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Notes on some Australian and New Zealand Stomatopod Crustacea, with an Account of the Species Collected by the Fisheries Investigation Ship *Endeavour*

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Figs. 1-10

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CONTENTS

ABSTRACT

Observations are presented on several small collections of stomatopods from Australia and New Zealand. In all, 24 species in 10 genera are reported, with the treatment of individual species varying from a brief listing to a complete redescription. A key to the 14 genera known from the area is presented. The New Zealand and Australian species of *Heterosquilla* are redescribed, and one new genus, *Hadrosquilla*, and two new subgenera of *Heterosquilla*, *Austrosquilla* and *Heterosquilloides*, are recognized. A new species of *Manningia* from Australia, *M. notialis*, is described. *Gonodactylus platysoma* Wood-Mason and *G. smithii* are resurrected from the synonymy of *G. chiragra* (Fabricius). It is shown that *Squilla inornata* Tate is not synonymous with *S. perpensa* Kemp, as previously believed, and that *S. anomala* Tweedie is a synonym of *S. perpensa*. Synonymies for the few New Zealand stomatopods are brought up-to-date. The references include most of the papers published on adult stomatopods from the Indo-Pacific since 1941.

INTRODUCTION

This paper was originally planned as a short report on the stomatopods collected by the ill-fated Fisheries Investigation Ship *Endeavour* in Australian waters between 1909 and 1914. The *Endeavour* collection, although small, includes specimens of two rare species, *Squilla foveolata* Wood-Mason and *Odontodactylus cultrifer* (White), as well as a large series of *Hemisquilla ensigera* (Owen).

It was then decided that this would be an opportune place to include remarks on the small series of stomatopods obtained from northern Australia by the joint U.S. National Museum-Australian Museum Expedition to Arnhem Land in 1948, hereafter referred to as the Arnhem Land Expedition. This collection included two species of *Gonodactylus* as well as an undescribed species of *Manningia*.

In the early stages of preparation of the manuscript, several letters relating to it were exchanged with J. C. Yaldwyn, of the Australian Museum, who encouraged further expansion and who made available, on loan and exchange, representatives of several species which I felt required further study. These included the specimens of *Gonodactylus* that Stephenson and McNeill (1955) had suggested were near *G. platysoma* Wood-Mason as well as specimens of the six species of *Heterosquilla* that had been recorded from Australia and New Zealand.

Our knowledge of the Indo-Pacific stomatopod fauna stems mainly from the excellent monograph published by Kemp in 1913, supplemented by many papers of more restricted coverage that have been published since that time. That his paper is still the standard reference work is a tribute to Kemp's thoroughness, accuracy, and good judgment. The respect for Kemp has been so great, however, that many subsequent workers have accepted his findings without question and have shown reluctance to re-examine his conclusions concerning several difficult problems. For example, many "variants" in *Gonodactylus* are referred to *G. chiragra* (Fabricius), and *G. platysoma* Wood-Mason has continued to be treated as a "variety" of *G. chiragra*. Additional problems in *Gonodactylus* and other genera have been ignored and Kemp's treatment has seldom been questioned. As shown below for *Gonodactylus*, which is one of the most difficult stomatopod genera, several recognizable species have been relegated to *G. chiragra*.

A similar situation exists in the Pacific species of *Lysiosquilla*. *L. maculata* (Fabricius) and two varieties, *sulcirostris* Kemp and *tredecimdentata* Holthuis are presently recognized. All three of these are actually distinct species, differing not only in

morphological features but in colour pattern. In addition, there are at least two undescribed species involved in what is now called *L. maculata*. All of the Pacific species of *Lysiosquilla* need to be restudied in detail.

In their key to the Australian species of *Lysiosquilla*, Stephenson and McNeill (1955, p. 246, footnote) note that "it seems doubtful if this variety [*sulcirostris*] is distinct from the '*forma typica*'." In my opinion, there are good reasons for recognizing *sulcirostris* as a distinct species; it may or may not occur in Australia.

It is also Kemp's authority that until recent years has stabilized the generic nomenclature of the stomatopods. Kemp's influence has been so great that some authors have argued that genus A was closely related to genus B because it was next to that genus in Kemp's key, even though Kemp himself made little attempt to show interrelationships of genera. Recent work, by Serène (1962) on *Pseudosquilla*, Manning (1963) on that genus and *Lysiosquilla*, and Holthuis (1964) on *Gonodactylus* and the *raphidea* section of *Squilla*, has shown that many of the old, accepted genera were composites. As several important generic changes have been proposed since the last major work on Australian stomatopods was published (Stephenson and McNeill, 1955), a key to the Australian genera is included here. Genera not further treated in the present paper are set off in brackets.

Inasmuch as no further work on the Australian stomatopods is currently planned by the present author, it seems best to include here observations on miscellaneous specimens from Australia examined in American and European museums.

The Australian Stomatopoda have been studied in some detail in recent years, primarily by W. Stephenson, of the University of Queensland. As a result of his efforts the Australian fauna is one of the best known in the world, perhaps second only to the Indian fauna. Some sixteen species were recorded from Australia by Kemp (1913); at the present time this number has increased to forty-eight. A further increase can be expected, for the present work clearly shows that there is still much to be learned about the Australian stomatopods, particularly in the genus *Gonodactylus*.

Fourteen genera, including a new genus described below, are known to occur in Australian and New Zealand waters, and species in ten of them are treated in this report. Species in two of the remaining four, *Pseudosquilla ciliata* (Fabricius) and *Lysiosquilla maculata* (Fabricius), were discussed by Stephenson and McNeill (1955), but representatives of the remaining two genera, *Mesacturus* and *Acanthosquilla*, were included by them under different generic names, *Gonodactylus* and *Lysiosquilla*, respectively. *Mesacturus* is represented in Australia by *M. spinosocarinatus* (Fukuda), and *Acanthosquilla* by *A. acanthocarpus* (Miers) and *A. multifasciata* (Wood-Mason).

In contrast with the Australian fauna, the New Zealand stomatopod fauna, although impoverished, is very poorly known. Eight species have been recorded from New Zealand, but the occurrences of only three, *Squilla armata* H. Milne-Edwards, *Heterosquilla tricarinata* (Claus), and *H. brazieri* (Miers), have been verified. These three species have been treated in the present paper.

The status of the following five species recorded from New Zealand is not clear: *Squilla nepa:* Heller, 1865; *S. armata:* Kirk, 1879 (part); *S. affinis:* Chilton, 1891, 1911; *S. tridentata* Thomson, 1882; and *Protosquilla trispinosa*: Heller, 1865. No attempt will be made here to comment on these records. A future paper is planned with J. C. Yaldwyn to treat the New Zealand fauna as a whole and to give new records for that area.

Available collections of stomatopods from New Zealand should be studied in the light of current knowledge in order to determine the status of the five species mentioned above and to give a firmer basis for assessing the relationships of the New

Zealand fauna. It seems probable that numerous specimens of stomatopods have been collected since the New Zealand species were last studied by Chilton (1911). Also, a comparative study of series of *S. armata* from New Zealand, South Africa, and South America should be made. As pointed out below, it is not unlikely that the New Zealand *S. armata* is a distinct population or a distinct species.

Only four published references to stomatopods collected by the *Endeavour* are known. *Hemisquilla ensigera* (Owen) was reported by Stephenson (1953, 1955) and Stephenson and McNeill (1955), and *Squilla inornata* Tate was recorded by Stephenson (1953). As Stephenson has studied most stomatopod collections present in Australian museums it is likely that the *Endeavour* specimens discussed herein form the remainder of that collection.

METHODS

Synonymies, unless prefixed by the phrase "Restricted Synonymy", are as complete as possible; in general, there is little need to provide complete synonymies for these have been given recently by Stephenson and McNeill (1955). The synonymies usually include references to the original description, the papers by Kemp (1913), Holthuis (1941), together with references to pertinent papers published since 1941. Generic synonymies are brief, and, for the more recently recognized genera, the citation of the original publication is given. For older genera no citation is needed.

The bibliography includes all references cited herein as well as all papers dealing with adult stomatopods from the Indo-Pacific published since 1941 that have come to my attention. The present bibliography, in combination with those given by Kemp (1913), Balss (1938), and Holthuis (1941), should provide almost complete coverage of the Indo-Pacific stomatopods.

Measurements used herein are given in mm. In the material examined, the numerals following the number of specimens denote total length (TL), unless carapace length (CL) is specified; the latter is given only for broken or damaged specimens. Total length is measured along the midline from the apex of the rostral plate to the apices of the submedian teeth of the telson; carapace length is also measured along the midline and does not include the rostral plate. The width of the abdomen is always measured at the fifth somite; this is usually the widest portion of the abdomen and a measurement here, immediately anterior to the uropods, eliminates the necessity of counting somites to make sure the same one is always measured. Broken specimens are indicated by the abbreviation "brk.".

An abdominal spine formula of: submedian, 6; intermediate, (1) 2-6; lateral, 2-6; marginal, 1-5, indicates that the submedian carinae terminate in spines on the sixth somite only, the intermediates and laterals are spined on the second to sixth somites, inclusive, and the marginal carinae are armed on the first five somites. The parenthesis in the formula indicates that on that somite the carina may be armed. A telson denticle formula of "5, 7-10, 1" indicates that on the telson margin there are 5 submedian, 7-10 intermediate, and 1 marginal denticle. The count of teeth on the dactylus of the raptorial claw always includes the terminal tooth.

Several indices are used below, and all are based on the relative length of a specific portion of the body to the carapace length, × 100. A much more reliable index can be calculated from the carapace length than from the total length, which is highly variable and difficult to measure accurately; total length is used here only to give an indication of the overall size of the specimens. The Corneal Index (CI) is

calculated as Carapace Length/Cornea Width × 100; this is comparable to Kemp's Corneal Index, which was only a ratio. In *Gonodactylus* the Abdominal Width/Carapace Length Index (AWCLI) is used as an expression of the relative width of the body.

The following abbreviations are used to show the disposition of the material reported herein: AM (Australian Museum); BM(NH) (British Museum (Natural History)); MNHNP (Muséum National d'Histoire Naturelle, Paris); MCZ (Museum of Comparative Zoology, Harvard); RNHL (Rijksmuseum van Natuurlijke Historie, Leiden); USNM (U.S. National Museum). As part of the original agreement between the Australian Museum and the U.S. National Museum, types and one-half of the material collected by the Arnhem Land Expedition are to be deposited in the Australian Museum.

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Many people have contributed to this study. J. C. Yaldwyn, of the Australian Museum, provided encouragement for working up the *Endeavour* collection, allowed a great deal of latitude in the expansion of the report, and supplied many critical specimens on loan and exchange, including a paratype of *Manningia notialis*. W. Stephenson, University of Queensland, commented upon some of the problems treated here and was instrumental in obtaining a specimen of *Manningia* from the Queensland Museum, through the late George Mack, then its Director. J. Forest made available on loan a specimen of *H. tricarinata* from the collection of the Muséum National d'Histoire Naturelle, Paris. L. R. Richardson, Victoria University of Wellington, donated three specimens of *S. armata* from New Zealand. On a recent trip to Europe, made possible by a grant from the National Science Foundation (NSF GB-1602), I had the opportunity of examining stomatopods in several museums. At the British Museum, Angela Evans and R. W. Ingle spent a great deal of time helping me locate specimens and literature; Ingle also expedited the loan of several specimens. At the Rijksmuseum van Natuurlijke Historie at Leiden, L. B. Holthuis spent the greater part of a week helping me locate specimens, especially de Haan's types. With the help of J. Stock at the Zoological Museum, Amsterdam, I was able to examine the important Siboga collection of stomatopods. The illustrations provided herein were executed by my wife, Lilly, under National Science Foundation Grant GB-1602; NSF support of studies on stomatopod systematics is gratefully acknowledged. Several of my colleagues, including F. A. Chace, Jr, D. L. Pawson, and H. H. Hobbs, Jr, provided helpful criticism of various portions of the manuscript.

SYSTEMATIC ACCOUNT

KEY TO GENERA OF STOMATOPOD CRUSTACEANS KNOWN FROM AUSTRALIA

1. Telson with well-defined median dorsal carina 2
   Dorsal surface of telson smooth or with a broad, raised area, but without a sharp median carina 11

2. Four or more intermediate denticles present on posterior margin of telson 3
   No more than two intermediate denticles on posterior margin of telson 5

3. Eyes small, cornea not as broad as dilated stalk; eye-scales fused; carapace usually with few carinae ..... *Clorida*, p. 86
   Eyes large or small, cornea as broad as or broader than stalk (except *Squilla foveolata*); eye-scales separate; carapace usually with normal complement of carinae 4

4. Posterolateral margin of carapace with deep excavation posterior to angular lobe; propodus of raptorial claw with erect spines on upper margin ..... *Harpiosquilla*, p. 87
Posterolateral margin of carapace not deeply excavated; propodus of claw with even pectinations on upper margin ..... *Squilla*, p. 89

5. Ischiomeral articulation of raptorial claw terminal 6
Ischiomeral articulation of raptorial claw distal to proximal end of merus 8

6. Dactylus of raptorial claw unarmed; rostral plate triangular; telson with three longitudinal carinae ..... *Hemisquilla*, p. 102
Dactylus of claw with teeth on inner margin; rostral plate variously shaped, not triangular; telson with more than three longitudinal carinae 7

7. Dactylus of claw with three teeth; rostral plate ovate; basal prolongation of uropod with two spines, outer longer, inner without spinules [*Pseudosquilla*]
Dactylus of claw with four teeth; rostral plate pentagonal; basal prolongation of uropod with two spines, inner longer, with spinules on inner margin ..... *Manningia*, p. 102

8. Dactylus of claw armed on inner margin; rostral plate unarmed *Odontodactylus*, p. 105
Dactylus of claw unarmed; rostral plate with at least one sharp spine 9

9. Anterolateral angles of carapace not in advance of base of rostral plate; posterior margin of sixth abdominal somite concave .... *Protosquilla*, p. 106
Anterolateral angles of carapace in advance of rostral plate; posterior margin of sixth abdominal somite straight or slightly convex 10

10. Rostral plate sharply trispinous ..... [*Mesacturus*]
Rostral plate with sharp median spine, anterolateral angles rounded or acute but not produced into spines ..... *Gonodactylus*, p. 107

11. Dorsal surface of telson without spines or prominent, raised median projection, marginal teeth and denticles largely fused..... [*Lysiosquilla*]
Dorsal surface of telson with transverse row of spines or prominent median projection, marginal teeth and denticles distinct 12

12. Dorsal armature of telson consisting of a semicircular, transverse row of 5 or more spines, median spine neither carinate nor on a broad median projection ..... [*Acanthosquilla*]
Telson with broad, raised median area, lateral spines or carinae present or absent 13

13. Median projection of telson broad, truncate; posterior margin of telson with four pairs of lateral projections, not carinate anteriorly, above marginal armature ..... *Hadrosquilla*, p. 115
Median projection of telson broad or tapering, apex sharp or obtuse, not truncate; lateral projections of telson, if present, carinate anteriorly ..... *Heterosquilla*, p. 118

Clorida Eydoux and Souleyet, 1842

Clorida Eydoux and Souleyet, 1842, p. 264.

Remarks.—In his discussion of the relationship of *Squilla granti*, Stephenson (1953a) pointed out that the "*Chloridella*" group of *Squilla*, to which *S. granti* belongs, does not conform to Kemp's (1913) widely accepted definition of the genus. This "group" corresponds to the genus *Clorida* which may be characterized by the following combination of characters: (1) the eyes are small, with the stalks dilated, broader than the cornea; (2) the eye-scales are fused; (3) the carinae of the carapace are poorly developed, generally being present on the posterior portion only; (4) the ischiomeral articulation of the raptorial claw is not really terminal, but is situated to one side of the proximal end of the merus; and (5) the submedian marginal teeth of the telson have movable apices.

Clorida now includes 11 species: *Squilla microphthalma* H. Milne-Edwards, 1837; *Clorida latreillei* Eydoux and Souleyet, 1842; *Clorida decorata* Wood-Mason, 1875; *Chloridella depressa* Miers, 1880; *Chloridella rotundicauda* Miers, 1880; *Squilla chlorida* Brooks, 1886; *Squilla gibba* Nobili, 1903; *Squilla verrucosa* Hansen, 1926; *Squilla choprai* Tweedie, 1935; *Squilla merguiensis* Tiwari and Biswas, 1952; and *Squilla granti* Stephenson, 1953. *Squilla fallax* Bouvier, 1914, may also belong in this genus. Of these, only three species, *C. depressa*, *C. microphthalma*, and *C. granti* have been recorded from Australia. Comments on the nomenclature of *Clorida* are included in a paper on stomatopods for the *Treatise on Invertebrate Paleontology* (Holthuis and Manning, in press).

During a recent visit to the British Museum (Natural History) I had the opportunity of examining the type of *C. depressa* as well as a specimen of *C. microphthalma* from Australia. Notes on both of these are given below.

Clorida depressa (Miers, 1880)

Restricted synonymy:—

Chloridella microphthalma: Miers, 1880, p. 14, pl. II, figs 1-4 [provisionally named *C. depressa* on p. 15] [not *S. microphthalma* H. Milne-Edwards, 1837].

Squilla depressa: Serène, 1952, p. 2, text-figs 3-4, 9, 18, 21, pl. 1, figs 3, 6, pl. 2, figs 3, 6-10—Stephenson and McNeill, 1955, p. 240 [and synonymy].

Material.—1♂, 37.0; Port Essington, Northern Territory; holotype; BM(NH) Reg. No. 1957.12.21.1.

Diagnosis.—Eyes small, not extending past midpoint of basal segment of antennular peduncle; cornea small, not half as long as eye but about half as wide as stalk; eyes not divergent, inner margins appressed for at least half their length; eye-scales fused, feebly indented along midline; antennular peduncle shorter than carapace; rostral plate semicircular; 4 epipods present; mandibular palp present; merus of raptorial claw extending to cornea; abdominal carinae spined as follows: submedian, 6; intermediate, 5-6; lateral, 5-6; marginal, 1-5.

Discussion.—*C. depressa* was provisionally synonymized with *C. microphthalma* by Kemp (1913) and only recently has been redescribed by Serène (1952), who pointed out the differences between the two species. The type agrees with Serène's account in most details, differing only in that the eyes are appressed for at least half their length rather than being divergent from their bases.

The presence of a mandibular palp distinguishes this species from *C. granti* and the short eyes, semicircular rostral plate, and larger number of spined marginal abdominal carinae distinguishes it from *C. microphthalma*.

Distribution.—Known only from Australia, where it has been recorded from the Northern Territory and several localities in Queensland. Shallow water.

Clorida microphthalma (H. Milne-Edwards, 1837)

Restricted synonymy:—

Squilla microphthalma: H. Milne-Edwards, 1837, p. 523—Kemp, 1913, p. 31, pl. I, figs 17-20—Stephenson, 1962, p. 39, pl. I, figs E, F, G, text-fig. 2.

Material.—1♂, 43.3; Roebuck Bay, Western Australia; Mrs B. Gray; BM(NH) Reg. No. 1932.11.30.191.

Remarks.—This specimen agrees well with Stephenson's (1962) account of specimens from the same locality, differing only in that the rostral plate is triangular and one of the marginal carinae of the third abdominal somite is armed posteriorly on one side.

Distribution.—Western Indo-Pacific, from Indonesia, Viet Nam and Australia to India and Zanzibar. In Australia it has been recorded from Western Australia and the Northern Territory. Littoral to 60 m.

Harpiosquilla Holthuis, 1964

Harpiosquilla Holthuis, 1964, p. 140.

Remarks.—This genus was erected to include three species heretofore placed in *Squilla*, *S. raphidea* Fabricius, 1798, *S. harpax* de Haan, 1844, and *S. annandalei* Kemp, 1911. *H. harpax* had been considered a synonym of *H. raphidea* until recently, when Tiwari and Biswas (1952) showed that they were distinct.

One of the specimens sent to the U.S. National Museum on exchange from the Australian Museum by J. C. Yaldwyn is apparently *H. harpax*. It seems likely that other specimens from Australia among those reported by Stephenson and McNeill (1955) as *Squilla raphidea* will also prove to be *H. harpax*. Judging by the size range reported by those authors for their material (TL 132-314 mm), both species are present in Australia.

The specimen described below differs from the account of *H. harpax* given by Tiwari and Biswas in several respects, and it also differs from specimens from other localities available for comparison. The entire *Harpiosquilla* complex needs to be re-examined to determine whether or not one or more undescribed species, related to *H. harpax*, exist or to determine the variability of that species. Particular attention should be paid to the abdominal carination, the shape of the lobe on the inner spine of the basal prolongation of the uropod, and the colour pattern.

Harpiosquilla harpax (de Haan, 1844)

Fig. 1

Squilla harpax de Haan, 1844, atlas, pl. li, fig. 1—Tiwari and Biswas, 1952, p. 358, text-fig. 3b, d, f—Ingle, 1963, p. 18, figs 9, 59.

Harpiosquilla harpax: Holthuis, 1964, p. 140 [discussion].

Material.—1♀, 170.0; Darwin, Northern Territory; early 1954; Capt. F. E. Wells, Harbourmaster, col.; exchange from Australian Museum, USNM 111354.

Diagnosis.—Antennular peduncle shorter than carapace; eye large, CI 336; lateral margins of rostral plate faintly sinuous, not markedly concave distally, apex short; carapace narrowed anteriorly, anterior width less than one-half median

length; carinae of carapace discernible, not sharply developed; dactylus of raptorial claw with 7 teeth; mandibular palp and 5 epipods present; lateral process of fifth thoracic somite unarmed; intermediate carinae of thoracic somites unarmed posteriorly; ventral keel of eighth thoracic somite broadly rounded, inclined posteriorly; submedian carinae of abdomen present; abdominal carinae spined as follows: submedian, 6; intermediate, 2-6; lateral, 1-6; marginal, 1-5; sixth abdominal somite with median keel on posterior half of ventral surface; telson as broad as long, denticles sharp, 5, 7-10, 1; prelateral lobe present dorsally, carina of lateral tooth over two-thirds as long as carina of prelateral lobe; lobe on outer margin of inner spine of basal prolongation of uropod with margin straight or convex, not strongly concave.

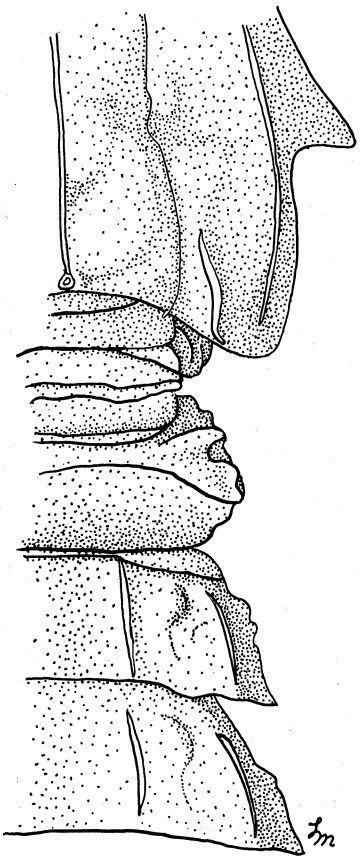

Fig. 1.—*Harpiosquilla harpax* (de Haan), female, TL 170.0 mm, Darwin. Lateral processes of thoracic somites and posterior portion of carapace.

Colour.—Dark pigment at least partially faded in this specimen, except for single dark spot on upper distal portion of merus of raptorial claw, dark lines on carinae and grooves of carapace and on posterior margins of all somites except for sixth abdominal; telson with elongate black patch, fully half as long as telson, on each side of median crest; uropods with faint indications of pigment.

Measurements.—Female, TL 170.0; carapace length, 30.6; anterior width of carapace, 13.6; cornea width, 9.1; rostral plate length, width, 5.7, 5.1; telson length, width, 29.0, 29.0.

Discussion.—This specimen differs from those reported by Tiwari and Biswas (1952) and from others in the collection of the U.S. National Museum in the following features: (1) the cornea is less broad (CI 336 instead of 270-320) and is noticeably stouter; (2) the carapace is narrower anteriorly and the carinae are not as sharply defined; (3) the submedian carinae of the abdomen are well-developed; (4) the telson is shaped and ornamented differently; it is as broad as long, the denticles are sharp, not rounded, and the prelateral lobe is well-formed dorsally; in addition, the carina of the prelateral lobe is noticeably shorter; (5) the lobe on the inner spine of the basal prolongation of the uropod is not strongly concave but is almost convex; and (6) there is one pair of elongate rectangular black pigment spots on the telson rather than a pair of small black squares.

These differences strongly suggest that there is more than one species involved in the currently-recognized *H. harpax* but it is not possible to determine whether or not the Australian form is *harpax* without comparing it directly with type material. The Australian form more nearly resembles de Haan's illustration of *H. harpax*, for he shows the carinate abdomen and the straight lobe on the basal prolongation of the uropod, than the specimens described by Tiwari and Biswas (1952).

The possibility that *H. harpax* is variable in the features mentioned above cannot be overlooked. A large series of specimens from different localities must be studied before the problem can be solved.

Distribution.—Indo-Pacific, from Japan and northern Australia westward to the Red Sea (Tiwari and Biswas, 1952; Ingle, 1963). Depth range unknown.

Squilla Fabricius, 1787

Remarks.—*Squilla*, which now includes over eighty species, is not only one of the largest but also is one of the best known of the stomatopod genera. With few exceptions the Indo-Pacific species, at least, have been reasonably characterized and illustrated, largely due to the efforts of Kemp (1913). It was somewhat surprising, then, to learn from a comparison of types that *S. oratoria* var. *perpensa* Kemp, 1911, was conspecific with *S. anomala* Tweedie, 1935, and distinct from *S. inornata* Tate, 1883. Kemp's species had been synonymized with Tate's and was considered to be distinct from *S. anomala*. Although the Indo-Pacific species of *Squilla* are comparatively well known, little is known about geographic variation or the overall range of many species. Thus it is still worthwhile to provide diagnoses and figures of material at hand when collections from limited geographic areas or areas beyond the known range of species are reported. For this reason diagnoses and sketches of diagnostic features, based on Australian specimens, are presented here for three members of the *S. oratoria* complex (*S. inornata*, *S. interrupta*, and *S. woodmasoni*).

Perhaps it will also be of value to comment here on the status of varietal forms such as those recognized by Kemp (1913) and some subsequent workers. Kemp used variety to indicate close affinity and/or similarity, as in *Gonodactylus chiragra* var. *platysoma*, *Lysiosquilla maculata* var. *sulcirostris*, and *Squilla oratoria* var. *perpensa*, among others. These varieties differed from the "typical" species in seemingly minor details, but the differences were constant. Although these "forms" were called varieties by Kemp and subsequent workers, they were treated as species. The term variety was not necessarily used to indicate a geographic race (subspecies) or an unnamable variant. In some cases Kemp's varieties were sympatric (*chiragra* and *platysoma*), in others they were allopatric (*oratoria* and *perpensa*). All three of the examples

mentioned above are valid, recognizable species in my opinion. They are distinct throughout their ranges and there is no evidence of intergradation where they are found together.

Sixteen species of *Squilla*, not including the species currently placed in *Clorida* and *Harpiosquilla*, have been recorded from Australia, and six of these are reported here. Among the Australian species are five members of the *S. oratoria* complex. Since there has been considerable confusion in the past over the diagnostic features of these similar but distinct species, a table is included summarizing these features for the Australian species.

A description of the single species of *Squilla*, *S. armata* H. Milne-Edwards, known with certainty to occur in New Zealand, is also included. *S. armata* and its ally *S. gracilipes* Miers share one feature which distinguishes them from all other species of *Squilla*, eye-scales produced into strong, anteriorly-directed spines. This feature, in combination with the reduction of carinae on the carapace, loss of the prelateral lobe and the presence of movable apices on the submedian teeth of the telson, and the restriction of these species to cold temperate waters of the Southern Hemisphere, seem to indicate separation at the generic level. The name *Pterygosquilla* Hilgendorf, proposed in 1890 for *P. laticauda* (a synonym of *Squilla gracilipes*), is available. Additional work with a larger series of specimens of *S. armata* and further analysis of characters within *Squilla* might well show that *Pterygosquilla* should be recognized.

Squilla armata H. Milne-Edwards, 1837

Fig. 2

Restricted synonymy:—

Squilla armata H. Milne-Edwards, 1837, p. 251.—Hector, 1877, p. 474.—Kirk, 1879a, p. 401.—Miers, 1880, p. 26.—Filhol, 1885, p. 52 [listed]; 1886, p. 435 [listed].—Chilton, 1891, p. 60.—Hutton, 1904, p. 256 [listed].—Chilton, 1911, p. 135, text-figs 1-2; 1911a, p. 306.—Kemp, 1913, p. 41, pl. II, figs 28-29.—Thomson, 1913, p. 241.—Thomson and Anderton, 1921, p. 108.—Parisi, 1922, p. 93.

not *Squilla armata:* Whitelegge, 1900, p. 199 [=*S. mcneilli* Stephenson].

Squilla armata var. *schizodontia* Richardson, 1953, p. 315, text-figs 1-3.

Material.—2♂, 113.6-114.3; 1♀, 121.7; New Zealand; no other data; from L. R. Richardson; USNM 112415.—1♀, 118.2; Laurie Harbor, Auckland Is.; BM(NH) Reg. No. 45.69.

Diagnosis.—Body rough, covered with minute tubercles; antennular peduncle slightly shorter than carapace; eyes of moderate size, set obliquely on stalk, CI 481-521; eye-scales produced into erect spinules; anterior margin of ophthalmic somite projecting forward, bituberculate; rostral plate triangular, lateral margins sinuous, apex rounded; carapace without median carina, other carinae reduced, reflected marginals and short laterals only present, laterals extending just anterior to cervical groove; dactylus of raptorial claw with 6-8 teeth, outer margin flattened but not markedly sinuate; dorsal ridge of carpus undivided, terminating in strong tooth; merus unarmed inferodistally; mandibular palp absent; 4 epipods present; lateral process of fifth thoracic somite a sharp spine directed laterally, ventral spines of fifth somite absent or reduced to blunt lobes; lateral processes of sixth and seventh thoracic somites rounded laterally, spined posteriorly; distance between submedian abdominal carinae about one-third distance between intermediates, submedian carinae very distinct; abdominal carinae spined as follows: submedian, 6; intermediate, (2-3) 4-6; lateral, (2) 3-6; marginal, 1-5; fifth somite with 2-5 accessory spinules on each side lateral to submedian carinae; telson with 3 pairs of marginal teeth, submedians with movable apices,

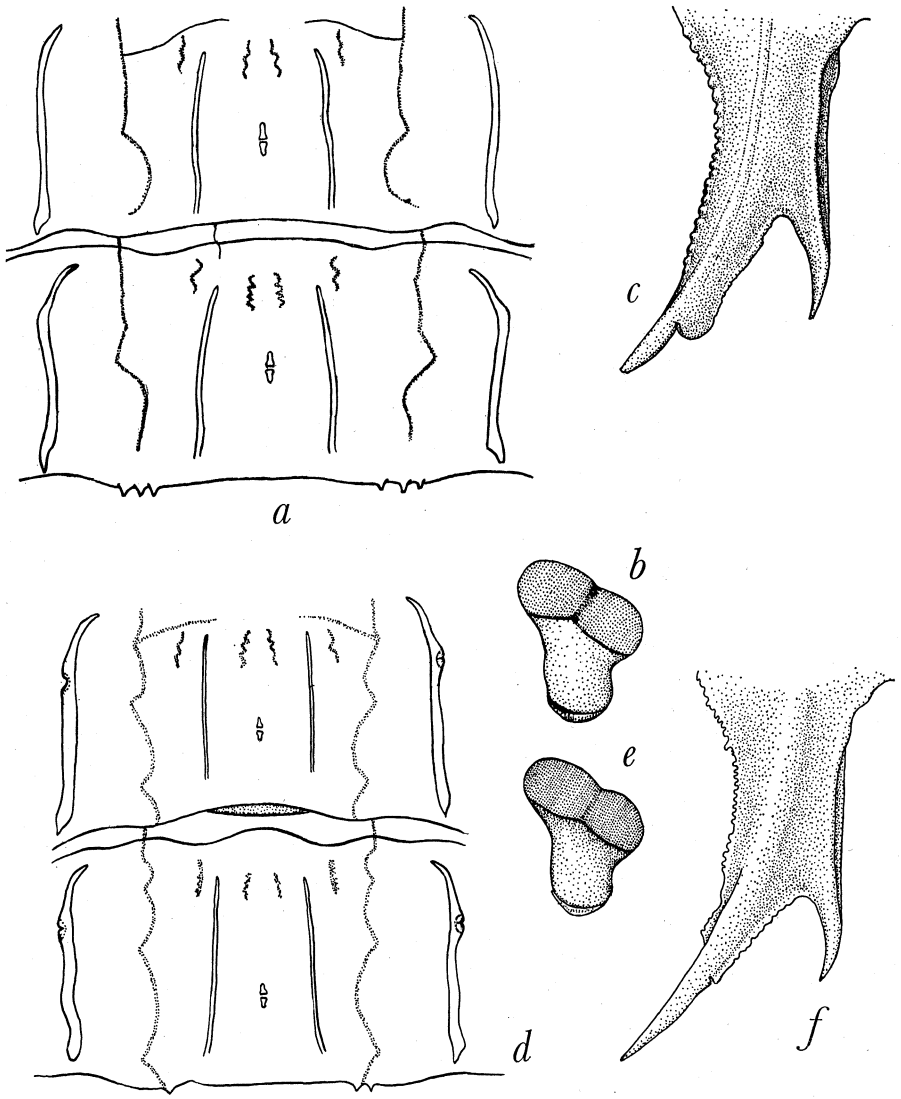

Fig. 2.—*Squilla armata* H. Milne-Edwards, male, TL 114.3 mm, New Zealand: *a*, fourth and fifth abdominal somites, dorsal view; *b*, eye; *c*, basal prolongation of uropod. Male, TL 109.7 mm, Chile: *d*, fourth and fifth abdominal somites, dorsal view; *e*, eye; *f*, basal prolongation of uropod.

prelateral lobes absent; denticles 1, 7-9, 1; telson with submedian tubercle on each side of anterior surface; ventral surface of telson with postanal keel; uropod with 7-8 movable spines, last short, on outer margin of penultimate segment of outer branch; basal prolongation of uropod with broad, rounded lobe on outer margin of inner spine.

Colour.—Completely faded in the present material and not recorded in the literature. A photograph of a living specimen was published in the New Zealand journal, *Tuatara* (Anonymous, 1964).

Size.—Males, TL 113.6-114.3 mm; females, TL 118.2-121.7 mm.

Discussion.—Richardson (1953) has suggested that the New Zealand population of *S. armata,* which he provisionally named *S. armata* var. *schizodontia,* might prove to be distinct from populations occurring off South Africa and South America. His suggestion was based upon the following features which he observed on New Zealand specimens: (1) more teeth on the dactylus of the raptorial claw; (2) wider range in number of accessory spinules on the fifth abdominal somite; (3) subdivision of the intermediate marginal denticles of the telson. These features are found in combination with a tendency towards subdivision or splitting of spines. Unfortunately, Richardson had no comparative material from other areas; the apparent differences reported by him were based upon comparisons of his observations with accounts in the literature.

Direct comparison of material from Chile with specimens from New Zealand seems to substantiate Richardson's statement as to the distinctness of the populations, but for different reasons. There is a great deal of overlap between Chilean and New Zealand specimens in the features mentioned by Richardson, as follows: (1) he noted that there were 6-8 teeth on the dactylus of the raptorial claw; Chilean specimens have 6-9; (2) New Zealand specimens had 1-5 accessory spinules on each side of the fifth abdominal somite, 2-10 total; the Chilean specimens have 0-4 on each side, 0-7 total; (3) there were 7-11 intermediate denticles on the telson of Richardson's New Zealand specimens; there are 7-13 in the Chilean. Some bifurcation of teeth is present in the Chilean specimens but not to the same extent as reported for New Zealand specimens by Richardson.

There are other differences in specimens from the two areas which in my opinion are of greater importance and which support the idea of distinct populations; these include: (1) the submedian carinae of the first five abdominal somites are more distinct and appear to be wider apart (one-third the distance between the intermediate carinae) (fig. 2a) on the New Zealand specimens than on those from Chile (one-fourth the distance between the intermediates) (fig. 2d); (2) the lobe on the outer margin of the inner spine of the basal prolongation of the uropod is much larger in the New Zealand specimens than in those from Chile (compare figs 2c and 2f). In addition to these two features, which seem to show the most important distinctions between specimens from the two areas, the abdominal carinae are much more distinct in the few specimens; (3) from New Zealand available for comparison with specimens from Chile, and there are slight differences in the shape of the eyes (figs 2b and 2e).

Although no specimens from South Africa are available at the time of this writing, I have been able to examine three specimens from that area through the courtesy of the South Africa Museum. These specimens differ from those from the other two areas in having very faint abdominal carinae, in lacking the accessory spinules on the fifth abdominal somite, and in having the two lobes of the cornea more pronounced. The lobe on the basal prolongation of the uropod is intermediate in size and shape between lobes on specimens from the other two areas. Also, the South African material examined by me had only the intermediate and lateral carinae of the last three abdominal somites armed with spinules; this feature might be expected to vary with a larger sample.

In view of the small size of the samples from the three areas and the immediate lack of specimens from South Africa, it seems best not to recognize a subspecies from New Zealand at this time. Further study with series of specimens from each area would probably indicate that three subspecies or species could be recognized.

S. armata is closely related to *S. gracilipes* Miers from Patagonia; both species differ from all others in the genus in having eye-scales produced into strong spines. In view of the shape of the eye-scales and other differences between these two species and the other members of *Squilla,* it seems likely that *Pterygosquilla,* which was erected

by Hilgendorf (1890) for *P. laticauda* (a junior synonym of *S. gracilipes*), should be separated from *Squilla*; further study will be required before this can be done.

Remarks.—The diagnosis given above is based entirely on the three specimens from New Zealand in the U.S. National Museum; all other descriptions appear to be based either on specimens from more than one area, on other accounts in the literature, or on American specimens only.

Although Bigelow (1894) noted that sexual dimorphism was not evident in his material from Patagonia, the present specimens from New Zealand are noticeably dimorphic. In males, the bases of the marginal teeth of the telson and the abdominal pleura between the lateral and marginal carinae are noticeably swollen.

Distribution.—*S. armata* is a southern cold-temperate or subantarctic species, known from South America, New Zealand, and South Africa. In New Zealand it has been recorded from Petone Beach, Wellington Harbour; Cook Strait; Dunedin, Otago; and Laurie Harbor, Auckland Is. The bathymetric range in New Zealand has not been recorded, but in other areas it has been collected in depths to 222 m.

In the legend of the photograph published in *Tuatara* (Anonymous, 1964), *S. armata* is said to occur in southern Australia. To my knowledge, the species does not occur there. Possibly Whitelegge's (1900) reference to *S. armata* was used as a source of information. As Stephenson (1953a) pointed out, *S. armata*: Whitelegge is actually *S. mcneilli* Stephenson, 1953.

Squilla foveolata Wood-Mason, 1895

Squilla foveolata Wood-Mason, 1895, p. 2, pl. 2, fig. 1.—Kemp, 1913, p. 58, pl. IV, fig. 48.—Kemp and Chopra, 1921, p. 29 [listed].—Liu, 1949, p. 30, pl. IV, figs 4, 5.—Stephenson, 1953, p. 41.—Stephenson and McNeill, 1955, p. 243 [listed].

Chloridella foveolata:Schmitt, 1929, p. 133, pl. 16, figs 1, 2.

Material.—1♂, 58.0; 12 mi. NNE of Bowen, Queensland; 35-46 m; *Endeavour*; AM Reg. No. P. 3530.

Discussion.—This specimen agrees well with Kemp's account in almost all respects, but the following minor differences were noted: (1) the anterior margin of the ophthalmic somite is not rectangular but rounded; (2) there is a prominent, posteriorly-directed spine on the basal segment of the raptorial claw; (3) the anterior portion of the bifurcated lateral process on the fifth thoracic somite is a sharp spine, directed anteriorly, but the upper, posterior lobe is spatulate, with the apex rounded; (4) the abdominal carinae are spined as follows: submedian, 4-6; intermediate, 4-6; lateral, 3-6; marginal, 1-5; in Kemp's material the submedian and intermediate carinae of the third were armed in some specimens. These differences are minor and fall within the expected variation for this species.

Remarks.—The body carinae are almost all ornamented with one or two parallel lines of pits which form what Kemp described as a meshlike reticulation; the carinae are defined by the reticulations rather than being obscured by them.

The eyes of *S. foveolata* resemble those found in some species of *Clorida;* the stalk is noticeably expanded. In all other respects *S. foveolata* agrees with *Squilla.*

Distribution.—This species has been reported from China, Burma, and Queensland, Australia; Stephenson (1953) recorded it from the latter locality. Shallow water to moderate depths, 5-84 m.

Table 1

Comparison of the major diagnostic features of five species of the *Squilla oratoria* complex from Australia (data partially from Kemp, 1913)

	S. inornata Tate, 1883	*S. perpensa* Kemp, 1911	*S. fabricii* Holthuis, 1941	*S. interrupta* Kemp, 1911	*S. woodmasoni* Kemp, 1911
Rostral Plate	Longer than broad	Broader than long	Broader than long	Broader than long	Broader than long
Anterior Width of Carapace ..	Less than 1/2 CL plus rostral plate.	Less than 1/2 CL plus rostral plate.	Less than 1/2 CL plus rostral plate.	Less than 1/2 CL plus rostral plate.	More than 1/2 CL plus rostral plate.
Median Carina of Carapace ..	Interrupted at bifurcation.	Interrupted at bifurcation.	Interrupted at bifurcation.	Interrupted at bifurcation.	Bifurcation obsolete.
Corneal Index	352-424	397-468	323-429	500-610	300-420
Dorsal Ridge of Carpus of Claw	Undivided ..	Undivided ..	Irregularly tuberculate.	2 tubercles ..	2-3 tubercles
Spine Formula, Abdomen ..	5-6; 4-6; 2-6; 1-5	5-6; 4-6; 3-6; 1-5	4-6; 3-6; 1-6; 1-5	5-6; 4-6; 3-6; 1-5	5-6; 3-6; 2-6; 1-5
Margin of Lobe on Basal Prolongation of Uropod.	Concave	Concave	Concave	Convex	Concave

Squilla inornata Tate, 1883

Fig. 3

Restricted synonymy:—

Squilla inornata Tate, 1883, p. 51, pl. ii, figs 3a-c.

Squilla oratoria var. *perpensa:* Kemp, 1913, p. 70 [part; not *S. oratoria* var. *perpensa* Kemp, 1911, =*S. anomala* Tweedie, 1935].—Hansen, 1926, p. 11.

Squilla oratoria var. *inornata:* Hale, 1924, p. 495; 1927, p. 32, fig. 22.—Chopra, 1934, p. 25 [part].—Tweedie, 1935, p. 48 [discussion].—Holthuis, 1941, p. 248.

Material.—1♂, 72.5; 1♀, 89.5; 12 mi. NNE of Bowen, Queensland; 35-46 m; *Endeavour*; AM Reg. No. P. 3530.—1♂, 90.8; same; USNM 111379.

In addition to these specimens from the *Endeavour* collection, I have examined these specimens reported from several Indo-Malayan localities by Holthuis (1941), the Siboga specimens reported by Hansen (1926), and that from Singapore in the British Museum reported by Kemp (1913). All are conspecific with the species reported here.

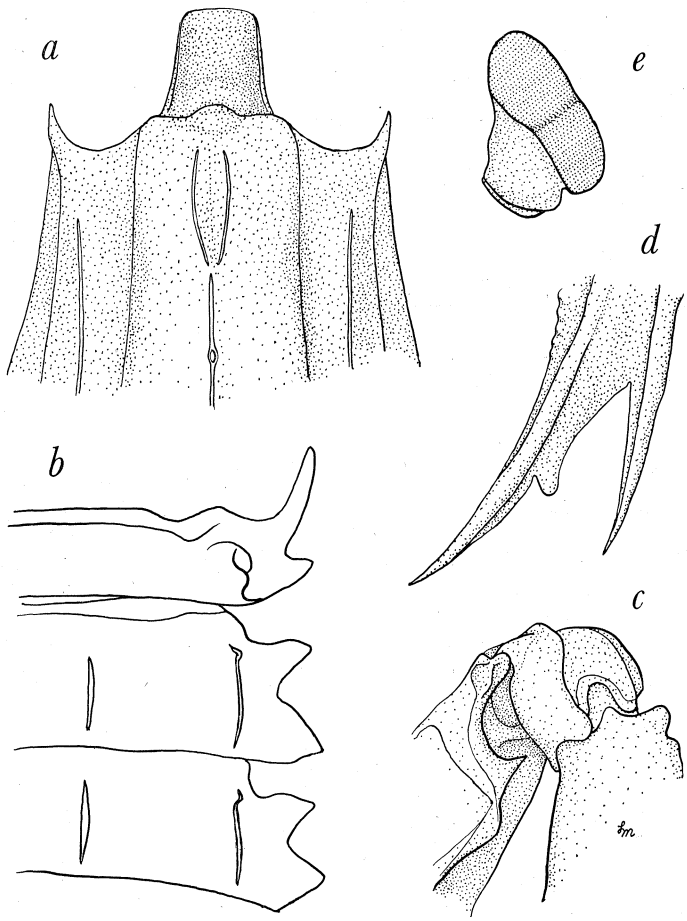

Fig. 3.—*Squilla inornata* Tate, male, TL 72.5 mm, off Bowen. *a*, anterior portion of carapace and rostral plate; *b*, lateral processes of fifth, sixth, and seventh thoracic somites; *c*, carpus of raptorial claw; *d*, basal prolongation of uropod; *e*, eye.

Diagnosis.—Antennular peduncle not as long as carapace; eyes large, set obliquely on stalk, CI 414-424 in *Endeavour* specimens; anterior margin of ophthalmic somite projecting forward, truncate or emarginate along midline; rostral plate elongate, longer than broad, apex usually truncate; median carina of carapace usually interrupted at base of bifurcation, distance from dorsal pit to bifurcation less than distance from bifurcation to anterior margin; intermediate carinae of carapace convergent anteriorly with laterals; dactylus of raptorial claw with 6 teeth, outer margin sinuate; dorsal ridge of carpus undivided; merus with blunt inferodistal spine; mandibular palp and 4 epipods present; lateral process of fifth thoracic somite with sharp anterior spine and short, angular posterior lobe; lateral process of sixth thoracic somite bilobed, anterior lobe large but smaller than posterior, truncate, posterior lobe triangular, apex not sharp; lateral process of seventh thoracic somite bilobed, anterior lobe triangular, smaller and sharper than posterior which is almost cordiform; abdominal carinae spined as follows: submedian, 5-6; intermediate, 4-6; lateral, 2-6; marginal, 1-5; telson with 3-4, 7-8, 1 rounded denticles; lobe on outer margin of inner spine of basal prolongation of uropod rounded, projecting, inner margin concave.

Colour.—Completely faded in the *Endeavour* specimens. Specimens from other localities have each of the body segments outlined posteriorly in dark pigment, the carinae of the marginal teeth of the telson dark, and a dark spot on the uropod, with the black pigment on the inner half of the distal segment sharply separated from the clear inner half, and the distal half of the inner branch of the uropod dark on both sides, lighter along the midline.

Size.—Males, TL 72.5-90.8 mm; only female, TL 89.5 mm.

Discussion.—The close similarity between *Squilla perpensa* Kemp, 1911 and *Squilla inornata* Tate, 1883 led Chopra (1934), who directly compared type-specimens, to consider them to be conspecific; in this Chopra followed Hale (1924). Apparently Tate's paper had been overlooked by Kemp, for *S. inornata* was not mentioned in any of Kemp's accounts. Unfortunately, Kemp (1911, 1913) did not provide a full description of *S. perpensa*, but merely pointed out the most obvious differences between it and the other members of the *S. oratoria* complex, namely, the presence of an undivided ridge on the carpus of the raptorial claw. In 1913 Kemp did provide illustrations of *perpensa*, and he showed a form with small eyes and a short, broad rostral plate.

In indicating that *inornata* Tate was identical with *perpensa* Kemp, Chopra (*loc. cit.*) noted that the Australian specimen differs from those from India in two features, (1) the rostral plate is longer and slenderer, and (2) the anterior lobe of the lateral process of the sixth thoracic somite is bluntly pointed. These are important observations, for the two characters mentioned can be used to distinguish *S. inornata* from *S. perpensa*; Tate (1885) also remarked on the long rostral plate of his specimens.

The problem was further complicated by the description in 1935 of *Squilla anomala* Tweedie, from Singapore. Tweedie pointed out that the eyes of *S. anomala* are small and the rostral plate is short, and gave other differences between his species and *S. interrupta* and *S. inornata* (as *S. oratoria inornata*).

A comparison of Tweedie's types with specimens of *S. perpensa*, including types, identified by Kemp in the collection of the British Museum, showed that *S. anomala* is a junior synonym of *S. perpensa*. *S. perpensa* is the older name.

The specimen from Singapore in the collection of the British Museum reported by Kemp (1913, p. 72) as *S. oratoria* var. *perpensa* is *S. inornata*. All of the other specimens in the British Museum collection reported by Kemp under the varietal name are clearly referable to *S. perpensa*.

S. inornata differs from *S. perpensa* in the following features: (1) the eye of *inornata* is larger, with the Corneal Index ranging from 352-424, larger in smaller specimens; the Corneal Index for *perpensa* ranges from 397-468. Although there is some overlap in this index, specimens of *inornata* when compared with specimens of *S. perpensa* of similar size always have a larger eye, and, of course, a smaller Corneal Index; the indices for the largest specimens of *inornata* are similar to those for small specimens of *perpensa*; (2) the rostral plate of *inornata* is slender, longer than broad; in *perpensa* it is short, blunt, broader than long; (3) the anterior lobe of the lateral process of the sixth thoracic somite is more truncate in *inornata* than in *perpensa*; (4) the lateral carina of the second abdominal somite is usually armed posteriorly in *inornata*; (5) the distal segment of the outer branch of the uropod is divided into a clear outer half and a dark inner half in *inornata*; in *perpensa* the inner half is suffused with dark pigment but there is no sharp line dividing inner and outer halves.

The synonymy given here is necessarily incomplete, for all of the many references to *S. oratoria* var. *inornata* and *S. oratoria* var. *perpensa* must be verified before an accurate synonymy can be compiled. All of the previous Australian records, which are summarized in the papers of Stephenson (1953, 1955, and 1962) and Stephenson and McNeill (1955), also must be verified.

There is a strong possibility that there are more than two species involved in this complex within the *Squilla oratoria* group that share an undivided dorsal ridge on the carpus of the raptorial claw. Kemp (1913) noted that there were some specimens examined by him in which the bifurcation of the median carina of the carapace was obsolete. The entire *S. oratoria* complex needs to be studied in detail.

Distribution.—This species is known with certainty from the south-western Pacific, from Singapore, Borneo, the Indo-Malayan area, and Queensland, Australia. Subtidal to moderate depths around 50 m.

Judging from the unpublished collections in the U.S. National Museum, *S. inornata* is one of the most common species of *Squilla* in the south-western Pacific.

Squilla interrupta Kemp, 1911

Fig. 4

Restricted synonymy:—

Squilla interrupta Kemp, 1911, p. 98; 1913, p. 72, pl. V, figs 60-62.—Holthuis, 1941, p. 253.—Stephenson, 1952, p. 7; 1953, p. 42.—Baig, 1954, p. 143 [listed].—Stephenson and McNeill, 1955, p. 244.—Stephenson, 1960, p. 61.

Squilla woodmasoni: Stephenson and McNeill, 1955, p. 243 [part][not *Squilla woodmasoni* Kemp, 1911].

Material.— 1 brk. ♀, CL 18.8; Queensland; C. E. Beddome, col.; MCZ 7887.—1 ♀, 90.4; Townsville, probably Cleveland Bay, Queensland; September 1952; G. Coates col.; exchange from Australian Museum; USNM 111356.—1 ♀, 105.5; Brisbane River (?), possibly obtained somewhere in Moreton Bay, Queensland; 9th June 1945; pres. J. S. Hynd; exchange from Australian Museum; USNM 111359.

Remarks.—All three specimens agree in all respects with published accounts. As noted by Holthius (1941), the spine formula for the abdominal carinae is as follows: submedian, 5-6; intermediate, 4-6; lateral, 3-6; marginal, 1-5.

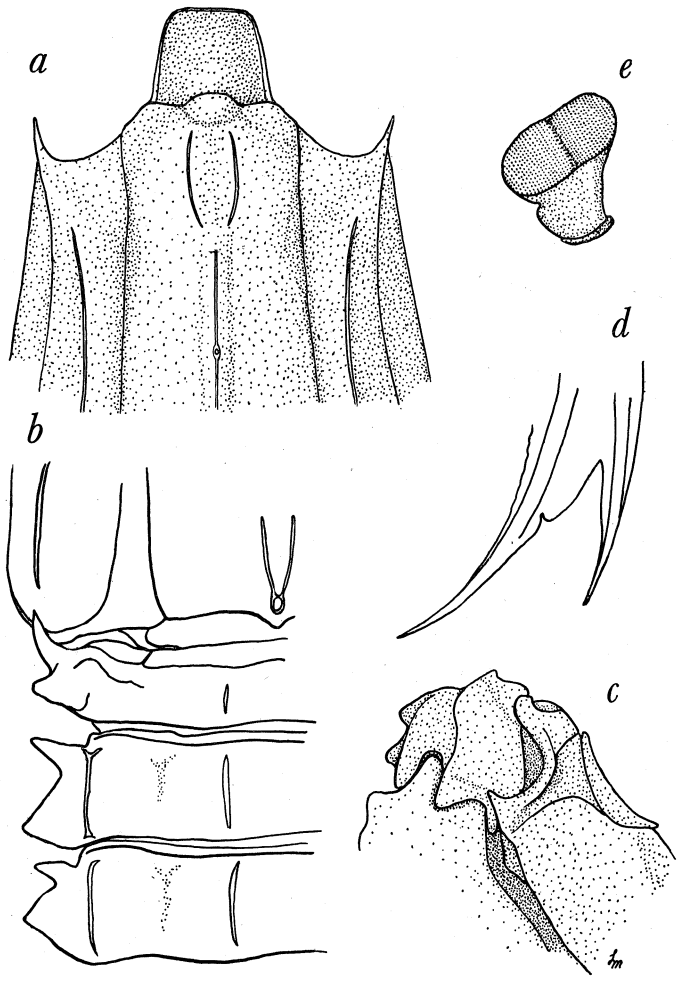

Fig. 4.—*Squilla interrupta* Kemp, female, TL 90.4 mm, Townsville. *a*, anterior portion of carapace and rostral plate; *b*, lateral processes of fifth, sixth, and seventh thoracic somites; *c*, carpus of raptorial claw; *d*, basal prolongation of uropod; *e*, eye.

The specimen from Cleveland Bay was reported by Stephenson and McNeill (1955) as *S. woodmasoni*.

Distribution.—Indian and western Pacific Oceans, from the Persian Gulf to Australia, Java, and Formosa. Shallow water, 20 m. or less. In Australia it has been recorded from Queensland and New South Wales (Stephenson and McNeill, 1955).

Squilla laevis Hess, 1865

Restricted synonymy:—

Squilla laevis Hess, 1865, p. 170, pl. vii, fig. 22.—Kemp, 1913, p. 49, pl. III, figs 35-37.—Stephenson, 1952, p. 6; 1953, p. 40.—Stephenson and McNeill, 1955, p. 242.—Stephenson, 1960, p. 61; 1962, p. 33.

Material.—1♂, 61.2; Parramatta River, Port Jackson, New South Wales; taken in prawn trawl; USNM 78429.—1♂, 78.2; Port Jackson, New South Wales; seined with haul of prawns; purchased; USNM 98875.

Colour.—(Not recorded previously.) Carinae and grooves of carapace dark; last three thoracic and all abdominal somites with posterior black line; lateral processes of sixth and seventh thoracic somites with dark spot; second and fifth abdominal somites with rectangular, black median patch, that on fifth almost divided into two submedian spots; carinae of marginal teeth and dorsal rows of pits on telson dark.

Remarks.—The rostral plate in these specimens is trapezoidal with the anterior margin transverse, not rounded as illustrated by Kemp (1913). Otherwise the specimens agree with Kemp's account in every respect.

Distribution.—Known only from Australia, from Queensland to Western Australia around the southern part of the continent. Shallow water, 10 m. or less.

Squilla mcneilli Stephenson, 1953

Squilla armata: Whitelegge, 1900, p. 199 [not *S. armata* H. Milne-Edwards, 1837].

Squilla mcneilli Stephenson, 1953a, p. 213, text-fig. 4.—Stephenson and McNeill, 1955, p. 242.—Stephenson, 1962, p. 34.

Material.—3♂, 54.3-66.5; 3♀, 64.0-67.4; N of Montague Island, New South Wales; 109 m; *Endeavour*; AM Reg. No. E. 6141.—1♂, 50.0; 3♀, 45.0-46.6; Great Australian Bight, S.W. of Eucla, Western Australia; Long. 126° E; 146 m; *Endeavour*; USNM 111376.—1♀, 88.2; (?) Norah Head S 40, W 15 miles; 82-106 m; *Endeavour*; AM Reg. No. E. 4505.

Remarks.—These specimens agree well with Stephenson's comprehensive original description. All specimens have four epipods. In two specimens, one raptorial claw is armed with six teeth; all of the others have five teeth on each claw. The number of denticles present on the telson is 11-16, 6-10, 1; Stephenson reported 14-17, 8-10, 1 in his original series. Three of the present specimens have posterior spines on the intermediate carinae of the first abdominal somite; usually this carina is unarmed. In the larger males the posterior margin of the telson is noticeably inflated, particularly at the bases of the marginal teeth.

Distribution.—Stephenson (1953a) recorded this species from numerous localities off New South Wales, at depths of 46-164 m, and more recently (1962) from Western Australia. All of the localities known are in Australian waters.

Squilla perpensa Kemp, 1911

Restricted synonymy:—

Squilla nepa: Miers, 1884, p. 298 [not *S. nepa* Latreille, 1825].

Squilla oratoria var. *perpensa* Kemp, 1911, p. 98; 1913, p. 70, pl. V, figs 57-59 [part].

Squilla anomala Tweedie, 1935, p. 45.—[?] Stephenson, 1952, p. 7; [?] 1953, p. 43.—[?] Stephenson and McNeill, 1955, p. 245.

Material.—2 damaged specimens; Hongkong; syntypes of *S. perpensa;* BM(NH) Reg. No. 1910.11.14.8-9.—1♂, 85.1; Siglap, Singapore; littoral; June 1934; M. W. F. Tweedie, col.; holotype of *S. anomala*; BM(NH) Reg. No. 1935.12.16.7.—1♂ 68.1; same; paratype of *S. anomala*; RNHL Reg. No. 397.—1,♀ 81.8; same;

paratype of *S. anomala*; RNHL Reg. No. 426.—1♂, 61.7; Port Darwin, N. Australia; 13-32 m; H.M.S. *Alert*; BM(NH) Reg. No. 82.7.

Remarks.—During a recent visit to the British Museum, syntypes of *S. perpensa* were compared with the holotype of *S. anomala*, and the latter was compared with a series of *S. perpensa* from various localities. No differences were found which could be used to separate *S. anomala* from *S. perpensa*, so it must be considered a synonym of the latter.

The types of both species each have a short, broad rostral plate, small eyes, and a slender anterior lobe on the lateral process of the sixth abdominal somite.

Tweedie (1935) clearly recognized that two distinct forms shared the undivided carpus on the raptorial claw, but concluded that *S. o. perpensa*, even though it had been illustrated as the species with a short rostral plate, was identical with *S. o. inornata*. The latter was characterized by Tweedie as a "variety" with a long rostral plate.

Since the material at the British Museum identified by Kemp contained both species (*perpensa* and *inornata*), it seems possible that both are represented in his type-series in the Indian Museum. If so, the selection of a lectotype will determine whether *S. perpensa* or *S. anomala* will be used for the species with the short rostral plate.

Differences between *S. inornata* and *S. perpensa* are summarized under the discussion of *S. inornata*.

Unfortunately, no specimens of *S. perpensa* are available at the time of this writing, so a diagnosis and illustrations cannot be provided here. Good illustrations, showing the main diagnostic features, have been provided by Kemp (1913, pl. V, figs 57-59).

As in *S. inornata*, all previous records of *S. perpensa* must be verified before an accurate synonymy can be given. The synonymy given here includes references to specimens seen by me, as well as Australian records which require verification. These latter are preceded by a question-mark.

Distribution.—Western Indo-Pacific, from Singapore and Australia to the Persian Gulf (Kemp, 1913). Moderate depths, 100 m or less.

Squilla woodmasoni Kemp, 1911

Fig. 5

Restricted synonymy:—

Squilla woodmasoni Kemp, 1911, p. 99; 1913, p. 74, pl. V, figs 63-65.—Holthuis, 1941, p. 255.—Gravely, 1941, pp. 73, 74.—Stephenson, 1952, p. 5 [part]; 1953, p. 42.—Kurian, 1954, p. 86.—Stephenson and McNeill, 1955, p. 243.—Chuang, 1961, p. 180, pl. 82.—Barnard, 1962, p. 244.

Material.—1 brk. ♂, ca. 155.0; 12 mi. NNE of Bowen, Queensland; 35-46 m; *Endeavour*; AM Reg. No. E. 3158.

Discussion.—This badly fragmented specimen differs from Kemp's account of this species in several important respects: (1) the anterior bifurcated portions of the median carina of the carapace are sharp and distinct; (2) the rostral plate, although short and truncate, is narrowed anteriorly; (3) the lobe on the outer margin of the inner spine of the basal prolongation of the uropod is well-defined; all of these differences are shown in fig. 5. Hansen (1926) and Holthuis (1941) reported specimens

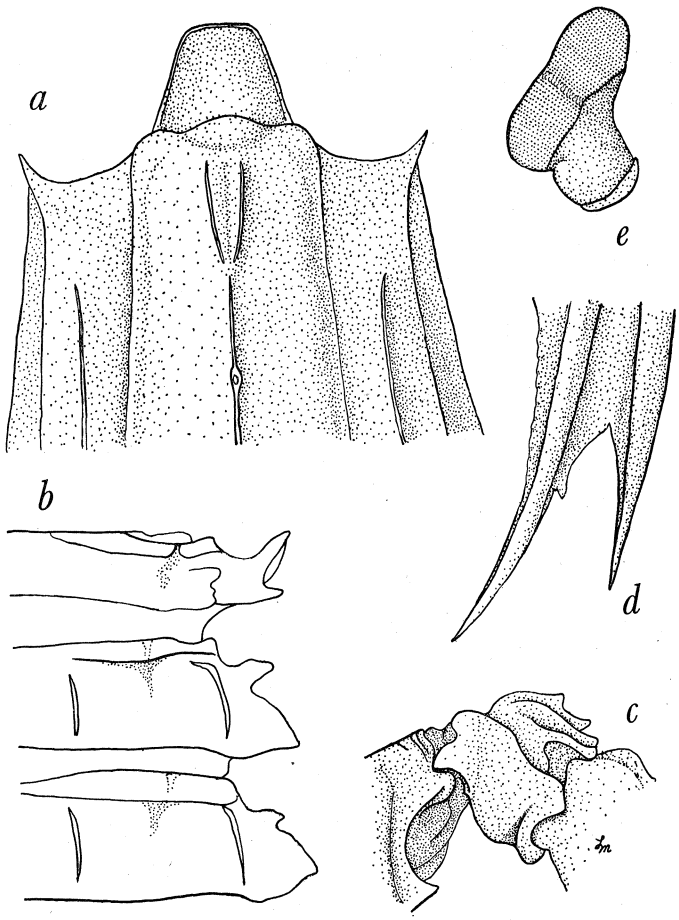

Fig. 5.—*Squilla woodmasoni* Kemp, male, TL ca. 155.0 mm, off Bowen. *a*, anterior portion of carapace and rostral plate; *b*, lateral processes of fifth, sixth, and seventh thoracic somites; *c*, carpus of raptorial claw; *d*, basal prolongation of uropod; *e*, eye.

with similar differences; Hansen's specimens also lacked the characteristic anterior spine on the ophthalmic somite. Since Kemp's material was mainly from the Indian Ocean, it seems possible that the Pacific specimens assigned to this species actually belong to a distinct species or subspecies. Kemp (1913) suggested that there might be a distinct subspecies in East Africa.

Distribution.—Western Indo-Pacific, from Japan and Australia through the Indian Ocean. In Australia it has been recorded from the Northern Territory, Queensland, New South Wales, and Western Australia (Stephenson and McNeill, 1955). Moderate depths, 50 m or less.

Hemisquilla Hansen, 1895

Hemisquilla ensigera (Owen, 1832)

Restricted synonymy:—

Gonodactylus ensiger Owen, 1832, p. 6.

Pseudosquilla stylifera: Whitelegge, 1900, p. 198.—Kemp, 1913, p. 106, pl. VII, figs 84-85, text.-fig. on p. 107.

Hemisquilla stylifera: Schmitt, 1940, p. 181 [discussion].—Stephenson, 1953, p. 43; 1955, p. 2.—Stephenson and McNeill, 1955, p. 253.

Hemisquilla ensigera: Manning, 1963b, p. 315.

Material.— 1, ♂ 138.0; near Tathra Head, near Moruya, New South Wales; 182-455 m; *Endeavour*; USNM 111374.— 1 ♀, 150.0; same; AM Reg. No. E. 4397.— 1 ♂, 155.0; Barren Island, New South Wales; 73 m; *Endeavour*; AM Reg. No. E. 4508.—1 damaged ♂, CL 27.0; 6 mi. SxE of Brush Island, New South Wales; 118 m; *Endeavour*; AM Reg. No. E. 2238.— 1 ♂, 157.0; eastern slopes, S of Gabo Is., Victoria; 200 m; *Endeavour*; AM Reg. No. E. 4794.— 1 ♂, 158.0; same; AM Reg. No. E. 4795.— 1 ♂, 158.0; same; AM Reg. No. E. 4796.—1 ♀, 156.0; S. of Mt Cann, Victoria; 109-146 m; *Endeavour*; USNM 111375.—1♂, 174.0; same; USNM 111371.—1 ♂, 135.0; same; 100-127 m; AM Reg. No. E. 6076.— 1 ♂, 142.0; S and SW of Mt Cann, Victoria; 127-182 m; *Endeavour*; USNM 111372.— 1 ♂, 169.0; same; AM Reg. No. E. 6100.—1 ♀, 153.0; S from Cape Everard, Victoria; 146-218 m; *Endeavour*; AM Reg. No. P. 3536.—1 ♂, 168.0; same; AM Reg. No. P. 3537.— 1 ♂, 174.0; SE of Cape Everard, Victoria; 127-146 m; *Endeavour*; AM Reg. No. E. 6098.—1 ♂, 137.0; off Cape Everard, Victoria; 109 m; *Endeavour*; AM Reg. No. E. 1317.—1 ♂, 145.0; same; 127 m; AM Reg. No. E. 2235.—1 ♂, 160.0; same; AM Reg. No. E. 2236.—1 ♀, 135.0; same; AM Reg. No. E. 2237.—1 ♀, ca. 140.0; same; 109 m; AM Reg. No. E. 1316.—1 ♂, 143.0; same; AM Reg. No. E. 1315.— 1♀, 143.0; same; USNM 111373.—1 ♂, 167.0; same; AM Reg. No. P. 2383.— 1♂, 146.0; Bass Strait, Victoria; *Endeavour*; AM Reg. No. E. 441.—1 ♂, 164.0; same; AM Reg. No. E. 442.—1 ♀, 127.0; eastern edge Bass Strait, Gabo to Gable Is., Victoria; 109-182 m; *Endeavour*; AM Reg. No. P. 3541.—1 ♂, 145.0; Disaster Bay, Tasmania; *Endeavour*; AM Reg. No. E. 4503.

Remarks.—The status of the Australian specimens of this species and their relation to the western American populations are currently being investigated by W. Stephenson.

Distribution.—Discontinuously distributed in the Pacific, with populations along the west coast of America and off Australia and Tasmania. In Australia it has been reported from New South Wales, Victoria and Tasmania in depths to 455 m (Stephenson and McNeill, 1955).

Manningia Serène, 1962

Manningia Serène, 1962, p. 20.

Remarks.—This genus was erected by Serène for *Pseudosquilla pilaensis* de Man 1888, which is rather rare and has been recorded only a few times since its original description. A survey of the few published illustrations of *M. pilaensis* has revealed a number of inconsistencies which seem to indicate that all of the known specimens should be re-examined to determine whether more than one species may be involved. The Australian record for *M. pilaensis* is based on the new species described below. It is hoped that a redescription of *M. pilaensis* accompanied by adequate illustrations can be completed at an early date.

The holotype of the new species described below was found among the small collection of stomatopods obtained by the Arnhem Land Expedition; one of the paratypes had been reported by Stephenson (1953) as *M. pilaensis*.

Manningia notialis, new species

Fig. 6

Pseudosquilla pilaensis: Stephenson, 1953, p. 44.—Stephenson and McNeill, 1955, p. 245 [not *M. pilaensis* (de Man, 1888)].

Holotype.—1♀, 63.0; ironstone reef (not coral) at Yirrkala, NW of Cape Arnhem, Northern Territory; Arnhem Land Exped. Sta. M48-21; emulsifiable rotenone; 6th August 1948; R. R. Miller and natives, col.; AM. Reg. No. P. 14788.

Paratype.—1 damaged ♂, ca. 50.0; Bowen, Queensland; ?.2.1934; J. MacGregor, don.; Queensland Museum Reg. No. W. 1782.—1♂, 52.9; Weipa, Gulf of Carpentaria, Queensland; dredged, 9 m, in silt; 9th July 1961; G. Webster, col.; exchange from Australian Museum; USNM 112436.

Description.—Cornea strongly bilobed, set very obliquely on stalk, outer margin of eye longer than inner; eyes not extending to end of first segment of antennular peduncle; ophthalmic somite and base of eyes completely covered by rostral plate; eye-scales truncate, separate.

Antennular peduncle two-thirds or more as long as carapace.

Antennal scale slender, elongate, curved, margins completely setose; antennal protopod with 1 ventral papilla.

Rostral plate pentagonal, without apical spine; apex sharp but obtuse; length of plate about two-thirds greatest width.

Carapace smooth, narrowed anteriorly, without spines or carinae except for short marginal carinae present on posterior margin of each lateral plate.

Raptorial claw stout; dactylus armed with 4 teeth, outer margin with strong basal notch; propodus broad, superior margin fully pectinate; carpus with 2 teeth on upper margin; merus lacking inferodistal spine.

Propodus of each of last 2 maxillipeds about as long as broad, that of fifth maxilliped longer than broad, with prominent distal brush of setae, more pronounced than on either of 2 preceding maxillipeds.

Mandibular palp and 5 epipods present.

Fifth thoracic somite with blunt, inconspicuous lateral process; lateral processes of next 2 somites rounded, that of seventh somite flattened laterally; last 3 thoracic somites each with 1 pair of dorsal carinae; inner branches of walking legs very slender, two-segmented; eighth thoracic somite with low, blunt median keel.

Abdomen smooth, flattened, distinct carinae present on last 2 somites only; second to fifth somites with lateral, longitudinal grooves, not flanked with sharp carinae; fifth somite with 3 pairs of lateral carinae, upper at level of lateral carina of last somite; other carinae, on each side, between upper carina and ventral margin, lower not on margin; middle carina short, oblique, not extending to posterior margin; fourth and fifth somites with posterolateral spines; sixth somite with 3 pairs of carinae, all armed posteriorly, submedians and intermediates broad, laterals terminating at base of lateral spine; sixth somite with inconspicuous ventral spine in front of articulation of uropod.

Telson much broader than long, with 3 pairs of marginal teeth, submedians with appressed bases and movable apices; submedian denticles absent; 2 broad intermediate denticles, outer with ventral spine, and 1 broad lateral denticle, with

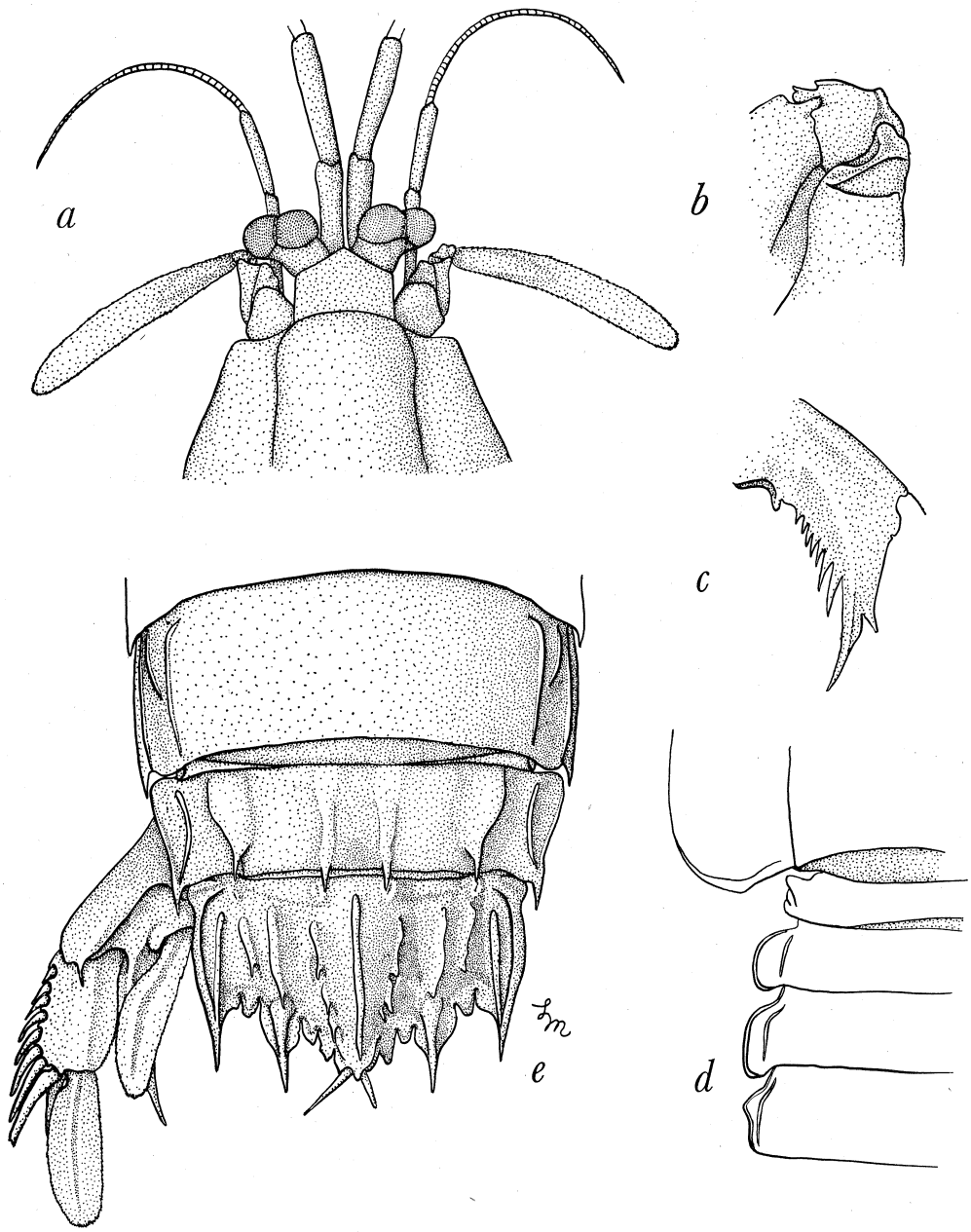

Fig. 6.—*Manningia notialis*, new species, female holotype, TL 63.0 mm, Yirrkala. *a*, anterior portion of body; *b*, carpus of raptorial claw; *c*, basal prolongation of left uropod, ventral view; *d*, lateral processes of exposed thoracic somites; *e*, last two abdominal somites, telson, and left uropod.

ventral spine; dorsal surface with median and 5 pairs of lateral carinae; inner pair of carinae interrupted, divided into 3 portions, each spined; next 2 carinae uninterrupted, terminating in blunt teeth; outer 2 carinae converging on lateral tooth; submedian teeth each with short, irregular, dorsal carina; postanal keel absent.

Uropod with 8-9 movable spines on outer margin of penultimate segment of outer branch, last extending well past midpoint of distal segment; inner branch broad, curved, outer margin convex; inner spine of basal prolongation longer than outer, armed with 7-8 fixed, graded spines on inner margin, distal the largest; no broadly-rounded lobe present between spines of basal prolongation.

Colour.—Largely faded in the present material. The holotype has inconspicuous dark chromatophores scattered over the body in no fixed pattern.

Measurements.—Female holotype, TL 63.0 mm; other measurements, in mm: carapace length, 13.7; cornea width, 3.2; rostral plate length, width, 2.2, 3.4; telson length, width, 7.6, 11.1.

Discussion.—*M. notialis* is very similar to *M. pilaensis* but can be distinguished from that species by the following features: (1) the rostral plate is unarmed anteriorly; (2) the inferodistal angle of the merus of the raptorial claw is unarmed; (3) the third lateral carinae of the telson are not interrupted; (4) there is no swollen area between the submedian and intermediate carinae of the sixth abdominal somite; and (5) the inner branches of the walking legs are slender on all the legs, whereas in *M. pilaensis* they are broad on the sixth legs, slenderer on the seventh and eighth. The single specimen of *M. pilaensis* available for comparison has two papillae present on the antennal protopod, one ventral and one mesial. The types of *M. notialis* each have but one ventral papilla. The absence of the rostral spine and that on the merus of the claw will immediately distinguish this species from *M. pilaensis*.

Name.—The specific name is from the Latin, *notialis*, southern, referring to the distribution of the species.

Distribution.—Yirrkala, Arnhem Land, and Bowen and Gulf of Carpentaria, Queensland.

Odontodactylus Bigelow, 1893

Odontodactylus cultrifer (White, 1850)

Restricted synonymy:—

Gonodactylus cultrifer White, 1850, p. 96, pl. 16, figs 1-2.

Gonodactylus carinifer Pocock, 1893, p. 478, pl. 25, figs 4-4b.

Odontodactylus cultrifer: Kemp, 1913, p. 137.—Stephenson, 1952, p. 10; 1953, p. 46.—Serène, 1954, pp. 6, 8, 11, 13, 17, 72, pl. 6, figs 5-6.—Stephenson and McNeill, 1955, p. 248.—Stephenson, 1962, p. 35.

Odontodactylus mindanaoensis Roxas and Estampador, 1930, p. 115, pl. IV.

Odontodactylus cultrifer var. *tridentata* Serène, 1954, pp. 6, 7, 8, 72, pl. 6, figs 7-8.

Material.—1 brk. ♂, 125.4; 10 mi. NW of Bustard Head, off Port Curtis Queensland; 29 m; *Endeavour*; AM Reg. No. E. 3154.—1 brk. ♀, 106.5; Platypus Bay, Queensland; 13-16 m; *Endeavour*; USNM 111380.—1♀, 118.2; same; *Endeavour*, No. 1, haul 2; 28th July 1910; AM Reg. No. P. 3549.

Discussion.—I follow Hansen (1926) in synonymizing *O. carinifer* (Pocock), which is based upon a juvenile specimen, with *O. cultrifer*. There is also little reason to recognize *O. mindanaoensis* Roxas and Estampador from the Philippines, for the description of that species agrees in all respects with previous accounts of *O. cultrifer* as well as with the present material. *O. cultrifer* var. *tridentata* Serène is also synonymized here with *O. cultrifer*. The main distinguishing feature of *tridentata* appears to be the presence of three teeth on the dactylus of the raptorial claw. As noted below, specimens of this species may have two, three or four teeth on the claw.

The rostral plate of this species is trapezoidal, with the anterior margin strongly deflexed. The number of teeth on the dactylus of the raptorial claw is variable, from two on the right and three on the left, three right and left, to three right, four left. On the ischium of the claw there is a high ventral crest armed with an anterior tubercle. The outer margin of the proximal segment of the uropodal outer branch may be armed with eight to 10 teeth. The characteristic high crest of the telson is noticeably higher in males than females; the telson width/crest height ratio is 2.35 in the male, 3.81-4.04 in the two females. In both females the dorsal submedian carinae of the telson merge with the carinae of the submedian marginal teeth; in the male the carinae are interrupted.

The trapezoidal rostral plate, the small number of teeth on the claw, the absence of the posteriorly-reflected portions of the submedian carinae of the sixth abdominal somite, and the high crest of the telson will serve to distinguish this species from all others in the genus. The only other species of the genus reported from Australian waters, *O. scyllarus* (Linnaeus) and *O. japonicus* (de Haan), both have two convergent carinae on either side of the median crest of the telson; only one carina on each side is found in *O. cultrifer*.

Remarks.—A complete redescription of this species and a review of the genus are in preparation. A study of the specimens reported herein as well as material from numerous other sources indicates that several of the currently-recognized species are juveniles of other, established species.

Distribution.—Indo-Pacific, from China, Viet Nam, Australia, and the Gulf of Siam. In Australia it has been recorded from Queensland and Western Australia (Stephenson and McNeill, 1955; Stephenson, 1962), in moderate depths, 36 m or less.

Protosquilla Brooks, 1886

Protosquilla Brooks, 1886a, p. 84.

Gonodactylus "Group III" Kemp, 1913, p. 146.

Remarks.—Five species of *Protosquilla* are now known to occur in Australian waters, *P. trispinosa* (Dana, 1852), *P. glyptocerca* (Wood Mason, 1875), *P. pulchella* (Miers, 1880), *P. stoliura* (Muller, 1886), and *P. tweediei* (Serène, 1952). Australian records for these species have been summarized by Stephenson and McNeill (1955) and Stephenson (1962).

While visiting the British Museum in June, 1964, I was able to examine the specimens from Shark's Bay, Western Australia, reported by Miers (1880, 1880a) as *Gonodactylus trispinosus*. Both are males (TL 37.8-45.0; BM(NH) Reg. No. 58.172) and, as suggested by Pocock (1893) who quoted Hansen's re-identification, both are *P. stoliura* (Muller). Stephenson and McNeill (1955, p. 476) noted that this species had "not previously been recorded with certainty from Australian waters". Those authors also had one specimen from Western Australia, and other specimens from the same area are mentioned by Stephenson (1962).

Gonodactylus Berthold, 1827

Remarks.—The Indo-Pacific species of this genus, which probably provides the greatest number of difficult problems for the systematist, have been the subject of several detailed studies, the results of which have been most ably summarized by Kemp (1913). Since the publication of that paper the nomenclature of the species and "varieties" recognized by him has remained relatively stable. To some extent this has been due to a general "lumping" of morphologically different forms into species which Kemp treated. Hansen (1926), for example, regarded several of the then recognized species as variants of the most common species, *G. chiragra* (Fabricius). Few taxonomists have gone as far as Hansen or the other extreme, which was advocated by Lanchester (1903), recognition of many named or lettered varieties.

The species in *Gonodactylus* are difficult to work with because they all superficially resemble each other; many of the characters that have been shown to be reliable in other genera, such as the armature of the raptorial claw, carination of the carapace, shape of the lateral processes of exposed thoracic somites, carination and spination of the abdomen, and marginal armature of the telson, among others, are either totally lacking in *Gonodactylus* or are essentially identical in all of the species. In the past, specific differences have been based largely on subjective evaluations of the few varying features that are available. Thus in one species anterolateral angles on the rostral plate are rounded, in another they are acute, and in a third they are spiniform; these are reliable characters, but they are difficult to assess without comparative material. However, there are other characters that are more useful, some of which have not been applied to *G. chiragra* and its close relatives in the Indo-Pacific. Among the features that can be used to separate these species are the colour pattern, the shape and size of the eye-scales, the shape of the rostral plate, the relative width of the abdomen, the shape and carination of the telson, and the shape of the uropodal inner branch. Perhaps the most important of these is colour, which is diagnostic for *G. platysoma* and *G. smithii*. Another feature which may be of importance is habitat. Some of these characters may be sexually dimorphic, including overall colour and colour pattern as well as telson and rostral plate form. Serène (1954) has recently provided some interesting observations on sexual dimorphism in this and several other species of stomatopods.

In his discussion of variation in *G. chiragra*, Kemp (1913) pointed out that small specimens exhibited more variation than larger ones. Among the possible explanations suggested by Kemp were (1) the existence of dwarf races, (2) loss of variation through growth, and (3) greater mortality rate for variable forms. Kemp apparently believed that the first and third explanations were improbable and was inclined toward the explanation of loss of variation through growth. Bigelow (1931) suggested that there were good reasons for investigating the existence of dwarf races, and more recently Serène (1954) named a dwarf race ("race naine"), *G. chiragra* var. *viridis*, from Viet Nam. Serène's variety is mature at 30 mm and ovigerous at 35 mm; further, it differs in colour and morphology from specimens of *G. chiragra* from the same area. In view of the other evidence given by Serène, I can see no reason for not recognizing his "race naine" as a distinct species.

In view of the limited amount of material available for this study, it is not possible to undertake any extensive revision of Indo-Pacific *Gonodactylus* here; such a revision is badly needed. *G. platysoma* Wood-Mason and *G. smithii* Pocock are recognized and briefly characterized. The former, which is usually regarded as a variety of *G. chiragra*, has a similar geographic range to that species and is distinct throughout its range; it must be treated as a distinct species. *G. smithii* is also a distinct species, and is probably not conspecific with *G. acutirostris* de Man, as suggested

by Serène (1954). *G. chiragra* is only treated briefly below, and notes on *G. falcatus* (Forskål) and *G. graphurus* Miers are included.

The genus *Gonodactylus* as used here is restricted to *Gonodactylus* Group I of Kemp (1913). Kemp's Group II is *Mesacturus* Miers, Group III is *Protosquilla* Brooks, and Group IV is *Hoplosquilla* Holthuis. Holthuis (1964) has commented briefly on these genera, and a more extensive treatment is in press (Holthuis and Manning).

KEY TO AUSTRALIAN SPECIES OF GONODACTYLUS

1. Central area of telson with 5 longitudinal carinae..... 2
   Central area of telson with 3 longitudinal carinae..... 3
2. First 5 abdominal somites each with a fine transverse groove.... *graphurus*, p. 108
   Abdominal somites not grooved ..... *falcatus*, p. 109
3. Eye-scales, broad, extending laterally to anterolateral angles of rostral plate; lateral teeth of telson suppressed ..... *platysoma*, p. 110
   Eye-scales narrow; lateral teeth of telson distinct..... 4
4. Anterolateral angles of rostral plate sharp; uropodal inner branch convex on inner margin ..... *smithii*, p. 112
   Anterolateral angles of rostral plate rounded; uropodal inner branch sinuous on inner margin ..... *chiragra*, p. 113

Gonodactylus graphurus Miers, 1875 (*sensu* Brooks, 1886)

Restricted synonymy:—

Gonodactylus graphurus: White, 1847, p. 85 [part; *nomen nudum*].

Gonodactylus graphurus: Miers, 1875, p. 344 [part; reference to part of White's material only].—Brooks, 1886, p. 58, pl. XIV, figs 1, 4, 6, pl. XV, figs 3, 8.—Kemp, 1913, p. 169, text-fig. 1 on p. 170.—Stephenson, 1952, p. 12; 1953, p. 47.—Stephenson and McNeill, 1955, p. 250.—Stephenson, 1962, p. 35.—Ingle, 1963, p. 29 [discussion].

Material.—1♂, 42.7; Prince of Wales Island, Queensland; 13th September, 1913; H. L. Clark, col.; MCZ.—1♂, 72.3; 18 mi. SW x S of Lady Elliott Island, off Queensland; 46-47 m; *Endeavour;* USNM 111378.—1♀, 38.2; same; in sponge; 33 m; *Endeavour;* USNM 111377.—4 spec., fragmented; Pine Peak, Queensland, S 29E; *Endeavour*; AM Reg. No. P. 3571.—1♂, 22.0; 4♀, 27.2-52.8; 11-14 mi. NW of Pine Peak, Queensland; 44-47 m; *Endeavour*; AM Reg. No. E. 3187.

Diagnosis.—Rostral plate with acute anterolateral angles; eye-scales small, erect; first to fifth abdominal somites each with fine transverse groove, interrupted along midline on posterior somites, situated just behind midpoint on each somite; on lateral portions of abdomen, grooves turn anteriorly, terminating in prominent, anterior pit; second, third and fourth somites each with oblique, ventrally-directed groove extending for short distance from pit; first somite lacking this groove; fifth somite with groove directed posteriorly, not ventrally; first five somites also with third oblique, longitudinal groove on pleura, not connected to ventrally-directed groove; sixth abdominal somite, telson, and uropod as in *G. falcatus*.

Colour.—Completely faded in these specimens.

Size.—Males, TL 22.0-72.3 mm; females, TL 27.2-52.8 mm.

Discussion.—The presence of the fine grooves across the abdominal somites immediately distinguishes this species from *G. falcatus*, which it otherwise resembles rather closely. The grooves are visible although incomplete in the smallest specimen examined, a male, TL 22.0 mm. A good illustration of the pattern of grooves on the abdomen has been given by both Brooks (1886) and Kemp (1913).

In his discussion of the past confusion between this species and *G. falcatus*, Ingle (1963) pointed out that the Samoan specimens recorded by Miers (1875) as *G. graphurus* were actually *G. falcatus*, and, further, that part of White's (1847) original series was also *falcatus*. L. B. Holthuis brought up in a discussion (in *litt.*) of this problem that since Miers referred to White, White's material must be considered part of the type-series; thus selection of a lectotype from White's specimens will determine whether or not the name *graphurus* can be retained for the species. R. W. Ingle of the British Museum (Natural History) is preparing a redescription of the species and will settle the problem in that paper.

Distribution.—Although there are numerous references to *G. graphurus* in the literature, there are no documented records of its occurrence west of the Indo-Malayan area. Pocock (1893) recorded specimens from the Arafura Sea and several Australian localities. Both Brooks (1886) and Kemp (1913) had material from Australia; recent records from that area have been summarized by Stephenson and McNeill (1955). All records in the literature, including those from Australia, need to be verified.

Gonodactylus falcatus (Forskål, 1775)

Restricted synonymy:—

Cancer falcatus : Forskål, 1775, p. 96.

Gonodactylus graphurus Miers, 1875, p. 344; 1880, p. 120, pl. III, fig. 9 [not *G. graphurus* White, 1847 (*nomen nudum*)].

Gonodactylus glabrous : Brooks, 1886, p. 62, pl. XIV, fig. 5, pl. XV, figs 7, 9.—Kemp, 1913, p. 167, pl. IX, fig. 113, text-fig. 2 on p. 170.—Bigelow, 1931, p. 127, text-fig. 1.—Armstrong, 1941, p. 14.—Barnard, 1950, p. 863, text-fig. 3f.—Dawydoff, 1952, p. 145.—Taramelli, 1955, p. 45.

(*?*) *Gonodactylus glabrous* var. *ternatensis* : de Man, 1902, p. 914, pl. XXVII, fig. 67.

Gonodactylus falcatus: Holthuis, 1941, p. 284, text-fig. 9a.—Tweedie, 1949, p. 40; 1950, p. 140.—Stephenson, 1952, p. 11; 1953, p. 47.—Holthuis, 1953, p. 61.—Serène, 1954, p. 79, pl. IX, text-fig. 13-6.—Stephenson and McNeill, 1955, p. 249.—Stephenson, 1962, p. 34.—Manning, 1962, p. 4.—Ingle, 1963, p. 29, figs 28, 57.

not *Gonodactylus glabrous:* Tokioka, 1953a, p. 143, text-fig. 1B [*?*=*Mesacturus spinosocarinatus* (Fukuda)].

(*?*) *Gonodactylus falcatus* var. *ternatensis:* Serène, 1954, p. 80, pl. 4, figs 7-12, pl. 10, text-fig. 13-7, 8.

Material.—1♂, 41.4; Green Island, near Cairns, Queensland; coral reef flat; USNM 107786.—1♂, 41.2; Bait Reef, E of Hayman Island, Cumberland Group, Queensland; USNM 107787.—1♀, 52.9; North West Island, Capricorn Group, Queensland; 1953; J. K. Howard, col.; USNM 96973.—5♂, 23.5-52.0; 4♀, 37.7-51.4; same; reef; December, 1925; USNM 64659.

Diagnosis.—Rostral plate with rounded anterolateral angles; eye-scales small, erect; abdomen without trace of transverse grooves, each somite with conspicuous lateral pit on each side; sixth abdominal somite with 6 carinae, usually spined, submedians and intermediates elevated, sharp laterally, tapering posteriorly, usually

excavate under marginal spines; lateral carinae of sixth somite narrower, interrupted anteriorly; short median carina usually present on sixth somite; telson with central group of 5 carinae, median and accessory medians usually spined and excavate posteriorly, anterior submedians usually unarmed and not excavate; 1 pair of short, oblique ridges converge but do not meet posterior to cluster of median carinae; anterior margin of telson with sharp tubercle on either side at level of intermediate spine of sixth somite; submedian and intermediate teeth of telson with long dorsal carinae, submedians each with ventral carina also; lateral tooth distinct, carinate laterally; postanal median carina present on ventral surface; inner branch of uropod slender, tapering distally, inner margin convex proximally, concave distally, setae of outer margin erect; outer spine of basal prolongation of uropod with prominent, acute lobe at base of inner margin.

Colour.—Two recently collected males (USNM 107786-7) mottled green, with dark, irregular bars across carapace and body somites; merus of claw with 3-4 dark bars; sixth abdominal somite with anterior pair of dark spots, one between each submedian and intermediate carina; telson with anterior pair of dark spots, one on each side at level of intermediate tooth of sixth abdominal somite.

Size.—Males, TL 23.5-52.0 mm; females, TL 37.7-52.9 mm.

Discussion.—A diagnosis of this well-known and very common species may seem superfluous, but in view of the obvious confusion in the past between this species and the closely related *G. graphurus* Miers, and in view of the distinct possibility that *G. falcatus* is made up of two or more species, it seems worthwhile to note the major features of these Australian specimens. All correspond with *G. falcatus ternatensis* (de Man), as defined by Serène (1954), but until more is known about geographic, morphological, and sexual variation it seems best to simply record these specimens as *G. falcatus*. Kemp (1913) and Bigelow (1931) both commented upon the variation in their specimens and neither recognized subgroups within the species. Serène (1954) has reported two morphologically distinct forms from Viet Nam, one of which he recognized as *G. falcatus ternatensis*, a "dwarf race". The possibility that more than one species is involved cannot be overlooked.

Both Brooks (1886) and Kemp (1913) have illustrated the differences between *G. falcatus* (as *G. glabrous*) and *G. graphurus* (Miers, sensu Brooks, 1886). None of the present specimens show any trace of the transverse grooves on the first five abdominal somites which are characteristic for *G. graphurus*.

Distribution.—Widely distributed in shallow water through the Indo-Pacific from Japan through Oceania and the Indian Ocean into the Red Sea; it has also been recorded from the Mediterranean (Holthuis, 1941).

Gonodactylus platysoma Wood-Mason, 1895

Restricted synonymy:—

Gonodactylus platysoma Wood-Mason, 1895, p. 11, pl. III, figs 3-9.—Manning, 1962, p. 3.

Gonodactylus chiragra var. *platysoma:* Kemp, 1913, p. 162, text-fig. 1 on p. 161; 1915, p. 180.—Bigelow, 1931, p. 117, pl. 1, fig. 2, pl. 2, fig. 2 [and synonymy].—Holthuis, 1941, p. 28 [and synonymy].—Tweedie, 1950, p. 140.

Gonodactylus chiragra: Stephenson and McNeill, 1955, p. 250 [part].—Gillett and McNeill, 1963, pl. 105 on p. 108 [colour plate].

Gonodactylus chiragra platysoma: Ward, 1942, p. 57.—Holthuis, 1953, p. 62.

Material.—1 brk. ♀, CL 15.5; North Australia; December, 1908; AM Reg No. P. 1761.—1 ♀, 78.8; same AM Reg. No. P. 1762.—1 ♂, 82.9; Murray Is., Torres Straits; 30th August-3rd October, 1907; Hedley and McCulloch, col.; AM Reg. No. P. 3131.—1 ♂, 88.2; same; AM Reg. No. P. 3132.—1 ♀, 68.7; same;

AM Reg. No. P. 3135.—2 ♂, 48.0-61.4; outer edge, St Crispin Reef, off Point Douglas, Queensland; September 1918; A. R. McCulloch, col.; AM Reg. No. P. 4297.—1 brk. ♀, 84.2; Green Is., near Cairns, Queensland; August, 1913; A. R. McCulloch, col.; AM Reg. No. P. 3846.—1 ♀, 84.0; Coates Reef, Queensland; April, 1925; Dr W. E. J. Paradice, pres.; AM Reg. No. P. 8032.—1 ♂, 88.3; reef, North West Is., Capricorn Group, Queensland; April, 1926; G. P. Whitley, pres.; AM Reg. No. P. 8581.—1 ♂, 53.6; Great Barrier Reef; British Great Barrier Reef Expedition 1928-1929; BM(NH) Reg. No. 1937.9.21.424.

Diagnosis.—Anterolateral angles of rostral plate rounded; eye-scales broad, extending to or beyond anterolateral angles of rostral plate, projecting laterally, dorsal margin irregular; abdomen broad, AWCLI 844-1038, usually over 910, mean 953 [n=7]; carinae of sixth abdominal somite slender or slightly swollen, usually armed posteriorly; median carina of telson broad, not sharp, rarely inflated or armed posteriorly; anchor absent; telson with 2 pairs of broad marginal teeth, laterals absent; inner branch of uropods elongate, tapering, inner margin sinuous.

Colour.—Body mottled green; in preservative, sixth thoracic and first abdominal somites with median black patch, lateral dark patches usually present on eighth thoracic somite and always on fifth abdominal somite.

An accurate coloured illustration of *G. platysoma* was published by Gillett and McNeill (1963).

Size.—Males, TL 48.0-88.3 mm; females, 68.7-84.2 mm. Kemp (1915) has recorded a male of 110 mm and a female of 99 mm.

Discussion.—With the exception of the specimen from the Great Barrier Reef Expedition which was in the collection of the British Museum, all of the above material is from the Australian Museum and was treated as *G. chiragra* by Stephenson and McNeill (1955). They noted that these specimens approached *platysoma* as defined by Kemp (1913) but that there was some variation in the breadth/length ratios of the body. For this and other reasons they concluded that the separation of *platysoma* as a varietal form could not be justified. Body breadth/length ratios were calculated from the abdominal width and the total length, as did Kemp in 1913.

Later, Kemp (1915) pointed out that the use of total length for this ratio could lead to inaccuracies because total length is variable, dependent upon the contraction or expansion of the body at the time of preservation. He again calculated length/breadth ratios, but this time used carapace length. Again, he could show complete separation on the basis of this character alone.

I have examined specimens of *G. platysoma* from many localities in the Indo-Pacific and I have seen no evidence of intergradation, in colour pattern or morphological features, between it and *G. chiragra*. *G. platysoma* can be distinguished from *G. chiragra* by the following features: (1) the eye-scales are much broader, extending to or beyond the anterolateral angles of the rostral plate; (2) the body is broader, the AWCLI varying between 844-1038, usually over 910; (3) there is no anchor on the posterior end of the median carina of the telson; (4) the median carina is never armed posteriorly; and (5) the lateral teeth of the telson are entirely suppressed. In view of these differences and the almost identical geographic ranges of *platysoma* and *chiragra*, I can see no reason for not recognizing *platysoma* as a distinct species.

Remarks.—The second largest specimen of *platysoma* examined, a male (TL 88.2 mm), was the slenderest, with an AWCLI of 844. This falls just below the upper limit (855) found for *G. chiragra*; specimens of *G. chiragra* of similar size (male, TL 80.2; female, TL 87.8) have an AWCLI of 781 and 756, respectively. Although there is overlap between these two species in the relative width of the body when all sizes are considered, when specimens of similar size are compared *G. platysoma* is always found to be broader.

Distribution.—*G. platysoma* has been recorded in the Indo-Pacific at localities ranging from Japan and Australia and the western Indian Ocean. It has not been recorded from the Hawaiian Islands or the Red Sea. Shallow water, on coral reefs.

Gonodactylus smithii Pocock, 1893

Restricted synonymy:—

Gonodactylus smithii Pocock, 1893, p. 475, pl. XXB, fig. 1.—Serène, 1954, pp. 6-7, 76, pl. VIII.

Material.—1 ♂, 27.1; 1 ♀, 19.1; Arafura Sea; H.M.S. *Penguin;* P. W. Bassett-Smith, col.; syntypes; BM(NH) Reg. No. 1892.4.18.231-232; 1 ♀, 74.0; Australia; BM(NH) Reg. No. 51.24.—1 ♂, 59.2; Murray Island, Torres Strait; 30th August-3rd October, 1907; Hedley and McCulloch, col; AM (in with *G. platysoma*, Reg. No. P. 3135).—2 ♂, 27.7-60.2; ironstone reef (not coral) at Yirrkala, NW of Cape Arnhem, Northern Territory; Arnhem Land Exped. Sta. M48-21; emulsifiable rotenone; 6th August, 1948; R. R. Miller and natives, col.; AM.—1 ♂, 52.6; same; USNM 111370.—1 ♂, 64.6; coral reef, Yirrkala, Arnhem Land, Northern Territory; Arnhem Land Exped. Sta. M48-21 (?); 12th August, 1948; USNM 111368.—1 brk. ♂, CL 18.8; 3 ♀, 59.6-71.8 (in 2 lots); Great Barrier Reef, Queensland; British Great Barrier Reef Expedition, 1928-1929; in with *G. chiragra*, BM(NH) Reg. No. 1937.9.21.414-423.—1 ♀, 57.0; Green Island, near Cairns, Queensland; coral reef flat; 1953; J. K. Howard; USNM 111381.—1 ♂, 73.5; 3 ♀, 63.2-67.8; Hook Reef, E of Hayman Island, Cumberland Group, Queensland; 1953; J. K. Howard; USNM 96972.—1 ♀, 69.2; Bass Strait (?), Victoria; *Endeavour;* AM Reg. No. E. 3140.

Diagnosis.—Rostral plate with anterolateral angles acute, sharp, but not spinous; eye-scales of moderate size, broader than high but not expanded laterally; body slender, AWCLI 750-806, mean 769 [n=7]; carinae of sixth abdominal somite sharp, apices usually spined; telson usually longer than broad, width occasionally subequal to length; median carina of telson usually sharp, apex spined, accessory median carinae sharp distally, converging under apex of median carina to form anchor; anterior submedian carinae sharp, apex acute but not always spinous; anterior surface of telson with noticeable tubercle under intermediate spine of sixth abdominal somite; submedian and intermediate marginal teeth of telson sharp, slender, with sharp dorsal carinae; lateral teeth of telson small but distinct; inner margin of inner branch of uropod evenly convex.

Colour.—In preservative, mottled green, with body segments outlined posteriorly and carinae of sixth abdominal somite and telson outlined with dark green; dactylus of claw bright pink, propodus with deep blue distal spot, merus with reddish distal dorsal pit, proximal edge of pit with black spot.

Size.—Males, TL 27.1-73.5 mm; females, TL 10.1-74.0 mm.

Discussion.—This species has long been synonymized with *G. chiragra* (Fabricius), which it closely resembles. However, specimens of *G. smithii* can be separated from *chiragra* by the following features: (1) the anterolateral angles of the rostral plate are acute, not rounded; (2) the carinae of the telson are sharp, with the median carina usually terminating in a slender spine; (3) the inner branch of the uropod is short and broad, with the inner margin evenly convex; (4) the dactylus of the claw is red or pink, the distal portion of the propodus is deep blue, and there is a bright red subdistal spot on the inner, dorsal margin of the merus.

The specimens of *G. smithii* available for this study seem to be slenderer than those of *G. chiragra;* this is borne out by the AWCLI for *smithii*, which ranges between 741 and 808, mean 769. This falls within the lower part of the range found for *G. chiragra*. The samples of both species are admittedly small.

The telson of *G. smithii* is usually longer than broad, although in some specimens length and width are subequal. The carinae of the telson may be slightly inflated in larger specimens, TL in excess of 65.0 mm, but these specimens can immediately be distinguished from *G. chiragra* by the evenly convex inner margin of the inner branch of the uropod.

G. smithii is not as broad as *G. platysoma*, and always has an anchor on the posterior portion of the median carina of the telson as well as distinct lateral teeth on the telson; in addition, *smithii* lacks the characteristic black dorsal spots of *G. platysoma*.

Serène (1954) recognized *G. smithii* from Viet Nam and suggested that *G. chiragra* var. *acutirostris* de Man was a synonym. This may be correct, but de Man's species differs in two important respects: (1) there are no tubercles on the anterior surface of the telson, and (2) the anchor is completely absent. The colour pattern of *G. acutirostris* (see Serène, 1947, p. 383) is very similar; the shape of the inner branch of the uropod is unknown. Until some specimens are found which show intergradation between these two species it seems best to recognize both.

Remarks.—The synonymy given above is undoubtedly incomplete, for most authors since Kemp (1913) have placed any and all variants under *G. chiragra*. As Kemp pointed out, Lanchester's *G. chiragra* var. D may be the same as *G. smithii*.

Distribution.—*G. smithii* is known with certainty only from Viet Nam (Serène, 1954), the Arafura Sea (Pocock, 1893), and from Arnhem Land and the Great Barrier Reef, Australia. The present questionable record from Bass Strait needs corroboration. Shallow water.

Gonodactylus chiragra (Fabricius, 1781)

Restricted synonymy:—

Gonodactylus chiragra; Fabricius, 1781, p. 515.—Kemp, 1913, p. 155, pl. IX, fig. 107, text-fig. 2 on p. 161.—Armstrong, 1941, p. 14.—Holthuis, 1941, p. 277, text-fig. 7.—Poisson, 1949, p. 23 [discussion; *chiraga*].—Tweedie, 1950, p. 139.—Barnard, 1950, p. 861.—Stephenson, 1952, p. 11; 1953, p. 47.—Dawydoff, 1952, p. 145.—Fourmanoir, 1953, p. 157, text-figs. 9-13 [development; possibly *G. platysoma*].—Holthuis, 1953, p. 61.—Tokioka, 1953, p. 127 [discussion]; 1953a, p. 143, text-fig. 1A.—Baig, 1954, p. 143 [listed].—Stephenson and McNeill, 1955, p. 250 [part].—Chuang, 1961, p. 180, pl. 80.—Stephenson, 1962, p. 34.—Manning, 1962, p. 3.

(*?*) *Gonodactylus chiragra chiragra:* Ingle, 1963, figs 27, 47, 63.

Material.—1 ♂, 50.9; north Australia; BM(NH) Reg. No. 58.97.—2 ♂, 74.0-78.2; Cape Borda, north-west Australia; Mrs B. Gray; BM(NH) Reg. No. 1932.11.30.185-186.—1 ♂, 78.0; reefs off S. entrance to Little Lagoon, Groote Eylandte, Arnhem Land, Northern Territory; Arnhem Land Expedition Sta. M48-9; 1948; USNM 111364.—1 ♂, 51.8; reef at Yirrkala, Arnhem Land, Northern Territory; Arnhem Land Expedition; 12th July, 1948; R. R. Miller and natives, col.; USNM 111369.—1 ♂, 14.5; reef at Yirrkala Mission, just NW of Cape Arnhem, Gulf of Carpentaria, Northern Territory; Arnhem Land Expedition Sta. C-2; 13th July, 1948; R. R. Miller, col.; AM.—1 ♂, 65.5; 1 ♀, 61.4; ironstone reef at rocky beach ca. 3 mi. S of the point E of Yirrkala and NW of Cape Arnhem, Northern Territory; Arnhem Land Expedition; 18th July, 1948; R. R. Miller and F. M. Setzler, col.; AM.—18 ♂, 28.8-79.6; 12 ♀, 36.0-71.2; ironstone reef (not coral) at Yirrkala, NW of Cape Arnhem, Northern Territory; Arnhem Land Expedition Sta. M48-21; emulsifiable rotenone; 6th August, 1948; R. R. Miller and natives, col.; AM (6 ♂, 6 ♀ to USNM 111363).—3 ♂, 66.2-78.0; 1 ♀, 63.0; reef at Yirrkala,

NW of Cape Arnhem; Northern Territory; Arnhem Land Expedition Sta. M48-21 (?); 12th August, 1948; R. R. Miller; USNM 111365.—1 ♀, 26.4; same; AM.—1 ♀, 13.5; coral reef at Yirrkala, NW of Cape Arnhem, Northern Territory; Arnhem Land Exped. Stats. C8-11; 25th August, 1948; R. R. Miller and natives, col.; AM.—2 ♂, 16.6-18.6; 2 ♀, 21.8-24.2; coral reef at Yirrkala, Arnhem Land, Northern Territory; Arnhem Land Exped. Stats. C13-17; 26th August, 1948; R. R. Miller, col.; USNM 111367.—9 ♂, 22.5-80.2; 12 ♀, 38.4-87.8 (in 7 lots); Great Barrier Reef, Queensland; British Great Barrier Reef Expedition, 1928-1929; BM(NH) Reg. No. 1937.9.21.414-4237.—1 ♀, 78.3; from coral crevices, North West Island, off Rockhampton, Queensland; *Endeavour* (*?*); AM Reg. No. E. 4504.—1 ♀, 57.0; Sydney, New South Wales; 21st March, 1948; F. D. McCarthy, col.; AM.—1 ♀, 63.5; same; USNM 111366.

Diagnosis.—Anterolateral angles of rostral plate rounded; eye-scales of moderate size, width usually greater than height, not extending laterally to edge of rostral plate; abdomen slender, AWCLI 756-855, mean 806 (n=26); carinae of sixth abdominal somite variously swollen and armed; carinae of telson variously swollen, rarely sharp, median usually lacking distal tubercle; anchor present; telson broader than long; marginal teeth of telson broad, lateral teeth present; inner branch of uropod tapering, inner margin sinuous, convex proximally, concave distally.

Colour.—Pattern almost completely faded in all of the present specimens; in the collection from Arnhem Land, all males have a darker ventral surface than females.

Size.—Males, TL 14.5-80.2; females, TL 13.5-87.8.

Discussion.—*G. chiragra*, as restricted here, can be distinguished from *G. platysoma* by the presence of lateral teeth on the telson, the narrower body, smaller eye-scales, lack of dark pigment patches on the body, and presence of an anchor on the telson. The sinuous inner margin of the uropodal inner branch distinguishes *chiragra* from the closely related *G. smithii*, which differs further in having sharp anterolateral angles on the rostral plate and a narrower telson usually ornamented with sharp, posteriorly-spined carinae.

The small specimens from Arnhem Land Expedition Sta. C13-17 appear to be adult in that the copulatory tubes of the males (TL 16.8-18.6 mm) are well developed and the carinae of the telson are very swollen. They also differ from the other available specimens in that the eye-scales are very small and erect, appearing taller than broad, and the anterolateral angles of the rostral plate are almost obtuse. The rostral plate is similar to that of *G. chiragra* var. *viridis* illustrated by Serène (1954). The telson of these small specimens is similar to that shown by Lanchester (1903) for G. *chiragra* var. *incipiens*. In view of the fact that there are only four specimens available and that nothing is known of their habitat or colour, it seems best to simply record them as variants. A revision of the genus may well show that they belong to a distinct species, corresponding to Kemp's dwarf races.

Remarks.—The specimen from the Red Sea illustrated by Ingle (1963) has sharp anterolateral angles on the rostral plate and may prove to be conspecific with *G. smithii*.

Distribution.—*G. chiragra* is widely distributed in the Indo-Pacific, from Japan, Oceania, and Australia to the Red Sea and South Africa. Stephenson and McNeill (1955) have summarized the numerous records from Australia. Shallow water.

Hadrosquilla, new genus

Definition.—Body depressed, compact; eyes small, cornea subglobular; rostral plate subquadrate; carapace narrowed anteriorly, smooth, without carinae, spines, or trace of cervical groove across dorsum; antennal protopod with 1 ventral and 2 mesial papillae; raptorial claw small, dactylus armed with 5-6 teeth; propodus stout, upper margin fully pectinate; propodi of third and fourth maxillipeds as broad as or broader than long; mandibular palp absent; 5 epipods present; thoracic and abdominal somites without longitudinal carinae, small spines present only at posterolateral angles of sixth abdominal somite; telson broad, thick, with rounded dorsal median projection and irregularly sculptured area between dorsal projection and marginal armature which consists of, on either side of midline, (a) a row of fixed submedian denticles, (b) 1 movable submedian tooth, (c) 2 intermediate denticles, (d) 1 intermediate tooth, (e) 1 lateral denticle, (f) 1 lateral tooth; basal prolongation of uropod produced into 2 trefoil spines, inner longer; inner branch of uropod with strong proximal fold on outer margin. Size small, TL 60 mm or less.

Type-species.—*Lysiosquilla perpasta* Hale, 1924. The genus is monotypic.

Gender.—Feminine.

Etymology.—The name is from the Greek, *hadros*, thick or bulky, in combination with the generic name *Squilla*.

Discussion.—*Hadrosquilla* most closely resembles *Nannosquilla*, particularly in the shape of the eyes, rostral plate, and inner branch of uropod, and in lacking a mandibular palp. It differs from *Nannosquilla* in having papillae on the antennal protopod, five epipods instead of four, in having a much stouter, more compact body, a stouter raptorial claw, with fewer teeth on the dactylus (5-6 instead of 7 or more), in having flattened spines on the basal prolongation of the uropod, in having only two intermediate denticles on the telson, and in lacking spatulate spines on the outer margin of the proximal segment of the uropodal outer branch, as well as lacking the long, ventrally-directed spinous process on the sixth abdominal somite in front of the articulation of each uropod. The rostral plate and eyes of *Hadrosquilla* also resemble those found in species of *Acanthosquilla*, but all members of that genus have five or more dorsal spines on the telson arranged in a semicircle.

Hadrosquilla differs from *Heterosquilla* in having elongate eyes with a subglobular cornea, a quadrate rather than cordiform or triangular rostral plate, a broad propodus on the raptorial claw, and a broad, triangular, ventrally-directed process on the sixth abdominal somite in front of the articulation of the uropod. The proximal fold on the inner branch of the uropod, among other features, distinguishes *Hadrosquilla* from the subgenera *Heterosquilla* and *Heterosquilloides* of *Heterosquilla*, and it shares this feature with the subgenus *Austrosquilla*. It can be distinguished from all the subgenera of *Heterosquilla* by the thick telson, with its broad, truncate median projection and highly sculptured posterior margin, which, as already noted, is similar to that found in *Nannosquilla*.

Hadrosquilla perpasta (Hale, 1924), new combination

Fig. 7

Lysiosquilla perpasta Hale, 1924, p. 497, pl. xxxiii, fig. 1, text-fig. 382.—Hale, 1927, p. 33, text-fig. 23; 1927a, p. 307 [listed].—Stephenson, 1952, p. 9; 1953; p. 45; 1955, p. 2.—Stephenson and McNeill, 1955, p. 245.

Heterosquilla perpasta: Manning, 1963, p. 321 [discussion].

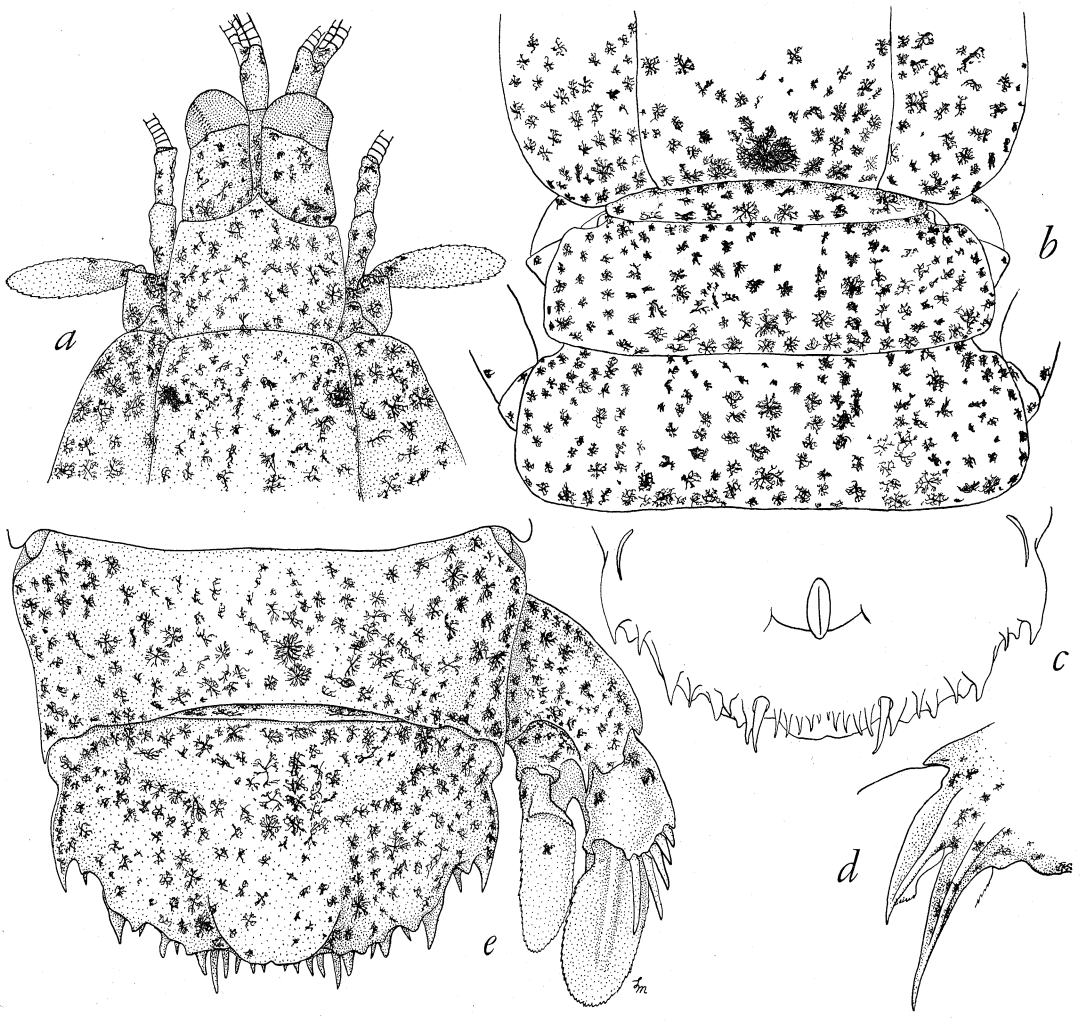

Fig. 7.—*Hadrosquilla perpasta* (Hale), male, TL 30.3 mm, Moreton Bay. *a*, anterior portion of body; *b*, lateral processes of fifth, sixth, and seventh thoracic somites; *c*, ventral view of telson; *d*, basal prolongation of right uropod, ventral view; *e*, last abdominal somite, telson, and right uropod.

Material.—1 ♂, 34.2; Botany Bay, New South Wales; builds burrows amongst colonies of *Diopatra dentata* K.; between tides; exchange from M. Ward; USNM 78424.—1 ♂, 41.6; Kumell, Botany Bay, New South Wales; M. Ward; BM(NH) Reg. No. 1940.2.23.14.—1 ♂, 30.3; 1 ♀, 33.7; Dunwich, Stradbroke Is., Moreton Bay, Queensland; 19th July, 1952; R. Domrow, col.; exchange from Australian Museum; USNM 111355.

Description.—Eye small, cornea subglobular, set obliquely on stalk and overhanging it laterally; eyes not extending to end of antennular peduncle; eye-scales low, completely fused along midline.

Antennular peduncle short, less than half as long as carapace; dorsal processes of antennular somite produced into slender, anteriorly-directed spines, usually concealed by rostral plate.

Antennal scale small, less than one-third as long as carapace; antennal peduncle extending to cornea; antennal protopod with 1 ventral and 2 mesial papillae.

Rostral plate subquadrate, as broad as or broader than long, lateral margins convex; anterolateral angles acute; apex obtuse but sharp, slightly in advance of anterolateral angles.

Carapace short, small, narrowed anteriorly, without carinae or spines.

Dactylus of raptorial claw with 5-6 teeth, penultimate not shorter than antepenultimate; outer margin of dactylus evenly convex, with strong proximal notch, flanked proximally by a sharp lobe, distally by obtuse lobe; propodus short, stout, fully pectinate, with 4 movable spines, first longest, at base of inner margin; dorsal ridge of carpus terminating in sharp spine; merus stout, longer than ischium, inferodistal margin unarmed.

Propodi of third and fourth thoracic appendages beaded ventrally, broader than long, propodus of fourth twice as broad as that of fifth; propodus of fifth thoracic appendage as broad as long, with ventral brush of setae.

Mandibular palp absent; 5 epipods present.

Exposed thoracic somites smooth, straight or slightly rounded laterally; lateral portions of fifth somite concealed by carapace, but without conspicuous lateral process; basal segment of walking legs with blunt triangular process on posterior margin; inner branches of walking legs two-segmented, ovoid on first leg, elongate on third; eighth thoracic somite with low median ventral projection.

Abdomen smooth, compact, depressed, unarmed dorsally except for blunt posterolateral lobes on sixth somite; sixth somite with blunt ventral projection in front of each articulation of uropod.

Telson broad, convex, thick, with broad median dorsal projection, truncate posteriorly, with median notch; posterior margin of telson highly sculptured, with numerous projections above true posterior armature; "upper" armature consisting of, on either side of midline, a sharp or blunt lobe above movable submedian tooth, 3 variously shaped lobes between submedian and intermediate teeth, above intermediate denticles, and blunt submedian lobes and a blunt lobe above lateral denticle; marginal armature consisting of, on either side of midline, (a) 3-5 sharp submedian denticles, in a curved row, inner smallest and highest, (b) a sharp, movable submedian tooth, (c) 2 sharp intermediate denticles, (d) 1 fixed intermediate tooth, (e) 1 sharp lateral denticle, and (f) 1 broad lateral tooth.

Basal segment of uropod with sharp outer and dorsal carinae, dorsal extending to distal spine; proximal segment of outer branch shorter than distal, with 5-6 slender, movable spines on outer margin, last extending slightly beyond midpoint of distal segment; distal angle of proximal segment of outer branch with broad rounded lobe armed with 5-6 stiff setae; inner branch elongate, tapering, proximal portion of outer edge folded over; basal prolongation consisting of 2 flattened spines, carinate ventrally, inner longer.

Colour.—Background cream, entire surface of body covered with small, stellate, black chromatophores, aggregated into long, broad bar on last 3 thoracic and first 5 abdominal somites; carapace also with 1 pair of anterior black spots along gastric grooves, 3 spots, 1 mesial, 2 lateral, in area of cervical groove, and 1 on median posterior margin.

Measurements.—Males, TL 15-45 mm; females, TL 21-55 mm (Stephenson and McNeill, 1955). Other measurements, in mm, of male, TL 34.2 mm: carapace length, 6.6; cornea width, 1.0; rostral plate length, width, 2.1, 2.2; fifth abdominal somite width, 6.8; telson length, width, 3.3, 5.5.

Discussion.—The thick telson with its highly sculptured posterior margin is characteristic of this species, and that feature, in combination with the small number of teeth on the claw (5-6), the compact body and the presence of only two intermediate denticles on the telson will distinguish it from similar species in *Heterosquilla* and *Nannosquilla.*

Distribution.—South-eastern coast of Australia, where it has been recorded from Queensland, New South Wales, Victoria, and South Australia. Stephenson (1955) also recorded it from Tasmania. Subtidal to 10 m.

Heterosquilla Manning, 1963

Heterosquilla Manning, 1963, p. 320.

Definition.—Body depressed, compact; eyes of moderate size, cornea usually bilobed or expanded; rostral plate usually triangular or cordiform; antennal protopod with one or more papillae; carapace narrowed anteriorly, smooth, without trace of carinae, spines, or cervical groove across dorsum; raptorial claw large, dactylus armed with 4 or more teeth; propodus slender, fully pectinate; mandibular palp usually present; at least 4 epipods present; thoracic and abdominal somites without longitudinal carinae, sixth somite with posterolateral spines and with or without additional dorsal spines; telson broad, with variously shaped median dorsal projection and with or without additional submedian dorsal projections or spines; marginal armature of telson consisting of, on either side of midline, (a) a row of submedian denticles, (b) 1 movable submedian tooth, (c) 2 or 4 intermediate denticles, (d) 1 intermediate tooth, (e) 1 lateral denticle, and (f) 1 lateral tooth; basal prolongation of uropod produced into triangular spines, length variable; inner branch of uropod usually without strong proximal fold on outer margin. Size moderate, maximum TL about 100 mm.

Remarks.—Thirteen species were provisionally referred to this genus when it was originally diagnosed (Manning, 1963). At that time I noted that the genus probably included several unrelated groups. Since 1963, studies have shown that two species, *Squilla eusebia* Risso and *Lysiosquilla enodis* Manning, are quite distinct from the remainder of the species in *Heterosquilla*, and these will be referred to a new genus in a revision of the Western Atlantic stomatopods now nearing completion. A study of the Australian species which were not available when the preliminary revision of *Lysiosquilla* was published indicates that one new genus and two new subgenera should now be proposed.

As shown below, two other species originally referred to *Heterosquilla*, *H. latifrons* (de Haan) and *H. spinosa* (Wood-Mason), are each made up of two closely-related but distinct species. *H. brazieri* (Miers) is the Australian analogue of the Japanese *H. latifrons; H. brazieri* was recently resurrected as a subspecies of *H. latifrons* by Stephenson (1962), but a direct comparison of specimens of both species leaves little doubt that they are distinct. Also, *H. tricarinata* (Claus) from New Zealand is distinct from *H. spinosa* (Wood-Mason) from the Andaman Islands; both species had previously been referred to *H. spinosa.*

H. perpasta (Hale) is here referred to a new genus. As noted in the discussion of that genus, it differs in many respects from the other species now placed in *Heterosquilla* and seems to be more closely related to *Nannosquilla* than *Heterosquilla.*

The twelve remaining species of *Heterosquilla* fall into two distinct groups, with either two or four intermediate marginal denticles present on the telson. There are four species in the former group, two from South America, *H. platensis* (Berg) (the type-species) and *H. polydactyla* (von Martens), and two from the Indo-Pacific, *H. tricarinata* (Claus) and *H. spinosa* (Wood-Mason). All share the following features: (1) the outer spine of the basal prolongation of the uropod is much larger than the inner; (2) there is no strong fold on the proximal portion of the outer margin of the uropodal inner branch; (3) the inner branches on the walking legs are slender; and (4) the rostral plate is cordiform. The cornea of the two American species is broadened, almost bilobed, whereas that of the Indo-Pacific species is subglobular. These four southern species are placed in the nominate subgenus, *Heterosquilla*.

The remaining eight species, all of which have four intermediate marginal denticles on the telson, also fall into two distinct groups. The two Australian species, *H. osculans* (Hale) and *H. vercoi* (Hale), differ from all the remainder in three features. The eye is subglobular and set very obliquely on the stalk (as in *Nannosquilla*), there is a strong fold on the inner margin of the uropodal inner branch, and there is a strong inferodistal spine on the ischium of the raptorial claw. These two species are referred to a new subgenus, *Austrosquilla*.

The remaining six species of *Heterosquilla* are very similar morphologically. All but the east American *H. armata* (Smith) have the inner spine of the basal prolongation of the uropod longer than the outer. All have a broad eye, with a bilobed cornea, a triangular rostral plate, and a slender inner branch on the uropod, lacking a strong proximal fold. These six species are referred to a second new subgenus, *Heterosquilloides*.

KEY TO INDO-PACIFIC SPECIES OF HETEROSQUILLA

1. Two intermediate marginal denticles present on telson. Subgenus *Heterosquilla* 2
   Four intermediate marginal denticles present on telson..... 3
2. Basal prolongation of uropod with distinct inner spine .... *tricarinata*, p. 120
   Basal prolongation of uropod with at most a rounded lobe ..... [*H. spinosa* (Wood-Mason, 1895)]
3. Ischium of raptorial claw unarmed; cornea expanded, usually bilobed; proximal portion of inner branch of uropod without strong fold. Subgenus *Heterosquilloides* 4
   Ischium of raptorial claw with inferodistal spine; cornea subglobular; proximal portion of outer margin of uropodal inner branch strongly folded over. Subgenus *Austrosquilla* 6
4. Ventral surface of telson with strong postanal spine; sixth abdominal somite armed as posterolateral angles only..... 5
   Ventral surface telson without postanal spine; sixth abdominal somite with dorsal spines in addition to those at posterolateral angles ..... [*H. insignis* (Kemp, 1911)]
5. One or more short longitudinal carinae present between median projection and anteriorly-connected submedian dorsal carinae..... *brazieri*, p. 125
   No short carinae present between median and anteriorly-connected submedian dorsal carinae ..... [*H. latifrons* (de Haan, 1844)]
6. Dorsal projection of telson spinous; rostral plate subquadrate.....*osculans*, p. 127
   Dorsal projection of telson obtuse, blunt; rostral plate triangular....*vercoi*, p. 130

Heterosquilla (Heterosquilla) tricarinata (Claus, 1871)

Fig. 8

Coronis tricarinata White, 1847, p. 85 [*nomen nudum*].

Coronis tricarinata Claus, 1871, p. 21.

Coronis spinosa Wood-Mason, 1875, p. 232; 1876, p. 263 [part].

Squilla indefensa Kirk, 1878, p. 466; 1879, p. 394, text-fig. on p. 394; 1879a, p. 401.—Filhol, 1885, p. 52 [listed]; 1886, p. 436, pl. 53, fig. 3.—Bigelow, 1894, p. 503 [key only].

Squilla laevis Hutton, 1879, p. 340.—Filhol, 1886, p. 491.—Bigelow, 1894, p. 503 [key only] [not *S. laevis* Hess, 1865].

Lysisosquilla spinosa: Miers, 1880, pp. 12, 125, pl. 1, figs 10-12.—Chilton, 1891, pp. 61, 63, pl. 10, figs 1-3.—Bigelow, 1894, p. 503 [key only].—Wood-Mason, 1895, p. 1, pl. 1, figs 1-3 [part; reference to New Zealand specimens only].—Hutton, 1904, p. 256 [listed].—Chilton, 1906, p. 270 [listed]; 1909, p. 615 [listed]; 1911, p. 139, text-fig. 4; 1911a, p. 306.—Thomson, 1913, p. 241 [listed].—Kemp, 1913, p. 118, pl. 8, fig. 94 [part; reference to New Zealand specimen only].—Thomson and Anderton, 1921, p. 108.—Young, 1929, p. 154 [listed].—Powell, 1947, p. 37.—Ralph and Yaldwyn, 1956, p. 64, pl. I, fig. 5.

not *Squilla tridentata* Thomson, 1882, p. 230.—Bigelow, 1894, p. 503 [key only].

not *Lysiosquilla spinosa:* Lanchester, 1901, p. 554.

Material.—1 ♂, 68.8; 1 ♀, 61.7; dug from sandflats, Portobello, Otago Harbour, New Zealand; 12th November, 1952; J. C. Yaldwyn, col.; exchange from Australian Museum; USNM 111358.—1 ♂, 77.5; Parakanui, Otago, New Zealand; from Otago University Museum; BM(NH) Reg. No. 86.56.—2 ♂, 50.5-67.2; Stewart Is., nr. New Zealand; A. Lysaght, pres.; BM(NH) Reg. No. 1955.10.20.6/7.—1 ♂, 54.3; Stewart [Is. (?)]; Filhol, col.; MNHNP.—1 dry ♂, CL 6.6; no specific locality; Ross Antarctic Exped., col.; holotype; BM(NH).

Description.—Eye small, cornea subglobular, set obliquely on stalk; ventral margin of stalk with prominent projecting lobe; eyes extending slightly beyond end of second segment of antennular peduncle; eye-scales erect, completely fused along midline.

Antennular peduncle short, about one-third as long as carapace; basal segment with proximal spine and 2 fleshy lateral papillae; dorsal processes of antennular somite produced into triangular lobes directed anterolaterally, visible either side of rostral plate.

Antennal scale small, less than half as long as carapace; antennal peduncle extending to end of cornea; antennal protopod with 2 ventral papillae.

Rostral plate triangular or cordiform, broader than long, anterolateral margins tapering to acute but blunt apex which extends to proximal portion of eyes.

Carapace smooth, short, narrowed anteriorly, without carinae or spines.

Dactylus of raptorial claw with 9-13 teeth, penultimate not markedly shorter than antepenultimate; outer margin of dactylus sinuate, with basal notch; propodus fully pectinate, with 3 movable spines at base, proximal the largest; dorsal ridge of carpus terminating in sharp tooth; merus longer than ischium, outer inferior angle unarmed; basis with ventrally-projecting tooth on inner margin.

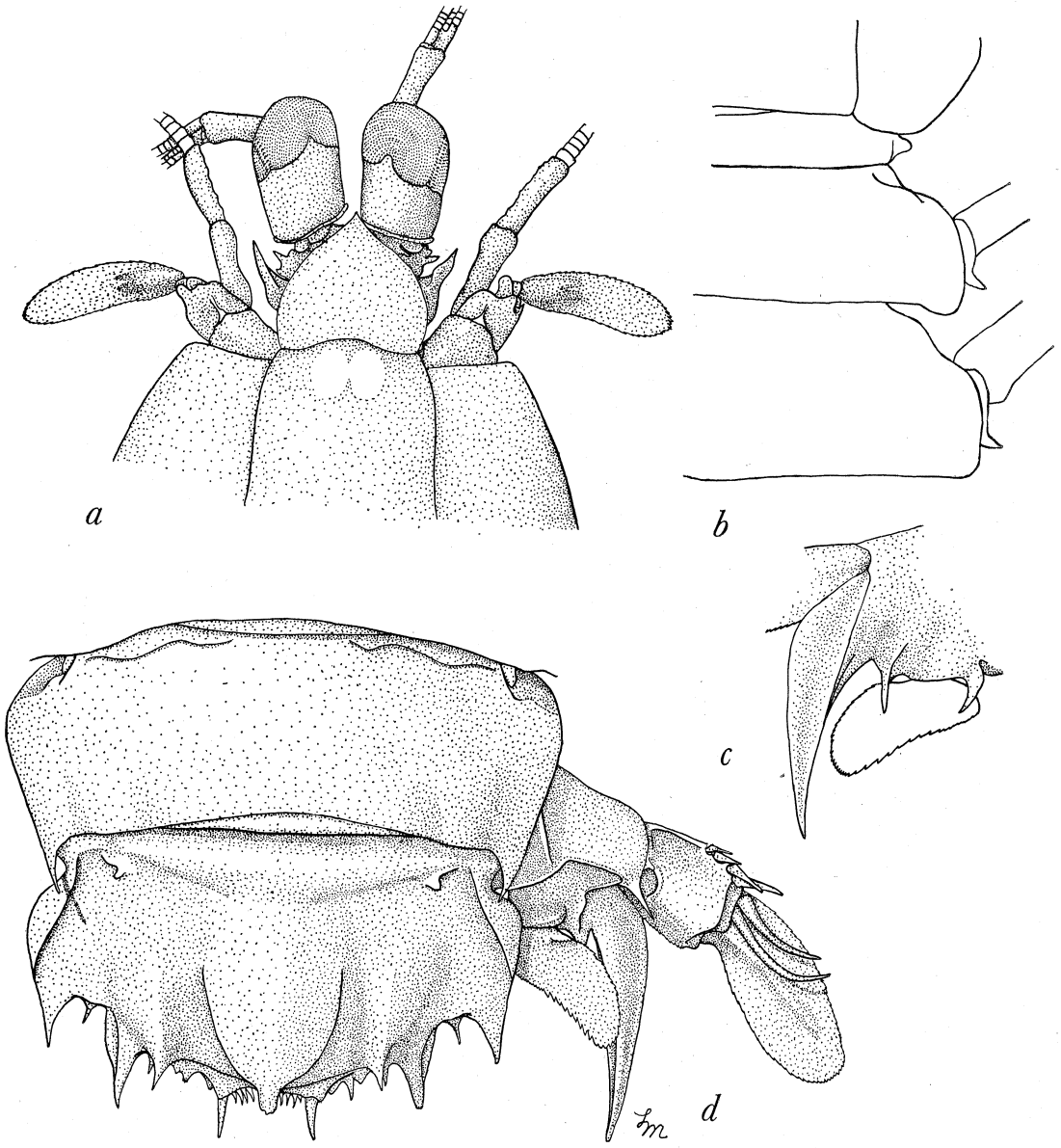

Fig. 8.—*Heterosquilla* (*Heterosquilla*) *tricarinata* (Claus), female, TL 61.7 mm, Otago Harbour. *a*, eye; *b*, lateral processes of fifth, sixth, and seventh thoracic somites; *c*, basal prolongation of right uropod, ventral view; *d*, sixth abdominal somite, telson, and right uropod.

Propodus of third and fourth thoracic appendages each beaded ventrally broader than long, propodus of fourth twice as broad as that of fifth appendage; propodus of fifth appendage as broad as long, with ventral brush of setae.

Mandibular palp present; 5 epipods present.

Exposed thoracic somites smooth dorsally; fifth somite with thin, blade-like, ventrally-directed lateral process, usually appearing acute in dorsal view, rounded ventrally; lateral processes of next 2 somites convex laterally, rounded anteriorly, more truncate posteriorly; basal segments of walking legs with large triangular outer spine and small sharp inner spine on posterior margin; inner branches of walking legs ovate on first 2 legs, elongate on third, two-segmented; eighth thoracic somite with low median ventral keel.

Abdomen smooth, depressed, usually armed at posterolateral angles of sixth somite only, posterolateral angles of fifth somite rarely armed; sixth somite with longitudinal lateral grooves, not sharply defined, and ventral projection in front of articulation of each uropod; sixth somite with slight median projection on postero-ventral margin in male, female with posterolateral projections, armed with spinules on one side; anterolateral plates fully articulated.

Telson broad, with broad median dorsal elevation, tipped with rounded or blunted lobe, and 2 low submedian elevations, each terminating in sharp tooth; 3 pairs of marginal teeth, movable submedians, fixed intermediates and laterals, with intervening denticles, arranged as follows: submedian, 6-10; intermediate, 2; lateral, 1; submedians in convex row on each side; low lobe present between sub-median tooth and first intermediate denticle, second low lobe between each inter-mediate denticle; oblique lateral carinae and anterolateral tubercles also present on dorsal surface.

Basal segment of uropod with sharp dorsal carina, extending almost to distal spine before curving ventrally; proximal segment of outer branch with 5-6 slender spines, last 2 elongate, strongly recurved, extending past midpoint of distal segment; inner distal angles of proximal segment of outer branch with rounded lobe, armed with 6-9 stiff setae; distal segment of outer branch longer than proximal; inner branch short, stout, convex, proximal portion of outer margin lacking strong fold; basal prolongation flattened, outer spine with strong ventral carina, much larger than inner spine; slender proximal spine also present on basal prolongation at articulation of inner branch.

Colour.—Male with 2-3 transverse bars of dark pigment on each body segment, anterior diffuse, posterior sharply defined, posterior not extending to ventral margin of pleuron; female with most of body dark, each segment with median and posterior clear areas; both sexes with 2 broad, submedian black patches on telson, interrupted by clear longitudinal line along midline, between median elevation and submedians, and along submedian elevations; uropod with broad proximal and distal dark patches, separated by clear area. The colour of living animals has been recorded by Chilton (1891) and Ralph and Yaldwyn (1956).

Measurements.—Males, TL 50.5-77.5 mm; female, TL 61.7 mm. Other measurements of 68.8 mm male, in mm: carapace length, 13.2; cornea width, 2.5; rostral plate length, width, 3.2, 3.7; fifth abdominal somite width, 14.4; telson length, width, 6.8, 11.5.

Discussion.—Although the forms originally recorded from New Zealand and the Andamans by Wood-Mason have always been considered to be conspecific, in my opinion the two should be considered distinct. The New Zealand species, herein referred to *H. tricarinata*, differs from the species recorded from the Andamans (and

perhaps Penang, Malaya) in several minute but important points, as follows: (1) in *H. spinosa* the basal segment of each walking leg is armed with one spine, whereas in *H. tricarinata* there are two; (2) *H. spinosa* has three sharp dorsal spines, the median of which, according to Kemp (1913), is situated on a conspicuous lobe; in *H. tricarinata* only the two lateral spines are sharp, the median (at least in the specimens reported herein) is bluntly rounded posteriorly and is situated on a prominent, elevated projection, almost carinate laterally; (3) *H. spinosa* lacks an inner spine on the basal prolongation of the uropod; this spine is well-developed in *H. tricarinata*. The most important difference between the two species is the lack of the inner spine on the basal prolongation of the uropod in *H. spinosa* and its presence in *H. tricarinata*. A direct comparison of specimens of both species might well show other differences.

H. tricarinata was first used by White (1847) in his List of the Crustacea of the British Museum; the name was merely listed and not described, and has been considered as an unidentifiable *nomen nudum*. White's specimen was later examined by Claus, who validated the name in his classic paper on stomatopod larvae published in 1871; Claus included remarks on some of the characters of White's specimen. Claus's use of the name would probably have been overlooked by me if it had not been brought to my attention by L. B. Holthuis.

While at the British Museum in June, 1964, I had the opportunity of examining White's specimen and I was able to verify that it belongs to this common species from New Zealand, as suggested by Miers (1880).

Coronis spinosa Wood-Mason, which is here restricted to the species reported from the Andaman Islands (Wood-Mason, 1875) and Penang, Malaya (Lanchester, 1901), was originally described from two females, one from the Andaman Islands, the other from New Zealand. No type was designated originally by Wood-Mason, but Kemp (1913, p. 120) selected the female from Port Blair, Andamans as the type. The name *spinosa* can be used for the more northern form, *tricarinata* for the species in New Zealand. If they prove to be conspecific, the older name, *tricarinata*, must be used. To my knowledge, only Wood-Mason (1875, 1876, 1895), Lanchester (1901), and Kemp (1913) actually deal with *H. spinosa* s.s.; specimens reported as *Coronis spinosa* or *Lysiosquilla spinosa* by all other authors are probably referable to *H. tricarinata*.

I follow Chilton (1891) and Kemp (1913) in synonymizing *Squilla laevis* Hutton and *Squilla indefensa* Kirk with *H. tricarinata*. I do not agree that *Squilla tridentata* Thomson, which has but four teeth on the dactylus of the raptorial claw, is conspecific with *H. tricarinata*, which has 9-11 teeth on the claw. Thomson's specimen is obviously a juvenile or post larva, and the armature of the raptorial claw is one feature that is not known to change with age. Thomson's type, if extant, should be re-examined and redescribed.

H. tricarinata is very similar to the American *Heterosquilla platensis* (Berg) from Argentina. Although agreeing with *H. platensis* in general appearance, *H. tricarinata* differs as follows: (1) the eye of *tricarinata* is smaller, with the cornea less expanded; (2) the apex of the rostral plate is shorter, and the anterolateral angles are not as strongly concave; (3) the antennal scale is not as elongate or slender; (4) there are 9-12 teeth on the claw of *tricarinata*, 13-15 in *platensis;* (5) the basal spines of the walking legs are more prominent in *tricarinata;* (6) *platensis* has 9-13 submedian denticles in a transverse row on the telson, *tricarinata* has 12-19 in two curved rows; (7) the submedian dorsal carinae of the telson are poorly marked in *tricarinata*, very prominent in *platensis;* (8) the lateral longitudinal carinae of the sixth abdominal somite are much more prominent in *platensis* than in *tricarinata;* (9) the inner spine of the basal prolongation is comparatively smaller in *tricarinata;* (10) the inner branch of the uropod is much longer and slenderer in *platensis* than *tricarinata*. In general colour pattern the two species are very similar; in *platensis* there is no colour

dimorphism, and both sexes resemble the males of *tricarinata*. There are some minor colour differences, such as the absence of a dark encircling ring on the antennal scale of *tricarinata*.

H. tricarinata also resembles the American *H. polydactyla* (von Martens), but the latter is immediately distinguished by its long rostral plate and large (17-20) number of teeth on the dactylus of the raptorial claw.

Remarks.—According to Article 23(b) of the present International Code of Zoological Nomenclature, *Coronis tricarinata* Claus must be considered as a *nomen oblitum*, since it has not been used in over 50 years. Since the International Commission itself has not been able to interpret this rule, which does systematics a gross disservice by unnecessarily multiplying names and by circumventing the Law of Priority, Claus's name is used here. There is no good reason for not using *C. tricarinata* for this species and there are numerous good reasons for not introducing a new name here. *Coronis tricarinata* Claus is the oldest name for the species and should be used.

Distribution.—H. tricarinata is known only from the waters of New Zealand and some surrounding islands. Records in the literature are: Hobson Bay and St Helier's Bay, Auckland Harbour; Kapiti Island and Waikanae, Wellington; Otago Harbour, Dunedin, and Resolution Island, Dusky Sound, Southland; Stewart Island; Chatham Islands; Auckland Islands. Known intertidally but bathymetric range has not been recorded.

Heterosquilloides, new subgenus

Diagnosis.—Cornea large, bilobed; rostral plate triangular or sub-cordiform; ischium of raptorial claw without inferodistal spine; 4 intermediate denticles on telson; inner branch of uropod without strong proximal fold on outer margin; inner spine of basal prolongation of uropod usually the longer.

Type-species.—Lysiosquilla insolita Manning, 1963.

Gender.—Feminine.

Etymology.—The name is composed of the Latin suffix, *—oides*, in combination with the generic name *Heterosquilla*.

Discussion.—This subgenus includes six of the species originally assigned to *Heterosquilla*, *H. latifrons* (de Haan), *H. brazieri* (Miers), *H. armata* (Smith), *H. insignis* (Kemp), *H. mccullochae* (Schmitt), and *H. insolita* (Manning). The bilobed cornea and the presence of four intermediate denticles on the telson will distinguish members of this subgenus from those in the nominate subgenus which have a broadened eye and but two intermediate denticles. As in the nominate subgenus, the inner branch of the last walking leg of *Heterosquilloides* is very slender and there is no strong fold on the inner, proximal margin of the uropodal inner branch. Species of this subgenus all have a very ornate telson, with the broad median elevation flanked by several variously armed carinae. Of the species assigned here, only *H. armata* has the outer spine of the uropodal basal prolongation longer than the inner.

The more ornate telson, with more than one dorsal spine, and the lack of the inferodistal spine on the ischium of the claw, among other features, will distinguish members of this subgenus from the third subgenus, *Austrosquilla*.

Heterosquilla (Heterosquilloides) brazieri (Miers, 1880)

Lysiosquilla Brazieri Miers, 1880, pp. 11, 125, pl. I, figs 3-6.—Haswell, 1882, p. 206.—Whitelegge, 1889, p. 222.—Bigelow, 1894, p. 503 [key only].—Chilton, 1911, p. 139.

Lysiosquilla latifrons: Kemp, 1913, p. 128 [part].—Stephenson and McNeill, 1955, p. 248 [not *L. latifrons* de Haan, 1844].

Lysiosquilla latifrons brazieri: Stephenson, 1962, p. 38, pl. I, figs A-D, text-figs 1e-1f.

Material.—1 ♀, 99.0; Port Jackson, New South Wales; J. Brazier; holotype; BM(NH) Reg. No. 79.8.—1 ♀, 56.3; trawled off Kingscliff, New South Wales; 56 m; June, 1961; L. Wale, col.; AM Reg. No. P. 13767.

Description.—Eye of moderate size, cornea bilobed, with prominent mesial tubercle; eye-scales erect, separate; eyes extending beyond end of first segment of antennular peduncle.

Antennular peduncle short, slightly more than half as long as carapace; dorsal processes of antennular somite visible lateral to rostral plate as erect spines, apex curved anteriorly.

Antennal protopod with at most 1 ventral papilla; antennal peduncle, long, extending well beyond eye; antennal scale more than one-third as long as carapace.

Rostral plate short, much broader than long; basal portion very short, broadly rounded laterally, apical spine long; apical spine bifurcate in dorsoventral plane, ventral spine fitting between eye-scales.

Carapace short, strongly narrowed anteriorly, with rounded anterolateral angles and more broadly rounded posterolateral angles.

Raptorial claws missing in Kingscliff specimen; dactylus in type armed with 6 teeth.

Propodus of third thoracic appendage broader than long, beaded ventrally; fourth thoracic appendages missing in Kingscliff specimen; propodus of fifth thoracic appendage as broad as long, with ventral brush of setae.

Exposed thoracic somites smooth dorsally, fifth without conspicuous lateral or ventral processes; lateral processes of sixth and seventh somites rounded, lateral process of sixth somite smaller than that of seventh, on both somites processes anteriorly rounded, posteriorly angled, apex rounded; basal segments of walking legs each with single posterior spine; inner branches of walking legs two-segmented, ovate on first 2 legs, slender on last; low median ventral projection present on eighth thoracic somite.

Abdomen compact, depressed, smooth, armed only at posterolateral angles of sixth somite; sixth somite also with lateral, longitudinal grooves, sharply defined mesially, parallel to lateral margin; ventrolateral spine present on each side of sixth somite in front of articulation of uropod.

Telson broad, with broad, sharply-defined median elevation terminating in 3 sharp spines; dorsal armature consisting of median elevation and 3 pairs of dorsal carinae; each armed posteriorly; median elevation connected anteriorly with second submedian carina on each side, first submedian carina lying in well-defined submedian depression; type with 2 carinae in depression; outer dorsal carina not as sharply defined dorsally as remainder; lateral carinae also present dorsally; anterior surface of telson with 1 pair of sharp, erect tubercles; posterior spinules, variable in number and position, present between apical spines of dorsal carinae and marginal armature;

posterior margin with shallow median sinus and, on either side of midline, (a) a curved row of 8-10 slender submedian denticles, (b) 1 short, movable submedian tooth, (c) 4 intermediate denticles, second and fourth slenderest and sharpest, (d) 1 intermediate tooth, (e) 1 lateral denticle, and (f) 1 lateral tooth; ventral surface with strong postanal spine.

Basal segment of uropod with strong dorsal carina extending to distal spine; proximal segment of outer branch shorter than distal, with 6 sharp spines on outer margin, distal 2 curved, distal extending well past midpoint of ultimate segment; proximal segment with 8-9 stiff setae on inner, distal lobe; inner branch broad, curved, proximal portion of outer margin with slight fold; spines of basal prolongation flattened, strongly carinate ventrally, inner longer; smaller, ventral spine present at articulation of inner branch.

Colour.—Rostral plate and anterior appendages with patches of dark pigment; carapace with at least 2, possibly 3, bands of dark pigment, increasing posteriorly in size and intensity of colour, posterolateral angles darkest (anterior bar poorly defined in Kingscliff specimen), several darker spots present on each bar; exposed thoracic and first 5 abdominal somites with 2 dark bands, anterior diffuse, posterior darker, more sharply-defined; anterolateral plates of abdomen black, adjacent areas on first abdominal somite darker than most of remainder of body; posterolateral angles of fifth abdominal somite very dark, with short, oblique, clear stripe; telson pattern varied, median elevation dark but with clear midline, 2 broad dark areas also present; outer branch of uropod with distal half of proximal segment and proximal half of distal segment dark; inner branch of uropod dark, with clear midline.

Measurements.—Females only examined, TL 56.3-99.0 mm; other measurements of 56.3 mm female, in mm: carapace length, 11.2; cornea width, 2.7; rostral plate length, width, 2.5, 3.8; fifth abdominal somite width, 12.7; telson length, width, 5.8, 10.7.

Discussion.—Chilton (1911) suggested that *L. brazieri* was identical with *L. latifrons* and Kemp (1913) agreed and synonymized the two. As both Kemp and Stephenson (1962), who regarded *brazieri* as a subspecies of *latifrons*, pointed out, the main differences originally pointed out by Miers (1880) were invalid; Miers used the following characters: (1) *brazieri* had six teeth on the claw instead of seven; (2) *brazieri* had more submedian marginal denticles than *latifrons* and lacked a median sinus on the telson; and (3) *brazieri* had slender inner branches on the last walking legs. I agree with Stephenson that these are not valid diagnostic characters inasmuch as there is considerable overlap in them between specimens from Japan and those from Australia, but a comparison of specimens from each locality shows that there are constant differences in other features.

The two specimens of *H. latifrons* listed by Holthuis (1941) were examined during a recent visit to the Leiden Museum; as Holthuis noted, one of these specimens is probably de Haan's (1844) type. A third specimen, that reported by Rathbun (1902), was compared with de Haan's specimens as well as the specimen from Kingscliff upon which this description is based. De Haan's specimens have but six teeth on the claw, as in *brazieri*, and have 10-12 submedian denticles; *brazieri* has 8-10, so there is some degree of overlap. Specimens of both species have a shallow median sinus on the telson and a slender inner branch on the last walking leg.

The most important difference between the species, and one which could not be detected from published illustrations of *latifrons*, is the dorsal armature of the telson. In *H. brazieri* there are one or more sharp carinae lying in the broad, dorsal depression that is situated lateral to the median elevation; these carinae are absent in *H. latifrons*. *H. brazieri* also differs from *latifrons* in having from 2-11 spinules on

the posterior margin between the dorsal spines and the marginal spines; these spinules are absent in *latifrons*. Finally, *brazieri* has a prominent tubercle on the mesial portion of the cornea which is absent in *latifrons*. In my opinion *latifrons* and *brazieri* must be considered as two distinct species.

Both *latifrons* and *brazieri* are also related to the American *H. mccullochae* (Schmitt), but that species has only 4 teeth on the claw and lacks the strong postanal spine present in its Indo-Pacific counterparts.

The strong postanal spine and the bifurcate rostral spine in *latifrons* and *brazieri* will distinguish them from all other Indo-Pacific species of *Heterosquilla*.

Remarks.—Stephenson (1962) has illustrated this species, so no figures are provided here. *H. latifrons* should be redescribed and illustrated in detail.

Although Stephenson (1962) noted that there might be some colour differences between *H. brazieri* and *H. latifrons*, these are not evident in the present material, as the pattern is at least partially faded. Comparison of recently-collected specimens of both species might well reveal differences in colour pattern.

Distribution.—Four specimens of *H. brazieri* are known from Australia, from New South Wales and the New South Wales-Queensland border, in moderate depths, 60 m or less; an additional two specimens have been collected from Otaki, New Zealand. *H. latifrons* is known only from Japan.

Austrosquilla, new subgenus

Diagnosis.—Cornea subglobular; rostral plate either triangular or subquadrate; ischium of raptorial claw with strong inferodistal spine; 4 intermediate denticles on telson; inner branch of uropod with strong proximal fold on outer margin; basal prolongation of uropod with inner spine longer.

Type-species.—*Lysiosquilla vercoi* Hale, 1924.

Gender.—Feminine.

Etymology.—The name is from the Latin, *australis*, southern, in combination with the generic name *Squilla*.

Discussion.—The subgenus *Austrosquilla* of *Heterosquilla* includes two species known only from Australia, *Lysiosquilla vercoi* Hale and *L. osculans* Hale, both of which are redescribed below. Whereas this subgenus shares many features with the subgenera *Heterosquilla* and *Heterosquilloides*, it also exhibits some characters more typical of *Acanthosquilla* and *Nannosquilla*, especially the shape of the eye and the presence of a strong fold on the proximal outer margin of the uropodal inner branch. Also the strong, ventrally-directed process which has on the sixth abdominal somite in *Acanthosquilla* and *Nannosquilla*, is reduced to a small spine in *Austrosquilla;* in *Heterosquilla* and *Heterosquilloides* this process is reduced to a blunt posterolateral projection. Finally, the inner branches of the walking legs are more ovate than in either of the other two subgenera of *Heterosquilla*. It seems possible that *Austrosquilla* should be considered as a distinct genus.

Heterosquilla (**Austrosquilla**) **osculans** (Hale, 1924)

Fig. 9

Lysiosquilla vercoi var. *osculans* Hale, 1924, p. 501, pl. xxxiii, fig. 3, text-fig. 384.

Lysiosquilla osculans: Hale, 1927, p. 34, text.fig. 25.—Stephenson and McNeill, 1955, p. 247.—Stephenson, 1955, p. 3; 1962, p. 34.

Heterosquilla osculans: Manning, 1963, p. 321 [listed; discussion].

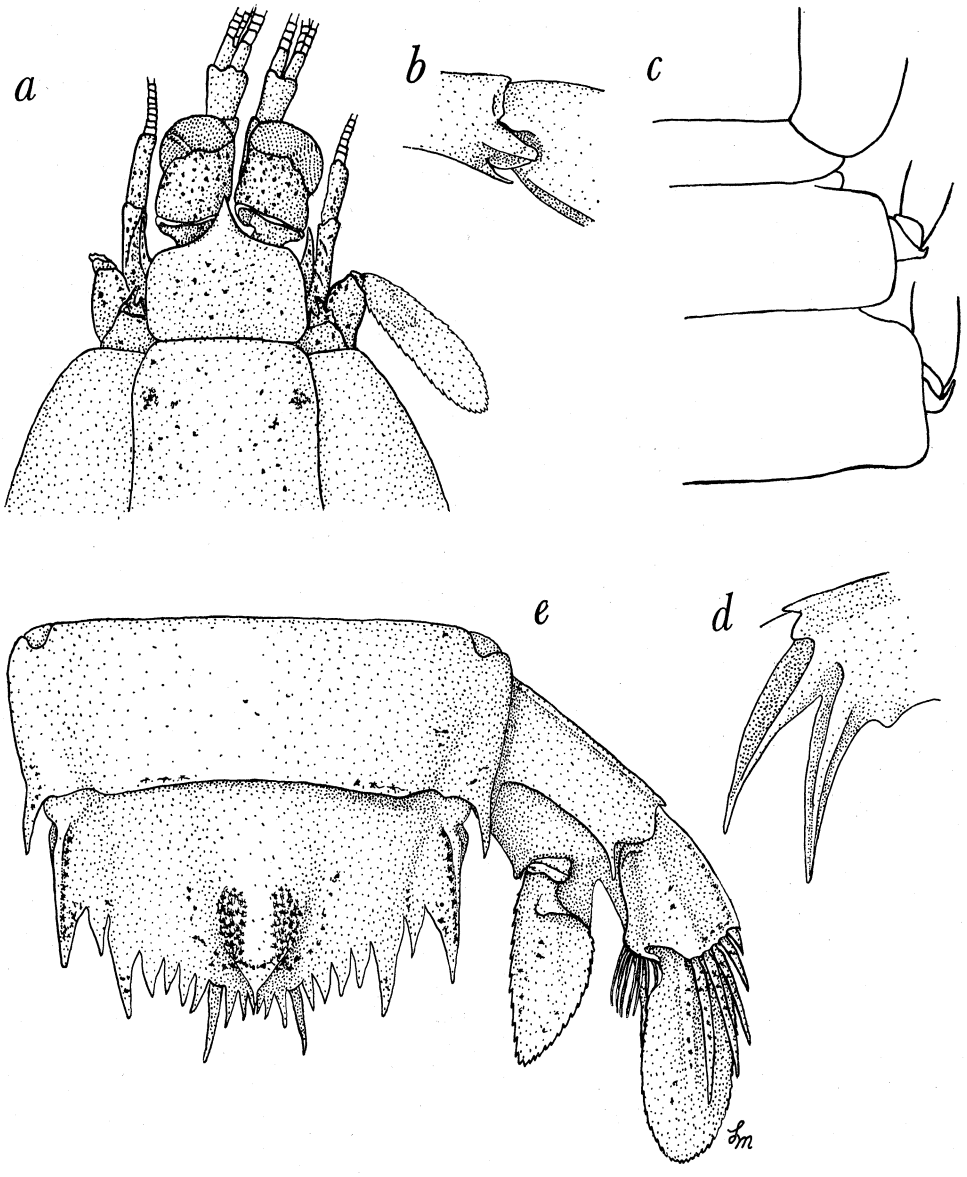

Fig. 9.—*Heterosquilla* (*Austrosquilla*) *osculans* (Hale), male, TL 42.7 mm, Beaumaris. *a*, anterior portion of body; *b*, ischiomeral articulation of raptorial claw; *c*, lateral processes of fifth, sixth, and seventh thoracic somites; *d*, basal prolongation of right uropod, ventral view; *e*, sixth abdominal somite, telson, and right uropod.

Material.—1 ♂, 42.7; Beaumaris, Port Phillip, Victoria; January, 1926; M. Ward, pres.; AM Reg. No. P. 8606.

Description.—Eye small, cornea subglobular, set obliquely on stalk and slightly overhanging stalk laterally; lateral margin of stalk with rounded prominence; eyes extending slightly beyond end of second segment of antennular peduncle; eyes-scales small, erect, fused along midline.

Antennular peduncle short, less than half as long as carapace; dorsal processes of antennular somite visible as sharp, anteriorly-directed spines lateral to rostral plate.

Antennal scale small, about one-third as long as carapace; antennal protopod with 1 ventral and 2 mesial papillae.

Rostral plate quadrangular, broader than long, with rounded anterolateral angles and sharp anterior spine.

Carapace smooth, narrowed anteriorly, without carinae or spines.

Dactylus of raptorial claw with 9 teeth, antepenultimate slightly but not markedly shorter than distal; outer margin of dactylus evenly curved with sharp basal denticle flanked distally by shallow groove; propodus stout, fully pectinate, with 4 movable teeth at base, proximal the longest; carpus with sharp dorsal carina terminating in strong tooth; ischium elongate but shorter than merus, with sharp subdistal spine at end of prominent ventral carina.

Propodi of third and fourth thoracic appendages beaded ventrally, as broad as or broader than long, propodus of fourth broader than that of third appendage and over twice as broad as that of fifth; propodus of fifth appendage as broad as long, with ventral brush of setae.

Mandibular palp absent; 4 epipods present.

Fifth thoracic somite without prominent lateral process or ventral spines; lateral processes of next two somites truncate, rounded anterolaterally and posterolaterally; basal segments of first 2 walking legs with inner and outer spines (appearing sharp in dorsal view, actually triangular), last leg in male with outer spine only; eighth thoracic somite with low triangular prominence on ventral surface.

Abdomen smooth, depressed, without dorsal carinae, armed only at posterolateral angles of last somite; anterolateral plates fully articulated; sixth somite with triangular ventral spine in front of articulation of each uropod.

Telson broad, flattened, with low median prominence terminating in sharp posterior spine; posterior armature of telson consisting of, on either side of midline, (a) 3 graded submedian denticles, outer largest, (b) a movable submedian tooth, (c) 4 subequal, sharp intermediate denticles, (d) 1 slender intermediate tooth, (e) 1 sharp lateral denticle, and (f) 1 slender lateral tooth.

Basal segment of uropod with inner and outer carina, inner extending to dorsal spine; proximal segment of outer branch shorter than distal, with 5 slender, movable spines on distal margin, last long but not extending to end of distal segment; inner distal margin of proximal segment with rounded lobe armed with 7 stiff setae; inner branch of uropod triangular, with proximal portion of outer edge folded over; spines of basal prolongation flattened, trefoil, inner the longer.

Colour.—Pigment pattern largely faded in the only specimen examined; body with traces of scattered small, dark chromatophores; telson with distal median black patch, divided into two submedian halves by a clear area.

Measurements.—Male, TL 42.7; other measurements, in mm: carapace length, 7.7; cornea width, 1.3; rostral plate length, width, 2.0, 2.5; fifth abdominal somite width, 8.3; telson length, width, 3.5; 6.7.

Discussion.—The quadrangular rostral plate and spined median prominence on the telson of *H. osculans* will immediately distinguish it from *H. vercoi* (Hale) which it closely resembles; other differences have been pointed out under the discussion of

H. vercoi. The flattened telson with a single dorsal spine will distinguish *H. osculans* from *Heterosquilla brazieri* (Miers), and *H. tricarinata* (Claus), the only other species of the genus that occur in the same geographic area.

Distribution.—Known only from the southern coasts of Australia, where it has been recorded from Victoria, South Australia, and Western Australia. Bathymetric range not recorded.

Heterosquilla (**Austrosquilla**) **vercoi** (Hale, 1924)

Fig. 10

Lysiosquilla vercoi Hale, 1924, p. 499, pl. xxxiii, fig. 2, text-fig. 383.—Hale, 1927, p. 33, text-fig. 34.—Stephenson, 1953, p. 46; 1955, p. 3.—Stephenson and McNeill, 1955, p. 247.

Heterosquilla vercoi: Manning, 1963, p. 321 [listed; discussion].

Material.—1 ♀, 51.2; Kingscliff, S. of Tweed Heads, New South Wales; dug from sand on ocean beach, L.T.L.; 1953; Mrs J. Kirchner, col.; AM Reg. No. P. 12371.

Description.—Eye small, cornea subglobular, set obliquely on stalk and overhanging it laterally; outer margin of stalk with prominent, rounded projection; eyes extending slightly beyond end of second segment of antennular peduncle; eyescales small, erect, completely fused along midline.

Antennular peduncle short, about half as long as carapace; dorsal processes of antennular somite visible lateral to rostral plate as sharp, slender, anteriorly-directed spines.

Antennal scale small, less than half as long as carapace; antennal peduncle with 1 ventral papilla.

Rostral plate triangular, slightly broader than long, lateral margins convergent, concave on both sides of acute apex.

Carapace smooth, short, narrowed anteriorly, without carinae or spines.

Dactylus of raptorial claw with 19 teeth (reported range: 10-21), penultimate not markedly shorter than antepenultimate; outer margin of dactylus flattened, margin not strongly sinuate, with obscure angular projection at base; propodus slender, fully pectinate, with 5 movable spines at base of inner margin, proximal longest, next smallest; dorsal keel of propodus ending in blunt tooth; merus and ischium subequal in length; ischium slender, with prominent, sharp, subdistal tooth on lower margin.

Propodi of third and fourth thoracic appendages beaded ventrally, as broad as or broader than long, propodus of fourth broader than third and twice as broad as that of fifth appendage; propodus of fifth appendage as broad as long, with ventral brush of setae.

Mandibular palp absent; 5 epipods present.

Fifth thoracic somite lacking prominent lateral process and ventral spines; lateral processes of next 2 somites truncate, anterolateral angles more rounded than posterolateral; basal segment of first 2 walking legs with sharp inner and outer spines on posterior margin, last leg with outer spine only; inner branches of walking legs two-segmented, slender, that of last leg most elongate, that of first most ovate; eighth thoracic somite with low median keel on posterior margin of ventral surface.

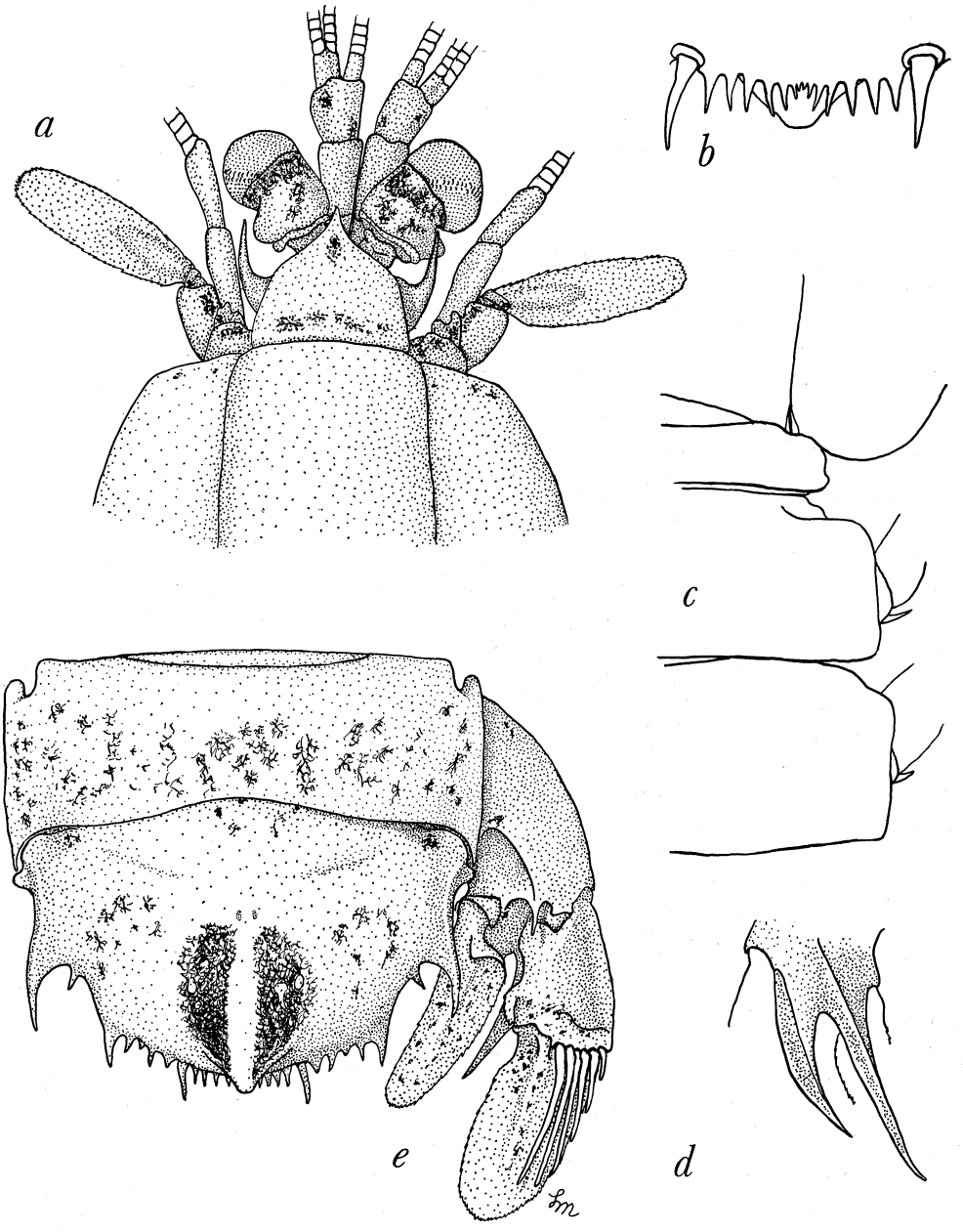

Fig. 10.—*Heterosquilla* (*Austrosquilla*) *vercoi* (Hale), female, TL 51.2 mm, Kingscliff. *a*, anterior portion of body; *b*, submedian teeth and denticles of telson, ventral view; *c*, lateral processes of fifth, sixth, and seventh thoracic somites; *d*, basal prolongation of right uropod, ventral view; *e*, sixth abdominal somite, telson, and right uropod.

Abdomen smooth, depressed, without dorsal carinae; spines present at posterolateral angles of sixth somite only; anterolateral plates fully articulated; sixth somite with slender ventral spine in front of articulation of each uropod.

Telson noticeably broader than long, flattened, low median prominence terminating posteriorly in acute, blunt projection; marginal armature consisting of, on either side of midline, (a) 6 submedian denticles, inner smallest, (b) a movable submedian tooth, (c) 4 intermediate denticles, first and third shorter, stubbier than second and fourth, (d) a blunt intermediate tooth, (e) a lateral denticle, and (f) a slender, curved lateral tooth.

Basal segment of uropod with sharp inner and outer carinae, inner extending to slender dorsal spine; proximal segment of outer branch shorter than distal, with 6 slender distal spines, articulated at distal rather than outer margin, last extending well beyond midpoint of distal segment; inner distal margin of proximal segment with 11 setae on rounded lobe; inner branch elongate, curved, proximal portion of outer edge folded over; basal prolongation with 2 flattened, trefoil spines, inner longer.

Colour.—Rostral plate with 1, carapace with 2, and each body segment with 1 broad, diffuse band of brown chromatophores; eye-stalks mottled brown; antennal peduncles with anterior dark line; telson with black median distal spot, pigment interrupted along midline, and 2 diffuse lateral circles of dark pigment; each segment of uropod with scattered dark chromatophores.

Measurements.—Female, TL 51.2 mm; other measurements, in mm: carapace length, 8.1; cornea width, 1.5; rostral plate length, width, 2.3, 2.8; fifth abdominal somite width, 9.1; telson length, width, 4.8, 7.5.

Discussion.—*H. vercoi* is very similar to *H. osculans* but differs from that species as follows: (1) the rostral plate is triangular, not quadrangular; (2) there is but one papilla on the antennal protopod, not three; (3) there is an epipod on the fifth maxilliped; (4) the median prominence on the telson is blunt, not produced into a spine; (5) the intermediate denticles of the telson are small and only the second and fourth are slender; in *H. osculans* all four intermediate denticles are slender, and sharp.

The presence of only one dorsal projection on the telson will distinguish both *H. vercoi* and *H. osculans* from *H. tricarinata* and *H. brazieri.*

H. vercoi and *H. osculans* are the only two species in the genus in which the ischium of the raptorial claw is armed with an inferodistal spine.

Remarks.—The number of spines on the dactylus of the raptorial claw seems to be more variable than is usual in this species; from 10 to 21 teeth have been reported. The present specimen, which has 19, agrees in all other respects with Hale's original description; Hale's specimen had 11-12 teeth on the claw.

Distribution.—Known only from Australian waters, where it has been recorded from several localities between Southport, southern Queensland, and Robe, South Australia, and from Coles Bay, Tasmania. Shallow water.

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