and from the Cretaceous rocks of Lebanon, and *Necroscilla wilsoni*, Woodward, a form of doubtful affinities described from a fragment obtained in the middle coal-measures.

The existing forms may be classed under six genera which are distinguished as follows :—

I. Articulation between merus and ischium of raptorial claw terminal (normal); merus grooved inferiorly for reception of propodus throughout its length; propodus finely pectinate or with a series of fixed spines along outer edge of dorsal surface; dactylus rarely inflated at base.

A. Carapace with well-marked carinae; cervical groove defined across dorsum of carapace; first five abdominal somites with longitudinal carinae (raptorial dactylus not inflated at base) .. .. .. *Squilla*, p. 16.

B. Carapace without carinae;[1] cervical groove not extending across dorsum of carapace;[1] first five abdominal somites without longitudinal carinae.[1]

1. Abdomen usually compressed; raptorial dactylus not inflated at base with two, rarely three, teeth on inner margin,[2] or unarmed; telson with sharp median carina and (in adults) with other carinae on either side .. .. *Pseudosquilla*, p. 94.

2. Abdomen depressed; raptorial dactylus not inflated at base with at least four teeth on inner margin[2]; telson without median carina, often smooth or with a transverse circlet of spines .. *Lysiosquilla*, p. 109.

3. Abdomen depressed; raptorial dactylus with three teeth on inner margin[2]; telson closely studded with fine spinules or large tubercles, with or without a pair of submedian carinae .. .. *Coronida*, p. 129.

II. Ischio-meral articulation of raptorial claw situated at a point anterior to proximal end of merus, which consequently extends backwards considerably beyond the joint; ventral surface of merus grooved and hollowed for reception of propodus for not more than three-quarters its length; dactylus inflated at base.

A. Dactylus of raptorial claw with teeth on its inner margin .. .. *Odontodactylus*, p. 133.

B. Dactylus of raptorial claw without teeth on its inner margin .. *Gonodactylus*, p. 145.

Genus **Squilla**, J. C. Fabricius.

1793. *Squilla*, J. C. Fabricius, Ent. Syst., ii, p. 511 (*partim*).
1825. *Squilla*, Latreille, Encycl. Méthod., X, p. 467 (*partim*).
1837. *Squilla*, Squilles fine-tailles, 2nd sect., H. Milne-Edwards, Hist. Nat. Crust., II, pp. 518, 520.
1841. *Clorida*, Eydoux and Souleyet, Voy. de la 'Bonite,' Zool., i, Crust., p. 264.

[1] Except in the Mediterranean *Pseudosquilla ferussaci*. I have seen no examples of this very rare and interesting Mediterranean species. It appears to combine the telson of a *Pseudosquilla* with many of the characteristic features of *Squilla*, but is perhaps rather more nearly allied to the former genus than to the latter. For an account and figures of the species, see Giesbrecht, 1910, p. 34, pl. iv, figs. 37–48.

[2] Excluding the terminal tooth.

1849. *Squilla*, sect. *Raphideae*, De Haan, in Siebold's Fauna Japonica, Crust., p. 221.
1852. *Squilla*, Dana, U. S. Explor. Exped., Crust., p. 618.
1880. *Squilla*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 16.
1880. *Chloridella*, Miers, *ibid.*, p. 13.
1880. *Leptosquilla*, Miers, *ibid.*, p. 12.
1886. *Squilla*, Brooks, Voy. H. M. S. 'Challenger,' XVI, Stomatop., p. 23.
1890. *Pterygosquilla*, Hilgendorf, Sitz.-ber. Ges. naturf. Freunde, Jahrg. 1890, pp. 172, 187.
1894. *Squilla*, Bigelow, Proc. U. S. Nat. Mus., XVII, p. 509.
1894. *Pterygosquilla*, Bigelow, *ibid.*, p. 492.
1894. *Leptosquilla*, Bigelow, *ibid.*, p. 492.
1895. *Squilla*, Hansen, Isop., Cumac. u. Stomatop., Plankton-Exped., p. 69.
1903. *Chloridella*,[1] Rathbun, Proc. U. S. Nat. Mus., XXVI, p. 54.
1910. *Squilla*, Stebbing, Ann. S. African Mus., VI, p. 405.

Carapace narrower in front than behind, with conspicuous gastric and cervical grooves, the latter sharp and continuous across mid-dorsal area; longitudinal carinae usually distinct, never wholly absent; antero-lateral angles usually spinous. Cornea of eyes bilobed. Mandibular palp three-segmented or wholly absent. Merus of raptorial claw articulating terminally with ischium; ventral surface of merus longitudinally hollowed throughout its length; upper margin of propodus finely pectinate, or (more rarely) with a series of long stiff spines; dactylus not inflated at base, armed with teeth on inner margin. Shorter ramus of last three thoracic appendages unjointed, or with an imperfect suture separating short basal and long linear distal parts. Free thoracic and abdominal somites depressed, with distinct longitudinal carinae. Telson of good length, with a median carina, and smooth, pitted, tuberculate or carinate on either side. Distal margin with three pairs of large teeth, submedians occasionally with movable tips; one or more submedian denticles, several (always more than four) intermediate and one lateral. Ventral process of uropods terminating in two sharp spines, inner longer than outer and nearly always bearing a small lobe on its external margin.

Well-marked secondary sexual distinctions occur in some species. The modifications, which are found only in the adult male, affect the structure of the raptorial claw or the development of the carinae of the abdominal somite and telson.

Miers recognized a distinct genus under the name *Chloridella*, comprising those species which possess very small eyes; but Brooks has shown that these forms are linked to the more typical representatives of the genus by such species as *S. lata* and *S. fasciata*. Hansen regards Hilgendorf's *Pterygosquilla* as a synonym of *Squilla* and identifies *P. laticauda*, the only known species of the former genus, with the earlier *Squilla gracilipes* of Miers. *Leptosquilla* appears to be founded only on a late post-larval stage, and, although it cannot be identified with any known adult form, there is little doubt that it may safely be referred to this genus.

Squilla, as has already been mentioned, is the oldest established genus of Stomatopoda at present living and probably contains the most primitive species of the order;

[1] Miss Rathbun considers that the name *Squilla* is preoccupied, but this view is not accepted by Stebbing (1910).

it comprises a large number of species inhabiting all the warm and temperate waters of the globe. Comparison of the species from the Atlantic, Mediterranean and W. Coast of America with those from the Indo-pacific seems to show that evolution has on the whole taken a distinct and separate course in the latter area. In the Indo-pacific a single species, *Squilla mantoidea*, is the sole representative of the section to which the vast majority of Atlantic, Mediterranean and W. American forms belong—a section which includes all the common species in those localities.[1] On the other hand the Indo-pacific section that surpasses all others in point of individual abundance and comprises some fourteen[2] species, is represented in the other regions only by the West Indian *Squilla alba*. The '*Chloridella*' group, moreover, is found only in the Indo-pacific.

One species only, *Squilla armata*, an isolated form wholly restricted to southern latitudes, is common to both areas.

A peculiar structural feature of the genus and one that, hitherto, has largely escaped attention, is the complete suppression of the mandibular palp in certain species. Hilgendorf first noticed its absence in the form which he called *Pterygosquilla laticauda* and, more recently, Jurich has made a similar discovery in the case of *Squilla leptosquilla*. Among the species which I have been able to examine eight show no trace of this appendage :—

Squilla gibba, Nobili.
Squilla armata, Milne-Edwards.
Squilla leptosquilla, Brooks.
Squilla tenuispinis, Wood-Mason.
Squilla scorpio, Latreille.
Squilla laevis, Hess.
Squilla hieroglyphica, Kemp.
Squilla costata, De Haan.

Squilla leptosquilla and *S. tenuispinis* are closely allied forms and the same is the case with *S. laevis* and *S. hieroglyphica*.

In Decapoda the structure of the mandibular palp, its presence or its absence, is recognized as a valuable clue to the affinities of the various species and in many cases it affords almost the sole distinction between genera. It is clear that its importance is far less in the Squillidae. *Squilla gibba* by many evident external characters takes its place in the '*Chloridella*' section of the genus, though it is perhaps a somewhat aberrant member thereof; *S. scorpio* finds distant allies in *S. lata* and *S. gilesi*; *S. laevis* and *S. hieroglyphica* seem to form a small subsection of the *S. nepa* and *quinquedentata* group, while *S. costata* by the number of carinae on its abdomen appears to be related to *S. multicarinata*. *Squilla armata* seems to be an isolated species and the same is the case with *S. leptosquilla* and *tenuispinis*, which are restricted to deep water.

It seems then that the palpless species found in the Indo-pacific fall into six separate classes, which show no trace of common ancestry distinct from that of the other species of the genus, and the inference that the palp has been suppressed on no less than six separate occasions in the ontogeny of the Indo-pacific species can scarcely be avoided.

[1] Such as *S. mantis, empusa, dubia, prasinolineata* and *panamensis*.
[2] *S. laevis, quinquedentata, nepa, oratoria, stridulans*, etc.

It will be noticed that the palp in this genus is either well formed and composed of three segments, or wholly absent; no instances of a one or two-segmented palp have been observed.

The inter-relationships of the Indo-pacific species cannot be traced with any great degree of satisfaction. *S. raphidea* and *S. annandalei*, in the possession of large fixed spines on the penultimate segment of the raptorial claw, stand apart from all the rest, and the latter fall into two groups characterized by the structure of the fifth thoracic somite. The first of these groups contains the small-eyed species originally placed in a separate genus, but linked to the more normal types by such forms as *S. chlorida*, *S. fasciata*, *S. lata* and *S. gilesi*. It also contains the highly-specialized deep-water section, comprising *S. leptosquilla* and *tenuispinis* and a few isolated species, *S. scorpio*, *S. armata* and *S. mantoidea*. The second group, which in point of individual abundance greatly outweighs the first, contains a number of closely-allied species that fall into three sections, typified respectively by *S. laevis*, *S. quinquedentata* and *S. nepa*. In addition it includes four highly-specialized forms, *S. investigatoris*, *S. costata*, *S. multicarinata* and *S. supplex*. The last is perhaps a remote connexion of *S. laevis*; the other three appear to be early offshoots of the original *nepa* and *quinquedentata* stock; but in each of them specialization has progressed on different lines.

The species of *Squilla* for the most part inhabit shallow water and seem to prefer sandy or muddy ground. They construct burrows; but as they frequently leave them in pursuit of prey, they are often taken in abundance in fishermen's nets. Giesbrecht (1910) gives a valuable account of the bionomics of *Squilla mantis* in the Mediterranean.

Brooks (1886, p. 168) states that "*Squilla* stridulates by rubbing the serrated spine of the swimmeret across the serrated ridge on the ventral surface of the telson. The noise which is thus made under water can be clearly heard above the surface." This observation was made on *Squilla empusa*. Giesbrecht (1910, p. 201) found that *Squilla mantis* produced sound in a similar way, but only when it was grasped with a pair of forceps. From the structure and relative position of the parts the method of sound-production is not very clear; but most Indo-pacific species possess a lateral carina on the under surface of the telson as in *S. empusa* and *S. mantis*, and it is probable, therefore, that stridulation is effected in the same way: my efforts to induce living *Squilla* to produce sound have, however, proved quite unsuccessful. Wood-Mason unfortunately gives no reason for his choice of *stridulans* as a specific name and his specimens do not seem to possess any special structural distinctions which would furnish an explanation.

KEY TO THE INDO-PACIFIC SPECIES OF *Squilla*.

The following key to the Indo-pacific species of *Squilla* is based on adult characters; great caution should be used when employing it for specimens under 40 mm. in length.

I. Upper margin of propodus of raptorial claw with a series of fine and even pectinations in addition to a few movable spines at proximal end.

A. Lateral margin of fifth thoracic somite, seen in dorsal view, composed of a single process, spinous or subacute.
  I. Cornea of eyes very small, its breadth less than greatest breadth of stalk.
    A. First five abdominal somites with faint but distinct submedian carinae.
      I. Mandibular palp present; telson with numerous granular ridges or scattered tubercles on either side of median crest.
        A. Lateral process of fifth thoracic somite directed outwards, those of two succeeding somites anteriorly rounded; inferior surface of telson smooth on either side of post-anal carina .. .. *latreillei*, p. 24.
        B. Lateral process of fifth thoracic somite bent obliquely forwards, those of two succeeding somites acutely pointed anteriorly; inferior surface of telson usually with tubercles or granular ridges on either side of post-anal carina .. .. .. *decorata*, p. 27.
      II. Mandibular palp absent; telson without dorsal tubercles: in adult male with a pair of huge smooth curved ridges terminating on intermediate marginal teeth .. *gibba*, p. 28.
    B. First five abdominal somites without trace of submedian carinae.
      I. Antero-lateral angles of carapace sharply spinous.
        A. Breadth of cornea about one-third of total length of eye; lateral process of fifth thoracic somite short *microphthalma*, p. 31.
        B. Breadth of cornea about one-half of total length of eye; lateral process of fifth thoracic somite long .. *chlorida*, p. 33.
      II. Antero-lateral angles of carapace rounded .. *rotundicauda*, p. 33.
  II. Cornea of eyes small or large, its breadth always greater than greatest breadth of stalk.
    A. Numerous sharp longitudinal carinae on either side of median crest of telson.
      I. Antero-lateral angles of carapace spinous; raptorial dactylus with six teeth[1]; no submedian carinae on first five abdominal somites .. .. .. *fasciata*, p. 34.
      II. Antero-lateral angles of carapace not spinous; raptorial dactylus with four teeth[1]; submedian carinae on all abdominal somites .. .. .. *miles*, p. 36.
    B. No longitudinal carinae on either side of median crest of telson.
      I. Raptorial dactylus with more than four teeth[1]; telson with short (normal) marginal teeth.
        A. Median carina of carapace, when present, not bifurcated anteriorly.
          1. Median carina of carapace absent; mandibular palp present; raptorial dactylus with six teeth[1]; lateral processes of sixth and seventh thoracic somites posteriorly rounded.
            a. Submedian carinae absent from at least first

[1] Including the terminal tooth

three abdominal somites; no marked secondary sexual distinctions .. *lata*, p. 37.

b. Submedian carinae present on all abdominal somites; telson of adult male differing greatly from that of female .. *gilesi*, p. 39.

2. Median carina of carapace absent; mandibular palp absent; raptorial dactylus with seven to nine (rarely six) teeth[1]; lateral processes of sixth and seventh thoracic somites spinous posteriorly .. .. .. *armata*, p. 41.

3. Median carina of carapace present; mandibular palp absent; raptorial dactylus with five teeth[1]; lateral processes of sixth and seventh thoracic somites posteriorly rounded.

a. Lateral process of fifth thoracic somite with a large black dorsal spot .. .. *scorpio*, p. 42.

b. Lateral process of fifth thoracic somite without a black spot .. .. *do.* var. *immaculata*, p. 45.

B. Median carina of carapace sharply defined and anteriorly bifurcated [raptorial dactylus with six teeth[1]; lateral processes of sixth and seventh thoracic somites sharply acute posteriorly] .. *mantoidea*, p. 45.

II. Raptorial dactylus with only four teeth[1]; submedian and intermediate marginal teeth of telson very long [mandibular palp absent].

A. Median and lateral carinae sharp and distinct in anterior half of carapace; lateral process of fifth thoracic somite directed straightly outwards .. *leptosquilla*, p. 46.

B. Median and lateral carinae entirely absent from anterior half of carapace; lateral process of fifth thoracic somite trending obliquely forwards .. *tenuispinis*, p. 48.

B. Lateral margin of fifth thoracic somite, seen in dorsal view, composed of two distinct processes, usually of a more or less antrorse anterior spine and a rounded posterior lobe, rarely of two sharp spines.

I. First five abdominal somites each with eight longitudinal carinae.

A. Lateral margin of sixth thoracic somite not bilobed; mandibular palp absent.

I. Anterior bifurcation of median carinae of carapace sharp and distinct; raptorial dactylus with six teeth[1] .. *laevis*, p. 49.

II. Anterior bifurcation of median carinae of carapace absent; raptorial dactylus with five teeth[1] .. .. *hieroglyphica*, p. 51.

B. Lateral margin of sixth thoracic somite bilobed, anterior lobe rarely (*i.e.* in *S. boops*) small and inconspicuous; mandibular palp present.

I. Raptorial dactylus with only five or six teeth.[1]

A. Raptorial dactylus with only five teeth.[1]

1. Rostrum with median carina; breadth of cornea more than one-third of median length of cara-

[1] Including the terminal tooth.

pace; lateral margin of seventh thoracic somite not bilobed .. .. .. *boops*, p. 55.

2. Rostrum without median carina; breadth of cornea much less than one-third of median length of carapace; lateral margin of seventh thoracic somite distinctly bilobed.

a. Cornea set almost transversely on eyestalk; outer inferior margin of raptorial merus terminating in a sharp tooth; anterior lobe of seventh thoracic somite short *quinquedentata*, p. 52.

b. Cornea set obliquely on eyestalk; outer inferior margin of raptorial merus not terminating in a tooth; anterior lobe of seventh thoracic somite well-developed, more than half as long as posterior lobe .. *gonypetes*, p. 54.

B. Raptorial dactylus with six teeth.[1]

1. Cornea not wider than eyestalk; rostrum with short median carina; surface of carapace and abdomen with a coarse mesh-like reticulation *foveolata*, p. 58.

2. Cornea very clearly wider than eyestalk; rostrum without median carina; surface of carapace and abdomen smooth or rugose, never reticulate.

a. Cornea set transversely on eyestalk.

i. Posterior half of median carina of carapace, anterior to cervical groove, simple; submedian carinae of fourth abdominal somite ending in spines .. *nepa*, p. 60.

ii. Posterior half of median carina of carapace, anterior to cervical groove finely bicarinate throughout almost its entire length; submedian carinae of fourth abdominal somite not ending in spines .. .. .. *holoschista*, p. 64.

b. Cornea set very obliquely on eyestalk.

i. Lateral carinae of first five abdominal somites simple—not bicarinate.

a. No rows of tubercles on either side of median crest of telson.

(i) Anterior breadth of carapace less than half its median length, including rostrum; anterior bifurcation of median carina of carapace rarely altogether obsolete; anterior margin of ophthalmic somite convex, truncate or emarginate; dorsal surface of cara-

[1] Including the terminal tooth.

pace and abdomen rarely smooth, never highly polished.

(α) Median carina of carapace sharp and distinct throughout its course; dorsal carina of raptorial carpus with 3–5 tubercles .. .. *oratoria*, p. 66.

(β) Median carina of carapace interrupted at base of anterior bifurcation [1], dorsal carina of raptorial carpus with less than three tubercles.

* Dorsal carina of raptorial carpus entire, but terminating abruptly before reaching anterior margin; margin of longer spine of bifurcate process of uropods in front of external lobe very clearly concave .. *do.* var. *perpensa*, p. 70.

** Dorsal carina of raptorial carpus with two prominent tubercles; margin of longer spine of bifurcate process of uropods in front of external lobe convex .. .. *interrupta*, p. 72.

(ii) Anterior breadth of carapace ~~less~~ more than half its median length, including rostrum; anterior bifurcation of median carina of carapace altogether obsolete; anterior margin of ophthalmic somite with a minute median point; dorsal surface of carapace and abdomen smooth and highly-polished .. *wood-masoni*, p. 74.

β. Distinct rows of tubercles on either side of median crest of telson .. *mussaensis*, p. 76.

[1] In rare instances the whole anterior bifurcation is obsolete as in *S. wood-masoni*.

ii. Lateral carinae of first five abdominal somites bicarinate .. .. *stridulans*, p. 78.

II. Raptorial dactylus with ten to eighteen (usually thirteen to seventeen) teeth[1] .. .. .. *investigatoris*, p. 80.

II. First five abdominal somites each with more than eight longitudinal carinae.

A. Lateral process of sixth thoracic somite not bilobed; first five abdominal somites with a median carina, making nine in a transverse series [mandibular palp present; raptorial dactylus with five teeth[1]] .. .. .. *supplex*, p. 82.

B. Lateral process of sixth thoracic somite bilobed; numerous sharp carinae on abdominal somites.

I. Carapace with normal number of carinae and with numerous short ridges and tubercles; abdomen tuberculate laterally with numerous carinae in middle line; mandibular palp absent; raptorial dactylus with six or seven teeth[1] .. .. *costata*, p 84.

II. Entire surface of carapace and abdomen multicarinate; mandibular palp present; raptorial dactylus with five teeth[1] .. .. *multicarinata*, p. 86.

II. Upper margin of propodus of raptorial claw with usual series of pectinations replaced by stiff spines; spines well-spaced, large and small alternating more or less regularly (raptorial dactylus with nine, rarely eight, teeth).[1]

A. Antennular peduncle shorter than rostrum and carapace combined; lateral margin of sixth thoracic somite not distinctly bilobed; submedian carinae of fifth abdominal somite not ending in spines; ultimate segment of outer uropod suffused with black only on its inner longitudinal half .. .. *raphidea*, p. 88.

B. Antennular peduncle fully as long as rostrum and carapace combined; lateral margin of sixth thoracic somite distinctly bilobed; submedian carinae of fifth abdominal somite ending in spines; ultimate segment of outer uropod jet-black with a white midrib .. .. *annandalei*, p. 92.

1. Squilla latreillei (Eydoux and Souleyet).

Plate I, figs. 1-4.

1841. *Clorida latreillei*, Eydoux and Souleyet, Voy. de la 'Bonite, Zool., I, Crust., p. 265, pl. v, figs. 2-5.

1880. *Chloridella latreillei*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 15.

1894. *Squilla latreillei*, Bigelow, Proc. U. S. Nat. Mus. XIV, p. 509.

1895. *Chloridella latreillei*, Wood-Mason, Figs. and Desc. of nine Squillidae, p. 6, pl. iv, figs. 6-13.

The dorsal surfaces of the carapace and abdomen are smooth and without trace of punctuation. The carapace is more or less triangular in shape; anteriorly it is a little more than half as broad as long, while its greatest width measured in front of the postero-lateral angles is about equal to its median length. Except for an indistinct

[1] Including the terminal tooth.

ridge running close to the inner edge of the gastric groove, the only carina on the carapace is a short portion of the marginal. It is invisible anteriorly, but defines the posterior edge on either side and is curved internally, extending forwards for a short distance on the surface of the carapace. The sharp teeth at the antero-lateral angles, owing to the strong convexity of the anterior margin, fail to reach the level of the rostral base.

The rostrum is smooth above and at the base fully twice as broad as its median length. The lateral margins are usually a trifle upturned and converge rapidly to a broad, rounded apex.

The eyes (fig. 3) are very broadly pyriform, little more than one and a half times as long as broad, and do not nearly reach to half the length of the basal segment of the antennular peduncle. The very small bilobed cornea is only about half the width of the greatly swollen median portion of the stalk. The inner margins of the stalk are straight, flat, and in close juxtaposition for three-quarters of their basal length; the external margins are feebly keeled.

The antennular peduncle is as long as, or a trifle longer than, the carapace. The two basal segments of the antennal endopodite are very long and reach as far as the apex of the scale.

The mandibular palp is composed of three segments.

The outer inferior margin of the merus of the raptorial claw is bluntly rounded distally. The dorsal carina of the carpus is sharp and entire, but terminates abruptly before reaching the distal edge. Externally the carpus is grooved and obscurely ridged. The propodus has three proximal movable spines, the second being the shortest, and a series of fine pectinations along the margin opposed to the dactylus. The dactylus bears four or five teeth including the terminal one, the fifth or proximal tooth, when present, is usually small[1] and lies close up against the next of the series. The outer margin of the dactylus is strongly convex and bears a rounded prominence at its base.

The last three thoracic somites bear intermediate carinae; submedian carinae may also be found, but as a rule are very obscure or wholly absent on all the somites except the last. The fifth somite is produced laterally to a short and sharp point directed almost transversely outwards (fig. 4); the pair of spines found on the inferior surface in certain allied species is obsolescent or entirely missing. The lateral margins of the sixth and seventh somites are slightly upturned and truncately rounded; those of the eighth project anteriorly in the form of a small acute or subacute lobe.

The abdominal somites are greatly depressed. The first five bear four pairs of longitudinal carinae of which the submedian and intermediate, though always clearly visible, are faintly marked. All the somites, except the first and last, bear a small transversely-grooved tubercle in the middle line. The six carinae of the sixth somite are strongly swollen in the adult male and, in both sexes, the submedians are slightly

[1] The dactylus of a male specimen figured by Wood-Mason (1895, pl. iv, fig. 9) is quite abnormal in the extreme reduction of *two* proximal teeth.

convergent posteriorly and the intermediates more or less curved inwards The following abdominal carinae end in spines[1] :—

Carinae.	*Abdominal somites.*
Submedian	6.
Intermediate	5, 6.
Lateral	5, 6.
Marginal	(2) (3) 4, 5.

The telson (figs. 1, 2) is considerably broader than long and is strongly convex dorsally. The median carina is distinct, very obscurely notched at the base, and in most cases terminates in a short spine; on either side of it there are a number of ridges which are usually broken up into tubercles. Close to the median carina on each side a row of from three to six tubercles is usually found, the two rows converging posteriorly and meeting in a small tubercle immediately behind the distal end of the carina. Beyond this there are a number of oblique ridges—in some cases very obscure, in others sharp and broken up into a series of tubercles—and, in addition, several isolated tubercles or transverse tuberculate ridges may usually be seen close to the proximal margin. The six marginal teeth are acute but short ; the submedian pair is provided with minute movable tips, but these in most well-grown specimens are broken off. The outer edges of at least the intermediate pair are serrate and a small blunt praelateral lobe is usually distinct. There are one or two pairs of submedian denticles, four to seven intermediate, and one lateral, and these like the primary teeth frequently possess serrate margins. The ventral surface of the telson is quite smooth except for a short, but well-marked, post-anal crest.

In adult males (fig. 2) the median carina is rather more swollen than in the female (fig. 1) and there is an enormously inflated triangular swelling at the base of each marginal tooth. The tubercles, moreover, are generally more rounded and less conspicuous than is the case in the other sex.

Wood-Mason (1895, pl. iv, figs. 8, 12) has given two figures of the telson of this species and two additional figures will be found on Pl. I, figs. 1 and 2. The latter, which were drawn from specimens obtained in the Persian Gulf, differ considerably from the more normal types figured by Wood-Mason, that of the female, in particular, showing quite an extreme tubercular development.

The peduncular segment of the outer uropod (figs. 1, 2) is provided with a single dorsal spine near its articulation with the exopodite. The inner spine of the ventral bifurcate process is more than twice the length of the outer and bears a well-developed lobe on its external aspect. Internally the process is armed with five to eight sharp spines. The spines on the outer margin of the basal segment of the exopod are flattened and curved and the ultimate is fully two and a half times as long as the next of the series.

[1] This tabular method has been adopted for showing the position of the spines on the abdominal somites. Numbers in brackets indicate that spines occur on these somites in some specimens, but not in all. (See p. 9.)

The colour of spirit specimens is not very striking. The posterior margins of the carapace and of the last three thoracic and first five abdominal somites are narrowly bordered with black pigment and frequently a small black spot is visible on the dorsal surface of the eyestalk, touching the cornea.

The eight specimens in the Indian Museum are registered as follows :—

$\frac{5767}{9}$	Sandheads, Ganges Delta.	A. J. Milner.	1 ♂, 61 mm.
$\frac{6704}{4}$	Sandheads, Ganges Delta.	J. Barnet.	1 ♀, 49 mm.
$\frac{7998}{9}$	Sandheads, Ganges Delta.	W. M. Daly.	1 ♂, 71 mm.
$\frac{3454}{9}$	Orissa Coast, Bengal, 13 fms.	'Investigator.'	1 ♂, 46 mm.
$\frac{5802}{9}$	Vizagapatam Coast, Madras.	'Investigator.'	1 ♀, 64 mm.
$\frac{3096}{5}$	Madras.	(purchased).	1 ♀, 62 mm.
$\frac{5366\text{-}7}{10}$	Persian Gulf, 25 fms. 28°59′ N., 50°5′ E.	'Investigator.'	1 ♂, 1 ♀, 57, 73 mm.

In addition to the above records *Squilla latreillei* is known only from Singapore (Eydoux and Souleyet).

2. Squilla decorata (Wood-Mason).

Plate I, figs. 13—16.

1875. *Clorida decorata*, Wood-Mason, Proc. As. Soc. Bengal, p. 231, reprinted in Ann. Mag. Nat. Hist. (4), XVII, p. 263 (1876).

1880. *Chloridella decorata*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 15.

1895. *Chloridella decorata*, Wood-Mason, Figs. and Desc. of nine Squillidae, p. 9, pl. iv, figs. 14–17.

This species may be readily distinguished from the preceding by the following characters :—

1. The lateral process of the fifth thoracic somite consists of a long and sharp spine which is strongly bent forwards (fig. 14).
2. The inferior margin of the same somite bears on either side a small acute tooth.
3. The lateral margin of the seventh somite is rounded behind, but in front is produced as a sharp spine (fig. 14).
4. The inferior surface of the telson bears a number of short carinae, which are more or less broken up into tubercles, on either side of the well-marked post-anal carina (fig. 16).

The rostrum is short, much wider than long, and its upturned lateral margins converge to a broadly-rounded apex. The eyes (fig. 13) are similar to those of *S. latreillei*, but the stalk is rather less swollen; the inner margins are flattened and in juxtaposition for about three-quarters of their basal length. There is a three-segmented mandibular palp. The raptorial claw also resembles that of the preceding species; in all the specimens examined the dactylus bears five teeth and the proximal tooth is well separated from the next of the series.

The lateral process on the anterior part of the eighth thoracic somite is sharply

acute and directed forwards, more so than in any example of *S. latreillei* (*cf.* figs. 4 and 14). Submedian carinae are present on all the abdominal somites and are also distinct on the last three segments of the thorax. The following carinae end in spines :—

Carinae.	*Abdominal somites.*
Submedian	6.
Intermediate	(3) 4, 5, 6.
Lateral	(3) 4, 5, 6.
Marginal	(2) 3, 4, 5.

The submedian carinae of the first five somites are strongly divergent posteriorly (fig. 15). On the sixth somite between the submedian and intermediate carinae are numerous well-marked vermiculate elevations.

The upper surface of the telson (fig. 15) is closely covered with tubercles, which in most cases form definite rows. The telson of the type specimen has already been figured by Wood-Mason (1895, pl. iv, fig. 16), that of another example is illustrated on Pl. I, figs. 15, 16. The marginal teeth are well developed and without serrations on their edges. There are two submedian denticles, seven intermediate and one lateral. The inner margin of the bifurcate process from the base of the uropod bears from seven to thirteen sharp spines (thirteen in the type). The lobe on the outer margin of the longer spine is large and distinct.

The specimens show no characteristic colouring, but, in one example, the black spot on the eyestalk already noticed in the preceding species is very distinct. According to Wood-Mason the colour of one of the specimens in life was ' delicate salmon-pink, darkest in the mid-dorsal line.'

There are four specimens of this species in the Indian Museum :—

$\frac{5086}{5}$	Port Blair, Andamans.	J. Wood-Mason.	1 ♀, badly mutilated, *ca.* 75 mm. TYPE.
$\frac{7713}{6}$	Yé River entrance, Burma.	'Investigator.'	1 ♀, 49 mm.
$\frac{5803}{9}$	Off Irrawaddy Delta. 15°29′ N., 94°55′ E.	'Investigator.'	1 ♀, 70 mm.
$\frac{7526}{10}$	Off Akyab, Arakan Coast, 34 fms., 19°56′ N., 92°32′ E.	'Investigator.'	1 ♀, 23 mm.

In the last and smallest of the above specimens the spinous process at the antero-lateral angles of the seventh thoracic somite is less well developed than in the others, though still clearly distinct from *S. latreillei* in this respect. The telson shows only faint traces of rows of tubercles on its dorsal aspect, and on its ventral surface none whatever can be distinguished. In other details this young example agrees well with the larger individuals.

Only the above specimens are known.

3. **Squilla gibba**, Nobili.

Plate I, figs. 5—12.

1903. *Squilla* (*Chloridella*) *gibba*, Nobili, Boll. Mus. Torino, XVIII, no. 447, p. 30; p. 31, fig. 3.

This species is allied to the two preceding, but may be distinguished from them by the following characteristics :—

1. The median carina of the carapace is well marked and there are in addition traces of intermediate and lateral carinae. There is a small subsidiary spinule below the stout spine which defines the antero-lateral angles (fig. 7).
2. The rostrum bears a distinct longitudinal carina in its anterior half.
3. The eyestalks reach beyond the middle of the basal segment of the antennular peduncle.
4. The two basal segments of the endopodite of the antenna are short and do not reach to half the length of the antennal scale.
5. The mandibular palp is entirely absent.
6. The lateral margin of the fifth thoracic somite is produced as a broad falcate process, which is very strongly bent forwards (much more so than in *S. decorata*) and closely resembles that of *S. scorpio* ; the lateral margins of the two succeeding somites are more narrowly rounded than in either of the preceding species (fig. 5).
7. The dorsal surfaces of the free thoracic and first five abdominal somites are finely rugose.
8. The dorsal surface of the telson, in the female (fig. 12), is finely rugose on either side of the median carina, but is without any trace of tubercular ridges. In the adult male (fig. 11) the surface is smooth, but a huge curved and rounded ridge, higher than the median carina, extends from the vicinity of the antero-external angle to the apex of the submedian teeth. In both sexes the post-anal crest is represented only by a single prominent tubercle.
9. The inner margin of the bifurcate process from the base of the uropod is finely serrate, not spinous.

The rostrum in this species is rather longer than in *S. latreillei* and *decorata* ; it is only a little broader than long and its lateral margins are upturned. The cornea of the eyes is also rather larger than in the two preceding species and the inner margins of the stalk, though considerably flattened, do not lie close against one another.[1] The antennular peduncle is shorter than the carapace, excluding the rostrum.

The dorsal crest of the carpus of the raptorial claw (figs. 8, 9) terminates in a subacute point and is sometimes obscurely notched near the middle. The propodus of the adult male (fig. 8) is very broad distally, though normally developed in the female (fig. 9). The dactylus is, in the male, externally convex and slightly swollen at the base ; in the female it is less swollen and the outer margin is very distinctly sinuous. There are five dactylar teeth (including the apical one) and these are much longer and more slender in the female than in the male. As in *S. decorata* all the teeth are well separated from one another.

In addition to the falcate lateral process, the fifth thoracic somite bears a blunt forwardly-directed tooth on either side of its inferior surface (fig. 10). The lateral

[1] It is the inner margin of the stalk that is dilated in this species and not the outer, as in *S. latreillei*, *S. decorata* and *S. microphthalma*. The figures are all of *right* eyes ; compare fig. 6 with figs. 3, 13 and 17.

margins of the two succeeding somites are more narrowly rounded than in *S. latreillei* and the anterior spinous process found on the seventh somite of *S. decorata* is absent (fig. 5). The eighth somite is produced laterally as a rounded anterior lobe.

Faint submedian and intermediate carinae are present on the last three thoracic and on all the abdominal somites. The submedians are parallel and not posteriorly divergent as in the preceding species. On the 3rd, 4th and 5th somites there are extremely faint traces of median tubercles. The following carinae end in spines :—

Carinae.	*Abdominal somites.*
Submedian	6.
Intermediate	5, 6.
Lateral	5, 6.
Marginal	1, 2, 3, 4, 5, 6.

The lateral carinae are semi-obsolete except on the 1st somite. The submedian and intermediate carinae of the 6th somite are greatly swollen in the adult male.

The form of the telson is astonishingly different in the two specimens examined. In the smaller female example (fig. 12), the median carina is obscurely notched near the base and terminates in a short spine. The dorsal surface on either side is very finely rugose, but is otherwise smooth except for the lateral edge which is upturned proximally and for obscure elevations at the base of the submedian and intermediate teeth. The usual three pairs of marginal teeth are well developed and those of the submedian pair appear to have had movable tips. There are two or three submedian denticles, six intermediate and one lateral. The praelateral denticle is missing. In the adult male, the type (fig. 11), the base of the submedian spines is greatly inflated, while from the intermediates two huge, swollen and internally curved ridges, higher than the median carina, extend backwards nearly as far as the antero-lateral corners. The submedian and intermediate spines are very blunt and the lateral spine and denticle are represented by two small nicks in the margin. There are three or four submedian and six or seven intermediate denticles. The median carina is obscurely notched at the base, the distal spine is non-existent and on either side, in the hollows between the three prominences, there are obscure indications of a longitudinal row of pits. The lateral margin is strongly upturned proximally.

The bifurcate process from the base of the uropod resembles that of the preceding species, except that the spines on the inner margin are replaced by a row of fine serrations.

The colouring of spirit specimens does not seem distinctive.

There is one specimen in the Indian Museum :—

$\frac{7529}{10}$ Buntal or Pulo Burong, Borneo. Sarawak Museum. 1 ♀, 48 mm.

This individual was presented by Mr. J. C. Moulton, to whom I am also indebted for the opportunity of examining and figuring Nobili's type specimen, the only other example known. The latter, a male 76 mm. in length, was found at Pulo Burong, Borneo.

4. Squilla microphthalma, H. Milne-Edwards.

Plate I, figs. 17—20.

1837. *Squilla microphthalma*, H. Milne-Edwards, Hist. Nat. Crust., II, p. 523.
1841. *Clorida microphthalma*, Eydoux and Souleyet, Voy. de la 'Bonite,' Zool. I, Crust., pp. 264, 266.
1849. *Squilla microphthalma*, de Haan, in Siebold's Fauna Japonica, Crust., p. 221.
? 1880. *Chloridella microphthalma* (*depressa*), Miers. Ann. Mag. Nat. Hist. (5), V, p. 14, pl. ii, figs. 1—4.
1882. *Chloridella microphthalma*, Haswell, Cat. Australian Crust., p. 207.
1894. *Squilla microphthalma*, Bigelow, Proc. U. S. Nat. Mus., XVII, p. 509.
1895. *Chloridella microphthalma*, Wood-Mason, Figs. and Desc. of nine Squillidae, p. 8, pl. iv, figs. 1—5.
1898. *Chloridella microphthalma*, de Man, Zool. Jahrb. Syst., X, p. 691, pl. xxxviii, fig. 76, a.
1904. *Squilla microphthalma*, Jurich, Stomatop. deutsch. Tiefsee-Exped., p. 368, pl. xxvi, fig. 1.

This species and the two following may easily be distinguished from the three preceding by the complete absence of submedian carinae on the first five abdominal somites and by the proportions of the eyes. The latter are decidedly longer than in the species of the *latreillei* group and the cornea, through narrower than the inflated basal portion of the stalk, is much broader (fig. 17).

The following appear to be the principal characters of *S. microphthalma* :—The dorsal surface of the carapace and abdomen is quite smooth. The carapace, which does not possess median or lateral carinae, bears an extremely close resemblance to that of *S. latreillei*, but is rather narrower in front. The antero-lateral angles are produced as sharp spines. The rostrum is smooth above, as long as, or a trifle longer than wide and its lateral margins which are not upturned meet in an acute but rounded apex.

The eyes (fig. 17) are narrowly pear-shaped and reach to at least two-thirds the length of the basal segment of the antennular peduncle. The cornea is two-thirds the maximum width of the stalk and its greatest breadth is about one-third the length of the whole organ. The internal margins of the stalk are not distinctly flattened and in juxtaposition as in *S. latreillei*. The antennular peduncle is about as long as the carapace, excluding the rostrum. The two basal segments of the antennal endopodite are long, reaching almost to the apex of the scale. The mandibular palp is present and is composed of three segments.

The raptorial claw is almost precisely similar to that of *S. latreillei*, but the external margin of the dactylus is very feebly sinuous. The latter segment bears four teeth including the apical one, and in some specimens a very small additional tooth is present, proximal in position and lying close up against the next of the series.

The last three thoracic somites bear faint intermediate, but no submedian, carinae. The fifth does not possess a pair of inferior spines but is produced laterally to a very short acute point, which is directed almost straight outwards (fig. 18). The lateral margins of the two following somites are broadly rounded; that of the eighth is produced anteriorly as a rounded lobe.

The abdominal somites bear faint intermediate, lateral and marginal carinae, but the submedian are entirely absent except on the last. The following carinae end in spines :—

Carinae.	*Abdominal somites.*
Submedian	6.
Intermediate	5, 6.
Lateral	5, 6.
Marginal..	(3) (4) 5.

The dorsal ornamentation of the telson is variable and, both in general features and in its sexual differences, presents a close resemblance to that of *S. latreillei*. The figures on Pl. I, figs. 19, 20, will convey a better idea of the characters than a long description. The submedian teeth have minute movable tips and there are two submedian denticles, six or seven intermediate and one lateral. The under surface of the telson is smooth except for an obsolete post-anal carina.

The process from the base of the uropod bears a series of six or seven sharp spines on its inner margin. Of the two primary spines the inner is nearly twice the length of the outer and bears a rounded external lobe near its middle point.

The smallest specimen in the Indian Museum, a female 33 mm. in length, differs from the foregoing description in having the rostrum distinctly broader than long, in having three submedian and five intermediate denticles on the telson, in having the outer margins of the intermediate teeth serrate, and in having the oblique rows of tubercles on either side of the telson more conspicuous. In other characters, however, it agrees so well with typical examples that there can be little doubt that it belongs to the same species.

The specimen from Australia which Miers doubtfully referred to *S. microphthalma* in some respects resembles this small individual ; but the rostrum, according to Miers' figure, is still broader and the inner margin of the ventral process of the uropods is stated to be armed only with a series of small spinules, as in *C. decorata*. On the acquisition of further specimens from the Australian coast it will perhaps appear that this form is distinct, and in this case the name *depressa*, suggested by Miers, is to be employed.

The colour of spirit specimens is not very striking. The lateral and posterior margins of the carapace and the posterior margins of the last three thoracic and five abdominal somites are rather broadly defined by black pigment.

There are four specimens of *Squilla microphthalma* in the Indian Museum :—

$\frac{3313}{7}$ Karachi.	Karachi Museum.	1 ♂, 52 mm.
$\frac{3085}{5}$ Karachi.	,, ,,	1 ♂, 41 mm.
$\frac{7530}{10}$ Bombay.	Bombay Nat. Hist. Soc.	1 ♀, 50 mm.
$\frac{7527}{10}$ Madras Coast.	(no history).	1 ♀, 33 mm.

In addition to the above records *S. microphthalma* is known from 'les côtes de l'Inde' (Milne-Edwards) and from Zanzibar, 33 fathoms (Jurich). The speci-

men described by Miers[1] and referred to above was found at Port Essington, N. Australia.

5. Squilla chlorida, Brooks.

1886. *Squilla chlorida*, Brooks, Voy. H.M.S. 'Challenger,' XVI, Stomatop., p. 40, pl. ii, figs. 1—5.
1894. *Squilla chlorida*, Bigelow, Proc. U. S. Nat. Mus., XVII, p. 510.

This species is only known from the type specimen. According to Brooks' description and figures it differs from *S. microphthalma* only in the following particulars :—

1. The carapace is rather broader anteriorly and possesses faint lines indicating lateral carinae.
2. The cornea of the eyes is considerably more expanded than in *C. microphthalma* ; its greatest breadth is about one half the total length of the organ, but is, however, decidedly less than the maximum width of the stalk.
3. The lateral process of the fifth thoracic somite is a long, straight, outstanding spine.
4. The postero-lateral angles of the first four abdominal somites are obtuse.

The dactylus of the raptorial claw possesses five well-separated teeth. The telson is smooth below and bears numerous scattered rounded tubercles on either side of the dorsal carina. There are three or four submedian denticles, six or seven intermediate and one lateral.

One specimen, a male 40 mm. in length, was found by the 'Challenger' Expedition at Amboina, China Sea, in 15 fathoms.

The specimen which Lanchester has recorded under the name of *Chloridella chlorida*, Brooks, from Kelantan, Malay Peninsula (Proc. Zool. Soc., 1901, p. 554) does not appear to belong to this species. Lanchester notes that submedian carinae occur on all the abdominal somites. This would seem to indicate that the specimen should be classed with the *latreillei* group, but it is not clear to which, if any, of the three species it should be referred.

6. Squilla rotundicauda (Miers).

1880. *Chloridella rotundicauda*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 15, pl. ii, figs. 5, 6.
1894. *Squilla rotundicauda*, Bigelow, Proc. U. S. Nat. Mus., XVII, p. 509.

Miers' description of the unique specimen runs thus :—

"This species is nearly allied to *C. microphthalma*, but differs as follows :—The rostrum is somewhat more elongated; there is no spine at the antero-lateral angles of the carapace. The carinae of the first to fifth postabdominal segments are very faintly indicated ; those of the sixth segment are strongly defined. The median carina

[1] Miers' statement that Eydoux and Souleyet have recorded this species from Singapore appears to be erroneous.

of the terminal segment is thickened and obtuse posteriorly ; the lateral marginal spines are obsolete, and the intervening denticles are small and not acute. The eye-peduncles have their inner margins straight and are convex only on their outer surface."

S. rotundicauda may be distinguished from all the species of the *microphthalma* and *latreillei* group by the absence of the spines at the antero-lateral angles of the carapace. The posterior thickening of the median carina of the telson (in the female) also appears to be a noteworthy feature.

It should be noticed that the rostrum of Miers' specimen of *S. microphthalma* seems to have been unusually short.

The type specimen, a female 70 mm. in length, was found at Formosa.

7. **Squilla fasciata**, de Haan.

Plate I, figs. 21—23.

1844? *Squilla fasciata*, De Haan, in Siebold's Fauna Japonica, Crust., atlas, pl. li, fig. 4.
1849. *Squilla fasciata*, De Haan, *ibid.*, text, p. 224.
1880. *Squilla fasciata*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 29.
1886. *Squilla fasciata*, Brooks, Voy. H.M.S. 'Challenger,' XVI, Stomatop., p. 37, pl. ii, fig. 8, pl. iii, figs. 4, 5.
1893. *Squilla fasciata*, Pocock, Ann. Mag. Nat. Hist. (6), XI, p. 473.
1894. *Squilla fasciata*, Bigelow, Proc. U. S. Nat. Mus., XVII, p. 510.
1903. *Chloridella fasciata*, Rathbun, Proc. U. S. Nat. Mus., XXVI, p. 54.
1907. *Chloridella fasciata*, de Man, Trans. Linn. Soc. Zool. (2) IX, p. 440.

The dorsal surface of the carapace and abdomen is smooth and highly polished. The carapace, measured behind the antero-lateral angles, is half, or rather more than half, its length, excluding the rostrum[1] (fig. 21). The lateral margins are not angulated in front of the postero-lateral corners. Between the gastric grooves and the margins, in the anterior half of the carapace, there is on each side a shallow groove ; the median and intermediate carinae are entirely absent[2] and the lateral and marginal are only visible in the posterior quarter of the carapace. The antero-lateral angles are produced as strong spines that reach almost or quite as far as the level of the rostral base. The rostrum is smooth dorsally, scarcely broader than long, and its lateral margins, which are not upturned, converge to a rather sharply rounded apex.

The cornea of the eyes is not large but is very clearly wider than any part of the stalk ; the greatest breadth (across the cornea) is equal to about three-quarters of the total length. The corneal and peduncular axes are very slightly oblique. The antennular peduncle is about as long as the carapace, excluding the rostrum. The two basal segments of the antennal endopodite are short and do not reach much beyond the middle of the scale. The mandibular palp is present and three-segmented.

The outer inferior margin of the merus of the raptorial claw terminates in a rounded angle ; the carpus has a groove and keel on its external aspect and its dorsal

[1] Brooks' figure is, I believe, incorrect in showing the carapace so very much narrowed anteriorly.

[2] In fig. 21 the representation of a groove on either side of the gastric grooves erroneously bears some resemblance to an intermediate carina.

carina is entire and ends in a sharp spine before reaching the distal margin. The propodus has the usual three movable spines and row of pectinations along the edge opposed to the dactylus. The dactylus bears six teeth, including the apical one, and the outer margin, which is obscurely angled posteriorly, is not, or is only very feebly, sinuous.

There are no submedian carinae on the last four thoracic somites (fig. 21). The intermediates are present and on the fifth somite each is oblique and is continuous with the posterior margin of the single sharp spine which forms the lateral process. This spine points forwards and a little downwards and beneath it on the inferior surface of the somite there is on each side another sharp spine, which is directed straight downwards. The lateral margins of the sixth and seventh somites are more or less truncate and rather sharply rounded posteriorly.

The first five abdominal somites are remarkable for the entire absence of the submedian carinae. These, however, are conspicuous on the sixth somite and the intermediates, laterals and marginals are well developed on all. The following carinae end in spines :—

Carinae.	*Abdominal somites.*
Submedian	6.
Intermediate	(3) 4, 5, 6.
Lateral	1, 2, 3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

The telson (fig. 23)[1] is as broad as, or a trifle broader than long. The median carina is well marked ; it is notched near the base and ends in a sharp spine which overhangs two small tubercles. On either side there is another longitudinal carina about three quarters the length of the median and external to these there are several other shorter carinae, six of which reach to the apices of the sharp primary marginal teeth. There are three or four submedian denticles, six to eight intermediate and one lateral. The praelateral denticle is present. On the ventral side of the telson the post-anal carina is distinct and on either side of it there are, in larger specimens, two other carinae which are more or less interrupted.

The basal segment of the uropod terminates in a sharp dorsal spine which projects over the articulation of the exopodite. The bifurcate process bears from nine to twelve spines on its inner margin. The inner primary tooth is almost twice the length of the outer and bears a prominent external lobe at about its middle point. The first segment of the exopodite is considerably longer than the second.

The spirit specimens are closely covered with brownish and black chromatophores, which, by their absence, define an interrupted and irregular pale transverse band in the posterior third of the carapace. The hinder edges of the abdominal somites may be suffused with black between the lateral and intermediate carinae. The exopodite of the uropod is quite black except for the anterior half of the proximal segment and the apices of the endopodite are similarly coloured.

[1] In the Andaman specimen, from which this figure was drawn, the telson is damaged and abnormal on the left side.

According to a colour-sketch kindly made for me from the smallest specimen by Capt. R. B. Seymour Sewell, the median part of the carapace is, in life, dark brown throughout its length. This patch of colour encloses a large, pale, oval spot in the anterior half and further back is very much narrowed. The carinae of the abdomen are brown, and this colour also defines the position of the non-existent median and submedian carinae. The eyes are golden yellow. The marginal spines of the telson and the distal portions of both inner and outer uropods are deeply suffused with reddish purple.

There are three specimens of *S. fasciata* in the Indian Museum :—

$\frac{1804}{6}$	Port Blair, Andamans.	(Purchased).	1 ♀, 68 mm.
$\frac{8034}{10}$	Off Tavoy Point, 50 fms., 13°29′ N., 97°30′ E.	'Investigator.'	1 ♀, 40 mm.
$\frac{8136}{10}$	Port Maria, Elphinstone I., Mergui Archipelago	'Investigator.'	1 ♂, 56 mm.

Through the kindness of Prof. K. Kishinouye I have been able to compare these specimens with an example from Japan : the specimens are in close agreement. Prof. Kishinouye informs me that the species is very rare in Japanese waters. His example, a male, 79 mm. in length, is encrusted with a Polyzoon, *Triticella korenii*, Sars (see p. 7) and was found in the Bay of Tokio.

Previous records of *Squilla fasciata* are not numerous. It is known from Japan, Inland sea and other localities (De Haan, Brooks, de Man, Rathbun) and in Chinese waters from Chusan, 10—14 fathoms, and Holothuria Bank, 34—36 fathoms (Pocock).

8. Squilla miles, Hess.

1865. *Squilla miles*, Hess, Arch. f. Naturgesch., XXXI, i, p. 169, pl. vii, fig. 21.
1880. *Squilla miles*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 17.
1882. *Squilla miles*, Haswell, Cat. Australian Crust., p. 207.
1887. *Squilla miles*, de Man, Zool. Jahrb. Syst., II, p. 714.
1894. *Squilla miles*, Bigelow, Proc. U. S. Nat. Mus., XVII, p. 509.

I have seen no examples of this fine species. It appears to be allied to the preceding, but is readily distinguished by the following characters :—

1. The antero-lateral angles of the carapace are not spinous.
2. The rostrum is somewhat longer than broad.
3. [1]The cornea of the eye is not so distinctly wider than the stalk. It is set obliquely ; but the obliquity is the reverse of that usually found, the inner margin of the stalk being shorter than the outer.
4. The dactylus of the raptorial claw bears only four teeth, including the terminal one.
5. [1]The lateral margin of the fifth thoracic somite is bluntly rectangular, not spinous and antrorse as in the preceding species.

[1] For this information I am indebted to Dr. W. T. Calman, who, at my request, made an examination of the specimen in the British Museum.

6. Submedian carinae are present on the last three thoracic and on all the abdominal somites[1], and on the sides of each between the lateral and intermediate carinae there is a flattened triangulate prominence.
7. The telson bears a great resemblance to that of *S. fasciata*, but there are two or three long continuous carinae on either side of the median crest in place of the one found in that species. According to Hess' figure the first and third of these carinae are connected proximally, while the second and third fuse posteriorly and are continued as a single keel to the apex of the submedian tooth. On the surface of the telson outside these carinae there is an oblique row of short ridges or tubercles. The submedian teeth have movable tips and are placed close together, the margin occupied by the intermediate denticles being thus much longer than in *S. fasciata*. There are three or four minute submedian denticles, nine or ten intermediate and one lateral. The praelateral denticle appears to be absent.

The type of *Squilla miles*, which measures 172 mm., was found at Sydney (Hess) and the only other known example, a male about 90 mm. in length, is recorded from Victoria (Miers).

9. **Squilla lata**, Brooks.

Plate II, fig. 24.

1886. *Squilla lata*, Brooks, Voy. H.M.S. 'Challenger', XVI, Stomatop., p. 34, pl. iii, figs. 1—3.
1894. *Squilla lata*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 510.

This species is allied to *S. fasciata*, but is easily distinguished by the absence of carinae on either side of the median crest of the telson.

The whole dorsal surface is smooth and polished. On the carapace the median carina is wholly absent, though the small mid-dorsal pit is visible; fine intermediate carinae are found on either side of the gastric groove, but the laterals and marginals only exist in the extreme posterior part of the carapace behind the cervical groove. The lateral margin is very obtusely angled in front of the rounded postero-lateral corners and the antero-lateral angles are produced to a sharp spine that does not reach the level of the rostral base. The anterior margins on either side of the rostrum are distinctly sinuous.

The rostrum is about one and a half times as long as broad, its lateral margins are sinuous—concave anteriorly—and converge to a narrow rounded apex. In its anterior half it may bear a very feeble longitudinal ridge, but it is never definitely carinate.

The eyes are elongated. The cornea is distinctly wider than the stalk; its breadth is about two-thirds the total length of the whole organ; the corneal and peduncular axes are a trifle oblique. The antennular peduncle is shorter than the median length of the carapace. The mandibular palp is present and is three-segmented.

The dorsal carina of the raptorial carpus terminates abruptly before reaching

[1] It seems that Hess, when he mentioned three longitudinal carinae on the abdomen, did not reckon the marginal.

the anterior margin. The dactylus bears six teeth including the terminal one ; the outer margin is convex and bears an acute lobe at the base.

The lateral process of the fifth thoracic somite is, in the Indian specimens, rather longer than is indicated in Brooks' figure ; it is almost straight and trends obliquely outwards and forwards. The pair of inferior spines are sharp. The lateral margins of the two succeeding somites are broadly rounded, those of the eighth somite are lobed anteriorly. The intermediate carinae of the free thoracic somites are distinct, but the submedians are either wholly absent or are represented only by obsolete traces on the last two somites.

There are no submedian carinae on the first three abdominal segments, obsolescent indications of them may, however, be found on the fourth and fifth somites ; on the sixth they are invariably present and well developed. The intermediate, lateral and marginal carinae are, as is usual, quite distinct. The following abdominal carinae end in spines :—

Carinae	*Abdominal somites.*
Submedian	6.
Intermediate	(3) 4, 5, 6.
Lateral	3, 4, 5, 6.
Marginal	(1) (2) 3, 4, 5.

These figures refer to the Indian specimens ; Brooks remarks that in the type spines are found *only* on the last somite.

The dorsal surface of the telson is finely rugose and, on either side of the median crest, is obscurely marked with faint parallel furrows. The marginal teeth are well developed and there are one to three[1] submedian denticles, six to eight intermediate and one lateral. In the Indian examples the outermost median denticle is borne on the inner face of the intermediate tooth and projects distally beyond its fellows. There is no praelateral denticle. The post-anal carina is short but distinct.

The bifurcate process of the peduncular segment of the uropods bears six to eleven sharp teeth on its inner margin and on the outer face of the longer spine there is a large and very conspicuous rounded lobe (fig. 24).

The two largest specimens examined are males ; but, except for a feeble swelling at the base of each intermediate marginal denticle of the telson, no distinctive sexual modifications are to be found.

The Indian examples of *S. lata* differ from Brooks' account in the possession of a dorsal spine at the distal end of the peduncle of the uropods and in a few other details noticed above, the most important being the greater abundance of spines on the abdominal somites. Should the distinctions prove constant it may be necessary to separate specimens from the Bay of Bengal under a distinct subspecific name.

Spirit specimens exhibit no characteristic colouring.

The three examples in the collection are registered as follows :—

$\frac{1707-9}{10}$ Gulf of Martaban, Burma; 53 fms.,
14°38′12″ N., 96°24′30″ E. 'Investigator.' 1 ♂, 2 ♀, 64—76 mm.

[1] Two or three in the Indian examples, a single broad lobe in the types.

The only other known specimens of *S. lata* are those on which Brooks founded his original description. They were found in the Arafura Sea, south of New Guinea, in 49 fathoms, and the largest measured 82 mm. in length.

10. Squilla gilesi, Wood-Mason, MS.

Plate II, figs. 25—27.

1908. *Squilla gilesi*, Lloyd, Rec. Ind. Mus., II, p. 33 (*sine desc.*).
1911. *Squilla gilesi*, Kemp, Rec. Ind. Mus., VI, p. 95.

Squilla gilesi is an extremely close ally of *S. lata* and it is possible that it will eventually prove to be nothing more than a race or variety of that species. It is distinguished only by the following characters :—

1. The intermediate carinae of the carapace are obsolete and are represented only by a pair of feeble and smoothly-rounded elevations. The lateral margins of the rostrum are in most cases less decidedly sinuous (fig. 26).
2. Submedian carinae are quite distinct on the last two thoracic (fig. 26) and on all the abdominal somites.
3. The inner margin of the bifurcate process of the uropods bears only a series of serrations, though one or two of the ultimate members of the series may be spinous (fig. 25). The lobe on the outer face of the longer tooth is small.
4. Secondary sexual characters are strongly marked. In adult males the distal end of the raptorial propodus is proportionately much broader than in the female, the dactylus is slightly dilated at the base, the teeth are shorter and the outer margin more strongly convex. In this sex also the median carina of the telson is greatly inflated, especially at its anterior and posterior ends and the greater part of the distal margin is strongly swollen (fig. 27).

The last character though only available in males, seems none the less to have considerable importance. Brooks has noted that the sexes in *S. lata* are alike and in the examples in the Indian Museum scarcely any differences are perceptible even in large examples over 70 mm. in length. In *S. gilesi*, on the contrary, the modifications in the telson and raptorial claw are quite striking even in specimens only 55 mm. in length.

In other respects *S. gilesi* bears an exceedingly close resemblance to the Indian examples of *S. lata*. The spines on the abdominal somites are sometimes a little more numerous :—

Carinae.	*Abdominal somites.*
Submedian	6.
Intermediate	(2) 3, 4, 5, 6.
Lateral	(1) (2) 3, 4, 5, 6.
Marginal	(1) 2, 3, 4, 5.

There are one to three submedian denticles, five to eight intermediate, and one lateral.

A very small specimen ($\frac{3077}{5}$), a male 19 mm. in length, taken in company with large typical examples, is in an early post-larval stage. The spines at the antero-lateral angles of the carapace are not developed, submedian carinae are absent except on the last somite, and on the margin of the telson there are numerous minute submedian denticles and ten or eleven intermediate. A similar but slightly larger example ($\frac{488}{10}$), measuring 23·5 mm., is referred with some doubt to this species. The denticles on the margin of the telson are, as might be expected, fewer in number than in the small example, but in the bifurcate process of the uropods the lobe on the outer face of the long tooth is very much larger than in that specimen or in adults. In both these individuals the inner edge of the process is finely serrate.

Spirit specimens of *S. gilesi* show no characteristic colouring.

The following examples are in the Indian Museum :—

$\frac{7514-18}{10}$	Off Madras Coast; 80—110 fms., 14° 18′ 15″ N., 80° 18′ 30″ E.	'Investigator.'	1 ♂, 94 mm; 4 ♀, 72—82 mm. TYPES.
$\frac{488}{10}$	Madras Coast.	'Investigator.'	1 ♂, 23·5 mm.
$\frac{5800}{9}$	Off Orissa Coast; 19° 49′ N., 86° 43′ E.	'Investigator.'	1 ♀, 81 mm.
$\frac{3077}{5}$	N.E. Bay of Bengal; 65 fms., 20° 18′ N., 90° 50′ E.	'Investigator.'	4 ♂, 19—59 mm.
$\frac{7519}{10}$	Persian Gulf; 35 fms., 26° 20′ 30″ N., 54° 52′ 30″ E.	'Investigator.'	1 ♀, 56 mm.

[*Squilla minor*, Jurich.]

1904. *Squilla minor*, Jurich, Stomatop. Deutsch. Tiefsee-Exped., p. 364, pl. xxv, figs. 4, 4*a*.

Allied, apparently, to the two preceding species is Jurich's *Squilla minor*, described from two extremely small specimens (16·5 and 19·5 mm. in length) from 50 metres near Zanzibar. According to the description and figures these examples differ from Brooks' adult *S. lata* in the following characteristics :—

1. There are no intermediate carinae on the carapace and no submedian carinae on any segment of the post-abdomen except the last.
2. The rostrum is much wider, a little broader than long.
3. The eyes are extremely large, their length being about one-third the length of the carapace and rostrum.
4. There is a prominent outstanding lobe at the proximal end of the external margin of the raptorial dactylus.
5. The spine on the ventral surface of the fifth thoracic somite is unusually well-developed; it extends outwards and is visible in dorsal view.
6. There are three or four submedian denticles on the telson and on either side of the median crest there is an oblique row of six short elevations which appear to correspond with the interspaces between the impressed lines in *S. lata*.

7. The lobe on the outer margin of the longer spine of the bifurcate process of the uropods is much larger.

Some at least of these features are such as one would expect to find in young post-larval *Squilla*, but it is, I believe, impossible to be certain of the relations of Jurich's species until adult specimens from the E. African Coast have been described.

11. Squilla armata, H. Milne-Edwards.

Plate II, figs. 28, 29.

1837. *Squilla armata*, H. Milne-Edwards, Hist. Nat. Crust., II, p. 521.
1849. *Squilla armata*, Nicolet, in Gay's Hist. fisica de Chile, Zool., III, p. 223.
1849. *Squilla armata*, De Haan, in Siebold's Fauna Japonica, Crust., p. 221.
1879 *Squilla armata*, Kirk, Trans. N. Zealand Inst., XI, p. 401.
1880. *Squilla armata*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 26.
1886. *Squilla armata*, Filhol, Miss. de l'ile Campbell, III, *2e*, p. 435.
1891. *Squilla armata*, Chilton, Trans. N. Zealand Inst., XXIII, p. 60.
1891. *Squilla armata*, A. Milne-Edwards, Mission à Cap Horn, VI, p. 53, pl. vii.
1894. *Squilla armata*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 515, figs. 9, 10.
1900. *Squilla armata*, Whitelegge, Mem. Australian Mus., IV, p. 199.
1902. *Squilla armata*, Stebbing, S. African Crust., II, p. 45.
1911. *Squilla armata*, Chilton, Trans. N. Zealand Inst., XLIII, p. 135, figs. 1, 2.
1911. *Squilla armata*, Chilton, Rec. Canterbury Mus., I, p. 306.

The dorsal surface is smooth. The breadth of the carapace is greater than half its median length; the median and intermediate carinae are entirely missing. The lateral carinae are distinct, but the marginals are only visible in the posterior quarter. The antero-lateral angles are produced to a short broad spine which reaches about to the level of the rostral base. The rostrum is about as long as wide; it has no dorsal carina and its lateral margins converge to a broadly rounded apex (fig. 28).

The dorsal processes of the ophthalmic somite differ noticeably from those of any other Indo-pacific species of the genus. They consist of a pair of sharp forwardly-directed spines widely separated from one another (fig. 28). The anterior edge of the ophthalmic somite terminates in two sharp points separated by a semicircular emargination. The cornea of the eyes is greatly expanded; its breadth is almost or quite equal to the length of the whole organ. The corneal and peduncular axes are oblique.

The mandibular palp is entirely absent.

The dorsal carina of the carpus of the raptorial claw terminates in a sharp tooth just behind the anterior margin (fig. 29). The dactylus bears seven, eight or nine (rarely six) teeth including the terminal one and its outer margin is convex with a small acute lobe at the base.

On the thoracic somites submedian and intermediate carinae are distinct. The lateral process of the fifth somite consists of a large tooth directed straightly outwards; the two spines on the inferior margin are distinct. The lateral margins of the two following somites are rounded in front, but posteriorly each is produced to an acute point.

On the abdominal somites the usual four pairs of carinae are well defined. The following terminate in spines:—

Carinae.	*Abdominal somites.*
Submedian	6
Intermediate	(1) (2), 3, 4, 5, 6.
Lateral	1, 2, 3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

In addition, on the posterior margin of the fifth abdominal somite between the submedian and intermediate carinae, there is a small group of one to four spines. These spines do not occur in any other species of *Squilla*.

The dorsal surface of the telson is finely rugose, but is otherwise almost smooth on either side of the median crest. Faint traces of symmetrical rows of pits are occasionally visible. The six marginal teeth are well developed and the submedian pair possesses movable tips. On the inner face of the submedian spines there is a broad lobe which is sometimes separated from the spine by an incision and so becomes a submedian denticle. The intermediate denticles vary in number from nine to twelve and there is one lateral. The praelateral denticle is absent.

The inner margin of the ventral process of the peduncular segment of the uropods is finely serrate. The lobe on the outer edge of the longer spine is large in the two specimens examined; but, according to Bigelow, is proportionately small in very large examples.

Both the individuals in the Indian Museum are female. According to Bigelow there are no marked secondary sexual differences.

Squilla armata seems to be an isolated form and does not appear to possess any close affinity with any other species of the genus.

The two specimens examined are registered as follows :—

$\frac{7228-9}{10}$ New Zealand. Chas. Chilton. 2 ♀, 64 and 80 mm.

The species is restricted to southern latitudes. It has been recorded from the Gulf of St. George on the Atlantic coast of Patagonia, from Cape Horn and from the Pacific coast of Patagonia and Chili (Milne-Edwards, Nicolet, Bigelow) and in these localities Bigelow notes that it is found between 51 and 122 fathoms. It is also known from New Zealand (Kirk, Chilton), from New South Wales (Whitelegge) and from S. Africa, off Cape Point Lighthouse, in 45 fathoms (Stebbing).

12. **Squilla scorpio**, Latreille.

Plate II, fig. 30.

1825. *Squilla scorpio*, Latreille, Encycl. Méthod, X, p. 472.
1837. *Squilla scorpio*, H. Milne-Edwards, Hist. Nat. Crust., II, p. 522.
1847. *Squilla scorpio*, White, List Crust. Brit. Mus., p. 84.
1849. *Squilla scorpio*, De Haan, in Siebold's Fauna Japonica, Crust., p. 221.
1880. *Squilla scorpio*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 18, pl. ii, fig. 7.
1892. *Squilla scorpio*, de Man, in Weber's Zool. Ergebn. Nied. Ost-Ind., II, p. 518.
1893. *Squilla scorpio*, Henderson, Trans. Linn. Soc. Zool. (2), V, p. 453.
1894. *Squilla scorpio*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 510.
1901. *Squilla scorpio*, Lanchester, Proc. Zool. Soc., II, p. 554.

The dorsal surface of the carapace is smooth and as a rule highly polished; the abdomen is very obscurely rugose. The breadth of the carapace, measured behind the antero-lateral angles, is barely half its length, excluding the rostrum. The median carina is distinct in front of the cervical groove (fig. 30), but is obsolete anteriorly. The small median dorsal pit is clearly visible and is placed nearer to the cervical groove than to the anterior margin. The intermediate carinae are well-marked; the lateral also are well-developed anteriorly and posteriorly, but are usually obsolete in the middle. The antero-lateral angles terminate in stout spines which, owing to the strong convexity of the anterior margin, fail to reach the level of the rostral base. Beneath each antero-lateral spine there is a small blunt or subacute lobe. The postero-lateral angles of the carapace are rounded.

The rostrum is a trifle longer than broad; its straight lateral margins are not upturned and converge to a rounded apex. Dorsally the rostrum is smooth except for a sharp and distinct median longitudinal carina in its distal half.

The eyes are small and elongated; the breath of the cornea is about equal to the length of the stalk (cornea excluded), and the corneal and peduncular axes are decidedly oblique. The antennular peduncle is short, scarcely two-thirds the length of the carapace. The two basal segments of the antennal endopodite are also short, the distal one not reaching to half the length of the scale. The mandibular palp is wholly absent.

The outer inferior margin of the merus of the raptorial claw is bluntly rounded anteriorly. The carpus bears the usual groove on its external aspect and its dorsal carina is entire and terminates acutely before reaching the distal margin. The distal end of the propodus is considerably broader in the male than in the female. The dactylus bears five teeth including the apical one. The outer margin is furnished with a small proximal lobe; it is convex in the male but distinctly sinuous in the female.

There are faint submedian and strong intermediate carinae on the last three thoracic somites. The fifth somite bears a pair of broad tooth-like lobes inferiorly; the lateral lobe consists of a single strong falcate process terminating in a sharp forwardly-directed spine. An oblique carina, which commences on the dorsal aspect of the somite in the position usually occupied by the intermediate carina, extends downwards and is continuous with the posterior margin of the process. The antero-lateral margins of the fifth somite are elevated and form a distinct ridge. The lateral margins of the sixth and seventh somites are rounded; the eighth projects as a blunt anterior lobe.

The first five abdominal somites possess four pairs of longitudinal carinae, but the submedians are not very strongly marked. The two median pairs of carinae on the sixth somite are distinctly swollen in the male. The following carinae end in spines:—

Carinae.	*Abdominal somites.*
Submedian	6.
Intermediate	5, 6.
Lateral	5, 6.
Marginal	(3) (4) 5, 6.

The telson has a well-marked median longitudinal carina which is usually obscurely notched at the base ; it terminates in a small spine overhanging a blunt tubercle. On either side of this carina the telson is smooth but, when examined with a lens, is seen to be very finely rugose, and occasionally faint traces of symmetrically arranged rows of pits are visible. On the margins, the submedian, intermediate and lateral teeth are well developed, as is also the small praelateral denticle ; each forms the termination of a short blunt carina. There are one or two submedian denticles, three to six intermediate and one lateral.

In the telson of the adult male the median carina, especially in its posterior half, and the carinae which abut on the marginal spines, are considerably more swollen than in the female, but the interspinous marginal areas are never dilated as they are in *S. gilesi* and some other species.

The bifurcate process from the base of the uropod is finely serrate internally. The inner spine is much longer than the outer and bears a prominent external lobe a little beyond its middle point.

Spirit specimens invariably possess a large and very distinct black patch on each lateral process of the fifth thoracic somite (fig. 30). There is also a black transverse patch on the second abdominal somite and a suffusion of the same colour at the distal end of the basal segment of the outer uropod.

Freshly preserved examples are pale in colour with a thin sprinkling of black chromatophores. The median and submedian carinae of the carapace, abdomen and telson are bright red. The eyes are black with a yellowish stalk. Frequently there is a row of four or five black spots on either side of the median crest of the telson ; and the swollen bases of the marginal teeth are dusky. The colouring noticed in spirit specimens is, of course, very distinct in fresh examples.

Most of the specimens of *Squilla scorpio* in the Indian Museum are referred to the var. *immaculata*. Only the following typical examples have been examined :—

$\frac{3092}{5}$	Madras.	(Purchased).	1 ♂ , 1 ♀ , 60 and 76 mm.
$\frac{7032-5}{10}$) $\frac{7459-61}{10}$)	Tuticorin, S. India ; 1 fm.	J. Hornell.	5 ♂ , 8 ♀ , 41—57 mm.
$\frac{7558}{5}$	Bombay.	Bombay Nat. Hist. Soc.	2 ♂ , 86 and 93 mm.
$\frac{3089}{5}$	Karachi ?	Karachi Museum.	1 ♀ , 97 mm.

I have also examined one other specimen kindly lent me by Mr. J. C. Moulton—

Tambak, Borneo.	Sarawak Museum.	1 ♀ , 90 mm.[1]

This species has been previously recorded from N. Australia (Miers) ; Celebes (de Man) ; the Malay Peninsula (Lanchester) ; Pondicherry (Latreille) and Madras (Henderson).

[1] In this specimen the right raptorial dactylus is malformed, doubtless owing to an injury. The teeth are twisted and distorted and are six in number.

var. **immaculata**, Wood-Mason, MS.

Plate II, fig. 31.

This form differs from typical *S. scorpio* in the entire absence of the black spot on the lateral processes of the fifth thoracic somite (fig. 31), and with this colour distinction the following minor structural differences are correlated :—

1. The rostrum is not longer than wide and its apex is rather broader than in typical specimens.
2. The median carina of the carapace is sharp and distinct for a longer distance in front of the mid-dorsal pit, but terminates more or less abruptly before reaching the anterior margin.
3. The lateral carinae of the carapace are usually distinct throughout their course.
4. The lateral margins of the sixth and seventh thoracic somites are slightly more upturned than in typical specimens and the process on the anterior part of the eighth somite is a trifle more acute.

The secondary sexual differences are as well marked as in the typical form.

The specimens in the Indian Museum are registered as follows :—

$\frac{3090}{5}$	E. of Terribles, Arakan Coast; 13 fms.	'Investigator.'	1 ♂, 48 mm.
$\frac{1317}{7}$	'Bay of Bengal.'	V. Ball.	1 ♂, 50 mm.
$\frac{3093}{5}$	'Calcutta.'	J. Wood-Mason and V. Ball.	8 ♂, 7 ♀, 41—95 mm.
$\frac{7531}{10}$	Pratapnagar, Calcutta.	B. L. Chaudhuri.	1 ♂, 87 mm.
$\frac{7784}{10}$	Ghaga Nata, Mutlah R. near Calcutta (brackish water).	S. B. Nath.	14 ♂, 8 ♀, 69—86 mm.
$\frac{7532}{10}$	Saugor I., M. of Hughli R.	J. Munro.	1 ♂, 87 mm.
$\frac{1407\text{-}9}{7}$	Hugli Estuary.	Mus. Collr.	2 ♂, 1 ♀, 51—64 mm.
$\frac{3091}{5}$	Port Canning, Ganges Delta.	R. D'Cruz.	1 ♀, 87 mm.
$\frac{7533}{10}$	Karachi.	(no history.)	1 ♂, 96 mm.
$\frac{7528}{10}$	(Locality unknown).		8 ♂, 8 ♀, 40—64 mm.

The variety has never been taken in company with typical examples. The specimen from Pratapnagar was found in brackish water and this was probably also the case with those labelled 'Calcutta.'

13. **Squilla mantoidea**, Bigelow.

1893. *Squilla mantoidea*, Bigelow, John Hopkins Univ. Circ., no. 106, p. 101.
1894. *Squilla mantoidea*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 521, figs. 13, 14.

Bigelow gives the following diagnosis of this species :—"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.'' For further details Bigelow's long and detailed description should be consulted.

Squilla mantoidea is probably, as Bigelow has suggested, a near ally of the Mediterranean *S. mantis* ; the mandibular palp, however, has not been examined. From all Indo-pacific species with a single lateral process on the fifth thoracic somite it is easily distinguished by (1) the sharp anteriorly-bifurcated carina of the carapace and (2) by the large eyes with the cornea set transversely on the stalk.

S. mantoidea is known only from a single specimen, a female 120 mm. in length, from Borneo (Bigelow).

14. Squilla leptosquilla, Brooks.

1886. *Squilla leptosquilla*, Brooks, Voy. H.M.S. 'Challenger,' XVI, Stomatop., p. 30, pl. i, figs. 1, 2.

1894. *Squilla leptosquilla*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 510.

1899. *Squilla leptosquilla*, Alcock and Anderson, Ann. Mag. Nat. Hist. (7), III, p. 292.

1904. *Squilla leptosquilla*, Jurich, Stomatop. deutsch. Tiefsee-Exped., VII, p. 370, pl. xxv, figs. 1, 2 (including var. *dentata*, p 372).

The dorsal surfaces of the carapace and abdomen are finely rugose, but when dried appear polished. The carapace measured behind the antero-lateral angles is considerably less than half its median length. The median carina is clear and distinct in front of the cervical groove, but is absent anteriorly for about half the distance in front of the small dorsal pit. The intermediate and lateral carinae are sharp and very conspicuous and the lateral margin is not angled posteriorly. Antero-laterally the carapace is produced as a short spine that reaches nearly as far as the level of the rostral base.

The rostrum is a trifle longer than wide and reaches to the base of the ophthalmic somite. The lateral margins, which are not upturned, are rounded and converge to a subacute apex. In the middle of the dorsal surface there is a short but distinct median longitudinal carina.

The eyes are rather small. The breadth of the cornea is about equal to the greatest length of the whole organ and the corneal and peduncular axes are very oblique. The antennular peduncle is as long as the rostrum and carapace combined. The two basal segments of the antennal endopodite are short and do not reach to half the length of the scale.

There is no palp on the mandible.

The outer inferior margin of the merus of the raptorial claw is broadly rounded. The carpus is grooved and ridged externally and the carina on its dorsal aspect is entire and terminates acutely close behind the distal margin. The outer end of the propodus is a little broader in the male than in the female and the pectinate margin is rather noticeably sinuous. The dactylus bears four slender teeth including the apical one and its outer margin is evenly convex in both sexes and projects as a small but prominent lobe near the articulation of the propodus.

The last four thoracic somites possess well-marked submedian and intermediate

carinae; the latter are very sharp on the anterior portions of the sixth and seventh somites and, in the fifth, are frequently produced as a small acute outstanding process. The fifth somite bears a pair of teeth on its inferior margin and, on each side, extends laterally as a single long and straight lobe, which ends acutely, but does not trend forwards as in many of the allied species. The lateral margins of the sixth and seventh somites consist of a single lobe, which is obliquely truncate and sinuous anteriorly and terminates posteriorly in a sharply acute point.

The abdominal somites are broad and greatly depressed. The first five possess eight well-marked longitudinal carinae and on each of them, except the first, a small but conspicuous transversely-grooved median tubercle is present. The last somite has six carinae and the spines that terminate the submedian and lateral pairs are very long, especially the latter. The complete spine formula is:—

Carinae.	*Abdominal somites.*
Submedian	6.
Intermediate	(1) 2, 3, 4, 5, 6.
Lateral	1, 2, 3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

The telson is very characteristic and shows little resemblance to that of any of the previously described species. Its peculiar appearance is due to the enormous development of the marginal and dorsal teeth, to the great elevation of the median carina and to the very deep incision between the submedian teeth. The form of the telson is moreover extremely broad and, if the marginal teeth are omitted, is only about half as long as wide. The dorsal carina is very high and very sharp, the basal notch is obsolete and the distal spine is strong and sharp, extending to fully half the length of the submedian teeth. The latter are quite two-thirds as long as the rest of the telson and are widely divergent posteriorly. On their inner margins they bear from ten to eighteen minute spinules, which are closely set proximally. The intermediate teeth are even longer than the submedian and are somewhat inturned, especially in the male; there are nine to twelve intermediate denticles, one or two of which are frequently situated on the outer margin of the submedian spines. In the female there is a small lateral denticle and the lateral tooth is long, reaching nearly to half the length of the intermediate. In the male the lateral tooth is short and greatly swollen at the base, completely obscuring the lateral denticle. There is also, in this sex, a well-marked swelling at the base of the intermediate teeth and this extends inwards along the interspinous margin. The mid-dorsal carina is not dilated in the male. The post-anal carina is short but distinct.

The bifurcate prolongation from the base of the outer uropod is composed of two very long and slender spines. The inner, which does not greatly exceed the outer, is very nearly half the length of the entire segment and bears in the distal third of its external margin only a minute rudiment of the usual lateral lobe. The outer uropod is not more than two and a half times as long as wide in the adult male; in a female of the same length it is much narrower, about three times as long as wide.

Two female specimens have the denticles on the telson arranged as in Jurich's

var. *dentata* ; another is on one side typical and on the other of the *dentata* form. The differences do not, in my opinion, deserve the distinction of a varietal name.

In spirit specimens light chestnut brown colouration defines all the carinae of the carapace and the submedian and intermediate carinae of the abdomen. There are also in some specimens rather conspicuous brown markings on each of the abdominal somites between the intermediate and lateral carinae. On either side of the median carina of the telson there is a large and conspicuous, oval, chestnut brown spot : the two are confluent posteriorly beneath the base of the distal spine.

There are five specimens in the Indian Museum, registered as follows :—

$\frac{2311-5}{10}$ $\frac{2615-6}{10}$	N. W. of Andamans.	13°17′15″ N., 93°10′25″ E. 185 fms. / 14°13′ N., 93°40′ E. 370—419 fms.	'Investigator.' 2 ♂, 2 ♀, 68—131 mm.
$\frac{6932}{9}$	S. of Port Blair, Andamans.	188—220 fms., 11°31′40″ N., 92°46′40″ E.	'Investigator.' 1 ♀, 89 mm.

S. leptosquilla has also been recorded from the Celebes sea near the Philippine Is., 115 fathoms (Brooks), and from the vicinity of the Nicobars, 296 metres (Jurich).

15 **Squilla tenuispinis**, Wood-Mason.

Plate III, figs. 32—34.

1891. *Squilla tenuispinis*, Wood-Mason, Ann. Mag. Nat. Hist. (6), VII, p. 271.
1894. *Squilla tenuispinis*, Alcock, Ann. Mag. Nat. Hist. (6), XIII, p. 409.

This species is very closely allied to *S. leptosquilla*, but may be distinguished from it by the following characters :—

1. The dorsal surfaces of the carapace and abdomen are smooth, polished and without trace of rugosity.
2. The median carina of the carapace is obsolete and is entirely absent in front of the small dorsal pit (fig. 32).
3. The intermediate carinae of the carapace are completely absent and the laterals are only visible in the extreme posterior part of the carapace (fig. 32[1]).
4. The rostrum only reaches to three-quarters the length of the antennular somite. It is broader than long, bluntly rounded anteriorly, and shows only the faintest indications of a median carina.
5. The eyestalks are rather more swollen.
6. The lateral process of the fifth thoracic somite trends obliquely forwards.
7. The telson is rather broader and the mid-dorsal carina is much less elevated (figs. 33, 34).

Several male specimens of comparatively large size were examined, but the margins of the telson are not nearly as strongly swollen as in large *S. leptosquilla* of the same

[1] The figure is erroneous in showing intermediate carinae on the carapace. Anterior to the cervical groove the regions external to the gastric grooves are evenly rounded; only at the extreme posterior end of the indicated carina is there the faintest trace of a keel. The median carina, also, does not extend as far forwards as is shown.

sex and the lateral tooth though shorter and stouter than in the female is much longer. There are ten to fourteen fine submedian denticles, nine to twelve intermediate and one lateral. The spines on the abdominal somites have the same distribution as in *S. leptosquilla* and, as in that species, there is no mandibular palp and the dactylus of the raptorial claw bears four teeth including the apical one.

The preserved specimens show no trace of colour; the large brown spots on the telson, which are invariably found in *S. leptosquilla*, seem to be absent. Wood-Mason remarks that the colour in life is deep pink.

There are eleven specimens in the Indian Museum registered thus :—

$\frac{5801}{9}$	Off Ganjam Coast, Madras; 98—102 fms., 18°40′ N., 84°46′ E.	'Investigator.' 1 ♂, 62 mm. TYPE.
$\frac{3081}{5}$	Off Cheduba, Arakan Coast, Burma.	'Investigator.' 1 ♀, 35 mm. TYPE.
$\frac{7033\text{-}4}{9}$	Off Masulipatam, Madras; 95 fms., 15°56′20″ N., 81°26′10″ E.	'Investigator.' 2 ♂, 45, 46 mm.
$\frac{6934}{9}$	Off Masulipatam, Madras; 240 fms., 15°56′50″ N., 81°30′30″ E.	'Investigator.' 1 ♂, 37·5 mm.
$\frac{7534}{10}$	Off Nellore Coast, Madras; 112 fms., 14°5′55″ N., 80°20′50″ E.	'Investigator.' 3 ♂, 2 ♀, 41—58 mm.
$\frac{6933}{9}$	Off Andaman Is.; 188—220 fms., 11°31′40″ N., 92°46′40″ E.	'Investigator.' 1 ♀, 50 mm.

Only the above specimens are known.

16. Squilla laevis, Hess.

Plate III, figs. 35—37.

1865. *Squilla laevis*, Hess, Arch. f. Naturgesch., XXXI, i, p. 170, pl. vii, fig. 22.
1887. *Squilla laevis*, de Man, Zool. Jahrb., Syst., II, p. 715.
1894. *Squilla laevis*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 511.
1898. *Squilla laevis*, Stead, Zoologist (4), II, p. 211.

The carapace is smooth or very feebly rugose and its breadth behind the antero-lateral spines is more than half its median length, including the rostrum. The lateral margin is concave and is produced to a blunt angular point immediately in front of the rounded postero-lateral angles. The median carina is distinct[1] and is anteriorly bifurcated for about one-fifth its length anterior to the well-marked cervical groove (fig. 35). The small mid-dorsal pit is conspicuous, as are also the intermediate and lateral carinae. The rostrum is subquadrate, considerably wider than long; its lateral margins converge to the rounded antero-lateral angles and the distal edge is truncate or broadly convex. Dorsally it bears a sharp carina in its distal half and a pair of other carinae running close to the lateral margins.

The cornea of the eye is wider than the stalk and is set obliquely on it; its breadth is clearly less than the whole length of the organ. The ophthalmic somite projects between the base of the eyestalks in the form of a very prominent subquad-

[1] Except in a large male specimen in which it is worn away and obsolescent.

rate lobe which is slightly emarginate at the apex (fig. 35). The antennular peduncle is shorter than the median length of the carapace, excluding the rostrum. The mandibular palp is entirely missing.

The outer inferior margin of the merus of the raptorial claw (fig. 36) is bluntly rectangular at its distal extremity. The carpus is deeply grooved externally and the dorsal carina, which is high and entire, terminates abruptly before reaching the anterior edge. The propodus possesses three movable spines at the base of its pectinate margin and the opposite or inferior edge is, in both sexes, remarkable for its sharp carina which is produced as a stout tooth at the distal end; this tooth is not found in any other species of *Squilla*. The dactylus itself is convex or feebly sinuous externally and on its inner margin bears six curved teeth including the apical one (fig. 36).

The dorsal surfaces of the exposed thoracic somites and abdomen are finely rugose. The lateral margin of the fifth thoracic somite consists of a sharp anterior forwardly-curved spine and a posterior lobe which is rather narrowly rounded at the apex. In the possession of a bilobed margin on this somite, *S. laevis*, along with fifteen other species hereinafter described, differs conspicuously from any of the forms previously mentioned. The pair of inferior spines found in most of the preceding species is entirely absent. The lateral processes of the two succeeding somites are composed of a single lobe, obliquely truncate in front and terminating in an acute but non-spinous postero-lateral angle. The eighth somite is provided with a sharp antero-lateral tooth (figs. 35, 37). The spines on the abdomen are disposed as follows:—

Carinae.	*Abdominal somites.*
Submedian	5, 6.
Intermediate	5, 6.
Lateral	(3) 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

The median carina of the telson is only very feebly notched at the base and the symmetrical rows of pits are distinct on either side. There are two or three submedian denticles, six to eight intermediate and one lateral. There is a carina at the base of each marginal tooth and the carina which runs along the lateral edge of the telson, in its anterior third, ends in a blunt praelateral denticle. There is no post-anal carina.

The inner spine of the bifurcate process of the uropod is twice the length of the outer and bears a small lobe on its outer edge just behind its middle point. The basal segment of the exopod is only a trifle longer than the ultimate segment and bears seven movable spines on its external margin.

Secondary sexual distinctions are slight. In the adult male the raptorial propodus is slightly more dilated than in the female; and the dactylus in the former sex is of a rather more clumsy build and has shorter and stouter teeth.

The preserved specimens show no characteristic colouration

There are five examples of the species in the Indian Museum:—

$\frac{7328-30}{10}$	New South Wales.	D. G. Stead.	3 ♂; 91—119 mm.
$\frac{7511-2}{10}$	Port Jackson, New South Wales.	Australian Museum.	2 ♀, 99 and 105 mm.

Squilla laevis is at present only known from the coasts of New South Wales; it has been recorded from Port Jackson (Stead) and Sydney (Hess).

17. Squilla hieroglyphica, Kemp.

Plate III, figs. 38—41.

1911. *Squilla hieroglyphica*, Kemp, Rec. Ind. Mus., VI, p. 96.

This species is closely allied to the preceding, but differs from it in the following characters :—

1. The median carina of the carapace is distinct in front of the small mid-dorsal pit, but the anterior bifurcated part is entirely absent. The lateral margins are not angled in front of the rounded postero-lateral corners and the anterior width is only about half the median length, including the rostrum (fig. 38).
2. The rostrum is as long as wide and its strongly convergent lateral margins meet in a narrow rounded apex. In its carination it resembles that of *S. laevis* (fig. 38).
3. The cornea of the eyes is set transversely on the stalk. The anterior margin of the ophthalmic somite is broadly convex and does not project as a prominent lobe between the base of the eyestalks (fig. 38).
4. The propodus of the raptorial claw does not possess a spine at the distal end of its inferior margin. The dactylus is armed with only five teeth including the terminal one (fig. 39).
5. The anterior lateral process of the fifth thoracic somite is broader and shorter, and the posterior process of this somite and the lateral margins of the two succeeding somites are more broadly rounded. The lateral portions project almost horizontally outwards and do not reach downwards as much as in the preceding species ; this feature, taken in conjunction with the slightly greater proportional length of the free thoracic somites, is responsible for the widely different aspect of these parts in lateral view (*cf.* fig. $37 \times 1\frac{1}{2}$ and fig. 40×5).
6. The following abdominal carinae end in spines :—

Carinae.	*Abdominal somites.*
Submedian	5, 6.
Intermediate	4, 5, 6.
Lateral	3, 4, 5, 6.
Marginal	2, 3, 4, 5.

7. On the telson there are five submedian denticles, ten to twelve intermediate and one lateral. There is no praelateral denticle. On the ventral surface there is a sharp and long post-anal carina (fig. 41).
8. There are eight or nine movable spines on the outer margin of the basal joint of the exopodite of the uropod.

The mandibular palp, as in *S. laevis*, is entirely missing.

The unique example of *S. hieroglyphica* is of a dark yellow colour and appears to have been preserved in spirit for many years ; jet-black markings are, however, distinct and on the telson seem to be quite characteristic. The surface of the carapace and abdomen is very sparsely covered with large black chromatophores which are aggregated and sharply define the outer margins and median carina of the rostrum, the anterior portion of the gastric groove and the posterior margin of the segments of

the post-abdomen except the first and last. There are three prominent spots arranged in the form of a triangle on each eyestalk. The peculiar arrangement of the chromatophores on either side of the telson is shown in fig. 41 ; it differs entirely from that seen in any other species.

The solitary specimen ($\frac{7327}{10}$) is a female 53 mm. in length. Unfortunately no information concerning the locality at which it was taken is available, though there can be little doubt that it was found within the area with which this paper is concerned.

18. Squilla quinquedentata[1], Brooks.

1886. *Squilla quinquedentata*, Brooks, Voy. H.M.S. 'Challenger,' XVI, Stomatop., p. 26, pl. i, fig. 3, pl. ii, fig. 6.

1894. *Squilla quinquedentata*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 511.

The surface of the carapace is smooth, highly polished and very finely punctate. The abdomen also presents a polished appearance, but is rather more coarsely pitted.

The breadth of the carapace, measured behind the antero-lateral angles, is about half its length excluding the rostrum. The median carina is well-marked in front of the cervical groove. Anterior to the small dorsal pit it is distinct for a distance equal to the length of the rostrum, but of the anterior bifurcated portion only the faintest traces exist. Behind the cervical groove the median carina is sharp ; it is bifurcated for the greater part of its length and ends posteriorly in a prominent rounded tubercle. The intermediate and lateral carinae are well developed. The antero-lateral angles are produced to short spines that barely reach to the level of the rostral articulation ; the posterior angles are sharply rounded.

The rostrum is subquadrate, longer than wide, with its upturned lateral margins only very slightly convergent. Dorsally it is finely punctate and bears a smooth, flat, median tubercle.

The eyes are not large; the breadth of the cornea is about equal to the total length and is not more than one-fifth the length of the carapace. The corneal and peduncular axes are very slightly oblique and the stalk is somewhat dilated externally. The anterior margin of the ophthalmic somite is evenly convex. The antennular peduncle is shorter than the carapace excluding the rostrum. The mandibular palp consists of three segments.

The merus of the raptorial claw is armed with a stout spine at the end of its outer inferior margin. The carpus is grooved and ridged externally and the dorsal carina is entire and terminates abruptly before reaching the anterior edge. The propodus is not broadened distally in the adult male. The dactylus is armed with five teeth including the apical one ; the external margin is rather strongly sinuous and is very obtusely angled near its basal articulation.

Submedian and intermediate carinae are distinct on the last three thoracic somites. The lateral margins of the fifth somite are bilobed ; the anterior lobe consists of a sharp forwardly-directed spine, the posterior is shorter and subacute. There are no inferior spines on this somite. The sixth and seventh somites are also bilobed later-

[1] See addendum, p. 195.

ally; in each the posterior lobe is acute and very much broader than the anterior. In the sixth somite the anterior lobe is narrow, acute, and a trifle shorter than the posterior; in the seventh it is very short and bluntly rounded. The lateral process on the anterior part of the eighth somite is sharply acute.

There are, as usual, four pairs of longitudinal carinae on the first five abdominal somites and three on the last, and on all the somites except the first and the sixth there is a small transversely-grooved median tubercle. The following carinae end in spines:—

Carinae.	*Abdominal somites.*
Submedian	5, 6.
Intermediate	4, 5, 6.
Lateral	4, 5, 6.
Marginal	1, 2, 3, 4, 5.

The median carina of the telson is well marked; it is obscurely notched at the base and terminates in a sharp spine overhanging a small tubercle. The dorsal surface on either side is finely rugose and is impressed with a number of parallel and oblique rows of pits. These are sometimes confluent and form distinct grooves. The six marginal teeth are well developed, the intermediate pair being sometimes slightly inturned. The praelateral denticle is distinct and at its base and at the base of each of the teeth there is a short rounded carina. There are three submedian denticles, seven or eight intermediate and one lateral. The post-anal carina is well developed.

The bifurcate process from the base of the uropods is finely serrate along its inner margin. The inner spine is about twice the length of the outer and bears a prominent external lobe near its middle point.

The two male specimens do not show any marked secondary sexual modifications.

This species bears a strong superficial resemblance to *S. wood-masoni*, but may at once be distinguished from it and from all other species of the *oratoria* group by the form of the eyes and by the number of teeth on the raptorial dactylus.

As in the specimen described and figured by Brooks there is a well-defined dark patch of colour at either end of the median ridge of the telson. In one of the Indian specimens the posterior margins of the post-abdominal segments are defined by black pigment and, in addition, in the posterior part of each somite except the first and last, there is a dark patch which extends laterally as far as the longitudinal grooves between the submedian and intermediate carinae. There is also on each of the first five abdominal somites a dark sinuous line immediately above the lateral carinae.

There are two specimens of *S. quinquedentata* in the Indian Museum—

$\frac{7535}{10}$	Bombay.	Bombay Nat. Hist. Soc.	1 ♂, 103 mm.
$\frac{7520}{10}$	Balasore Bay, Orissa coast; 15 fms.	'Golden Crown.'	1 ♂, *ca.* 115 mm. (damaged).

Hitherto this species was known only from the type specimen, a male 136 mm. in length, found by the 'Challenger' Expedition in the Arafura Sea, south of New Guinea, in 28 fathoms.

19. Squilla gonypetes, Wood-Mason, MS.

Plate IV, figs. 42—44.

1893. *Squilla affinis*, Pocock, Ann. Mag. Nat. Hist. (6), XI, p. 474 (*partim*).
1908. *Squilla gonypetes*, Lloyd, Rec. Ind. Mus., II, p. 33 (*sine desc.*).
1911. *Squilla gonypetes*, Kemp, Rec. Ind. Mus., VI, p. 96.

This species is very closely allied to *S. quinquedentata* but may be distinguished by the following characters :—

1. The rostrum is distinctly longer and its upturned lateral margins are rather more strongly convergent.
2. The eyes are larger, the breadth of the cornea is about one quarter the length of the carapace and the corneal and peduncular axes are strongly oblique (fig. 42).
3. The antennular peduncle is a little longer than the carapace excluding the rostrum.
4. The outer inferior margin of the merus of the raptorial claw is not produced as a spine ; the external margin of the dactylus shows only the very feeblest traces of sinuation (fig. 43).
5. The lateral lobes of the sixth thoracic somite are about equal in length ; the anterior one is apically truncate and is not very much narrower than the posterior which terminates acutely. Both lobes of the seventh somite are acute, the anterior being more than half the length of the posterior (fig. 42).
6. There are more spines on the abdominal somites. The following carinae end in spines :—

Carinae.	*Abdominal somites.*
Submedian	5, 6.
Intermediate	3, 4, 5, 6.
Lateral	2, 3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

In respect of the punctuation and carination of the carapace and abdomen and in the number of teeth on the raptorial dactylus, this species bears the closest resemblance to *S. quinquedentata* and, like it, possesses a three-segmented mandibular palp.

The telson (fig. 44) also is closely similar, but the marginal teeth are longer and the outermost submedian denticle is often distinctly larger than any of the rest. The lobe on the outer aspect of the longer spine of the uropodal process is rather unusually prominent. There are three or four submedian denticles, six or seven intermediate and one lateral.

Though so nearly allied to *S. quinquedentata*, there is, I believe, no doubt that *S. gonypetes* is a distinct species. The greater obliquity of the corneal portion of the eyes and the different form of the lobes on the margins of the thoracic somites are characters which preclude the suggestion that the specimens are merely young examples of the form described by Brooks.[1]

[1] Among the species belonging to the *S. oratoria* group it is noticeable that in very young specimens

The colouring of the telson is much the same as in the preceding species, but that of the abdomen is different. The proximal half of the second abdominal somite bears a prominent transverse black patch extending laterally as far as the sinuous groove between the submedian and intermediate carinae and there is also, on the posterior half of the fifth abdominal somite external to each submedian carina, a large well defined quadrate black spot (fig. 44).

Four specimens in the Indian Museum agree in possessing the above characters :—

$\frac{3476}{10}$	Off Andaman Is.; 60 fms.	'Investigator.'	1 ♂, 56 mm.; 1 ♀, 36 mm. TYPES.
$\frac{3359}{7}$	Off Cheduba, Arakan Coast; 7 fms.	'Investigator.'	1 ♂, 49 mm.
$\frac{4421}{10}$	Persian Gulf; 47 fms., 26°24′ N., 56°2′ E.	'Investigator.'	1 ♀, 26 mm.

I also refer to this species a single specimen which differs from the rest in having the anterior bifurcated part of the rostrum fine but distinct, and absent at the point of junction with the single posterior part of the carina (as in *S. interrupta*) ; the rostrum also is subtriangular, the margins distinctly more convergent than in typical *gonypetes* and the intermediate carinae of the third and the laterals of the fourth abdominal somites do not terminate in spines. In other respects the specimen bears the closest resemblance to those listed above.

$\frac{7536}{10}$	Off Vizagapatam Coast, Madras; 20 fms.	'Investigator.'	1 ♀, 47 mm.

Two specimens from the British Museum collection (recorded by Pocock under the name of *Squilla affinis*) have also been examined, and one, which is identified with some doubt, kindly lent by Mr. A. Patience :—

Holothuria Bank, China Seas, 53 fms.	H.M.S. 'Penguin.'	2 ♀, 25 and 37 mm.
Mergui Archipelago.	Simpson and Rudmose Brown.	1, 33 mm.

Two of these three specimens have lost their raptorial claws and in them the median carina of the carapace resembles that of the example from the Madras Coast. The other individual (China Seas, 25 mm.) is perfect and is quite typical.

20. Squilla boops, Kemp.

Plate IV, figs. 45—47.

1911. (May) *Squilla boops*, Kemp (*sphalm. boopis*), Rec. Ind. Mus., VI, p. 97.
1911. (August) *Squilla quadraticauda*, Fukuda, Annot. Zool. Japon., VII, p. 287, pl. xi, figs. 3—5.
1911.[1] *Squilla quadraticauda*, Fukuda, Döbuts. Z. Tokyo, XXIII, p. 174, fig. 1.

This very distinct species may be readily distinguished from both the preceding by the following characters :—

1. The rostrum bears a sharp median longitudinal carina.
2. The eyes (fig. 45) are enormously swollen and expanded ; the breadth of the cornea is considerably more than one-third the length of the carapace and

the cornea of the eye is a trifle more transversely placed than in adults, while there is very little difference in the form of the thoracic lobes.

[1] I have not seen this publication and have no knowledge of the precise date at which it was issued. The paper is, I believe, in the Japanese language.

there is a prominent lobe on the external aspect of the eyestalk. The corneal and peduncular axes are very oblique.

3. The antero-lateral angles of the carapace are produced as acute points which project outwards and downwards, scarcely reaching at all forwards beyond the adjacent anterior margin.
4. The lateral processes of the fifth thoracic somite consist of a sharp and very slender anterior spine, which is oblique but is not strongly curved forwards as in most allied species, and a very short acute posterior process. The anterior process of the sixth somite has the form of a very small acute lobe which at its base is not more than one-fifth the width of the broad but acute posterior process. The seventh somite is not bilobed laterally but is angled acutely behind and rectangularly in front (fig. 45).

For the rest the principal characters of the species are as follows :—

The whole surface of the carapace and abdomen is smooth, highly polished and without trace of punctuation. The carapace is broad anteriorly; its breadth measured behind the antero-lateral angles greatly exceeds half its length, including the rostrum. The median carina is entirely absent in front of the small dorsal pit but otherwise resembles that of *S. quinquedentata*. The lateral and intermediate carinae are well marked. The rostrum is broader than long and its upturned lateral margins converge to a broad, evenly rounded apex. The anterior margin of the ophthalmic somite is sharply pointed between the base of the eyestalks. The antennular peduncle is about as long as the carapace.

The outer inferior margin of the merus of the raptorial claw (fig. 46) is distally rounded. The dorsal carina of the carpus is high and terminates in a strong lobe-like tooth behind which a minute tubercle is visible. The dactylus, as in the two preceding species, possesses five teeth including the apical one ; the outer margin is very feebly sinuous and is produced almost rectangularly near its articulation with the propodus (fig. 46).

The submedian carinae are rather faint on the abdomen and on the free thoracic somites are semi-obsolete. The intermediate carinae are distinct on the thoracic and abdominal somites. The following abdominal carinae end in spines :—

Carinae.	*Abdominal somites.*
Submedian	5, 6
Intermediate	2, 3, 4, 5, 6.
Lateral	1, 2, 3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

The telson is almost precisely similar to that of *S. quinquedentata*, but the teeth are rather longer and the intermediate pair, in the type specimen, are not inturned. There are three or four submedian denticles, eight intermediate and one lateral (fig. 47).

All the median parts of the carapace, abdomen and telson are covered with very small grey chromatophores. These are not sufficiently crowded to detract from the general yellowish appearance of the spirit specimen, but are closely aggregated and form faint transverse lines at the posterior margins of the abdominal and last three

thoracic somites. The posterior half of the fifth abdominal somite between the marginal and lateral carinae and the outer posterior angles of the sixth somite are black.

The only differences that I have been able to detect between the specimen which Fukuda has described under the name of *Squilla quadraticauda* and the type of *S. boops* are that in the former example the rostrum is more triangular in outline, the intermediate carinae of the second and the lateral carinae of the first abdominal somites do not end in spines, and the submedian pair of marginal spines of the telson are more divergent and the intermediate pair more convergent. Also, according to Fukuda's figure, the anterior margin of the ophthalmic somite is not pointed in the Japanese individual, the antennular peduncle is longer and the teeth of the raptorial dactylus shorter.

Fukuda's specimen is much smaller than that from Indian waters and some of the differences noticed may be merely growth-stages. The Japanese example may possibly represent a distinct variety, but there can be little doubt that both individuals must be referred to a single species.

$\frac{1710}{10}$ Gulf of Martaban, Burma; 67 fms. 14°26′ N., 96°23′ E. 'Investigator.' 1 ♀, 89 mm. TYPE.

The example described by Fukuda under the name of *S. quadraticauda* is a female, 40 mm. in length. It was obtained at Matsuwa, Sagami Province, Japan.

THE SPECIES OF THE *S. NEPA* GROUP.

This group may be briefly defined as containing those species of *Squilla* which have a series of fine pectinations along the upper edge of the propodus of the raptorial claw, six teeth on the raptorial dactylus (including the terminal one), bilobed lateral margins to the fifth and sixth thoracic somites and eight longitudinal carinae on the first five segments of the abdomen.

Until comparatively recently all the species which agreed in the above characters were included under a single specific name, *Squilla nepa*. Bigelow, however, in 1894, redefined Berthold's *S. affinis* (=*S. oratoria*, De Haan) and pointed out the features by which it might be distinguished from *S. nepa*. Shortly afterwards two other species, *S. foveolata* and *S. stridulans*, were described by Wood-Mason and during the last few years Nobili and Balss have insisted on the claims of Kossmann's *S. massavensis* to specific recognition.

But even now, the characters of some of the forms are very imperfectly known, and in examining the material at my disposal I have been led to describe three new species and one new variety, all of which appear to be far from uncommon in Indo-pacific waters. Fortunately, I am able to introduce these new forms with a very considerable degree of confidence. This is due in the first place to the large and valuable series of specimens in the Indian Museum and secondly to the numerous examples from other sources which I have been able to examine. In particular, mention must be made of the fine series kindly lent by the Trustees of the British Museum. This collection, which contains numbers of specimens recorded by Miers, Brooks, Henderson and Pocock, has enabled me to trace the synonymy of some of the species in a way that

would otherwise have been impossible and has proved of inestimable value in checking and correcting the preliminary results arrived at from a study of the material in the Indian Museum. Moreover, coming as they do from many widely distant localities, I have been able to obtain a very good estimate of the distribution of the various forms. In all nearly 800 specimens have been examined.

To many, the characters of the species which I have described below will appear extremely trivial, and it must be admitted that much more work is necessary before their exact relations can be decided in a really satisfactory manner. The point, however, which I specially desire to emphasize, which has been more and more impressed upon me as additional collections came under examination, is that in Indian waters there exist seven perfectly distinct forms that may always be separated from one another with the greatest facility. Four of these, which I have called *S. oratoria* var. *perpensa*, *S. interrupta*, *S. wood-masoni* and *S. massavensis*, are very close allies of *S. oratoria*, *s.s.*, a species which does not seem to occur in its typical form westwards of the Philippines. Some will perhaps be inclined to regard them as varieties or subspecies, but this is a point of little moment so long as their structure and distribution are understood.

It is only with great difficulty that young specimens (sometimes as much as 40 mm. in length) can be determined. In several cases I have been obliged to defer any attempt at precise identification, but I do not doubt that if sufficiently extensive series were available it would be possible to separate the different forms in a satisfactory manner at all stages.

I have found myself unable to determine the precise position of the form which Nobili recognized under the name *Squilla affinis* var. *intermedia*.[1] The original specimens were obtained at Nias and Singapore and, on comparing them with '*S. affinis*'[2] from the latter locality, Nobili notes that the external margin of the raptorial dactylus is more strongly sinuous and the eyes a little smaller. The dorsal carina of the carpus of the raptorial claw is without tubercles. It is possible, and even probable, that the form will prove identical with one of those described in this paper,[3] but without knowledge of the characters afforded by the median carina of the carapace, by the lateral lobes of the free thoracic somites, and by the basal process of the uropods, no satisfactory conclusions can be reached. I have tried to obtain a loan of the original specimens, but have been unable to discover where they are preserved.

21. Squilla foveolata, Wood-Mason.

Plate IV, fig. 48.

1895. *Squilla foveolata*, Wood-Mason, Figs. and Desc. of nine Squillidae, p. 2, pl. ii, fig. 1.

The dorsal surface of the carapace and abdomen is very coarsely and deeply impressed. This is specially marked on the antero-lateral parts of the carapace and

[1] Nobili, Boll. Mus. Torino, XVIII, 1903, No. 455, p. 39.

[2] These specimens are perhaps *Squilla oratoria* var. *perpensa* and *S. interrupta*.

[3] As a specific name *intermedia* is preoccupied by Bigelow's *S. intermedia* from the American Coast.

over all the median portions of the carapace and abdomen. On these areas the punctuation is so coarse and so close that the surface stands up as a sharp mesh-like reticulation which obscures the median and submedian carinae (fig. 48).

The breadth of the carapace measured behind the antero-lateral angles is about half its length, excluding the rostrum. The median carina, which owing to the reticulation of the surface can only be traced with difficulty, extends throughout the length of the carapace and is bifurcated anteriorly for about half its length in front of the small but distinct dorsal pit; it is also deeply bifurcate posterior to the sharply-defined cervical groove. The lateral and intermediate carinae are more distinct. The antero-lateral angles are produced as sharp spines that fail to reach the level of the rostral base and the lateral margins are obtusely angled in front of the postero-lateral corners.

The rostrum is fully as broad as long and its lateral margins are upturned and converge to an evenly rounded extremity. The dorsal surface is rugose and bears a sharp median carina in its anterior two-thirds.

The eyes are very small. The cornea is about as wide as the basal portion of the stalk and the internal margin of the latter is dilated and ridged. The corneal and peduncular axes are very slightly oblique.[1] The ophthalmic somite is produced anteriorly as a short rectangular process between the bases of the eyestalks. The antennular peduncle is unusually long, greatly exceeding the combined length of the carapace and rostrum. The dorsal processes of the antennular somite are pitted and reticulate dorsally. The mandibular palp is present and is composed of three segments.

The outer inferior edge of the merus of the raptorial claw is pitted externally and is distally rounded. There are two parallel and connected ridges forming an H-figure on the outer aspect of the carpus. The dorsal carina is entire and terminates abruptly before reaching the anterior margin. The propodus bears the usual three movable spines and the row of pectinations on the margin opposed to the dactylus. The latter is provided with six slender teeth including the apical one and the external margin, which shows only the faintest traces of sinuation, is bluntly angled proximally.

The last three thoracic somites (fig. 48) are furnished with submedian and intermediate carinae, the former being very indistinct. The lateral margin of the fifth somite is deeply bifurcated and consists of two subequal spines, the anterior of which is sharper and situated on a lower plane than the posterior and points almost straight forwards. The sixth thoracic somite is deeply bilobed laterally; the lobes are greatly expanded, coarsely pitted and are of about equal length and breadth: the anterior is distally truncate while the posterior is rounded at the apex. In the seventh somite

[1] The eye in *S. foveolata* is very peculiar. In other species of *Squilla* the long axis of the cornea is usually in the same plane as the longest transverse axis of the stalk, but in the present case the cornea is twisted and its inner end is, in relation to the stalk, subdorsal. The cornea, as mentioned above, is set rather obliquely on the stalk; but this obliquity is the reverse of that found in most other species, for the inner margin of the stalk is a trifle shorter than the outer.

the anterior process is acute and is much shorter and narrower than the rounded posterior one (fig. 48).

Four pairs of longitudinal carinae are present on the first five abdominal somites and three pairs on the sixth. The submedians, on all except the last somite, are almost lost in the coarse reticulation of the surface. There is an obscure median tubercle on the 2nd, 3rd, 4th and 5th somites.

The following carinae end in spines :—

Carinae.	*Abdominal somites.*
Submedian	(3), 4, 5, 6.
Intermediate	(3), 4, 5, 6.
Lateral	(2), 3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

The telson is considerably longer than broad. The median carina is not notched at the base and terminates in a short spine which overhangs a small tubercle. On either side the surface is finely rugose; it bears a longitudinal line of small tubercle and beyond this several oblique rows of symmetrically-disposed pits leading to the interspaces of the intermediate denticles. These pits are very deep and often confluent so that the spaces between them are well defined and appear as blunt ridges. Six sharp marginal teeth are present, each of which forms the termination of a sharp dorsal carina. There is no praelateral denticle. There are three (rarely two) submedian denticles, six to eight intermediate and one lateral. The post-anal crest is often broken up into a number of irregular tubercles.

The bifurcate process from the base of the uropod is finely serrate internally. The inner spine is nearly twice the length of the outer and bears externally, at about its middle point, a prominent rounded lobe. The paddle or outer segment of the exopodite is distinctly shorter than the basal segment.

The preserved Indian specimens of *S. foveolata* show no trace of their original colour; the Chinese examples are of a uniform blue-green tone.

This beautifully sculptured species appears to be very rare. Nine specimens from the following localities are in the Indian Museum :—

$\frac{3332}{9}$	Hongkong.	G. Dennys.	1 ♂, 6 ♀, 77—108 mm.
			TYPES.
$\frac{7705}{6}$	Yé River entrance, Tennasserim, Burma.	'Investigator.'	1 ♀, 76 mm.
$\frac{3454}{10}$	Off Amherst I., Tennasserim, Burma.	'Investigator.'	1 ♀, 67 mm.

Only the above specimens are known.

22. Squilla nepa, Latreille[1] (Bigelow)

Plate IV, fig. 49.

1825. *Squilla nepa*, Latreille, Encycl. Méthod., X, p. 471.
1845. *Squilla nepa*, Berthold, Abhandl. Gess. Wiss. Göttingen, III, p. 29, pl. iii, figs. 3-5.
1849. *Squilla nepa*, De Haan, in Siebold's Fauna Japonica, Crust., p. 221.
1861. *Squilla edwardsii*, Giebel, Zeitschr. Ges. Naturwiss., XVIII, p. 320.

[1] See addendum, p. 195.

1880. *Squilla nepa*, Miers, Ann. Mag. Nat. Hist. (5), V, pp. 25, 458, pl. ii, fig. 13 (*partim*).
1893. *Squilla nepa*, Henderson, Trans. Linn. Soc. Zool. (2), V, p. 452 (*partim*).
1893. *Squilla nepa*, Bigelow, John Hopkins Univ. Circ., No. 106, p. 102.
1894. *Squilla nepa*, Bigelow, Proc. U.S. Nat. Mus , XVII, p. 535, fig. 21.
1908. *Squilla hemischista*, Wood-Mason, MS., Lloyd, Rec. Ind. Mus., II, p. 32 (*sine desc.*).

Squilla nepa was only clearly distinguished from *S. oratoria* in 1893. The precise identity of the specimens recorded in the following papers is uncertain :—

1796. *Cancer* (*mantis*) *digitalis*, Herbst, Krabben u. Krebse, II, p. 92, pl. xxxiii, fig. 1.
1837. *Squilla nepa*, H. Milne-Edwards, Hist. Nat. Crust., II, p. 522.
1839. *Squilla nepa*, Randall, Journ. Acad. Sci. Philadelphia (1), VIII, p. 147.
1847. *Squilla nepa*, White, Hist. Crust. Brit. Mus., p. 83.
1859. *Squilla nepa*, Nicolet, in Gay's Hist. fisica de Chile, Zool. III, p. 224.
1865. *Squilla nepa*, Heller, Reise 'Novara' Exped., Crust., p. 124.
1876. *Squilla nepa*, Miers, Cat. Crust. N. Zealand, p. 89.
1882. *Squilla nepa*, Haswell, Cat. Australian Crust., p. 208.
1886. *Squilla nepa*, Filhol, Miss. de l'île Campbell, III, 2*e*, p. 435.
1887. *Squilla nepa*, Walker, Journ. Linn. Soc., XX, p. 113.
1892. *Squilla nepa*, de Man, in Weber's Zool. Ergebn. Nied. Ost.-Ind., II, p. 518.
1892. *Squilla nepa*, Thallwitz, Abhandl. Kön. Mus. Dresden, No. 3, p. 55.
1901. *Squilla nepa*, Lanchester,[1] Proc. Zool. Soc., p. 553.
1906. *Squilla nepa*, Lanchester,[1] Fascic. Malayenses, Zool., III, p. 133.

In the following papers reference is probably made to the true *S. nepa*, but there is a possibility of confusion with *S. holoschista* :—

1898. *Squilla nepa*, de Man, Zool. Jahrb. Syst., X, p. 693.
1899. *Squilla nepa*, Nobili, Ann. Mus. Civ. Genova (2), XX, p. 275.
1900. *Squilla nepa*, Nobili, Ann. Mus. Civ. Genova (2), XX, p. 519.
1901. *Squilla nepa*, Lenz, Zool. Jahrb. Syst., XIV, p. 477.
1903. *Squilla nepa*, Nobili, Boll. Mus. Torino, XVIII, No. 452, p. 23, and No. 455, p. 38.
1906. *Squilla nepa*, Tattersall, Ceylon Pearl Oyster Rep., V, p. 166.
1908. *Squilla nepa*, Stebbing, Ann. S. African Mus., VI, p. 44.
1910. *Squilla nepa*, Lenz, in Voeltzkow's Reise in Ost-Afrika, II, p. 571.

The dorsal surface of the carapace and abdomen is finely rugose; especially so on the median area of the latter. The carapace measured behind the antero-lateral angles is rather less than half its length, including the rostrum. The median carina of the carapace (fig. 49) is sharp and distinct throughout its course. It is bifurcated in front for half, or rather more than half, its length anterior to the cervical groove, and the small median dorsal pit is enclosed in the base of the fork. Behind the cervical groove it is bifurcated for the greater part of its length and projects as a prominent tubercle in the middle of the posterior margin. The intermediate and lateral carinae are distinct. The spines at the antero-lateral angles are very strong and project far beyond the level of the rostral articulation ; the postero-lateral angles are rounded.

The rostrum is a little broader than long and its upturned lateral margins are rather strongly convergent. Dorsally it sometimes bears an obscure median tubercle and this, in one very large specimen, forms an obsolete median carina.

[1] Lanchester does not seem to have been aware of Bigelow's important paper of 1894.

The eyes are not greatly expanded. The cornea is much broader than the stalk and its greatest breadth is distinctly less than the length of the whole organ. The corneal and peduncular axes are at right angles to one another and the anterior margin of the ophthalmic somite is produced and at the apex truncate or slightly emarginate. In very young specimens, about 30 mm. in length, the corneal index[1] is approximately 4·5; it increases as the animal grows and is about 7·0 in examples between 80 and 90 mm. in length, while in the largest individual examined it is as much as 8·0. The antennular peduncle is shorter than the carapace excluding the rostrum. The mandibular palp is composed of three segments.

The outer margin of the merus of the raptorial claw terminates anteriorly in a sharp tooth. The carpus is grooved and carinate externally and its dorsal keel is furnished with two tubercles, of which the distal is often bilobed; more rarely there are three distinct tubercles. The merus is somewhat expanded at its distal end in the adult male and bears three movable spines and a row of fine pectinations on the margin opposed to the dactylus. The dactylus is provided with six curved teeth including the apical one; the external margin is obtusely angled at the base and is strongly sinuous in both sexes. The proximal part of the dactylus is slightly swollen.

The last three thoracic somites are furnished with sharp submedian and intermediate carinae. The fifth somite is bilobed laterally and does not possess any spines on the inferior margin. The anterior process consists of a very sharp antrorse spine; the posterior process, which is not so sharp, is directed straight outwards and is less than half the length of the anterior. The two marginal lobes of the sixth somite are almost equal in length, but the anterior is narrower than the posterior and is obliquely truncate at the apex. Both lobes of the seventh somite are acute, but the anterior is very much shorter and narrower than the posterior.

There are four pairs of sharp longitudinal carinae on the first five abdominal somites and three pairs on the sixth. On the 2nd, 3rd, 4th and 5th between the submedian carinae there is a small elongated and transversely-notched median tubercle. The following carinae end in spines :—

Carinae.	*Abdominal somites.*
Submedian[2]	4, 5, 6.
Intermediate	(2) 3, 4, 5, 6.
Lateral	(1) 2, 3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

The telson bears a close resemblance to that of the species belonging to the *quinquedentata* group. The median carina is sharp and is very obscurely notched at the base; it terminates in a short spine which overhangs a single blunt tubercle. The oblique rows of pits leading to the interspaces of the intermediate marginal denticles are distinct and there is also a single longitudinal row on either side of the median carina. The submedian, intermediate and lateral teeth are well marked and behind

[1] The corneal index :—the number of times the breadth of the cornea is contained in the median length of the carapace, excluding the rostrum. (See p. 9.)

[2] Very rarely, in large specimens, the submedian carinae of the third abdominal somite end in spines.

the last there is a small praelateral denticle. This denticle and each of the teeth forms the termination of a short but well-marked longitudinal carina. There are three or four (rarely two) submedian denticles, seven to nine (rarely six) intermediate and one lateral. The post-anal carina is well marked.

The bifurcate process of the uropod is finely serrate internally. The inner spine is fully twice the length of the outer and bears a small rounded external lobe near the distal end of its proximal half. The ultimate segment of the exopodite is almost equal in length to the basal segment.

To this species I refer several extremely young individuals, between 20 and 30 mm. in length, in which the spines at the antero-lateral angles of the carapace are not developed. In these examples the corneal index varies from 3·6 to 4·5, the corneal and peduncular axes are very slightly oblique and the median carina of the carapace is obsolete anteriorly.

The general colour of living specimens of this species is usually smoky-grey. All the carinae of the carapace, abdomen and telson are defined by very dark grey pigment; on the second abdominal somite there is frequently a dark dorsal patch and a similar patch is occasionally found on the fifth somite. The eyes are bright translucent green, darker at the inner dorsal end of the cornea. The last three segments of the raptorial claw are pure white, those of the appendages of the last three thoracic somites and portions of the uropods are greenish yellow. The ventral surface is uniformly pale.

The dark grey colouration mentioned above appears to persist fairly well in alcohol, but is sometimes entirely absent. Several specimens from Tuticorin, received in formalin shortly after capture, showed a wholly different type of colouring. There was no trace of dark pigmentation and the whole dorsal surface along with the basal parts of the appendages was suffused with rosy red, tending to dull purple on the telson and to a deep bluish purple on all the segments of the uropods except the outer segment of the exopod. The median and submedian carinae were red and the antennular peduncle purple.

There are two hundred and fifteen specimens in the Indian Museum from the following localities :—

$\frac{3331}{9}$	Hongkong.	G. Dennys.	1 ♂, 1 ♀, 99 and 129 mm.
$\frac{4742}{9}$	Singapore ?	Raffles Museum.	1 ♂, 119 mm.
$\frac{3058}{5}$	Penang.	F. Stoliczka.	1 ♂, 3 ♀, 84—118 mm.
$\frac{3060}{5}$, $\frac{7994-7}{9}$	Sandheads, Ganges Delta.	J. Barnett.	4 ♂, 3 ♀, 38—58 mm.
$\frac{6979-86}{10}$, $\frac{8041}{10}$	Puri, Orissa Coast.	N. Annandale, F. H. Gravely, S. W. K. and J. Caunter.	18 ♂, 16 ♀, 55—101 mm.
$\frac{448\ 59}{4}$, $\frac{3455-6}{9}$, $\frac{3462-79}{9}$	Off Orissa Coast, 7—8 fms.	'Investigator.'	15 ♂, 24 ♀, 59—105 mm.

$\frac{3338-41}{7}$, $\frac{5823-7}{9}$	Off Ganjam Coast, Madras, 7—9 fms.	'Investigator.'	6♂, 3♀, 22—93 mm.
$\frac{5781-97}{9}$, $\frac{5831-3}{9}$	Off Vizagapatam Coast, Madras. 7½—9½ fms.	'Investigator.'	7♂, 13♀, 64—100 mm.
$\frac{191-4}{10}$, $\frac{3068}{5}$, $\frac{3146}{5}$, $\frac{3461-6}{7}$	Madras.	'Investigator.' Madras Museum. (purchased.)	34♂, 30♀, 26—133 mm.
$\frac{7441-6}{10}$	Cuddalore and Porto Novo, S. India.	T. H. Hill.	5♂, 6♀, 59—158 mm.
$\frac{3061}{5}$	Cochin, S. W. India.	F. Day.	4♂, 4♀, 56—67 mm.
$\frac{3059}{5}$, $\frac{7560}{6}$, $\frac{4691}{9}$	Bombay.	Bombay Nat. Hist. Soc. H. P. le Mesurier.	2♂, 2♀, 57—166 mm.
$\frac{7005}{10}$	Karachi.	Karachi Museum.	1♂, 57 mm.
$\frac{7307-10}{10}$	(no locality).		5♂, 1♀, 58—149 mm.
$\frac{7523}{10}$	Tuticorin, S. India.	J. Hornell.	1♂, 4♀, 51—114 mm.

I have also examined the following specimens from other sources :—

Sarawak Museum.		
Buntal and Burong Is., Borneo.		1♂, 3♀, 58—117 mm.
Colombo Museum.		
Ceylon.		2♂, 2♀, 84—145 mm.
Trivandrum Museum.		
Thirkaunapuzha, Travancore.	R. S. N. Pillay.	1♂, 1♀, 70, 84 mm.

In the present confused state of our knowledge it is scarcely necessary to enumerate the many localities from which *S. nepa* has been reported. It is clear from the series in the Indian Museum that the species is distributed over a very wide area ranging from Hongkong to Karachi. Most of the records subsequent to 1894 may very reasonably be regarded as correct and, if this should prove to be the case, the known distribution extends from Honolulu (Lenz) to Madagascar (Lenz) and Durban (Stebbing).

23. Squilla holoschista[1], Wood-Mason, MS.

Plate IV, figs. 50—53.

1893. *Squilla nepa*, Henderson, Trans. Linn. Soc., Zool. (2), V, p. 452 (*partim*).
1908. *Squilla holoschista*, Lloyd, Rec. Ind. Mus., II, p. 32 (*sine desc.*).
1911. *Squilla holoschista*, Kemp, Rec. Ind. Mus., VI, p. 97.

This species is very closely allied to the preceding, but may readily be distinguished from it by the following well-marked characteristics :—

1. The median carina of the carapace in front of the cervical groove is bifurcated anteriorly for less than one third of its length and is *finely bicarinate throughout the greater part of its entire extent* (fig. 51).
2. The lateral margins of the rostrum are rather more strongly convergent anteriorly and the apex is more rounded (fig. 50).

[1] See addendum, p. 195.

3. The corneal portion of the eyes is less expanded; in specimens from 80 to 90 mm. in length the corneal index is about 9·0 whereas it is about 7·0 in examples of *S. nepa* of a similar size.
4. In the raptorial claw the spine which terminates the outer inferior margin of the merus is smaller and in the adult male the distal end of the propodus is very broad and the external margin of the dactylus is only very feebly sinuous (fig. 52).
5. The submedian carinae of the fourth abdominal somite never end in spines:—

Carinae.	*Abdominal somites.*
Submedian	5, 6.
Intermediate	(3) 4, 5, 6.
Lateral	(1) (2) 3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

Not infrequently the marginal teeth of the telson are a trifle shorter than in the preceding species and the dorsal rows of pits are less strongly marked. There are two to four submedian denticles, eight to ten intermediate, one lateral, and one praelateral.

Living specimens of *S. holoschista* closely resemble *S. nepa* in colour, but the dark transverse patches on the second and fifth abdominal somites are absent and the general tone of all the other markings is greenish rather than smoky-grey. This greenish colouring is especially distinct on the median and marginal carinae of the telson. The yellowish pigment has the same distribution as in *S. nepa*.

I have examined one hundred and three specimens of this species:—

$\frac{7926}{9}$	Sandheads, Ganges Delta.	A. J. Milner.	1 ♂, 76 mm.
$\frac{7301-6}{10}$, $\frac{8012}{10}$	Puri, Orissa Coast.	N. Annandale, F. H. Gravely and S. W. K.	5 ♂, 5 ♀, 76—90 mm.
$\frac{5798-9}{9}$, $\frac{5828-9}{9}$	Off Vizagapatam Coast, Madras. $7\frac{1}{2}$—9 fms.	'Investigator.'	1 ♂, 3 ♀, 73—93 mm.
$\frac{3069}{5}$, $\frac{3451}{7}$	Madras.	Madras Museum and purchased.	5 ♂, 12 ♀, 49—90 mm.
$\frac{3147}{5}$	Madras.	Madras Museum.	7 ♂, 12 ♀, 59—88 mm. TYPES.
$\frac{7445-50}{10}$	Cuddalore and Porto Novo, S. India.	T. H. Hill.	19 ♂, 21 ♀, 63—95 mm.
$\frac{3062}{5}$	Ceylon.	Colombo Museum.	1 ♂, 2 ♀, 70—85 mm.
$\frac{7300}{10}$	(no locality).		2 ♂, 4 ♀, 67—83 mm.
British Museum.			
	Madras.	J. R. Henderson. (1893, *sub S. nepa*.)	1 ♂, 64 mm.
	Rameswaram I., G. of Manaar.	J. R. Henderson.	1 ♂, 77 mm.
Trivandrum Museum.			
	Cape Comorin.		1 ♀, 76 mm.

Distribution.—East Coast of India from the Ganges Delta to Ceylon.

24. Squilla oratoria, de Haan.

Plate V, figs. 54–56.

1844 ?[1] *Squilla oratoria*, De Haan, in Siebold's Fauna Japonica, Crust., atlas, pl. li, fig. 2.
1845. *Squilla affinis*, Berthold, Abhandl. Gess. Wiss. Göttingen, III, p. 26, pl. iii, figs. 1—2.
1849. *Squilla oratoria*, De Haan, in Siebold's Fauna Japonica, Crust., p. 223.
1880. *Squilla nepa*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 25 (*partim*).
1886. *Squilla nepa*, Brooks, Voy. H.M.S. 'Challenger,' XVI, Stomatop., p. 25.
1893. *Squilla affinis*, Pocock, Ann. Mag. Nat. Hist. (6), XI, p. 474 (*partim*).
1893. *Squilla affinis*, Bigelow, John Hopkins Univ. Cric., No. 106, p. 102.
1894. *Squilla affinis*, Bigelow, Proc. U. S. Nat. Mus., XVII, p. 538, fig. 22.
1907. *Chloridella affinis*, de Man, Trans. Linn. Soc. Zool. (2), IX, p. 439.
1908. *Squilla oratoria*, Stebbing, Ann. S. African Mus., VI, pp. 44, 45.
Squilla mauritiana, Wood-Mason, MS.
1908. *Squilla ovatoria*, Lloyd, Rec. Ind. Mus., II, p. 33.

The identity of the specimens recorded in the following papers is uncertain; some very probably belong to one or other of the new forms described below :—

1865. *Squilla oratoria*, Heller, Reise 'Novara' Exped., Crust., p. 124.
1898. *Squilla affinis*, de Man, Zool. Jahrb., Syst. X, p. 693.
1899. *Squilla affinis*, Nobili, Ann. Mus. Civ. Genova, (2), XX, p. 275.
1900. *Squilla affinis*, Nobili, Ann. Mus. Civ. Genova, (2), XX, p. 519.
1901. *Squilla affinis*, Nobili, Boll. Mus. Torino, XVI, No. 397, p. 14.
1902. *Squilla affinis*, de Man, Abhandl. Senck. Ges. Frankfurt, XXV, p. 911.
1903. *Chloridella affinis*, Rathbun, Proc. U. S. Nat. Mus., XXVI, p. 55.
1903. *Squilla affinis*, Nobili, Böll. Mus. Torino, XVIII, No. 455, p. 38.

Squilla oratoria along with its variety *perpensa* and the allied species *interrupta*, *wood-masoni*, *stridulans* and *massavensis* form a very compact group; all may be separated at a glance from *S. fovcolata*, *nepa* and *holoschista* by the large eyes, the cornea of which is set very obliquely on the stalk.

The special characters by which *S. oratoria* is distinguished from the other closely allied forms are :—

1. The dorsal surface of the carapace and abdomen is strongly punctate and never presents a polished appearance.
2. The median carina of the carapace is sharp and distinct throughout its course and is bifurcated in front for only about one quarter its length anterior to the cervical groove (fig. 54).
3. The breadth of the carapace measured behind the antero-lateral angles is less than half its length, including the rostrum.
4. The rostrum is subquadrate and its lateral margins, which are not infrequently upturned, are slightly convergent anteriorly.

[1] I am not certain of the exact date when the atlas to the Fauna Japonica was published (in the copy consulted the plates are bound up with the text and are undated), but I have accepted Stebbing's statement (1908) that, as De Haan himself contended in 1849, it antedates Berthold's paper.

5. The corneal index varies from 3·8 in a specimen only 31·5 mm. long to 6·0 in the largest examples. In specimens between 80 and 90 mm. in length it varies from 4·1 to 4·3.
6. The anterior margin of the ophthalmic somite between the bases of the eye-stalks is squarely truncate or emarginate, never pointed.
7. The outer inferior margin of the merus of the raptorial claw is produced to a sharp and prominent spine.
8. The dorsal carina of the raptorial carpus bears from three to five sharp tubercles in large specimens[1]; in smaller examples (50-80 mm.) these are frequently represented merely by more or less obscure lobes, while in very young individuals (30-60 mm.) the dorsal margin is often entire. The outer margin of the dactylus is distinctly sinuous.
9. The anterior lobe of the lateral margin of the sixth thoracic somite is parallel-sided and is much narrower but scarcely shorter than the posterior lobe (fig. 54).
10. The following abdominal carinae end in spines :—

Carinae.	*Abdominal somites.*
Submedian[2]	5, 6.
Intermediate	(2) (3) 4, 5, 6.
Lateral	(2) 3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

11. There are four, less commonly three or five, submedian denticles, seven to nine, less commonly six or ten, intermediate and one lateral.
12. In the bifurcate process from the basal segment of the uropods, the margin anterior to the small lobe on the outer edge of the longer spine is always strongly concave.

The colour of spirit specimens is not characteristic.

Squilla oratoria is, in my experience, much the most variable of the species in the group to which it belongs. In practice, however, the sharp and continuous median carina of the carapace and its very short anterior bifurcation will, in nearly every instance, suffice to distinguish it. The principal features in which the specimens differ from the account given above are noticed under the separate records.

In the Indian Museum are nineteen specimens :—

$\frac{3079}{5}$	Yokohama.	Berlin Museum.	1 ♀, 186 mm.
$\frac{9861}{6}$	Nagasaki.	F. C. Dale.	1 ♀, 160 mm.
$\frac{3330}{9}$, $\frac{9829-33}{6}$, $\frac{4850}{9}$	Hongkong.	Hongkong Museum. G. Dennys.	3 ♂, 8 ♀, 55—146 mm.

[1] The tubercles are not sufficiently sharp or distinct in fig. 55.

[2] In four specimens the submedian carinae of the fourth abdominal somite end in spines (see notes under the several records).

$\frac{8133}{8}$ $\frac{3394-6}{7}$	Hongkong.	Hungerford.	3 ♂, 1 ♀, 64—113 mm.
$\frac{1269}{1}$	Mauritius.[1]	(Purchased.)	1 ♂, 1 ♀, 116, 126 mm.

(*S. mauritiana*, Wood-Mason, MS.)

These specimens differ from typical examples in having the punctuation of the dorsal surface very poorly developed. The rostrum also is longer (about as long as broad) and its lateral margins are very strongly upturned; the anterior lateral process of the sixth thoracic somite is very clearly shorter than the posterior and the submedian carinae of the 4th abdominal somite and the lateral carinae of the 1st and 2nd end in spines.

Thanks to the courtesy of the Trustees of the British Museum, I have also been able to examine the following very interesting series of thirty-one specimens :—

Hawaiian Is.	Hawaiian Govt. from Internat. Fish. Exhib. of 1883.	1 ♀, *ca.* 120 mm.

Except that the carpus of the raptorial claw bears only two tubercles and obscure traces of a third on its dorsal margin, this specimen is almost the exact counterpart of the two peculiar examples recorded from Mauritius.

Honolulu reefs, Hawaiian Is.	'Challenger.' (Brooks, 1866, *sub S. nepa.*)	1 ♀, 146 mm.

Except that the intermediate and lateral carinae of all the abdominal somites end in spines this example is precisely similar to the preceding. One raptorial claw is missing and in the other, which has been broken off and subsequently redeveloped, the dorsal carina of the carpus (as in young specimens) terminates abruptly at its distal end but is otherwise entire.

Yokohama.	H. Batson Joyner. (Miers, 1880, *sub S. nepa.*)	4 ♂, 147—177 mm.
Yokohama.	'Challenger.' (not mentioned by Brooks.)	1 ♂, 140 mm.
Pokoska, Japan, 5—25 fms.	'Challenger.' (Brooks, 1886, *sub S. nepa.*)	1 ♀, 145 mm.
Kobe, Japan.	'Challenger.' (Brooks, 1886, *sub S. nepa.*)	1 ♀, 77 mm.
Inland Sea of Japan, 15 fms.	'Challenger.' (Brooks, 1886, *sub S. nepa.*)	1 ♀, 46 mm.
Inland Sea of Japan.	R. Gordon Smith.	3 ♂, 71—138 mm.
Inland Sea of Japan.	(de Man, 1907, *sub C. affinis.*)	1 ♂, 45 mm.

De Man mentions that the submedian spines of the telson probably possess movable tips, but this, I believe, is due merely to their partial fracture. No such character is shown in other examples of a similar length.

[1] The localities of specimens obtained by purchase are frequently inaccurate and, though I have no special reason to distrust this label, I am none the less inclined to regard the record with suspicion. Before we can accept the enormous increase in the known geographical range which is implied, fresh specimens either from Mauritius or from localities lying between it and the China Seas must be examined, for *S. oratoria* in the strict sense appears to be entirely absent from the coasts of British India. In the peculiar varietal characters which are noticed the specimens agree closely with two examples from Hawaii.

Cheefoo, China. Swinhoe. 1 ♂, 76 mm.
(Miers, 1880, *sub S. nepa.*)

Shanghai. Swinhoe.
(Miers, 1880, *sub S. nepa.*) 2 ♂, 1 ♀, 89—103 mm.

Chusan, China. P. W. Bassett Smith. 3 ♂, 4 ♀, 31·5—88 mm.
(Pocock, 1893, *sub S. affinis.*)

The two largest specimens are typical, but in three of the small ones the tubercles on the dorsal aspect of the carpus are undeveloped.

Foochow, China. F. W. Styan. 3 ♀, 78—87 mm.

In the largest specimen the median carina is not continuous, but shows a small gap on either side near the base of the anterior bifurcation. In one of the smaller specimens also the right limb of the bifurcate part is finely interrupted near its anterior end.

Amoy, China. Stevens. 1 ♂, 1 ♀, 101, 108 mm.
(Miers, 1880, *sub S. nepa.*)

The dorsal punctuation of the carapace and abdomen is very poorly developed. In the larger specimen the anterior half of the bifurcate portion of the median carina of the carapace is entirely missing and a wide gap separates the base of the forked portion from the simple posterior part; in the smaller specimen the carina is, as usual, continuous. In both there are only very feeble indications of the tubercles on the dorsal aspect of the carpus (considering the size of the specimens these should be well developed), the anterior lateral process of the 6th thoracic somite is noticeably shorter than the posterior and the anterior process of the 7th somite, which in other specimens is acutely produced, is represented merely by a blunt obtuse and rounded angle (fig. 56). The spinulation of the abdomen is normal.

Philippine Is. H. J. Veitch. 1 ♂, 81 mm.
(Miers, 1880, *sub S. nepa.*)

In this specimen the median carina of the carapace is interrupted at the base of the bifurcate part as in var. *perpensa* and *S. interrupta*. For the rest it very closely resembles the Hawaiian examples and those reported from Mauritius, though the rostrum is a trifle shorter. The submedian carinae of the last three, the intermediate carinae of the last five, and the lateral carinae of all six abdominal somites are produced posteriorly in the form of spines.

The following specimens from other sources have also been examined :—

Prof. K. Kishinouye.

Bay of Tokio, Japan. "Most common and widely distributed." K. K. 3 ♂, 2 ♀, 38—168 mm.

Mr. Alan Owston.

Okinose, Sagami, Japan. 1 ♂, 1 ♀, 150 and 165 mm.

It is possible that the specimens labelled Mauritius, along with those in the British Museum collection from the Hawaiian and Philippine Is., deserve to be separated from the rest under a distinct varietal or subspecific name, but the material available is not sufficient to justify such a course. It should, however, be remembered that these examples differ from those found on the coasts of China and Japan in the longer rostrum with strongly upturned lateral margins and in the more complete spinous formula

on the abdomen. The shortness of the anterior lateral process of the sixth thoracic somite is paralleled in the two remarkable specimens from Amoy.

Squilla oratoria is evidently an abundant species in Chinese and Japanese waters, but is perhaps scarce in other localities. Apart from the record from Mauritius, which, for the present at least, may be regarded as doubtful, it is only known from the Hawaiian and Philippine Is. The probability of confusion with one or other of the succeeding forms is so great that little reliance can be placed on the localities given in the literature.

var. **perpensa**[1], Kemp.

Plate V, figs. 57–59.

1880. *Squilla nepa*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 25 (*partim*).
1884. *Squilla nepa*, Miers, Voy. H.M.S. 'Alert', p. 298.
1888. *Squilla nepa*, de Man, Journ. Linn. Soc., XXII, p. 295.
1893. *Squilla affinis*, Pocock, Ann. Mag. Nat. Hist. (6), XI, p. 474.
Squilla interrupta, Wood-Mason, MS. (*partim*).
1908. *Squilla interrupta*, Lloyd, Rec. Ind. Mus. ii, p. 32 (*sine desc.*).
1911. *Squilla oratoria*, var. *perpensa*, Kemp, Rec. Ind. Mus., VI, p. 98.

Under this name I separate the form of *Squilla oratoria* which occurs on the coasts of British India. In these localities the variety exists to the complete exclusion of the typical race, but both forms occur together on the coasts of S. China.

The var. *perpensa* may be easily distinguished from the typical form by two characters :—

1. The median carina of the carapace is *always* interrupted, and wholly absent for a short space, at the base of the anterior bifurcation (fig. 57). The two arms of the bifurcate portion are frequently fine and obscure and, in a few specimens, quite obsolete.
2. The carpus of the raptorial claw has a sharp elevated carina on its dorsal aspect which terminates abruptly before reaching the anterior margin ; apart from this, there is no trace whatever of any dorsal tubercle (fig. 58).

The variety also differs from most examples of the typical form in the more quadrate shape of the rostrum, the apex of which is squarely truncate or even a trifle concave. The lateral lobes of the sixth somite sometimes bears the closest resemblance to those of *oratoria*, *s.s.*, more usually the anterior is broader, more pointed and less parallel-sided. The anterior lobe of the seventh somite is usually clearly longer than in the allied form (fig. 57).

The following abdominal carinae end in spines :—

Carinae.	*Abdominal somites.*
Submedian	5, 6.
Intermediate	4, 5, 6.
Lateral	3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

On the telson there are three or four submedian denticles, six to nine intermediate and one lateral.

[1] See addendum, p. 196.

It will be noticed that under the records of typical *S. oratoria* are included four examples from the British Museum collection in which the median carina of the carapace is partially or completely discontinuous. There is reason to believe that one of these examples (that from Amoy) is wholly abnormal; the others are in this respect, and in this respect only, intermediate between the typical form and the variety.

In the entire absence of tubercles on the dorsal carina of the carpus, the var. *perpensa* resembles some very young individuals of *S. oratoria*, *s.s.*, but in the former the character persists throughout life and in all examples except the four mentioned above it is found in association with a discontinuous median carina.

The Indian specimens present scarcely any perceptible difference from those found in S. China, except that in examples from the latter locality the breadth of the cornea is perhaps a trifle less and the dorsal punctuation frequently rather more pronounced.

The colour of spirit specimens is not characteristic. In recently caught examples from Tuticorin the posterior margins of the last three thoracic and all the abdominal somites are defined by dull greenish pigment. The submedian post-abdominal carinae are of a similar colour, as are also those of the carapace and the median and marginal carinae of the telson. The spines of the telson and of the ventral process of the uropod are tipped with bright rosy red and in many specimens suffused patches of the same colour are visible on the abdomen between the submedian, intermediate and marginal carinae and on the free thoracic somites external to the intermediates. The outer surface of the raptorial merus is also rosy red and traces of the same tint are frequently visible on the carapace. The inner half of the outer uropod is dusky and the eyes are brown.

I have examined one hundred and fifty-two specimens of *S. oratoria* var. *perpensa*, and in this series the constancy of the characters noted above is most remarkable.

In the Indian Museum are one hundred and forty-six examples :—

$\frac{9817-26}{6}$	Hongkong.	Hongkong Museum.	8 ♂, 16 ♀, 55—107 mm.
$\frac{4851-72}{9}$, $\frac{6728}{10}$	Hongkong.	G. Dennys.	18 ♂, 22 ♀, 67—98 mm.
$\frac{3384-93}{7}$	Hongkong.	R. Hungerford.	5 ♂, 5 ♀, 66—101 mm.
$\frac{8179}{7}$	Mergui Archipelago.	Mus. Collr. (de Man, 1888, *sub S. nepa.*)	1 ♀, 70 mm.
$\frac{5776-80}{9}$	Off Irrawaddy Delta, 20 fms. 15° 20′ N., 94° 55′ E.	'Investigator.'	3 ♂, 2 ♀, 35—76 mm.
$\frac{5769}{9}$, $\frac{6729}{10}$	Sandheads, Hugli Delta.	A. J. Milner.	2 ♀, 57 and 60 mm.
$\frac{7266-7}{10}$	Madras Coast.	(no history.)	1 ♂, 1 ♀, 65 and 79 mm.
$\frac{7036-41}{10}$, $\frac{7451-8}{10}$, $\frac{7521-4}{10}$	Tuticorin, S. India.	J. Hornell.	22 ♂, 40 ♀, 39—75 mm. TYPES.

The following two small specimens may probably be referred to this species; they differ, however, from the other examples in having the lateral margins of the rostrum rather strongly convergent :—

$\frac{3134}{7}$	Port Blair, Andaman Is.	J. Wood-Mason.	1 ♂, 26 mm.
$\frac{4520}{10}$	Persian Gulf, 53 fms., 26° 20′ N., 53° 54′ E.	'Investigator.'	1 ♀, 31 mm.

The following specimens from the British Museum collection have also been examined :—

Holothuria Bank, China Seas.	P. Basset Smith. (Pocock, 1893, *sub S. affinis.*)	1 ♂, 43 mm.
The anterior bifurcated part of the median carina of the carapace is obsolete.		
Kowlson Bay, Hongkong.	P. Basset Smith. (Pocock, 1893, *sub S. affinis.*)	1 ♂, 44 mm.
Port Darwin, N. Australia.	'Alert.' (Miers, 1884, *sub S. nepa.*)	1 ♂, 61 mm.
Singapore.	S. F. Flower.	1 ♂, 92 mm.

The var. *perpensa* is distributed over an area extending from Hongkong and N. Australia to the Persian Gulf, entirely replacing the typical form in the western part of its range. I have seen no specimens from Japan or the northern coasts of China.

25. **Squilla interrupta**, Wood-Mason, MS.

Plate V, figs. 60—62.

? 1852. *Squilla oratoria*, Dana, U.S. Explor. Exped., Crust., I, p. 621.
1893. *Squilla affinis*, Henderson, Trans. Linn. Soc., Zool. (2), V, p. 453 (*partim*).
Squilla interrupta, Wood-Mason, MS. (*partim*).
1908. *Squilla interrupta*, Lloyd, Rec. Ind. Mus., II, p. 32 (*partim*; *sine desc.*).
1911. *Squilla interrupta*, Kemp, Rec. Ind. Mus., VI, p. 98.

This species differs from *S. oratoria, s.s.* in the following constant characteristics:—

1. The median carina of the carapace is interrupted at the base of the anterior bifurcation as in *S. oratoria* var. *perpensa* (fig. 60).
2. The rostrum is subquadrate; its anterior margin is truncate (sometimes even a trifle concave) and its lateral margins are only very slightly convergent anteriorly (fig. 60).
3. The eyes are distinctly smaller than in *S. oratoria* or its variety, specimens of similar size being compared. In the smallest examples in the collection the corneal index is about 5·0, in the largest about 6·1, while in individuals between 80 and 90 mm. in length, the figure usually falls between 5·2 and 5·5.
4. The carpus of the raptorial claw is constantly provided with two, and only two, dorsal tubercles (fig. 61).
5. In the bifurcate process from the base of the uropod the margin of the longer spine anterior to the external lobe is never concave; it is occasionally feebly sinuous, but in nearly every instance is definitely convex (fig. 62).

Squilla interrupta differs from the var. *perpensa* in regard to characters 3, 4 and 5 (*supra*). The anterior margin of the ophthalmic somite is usually definitely emarginate, never pointed. The lateral processes of the sixth and seventh thoracic somites generally bear a close resemblance to those of *S. oratoria* var. *perpensa*, and the same number of spines on the abdominal somites and of marginal denticles on the telson are found. The outer margin of the dactylus of the raptorial claw is more strongly sinuous than in either of the preceding forms, but hardly so much so as in *S. nepa*.

The colour of spirit specimens does not appear to be characteristic.

This is one of the commonest species of *Squilla* in Indian waters. Except that in three examples there are exceedingly feeble indications of a third tubercle on the dorsal aspect of the raptorial carpus (on one side only), the one hundred and twenty-two specimens examined are absolutely constant in exhibiting the characters noted above.

The Indian Museum contains the following series:—

9827—8/6	Hongkong.	Hongkong Museum.	1 ♂, 1 ♀, 100 and 103 mm.
3329/9	Hongkong.	G. Dennys.	4 ♂, 4 ♀, 74—102 mm.
4743—5/9	Singapore?	Raffles Museum.	3 ♂, 84—103 mm.
3095/5	Camorta, Nicobars.	F. Stoliczka.	1 ♀, 81 mm.
3094/5	Akyab, Arakan Coast.	W. Dodgson.	1 ♀, 58 mm.
7982—91/9	Sandheads, Hughli Delta.	Commissioners of H.M. Pilot Brigs.	5 ♂, 5 ♀, 44—109 mm. TYPES.
6705/4 3065—6/5 9843/6 1284—6/7 5770/9	Sandheads, Hughli Delta.	Commissioners of H.M. Pilot Brigs.	3 ♂, 10 ♀, 63—106 mm.
7783/10	Ghapa Natta, Mutlah R., near Calcutta.	S. B. Nath.	1 ♂, 84 mm.
7268—74/10	Mouth of R. Hughli.	J. Munro.	7 ♂, 8 ♀, 48—105 mm.
3080/5	Off Mutlah Light, Hughli R.	G. M. Giles.	1 ♂, 91 mm.
8043/10	Puri, Orissa Coast.	F. H. Gravely.	1 ♂, 1 ♀, 70 and 72 mm.
3336-7/7	Off Ganjam Coast, Madras, 7 fms.,	'Investigator.'	4 ♂, 56—85 mm.
5830/9	Off Vizagapatam Coast, Madras, 7½—9 fms.	'Investigator.'	1 ♂, 61 mm.
7557/6 7559/9	Bombay.	Bombay Nat. Hist. Soc.	4 ♂, 17 ♀, 47—119 mm.
7275—8/10	Panvel Creek, Bombay	J. Caunter.	4 ♂, 5 ♀, 68—90 mm.
7004/10	Karachi?	Karachi Museum.	1 ♂, 1 ♀, 85 and 93 mm.
3047/5 3067/5	Arabian Sea.	Karachi Museum and A. O. Hume.	4 ♂, 4 ♀, 49—124 mm.
647/10	Persian Gulf.	F. H. Townsend.	1 ♀, 67 mm.

$\frac{7282-3}{10}$	Persian Gulf, 13 fms., 29° 20′ N., 48° 47′ E.	'Investigator.'	2 ♂, 57 and 82 mm.
$\frac{7279-81}{10}$	Persian Gulf, 25 fms., 28° 59′ N., 50° 5′ E.	'Investigator.'	2 ♂, 1 ♀, 93—96 mm.
$\frac{7284}{10}$	Koweit, Persian Gulf.	'Investigator.'	1 ♀, 34 mm.
$\frac{4727}{10}$	(locality unknown.)	S. McLachlan.	1 ♂, 57 mm.

The following specimens from other sources have also been examined :—

British Museum.		
S. Formosa.	Formosa Museum.	1 ♂, 90 mm.
Singapore.	Bedford and Lanchester.	2 ♀, 98 and 101 mm.
Sunderbunds, Ganges Delta.	F. Day.	2 ♂, 4 ♀, 42—66 mm
Sarawak Museum.		
Buntal and Burong Is., Borneo.		3 ♀, 37—73 mm.
Bombay Natural History Society.		
Bombay.		2 ♂, 86 and 120 mm.

The range of *S. interrupta* consequently extends from Formosa and Hongkong westwards to the Persian Gulf.

26. Squilla wood-masoni, Kemp.

Plate V, figs. 63—65.

1880. *Squilla nepa*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 25 (*partim*).
1893. *Squilla affinis*, Henderson, Trans. Linn. Soc. Zool. (2), V, p. 453 (*partim*).
Squilla polita, Wood-Mason, MS. (*nec* Bigelow).
1908. *Squilla polita*, Lloyd, Rec. Ind. Mus., II, p. 33 (*sine desc.*).
1911. *Squilla wood-masoni*, Kemp, Rec. Ind. Mus., VI, p. 99.

Squilla wood-masoni may be distinguished from the three preceding forms by the use of the following characters :—

1. The dorsal surface of the carapace and abdomen is smooth, highly polished and without trace of punctuation.
2. The carapace is shorter and broader ; its breadth behind the antero-lateral angles is almost invariably more than one-half of its length in the median line, including the rostrum (fig. 63).
3. The anterior bifurcate portion of the median carina of the carapace is entirely obsolete, though its position is often marked by dark lines of pigment.
4. The eyes are large ; the corneal index varies from 3·0 in young examples to 4·2 in large specimens. In examples between 80 and 90 mm. in length it falls between 3·4 and 3·9. The anterior margin of the ophthalmic somite is strongly convex and is produced to a small but quite distinct median point.
5. The carpus of the raptorial claw somewhat resembles that of *S. oratoria*, *s.s.* It is armed dorsally with two or three tubercles, and in addition the extreme distal edge is usually produced to a blunt tooth-like process (fig. 64).
6. The dactylus of the same limb is strongly sinuate externally. The whole segment is of a more clumsy build than in the preceding forms ; the teeth on the

inner margin are shorter and stouter and the incisions between them are less deeply cut.

7. The margin of the bifurcate process of the basal segment of the uropod, anterior to the lobe on the outer face of the longer spine, is sharply concave as in *S. oratoria*; the lobe itself is, however, much smaller and less conspicuous than in that species or than in *S. interrupta* (fig. 65).

In this species, also, the cervical groove of the carapace is exceptionally deeply-cut and the spines at the antero-lateral angles are (in adults) unusually small. The rostrum is subquadrate with its lateral margins slightly convergent anteriorly. The lateral processes of the thoracic somite are decidedly shorter than in the two preceding species, especially the anterior one on the fifth somite. The following abdominal carinae end in spines :—

Carinae.	*Abdominal somites.*
Submedian	5, 6.
Intermediate	3, 4, 5, 6.
Lateral	2, 3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

The post-anal carina on the ventral surface of the telson is, as a rule, longer than in the preceding species and on the margin there are two or three submedian denticles, eight to eleven intermediate and one lateral.

In a very young example from Muscat[1] (34·5 mm.) the lateral margins of the rostrum are more strongly convergent anteriorly than in adults and the tubercles on the raptorial carpus are less distinct. In this example, moreover, the carapace is not so wide as in adults, the breadth being a trifle less than one-half the length including the rostrum. The great breadth of the carapace is, in Indian waters, a very marked character of this species and is quite constant in all examples except the two immature individuals mentioned above. Two large specimens from Zanzibar are, however, wholly abnormal in this respect, for, in both, the breadth of the carapace, as in the preceding species, is very clearly less than half the length including the rostrum. In other respects they agree closely with the remaining specimens, and there is little doubt that they may safely be referred to *S. wood-masoni*. Should further collections show that the character is constant in specimens found on the E. African Coast the creation of a distinct subspecies will, I believe, be justified.

Of this species fifty-four specimens have been examined. The following are in the Indian Museum :—

$\frac{9814-6}{6}$	Hongkong.	Hongkong Museum.	3 ♀, 66—131 mm.
$\frac{7513}{10}$	Port Jackson, N. S. Wales.	Australian Museum.	1 ♀, 144 mm.
$\frac{7294}{10}$	Pondicherry.	(Purchased.)	1 ♀, 107 mm.
$\frac{3098}{5}$	Madras.	(Purchased.)	5 ♂, 3 ♀, 89—109 mm. TYPES.

[1] This specimen was identified prior to the examination of a series of *S. massavensis*. It is not improbable that this example along with that from Aden should more properly be referred to that species.

$\frac{3078}{5}$ $\frac{3087}{5}$ $\frac{3152-6}{7}$	Madras.	Madras Museum. (purchased.)	8 ♂, 65—99 mm.
$\frac{7295}{10}$	Off Madras Coast, 23 fms. 14°4′57″ N., 80°20′50″ E.	'Investigator.'	1 ♀, 101 mm.
$\frac{2480}{9}$	Orissa Coast, 7—8 fms.	'Investigator.'	1 ♂, 98 mm.
$\frac{7296-9}{10}$ $\frac{8040}{10}$	Puri, Orissa Coast.	N. Annandale, F. H. Gravely and J. Caunter.	9 ♂, 13 ♀, 50—90 mm.
$\frac{7992}{9}$	Sandheads, Ganges Delta.	W. M. Daly.	1 ♀, 69 mm.
$\frac{649}{10}$	Persian Gulf.	F. H. Townsend.	1 ♂, 52 mm.

The following specimens from the British Museum collection have also been examined :—

Singapore.	S. F. Flower.	1 ♂, 77 mm.
Rameswaram I., G. of Manaar.	J. R. Henderson. (Henderson, 1893, *sub S. affinis.*)	1 ♂, 89 mm.
Madras.	F. Day. (Henderson, 1893, *sub S. affinis.*)	1 ♂, 106 mm.
Muscat.[1]	J. B. Miles.	1 ♂, 34·5 mm.
Aden, 5—8 fms.[1]	Capt. Shotland.	1 ♂, 41 mm.
Zanzibar.	Col. Playfair. (Miers, 1880, *sub S. nepa.*)	1 ♂, 1 ♀, 75 and 105 mm.

According to the above records this species extends over an area ranging from Hongkong and the Australian Coast to the Persian Gulf, Aden and Zanzibar.

27. Squilla massavensis, Kossmann.

1880. *Squilla massavensis*, Kossmann, Zool. Ergebn. Roth. Meer., III, p. 99.
1906. *Squilla massavensis*, Nobili, Ann. Sci. Nat., Zool. (9), IV, p. 340.
1910. *Squilla massavensis*, Balss, Denk d. math.-naturwiss. Klasse d. Kais. Akad. Wiss., Wien, LXXXV, p. 11, text-figs. *a*, *c*, *d*.

I refer to this species nine specimens obtained by Mr. F. H. Townsend in the Gulf of Oman and the Persian Gulf. The largest is only 108 mm. in total length and is consequently much smaller than Kossmann's type (140 mm.).

Squilla massavensis is evidently an extremely close ally of *S. wood-masoni* and like that species may be distinguished from *S. oratoria* and *S. interrupta* by the dactylus of the raptorial claw (see Balss, 1910, text-fig. 3), which is strongly sinuous externally and provided with short teeth, while other less conspicuous characters are the size of the cornea—the corneal index is about the same as in *S. wood-masoni*—the deep-cut cervical groove and the extreme reduction in size of the lobe on the outer aspect of the longer of the two spines forming the basal process of the uropod.

From *S. wood-masoni* the species may be distinguished by the following characters :—

1. The dorsal surfaces of the carapace and abdomen do not present a polished appearance.

[1] The specimen was identified prior to the examination of a series of *S. massavensis*. It is not improbable that it should more properly be referred to that species.

2. The anterior breadth of the carapace is less than half the median length, including the rostrum.
3. The rostrum is much more strongly narrowed anteriorly and is proportionately a trifle longer.
4. The anterior lateral process of the sixth thoracic somite is usually a little longer and narrower.
5. The telson shows important distinctions. It has the same series of impressed pits as are found in other species of the group; but, in addition, is provided with rows of tubercles on either side of the middle line converging to a point beneath the apex of the spine which terminates the median carina. This feature is possessed by no single one of its allies. The tubercles are only developed in well-grown specimens and cannot be detected in the two smallest examples which measure 45 and 49 mm. The single row which can be seen in a specimen 65 mm. in length is a prominent feature of all the other larger examples. In very large individuals, such as those described by Kossmann and Nobili and figured by Balss (1910, text-fig. 4), three rows of tubercles are found, and in these the difference between *S. massavensis* and its allies is very pronounced. In the largest specimen from the Persian Gulf the row nearest the median carina is well developed, while the other two are quite rudimentary.

There are two or three sharp tubercles on the dorsal aspect of the carpus and the number of spines on the abdominal somites is the same as in *S. wood-masoni*. In the specimens examined there are two to four (usually three) submedian denticles, seven to nine intermediate and one lateral. Nobili mentions that in the specimen which he examined there are six intermediate and *two* (!) laterals. In the largest male the carinae of the marginal telson teeth and the bases of the intermediate denticles are noticeably inflated, more so than in any other species of the same group.

It must be confessed that had the two smallest individuals (under 50 mm. in length) been found alone, and not taken in company with larger examples, the greatest difficulty would have been experienced in their identification. From *S. wood-masoni* of similar size, they are distinguished only by the rostrum, which is more strongly narrowed anteriorly, and by the different proportions of the carapace. To young *S. oratoria* var. *perpensa* the resemblance is even closer; the form of the rostrum and the total absence of the anterior bifurcation of the median carina of the carapace[1] afford almost the only means of distinction, for in immature *S. massavensis* the characteristics of the raptorial propodus and carpus are not developed and the lobe on the larger spine of the basal process of the uropod is conspicuous.

According to the authors who have previously described this species, the anterior bifurcation of the median carina of the carapace is present, but this feature is not shown in any of the specimens I have examined. Nobili (1906) considers that the two small tubercles found on the last five abdominal somites between the interme-

[1] The presence of the anterior part of this bifurcation is not absolutely constant in *S. oratoria* var. *perpensa*.

diate and lateral carinae constitute a valuable character of the species. They are, indeed, rather exceptional in their development in large individuals, but more or less evident traces of them can usually be seen in large examples of the allied forms. Balss (1910) in comparing this species with *S. nepa* notes a distinction in the carinae of the carapace, those of the intermediate pair being confluent anteriorly with the laterals in *S. nepa*, whereas they end abruptly in *S. massavensis*. The condition of these carinae in *S. oratoria* and other large-eyed species of the group is, however, identical with that found in *S. massavensis*, while the confluence of the two carinae in *S. nepa* is not a constant character.

The colouring of spirit material is not striking; but there are large dark grey patches on the second and fifth abdominal somites—a feature not found in *S. wood-masoni* or in *S. oratoria* var. *perpensa*.

For the opportunity of examining a series of this scarce species I am indebted to the Secretary of the Bombay Natural History Society, who has kindly forwarded to me eight specimens, 45–108 mm. in length, obtained by Mr. F. H. Townsend in the Gulf of Oman, lat. 25° 21′ N., long. 58° 07′ E., at a depth of 175 fathoms. The only other example I have seen is registered as follows:—

$\frac{619}{10}$ Persian Gulf. F. H. Townsend. 1 ♂, 52 mm.

Prior to an examination of the other specimens I had identified this individual as *S. wood-masoni*, while remarking on the difference in the proportions of the carapace and rostrum. On re-examination I find slight but distinct traces of tubercles on the telson. The two small specimens in the British Museum collection, recorded on p. 76 as *S. wood-masoni*, should also, in all probability, be referred to this species.

The precise locality of the type specimen, which was obtained in the Red Sea, is not given. Nobili has recorded the species from Massouah and Djibouti, while the specimen determined by Balss was found at Suez.

28. **Squilla stridulans**, Wood-Mason.

Plate V, fig. 66.

1894. *Squilla stridulans*, Wood-Mason, Ann. Mag. Nat. Hist. (6), XIII, p. 409.

1895. *Squilla stridulans*, Wood-Mason, Figs. and Desc. of nine Squillidae, p. 5, pl. ii, fig. 3; pl. iii, fig. 1.

Squilla stridulans may be readily distinguished from the six preceding forms by the following characters:—

1. The lateral process of the fifth thoracic somite can scarcely be termed bilobed; it consists of two sharp and subequal spines (fig. 66).
2. The lateral carinae of the first five abdominal somites are sharply bicarinate throughout their length.

For the rest the principal characters of the species are as follows:—

The carapace is narrow anteriorly and its breadth behind the antero-lateral angles is less than half the median length excluding the rostrum. The median carina is sharply defined throughout its course and is bifurcated in front for more than one-third its length anterior to the cervical groove, the junction of the two carinae being quite

close to the small mid-dorsal pit. The lateral margin is obtusely angled in front of the rounded postero-lateral corners as in *S. foveolata*. Both carapace and abdomen are deeply and rather coarsely punctured.

The lateral margins of the rostrum are upturned and converge to a truncate apex. The corneal portion of the eyes is greatly expanded and is set obliquely on the stalk. The corneal index varies from 3·7 to 4·2 and in one specimen, which is quite exceptional among Indian examples, is as much as 4·9. The anterior margin of the ophthalmic somite is rounded.

The outer inferior margin of the merus of the raptorial claw terminates in a rounded angle, and is not toothed. The dorsal carina of the carpus is entire or with a very obscure tubercle and ends abruptly before reaching the anterior margin. The outer margin of the dactylus is evenly convex throughout its length and the teeth on its inner margin are long and slender.

The anterior of the two spines on the margin of the fifth thoracic somite is situated at a lower level than the posterior. The lateral lobes of the sixth somite are about equal in length and breadth; the posterior lobe is sharply pointed, the anterior more or less obliquely truncate. Both processes of the seventh somite are acute, the anterior being both shorter and narrower than the posterior.

As already mentioned the lateral carinae of the first five abdominal somites are sharply bicarinate. This unusual feature is very distinct in adults and the narrow area between the two carinulae is coarsely pitted; in very young individuals the bicarination is inconspicuous. The following abdominal carinae end in spines :—

Carinae.	*Abdominal somites.*
Submedian	5, 6.
Intermediate	3, 4, 5, 6.
Lateral	1, 2, 3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

The marginal teeth of the telson are unusually long and the denticles are exceptionally numerous. Of the latter there are five or six submedians, twelve to sixteen intermediate,[1] and one lateral.

In the bifurcate process from the base of the uropods, the lobe on the outer margin of the longer spine is small or obsolete in adults, but is usually quite distinct in very small specimens.

In very young examples, also, the median projection on the posterior margin of the carapace is exceptionally well developed and the rostrum, as noticed in small individuals of some of the preceding species, is more strongly narrowed anteriorly.

A single very large specimen from Japan, the only individual known from any locality outside the Bay of Bengal, differs from the Indian examples in the following particulars :—

1. The carapace is distinctly broader; its breadth at the antero-lateral angles is exactly half the median length. The median carina of the carapace is

[1] In one specimen, which appears to be abnormal in this respect, there are only ten intermediate denticles.

bifurcated anteriorly for only two-sevenths of its length in front of the cervical groove; the distance between the small mid-dorsal pit and the base of the fork is more than half the length of the bifurcated part and is far greater than in typical examples.

2. The rostrum is proportionately broader and its apex is more rounded anteriorly.
3. The corneal and peduncular axes of the eye seem to be a trifle less oblique and the corneal index, as might be expected in so large a specimen, is greater: 5·3.

In other respects, however, the specimen agrees very closely with typical examples.

As regards colour, spirit specimens are as a rule darker than those of the allied species but the general plan is closely similar. The longitudinal grooves of the carapace, the lateral margins of the rostrum, and the posterior margins of the last three thoracic and first four abdominal somites are rather broadly marked with black pigment. The median carina of the carapace is also defined by similar pigment, but much less distinctly. The abdominal somites are rather thickly strewn with black chromatophores, which in most cases form decided patches along the inner aspect of each lateral carina. These patches are specially well-marked on the fifth somite and there is also in most cases, more particularly in young specimens, a pair of dark spots in the middle of the second somite. The pits and carinae on the dorsal surface of the telson are defined by black pigment and the uropods are faintly suffused with the same colour.

I have been unable to find any structural character which will account for the name which Wood-Mason chose for this species (see p. 19).

There are thirty-five specimens of *S. stridulans* in the Indian Museum :—

$\frac{7285-93}{10}$	Nellore Coast, Madras; 80—110 fms., 14° 18′ 15″ N., 80° 18′ 30″ E.	'Investigator.'	4 ♂, 5 ♀, 69—100 mm.
$\frac{7035-40}{9}$	Masulipatam Coast, Madras; 95 fms., 15° 56′ 20″ N., 81° 26′ 10″ E.	'Investigator.'	6 ♀, 41—92 mm.
$\frac{6935-6}{9}$	Masulipatam Coast, Madras; 240 fms., 15° 56′ 50″ N., 81° 30′ 30″ E.	'Investigator.'	2 ♀, 48 and 74 mm.
$\frac{3481-2}{9}$	Orissa Coast; 68 fms.	'Investigator.'	1 ♂, 1 ♀, 52 and 97 mm. TYPES.
$\frac{3483-97}{9}$	Orissa Coast; 68 fms.	'Investigator.'	3 ♂, 12 ♀, 38—86 mm.
$\frac{7685}{10}$	Misaki, Japan.	A. Owston.	1 ♂, 144 mm.

Only the above specimens are known.

29. **Squilla investigatoris**, Lloyd.

Plate VI, figs. 67, 68.

1907. *Squilla investigatoris*, Lloyd, Rec. Ind. Mus., I, p. 10.
1908. *Squilla investigatoris*, Lloyd, Rec. Ind. Mus., II, p. 29, pls. ii and iii.

This species is readily distinguished from its allies by the unusually large number of teeth on the dactylus of the raptorial claw. In other respects it bears a close resemblance to the species of the preceding group.

The dorsal surface is smooth, highly polished and without trace of punctuation. The carapace measured behind the antero-lateral angles is about half its length including the rostrum. The median carina is distinct posteriorly, but is almost or entirely obsolete in front of the small mid-dorsal pit. Frequently two feeble ridges are visible near the frontal margin—the vestiges of the anterior bifurcation. Intermediate and lateral carinae are distinct. The antero-lateral angles are produced as short spines which fail to reach the level of the rostral base. The rostrum is subquadrate, its basal breadth being equal to its median length. The lateral margins are scarcely upturned and converge very slightly to a broad rounded apex.

The cornea of the eyes is greatly expanded; its breadth is about one-third the median length of the carapace. The corneal and peduncular axes are very slightly oblique. The anterior margin of the ophthalmic somite is sometimes straight or slightly convex, but in most cases is produced to three small but distinct points. The mandibular palp is three-segmented.

The outer inferior margin of the merus of the raptorial claw is bluntly angled at its distal end. The dorsal carina of the carpus is furnished with from two to four sharp teeth. The dactylus bears thirteen[1] to eighteen teeth including the terminal one, this number far exceeding that found in any other species of the genus. The outer margin is slightly sinuous and is obtusely angled behind.

The last three thoracic somites bear the usual submedian and intermediate carinae. The lateral margin of the fifth thoracic somite is bilobed; the anterior lobe consists of a sharp spine directed obliquely forwards; the posterior lobe is straight, sharply-acute, and only about half its length. Both lobes of the sixth somite are pointed; the anterior is a little shorter than the posterior and is only about half its width. The posterior lobe on the seventh somite is subacute; the anterior is very small and in some cases almost obsolete.

There are, as usual, eight longitudinal carinae on the first five abdominal somites and six on the sixth. The following carinae end in spines :—

Carinae.	*Abdominal somites.*
Submedian	(5) 6.
Intermediate	3, 4, 5, 6.
Lateral	(2) 3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

The telson closely resembles that found in the six preceding species. The median carina is notched near the base and the intermediate marginal teeth are sometimes slightly inturned. There are three or four (rarely five[2]) submedian denticles, eight to eleven intermediate and one lateral. The small praelateral lobe is conspicuous.

The bifurcate process of the uropods is serrate on its internal margin. The usual lobe on the outer edge of the longer spine is distinct.

The dorsal surfaces of the carapace, antennules, antennae, raptorial merus, abdo-

[1] One specimen has only ten teeth on the left dactylus.

[2] In several cases the submedian denticles are abnormally developed; in one specimen eight were observed.

men and telson are in most cases thickly strewn with small black chromatophores, which give the animal a decidedly dusky appearance. The chromatophores are aggregated on the longitudinal carinae and on the posterior margins of the abdominal and last three thoracic somites. The telson is often very densely pigmented all over except in the vicinity of the marginal denticles. On the uropods the endopod and basal segment of the exopod are suffused with black at their distal ends and the proximal part of the ultimate exopodal segment is tinged with the same colour.

In the Indian Museum are nineteen specimens registered as follows :—

$\frac{5^{*}5^{1}-66}{10}$	Off the S Coast of Arabia; 110 fms., 15° 8′ 30″ N., 51° 52′ 15″ E.	'Investigator.'	10 ♂, 8 ♀,[1] 73–84 mm. TYPES.
$\frac{648}{10}$	Persian Gulf.	F. H. Townsend.	1 ♀, 73 mm.

30. Squilla supplex, Wood-Mason.

Plate VI, fig. 69.

1875. *Squilla supplex*, Wood-Mason, Proc. As. Soc. Bengal, p. 232, reprinted in Ann. Mag. Nat. Hist. (4), XVII, p. 263 (1876).

1880. *Squilla supplex*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 20.

1894. *Squilla supplex*, Bigelow, Proc. U. S. Nat. Mus., XVII, p. 511.

1895. *Squilla supplex*, Wood-Mason, Figs. and Desc. of nine Squillidae, p. 4, pl. ii, fig. 2; pl. iii, fig. 2.

This and the two succeeding forms may easily be recognized from all other species of the genus by the increased number of carinae (more than eight) on the abdominal somites.

In *Squilla supplex* the carapace and abdomen show no trace of punctuation. The carapace, measured behind the antero-lateral angles, is about half its median length excluding the rostrum. The median carina is sharp and distinct except for its anterior bifurcation[2] which is obsolete. The intermediate and lateral carinae are indistinct in the small type specimen but quite clear in the larger examples. The lateral margins are not angled in front of the posterior corners, but antero-laterally are produced as sharp spines, which, however, fail to reach as far forwards as the level of the rostral base. The breadth of the rostrum is a little greater than its median length and its upturned lateral margins converge gradually to the broadly-rounded anterior margin. Dorsally the rostrum is smooth except for an indistinct median carina in its anterior half.

The eyes are short. The breadth of the cornea is about equal to the total length and the corneal and peduncular axes are set at right angles to one another. The antennular peduncle is shorter than the carapace. There is a three-segmented mandibular palp.

The outer inferior margin of the merus of the raptorial claw is bluntly angled distally and the carina on the dorsal aspect of the carpus is entire, but terminates

[1] Part of a haul of over 500 specimens.

[2] In Wood-Mason's figure it is much too clearly shown.

abruptly before reaching the anterior edge. The dactylus is provided with five teeth including the terminal one and its outer margin is evenly convex and obscurely lobed at its proximal end.

The last three thoracic somites possess the usual submedian and intermediate carinae and between these, in the anterior half of the somite, each bears a short and rather obscure keel directed outwards and forwards. The fifth somite is bilobed laterally; the anterior lobe consists of a long and sharp antrorse spine, the posterior is short and bluntly rounded. The margins of the two following somites are not bilobed, but are obliquely truncate (more squarely than in *S. laevis* or *S. hieroglyphica*) and are rounded posteriorly.

The first five abdominal somites, in addition to the usual eight longitudinal carinae, possess also a sharp and distinct median keel. This carina never terminates in a spine :—

Carinae.	*Abdominal somites.*
Submedian	5, 6.
Intermediate	5, 6.
Lateral	(1)[1] (2)[1] 3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5, 6.

The telson is rather longer than broad, and is sharply distinguished from the majority of the preceding species by the prominent carination of its dorsal surface. The median carina is well developed and terminates in a sharp spine overhanging a small tubercle. On either side there is a deep longitudinal groove formed by a number of confluent pits and beyond this there is a well-marked longitudinal carina continued with or without interruption to the apex of the submedian spines. Each of the usual oblique rows of pits is replaced by a rather deep groove and the surface between the grooves is raised, forming three or four short[2] but distinct oblique carinae on either side of the median ridge. On the edge of the telson the usual six teeth are well developed and there is a prominent praelateral lobe. There are three or four submedian denticles, six or seven intermediate and one lateral. The post-anal crest is absent.

In the bifurcate process from the base of the uropod, the outer margin of the longer spine bears the usual lobe near the distal end of its proximal half ; the margin anterior to this lobe is straight or feebly convex. The inner margin of the process is slightly serrate.

The secondary sexual distinctions appear to be rather pronounced. In the single large male the submedian carinae of the fifth abdominal somite, all the carinae of the last somite and the median and marginal carinae of the telson, are conspicuously swollen (fig. 69) and the propodus of the raptorial claw is strongly dilated at its distal end (fig. 69).

The large male specimen, examined shortly after capture, exhibited a considerable amount of lemon yellow colouration on the abdominal somites, telson and raptorial

[1] In the large male specimen only.

[2] In the large male these carinae are extremely short, little more than rounded tubercles, and the grooves are less conspicuous (fig. 69).

claws ; but as the specimen had sojourned, though evidently for a brief period only, in the stomach of a fish, the pigmentation was perhaps somewhat modified. The black pigment, which appears to be fairly permanent in alcohol, defines all the carinae of the carapace and of the abdomen as far as the fourth somite. There are also dark median transverse patches on the free thoracic and first two abdominal somites, extending laterally as far as the impressed line between the submedian and sublateral carinae. The inner uropod and spines of the bifurcate process are tipped with black and the terminal segment of the outer uropod is suffused with the same colour.

Only three examples of *Squilla supplex* are known ; all are preserved in the Indian Museum.

$\frac{3048}{5}$	Bombay.	F. Stoliczka.	1 ♂, 45 mm. TYPE.
$\frac{7426}{10}$	Bombay.	Bombay Nat. Hist. Soc.	1 ♀, 73 mm.
$\frac{7031}{10}$	Tuticorin, S. India.	J. Hornell.	1 ♂, 79 mm.

The last specimen was found in the stomach of *Polynemus tetradactylus*, Shaw.

31. Squilla costata, De Haan.

Plate VI, figs. 70—72.

1884 ? *Squilla costata*, De Haan, in Siebold's Fauna Japonica, Crust., atlas, pl. li, fig. 5.
1849. *Squilla costata*, De Haan, *ibid.*, text, p. 223.
1880. *Squilla costata*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 21.
1894. *Squilla costata*, Bigelow, Proc. U. S. Nat. Mus., XVII, p. 511.
1903. *Chloridella costata*, Rathbun, Proc. U. S. Nat. Mus., XXVI, p. 55.
1910. *Squilla costata*, Fukuda, Annot. Zool. Japon., VII, p. 151.

In this and in the succeeding form the lateral margins of the sixth and seventh thoracic somites are bilobed as in the *S. quinquedentata* and *S. nepa* groups. By this feature they are readily separated from *S. supplex*, from which, as from all other species, they are distinguished at a glance by the profuse carination of the abdominal somites.

The principal characters of *Squilla costata* are as follows :—

The carapace (fig. 70) is narrow and its breadth behind the antero-lateral angles is about two-fifths its median length including the rostrum. The median carina is distinct and is continuous in front of the well-marked cervical groove except for a gap at the base of the short anterior bifurcation. Posterior to the cervical groove the median carina is conspicuous and is bifurcate in its anterior two-thirds. The lateral and intermediate carinae are distinct. Between the median carina and the gastric groove, there are on each side numerous short carinules or tubercles. In the Burmese example (fig. 70) they are disposed obliquely on the area in front of the cervical groove, but behind it are situated transversely. In the Japanese specimen this feature is less evident. Other tubercles occur on the sides of the carapace and are most distinct in the posterior part. The antero-lateral angles are produced to strong spinous terminations that extend as far as or a little beyond the level of the rostral base. The rostrum is about as long as wide ; its upturned lateral margins are slightly convergent and meet in a broadly rounded apex ; on its dorsal surface it is finely rugose or with a few obscure tubercles and in the larger specimen there is a faint median carina.

The corneal portion of the eyes is set very obliquely on the stalk and its breadth, in the specimens examined, is about one quarter the median length of the carapace excluding the rostrum. The antennular peduncle is as long as the carapace (rostrum excluded). The mandibular palp is entirely missing.

The outer inferior margin of the merus of the raptorial claw is rounded distally and the dorsal carina of the carpus terminates bluntly before reaching the distal edge (fig. 71). The dactylus bears six or seven[1] teeth including the terminal one and its outer margin is convex and very obscurely notched at the base.

The lateral margins of the fifth, sixth and seventh thoracic somites are bilobed (fig. 70). The anterior lobe on the fifth consists of a sharp antrorse spine; the other lobes are rounded. The sculpture on the somites is shown in fig. 70. In addition to the intermediate and submedian carinae there are on the sixth and seventh somites four longitudinal carinae between the submedians, while on the eighth somite there are three. The whole surface is covered with numerous short ridges that are sometimes confluent with one another and so form a coarse mesh-like reticulation.

On the abdominal somites the usual four pairs of carinae may be distinguished and, in addition, between the submedians there are three complete carinae and occasionally traces of others. Outside the submedians there are one or more additional carinae which are sometimes incomplete.

The whole surface external to the submedian carinae is beset with short irregular tubercles and ridges (fig. 72). The lateral carinae of the first five somites are bicarinate[2] and traces of similar sculpture are sometimes found on the intermediates. None of the median carinae end in spines :—

Carinae.	*Abdominal somites.*
Submedian	(4) 5, 6.
Intermediate	(1) 2, 3, 4, 5, 6.
Lateral	(1) 2, 3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

The telson bears numerous carinae and tubercles disposed as shown in fig. 72. The median carina terminates in a long and slender spine. The marginal teeth are longer than is customary and there may or may not be a denticle on the edge in front of the lateral. There are three or four submedian denticles, six to eight intermediate and one lateral.

The inner and longer spine of the ventral process of the uropods bears a sharply-acute lobe on its edge and the margin anterior to this lobe is concave. The inner margin of the process is serrate.

Of the two specimens examined, the smaller example from the Burmese coast differs in several details from the larger individual which was sent me from Japan—the type locality. It is possible that the differences are due merely to age or to normal variation, but the Indian specimen may represent a distinct race.

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[1] The larger specimen bears six teeth—the customary number; the smaller example (fig. 71) possesses only one raptorial claw which is furnished with seven.

[2] Not shown in fig. 72.

The principal distinctions between the two specimens are as follow:—

Burmese Coast.	*Japanese Coast.*
1. The median carina of the rostrum is very indistinct.	1. The median carina of the rostrum is distinct.
2. There are seven teeth on the raptorial dactylus (one dactylus only examined).	2. There are six teeth on the raptorial dactylus.
3. The anterior lateral lobe of the sixth thoracic somite is nearly as broad as the posterior.	3. The anterior lobe of the sixth thoracic somite is very much narrower than the posterior.
4. The submedian carinae of the fourth abdominal somite terminate in spines.	4. The submedian carinae of the fourth abdominal somite do not terminate in spines.
5. The submedian carinae of the sixth abdominal somite are bicarinate and there are three carinae between them.	5. The submedian carinae of the sixth abdominal somite are entire and there is only a single carina between them.
6. The carinae which terminate in the submedian teeth of the telson edge are proximally bifurcate.	6. The carinæ which terminate in the submedian teeth of the telson edge are not bifurcated proximally.
7. There is no praelateral denticle on the margin of the telson.	7. There is a very conspicuous praelateral denticle on the margin of the telson.
8. On the external edge of the basal segment of the outer uropod there are ten movable spines.	8. On the external edge of the basal segment of the outer uropod there are seven movable spines.

The specimens examined do not show any distinctive colouration.

We are indebted to Mr. Alan Owston for the specimen from the Japanese coast :—

$\frac{1911}{10}$ Okitsu, Suruga Gulf, Japan. A. Owston. 1 ♂, 65 mm.

For the opportunity of describing and figuring the only known Indian example of this scarce species I have to thank Mr. A. Patience who has kindly permitted me to examine the specimen obtained on the Burmese coast by Messrs. Simpson and Rudmose Brown. This individual is a male, 31·5 mm. in length.

Miss Rathbun records a specimen 87 mm. in length.

Squilla costata was originally described from Japan (De Haan) and, except for the specimen from the Burmese coast which is mentioned above, the few examples that have since been found were all obtained on the coasts of that country. The species is known from Wakanoura and Nagasaki (Rathbun) and from Misaki (Fukuda).

32. Squilla multicarinata[1], White.

Plate VI, figs. 73—76.

1847. *Squilla multicarinata*, White, List Crust. Brit. Mus., p. 84 (*sine desc.*)
1848. *Squilla multicarinata*, White, Proc. Zool. Soc., p. 144, pl. vi, figs. 1, 1a.
1849. *Squilla multicarinata*, White, Ann. Mag. Nat. Hist. (2), IV, p. 381.
1880. *Squilla multicarinata*, Miers, Ann Mag. Nat. Hist. (5), V, p. 20.
1894. *Squilla multicarinata*, Bigelow, Proc. U. S. Nat. Mus., XVII, p. 511.
1903. *Squilla multicarinata*, Nobili, Boll. Mus. Torino, XVIII, No. 455, p. 38.

This species is allied to *Squilla costata*, but in addition to the possession of a three-segmented mandibular palp, is still more profusely carinate, the entire dorsal surface of the animal being closely ribbed.

[1] See addendum, p. 196.

The details of the carination (figs. 73—76) are as follows :—

On the carapace the median carina is distinct throughout its course and is bifurcated in front for half its length anterior to the cervical groove. Behind this groove there are 26 to 30 longitudinal carinae, of which 18 are sharper and rather more conspicuous than the rest. The carinae are least numerous in the extreme anterior part of the carapace, where there are only 16 in a transverse series. The rostrum bears 5 carinae ; two of these are quite close to, but distinct from, the lateral margin, and two, which only extend for less than half the entire length, occur at the base on either side of the well-developed median keel. There are two dorsal carinae on the basal segment of the antenna and one on the succeeding segment. On the outer surface of the merus of the raptorial claw there is a single long carina running forwards and upwards.

The fifth thoracic somite bears four *transverse* carinae and is the only part of the animal in which the carination is not longitudinal. Only the anterior carina extends across the middle line. Prior to reaching the latter point the posterior one turns obliquely forwards and, before arriving at the anterior margin, turns abruptly back to the hinder edge. The posterior half of this somite therefore bears, near the centre, four short carinae which are almost longitudinal.

The last two thoracic and all the abdominal somites are covered with close-set longitudinal carinae, most of which terminate in spines on the posterior margin. In well-grown examples there are 28 on the sixth thoracic, 25 on the last thoracic and 41 to 45 on the somites of the abdomen. The median, submedian, intermediate, lateral and marginal carinae are prominent and can easily be distinguished from the others. Of these the following end in spines :—

Carinae.	*Abdominal somites.*
Median	1, 2, 3, 4, 5.
Submedian	1, 2, 3, 4, 5, 6.
Intermediate	1, 2, 3, 4, 5, 6.
Lateral	3, 4, 5, 6.
Marginal	2, 3, 4, 5, 6.

There are ten or eleven carinae on either side of the median crest of the telson, a few of which are not continuous. With the exception of the two innermost pairs they run to the marginal teeth and to alternate denticles of the submedian and intermediate series ; their exact arrangement is, however, subject to much irregularity. On the underside of the telson there is a sharp post-anal crest and eight or nine other carinae on either side. There are also several sharp carinae on both upper and lower surfaces of the uropod and on the basal and proximal segments of the exopod.

Apart from the disposition of the carinae, *Squilla multicarinata* differs from *S. costata* in the following features :—

The carapace is broader than in *S. costata* and its anterior breadth is a little less than half its median length including the rostrum. The antero-lateral spines are considerably shorter. The eyes are more expanded and the cornea is set transversely on the stalk. The mandibular palp is present and composed of three

segments. The dactylus of the raptorial claw usually bears five[1] teeth including the apical one.

The anterior marginal lobe of the fifth thoracic somite is rather broader at the base; that of the sixth somite is truncate and the posterior lobe of the seventh somite is subacute and is more strongly produced than its fellow. The teeth on the margin of the telson are shorter and behind the lateral as in the Japanese example of *S. costata* there is a sharp and well-developed praelateral denticle; there are three submedian denticles, seven or eight (rarely nine or ten) intermediate and one lateral. The bifurcate process from the base of the uropods bears a small rounded lobe on the outer edge of the inner and longer spine. The inner edge of the process is provided with five to eight sharp spines. The basal segment of the uropod is only a little longer than the ultimate.

The colour of well-preserved spirit specimens is characteristic. Dusky patches are usually visible on the dorsal surfaces of the second and fifth abdominal somites, and the distal end of the inner uropod and basal segment of the outer uropod are suffused with black. The ultimate segment of the outer uropod is entirely jet-black and in this respect differs conspicuously from that of any other species examined (fig. 76).

There are nine specimens in the Indian Museum :—

$\frac{9806-13}{6}$	Hongkong.	Hongkong Museum.	5 ♂, 3 ♀, 63--72 mm.
$\frac{8426}{10}$	Burma, Xmas I.	Simpson and Rudmose Brown.	1 ♀, 46 mm.[2]

Squilla multicarinata has also been recorded from Nagasaki Bay, Japan, from the Philippine Is. (White, Miers) and from Singapore (Nobili).

33. **Squilla raphidea**, Fabricius.

Plate VII, fig. 77.

1758. *Squilla arenaria marina*, Seba, Thesaurus, III, p. 50, pl. xx, fig. 2.
1798. *Squilla raphidea*, Fabricius, Ent. Syst. Suppl., p. 416.
1818. *Squilla mantis* var. B. *major*, Lamarck, Hist. Nat. Anim. sans Vert., V, p. 187.
1825. *Squilla raphidea*, Latreille, Encycl. Méthod., X, p. 471: atlas (*sub S. mantis*), pl. cccxxiv
1837. *Squilla raphidea*, H. Milne-Edwards, Hist. Nat. Crust., II, p. 524.
1844? *Squilla harpax*, De Haan, in Siebold's Fauna Japonica, Crust., atlas, pl. li, fig. 1.
1845. *Squilla raphidea*, Berthold, Abhandl. Gess. Wiss. Göttingen, III, p. 29.
1847. *Squilla raphidea*, White, List Crust. Brit. Mus., p. 84.
1849. *Squilla harpax*, De Haan, in Siebold's Fauna Japonica, Crust., text, p. 222.
1880. *Squilla raphidea*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 27.
1882. *Squilla raphidea*, de Borre, C. R. Ent. Soc. Belge, (III), 20, p. cxi.
1888. *Squilla raphidea*, de Man, Journ. Linn. Soc., XXII, p. 296.
1892. *Squilla raphidea*, Thallwitz, Abhandl. kön. Mus. Dresden, no. 3, p. 55.
1893. *Squilla raphidea*, Henderson, Trans. Linn. Soc. Zool. (2), V, p. 453.
1894. *Squilla raphidea*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 535.

[1] Miers (1880 (*a*), p. 20) found seven teeth on the left-hand dactylus of a specimen from the Philippine Is. The additional teeth in this case were perhaps formed subsequent to an injury.

[2] I am indebted to Mr. Patience for an opportunity of examining this specimen.

1898. *Squilla raphidea*, de Man, Zool. Jahrb. Syst., X, p. 694.
1901. *Squilla raphidea*, Lanchester, Proc. Zool. Soc., II, p. 553.
1903. *Chloridella raphidea*, Rathbun, Proc. U.S. Nat. Mus., XXVI, p. 55.
1903. *Squilla raphidea*, Nobili, Boll. Mus. Torino, XVIII, No. 455, p. 38.
1906. *Squilla raphidea*, Lanchester, Fascic. Malayenses, Zool. III, p. 133.
1906. *Squilla raphidea*, Tattersall, Ceylon Pearl Oyster Rep., V, p. 166.
1910. *Squilla raphidea*, and var. *africana*, Balss, Abh. math.-phys. Klasse K. Bayer. Akad. Wiss., Suppl., Bd. II, Abh. 2., p. 8, text figs. 2*a*—*b*.

The dorsal surface of the carapace and abdomen is, as a rule, smooth, polished and impunctate, but in very old examples is finely rugose. The breadth of the carapace, measured behind the antero-lateral angles, is considerably less than half its median length. The postero-lateral angles are very narrowly rounded and the lateral margin, in the middle of its posterior half, projects as an acute lobe, the posterior edge forming a rectangle with the adjacent margin of the carapace. The antero-lateral angles end in small spines which in large specimens are a trifle upturned ; they fail to reach the level of the rostral base. In front of the cervical groove the median carina is distinct and is continued forwards beyond the small mid-dorsal pit ; the anterior bifurcated portion is however entirely absent. The posterior margin is deeply concave and the imperfectly calcified third and fourth thoracic somites are exposed.

The rostrum is very variable in shape. It is smoothly elevated in the middle and its upturned lateral margins meet in an acute or narrowly-rounded apex. In some examples the rostrum reaches only to three-quarters the length of the antennular somite and the lateral margins are evenly concave, while in others it may reach to the distal edge of the somite and may have sinuous margins—concave on either side of the apex.

The corneal and peduncular axes of the eye are at right angles. The cornea is sausage-shaped and its greatest breadth is fully one and a half times the length of the whole organ. The antennular peduncle is about as long as the median length of the carapace.

The mandibular palp is composed of three segments.

The merus of the raptorial claw is longer than in most species of *Squilla* ; when naturally flexed it projects backwards beyond the postero-lateral angle of the carapace. The outer inferior margin terminates distally in a blunt angle. The carina on the external aspect of the carpus is not sharp and that on its dorsal edge is entire and bends strongly inwards before reaching the distal margin. The propodus is characteristic. The row of fine pectinations which exists in most species along the margin opposed to the dactylus is replaced by a series of strong fixed spines ; seven or eight of these spines are longer than the others and alternate more or less regularly with them. As in allied species there are three strong movable spines on the inner basal edge of this margin. The dactylus is provided with eight (rarely nine) teeth including the terminal one. The outer margin is evenly convex in females and young males, but, in large examples of the latter sex, is excavate at the base, the distal border of the excavation being produced outwards as a strong rectangular process.

The last three thoracic somites (fig. 77) bear submedian and intermediate carinae; the former are often obscure or quite obsolete, while the latter are more prominent and in large specimens of both sexes terminate posteriorly in spines. On either side of the inferior surface of the fifth somite there is a broad but thin downwardly-directed lobe, which is often anteriorly acute or spinous; from its base a deep and wide groove runs upwards dividing the somite transversely into two unequal portions. The lateral margins of the sixth somite are produced to an acute posterior point; anteriorly a very short, broad and ill-defined process represents all that remains of the prominent lobe found in the species of the *S. nepa* group. The margins of the seventh somite resemble those of the sixth, but the anterior process is never represented by more than a slight angulation.

There are eight longitudinal carinae on the first five abdominal somites and six on the sixth. Those of the submedian pair are often very faintly marked except on the last somite where they appear as strong blunt ridges. The following carinae end in spines:–

Carinae.	*Abdominal somites.*
Submedian	6.[1]
Intermediate	(1)[2] (2)[2] 3, 4, 5, 6.
Lateral	1, 2, 3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

The telson is thick and massive. The median carina has the form of a strong blunt ridge which, except in very large examples (where it appears to have been worn away), terminates posteriorly in a spine. The ridge is continued beyond the spine and, as a rule, projects as a median tubercle on the distal margin. On either side of the median crest are a few oblique rows of pits. The six marginal teeth are sharp and prominent and in old specimens somewhat rugose, each forming the termination of a short rounded carina. There is no praelateral denticle. In large specimens *of both sexes* the entire margin of the telson is strongly swollen and tends to obscure the denticles. Of the latter there are four to six submedian, seven to thirteen (usually nine or ten) intermediate and one lateral. The post-anal carina is distinct and in old specimens more or less tuberculate.

In the bifurcate process from the base of the uropod the inner spine is about twice the length of the outer and bears a small lobe on its outer margin near the end of its distal half.

Among Indo-pacific species *Squilla raphidea* is peculiar in that the margins of the telson are inflated in large specimens of both sexes. The angled external edge of the raptorial dactylus, characteristic of the mature male, is, as a rule, well-marked in all examples of that sex measuring 190 mm. or more in length; but one male of 190 mm. is remarkable for the entire absence of this feature.

Balss has described a variety under the name, var. *africana*, distinguished by the form of the rostrum, the sharpness of the submedian carinae of the post-abdomen and the thickened teeth and denticles on the margin of the telson. The rostra of

[1] Often worn down and obsolete in very large specimens.

[2] In large specimens only.

several specimens in the Indian Museum resemble that figured by Balss, others are normal or short and with convex margins as in De Haan's figure of *S. harpax*. The other characters mentioned by Balss are also seen in some specimens, but it appears quite impossible to correlate them with any particular type of rostrum.

In most spirit specimens the hinder margins of all the segments of the post-abdomen except the first and last are defined by a line of black pigment. There are, as a rule, two black spots on the superior margin of the raptorial merus near its distal end, a spot or streak on the inside of the carpus close to the dorsal carina, a spot on either side of the propodus near its distal end and a round and often well-defined spot at the base of the telson on each side of the median carina. The distal ends of the uropods are also suffused with black pigment; but in the terminal segment of the exopod the suffusion is confined to the inner longitudinal half.

The following specimens of *Squilla raphidea* are in the Indian Museum :—

9834–40/6, 2328/9, 1843–9/9	Hongkong.	Hongkong Museum. G. Dennys.	18 ♂, 14 ♀, 82—179 mm.
474/9	Singapore.	Raffles Museum.	1 ♀, 253 mm.
9805/6	Port Blair, Andamans.	(purchased.)	1 ♀, 124 mm.
8178/6	Mergui Archipelago.	Mus. Collr.	3 ♂, 1 ♀, 101—175 mm.
3088/5	Rangoon.	Mus. Collr.	1 ♂, 235 mm.
5774–5/9	Off Irrawaddy Delta; 20 fms., 15° 20′ N., 94° 55′ E.	'Investigator.'	1 ♂, 1 ♀, 53, 100 mm.
7325/10	Akyab, Tenasserim.	I. H. Burkill.	1 ♂, 193 mm.
3097/5, 3112/5, 2490/7, 799/9, 9841–2/6, 8031/9, 7326/10, 765/10	M. of R. Hughli, Ganges Delta.	'Investigator.' J. H. Row. W. M. Daley. J. Butler. A. J. Milner.	9 ♂, 8 ♀, 92—300 mm.
7318–20/10	Off Puri, Orissa Coast.	'Golden Crown.'	1 ♂, 2 ♀, 243—288 mm.
7322/10	Off Gopalpur, Ganjam Coast; 25—28 fms.	'Golden Crown.'	1 ♂, 100 mm.
7323/10	Off Madras Coast.	'Golden Crown.'	1 ♂, 152 mm.
3063/5	Ceylon	Colombo Museum.	1 ♂, 127 mm.
7556/6, 7324/10	Bombay.	Bombay Nat. Hist. Soc. J. Caunter.	8 ♂, 9 ♀, 72—335[1] mm.

[1] This is, I believe, the largest known Stomatopod.

$\frac{7311}{10}$	Karachi.	Karachi Museum.	1 ♂, 108 mm.
$\frac{5261}{10}$	Persian Gulf; 28°59′ N., 50° 5′ E., 25 fms.	'Investigator.'	1 ♀, 129 mm.
$\frac{1726}{10}$	(no history.)		2 ♂, 5 ♀, 83—271 mm.

I have also examined the following specimens from other sources :—

Suruga Gulf, Japan.	A. Owston.	1 ♀, 188 mm.
Bombay Harbour.	Bombay Nat. Hist. Soc.	1 ♀, 298 mm.

Squilla raphidea has been recorded from the following localities:—Japan (De Haan, Rathbun, Balss); Hongkong (Bigelow); Formosa (Balss); Philippine Is. (Miers); Borneo (Miers); Java and Java Sea (de Man, Thallwitz); Malay Peninsula (Miers, de Man, Nobili, Lanchester); Mergui Archipelago (de Man); Madras (Henderson); Palk Bay and Rameswaram (Tattersall); E. Africa (Balss); Zanzibar (Miers).

34. Squilla annandalei, Kemp.

Plate VII, figs, 78—80.

1911. *Squilla annandalei*, Kemp, Rec. Ind. Mus., VI, p. 99.

This species is very closely allied to *S. raphidea*, but differs in the following particulars :—

1. The rostrum (fig. 78) bears some resemblance to that seen in the form of *S. raphidea* figured by De Haan under the name of *S. harpax*. The apex, however, is more bluntly rounded.
2. The dorsal processes of the ophthalmic somite are more sharply-pointed distally.
3. The antennular peduncle is at least as long as the carapace and rostrum combined.
4. The anterior lateral lobe of the sixth thoracic somite (fig. 80) is prominent and acute. It is a little shorter than the posterior lobe, the latter, however, being better developed than in *S. raphidea*.
5. The anterior lateral lobe of the seventh thoracic somite is small, but distinct and acute (fig. 80).
6. The intermediate carinae of the last three thoracic somites end in spines. These are never found in *S. raphidea* of a corresponding size.
7. The submedian carinae of the fifth abdominal somite end in spines. The complete formula is :—

Carinae.	*Abdominal somites.*
Submedian	5, 6.
Intermediate	1, 2, 3, 4, 5, 6.
Lateral	1, 2, 3, 4, 5, 6.
Marginal	1, 2, 3, 4, 5.

8. The dorsal carina of the telson is sharp and considerably higher than in *S. raphidea*. It terminates in a sharp spine overhanging a single tubercle, but is not continued beyond this to the distal margin.

The corneal portion of the eyes is a trifle larger than in *S. raphidea*, specimens

of similar size being compared. Submedian carinae are very distinct on the last three thoracic and on all the abdominal somites. The last two somites and telson are finely rugose and, frequently, a fine pearly sheen is visible on various parts of the body; most conspicuously on the under-surface of the telson. The marginal teeth of the telson are rather longer than in *S. raphidea*; there are six to eight submedian denticles, seven to eleven intermediate and one lateral.

In other structural details *S. annandalei* seems to bear an exceedingly close resemblance to the preceding species. There are eight teeth on the raptorial dactylus, a row of stiff spines along the upper margin of the propodus and an acute angular lobe on the lateral margin of the carapace. The single male example has only one raptorial claw and that has obviously been broken off and subsequently regenerated. The dactylus shows no trace of the external process found in adult *S. raphidea* of the same sex.

The pigmentation of the external segment of the outer uropod is quite distinctive and is conspicuous in all the specimens. The segment is entirely jet-black except for a white midrib (fig. 79). In *S. raphidea* there is merely a rather indefinite suffusion of black along the inner longitudinal half. There is also a dark transverse patch, sometimes broken up into four separate spots, on the second abdominal somite and various short transverse streaks on other somites (fig. 79). For the rest the dark markings resemble those of *S. raphidea*; the two black spots near the proximal end of the telson are distinct and sharply defined.

The four specimens of *Squilla annandalei* were all found in comparatively deep water in the Gulf of Martaban :—

$\frac{7563}{10}$	Gulf of Martaban; 61 fms., 14° 46′ N., 95° 52′ E.	'Investigator.'	1 ♀, 115 mm. TYPE.
$\frac{1748}{10}$	Gulf of Martaban; 67 fms., 14° 26′ N., 96° 23′ E.	'Investigator.'	1 ♂, 106 mm.
$\frac{1711}{10}$	Gulf of Martaban; 55 fms., 14° 54′ 30″ N., 96° 13′ E.	'Investigator.'	1 ♀, 101 mm.
$\frac{1749}{10}$	Gulf of Martaban: 53 fms., 14° 38′ 12″ N., 96° 24′ 30″ E.	'Investigator.'	1 ♀, 96 mm.

"Leptosquilla schmeltzii" (A. Milne-Edwards).

Plate VII, figs. 81—83.

1873. *Squilla schmeltzii*, A. Milne-Edwards, Journ. Mus. Godeffroy, I, iv, p. 87, pl. ii, fig. 7.
1880. *Squilla schmeltzii*, Richters, in Möbius' Meeresfauna Mauritius, p. 168.
1880. *Leptosquilla schmeltzii*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 13.

There can be little doubt that the Stomatopod to which this name has been applied is merely a late post-larval example of the genus *Squilla*. One of its most prominent features, that on which Miers founded the genus *Leptosquilla*, is the peculiar elongated form of the antennular somite[1] and it is clear from comparison with Bigelow's figure of the "first stage of the adult form" in *Squilla quadridens* (1894, p. 548, text-fig. 28)

[1] Miers states that it is "the ophthalmic segment which is greatly elongated and prolonged beyond the rostrum." This is clearly an error.

that this is characteristic merely of a particular stage in the development of certain species.

There is a single specimen of this form in the Indian Museum which appears to belong to the same species as that described by Milne-Edwards. The chief characters are sufficiently well shown in the figures (figs. 81-83) to render detailed description unnecessary.

I am inclined to agree with Hansen (1895, p. 69) that the form is in all probability related to one of the species of *Squilla* to which Miers applied the name *Chloridella*, though the possibility of some affinity with such species as *S. fasciata*, *S. lata* and *S. scorpio* cannot be overlooked.

In the very elongated cylindrical eyes *L. schmeltzii* bears no resemblance to any adult species of *Squilla*; it is probable, however, that this feature is subject to considerable modification during further growth. But the chief difficulty that is encountered in an attempt to discover relations between this form and any species of *Squilla* hitherto known from the Indo-pacific region concerns the structure of the raptorial claw. The dactylus of *L. schmeltzii* bears seven teeth and, among species of *Squilla* with a single lateral process on the fifth thoracic somite, this number is found only in *S. armata*, a species of isolated position and a peculiar distribution confined to southern latitudes.

In the present state of our knowledge it seems impossible to suggest any plausible view of the relations of this form; but it may prove considerably easier when the early post-larval history of the adult species is better known.

The single specimen in the Indian Museum is registered as follows :—

$\frac{3117}{7}$ Port Blair, Andamans. J. Wood-Mason. 1 ♂, 11 mm.

Genus **Pseudosquilla**, Dana.

1837. *Squilla*, Squilles trapues, H. Milne-Edwards, Hist. Nat. Crust., II, pp. 518, 525.
1837. *Gonodactylus*, H. Milne-Edwards, *ibid.* pp. 528, 530 (*partim*).
1849. *Squilla*, sect. *Parallelæ*, De Haan, in Siebold's Fauna Japonica, Crust., p. 221.
1852. *Pseudosquilla* (Guérin *ined.*) Dana, U.S. Explor. Exped., Crust., p. 621.
1880. *Pseudosquilla*, Miers, Ann. Mag. Nat. Hist (5), V, p. 108.
1894. *Pseudosquilla*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 498.

Carapace little narrower in front than behind with conspicuous gastric grooves; cervical groove usually absent, never visible mid-dorsally; no carinae on carapace; antero-lateral angles not spinous, cornea of eye rarely bilobed. Mandibular palp composed of three, rarely of two, segments. Merus of raptorial claw articulating terminally with ischium; ventral surface of merus channelled longitudinally throughout its length; upper margin of propodus finely pectinate externally; dactylus not inflated at base and armed with at most three teeth excluding terminal one. Shorter ramus of last three thoracic limbs linear, composed of a single segment. Free thoracic and abdominal somites compressed, first five of the latter without sharp longitudinal carinae. Telson with median carina and one to five pairs of additional carinae; submedian, intermediate and lateral marginal teeth, well-formed, the first

with at least the tips movable; no submedian denticles, never more than three intermediate denticles. Ventral process of uropods consisting either of two well-formed spines, inner longer than outer, or *vice versa* and with an additional spine or spine and spinules on inner margin near base.

In structure there do not appear to be any marked secondary sexual differences.

One species, the very curious and rare *P. ferusacci* from the Mediterranean, disagrees in several important particulars from the diagnosis given above and seems in fact to be almost exactly intermediate in character between *Pseudosquilla* and *Squilla*. The principal features in which alliance with the latter genus is shown are (i) the well marked cervical groove, (ii) the presence of the posterior reflected part of the marginal carina of the carapace and (iii) the presence of fine submedian, intermediate and lateral carinae on the abdomen. The form of the telson is, however, similar to that found in *Pseudosquilla* and the characters afforded by the ventral process from the basal segment of the uropods seem to indicate a position near *P. empusa*, *P. cerisii*, *P. lessoni* and their allies.

Another outstanding form of doubtful position is *P. stylifera*; this species is known from the Australian and Chilian Coasts and there is some evidence to show that different races inhabit these widely separated localities.

Of the twelve species of *Pseudosquilla* that are known, nine have been found within the area with which this memoir is concerned and two of these, *P. ciliata* and *P. oculata*, have also been taken in the Atlantic. Two forms, *P. cerisii* and *P. ferussaci*, appear to be restricted to the Mediterranean and one, *P. lessoni*, is known only from the Pacific Coast of America.

In *Pseudosquilla ciliata* and its immediate allies a curious process springs from the dorsal aspect of the antennal protopodite. This consists of a flat elongated plate, directed forwards, and provided inferiorly with a deep vertical keel. In some cases this process seems to afford useful specific indications.

The species of *Pseudosquilla* seem to prefer rough ground, inhabiting coral reefs, oyster-beds and similar situations. They are invariably found in shallow water, the greatest depth from which any species is known being 20–23 fathoms (*P. ciliata*, Bigelow).

The carinae on the telson, in species which possess the full complement, consist of a median and five pairs and for these I have used the terms "submedian," "intermediate," "first lateral," "second lateral" and "marginal." This terminology is the same as that employed in the case of *Odontodactylus* (see text-fig. 4, p. 12), but the "second submedians" are never found in the present genus.

Key to the species of *Pseudosquilla*.

I. Dactylus of raptorial claw with teeth on its inner margin.

A. Basal process of uropods terminating in two large teeth, its inner margin smooth.

1. Telson with only three carinae on either side of median crest, the first and second laterals being absent.

A. Eyes long and cylindrical; cornea set very obliquely on stalk .. *ciliata*, p. 96.
B. Eyes short and flattened; cornea set transversely on stalk.
1. Rostrum without a median distal spine; a pair of dark spots on carapace, usually surrounded by a white ring .. .. *ornata*, p. 100.
2. Rostrum with a slender median distal spine; a pair of dark spots on carapace not surrounded by a white ring .. .. *oxyrhyncha*, p. 101.

II. Telson with four pairs of carinae on either side of median crest, the first lateral present.
A. Breadth of cornea scarcely equal to whole length of eye; six posterior spines on last abdominal somite; first lateral carinae of telson parallel, terminating behind base of intermediate marginal teeth. .. .. *oculata*, p. 102.
B. Breadth of cornea greater than whole length of eye; eight posterior spines on last abdominal somite; first lateral carinae of telson posteriorly divergent, coterminous with lateral marginal teeth .. *megalophthalma*, p. 103.

B. Basal process of uropods with a single large additional tooth or with a series on inner margin.
I. Telson with not more than three carinae on either side of the median crest.
A. Rostrum less than twice as broad as long; abdomen with nine fine longitudinal carinae; telson without submedian carinae. .. [*ferussaci.*]
B. Rostrum almost three times as broad as long; first five abdominal somites without carinae; telson with one pair of submedian carinae .. .. *empusa*, p. 104.
II. Telson with full complement of carinae, five on either side of median crest.
A. Raptorial dactylus with three teeth[1]; telson carinae not spinous.
1. Basal process of uropod bearing three large teeth, one terminal and two on inner margin.
a. Rostrum with sharp median spine and obtuse antero-lateral angles .. .. [*cerisii.*]
b. Rostrum with sharp median spine and acute or spinous antero-lateral angles .. .. [*lessoni.*]
2. Basal process of uropod with two large teeth and numerous small spines on inner margin .. .. .. *dofleini*, p. 104.
B. Raptorial dactylus with four teeth,[1] submedian carinae of telson with two or three sharp spines, intermediate with two distal spinules, first lateral with one .. .. .. *pilaensis*, p. 105.
II. Dactylus of raptorial claw with spinous termination, but without teeth on inner margin. [Rostrum longer than broad; ophthalmic somite largely exposed; eyes long with very oblique cornea; telson with intermediate carinae; basal process of uropod terminating in a single large tooth] .. *stylifera*, p. 106.

1. Pseudosquilla ciliata[2] (Fabricius).

1787. *Squilla ciliata*, Fabricius, Mantiss. Insect., I, p. 333.
1790. *Cancer ciliatus*, Linnaeus, Syst. Nat., ed. XIII, I, p. 2990.

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[1] Including the terminal tooth.
[2] See addendum, p. 196.

1793. *Squilla ciliata*, Fabricius, Ent. Syst., II, p. 512.
1796. *Cancer (mantis) ciliatus*, Herbst, Krabben u. Krebse, II, p. 102.
1798. *Squilla ciliata*, Fabricius, Ent. Syst. Suppl., p. 417.
1818. *Squilla stylifera*, Lamarck, Hist. Nat. Anim. sans Vert., V, p. 189.
1825. *Squilla stylifera*, Latreille, Encycl. Méthod., X, p. 472.
1829-43. *Squilla stylifera*, Guérin Méneville, in Cuvier's Iconogr. Règne Anim., III, Crust., p. 19, pl. xxiv, fig. 1*a*, *b*.
1832. *Squilla ciliata*, Owen, Proc. Zool. Soc., p. 6.
1837. *Squilla stylifera*, H. Milne-Edwards, Hist. Nat. Crust., II, p. 526.
1838. *Squilla stylifera*, H. Milne-Edwards, in Lamarck's Hist. Nat. Anim. sans Vert., 2nd ed., V, p. 324.
1839. *Squilla ciliata* (Leach, MS.), Owen, Zool. Voy. 'Blossom' Crust., p. 90, pl. xxvii, fig. 5, 5*a-d*.
1839. *Squilla stylifera*, Randall, Journ. Acad. Nat. Sci. Philadelphia (1), VIII, p. 147.
1841. *Squilla quadrispinosa*, Eydoux and Souleyet, Voy. de la 'Bonite,' Zool., I, Crust., p. 262, pl. v, fig. 1.
1847. *Squilla ciliata*, White, List Crust. Brit. Mus., p. 84.
1850. *Squilla stylifera*, Gibbes, Proc. Americ. Assoc., p. 200.
1852. *Pseudosquilla stylifera*, Dana, U.S. Explor. Exped., Crust., I. p. 622, pl. xli, figs. 4, *a-e*.
1862. *Squilla stylifera*, A. Milne-Edwards, in Maillard's l'île Réunion, ann. F., p. 16.
1869. *Squilla stylifera*, Clark, Proc. Zool. Soc., p. 3.
1872. *Pseudosquilla stylifera*, v. Martens, Arch. f. Naturgesch., XXXVIII, i, p. 146.
1874. *Squilla stylifera*, Hoffmann, Réch. Faune Madagasc., V, ii, p. 36.
1880. *Pseudosquilla ciliata*, Miers, Ann. Mag. Nat. Hist. (5), V, pp. 108, 458, pl. iii, figs. 7, 8.
1880. *Squilla quadrispinosa*, Richters, in Möbius' Meeresfauna Mauritius, p. 168.
1880. *Pseudosquilla stylifera*, Richters, *ibid.* p. 169.
1882. *Pseudosquilla ciliata*, Haswell, Cat. Australian Crust., p. 209.
1886. *Pseudosquilla ciliata*, Müller, Verhandl. naturf. Ges., Basel, VIII, p. 471.
1886. *Pseudosquilla ciliata*, Brooks, Voy. H.M.S. 'Challenger,' XVI, Stomatop., p. 53, pl. xv, fig. 10.
1887. *Pseudosquilla ciliata*, de Man, Arch. f. Naturgesch., LIII, i, p. 571.
1892. *Pseudosquilla ciliata*, Thallwitz, Abhandl. kön. Mus. Dresden, no. 3, p. 55.
1893. *Pseudosquilla ciliata*, Henderson, Trans. Linn. Soc., Zool., (2), V. p. 454.
1893. *Pseudosquilla ciliata*, Pocock, Ann. Mag. Nat. Hist. (6), XI, p. 474.
1894. *Pseudosquilla ciliata*, Bigelow, Proc. U.S. Nat. Mus., XVII. p. 499.
1895. *Pseuderichthus communis*, Hansen, Isop. Cumac. u. Stomatop. Plankton. Exped., p. 86, pl. viii, figs. 5-5*b*. (larval form).
1898. *Pseudosquilla ciliata*, de Man, Zool. Jahrb., Syst., X, p. 694.
1898. *Pseudosquilla ciliata*, Borradaile, Proc. Zool. Soc., p. 36.
1899. *Pseudosquilla ciliata*, Rankin, Ann. N. Y. Acad. Sci., XII. p. 545.
1899. *Pseudosquilla ciliata*, Borradaile, in Willey's Zool. Results, p. 402 (including var. *occidentalis*).
1899. *Pseudosquilla ciliata*, Nobili, Ann. Mus. civ. Genova (2), XX, p. 275.
1901-3. *Pseudosquilla ciliata*, Verrill, Trans. Conn. Acad., XI. p. 20.
1902. *Pseudosquilla ciliata*, Bigelow, Bull. U.S. Fish Comm. for 1900, XX, 2, p. 154, figs. 3, 4.
1902. *Pseudosquilla ciliata*, de Man, Abhandl. senck. Ges. Frankfurt, XXV, p. 911.
1903. *Pseudosquilla ciliata*, Lanchester, Faun. and Geog. Maldives and Laccadives, I, p. 457.
1904. *Pseuderichthus communis*, Jurich, Stomatop. deutsch. Tiefsee-Exped., p. 395, pl. xxix, fig. 1.
1906. *Pseudosquilla ciliata*, Tattersall, Ceylon Pearl Oyster Rep., V, p. 167.
1906. *Pseudosquilla ciliata*, Nobili, Ann. Sci. Nat. Zool. (9), IV, p. 335.
1907. *Pseudosquilla ciliata*, Borradaile, Trans. Linn. Soc., Zool. (2), XII, p. 213.
1910. *Pseudosquilla ciliata*, Lenz, in Voeltzkow's Reise in Ost-Afrika, II, p. 571.
1910. *Pseudosquilla ciliata*, Fukuda, Annot. Zool. Japon., VII, p. 145.

The carapace is smooth, without carinae, and is considerably longer than its greatest breadth. The gastric grooves converge anteriorly; of the cervical groove no trace remains. The antero-lateral angles are rounded. The rostrum is fully one and a half times as broad as long, widest in front of the base, and its strongly rounded, lateral margins meet apically in a very broad, obtuse, and almost obsolete angle.

The eyes are cylindrical and about as long as the greatest breadth of the rostrum. The cornea scarcely exceeds the breadth of the stalk and is set very obliquely on it. It is traversed laterally, both inside and outside, by a narrow longitudinal band composed of fine parallel grooves. The antennular peduncle is about half the length of the carapace and rostrum combined. The dorsal process of the proximal segment of the antennal protopodite is flat above and the margin of the vertical keel on its ventral surface is concave in lateral view.

The carpus of the raptorial claw is bluntly carinate dorsally; the propodus bears three movable spines at the base of its pectinate margin and the dactylus is very slender, convex externally, and possesses three long flattened teeth including the apical one.

The exposed thoracic somites are smooth dorsally. The fifth has a deep vertical groove on its lateral face. The lateral margins of the sixth somite are truncate; those of the seventh are less sharply truncate and, owing to the oblique antero- and postero-lateral edges, are much narrower. The eighth somite is narrowly rounded laterally with a small and deeply incised apical notch.

The first five abdominal somites are smooth except for a deep Y-shaped groove on the lateral face of the first and for a pair of conspicuous pits on each of the four succeeding somites. The postero-lateral angles of the fourth end in a small spine in Atlantic specimens and in some from the Indo-pacific; those of the fifth somite are invariably spinous. The sixth somite has a pair of strong submedian spines on its posterior margin and a similar pair at the postero-lateral angles. Between these two pairs there is an additional spine on either side which springs from the middle of the somite and does not quite reach to the distal edge. The abdomen is very strongly arched from side to side and its greatest breadth is contained rather less than five and a half times in the total length.

The telson bears seven carinae on its dorsal surface, the first and second laterals being absent. The median carina is high and sharp and terminates in a strong spine which may reach as far as the distal margin. The submedians are low and in young examples inconspicuous; they converge distally to the posterior end of the median carina and are absent in the anterior third of the telson. The intermediate carinae are strong, posteriorly divergent, and end abruptly in a sub-acute apex. The marginal carinae are externally curved and reach the edge of the telson in front of the posterior marginal tooth. Inside this carina near the proximal end there is a small tubercle. On the margin there are six large spines: a pair of long movable submedians and two pairs, the intermediates and laterals, which are fixed. The edge between the submedians is usually rather deeply incised, rarely entire. On the inner side of the intermediates there is a minute spinule succeeded by a rounded lobe and the margin

between the intermediates and laterals is concave or slightly sinuous with a small spinule at the base of the latter. The ventral surface of the telson is smooth.

The external margin of the peduncular segment of the uropod is rounded; dorsally there is a blunt longitudinal carina which is produced as a spine over the articulation of the basal segment of the exopod. The ventral process is long, reaching almost to the apex of the exopod; distally it is cut into two strong spines, the inner of which is usually a trifle longer than the outer. There are seven to nine movable spines on the outer margin of the proximal segment of the exopod; the terminal one, which is the longest, fails to reach, or only just reaches the distal end of the ultimate segment. On the ventral surface there is a single fixed spine at the distal end. The paddle or ultimate segment of the exopod is at least three-quarters the length of that which precedes it.

The colour of spirit specimens is not specially distinctive; the large eye-spot on either side of the carapace, which occurs in some of the allied species, is missing. Clark (1869, *sub Squilla stylifera*) has given a most interesting account of the habits of this species and has described the colour of the living animal as follows :—

"When first hatched the larvae are of a delicate yellowish green, and are very active. As they grow they assume a mottled grey, and the swimmerets and legs become pea-green. The green gradually increases in brightness, but it is not till they have reached a length of three inches that the colours of the adult appear. The male is then of a beautiful bluish green, with the jaw-feet, the swimmerets, and the branchiae, as well as the antennae and the fimbriae which border the different organs, of a cherry-red. The female is clouded with brown and grey, presenting much the appearance of tortoise shell, and the red about her is much less vivid than in the male."

Specimens preserved in formalin and examined shortly after capture were of a uniform dull olivaceous yellow, very faintly mottled with white laterally, and tending to a slightly redder shade on the telson and to a green tone on the inner and outer uropods. The antennal and antennular peduncles, the base of the antennal scale, and the raptorial claw were mottled with dull yellow and white and the raptorial dactylus was in addition marbled with red. The other thoracic and abdominal appendages were olivaceous, sometimes faintly mottled and all the fringes of setae were red.

According to Brooks' observations (1886) Atlantic specimens of this species differ in certain small details from those found in the Indo-pacific seas, and Borradaile (1899) proposed to distinguish the former by the name var. *occidentalis*. Bigelow, however, in 1902, supplied a description and good figures of the Atlantic specimens from which it appears that only one character (*i.e.* the presence or absence of a postero-lateral spine on the fourth abdominal somite) remains to distinguish the two forms. Now that Tattersall has found by actual comparison that a specimen from Ceylon possesses all the characters which Brooks noted as distinctive of his West Indian specimens, there seems little to justify Borradaile's statement in 1907 that "it is not clear if the true *P. ciliata* is found in the Atlantic."

Of the sixteen specimens, all from Indo-pacific waters, which are preserved in the

Indian Museum, three possess spines at the postero-lateral angle of the fourth abdominal somite, while, in all, the inner spine of the bifurcate process of the uropod is, as shown in Bigelow's figure, slightly longer than the outer.

The specimens examined are registered as follows :—

$\frac{3357}{7}$	Australia.	.. Queensland Museum.	.. 1 ♀, 76 mm.
$\frac{3054}{5}$	Upolu, Samoa.	.. (purchased.)	.. 1 ♀, 81 mm.
$\frac{3046}{5}$	Andaman Is.	.. { B. Ford, V. Ball, J. Wood-Mason. }	.. 1 ♂, 3 ♀, 19–56 mm.
$\frac{5772-3}{9}$	Andaman Is.	.. G. H. Booley.	.. 2 ♀, 61 and 75 mm.
$\frac{7317}{10}$	N. Cheval Paar, Ceylon.	.. T. Southwell.	.. 2 ♂ 1 ♀, 50–55 mm.
$\frac{651-4}{10}$	Persian Gulf.	.. F. H. Townsend.	.. 2 ♂ 2 ♀, 27–51 mm.
$\frac{3055}{5}$	Mauritius.	.. Stege.	.. 1 ♂, 31 mm.

I have also seen three examples, kindly sent me on loan by Mr. Alan Owston. These were found at Iriomote, Yayeyama, Liu Kiu Is.

Pseudosquilla ciliata appears to be a common species, of constant occurrence in coral reefs, and has a wide distribution in Indo-pacific and Atlantic waters. In the former region it has been recorded from the Ogasawara Is., Japan (Fukuda), Hawaiian Is. (Owen, Randall, Miers, Eyd. and Soul., Dana, Brooks, Bigelow), Solomon Is. (Miers), Fiji Is. (Miers, Dana), Loyalty Is., New Britain and Ellice Is. (Borradaile), Australia (Miers), Arafura Sea (Pocock), New Guinea (Miers, Thallwitz), Amboina (de Man), Celebes (de Man), Sooloo Sea and Philippine Is. (Miers), Sumatra (Nobili), Timor (30 fms.), Ceylon (Muller, Tattersall), Minikoi (Lanchester), Maldives (Lanchester), Madras (Henderson), Red Sea (Nobili), Seychelles (Borradaile), Mauritius (Richters, Clark), Réunion (Milne-Edwards, Hoffmann), Madagascar (Lenz) and from Diego Garcia, Wazin I. and Zanzibar (Borradaile).

In the Atlantic the adult is known from Bermuda (Bigelow) Bahama Is. (Rankin, Bigelow), S. Carolina (v. Martens), Florida Keys, Porto Rico and Culebra Is. (Bigelow) and from St. Thomas (Bigelow, 20-23 fms. ; Brooks, 2 fms.).

The larva has been recorded from the Indian Equatorial current (Jurich) from Ceylon (Tattersall) and from the Chagos Archipelago ; Alphonse Is., Amirante group ; Providence Is. and between Mauritius and Cargados (Borradaile). In the Atlantic it has been recorded from the Sargasso Sea and the N. Equatorial current (Hansen).

2. **Pseudosquilla ornata**, Miers.

1861. *Pseudosquilla oculata*, Heller, Verhandl. zool-bot. Ges. Wien, XI, p. 497.
1865. *Pseudosquilla oculata*, Heller, Reise ' Novara ' Exped., Crust., p. 124.
1880. *Pseudosquilla ornata*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 111, pl. iii, figs. 5, 6.
1887. *Pseudosquilla ornata*, de Man, Arch. f. Naturgesch., LIII, i, p. 571.
1894. *Pseudosquilla ornata*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 500.
1894. *Pseudosquilla ornata*, Ortmann, Denk. med-wiss. Ges. Jena, VIII, p. 60.
1907. *Pseudosquilla ornata*, Borradaile, Trans. Linn. Soc., Zool. (2), XII, p. 213.

Pseudosquilla ornata is closely allied to *P. ciliata* but differs from it in the following characters :—

1. The rostrum is shorter, nearly twice as broad as long.
2. The eyes are much stouter, shorter than the greatest breadth of the rostrum and the cornea is dorso-ventrally flattened and is set transversely on the stalk.
3. The dorsal process of the basal segment of the antennal protopodite is deeply chanelled dorsally and the margin of the vertical keel on its ventral surface is not concave in lateral view.
4. The seventh thoracic somite is squarely truncate laterally and is not narrowed, and the lateral margin of the eighth shows only obscure indications of the deeply-incised notch which occurs in *P. ciliata*.
5. The anterior limb of the Y-shaped groove on the lateral wall of the first abdominal somite is obsolete.
6. There is a deep incised groove isolating *two* separate lobes between the submedian and intermediate spines of the telson, and a similar groove defining a similar lobe just inside the lateral spines. These lobes replace the small spinules noticed in the preceding species.
7. The outer spine of the bifurcate process of the uropod is much larger than the inner and reaches to the distal end of the exopod.
8. The ultimate segment of the exopod is very small, less than half the length of the preceding segment and the outermost of the 9-11 movable spines which fringe the external margin of the latter, reaches beyond the apex of the former.
9. The whole animal is narrower, the greatest breadth of the abdomen being about one-sixth the total length.

In most spirit specimens a pair of conspicuous dark eye-spots, which are frequently defined by a white ring, are found on the carapace.

There are only two specimens in the Indian Museum :—

$\frac{3051}{5}$	Samoa.	.. (purchased.)	.. 1 ♂, 82 mm.
$\frac{3050}{5}$	Mauritius.	.. Stege.	.. 1 ♀, 47 mm.

This species appears to be much scarcer than *P. ciliata*; it has been recorded from Tahiti (Heller); Samoa (Ortmann); Kagoshima, Japan (Ortmann); Philippines (Miers); Amboina (Miers, de Man, Ortmann); Salomon Atoll, Chagos Arch. (Borradaile)· Coetivy, Seychelles (Borradaile) and Mauritius (Bigelow).

3. **Pseudosquilla oxyrhyncha**, Borradaile.

1898. *Pseudosquilla oxyrhyncha*, Borradaile, Proc. Zool. Soc., p. 37, pl. vi, figs. 9, 9*a-d*.
1907. *Pseudosquilla oxyrhyncha*, Borradaile, Trans. Linn. Soc., Zool. (2), XII, p. 213.

This species is known to me only from Borradaile's description and figures. It is evidently extremely closely allied to *P. ornata*, but differs from it in possessing a delicate apical spine on the rostrum. Borradaile (1907) states that, in addition, the last segment of the expodite of the uropod is outreached by the inner spine of the bifurcate process, but in his figure (1898) the reverse is shown. The dorsal edge of the carpus of the raptorial claw terminates (according to the figure) in a spine and in this respect differs from the examples of *P. ornata* in the Indian Museum. In other details, such as the form of

the eyes, of the telson, and of the lateral margins of the sixth and seventh thoracic somites, there appears to be the closest resemblance between the two forms.

The colour is as follows :—"Abdomen olive-green, mottled with paler green ; carapace greenish brown, mottled with cream ; raptorial claw brown (dactylus purple) mottled with cream." There is also a pair of large dark spots on the carapace, not surrounded by a white ring.

The only known specimen, a male, 88 mm. in length, was found at Rotuma, Fiji Is.

4 **Pseudosquilla oculata** (Brullé).

1836-44. *Squilla oculata*, Brullé, in Webb and Berthelot's Iles Canaries, Zool., II, ii, Crust., p. 18, pl. unique, fig. 3.
1880. *Pseudosquilla oculata*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 110, pl. iii, figs. 3, 4.
1880. *Pseudosquilla oculata*, Richters, in Möbius' Meeresfauna Mauritius, p. 169.
1891. *Pseudosquilla oculata*, de Man, Notes Leyden Mus., XIII, p. 59.
1893. *Pseudosquilla oculata*, Pocock, Ann. Mag. Nat. Hist. (6), XI, p. 474.
1894. *Pseudosquilla oculata*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 500.
1895. *Pseudosquilla distinguendus*, Hansen, Isop. Cumac. u. Stomatop. Plankton. Exped., p. 86.
1904. *Pseuderichthus distinguendus*, Jurich, Stomatop. deutsch. Tiefsee-Exped., p. 39, pl. xxvii, fig. 5.
1907. *Pseudosquilla oculata*, Borradaile, Trans. Linn. Soc. Zool. (2), XII, p. 214.
1907. *Pseuderichthus distinguendus*, Borradaile, *ibid.*, p. 215.

This species is also a close ally of *P. ornata*, but is readily distinguished from it and from both the preceding species by the possession of an additional pair of short longitudinal carinae on the telson. These carinae, the first laterals, are parallel and terminate behind the base of the intermediate marginal teeth.

In other respects the points of distinction between *P. oculata* and *P. ornata* are few :—

1. The rostrum is provided with an apical spine.[1]
2. The eyes are flattened as in *P. ornata*, but are shorter and more thick-set ; the cornea is transverse, very noticeably wider than the stalk, and its greatest breadth is almost equal to the length of the whole organ.
3. The ultimate segment of the exopod is even smaller than in *P. ornata*, being much less than half the length of the preceding segment. It is outreached both by the distal external spine of the basal segment and by the outer (and longer) spine of the bifurcate process.

De Man has compared the type specimen of this species, which was found at the Cape Verde Is., with two from Samoa, and notes that the only differences he can find are that in the Pacific examples the eye-peduncles are a little more dilated at the distal end and that the rostrum is slightly more transverse with the apical spine a trifle longer.

According to Miers the colour of this species is described by Webb and Berthelot as being of a green colour, with numerous yellow rounded spots ; there is a large round

[1] This spine in the single specimen examined, is much larger than is indicated in Miers' figure.

green spot on each side bordered with a yellow ring; penultimate joint of raptorial limbs bordered with green and yellow; dactyli rose-coloured.

There is only a single small specimen of *P. oculata* in the Indian Museum:—

$\frac{3052}{5}$ Society Is. Otago Museum. 1 ♀, 27 mm.

Pseudosquilla oculata has been recorded from Samoa (de Man); Macclesfield Bank, China Seas (Pocock) and from Mauritius (Richters, Bigelow). In the Atlantic it is known from the Cape Verde Is. (Brullé) and from Madeira (Miers).

5. Pseudosquilla megalophthalma, Bigelow.

1894. *Pseudosquilla megalophthalma*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 500.
1906. *Pseudosquilla megalophthalma*, Nobili, Ann. Sci. Nat. Zool. (9), IV, p. 336.

P. megalophthalma, of which I have seen no specimens, is related to *P. oculata*, and possesses the same number of carinae on the telson. It may be distinguished by the following characters:—

1. The rostrum is broadly heart-shaped, truncated at the base, and is intermediate in form between that of *P. ornata* and *P. oculata*.
2. The eyes are large and triangular. The conical portion is set transversely on the stalk and its breadth is considerably greater than the length of the whole organ.
3. In addition to the usual six spines on the last abdominal somite there is a small one on the inner side of each of the intermediates.
4. On the dorsal surface of the telson the first lateral carinae[1] are not parallel as in *P. oculata*, but are posteriorly divergent and are continued to the tips of the lateral spines.
5. The distal segment of the exopodite of the uropods is larger than in *P. oculata* or *P. ornata*.

The raptorial claw also is longer and more slender, and, when folded, extends from the apex of the eyes to the most posterior part of the carapace.

In the type specimen the postero-lateral angles of the last five abdominal somites are spinous; only the last three in the specimens recorded by Nobili. The outer of the two spines of the bifurcate process of the uropod is longer than the inner in Bigelow's example, but in Nobili's specimens the two are subequal.

The colouring, according to Nobili is characteristic:—"Sur la carapace il y a une grosse tache oculiforme noire, entourée par une ligne jaunâtre. Les angles postérieurs du cinquième et du sixième segment de l'abdomen sont aussi colorés de noir avec une ligne jaunâtre. Le dos du doigt des pattes ravisseuses, et les épines et les crêtes du telson ont une couleur violette."

Bigelow's specimen, which is 68 mm. in length, was found at Mauritius, the five smaller examples recorded by Nobili were taken at Obock in the Red Sea and at Djibouti.

[1] It is possible that these carinae are not in reality first laterals, but are homologous with the second lateral carinae found in *P. dofleini*, *pilaensis* and *cerisii*. No figure of the telson is extant.

6. Pseudosquilla empusa (De Haan).

1844? *Squilla empusa*, De Haan, in Siebold's Fauna Japonica, Crust., atlas, pl. li, fig. 6.
1849. *Squilla empusa*, De Haan, *ibid.*, text, p. 224.
1880. *Pseudosquilla ? empusa*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 113.
1884. *Pseudosquilla empusa*, Miers, Voy. H.M.S. 'Alert,' p. 567.
1894. *Pseudosquilla ? empusa*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 499.

The rostrum is broadly truncate in front, almost three times as wide as long and is impressed in the middle. The cornea of the eyes, according to De Haan's description is scarcely wider than the middle of the stalk ; in the figure, however, it appears to be considerably broader. The raptorial dactyli bear three teeth including the terminal one.

The thorax and first five abdominal segments have the same form as in *P. ciliata*. The sixth somite is furnished with six indistinct carinae ; the submedian and intermediate carinae do not terminate in spines. On the telson there is a median carina, a pair of submedians, one pair of laterals and perhaps also a pair of marginals. The six large marginal teeth are broad and flattened ; De Haan does not state that the submedians are movable, and the feature is not apparent in his figure. The basal process of the uropods terminates in two large teeth, the outer longer than the inner. In addition there is one stout tooth, and possibly a series of smaller teeth also, on the internal margin of the process.

Pseudosquilla empusa has not been rediscovered since it was originally described by De Haan. The type specimen, about 83 mm. in length,[1] is recorded from Japan.

7. Pseudosquilla dofleini, Balss.

1910. *Pseudosquilla dofleini*, Balss, Abh. math.-phys. Klasse k. bayer. Akad. Wiss., Suppl., Bd. II, Abh. 2, p. 7, text-fig. 1.

The principal characters of this species are as follows :—

The rostrum consists of a short basal part with rounded lateral margins and a strong median spine. The cornea of the eyes is greatly expanded, much wider than the stalk and is set obliquely. The dactylus of the raptorial claw is furnished with a tubercle at the base of its outer edge ; it bears three teeth, the terminal one long, the other two much shorter.

The lateral margins of the last three thoracic somites are rounded. The posterolateral angles of the fifth abdominal somite are spinous, those of the four preceding somites, though sharply angled, do not bear spines. The last somite has six longitudinal ridges, terminating in spines, as in *P. ciliata*. On the telson the full number of carinae are present, five on either side of the median keel. The intermediate carinae are continued to the apex of the submedian spines, the first laterals stop close behind the base of the intermediate teeth and the second laterals are coterminous with the lateral teeth.

The basal process of the peduncular joint of the uropods bears a row of small teeth

[1] There is reason to believe that De Haan's figure represents his specimen at its full size.

on its inner margin. It terminates in two larger teeth, the outer about twice the length of the inner.

Pseudosquilla dofleini is allied to *P. cerisii*, and *P. lessoni*, but is readily distinguished from them by the numerous teeth on the inner margin of the uropodal process.

The above account is derived from Balss' figure and description of the only known specimen. This example a female, 85 mm. in length, was found in Sagami Bay, Misaki, Japan.

8. **Pseudosquilla pilaensis**, de Man.

1888. *Pseudosquilla pilaensis*, de Man, Journ. Linn. Soc., XXII, p. 296.
1894. *Pseudosquilla pilaensis*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 499.
1906. *Pseudosquilla pilaensis*, Nobili, Ann. Sci. Nat., Zool. (9), IV, 1906, p. 336.

The principal features of this well-marked species are as follows :—

The rostrum terminates in a prominent acute spine reaching a little beyond the eyes; its basal portion is about twice as broad as long with slightly obtuse antero-lateral angles. The eyes are short and the cornea is dilated and conspicuously bilobed.

The dactylus of the raptorial claw possesses four teeth including the terminal one, differing in this respect from all other species of the genus; its external margin bears a sharply rounded lobe at the proximal end.

The lateral margins of the sixth and seventh thoracic somites are rounded, broadly in front and narrowly behind. The postero-lateral angles of the fourth and fifth somites are spinous. The fifth bears on either side a deep longitudinal sulcus and a carina close to the margin. The sixth somite bears six smooth triangular elevations ending in sharp spines and between the submedians and intermediates, there is a small rounded tubercle.

The telson is twice as broad as long and, as in *P. dofleini*, bears the full number of carinae. The median terminates in a sharp spine; the submedian consists of a carina in the anterior half ending in a spine and succeeded by one, more commonly by two, spines; the intermediate is entire and ends in a spine overhanging a small tubercle before reaching the margin behind the outer intermediate denticle; the first lateral may be interrupted and terminates in a spine overhanging a tubercle at the base of the intermediate marginal tooth. The second lateral is continued to the apex of the lateral marginal tooth. Between the two laterals there is, in the single specimen examined, an additional short carina ending in a spine. On the margin the usual three pairs of primary teeth are prominent, the submedians being mobile. There are two rounded intermediate denticles and one lateral. The inferior surface is smooth except for a pair of spines on either side placed opposite the interspaces of the primary marginal teeth.

The basal process of the uropods consists of a long and sharp spine, bearing a small spine on its outer margin and a series of five to seven similar spines on its inner margin.

In colour the single example is pale with dark pigmentation along the sides of the carapace and abdomen.

$\frac{8137}{10}$ Port Maria, Elphinstone I., Mergui Archipelago. 'Investigator.' 1 ♀, 48 mm.

Hitherto known from two specimens only. The type, 88 mm. in length, was found at Elphinstone I. (de Man), while the second example is recorded from the Red Sea (Nobili).

9. **Pseudosquilla stylifera** (H. Milne-Edwards).

Plate VII, figs. 84, 85.

1837. *Gonodactylus stylifcrus*, H. Milne-Edwards, Hist. Nat. Crust., II, p. 530, pl. xxvii, figs. 9-14.
1839. *Gonodactylus stylifcrus*, Randall, Journ. Acad. Sci. Philadelphia (1), VIII, p. 147.
1849. *Gonodactylus stylifcrus*, Nicolet, in Gay's Hist. fisica de Chile, Zool., III, p. 225, pl. ii, fig. 3.
1880. *Pseudosquilla stylifera*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 112.
1894. *Pseudosquilla stylifera*, Bigelow. Proc. U.S. Nat. Mus., XVII, p. 502, fig. 3, p. 505.
1900. *Pseudosquilla stylifera*, Holmes, Occ. Papers Calif. Acad. Sci., VII, p. 220.
1900. *Pseudosquilla stylifera*, Whitelegge, Mem. Australian Mus., IV, p. 198.
1910. *Pseudosquilla bigelowi*, Rathbun, Proc. U.S. Nat. Mus., XXXVIII, p. 608.

The carapace is broad, its posterior breadth being equal to its mid-dorsal length. The cervical groove is distinct laterally, but is absent in the middle line. The antero-lateral angles are subrectangular, the postero-lateral broadly rounded and carinate. The rostrum is smooth above, triangular, longer than broad, with straight lateral margins converging to a narrow rounded apex.

The cornea of the eyes is greatly swollen and is set very obliquely on the stalk. In dorso-internal view the peduncle terminates in a narrow triangular area, invested on two sides by the cornea. The dorsal processes of the ophthalmic somite consist of a pair of large triangular lobes directed straightly outwards on either side and wholly exposed in dorsal view. The anterior margin of the somite is produced between the bases of the eyestalks and terminates in an acute point. There are no distinct dorsal processes on the antennal protopodite (fig. 84).

The mandibular palp is composed of two or three segments.

There is a stout tooth on the dorsal edge of the raptorial carpus at its distal end. The propodus bear only two mobile spines at the proximal end of its upper margin ; the outer of the two edges opposed to the dactylus is furnished with a series of fine pectinations on its basal two-thirds. The dactylus consists of a single stout spine, at the base almost square in section. Its inner margin is microscopically serrate, but is without trace of the large teeth found in most species of the genus.

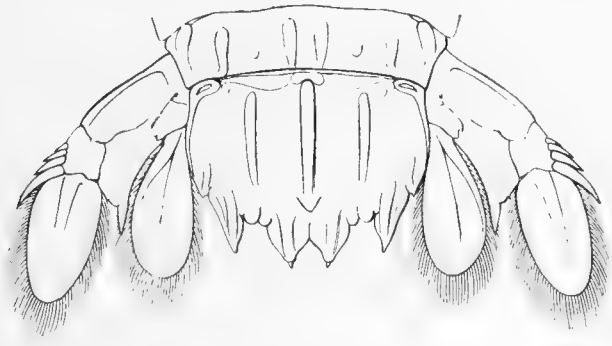
The margins of the sixth and seventh thoracic somites are rounded and reflected a little outwards. The postero-lateral angles of the abdominal somites are not spinous. The first four somites are smooth; the fifth has a shallow longitudinal depression on either side ; the sixth has eight blunt longitudinal carinae which do not terminate in spines. The two submedian pairs are obscure or obsolete in very large specimens.

On the telson there are five longitudinal carinae, a median, one pair of parallel intermediates and the marginals. The median carina does not terminate in a spine. The marginal teeth are large and broad and each is strengthened by a short rounded keel. The submedians have small movable tips. There are no submedian or lateral denticles; but between the submedian and intermediate teeth there are one or two conspicuous rounded lobes (fig. 85).

The peduncular segment of the uropods is externally ridged, but does not possess a spine at the distal end of the upper margin. The ventral process is strikingly different from that of any other known Stomatopod. It terminates in a stout tooth, homologous with the inner one of the two found in *P. ciliata*, and the external margin behind the apex of this tooth is convex and is continued evenly backwards to the point of articulation of the exopod, on this margin near its distal end is found a minute spinule representing the outer tooth of *P. ciliata* and the other species. The internal margin of the process is smooth.[1] The basal segment of the exopodite is extremely short and bears four or five mobile spines on its external margin, the outermost much the longest. Both the endopod and ultimate segment of the exopod are very large and broadly expanded; the latter is fully two and a half times the length of the proximal segment (fig. 85).

The colouring of spirit specimens is not characteristic; Whitelegge notes that the outer laminae of the uropods are brilliant violet in living examples.

In two large specimens from the Australian coast the mandibular palp is two-jointed[2] and there are two prominent lobes between the submedian and intermediate



Pseudosquilla stylifera. Last abdominal somite, telson and uropods of an Australian specimen.

marginal teeth of the telson (see text-fig.). In a slightly smaller example from Chili there is only a single intermediate lobe on the telson (fig. 85), and the mandibular palp is composed of three quite distinct joints.

Both Milne-Edwards and Bigelow, in their figures of S. American specimens, show only a single intermediate lobe on the telson; but Whitelegge does not mention the existence of two in the examples which he records from New South Wales, while Milne-Edwards figures the mandibular palp of a Chilian example in one case with two segments (1837, pl. 27, fig. 10), and in another with only a single segment (*ibid.*, fig. 11).

There can be little doubt that the Australian and American specimens both belong to the same species, for, with the exception of the two characters noticed above, the examples from the two localities are, as nearly as possible, identical. The distinction in the number of segments in the mandibular palp is consequently the more remarkable,

[1] Miers states, perhaps in error, that this margin is denticulated.

[2] The two distal segments of the normal three-segmented palp are fused.

for among other Stomatopoda in the Indian Museum any two species which show very close structural affinity invariably agree in this character. It is not improbable that distinct races of *P. stylifera* exist on the coasts of Australia and America, but this cannot be established with any certainty without the examination of large numbers of specimens from the two localities.

The three examples in the Indian Museum are registered as follows :—

$\frac{7583}{10}$	Disaster Bay, Victoria.	.. Australian Museum.	.. 2 ♂, 138, 150 mm.
$\frac{7290}{10}$	Coquimbo, Chili.	.. Berlin Museum.	.. 1 ♂, 93 mm.

Pseudosquilla stylifera has been recorded from Chili (Milne-Edwards, Nicolet, Miers), from California (Bigelow, Holmes) from the Hawaiian Is. (Randall), and from Newcastle Bight, New South Wales (Whitelegge). It is strange that the species has not been found on the New Zealand coast.

Post-larval stages of *Pseudosquilla*.

Two small specimens, 19 and 27 mm. in length, belong to what has been termed the '*monodactyla*' stage of this genus.[1] Hansen has shown that this form is not a distinct species, as was supposed by Milne-Edwards and Miers; but is a '*zwischen-stadium*' in the development of members of this genus. In the absence of teeth on the raptorial dactylus and of carinae on either side of the median crest of the telson, the appearance of these forms is so strikingly dissimilar to that of the adult species that the mistake made by the earlier writers is not astonishing.

Specimens of *Pseudosquilla oculata* in the '*monodactyla*' stage have been recorded of lengths varying from 28 to 34 mm., while those of a similar stage of *P. ciliata* range from 16 to 21·3 mm.

I am uncertain as to the species to which the two examples in the Indian Museum should be referred. It is probable that they belong to *P. ciliata* since that is the only species of *Pseudosquilla* known from the localities in which they were found.

It will be noticed that among the recorded specimens of *P. ciliata* (p. 100) are two specimens which also measure only 19 and 27 mm. in length. These examples possess all the adult characteristics; but their existence does not necessarily prove that the '*monodactyla*' of the same size cannot belong to that species, for it is very probable that an actual shrinkage in total length may take place at the close of the post-larval stages.

The examples agree closely with the individual, 20 mm. in length, which de Man has recorded from Amboina, and differ in the various points which have been mentioned by that author from the description and figures given by Miers.

The specimens are registered as follows :—

$\frac{9746}{6}$	S. Ceylon, 34 fms., 6° 10′ N., 81° 16′ E.	.. 'Investigator'.	.. 1 ♀, 27 mm.
$\frac{3450}{7}$	Port Blair, Andaman Is.	.. J. Wood-Mason.	.. 1 ♀, 19 mm.

[1] For literature dealing with these post-larval stages see A. Milne-Edwards, 1877-8, p. 232; Miers, 880, p. 110, pl. iii, figs. 1, 2; de Man, 1887, p. 571, pl. xxii a, fig 6; Hansen, 1895, p. 85; Bigelow, 1902, p. 156, and Nobili, 1906, p. 336.

Genus **Lysiosquilla**, Dana.

1825. *Coronis*, Latreille, Encycl. Méthod., X, p. 474 (*nom. praeocc.*).
1837. *Squilla* (Squilles fine-tailles, 1*st* sect.), H. Milne-Edwards, Hist, Nat. Crust., II, p. 518.
1837. *Coronis*, H. Milne-Edwards, *ibid.* p. 530.
1849. *Squilla* (sect. *Maculatae*), De Haan, in Siebold's Fauna Japonica, Crust., p. 220.
1852. *Lysiosquilla*, Dana, U.S. Explor. Exped., Crust., p. 616.
1880. *Lysiosquilla*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 5.
1894. *Lysiosquilla*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 502.
1910. *Lysiosquilla*, Giesbrecht, Faun. Flor. G. v. Neapel, XXXIII, p. 44.

Carapace little if at all narrowed anteriorly; cervical groove wholly absent or scarcely traceable, never continuous from side to side; longitudinal carinae absent; antero-lateral angles never spinous. Cornea of eyes small or considerably expanded. Mandibular palp composed of three segments. Merus of raptorial claw articulating terminally with ischium; ventral surface of merus longitudinally hollowed throughout its length; upper margin of propodus finely pectinate; dactylus not inflated at base, armed with teeth on inner margin. Penultimate segment of third and fourth thoracic limbs close to insertion of ultimate segment flattened and transversely ribbed. Shorter ramus of last three thoracic limbs composed of two segments, basal segment short, ultimate segment longer, linear or oval. Free thoracic and abdominal somites flat, depressed and without longitudinal carinae. Telson broader than long, in Indo-pacific forms of two distinct types. First type without dorsal spines and with posterior margin unarmed or cut into a few large blunt teeth. Second type with a curved transverse row of spines or prominences near distal end, with sharp primary teeth, a number of submedian spinules and a few intermediate denticles. One slender movable spine situated beneath submedian teeth or wholly replacing them. Ventral process of uropods consisting of two large spines, inner longer than outer; inner spine rarely suppressed.

Some of the species are transversely barred with deep blue-black or black pigment.

Secondary sexual distinctions are usually absent; but the raptorial claw of very large female *L. maculata* and *L. glabriuscula* is modified.

In some, perhaps in all, species of the genus soft elongated papillae are found on the antennal protopodite. These are well-developed in *L. maculata* and are three in number, one situated antero-dorsally and curved backwards and inwards towards the base of the rostrum and two on the ventral surface at the base of the endopod, a long one directed forwards and a much shorter one pointing backwards. In *L. acanthocarpus*, *L. multifasciata*, *L. spinosa* and *L. insignis* only one of these processes is found, placed on the ventral surface and pointing outwards or backwards.

One Indo-pacific form, *L. maculata*, is found in the Atlantic, but appears to be very scarce in those waters; another is so closely allied to *L. biminiensis* from the Bahamas that it has only been accorded subspecific rank. With these exceptions no Indo-pacific species of the genus is known to occur in the Mediterranean and Atlantic or on the Pacific coasts of America.

The twelve species found in the Indo-pacific fall readily into two groups distinguished at a glance by the presence or absence of a transverse dorsal series of spines near the distal end of the telson. The first group, comprising those species without these spines,

includes *L. maculata*, the only common Indo-pacific representative of the genus, and three species described from unique specimens. One of the latter, *L. crassispinosa*, Fukuda, furnished with a remarkably large number of movable spines on the penultimate segment of the raptorial claw, appears to be an isolated form, but may perhaps find allies among the less well-known Atlantic species. The typical representative of the second group is *L. acanthocarpus*. *L. insignis* and *L. latifrons* form a small highly specialized section characterized by the elaborate ornamentation of the telson, while *L. spinosa*, in which the inner spine of the ventral process of the uropods is suppressed, seems to have no close affinity with any other known species.

Practically nothing is known of the habits of Indo-pacific species of *Lysiosquilla*. Brooks, however, notes that those of *L. excavatrix* are very different from those of *Squilla empusa*, and it is probable that his observations afford an explanation of the extreme scarcity of many species. *L. excavatrix* inhabits much deeper burrows than *S. empusa* ; it lies in wait for its prey at the mouth of the burrow and seldom ventures more than a few inches away. *Squilla empusa* on the contrary wanders about and is in consequence caught without much trouble. The burrows of *L. excavatrix* extend vertically downwards for a distance of several feet and Brooks found it almost impossible to obtain them by digging. Under these conditions it will readily be understood that the difficulty of obtaining specimens is very great and when the species inhabits comparatively deep water, as some are known to do, it can only be by the merest chance that a specimen is caught at all.

The greatest depth at which any species of the genus has been found is 235 fathoms (*L. insignis*).

Many undescribed forms doubtless remain to be found and a number of those that are already known stand in need of redefinition.

Key to the Indo-pacific species of *Lysiosquilla*.

I. Telson without dorsal spines; limbs of sixth and seventh thoracic somites with shorter ramus linear.

A. Upper margin of raptorial propodus with not more than four movable spines; postero-lateral angles of first five abdominal somites not spinous.

1. Raptorial dactylus with eight to eleven teeth.[1]

A. Exposed thoracic somites without longitudinal wrinkles; sixth abdominal somite not grotesquely sculptured; terminal tooth of raptorial claw not dilated at apex.

1. Rostrum cordiform, at least as wide in front of base as at base, not grooved near margin; raptorial dactylus with ten or eleven teeth[1] in male .. .. .. *maculata*, p. 111.

2. Rostrum triangular, widest at base, with a deeply-incised antero-lateral groove; raptorial dactylus of male with eight teeth[1] .. .. do. var. *sulcirostris*, p. 116.

B. Exposed thoracic somites irregularly and longitudinally wrink-

[1] Including the terminal tooth.

led; sixth abdominal somite grotesquely sculptured; terminal tooth of raptorial claw dilated at apex .. .. *miersi*, p. 116.

II. Raptorial dactylus with fifteen teeth[1] .. .. .. *capensis*, p. 117.

B. Upper margin of raptorial propodus with a series of ten or more movable spines; postero-lateral angles of abdominal somites spinous .. *crassispinosa*, p. 117.

II. Telson with a transverse row of dorsal spines near distal margin; limbs of sixth and seventh thoracic somites with shorter ramus broadly ovate.

A. Only three dorsal spines in a transverse row on telson in adults; outer spine of ventral process of uropods much longer than inner .. *spinosa*, p. 118.

B. More than three dorsal spines in a transverse row on telson in adults; inner spine of ventral process of uropods longer than outer.

I. Five dorsal spines on telson; median spine simple and acute.

A. Rostrum with median spine and rounded or subrectangular antero-lateral angles.

1. Raptorial dactylus with six or seven teeth;[1] postero-inferior margin of last abdominal somite without spines; telson with three pairs of large marginal teeth.

a. Penultimate tooth of raptorial dactylus much shorter than antepenultimate.

i. Raptorial dactylus with two lobes of about equal size at base of external margin .. .. *acanthocarpus*, p. 120.

ii. Raptorial dactylus with a very large distal and a small proximal lobe at base of external margin .. *multifasciata*, p. 122

b. Penultimate tooth of raptorial dactylus longer than antepenultimate .. .. *biminiensis* subsp. *pacificus*, p. 124.

2. Raptorial dactylus with eleven teeth;[1] postero inferior margin of last abdominal somite with a series of spines; telson with four pairs of large marginal teeth .. *tigrina*, p. 125.

B. Rostrum with sharp median and antero-lateral spines [telson with four pairs of large marginal teeth] .. .. *vicina*, p. 126.

II. Five dorsal spines on telson, median one trilobed, or seven distinct and separate spines.

A. Rostrum more than one and a half times as long as broad; eyes large; a pair of posterior spines on sixth abdominal somite in addition to those at postero-lateral angles .. .. *insignis*, p. 126.

B. Rostrum broader than long; eyes small; sixth abdominal somite with spines at postero-lateral angles only .. *latifrons*, p. 128

1. Lysiosquilla maculata (Fabricius).

Plate VIII, figs. 86–91.

1705 *Squilla arenaria terrestris* or *locusta*, Rumphius, Amboinsche Rariteitkamer, p. 4, pl. iii, fig. E.
1793. *Squilla maculata*, Fabricius, Ent. Syst., II, p. 511.
1796. *Cancer* (*mantis*) *arenarius*, Herbst, Krabben u. Krebse, II, p. 96, pl. xxxiii, fig. 2.
1798. *Squilla maculata*, Fabricius, Ent. Syst. Suppl., p. 415.
1818. *Squilla maculata*, Lamarck, Hist. Nat. Anim. sans Vert., V, p. 188.
1823. *Squilla maculata*, Desmarest, Dict. des Sci. Nat., XXVIII, p. 341.

[1] Including the terminal tooth.

1825 *Squilla maculata*, Latreille, Encycl. Méthod. X, p. 470.
1837. *Squilla maculata*, H. Milne-Edwards, Hist. Nat. Crust., II, p. 518, pl. xxvi, fig. 11.
1838. *Squilla maculata*, H. Milne-Edwards, in Lamarck's Hist. Nat. Anim. sans Vert., 2nd ed., V, p. 323.
1839. *Squilla arenaria*, Randall, Journ. Acad. Sci. Philadelphia (1), VIII, p. 146.
1847. *Squilla maculata*, White, List Crust. Brit. Mus., p. 83.
1849. *Squilla maculata*, De Haan, in Siebold's Fauna Japonica, Crust., p. 221.
1852. *Lysiosquilla maculata*, Dana, U.S. Explor. Exped., Crust., p. 616.
1877. *Lysiosquilla maculata*, Miers, Proc. Zool. Soc., p. 138.
1879. *Lysiosquilla maculata*, Miers, Phil. Trans. Roy. Soc., CLXVIII, p. 494.
1880. *Lysiosquilla maculata*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 125, pl. i, figs 1, 2 and p. 458.
1881. *Lysiosquilla maculata*, Lenz and Richters, Abhandl. Senck. Ges., Frankfürt, XII, p. 428.
1886. *Lysiosquilla maculata*, Brooks, Voy. H.M.S. 'Challenger,' XVI, Stomatop., p. 45, pl. x, figs. 1-7.
1887. *Lysiosquilla maculata*, de Man, Arch. f. Naturgesch., LIII, i, p. 571.
1892. *Lysiosquilla maculata*, de Man, in Weber's Zool. Ergebn. Nied. Ost-Ind., II, p. 518.
1892. *Lysiosquilla maculata*, Thallwitz, Abhandl. kön. Mus. Dresden, No. 3, p. 55.
1893. *Lysiosquilla maculata*, Henderson, Trans. Linn. Soc. Zool. (2), V, p. 452.
1894. *Lysiosquilla maculata*, Bigelow, Proc. U. S. Nat. Mus., xvii, p. 508.
1894. *Lysiosquilla maculata*, Ortmann, Denk. med.-wiss. Ges. Jena, VIII, p. 60.
1895. *Lysiosquilla maculata*, Hansen, Isop. Cumac. u. Stomatop. Plankton. Exped., p. 74.
1898. *Lysiosquilla maculata*, Borradaile, Proc. Zool. Soc., p. 37 (habits).
1898. *Lysiosquilla maculata*, Whitelegge, Proc. Linn. Soc. N.S.W., XXIII, p. 368.
1899. *Lysiosquilla maculata*, Nobili, Ann. Mus. Civ. Genova (2), XX, p. 276.
1902. *Lysiosquilla maculata*, Stebbing, S. African Crust., II, p. 46.
1902. *Lysiosquilla maculata*, de Man, Abhandl. senck. Ges. Frankfürt, XXV, p. 910.
1910. *Lysiosquilla maculata*, Balss, Abh. math.-phys. Klasse k. bayer. Akad. Wiss, Suppl., Bd. II, Abh. 2, p. 5.
1910. *Lysiosquilla maculata*, Fukuda, Annot. Zool. Japon., VII, p. 146, pl. iv, fig. 3.
1910. *Lysiosquilla maculata*, Stebbing, Ann. S. African Mus., VI, p. 406.

The whole dorsal surface of the animal is smooth and polished. The carapace is strongly convex from side to side and is almost as broad anteriorly as posteriorly. There are no carinae on the carapace. The gastric grooves are sharp and distinct, but the cervical groove is obsolete and is represented merely by a short and shallow depression on the outer side of the gastric. The lateral margins are convex, the antero- and postero-lateral angles are rounded and the posterior margin is deeply concave.

The rostrum (fig. 86) is broader than long, cordiform and widest at a point somewhat in advance of its proximal end. The lateral margins are not upturned and converge rapidly to an acute, but rounded, apex behind which they are often slightly concave. The dorsal surface is smooth except for a blunt longitudinal carina in the anterior third.

The eyes are large. The breadth of the cornea is about equal to the greatest length of the cornea and stalk combined, and the corneal and peduncular axes are very oblique. On its outer margin the eyestalk bears a small but not inconspicuous tubercle. The anterior margin of the ophthalmic somite is sharply pointed, and its dorsal processes consist of a pair of upstanding lobes which terminate subacutely on either side of the rostral apex.

The antennular peduncle is considerably less than half the length of the carapace, excluding the rostrum. There are three soft papillae on the antennal protopodite (see p. 109). The mandibular palp is composed of three segments.

The outer inferior margin of the merus of the raptorial claw is rounded distally. The dorsal carina of the carpus is blunt and terminates in a sharp spine which may overhang the anterior margin. In males and young females the width of the propodus is nearly one quarter its greatest length ; the margin in contact with the dactylus bears a series of fine pectinations externally, while internally at its proximal end it is provided with four movable spines. The dactylus is slender and bears nine to eleven teeth (usually ten, very rarely nine), including that at the apex. The latter is usually more than twice the length of the next of the series. The outer margin of the dactylus is straight or slightly concave (fig. 91).

In very large females, as has been noticed by Miers, the form of the raptorial claw is strikingly different (fig. 90). In a specimen of 186 mm. the carpus and basal part of the propodus bear tufts of long hairs, and the latter segment is much wider than in the male, being more than one-third as broad as long ; it is, moreover, provided with only two movable spines at the proximal end of its upper margin. The dactylus also is strongly convex externally, and the armature consists only of seven or eight nicks along the inner margin in addition to the strong terminal tooth.

The third and fourth thoracic somites are exposed in dorsal view. The lateral margin of the fifth is transversely channelled by a broad and shallow groove, separating blunt anterior and posterior carinae which converge as they approach the inferior aspect of the somite. The lateral margins of the sixth and seventh somites are rounded in front and subrectangular behind. The shorter ramus of the last three thoracic limbs is linear.

Near the anterior margin of each post-abdominal segment except the first and last there is a short and rather faint longitudinal furrow which divides the somite anteriorly into three sub-equal portions and, on either side of the middle line, a very shallow depression is sometimes visible delimiting a very faint longitudinal elevation. The lateral margin of each somite (except the last) is concave, and its postero-lateral angle is rounded. The sixth somite has a transverse groove on either side of the middle line near its anterior edge, an oblique groove external to this and beyond this again a shallow longitudinal furrow which defines a swollen lateral lobe. In addition there are sometimes a number of obscure and irregular elevations and depressions on either side of the smooth median portion of the somite. On its inferior margin the sixth somite bears a single strong tooth at each antero-lateral angle, projecting backwards over the base of the uropod.

The telson is nearly twice as broad as long, convex above and concave below. On both dorsal and ventral surfaces it presents a feeble median triangular elevation limited by a pair of very shallow posteriorly-convergent grooves. On either side there is a large oval patch of more or less regularly disposed pits which are in some cases scarcely visible, but usually are specially conspicuous in the neighbourhood of the lateral and antero-lateral margins. Along the anterior and antero-lateral edges of the telson there is a well-marked groove, which is interrupted in the middle line and fades

away laterally before reaching the external marginal tooth. The ventral surface is obscurely pitted on either side. The posterior margin of the telson is indistinctly notched in the middle line and bears on each side two, three, or more usually four, blunt lobes, the outermost or two outermost being generally sharper and more conspicuous than the rest.

The inner dorsal edge of the peduncular segment of the uropod terminates in a short spine. The inferior bifurcate process consists of two long spines. Each is triangular in section, bearing three longitudinal grooves and three carinae ; the inner is nearly twice the length of the outer and is considerably longer than the segment from which it arises. The proximal segment of the exopod bears a fixed distal spine on its inferior aspect and a series of eight or nine, which are movable, on its outer margin.

In the genus *Squilla* marked secondary sexual characters, when present, are found in the male only and differentiate large examples of that sex from females and young males. In *L. maculata*, however, the reverse is the case, special modifications occurring only in large females. Among specimens in the Indian Museum the peculiar form of the raptorial claw [1] (mentioned above) is found only in a single female which measures 186 mm. In another scarcely smaller example (182 mm.) the raptorial teeth, though somewhat reduced in size, are still well formed and there are, as usual, four movable spines on the propodus. In both these females the eye is small and it seems probably that this again is a special feature of large examples of this sex (*cf.* figs. 87 and 88). The following table contains measurements of five females and seven males. It will be noticed that, as in all Stomatopoda, the relative size of the eye diminishes with growth and that, whereas the proportions in young females are closely comparable with those of males, the breadth of the cornea in the two large females is very much less than would be expected to occur in males of a similar length.

Total length.	Sex.	Length of carapace.	Breadth of cornea.	Corneal Index.[2]	
				♂	♀
mm.		mm.	mm.		
283	♂	53·5	11	4·9	..
208	♂	39	10	3·9	..
186	♀	30	6·2	..	4·8
182	♀	32	7·2	..	4·4
144	♂	27	7·3	3·7	..
136	♂	24	6·5	3·7	..
133	♂	22·5	6·2	3·6	..
112	♂	20·5	5·5	3·7	..
107	♀	19·0	5·4	..	3·5
100	♀	18·5	5·5	..	3·4
95	♂	17·5	5·3	3·3	..
80	♀	14·5	4·5	..	3·2
66	♂	13·0	4·5	2·9	..

[1] De Man's suggestion that the teeth are merely worn down in large females cannot be supported, for the whole form of the propodus and dactylus is altered

[2] The number of times that the breadth of the cornea is contained in the median length of the carapace (see p. 9).

The colouring of *L. maculata* is very striking and is usually distinct in spirit specimens. There are, as a rule, three broad transverse bands of blue-black pigment on the carapace; the fifth thoracic and last abdominal somites are blue-black, while the other segments of the post-abdomen are broadly bordered both anteriorly and posteriorly with the same colour. A typical scheme of colour is shown in fig. 88; sometimes the pigmentation is better developed (fig. 87) and occasionally it is much less marked, with narrow bands on the carapace, the fifth thoracic somite entirely pale, and a large pale patch on the last abdominal somite. The telson may show three large blue-black spots, isolated (as in Herbst's figure), or partially connected with one another; more usually there is a pale anterior transverse band and a pale bilobed distal patch. In one specimen the anterior band is divided by oblique bars of pigment into three separate spots (fig. 89). In the uropods the spines of the bifurcate process are blue-black distally as is also the inner exopodal segment. The peduncular segment is blue-black proximally and the outer segment of the exopod is divided obliquely into dark proximal and pale distal areas. The endopod is blue-black except for a narrow transverse band at the base.

The specimens in the Indian Museum are registered as follows :—

$\frac{7565}{10}$	Fiji Is.	Australian Museum.	1 ♀, 182 mm.
$\frac{7566}{10}$	New Guinea.	Australian Museum.	1 ♂, 283 mm.
$\frac{7567}{10}$	Christmas I., Polynesia.	D. G. Stead.	(Raptorial claws only.[1])
$\frac{3036}{5}$	Nicobars.	F. A. de Roepstorff.	1 ♀, 77 mm.
$\frac{3031}{5}$	Andamans.	Homfray and Tytler.	1 ♂, *ca.* 93 mm.
$\frac{3044}{5}$	Andamans.	B. Ford.	(Fragment.)
$\frac{3630\text{-}1}{7}$	Madras.	Madras Museum.	2 ♂, 137, 144 mm.
$\frac{3517\text{-}31}{7}$	Coconada, Madras Pdy.	G. W. Wicks.	6 ♂, 3 ♀, 69-185 mm.
$\frac{3037}{5}$	(No history.)		1 ♀, 91 mm.

The following specimens from other sources have also been examined:—

Christmas I., Polynesia.	D. G. Stead.	1 ♂, 270 mm.
Ceylon.	Colombo Museum.	2 ♂, 2 ♀, 99-251 mm.

Lysiosquilla maculata seems to occur only in shallow water; though never found in abundance, it has a wide Indo-pacific distribution extending from Japan and Oceania to South Africa. It has been recorded from the following localities: Japan (De Haan, Fukuda), Hawaiian Is. (Randall, Miers), Marquesas Is. (Bigelow), Duke of York Is. (Miers), Samoa (Miers, Thallwitz, Bigelow, Balss), Fiji (Miers), Rotuma (Borradaile), New Guinea (Nobili, Thallwitz, Whitelegge), Amboina (Brooks, de Man, Ortmann, Nobili), Goram (Miers), Batjan (de Man), Flores (Thallwitz), Celebes (de Man), Philippine Is. (Miers, Brooks), Penang (Miers), Tuticorin and Madras (Henderson), Mysore (Thallwitz), Rodriguez (Miers) and Durban (Stebbing).

[1] The raptorial dactyli are 80 mm. in length, and must have belonged to a specimen measuring over 300 mm.

In the Atlantic this species has been recorded from Antigua, W. Indies (Stebbing)[1] and the larva, *Lysierichthus duvaucellii*, Guérin, has been recorded by Hansen (1895) from the vicinity of the Cape of Good Hope (32° 30′ S., 15° 0′ E.).

var. **sulcirostris**, nov.

Plate VIII, figs. 92, 93.

This variety differs from typical specimens in the following points :—

1. The rostrum is triangular, widest at the base, and is produced to a much sharper point than in typical *L. maculata*. In the anterior two-thirds there is on each side a sharply-defined and deep groove running parallel to the lateral margin (fig. 92).
2. The dactylus of the single male specimen resembles that of typical male *maculata*, but has only eight teeth including the terminal one (fig. 93).
3. The sixth abdominal somite is grooved as in the typical form, but much less distinctly, and the irregular wrinkling on either side is absent.

The colour pattern is closely similar to that of *L. maculata*, but the dark transverse bands are much narrower than in typical examples of the species.

L. sulcirostris is perhaps specifically distinct from *L. maculata*, but its resemblance to the latter form is so great that I hesitate to adopt such a course on the evidence of a single specimen.

$\frac{7561}{10}$ Andaman Is. .. Homfray and Tytler. .. 1 ♂, 116 mm.

Apparently found in company with a typical specimen of *L. maculata*.

2. Lysiosquilla miersi, De Vis.

1883. *Lysiosquilla miersii*, De Vis, Proc. Linn. Soc. N.S.W., VII, p. 321.
1894. *Lysiosquilla miersii*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 504.

De Vis' description of the only known specimen runs as follows :—

" Carapace smooth, in the form of a truncate isosceles triangle, rounded at the posterior lateral angles. Rostrum elongate, cordiform, acuminate, with a median ridge on its produced limb. Exposed segments with irregular longitudinal wrinkles on the dorsum, which is slightly depressed, the wrinkling and depression becoming more pronounced posteriorly. An irregular semi-lunar depression on each segment near the lateral line. Penultimate segment, narrow, deeply sculptured in a grotesque fashion. Telson smooth, with a bold sagittate median ridge and four teeth on the lateral margin, of which the anterior two are strong. Ten long sharp teeth on the dactyli of the raptorial limbs including the terminal one, which near the tip is anteriorly dilated and presents a sharp edge. All the teeth finely serrated on the posterior edge. Four long sharp teeth on the propus, the posterior one moderately recurved.

[1] According to Stebbing's account the specimen from this locality differs from any Indo-pacific example that I have seen in having the fifth pleon segment denticulate along the hind margin, the sixth denticulate in an arched proximal band and round the distal margin, and the telson with three spines on each side and the truncate portion cut into five square teeth on one side and six on the other side of a small median emargination.

Colour light horn-brown. Exposed thoracic segments with a broad black basal band. Post-abdominal segments with a similar band at each suture. Carapace and penultimate joint of raptorial limbs with three broad bands, appearing beneath the surface, a large black blotch on each side of the telson, and on the rami of the appendages of the sixth segment; a conspicuous white longitudinal band on each side of the dorsum."

As noted by De Vis this species belongs to the *maculata* section of *Lysiosquilla*. It seems to be easily distinguished by the irregular wrinkling on the exposed thoracic somites, by the sculpture of the last segment of the abdomen and by the dilated apex of the terminal spine of the raptorial claw.

L. miersi is known only from a single specimen (sex and length not noted) found on sand banks at Moreton Bay, Queensland.

3. Lysiosquilla capensis, Hansen.

1895. *Lysiosquilla capensis*, Hansen, Isop. Cumac. u. Stomatop. Plankton. Exped., p. 74.
1910. *Lysiosquilla capensis*, Stebbing, Ann. S. African Mus., VI, p. 406.

Hansen's short description of this form runs as follows: "eine Art, die von allen anderen dadurch leicht zu unterscheiden ist, dass sie ausser dem Enddorn 14 Dornen an dem Dactylus besitzt, 7 Uropoddornen und Telson wie bei *Lys. maculata* (F.) geformt (1 Exemplar von Port Elisabeth im Museum zu Strassburg)." A fuller account of this specimen is badly needed.

Lysierichthus pulcher, Hansen, which according to its author is the larva of *L. capensis*, is recorded from the Atlantic, N.W. of the Cape of Good Hope (32° 30′ S., 15°0′ E.).

4. Lysiosquilla crassispinosa, Fukuda.

1910. *Lysiosquilla crassispinosa*, Fukuda, Annot. Zool Japon., VII, p. 146, pl. iv, figs. 4, 4a.

Fukuda gives the following diagnosis of this species:—"Eyes with the corneal region nearly globular. The manus of raptorial limb bearing, besides the usual serration, ten or more acute jointed spines on the inner margin; dactylus armed with ten teeth including the terminal one. Rostrum triangular, terminating in an acute median spine. Carapace smooth, with all its angles rounded. Last two thoracic and first two abdominal segments provided with a pair of inconspicuous carinae. All abdominal segments with their postero-lateral angles ending in spines. The whole dorsal surface of the last two segments and a part of that of the fifth abdominal segment covered with irregularly shaped granules. Eight stout spines or lobes on the postero-lateral margin of the telson, the median crest of which is broad and somewhat obscurely defined. The inner spine of the dorsal prolongation of uropod much longer than outer." For further details Fukuda's long and careful description should be consulted.

The unique example of this curious species, a female 275 mm. in length, is recorded from the Sagami Sea, Japan.

5. **Lysiosquilla spinosa** (Wood-Mason).

Plate VIII, fig. 94.

1847. *Coronis tricarinata*, Gray MS., White, List. Crust. Brit. Mus., p. 85 (*sine desc.*).
1875. *Coronis spinosa*, Wood-Mason, Proc. As. Soc. Bengal, p. 232; reprinted in Ann. Mag. Nat. Hist. (4) XVII, p. 263 (1876).
1878. *Squilla indefensa*, Kirk, Ann. Mag. Nat. Hist. (5), II, p. 466.
1879. *Squilla indefensa*, Kirk, Trans. N. Zealand Inst., XI; p. 394 (text-fig.) and p. 401.
1879. *Squilla laevis*, Hutton (*non* Hess), Trans. N. Zealand Inst., XI., p. 340.
1880. *Lysiosquilla spinosa*, Miers, Ann. Mag. Nat. Hist. (5), V, pp. 12, 125, pl. i, figs. 10-12.
1882. *Squilla tridentata*, Thomson, Trans. N. Zealand Inst., XIV, p. 230.
1886. *Squilla indefensa*, Fihol, Miss. de l'île Campbell, III, 2e, p. 436, pl. lv, fig. 3.[1]
1886. *Squilla laevis*, Filhol, *ibid.* p. 491.
1891. *Lysiosquilla spinosa*, Chilton, Trans. N. Zealand Inst., XXIII, p. 61, pl. x, figs. 1-3.
1894. *Lysiosquilla spinosa*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 503.
1894. *Lysiosquilla* (?) *tridentata*, Bigelow, *ibid.* p. 503.
1895. *Lysiosquilla spinosa*, Wood-Mason, Figs. and Desc. of nine Squillidae, p. 1, pl. i, figs. 1-3.
1901. *Lysiosquilla spinosa*, Lanchester, Proc. Zool. Soc., II, p. 554.
1909. *Lysiosquilla spinosa*, Chilton, in Subantarctic Is. of N. Zealand, II, p. 615.
1910. *Lysiosquilla spinosa*, Chilton, Trans. N. Zealand Inst., XLIII, p. 139.

The carapace and abdomen are smooth and polished dorsally and the former is considerably wider posteriorly than anteriorly. The gastric grooves are distinct throughout their course and the cervical is represented by a short transverse depression on either side as in *L. maculata*. The antero- and postero-lateral angles are broadly rounded and the posterior margin is deeply concave. The rostrum is perfectly smooth dorsally; it is a little broader than long and its strongly convex lateral margins converge to a small but acute apex.

The corneal portion of the eyes is a trifle wider than the stalk, not bilobed, and the corneal and peduncular axes are slightly oblique with regard to one another. The anterior margin of the ophthalmic somite is truncate but, in dorsal view, is entirely concealed by the rostrum. The dorsal processes of the somite are for the same reason quite invisible. The antennular peduncle is less than one and a half times the length of the carapace, excluding the rostrum. The dorsal processes of the antennular somite are acute and reach to the base of the eyestalks. The mandibular palp is composed of three segments.

The outer inferior margin of the merus of the raptorial claw is subrectangular, but rounded distally. The dorsal edge of the carpus is not carinate but its upper margin ends in a sharp spine overhanging the propodal articulation. There are three movable spines at the base of the pectinate edge of the propodus. The dactylus is sinuous externally with a very small outstanding proximal lobe. It bears from nine to fourteen teeth [2] (including the terminal one) which increase regularly in size from the base to the apex.

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[1] A bad reproduction of Kirk's rough text-figure.

[2] Of the two specimens examined, the type has ten spines, while the other has ten on one side and eleven on the other. The type of Thomson's *S. tridentata* has only four teeth on the raptorial dactylus; but the specimen is exceedingly small; only ·75 inches in length.

The lateral margins of the fifth thoracic somite are greatly compressed antero-posteriorly and form a thin outstanding blade which, in dorsal view, looks like a spine. The sixth and seventh somites are rounded antero-laterally, while their postero-lateral angles are almost rectangular. The basal segment of the last three thoracic limbs bears a short stout tooth on its external aspect. The first five abdominal somites are dorsally smooth and their postero-lateral angles do not project backwards as spines. The sixth somite possesses a shallow longitudinal groove on either side and its postero-lateral angles are sharply spinous.

The telson is semicircular in shape and is more than twice as broad as long. On its dorsal surface near the distal margin it is provided with a transverse series of three short but acute spines; the two lateral form the terminations of carinae, while the median is situated at the end of a rather conspicuous lobe. The submedian, intermediate and lateral marginal spines are well developed. The submedians are movable and the edge between them, which is slightly emarginate, bears four to seven minute denticles. There are two spines, the outermost of which is the largest, between the submedians and intermediates, and one between the intermediate and the lateral. The ventral surface of the telson is smooth.

The basal segment of the uropod bears a single dorsal spine on its distal margin, projecting over the articulation of the inner segment of the exopod. The outer spine of the bifurcate process (fig. 94) is enormously larger than the inner; it is broad, very greatly expanded laterally, and is deeply keeled ventrally. The inner spine of the process is, in the type specimen, represented merely by a small rounded lobe; it is larger and sharply spinous in an example from New Zealand. In addition, there is another small ventral spine at the inner distal angle of the basal segment which projects over the base of the inner uropod. The proximal segment of the exopod bears a single spine ventrally and distally and a series of five or six, which are movable, along its outer margin. Of these spines the two outermost are long and recurved.

Chilton (1891, p. 66) has given an account of the adult colouration. There is, it appears, a very great difference in this respect between the two sexes, for the male is greyish in general tone, while the carapace of the female is similar, but darker, and the whole of the central part of the abdominal segments is coloured a bright red. Lanchester (1901) notes that the small specimens which he examined were suffused with rosy red and sprinkled with red and black spots, the latter forming two conspicuous black marks over the submedian marginal spines of the telson. From these two accounts it is clear that the transverse bars of blue pigment that characterize the majority of the species of *Lysiosquilla* are entirely absent in *L. spinosa*. No trace of the original colour remains in the case of the two specimens preserved in the Indian Museum.

For the elucidation of the synonymy of this species we are indebted to Chilton who has been able to examine the type specimens of *S. laevis*, *S. indefensa* and *S. tridentata*. The latter species was described from a specimen ·75 inches in length and it possesses only four teeth on the dactylus of the raptorial claw. It is probable, as Chilton remarks, that it is a young individual, but nevertheless, on the assumption that it is to be referred to *L. spinosa*, it is not very easy to account for the small number of

dactylar teeth, for the specimens which Lanchester records from Penang, and which also were only ·75 inches in length, possess twelve to fourteen teeth. It is, however, not impossible that the post-larval development of the species may vary in different localities.

The two examples of *L. spinosa* in the Indian Museum were found at the following localities :—

$\frac{3052}{5}$	Port Blair, Andamans.	.. J. Wood-Mason.	.. 1 ♀, 68 mm. TYPE.
$\frac{3054}{5}$	Dunedin, New Zealand.	.. F. W. Hutton.	.. 1 ♀, 74 mm.

The species has been recorded from numerous localities in New Zealand and in the neighbouring islands : Chatham Is., Kapiti and Waikanae, near Wellington (Kirk), Waipapa Pt. and Port Pegasus, Stewart I. (Thomson), Port Chalmers, Otago Harbour, Resolution I. (Chilton), Napier District (Hamilton) and Auckland Is., in the stomach of *Notothenia microlepidota* (Hutton). In addition it was found by Sir J. C. Ross' Antarctic Expedition (Miers) and is known from Penang (Lanchester). According to Chilton most of the specimens which have been recorded were taken from the stomachs of fish.

6. Lysiosquilla acanthocarpus[1], Miers.

1847. *Cornis acanthocarpus*, Gray MS., White, List Crus. Brit. Mus., p. 85 (*sine desc.*).
1880. *Lysiosquilla acanthocarpus*, Miers, Ann. Mag. Nat. Hist. (5), V, pp. 11, 125, pl. i, figs. 7-9.
1882. *Lysiosquilla acanthocarpus*, Haswell, Cat. Australian Crust., p. 206.
1886. *Lysiosquilla sarasinorum*, Müller, Verhandl. naturf. Ges. Basel, p. 478, pl. iv, fig. 3.
1894 *Lysiosquilla acanthocarpus*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 503.
1894. *Lysiosquilla saracinorum*, Bigelow, *ibid.*, p. 503.
1904. *Lysiosquilla acanthocarpus*, Jurich, Stomatop. Deutsch. Tiefsee-Exped., p. 374, pl. xxvi, fig. 3.

The dorsal surface is smooth and polished. The greatest breadth of the carapace is about equal to its mid-dorsal length ; for the rest, it bears a close resemblance to that of *L. maculata*. The rostrum is widest at the base and is usually a little longer than its greatest breadth. It terminates in a slender median spine and possesses in addition prominent antero-lateral angles on either side. These are rectangular or slightly obtuse, and the margin both before and behind them is concave : the former more strongly so than the latter. The rostrum is thus composed of an almost square proximal portion which bears at its distal end a sharp spine with a very broad base.

The eyes are composed of two closely-approximated lobes. The greatest breadth of the cornea is about equal to the greatest length of the stalk. The anterior edge of the ophthalmic somite is rounded, but, when the animal is viewed from above, is entirely concealed by the rostral plate, as are also the dorsal processes of the same somite. The antennular peduncle is less than half the length of the carapace excluding the rostrum. The dorsal processes of the antennular somite consist of two long and sharp spines directed obliquely outwards and forwards and reaching to the middle of the eyes. The mandibular palp is composed of three segments.

[1] See addendum, p. 196.

The outer inferior margin of the raptorial claw is rounded distally. The carpus is not carinate above, but its dorsal margin is provided with a sharp distal spine. Along its inner edge the propodus is finely serrate and bears four large movable spines near the base. Externally the dactylus is convex and at its proximal end is cut into two small subequal lobes, the distal of which is the more obtuse. Internally it is provided with five, more commonly with six spines, including the large terminal one. The teeth are as a rule microscopically serrate and the penultimate is much shorter and more slender than the ante-penultimate.

The lateral margins of the fifth thoracic somite are vertically grooved ; those of the two succeeding somites are truncate with rounded anterior and posterior angles. The shorter ramus of the limbs of the last thoracic somite is linear, those of the two preceding somites broadly ovate.

The first five abdominal somites do not possess spines at the postero-lateral angles. The sixth bears a stout spine at each of these angles and its dorsal surface is very obscurely furrowed longitudinally on either side. On its ventral surface this somite possesses a slender curved spine at its outer anterior angles, projecting backwards over the base of the peduncle of the uropods.

The telson is more than twice as broad as long. Near its base it bears dorsally a pair of shallow oblique grooves which run towards the antero-lateral angles, but disappear close to a small and obscure tubercle before reaching it. Distally there is a dorsal series of five sharp spines arranged in a semicircle. These spines do not form the terminations of longitudinal carinae as they do in certain other species of *Lysiosquilla*. On the margin three pairs of fixed primary spines may be distinguished ; the submedians are the smallest and the laterals much the largest. Close beneath each submedian there is a conspicuous movable spine and the margin between the two is occupied by a series of five or six (rarely four) pairs of small, sharp, fixed denticles. There are three stout denticles, two of which are usually placed close together, between the submedians and intermediates and one between the intermediates and laterals. Beneath the base of each lateral spine there is a small, acute, outwardly-directed lobe. The inferior surface of the telson is swollen with a large depression behind the anus.

The peduncular segment of the uropods bears a longitudinal carina along its antero-lateral margin, and a small dorsal spine posteriorly near its articulation with the exopod. The ventral bifurcate process consists of two long tricarinate spines, the outer of which is less than two-thirds the length of the inner. Behind these spines the lower surface bears a median carina which runs backwards and terminates abruptly in a blunt tooth close to the proximal margin.

The outer margin of the basal segment of the exopod bears a series of six or seven movable spines of which the two last are much longer than the rest. There is also a short fixed ventral spine projecting over the articulation of the ultimate segment, and inwards of this a small rounded plate bearing a series of long setae. The antero-lateral angle of the inner uropod is always permanently bent over and rests against the dorsal surface.

The only male specimen examined is very small (48 mm.) and does not possess any special structural modifications characteristic of its sex.

The colouration of spirit specimens is very characteristic. The whole of the rostrum except the apical spine and a narrow proximal band is black. There are three broad transverse bands of the same colour on the carapace, the posterior of which encloses a pale oval spot on either side. The last three thoracic and all the abdominal somites have each a broad, median, transverse, black band, leaving pale anterior and posterior borders. On the sixth somite the posterior pale border is sometimes obsolete. The telson has a pair of large rounded patches of the same black pigment, involving both the intermediate and lateral dorsal spines and frequently coalescing anteriorly. In some specimens there is a single large patch which is cut into four distal lobes. The inner uropod is entirely black, as are also the spines of the bifurcate process except at the extreme apex. The peduncular segment is dark proximally; the first segment of the exopod has a round black distal spot, while the ultimate segment is obliquely divided into dark anterior and pale posterior portions.

The collection in the Indian Museum comprises ten specimens :—

$\frac{5768}{9}$	Port Blair, Andaman Is.	G. H. Booley.	1 ♀, 41 mm.
$\frac{3520\text{-}4}{7}$	Coconada, Madras Presidency.	G. W. Wicks.	1 ♂, 5 ♀, 48—74 mm.
$\frac{8106}{9}$	Coconada, Madras Presidency.	'Investigator.'	1 ♀, 86 mm.
$\frac{7562}{6}$	Bombay.	Bombay Nat. Hist. Soc.	2 ♀, 65 and 85 mm.

Lysiosquilla acanthocarpus has been recorded from Port Essington, N. Australia (Miers), from Penang (Miers) and from Trincomali (Muller, *sub S. sarasinorum*).

Miers[1] has described a small female *Lysiosquilla* from Goree I., Senegambia, under the name *L. acanthocarpus* var. *septemspinosa*. This specimen differs from typical *acanthocarpus* in the slightly transverse rostrum, in the less prominent eyes and in the possession of seven teeth on the dactylus of the raptorial claw, the penultimate of which is not shorter than the antepenultimate. This form should, perhaps, be recognized as a separate species.

7. Lysiosquilla multifasciata, Wood-Mason.

1895. *Lysiosquilla multifasciata*, Wood-Mason, Figs. and Desc. of nine Squillidae, p. 1, pl. i, figs. 4-7.

? 1903. *Lysiosquilla multifasciata*, Nobili, Boll. Mus. Torino, XVIII, no. 447, p. 30.

? 1904. *Lysiosquilla valdiviensis*, Jurich. Stomatop. Deutsch. Tiefsee-Exped. p. 372, pl. xxvi, figs. 2-2g.

? 1906. *Lysiosquilla multifasciata*, Nobili, Ann. Sci. Nat. Zool. (9), IV, p. 337.

1910. *Lysiosquilla multifasciata*, Balss, Abh. math.-phys. Klasse k. bayer. Akad. Wiss. Suppl. Bd. II, Abh. 2, p. 6.

This species is very closely allied to the preceding, differing from it only in the following particulars:—

1. The dactylus of the raptorial claw bears five or six teeth of which the penulti-

[1] Miers, Ann. Mag. Nat. Hist. (5), VIII, 1881, p. 368, pl. xvi, fig. 7.

mate is short, as in *L. acanthocarpus*, but the two lobes at the base of its external margin are very unequal, the distal one being greatly expanded and more than twice the size of the proximal.

2. There are four short evenly-spaced spinules between the intermediate marginal teeth and the movable submedians. The innermost of these perhaps represents the stout fixed submedian tooth which is found overlying the movable spine in *L. acanthocarpus*, but in the present species is not any larger than the three external to it. In the type specimen there are four pairs of fixed denticles between the two movable submedians.

It may also be mentioned that the rostrum is a trifle longer proportionally than in *L. acanthocarpus*, its lateral margins are rather more distinctly convergent anteriorly and the antero-lateral angles are a little more obtuse. The eyestalks moreover appear to be a trifle more slender and the cornea a little narrower. In other structural details, notably in the form, carination and spinulation of the segments composing the uropods, the two species are in closest accord.

The colour pattern is, however, different, at any rate in the type specimen. The two anterior dark bands on the carapace are indistinct and are composed of dark speckles and mottling; the posterior one is very well marked, especially at the sides where there is no trace of the pale enclosed spot which occurs in *L. acanthocarpus*. Each segment of the post-abdomen from the sixth thoracic to the fifth abdominal inclusive bears *two* transverse dark bands. The anterior of these[1] is very narrow and does not reach the lateral margin on either side, while the posterior, which is about as broad as the pale band in front of it, is separated from the distal margin of the somite by a very narrow pale border. The sixth abdominal somite possesses a single dark transverse band close to the posterior edge. The telson bears four indistinctly separated dark spots in much the same position as those of *L. acanthocarpus*, and in the pigmentation of the uropods there is a close resemblance between the two species.

I am not certain that the specimens which Nobili described in 1906 are correctly identified. In his account there is no reference to the curious form of the external lobes on the raptorial dactylus (much the most important structural feature possessed by *L. multifasciata*), while with regard to the colour he merely informs us that "la coloration est celle des autres *Lysiosquilla*, par bandes transversales noires, dont trois sur la carapace." From the description supplied it seems possible that the specimens may really belong to *L. acanthocarpus*.

Lysiosquilla valdiviensis, Jurich, described from a semi-larval specimen 14·6 mm. in length, is probably synonymous with this species. The form of the raptorial claw bears a very close resemblance to that of *L. multifasciata*; but the rostrum is without trace of antero-lateral angles, and there are only three dorsal spines near the distal margin of the telson. The eyes are larger; but this is invariably the case in very young specimens and there is good reason to believe that the two characters mentioned above are also due merely to immaturity. The description of species from semi-larval

[1] Balss notes that this band is obsolete in the specimen which he examined.

forms, as Jurich has done both in this case and in the case of *Squilla minor*, is greatly to be deprecated.

Wood-Mason's type specimen is the only example of *L. multifasciata* preserved in the Indian Museum:—

$\frac{3342}{7}$ Bombay. Bombay Nat. Hist. Soc. 1 ♀, 44 mm. TYPE.

Balss has recorded the species from Formosa. Nobili's examples, which are perhaps wrongly determined, were found at Samarinda in Borneo and at Obock in the Red Sea. The locality of Jurich's *L. valdiviensis* is unknown.

8. Lysiosquilla biminiensis, Bigelow.

1893. *Lysiosquilla biminiensis*, Bigelow, John Hopkins Univ. Circ., No. 106, p. 102.

1894. *Lysiosquilla biminiensis*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 504, text figs. 4-7.

subsp. **pacificus**, Borradaile.

1899. *Lysiosquilla biminiensis* var. *pacificus*, Borradaile, in Willey's Zool. Results, p. 403.

This species, like the preceding, is a close ally of *L. acanthocarpus*, but differs from it structurally in the following features:—

1. The dactylus of the raptorial claw bears six teeth, including the apical one, and the penultimate is longer than the ante-penultimate. The lobes at the base of the external margin have much the same form as in *acanthocarpus*.
2. There are only three pairs of denticles, which are comparatively large, between the mobile submedian spines of the telson.
3. The rounded lobe fringed with long setae which is found in *L. acanthocarpus* on the ventral aspect of the basal segment of the outer uropod, projecting over the articulation with the ultimate segment, does not exist (*fide* Bigelow, fig. 4) in *L. biminiensis* and the carina on the lower surface of the peduncular segment (which ends in a strong anterior tooth in *L. acanthocarpus*) also appears to be missing.

The colour of the living animal, according to the full description which Bigelow gives, is fawn or pink with black, reddish brown and bright lemon yellow markings. The black colouring, which alone persists in alcohol, exists as a narrow border round the postero-lateral angles of the carapace. There is also a black posterior transverse streak on either side of the last thoracic and fifth abdominal somites and a pair of small black eyespots on the telson placed side by side in the median line just in front of the dorsal spines.

The specimen which Borradaile names *pacificus* differs structurally from those described by Bigelow only in the most insignificant features, but the colouring is different for on each somite from the sixth thoracic to the fifth abdominal inclusive, there is a narrow deep-black posterior border.

Bigelow's two specimens (48 mm. in length) were found in a burrow in the sand at the Bimini Is., Bahamas, while the single individual which Borradaile records was found at New Britain and is called *pacificus* in order to emphasize the remarkable distribution of the species.

9. **Lysiosquilla tigrina,** Nobili.

Plate VIII, figs. 95–98.

1903. *Lysiosquilla tigrina*, Nobili, Boll. Mus. Torino, XVIII, no. 447, p. 28.

The carapace is dorsally smooth and polished, and its greatest breadth is about equal to its mid-dorsal length. The gastric grooves are well-defined and slightly convergent posteriorly; but of the cervicals scarcely a trace remains. The antero- and postero-lateral angles are rounded. The rostrum is as long as broad; the lateral margins are only slightly convergent anteriorly and terminate in well-marked subacute angles. The apex is sharply acute and reaches a little beyond the base of the eyestalk (fig. 95).

The eyes are nearly one-third the mid-dorsal length of the carapace, and the cornea, which is not pigmented at the extreme apex, is obscurely bilobed, its breadth being about equal to the length of the stalk. The antennular peduncle is about half the length of the carapace. The mandibular palp is composed of three segments.

The outer inferior margin of the raptorial claw (fig. 96) is bluntly angled distally; the carpus is not carinate dorsally but terminates in a sharp spine overhanging the carpo-propodal articulation. The propodus bears four mobile spines at the proximal end of its pectinate edge. The dactylus is provided with eleven spines, including the apical one, the penultimate being very slightly shorter than the next of the series. The outer margin is convex and at its proximal end bears two small lobes, the anterior of which is broad and rounded while the posterior is narrow and subacute.

The free thoracic and abdominal somites are smooth; the lateral margins of the former are very broadly rounded, almost truncate, and the postero-lateral angles of the latter are also rounded except in the case of the last somite, in which they project posteriorly as a pair of long and sharp spines. On its inferior margin the sixth somite (fig. 98) bears *a pair* of curved spines on either side at the antero-lateral angles and a number of short spines rather irregularly disposed (nine in the only known specimen) along the posterior margin. This series of spines is not known to occur in any other species of *Lysiosquilla*.

The telson (fig. 97) is smooth and rounded dorsally except for a faint transverse depression on either side of the median line; on its inferior surface there is a central depression behind the anus. Dorsally it possesses a series of five spines arranged in a curved transverse row near the posterior margin. There are *four* pairs of large marginal teeth, a pair of submedians, two pairs of intermediates and one pair of laterals. Between the submedians there are six pairs of small denticles, the outermost of which are mobile and longer than the rest, and outside these are three small fixed spines, one in each interspace between the primary teeth. These small spines are all inferior in position and are situated beneath the level of the larger ones (fig. 98). In addition there is a single large spine immediately below the proximal primary tooth.

On the posterior margin of the peduncle of the uropods there is a small median dorsal spine and another at the external angle. The bifurcate process from the inferior margin consists of a pair of long curved spines, of which the inner is only very slightly longer than the outer, and on the margin inside the process there is also

another spine which is stout and much shorter. The proximal segment of the outer uropod bears the usual series of movable spines along its external margin. As in *L. acanthocarpus* there is on the ventral side a small fixed spine and a setose lobe projecting over the articulaton of the ultimate segment (fig. 98).

The type specimen is pale in colour with scattered dark chromatophores on the carapace, which are closely aggregated near the posterior margin (fig. 95). The rostrum is sprinkled with similar chromatophores which are thickest proximally. On each of the free thoracic and abdominal somites there is a broad transverse dark band separating narrow anterior and still narrower posterior borders. On the first five abdominal somites the dark band shows a tendency to become divided by a narrow and obscure, transverse, pale stripe. The colouring of the sixth somite and of the telson is shown in fig. 97. The peduncular segment of the uropods is dark as is also the inner ramus. There is a dark spot near the distal end of the proximal segment of the exopod and the outer segment is suffused with dark pigment at the base.

Thanks to the kindness of Mr. J. C. Moulton, I have had an opportunity of examining the only known example of this species, and I have been able in consequence to supplement Nobili's account with figures and a few further details.

The type of *Lysiosquilla tigrina* is a male, 45 mm. in length. It was found at Santubong, Borneo, and is preserved in the Sarawak Museum.

10. Lysiosquilla vicina, Nobili.

1904. *Lysiosquilla vicina*, Nobili, Bull. Mus. Hist. Nat., X, p. 229.
1906. *Lysiosquilla vicina*, Nobili, Ann. Sci. Nat., Zool. (9), IV, p. 339.

This species is founded on a single small specimen in which the raptorial claws are wanting. It appears to be allied to *L. tigrina* ; but is distinguished by the following characters :—

1. The rostrum is trispinous, each antero-lateral angle being acutely produced.
2. The posterior ventral border of the sixth abdominal somite is smooth and without spines.
3. As in *L. tigrina* there are four pairs of large primary teeth on the margin of the telson, but the stout additional spine, which occurs in that species below the proximal lateral tooth, is missing.

L. vicina seems to be easily distinguished from all other known species of *Lysiosquilla* by the trispinous rostrum, and from all except *L. tigrina* by the four pairs of long fixed spines on the margin of the telson.

The type and only known example, a male only 27 mm. in length, was found at Obock in the Red Sea in sand inhabited by *Balanoglossus*.

11. Lysiosquilla insignis, Kemp.

Plate IX, figs. 99–102.

1911. *Lysiosquilla insignis*, Kemp, Rec. Ind. Mus., VI, p. 94.

The carapace is smooth, longer than its greatest breadth and is obtusely angled

antero-laterally. There is no cervical groove, but the gastric grooves are distinct throughout. The rostrum has the form of a narrow isosceles triangle and is more than one and a half times as long as broad. There are no antero-lateral angles and the lateral margins, which are feebly sinuous, converge to a very fine spinous apex (fig. 99).

The eyes are very large. The cornea is oblique and obscurely bilobed ; its greatest breadth is one-third the mid-dorsal length of the carapace and is about equal to the total length of the whole eye. Seen from above, the anterior margin of the ophthalmic somite and its dorsal processes are entirely concealed by the rostrum. The antennular peduncle is nearly half the length of the carapace (excluding the rostrum), and its ultimate segment is only half the length of the penultimate ; the dorsal processes of the somite consist of a pair of sharp divergent spines. The mandibular palp is composed of three segments.

The carpus of the raptorial claw (fig. 100) is not carinate, but its dorsal margin terminates in a sharp spine ; the propodus bears four movable spines at the base of its pectinate margin. The dactylus is provided with seven or eight teeth including the terminal one, the penultimate being, as in *L. acanthocarpus*, very noticeably shorter than the ante-penultimate. The external margin is concave and at its base bears two lobes, the anterior of which is obsolete, while the posterior has the form of a sharply acute tooth.

The posterior portion of the lateral margin of the fifth somite projects outwards as a thin vertical blade. The sixth somite has an angular dorsal elevation on either side near the anterior edge ; antero-laterally the margin is deeply excavate and behind this projects in the form of a truncate lobe with rounded subrectangular anterior and posterior angles. The seventh somite is broadest posteriorly ; its lateral margins are obliquely truncate in front and rather sharply rounded behind (fig. 99). The basal segment of the last three thoracic appendages terminates posteriorly in a sharp spine. The shorter ramus of the limb attached to the sixth somite is rather broadly oval, that of the eighth much narrower, though it could scarcely be termed linear, while that of the seventh is intermediate in form.

The first four abdominal somites are smooth dorsally. The postero-lateral angles of the first three are rounded ; those of the last three are sharply spinous. The fifth somite bears an obscure longitudinal carina on either side in its posterior half. The sixth somite, in addition to the spines at its postero-lateral angles, possesses a dorsal pair situated close to the distal margin (fig. 101). Each of the latter forms the termination of an irregular blunt carina, and between this and the outer margin there is also another carina which runs obliquely towards the postero-lateral spine. On its ventral surface the sixth somite bears a sharp curved spine at its antero-lateral angles situated immediately in front of a prominent rounded lobe.

The telson (figs. 101, 102) is rather less than twice as broad as long. It bears on its dorsal surface two pairs of tubercles and eight longitudinal carinae, the outermost of which is bifurcated proximally. The peculiar arrangement of these carinae, which are slightly irregular and not precisely similar on either side, is shown in fig. 101 and does not call for detailed description. In place of the curved series of dorsal spines

which occurs in most of the preceding species, there is in *L. insignis* a very peculiar armature which consists of a trilobed median prominence, a sharp intermediate spine and an angular lateral lobe. These are not separated by the smooth declivous dorsum of the telson, as in *L. acanthocarpus* and the other species with a dorsal circlet of spines, but are connected by a sharp transverse ridge. On the margin of the telson there are two very large teeth, the intermediate and the lateral, on each side and two long movable submedian spines. Between the latter are six pairs of small denticles (fig. 102). There are four short spines[1] between the mobile pair and the intermediate tooth, and one between the intermediate and the lateral.

The peduncular segment of the uropods is carinate along its antero-lateral margin and a second carina, parallel to the above, runs to the middle of the distal margin where it is continued as a long spine extending over the base of the proximal segment of the exopod. The bifurcate process consists of a pair of large tricarinate spines, the outer of which is scarcely shorter than the inner. In addition there is a sharp inferior spine at the point of articulation of the inner uropod. On the external margin of the basal segment of the outer uropod there is a series of six mobile spines; the two outermost are curved and many times longer than the next of the series. On the ventral surface there is a stout fixed distal spine projecting over the base of the ultimate segment.

No trace of any colour remains in the single specimen examined.

$\frac{7568}{10}$ Off N. Andaman I., 235 fathoms, .. 'Investigator'. .. 1 ♂, 49 mm. TYPE.
~~10° 7'~~ 14°27' N., ~~79° 7'~~ 93°50' E.

12. Lysiosquilla latifrons (de Haan).

1844? *Lysiosquilla latifrons*, De Haan, in Siebold's Fauna Japonica, Crust., atlas, pl. li, fig. 3, text, 1849, p. 222.
1880. *Lysiosquilla* (*Coronis*) *latifrons*, Miers, Ann. Mag. Nat. Hist. (5), V, pp. 10, 25.
1880. *Lysiosquilla brazieri*, Miers, *ibid.*, pp. 11, 125, pl. i, figs. 3-6.
1882. *Lysiosquilla brazieri*, Haswell, Cat. Australian Crust., p. 206.
1894. *Lysiosquilla latifrons*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 503.
1894. *Lysiosquilla brazieri*, Bigelow, *ibid.*, p. 503.
1903. *Lysiosquilla latifrons*, Rathbun, Proc. U.S. Nat. Mus., XXVI, p. 54.
1910. *Lysiosquilla brazieri*, Chilton, Trans. N. Z. Inst., XLIII, p. 139.

I have seen no examples of *L. latifrons*; the principal characters of the species appear to be as follows :—

The rostrum is broader than long with very strongly rounded lateral margins and a sharp median spine. The cornea of the eyes is bilobed, but is very much smaller than in the preceding species.[2] The dactylus of the raptorial claw bears six, rarely seven, teeth. The lateral margins of the exposed thoracic somites are truncate. The short

[1] The innermost of these is probably homologous with the fixed submedian spine in *L. acanthocarpus* and other species.

[2] In De Haan's figure, which probably represents a small specimen natural size, the breadth of the cornea is about one-fifth the length of the carapace. In Mier's large example the eye, as might be expected, is proportionately smaller.

ERRATUM.

P. 128, line 22 from top of page, *for* "50° 7′ N., 79° 7′ E." *read* "14° 27′ N., 93° 50′ E."

ramus of the appendages of the sixth and seventh somites is broadly oval; that of the succeeding somite almost linear.

The first five abdominal somites are not spinous at the postero-lateral angles; the sixth is obliquely sulcated on either side with sharp postero-lateral spines. The telson bears seven dorsal spines in a transverse row near the posterior margin. According to the figures the two outermost on either side are separated from one another and from the three median by a very distinct furrow which extends forwards half way to the anterior margin. There are three pairs of large marginal teeth, the submedians being mobile. Between the submedians are ten to fourteen small spinules and there are three short spines between the submedians and the intermediate and one between the intermediate and the lateral. On the inferior surface there is a single spine behind the anus.

The descriptions published contain no mention of any distinctive colouring.

There can be little doubt that, as Chilton has suggested, Miers' *L. brazieri* is synonymous with *L. latifrons*. De Haan states that there are seven dactylar teeth in the latter form, whereas Miers found six only in *L. brazieri*; but, as Miss Rathbun has pointed out, six are shown on the right raptorial claw in De Haan's figure. In Miss Rathbun's example, which, like the type, was found in Japanese waters, both raptorial dactyli bear six teeth.

Lysiosquilla latifrons seems to present some affinity with *L. insignis*, but the two forms are readily distinguished by the characters afforded by the rostrum, eye, raptorial dactylus, sixth abdominal somite and telson.

The largest of the known specimens is about 105 mm. in length.

The species is recorded from Japan (De Haan), Nagasaki, Japan (Rathbun), Port Jackson, New South Wales (Miers), and from Otaki, New Zealand (Chilton).

Genus **Coronida**, Brooks.

1886. *Coronida*, Brooks, Voy. H.M.S. 'Challenger,' XVI, Stomatop., p. 79.

Carapace strongly, or scarcely at all, narrowed anteriorly, without carinae; antero-lateral angles rounded; gastric grooves distinct; cervical groove almost obsolete, wholly absent mid-dorsally. Mandibular palp three-segmented or entirely absent. Merus of raptorial claw articulating terminally with ischium; ventral surface of merus longitudinally hollowed throughout its length; upper margin of propodus pectinate proximally along outer edge, distally with a pair of smooth blunt ridges; dactylus inflated at base, armed with teeth on inner margin. Shorter ramus of last three thoracic appendages linear, composed of two segments. Free thoracic somites without carinae. Abdominal somites depressed, first four without carinae or sculpture. Last one or two abdominal somites and telson with elaborate ornamentation consisting of close set spinules or of carinae and large tubercles, in the latter case a pair of submedian carinae on telson; telson semicircular in shape, marginal teeth minute. Ventral process of uropods consisting of a single strong spine with a much smaller spine on outer margin.

There are no marked secondary sexual distinctions.

The form of the articulation of the ischium and merus of the raptorial claw leads me to believe that the affinities of this genus are with *Squilla*, *Pseudosquilla*, and *Lysiosquilla* rather than with *Odontodactylus* and *Gonodactylus*.

Of the three known species one inhabits the Atlantic and two the Indo-Pacific. The Atlantic form, *C. bradyi*, is very closely allied to *C. trachura* and the two may, in fact, belong to the same species; *C. bradyi* is only known from a single example described in 1869. *C. multituberculata*, though very different in general appearance, must certainly be accommodated in this genus.

Key to the species of *Coronida*.

I. Mandibular palp present; *external* margin of raptorial dactylus with a single blunt lobe at base; dorsal surface of last abdominal somite and telson covered with spinules; form broad, greatest width of abdomen more than one-fifth of total length.
   A. Spinules simple, covering last abdominal somite and telson only .. [*bradyi*.]
   B. Spinules stellate, covering last abdominal somite and telson and, in addition, posterior half of fifth somite .. .. .. *trachura*, p. 130.

II. Mandibular palp absent; *external* margin of raptorial dactylus with three teeth; fifth abdominal somite smooth and unarmed; sixth with eight dorsal ridges; telson with two median dorsal carinae and numerous large tubercles on either side; form narrow, greatest breadth of abdomen much less than one-fifth of total length .. .. .. *multituberculata*, p. 132.

1. Coronida trachura (v. Martens).

1881. *Gonodactylus trachurus*, v. Martens, Sitz.-ber. Ges. naturf. Freunde, Berlin, p. 93.
1884. *Gonodactylus trachurus*, Miers, Proc. Zool. Soc., p. 16, pl. i, figs. 3, 3*a*.
1886. *Coronida trachura*, Brooks, Voy. H.M.S. 'Challenger,' XVI, Stomatop., pp. 7 and 97-80.
1894. *Odontodactylus trachurus*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 496.
1906. *Coronida trachura*, Nobili, Ann. Sci. Nat. Zool. (9), IV, p. 334.

The carapace is smooth without trace of carinae and is widest posteriorly, its greatest breadth being about equal to its median length including the rostrum. The gastric grooves are well marked, and on either side of them faint traces of the transverse cervical groove may be observed. The antero-lateral angles are angular but not produced as spines, the postero-lateral are very broadly rounded. The rostrum is subrectangular, much wider than long; its lateral margins are parallel, the antero-lateral angles almost rectangular, and the apex is formed by a blunt obtuse or subrectangular prominence.

The eyes are about one-third the length of the carapace, excluding the rostrum. The cornea is prominently bilobed, set transversely on the stalk, and in breadth is rather less than the total length of the whole organ. The ophthalmic somite terminates in a small acute apex. The antennular peduncle is a little shorter than the carapace excluding the rostrum. The mandibular palp is three-segmented.

The outer inferior margin of the merus of the raptorial claw is broadly rounded distally; the carpus has a dorsal carina which is cut into one or two sharp teeth near its distal end. The propodus bears three movable spines at the base of the margin opposed

to the dactylus. This margin as in allied genera is pectinate, but only along its basal two-thirds. In the distal third, where there are no pectinations, the inner and outer edges are elevated and form a pair of low smooth crests, between which the proximal edge of the dactylus fits when the claw is closed. The dactylus bears four[1] spines including the terminal one. Its outer margin is notched at the base, and in front of this notch is strongly inflated somewhat after the fashion of *Gonodactylus*.

The free thoracic and first four abdominal somites are smooth dorsally. The lateral margin of the fifth possesses a vertical groove, which separates a pair of inferiorly convergent carinae, the posterior of which is the highest and in dorsal view resembles a lateral spine. The sixth and seventh somites are broadly rounded laterally and the short inner ramus of the three pairs of thoracic limbs is linear.

The postero-lateral angles of the first four abdominal somites are not spinous. The posterior half of the fifth somite is rather thickly scattered with small irregular tubercles, and close to the external margin there is a fine longitudinal carina which runs outwards and terminates in the angular and produced postero-lateral angle. The sixth somite is densely covered with stellate or spinous tubercles, and its postero-lateral angles end in spines. The posterior margins of both the last two abdominal somites are fringed with a series of sharp spinules.

The telson is rather less than twice as broad as long; it is strongly convex and, like the preceding segment, is covered with closely packed spinous tubercles. Seen from below a pair of submedian movable spines may be distinguished, and two pairs of large fixed lateral spines; there are also, near the distal margin, two pairs of inferior spines situated inwards of the two pairs of laterals. The ventral surface bears numerous scattered spinules.

Tubercles similar to those on the dorsal aspect of the telson are found on the upper side of all the segments composing the uropods, but on the endopod and ultimate segment of the exopod, they exist only in a narrow median crest. The peduncular segment is strongly arched and sharply carinate antero-laterally; distally it is produced as a spine, supported by a short carina, which overhangs the articulation of the basal segment of the exopod. The ventral bifurcate process consists of a sharp inwardly curved spine which is very broad proximally. Its outer margin bears a sharp tooth near the apex, while its inner margin is cut into three or four strong teeth. The process is strengthened by a blunt longitudinal ventral carina. The external margin of the basal segment of the exopod carries nine or ten movable spines, and there is also an additional one, which is fixed, at the extreme distal end of the ventral surface. The internal margin of the inner uropod is concave, the segment being more or less crescentic in outline.

Two of the specimens examined are pale straw colour in spirit sprinkled with very small black chromatophores. These are aggregated and tend to form a dark posterior band on the carapace, enclosing a small pale area on either side. In addition, there is a median and pair of lateral patches on each of the first five abdominal somites. The

[1] In one of the specimens examined there are on one side only three spines, but this appears to be quite abnormal.

sixth thoracic is thickly sprinkled with black dots, as are also the lateral portions of the two succeeding somites, the basal segments of the thoracic appendages and the outer uropods. In the third example the distribution of the pigment is precisely similar; but the chromatophores, which appear to be expanded, form conspicuous black patches.

As Miers has mentioned, *Coronida trachura* is very closely allied to *C. bradyi* (A. Milne-Edwards, 1869) from St. Vincent, Cape Verde Is. According to Milne-Edwards' description *C. bradyi* appears to be distinct from the Indo-pacific species, but a fresh account of the Atlantic form is badly needed.

The three specimens of *C. trachura* in the Indian Museum are registered as follows :—

$\frac{4271}{5}$ Mauritius. Purchased. 2 ♂, 1 ♀, 38-40 mm.

The species has been previously recorded from Mauritius (v. Martens, Miers) from the Red Sea (Nobili) and from the Pelew Is. (Palass Ins.), Caroline group (v. Martens).

2. Coronida multituberculata (Borradaile).

1898. *Squilla multituberculata*, Borradaile, Proc. Zool. Soc., p. 38, pl. vi, figs. 7, *a-c.*

1899. *Squilla multituberculata*, Borradaile, in Willey's Zool. Results, p. 403.

Through the kindness of Mr. L. Doncaster I have been able to examine two of the type specimens of Borradaile's *Squilla multituberculata*, and have thereby been able to satisfy myself that the species must be transferred to the genus *Coronida*. In the total absence of the cervical groove in the median part of the carapace, in the absence of abdominal carinae, and in the proximal inflation of the raptorial dactylus, *C. multituberculata* agrees very closely with *C. trachura*, and the ornamentation of the body is, as in the latter species, restricted to the last abdominal somite and telson. Moreover, in the minute and peculiar characters afforded by the raptorial propodus and by the basal segment of the uropods, and its spinous process, there is such a close resemblance between the two species that no doubt of their affinity can be entertained.

The principal characters of *C. multituberculata* are as follows :—

The carapace is wide posteriorly and is closely similar to that of the preceding species; its greatest breadth, however, is less than its median length, excluding the rostrum. The rostrum is longer than wide and has the shape of an inverted triangle, its straight lateral margins diverging anteriorly to a broad, squarely truncate apex. The eyes are dorso-ventrally flattened; the bilobed cornea is not wider than the stalk and is set obliquely on it. The mandibular palp is entirely absent.

The dorsal edge of the carpus of the raptorial claw is cut into two large teeth near its distal end. The propodus is proportionately broader than in *C. trachura*; on its upper margin it bears a series of conspicuous pectinations, and in its proximal portion three movable spines. Distally the pectinations are replaced by a pair of smooth crests, much as in the preceding species. The dactylus bears four teeth including the terminal one; the basal part is inflated, though not very strongly so, and the external edge of this inflated part is cut into three blunt teeth, of which the proximal is the largest.

The fifth thoracic somite resembles that of *C. trachura*, but the lateral margins of the three following are more truncate, and all the segments of the post-abdomen are

proportionately longer than in that species. The first five abdominal somites are quite smooth above and their postero-lateral angles are rectangular, but slightly rounded. The sixth abdominal somite bears four pairs of longitudinal carinae, the outermost of which run along the lateral margins and terminate in subacute postero-lateral angles. The carinae of the submedian pair are slightly curved and project a trifle beyond the posterior margin; between them, in one specimen, there is a short median carina in the posterior part of the somite. The two intermediate carinae on either side are connected posteriorly and form a V-shaped figure, and between the innermost of these and the submedians there are several smoothly rounded tubercles.

The telson is semicircular in outline, about one and a half times as broad as long, and is strongly convex above. It bears a pair of posteriorly convergent submedian carinae, and the surface is otherwise closely covered with smooth rounded tubercles: shortest on the vertex and longest at the edges. The ventral surface is smooth and on the posterior margin (seen from below) three sharp spines may be observed, as well as series of five submedian and intermediate spinules.

The outer edge of the basal segment of the uropod is strongly arched as in the preceding species, and the process arising from its inferior aspect consists of a single sharp spine bearing a very small tooth high up on its outer margin. The proximal segment of the exopodite is shorter than the ultimate segment and is provided with a series of nine movable spines. The endopod is curved as in *C. trachura*, but much less distinctly so.

No secondary sexual distinctions could be detected.

Only three specimens of *Coronida multituberculata* are known. Their very small size, 12–13 mm., suggests that they are perhaps immature; but, with the possible exception of the shape of the rostrum, it does not seem likely that their characters would be much modified by further growth. One male and two females were found at Sandal Bay, Lifu, Loyalty Is. (Borradaile).

Genus **Odontodactylus**, Bigelow.

1894. *Odontodactylus*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 445 (*ubi syn.*).

Carapace little, if at all, narrowed anteriorly; without carinae; gastric grooves distinct, cervical groove wholly absent; antero-lateral angles rounded, cornea of eye not distinctly bilobed. Mandibular palp present and composed of three segments or (?) entirely absent. Ischio-meral articulation of raptorial claw situated at a point in advance of proximal end of merus, the latter segment consequently extending backwards considerably beyond the joint; the inferior surface of merus not channelled longitudinally throughout its entire length; upper margin of propodus not pectinate; dactylus inflated at base, armed with two to nine teeth on inner margin. Shorter ramus of last three thoracic appendages linear, composed of two segments. Free thoracic and abdominal somites compressed; distinct carinae present only on last abdominal somite. Telson with sharp median carina and one or more carinae on either side; strong submedian, intermediate and lateral teeth on distal margin, the first with movable apices; no submedian denticles (though there may be minute

spinules), one or two intermediate denticles and one lateral. Ventral process of uropods terminating in two sharp spines, inner usually shorter than outer.

There are no well-marked secondary sexual distinctions.

Ten species of this genus are known; nine have been found in Indo-pacific waters and one, *O. havanensis*, in the Atlantic. No species is known to inhabit both areas.

Specimens of *Odontodactylus* are, unfortunately, not numerous in collections and consequently little is known of the variation that occurs within the limits of the species and of the alteration in form due to growth. In taxonomic work the precise number and disposition of the carinae on the telson is of great importance, but this is a character that may perhaps be modified in the course of growth from the post-larval form to the adult. Another feature which appears to have considerable systematic value is the size of the eye. In *Squilla* the breadth of the cornea is known to decrease proportionately during growth and this, if true in *Odontodactylus*, must have much influence on our views of the limits of the various species. Examination of seven specimens of *O. southwelli*, varying from 21 to 37 mm. in length, seems, however, to indicate that this proportional difference, due to growth, is not one of any considerable magnitude, at any rate in that form.

The species appear to live on rough ground, but of their habits nothing precise is known. The greatest depth from which any member of the genus has been obtained is 163 fathoms (*O. havanensis*, Bigelow).

For explanation of the terminology used below in designating the carinae of the telson, see text-fig. 4, p. 12.

Key to the species of *Odontodactylus*.

I. Dactylus of raptorial claw with only two or three teeth on its inner margin.
  A. Several carinae on sixth abdominal somite, six of them terminating posteriorly in spines; several carinae in anterior half of telson on either side of median crest.
    I. Raptorial dactylus with two teeth; second lateral carinae of telson present.
      A. Breadth of cornea about one-fifth median length of carapace; raptorial dactylus very strongly dilated at base; median crest of telson not remarkably high, with two pairs of submedian carinae .. .. *scyllarus*, p. 135.
      B. Breadth of cornea about one-third median length of carapace; raptorial dactylus not very strongly dilated at base; median crest of telson remarkably high with a single pair of submedian carinae .. *cultrifer*, p. 137.
    II. Raptorial dactylus with three teeth; second lateral carinae of telson absent (breadth of cornea about one half median length of carapace) .. *carinifer*, p. 138.
  B. Sixth abdominal somite without carinae, with only four posterior spines, submedians and postero-laterals; telson with median carina only .. *elegans*, p. 139.
I. Dactylus of raptorial claw with at least six teeth on its inner margin.
  A. Second lateral carina of telson present.
    I. Telson with two pairs of submedian carinae; second lateral carina running to apex of lateral marginal tooth (text-fig. 4, p. 12) .. *japonicus*, p. 139.
    II. Telson with a single pair of submedian carinae; second lateral carina

parallel with outer margin, running towards outer edge of intermediate marginal tooth.

A. Breadth of cornea not more than one-third median length of carapace; median portion of exposed dorsal process of opthalmic somite anteriorly concave.

1. Rostrum evenly rounded anteriorly; basal segment of outer uropod with terminal mobile spine reaching to apex of distal segment .. *hanseni*, p. 140.

2. Rostrum anteriorly truncate; basal segment of outer uropod with terminal mobile spine not reaching to apex of distal segment .. *latirostris*, p. 141.

B. Breadth of cornea about one half median length of carapace; median portion of exposed dorsal process of ophthalmic somite very strongly excavate anteriorly, enclosing a deep and almost circular pit .. *southwelli*, p. 142.

B. Second lateral carina of telson absent.

I. Ophthalmic somite largely exposed in dorsal view; raptorial dactylus strongly inflated at base and not notched externally .. .. [*havanensis.*][1]

II. Ophthalmic somite almost entirely covered by rostrum; raptorial dactylus only very slightly inflated at base and notched externally near its proximal end .. .. *brevirostris*, p. 143.

1. Odontodactylus scyllarus (Linnaeus).

1705. *Squilla lutaria*, Rumphius, Amboinsche Rariteitkamer, p. 6, pl. iii, fig. F.
1758. *Squilla arenaria prona*, Seba, Thesaurus, III, p. 51, pl. xx, fig. 3.
1767. *Cancer scyllarus*, Linnaeus, Syst. Nat., 12th ed., I, ii, p. 1054.
1787. *Squilla scyllarus*, Fabricius, Mantiss. Insect., I, p. 333.
1796. *Cancer (mantis) scyllarus*, Herbst, Krabben u. Krebse, II, p. 99, pl. xxxiv, fig. 1.
1793. *Squilla scyllarus*, Fabricius, Ent. Syst., II, p. 512.
1798. *Squilla scyllarus*, Fabricius, Ent. Syst. Suppl., p. 416.
1818. *Squilla scyllarus*, Lamarck, Hist. Nat. Anim. sans Vert., V, p. 188.
1825. *Gonodactylus scyllarus*, Latreille, Encycl. Méthod., X, p. 473.
1829. *Gonodactylus scyllarus*, Latreille, in Cuvier's Règne Anim., 2nd ed., IV, p. 109.
1837. *Gonodactylus scyllarus*, H. Milne-Edwards, Hist. Nat. Crust., II, p. 529.
1838. *Gonodactylus scyllarus*, H. Milne-Edwards, in Lamarck's Hist. Nat. Anim. sans Vert., 2nd ed., V, p. 324.
1836-49. *Gonodactylus scyllarus*, H. Milne-Edwards, in Cuvier's Régne Anim., 3rd ed., atlas, pl. lv, fig. 2.
1847. *Gonodactylus scyllarus*, White, List Crust. Brit. Mus., p. 85.
1862. *Gonodactylus scyllarus*, A. Milne-Edwards, in Maillard's l'île Réunion, ann. F., p. 10.
1868. *Gonodactylus bleekeri*, A. Milne-Edwards, Nouv. Arch. Mus. Hist. Nat., IV, p. 65, foonote.
1874. *Gonodactylus scyllarus*, Hoffmann, Réch. Faune Madagasc., Crust., p. 43.
1880. *Gonodactylus scyllarus*, Miers, Ann. Mag. Nat. Hist. (5), V, pp. 115, 459.
1880. *Gonodactylus bleekeri*, Miers, *ibid.*, p. 118.
1880. *Gonodactylus scyllarus*, Richters, in Möbius' Meeresfauna Mauritius, p. 167.
1886. *Gonodactylus scyllarus*, Müller, Verhandl. naturf. Ges. Basel, VIII, p. 471.
1887. *Gonodactylus scyllarus*, de Man, Arch. f. Naturgesch., LIII, i, p. 572.
1894. *Odontodactylus scyllarus*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 496.
1894. *Odontodactylus bleekeri*, Bigelow, *ibid.*, p. 496.
1894. *Gonodactylus scyllarus*, Ortmann, Denk. med.-wiss. Ges. Jena, VIII, p. 60.

[1] See p. 144.

1898. *Odontodactylus scyllarus*, Borradaile, Proc. Zool. Soc., p. 36, pl. v, fig. 6.
1899. *Odontodactylus scyllarus*, Borradaile, in Willey's Zool. Results, p. 402.
1899. *Odontodactylus scyllarus*, Nobili, Ann. Mus. Civ. Genova (2), XX, p. 276.
1903. *Odontodactylus scyllarus*, Rathbun, Proc. U.S. Nat. Mus., XXVI, p. 54.

The carapace is smooth with its antero-lateral and postero-lateral angles rounded: the former more broadly than the latter. It bears no carinae and the cervical groove is entirely obsolete. The rostrum is cordiform, widest a little in front of the base, and is rather more than one and a half times as broad as long; seen from above it entirely conceals the dorsal processes of the ophthalmic somite. The apex is acute, depressed, and ventrally thickened.

The eyestalks are short and broad and the breadth of cornea, which is a little wider than the stalk, is in large specimens contained about five times in the median length of the carapace, excluding the rostrum. The antennal scale is very large, between ·8 and ·9 times the length of the carapace, and is nearly three times as long as wide.

The dactylus of the raptorial claw is very strongly and abruptly swollen at the base; distally it is slender and almost straight and the knife-like edge on its inner margin is cut into two strong teeth, the posterior of which springs from the mid-ventral point of the inflated portion, and is longer and more slender than the other.

The thoracic somites are smooth above. The lateral margin of the sixth is truncate and rounded at either angle; that of the seventh is similar but rather less sharply truncate and a trifle broader. The lateral margin of the eighth somite is produced to a rounded point and is notched antero-laterally.

The median portion of the first five abdominal somites is smooth, but on each side there is a well-defined ⌊-shaped groove running parallel to the anterior and lateral borders. On the fifth and sixth somites, also, a broad depression well above the lateral margin is confined by two longitudinal ridges the innermost of which is proximally notched. Traces of similar depressions are visible on the sides of the two preceding somites. The postero-lateral angles become gradually more acute from before backwards, and those of the fourth and fifth somites terminate in spines. The sixth somite bears four pairs of longitudinal carinae; the submedian and lateral end in spines which project beyond the posterior margin, while, of the two intermediate pairs, the innermost is entire and the outer ends in spines which fail to reach the distal edge. Between the submedian and first intermediate carinae there is a prominent proximal tubercle, and another which is elongated and forms a stout keel, is found between the second intermediates and the laterals.

In the single specimen examined the height of the median crest of the telson above the general surface is less than one-sixth the greatest breadth of the telson, and below its small terminal spine there are two blunt points. In the anterior half there are on each side two closely-approximated submedian carinae which meet or almost meet at the distal end of the median ridge, an intermediate which is continuous, though not very clearly so, with that which runs to the apex of the submedian spine, and the second lateral which fuses distally with the marginal to form the lateral marginal spine. The first lateral carina, found in *O. japonicus* (see text-fig. 4, p. 12) does not exist in the anterior part of the telson. There is a strong carina in the

posterior half of the telson which supports the intermediate spines and another, shorter and far less conspicuous, which runs out on to the intermediate marginal denticle. The six principal marginal teeth are well-developed; the submedians are broad and have small movable tips. In the large specimen examined there are only the most obscure traces of minute submedian spinules. Normally there is one large intermediate and one lateral denticle, which may bear one or two minute apical spinules. The ventral surface of the telson is quite smooth.

The ventral process of the uropods bears two blunt keels on its lower surface and is cut distally into two spines, the inner of which is about two-thirds the length of the outer. The proximal segment of the exopod is provided with twelve movable spines on its outer margin; the distal segment extends beyond the apex of the last of these spines and is only a little more than half the length of the proximal.

In colour the preserved specimen is olivaceous green with obscure traces of marbling. The carinae of the sixth somite and telson are quite pale, and the antennal scale is pale with a large dark distal patch. According to Milne-Edwards' coloured figure the marbling is conspicuous in fresh specimens and the raptorial dactylus, the spines on the outer uropod, and all the fringes of setae are crimson.

Odontodactylus bleekeri, founded on a specimen from Batavia, is described by A. Milne-Edwards as follows: "Cette espèce . . . . se distingue du *Gonodactylus scyllarus* par la forme de la plaque rostrale, qui, bien qu'élargie à sa base, se termine en pointe, et par l'existence d'une carène médiane lamelleuse que porte en dessus le dernier segment de l'abdomen; cette carène est notablement moins élevée que celle du Gonodactyle cultrifer." A Milne-Edwards seems to have misunderstood the characters of *O. scyllarus*, for, in the features which he notes, his new species does not seem to present any difference from that form.

Of *Odontodactylus scyllarus* I have seen only a single example :—

$\frac{3 \cdot 3 \cdot 32}{5}$ Mauritius. Purchased. 1 ♀, 115 mm.

This species appears to have a wide Indo-pacific distribution extending from Samoa and Japan to Madagascar. It has been recorded from Samoa (Miers, Bigelow); Rotuma (Borradaile); Kii, Japan (Rathbun); New Britain (Borradaile); New Guinea and Goram I. (Miers); Amboina (Miers, de Man, Ortmann, Nobili); Celebes (Rumph); Lette I., Timor (de Man); Batavia (A Milne-Edwards); Trincomali (Müller); Seychelles (Miers); Zanzibar (Miers); Madagascar (Miers, Richters); Réunion (Milne-Edwards, Hoffman); Mauritius (Miers).

2. Odontodactylus cultrifer (White).

1850. *Gonodactylus cultrifer*, White, Proc. Zool. Soc., p. 96, pl. xvi, figs. 1, 2.
1851. *Gonodactylus cultrifer*, White, Ann. Mag. Nat. Hist. (2), VII, p. 422.
1880. *Gonodactylus cultrifer*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 117.
1894. *Odontodactylus cultrifer*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 496.
1901. *Gonodactylus cultrifer*, Lanchester, Proc. Zool. Soc., II, p. 555.

Of this species I have seen no specimens. According to the accounts of White, Miers and Lanchester and from the figures which the first of these authors has given, it may be separated from *O. scyllarus* by the following characters :—

1. The rostrum is quadrilateral, with the sides distally convergent and the anterior margin straight.
2. The eyes, according to White's figure, are much larger, the breadth of the cornea being about one-third the length of the carapace excluding the rostrum.
3. The dactylus of the raptorial claw is much less strongly dilated at the base, but otherwise resembles that of *O. scyllarus*.
4. There are only six carinae on the sixth abdominal somite, the inner intermediate pair found in the preceding species being absent.
5. The median crest of the telson is very remarkably elevated ; its height above the general surface is nearly equal to the breadth between its base and the lateral margin. The submedian carinae are entire ; the submedian spines are less expanded at the base than in *O. scyllarus* and their movable tips appear to be larger.
6. The basal segment of the outer uropod is, according to the figure, only about two-thirds the length of the distal segment ; there are only eight or nine movable spines on its external margin.

Lanchester notes that in his specimen the rostrum does not nearly reach the base of the eyestalks as it appears to do in White's figure. Even in the latter a greater portion of the ophthalmic somite is exposed than in *O. scyllarus*.

White remarks that in his dried specimen the greater part of the upper surface is tinged with a reddish hue, while along the middle of the back there is a pale line.

O. cultrifer is known only from two examples, 4 and $4\frac{1}{2}$ ins. in length. One is recorded from China (White, Miers) and the other from Kelantan in the G. of Siam (Lanchester).

3. Odontodactylus carinifer (Pocock).

1893. *Gonodactylus carinifer*, Pocock, Ann. Mag. Nat. Hist. (6), XI, p. 478, pl. xx B, figs. 4, 4*a*, *b*.
1894. *Odontodactylus carinifer*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 496.

O. carinifer is known only from a single small specimen which is distinguished from the two preceding species by the following characters :—

1. The rostrum is semicircular, not quadrilateral or cordiform.
2. The eyes are extremely large, according to Pocock's figure the breadth of the cornea is exactly half the median length of the carapace excluding the rostrum.
3. The dactylus of the raptorial claw is moderately dilated at the base and is armed along its inner margin with *three* sharp subequal teeth in addition to the spinous termination.
4. The sixth abdominal somite bears six carinae only, as in *O. cultrifer*. The telson also resembles that of this species, but the median crest is only half the height, and the second lateral carina, found in the two preceding species running to the apex of the lateral marginal teeth, is absent.

Pocock observes that *O. carinifer* may possibly prove to be a young example of *O. cultrifer*, but this, I believe, is improbable.

The single specimen, a male, 24 mm. in length, was caught in 24 fathoms on the Holothuria Bank, China Seas.

4. Odontodactylus elegans (Miers).

1884. *Gonodactylus elegans*, Miers, Voy. H.M.S. 'Alert,' p. 566, pl. lii, figs. B, *b*.
1894. *Odontodactylus elegans*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 496.

Odontodactylus elegans may be readily separated from all other species of the genus by the sculpture of the sixth abdominal somite and telson.

1. The rostrum is transverse, subtriangular, with its anterior margin regularly arcuated.
2. According to the figure the breadth of the cornea is about one-third the median length of the carapace and the ophthalmic somite, as in *O. scyllarus*, is entirely concealed in dorsal view by the rostrum.
3. The raptorial dactylus is only feebly dilated at the base and bears two teeth on its inner margin.
4. On the third, fourth and fifth abdominal somites there are five small pits.
5. On the posterior margin of the sixth abdominal somite there are four spines; the longitudinal carinae found in other species of the genus are absent.
6. Except for a single median keel the dorsal surface of the telson is smooth and without carinae. There are about twenty-six minute submedian spinules, and, on each side, two intermediate denticles and one lateral.

I have seen no specimens of this species. The two individuals on which Miers based his description were found in 13–20 fathoms and 24 fathoms at Providence I., S. of the Seychelles. The largest example is only 23 mm. in length and is almost certainly immature.

5. Odontodactylus japonicus (De Haan).

1844.?[1] *Gonodactylus japonicus*, De Haan, in Siebold's Fauna Japonica, Crust., atlas, pl. li, fig. 7.
1845. *Gonodactylus edwardsii*, Berthold, Abhandl. kön. Ges. wiss. Gottingen, III, p. 30, pl. iii, fig. 6.
1849. *Gonodactylus japonicus*, De Haan, in Siebold's Fauna Japonica, Crust., Text, p. 225.
1880. *Gonodactylus japonicus*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 116.
1894. *Odontodactylus japonicus*, Bigelow, Proc. U.S. Nat. Mus. XVII, p. 496.
1907. *Odontodactylus japonicus*, Borradaile, Trans. Linn. Soc., Zool. (2), XII, p. 212.
1910. *Odontodactylus japonicus*, Fukuda, Annot. Zool. Japon., VII, p. 145.
1910. *Gonodactylus edwardsii*, Balss. Abh. math.-phys. Klasse k. bayer. Akad. Wiss., Suppl. Bd., II. Abh. 2, p. 5.

The principal characters of this species are as follows :—

The rostrum is subtriangular, about one and a half times as broad as long; the lateral margins are sinuous, and the apex, which is bluntly pointed, is very strongly deflexed. The eyestalks are short and the greatest breadth of the cornea is contained about

[1] See footnote p. 66.

five times in the length of the carapace excluding the rostrum. The dorsal processes of the ophthalmic somite are composed of two wing-like processes which meet and fuse anteriorly ; they are almost wholly exposed in dorsal view. The antennal scale is remarkably large ; its length is at least equal to that of the carapace excluding the rostrum.

The dactylus of the raptorial claw is only slightly dilated at the base and the knife-like edge on its inner margin is cut into from five to seven teeth.

The exposed thoracic and first five abdominal somite closely resemble those of *O. scyllarus*, but the lateral depressions and ridges are practically obsolete. The postero-lateral angles of the fourth and fifth somites are rounded in the two large specimens examined. The sixth abdominal somite bears a rather obscure median carina and four others on either side. The lateral, outer intermediate and submedian carinae end in spines in De Haan's figure, but appear to have been worn away in the two large specimens in the Indian Museum. Between the outer intermediates and the laterals in the anterior part of the somite there is a prominent rounded tubercle.

The arrangement of the carinae on the dorsal surface of the telson resembles that shown in text-fig. 4, p. 12. The median carina is not high. The submedians are longitudinally bisected and consist of a conspicuous inner and a less prominent outer ridge, the latter being distinctly beaded. The intermediate carina is continued, though with a slight interruption in the middle, to the apex of the submedian teeth. The first lateral is obscure ; it passes close to the anterior end of the carina of the intermediate marginal teeth, and trends inwards towards the base of the intermediate denticle. The second lateral carina is sharp and is continued to the apex of the lateral marginal tooth. Close to the anterior margin of the telson are two pairs of large tubercles, one placed between the submedian and intermediate carinae, and one between the intermediate and first lateral carinae ; the latter tubercle is sometimes obsolete. The marginal teeth do not differ greatly from those of *O. scyllarus*.

The ventral process of the peduncular segment of the uropod is cut distally into two broad teeth, the outer about twice the length of the inner ; each bears on its lower surface a strong flat ridge. The basal segment of the exopod is about one and a third times the length of the distal segment, and on its outer margin is provided with a series of twelve or thirteen movable spines. These spines are flattened and blunt at the apex ; the outermost reaches almost to the end of the distal segment.

Two large specimens, pale yellow in spirit, are preserved in the Indian Museum :—

$\frac{8152}{6}$	Hongkong.	R. Hungerford.	1 ♂, 142 mm.
$\frac{7686}{10}$	Misaki, Sagami Sea, Japan.	A. Owston.	1 ♂, 158 mm.

Odontodactylus japonicus was described by De Haan from Japan, and has since been found in several localities in Japanese waters (Fukuda, Balss). It has been recorded from the Chinese Seas (Berthold, Miers) and from 55 fathoms on the Saya de Malha Bank, S.E. of the Seychelles (Borradaile).

6. Odontodactylus hanseni (Pocock).

1893. *Gonodactylus hansenii*, Pocock, Ann. Mag. Nat. Hist. (6), XI, p. 477, pl. xx, B, figs. 3-3*b*.

1894. *Odontodactylus hanseni*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 496.

According to the description and figures which Pocock has given, this species differs from *O. japonicus* in the following features :—

1. The rostrum is evenly rounded anteriorly from side to side and is twice (or according to the figure rather more than twice) as broad as long.
2. The breadth of the corneal part of the eye is contained only a little more than three and a half times in the median length of the carapace excluding the rostrum. The ophthalmic somite is exposed in dorsal view, and the dorsal process is deeply excavate anteriorly.
3. The antennal scale is a little shorter than the median length of the carapace.
4. The raptorial dactylus is armed with nine distinct teeth (including the terminal one ?).
5. There are four pairs of longitudinal carinae on the sixth abdominal somite as in *O. japonicus*, but the feeble median keel found in that species is missing and the proximal tubercle, which is found in most other species between the lateral and outer intermediate carinae, is omitted, possibly by error, in Pocock's figure.
6. On the telson there is only a single submedian carina, the first lateral is absent and the second lateral instead of fusing with the marginal to form the lateral tooth as in *O. scyllarus* and *japonicus* is parallel to the edge and runs towards the outer margin of the intermediate tooth.

The number of movable spines on the outer margin of the uropod is not given ; the distal spine is, however, said to reach to the apex of the ultimate segment.

Pocock records a single female, 60 mm. in length, from the Macclesfield Bank, S. China Seas, in 35 fathoms.

7. Odontodactylus latirostris, Borradaile.

1907. *Odontodactylus latirostris*, Borradaile, Trans. Linn. Soc., Zool. (2), XII, p. 212, pl. xxii, figs. 3, 3*a*.

This species is perhaps not distinct from *Odontodactylus hanseni*. Borradaile does not say anything of the affinities of his new form and was perhaps unaware of Pocock's work at the time of writing. In the descriptions and figures which the two authors have supplied I am only able to detect the following trifling differences.

1. The rostrum is a little broader in *O. latirostris* than in *O. hanseni*, and its anterior margin is more definitely truncate.
2. The raptorial dactylus bears only seven teeth on its inner margin.[1]
3. On the sixth abdominal somite there is the customary tubercle near the an-

[1] According to Borradaile's description. In the figure, however, there appears to be an additional tooth lying close alongside the apex and a series of obscure serrations on the external margin of the swollen basal part of the dactylus. The latter feature, which is not mentioned in the text, does not seem to occur in any other species of the genus.

terior margin inside the lateral carina (this is perhaps omitted by error in Pocock's figure).

4. The telson is proportionately broader in *O. latirostris*, and the movable tips of the submedian spines are shorter.
5. The terminal movable spine on the outer margin of the uropod fails to reach the apex of the ultimate segment.

In such important characters as the breadth of the eye, the form of the exposed dorsal processes of the ophthalmic somite and the details of the carination of the telson there appears to be the closest resemblance between the two forms.

In *O. latirostris* the lateral margin of the seventh thoracic somite is rounded and is distinctly narrower than that of the sixth, which is truncate. There are ten movable spines on the outer margin of the exopodite of the uropods.

Borradaile records two specimens of this species, the largest 55 mm. in length, from the Amirante Is., in 25–30 fathoms.

8. **Odontodactylus southwelli**, Kemp.

Plate IX, figs. 103–106.

1911. *Odontodactylus southwelli*, Kemp, Rec. Ind. Mus., VI, p. 94.

This species is allied to the two preceding, but may be distinguished from them at a glance by the enormous size of the eyes. Its principal characters are as follows:—

The rostrum is almost exactly twice as broad as long; its anterior margin is evenly rounded from side to side and is not depressed in the centre of its distal margin. The eyes (fig. 103) are enormously dilated, the breadth of the cornea being contained only from two to two and a quarter times in the median length of the carapace excluding the rostrum. A greater portion of the ophthalmic somite is exposed than in any of the allied species; it bears dorsally a pair of strong anteriorly convergent ridges, and in the centre is very conspicuously excavated, the cavity so formed taking the shape of a deep and almost circular pit. The antennal scale is about four-fifths the median length of the carapace.

The dactylus of the raptorial claw (fig. 104) is moderately dilated at the base and bears seven to nine well-defined teeth on its inner margin in addition to the terminal one.

The lateral margins of the sixth and seventh thoracic somites are rounded, that of the sixth being a trifle broader and more broadly rounded than that of the seventh (fig. 105). A lateral depression confined by a pair of blunt carinae is visible on the fourth and fifth abdominal somites as in *O. scyllarus* and traces of a similar depression may be seen on the two preceding somites. The postero-lateral angles of the fourth and fifth somites are spinous. The arrangement of the carinae on the sixth abdominal somite is similar to that of the two preceding species (fig. 106). The submedian, second intermediate and lateral pairs of carinae terminate in spines; the first intermediates are connected proximally with the submedians, and the usual proximal denticle inside the laterals is well-marked.

On the telson (fig. 106) the carinae are similar to those of the two preceding species. The intermediates are continued to the apices of the submedian teeth, and the second lateral is parallel to the external edge and does not run to the tip of the lateral tooth. In the bifurcation between the submedian teeth there are twelve to sixteen pairs of minute spinules; there are two sharp-pointed denticles between the submedians and intermediates and one between the intermediates and laterals.

The outer of the two spines forming the bifurcate process of the uropod is one and a half times as long as the inner and reaches to the apex of the endopod. On the basal segment of the exopod there are ten or eleven (rarely nine) movable spines, the outermost reaching almost or quite to the apex of the ultimate segment.

The specimens in the collection vary considerably in length, but the proportional size of the eye remains approximately constant.

There are seven examples of *Odontodactylus southwelli* in the Indian Museum :—

$\frac{3526}{10}$	Andamans.	'Investigator.'	1 ♀, 37 mm. TYPE.
$\frac{3502}{10}$	Andamans; 53 fms.	'Investigator.'	1 ♂, 2 ♀, 22—31 mm.
$\frac{9751}{6}$	Off Cinque Is., Andamans; 20 fms.	'Investigator.'	1 ♀, 22 mm.
$\frac{9747}{6}$	Off Interview I., Andamans.	'Investigator.'	1 ♂, *ca.* 28 mm.
$\frac{7313}{10}$	N. Cheval Paar, Ceylon.	T. Southwell.	1 ♀, 21 mm.

9. Odontodactylus brevirostris (Miers).

1884. *Gonodactylus brevirostris*, Miers, Voy. H.M.S. 'Alert,' p. 567, pl. lii, fig. C.
1894. *Odontodactylus brevirostris*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 496.
1906. *Odontodactylus brevirostris*, Tattersall, Ceylon Pearl Oyster Rep., V, p. 172, pl. ii, figs. 16-18.
1907. *Odontodactylus brevirostris*, Borradaile, Trans. Linn. Soc., Zool. (2), XII, p. 212.

Odontodactylus brevirostris is easily distinguished from all other species of the same group (*i.e.* those with more than three teeth on the raptorial dactylus) by the complete absence of lateral carinae in the anterior part of the telson.

The rostrum is more than two and a half times as wide as long, and its lateral and anterior margins form an evenly rounded curve. The middle of its distal margin is slightly depressed. The dorsal processes of the ophthalmic somite consist of a pair of upstanding triangular projections placed close together near the middle line and in dorsal view almost concealed by the rostrum. The eyes are large. The breadth of the cornea is contained about two and a half times in the median length of the carapace, excluding the rostrum.

The dactylus of the raptorial claw is only very slightly swollen at the base. It is sharply notched at the proximal end of its external margin and bears six to nine (usually seven or eight) teeth, not reckoning the spinous apex.

The lateral margins of the sixth and seventh thoracic somites are rounded, not truncate, and are of equal width. The fourth and fifth abdominal somites are spinous at the postero-lateral angles and show feeble indications of a lateral depression similar to that noticed in *O. scyllarus*. The sixth abdominal somite bears six longitudinal carinae all of which terminate in spines. The inner intermediate carina found in the

allied species is obsolete, and its position is indicated merely by a low smooth eminence. The customary proximal tubercle is present between the outer intermediate carinae and the laterals.

The telson differs from that of most of the preceding species in the entire absence of lateral carinae. The intermediate carinae run towards, but are not continuous with, those on the submedian marginal spines. The margin between the submedian spines is provided with a number (about sixteen pairs) of minute spinules; there are two sharply acute denticles between the submedians and intermediates and one between the intermediates and laterals.

The outermost of the two spines forming the bifurcate process of the uropod is more than one and a half times the length of the inner, and reaches almost to the apex of the exopod. There are ten or eleven movable spines on the outer margin of the basal segment of the exopodite and the distal one, which is the longest, reaches to or beyond the apex of the ultimate segment.

In one of the specimens examined the rostrum is only slightly depressed in the middle line, as figured by Tattersall, but there is a small incision, perhaps due to injury, in the middle of the distal margin. In the outer example the centre is more obviously deflexed and the margin is entire. In both examples the mandibular palp appears to be missing. The specimens are perhaps immature; but in *T. southwelli* the palp is distinct, though not very clearly segmented, in individuals of a similar size.

Brown mottling is visible on the dorsal surface of one of the preserved specimens and forms decided patches in the middle of the last three thoracic somites. In this individual also the basal segment of the exopod of the uropod is very dark brown except for a pale postero-lateral triangular area.

This species is closely allied to *Odontodactylus havanensis*, Bigelow (1894, p. 479), the only known Atlantic representative of the genus. The form described by the American author seems, however, to be distinguished by the following characters:—

The rostrum is longer and has no median depression; the greater part of the ophthalmic somite is exposed in dorsal view; the antennal scale is longer and the basal part of the raptorial dactylus is strongly swollen and is not notched externally at the base.

O. havanensis is known from a single specimen, 20 mm. in length, found in 163 fathoms off Havana, Cuba.

There are only two examples of *Odontodactylus brevirostris* in the Indian Museum:—

$\frac{3332}{10}$	Andamans.	'Investigator.'	1 ♀, 23 mm.
$\frac{7314}{10}$	Andamans, 53 fathoms.	'Investigator.'	1 ♀, 21 mm.

This species has been previously recorded from the Pearl Banks, G. of Manaar (Tattersall), from the Seychelles in 34 fathoms (Borradaile), and from Providence I., S. of the Seychelles, in 19 fathoms (Miers).

Genus **Gonodactylus**, Latreille.

1825. *Gonodactylus*, Latreille, Encycl. Méthod., X, p. 473.
1837. *Gonodactylus*, H. Milne-Edwards, Hist. Nat. Crust., II, p. 528 (*partim*).
1849. *Gonodactylus*, De Haan, in Siebold's Fauna Japonica, Crust., p. 220.
1880. *Gonodactylus*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 115 (*partim*).
1886. *Gonodactylus*, Brooks, Voy. H.M.S. 'Challenger,' XVI, Stomatop., p. 55.
1886. *Protosquilla*, Brooks, *ibid.*, p. 65.
1894. *Gonodactylus*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 492.
1894. *Protosquilla*, Bigelow, *ibid.*, p. 492.
1895. *Gonodactylus*, Hansen, Isop. Cumac. u. Stomatop., d. Plankton-Exped., p. 86.
1906. *Gonodactylus*, Nobili, Ann. Sci. Nat. Zool. (9), IV, p. 326.

Carapace little, if at all, narrowed anteriorly; without carinae; gastric grooves distinct, cervical groove wholly absent; antero-lateral angles rounded or acute. Cornea of eye sometimes indistinctly bilobed, mandibular palp present and composed of two or three segments or absent. Ischio-meral articulation of raptorial claw situated at a point in advance of proximal end of merus, the latter segment consequently extending backwards beyond the joint; inferior surface of merus not channelled longitudinally throughout its entire length; upper margin of propodus not pectinate; dactylus inflated at base, without teeth on inner margin. Shorter ramus of last three thoracic appendages linear, composed of two segments. Free thoracic and abdominal somites compressed, no sharp carinae on first four abdominal somites. Telson very variable in form and sculpture, carinate, tuberculate or spinous. Ventral process of uropods terminating in two sharp spines, inner usually shorter than outer.

There are no well-marked secondary sexual distinctions.

In reducing Brooks' *Protosquilla* to a synonym of *Gonodactylus* I have followed Hansen and Nobili. The character which Brooks employed, the fusion or free articulation of the last abdominal somite and telson, is, as Hansen has shown, wholly unreliable and no other feature sufficiently well-marked to serve as a generic distinction can be found. On the contrary it seems that the species here included in *Gonodactylus* fall into four natural groups of approximately equal value, but these do not, I believe, possess any greater claims to nomenclatorial distinction than do the groups in *Lysiosquilla* or in other genera.

The four groups may be distinguished by the following characters :—

GROUP I.—The anterior margin of the carapace slopes forward on either side of the rostrum, so that the antero-lateral angles are well in advance of the rostral base. The rostrum has a sharp median spine and its antero-lateral angles are rounded or subacute: in rare cases acute. The mandibular palp is composed of three distinct segments. The posterior margin of the sixth abdominal somite is straight or slightly convex in dorsal view. The basal segment of the outer uropod projects posteriorly a little beyond the articulation of the ultimate segment, and its external margin is armed with a series of straight, or almost straight, movable spines. The inner uropod is normal in shape and, as a rule, in the disposition of its setae.

This group includes *G. chiragra*, *demani*, *graphurus* and their immediate allies.

GROUP II.—The anterior margins of the carapace slope forwards as in the preceding group. The rostrum is trispinous: the antero-lateral angles are produced to sharp spines often almost as slender as the

median. The mandibular palp is two or three-segmented.[1] The posterior margin of the sixth abdominal somite is straight or slightly convex in dorsal view. The basal segment of the outer uropod extends far beyond the point of articulation of the ultimate segment, and the spines on the external margin of this projecting portion are in most cases very distinctly recurved. The inner uropod is always abnormal in shape; it is usually more or less crescentic when seen from above, or may be strongly arched in lateral view. The setae are restricted to only a portion of the margin or may invest all the edges and the greater part of the upper surface as well.

This highly-specialized and peculiar group includes six species, all of which seem to be very rare. They are *G. herdmani*, *drepanophorus*, *brevisquamatus*, *fimbriatus*, *spinosocarinatus* and *furcicaudatus*. The first two possess a closer affinity with the preceding section than the rest.

Group III.—The anterior margins of the carapace do not slope forwards on either side of the rostrum and the antero-lateral angles are consequently not in advance of the level of the rostral base. The rostrum, typically, is trispinous; the antero-lateral angles are produced to sharp spines similar to the median, but these in rare cases are only acute. The mandibular palp comprises two segments only.[2] The posterior margin of the sixth abdominal somite, when seen in dorsal view, is distinctly convex in the middle. The basal segment of the outer uropod articulates terminally with the ultimate segment and is armed with straight movable spines on its external edge. The inner uropod, as in Group I, is normal in shape and in its investment of setae.

This group includes nearly all the species which Brooks referred to *Protosquilla*. It comprises *G. trisspinosus*, *stoliurus*, *excavatus*, *folini*, *brooksi*, *spinosissimus* and numerous allied forms.

Group IV.—The anterior margins of the carapace slope forwards on either side of the rostrum, so that the antero-lateral angles are well in advance of the rostral base. The rostrum is trispinous, but the lateral spines are not so well developed as in most species of the two preceding groups. The mandibular palp is wholly absent. The posterior margin of the last abdominal somite is straight in dorsal view. The basal segment of the outer uropod projects posteriorly a little beyond the insertion of the ultimate segment and bears a series of straight spines on its outer margin. Both the inner uropod and the terminal segment of the outer uropod are provided with setae only on the distal half of their outer margins; the inner margin in each case bears sharp spines.

This group includes a single species only; *G. acanthurus*,

Of the thirty-two species here recognized, twenty-eight are restricted to Indo-pacific waters. Three, *G. oerstedi*, *G. festae*, and *G. folini*, are known only from the Atlantic, while *G. glabrous*, a widely distributed Indo-pacific form, is recorded from the Mediterranean.

Brooks (1893, p. 353) has given a most valuable account of the habits of *Gonodactylus*[3] in the Bahamas, where he found that the animals made burrows in hard stone. He gives most interesting details of their cannibalistic propensities and of the manner in which the female tends the egg-masses. Of the habits of the Indo-pacific species practically nothing is known; they seem to prefer rough ground and coral reefs and possibly all of them burrow in coral or rock as in the case of the

[1] Two species only have been examined; the palp is three-segmented in *G. herdmani*, two-segmented in *G. furcicaudatus*.

[2] Six species examined.

[3] Brooks calls the species *G. chiragra*, but the specimens doubtless belong to *G. oerstedi*, Hansen.

species observed by Brooks.[1] As a rule they are found in shallow water, but *G. spinosissimus* and *G. acanthurus* have been recorded from 45–50 fathoms.

Key to the species of *Gonodactylus*.

I. Mandibular palp present; margins of inner uropod and ultimate segment of outer uropod, not bearing spines.

A. Antero-lateral angles of carapace well in advance of rostral base; posterior margin of last abdominal somite straight or slightly convex in dorsal view; basal segment of outer uropod extending at least a little beyond insertion of ultimate segment.

I. Rostrum with antero-lateral angles rounded or acute, never sharply spinous; inner uropod normal in shape and in its investment of setae [mandibular palp three-segmented]. Group I.

A. Mid-dorsal portion of telson with three long keels, occasionally with a short additional keel on either side at hinder end of median.

1. No ridge on inner side of keel of intermediate marginal teeth of telson.

a. Dorsal processes of ophthalmic somite large and subtriangular; median keel of telson not very strongly arched in lateral view, its depth[1] less than half its greatest breadth; no spinules on dorsal surface of telson.

i. Antero-lateral angles of rostrum rounded or subacute; a pair of small round tubercles close to anterior margin of telson; submedian dorsal keels of telson parallel.

α. Form narrow; abdomen compressed and strongly arched from side to side; lateral marginal teeth of telson small but distinct, rarely absent .. .. *chiragra*, p. 155.

β. Form broader; abdomen less compressed; lateral marginal teeth of telson wholly absent .. .. .. *do.* v. *platysoma*, p. 162.

ii. Antero-lateral angles of rostrum acute; no tubercles near anterior margin of telson; submedian dorsal keels of telson posteriorly convergent .. .. *acutirostris*, p. 163.

b. Dorsal processes of ophthalmic somite consisting a pair of small and inconspicuous transverse plates; median keel of telson very strongly arched in lateral view, its depth[2] fully half its greatest breadth; dorsal surface of telson usually beset with spinules.

i. Telson broader than long; intermediate marginal teeth well-developed; dorsal surface with spinules .. .. .. *demani*, p. 164.

ii. Telson as long as broad; intermediate marginal teeth rudimentary or absent; dorsal surface with abundant spinules .. .. *do.* v. *spinosus*, p. 165.

iii. Telson broader than long; intermediate marginal teeth rudimentary; dorsal surface without spinules .. .. .. *do.* v. *espinosus*, p. 166.

2. A ridge on inner side of keel of intermediate marginal teeth of telson.

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[1] See addendum, p. 197, for further notes on this subject.

[2] Measured from the highest point of the median keel to the corresponding point on the lower surface.

a. Antero-lateral angles of rostrum rounded; no spinules on dorsal surface of telson .. .. [*oerstedi*].[1]

b. Antero-lateral angles of rostrum acute; numerous spinules on dorsal surface of telson .. .. [*festae*].

B. Mid-dorsal portion of telson with five long keels.

1. First five abdominal somites smooth .. .. .. *glabrous*, p. 167.

2. First five abdominal somites finely grooved transversely and longitudinally .. .. *graphurus*, p. 169.

II. Rostrum sharply trispinous; inner uropod abnormal in shape and in its investment of setae [mandibular palp two- or three-segmented]. Group II.

A. Telson normal in shape, its length greater or only a trifle less than its length.

1. Spines on external edge of basal segment of outer uropod forming an even series throughout its length, outermost slightly recurved; inner uropod more or less crescentic in shape, apex curved inwards.

a. Submedian teeth of telson without spinules on inner margins; lateral teeth represented by blunt rounded lobes; dorsal surface with three keels and a few rounded tubercles .. .. *herdmani*, p. 171.

b. Submedian teeth of telson with spinules on inner margins; lateral teeth sharp and well-formed; dorsal surface with three keels and large sharp spinules .. .. *drepanophorus*, p. 173.

2. On external edge of basal segment of outer uropod two or three spines at distal end form large hooks, proximal part bare or with few small straight spines; apex of inner uropod more or less curved outwards.

a. Intermediate teeth of telson edge large; lateral teeth absent.

i. Intermediate ridges of last abdominal somite much narrower than submedians; mid-dorsal portion of telson occupied by three large ridges[2]; no spinules on inner edges of submedian marginal teeth .. .. *brevisquamatus*, p. 174.

ii. Intermediate and submedian ridges of last abdominal somite of equal breadth; mid-dorsal portion of telson with three keels closely packed together in middle, with two fainter keels on either side[2]; spinules on both edges of submedian marginal teeth *fimbriatus*, p. 175.

b. Intermediate teeth of telson edge very small; lateral teeth minute [dorsal surface of telson with nine closely packed keels] .. *spinoso-carinatus*, p. 173.

B. Telson very abnormal in shape, about four times as broad as long, sharply truncate behind; the truncate portion reniform in shape and honeycombed, with a pair of long furci springing from the middle of its inferior edge .. .. *furcicaudatus*, p. 176.

B. Antero-lateral angles of carapace not in advance of rostral base; median part of posterior margin of last abdominal somite concave in dorsal view;

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[1] Hansen 1895, p. 65 (footnote) and Bigelow, 1902, p. 152, text figs. 1, 2. To the synonymy of this species as given by the latter author, the following may be added:—

1890. *Gonodactylus chiragra*, Pocock, Journ. Linn. Soc. Zool., XX, p. 526 (Fernando Noronha).

1897. *Gonodactylus chiragra*, Nobili, Boll. Mus. Torino, XII, no. 280, p. 6 (Darien).

1901. *Gonodactylus falcatus*, Moreira, Arch. Mus. Nac. Rio de Janeiro, XI, p. 1 (Brazil).

[2] Not reckoning the ridge that runs to the apex of the intermediate marginal teeth.

basal segment of outer uropod articulating terminally with ultimate segment [mandibular palp two-segmented]. Group III.

I. Large spines on last abdominal somite and telson with a soft fleshy process protruding from apex .. .. *guerini*, p. 192.

II. Large spines on last abdominal somite and telson, if present, without fleshy process at apex.

A. Distal margin of telson divided into right and left halves by a long and very narrow median fissure with its edges partly in contact with one another.

1. Three round or oval bosses in centre of telson, external boss on each side not reaching distal margin.

a. External boss on each side reaching only to middle of telson.

i. Median portion of fifth abdominal somite entirely smooth.

α. Rostrum sharply trispinous; dorsal processes of ophthalmic somite produced, with acute antero-lateral corners .. *pulchellus*, p. 177.

β. Antero-lateral angles of rostrum acute but not spinous; dorsal processes of ophthalmic somite not produced antero-laterally .. .. *nefandus*, p. 179.

ii. Median portion of fifth abdominal somite longitudinally wrinkled.

α. Rostrum sharply trispinous; external bosses of telson oval in outline .. .. *trispinosus*, p. 180.

β. Antero-lateral angles of rostrum acute but not spinous; external bosses of telson strictly circular in outline .. *tuberosus*, p. 181.

b. External boss on each side reaching well beyond middle of telson, but not extending to distal margin.

i. Median portion of fifth abdominal somite smooth; distal margin of telson with three large teeth on either side of median fissure.

α. Dorsal surface of telson, between bosses, smooth .. *glaber*, p. 182.

β. Dorsal surface of telson, between bosses, covered with well-marked irregular depressions .. .. .. *tanensis*, p. 183.

ii. Median portion of fifth abdominal somite furrowed; distal margin of telson with four large teeth on either side of median fissure .. *stoliurus*, p. 184.

2. Three bosses in centre of telson, external boss on each side terminating in a point on distal margin.

a. Fifth abdominal somite smooth mid-dorsally; sixth with six rounded bosses; bosses of telson smooth and entire .. .. *ectypus*, p. 185.

b. Fifth and sixth abdominal somites finely grooved; dorsal bosses of telson incised at margins by fine grooves runnings towards summit of each boss .. .. *glyptocercus*, p. 186.

B. Distal margin of telson divided into right and left halves by a large, wide and deep excavation.

1. No spines or spinules on dorsal surface of telson.

a. Distal margin of telson with two large teeth on either side of median excavation .. .. *excavatus*, p. 187.

b. Distal margin of telson with three large and blunt teeth on either side of median excavation .. .. [*folini*, p. 189.]

2. Dorsal surface of last abdominal somite and telson beset with spines or spinules.

a. With short spinules.

i. Telson with three pyriform bosses; spinules straight .. *brooksi*, p. 189.

ii. Telson with three circular bosses; spinules with recurved points directed backwards .. .. *hystrix*, p. 190.

b. With long spines .. .. *spinosissimus*, p. 191.

II. Mandibular palp absent; inner margins of inner uropod and of ultimate segment of outer uropod bearing large spines [numerous slender dorsal spines at distal end of telson]. Group IV. .. .. .. *acanthurus*, p. 193.

Gonodactylus chiragra and its allies.

There is considerable difference of opinion respecting the precise relationships between *Gonodactylus chiragra* and its near allies *oerstedi*, *acutirostris*, *demani*, *spinosus*, *espinosus*, *festae*, *glabrous* and *graphurus*, and Lanchester, whose important paper on the subject (1903) deserves careful consideration, holds that all must be regarded as varieties of a single species. In this view he has not been followed by more recent authors, and a careful survey of the large collection in the Indian Museum seems to show that he has omitted to lay sufficient emphasis on the more outstanding features of the case.

The variation shown in these species of Stomatopoda presents problems of rather unusual interest and before any final conclusions can be reached much work based on living material must be undertaken; it is, I believe, only by direct observation on the post-larval growth, habits and associations that a true estimate of the relationships of the various forms can be reached. The variation in these species seems to find no parallel among other Stomatopoda, many of which, notably the species of *Squilla* belonging to the *S. oratoria* group, are remarkable for the constancy of small and seemingly trivial characters.

The outstanding features of the variation in the *chiragra* section of the genus *Gonodactylus* appear to me to be as follows:—

Distributed throughout the Indo-pacific region, occurring on rough ground, in rock-pools or on coral reefs, a form which may be called *Gonodactylus chiragra, s.s.*,[1] is abundant. In the characters afforded by the ornamentation of the last abdominal somite and telson a large amount of variation may be found; the keels with which these segments are furnished may be swollen or narrow and may or may not terminate in spines; the median carina on the telson is moreover simple and linear or it may bear short lateral branches at its distal end and so take the form of an 'anchor.' Between the various forms every shade of intermediate can be found. Intermediate forms in any selected character are also commoner than those which exhibit it in an extreme development, but in their turn are less abundant than those which conform more or less closely with the prevailing type.

Now in examining large series of examples one feature is predominant in the Indian Museum collection: the variation shown among large examples (70 mm. or more in length) is very much less than that found in small specimens (60 mm. or less in length), and it is further to be noticed that the individuals which in Lanchester's opinion formed connecting links between this form and its allies are also characterized by their extremely small size.

[1] The characters employed for the separation of this form from its allies are shown in the key on p. 147.

From this result various interesting speculations arise. Must we conclude (i) that all the small specimens exhibiting extremes of variation die before reaching maturity, or (ii) do they represent dwarf races capable of breeding and perpetuating their precise type, or (iii) do they at subsequent moults lose their peculiar features and approximate to the typical form ?[1]

Of these alternatives the second is, I believe, very improbable,[2] though with our present lack of knowledge regarding the size of sexually mature specimens, it cannot be wholly disregarded. There remain the first and third ; the former implies a large numerical preponderance of small individuals, a factor at present unproved, while the latter, the theory to which I myself am inclined, can only be properly substantiated by prolonged rearing experiments demanding infinite patience and beset with many technical difficulties. This theory nevertheless will acquire much probability if the two others can be disproved, a task somewhat easier in performance.

The question of the nomenclature of this varietal series in *G. chiragra* is one of less interest. Numerous terms such as *incipiens*, *tumidus*, *anancyrus*, etc., have been employed ; but if, as I believe, it can be shown that the case is to a very large extent one of continuous variation, the adults approaching a standard type while young examples exhibit a much greater diversity of form, all the terms must lapse, for the application of names to arbitrarily selected points in a perfectly graded series cannot be upheld, nor is it clear that any limit can be set to such a process.

In this connection I would refer to Borradaile's valuable discussion on ' Varieties in Decapod Crustaceans '[3] and in particular to the following passage in the opening paragraph.—" It must, however, be borne in mind that the intermediate specimens between varieties are much less numerous than those which exhibit the peculiarities of the varieties in a typical development. Otherwise it is only possible to say that the species exhibits considerable range of variation, but that definite varieties are not established."

With this statement I am in entire agreement. The author was doubtless unaware of the main features of the present case when, at a later date, he divided the species *G. chiragra* into a considerable number of named varieties and the same time added to the named varieties of *G. glabrous*. That data of value from a distributional or from some other point of view are likely to accrue by a precise definition of these varietal phases is not improbable, but they should be designated by the letters or

[1] In most known instances of variation the distinctions between the varietal and typical forms are more readily perceptible in the adult than in the young and instances similar to that found in *G. chiragra* seem to be exceedingly rare. The only case, of which I am aware, that presents features of an analogous nature is afforded by *Thalassochelys caretta*. Gadow notes that in this species of turtle the number of dorsal scutes varies from 16 to 24 ; in adults, however, there are as a rule only 16 and abnormalities are from four to seven times as common in new-born as in mature specimens. The explanation, according to Gadow, lies in the partial or complete correction of the abnormalities in the course of growth. [Gadow, Orthogenetic variation in the shells of *Chelonia*. Willey's " Zoological Results," p. 207.]

[2] There is, however, some evidence that this is the case with the form to which the name '*smithi*' has been applied.

[3] Borradaile, " Fauna and Geog. of Maldives and Laccadives," I, p. 193.

numbers already in use, the term variety being restricted to such cases as conform with Borradaile's definition.

Turning to the forms that differ from *G. chiragra* in characters of a more trenchant nature, intermediates being rare or perhaps wholly absent, the first that must be considered is Wood-Mason's *Gonodactylus platysoma*. No description of this form has ever appeared and its claim to recognition rests solely on the figures published in 1895. *G. platysoma* may be distinguished from *G. chiragra* by its broader form and by the size and shape of the terminal part of the raptorial dactylus. The telson, with its narrow carinae and complete absence of lateral teeth on the margin differs markedly from that of any *G. chiragra* in the collection ; but in this respect the form bears a close resemblance to certain examples to which Lanchester gave the name of *G. chiragra* var. *acutus*, and it is possible that these specimens are identical with those determined by Wood-Mason. Judging from the material in the Indian Museum *G. platysoma* seems quite sufficiently distinct from *G. chiragra* to claim recognition as a variety.

In Atlantic waters *G. chiragra* is represented by a form known as *G. oerstedi*, Hansen, which differs from its Pacific relative in the possession of a small additional keel on the inner face of the intermediate teeth of the telson edge. The character is so trivial that for many years it entirely escaped detection, but it seems nevertheless to prevail with the most absolute constancy. I have followed the general consensus of opinion in regarding this form as a distinct species, but some may consider subspecific rank more suitable.

When describing *Gonodactylus acutirostris*, Dr. de Man mentions that it is possibly only a variety of *chiragra* ; but, though it is true that it may eventually prove to be a very abnormal form of that species, it should remain separate pending further information. In the single known example the antero-lateral angles of the rostrum are much more acutely produced than in any *G. chiragra*,[1] and on the dorsal surface of the telson the two small tubercles, that are situated close to the anterior margin in all the allied forms, are entirely absent, while the submedian carinae are posteriorly convergent. I have seen no specimen possessing any one of these characters.

Gonodactylus demani, Henderson, and *spinosus*, Bigelow, are forms which are distinguishable at a glance from all the preceding by the presence of spinules on the dorsal surface of the telson. Apart from this feature *G. demani* bears a close resemblance to *G. chiragra*, from which, however, it may be separated by the shape of the dorsal processes of the ophthalmic somite and by the height and extreme convexity of the mid-dorsal lobe of the telson when seen in lateral view. The dorsal aspect of the telson presents, moreover, a very distinct and characteristic facies, for the three dorsal keels, and those which terminate in the submedian and intermediate marginal teeth, are all strongly swollen, and are separated from one another by narrow V-shaped grooves that form a striking contrast to the comparatively wide interspaces found practically without exception in *G. chiragra*. Lanchester, strangely enough, does not mention this form in his synopsis of the varieties of *G. chiragra* ; he has in fact omitted all reference to it, though he cites the paper by Henderson that contains the original description.

[1] But there is, indeed, no little variation in *G. chiragra* in this respect.

But *G. spinosus*, which is unquestionably more remote from *G. chiragra*, he includes under the latter name as a variety.

G. demani is, it seems, a smaller form than *G. chiragra* and does not exceed 40 mm. in length. The spinulation of the telson is most astonishingly variable (as will be seen by reference to pl. ix, figs. 109–111); but even if, as is not unlikely, an individual wholly destitute of spinules should appear, the other characters noted above will, I believe, remain amply sufficient to justify specific separation from *G. chiragra*. The variation in the number of spinules is unquestionably continuous.

Gonodactylus spinosus, Bigelow, described one month later than Henderson's *G. demani*, differs from that species only in the slightly greater proportional length of the telson and in the suppression of the intermediate teeth of the margin. But *G. demani* itself shows no little variation in this respect, and in the Indian specimens which I have referred to *spinosus*, these teeth are slightly better developed than in the typical individual figured by Lanchester. I am forced therefore to the conclusion, already suggested by Nobili, 1906 (*a*), p. 331, that *G. spinosus* can, at most, only be retained as a variety of *G. demani*.[1] The form appears to be rare; in the details of its spinulation it is perhaps as variable as *G. demani*,[1] but on this point little is known.

Borradaile's *Gonodactylus espinosus*, known only from a single specimen of small size, differs from *spinosus* solely in the greater breadth of the telson and in the total absence of spinules on its dorsal surface. In *G. demani* the variation in the number of spinules, as illustrated in the material examined, is so great that should a wholly smooth example be added thereto the series would still be almost continuous in its variation. On analogy therefore with its ally it may be expected that a complete transition between *spinosus* and *espinosus* will ultimately be found and, in giving the latter name admission as a variety, it must be understood that with the access of fresh material there is a probability that the name will cease to possess any greater significance than '*incipiens*,' '*tumidus*' and others which have been employed in the case of *G. chiragra*.

In his inclusion of *spinosus* and *espinosus* as varieties of *G. chiragra* Lanchester has not, I believe, been followed by any subsequent writer, and I am unable to find any sufficient reasons for such a course either in his work or from an examination of the material in the Indian Museum. On the contrary the separation of *G. chiragra* and its variety from *G. demani* and its variety has been conspicuously easy in performance.

Gonodactylus festae, Nobili, is an Atlantic species resembling *G. oerstedi* in the possession of a short additional carina on the intermediate marginal spines of the telson, but differing in the spinulation of this segment. It is only known from the original description based on a small number of specimens. It bears, perhaps, much the same relation to *G. oerstedi* that *G. demani* does to *G. chiragra*, though, according to Nobili's account, it differs from all these and resembles de Man's *acutirostris* in the sharply produced antero-lateral angles of the rostrum.

Gonodactylus glabrous, Brooks, and *G. graphurus*, Miers, are more clearly distinct and in the possession of five long keels in the middle of the dorsal surface of the

[1] See addendum, p. 198.

telson are distinguishable at a glance from *G. chiragra* or any of the other species already mentioned. It is true that one particular telson pattern in *G. chiragra*, in which the flukes of the ' anchor ' are separated from the distal end of the median carina and form short additional carinae on either side of it, seems to represent a type intermediate between that species and *G. glabrous*. But such specimens are invariably extremely small in size, and even if it were impossible to separate the two forms at this early age, which is not the case, there would still be no justification for uniting the two as Lanchester has done. In addition to the distinctions afforded by the telson, *G. glabrous* and *graphurus* may be distinguished from *G. chiragra* by the small size of the dorsal processes of the ophthalmic somite and by the presence of a small tooth at the base of the outer spine of the bifurcate process of the uropods ; but these characters are of little value in the case of very small specimens.

G. graphurus is separated without difficulty from *G. glabrous* by the presence of the fine incised lines or grooves which traverse the first five abdominal somites in the former species. The character is an obvious one and, as yet, there is no evidence of the existence of intermediate forms. *G. glabrous* seems to be the most abundant of the two, and exhibits a very considerable amount of variation in the development of the keels on the telson. The keels may be narrow and well separated or swollen and touching one another and the three median keels, as well as those on the last somite of the abdomen, may or may not terminate in spines. There can be no doubt that the variation, as in the case of *G. chiragra*, is continuous and the same objections that have already been made must be urged in this instance also against the use of special names to designate particular varietal phases. *G. graphurus* seems to exhibit a range of variation closely similar to that of *G. glabrous*.

The species belonging to the *chiragra* section of *Gonodactylus* form a very homogeneous group. It seems probable that they are more primitive than the others included in the genus, and it may be inferred that all the other more highly specialized forms were derived from the common ancestor of this section.

The abundance of species of *Gonodactylus* in the Indo-pacific region and their poverty in the Atlantic may perhaps indicate that they have originated in the former area, while the very slight distinctions that exist between *G. chiragra* and *G. oerstedi* may be taken as evidence that their extension to Atlantic waters is of comparatively recent date, though it is possible that unknown factors, absent in the Atlantic, may have induced a more speedy differentiation of species in Indo-pacific waters.

Of the species with a three-segmented mandibular palp, *G. chiragra*, in the simplicity of its structure appears the most primitive, while *G. graphurus* is perhaps the most highly specialized.

As has already been pointed out, the vast range of variation in these species is the more remarkable when the singular constancy of slight specific distinctions in other Stomatopoda is considered. I am of the opinion that four, or perhaps five forms in the Indo-pacific, and two in the Atlantic, are sufficiently isolated to merit specific recognition ; but from the numerous varietal phases it is impossible, in the present state of our knowledge, to draw any satisfactory conclusions. That the ceaseless production of

such forms—even though some seem never to reach maturity—will in the ordinary course of natural selection result in races specially adapted to particular environmental factors is far from improbable, and that it may already have occurred is still an open question. Results of great importance may be expected from direct observations on living animals and from a comparative examination of large collections from distant but strictly localized areas.

The scheme of classification adopted for these species differs, though not very widely, from that given by most previous writers, but is diametrically opposed to that suggested by Lanchester. The latter author was, I believe, misled by the small size of the specimens which formed the vast majority of his material and many forms that in the opinion of all previous authors were entitled to specific distinction he regarded as varieties of a single species. In this there is perhaps no great cause of complaint, for the classification of some of the forms must long remain a matter of individual opinion. But in Lanchester's scheme, which comprises a single species, fourteen named varieties and a large number of lettered and numbered subheads, the main features of the case are to a very great extent lost sight of, and certain forms which by reason of their structure, geographical distribution or abundance, stand out far ahead of all others are, in his account, placed on the same footing as other forms to which not nearly the same significance can be attributed. It is here that I must dissent most strongly from this author's views.

But, in any endeavour to arrive at a true understanding of these matters, the data supplied by Lanchester and the excellent figures which he has given will always prove of great value and though, in a recent revision of the genus, his work is wholly ignored, such a course can hardly tend to a satisfactory solution of the problems that are involved.

1. **Gonodactylus chiragra** (Fabricius).

Plate ix, fig. 107.

1781. *Squilla chiragra*, Fabricius, Species Insectorum, I, p. 515.
1787. *Squilla chiragra*, Fabricius, Mantiss. Insect., I, p. 334.
1790. *Cancer chiragricus*, Linnaeus, Syst. Nat., ed. XIII, I, p. 2990.
1793. *Squilla chiragra*, Fabricius, Ent. Syst. II, p. 513.
1796. *Cancer* (*mantis*) *chiragra*, Herbst, Krabben u. Krebse, II, p. 100, pl. xxxiv, fig. 2.
1798. *Squilla chiragra*, Fabricius, Ent. Syst., Suppl., p. 417.
1823. *Squilla chiragra*, Desmarest, Dict. des Sci. Nat., XXVIII, p. 342.
1825. *Squilla chiragra*, Desmarest, Consid. Crust., p. 251, pl. xliii.
1825. *Gonodactylus chiragra*, Latreille, Encycl. Méthod., X, p. 473, Atlas, pl. cccxxv, fig. 2.
1829. *Gonodactylus chiragra*, Latreille, in Cuvier's Régne Anim., 2nd ed., IV, p. 109.
1832. *Gonodactylus chiragra*, Owen, Proc. Zool. Soc., p. 6.
1837. *Gonodactylus chiragra*, H. Milne-Edwards, Hist. Nat. Crust., II, p. 528.
1843. *Gonodactylus chiragra*, Krauss, Süd-afric. Crust., p. 60.
1847. *Gonodactylus chiragra*, White, List. Crust. Brit. Mus., p. 84.
1852. *Gonodactylus chiragra*, Dana, U.S. Explor. Exped., Crust., p. 623, pl. xli, figs. 6*a*, *b*.
1861. *Gonodactylus chiragra*, Heller, Verhandl. zool.-bot. Ges. Wien, XI, p. 29.
1862. *Gonodactylus chiragra*, A. Milne-Edwards, in Maillard's l'ile Réunion, Ann. F., p. 16.
1865. *Gonodactylus chiragra*, Heller, Reise 'Novara' Exped., Crust., p. 126.
1866. *Gonodactylus chiragra*, Annesley. Proc. Zool. Soc., p. 338 (*habits*).

1869. *Gonodactylus chiragra*, Hilgendorf, in von d. Decken's Reise in Ost-afr., III, i, p. 103.
1874. *Gonodactylus chiragra*, Hoffmann, Réch. Faune Madagasc., V, ii, p. 36.
1875. *Gonodactylus chiragra*, Paulson, Réch. Crust. Mer Rouge, p. 127.
1879. *Gonodactylus chiragra*, Hilgendorf, Monatsber. Ak. Wiss. Berlin, p. 846.
1879. *Gonodactylus chiragra*, Miers, Phil. Trans. Roy. Soc., CLXVIII, p. 495.
1880. *Gonodactylus falcatus*, Kossmann, Zool. Ergebn. Roth. Meer., III, p. 100.
1880. *Gonodactylus chiragra*, Miers, Ann. Mag. Nat. Hist. (5), V, pp. 118 and 459.
1880. *Gonodactylus chiragra*, Richters, in Möbius' Meeresfauna Mauritius, p. 169.
1880. *Gonodactylus chiragra*, Stossich, Boll. Soc. Adriat. Sci. Nat. Trieste, p. 218.
1881. *Gonodactylus chiragra*, Lenz and Richters, Abhandl. Senck. Ges. Frankfürt, XII, p. 428.
1882. *Gonodactylus chiragra*, Haswell, Cat. Australian Crust., p. 210.
1884. *Gonodactylus chiragra*, Miers, Voy. H.M.S. ' Alert,' pp. 298 and 565.
1886. *Gonodactylus chiragra* ?, Müller, Verhandl. naturf. Ges. Basel, VIII, p. 471.
1886. *Gonodactylus chiragra*, Brooks, Voy. H.M.S. ' Challenger,' XVI, Stomatop. p. 56, pl. xv, fig. 4 (*partim*).
1887. *Gonodactylus chiragra*, de Man, Arch. f. Naturgesch., LIII, i, p. 573.
1887. *Gonodactylus chiragra*, Walker, Journ. Linn. Soc., XX, p. 113.
1888. *Gonodactylus chiragra*, de Man, Journ, Linn. Soc., XXII, p. 299.
1890. *Gonodactylus chiragra*, Pocock, Ann. Mag. Nat. Hist. (6); V, p. 72.
1892. *Gonodactylus chiragra*, de Man, in Weber's Zool. Ergebn. Nied. Ost-Ind., II, p. 518.
1892. *Gonodactylus chiragra*, Thallwitz, Abhandl. kön. Mus. Dresden, no. 3, p. 54.
1893. *Gonodactylus chiragra*, Henderson, Trans. Linn. Soc. Zool. (2), V, p. 454.
1893. *Gonodactylus chiragra*, Pocock, Ann. Mag. Nat. Hist. (6), XI, p. 474.
1893. *Gonodactylus smithii*(? var. of *G. chiragra*), Pocock, *ibid.*, p. 475, pl. xx, B, fig. 1.
1894. *Gonodactylus chiragra*, Ortmann, Denk. med.-wiss. Ges. Jena, VIII, p. 60.
1894. *Gonodactylus chiragra*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 495 (*partim*).
1894. *Gonodactylus chiragra*, Wedenissow, Bull. Soc. Ent. Ital., XXVI, p. 417.
1897. *Gonodactylus chiragra*, Whitelegge, Mem. Australian Mus., III, p. 148.
1898. *Gonodactylus chiragra*, de Man, Zool. Jahrb. Syst., X, p. 694, pl. xxxviii, fig. 77.
1898. *Gonodactylus chiragra*, Borradaile, Proc. Zool. Soc., p. 34, pl. v, fig. 4; pl. vi, fig. 8.
1899. *Gonodactylus chiragra*, Borradaile, in Willey's Zool. Results, pp. 400, 401 (including vars. *anancyrus* and *smithi*).
1899. *Gonodactylus chiragra*, Nobili, Ann. Mus. Civ. Genova (2), XX, p. 276.
1900. *Gonodactylus chiragra*, Nobili, Ann. Mus. Civ. Genova, (2), XX, p. 519.
1901. *Gonodactylus chiragra*, Lenz, Zool. Jahrb. Syst., XIV, p. 477.
1901. *Gonodactylus chiragra*, Nobili, Ann. Mus. Zool. Naples, I, 3, p. 16.
1901. *Gonodactylus chiragra*, Lanchester, Proc. Zool. Soc., II, p. 555.
1902. *Gonodactylus chiragra*, de Man, Abhandl. Senck. Ges. Frankfürt, XXV, p. 912 (including vars. *affinis* and *confinis*, pl. xxvii, fig. 66).
1902. *Gonodactylus chiragra*, Schenkel, Verhandl. naturf. Ges. Basel, XIII, p. 582.
1903. *Gonodactylus chiragra*, Nobili, Boll. Mus. Torino, XVIII, no. 447, p. 32.
1903. *Gonodactylus chiragra*, Lanchester, Faun. Geog. Maldives and Laccadives, I, p. 445 *et seq.*, pl. x-xiii, figs. 1-7 and 10-12 (including vars. *tumidus*, *acutus*, *smithii*, *segregatus*, *incipiens* and *anancyrus*.
1904. *Gonodactylus chiragra*, Jurich, Stomatop. deutsch. Tiefsee-Exped., p. 375, pl. xxvi, figs. 4-5*a*.
1905. *Gonodactylus chiragra*, Lenz. Abhandl. Senck. naturf. Ges. Frankfürt, XXVII, p. 386 (including var. *smithi*, p. 387).
1906. *Gonodactylus chiragra*, Nobili, Ann. Sci. Nat. Zool. (9), IV, p. 327 (including var. *smithi*, p. 329)
1906. *Gonodactylus chiragra*, Tattersall, Ceylon Pearl Oyster Rep., V, p. 167 (including vars. *smithii* and *incipiens* and *G. glabrous* var. *affinis*, p. 169).

1907. *Gonodactylus chiragra*, Borradaile, Trans. Linn. Soc. Zool. (2), XII, p. 211 (including vars. *affinis*, *smithi*, *incipiens*, *anancyrus*, *confinis* and *tumidus*).

1910. *Gonodactylus chiragra*, Lenz, in Voeltzkow's Reise in Ost-Africa, II, p. 571 (including vars. *tumidus*, *smithii* and *incipiens*).

1910. *Gonodactylus chiragra*, Fukuda, Annot. Zool. Japon., VII, p. 141.

The carapace is slightly narrower in front than behind and its greatest breadth is about three quarters its median length excluding the rostrum. The posterior margin is straight or very slightly concave and the anterior margins on either side of the rostrum slope forwards, so that the broadly rounded antero-lateral angles are very considerably in advance of the rostral base. The rostrum bears a stout median spine which may project beyond the middle of the eyestalks; the lateral margins are anteriorly divergent and the antero-lateral angles are subacutely, or, in rarer instances, rather broadly rounded.

The dorsal processes of the ophthalmic somite (fig. 107) consist of two large subtriangular plates, separated distally by a narrow fissure; the anterior margin of each is oblique and is recedent from the middle line. The eyes in well-grown specimens are about one quarter the median length of the carapace and reach almost to the middle of the second segment of the antennular peduncle. The cornea is set very obliquely on the stalk.

The mandibular palp is composed of three segments.

The propodus of the raptorial claw is greatly dilated at its distal end in both sexes and its upper margin is deeply channelled for the reception of the dactylus. The outer edge of this channel is as a rule very finely spinulose, but not pectinate, in its proximal half; distally the edges are flattened and both are transversely striate. At the proximal end of the inner edge there is a single mobile spine. The basal portion of the dactylus is very strongly inflated; the slender finger bears microscopic spinules on its inner margin and is flexed inwards near the apex.

The lateral margins of the sixth and seventh thoracic somites are truncate with rounded anterior and posterior angles. Those of the eighth somite are produced to a bluntly rounded point. The first five abdominal somites are quite smooth except for a sharp L-shaped groove running along the lateral and antero-lateral margins. The postero-lateral angles of the first four somites are rounded, those of the fifth bluntly rectangular. The posterior margin of the sixth somite is straight or slightly convex in dorsal view and on the upper surface of this somite there are six longitudinal ridges which usually terminate in spines. The latter in young specimens are not infrequently large and stout, while in very old examples they may be wholly obsolete. The carinae of the lateral pair terminate in the postero-lateral angles.

The telson is broader than long and in the middle of its dorsal surface there are three smooth longitudinal ridges. Close to the anterior margin, immediately below the intermediate carinae of the last abdominal somite, there are two small rounded tubercles. In large specimens a small lateral outgrowth is usually visible at the posterior end of the median ridge trending forwards on either side, and thus giving to the whole keel the form of an anchor. The flukes of this anchor are occasionally wholly absent both in large

and small specimens and, in the latter, they are sometimes quite separate from the median keels and so form incomplete additional carinae between the medians and laterals. The distal end of the median keel may be rounded, bluntly pointed or sharply spinous either with or without the addition of anchor-flukes. The flukes themselves, in cases where they are separate from the median ridge, may also terminate in spines.

The three main keels may take the form of thin narrow crests or may be greatly swollen, but in practically every known instance there is a definite interspace between them, and between them and the keels on the marginal teeth. The submedian and intermediate marginal teeth are well-developed and each is supported by a prominent longitudinal ridge. There are as a rule numerous spinules on the inner edges of the submedians and a small rounded lobe or denticle in conjunction with one or two spinules between the submedians and intermediates. At the tip of each submedian tooth there is a small movable spinule. The lateral margin is sharply carinate anteriorly and terminates in a sharp notch representing the lateral tooth. This tooth is never well-developed, and in some cases is perhaps wholly absent.[1]

The basal segment of the uropods is provided with a short dorsal spine projecting over the first segment of the exopod. Inferiorly it is produced to a long broad process, divided by a distal emargination of less than half its entire length into two strong teeth. The outer of these reaches almost or quite to the apex of the exopod and is usually a trifle longer than the inner. The internal margin of the outer spine is unarmed and does not bear a small tooth as in large specimens of *G. glabrous* and *graphurus*. The basal segment of the outer uropod projects a little beyond the articulation of the ultimate segment, and bears, as a rule, ten or eleven movable spines—the outermost sometimes slightly recurved at the apex—on its external edge. The inner uropod is oval and elongate and, as is customary, bears a single row of setae on its margins.

In the table on p. 159 I have attempted, with the help of the key given by Borradaile (1907, p. 211), to arrange the 224 specimens that have been examined under different varieties, giving the sex and approximate length in mm. of each specimen. The form K (= '*confinis*') is not represented in the collection.

Owing to the fact that the series is perfectly continuous in its variation it has proved well nigh impossible to catalogue the various individuals in a satisfactory manner, but conclusions of some interest are none the less indicated.

The table will, I believe, be found to substantiate my statement (p. 150) that young examples exhibit a much greater range of variation than those of large size. This is well shown in the case of the specimens referred to H (= '*affinis*'), and is also noticeable in those catalogued as HA, AD, D, HD and HF, while some corroboration is afforded by a study of the data given by Lanchester. Of the three explanations which I have suggested the most probable in my view is that the young forms alter during subsequent moults and eventually reach or nearly reach the standard adult pattern; it is possible, however, that this is not the case with D (= '*smithi*').

In the next place it will be seen at a glance that A (= '*incipiens*') is far more

[1] It is present in every example of *G. chiragra* that I have seen, but is absent in all specimens of the var. *platysoma*.

	H.="*affinis*."	HA.="*affinis-incipiens*."	A.="*incipiens*."	AB.="*incipiens-anancyrus*."	B.="*anancyrus*."	AF.="*incipiens-tumidus*."	F.="*tumidus*."	BF.="*tumidus-anancyrus*."	AD.="*incipiens smithi*."	D.="*smithi*."	HD.="*affinis-smithi*."	HF.="*affinis-tumidus*."
Queensland, Australia ..			♀ 62	♀ 65								
Liu Kiu Is., Japan ..				♂ 78								
				♂ 71								
			♂ 83	♂ 94								
Borneo			♂ 78	♂ 89								
			♂ 55									
Mergui Archipelago and Tavoy.		♀ 50	4 ♀ 80–92						♀ 40	♀ 21	♀ 34	
			1 ♂ 2 ♀ 32–49						♀ 36	♂ ♀ 17	♂ 27	
Nicobars			♂ 105									
			♀ 83									
	♀ 28	♀ 45	5 ♂ 100–105	♂ 91	♂ 96	♂ 78			♀ 36	♀ 40		♀ 23
	♂ 22	♀ 39	5 ♂ 3 ♀ 90–99	♂ 83						♂ 27		
	♂ ♀ 18	♀ 33	11 ♂ 6 ♀ 80–89	♀ 78								
	♀ 17	2 ♀ 31	12 ♂ 10 ♀ 70–79	♂ 60								
Andamans ..	♀ 11	♀ 23	6 ♂ 5 ♀ 60–69	♂ 38								
		2 ♀ 20	2 ♂ 1 ♀ 50–59									
		♂ 18	♀ 49									
		♀ 17	1 ♂ 2 ♀ 33–38									
		♀ 16	♂ 17									
	♂ 16	♀ 31	♂ 81	♂ 68	♂ 80							
		♀ 23	4 ♀ 7 ♂ 70–79	♂ 62	♂ 34							
			5 ♂ 5 ♀ 60–69	♂ 33								
Coco Is.			1 ♂ 1 ♀ 57–58									
			2 ♂ 1 ♀ 43–49									
			♀ 36									
			1 ♂ 1 ♀ 29									
Preparis I.	♂ 13											
	♀ 23			♂ 52						♀ 50		
	♀ 22									♀ 48		
	♀ 18									♂ ♀ 38		
Ceylon	♀ 16									♀ 32		
										2 ♀ 28		
										♀ 14		
			♀ 75	♂ 54	♀ 72	♀ 73	♂ 69	♂ 59				
Karachi			2 ♀ 50, 54	♂ 46								
			2 ♀ 42, 49									
			♀ 73	♀ 56	♂ 79			♂ 53	♀ 30			
			2 ♀ 57, 58	♀ 54	♂ 49				♂ 27			
Persian Gulf ..			1 ♂ 3 ♀ 40–48	♂ 52					♀ 22			
			1 ♂ 2 ♀ 30–39	2 ♂ 50								
									♂ 50			
Mauritius									♀ 42			
									♀ 39			
									♀ 37			
Locality unknown ..			♀ 89	♀ 68								
			♀ 66									
Number of specimens ..	12	14	140	22	6	2	1	2	10	12	2	1
Number 50 mm. or more in length ..	0	1	124	19	4	2	1	2	1	1	0	0

numerous than any other form and comprises the vast majority of large specimens. From the fact that it is connected by numerous intermediates with practically every other type, it may be suggested that this is the starting-point from which the others have diverged; on the other hand it may be argued that A is a specialized type that has become more or less isolated in such localities as the Andamans, Cocos Is., and the Persian Gulf—the only places from which any considerable number of specimens have been examined. Before any definite conclusions on this point can be reached, data supplied by large collections from other localities are necessary.

As regards evidence of isolation among other varieties, it will be noted that A seems to be entirely absent from the Ceylon Coast. Only a few specimens are available and most of these were obtained on the Pearl Banks where *G. chiragra* seems to occur sparingly in company with large numbers of *G. glabrous*. None of the specimens are large; the majority belong to D (= '*smithi*'), while some, all very young, are referred to H. Further material is necessary before any decided opinion can be formed, but there appears to be some indication that D represents a small race that exists in this locality to the exclusion of the more generally abundant form A. Lanchester's work seems also to suggest that this type prevails at Male Atoll in the Maldives, but the number of recorded specimens is again very small.

From the figures given it will be seen that males and females occur in equal proportions, and that there is no trace of any correlation between sex and varietal form.

The colouring of this species in life appears to be fully as variable as the detailed structure of its telson. Among the limited number of fresh specimens that have been examined, the general tone was in some cases yellow, in others dull orange, brick red or olivaceous brown. Numerous other shades doubtless occur and occasional reference to them is found in the literature; it may well be that colour changes due to environment, and possibly to other factors, still remain to be discovered. Males are in most cases very darkly coloured on the ventral surface and in this respect differ strikingly from females which are invariably pale beneath.

That *G. chiragra* is capable of making a loud snapping noise there can be little doubt, but the means by which this is effected has not, so far as I am aware, been determined.[1] It is possibly caused by snapping the fingers as in many Alpheidae, but it may perhaps be due merely to striking stones on other surrounding objects with its prehensile claws. Annesley (1866, p. 338), who succeeded in keeping a specimen alive for more than a month, notes that it made a loud sound by knocking its claws against the glass in which it was confined, but the noise was produced quite inadvertently when the animal was engaged in attacking an ophiuroid.

Annesley found that his specimen fed voraciously on actinians.

The localities from which the specimens examined were obtained[2] are indicated in the table on p. 159. The largest examples are males, 105 mm. in length. The

[1] See addendum, p. 198.

[2] The majority of these specimens are from the Indian Museum collection, but others, which were kindly sent me for examination by Prof. Kishinouye, Mr. J. C. Moulton and Dr. J. Pearson, are included.

majority were found when shore-collecting, but a few, all very small, were taken at depths of 20, 30 and even 41 fathoms.

Gonodactylus chiragra has been recorded from a vast number of localities in the Indo-pacific region. It extends from the Gulf of Suez (Miers, Kossmann) and the Red Sea (Miers, Nobili) along the African Coast southwards to Natal Point, where, according to Krauss, it is rather rare. Eastwards of this it seems to occur in every favourable situation, and on the Australian coast reaches south to the Swan River in the west and to Port Molle in the east (Miers). It appears to be absent from the S. coast of Australia and from New Zealand. In Oceania it is abundant and has been found as far east as Tahiti (Heller). Northwards it extends as far as Japan (Fukuda); but it has not, I believe, been taken at the Hawaiian Is.

Miers' record from Panama, the only one from the Pacific coast of America, requires confirmation and Nobili (1897, p. 6) and Moreira (1901, p. 1, *sub G. falcatus*) appear to have been unaware of Hansen's separation of the Atlantic form under the

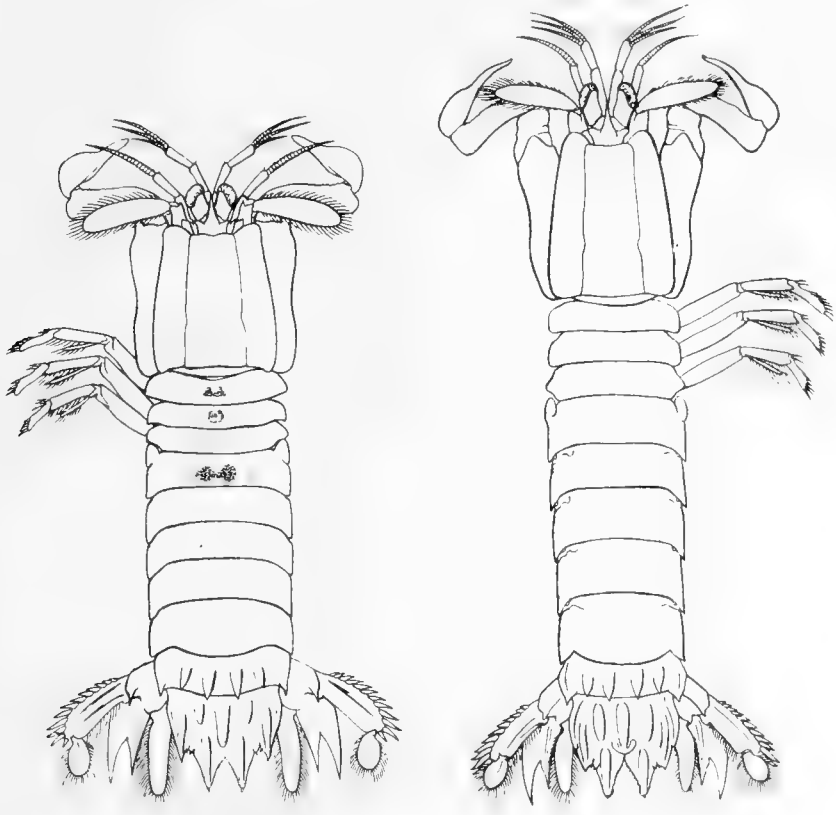

Fig. 1 *Fig. 2*

FIG. 1. *Gonodactylus chiragra* var. *platysoma*.
FIG. 2. *Gonodactylus chiragra*, typical form.

name of *G. oerstedi* when they recorded specimens from Darien and the Brazilian coast. From Hansen's notes (1895, p. 65, footnote) and from the further study of numerous specimens by Bigelow (1902, p. 152), it seems certain that every Atlantic specimen exhibits the characters of *G. oerstedi* and all references of *G. chiragra* from these localities may be placed with confidence in the synonymy of that species.

G. chiragra has been recorded by Heller (1863, p. 309), and others, from the Mediterranean; but these records do not seem to be authentic. Steuer (1911, p. 734) has re-examined specimens from Heller's collection found in the Adriatic, and has shown that they are to be referred to Lanchester's *G. chiragra* var. *mutatus*, a form of *G. glabrous*. This is the only record that can be accepted of the occurrence of the genus *Gonodactylus* in the Mediterranean.

var. **platysoma**, Wood-Mason.

1895. *Gonodactylus platysoma*, Wood-Mason, Figs. and Desc. of nine Squillidae, p. 11, pl. iii, figs. 3-9 (*sine desc.*).

? 1903. *Gonodactylus chiragra* var. *acutus*, Lanchester, Faun. and Geog. Maldives and Laccadives, I, p. 447, pl. xxiii, figs. 2, 3, 3*a*.

? 1910. *Gonodactylus chiragra* var. *acutus*, Lenz, in Voeltzkow's Reise in Ost-Afrika, II, p. 571.

The specimens to which Wood-Mason gave the name of *Gonodactylus platysoma* seem by their structure to possess better claims to varietal recognition than any of the forms listed on p. 159. *G. platysoma*, as its name implies, is much more depressed than *G. chiragra* and is proportionately broader. The greatest breadth of the abdomen is from 21·5 to 23·5 % of the total length of the animal including the rostrum, whereas it is always less than 20 % in typical *G. chiragra*. The difference does not appear great when expressed in figures, but on actual comparison of specimens is a very conspicuous feature (see text-fig., p. 161).

The measurements of six specimens of var. *platysoma* are given below in conjunction with similar measurements of eight *G. chiragra, s.s.* With respect to the figures of the latter form it is to be noted that in normal specimens the percentage of length to

Locality.	Sex.	Total length including rostrum.	Greatest breadth of abdomen.	Proportion of breadth to length.
G. chiragra var. *platysoma*.		mm.	mm.	%
Andamans	♂	80	17·5	22
Do.	♀	79	18·5	23·5
Do.	♂	77	16·5	21·5
Society Is.	♀	75	16·0	21·5
Mauritius	♀	70	15·5	21·5
Do.	♀	48·5	11·0	22·5
G. chiragra, s.s.				
Andamans	♂	100	19·0	19
Do.	♂	92	17·0	19·5
Do.	♀	82	15·0	18·5
Do.	♀	82	15·5	19
Do.	♂	78	15·0	19
Do.	♀	72	13·0	19·5
Coco Is.	♀	71	14·0	19·5
Do.	♀	57	11·0	19·5

breadth is usually not more than 18·5 ; the majority of the specimens were specially selected because they appeared broader than was customary.

Along with this character is correlated a difference in the dactylus of the raptorial claw. In *G. chiragra* the slender terminal portion is long and its apex is always very definitely inturned. In the var. *platysoma*, however, the finger is much shorter and is not, or is only very slightly, bent at the tip.

In the form of the telson all the specimens of var. *platysoma* correspond very closely with the individuals to which Lanchester gave the name of *acutus* (1903, pl. xxiii, fig. 3). The keels on the dorsal surface are narrow and the median one is not anchor-shaped and does not terminate in a spine ; the lateral marginal teeth are entirely absent. Lanchester's examples are perhaps identical with those named by Wood-Mason ; but the point cannot be definitely settled, for the former author does not mention the other characters that separate *platysoma* from typical *chiragra*. It is rather remarkable that, among normal *G. chiragra* in the Indian Museum, no specimen occurs with this type of telson, whereas all the examples of the var. *platysoma* from three widely distant localities, agree in possessing it. It seems possible, therefore, that this feature is correlated with the other characters of the variety; but the variation in the telson is so great among typical *G. chiragra* that it would be astonishing if the form proved constant in a large series of specimens.

The six examples retain but little trace of their original colour, but in four that are better preserved than the rest there is a pair of conspicuous round black spots, placed close together in the middle of the first abdominal somite. These spots seem only to occur very rarely in typical *G. chiragra* and perhaps constitute a special feature of the variety.

The specimens are registered as follows :—

$\frac{3150\text{-}2}{9}$	Port Blair, Andamans.	G. H. Booley.	2 ♂ 1 ♀, 77—80 mm. TYPES.
$\frac{3033}{5}$	Society Is.	Otago Museum.	1 ♀, 75 mm.
$\frac{3039}{5}$	Mauritius.	Purchased.	2 ♀, 48·5 and 70 mm.

The examples which Lanchester recorded as *G. chiragra* var. *acutus* were taken at Minikoi, and those which Lenz attributed to the same form were found at Zanzibar and Madagascar.

2. Gonodactylus acutirostris, de Man.

1898. *Gonodactylus chiragra* var. *acutirostris*, de Man, Zool. Jahrb. Syst., X, p. 695, pl. xxxviii, figs. 77*b*, *c*.
1899. *Gonodactylus chiragra* var. *acutirostris*, Borradaile, in Willey's Zool. Results, p. 400.
1903. *Gonodactylus chiragra* var. *acutirostris*, Lanchester, Faun. and Geog. Maldives and Laccadives, I, p. 454.
1907. *Gonodactylus acutirostris*, Borradaile, Trans. Linn. Soc. Zool. (2), XII, p. 210.

This species, known from a single specimen only, may perhaps prove to be merely an abnormal example of *G. chiragra*; it is distinguished by the following features :—

1. The antero-lateral angles of the rostrum are acute : distinctly sharper than in *G. chiragra*.
2. The customary pair of tubercles near the anterior margin of the telson are

wholly absent, and the submedian ridges in the middle of the dorsal surface are strongly convergent posteriorly.

The only known specimen, a female 56 mm. in length, is recorded by de Man from the Mergui Archipelago. Patience has examined an example from the same locality, which in the form of the rostrum resembles the type of this species, while the telson shows the characters of *chiragra* (form *acutus*).

3. Gonodactylus demani,[1] Henderson.

Plate IX, figs. 108–111.

1887. *Gonodactylus*, n. sp., de Man, Arch. f. Naturgesch., LIII, i, p. 574, pl. xxii *a*, fig. 7.
1893.[2] *Gonodactylus Demanii*, Henderson, Trans. Linn. Soc. Zool. (2), V, p. 455, pl. xl, figs. 23, 24.
1905. *Gonodactylus Demani*, Nobili, Boll. Mus. Torino, XX, no. 506, p. 11.
1905. *Gonodactylus spinosus*, Lenz, Abhandl. Senck. naturf. Ges. Frankfürt, XXVII, p. 387, pl. xlvii, fig. 12.
1906. *Gonodactylus De Mani*, Nobili, Ann. Sci. Nat. Zool. (9), IV, p. 330.
1906. *Gonodactylus de Mani*, Nobili, Bull. Sci. France et Belg., XL, p. 158.
1907. *Gonodactylus demani*, Borradaile, Trans. Linn. Soc. Zool. (2), XII, pp. 210, 212.
1910. *Gonodactylus De Mani*, Lenz, in Voeltzkow's Reise in Ost-Afrika, II, p. 572.

This species is very closely allied to *G. chiragra* and appears to be distinguished from it only by the following characters :—

1. The dorsal processes of the ophthalmic somite are (fig. 108) extremely small and inconspicuous and take the form of two very small transverse plates with straight or almost straight anterior edges.
2. The telson (figs. 109–111) has three swollen ridges in the middle of its dorsal surface as in *G. chiragra*, but the median one is very strongly convex in lateral view and its depth, measured from the summit to a point vertically below on the inferior surface is equal to half its extreme breadth. The three median ridges and those running to the apices of the submedian and intermediate marginal spines occupy practically the whole surface of the telson and are separated from one another merely by narrow **V**-shaped furrows; the interspaces found in *G. chiragra* are absent. This feature is well shown on the submedian spines; the latter are evenly convex from side to side from the apex to the base and never bear a median keel distinct from the general surface as in *G. chiragra*. The telson, in all known specimens except one (var. *espinosus*) is beset with tubercles or spinules that vary greatly in size and number.

In the typical form of *G. demani* the telson is broader than long, the intermediate marginal teeth are well-developed and the lateral teeth, though small, are usually quite distinct. The figures on pl. IX (figs. 109–111) will give some idea of the range of variation in the number and size of the spinules. In most examples they are absent

[1] See addendum, p. 198.

[2] Henderson's *G. demani* has one month's priority over *G spinosus*, Bigelow; the latter is here regarded as a variety of the former.

from the summits of the median telson ridges, but Nobili has noted that they may cover the entire surface as is usually the case with the var. *spinosus*. It will be noticed that the median ridge of the telson is sometimes very much broader than the others, and this is the case with the type specimen figured by Henderson.

Spirit specimens do not show any very characteristic colouring. Most of the examples are yellowish brown with a speckling of black chromatophores, which tend to form a transverse band in the posterior third of the carapace, lateral patches on the sixth thoracic somite, and a pair of ill-defined spots in the middle of the sixth thoracic and first abdominal somites.

G. demani is a small species and does not seem to exceed 40 mm. in length. The specimens in the Indian Museum are not numerous:—

$\frac{7315}{10}$	Bombay.	F. W. Townsend.	1 ♂, 28 mm.
$\frac{641\text{-}6}{10}$	Persian Gulf.	F. W. Townsend.	2 ♂ 4 ♀, 19–37 mm.
$\frac{3343}{7}$	Henjam Is., Persian Gulf.	W. T. Blanford.	1 ♀, 28 mm.
$\frac{3199}{7}$, $\frac{191}{10}$	Karachi.	Karachi Museum.	2 ♂, 27, 30 mm.
$\frac{7562}{10}$	'Arabian Sea.'	Karachi Museum.	1 ♀, 29 mm.
$\frac{7688}{10}$	Ibo Archipelago, Portuguese E. Africa.[1]	J. F. Simpson.	1 ♂ 2 ♀, 27–39 mm.

An additional specimen lent by the Bombay Natural History Society has also been examined :—

Persian Gulf, Pearl Banks, 5–7 fms.	1 ♀, 22 mm.

Gonodactylus demani has been recorded from Pulo Edam on the Java Coast (de Man), from Rameswaram in the G. of Manaar (Henderson) from the Persian Gulf and Red Sea (Nobili) and from Zanzibar (Lenz, Borradaile).

var. **spinosus**, Bigelow.

Plate IX, fig. 112.

1893. *Gonodactylus spinosus*, Bigelow, John Hopkins Univ. Circ., no. 106, p. 101.
1894. *Gonodactylus spinosus*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 493.
1903. *Gonodactylus chiragra* var. *spinosus*, Lanchester, Faun. and Geog. Maldives and Laccadives, I., p. 454, pl. xxiii, fig. 14.
1906. *Gonodactylus spinosus*, Nobili, Ann. Sci. Nat. Zool. (9), IV, p. 330.
1907. *Gonodactylus spinosus*, Borradaile, Trans. Linn. Soc. Zool. (2), XII, pp. 210, 212.

The telson is as long as broad, and the incision between the submedian marginal spines is slightly deeper than in typical *G. demani*. The intermediate teeth of the telson edge are very small, and the laterals are minute or wholly absent. The dorsal surface is closely covered with small spinules, but in some cases the summit of the median ridge is bare.

The claims of this form to varietal recognition are very slight and appear to rest almost solely on the greater length of the telson, and the reduced size of the intermediate

[1] I am indebted to Mr. Patience for the opportunity of examining these specimens.

marginal teeth. In other respects its characters are closely paralleled by certain extreme forms of typical *G. demani*. In some of the examples in the Indian Museum the lateral and intermediate teeth of the telson are slightly better developed than is indicated in Lanchester's figure (see fig. 112).

Nobili (1906 (*a*), p. 330), when recording comparatively large specimens that appear to a great extent intermediate between *G. demani* and var. *spinosus*, considers it probable that the lateral and intermediate telson teeth develop with age.

The colouring of two of the Indian specimens, examined in weak formalin shortly after capture, was peculiar. The general tone was straw or lemon yellow marbled with a paler shade, and a few isolated jet-black chromatophores were placed in transverse rows on the posterior third of the carapace and on most of the abdominal somites, each chromatophore being set in the middle of a pale spot. The yellow colouring ceased abruptly at a distinct olivaceous brown line on the last abdominal somite, and behind this there was a broad band of pure white involving the ends of all the carinae. The telson was mottled with white, olivaceous brown and yellow, and the antennal and antennular peduncles were faintly banded with dull red.

Mr. Patience regards *G. spinosus* merely as a synonym of *G. demani*, but I am not convinced that this is so. The examples of the form *spinosus* which I have been able to examine were all found on the Ceylon Pearl Banks, on which, so far as I am aware, no specimen of the typical *G. demani* has yet been obtained.

The largest specimen known is 33 mm. in length (Nobili). Eight specimens have been examined :—

$\frac{7497-8}{10}$	N. Cheval Paar, Ceylon.	T. Southwell.	2 ♂, 16, 16·5 mm.
$\frac{8038}{10}$	Pearl Banks, Ceylon (from *Spongodes*).	T. Southwell.	3 ♂, 3 ♀, 18–22 mm.

G. demani var. *spinosus* has been recorded from the Maldives (Lanchester), the Red Sea (Nobili) and from Mauritius (Bigelow).

var. **espinosus,** Borradaile.

1898. *Gonodactylus espinosus*, Borradaile, Proc. Zool. Soc., p. 35, pl. v, fig. 5, 5*a*, *b*.
1903. *Gonodactylus chiragra* var. *espinosus*, Lanchester, Faun. and Geog. Maldives and Laccadives, I, p. 455.

The telson is as broad as, or perhaps a trifle broader than long, the intermediate and marginal teeth are obsolete, and on the dorsal surface the customary spinules are entirely absent.

This form seems to be nothing more than a variety of *G. demani*, and it may ultimately appear that it is merely an extreme form in a series exhibiting continuous variation and, as such, does not deserve recognition under a separate name. As far as I am aware it differs from *G. demani* only in the total absence of the spinules on the telson, and in the reduction of the intermediate and lateral teeth of the margin and, both in the size of these teeth and in the number of dorsal spinules, *G. demani* is extremely variable. From the var. *spinosus* it is distinguished by the absence of spinules and by the slightly broader form of the telson.

Borradaile has recorded a single male, olive-green in colour and a trifle more than 18 mm. in length, from Rotuma, a locality far distant from the regions in which typical *G. demani* or var. *spinosus* have been found.

4. Gonodactylus glabrous,[1] Brooks.

Plate IX, fig. 113.

1886. *Gonodactylus glabrous*, Brooks, Voy. of H.M.S. 'Challenger,' XVI, Stomatop., p. 62, pl. xiv, fig. 5; pl. xv, figs. 7, 9.
1887. *Gonodactylus graphurus*, F. Müller, Verhandl. naturf. Ges. Basel, VIII, p. 471.
1887. *Gonodactylus graphurus*, de Man, Arch. f. Naturgesch., LIII, i, p. 573.
1893. *Gonodactylus glaber*, Henderson, Trans. Linn. Soc. Zool. (2), V, p. 454.
1894. *Gonodactylus glabrous*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 493.
1894. *Gonodactylus glaber*, Ortmann, Denk. med.-wiss. Ges. Jena, VII, p. 60.
1898. *Gonodactylus glabrous*, Borradaile, Proc. Zool. Soc., p. 36.
1899. *Gonodactylus glabrous*, Nobili, Ann. Mus. Civ. Genova (2), XX, p. 276.
1901. *Gonodactylus glaber*, Nobili, Ann. Mus. Zool. Napoli, I, no. 3, p. 17.
1901. *Gonodactylus graphurus*, Nobili, *ibid.*, p. 16 (*fide* Nobili, 1906).
1902. *Gonodactylus glabrous*, de Man, Abhandl. Senck. ges. Frankfürt, XXV, p. 913, pl. xxvii, fig. 67 (including var. *ternatensis*, p. 914).
1903. *Gonodactylus chiragra* vars. *glabrous* and *mutatus*, Lanchester, Faun. and Geog. Maldives and Laccadives, I, pp. 448, 451, pl. xxiii, figs. 8, 9, 15.
1904. *Gonodactylus glabrous*, Jurich, Stomatop. deutsch. Tiefsee-Exped., p. 376.
1905. *Gonodactylus graphurus*, Lenz, Abhandl. Senck. naturf. Ges. Frankfürt, XXVII, p. 387 (*partim*, *fide* Lenz, 1910).
1905. *Gonodactylus glaber*, Nobili, Boll. Mus. Torino, XX, no. 506, p. 11.
1906. *Gonodactylus glabrous*, Tattersall, Ceylon Pearl Oyster Rep., V, p. 167.
1906. *Gonodactylus graphurus*, Nobili, Bull. Sci. France et Belg., XL, p. 159.
1906. *Gonodactylus glaber*, Nobili, Ann. Sci. Nat. Zool. (9), iv, p. 333.
1907. *Gonodactylus glaber*, Borradaile, Trans. Linn. Soc. Zool. (2), XII, pp. 211, 212 (including vars. *ternatensis* and *rotundus*).
1910. *Gonodactylus glaber*, Lenz, in Voeltzkow's Reise in Ost-Afrika, II, p. 572.
1910. *Gonodactylus glabrous*, Fukuda, Annot. Zool. Japon., VII, p. 141.
1911. *Gonodactylus chiragra* var. *mutatus*, Steuer, Sitz.-ber. math.-naturwiss. Klasse d. k. Akad. Wiss., Wien, CXX, p. 734, text-fig.

Gonodactylus glabrous differs from *G. chiragra* only in the following characters :—

1. The dorsal processes of the ophthalmic somite (fig. 113) consist of two small plates, rounded anteriorly; they are longer than in *G. demani* and much narrower than in *G. chiragra*.
2. At the base of the upper margin of the raptorial propodus the small movable spine, almost invariably present in *G. chiragra*, is entirely absent.
3. On the sides of the 2nd, 3rd, 4th and 5th abdominal somites near the anterior margin there is a rather conspicuous pit. This in *G. chiragra* is very faint or wholly absent.
4. There are *five* long keels in the middle of the dorsal surface of the telson and

[1] The inclusion of Lenz's *Protosquilla glabra* in the genus *Gonodactylus* renders any change in the original spelling of this name inconvenient. For further notes on this species see addendum, p. 197.

immediately behind the median there is a pair of small tubercles. The lateral marginal teeth are frequently rather more distinct than in *G. chiragra*.

5. On the inner side of the external spine of the basal process of the uropods there is a small tooth or lobe placed quite near the base.

The keels on the sixth somite like those of *G. chiragra* may be swollen or narrow, and may or may not terminate in spines. Between the submedians an additional narrow longitudinal keel is occasionally found. Except for the usual L-shaped ridge along the lateral and antero-lateral margins and for the small pit mentioned above, the first five abdominal somites are quite smooth. The five keels in the middle of the dorsal surface of the telson may be swollen without distinct interspaces, or narrow and well separated ; the three median frequently end in spines. The central keel never, or very rarely, assumes the shape of an anchor, but is sometimes subdivided into three very short branches at its distal end (see Lanchester, pl. xxiii, fig. 8). In respect of the above modifications the species unquestionably exhibits continuous variation, but among the Ceylon specimens, which form the vast majority of those examined, a spineless form with moderately or greatly swollen keels seems to predominate.

The Ceylon examples were preserved in formalin, and when examined, not long after capture, showed a most remarkable range of colour variation. The commonest shade was a uniform olivaceous yellow, while other examples were dull purple, deep purplish green profusely mottled, dark olive, olive brown with paler marbling, brick red or dull orange. On the last abdominal segment a pair of very small black spots were constantly found close to the anterior margin, situated one on either side between the submedian and intermediate keels. The keels on this somite and on the telson were in most cases defined by a darker tone.

The specimens of *G. glabrous* in the Indian Museum are registered as follows :—

$\frac{7716}{6}$	Mergui Archipelago.	'Investigator.'	1 ♂, 21 mm.
$\frac{3035}{5}$	Nicobars.	F. Stoliczka.	1 ♀, 35 mm.
$\frac{3043}{6}$	Port Blair, Andamans.	F. A. de Roepstorff.	1 ♀, 98 mm.
$\frac{8988}{6}$	Andamans.	'Investigator.'	1 ♂, 23 mm.
$\frac{3034}{5}$	Galle, Ceylon.	J. Anderson.	2 ♀, 34, 38 mm.
$\frac{7490}{10}$	Cheval Paar, Ceylon.	T. Southwell.	22 ♂, 56 ♀, 14·5–61 mm.
$\frac{8036}{10}$	Pearl Banks, Ceylon (from *Spongodes*).	T. Southwell.	1 ♂, 3 ♀, 41–64 mm.
$\frac{7499}{10}$	Bombay.	Bombay Nat. Hist. Soc.	1 ♂, 33 mm.
$\frac{8425}{10}$	Ibo Archipelago, Portuguese E. Africa.[1]	J. J. Simpson.	1 ♂, 2 ♀, 50–68 mm.

In addition the following specimens have been lent me for examination :—

Ceylon.	Colombo Museum.	1 ♂, 1 ♀, 33, 35 mm.
Bombay.	Bombay Nat. Hist. Soc.	2, 33, 40 mm.

Gonodactylus glabrous appears to be a common species, but perhaps frequents

[1] For these examples I am indebted to Mr. Patience.

ground of a different nature to that in which *G. chiragra* flourishes. Although both species occur together on the Ceylon pearl banks, *G. glabrous* is vastly in the majority.

G. glabrous is distributed throughout the Indo-pacific region and has been recorded from the following localities: Rotuma (Borradaile); Liu Kiu Is., Japan (Fukuda); British New Guinea (Nobili); Sir C. Hardy's I., N.E. Australia (Henderson); Ternate (de Man); Samboanga (Brooks); Sulu Sea (Henderson); Pulo Edam (de Man); Ceylon, Tuticorin and Rameswaram (Henderson, Tattersall); Maldives and Laccadives (Lanchester); Persian Gulf (Nobili); Aden (Henderson); Red Sea (Nobili); Seychelles (Jurich, Borradaile); Cargados Carajos (Borradaile); British East Africa (Borradaile); Zanzibar (Lenz, etc); Dar-es-Salaam (Ortmann). Müller's record of *G. graphurus* from Trincomali doubtless refers to this species.

Steuer (1911, p. 734) has examined specimens from Heller's collection which were obtained at Lesina in the Adriatic. This is the only authentic record of any species of *Gonodactylus* in the Mediterranean.

5. **Gonodactylus graphurus**, Miers.

1847. *Gonodactylus graphurus*, White, List Crust. Brit. Mus., p. 85 (*sine desc.*).
1875. *Gonodactylus graphurus*, Miers, Ann. Mag. Nat. Hist. (4), XVI, p. 344.
1880. *Gonodactylus graphurus*, Miers, Ann. Mag. Nat. Hist. (5), V, pp. 120, 459, pl. iii, fig. 9 (*partim*).
1882. *Gonodactylus graphurus*, Haswell, Cat. Australian Crust., p. 211.
1884. *Gonodactylus graphurus*, Miers, Voy. H.M.S. 'Alert,' pp. 298, 566 (*partim*).
1886. *Gonodactylus graphurus*, Brooks, Voy. H.M.S. 'Challenger,' XVI, Stomatop., p. 58, pl. xiv, figs. 1, 4, 6; pl. xv, figs. 3, 8.
1893. *Gonodactylus graphurus*, Pocock, Ann. Mag. Nat. Hist. (6), XI, p. 474.
1894. *Gonodactylus graphurus*, Zehntner, Rev. Suisse Zool., II, p. 213.
1894. *Gonodactylus graphurus*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 493.
1894. *Gonodactylus graphurus*, Ortmann, Denk. med.-wiss. Ges. Jena, VIII, p. 60.
1901. *Gonodactylus graphurus*, Lenz, Zool. Jahrb. Syst., XIV, p. 478.
1903. *Gonodactylus chiragra* var. *graphurus*, Lanchester, Faun. and Geog. Maldives and Laccadives, I, p. 450.
? 1905. *Gonodactylus graphurus*, Nobili, Boll. Mus. Torino, XX, no. 506, p. 11.
? 1905. *Gonodactylus graphurus*, Lenz, Abhandl. Senck. naturf. Ges. Frankfürt, XXVII, p. 387 (*partim, fide* Lenz, 1910).
1906. *Gonodactylus graphurus*, Nobili, Ann. Sci. Nat. Zool. (9), IV, p. 333.
1910. *Gonodactylus graphurus*, Lenz, in Voeltzkow's Reise in Ost-Afrika, II, p. 571.

Gonodactylus graphurus is closely allied to *G. glabrous* and may be separated from *G. chiragra* by the same characters that have been given under that species. It may be distinguished at a glance from *G. glabrous* (and from all the other species of the same section as well) by the fine transverse and longitudinal grooves on the first five abdominal somites.

The most conspicuous of these grooves starts from the small pit mentioned in the case of the preceding species and, after running backwards a short distance, curves upwards, and is continued almost to the mid-dorsal line as a transverse groove in the posterior third of each somite. The L-shaped antero-lateral groove, found in all the species of this group, is distinct and there is also on each somite an addi-

tional groove, running almost longitudinally and situated midway between the lateral margin, and the commencement of the transverse groove.

The presence of these grooves (see text-fig. 1), though the only constant character by which *G. graphurus* may be distinguished from its ally, is, I believe, a feature of sufficient importance to justify specific separation ; intermediate specimens appear to be wholly unknown. Pocock (1893, p. 475) notes that in a semi-larval form, 10 mm. in length, the grooves are found only on the fifth abdominal somite, but that in all the other numerous examples which he examined, they were well-marked without sign of failing.

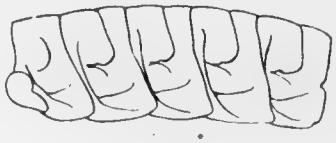

Fig. 1.

Fig. 2.

Fig. 1. *Gonodactylus graphurus*
Fig. 2. *Gonodactylus glabrous*
} First five abdominal somites viewed laterally.

A fine median carina is usually—perhaps invariably—found on the sixth abdominal somite, but this character is shared by some examples of *G. glabrous*.

The other keels on the last abdominal somite and those on the telson appear to vary in precisely the same way as in the preceding species. In the two examples from Port Molle they are slender, but moderately swollen in the third specimen ; in all three the median and submedian keels of the telson terminate in spines.

The colouring of living *G. graphurus* is doubtless as variable as that of its allies.

There are only three specimens in the Indian Museum :—

$\frac{3356}{7}$	Australia.	Queensland Museum.	1 ♂, 60 mm.
$\frac{3606}{3}$	Port Molle, Queensland.	Australian Museum.	1 ♂, 1 ♀, 35, 40 mm.

Both in Henderson's experience and in my own, *G. glabrous* occurs on the coasts of India to the complete exclusion of *G. graphurus*, and it would naturally be expected that, in the case of the latter species, further indications of a geographical range more limited than that of *G. glabrous* would be found in the published records. It is not altogether clear, however, that this is so. The head-quarters of *G. graphurus* appear to lie in an area comprising Oceania, the N. coast of Australia, Amboina and the China Seas, but from certain isolated records from the E. African coast, it would seem that the species is in reality distributed over the whole Indo-pacific region.

As regards the African records it will be noticed that Nobili, writing towards the end of 1906, includes in his synonymy of *G. glabrous*, his record of *G. graphurus* from

Zanzibar made in 1901, and remarks that the specimens collected by MM. Bonnier and Perez in the Persian Gulf—evidently those that he recorded as *G. graphurus* in April, 1906—are also examples of *G. glabrous*. It is therefore apparent that little confidence can be placed in Nobili's other record from Zanzibar made in 1905.

But, in addition to Nobili, Lenz on two occasions notes the occurrence of *G. graphurus* at Zanzibar. In his latest paper (1910), he refers some of the specimens recorded in his previous account to *G. glabrous*, but it seems hardly possible that there can be any mistake regarding the remainder, for the author notes the presence of grooves on the abdominal somites.

The type specimens of *G. graphurus* were obtained at Samoa (Miers) and since 1886, when the features of *G. glabrous* were first recognized, the following records, believed to be authentic, have been made: Samoa (Lenz); Thursday I. (Ortmann); Baleine Bank, N.W. Australia, 20 fms.; Baudin I., 8–15 fms.; Arafura Sea; Holothuria Bank, China Seas, 15–24 fms. (Pocock); Amboina (Zehntner); Zanzibar! (Lenz).

The confusion between this and the preceding species has in a large measure arisen from the use of characters derived from the carination of the last somite and telson, while the more valuable feature of the presence or absence of grooves on the first five segments of the abdomen seems to some extent to have been overlooked.

6. **Gonodactylus herdmani**, Tattersall.

Plate X, fig. 114, 114*a*.

1906. *Gonodactylus herdmani*, Tattersall, Ceylon Pearl Oyster Rep., V, p. 169, pl. i, figs. 8–10.
1907. *Gonodactylus herdmani*, Borradaile, Trans. Linn. Soc. Zool. (2), XII, p. 210.

The carapace is about one and a third times as long as broad and is not narrower in front than behind. The anterior margins on either side of the rostrum slope forwards, and the rounded antero-lateral angles are well in advance of the rostral base. The rostrum is sharply trispinous; the median spine may extend beyond the middle of the eyestalks or may reach only to their base.

The dorsal processes of the ophthalmic somite consist of a pair of small transverse plates with broadly-rounded anterior edges. The cornea is not wider than the stalk and is set very obliquely on it.

The mandibular palp is three-segmented, but the division between the two proximal segments is rather indistinct.

The form of the raptorial claw is almost exactly the same as that of *G. chiragra*; there is a single large movable spine on the dorsal surface of the propodus close to the proximal end.

The lateral margins of the eighth thoracic somite are rounded; those of the sixth and seventh somites are more or less truncate with rounded anterior and posterior angles.

The first five abdominal somites, except for the customary L-shaped carina along the antero-lateral margins, are entirely smooth, though in large specimens one or two minute pits may be discerned in the middle of the dorsal surface. The postero-lateral

angles are not spinous. The posterior margin of the sixth somite is straight or slightly convex in dorsal view, and on its dorsal surface there are six rounded longitudinal ridges, the outermost of which are coterminous with the acute postero-lateral angles. The four median ridges are distally rounded in the two type specimens and in two which I have examined ; but in another example—a small one—each of the submedians terminates in a minute spinule.

The telson is much broader than long and bears on either side near the anterior margin, the small rounded tubercle which occurs in most of the preceding species. In the middle of the dorsal surface are three ridges that are smooth anteriorly, but posteriorly tend to break up into a few large tubercles. The median ridge is much wider than the other two and, in the specimens examined, bears three tubercles at its distal end and sometimes one other, much less distinct, on either side near the middle. Each submedian ridge is composed of an elongate anterior portion, and a large rounded posterior tubercle, the latter being sometimes entirely separate from the former.[1] The tubercles in the type specimen are rather more numerous, as will be seen by comparing pl. X, fig. 114 with the figure given by Tattersall. On the margin of the telson the submedian and intermediate teeth are large and well-developed ; the former have movable tips but bear no spinules on their inner margins ; the intermediate denticle is obsolete. Each tooth is strengthened by a dorsal carina broken up into a small number of large tubercles. The lateral marginal teeth take the form of lobes ; they are comparatively prominent in the type, but in the specimens examined are very broadly rounded.

The peduncular segment of the uropod is carinate dorsally and terminates in a stout spine projecting over a similar carina on the proximal segment of the exopod ; the ventral process is composed of two spines of equal length, the outer a little broader than the inner. The first segment of the exopod projects far beyond the articulation of the second segment, and on its outer margin bears an even series of ten or eleven spines. The outermost spines are slightly recurved : more so than is ever the case with *G. chiragra*. The terminal segment is comparatively long; it is strongly carinate above and bears setae only in the distal half of its outer margin. The endopod is a comparatively solid structure, not laminar as in the preceding species. It is more or less crescentic in shape with a concave inner margin and ends anteriorly in a subacute angle well in advance of its point of articulation with the peduncular segment. It bears a strong carina near its external edge and inwards of this carina is feebly ridged longitudinally both above and below. Setae are present only on the outer half of its distal margin.

Living specimens are quite pale in colour with dull yellow marbling, darkest at the antero-lateral corners of the abdominal somites and tending to a more reddish tone on the sixth somite and telson. The ridges and tubercles of these last two segments are pure white. The propodus of the raptorial claw has a red-brown patch at the extreme distal end, and near the apex of each of the rostral spines, there is a transverse red band.

[1] In an abnormal specimen from the Colombo Museum the left submedian ridge is absent; but its distal tubercle persists.

The black spots mentioned by Tattersall are distinct, but are decidedly irregular in size and distribution.

The larger of the type specimens measured 28 mm.; the three examples which I have been able to examine are rather smaller.

$\frac{7500\text{-}1}{10}$	N. Cheval Paar, Ceylon.	T. Southwell.	2 ♂, 18, 26 mm.
	Ceylon Pearl Banks.	Colombo Museum.	1 ♀, 22 mm.

The types and only other known examples are recorded by Tattersall from coral reefs in the G. of Manaar.

7. **Gonodactylus drepanophorus**, de Man.

1902. *Gonodactylus drepanophorus*, de Man, Abhandl. Senck. Ges. Frankfürt, XXV, p. 914, pl. xxvii, fig 68.

1907. *Gonodactylus drepanophorus*, Borradaile, Trans. Linn. Soc., Zool. (2), XII, p. 210.

In the long description given by de Man I am only able to detect the following differences between this species and *G. herdmani*:—

1. The carinae of the last abdominal somite are rather narrower and all of them terminate posteriorly in spines.
2. The submedian and intermediate teeth of the telson are rather longer and more slender, and the inner edges of the former are beset with spinules.
3. The lateral teeth of the telson are large, well-formed and sharply acute.
4. The tubercles on the dorsal surface are rather more numerous and each, in place of being rounded, is sharply pointed.
5. The inner uropod has the same form, but is much more strongly bent inwards at the apex.

The type specimen was speckled with black chromatophores comparable with those of *G. herdmani*.

A single specimen, a female 18 mm. in length, is recorded by de Man from Ternate, one of the Molucca Islands. No other examples are known.

8. **Gonodactylus spinoso-carinatus**, Fukuda.

1910. *Gonodactylus spinoso-carinatus*, Fukuda, Annot. Zool. Japon., VII, p. 143, pl. iv, figs. 2, 2*a*.

The telson, which has formed the subject of a long and careful description by Fukuda, readily distinguishes *G. spinoso-carinatus* from all other species of *Gonodactylus*. In brief, the whole surface except for the base of the submedian spines is completely covered by nine longitudinal keels. These keels are smooth dorsally, with minute prickles on the lateral borders, and a few spinules directed obliquely backwards at their distal ends. The median keel is very broad anteriorly. The submedian teeth are large and are separated by a deep incision with spinulose margins; the intermediate and lateral teeth are exceedingly small.

The peduncular segment of the uropods is furnished with three or four spines on its dorsal surface in addition to the terminal one. The proximal segment of the exopod bears five or six spines on its outer margin; the first two or three are slender and

straight, the others, situated at the distal end behind the articulation of the ultimate segment are stout and very strongly recurved. The endopod is curved outwards. Fukuda does not give any details of the disposition of setae on the inner uropod and on the last segment of the outer uropod, but from his figure it appears that they exist only on the distal half of the outer margins as in *G. herdmani* and *drepanophorus*.

In other respects *G. spinoso-carinatus* appears to resemble the two preceding species closely ; but it is much narrower in form, the greatest breadth being less than one-seventh the total length.

Only two examples are known, the largest being 28·5 mm. in length. They are recorded by Fukuda from Jogashima, Sagami Prov., Japan.

9. **Gonodactylus brevisquamatus**, Paulson.

Plate X, figs. 115, 116.

1875. *Gonodactylus brevisquamatus*, Paulson, Réch. Crust. Mer Rouge, p. 127, pl. xxi, figs. 3–3*g*.
1906. *Gonodactylus brevisquamatus*, Nobili, Ann. Sci. Nat. Zool. (9), IV, p. 331.

The rostrum is sharply trispinous as in the three preceding species ; the antero-lateral angles of the carapace are acute.

In the middle of the sixth somite there are two smooth and broad elevations, placed parallel to one another in the male, but posteriorly divergent in the female. The lateral margins are swollen, but scarcely carinate, and between them and the sub-median elevations there is on each side a narrow intermediate keel. There are no spines on the posterior margin.

The telson (figs. 115, 116) is broader than long, and at its distal end bears two pairs of large teeth, the submedians and intermediates. The former are separated by a large rounded emargination and are about twice the length of the latter; an angular incision, reaching to the same level as the median emargination, divides the submedians from the intermediates. There are no spinules on the inner edges of the submedian teeth. The lateral margins of the telson are evenly curved and there is no trace whatever of lateral teeth. In the middle of the dorsal surface there is a large, smoothly-rounded, oval elevation placed between a pair of narrower and less prominent keels. The base of the submedian spines is somewhat swollen and a ridge extends from near the anterior margin to the apex of the intermediate spines.

The peduncular segment of the uropods appears to resemble that of *G. herdmani*. The basal segment of the exopod projects far beyond the articulation of the ultimate segment. The proximal part of the outer margin is smooth (*fide* Nobili) or with a few small spines (*fide* Paulson's fig.), while at the distal end there are two or three stout spines which are very strongly recurved. The ultimate segment of the exopod is covered with setae over its entire surface; the endopod is similarly clothed[1] and is strongly curved outwards.

Through the help of my friend Dr. Calman I am able to reproduce two figures of this species from Paulson's very rare work.

[1] The setae on the surface of these segments are not shown in Paulson's figure.

G. brevisquamatus is known to reach a length of 23 mm. It appears to be exceedingly scarce and has as yet only been found in the Red Sea.

10. Gonodactylus fimbriatus, Lenz.

1905. *Gonodactylus fimbriatus*, Lenz, Abhandl. Senck. naturf. Ges. Frankfürt, XXVII, p. 388, pl. xlvii, fig. 11.
1907. *Gonodactylus fimbriatus*, Borradaile, Trans. Linn. Soc. Zool. (2), XII, p. 211.
1910. *Gonodactylus fimbriatus*, Lenz, in Voeltzkow's Reise in Ost-Afrika, II, p. 572.

Gonodactylus fimbriatus is very closely allied to *G. brevisquamatus*, and appears to be distinguished from it only by the following characters :—

1. Of the three pairs of longitudinal ridges on the last abdominal somite the submedians and intermediates are about equal in width, while those of the lateral pair are slightly narrower.
2. The marginal teeth of the telson are closely similar to those of *G. brevisquamatus*, but the intermediates are rather larger and there are spinules on the inner edge of the latter and on both edges of the submedian teeth.
3. In the middle of the dorsal surface of the telson there is a large oval prominence with a narrower lenticular keel pressed close against it on either side and between these, and the thickened lateral margin there are two other feeble longitudinal ridges. At the hinder end of the median boss there are three small tubercles and two other tubercles, homologous perhaps with those of *G. chiragra*, are found near the anterior margin. All the median dorsal ridges stop before reaching the posterior third of the telson, terminating well behind the base of the submedian emargination.

The uropods seem closely similar to those of *G. brevisquamatus*, but in the ventral process of the peduncular segment the inner spine is less than half the length of the outer, and is perhaps shorter than in that species. The basal segment of the exopod bears no spines on the anterior half of its external margin, but is furnished distally with three large recurved teeth. The endopod is flexed outwards and the margins, both of this segment and of the distal segment of the exopodite, appear to be fringed with setae as in *G. brevisquamatus*; their surfaces, however, according to Lenz's figure, are not clothed with hairs.

Gonodactylus fimbriatus reaches a length of 28 mm. and is recorded from Zanzibar (Lenz) and from Coetivy, Seychelles (Borradaile).

Since the above was written I have, thanks to the courtesy of the author, had an opportunity of seeing the manuscript of Mr. Patience's valuable account of the Stomatopoda collected by Messrs J. J. Simpson and R. N. Rudmose Brown in the Mergui Archipelago and in Ibo Archipelago in Portuguese East Africa. In this paper Mr. Patience gives, under the name *G. brevisquamatus*, a detailed account and figures of a specimen obtained at Mergui. *G. fimbriatus* is cited as a synonym and strong reasons for the adoption of this course are adduced. Inasmuch, however, as I have not been able to examine any specimens of this scarce species, I have preferred to let my notes stand in

their original form referring those interested in the question to Mr. Patience's full discussion.

11. **Gonodactylus furcicaudatus** (Miers).

1880. *Gonodactylus furcicaudatus*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 124, pl. iii, figs. 13–16.
1886. *Protosquilla* (?) *furcicaudatus*, Brooks, Voy. H.M.S. ' Challenger,' XVI, Stomatop., p. 78.
1907. *Gonodactylus furcicaudatus*, Nobili, Mem. Acc. Sci. Torino (2), LVII, p. 410, pl. ii, fig. 6.

The carapace is fully one and a half times as long as wide, and the anterior margins on either side of the rostrum are straight and trend a little forwards, so that the narrowly-rounded antero-lateral angles are in advance of the rostral base. The rostrum is trispinous, but the lateral spines are less slender than in *G. herdmani*, and the basal undivided part is considerably longer.

The mandibular palp is composed of two segments. There is no movable spine at the base of the raptorial propodus.

The sixth abdominal somite is somewhat similar to that of *G. brevisquamatus*. In the middle there are two large smooth prominences of no great height and nearly as broad as long, and on either side there is a short intermediate ridge and a smooth lateral swelling which is coterminous with the rectangular antero-lateral angles.

The form of the telson is extremely peculiar and consists of a broad and very thick anterior portion, abruptly truncate behind and with two long furci projecting from the middle of the lower edge of the truncate portion. The dorsal part is nearly four times as broad as long, strongly convex from side to side with its ridged lateral margins posteriorly divergent. An obscure tubercle is found on either side near the anterior end, and three feeble and partially confluent swellings may be detected near the hinder edge. The latter edge is nearly straight from side to side, but obscure median, intermediate and lateral lobes, separated by four very shallow emarginations, are shown. There are numerous stout spinules on this edge, disposed in an irregular fashion. Behind this margin the telson, which is of very considerable thickness is abruptly and vertically truncate and the truncate portion, seen from behind, presents a kidney-shaped outline and is hollowed and honey-combed in an extremely curious manner. From the inferior edge of this portion, and from its middle point, two stout furci arise which are longer than the rest of the telson. They are closely approximate at the base, but near the tips they diverge outwards ; a few very fine spinules are visible on their anterior margins.

The peduncular segment of the uropods terminates in a dorsal spine projecting over the base of the exopod and, of the two spines that form its ventral process, the inner is more slender than the outer and only about half its length. The ultimate segment of the exopod articulates with the basal segment at about the middle point of the latter. On the external margin of the basal segment there are five small straight spines in the anterior part, while at the distal end there are three stout recurved hooks. The ultimate segment of the exopod is clothed all over its dorsal surface with setae of two kinds. The central part, more particularly near the base, is beset with short club-

shaped hairs; the others, which occupy the rest of the surface, are long and slender. The endopod rises straight upwards from its articulation and having reached the upper level of the telson bends abruptly backwards in a right angle. It is a solid structure and is beset with setae like the last segment of the exopod. The setae on its upper surface form a dense brush.

Miers states that his largest specimen was about $29\frac{1}{2}$ mm. in length.

The only example in the collection is a co-type presented by the British Museum:—

$\frac{7225}{10}$ (Locality ?) British Museum (H.M.S. 'Herald'). 1 ♂, 24 mm.

The locality at which the type specimens were obtained is unfortunately unknown, and since the species was originally described it has only once been found: Nobili (1907) records a single small example from Matakea in Polynesia, N.E. of Tahiti.

12. **Gonodactylus pulchellus**, Miers.

Plate X, figs. 117, 118.

1880. *Gonodactylus trispinosus* var. *pulchellus*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 122.
1893. *Protosquilla trispinosa*, Henderson, Trans. Linn. Soc., Zool. (2), V, p. 455.
1894. *Gonodactylus trispinosus* var. *pulchella*, Ortmann, Denk. med.-wiss. Ges. Jena, VIII, p. 61.
1902. *Protosquilla trispinosa* var. *pulchella*, de Man, Abhandl. Senck. ges. Frankfürt, XXV, p. 920.
1906. *Gonodactylus trispinosus* var. *pulchellus*, Nobili, Ann. Sci. Nat. Zool. (9), IV, p. 326.
1906. *Protosquilla trispinosa* var. *pulchella*, Tattersall, Ceylon Pearl Oyster Rep., V, p. 173.

The carapace is a little longer than broad and its posterior margin is concave. The anterior margins on either side of the rostrum are also concave and do not protrude forwards; the subacute antero-lateral angles are consequently not in advance of the rostral base. The rostrum is trispinous and the sharp lateral spines are only a trifle stouter and shorter than the slender median one. The undivided basal part of the rostrum is short and wide, its length being much less than that of the median spine.

The dorsal processes of the ophthalmic somite can be clearly seen between the rostral spines. They consist of a plate, straight in front except for a narrow median incision, with sharp antero-lateral angles that project transversely outwards almost as far as the external edge of the basal part of the eyestalk. The eyes themselves are cylindrical and in length about one-third the median length of the carapace (a trifle longer in small specimens); the cornea is scarcely wider than the stalk and is set very obliquely on it. The eyestalks extend to a little beyond the second segment of the antennular peduncle.

The mandibular palp is composed of only two segments.

The basal part of the dactylus of the raptorial claw is strongly swollen, the distal portion is slender and slightly curved.

The lateral margins of the sixth thoracic somite are broadly rounded, those of the seventh truncate with rounded angles, those of the eighth subacute.

The median portions of the first five abdominal somites are entirely smooth except that each bears four minute and very obscure pits in a transverse line near the anterior margin, while three others, a central and a pair of lateral, may be found in the middle of each somite except the first. In all these five somites there is a well-defined ridge

on either side defining the lateral and antero-lateral margins, and on the second, third and fourth there are two broad and shallow lateral depressions between the thickened lateral edge and the feeble ridge that limits the smooth central portion of the somite. These two depressions are separated by a longitudinal elevation which is itself furrowed This sculpture is inconspicuous, but may be seen without much difficulty in specimens of good size, especially after the removal of all surface moisture. The fifth somite is strongly puckered and wrinkled laterally. The postero-lateral angles of all four somites are subacute, but not spinous.

The sixth abdominal somite is almost immovably articulated with the telson and the middle of its posterior margin is concave in dorsal view. It bears six oval bosses in a transverse row and the outermost, which is the longest (more a ridge than a boss), trends outwards to meet the external margin in a small postero-lateral spine. In most perfect specimens these elevations are clothed with short setae; the interspaces between them are coarsely and irregularly punctate.

The general form of the telson is shown in fig. 118. The median of the three dorsal bosses or elevations is somewhat triangular in shape while the submedians, which, though longer, reach only to about the middle of the telson, are more or less pyriform. The lateral margins of the telson and the surfaces of all three elevations are usually beset with short setae similar to those on the last abdominal somite, elsewhere the surface is coarsely reticulate. The distal margin is divided by seven fissures, cut right through the telson, into eight lobes. These fissures [1] are exceedingly narrow; they are widest proximally, but distally their margins are usually in contact. The median incision extends almost to the base of the central elevation; those on either side reach about half way to the lateral elevations. Each distal lobe of the telson comprises an outer subacute portion and an inner movable denticle. In addition there are numerous denticles on the margins of the median incision, and on the convex inner edges of the submedian lobes.

The process from the base of the uropods consists of two sharp teeth: the inner at least half the length of the outer. The two segments forming the exopod articulate normally with one another; the innermost bears nine movable spines on its external margin. The margins of the distal segment and of the endopod are uniformly beset with setae.

Miers regarded this form merely as a variety of *G. trispinosus*, and in this he has been followed by most subsequent writers; but, although I have not been able to compare the two, there is, I believe, little doubt that *G. pulchellus* is entitled to rank as a distinct species.

The colouring of fresh specimens is rather striking. The general tone is pale olivaceous brown due to a profuse marbling of warm olive brown on a pale ground. The whole surface is in addition sprinkled with very small black chromatophores. On the carapace there are faint indications of anterior and post-median dark transverse bands, while, on the post-abdomen, two pairs of dark spots on the sixth thoracic, and a dark median patch on the first abdominal somite are generally conspicuous. Median patches

[1] The fissures are best seen if the telson is examined from below.

are also sometimes found on the last two thoracic, and on the fourth and fifth abdominal somites. The marbling is on the whole very uniform in all the fresh specimens examined, but the distribution of the various patches of pigment is too complicated to admit of description. In some specimens the general tone of the colouring tends to a dull purple on the sixth somite and telson. The merus of the raptorial claw may have a vertical crimson streak near its distal end and the anterior parts of the propodus and swollen base of the dactylus are always white. The ventral surface is pale throughout except that the posterior half of the telson is suffused with brown.

There are in the Indian Museum specimens of *Gonodactylus pulchellus*, registered as follows :—

$\frac{7462\text{-}6}{10}$	N. Cheval Paar, Ceylon.	T. Southwell.	2 ♂, 2 ♀, 37–43 mm.
$\frac{8037}{10}$	Pearl Banks, Ceylon (from *Spongodes*).	T. Southwell.	3 ♂, 2 ♀, 26–37 mm.
$\frac{650}{10}$	Persian Gulf.	F. H. Townsend.	1 ♀, 25 mm.
$\frac{8427}{70}$	Portuguese E. Africa.[1]	J. J. Simpson.	1 ♀, 9 mm.

The species has been previously reported from Ceylon (Miers, Tattersall), Aden (Nobili) and Dar-es-Salaam (Ortmann). It is probable, too, that the examples which Henderson has recorded from Ceylon under the name of *Protosquilla trispinosa* are to be referred to this species for there is reason to believe that *G. trispinosus* does not extend as far west as India.

13. Gonodactylus nefandus, Kemp.

Plate X, figs. 119, 120.

1911. *Gonodactylus nefandus*, Kemp, Rec. Ind. Mus., VI, p. 93.

This species is very closely allied to the preceding, but may be separated from it without difficulty by the form of the rostrum, by the shape of the dorsal processes of the ophthalmic somite, and by the shallow incisions separating the distal lobes of the telson.

The distinctions between the two species are as follows :—

1. The antero-lateral angles of the carapace are rectangular and slightly rounded, not subacute, and the anterior margin on either side of the rostral base is straight.
2. The lateral spines of the rostrum are acute but very broad, forming a striking contrast with the very slender median spine; the undivided basal part is much longer than in *G. pulchellus*, its length being equal to that of the median spine.
3. The antero-lateral angles of the plate forming the dorsal process of the ophthalmic somite are rectangular and do not project outwards as in the preceding species. The eyes, moreover, are noticeably stouter and their length, in full-grown specimens, is considerably more than one-third the median length of the carapace.
4. The base of the raptorial claw is less strongly swollen and the distal part is rather stouter and a little less curved.

[1] I am indebted to Mr. Patience for this specimen.

5. The lateral margin of the sixth thoracic somite is more sharply rounded and that of the seventh is less clearly truncate.
6. The dorsal pits and lateral sculpture on the first five abdominal somites are wholly obsolete.
7. The boss-like elevations on the sixth somite and telson exhibit no trace of the clothing of setae found in the preceding species, and the rest of the surface shows only the feeblest indication of pitting and reticulation.
8. The three bosses on the telson are less elevated and are separated only by a shallow groove ; in consequence, they appear to be partially connected with one another anteriorly. The median fissure in the distal part is similar to that in *G. pulchellus* and is cut right through the telson ; but the margins touch one another throughout all, or almost all, their length. The four lobes on either side are separated by incisions that are much shallower than in the preceding species. On the dorsal surface they are continued forwards as grooves almost halfway to the base of the lateral bosses, but they are not cut right through the telson for this distance and are not widened proximally as in *G. pulchellus*.
9. The inner spine of the process from basal segment of the uropods is not more than half the length of the outer. The inner uropod is broader in proportion to its length, and the outer margin of the proximal segment of the exopod bears from ten to twelve movable spines.

No characteristic colouration can be found in spirit specimens.

The forty-seven specimens in the Indian Museum were found at the following localities :—

$\frac{3045}{5}$	Andamans.	J. Wood-Mason.	15 ♂ , 19 ♀ , 11–39 mm. TYPES.
$\frac{3040}{5}$	Andamans.	J. Wood-Mason.	1 ♀ , 32 mm.
$\frac{9025}{6}$	Andamans, 20 fathoms.	' Investigator.'	1 ♀ , 16 mm.
$\frac{2825\text{-}6}{7}$	Port Blair, Andamans.	G. H. Booley.	2 ♂ , 19 and 27 mm.
$\frac{2546}{3}$	Cheduba, Arakan Coast, 7 fathoms.	' Investigator.'	4 ♂ , 4 ♀ , 16–40 mm.
$\frac{1490}{7}$	Southern portion of Malacca Strs.	' Sherard Osburn.'	1 ♀ , 20 mm.

14. **Gonodactylus trispinosus,** Dana.

1847. *Gonodactylus trispinosus*, White, List Crust. Brit. Mus., p. 85 (*partim, nom. nud.*).
1852. *Gonodactylus trispinosus*, Dana,[1] U.S. Explor. Exped., Crust., p. 623.

[1] In this work Dana attributes the species to White, and cites as his authority pl. V of the Voyage of the ' Erebus ' and ' Terror,' a work that, in its completed form, was only issued twenty-four years subsequently (1874). In this volume, moreover, the text is written by Miers ; there are only four plates, and there is no account or figure of *G. trispinosus*. It seems, however, from Miers' introductory statement that the plates were issued under White's supervision many years previously, and copies must have been in Dana's possession when writing in 1852. Of the absence of plate V in the completed account, no explanation is forthcoming.

1865. *Gonodactylus trispinosus*, Heller, Reise ' Novara ' Exped., Crust., p. 126.
1876. *Gonodactylus trispinosus*, Miers, Cat. Crust. N. Zealand, p. 90.
1880. *Gonodactylus trispinosus*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 121, pl. iii, fig. 10 (*partim*).
1882. *Gonodactylus trispinosus*, Haswell, Cat. Australian Crust., p. 211.
1886. *Gonodactylus trispinosus*, Filhol, Miss., de l'île Campbell, III, 2e, p. 436.
1886. *Protosquilla trispinosa*, Brooks, Voy. H.M.S. ' Challenger,' XVI, Stomatop., p. 71.
1891. *Protosquilla trispinosa*, Chilton, Trans. N. Zealand Inst., XXIII, p. 61.
1893. *Gonodactylus trispinosus*, Pocock, Ann. Mag. Nat. Hist. (6), XI, p. 476.
1898. *Protosquilla trispinosa*, Borradaile, Proc. Zool. Soc., p. 33, pl. v, figs. 1, 1*a*.
1899. *Protosquilla trispinosa*, Borradaile, in Willey's Zool. Results, p. 400.

This species and *G. tuberosus* may be distinguished at a glance from the two preceding forms by the close and conspicuous corrugations in the middle of the fifth abdominal somite. In other respects *G. trispinosus* is very similar to *G. pulchellus*, from which, according to Borradaile's description and figures, it would seem to differ only in the following features :—

1. The antero-lateral angles of the carapace are not subacute, scarcely even rectangular.
2. The lateral margin of the last thoracic somite is broadly rounded.
3. The bosses on the last abdominal somite and telson are clothed with setae as in *G. pulchellus*, but the lateral pair on the telson are rather more broadly oval in outline. The telson is also rather more rounded at the apex than in the allied species, and the surface behind the elevations, in place of being reticulate, is marked with parallel impressed lines. The fissures in the distal margin do not appear to be widened proximally.

I have seen no examples of *Gonodactylus trispinosus*. It has been recorded from the Fiji Is. (Dana) ; Loyalty Is. (Borradaile) ; Auckland Is. (Heller) ; Swan R., W. Australia (Miers); and Baleine Bank, N.W. Australia (Pocock). Chilton considers Heller's record doubtful.

Hoffmann (1874, p. 43) includes *G. trispinosus* in a list of Stomatopods from Mauritius ; but Miers and Brooks both regard this record as untrustworthy and a consideration of the known geographical range of the species supports their view. Pocock notes, on Hansen's authority, that the two specimens from Sharks Bay which Miers referred to this species are in reality examples of Müller's *G. stoliurus*.

15. Gonodactylus tuberosus, Pocock.

1893. *Gonodactylus tuberosus* (? var. of *G. trispinosus*) Pocock, Ann. Mag. Nat. Hist. (6), XI, p. 476, pl. xx B, fig. 2.

This species [1] seems to bear much the same relation to *G. trispinosus* that *G. nefandus* does to *G. pulchellus*.

The rostrum is very similar to that of *G. nefandus*, but the lateral spines are even

[1] Pocock does not mention the median corrugations on the fifth abdominal somite, but from his remarks concerning the close resemblance of this species to *G. trispinosus* (specimens of which were before him at the time) the presence of this important character may be inferred.

stouter than in that species; the undivided basal part is as long as the median spine thus agreeing with *nefandus* and differing from *trispinosus* and *pulchellus*.

The form of the telson is somewhat different from that of any of the preceding species. In shape it is more or less square, but the submedian lobes project distally beyond the next pair, and so break the evenness of the posterior margin. The fissures separating the lobes are well-marked, and the outermost on each side is specially broad and deeply cut, widening distally. The dorsal bosses are higher than in the other species, more particularly the median one, and the laterals are round (not oval) in shape.

I have seen no examples of *Gonodactylus tuberosus*. The two known specimens were obtained on the Macclesfield Bank, China Seas, 37 fathoms (Pocock).

16. Gonodactylus glaber (Lenz).

Plate X, fig. 121.

1905. *Protosquilla glabra*, Lenz, Abhandl. Senck. naturf. Ges. Frankfürt, p. 388, pl. xlvii, fig. 13.
1910. *Protosquilla glabra*, Lenz, in Voeltzkow's Reise in Ost-Afrika, II, p. 572.

The carapace is fully one and a half times as long as wide, and is slightly broader behind than in front. The posterior margin is almost straight, and the anterior margins on either side of the rostral base slope slightly backwards and are feebly concave. The antero-lateral angles are rectangular in the small specimen, rather more acute in the larger individual. The rostrum is sharply trispinous. The median spine is slender and very long; it reaches almost to or beyond the middle of the eyestalks, and is fully twice as long as the undivided basal part. The lateral spines are only about half the length of the median, stouter and curved forwards.

The dorsal processes of the ophthalmic somite consist of a pair of plates which extend outwards almost to the external edge of the proximal part of the eyestalks; their anterior and postero-lateral margins are slightly convex and meet in a subacute point. The eyestalks are two-fifths the length of the carapace in the larger example, longer in the smaller individual; they reach to the end of the second segment of the antennular peduncle. The cornea is not noticeably wider than the stalk and is set obliquely on it. The mandibular palp is composed of two segments.

The dactylus of the raptorial claw is strongly swollen at the base and its external margin is notched posteriorly; the slender terminal part is curved inwards at the apex.

The lateral margins of the sixth and seventh thoracic somites are truncate with broadly rounded anterior and posterior angles. The first five abdominal somites are smooth dorsally, but show obscure traces of pitting similar to that noticed in *G. pulchellus*. Laterally there is a well-defined L-shaped ridge on each somite except the first, running parallel to the anterior and external edges. The fifth somite is obscurely furrowed longitudinally on either side of the smooth median portion. The sixth somite bear six eroded tubercles on its dorsal aspect, and the outermost of these, the longest and narrowest, meet the external margins in a blunt postero-lateral point.

The telson is a trifle wider than long and appears to be immovably connected with the preceding segment. Of the three mid-dorsal bosses the two outer ones are much longer than in any of the preceding species; they are pyriform in shape and terminate

in an evenly rounded apex before reaching the distal margin. The three lobes are connected with one another in the extreme anterior part of the telson and, in the larger specimen, the margins of the lateral pair are feebly corrugated. Along the lateral edge of the telson there is a prominent rounded ridge; this ridge is continued to the outermost tooth on the distal margin, and is obliquely grooved in its posterior third. In the centre of the distal margin there is a deep and very narrow fissure extending half-way to the median boss, and on either side of this the edge is inflated and so forms a pair of obscure ridges. Three stout teeth, separated by triangular notches are found in each half of the posterior margin. There are numerous submedian denticles and one on the inner aspect of each of the lateral teeth.

The inner spine of the bifurcate process of the uropod is extremely small, not more than one quarter the length of the large and broad outer one. There are eight movable spines on the external aspect of the basal segment of the outer uropod.

There can be little doubt that the two specimens on which the above description is based are correctly referred to *Gonodactylus glaber*. They differ, however, from Lenz's account in having the carapace and median rostral spine slightly longer proportionally. The keels on the lateral margins of the telson are not clearly shown in the original figure, and there is no mention of the proximal notch on the external margin of the raptorial dactylus.

Spirit specimens are pale or brownish in colour with scattered black chromatophores which tend to form bands or patches in the posterior part of the carapace, on the sixth and seventh thoracic and on the first, fourth and fifth abdominal somites.

The two examples of *Gonodactylus glaber* in the Indian Museum are registered thus :—

$\frac{2960}{7}$	Gt. Coco I., N. Andamans.	'Investigator.'	1 ♀, 26 mm.
$\frac{5805}{9}$	Gt. Coco I., N. Andamans.	'Investigator.'	1 ♀, 12 mm.

Previously known from Ceylon and Zanzibar (Lenz). The largest recorded specimen is 30 mm. in length.

17. Gonodactylus tanensis (Fukuda).

1911. *Protosquilla tanensis*, Fukuda, Annot. Zool. Japon., VII, p. 285, pl. xi, figs. 1, 2.

Of this species I have seen no specimens. It is, as Fukuda has remarked, closely allied to *G. glaber*, but may readily be distinguished from it by the sculpture of the last abdominal somite and telson.

In addition to the usual prominences, the last abdominal somite is "completely covered with irregularly-marked depressions." The telson bears three bosses, situated much as in *G. glaber*, but with larger interspaces. These interspaces are covered with irregular depressions and in Fukuda's figure look almost as if honeycombed. The median distal fissure and the lateral marginal lobes are nearly as in *G. glaber* and are provided with similar spinulation.

The inner spine of the bifurcate process of the uropods, though very much shorter than the outer, appears to be noticeably larger than in the allied species. There are only seven movable spines on the outer margin of the proximal segment of the exopodite.

Fukuda records a single male, 30·5 mm. in length, from Tanegashima, Osumi Province, Japan.

18. Gonodactylus stoliurus (Müller).

1880. *Gonodactylus trispinosus*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 121 (*partim*) and p. 460 (*fide* Pocock, 1893, p. 476).
1886. *Protosquilla stoliura*, Müller, Verhandl. naturf. Ges. Basal, VIII, p. 477, pl. iv, fig. 2.
1887. *Protosquilla stoliura*, de Man, Arch. f. Naturgesch., LIII, i, p. 576.
1894. *Protosquilla stoliura*, Zehntner, Rev. Suisse Zool., II, p. 213.
1894. *Gonodactylus stoliurus*, Ortmann, Denk. med.-wiss. Ges. Jena, VIII, p. 61.
1902. *Protosquilla stoliura*, Schenkel, Verhandl. naturf. Ges. Basel, XIII, p. 582.

The principal characters of this species seem to be as follows :—

The carapace is only very slightly longer than wide, with a concave posterior margin and rectangular, but rounded, antero-lateral angles. The rostrum bears three sharp spines ; the median one reaches only to the base of the eyestalks, while those of the lateral pair are slightly shorter.

The eyes are cylindrical and the cornea is not wider than the stalk. The inner edge of the raptorial dactylus is finely serrate, and the basal part is greatly inflated.

The first four abdominal somites are smooth dorsally, with blunt postero-lateral angles. The upper surface of the fifth is wrinkled and grooved in a symmetrical fashion. On the sixth somite there are six dorsal prominences, those of the median pair are rounded, the others eroded at the margins. The surface of the sixth somite and hinder part of the fifth is beset with numerous very small spinules.

The telson is distinctly broader than long and bears, as usual, three prominent rounded elevations on its dorsal surface. The median boss is triangular in shape, while those of the lateral pair are pyriform, rounded posteriorly, and reach to the distal third of the telson. On either side, between the lateral elevations and the thickened external margin, there is a well-marked rounded longitudinal ridge. On the distal margin there are eight broad triangular teeth ; between the two submedians there is a very narrow fissure extending forwards almost to the base of the median boss. The teeth on either side are separated by short notches and bear small spinules on their edges. In addition the whole surface of the telson is beset with spinules similar to those found on the two preceding somites.

The outer spine of the process from the base of the uropods is twice the length of the inner. The basal segment of the exopod bears ten or eleven spines on its external margin.

By the length of the lateral elevations on the telson, and by the very narrow median fissure in the middle of the distal margin, this species is easily distinguished from all species except *G. glaber* ; from the latter it may be separated at a glance by the wrinkling in the median part of the fifth abdominal somite, by the presence of four pairs of

teeth in place of three on the distal margin of the telson, and by the numerous spinules on the telson and last abdominal somite.

Schenkel (1902, p. 581) gives an account of the colouration.

I have seen no examples of *Gonodactylus stoliurus*. It has been recorded from Amboina (Müller, Ortmann, Zehntner and de Man) and from Makassar (Schenkel). Pocock (1893, p. 476) notes, on Hansen's authority, that the specimens from Sharks Bay, W. Australia, which Miers referred to *G. trispinosus*, are in reality examples of this species, and it is clear that the individual from Amboina, which Miers subsequently recorded under the same name (1880 (*b*), p. 640) also belongs to *G. stoliurus*. The largest known specimen is a male 61 mm. in length (Schenkel).

19. Gonodactylus ectypus (Müller).

1880. *Gonodactylus folinii*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 123 (*fide* Hansen, 1895, p. 90).
1886. *Protosquilla ectypus*, Müller, Verhandl. naturf. Ges. Basel, VIII, p. 476, pl. iv, fig. 1.

Gonodactylus ectypus, along with the succeeding species, *G. glyptocercus*, may be distinguished from all the preceding forms by the elongate shape of the two submedian bosses of the telson which extend throughout the whole length of the segment and terminate in a tooth on the distal margin.

In *G. ectypus* the antero-lateral angles of the carapace are subacute, and the median of the three spines on the rostrum reaches (according to Müller's figure) to about the middle of the eyes.

The first four abdominal segments are smooth dorsally, but on the sides of the fifth there are three pairs of oblique furrows which are posteriorly convergent. The sixth somite bears six dorsal tubercles, the outermost of which are flattened and thorny while the other four are rounded and convex.

The telson is a little longer than wide. The median of the three dorsal bosses is oval and smooth and is produced to a posterior point, while those of the lateral pair are also smooth, and in the posterior half of the carapace are regularly narrowed to a sharp tooth-like apex which extends beyond the distal margin. On either side of these eminences there are two ridges running parallel to the external margin, both of which terminate distally in teeth. The outer of these is better developed than the inner. In the middle of the distal margin two broadly-rounded submedian lobes are visible, separated by an incision that seems to be rather wider than in the preceding species; on either side are three teeth forming the terminations of the submedian bosses and of the lateral carinae already mentioned. The spinules usually found on the distal margin appear to be missing.

The outer spine of the ventral process of the uropod is much longer and broader than the inner.

Müller notes that large examples are dark brown in colour, while younger individuals are light yellowish grey with brown speckles.

There are no examples of *Gonodactylus ectypus* in the Indian Museum. Müller described the species from six specimens, the largest 3 cms. in length, from Trincomali Bay, Ceylon, and the only other recorded individual was found at Mauritius (Miers, *sub G. folinii*, *fide* Hansen).

20. Gonodactylus glyptocercus, Wood-Mason.

1875. *Gonodactylus glyptocercus*, Wood-Mason, Proc. As. Soc. Bengal, p. 232; reprinted in Ann Mag. Nat. Hist. (4), XVII, p. 263 (1876).
1880. *Gonodactylus glyptocercus*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 122.
1886. *Protosquilla cerebralis*, Brooks, Voy. H.M.S. 'Challenger,' XVI, Stomatop., p. 72, pl. xiv, figs. 2, 3; pl. xvi, figs. 2, 3.
1886. *Protosquilla glyptocerca*, Brooks, *ibid.*, p. 75.
1887. *Protosquilla cerebralis*, de Man, Arch. f. Naturgesch., LIII, i, p. 575.
1898. *Protosquilla cerebralis*, Borradaile, Proc. Zool. Soc., p. 33, pl. v, fig. 6*a*.
1899. *Protosquilla cerebralis*, Borradaile, in Willey's Zool. Results, p. 399.
1902. *Protosquilla cerebralis*, de Man, Abhandl. Senck. Ges. Frankfürt, XXV, p. 921.
1910. *Protosquilla cerebralis*, Fukuda, Annot. Zool. Japon., VII, p. 139.

Gonodactylus glyptocercus is readily distinguished from its ally *G. ectypus* by the peculiar sculpture on the telson and last two abdominal somites.

The length of the carapace in the median line is more than one and a half times its breadth at the subacute, but rounded, antero-lateral angles. The posterior margin is slightly concave as are also the anterior edges on either side of the rostral base. The rostrum is sharply trispinous. The median spine reaches to half the length of the eyestalks, is fully three times as long as the basal undivided part, and is longer and more slender than the forwardly curved lateral spines.

The dorsal processes of the ophthalmic somite are similar in shape to those of *G. glaber*. The eyes are cylindrical; in large examples they are about one third the median length of the carapace and reach a little beyond the middle of the second segment of the antennular peduncle. In dorso-lateral view the cornea is set almost transversely on the stalk.

The mandibular palp is composed of two segments.

The basal part of the dactylus of the raptorial claw is strongly swollen; the external margin is notched (sometimes very obscurely) in its proximal portion and the inner edge is microscopically serrate. The lateral margins of the sixth and seventh thoracic somites are rounded, the latter rather more broadly than the former.

Except for the customary lateral L-shaped marginal ridge the first four abdominal somites are entirely smooth. The postero-lateral angles of the first two are rounded, those of the third slightly more pointed, those of the fourth subacute. The dorsal surface of the fifth somite is characteristically grooved. The grooves are very fine and separated by broad and flat longitudinal ridges; in large examples there are about twenty-four in a transverse series, but a few of these bifurcate before reaching the posterior margin. On either side of the middle line the grooves are parallel, but laterally they run obliquely inwards and backwards. The postero-lateral angles are bluntly pointed.

On the sixth somite the customary elevations are obscure, and the whole surface is finely grooved in a complicated, but symmetrical pattern, the details of which are well shown in the figure given by Brooks (*sub P. cerebralis*). A peculiar ∩-shaped ridge on either side near the anterior margin is perhaps worthy of special mention. The postero-lateral angles are rounded.

The telson is considerably broader than long. The median elevation is low, somewhat triangular in shape, and is continued to the posterior margin as a pair of blunt ridges. The submedian elevations are oval and extend posteriorly to the extreme distal edge where each terminates in a small submedian tooth. These three elevations are bounded by furrows and their margins are characteristically incised by numerous grooves running towards the centre of each. Along the lateral edges of the telson there are four blunt ridges; the innermost projects as an intermediate tooth on the distal margin, while the three others are united posteriorly to form a lateral tooth. The median fissure is well-marked; it is cut right through the telson for nearly half its distal length and is continued forwards on the dorsal surface as a deep groove. The convex margins between the submedian teeth bear a series of spinules, the outermost of which is larger than the rest, and there is in addition a small spinule on the inner aspect of each of the two lateral teeth.

The inner spine of the process from the base of the uropods is more than half the length of the outer, and the proximal segment of the exopod bears eight to ten movable spines on its external edge.

In small specimens, up to 12 mm. in length, the grooves on the last two abdominal somites are imperfectly developed, but the characteristic sculpture is found on the telson.

Comparison of Brooks' figures of *Protosquilla cerebralis* with Wood-Mason's type of *G. glyptocercus* leaves no doubt that the two forms are synonymous, as de Man has already suggested. The Indian specimens, however, differ from the figures in the 'Challenger' report in the particulars mentioned by Fukuda.

The dorsal surface of many preserved specimens is closely mottled with dark pigment except on the last abdominal somite and telson. Other specimens are pale with four dark spots on the sixth thoracic somite and dark median patches on the seventh thoracic and first and fourth abdominal somites.

There are sixteen specimens in the Indian Museum, registered as follows:—

$\frac{3058}{5}$	Nicobars.	S. Kurz.	1 ♀, 25 mm. TYPE.
$\frac{2953}{7}$ $\frac{5806-17}{9}$	Gt. Coco I., N. Andamans.	'Investigator.'	6 ♂, 8 ♀, 10·5–29 mm.
$\frac{7700}{6}$	Kabusa Is., Mergui Archipelago.	'Investigator.'	1 ♀, 21 mm.

Gonodactylus glyptocercus has also been recorded from the Fiji Is. (Brooks); Rotuma, the Loyalty Is. and New Britain (Borradaile); the Ogasawara Is. (Fukuda); Ternate (de Man) and Pulo Edam, near Java (de Man).

21. **Gonodactylus excavatus,** Miers.

Plate X, figs. 122, 123.

1880. *Gonodactylus excavatus*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 123, pl. iii, figs. 11, 12.
1886. *Protosquilla excavata*, Brooks, Voy. H.M.S. 'Challenger,' XVI, Stomatop., p. 78.
1893. *Gonodactylus excavatus*, Pocock, Ann. Mag. Nat. Hist. (6), XI, p. 476.

This species along with the four following is easily distinguished from the others in the section (*i.e.* species 12–20) by the very wide median excavation in the distal margin of the telson.

The carapace is broader behind than in front and, at its narrowest, is about two-thirds the median length. The posterior margin and the anterior margins on either side of the rostral base are slightly concave; the antero-lateral angles are produced and subacute. The rostrum is sharply trispinous; the median spine reaches as far as the corneal portion of the eyes; those of the lateral pair are much shorter and rather stouter. The basal part of the rostrum is extremely short, little if at all longer than one quarter the length of the median spine.

The dorsal processes of the ophthalmic somite have much the same form as in *G. glaber*. The eyes reach to about the middle of the second segment of the antennular peduncle; they measure one-third the median length of the carapace in large specimens, but are longer in small examples. They differ from those of the preceding species in being distinctly flattened and the cornea, seen in dorso-lateral view, is set transversely on the stalk. The mandibular palp is composed of two segments.

The basal part of the dactylus of the raptorial claw is greatly inflated and its external margin is notched proximally, as in *G. glaber*.

The margins of the sixth and seventh thoracic somites are truncate with rounded anterior and posterior angles. The median portions of the first five abdominal somites are entirely smooth, but each possesses laterally the L-shaped ridge noticed in the preceding species; the postero-lateral angles of the first three are rounded, those of the fourth subacute, while those of the fifth are strongly produced and spinous. In the fifth there is a rather deep furrow on either side which runs to the extreme distal edge of the somite, external to a small rounded lobe on the posterior margin. The sixth somite bears three pairs of smooth elevations; the innermost are the shortest, those of the intermediate pair are constricted in the middle, while the outermost, which are the longest, meet the external margin in an obtuse postero-lateral angle.

The telson is about as long as wide. The three mid-dorsal bosses are similar to those of *G. glaber*, but the median one is longer and is entirely separated by grooves from the two laterals. The outline of these prominences is not even: the edges of each are furrowed and eroded. As in the preceding species there is a strong rounded keel running along the lateral margins. Distally there is a wide and deep triangular excavation, which bears on its edges numerous (about twelve) small denticles. This excavation forms a sharp contrast with the very narrow median fissure found in the preceding species. On either side of this gap there are two small tooth-like lobes, the inner more acute than the outer, and between each pair of lobes there are one or two small denticles.

The inner spine of the bifurcate process of the uropod is more than half the length of the outer, and on the external margin of the basal segment of the exopod there is a series of nine to eleven movable spines.

A few of the specimens are, in spirit, densely mottled with dark pigment on the carapace and first five abdominal segments; the other examples are faintly speckled or colourless.

The fourteen examples of this species in the Indian Museum were obtained at the following localities :—

$\frac{9177}{6}$	Off Andaman Is., 20 fathoms.	'Investigator.'	2 ♂, 4 ♀, 11·5–18 mm.
$\frac{9850-3}{6}$	Off Little Andaman I., 10½ fathoms.	'Investigator.'	1 ♂, 3 ♀, 16–26 mm.
$\frac{9846-9}{6}$	Off Table I., Coco group, Andamans, 9½ fms.	'Investigator.'	1 ♂, 3 ♀, 13–16·5 mm.

The locality of Miers' type specimen of *Gonodactylus excavatus* is unknown. The only other example which has hitherto been recorded was found on the Macclesfield Bank, China Seas, in 24 fathoms (Pocock).

[Gonodactylus folini, A. Milne-Edwards.]

1868. *Gonodactylus folinii*, A. Milne-Edwards, Nouv. Arch. Mus. Hist. Nat., IV, p. 65, pl. xviii, figs. 8–11.
1886. *Protosquilla folinii*, Brooks, Voy. H.M.S. 'Challenger,' XVI, Stomatop., p. 70.
1886. *Protosquilla elongata*, Brooks, *ibid.*, p. 67, pl. xv, figs. 2, 12; pl. xvi, fig. 4.
1895. *Gonodactylus folinii*, Hansen, Isop., Cumac. u. Stomatop. Plankton-Exped., p. 86.

Gonodactylus folini is known only from the Atlantic, in the vicinity of the Cape Verde Is. Hansen has re-examined the specimen which Miers (1880 (*a*), p. 123) recorded from Mauritius and remarks that it is in reality an example of *Gonodactylus ectypus*, Müller. The species has in consequence no place in a list of Indo-pacific species.

G. folini is allied to *G. excavatus*, but the distal excavation of the telson is not so deep and bears setae, but no denticles, on its edges. Moreover, the two apical teeth, which are found in the preceding species on either side of the excavation, are replaced in the Atlantic form by three blunt lobes.

22. Gonodactylus brooksi (de Man).

1887. *Protosquilla brooksii*, de Man, Arch. f. Naturgesch., LIII, i, p. 579, pl. xxii *a*, fig. 8.
1910. *Protosquilla brooksii*, Fukuda, Annot. Zool. Japon., VII, p. 140, pl. iv, figs. 1, 1*a*.

In the possession of a wide and deep median excavation in the distal margin of the telson *G. brooksi* and the three succeeding species resemble *G. excavatus* and *folini*; they are, however, readily distinguished by the presence of stout spinules or long spines on the dorsal aspect of the telson.

The carapace, in *G. brooksi*, is a little longer than broad; it is rather wider behind than in front, and the antero-lateral angles are rectangularly rounded. The median of the three rostral spines is very long, reaching to or beyond the anterior extremity of the eyes, while those of the lateral pair are much shorter, and extend obliquely forwards to the base of the eyestalks. The proximal undivided portion of the rostrum is exceedingly stout. The eyes are slightly flattened dorso-ventrally; the cornea is a little wider than the stalk, and is set transversely on it.

The first four abdominal somites are laterally carinate as in the preceding species, but are quite smooth dorsally. The postero-lateral angles of the first three segments are rectangularly rounded; those of the fourth are pointed, while those of the fifth are sharply spinous. The median portion of the fifth somite is smooth in front, but posteriorly bears four longitudinal depressions, often constricted in the middle, and evidently

very variable in form. The lateral portions are grooved longitudinally throughout the length of the somite. On the sixth somite there are four large tubercles placed in a transverse series. In de Man's type specimen those of the submedian pair bear each two stout spinules, but ten were observed by Fukuda in a larger example from the Japanese coast. The lateral tubercles, which may also bear a varying number of spinules, are sometimes broken up into a number of smaller eminences. Numerous stout spinules also occur between these and the lateral edges, and in the Japanese example several small spinules are found on the anterior margin.

The telson is about as long as wide and the deep median excavation extends to almost half its entire length. It bears three median bosses: the median being triangular and pointed behind, the lateral pyriform, posteriorly rounded and not reaching the distal margin. The surface of the telson, like that of the sixth somite, is beset with numerous spinules, but their precise number seems subject to much variation. The median boss bears nine in the type specimen, while on those of the lateral pair there are ten. In Fukuda's specimen there are on the contrary about thirty on each of the bosses. The lateral margin is armed with six to fourteen spinules, and there may be as many as twenty others between this edge and the lateral dorsal bosses. On the margins of the large distal excavation there are six to twelve pairs of spinules.

There is a stout spinule at the proximal end of the basal segment of the uropods and the inner spine of the broad ventral bifurcate process is about half the length of the outer. The inner segment of the exopod bears ten movable spines on its external margin.

The variation in the number of spinules in this species is very remarkable. It may be shown eventually that Fukuda's example deserves varietal recognition; but, inasmuch as only three specimens are yet known, it is impossible at present to reach any definite conclusion.

De Man notes the presence of bright green colouration on the tubercles of the last two segments, but Fukuda did not find this in the specimen which he records, and examined when living.

There are no examples of *Gonodactylus brooksi* in the Indian Museum. The two type specimens, the largest 28 mm. in length, were found at Pulo Edam, Java (de Man), while Fukuda's specimen, 39·5 mm., was found in Tateyama Bay, Awa, Japan.

23. Gonodactylus hystrix (Nobili).

1899. *Protosquilla hystrix*, Nobili, Ann. Mus. Civ. Genova (2), XX, p. 276.

This species, which has not been figured, is evidently very closely allied to *G. brooksi*. According to the published account it differs from the latter in having fifteen carinae on the fifth abdominal somite (including the two marginal), the seven median being limited to its posterior half. The sixth somite is covered with small spinules with recurved points, directed backwards, and arranged in three regular series. The telson is beset with spinules of a similar character, and the three dorsal bosses are of a circular shape.

Nobili records a single specimen, 15 mm. in length, from Beagle Bay, British New Guinea.

24. Gonodactylus spinosissimus, Pfeffer.

Plate X, figs. 124, 125.

1888. *Gonodactylus spinosissimus*, Pfeffer, Mitth. naturh. Mus. Hamburg, VI, 4, p. 35.
1894. *Gonodactylus spinosissimus*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 493.
1906. *Gonodactylus spinosissimus*, Nobili, Ann. Sci. Nat. Zool. (9), IV, p. 326.
1906. *Protosquilla spinosissima*, Tattersall, Ceylon Pearl Oyster Rep., V, p. 173, pl. ii, fig. 19.

The carapace is widest posteriorly and is a little longer than its greatest breadth. Its posterior margin and the anterior edges on either side of the rostral base are concave. The antero-lateral angles are subacute. The rostrum is sharply trispinous; the median spine is more than three times as long as the proximal undivided part and extends to the cornea of the eyes; the outer spines are much shorter and reach a little beyond the base of the stalk.

The dorsal processes of the ophthalmic somite are clearly visible between the rostral spines and resemble those of *G. pulchellus*, their acute antero-lateral angles extending outwards almost to the external margin of the eyestalk. The eyes are flattened; the cornea is wider than the stalk, distinctly bilobed, and the corneal and peduncular axes are a little oblique.

The mandibular palp is composed of two segments. The basal part of the raptorial dactylus is very strongly swollen and its external margin is feebly notched proximally.

The lateral margins of the sixth and seventh thoracic somites are truncately rounded, the former more broadly than the latter. Except for the customary antero-lateral carinae, the first four abdominal somites are smooth. The postero-lateral angles of the first three are rounded, those of the fourth rounded or subacute, those of the fifth sharply spinous. The fifth somite is smooth in the middle, but bears three or four longitudinal carinae on either side separated by furrows.

The sixth somite is fused with the telson.[1] It bears four large rounded tubercles, a pair of submedians and a pair of laterals, the former situated well in advance of the latter. All four tubercles are beset with long and slender spines and in addition there is a row of similar spines along the anterior and lateral margins and numerous others in the vicinity of the lateral tubercles.

The telson excluding the spines on the edges is almost as broad as long. The lateral margins are only very slightly convex. The wide and deep median distal emargination is conspicuous, and the apices on either side are composed of two subequal lobes separated by a wide notch. The inner of these lobes is narrower than the outer and terminates in a stout spine with a movable spinule on its inner aspect. On the dorsal surface there are three rounded bosses. The median is nearly circular, while the two forming the lateral pair are slightly oval and are situated much further backwards. All three tubercles bear long and slender spines similar to those on the preceding segment, and in addition, others are found investing all the margins and the surface near the tubercles. Those situated between the tubercles and the spinous lateral margin are arranged on either side in two regular longitudinal rows.

[1] More completely so than in any other species examined.

The basal segment of the uropods bears one or two sharp spines on its dorsal surface at the proximal end, and the inner spine of its ventral process is fully two-thirds the length of the outer. There are nine to eleven movable spines on the external edge of the basal segment of the exopodite.

The colouring of living specimens is rather constant. The whole dorsal surface of the carapace and abdomen is densely maculated with dark brown tending to red or purplish red at the anterior margin of each post-abdominal segment and especially well-defined on the fourth and fifth abdominal somites. There is a pale transverse band a little behind the middle of the carapace and, frequently, a large subquadrate pale patch on the last thoracic and third abdominal somites close to the posterior margin. The sixth abdominal somite and telson, with their investing spines, are red or dull purplish red, the boss-like prominences usually paler. The antennular flagella are orange yellow; the eyes black with mottled brown stalks. The merus of the raptorial claw is pale or mottled with brown and the dactylus is suffused with red.

The specimens in the Indian Museum are registered as follows :—

$\frac{7191\text{-}6}{10}$	N. Cheval Paar, Ceylon.	T. Southwell.	6 ♂ , 10 ♀ , 12–34 mm.
$\frac{7221}{10}$	Ceylon.	*ex* coll. Herdman.	1 ♀ , 28 mm.
$\frac{8039}{10}$	Pearl Banks, Ceylon (from *Spongodes*).	T. Southwell.	1 ♂ , 25 mm.

Gonodactylus spinosissimus has been recorded from several localities in the neighbourhood of Ceylon (Tattersall), from the Red Sea (Nobili), and from Zanzibar (Pfeffer). It is usually found in shallow water, but Tattersall records it from 45-50 fms. on Muttuvaratu Paar.

25. Gonodactylus guerini, White.

1861. *Gonodactylus guerinii*, White, Proc. Zool. Soc., p. 43, pl. vii, and Ann. Mag. Nat. Hist. (3), VII, p. 480.

1880. *Gonodactylus guerinii*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 121.

1886. *Protosquilla guerinii*, Brooks, Voy. H.M.S. 'Challenger,' XVI, Stomatop., p. 75, pl. xvi, figs. 1, 6.

This peculiar species, which is not represented in the Indian Museum, is perhaps distantly related to *G. spinosissimus*. According to Brooks' excellent description it may be distinguished by the following characters :—

1. The antero-lateral angles of the carapace are broadly rounded.
2. The median spine of the rostrum is a little shorter, and the basal undivided part is, according to Brooks' figure, considerably longer.
3. The first four abdominal somites have a small sharply defined indentation on each side at about one-third the distance from the lateral edge to the middle.
4. The posterior part of the fifth abdominal somite bears six transverse rows of short spines, and is separated from the smooth anterior part by a curved transverse line.
5. The sixth abdominal somite is armed with very numerous long cylindrical spines each of which ends in a blunt rounded tip from which a soft tubular fleshy process protrudes. The customary tubercles appear to be absent.

6. The telson is covered with regularly arranged spines with fleshy appendages similar to those on the preceding segment, twenty-two of the largest occupying the median area. The customary tubercles are again absent. On the distal margin there are four long spine-like processes which bear secondary spines on their edges. These processes are separated by three deep subequal notches which, though much wider than the narrow fissures found in *G. pulchellus* and its allies, are nevertheless parallel-sided: the median fissure does not take the form of a wide gap or emargination as in the five preceding species.
7. The inner uropod bears five immovable spines placed in a longitudinal row on its dorsal surface.

The function of the curious fleshy processes on the tips of the spines of the last two segments is wholly unknown, and in their possession the species is unique among Stomatopoda.

Brooks notes that his spirit specimen was brown with a pale transverse band on the carapace.

Only two examples of *Gonodactylus guerini* are known. The type, a male 57 mm. in length, was found by H.M.S. ' Herald ' at the Fiji Is. (White, Miers); the second example, a female 28·5 mm. in length, was obtained by H.M.S. ' Challenger ' at Honolulu (Brooks).

26. Gonodactylus acanthurus, Tattersall.

1906. *Gonodactylus acanthurus*, Tattersall, Ceylon Pearl Oyster Rep., V, p. 171, pl. i, figs. 11-15.
1907. *Gonodactylus acanthurus*, Borradaile, Trans. Linn. Soc. Zool. (2), XII, p. 210.

The carapace is about one and a third times as long as broad; its anterior margin trends forwards on either side of the rostrum, so that the subacute antero-lateral angles are in advance of the rostral base. The rostrum is trispinous; the median spine is long and reaches almost or quite to the middle of the eyestalks, while the laterals are decidedly shorter than in most species of the preceding group, and fail to reach the base of the eyestalks. The cornea of the eye is narrower than the stalk and is set very obliquely on it. The antennular peduncle is extremely short and is exceeded in length by the eyestalks.

The mandibular palp is entirely absent.

There is a long movable spine at the proximal end of the raptorial propodus on its upper margin, and the external edge of the dactylus is feebly notched at the base.

The last three thoracic somites have the usual form, and the first five segments of the abdomen are entirely smooth except for the customary ridge along the lateral and antero-lateral margins and for a few microscopic pits on the dorsal surface. The postero-lateral angles of the first four are rounded, those of the fifth subacute.

The posterior margin of the sixth somite is almost straight in dorsal view and bears six smooth longitudinal ridges; the submedians are swollen, both higher and broader than the intermediates and the laterals are co-terminous with the spinous postero-lateral angles. The submedian and intermediate ridges do not terminate in spines.

The length of the telson, including the terminal spines, is less than its greatest breadth. The submedian, intermediate and marginal teeth are represented by long and slender spines placed almost in a transverse row on the distal edge. The submedians have movable tips and a series of slender denticles on their inner margins; there are two similar denticles between the submedians and intermediates and one between the intermediates and laterals. In the middle of the dorsal surface are three oval bosses, the median slightly the broadest. They are smooth anteriorly; but posteriorly bear a varying number of spinules and short spines. There are also between these bosses and the posterior margin two transverse rows of five spines. The spines at the ends of the bosses are the shortest and those on the distal margin the longest; those of the intervening rows are intermediate in length. In the largest specimen in the Indian Museum the spines are rather more numerous than in the type specimen figured by Tattersall.

The ventral process of the peduncular segment of the uropods is split into two long spines, the inner a little shorter and more slender than the outer. The proximal segment of the exopod projects a little beyond the insertion of the ultimate segment and bears eight or nine movable spines on its external edge. The endopod and small ultimate segment of the exopod bear setae on their outer margins only. The inner margin of the former segment bears from four to six flat and acute spines, while three or four similar spines are found on the same margin of the latter segment.

The colouring of fresh specimens is variable. Two examples were quite pale in general tone, while a third was bright brick red, faintly mottled with pale dull yellow. The patches of black chromatophores which Tattersall has mentioned on the sixth thoracic and first abdominal somites were conspicuous, and on the former segment there were in addition a pair of lateral patches. The last somite and telson were beautifully marbled with olive green in the pale specimens, and with dark red in the red example, but the two median ridges on the last abdominal somite were pure white. On the merus of each raptorial claw there was a dorsal black spot.

This peculiar species appears to be one of the smallest known Stomatopoda. The largest example in the Indian Museum is a trifle longer than either of Tattersall's type specimens.

$\frac{7502-4}{10}$ N. Cheval Paar, Ceylon, 5 fms. T. Southwell. 3 ♀, 10–11·5 mm.

G. acanthurus was hitherto known only from two specimens found in 45–50 fathoms at Muttuvaratu Paar, Ceylon (Tattersall).

ADDENDUM.

Since the preceding report has been in press I have had an opportunity of visiting Kilakarai and Pamban in the Ramnad District, S. India. During the first half of the tour I was fortunate in being accompanied by Dr. J. R. Henderson, Superintendent of the Madras Museum: it was in localities at no great distance from those that we visited that Dr. Henderson, some twenty-four years ago, made a great part of the extensive collections of Crustacea which he subsequently described in the Transactions of the Linnean Society (1893) under the title "A Contribution to Indian Carcinology."

The fauna of the district seems to be one of almost inexhaustible richness and during the comparatively short period in which we were collecting, we succeeded in obtaining nine species of Stomatopoda, including several scarce forms; we were also able to make a few interesting observations on the habits of *Gonodactylus*.

Squilla quinquedentata, Brooks. [p. 52.]

Judging by the number of specimens hitherto found in Indian waters this species appears to be very scarce, but three large individuals, two males and one female, ranging from 117 to 125 mm. in length, were obtained from the fishermen at Kilakarai.

The specimens differ in a few unimportant details from those previously described. In two examples the anterior bifurcated portion of the median carina of the carapace is distinct, but interrupted and non-existent at its proximal end as in *Squilla interrupta* and in *S. oratoria* var. *perpensa*. In all the specimens the anterior margin of the ophthalmic somite is feebly emarginate and the posterior lobe of the fifth thoracic somite is acute. The lateral carinae of all the abdominal somites end in spines, the intermediate teeth of the telson are only very slightly inturned and there are four submedian denticles, eight or nine intermediate and one lateral. The colouration of the living specimens was not distinctive, the dark patches noticed in the previously recorded examples at either end of the median carina of the telson being indistinguishable.

Squilla nepa, Latreille. [p. 60.]

Found in abundance by the fishermen at Kilakarai. The largest specimen seen was a female 134 mm. in length; small individuals, including one only 21 mm. in length, were caught among weeds close to the shore.

Squilla holoschista, Wood-Mason, MS. [p. 64.]

Not uncommon in fishermen's nets.

Squilla oratoria var. **perpensa**, Kemp. [p. 70.]

A few specimens of no great size were brought in by the fishermen at Kilakarai, and a very youngle example, 21 mm. in length, was found among weeds near the shore.

Squilla multicarinata, White. [p. 86.]

A magnificent example of this scarce and finely sculptured species, a male measuring 82 mm., was brought in by a fisherman during our stay at Kilakarai. The dusky patches noticed on the second and fifth abdominal somites are not visible in this specimen, but in every other respect it agrees precisely with the examples in the Indian Museum from Hongkong.

Squilla multicarinata has not hitherto been recorded west of Burma.

Pseudosquilla ciliata (Fabricius). [p. 96.]

A large male, 82 mm. in length, was brought to us by a fisherman at Kilakarai. The specimen was bright olive green in life with the fringes of the antennal scale and uropods crimson.

Lysiosquilla acanthocarpus, Miers. [p. 120.]

A living specimen of this uncommon species, a female 56 mm. in length, was discovered at low water on the beach at Kilakarai. The spot where it was found was one that we habitually passed, but though careful watch was kept no further specimens were obtained. A dredge was shot several times a short distance from shore and dragged to land, but this too proved unsuccessful.

Placed in a shallow dish with a little water the specimen gave an interesting demonstration of the ease with which the species of this genus can reverse their position in a narrow burrow. When laid on its back it would rapidly assume a normal posture by turning its anterior extremity upwards and backwards and creeping along its own body. Such an action would be impossible in the case of more firmly segmented species such as those of the genera *Squilla*, *Pseudosquilla* and *Gonodactylus* and there can be little doubt that it is among the species of *Lysiosquilla* that the highest degree of specialization for life in burrows is to be found.

When picked up, the specimen attacked the fingers of its captor with both ends of its body simultaneously, striking out vigorously with its raptorial claws and at the same time endeavouring to make wounds with the spinous armature on its telson and uropods.

Its colour did not differ very much from that of specimens preserved for many years in alcohol. The rostrum, eye-peduncles, and the basal segments of the antennules and antennae were mottled with russet brown, black and pure white. The proximal part of the antennal scale was white. The dark bands on the free thoracic somites and abdomen were blackish grey, separated by ivory white. On the telson the black colouring was much more intense than elsewhere and the three pale streaks that invade the black patch proximally were pale lemon yellow. Seen from below the animal was semi-transparent.

The fishermen spoke of a large species with similar colouring, doubtless *Lysiosquilla maculata*; no specimens, however, could be obtained.

Gonodactylus glabrous, Brooks. [p. 167.]

The species occurred in profusion on coral reefs both at Kilakarai and Pamban, and at the latter place was also obtained on reefs exposed at low tide. The specimens were, for the most part, found in crevices and holes in coral blocks and in these situations examples of all sizes (from 7·5 mm. in length and upwards) were obtained. Very small individuals were also caught by dragging a fine-meshed net through the *Zostera* and other weeds which flourished inside the reef in water not more than one or two feet deep.

In specimens 7·5 mm. in length only the median carina of the telson is distinguishable, but in examples only 1 mm. longer all five are developed. Among the various forms which the telson may assume in *Gonodactylus chiragra*, form A (=*incipiens*) most nearly resembles *G. glabrous*, and according to Lanchester this form constitutes a true connecting link between the two species. It is therefore noteworthy that no specimen was found on this occasion that can be referred to the variety and that even at a very early age (specimens 8–9 mm. in length) the distinctions between *G. glabrous* and *G. chiragra* form H are well-marked. In all *G. glabrous* exceeding 7·5 mm. in length five carinae are developed, and of these five the submedians are invariably longer than those of the pair external to them.

Many females with egg-masses were found and this observation is one of some interest seeing that it does not appear to have been made hitherto in Indo-pacific waters. The females were found in the coral-masses in holes that appeared to have been made originally by *Lithodomus* or some other rock-boring mollusc, the eggs, which were of a bright greenish-yellow colour, lying at the bottom of the burrow in a loosely-compacted discoidal mass. When disturbed the female rapidly gathered the eggs into a ball and, holding them with her thoracic appendages, rushed wildly to and fro seeking concealment or escape. Even the shock of sudden immersion in alcohol was not always sufficient to induce the mother to lay aside her parental responsibilities. The egg-masses varied, according to the size of the female, from 8 to 14 mm. in diameter, individual ova measuring from ·7 to ·85 mm.

The habits of the species appear to be closely similar to those of *G. oerstedi*, observed by Brooks in the Bahamas; but whereas the latter species is said to construct burrows for itself in solid coral, *G. glabrous* seems merely to inhabit those made by other animals.[1] In order to tunnel in hard rock an animal must needs be highly specialized and consideration of the very close uniformity in structure in *G. glabrous* and *G. oerstedi* leads one to believe that adaptation for such a purpose, if present in one form, would certainly be present in the other. Although Brooks never saw specimens engaged in tunnelling he had no doubt that the species actually made its

[1] Specimens were never found in new and clean-cut burrows, but only in those eroded and overgrown with encrusting organisms.

burrows itself and his observations are, as a rule, so accurate that one hesitates to suggest that he may in this instance have been misled.

The source of the noise made by the species of *Gonodactylus* seems never to have been adequately described. In the case of *G. glabrous* and *G. demani*, and doubtless with other species of the genus also, it is caused by the raptorial claws when these limbs are used for offensive or defensive purposes. When a living specimen is seized the distal end of the raptorial propodus is fitted into the socket hollowed in the merus for its reception, and while still lodged in this socket muscular effort is brought to bear. Then by a slight alteration in the relative positions of the mero-carpal and carpo-propodal joints the propodus is suddenly released and flies straight out in front. The dactylus, which before the release of the propodus is flexed close against that segment, also flies forwards so that all the segments of the limb are momentarily extended as nearly as possible in a straight line. The action takes place with great rapidity and is in consequence somewhat difficult to observe; it is roughly comparable to a rapier-thrust and a well-grown specimen might, I believe, under favourable circumstances succeed in piercing the skin of the hand.

The sound appears to be produced by the release of the propodus from the socket in the merus. In all probability it is merely a subsidiary result of the mechanical process involved; it is not so loud as that made by the Alpheid Macrura, and is no doubt less effectual in frightening an opponent.

Gonodactylus demani, Henderson. [p. 164.]

This species was not uncommon both at Kilakarai and Pamban, occurring in the same situations as *G. glabrous*. It was in an adjacent locality that Dr. J. R. Henderson in 1889 obtained the specimens from which he drew up the original description of the species.

A curious feature of all the specimens collected is that the setae on the inner margin of the inner uropod are absent. In all other examples of *G. demani* in the Museum collection, with the exception of one from the Henjam Is., Persian Gulf, the entire margin is invested with setae. The absence of these setae is clearly shown in Henderson's figure of the type specimen, and on careful examination of the specimens recently obtained, it is evident that their absence is not traumatic, as no trace of the pits from which the setae arise can be detected.

The character no doubt appears somewhat insignificant and the evidence at present available is not sufficient to permit of any suggestions regarding the possible existence of local races: the specimens in the Indian Museum prove that both forms occur in the Persian Gulf. Considering, however, the differences of opinion that prevail regarding the status of the species in the *chiragra* section of the genus, it is well to place on record any definite character such as that noted above; and in the present instance a considerable amount of interest attaches to the disposition of the setae[1] on the uropod in view of the fact that the form of this segment and its setal

[1] It may be mentioned here that in the specimens from Ceylon which I have referred to *G. demani* var. *spinosus* the setae invest all the margins of the inner uropod.

investment are curiously modified in the small section of the genus that comprises *G. herdmani*, *brevisquamatus*, *furcicaudatus* and other species. The S. Indian examples of *G. demani* are, in my opinion, more closely related to the members of this section (in particular to *G. herdmani*, the least specialized form) than any other known species of the genus not included therein.

In the majority of the specimens the spinulation of the telson consists of a few sharp prickles at the distal ends of the carinae and at the bases of the submedian and intermediate teeth. The median carina, as in the type specimen, is often considerably wider than those on either side.

The colour of living specimens was very variable, but usually dark in tone. As a rule three characteristic pale patches were distinct: (i) a narrow transverse band at the junction of the middle and posterior thirds of the carapace, (ii) a lateral streak on either side of the first abdominal somite, and (iii) a narrow transverse band at the end of the last abdominal somite which is continued laterally as a patch at the distal end of the peduncle of the uropods. In addition, living specimens invariably possessed a number of small brilliant blue spots surrounded by a black ring. The spots were always arranged in transverse series on the thorax and abdomen, and at the base of the telson, their number and arrangement being subject to much variation. The spots immediately turn black when the specimen is placed in alcohol.

Several females of this species were found guarding their eggs. The egg-mass is usually about 5 or 6 mm. in diameter and individual ova measure about ·8 mm.

No examples of *Gonodactylus chiragra* were obtained and I am inclined to believe that the species does not occur on the reefs which we examined. The experience which I obtained in the course of this visit has confirmed my belief that the species of the *chiragra* section of the genus *Gonodactylus* are well-defined, though variable within certain limits and showing a tendency towards the formation of local races. That *G. glabrous* and *G. demani* are specifically distinct, could, I venture to believe, hardly be doubted by any biologist who had had the opportunity of visiting the reefs at Kilakarai and Pamban, and had observed large numbers of individuals of both forms in their natural environment.

In concluding this note I take the opportunity to express my indebtedness to Dr. J. R. Henderson, whose long experience and hearty co-operation in making the collection on which the note is based proved of the greatest possible assistance.

LIST OF THE SPECIES OF STOMATOPODA KNOWN FROM THE ATLANTIC AND THE MEDITERRANEAN AND FROM THE PACIFIC COAST OF AMERICA, WITH A FEW OF THE MORE IMPORTANT REFERENCES AND SYNONYMS.

SQUILLA.

Squilla aculeata, Bigelow, 1893.

1894. *Squilla aculeata*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 523, text. figs. 15, 16.
Panama ; Chili.

Squilla alba, Bigelow, 1893.

1894. *Squilla alba*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 539, pl. xxii.
Bahama Is.

Squilla armata, H. Milne-Edwards, 1837.

See p. 41.

Squilla biformis, Bigelow, 1893.

1894. *Squilla biformis*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 532, pl. xxi, text-fig. 20.
Bay of Panama, G. of California ; 85–259 fms.

Squilla desmaresti, Risso, 1816.

1816. *Squilla desmarestii*, Risso, Crust. Nice, p. 114, pl. ii, fig. 8.
1863. *Squilla desmarestii*, Heller, Crust. südlich. Europ., p. 307.
1880. *Squilla desmarestii*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 28.
1910. *Squilla desmarestii*, Giesbrecht, Faun. Flor. G. Neapel, XXXIII, p. 25, pl. i, figs. 6, 7, pl. iii.
Mediterranean ; British Coasts.

Squilla dubia, Milne-Edwards, 1837.

1837. *Squilla dubia*, H. Milne-Edwards, Hist. Nat. Crust., II, p. 522.
? 1852. *Squilla rubrolineata*, Dana, U.S. Explor. Exped., Crust., p. 618, pl. xli, fig. 2*a*, *b*.
1880. *Squilla dubia*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 24.
1894. *Squilla dubia*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 518.
1910. *Chloridella dubia*, Rathbun, Proc. U.S. Nat. Mus., p. 565, pl. liv, fig. 3.
E. Coasts of America ; West Indies ; Ecuador ; Peru.

Squilla empusa, Say, 1818.

1817. *Squilla empusa*, Say, Journ. Ac. Sci. Philad., I, p. 250.
1880. *Squilla empusa*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 23, pl. ii, fig. 12.
1894. *Squilla empusa*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 525.
E. Coast of N. America ; West Indies ; W. Africa.

Squilla gracilipes, Miers, 1881.

1881. *Squilla gracilipes*, Miers, Proc. Zool. Soc., p. 75, pl. vii, fig. 8.
1890. *Pterygosquilla laticauda*, Hidgendorf, Sitz. Ges. naturf. Fr. Berlin, p. 172, text-fig.
1895. *Pterygosquilla laticauda* = *Squilla gracilipes*, Hansen, Isop. Cumac. u. Stomatop. Plankton-Exped., p. 69.
W. Coast of Patagonia.

Squilla intermedia, Bigelow, 1893.

1894. *Squilla intermedia*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 530, text-fig. 19.
1902. *Squilla intermedia*, Bigelow, Bull. U.S. Fish Comm. for 1900, XX, 2, p. 159.

G. of Mexico; Little Bahama Bank; Porto Rico.

Squilla mantis, Latreille, 1802.

1825. *Squilla mantis*, Latreille, Encycl. Méthod., X, p. 471.
1863. *Squilla mantis*, Heller, Crust. südlich. Europ., p. 306, pl. x, figs. 15–19.
1880. *Squilla mantis*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 21, pl. ii, fig. 11.
1910. *Squilla mantis*, Giesbrecht, Faun. Flor. G. Neapel, XXXIII, p. 25, pl. i, figs. 1, 2, 9, pl. ii, pl. v, figs. 43–60.

Mediterranean, Portugal, English Channel, North Sea.

Squilla neglecta, Gibbes, 1850.

1850. *Squilla neglecta*, Gibbes, Proc. Americ. Assoc., p. 200.
1880. *Squilla neglecta*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 23. see Lunz.

South Carolina.

Squilla pallida, Giesbrecht, 1910.

1910. *Squilla pallida*, Giesbrecht, Faun. Flor. G. Neapel, XXXIII, p. 25, pl. i, fig. 5, pl. iii.

Mediterranean.

Squilla panamensis, Bigelow, 1893.

1894. *Squilla panamensis*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 526, text-figs. 17, 18.

Bay of Panama; W. Coast of Mexico; California; Brazil (?).

Squilla parva, Bigelow, 1893.

1894. *Squilla parva*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 518, text-figs. 11, 12.

Bay of Panama; W. Coast of Mexico.

Squilla polita, Bigelow, 1893.

1894. *Squilla polita*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 513, text-fig. 8.

California.

Squilla prasinolineata, Dana (Ives), 1852.

1852. *Squilla prasinolineata*, Dana, U.S. Explor. Exped., Crust., p. 620, pl. xli, figs 3, *a-c*.
1880. *Squilla dufresnii*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 18, pl. ii, figs. 8, 9.
1891. *Squilla prasinolineata*, Ives, Proc. Acad. Sci. Philadelphia, p. 184.
1901. *Squilla prasinolineata*, Moreira, Arch. Mus. Nac., Rio Janeiro, XI, p. 5 (*partim* ?).

Brazil, Yucatan, Cuba.[1]

Squilla prasinolineata, Miers (*nec* Dana).

1880. *Squilla prasinolineata* ?, Miers. Ann. Mag. Nat. Hist. (5), V, p. 19, pl. ii, fig. 10.
1891. *Squilla prasinolineata* (Miers *nec* Dana), Ives, Proc. Acad. Sci. Philadelphia, p. 185.
1894. *Squilla prasinolineata* (Dana ?, Miers), Bigelow, Proc. U.S. Nat. Mus., XVII, p. 520.
? 1901. *Squilla prasinolineata* (Dana), Moreira, Arch. Mus. Nac., Rio Janeiro, XI, p. 5 (*partim*).

Brazil.

Moreira considers that this form is at most a variety of the real *S. prasinolineata* of Dana; but it seems evident that the examples which Miers described under the names *S. prasinolineata* ? and *S. dufresnii* are specifically distinct and Ives' subsequent remarks on the synonymy appear reasonable. It

[1] Specimens from this locality, received in exchange from the Berlin Museum, have been examined.

is probable, therefore, that a new name will be wanted for the present form when further specimens have been examined and the question has been finally settled.

Squilla quadridens, Bigelow, 1893.

1894. *Squilla quadridens*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 511.

Florida.

Squilla rugosa, Bigelow, 1893.

1894. *Squilla rugosa*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 541, text-figs. 23, 24.

G. of Mexico.

PSEUDOSQUILLA.

Pseudosquilla cerisii (Roux), 1828. (See p. 96.)

1828. *Squilla cerisii*, Roux, Crust. Méditerran., p. *innum.*, pl. v.
1863. *Squilla cerisii*, Heller, Crust. südlich. Europ., p. 308.
1880. *Pseudosquilla cerisii*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 114.
1910. *Pseudosquilla cerisii*, Giesbrecht, Faun. Flor. G. Neapel, XXXIII, p. 34, pl. i, fig. 3; pl. iv, figs. 1-36.

Mediterranean.

Pseudosquilla ciliata (Fabricius), 1787.

See p. 96.

Pseudosquilla ferussaci (Roux), 1828. (See p. 96.)

1828. *Squilla ferussacii*, Roux, Crust. Méditerran., p. *innum.*, pl. xxviii.
1863. *Squilla ferussacii*, Heller, Crust. südlich. Europ., p. 308.
1880. *Squilla ferussacii*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 16.
1910. *Pseudosquilla ferussaci*, Giesbrecht, Faun. Flor. G. Neapel, XXXIII, p. 34, pl. i, fig. 8; pl. iv, figs. 37-48.

Mediterranean.

Pseudosquilla lessoni (Guérin), 1830. (See p. 96.)

1830. *Squilla lessonii*[1], Guérin, Voy. 'Coquille,' Crust., pl. iv, fig. 1.
1832. *Squilla spinifrons*, Owen, Proc. Zool. Soc., p. 6.
1837. *Squilla lessonii*, H. Milne-Edwards, Hist. Nat. Crust., II, p. 527.
1837. *Squilla monoceros*, H. Milne-Edwards, *ibid.*, p. 526.
1877. *Pseudosquilla marmorata*, Lockington, Proc. Acad. Sci. California, VII, p. 33.
1880. *Pseudosquilla lessonii*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 113.
1900. *Pseudosquilla lessonii*, Holmes, Occ. Papers. Calif. Acad. Sci., VII, p. 220.
1910. *Pseudosquilla lessonii*, Rathbun, Proc. U.S. Nat. Mus., XXXVIII, p. 565, pl. lii, fig. 3.

W. Coast of America from California to Chili.

Pseudosquilla oculata (Brullé), 1836-44.

See p. 102.

Pseudosquilla stylifera (H. Milne-Edwards), 1837.

See p. 106.

LYSIOSQUILLA.

Lysiosquilla armata, Smith, 1881.

1881. *Lysiosquilla armata*, Smith, Proc. U.S. Nat. Mus., III, p. 446.
1894. *Lysiosquilla armata*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 507.

N.E. Coast of America, 17-120 fms.

[1] *Squilla lessonii* on plate, *S. cerisii* in text, p. 40.

Lysiosquilla biminiensis, Bigelow, 1893.

See p. 124.

Lysiosquilla decemspinosa, Rathbun, 1910.

1910. *Lysiosquilla decemspinosa*, Rathbun, Proc. U.S. Nat. Mus., XXXVIII, p. 566, pl. liii, fig. 3.

Peru.

Lysiosquilla desaussurei, Stimpson, 1857.

1853. *Squilla scabricauda*, De Saussure, Rev. Mag. Zool., (2), V, p. 367.
1857. *Squilla desaussurei*, Stimpson, Boston Journ. Nat. Hist., VI, p. 503.
1880. *Lysiosquilla desaussurei*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 8.

W. Coast of Mexico.

Lysiosquilla digueti, Coutière, 1905.

1905. *Lysiosquilla digueti*, Coutière, Bull. Soc. Philom., (9), VII, p. 174, text figs. 1–7.

G. of California.

Lysiosquilla eusebia (Risso), 1816.

1826. *Squilla eusebia*, Risso, Hist. Nat. Europe Mérid, V, p. 87, pl. iv, fig. 15.
1869. *Squilla eusebia*, Nardo, Annot. Crost. ; Mem. Inst. Venetio, XIV, p. 112, pl. iii, fig. 7.
1880. *Lysiosquilla eusebia*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 30.
1910. *Lysiosquilla eusebia*, Giesbrecht, Faun. Flor. G. Neapel, XXXIII, p. 40, pl. i, figs. 4, 10 ; pl. v, figs. 1–42.

Mediterranean.

Lysiosquilla excavatrix, Brooks, 1886.

1886. *Lysiosquilla excavatrix*, Brooks, Voy. H.M.S. ' Challenger,' XVI, Stomatop., p. 48, pl. x, figs. 8–16.

North Carolina.

Lysiosquilla glabriuscula (Lamarck), 1818.

1818. *Squilla glabriuscula*, Lamarck, Hist. Nat. Anim. sans Vert., V, p. 188.
1837. *Squilla vittata*, H. Milne-Edwards, Hist. Nat. Crust., II, p. 519.
1880. *Squilla glabriuscula*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 7.

West Indies ; Florida.

Lysiosquilla maiaguesensis, Bigelow, 1902.

1902. *Lysiosquilla maiaguesensis*, Bigelow, Bull. U.S. Fish Comm. for 1900, XX, 2, p. 158, figs. 10–13.

Porto Rico ; 161–172 fms.

Lysiosquilla occulta, Giesbrecht, 1910.

1910. *Lysiosquilla occulta juv.*, Giesbrecht, Faun. Flor. G. Neapel, XXXIII, p. 131, pl. vi.

Mediterranean.

Lysiosquilla plumata, Bigelow, 1902.

1902. *Lysiosquilla plumata*, Bigelow, Bull. U.S. Fish Comm. for 1900, XX, 2, 156, figs. 5-9.

Porto Rico, 25–30 fms.

Lysiosquilla polydactyla, v. Martens, 1881.

1881. *Lysiosquilla polydactyla*, v. Martens, Sitz.-ber. Ges. naturf. Fr. Berlin, p. 92.
1912. *Lysiosquilla polydactyla*, Doflein und Balss, Mitt. Nat. Hist. Mus. Hamburg, XXIX, p. 40.

Chili ? Tierra del Fuego.

Lysiosquilla maculata (Fabricius), 1793.

See p. 111.

Lysiosquilla scabricauda (Lamarck), 1818.

1818. *Squilla scabricauda*, Lamarck, Hist. Nat. Anim. sans Vert., V, p. 188.
1825. *Squilla scabricauda*, Latreille, Encycl. Méthod., X, p. 470 ; Atlas pl. cccxxv, fig. 1.
1837. *Squilla scabricauda*, H. Milne-Edwards, Hist. Nat. Crust., II, p. 519.
1851. *Squilla hoeveni*, Herklots, Addit. Faun. Carcin. Afric. occident., p. 17, pl. i, fig. 11.
1852. *Lysiosquilla inornata*, Dana, U.S. Explor. Exped., Crust., p. 616, pl. xli, fig. 1 *a-e*.
1880. *Lysiosquilla scabricauda*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 7.

Texas ; Florida ; S. Carolina ; W. Indies ; Brazil ; Cayenne ; W. Africa.

Lysiosquilla scolopendra (Latreille), 1825.

1825. *Coronis scolopendra*, Latreille, Encycl. Méthod., X, p. 474.
1837. *Coronis scolopendra*, H. Milne-Edwards, Hist. Nat. Crust., II, p. 531.
1836-49. *Cornis scolopendra*, H. Milne-Edwards, in Cuvier's Regne Anim., Crust., Atlas, pl. lv, fig. 3.
1880. *Lysiosquilla scolopendra*, Miers, Ann. Mag. Nat. Hist. (5), V, p. 9.

Brazil ?

Lysiosquilla septemspinosa, Miers, 1881. (See p. 122).

1881. *Lysiosquilla acanthocarpus* var. *septemspinosa*, Miers, Ann. Mag. Nat. Hist. (5), VIII, p. 368.

W. Africa.

CORONIDA.

Coronida bradyi (A. Milne-Edwards), 1869. (See p. 130).

1869. *Squilla bradyi*, A. Milne-Edwards, in De Folin and Périer's Fonds de la Mer. I., Crust., p. 137, pl. xvii, fig. 11.
1880. *Gonodactylus ? bradyi*, Miers. Ann. Mag. Nat. Hist. (5), V, p. 117.
1884. *Gonodactylus bradyi*, Miers, Proc. Zool. Soc., p. 16.
1886. *Coronida bradyi*, Brooks, Voy. H.M.S. ' Challenger,' XVI, Stomatop., p. 80.

Bay of St. Vincent.

ODONTODACTYLUS.

Odontodactylus havanensis, Bigelow, 1893. (See pp. 135, 144.)

1894. *Odontodactylus havanensis*, Bigelow, Proc. U.S. Nat. Mus., XVII, p. 497, pl. xx, text figs. 1, 2.

Cuba.

GONODACTYLUS.

Gonodactylus festae, Nobili, 1901. (See pp. 147, 153.)

1901. *Gonodactylus festae*, Nobili, Boll. Mus. Torino, XVI, no. 415, p. 53.
1903. *Gonodactylus chiragra* var. *festae*, Lanchester, Faun. and Geog. Maldives and Laccadives, p. 456.

Ecuador, Colombia.

Gonodactylus folini, A. Milne-Edwards, 1868.

See p. 189.

Gonodactylus oerstedi, Hansen, 1895. (See footnote p. 147.)

1890. *Gonodactylus chiragra*, Pocock, Journ. Linn. Soc., XX, p. 526.
1895. *Gonodactylus oerstedi*, Hansen, Isop. Cumac. u. Stomatop. Plankton-Exped., p. 65, footnote.
1900. *Gonodactylus oerstedi*, Bigelow, Bull. U.S. Fish. Comm. for 1900, XX, ii, p. 152, text figs. 1, 2.
1901. *Gonodactylus falcatus*, Moreira, Arch. Mus. Nac., Rio de Janeiro, XI, p. 1.

West Indies to Brazil ; Fernando Noronha.

DOUBTFUL SPECIES.

1798. *Squilla phalangium*, Fabricius, Ent. Syst. Suppl., p. 416.

"S. pollice falcato quinquedentato: dente tertio quintoque longioribus, corpore laevi.

Habitat in India orientali Dom. Daldorff.

Corpus S. Mantis paullo minor, laeve, glabrum, ultime segmento spinoso serratum."

Perhaps belonging to the *acanthocarpus* section of the genus *Lysiosquilla*.

1798. *Squilla ichneumon*, Fabricius, Ent. Syst. Suppl., p. 416.

"S. pollice falcato quadridentata cauda margine nodoso spinoso.

Habitat in India orientali D. Daldorff.

Praecedente (*S. phalangium*) adhuc minor. Carpus utrinque lineis tribus elevatis. Cauda rotundata spinis crassis nodosis ciliata."

Possibly a species of *Squilla* of the '*Chloridella*' group.

1798. *Squilla vitrea*, Fabricius, Ent. Syst. Suppl., p. 417.

"S. thorace laevi carinato: angulis subulatis, pollice falcato sublato inermi.

Habitat in Oceano atlantico Mus. D. Banks."

1832. *Gonodactylus ensiger*, Owen, Proc. Zool. Soc., p. 6.

"*Gon. pollice edentato, ensato, intus acuto; rostro 3-spinoso, spina intermedia obsoleta.*

Long 6 unc. *Hab.* Valparaiso.

Color flavus; chelarum caeruleus.

Praecedenti (i.e. *G. chiragra*) valde affinis, praesertim sculptura armaturaque segmentorum ultimorum; sed differt pollice ad basin non ventricoso, ad marginem internum non crenato, spina rostri media non producta; necnon magnitudine."

1841. *Pseudosquilla cylindrica, nom. nud.*? } Attributed to Guérin by Eydoux and Souleyet, Voy. de la
1841. *Pseudosquilla leptodactyla, nom. nud.*? } 'Bonite,' Zool. Crust., I, p. 263.

1869. *Squilla mantis*, Rondel., Bianconi, Mem. Accad. Sci. Bologna (2), IX, p. 210.

Probably one of the species included in the *oratoria* section of the genus *Squilla*. The reference is quoted by Hilgendorf, Monatsber, d. kön. Akad. Wiss. Berlin, 1879, p. 846.

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[1] See footnote, p. 66.

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INDEX.

Synonyms are printed in italics.

EXPLANATION OF PLATE I.

Squilla latreillei (Eydoux and Souleyet).

FIG. 1.—Last two abdominal somites, telson and right uropods of a female specimen from the Persian Gulf : dorsal view.

,, 2.—Last two abdominal somites, telson and left uropods of a male specimen from the Persian Gulf : dorsal view.

,, 3.—Right eye in dorsal view.

,, 4.—Left half of last four thoracic somites in dorsal view.

Squilla gibba, Nobili.

,, 5.—Anterior half of the type specimen, a male, in dorsal view.

,, 6.—Right eye in dorsal view.

,, 7.—Antero-lateral angle of carapace in lateral view.

,, 8.—Raptorial claw of male.

,, 9.—Raptorial claw of female.

,, 10.—Fifth, sixth and seventh thoracic somites in lateral view.

,, 11.—Last two abdominal somites, telson and uropods of the type specimen : dorsal view.

,, 12.—Last abdominal somite and telson of female in dorsal view.

Squilla decorata (Wood-Mason).

,, 13.—Right eye in dorsal view.

,, 14.—Left half of last four thoracic somites in dorsal view.

,, 15.—Last two abdominal somites, telson and right uropods of a small female from the Yé River entrance : dorsal view.

,, 16.—The same in ventral view.

Squilla microphthalma, H. Milne-Edwards.

,, 17.—Right eye in dorsal view.

,, 18.—Left half of last four thoracic somites in dorsal view.

,, 19.—Last two abdominal somites, telson and uropods of a female from the Madras Coast.

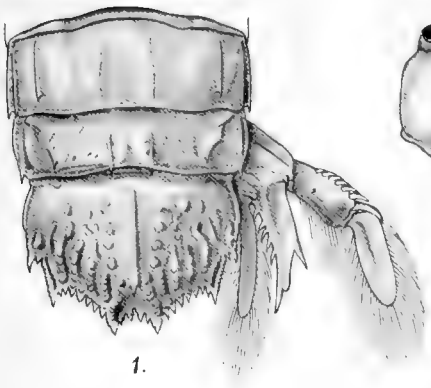
,, 20.—The same parts of a female from Karachi.

Squilla fasciata, De Haan.

,, 21.—Anterior half of the female specimen from the Andamans : dorsal view.

,, 22.—Raptorial claw of the same specimen.

,, 23.—Last two abdominal somites and telson of the same specimen : dorsal view.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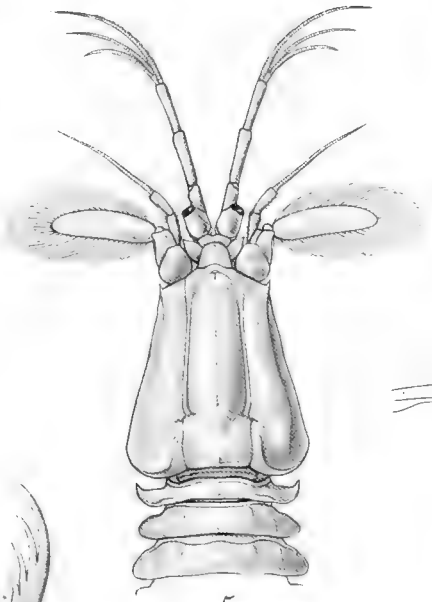
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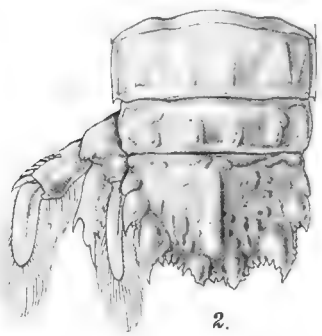
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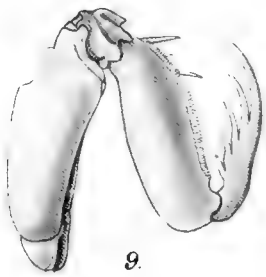
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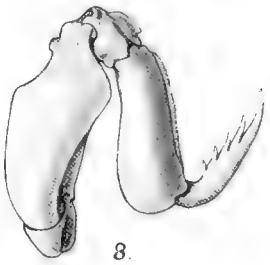
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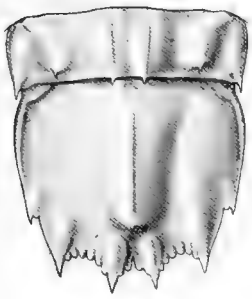
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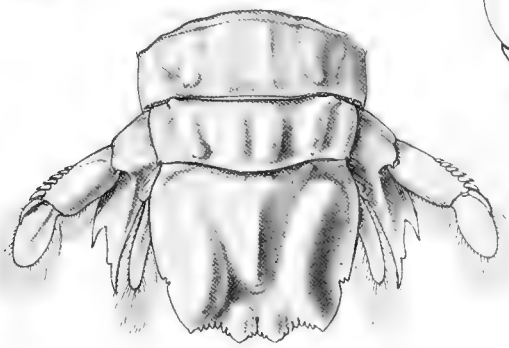
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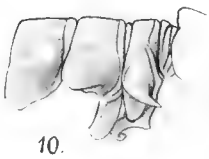
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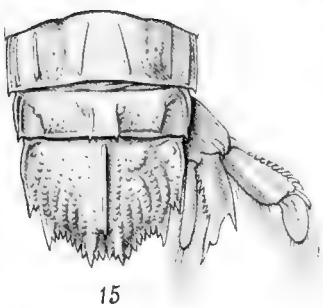
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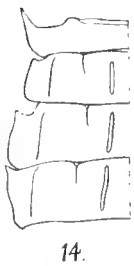
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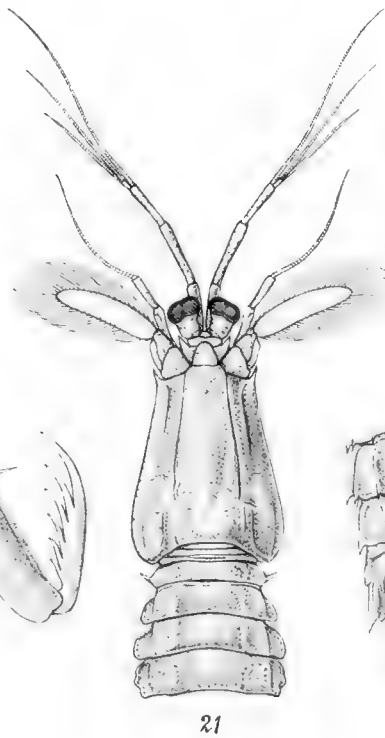
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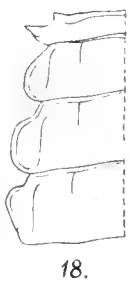
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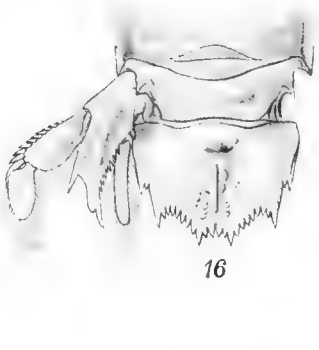
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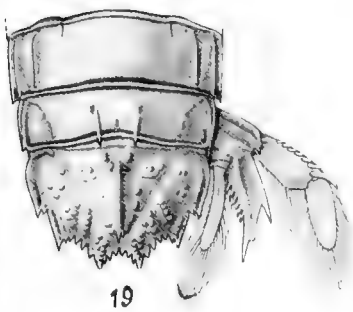
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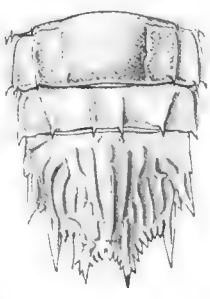
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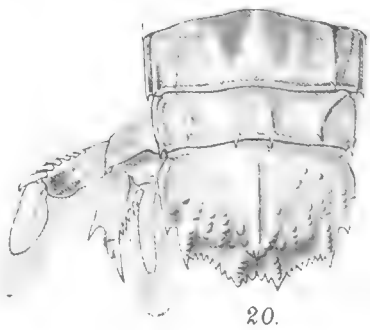
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Figs. 1-4 Squilla latreillei. Figs. 5-12 Squilla gibba. Figs. 13-16 Squilla decorata.
Figs. 17-20 Squilla microphthalma. Figs. 21-23 Squilla fasciata.

EXPLANATION OF PLATE II.

Squilla lata, Brooks.

FIG. 24.—Basal process of right uropod of a specimen from the Gulf of Martaban : ventral view.

Squilla gilesi, Wood-Mason MS.

,, 25.—Basal process of left uropod in ventral view.

,, 26.—Anterior half of one of the type specimens in dorsal view.

,, 27.—Last abdominal somite, telson and left uropods of the male type specimen : dorsal view.

Squilla armata, H. Milne-Edwards.

,, 28.—Anterior half of a female from New Zealand : dorsal view.

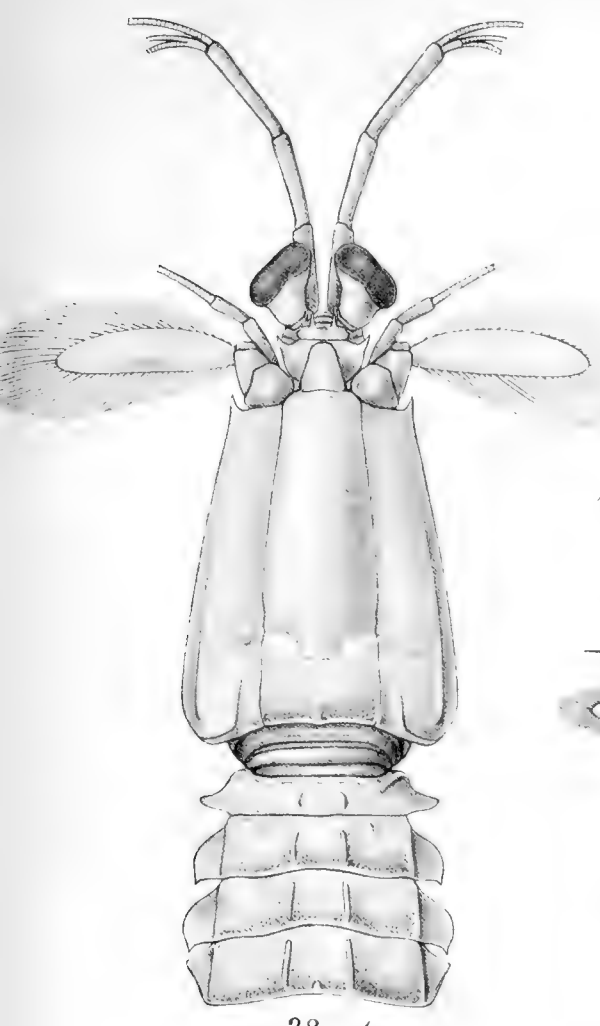
,, 29.—Raptorial claw of the same specimen.

Squilla scorpio, Latreille.

,, 30.—Rostrum, carapace and fifth abdominal somite in dorsal view.

Squilla scorpio var. *immaculata*, Wood-Mason, MS.

,, 31.—Anterior half of one of the type specimens in dorsal view.



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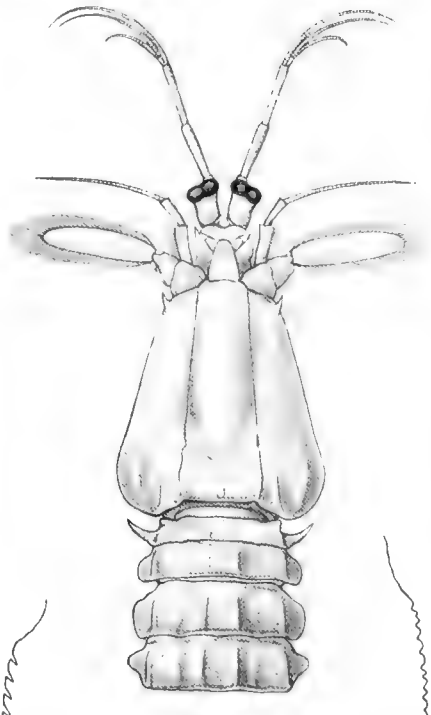

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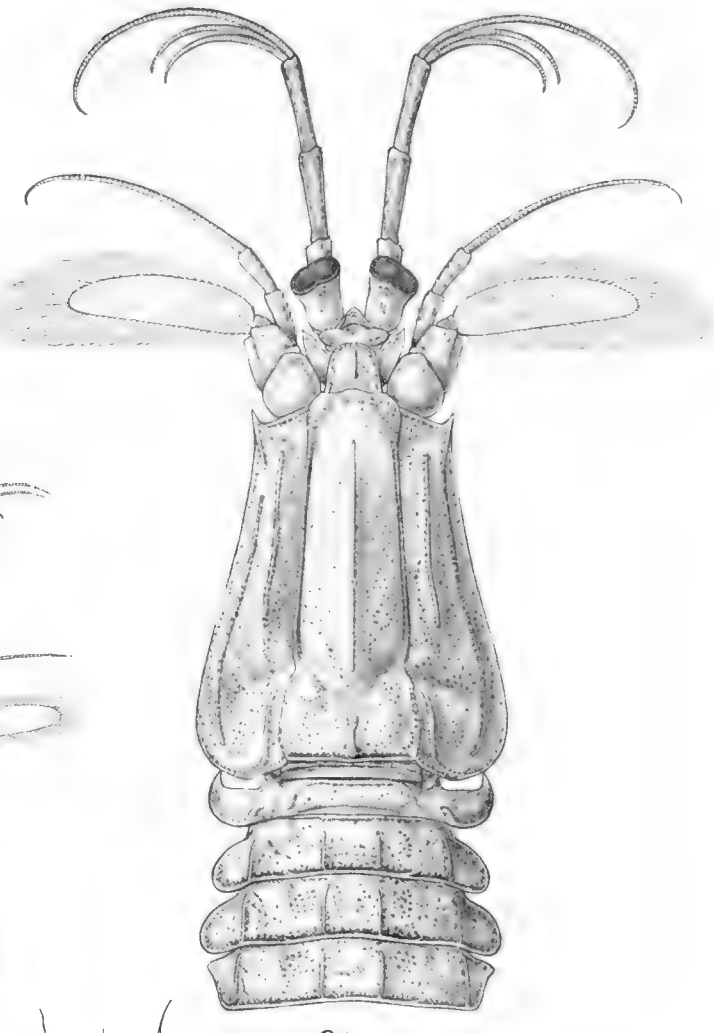

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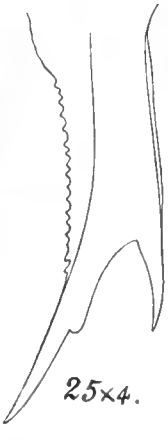

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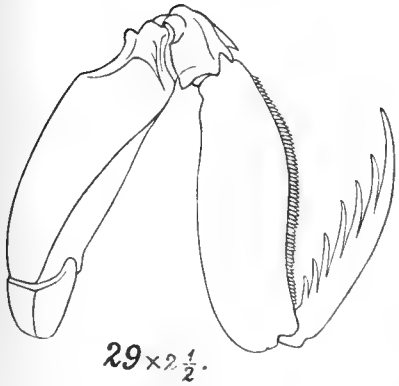

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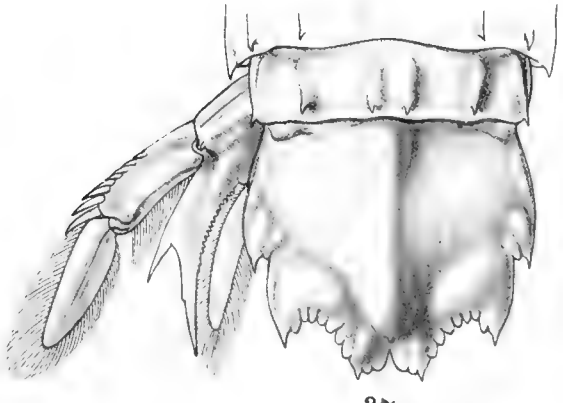

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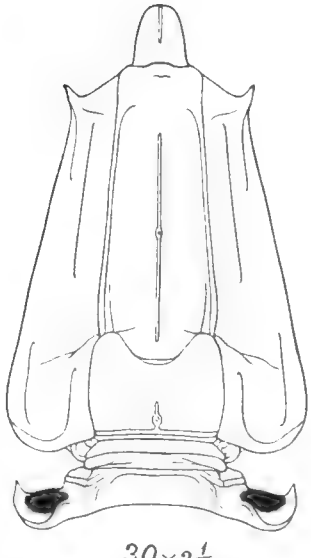

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Fig. 24 Squilla lata. Figs. 25-27 Squilla gilesi. Figs. 28-29 Squilla armata.
Fig. 30 Squilla scorpio. Fig. 31 Squilla scorpio var. immaculata.

EXPLANATION OF PLATE III.

Squilla tenuispinis, Wood-Mason.

FIG. 32.—Anterior half of a male from the Ganjam Coast in dorsal view.

,, 33.—Last two abdominal somites, telson and left uropods of the same specimen: dorsal view. *The figure is erroneous in showing intermediate carinae on the carapace on either side of the gastric grooves.*

,, 34.—Telson of the same specimen in lateral view.

Squilla laevis, Hess.

,, 35.—Anterior half of a male in dorsal view.

,, 36.—Raptorial claw of the same specimen.

,, 37.—Last four thoracic somites in lateral view.

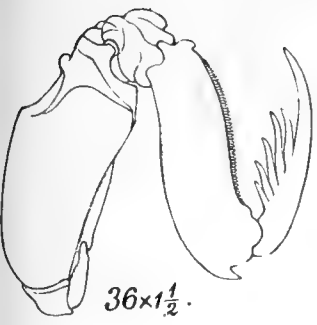
Squilla hieroglyphica, Kemp.

,, 38.—Anterior half of the type specimen in dorsal view.

,, 39.—Raptorial claw.

,, 40.—Fifth, sixth and seventh thoracic somites in lateral view.

,, 41.—Last two abdominal somites and telson in dorsal view.



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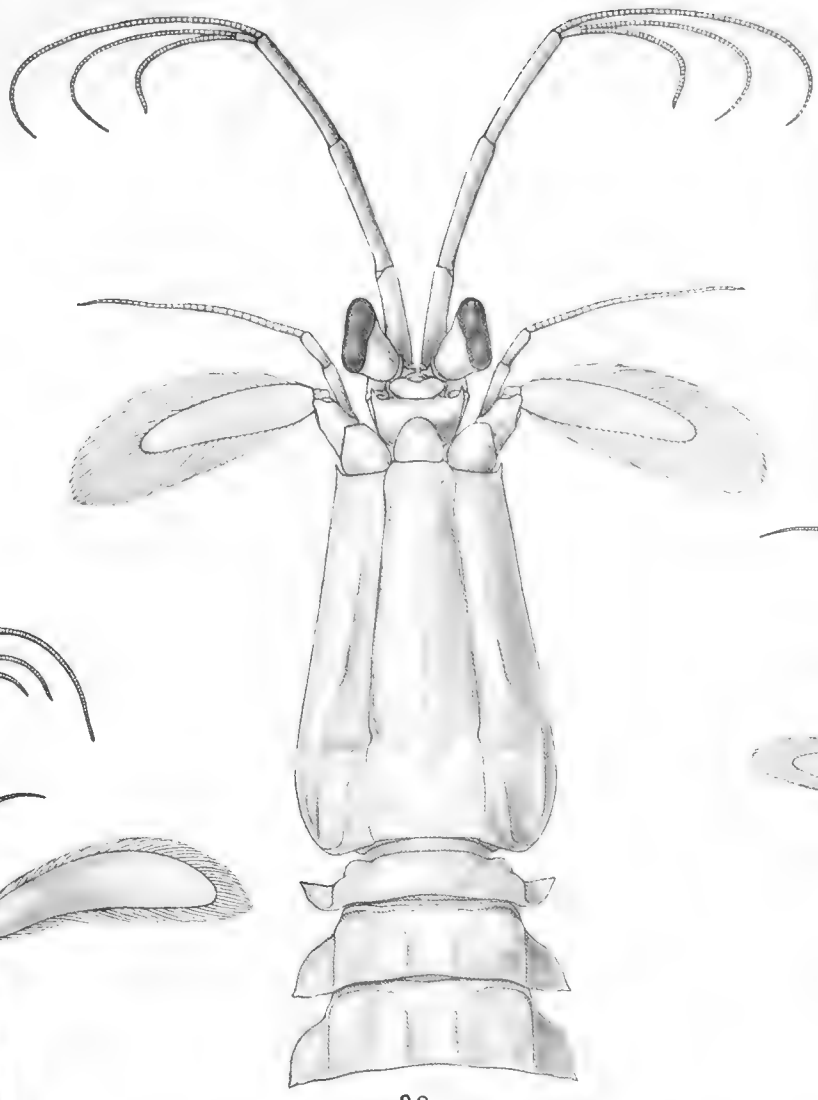

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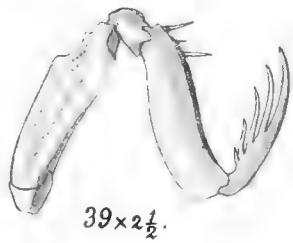

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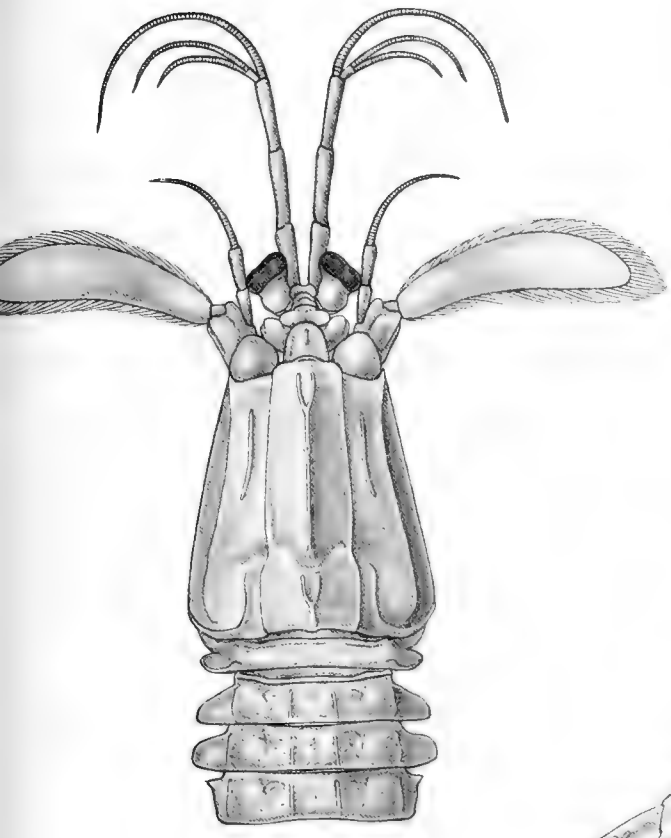

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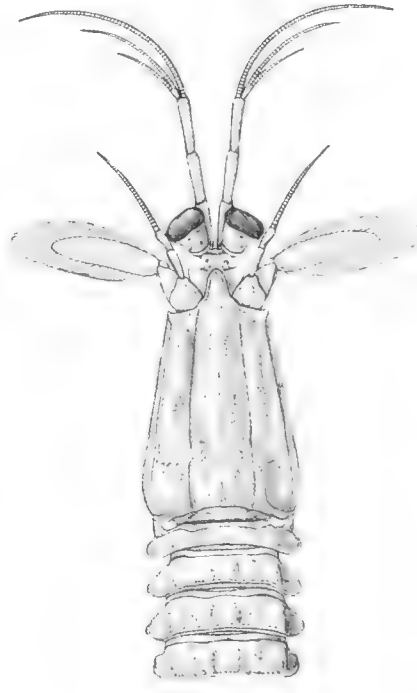

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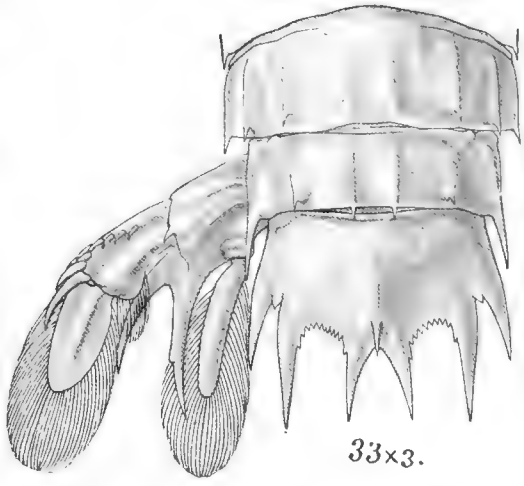

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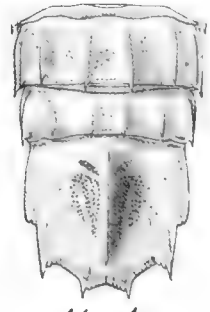

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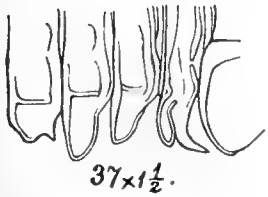

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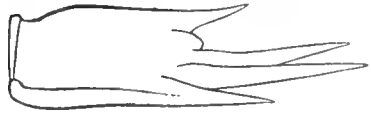

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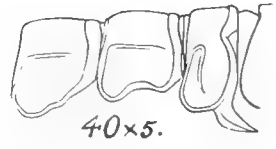

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Figs. 32-34 Squilla tenuispinis. Figs. 35-37 Squilla laevis. Figs. 38-41 Squilla hieroglyphica. p. 51.

EXPLANATION OF PLATE IV.

Squilla gonypetes, Wood-Mason, MS.

FIG. 42.—Anterior half of the male type specimen in dorsal view.

,, 43.—Raptorial claw of the same specimen.

,, 44.—Last two abdominal somites, telson and uropods of the same specimen : dorsal view.

Squilla boops, Kemp.

,, 45.—Anterior half of the type specimen in dorsal view.

,, 46.—Raptorial claw of the same specimen.

,, 47.—Last two abdominal somites, telson and uropods of the same specimen : dorsal view.

Squilla foveolata, Wood-Mason.

,, 48.—Right half of the last four thoracic somites in dorsal view.

Squilla nepa, Latreille.

,, 49.—Median carina of carapace anterior to cervical groove.

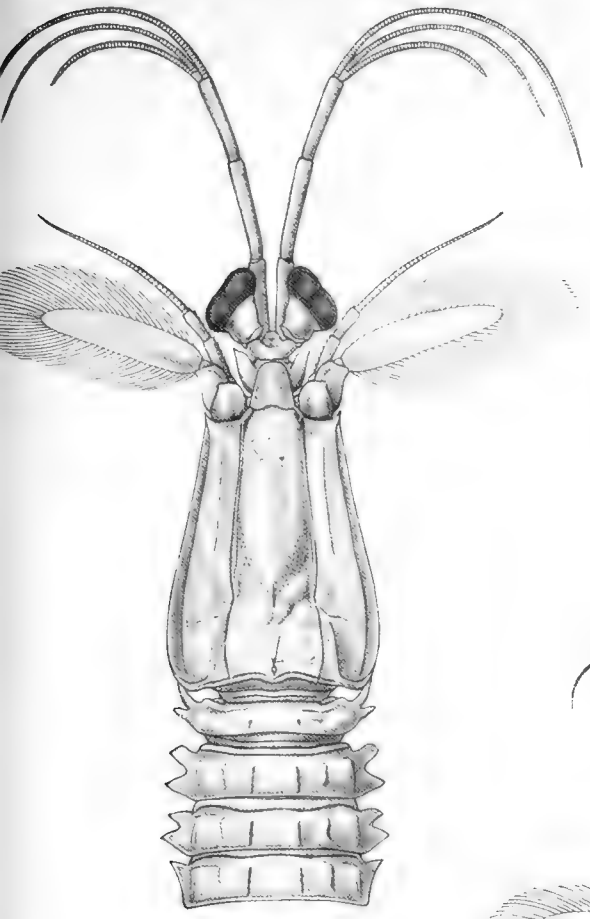
Squilla holoschista, Wood-Mason, MS.

,, 50.—Anterior half of one of the type specimens in dorsal view.

,, 51.—Median carina of carapace anterior to cervical groove.

,, 52.—Raptorial claw of male.

,, 53.—Raptorial claw of female.



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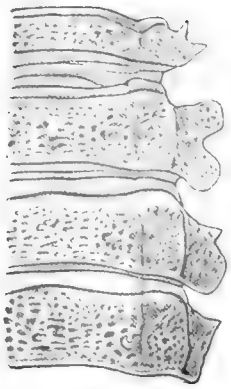

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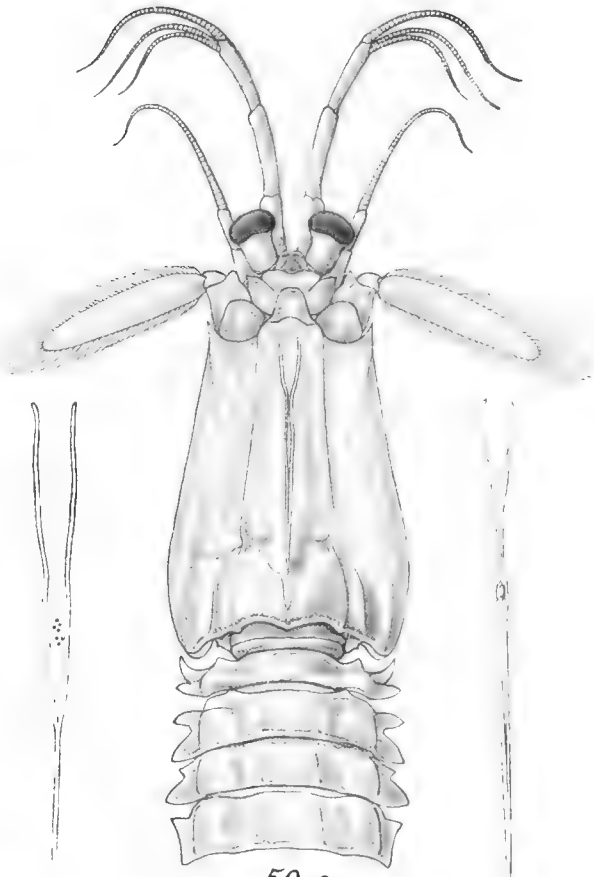

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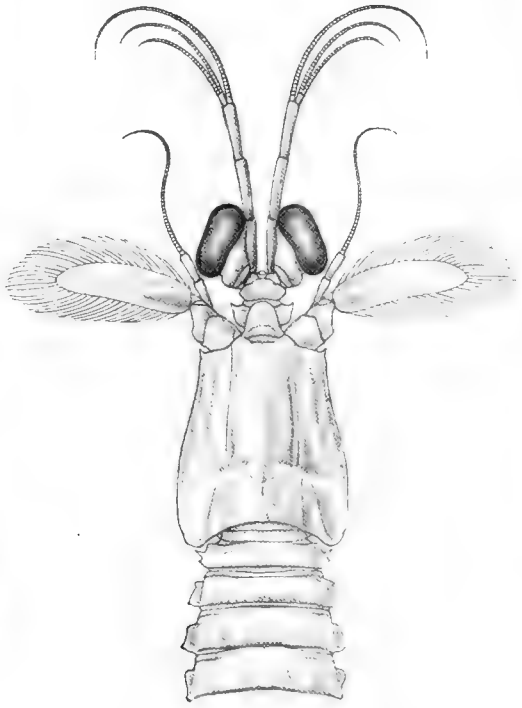
51×4.



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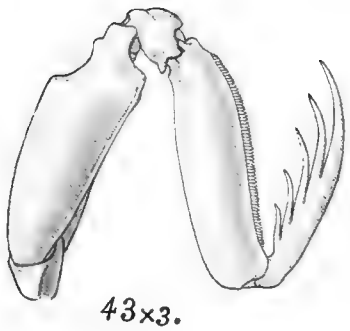

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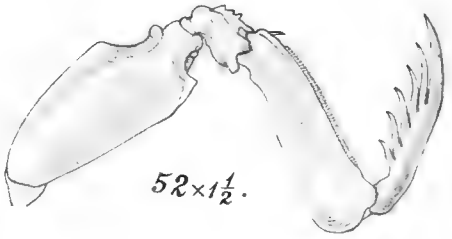

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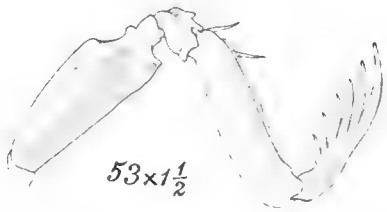

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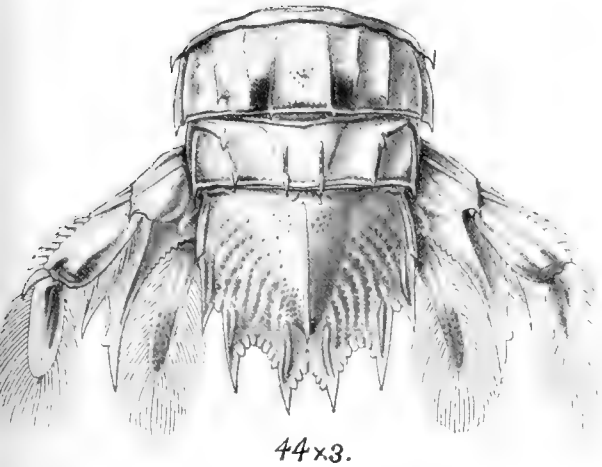

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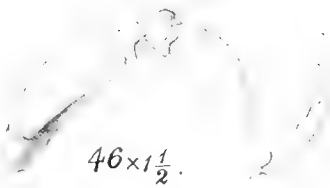

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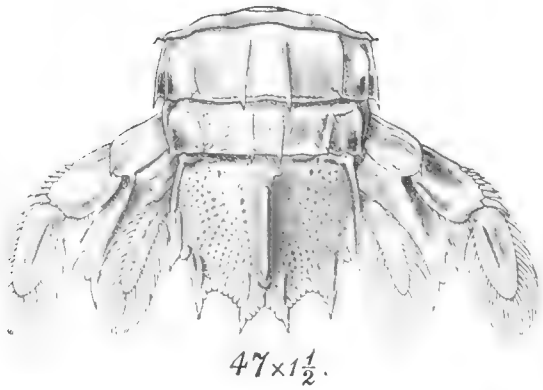


47×1½.

. C. Mondul, del

Figs. 42-44 Squilla gonypetes. Figs. 45-47 Squilla boops. Fig. 48 Squilla foveolata.
Fig. 49 Squilla nepa. Figs. 50-53 Squilla holoschista.

EXPLANATION OF PLATE V.

Squilla oratoria, De Haan.

FIG. 54.—Anterior half in dorsal view.

,, 55.—Carpus of raptorial claw ; the dorsal tubercles are not quite sharp enough.

,, 56.—Left half of last four thoracic somites in a specimen from Amoy.

Squilla oratoria var. *perpensa*, Kemp.

,, 57.—Anterior half of one of the type specimens in dorsal view.

,, 58.—Carpus of raptorial claw.

,, 59.—Basal process of uropod, left side in ventral view.

Squilla interrupta, Wood-Mason, MS.

,, 60.—Anterior half of one of the type specimens in dorsal view.

,, 61.—Carpus of raptorial claw.

,, 62.—Basal process of uropod, left side in ventral view.

Squilla wood-masoni, Kemp.

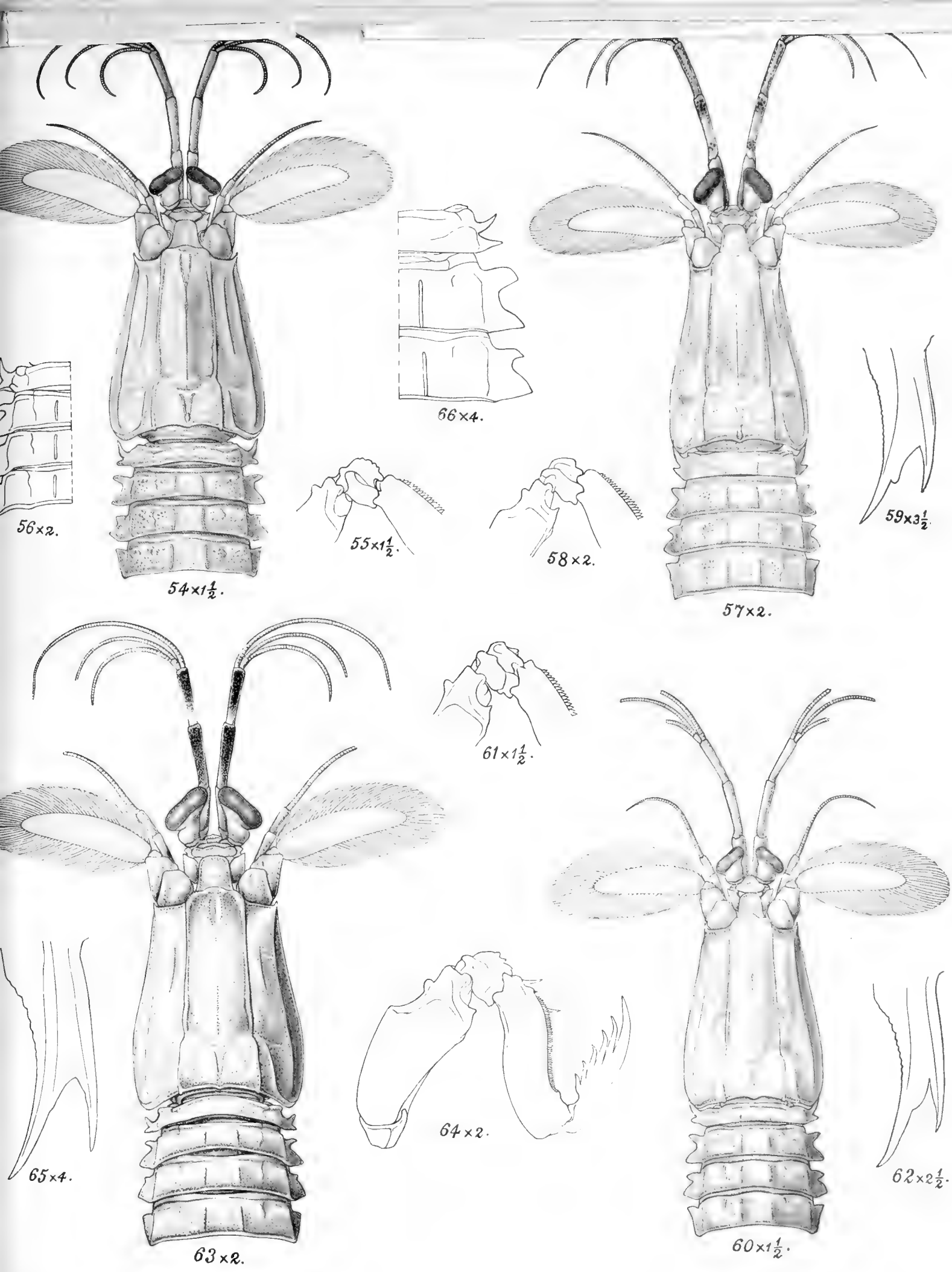
,, 63.—Anterior half of one of the type specimens in dorsal view.

,, 64.—Raptorial claw.

,, 65.—Basal process of uropod, left side in ventral view.

Squilla stridulans, Wood-Mason.

,, 66.—Right half of fifth, sixth and seventh thoracic somites in dorsal view.



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Figs. 54-56 Squilla oratoria. Figs. 57-59 Squilla oratoria var. perpensa. Figs. 60-62 Squilla interrupta.
Figs. 63-65 Squilla wood-masoni. Fig. 66 Squilla stridulans.

EXPLANATION OF PLATE VI.

Squilla investigatoris, Lloyd.

FIG. 67.—One of the type specimens, natural size.

,, 68.—Propodus and dactylus of raptorial claw.

Squilla supplex, Wood-Mason.

,, 69.—Last two abdominal somites, telson and left uropods of the male from Tuticorin : dorsal view.

Squilla costata, De Haan.

,, 70.—Anterior half of the specimen from Burma in dorsal view.

,, 71.—Raptorial claw of the same specimen.

,, 72.—Last three abdominal somites, telson and left uropods of the same specimen : dorsal view.

Squilla multicarinata, White.

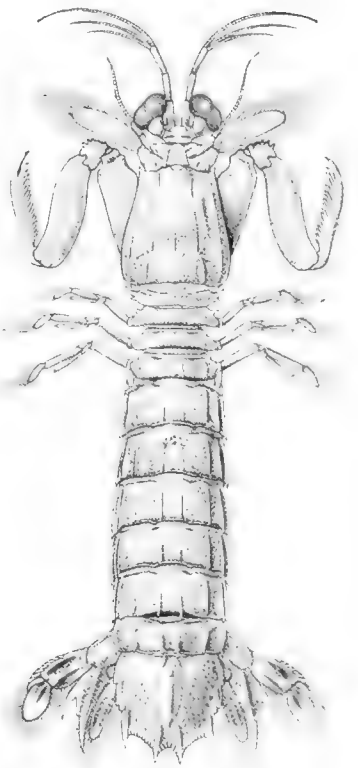
,, 73.—Anterior half of a specimen from Hongkong in dorsal view.

,, 74.—Raptorial claw.

,, 75.—Fifth, sixth and seventh thoracic somites in lateral view.

,, 76.—Last two abdominal somites, telson and uropods in dorsal view.

73×2.



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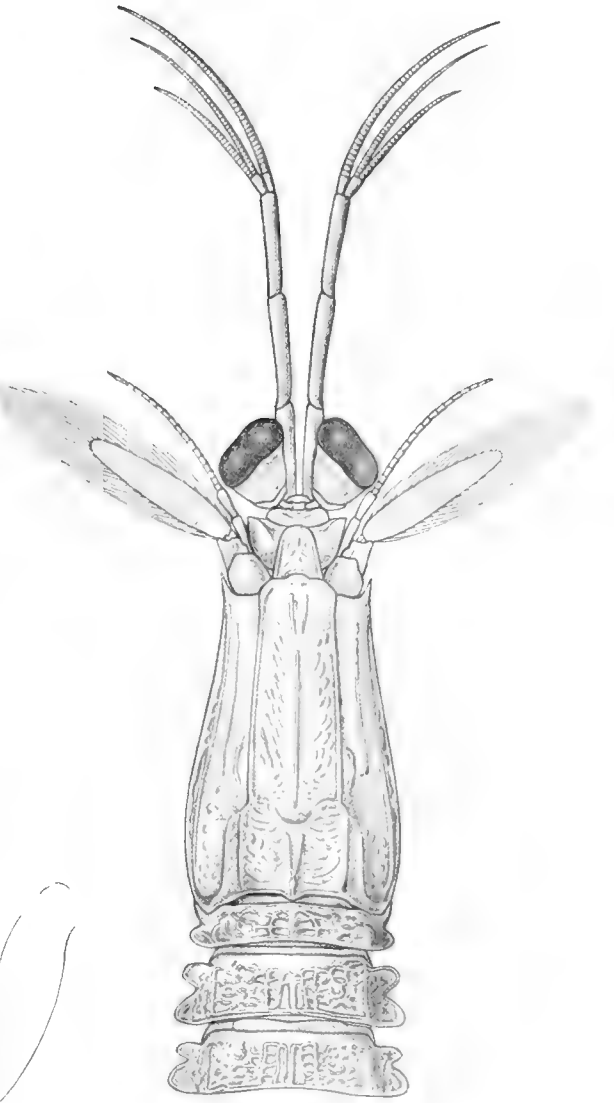

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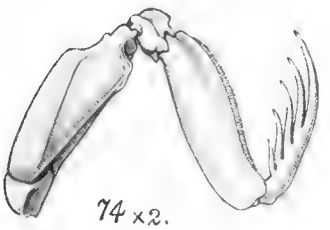

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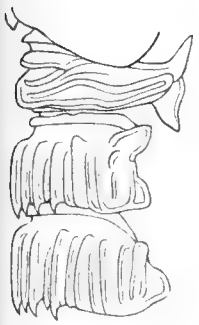
68×2.



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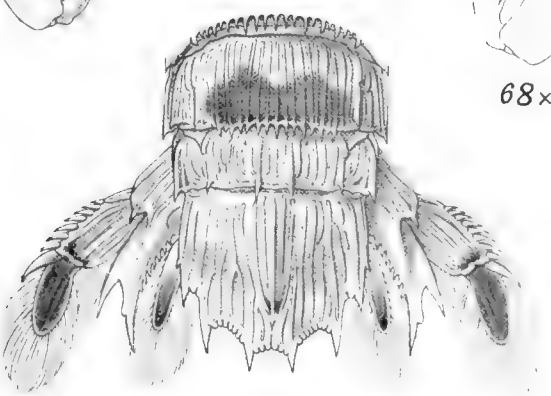

76×2.

69×2.

71×6.

72×6.

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Figs. 67-68 Squilla investigatoris. Fig. 69 Squilla supplex. Figs. 70-72 Squilla costata.
Figs. 73-76 Squilla multicarinata.

EXPLANATION OF PLATE VII.

Squilla raphidea, Fabricius.

FIG. 77.—Left half of fifth, sixth and seventh thoracic somites in dorsal view.

Squilla annandalei, Kemp.

,, 78.—Anterior part of carapace, rostrum, eystalks, etc., in dorsal view.

,, 79.—Outline of a specimen showing the characteristic pigmentation of the abdomen, telson and ultimate segment of outer uropods.

,, 80.—Left half of fifth, sixth and seventh thoracic somites : dorsal view.

"*Leptosquilla schmeltzii*" (A. Milne-Edwards).

,, 81.—Anterior half of the specimen from the Andamans : dorsal view.

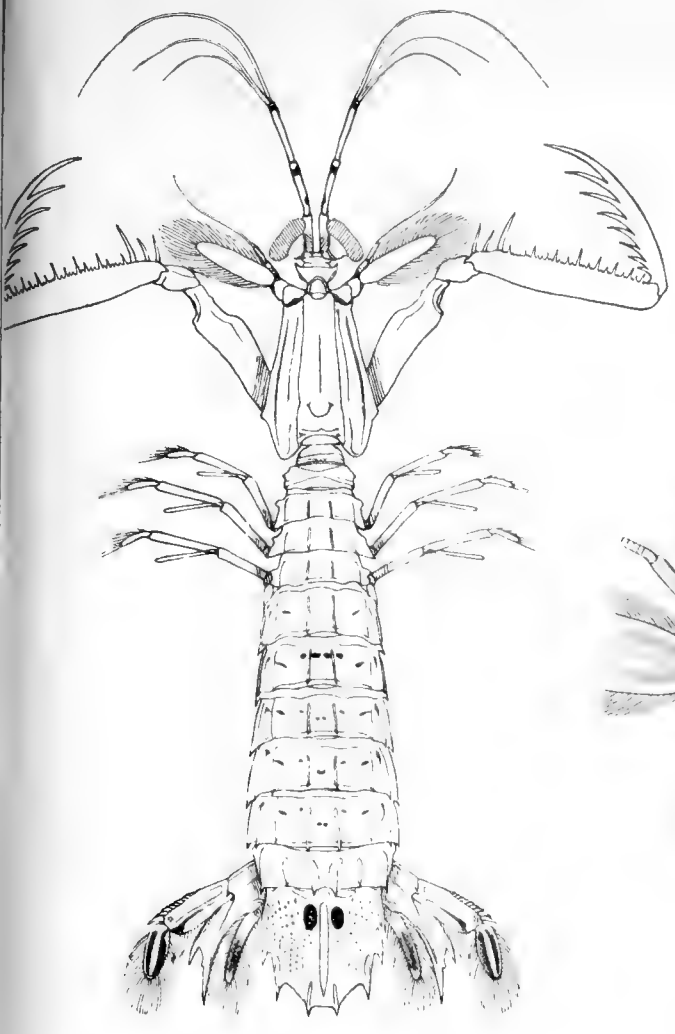
,, 82.—Raptorial claw of the same specimen.

,, 83.—Last two abdominal somites, telson and right uropods of the same specimen : dorsal view.

Pseudosquilla stylifera (H. Milne-Edwards).

,, 84.—Anterior part of carapace, rostrum, eyes, antennal scales, etc., of a specimen from Chili.

,, 85.—Last abdominal somite, telson and right uropods of the same specimen.



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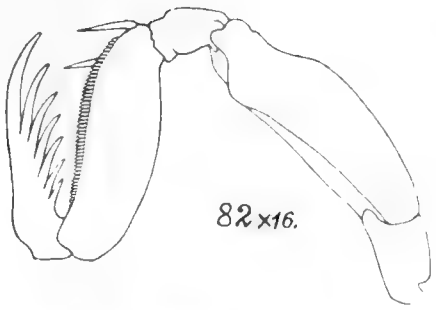

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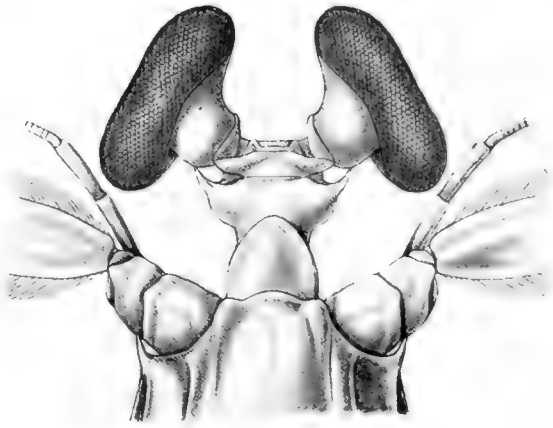

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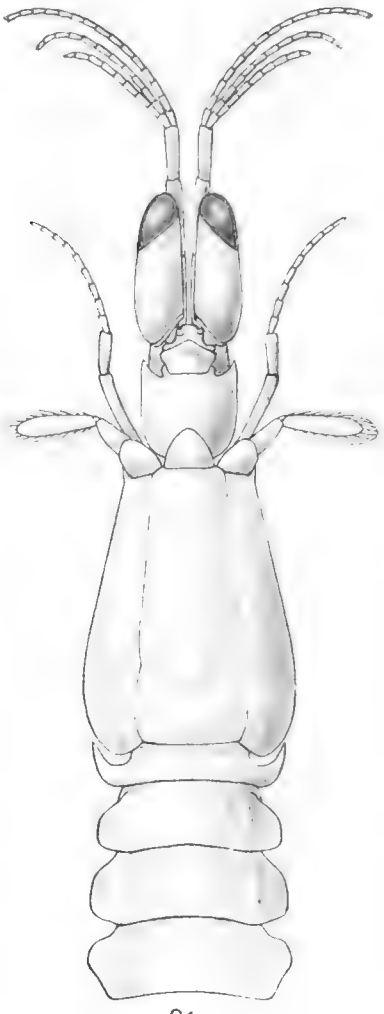

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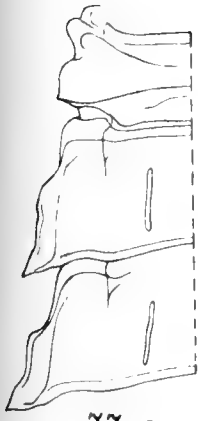

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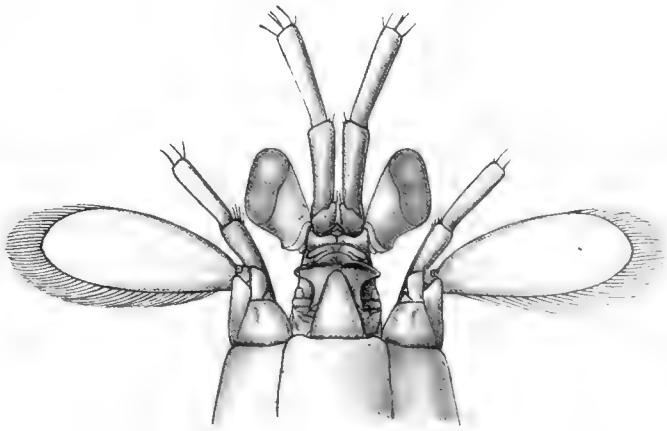

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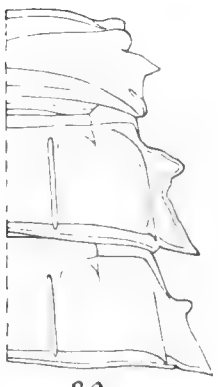

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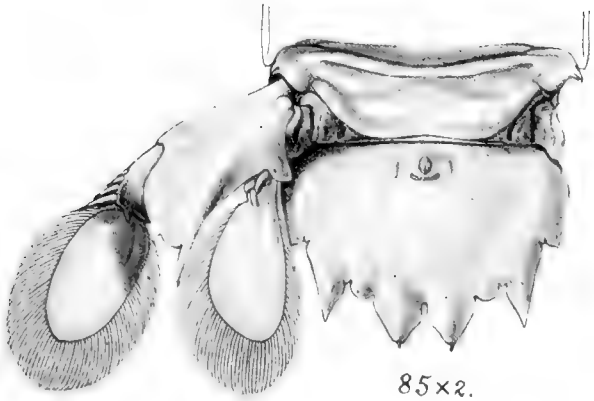

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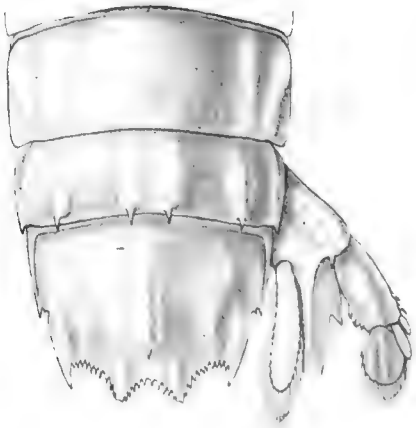

83×16.

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Fig. 77 Squilla raphidea. Figs. 78-80 Squilla annandalei. Figs. 81-83 'Leptosquilla schmeltzii.' Figs. 84-85 Pseudosquilla stylifera.

EXPLANATION OF PLATE VIII.

Lysiosquilla maculata (Fabricius).

FIG. 86.—Rostrum of a typical specimen.
,, 87.—Sketch of a large female, showing distribution of blue-black pigment.
,, 88.—Sketch of a male, showing distribution of pigment.
,, 89.—Telson of another male showing different pigmentation.
,, 90.—Raptorial claw of large female.
,, 91.—Raptorial claw of large male.

Lysiosquilla maculata var. *sulcirostris*, Kemp.

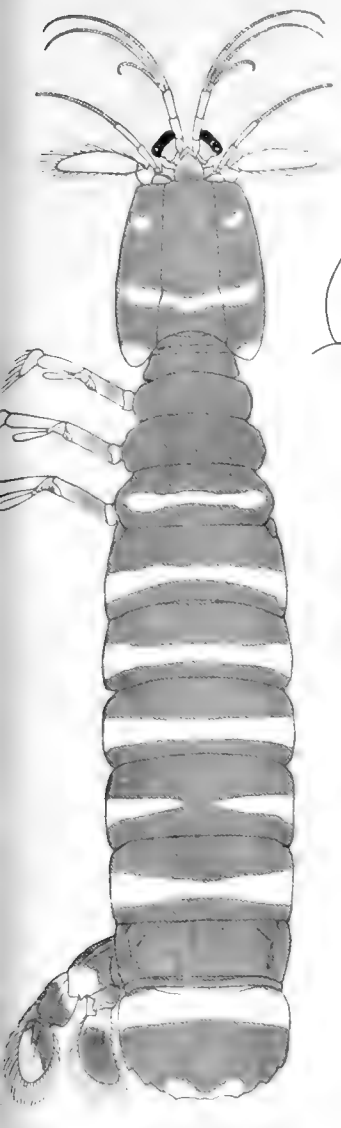
,, 92.—Rostrum.
,, 93.—Raptorial claw.

Lysiosquilla spinosa, Wood-Mason.

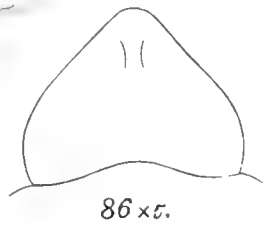
,, 94.—Left uropod of the type specimen, seen from beneath.

Lysiosquilla tigrina, Nobili.

,, 95.—Carapace and anterior appendages of the type specimen.
,, 96.—Raptorial claw of the same specimen.
,, 97.—Last abdominal somite and telson of the same specimen : dorsal view.
,, 98.—Last two abdominal somites, telson and uropods of the same specimen : ventral view.



87 2/3.



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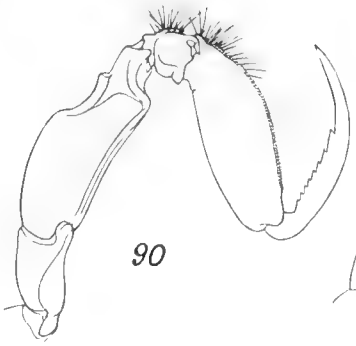

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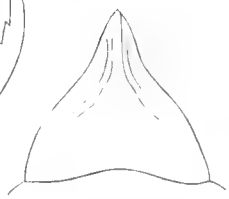
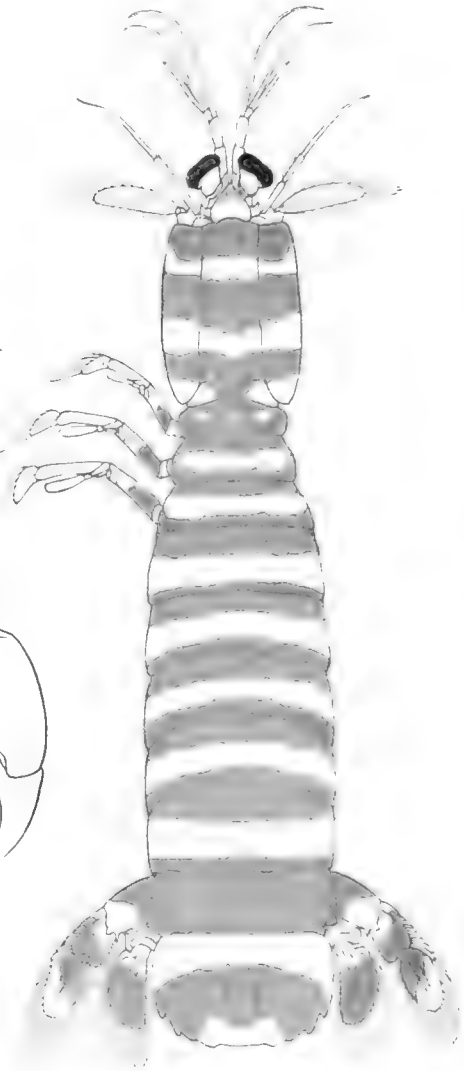


92×5.

91×1½.

93×1½.



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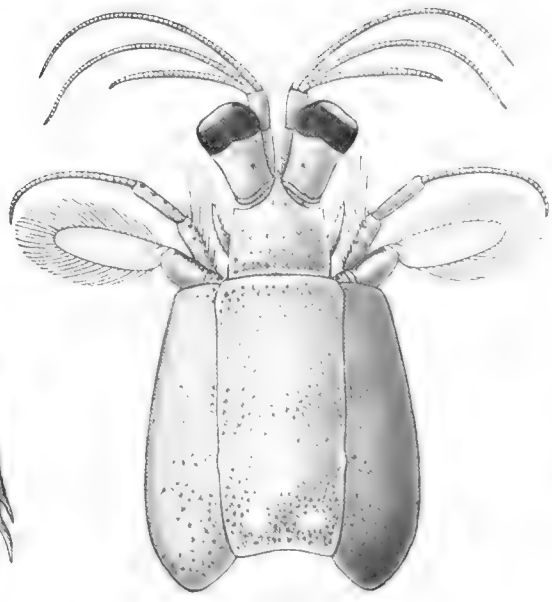

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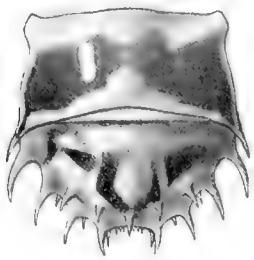

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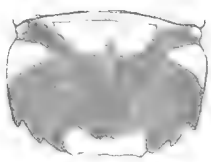

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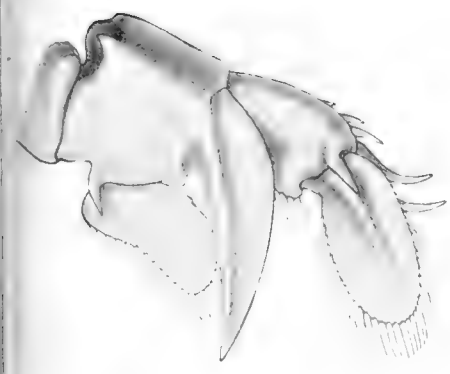

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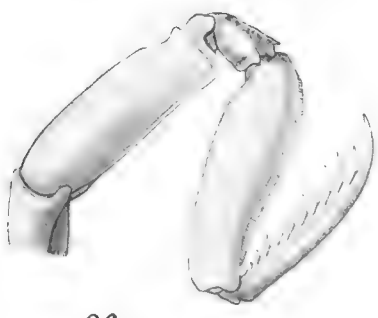

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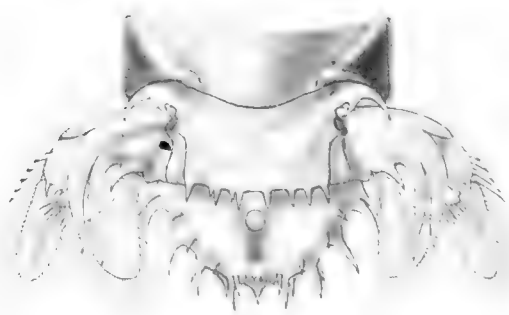

98×5.

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Figs. 86-91 Lysiosquilla maculata. Figs. 92-93 Lysiosquilla maculata var. sulcirostris.
Fig. 94 Lysiosquilla spinosa. Figs. 95-98 Lysiosquilla tigrina.

EXPLANATION OF PLATE IX.

Lysiosquilla insignis, Kemp.

FIG. 99.—Anterior half of the type specimen in dorsal view.

,, 100.—Raptorial claw of the same specimen.

,, 101.—Last two abdominal somites, telson and uropods of the same specimen : dorsal view.

,, 102.—Telson viewed from beneath a little obliquely.

Odontodactylus southwelli, Kemp.

,, 103.—Carapace and anterior appendages of the type specimen in dorsal view.

,, 104.—Raptorial claw of the same example.

,, 105.—Fifth, sixth and seventh thoracic somites in lateral view.

,, 106.—Last two abdominal somites, telson and uropods of the same specimen : dorsal view.

Gonodactylus chiragra (Fabricius).

,, 107.—Anterior part of a specimen with rostrum removed to show the form of the dorsal processes of the ophthalmic somite.

Gonodactylus demani, Henderson.

,, 108.—Anterior part of a specimen with rostrum removed to show the form of the dorsal processes of the ophthalmic somite.

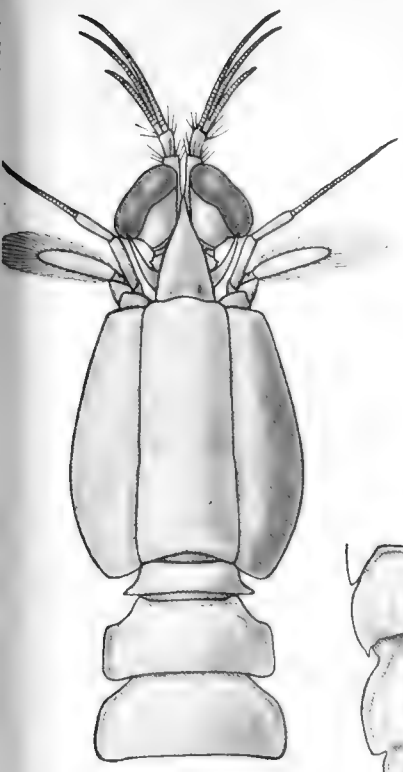
,, 109.
,, 110.
,, 111. } Last abdominal somite and telson of three individuals showing the variation in spinulation and in the form of the three median carinae : dorsal views.

Gonodactylus demani var. *spinosus*, Bigelow.

,, 112.—Last abdominal somite and telson of a specimen from Ceylon which is somewhat intermediate between the variety and the typical form : dorsal view.

Gonodactylus glabrous, Brooks.

,, 113.—Anterior part of a specimen with rostrum removed to show the form of the dorsal processes of the ophthalmic somite.



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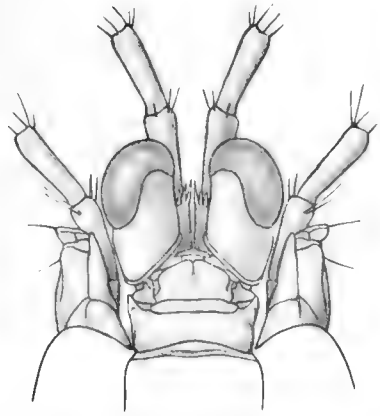

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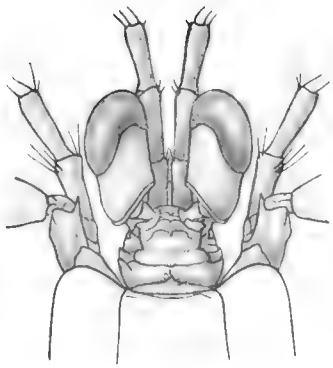

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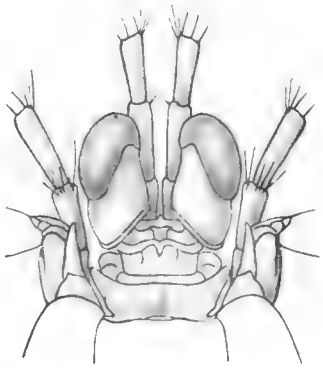
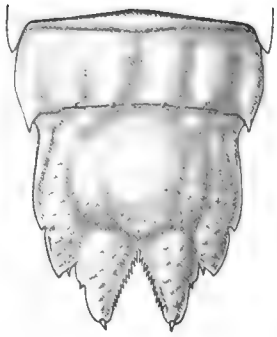


113×4.

109×7.



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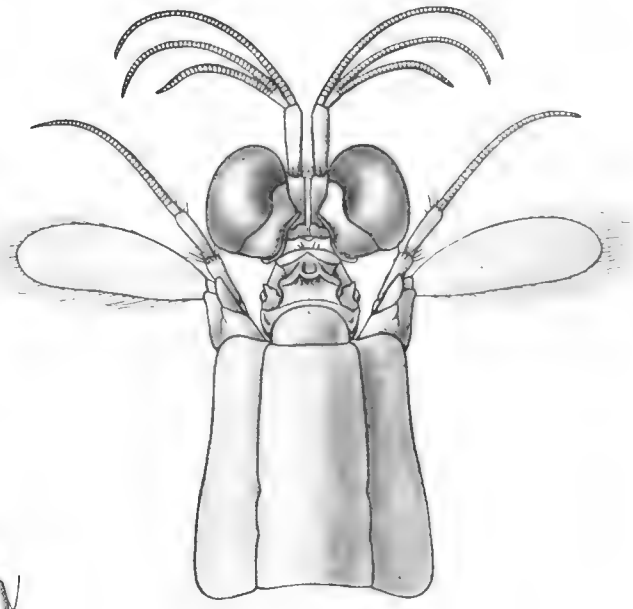

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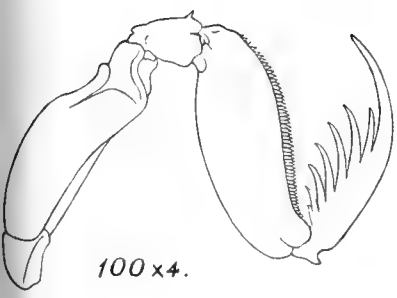

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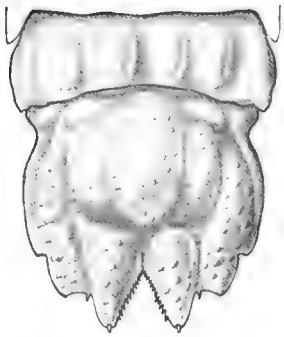

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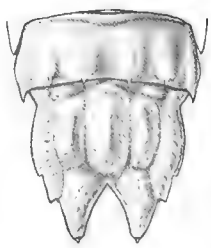

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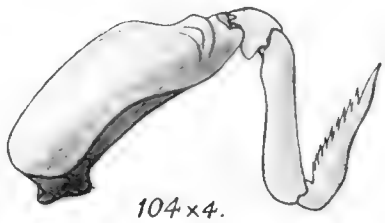

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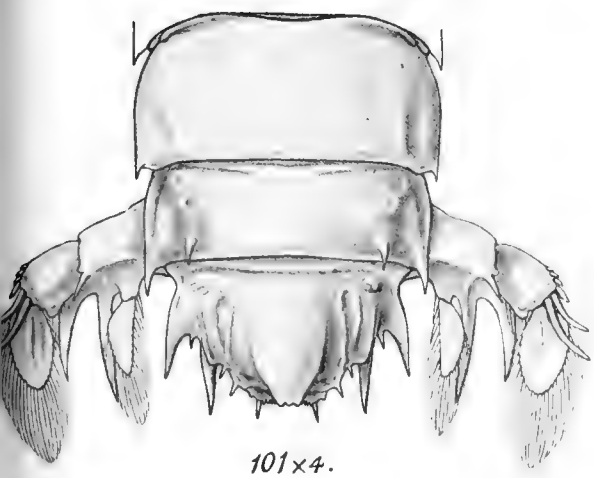

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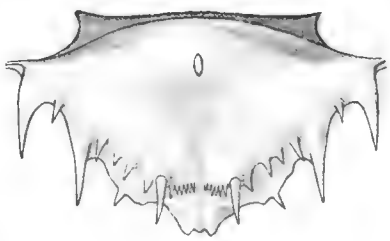

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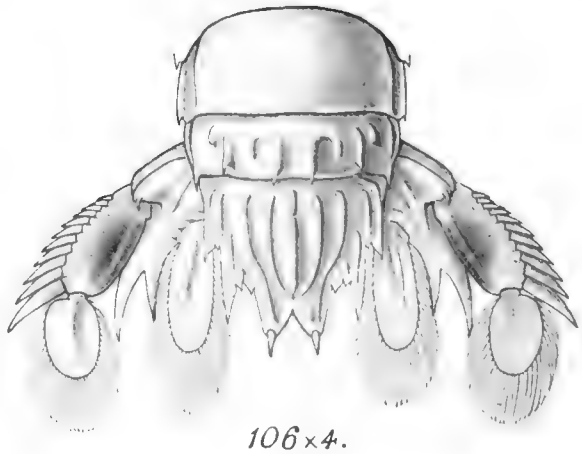

106×4.

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Figs. 99-102 Lysiosquilla insignis. Figs. 103-106 Odontodactylus southwelli. Fig. 107 Gonodactylus chiragra.
Figs. 108-111 Gonodactylus demani. Fig. 112 Gonodactylus demani var. spinosus.
Fig. 113 Gonodactylus glabrous.

EXPLANATION OF PLATE X.

Gonodactylus herdmani, Tattersall.

FIG. 114.—Last abdominal somite, telson and right uropods in dorsal view.
,, 114a.—Right inner uropod in dorsal view.

Gonodactylus brevisquamatus, Paulson.

,, 115.—Last two abdominal somites, telson and uropods in dorsal view (after Paulson).
,, 116.—Last abdominal somite, telson and left uropods viewed obliquely (after Paulson).

Gonodactylus pulchellus, Miers.

,, 117.—Anterior part of carapace, rostrum, eyes, etc., in dorsal view.
,, 118.—Last two abdominal somites, telson and left uropods in dorsal view.

Gonodactylus nefandus, Kemp.

,, 119.—Anterior part of carapace, rostrum, eyes, etc., in dorsal view.
,, 120.—Last two abdominal somites, telson and right uropods in dorsal view.

Gonodactylus glaber (Lenz).

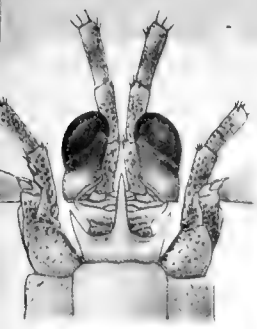
,, 121.—Last two abdominal somites, telson and right uropods in dorsal view.

Gonodactylus excavatus, Miers.

,, 122.—Anterior half of a specimen in dorsal view.
,, 123.—Last two abdominal somites, telson and left uropods in dorsal view.

Gonodactylus spinosissimus, Pfeffer.

,, 124.—Anterior half of a specimen in dorsal view.
,, 125.—Last two abdominal somites, telson and left uropods in dorsal view.



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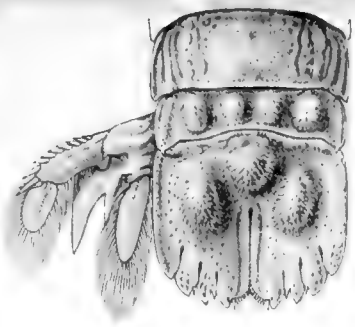

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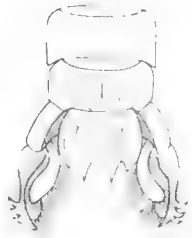

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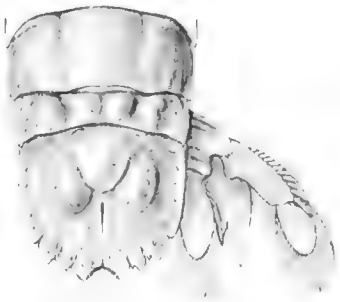

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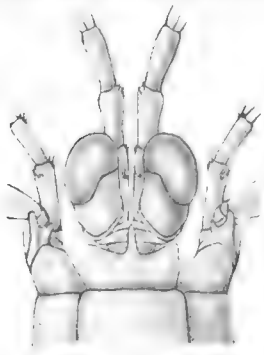

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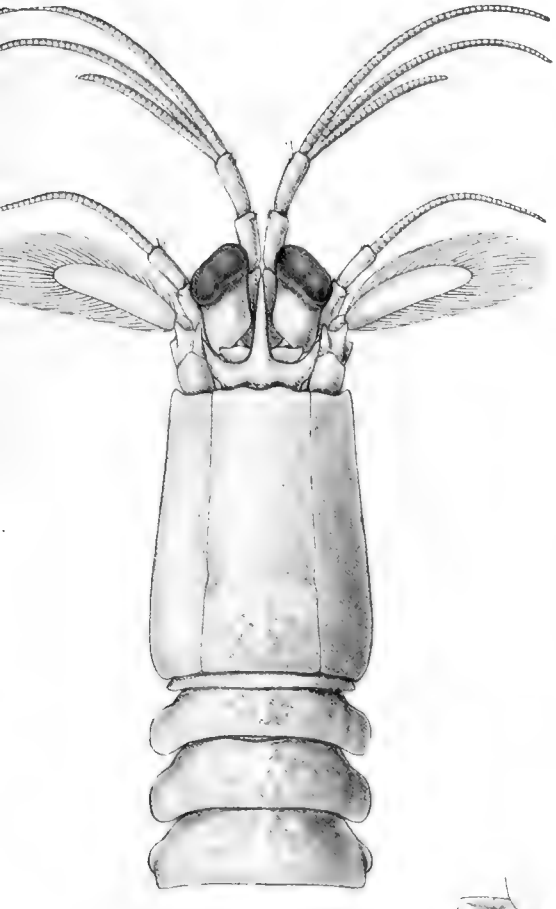

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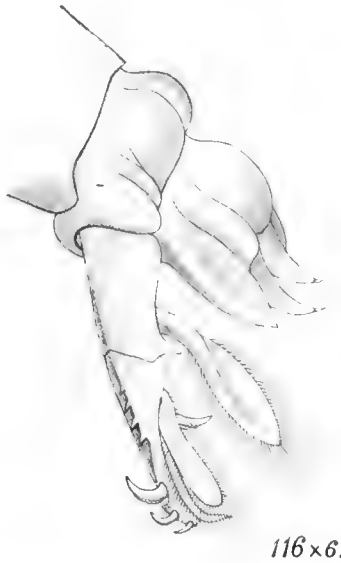

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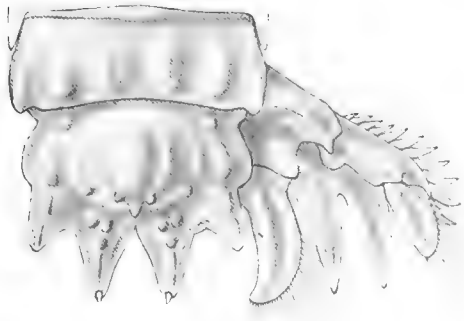

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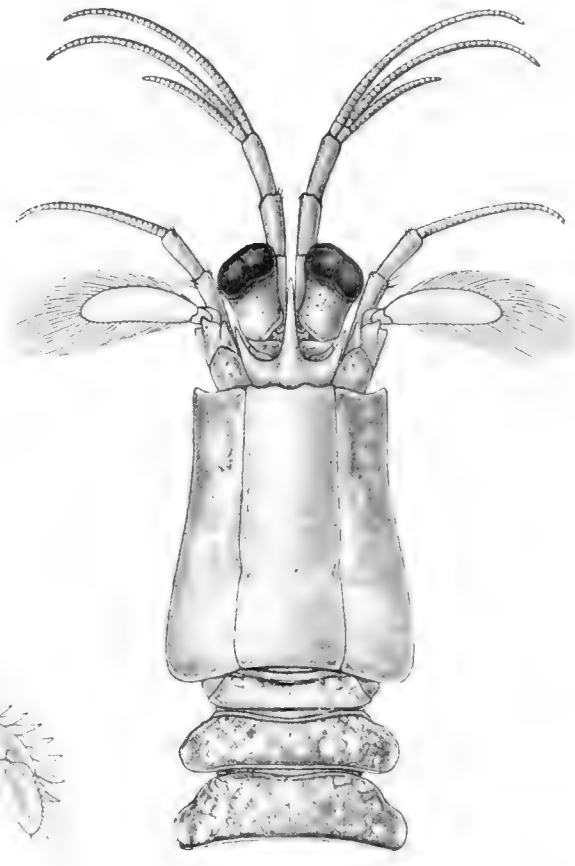

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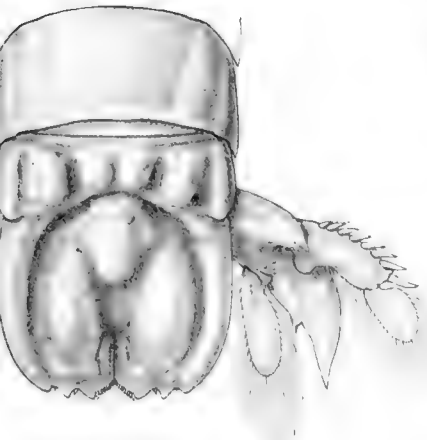

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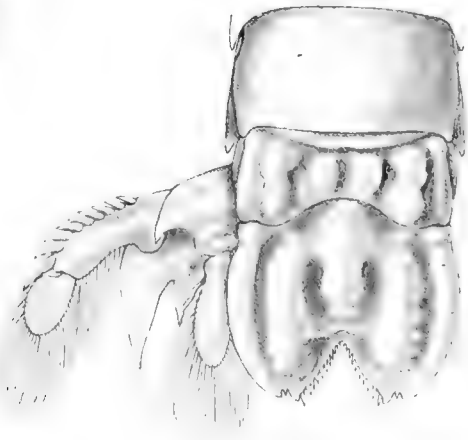

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C. Mordul, del.

Fig. 114 Gonodactylus herdmani. Figs. 115-116 Gonodactylus brevisquamatus. Figs. 117-118 Gonodactylus pulchellus. Figs. 119-120 Gonodactylus nefandus. Fig. 121 Gonodactylus glaber. Figs. 122-123 Gonodactylus excavatus. Figs. 124-125 Gonodactylus spinosissimus.

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