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# CRUSTACEA : DROMIACEA

PART I:

SYSTEMATIC ACCOUNT OF THE DROMIACEA COLLECTED BY THE "JOHN MURRAY" EXPEDITION.

PART II:

THE MORPHOLOGY OF THE SPERMATHECA IN CERTAIN DROMIACEA.

BY

ISABELLA GORDON, D.Sc., Ph.D.

*Department of Zoology, British Museum (Natural History).*

WITH ONE PLATE AND TWENTY-SIX TEXT-FIGURES

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## INTRODUCTION.

When I commenced my examination of the " John Murray " collection of Dromiacea during the war years it became apparent that this tribe was badly in need of critical revision. Much time was devoted to a revision of the material then available, namely, that in the British and Cambridge Museum collections. The work was handicapped at the time by lack of adequate library facilities and, in the post-war period, the complete revision has had to be postponed for various reasons. The systematic account of the " John Murray " Dromiacea is therefore published separately to avoid further delay.

In the course of the revisionary work a detailed comparative study was made of the spermatheca in the Homolidæ (now Thelxiopidæ) and later *Dromia* was examined for comparison with that family. This morphological work is new and I am much indebted to Lt.-Col. R. B. Seymour Sewell for permission to include the results as part of this report. I also wish to express my thanks to Mr. Hubert Williams for the excellent drawings reproduced as Text-figs. 15 and 25. The other figures I prepared from camera lucida sketches ; magnifications are usually given to the nearest whole number.

Although the Dromiacea form a very small percentage of the crabs collected by the John Murray Expedition, they include one new species, *Pseudodromia murrayi*, and two that are now recorded for the second time, namely, *Homolochunia valdiviæ* Doflein and *Homologenus braueri* Doflein.

The lists of references given under genera and species, have, as a rule, been kept as short as possible ; fairly complete bibliographical references have been given by Alcock (1899, 1901), Ihle (1913) and others, and I have indicated where these may be found.

## THE SYSTEMATIC IMPORTANCE OF THE BRANCHIAL FORMULA.

The gills are trichobranchiate and the branchial formula is high in the families Dynomenidæ (19–20 gills + 7 epipodites) and Homolodromiidæ (19–21 gills + 6–7 epipodites — see A. M.-Edwards and Bouvier, 1902, pp. 12 and 17 ; 1900, p. 15). In the Dromiidæ and the Homolidæ or Thelxiopidæ the gills are phyllobranchiate and the formula never exceeds 14 + 4 and 14 + 6 respectively, There is, moreover, a marked tendency for the gills and epipodites to be reduced in number in both these families—it must be remembered that in immature specimens some of the gills may be absent, since they only make their appearance at a slightly later stage.

In *Dromia* and *Dromidiopsis* the formula is 14 + 4, in *Dromidia* 14 + 3, and appears to be constant in the species examined—even immature specimens have 12–13 gills. In *Petalomera* the formula is usually 14 + 4, but in certain species there may be only 12–13 or even as few as 9 gills in adults. The majority of the species referred to *Cryptodromia* have 14 + 3, but again the number of gills may be reduced to 12 or to 9. The range of variation in the number of gills is even greater in the genus *Pseudodromia*—from 12 to 6 + r, see Table II p. 212. The number of epipodites is much more constant in the various genera than that of the gills, but there are occasional anomalies.

The systematic importance of the branchial formula may have been exaggerated by previous workers on the Dromiacea and I may be inconsistent in accepting a wide range of variation in the genus *Pseudodromia* and refusing to accept it in the genus *Latreillopsis* (*cf.* Tables II and III, and p. 220). Where there is a marked tendency to gill reduction in a family there seems to be no reason why the species in any one genus should not also show the same trend.

## LIST OF SPECIES.

Subtribe *DROMIIDEA* Alcock.

Family HOMOLODROMIIDÆ Alcock.

*Dicranodromia baffini* Alcock and Anderson.

Family DROMIIDÆ Alcock.

*Dromia* sp ? (immature specimens).
*Dromidia unidentata* (Rüppell).
*Cryptodromia bullifera* Alcock.
*C. gilesi* Alcock.
*Pseudodromia murrayi* n. sp.

Subtribe *THELXIOPIDEA* Rathbun.

Family THELXIOPIDÆ Rathbun (= Thelxiopidea Rathbun, *i.e.* it includes the families Thelxiopidæ and Latreillidæ).

*Thelxiope orientalis* (Henderson).
*T. megalops* (Alcock).
*Paromola alcocki* (Stebbing).
*P. profundarum* Alcock and Anderson.
*Hypsophrys supersiliosa* Wood-Mason.
*Homolochunia valdiviæ* Doflein.
*Homologenus braueri* Doflein.
*Latreillia pennifera* Alcock.

## GEOGRAPHICAL DISTRIBUTION OF THE DROMIACEA COLLECTED

Red Sea :

St. M.B. I(d). 26 m.

*Dromidia unidentata* (Rüppell).
*Cryptodromia bullifera* Alcock.
*Pseudodromia murrayi* n. sp.

St. 10. 55 m.

*Pseudodromia murrayi* n. sp.

Gulf of Aden :

St. 24. 73–220 m.

*Thelxiope orientalis* (Henderson).

St. 27. 37 m.

*Dromia* sp.—young.
*Dromidia unidentata* (Rüppell).

St. 35. 441 m.

*Thelxiope* (*Homolax*) *megalops* (Alcock).

South Arabian coast :

St. 45. 38 m.

*Dromia* sp.—young.
*Dromidia unidentata* (Rüppell).
*Cryptodromia bullifera* Alcock.
*C. gilesi* Alcock.
*Pseudodromia murrayi* n. sp.

Northern area of Arabian Sea :

St. 62. 1893 m.

*Hypsophrys superciliosa* Wood-Mason.

Zanzibar area :

St. 106. 212 m.

*Thelxiope orientalis* (Henderson)
*Latreillia pennifera* Alcock

St. 108. 781 m

*Homolochunia valdiviæ* Doflein.

St. 115. 640 m.

*Homolochunia valdiviæ* Doflein.

St. 119. 1204 m.

*Homologenus braueri* Doflein.

Maldive area :

St. 145. 494 m.

*Dicranodromia baffini* (Alc. and And.).

St. 153. 256 m.

*Paromola profundarum* Alc. and And.

St. 157. 229 m.

*Paromola alcocki* (Stebbing).

St. 162. 1829 m.

*Hypsophrys superciliosa* Wood-Mason.

# PART I.

# SYSTEMATIC ACCOUNT OF THE DROMIACEA COLLECTED BY THE "JOHN MURRAY" EXPEDITION.

## Sub-tribe *DROMIIDEA* Alcock, 1901, p. 29.

Superfamily Dromiidea, Rathbun, 1937, p. 27 (earlier references).

## Family Homolodromiidæ Alcock, 1899, p. 127.

### Genus Dicranodromia A. Milne-Edwards. Text-fig. 1.

*Dicranodromia* A. Milne-Edwards, 1880, p. 31.
,, A. M.-Edwards and Bouvier, 1899, p. 14.
,, Doflein, 1904, p. 5.
,, Ihle, 1913, pp. 86 and 89.
,, Sakai, 1936, p. 6.

*Arachnodromia* Alcock and Anderson, 1899, p. 7.
,, Alcock, 1899*a*, p. 17 ; 1899, p. 130.
,, Alcock, 1901, p. 32.

### *Dicranodromia baffini* (Alcock and Anderson).

*Arachnodromia baffini* Alcock and Anderson, 1899, p. 7.
,, ,, Alcock, 1899*a*, p. 17 ; 1899, p. 132.
,, ,, Alcock, 1901, p. 33, pl. 1, figs. 1, 1*a–c*.

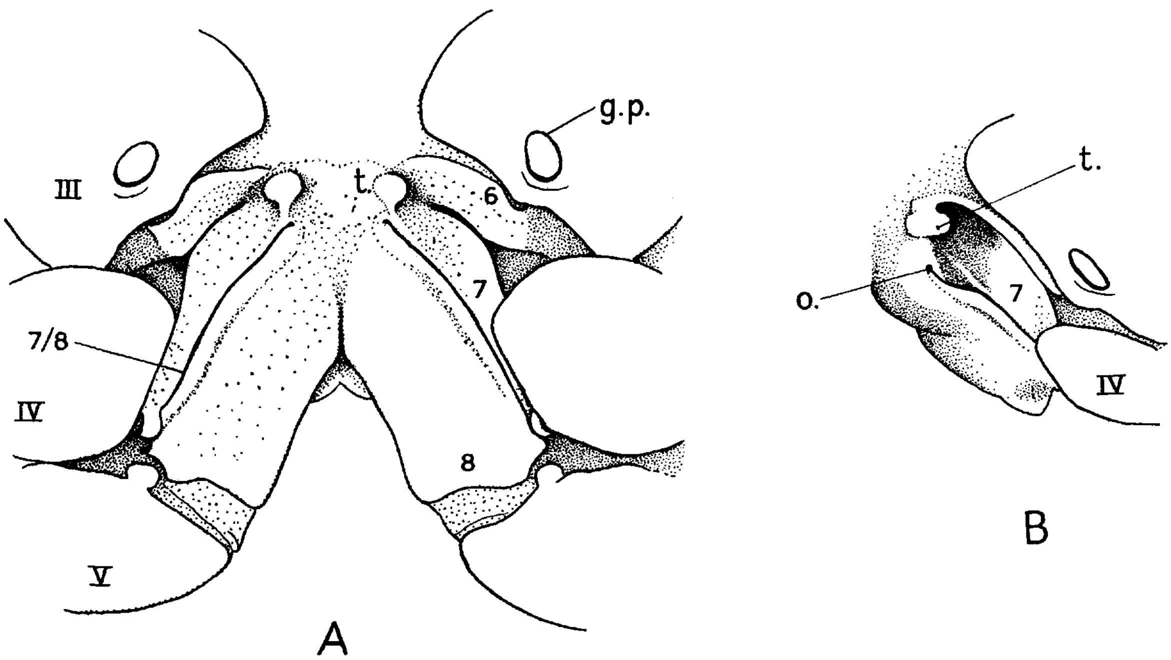
*Dicranodromia baffini* Ihle, 1913, pp. 86 and 89.

Occurrence.—St. 145, 2.iv.34. Maldive area. 494 m. 1 ♀ (*c.l.* = 23 mm. including rostral spines).

Recorded Distribution.—Off the Travancore Coast and off west coast of Andamans in 345 to 786 m.

Descriptive Notes.—This rare and primitive species is represented by a single female, which agrees well with Alcock's description and figures (1901, p. 33, pl. 1, figs. i–ic). Regarding the sternal furrows Alcock merely says that " the sternal grooves end opposite the openings of the oviducts, without tubercles." The anterior half of the plastron is narrowly triangular, with a pair of lateral wing-like processes separating coxæ I/II and coxæ II/III respectively. The posterior half slopes rather steeply upwards and backwards so that, when the specimen is lying on its back, thoracic sternites 6, 7 and 8 appear as represented in Text-fig. 1, b. The posterior end of the 7/8 suture is thus concealed by coxa IV ; anteriorly it is visible as a somewhat sinuous groove ending in a tiny opening *o* situated a little behind the tubercle *t* and opposite the anterior rim of the genital pore. The tubercle is near the junction of sternites 6 and 7, and may be formed partly by both or may belong to sternite 7.

When the specimen is tilted to show the whole of sternites 7 and 8, as in Text-fig. 1, A, the posterior part of the 7/8 suture can be seen, but the anterior fourth and the terminal opening are partially hidden by a ridge on thoracic sternite 8. In this position the tubercles are on a level with the genital pores. As this is the only available specimen I have not attempted to examine the internal structure of the spermatheca for comparison with that of *Dromia* (see p. 247, part II), although such a comparison would be very interesting.




TEXT-FIG. 1.—*Dicranodromia baffini* (Alc. and And.). St. 145. A. Posterior half of plastron or thoracic sternum, tilted to show the full extent of the sternal furrows, with proximal parts of coxæ III–V. B. Left half of same in normal position (*i.e.* placed on its back and not tilted). Both × 7. *g.p.*, Genital pore ; *o.* spermathecal opening ; *t.*, tubercle ; III, IV, V, proximal part of coxæ III–V respectively ; 6, 7, 8, thoracic sternites 6, 7 and 8 ; 7/8, suture 7/8 = furrow.

## Family DROMIIDAE Alcock, 1899, p. 128.

### Genus *Dromia* Fabricius.

*Dromia* ALCOCK, 1899, p. 136 (earlier references).
,, IHLE, 1913, p. 21.

### *Dromia* sp.

OCCURRENCE :

St. 27. Gulf of Aden. 37 m. 1 immature ♀ (*c.l.* = *c.b.* = 19 mm.).

St. 45. South Arabian Coast. 38 m. 1 immature ♂.

REMARKS.—These young specimens possess an epipodite on the cheliped, which places them in either the genus *Dromia* or *Dromidiopsis*. The branchial formula of the larger specimen (the female from St. 27) is 14 gills + 4 epipodites, but the arthrobranch on pereiopod IV has just appeared and is minute. The sternal furrows or sulci of the female are not fully developed ; they end opposite the anterior half of the coxæ of pereiopods II and appear to be well separated, but there is as yet no trace of any terminal tubercles. This would place the female in the genus *Dromia*. The arrangement of the spines on the propodus of pereiopod V and the presence of a thorn on the dactylus is similar to that found in, *e.g.*, *Dromia intermedia* Laurie (1906, p. 351). The male is in a soft, poorly calcified condition and had probably just moulted. It does not seem advisable to try to name these specimens for the present, until more is known about the young stages of the Dromiidea. They may not belong to the same species.

### Genus *Dromidia* Stimpson emend. Borradaile.

*Dromidia* STIMPSON, 1859, p. 225.
,, ALCOCK, 1899, p. 140 (as subgenus of *Dromia*).
,, IHLE, 1913, p. 31.
,, BORRADAILE, 1903, p. 299 (excluding " ? *Pseudodromia* ").

### *Dromidia unidentata* (Rüppell).

*Dromia unidentata* ALCOCK, 1901, p. 47, pl. 2, fig. 6.

*Dromidia unidentata* IHLE, 1913, p. 31 (earlier references).
,, ,, STIMPSON, 1907, p. 171.
,, ,, SAKAI, 1936, p. 13, text-fig. 2 and pl. vi, fig. 2.

OCCURRENCE :
St. 27. Gulf of Aden. 37 m. 1 ♂ (*c.l.* = 15 mm., right pereiopods I–III missing).
St. 45. South Arabian Coast. 38 m. 1 young ♀.
St. M.B. I(d). Red Sea. 26 m. 1 immature specimen.

RECORDED DISTRIBUTION.—From the Red Sea and East African coast to Japan. A male from Bermuda in the B.M. coll (1937.11.12.2) also seems to belong to this species.

REMARKS.—None of the specimens is accompanied by its shelter ; Sakai says that in Japanese waters the animal was always carrying a monascidian.

### Genus *Cryptodromia* Stimpson.

*Cryptodromia* STIMPSON, 1858, p. 255.
,, ALCOCK, 1899, p. 140 (for earlier references); 1901, p. 48 (key to Indian species).
,, IHLE, 1913, p. 32, key to species pp. 33–35.
,, SAKAI, 1936, p. 15, key to Japanese species pp. 16–17.

### *Cryptodromia bullifera* Alcock.

ALCOCK, 1899, p. 143 ; 1901, p. 51, pl. ii, figs. 9, 9*a*.
IHLE, 1913, p. 40 (earlier references).
SAKAI, 1936, p. 23, pl. vii, fig. 3.

OCCURRENCE :
St. 45. South Arabian Coast. 38 m. 1 ♂ (carapace = 10 × 10.5 mm.).
St. M.B. I(d) 17.ix.33. Red Sea. 26 m. 1 ♂ (carapace = 8·3 × 8·2 mm.) and 2 young ♀♀.

RECORDED DISTRIBUTION.—Andaman Sea, Ceylon, East Indian Archipelago and Japan. The depth varies from 38 m. to about 900 m.

DESCRIPTIVE NOTES.—This species is easily recognized by the presence of round pearl-like tubercles, which are distributed as follows : one on the merus of the external maxilliped ; one on the second segment of the antennal peduncle, which is not very pronounced in the " John Murray " specimens ; one below the suborbital tooth ; and one on the sub-hepatic region, The last named is visible in dorsal aspect when the carapace is denuded, as also is the spine immediately below it. There is a blunt lobule at the antero-lateral corner of the buccal cavity.

The median rostral spine is in contact posteriorly with the spiniform apex of the rounded epistome. The antennal flagellum is not quite complete and has 28 + segments.

In the male segments 3–6 of the abdomen each bears a pair of lateral tubercles—those on segment 6 are smaller than the others and are not yet developed in the smaller specimen. Sakai (1936, p. 24) says that " the third to fifth terga have each three tubercles in the median line, one in front of the other two." In the " John Murray " specimens there is a pair of minute tubercle near the median posterior margin of each of these segments ; the single anterior one has presumably not yet developed. When the abdomen of the larger specimen is in its normal flexed position its apex is opposite the middle of coxa I, leaving exposed a considerable portion of the apex of the thoracic sternum. In the smaller male only a tiny part of the apex of the thoracic sternum is visible, so that this would appear to be an age difference.

In places the short tomentum takes the form of club-shaped feathered setæ, notably on the front, the antero-lateral margins, the chelipeds and pereiopods II and III ; on the last two pairs of pereiopods the long feathered setæ have pointed apices.

### *Cryptodromia gilesi* Alcock. Text-fig. 2, C–E.

*Dromia (Cryptodromia) gilesi* ALCOCK, 1899, p. 146.
*Cryptodromia gilesi* ALCOCK, 1901, p. 54, pl. 3, fig. 13.
,, ,, LAURIE, 1915, p. 427.

OCCURRENCE :

St. 45. South Arabian Coast. 38 m. 1 ♂ minus chelipeds, *c.l.* 10·1 mm., *c.b.* 11·2 mm. 1 young ♂, 5·2 × 5·5 mm.

RECORDED DISTRIBUTION.—Off Malabar coast, 29 fms. (= 53 m.) ; Sudanese Red Sea, St. 11 (Laurie). A male specimen from Muscat, 9–37 m., in the British Museum coll. (Reg. no. 86.17) also seems referable to this species.

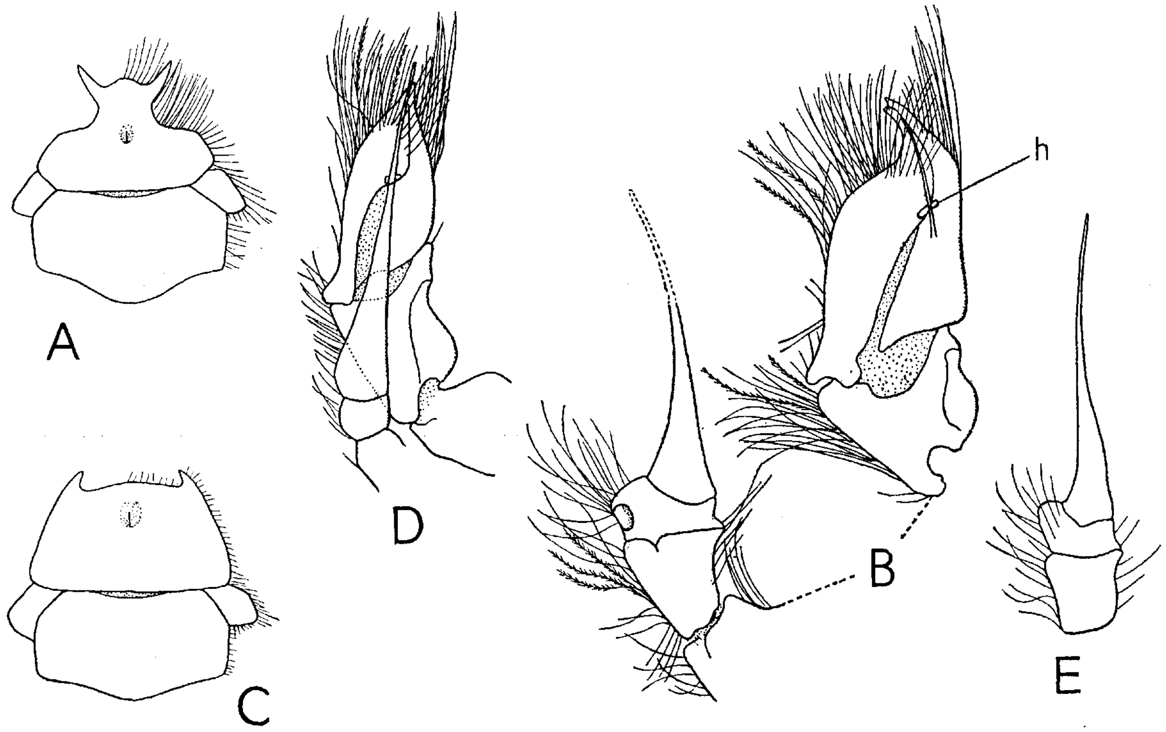
REMARKS.—Owing to the war I have not been able to obtain any of the twelve type specimens from off the Malabar coast, and Alcock's description is very brief. He states that the carapace is without tomentum, but the male from the Red Sea determined by Laurie 1915, p. 427) is covered by a very short fine tomentum, which is easily rubbed off. Also, Alcock states that the last two pairs of pereiopods end " in hook-like dactyli, not cheliform," and his figure shows no trace of a spinule on the propodus. In the specimens at my disposal there is always a small spine on the propodus, opposed to the dactylus, although the pereiopods are scarcely cheliform. Such a condition has been noted by Alcock in, *e.g.*, *C. canaliculata* (1899, p. 143 ; 1901, p. 51).

Nobili (1906, p. 147) suggested that *C. gilesi* Alcock might be a synonym of *C. granulata* (Kossmann), but his figure represents a species which, as Laurie remarks (1915, p. 427), differs markedly from *C. gilesi* as regards the form of the front. Again, I have not examined type material of *C. granulata*, but there are specimens which seem referable to it in the B.M. coll.—1 ♂ from Gulf of Suez (69.49); 1 ♂ and 2 ♀♀ from Aden (85.14); and 2 ♀♀ from Muscat (1912.12.17.2 and 1925.2.25.6). These agree well with Nobili's figure, and the differences between them and the specimens referred to *C. gilesi* are quite marked. The more important of these are tabulated below :—

TABLE I.

| | *C. gilesi* Alcock. | *C. granulata* (Kossm.). |
|---|---|---|
| Carapace | Definitely pentagonal in outline; antero-lateral borders the longest. In frontal aspect the dorsal surface is flatter, and the ext. mxpds. are set much less obliquely. | Antero-lateral margins and front more arcuate. In frontal aspect the dorsal surface is more convex, and the ext. mxpds. are set very obliquely —the carapace is thus deeper. |
| Front | Lateral lobes large, smooth or nearly so, and projecting well beyond the minute median lobe to form large eaves over the eyes. | Lateral lobes small, granular, wider than, but not projecting beyond, the minute median lobe. |
| Pereiopods II and III | Slender, much less setose. *l.* : *b.* of merus = 1·5–2 : 1 | Robust, heavily setose laterally and ventrally. *l.* : *b.* of merus = 1 : 1. |
| Abdomen of male | Terminal segment as represented in Text-fig. 2, C, apex emarginate. | Terminal segment as represented in Text-fig. 2, A, distal third much narrowed, apex armed with two long antero-lateral spines. |
| Pleopods of male | As represented in Text-fig. 2, D, E, slender; apex of pl. 1 short and straight. | As represented in Text-fig. 2, B, robust; apex of pl. 1 forming a long curved beak. |
| Size of male | 10·1 × 11·2 mm. | 9·5 × 10·8 mm. |

The male pleopods are obviously much more slender in *C. gilesi* than in *C. granulata* (*cf.* Text-fig. 2, D, E and 2, B); the setæ on the pleopods are nearly all finely feathered, although they may appear to be simple when the appendages are cleared in xylol or benzyl alcohol. The second pleopod of *C. granulata*, which was interlocked with its partner, snapped off and the terminal portion was left in the apex of pleopod 1 (Text-fig. 2, B); I am not quite sure how long this broken piece is, but it does not, though it may, project beyond the apex of pleopod 1. In each species there is a strongly chitinized hook or ring, some distance down from the apex of pleopod 1, which keeps the needle-like terminal portion of pleopod 2 in position when the two are interlocked (Text-fig. 2, B, *h*).




TEXT-FIG. 2.—*Cryptodromia granulata* (Kossmann). ♂ from Aden (85.14). A. Apex of abdomen; × 9. B. Right pleopods 1 and 2; × 16. *Cryptodromia gilesi* Alcock. ♂ from St. 45. C. Apex of abdomen; ×9. D. Right pleopods 1 and 2 interlocked. E. Pleopod 2 removed from its partner; ×16.

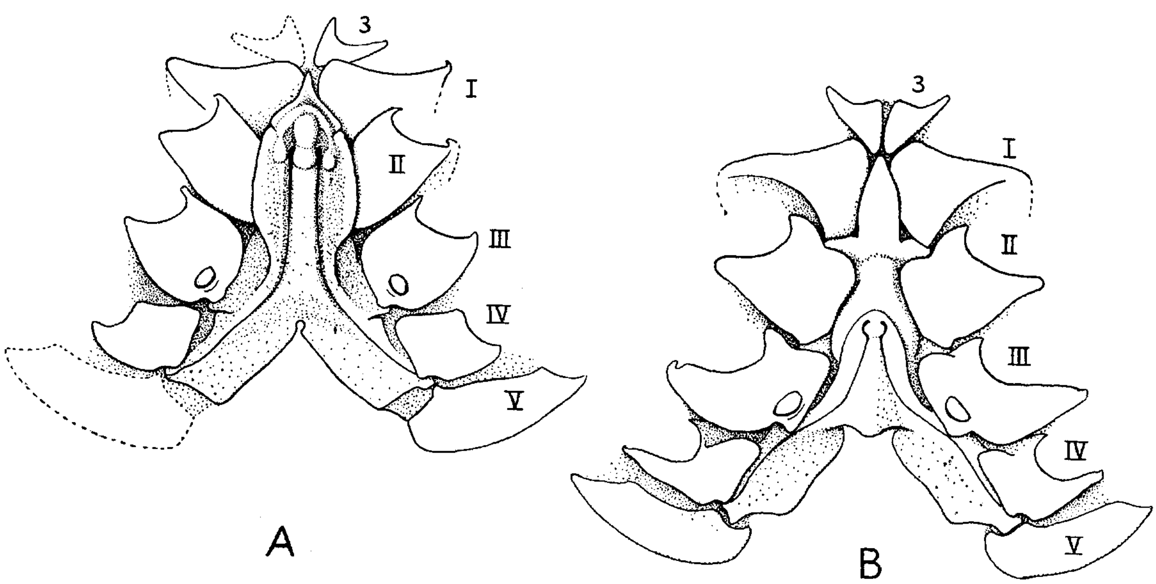
The terminal abdominal segment of the male in *C. gilesi* is twice as wide as long, the truncate apex is widely emarginate and armed with a pair of short antero-lateral spines; in *C. granulata*, on the other hand, there is a narrow neck in the distal third behind the conspicuously forked apex (Text-fig. 2, A, C).

## Genus *Pseudodromia* Stimpson.

*Pseudodromia* STIMPSON, 1859, p. 226.
,, BALSS, 1922, p. 110 (earlier refs. and synon.).
,, BARNARD, 1947, p. 369.
*Ascidiophilus* RICHTERS, 1880, p. 158.

When I first examined the specimens described below I thought that they must be congeneric with *Ascidiophilus caphyræformis* Richters from Mauritius, but I hesitated to identify them with that species because, if Richters figures are accurate (which I doubt), he represents pereiopods IV as being similar to the two preceding pairs although they are stated to be shorter. He also represents the carapace as being much wider just behind the orbits than is the case in the " John Murray " material, although, if the chelipeds are folded closely against the body, the latter seems at first sight to be much as in Richter's fig. 7, pl. xvii. Richters does not seem to mention the size of his male and female. Then I recalled that *Pseudodromia integrifrons* Henderson closely resembles *Ascidiophilus* in its association with an Ascidian, the triangular front with its ventral keel, the shape of the ocular peduncles and of the long dorsal last pereiopods.

On going through the literature I found that Balss (1922, p. 110) identifies *Ps. integrifrons* with *Ascidiophilus caphyræformis*, which he names *Pseudodromia caphyræformis* (Richters). Lenz (1905, p. 364) refers a male measuring 7·5 × 5·5 mm. to *Ascidiophilus caphyræformis* Richters ; this is small for *P. integrifrons* Hend. and rather larger than any of the *P. murrayi* specimens. The genus *Pseudodromia* thus contains four species with very different branchial formulæ, namely : *P. latens* Stimpson, *P. rotunda* (McLeay), *P. integrifrons* (= ? *caphyræformis*) and the new species, *P. murrayi*. These four prove to differ markedly from each other although the first two and the last two are closely related. The branchial formulæ have been ascertained by myself and the material of *P. latens* and *P. rotunda* was either determined by, or compared with specimens determined by, Dr. Barnard (1947, pp. 368–9). Of *P. integrifrons* I examined two female cotypes from Tuticorin in the British Museum collection. In Table II, I have given the most obvious differences




TEXT-FIG. 3.—Plastron or thoracic sternum of female, with coxæ of maxillipeds 3 and pereiopods I–V, of : A. *Pseudodromia integrifrons* Hend. Larger co-type (*c.l.* = 18·3 mm. ; *c.b.* = 14·3 mm). B. *Pseudodromia latens* Stimpson. Female from False Bay, South Africa, det. by Dr. Barnard. (*c.l.* = 19 ; *c.b.* = 15·5 mm.). 3, Coxa of maxilliped 3 ; I–V, coxæ of pereiopods I–V respectively. × 5.

between the species. Of the 12 gills present in *P. rotunda*, three—an arthrobranch at the base of pereiopods IV, III and II respectively—are very small and in a small specimen from Simon's Bay (" Challenger " 88.33) the posterior one has not yet appeared. It is these three gills that are absent in *P. latens*. The next gill to go is the anterior arthrobranch of the third maxilliped in *P. integrifrons*. Finally, in *P. murrayi*, the anterior arthrobranch of the cheliped is lacking and the podobranch of the second maxilliped appears to be represented by a small rudiment (Text-fig. 7, C, *r*).

In *P. rotunda* the three frontal spines are distinct, but the rostral or median one has a ventral keel and all three unite proximally to form a triangular wedge between the orbits. In *P. latens* these three spines are in process of fusing ; in a female from False Bay, sent to me by Dr. Barnard, the two dorsal spines are in close contact proximally, though the apices are distinct, the rostral spine is fused proximally with both, while its apex is still distinct ; in the male from the same locality the rostral spine is completely fused with the left dorsal spine, the right one being in close contact with the fused piece. *P. latens* is intermediate between *P. rotunda* and *P. integrifrons* in number of gills and form of front. The triangular front of *P. integrifrons* and *P. murrayi* would thus appear to be derived from the complete fusion of three spines and the incorporation of part of the orbit.

The plastron of the female is represented for both *P. integrifrons* and *P. latens* in Text-fig. 3, A and B ; that of P. *rotunda* bends so sharply that it is difficult to make a camera lucida sketch of it, but it is, as might be expected, nearest to that of *P. latens*.

### *Pseudodromia murrayi*. n. sp.

OCCURRENCE :

St. 10. Red Sea. 55 m. 1 ♀ in its Ascidian

St. M.B. I(d). Red Sea. 26 m. 1 ♀ with its Ascidian.

St. 45. S. Arabian Coast. 38 m. 1 ♀ (holotype, reg. no. 1948.9.7.15), 2 ♀♀ paratypes—all with ova or empty egg-cases— and 2 ♂♂ paratypes. *Note.*—Unfortunately the female that was dissected in 1943 has not as yet been found and may have been destroyed by blast at a later date. One of the other females from the same station has been selected as the holotype.

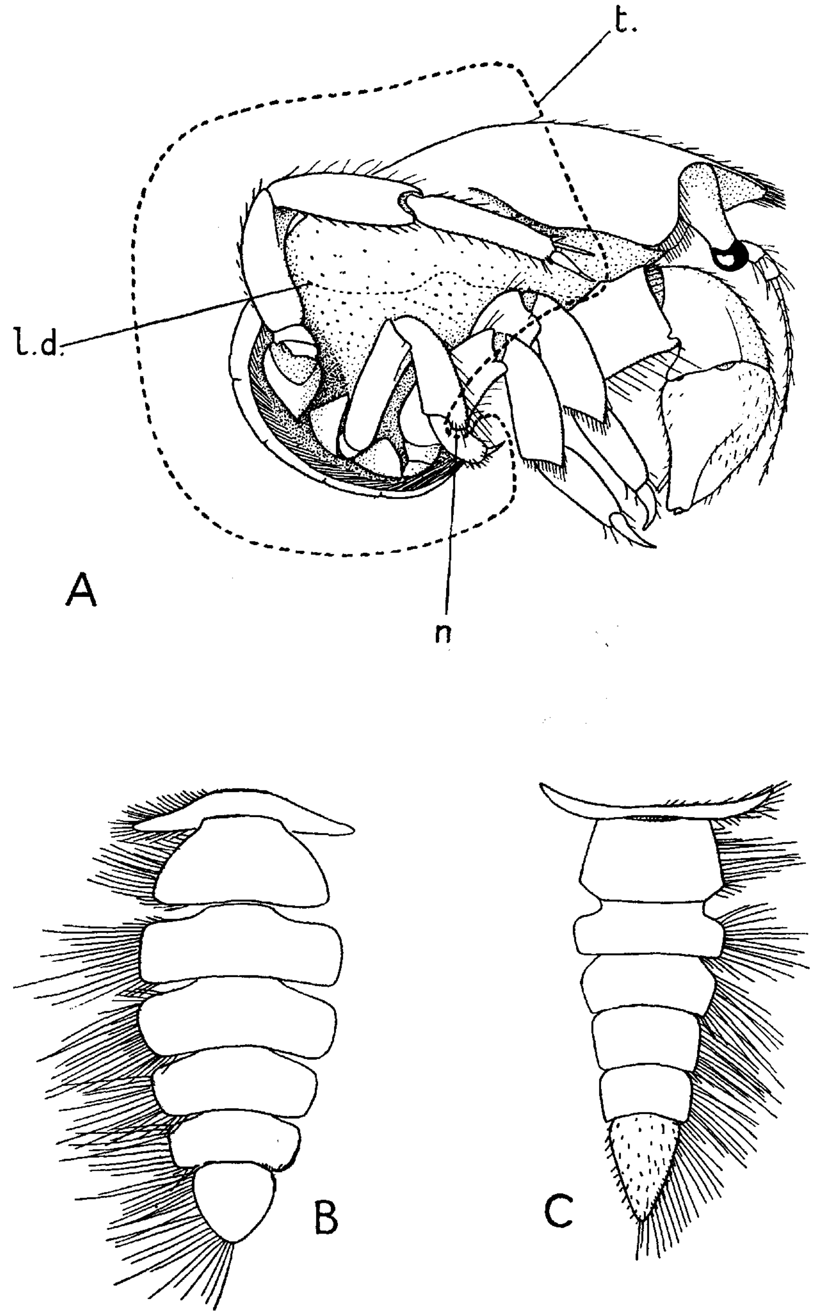
There is also a ♂ from Ceylon in the British Museum collection—reg. no. 75.14 ; *c.l.* 5·7 mm.—which appears to belong to this small species.

ASSOCIATION WITH AN ASCIDIAN.—This small crab is about the size of a pea (*c.l.* = 4·5–6 mm.) and is specially adapted for living with a compound Ascidian. The carapace is poorly calcified, the part covering the gills being especially thin and membranous. The fourth pair of pereiopods are much shorter than any of the others and are used to grasp the Ascidian on either side of the ventral margin of the opening ; the dactylus and some subsidiary spines at the distal end of the propodus give the necessary grip on the host, while the large lobe, *l*, at the upper distal end of the car pusfits into a notch *n* thus preventing the enveloping membranous blanket from slipping (Text-figs. 5, D, and 4, A). The fifth pereiopods are more dorsal in position and much longer than the fourth pair ; they hold the Ascidian firmly, one on either side of the opening, by means of the dactylus and the special spines at the distal end of the propodus. By bending and straightening these last pereiopods the Ascidian can be lowered or raised at will over the back of the crab.

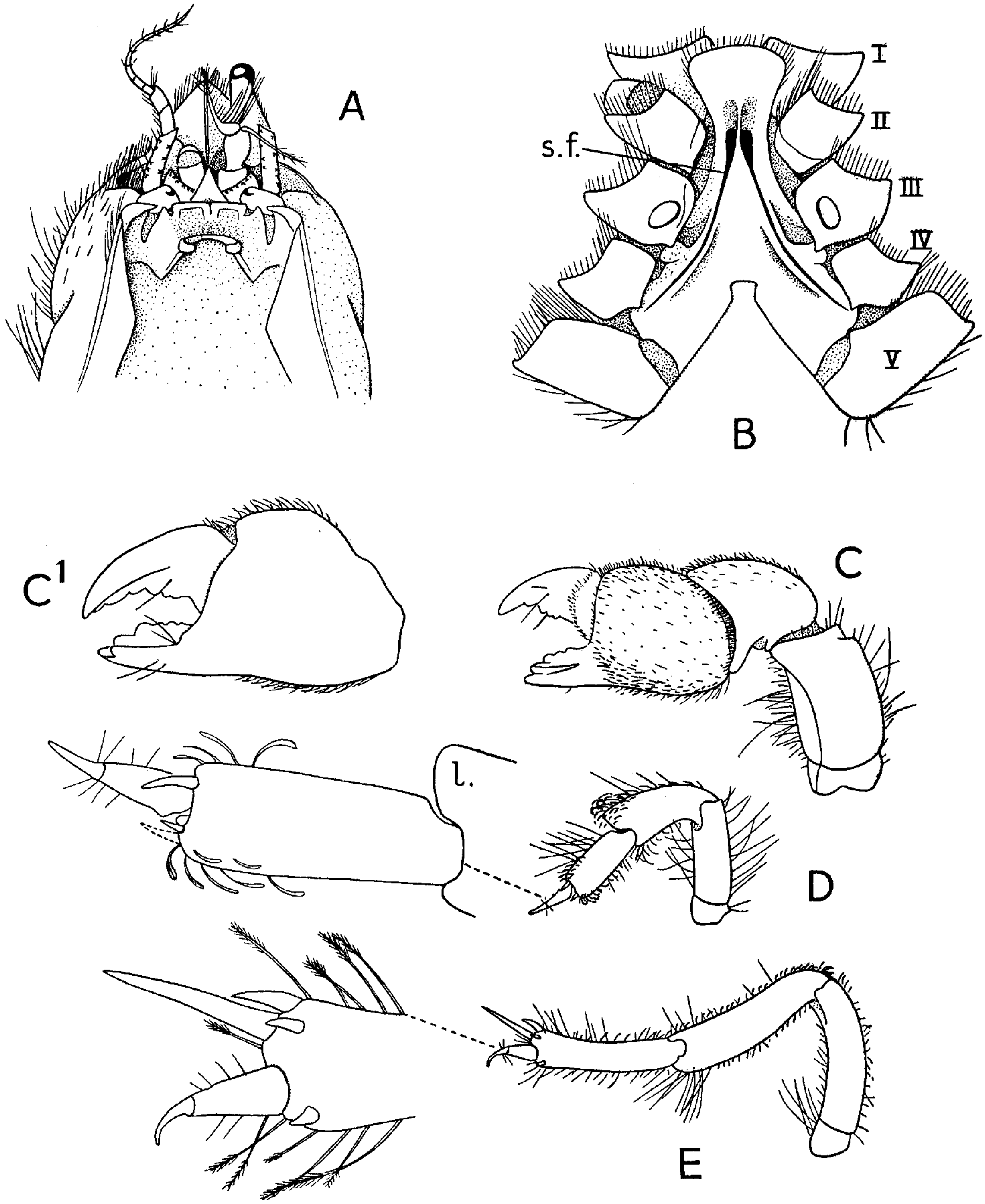
DESCRIPTION OF THE FEMALE.—The specimen from St. M.B. I(d) is represented in lateral aspect in Text-fig. 4, A, and in dorsal aspect in Text-fig. 6, A. The carapace, which measures approximately 6 by 4·5 mm., is poorly calcified, especially in the posterior third ; the dorsal surface is smooth and the various regions are scarcely indicated. Owing to the fact that calcification stops abruptly on the lateral wall of the carapace, the ventral half being so thin that the gills are visible through it, the *linea dromiidica* is sometimes seen only with great difficulty. The antero-lateral margin is well defined and bends inwards posteriorly to emphasize the deep branchial furrow ; the other furrows are not distinct and appear to be absent. The triangular front is prominent and somewhat deflected, projecting well beyond the outer angle of the orbit. The cornea is quite conspicuous at the end of a long, stout, somewhat flask-shaped ocular peduncle ; when the eye is retracted into the orbit the cornea is entirely concealed in dorsal aspect by a fringe of fine feathered

| | *P. rotunda* (McLeay) | *P. latens* Stimpson. | *P. integrifrons* Henderson | *P. murrayi* n. sp. |
|---|---|---|---|---|
| Length of carapace | 25 to 30 mm. | 19 and 21 mm. | 14 and 18·3 mm. | 4·5 to 6·0 mm. |
| Front | Small; three spines distinct, rostral spine keeled ventrally, meeting epistome | Small; two dorsal spines in close contact, rostral spine more or less fused with rest; gap between keel and epistome | Larger than in preceding two; triangular, with a ventral keel meeting epistome | Relatively larger than in *P. integrifrons*; triangular, with a ventral keel meeting epistome |
| Orbit | Conspicuous median lobule on dorsal margin; suture line in ventral margin near outer angle | Lobule on dorsal margin nearly obsolete; suture line in ventral margin near outer angle | No trace of lobule which is incorporated in front; suture line in ventral margin near outer angle | As in *integrifrons*, but a wide shallow V-shaped fissure near outer angle |
| Second segment of antennal peduncle | Short and stout, with massive lobe at antero-external angle | Short but not so stout, smaller lobe at antero-external angle | Twice as long as wide, no trace of lobule at antero-external angle | Thrice as long as wide, no trace of lobule at antero-external angle |
| Antennal flagellum | 25 to 27 segments | ? | 26 segments | 11–13 segments (16 in ♂ from Ceylon) |
| Maxillipeds 3 | Set obliquely; in frontal aspect meri and parts of ischia form a deep inverted triangle | Set obliquely; in frontal aspect meri form a shallower segment of a circle | Forming a flat operculum (*i.e.* not oblique) | Forming a flat operculum |
| Thoracic sternum of female | Anterior sternite does not reach coxæ of mxps. 3; sternal furrows end on a prominent boss opposite anterior third of coxæ II where sternum bends abruptly, almost at right angles. Bridge between sternites 8 straight | As represented in Text-fig. 3*b*; apex reaches coxæ of mxps. 3; boss less prominent and opposite posterior third of coxæ II, where sternum bends much less abruptly. Bridge between sternites 8 with median convexity | As represented in Text-fig. 3*a*; the whole slopes gently backwards without any abrupt bending | As represented in Text-fig. 5, *b*; but apex rather variable (see Text-fig. 7, c, c[1]). Apex white like fingers of chelæ |
| Terminal abdominal segment of female | Longer than wide (*l.* not quite = *l.* of 6 + 5); apex more rounded than in *P. latens* | Longer than wide (*l.* = *l.* of 6 + 5); more pointed than in *P. rotunda* | Chordate, length = max. width | Rather more triangular than in *P. integrifrons*, rather longer than wide |
| Diameter of ova | 1·8 to 2·2 mm. | ? (empty egg cases) | 0·8 to 1·0 mm. | 0·6 to 0·7 mm. |
| Terminal abdominal segment of male | Length = breadth near base; apex with a short inwardly directed spine | Rather longer than wide; apical spine longer | ? | Rather narrowly triangular—see Text-fig. 4, c |
| Thoracic sternum of male | A long forwardly directed tuft of setæ in front of the transverse suture | A shorter tuft of setæ than in *P. rotunda* (? age difference) | ? | No tuft, but a few short scattered setæ in front of transverse suture |
| Pleopod 1 of male | Terminal segment short and stout, with a long, heavy terminal mass of setæ | Very similar to that of *P. rotunda* | ? | Terminal segment long and not very heavily setose at apex—see Text-figs. 8, c, d, and 9, d |
| Pleopod 2 of male | Terminal segment relatively shorter than in *P. murrayi*; basal half broader, distal style concealed by the setæ on pl. 1 when the two are interlocked | Very similar to that of *P. rotunda* | ? | Terminal segment very long and slender, not concealed by terminal setæ of pl. 1 when the two are interlocked (see Text-figs. 8, e, and 9, d) |
| Branchial formula | 12-11 gills + 3 epipodites | 9 + 3 | 8 + 3 | 6 (+ r?) + 3 |

setæ, and is very inconspicuous in ventral aspect as well (in Text-figs. 5, A, and 8, A, the eyes are much more conspicuous than they actually are because the setæ are only indicated very diagrammatically).




TEXT-FIG. 4.—*Pseudodromia murrayi* n. sp. A. Female from St. M.B. I(d), in lateral aspect, the compound Ascidian with which it lives is represented by a heavy broken line *t*. *n*. Notch in Ascidian into which the lobe *l* at the distal end of the carpus of pereiopod IV fits ; *l.d.*, linea dromiidica. B. Abdomen of female from St. 45 that was dissected. C. Abdomen of male from St. 45. All × 11.




TEXT-FIG. 5.—*Pseudodromia murrayi* n. sp. Female from St. 45 that was dissected. A. Anterior half of carapace in ventral aspect, showing rostrum or triangular front, eyes and eyestalks, antennules, antennæ, epistome and endostome ; × 14. B. Thoracic sternum of somites 4–8, with coxæ of pereiopods I–V ; *s.f.*, sternal furrow or groove ; × 20. C. Left cheliped, × 15, and $C^1$, right chela, from inner side, more highly magnified. D. Fourth pereiopod, with distal part more highly magnified ; *l.*, lobe at distal end of carpus ; ×15 and 47. E. Fifth pereiopod, with distal end more highly magnified ; ×15 and 47.

Text-fig. 5, A, represents the anterior half of the carapace of a female from St. 45 in ventral aspect ; the right eye and antennule are retracted while those on the left side are projecting. The ventral keel of the rostrum is in contact posteriorly with the apex of the triangular epistome ; the inner half of the antennulo-orbital pit is bounded ventrally by the basal joints of the antennular and antennal peduncles. The antennular flagellum has some 11–13 segments (16 segments in the flagellum of a male from Ceylon B.M. coll., 75.14). The details of the endostome and buccal frame are also shown. There is a wide V-shaped gap near the outer orbital angle.

The thoracic sternum of the same female is represented in Text-fig. 5, B, together with the coxæ of pereiopods I–V. The anterior sternites are fused to form a narrow shield, the apex of which varies somewhat in shape (*cf*. Text-fig. 9, C and $C^1$) and is very conspicuous, being white and strongly calcified, like the fingers of the chelipeds, whereas the rest of the animal is yellowish. The sternal furrows are very conspicuous in all the specimens from St. 45, which carry ova or empty egg-cases. Sometimes there is a brown streak in the anterior half of the furrow in these sexually mature females. This I take to be the remains of the male secretion which has hardened in the groove after the ova have been fertilized. The specimens are too small and too rare to enable me to describe the internal spermatheca in detail (see Part II, p. 247 under *Dromia*).

The *abdomen* consists of 7 separate segments as shown in Text-fig. 4, B ; a certain amount of displacement of the segments has occurred because, in order to make the camera lucida sketch, the abdomen was flattened out under two pieces of a glass slide. The terminal segment is in reality rather longer than wide, but is foreshortened in the figure and thus seems to be as wide as long. There is no trace of the uropods. The marginal setæ are long and somewhat plumose.

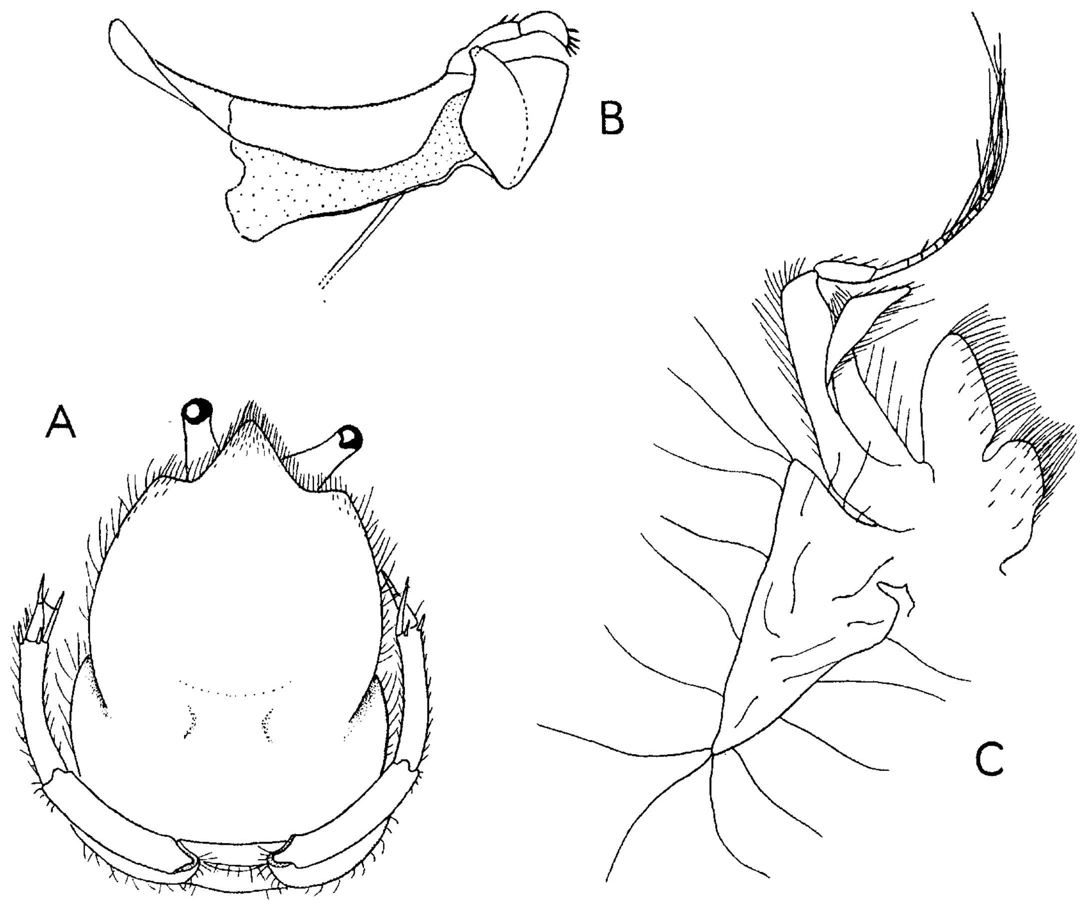
The *mouthparts* are all represented in Text-figs. 6, B, C, and 7, A–D ; the mastigobranch (or epipodite) on the first maxilliped is very large ; that on the second and third maxillipeds respectively is very reduced. The mandibular palp appears to be three, but is only two, segmented.

The *branchial formula* is 6 gills + 3 epipodites ; there is a large pleurobranch to each of the last four pereiopods, a large arthrobranch to the cheliped and a small one to maxilliped 3 ; presumably the upper branch of the bifurcated epipodite on maxilliped 2 represents a vestigial podobranch (Text-fig. 7, C, *r*).

*Pereiopods* I, IV and V are represented in Text-fig. 5, C–E. The chelipeds are equal, though the arrangement of the teeth on the cutting edges of the fingers may not be absolutely identical in both. They are as long as, but much more massive than, the second pereiopods ; the merus is twice as long as wide ; the carpus is unarmed ; the whole of the outer surface of the deep palm and the base of the dactylus are clothed with a short yellowish felt which has been partially rubbed off in the figured specimen. The pointed apex of the dactylus fits into the space between the two terminal teeth of the slightly spooned immovable finger (Text-fig. 5, C and $C^1$). The second and third pereiopods are alike, although the latter is a little longer than the former ; they are normal walking legs (see Text-fig. 4, A). The fourth pereiopods are, as already stated, greatly reduced in size, somewhat dorsal in position and specially modified to hold the enveloping Ascidian in place ventrally (Text-fig. 5, D, and 4, A). The details of the fifth pereiopod are represented in Text-figs. 5, E, and 4, A; when it is flexed the carpus and merus are in contact with each other, as shown in Text-fig. 6, A, when straightened out it is as long as the carapace.

Sometimes, as a result of fixation, the Ascidian shrinks and the distal end of pereiopod V pierces the tissue of the commensal and projects beyond it.

The first pair of *pleopods* are very small and uniramous. The next three pairs are large, each having a long slender endopodite and exopodite. The last pair, which are also biramose, are much shorter. The endopodites of pleopods 2–5 carried 3, 6, 8 and 3 empty egg-cases respectively; the total number of ova was thus 40. The *ova* are large in proportion to the size of the mother and have a diameter of about 0·6–0·7 mm.

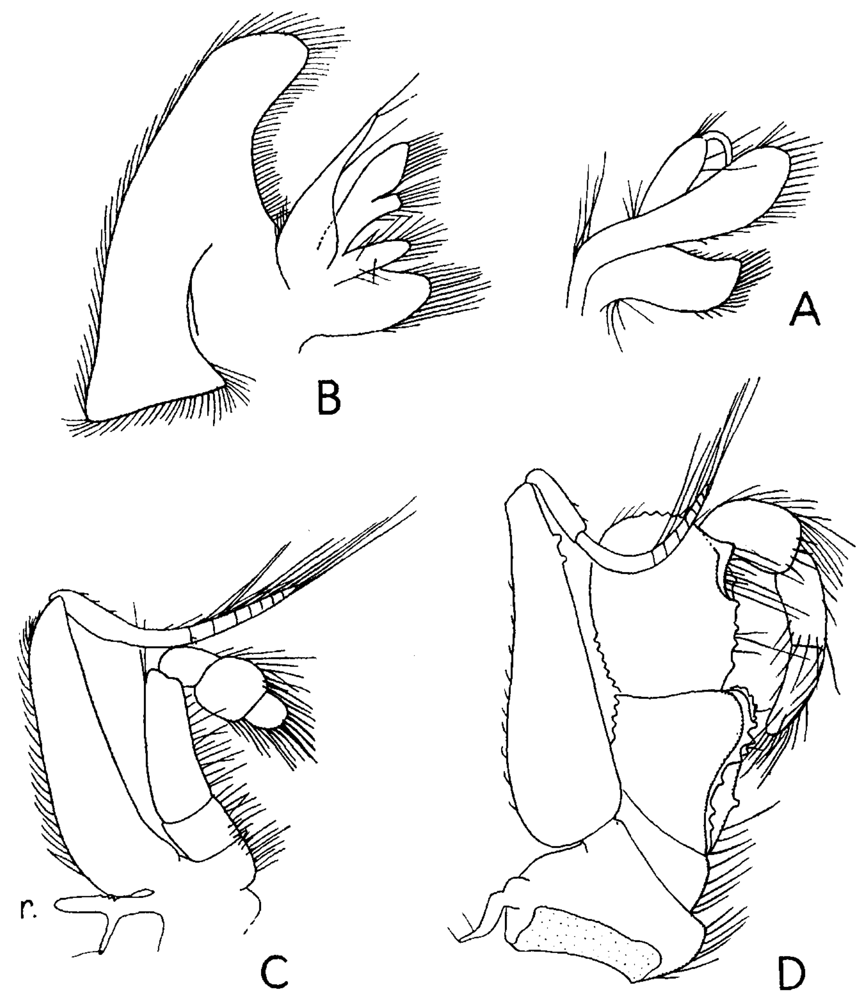



TEXT-FIG. 6.—*Pseudodromia murrayi* n. sp. A. Female from St. M.B. I(d), in dorsal aspect, showing carapace, eyestalks and folded fifth pereiopods; × 9. Female from St. 45. B., mandible, inner aspect; C., first maxilliped; × 36.

The *setæ* on body and appendages are for the most part finely plumose.

The *colour* in the preserved state is a light yellowish or yellowish brown; the fingers of the chelipeds, the apex of the thoracic sternum and the minute spinules on the peduncles of the antennae and antennules are conspicuously white, being all well calcified. In some specimens the dorsal surface of the carapace is whiter—and presumably rather more calcified—than in others.

THE MALE is smaller than, but very similar to, the female; the chelipeds are relatively larger. The outline of the carapace is as represented in Text-fig. 8, A; the branchial furrow is shallower and the antero-lateral border does not turn inwards so conspicuously. The *linea* *dromiidica* is very distinct on the lateral wall of the carapace, being rather brown in colour; the branchial furrow bends down towards it and then forwards parallel to it along the pterygostomial region. The abdomen is represented in Text-fig. 4, C; it is narrower than in the female, the pleura of segments 2–6 being greatly reduced and the terminal segment is longer and more narrowly triangular; the margins bear long plumose setæ. The copulatory apparatus on each side comprises three parts which must all fit together during copulation. Pleopods 1 and 2 are represented in Text-fig. 8, C–E, and those of another

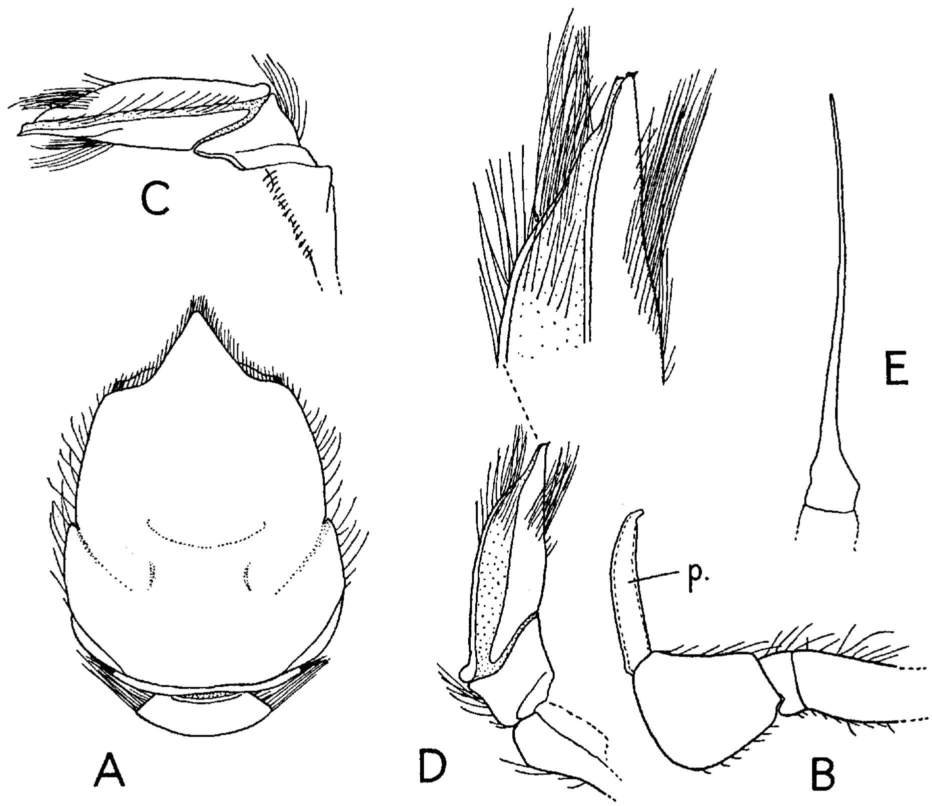



TEXT-FIG. 7.—*Pseudodromia murrayi* n. sp. Female from St. 45. A. Maxillule. B. Maxilla. C. Second, and D third, maxilliped. × 36. *r.*, Gill rudiment.

male are interlocked in Text-fig. 9, D. The long needle-like apex of pleopod 2 projects far beyond the apex of its partner and presumably passes backwards through the opening of the sternal furrow of the female and along the channel towards, or even into, the spermathecal pit in the antero-ventral corner of endosternite 7/8 (see details for *Dromia* in part II, p. 426, Text-figs. 24 and 25). The third part referred to is a long tube or penis projecting from the coxa of pereiopod V; how this piece functions in conjunction with the other two is not known—perhaps it also interlocks with pleopod 1 and pours the male secretion into the needle-like apex of pleopod 2 (Text-fig. 8, B, *p*).

REMARKS.—A specimen from St. 45 was dissected and Text-figs. 4–8 were prepared towards the end of 1943. The specimen, unfortunately, cannot now be found, and so I have not been able to check all my figures. The only alteration I have made was to remove traces of a pair of uropods that I once thought I detected, from Text-fig. 4, B; there is no trace of uropods in any of the other specimens.

Although the female from St. M.B. I(d) is the largest in size it does not seem to be quite mature. The apex of the thoracic sternum is not enlarged and somewhat heart-shaped, as in the mature females from St. 45 (*cf.* Text-figs. 9, A, and 5, B). As the other

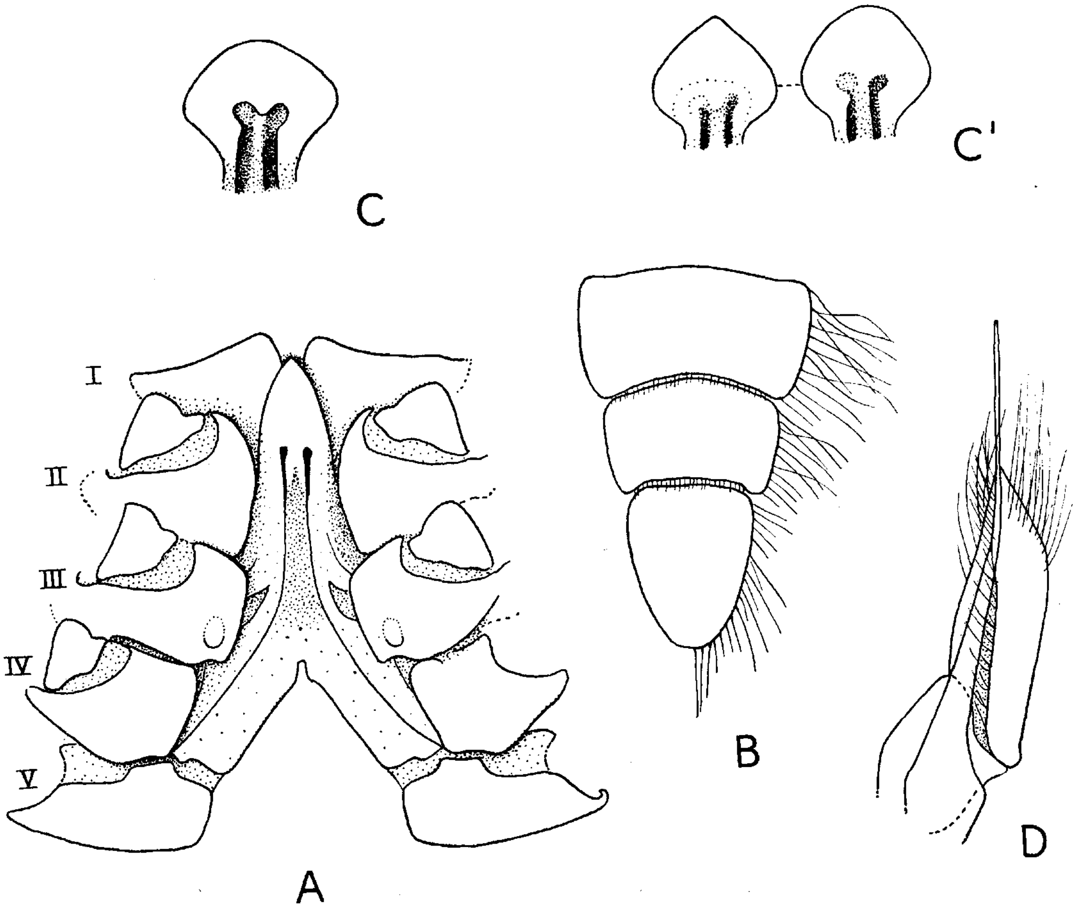



TEXT-FIG. 8.—*Pseudodromia murrayi* n. sp. Male. A. Carapace of specimen from St. 45, in dorsal aspect—the eyes are withdrawn into the orbits and are scarcely visible beneath the fringe of fine setæ; ×9. B. Proximal part of left pereiopod V, in lateral aspect, showing long penis, *p.*, projecting from the coxopodite. C and D. Left pleopod 1, thoracic and abdominal aspects, × 20, with apex more highly magnified. E. Left pleopod 2; × 20.

female from the Red Sea also has a narrower apex to the plastron I was at first inclined to think that two species might be represented, and this may be so. On the other hand, the sternum is very poorly calcified between the sternal furrows (opposite coxæ II and III), the furrows do not seem to be fully developed and the genital openings are apparently not perforate, *i.e.* the specimen is slightly immature. The abdomen is also narrower (*cf.* Text-figs. 9, B, and 4, B). The other Red Sea specimen is so firmly enveloped in its Ascidian that I have not removed it; its sternum, though narrow, shows a hint of becoming more heart-shaped. For the present I prefer to regard all the specimens as belonging to one small species, which probably attains the full development of the sternal furrows and sternum at the moult preceding the first copulation and oviposition.

The thoracic sternum of the females from St. 45 varies somewhat as to apex ; Text-fig. 9, C[1], represents the apex, in two slightly different aspects, of the female without its Ascidian—as the actual apex is deflexed the point is not visible in the right-hand figure. Text-fig. 9, C, represents the apex of the specimen inside its Ascidian ; here there is no point. In Text-fig. 5, B, the sternum is tilted backwards slightly to show the posterior part of the sternal groove and the actual anterior margin is not visible.

The ova are larger in proportion to the size of the female than in the other species, being almost as large as those of *P. integrifrons*—see Table II.




TEXT-FIG. 9.—*Pseudodromia murrayi* n. sp. Female from St. M.B. I(d). A. Thoracic sternum and coxæ of pereiopods I–V, to show the rather immature sternal furrows. B. Terminal segments of abdomen ; × 18. C and C[1]. Apex of thoracic sternum of two females from St. 45 ; × 18. D. Left sexual pleopods 1 and 2, interlocked, of male from Ceylon (B.M. coll.), in abdominal aspect ; × 20.

Sub-tribe *THELXIOPIDEA* Rathbun, 1937, p. 61 (earlier references).

= HOMOLIDEA Alcock, 1899, p. 154 ; 1901, p. 58 ; Calman 1909, p. 314.

CLASSIFICATION OF THE THELXIOPIDEA.—Alcock (1901, p. 59) divided the Homolidea into two families as follows :

" I. The slender basal joint of the eyestalk is not much longer, or may be even shorter, than the terminal joint. The gill-plumes are 13 or 14 on either side and epipodites are present on the chelipeds and often also on the first two pairs of ambulatory legs . . . HOMOLIDÆ.

" II. The slender basal joint of the eyestalk is much longer than the terminal joint. The gill-plumes are 8 on either side and no epipodites are present on the chelipeds or legs LATREILLIDÆ."

This key would require modification as far as the branchial formula is concerned, for the *Latreillopsis* species that I have examined have a higher formula than that given by Alcock for the Latreillidæ—see Table III. On the strength of the gill formula I feel justified in separating "*Latreillopsis*" *petterdi* Grant from the other two species and transferring it to the genus *Paromola*; moreover *Paromola cuvieri*, *alcocki* and *petterdi* form a series in which certain spines become progressively more developed (see p. 223). Ihle accepted Alcock's branchial formula of 8 gills + 3 epipodites for the genus *Latreillopsis* and does not appear to have examined that of *L. multispinosa* Ihle (1913, pp. 68 and 78). It is therefore uncertain whether this species belongs to *Latreillopsis* or to *Paromola*.

TABLE III.

| Specific name. | Epipodites present on pereiopods. | Branchial formula. |
|---|---|---|
| *Paromola cuvieri* (Risso) | I–III | 14 gills + 6 epipodites |
| "*Latreillopsis*" *petterdi* Grant. | I–III | 14 ,, + 6 ,, |
| *Homola vigil* A. M.-Edw. (from Ihle,* 1913, p. 67) | I–III | 14 ,, + 6 ,, |
| *Hypsophrys superciliosa* W.-M. | I–III | 14 ,, + 6 ,, |
| *Paromola profundarum* Alc. and And. | I–III | 14 ,, + 6 ,, |
| *Homolochunia valdiviæ* Doflein | I–III | 13 + r ,, + 6 ,, |
| *Paromola alcocki* (Stebbing) | I–III | 13 ,, + 6 ,, |
| | or I–II | 13 ,, + 5 ,, |
| *Homologenus rostratus* A. M.-Edw. (after Ihle, 1913, p. 67) | I | 13 ,, + 4 ,, |
| *H. braueri* Doflein | I | 13 ,, + 4 ,, |
| *Latreillopsis bispinosa* Hend. | I | 10 ,, + 4 ,, |
| *L. laciniata* Sakai | I | 10 ,, + 4 ,, |
| *Latreillia pennifera* Alcock† (from Alcock, 1901, p. 70) | — | 8 ,, + 3 ,, |
| *L. valida* de Haan | — | 8 ,, + 3 ,, |

* This formula should include 4 additional rudiments, one on the epipodite attached to maxilliped 3 and pereiopods I, II and III respectively, according to Milne-Edwards and Bouvier, 1902, p. 27—Ilhe reproduced their formula—but throughout I have ignored these. The rudiment mentioned under *Homolochunia* is that of the arthrobranch (pleural) on the somite that bears pereiopod IV; Ihle gives only 12 gills for *Homolochunia*, but I found 13 + r.

† I presume that Alcock must have examined the gills of *Latreillia pennifera* Alcock rather than those of *Latreillopsis bispinosa* for his formula on p. 70, since he only mentions these two species.

Ihle (1913, p. 52) regarded the genera *Homolochunia* Doflein and *Homolomannia* Ihle as forming a bridge between Alcock's two families and reverted to the use of Homolidæ in the wider sense. Later Rathbun substituted *Thelxiope* Rafinesque, 1814, for *Homola* Leach, 1815, and this necessitated the adoption of the names "Thelxiopeidea" and "Thelxiopeidæ" (Rathbun, 1937, p. 62). Bouvier (1940, p. 190), however, did not follow Rathbun, but pointed out that Thelxiopidæ (as he preferred to spell it, and this would appear to be correct according to Article 4 of the International Rules of Nomenclature), is equivalent to his subfamily Homolinæ. Rathbun and Bouvier both retain two divisions of the sub-tribe Homolidea or Thelxiopidea, which the former calls families, the latter subfamilies. For the present I prefer to use the family Homolidæ or Thelxiopidæ in the wider sense, as Ihle did. One could, of course, alter Alcock's key to suit the known branchial formulæ, but this seems unwise while the formulæ for *Homolomannia sibogæ* Ihle and various other species of Thelxiopidea are unknown. *Paromolopsis boasi* Wood-Mason probably has 14 gills + 6 epipodites, while *Thelxiope barbata* (Fabr.) has 13 gills + 6 epipodites, the podobranch on maxilliped 3 being absent. In any case, *Homologenus*, with its high number of gills and reduced number of epipodites makes any hard and fast division impossible.

## Family Thelxiopidæ Rathbun (*sensu lato*).

Thelxiopeidæ + Latreillidæ Rathbun, 1937, pp. 62 and 73.
Homolidæ Ihle, 1913, pp. 52 and 92 ; Balss, 1927, p. 1014.
Homolidæ + Latreillidæ Calman, 1909, p. 314.

### Genus *Thelxiope* Rafinesque.

*Thelxiope* Rafinesque, 1814, p. 21.
,, Rathbun, 1937, p. 62 (references and synonymy).
*Homola* Leach, 1815, p. 324 ; 1815*a*, p. 82 ; and later authors.

### *Thelxiope orientalis* (Henderson).

*Homola barbata orientalis* Doflein, 1904, p. 15, pl. v, figs. 4 and 5 (earlier references, group *b*).
,, ,, Yokoya, 1933, p. 99 (references, excluding those for typical *barbata*).
,, *orientalis* Rathbun, 1923, p. 143, pl. xxxvii, figs. 1 and 2.

Occurrence :

St. 24, Gulf of Aden. 73–220 m. 1 rather immature ♀ (*c.l.* = 16 mm. including the short rostrum).

St. 106. Zanzibar Area. 212 m. 1 immature specimen.

Recorded Distribution.—Indian Ocean, Andaman Sea ; Pacific Ocean—Little Ki Island, Zebu, Sumatra, off Victoria, Australia, Sagami Bay and Tanabe, Japan. Depths from 90–548 m.

Remarks.—The two syntypes from the " Challenger " collection (*c.l.* = 14·4 and 17 mm. respectively) as well as the specimen from " J.M." St. 24, are all slightly immature. The genital pores, though they may be visible on one or both sides, do not appear to be perforate, but are covered by a membranous plug, and the abdomen is comparatively narrow. The spermatheca, as will be described later (see p. 241), is quite distinct from that of a rather small female of *Th. barbata* from the Dry Tortugas (reg. no. 1938.3.19.125 ; *c.l.* = 16 mm.). This, in addition to the differences enumerated by Doflein (1904, p. 15) and Rathbun (1923, p. 144), is sufficient to justify the separation of *Th. orientalis* as a distinct species. The geographical distribution of these two distinct though allied species also differs. *Th. barbata* is restricted to the northern half of the Atlantic Ocean and to the Mediterranean ; Doflein also mentions South Africa (1904, p. 15, reference to Stebbing's paper, 1902 [1904], p. 22, False Bay).

### *Thelxiope megalops* (Alcock).

*Homola* (*Homolax*) *megalops* ALCOCK, 1901, p. 62, pl. iv, fig. 21 (earlier references).
,, *megalops* KEMP and SEWELL, 1912, p. 27.

OCCURRENCE :

St. 35. Gulf of Aden, 441 m. 4 ♀♀, 1 ♂, and 1 young specimen.

RECORDED DISTRIBUTION.—Indian Ocean, Andaman Sea, off Madras Coast and off Colombo, at depths ranging from 260–766 m.

REMARKS.—These specimens are all of small size, the carapace length being 20 mm. or less. None of the females appears to be sexually mature ; in one or two the genital pores are visible, but not, I think, perforate. The external part of the spermatheca is smaller than, and different from, that of either *Th. barbata* or *Th. orientalis*—see part II, p. 241.

The shells of these specimens are unusually thin and delicate, partly perhaps because they had become dry at some time during the war years and had been relaxed in a mixture of spirit and glycerine.

### Genus *Paromola* Wood-Mason.

*Homola* (*Paromola*) ALCOCK, 1901, p. 64 ; IHLE, 1913, p. 69 (in key) ; SAKAI, 1936, p. 47.
*Paromola* BOUVIER, 1940, p. 191.
*Thelxiope* (*Moloha*), BARNARD, 1947, p. 372.

### *Paromola alcocki* (Stebbing). Pl. I, fig. A.

*Latreillopsis alcocki* STEBBING, 1920, p. 255, pl. 24 (Crust., pl. 104).
,, ,, STEBBING, 1924, p. 4.
,, ,, BARNARD, 1926, p. 120.
,, *multispinosa* STEBBING, 1923, p. 5 ; *non* IHLE, 1913, p. 78.
*Thelxiope* (*Moloha*) *alcocki* BARNARD, 1947, p. 372.
? *Latreillopsis major* KUBO, 1936, p. 63, pl. xvii.
? *Homola* (*Paromola*) *majora* SAKAI, 1936, p. 49, pl. ix, fig. 2.

OCCURRENCE :

St. 157. Maldive area, 229 m. 1 ♂ (*c.l.* = 52 mm. including rostral spine).

RECORDED DISTRIBUTION.—Previously recorded from South African waters. *Homola* (*Paromola*) *majora* (Kubo) from Japanese waters is a very closely allied and perhaps identical species.

DESCRIPTION.—Carapace urn-shaped, conspicuously spinose. The principal spines agree with those on the carapace of the female from the Bell-Marley Collection (Umvoti R., 22 miles, 130 fm.) referred to *Latreillopsis multispinosa* by Stebbing (1923, p. 5) as well as with those figured by Stebbing for his *L. alcocki* (1920, pl. 24 (Crust. 104)). These may be enumerated as follows : (1) rostral spine ; (2) a pair of prominent supraorbital spines each with a dorso-lateral branch near the middle ; (3) a prominent spine slightly ventral to the eyestalk and rostrum and equal in length to the latter ; (4) a much shorter spine external to the base of the antenna ; (5) a transverse row of four spines and, behind these, a median gastric spine ; (6) a group of one spine and four spinules on the hepatic region ; (7) behind this group three spinules slightly more ventrally placed, and one spinule near the anterior angle of the buccal cavern ; (8) a transverse row of four metagastric spinules in the mid-dorsal line, just in front of the cervical groove ; (9) a transverse pair of median spinules on the raised urogastric area ; (10) on the branchial region the most prominent are four spines near the lateral border—the second is the longest and the fourth the shortest; (11) a rather prominent epibranchial spine on a level with the metagastric row, and a rather shorter mesobranchial spine slightly below and in front of the urogastric pair ; (12) a group of 4 + 3 mesobranchial spinules. In addition to these are various minute spinules scattered amongst the main groups ; the lateral wall, posterior to the cervical groove, also bears a number of spinules (see Pl. I, fig. A).

The merus and ischium of the third maxilliped are of equal length, measured along the inner margins ; three spinules in a row on the ischium get progressively larger distally and there is an even more prominent one on the proximal fourth of the merus.

All 7 abdominal segments are distinct ; segments 1, 2, 3 and 6 each bears a prominent spine ; segment 5 has an anterior and a posterior spine (the latter the more pronounced), while 4 has an anterior spine and two distal spinules side by side. The widest part is across the middle of 5 ; the terminal segment is long and narrow ($l : b = 4 : 3$), the distal half being narrowly triangular, there are 3 grooves—a median one near the pointed apex, and a pair of lateral ones in the proximal two-thirds.

The branchial formula is 13 gills + 6 epipodites.

REMARKS.—Barnard (1947, p. 371) has recently introduced a new subgenus *Moloha* with *alcocki* as the type species, but I hardly think that this subdivision is necessary. *P. cuvieri* (Risso), the type species of *Paromola* has : (1) the rostrum entire and spiniform, flanked by two strong supraocular spines ; (2) the carapace moderately spinose—*i.e.* numerous spines are present, but the principal ones are not so long as in *alcocki* ; (3) carapace urn-shaped, with the *linea homolica* well within the lateral borders as in *Moloha* ; (4) the chelipeds quite slender considering its much larger size—probably in all species the male chelipeds become much more robust with age, as Kemp and Sewell found in *Thelxiope megalops* (Alcock) (1912, p. 28, diagram), *cf.* Kubo's large male figured on Pl. XVII, fig. A, with Sakai's smaller specimen on Pl. IX, fig. 2 (Kubo, 1936, and Sakai, 1936) ; (5) the fifth pereiopod exceeds the merus of pereiopod IV by the length of its dactylus (for *Moloha* Barnard says, "fifth leg reaching to about end of fifth joint of fourth leg"). In the "John Murray" specimen of *P. alcocki*, pereiopod V exceeds the merus of pereiopod IV by propodus + dactylus. *Paromola profundarum* Alcock and Anderson is not a spiny form apart from the rostrum, the supra-orbital spines that flank its base, one hepatic spine behind each orbit and a spinule on each branchial region. It seems to me unnecessary to separate *alcocki* from *cuvieri*, since *cuvieri-alcocki-petterdi* form a series in which certain spines become progressively more pronounced. The remaining species are less spinose and in this respect not so close to *cuvieri*.

### *Paromola profundarum* Alcock and Anderson.

*Homola (Paromola) profundarum* ALCOCK and ANDERSON, 1899, p. 5.
,, ( ,, ) ,, ALCOCK, 1899, p. 159 ; 1899*a*, p. 10, pl. i, fig. 2 ; 1901, p. 64, pl. v, fig. 22.
,, ( ,, ) ,, DOFLEIN, 1904, p. 16, pl. vii, figs. 1–2.
*Paromola profundarum* IHLE, 1913, p. 92 (no new record).

OCCURRENCE :

St. 153. Maldive area. 256 m. 1 ♂, *c.l.* = 16 mm., including rostrum.

RECORDED DISTRIBUTION.—Travancore coast ; East African coast. Depth 786–1362 m.

REMARKS.—This specimen was dredged from much shallower water than the " Investigator " and " Valdivia " material.

As already mentioned, this species is much less spinose than *Paromola cuvieri-alcocki-petterdi* (see p. 223). The supraorbital spines are nearly as long as the rostrum ; Sakai calls these " preorbital " spines in the case of *P. japonica* and " supraorbital " spines in the case of *P. majora* (1936, pp. 48 and 49), but the base of the eyestalk is inserted nearer to the rostrum, *i.e.* between the rostrum and the supraorbital spine. Miss Rathbun calls them supraorbital spines in the case of *P. faxoni* and *P. rathbuni* (1937, pp. 68 and 69) and I use the same term. But, when the genus "*Homola* " with its subgenera *Paromola, Homolax* and *Moloha* are revised, a critical examination of the arrangement of the spines and spinules will be necessary and a more precise terminology will have to be worked out.

This species is characterized by the special form of the propodus and dactylus of pereiopod V ; according to Alcock these parts are " cheliform rather than subcheliform " (1899, p. 160 ; 1899*a*, p. 11).

### Genus *Hypsophrys* Wood-Mason.

WOOD-MASON, 1891, p. 269.
ALCOCK, 1899*a*, p. 12 ; 1899, p. 162 ; 1901, p. 66.

### *Hypsophrys superciliosa* Wood-Mason.

WOOD-MASON, 1891, p. 269 ; 1895, Illustr. Zool. ' Investigator," Crustacea, pl. xiv, figs. 4, 4*a*.
ALCOCK, 1899*a*, p. 14 ; 1899, p. 163 ; 1901, p. 67, pl. iv, fig. 24 and 24*a*.

OCCURRENCE :

St. 62. Northern area of Arabian Sea. 1893 m. 15♂♂, 23♀♀ (many ovigerous), 6 young.

St. 162. Maldive area. 1829 m. 1 immature specimen, *c.l.* = 11·6 mm., including rostrum.

RECORDED DISTRIBUTION.—Previously recorded from Arabian Sea and Bay of Bengal in 1350–1800 m.

REMARKS.—The specimen from St. 162 is a little damaged, but, though of small size it agrees well with Alcock's description and figures (1901, p. 67, fig. 24 and 24*a*, pl. iv). The first pleopod is uniramose, but stouter than the biramose second pair ; this suggests that the specimen is an immature male. The next three pleopods are uniramose and gradually diminish in size, the last pair being very small. The other specimens, received after this paper had been sent to press, bear this field-note " Colour, light coral red or coral red ; the specimens matched with Ridgway's Standards, Pl. xiii."

### Genus *Homolochunia* Doflein.

DOFLEIN, 1904, p. 21.

### *Homolochunia valdiviæ* Doflein.

DOFLEIN, 1904, pp. 22–26 ; pls. i, figs. 1 and 2 ; ix, figs. 1–8 ; x, figs 1 and 2 ; xliii, fig. 1.

OCCURRENCE :

St. 108. Zanzibar area. 781 m. 1 ovig. ♀ with a few small pedunculate Cirripedes.

St. 115. Zanzibar area. 640 m. 1 ovig. ♀—carapace bears some large tubes of an Annelid ; legs bear some Gorgonids and Sponges.

Recorded Distribution.—Previously recorded from " Valdivia " Stns. 251 and 254, off the coast of Equatorial East Africa in 693 and 977 m. respectively.

Descriptive Notes.—This is only the second record for Doflein's remarkable species and the specimens agree very well with his description of the female. The sculpturing of the cephalothorax, the *linea homolica* and certain of the small spinules are partially or completely masked by the dense short felt or tomentum. The right supraorbital horn is broken in the rather damaged specimen from St. 108, but the left one is complete and it is obvious that the horns diverged distally, outwards and downwards, much more than they do in the specimen from St. 115. The left supraorbital horn is, in fact, rather similar to the right one in Doflein's pl. ix, figs. 1 and 2.

The *linea homolica* is distinctly seen throughout its length when the tomentum is removed; it commences at the orbital margin, external to the base of the supraorbital horn, and pursues a slightly sinuous course on account of the sculpturing of the carapace, to end between coxæ IV and V.

The abdomen is, as stated by Doflein, 7-segmented, but there is partial fusion between segments 5 and 6, for the suture line is distinct medially and fades out laterally, its position being indicated by a whitish ridge. Each specimen carries numerous small ova. The spermathecæ are conspicuous in the posterior third of the thoracic sternum; externally they are very similar to those of *Paromola cuvieri* save that there is no boss on the ridge on sternite 8—for a more detailed description of the spermatheca, see Part II, p. 237.

The gill formula has been confirmed forwards to the level of the second maxillipede; there are 13 + r gills and 6 epipodites, the tiny rudiment above pereiopod IV having no trace of gill filaments. Doflein gives only 12 + r + 6, but the second maxilliped has an arthrobranch as well as a podobranch; being small, the former may easily be overlooked. The chelipeds are very slender; merus and ischium are distinctly flattened, the carpus is almost cylindrical in cross-section; the long narrow palm is also somewhat compressed and the fingers are very compressed blades with a distinct crest on the upper border of the movable, and lower border of the immovable, finger; the cutting edge of each finger is unarmed.

Remarks.—Doflein (1904, p. 21) compares this genus with *Latreillopsis* Henderson, but points out that the branchial formula is higher and nearer to that of the " Homolidæ." In fact it almost seems as if Doflein included his new genus in the family Latreillidæ. As already pointed out on p. 220, it is by no means easy to separate the Thelxiopidea into two well defined families.

### Genus *Homologenus* A. M.-Edw. in Henderson.

*Homolopsis* A. Milne-Edwards 1880, p. 34 (preoccupied).
*Homologenus* Henderson, 1888, p. 20 (in a footnote Henderson states that the new name was suggested by A. Milne-Edwards).
,, Ihle, 1913, p. 69 (other references).

### *Homologenus braueri* Doflein. Text-figs. 10, 11 and 12.

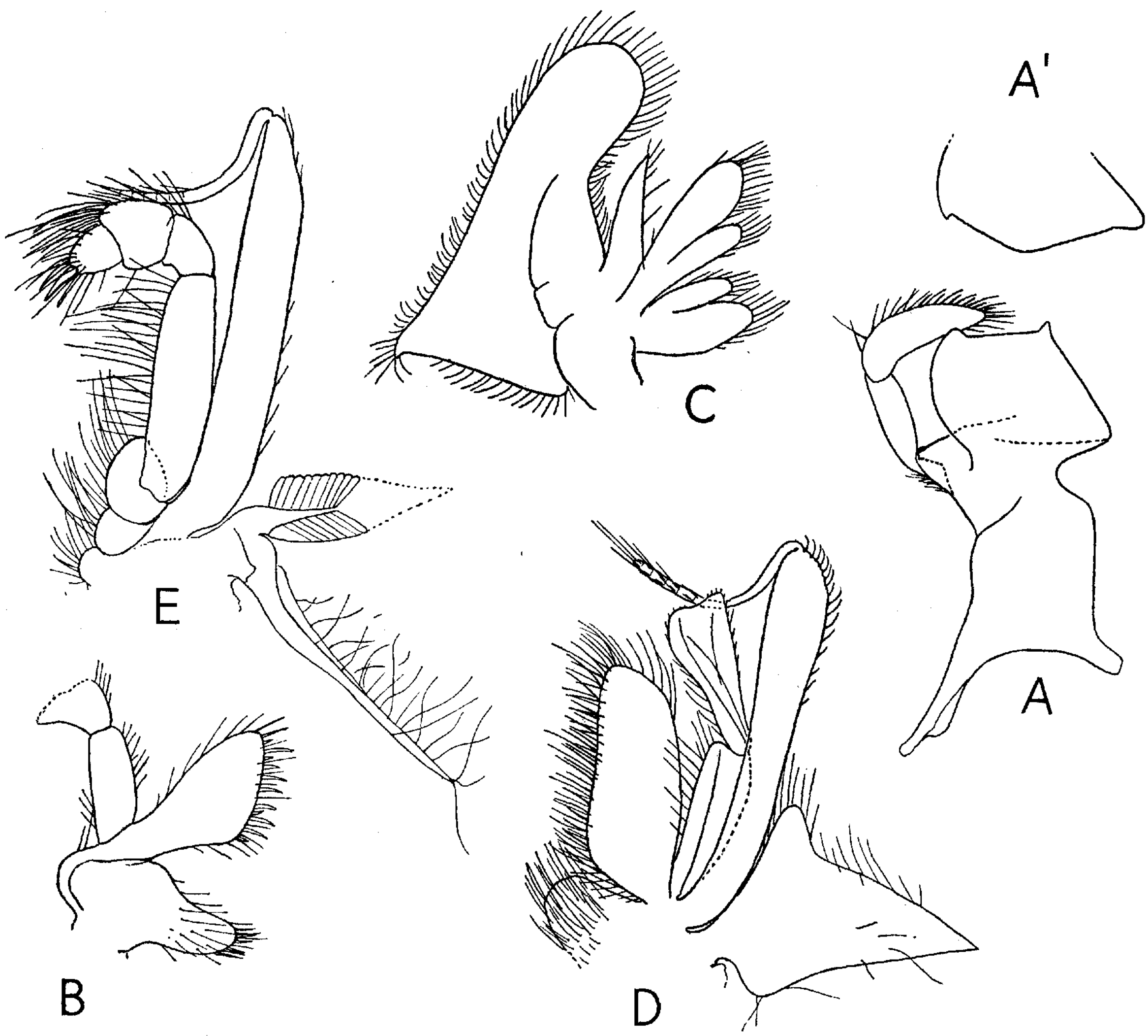
Doflein, 1904, p. 18, pl. xi, figs. 3 and 4.
Ihle, 1913, p. 70 (in table).

Occurrence :

St. 119. Zanzibar area, 1204 m. 1 ♂, 2 ♀♀ (one ovigerous), 1 immature specimen.

Recorded Distribution.—The holotype, a ♀, off the coast of Somaliland, 1242 m.

Descriptive Notes.—These specimens undoubtedly belong to Doflein's species, although they differ from the holotype in some minor points. There is, for example, a slender ventral spine near the proximal end of the propodus of pereiopod V, which may sometimes be broken off (Text-fig. 12, A).



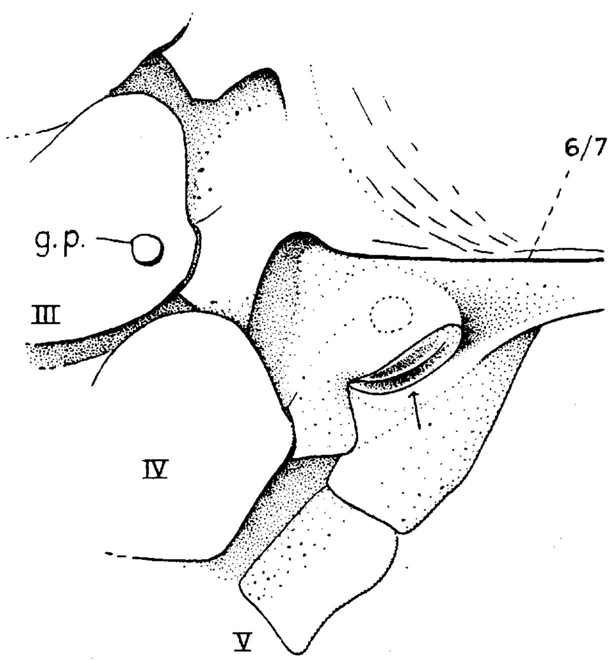

Text-fig. 10.—*Homologenus braueri* Doflein. Female, non-ovigerous. A. Right mandible. A[1]. Cutting edge of left mandible. B. Maxillule. C. Maxilla. D. First Maxilliped. E. Second maxilliped. All × 20.

Measurements in mm. :

| | | ♂ | Ovig. ♀ | ♀ |
|---|---|---|---|---|
| *l.* of rostrum | = | 4·0 | 4·5+ | 4·5+ |
| *l.* of carapace | = | 5·3 | 7·0 | 7·3 |
| *l.* of carapace + rostrum | = | 8·7 | 10·8+ | 11·0+ |
| Greatest *w.* of carapace | = | 5·0 | 6·8 | 7·0 |
| *l.* of lateral spine | = | 3·5 | 3·0 | 3·8 |

The rostrum is longer than in either *H. rostratus* or *H. malayensis* ; it slopes obliquely forwards and downwards, and its distal pair of spines are situated about one-third of the way along ; the proximal pair are exactly at the base of the rostrum.* Owing to the curvature of the carapace and oblique slope of the rostrum the total length of carapace and rostrum is less than the sum of the two (see measurements). The only other spines on the dorsal surface of the carapace are the pair of long lateral or branchial spines and, midway between them, a much shorter spine. A slender ventral spine, external to the base of the antenna, and another shorter spine slightly above and behind this one, are visible in dorsal aspect. There are also three spinules near the antero-lateral angle of the buccal cavern.

The carapace is almost as broad as long, and is closely beset with minute granules. The antennular peduncle is a trifle shorter than the rostrum and the bulge on its basal



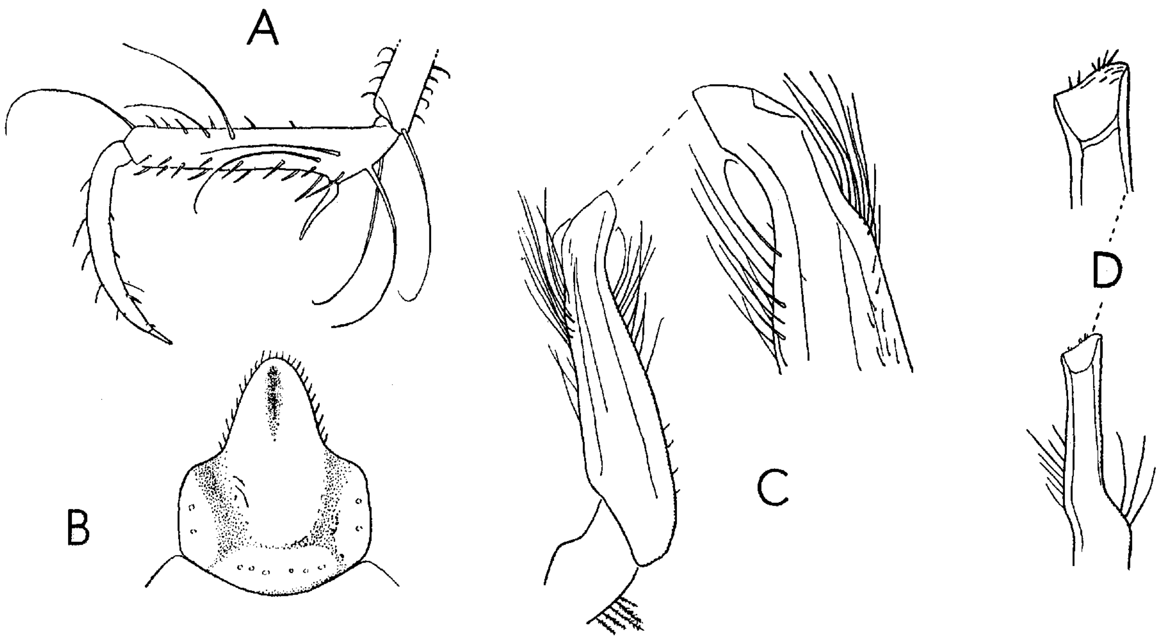

TEXT-FIG. 11.—*Homologenus braueri* Doflein. Female. Right posterior half of thoracic sternum to show spermatheca. III–V, Coxæ of pereiopod III to V respectively ; 6/7, transverse suture between sternites 6 and 7 ; *g.p.*, genital pore. × 27.

segment is partially concealed by the eye-stalk, which differs from that figured by Milne-Edwards and Bouvier (1902, pl. vi, figs. 9, 11, 12) in that the distal segment bulges conspicuously at its base ; this segment, though short, is much longer than the basal one. The antennal peduncle is considerably shorter than the rostrum and is beset with fine hairs, as is its long 10–13 segmented flagellum, the pereiopods and, to some extent, the carapace also. These are scarcely visible in Doflein's photographs (1904, pl. xi, figs. 3 and 4).

There is a prominent conical projection, armed with a terminal spine and one or two smaller spinules, on the ventral distal margin of the coxa of each cheliped ; these are clearly visible in the photograph of the holotype also (Doflein, 1904, pl. xi, fig. 4). The dactyli of pereiopods II–IV are markedly setose, especially on the distal third of the upper margin.

* ? = the supraorbital spine—see remarks on p. 229 and 224.

The non-ovigerous female was dissected. The gills are 13 in number, arranged as in *H. rostratus* (A. M.-Edw. and Bouvier, 1902, p. 32), and there are 4 epipodites. The mouthparts, the third maxilliped excepted, are represented in Text-fig, 10, A–E. The distal segment of the endopodite of the maxillule is incomplete. The third maxilliped is slender and pediform ; the propodus is rather shorter than the dactylus and armed with 4 spines on the medial border ; dactylus, merus and ischium are all subequal ; there is a longitudinal row of 4 spines, the distal the largest, along the middle of the ischium and, as a continuation of this series, 4–5 on the proximal third of the merus ; the latter is the longest segment, but it is rather curved and appears to be subequal to the ischium. The dactylus of the second maxilliped bears three apical spines, the median being the strongest.




TEXT-FIG. 12.—*Homologenus braueri* Doflein. Male. A. Terminal segments of pereiopod V, to show details of dactylus and propodus. B. Terminal abdominal segment ; × 24. C and D. First and second right pleopods, × 24, with apex of each, × 40.

All seven abdominal segments are distinct in both sexes ; the terminal segment of the male is represented in Text-fig. 12, B ; that of the female is also very similar in shape, though it is much more imbedded in the wide penultimate segment. In both sexes there is a prominent median spine on the second abdominal segment.

The thoracic sternum of the female shows the usual transverse division at the 6/7 suture. In front of this sternites 6–4 form a broad, flat, somewhat concave shield, while sternites 3–1 slope obliquely forwards and upwards. Sternites 7 and 8 are represented in Text-fig. 11 ; sternites 8 are widely separated from each other but are connected anteriorly by a narrow median bridge, which is strongly calcified. The modified part of the 7/8 suture is unusually distinct for a Homolid ; it forms the external part of the spermatheca and is visible under low magnification as a brownish oval patch, with a slit-like opening. Beyond the spermathecal part the 7/8 suture has not been detected, but the bridge is probably formed by both sternites 7 and 8. Sternite 7 is slightly concave laterally, in the neighbourhood of coxa IV, and again medial to the spermathecal part. In the non-ovigerous female a small round body is visible through the chitin when the specimen is examined under good lighting conditions, and this I take to be the spermatophore (or group of spermatophores)—see part II, p. 244 ; its position is indicated by a broken line in Text-fig. 11. In the ovigerous female a small brown body protrudes from the slit of each spermatheca ; this is presumably the empty case of the spermatophore.

The ova, which measure approximately 0·5–0·45 mm. in diameter, number some 120–140.

The copulatory pleopods of the male are as represented in Text-fig. 12, C and D; as far as can be seen without damaging the specimen, the penial projection on coxa V is very short.

## Genus *Latreillia* Roux.

*Latreillia* RATHBUN, 1937, p. 73 (earlier references).

### *Latreillia pennifera* Alcock.

*Latreillia pennifera* ALCOCK, 1901, p. 71, pl. vii, fig. 27.
,, ,, ALCOCK, 1899, p. 168.
,, ,, IHLE, 1913, p. 82.
,, ,, RATHBUN, 1911, p. 196.
,, ,, YOKOYA, 1933, p. 102 (references).

OCCURRENCE :

St. 106. Zanzibar Area. 212 m. 2 ovig. ♀♀ (three of the chelipeds and most of the walking legs missing or incomplete) ; *c.l.* = 8 mm.

RECORDED DISTRIBUTION.—As given in Yokoya's paper, p. 103. Indian Ocean, Phillipines and Japanese waters.

REMARKS.—Stebbing (1903, p. 24, referred to by Ihle, 1913, p. 81) thought it highly probable that *L. pennifera* Alcock from the Indian Ocean and *L. valida* de Haan from Japan would prove to be synonymous with *L. elegans* Roux from the Mediterranean and Atlantic Ocean. Yokoya (1933, p. 102) gives *L. pennifera* as a synonym of *L. valida.*

In the British Museum collection these three species are represented by a total of only 7 specimens, some of which are incomplete. The localities represented are as follows: Mediterranean, 2 specimens, one has been mounted in the Exhibition Gallery, the other, a ♂ *c.l.* = 13 mm., is minus pereiopods V ; off Martha's Vineyard, 1 ♂, *c.l.* = 8 mm ; Mauritius, 1 ♂, *c.l.* = 7·5 mm. ; Macclesfield Bank, 1 ovigerous ♀, *c.l.* = 9·5 mm. ; off Zebu, 1 ovigerous ♀, *c.l.* = 16·5 mm. ; Inland Sea, Japan, 1 ♀, *c.l.* = 10 mm.

These specimens exhibit a good deal of variation. (1) The " supraocular " spine (also referred to as " lateral horn " by Rathbun, 1937, p. 74), when complete, varies greatly in length ; it is longer than (Naples and Martha's Vineyard), four-fifths of (Macclesfield Bank) or half (Zebu and Japan) the length of the slender basal segment of the ocular peduncle. (2) There is a median sharply pointed spine on the proximal third of the " neck" of the cephalothorax (Zebu and Japan) ; this spine is represented by a low mound (Macclesfield Bank), or is absent (Naples, Martha's Vineyard). (3) The dactylus of the third or fourth pereiopod varies considerably in length, being one-third (Japan), one-fourth (Zebu and Macclesfield Bank), or only one-sixth (Naples and Martha's Vineyard) of the length of the propodus. (4) In the reduced pereiopod V, the carpus : propodus ratio is 1·5–1·8 : 1 (Naples, Martha's Vineyard) or approximately 1 : 1 (Zebu, Japan, Macclesfield Bank).

In most of the specimens the two rows of fine setae on the propodus of pereiopod V are present, although the setae vary considerably in length (from $\frac{1}{3}$ to $\frac{1}{7}$ of the length of the segment that bears them); sometimes these setæ have been almost completely rubbed off, though traces of the plume are always present. I am inclined to think that the setæ are longer and more conspicuous in small than in large specimens.

In the "John Murray" specimens the "supraocular" spines are incomplete, but they probably equalled, or exceeded, the basal segment of the ocular peduncle. The propodus of the fifth pereiopod bears a conspicuous plume of long setæ ($\frac{1}{3}$ of the propodus) and is much shorter than the carpus (1 : 1·8). In the latter respect it agrees with the specimens of *L. elegans* from Naples and Martha's Vineyard, and also with Roux's figure of the type of *L. elegans* (Roux, 1828–30, pl. 22). Alcock's figure (1901, pl. vii, fig. 27) shows the carpus and propodus subequal.

The material at my disposal is far too scanty to enable me to form a definite opinion as to the validity, or otherwise, of *L. pennifera* and *L. valida*. It is to be regretted that Yokoya omitted to mention how much variation, if any, was exhibited by his 27 specimens of *L. valida*. Some of the variations mentioned above may depend on the age and the sex of the specimens.

## PART II.

## THE MORPHOLOGY OF THE SPERMATHECA IN CERTAIN DROMIACEA.

INTRODUCTION.—The tribe Dromiacea is usually divided into two sections, referred to as "tribal groups" (Alcock, 1901, p. 29), "sub-tribes" (Calman, 1909, p. 314) or "superfamilies" (Rathbun, 1937, p. 27). The Dromiidea comprises the families Homolodromiidæ Dromiidæ and Dynomenidæ; the Thelxiopidea, better known as the Homolidea, is here regarded as comprising one family, the Thelxiopidæ (= Thelxiopidæ and Latreillidæ of Rathbun, 1937, pp. 62 and 73)—see p. 219. Balss (1927, p. 1013) omits the subdivision and includes the fossil family, Prosoponidæ v. Meyer, 1860, in addition to the four already mentioned.

It has been known for a very long time that in the Dromiidea "the sternum of the female is traversed in more or less of its extent by two obliquely-longitudinal grooves" or furrows (Alcock, 1901, p. 29). These sternal furrows are said to be absent in the Thelxiopidea—see Alcock, 1901, p. 29; Calman, 1909, p. 314; Balss, 1927, pp. 1013–4; and Rathbun, 1937, p. 27. With one exception to be mentioned later, no one has suggested a possible function for these sternal grooves. In the course of revising the Dromiacea in the British Museum collection I paid special attention to the thoracic sternum in the female and found that, although *long* sternal grooves are not present in the Thelxiopidea, they nevertheless possess homologous structures. In *Thelxiope* [= *Homola*] *barbata* a pair of large brownish membranous areas, set obliquely in the posterior third of the plastron of the female, are most striking even to the unaided eye, and yet, as far as I know, they have not hitherto been described or figured (see Text-fig. 19, A). These structures are not found in the male (Text-fig. 19, B) and it seems obvious that part of the plastron of the female is specially modified for some sexual function. In each of the species of

Thelxiopidæ examined there is a distinct difference between the sexes as regards the last two pairs of thoracic sternites although it is more pronounced in some than in others. As far as the material allowed I have examined the external morphology of these structures, which I take to be spermathecæ, and in three species the internal morphology has been studied in considerable detail.

Ihle (1913, pp. 12–18) has discussed the sternal furrows of the Dromiidea at some length and he alone has suggested their probable significance. He says, correctly, that the posterior part of the furrow, which is also present in the male, is the suture between the last two thoracic sternites (7 and 8), but that the anterior part is a new structure, found only in the female. He adds : " Zweifellos dienen die Sternalfurchen sexuellen Zwecken, da sie dieselbe Lage haben wie die ersten Pleopoden des ♂. Bei einem erwachsenen ♀ von *Dromidiopsis cranioides* sah ich, wie in und um den hintern (*sic*) Teilen der Furchen längliche Gebilde festgeklebt waren, welche wir vielleicht als Spermatophoren betrachten dürfen." . . . " Bie einem Exemplar deiser Art [*Dromidia intermedia*] waren die Tuberkeln mit einem braunen Sekretionsproduct bedeckt." The tubercle referred to lies at the extreme anterior end of the sternal furrows which terminate on it, and " hintern," in the first sentence quoted, should read " vordern."

I also arrived independently at the same conclusion as Ihle, having observed, in various species of Dromiidea in the British Museum collection, a tough leathery brown secretion. Sometimes this takes the form of a disc round the anterior end of one sternal furrow only, sometimes there is a long streak or blotch covering the anterior fourth or third of both furrows. Until quite recently I had regarded the sternal furrows as a pair of very simple, purely external, spermathecæ. Now that I have dissected a specimen of *Dromia vulgaris* and examined the internal morphology of these structures (for comparison with those of the Thelxiopidæ) they prove to be much more complex than I had supposed (see p. 247).

Ihle (1913, p. 60) also came very near to the truth in the case of the Thelxiopidea and it is difficult to understand why he just missed it. I therefore quote him at some length : " Während die Furche zwischen dem 7. und 8. Thoracalsterniten ursprünglich (z.B. bei dem ♂ von *Homola* Text-fig. 23, A) nicht unterbrochen ist, finde ich, dass sie bei höher entwickelten Formen (z.B. beim ♀ von *Paromolopsis boasi*) unterbrochen sein kann und dann aus einem medianen und einem gepaarten, lateralen Teil besteht (Text-fig. 23 B,).

" Der laterale Teil dieser Furche, welcher bei den weiblichen Dromiiden jederseits den hintern Teil der Sternalfurche bildet, ist gut entwickelt, sein vorderes (mediales) Ende bleibt weit von der Medianlinie entfernt. Dieses kann etwas verbreitert sein, so dass es sehr gut möghich ist, dass diese Furche auch hier eine Bedeutung im Sexualleben des Tieres besitzt, zumal da bei *Homolomannia sibogæ* und *Latreillopsis multispinosa* der Hinterrand des 7. Thoracalsterniten über das craniale Ende des lateralen Teils der Furche jederseits einen Vorsprung bildet, welcher an der Höcker erinnert, auf welchem die Sternalfurche der Dromiiden endet.

" Der mediane Teil der Furche zwichen dem 7. und 8. Thoracalsterniten verschwindet gänzlich bei dem ♂ und ♀ von *Homologenus*, so dass das 7. und das hier sehr schwach entwickelte 8. Thoracalsterniten nur seitlich getrennt bleiben."

From the above it seems as if Ihle paid too little attention to the differences between the sexes in the species examined. But, from the systematic part of his paper, it is clear that his material was inadequate except in the case of *Homologenus malayensis* Ihle, which was represented by four males and six females. It is rather surprising that he did not select the male and female of this species for his text-fig. 23, A and B; his sketch of *Paromolopsis boasi* Wood-Mason (p. 60, fig. 23, B) is very poor; had he given instead a good detailed figure of the female thoracic sternum of *Homologenus malayensis*, or of *Latreillopsis multispinosa* Ihle, some carcinologist might have been inspired to investigate this subject long ere this (*c.f.* p. 244).

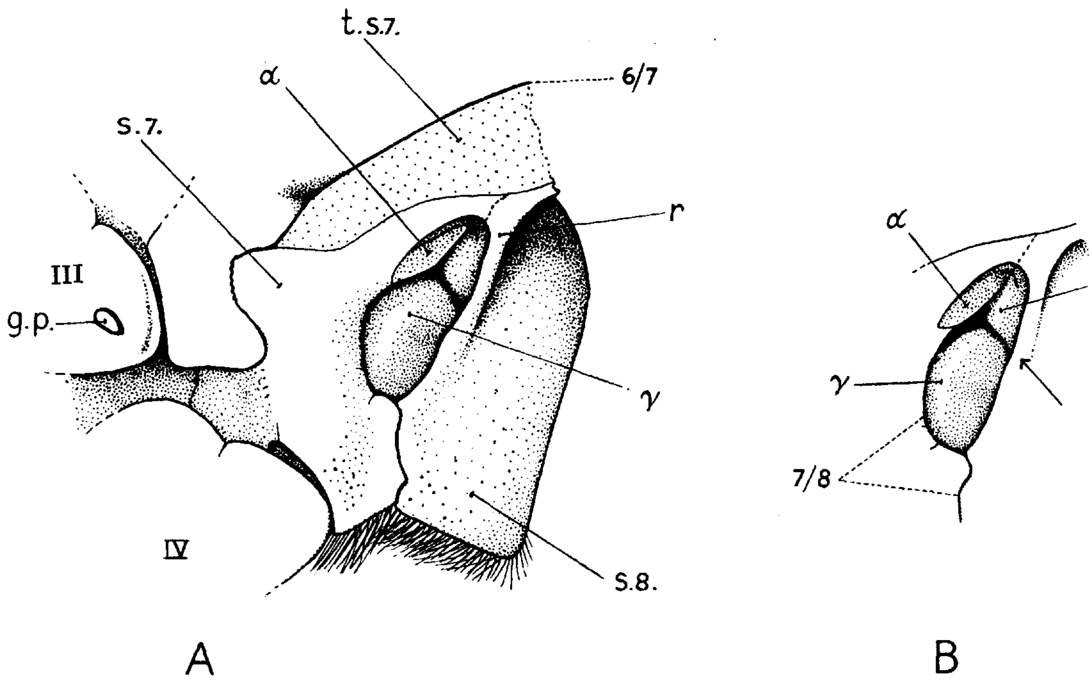
TERMINOLOGY.—The terminology used throughout the following pages is rather similar to that of Ihle (1913), Pearson (1908) and Cochrane (1935). Only the thoracic somites are referred to and they are numbered 1 to 8; No. 1 bears the first maxillipeds, No. 2 the second maxillipeds . . . No. 8 the fifth pereiopods. The correct number of the body somite is obtained by adding 5 somites for the head region; thoracic somites 1 to 8 are thus body somites 6 to 13. To avoid much repetition, the word "thoracic" before "somite" or "sternite" is often omitted *but is always understood.* H. Milne-Edwards (1851, p. 268) introduced a rather cumbersome set of terms which has not been generally accepted; for example, protosomite, deutosomite, meso- or trito-somite, tetartosomite, pemptosomite, hectosomite and hebdosomite are his respective terms for thoracic somites 2 to 8. I differ from Pearson in referring to the endosternites as endosternite 1/2, 2/3, 3/4 . . . instead of simply endosternite 1, 2, 3, . . . This seems more logical, since each is, as explained in the following paragraph, double; the sutures between the somites are usually referred to as 1/2, 2/3, . . . by carcinologists.

### A. Family THELXIOPIDÆ (= HOMOLIDÆ + LATREILLIDÆ).

In the Thelxiopidæ the thoracic sternum or plastron of the female forms a broad shield divided into two parts by the transverse suture between sternites 6 and 7. Sternites 3 to 6 are almost completely fused together to form the anterior two thirds of the shield; traces of some of the sutures are still visible laterally near the points of insertion of the coxæ of the pereiopods (Text-fig. 22, A and B). Sternites 7, fused in the median line, form a wide low arch, which encloses sternites 8; the latter may be completely separated medially by the abdomen, as in *Latreillia valida* (Text-fig. 22, B), or may be in contact anteriorly, as in *Thelxiope barbata* (Text-fig. 19, A and B). In *Latreillia valida* a lateral wing-like outgrowth from the plastron separates the coxa of the third maxilliped from that of pereiopod I, whereas in *Latreillopsis bispinosa* this outgrowth is absent (*cf.* Text-fig. 22, A and B). Part of the sternum around the 7/8 suture is modified to form the external part of the spermatheca. When describing the internal morphology of the spermatheca it will be necessary to mention part of the complex endophragmal system. This system of internal skeletal structures is developed by infoldings of the cuticle known as apodemes or arthrophragms. The apodemes of the sternites are known as endosternites, those of the epimera as endopleurites. Each apodeme is double, *e.g.* the 7/8 endosternite, in which the main part of the spermatheca lies, consists of the posterior infolding of sternite 7 and the anterior infolding of sternite 8 in close contact with each other.

The plastron is, of course, much narrower in the male (*cf.* Text-fig. 19, A and B); the 6/7 suture is distinct throughout its entire length. Sternites 7 form a much higher narrower arch over sternites 8; when the latter are flush with the former, as in *Paromola cuvieri*, the 7/8 suture is clearly visible throughout its extent; when the last pair of sternites are sunk beneath the level of the arch, however, as in *Thelxiope barbata*, much of the 7/8 suture lies in deep shadow when the specimen is examined from the ventral surface (Text-fig. 22, B) In the male the whole surface of sternites 7 is strongly calcified, whereas in the female the antero-median part is usually poorly calcified and more brownish in colour than the well calcified postero-lateral parts (Text-figs. 13, A, and 16, A).

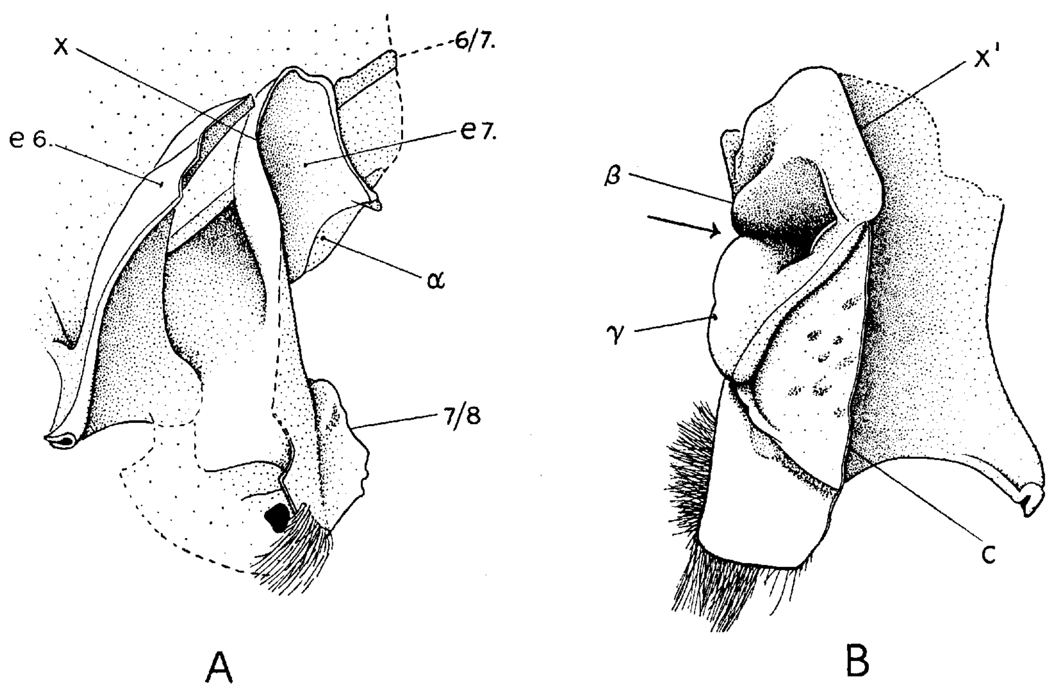
1. *Paromola alcocki* (Stebbing) (Text-figs. 13–15 ; Pl. I, fig. A). A female specimen in the B.M. collection (reg. no. 1928.12.1.240) *c.l.* = 59 mm., from off the Umvoti River, Natal, was badly damaged. The detached carapace is complete, but since the rest of the thorax was already broken in two down the median line, the specimen was used to study the internal morphology of the spermatheca in detail.




TEXT-FIG. 13.—*Paromola alcocki* (Stebbing). Female, *c.l.* = 59 mm. Natal. A. Right thoracic sternites 6–8 with the proximal parts of coxæ III and IV, to show external morphology of the spermatheca. B. Spermatheca, tilted to show the opening ; × 5. α, Thin membranous lobe on sternite 7 ; β + γ, the rather membranous modified parts of sternite 8 ; *g.p.*, genital opening ; *s.*7, strongly calcified postero-lateral, and *t.s.*7, thinly calcified brownish parts of sternite 7 ; *r.*, strong ridge on sternite 8 ; 6/7 and 7/8, the sutures between sternites 6 and 7 and 7 and 8 respectively.

Text-fig. 13, A, represents the right thoracic sternites 6, 7 and 8, together with the proximal portion of the coxa of pereiopod III and IV respectively. The 6/7 suture, which is distinctly seen, originates slightly posterior to the genital pore. The thinly calcified antero-median part of sternite 7 is darker in colour than, and thus quite distinct from, the postero-lateral part (Text-fig. 13, A, *t.s.* 7 and *s.*7). The external part of the spermatheca is a conspicuous, poorly calcified area on a level with the genital opening and easily seen with the unaided eye. This rather membranous area consists of three parts, α, β, and γ, the two latter are continuous though separated by a depression or groove which leads to the opening situated beneath α. When the specimen is tilted somewhat as in Text-fig. 13, B, a short, wide, slit-like opening is clearly seen (represented in black in the figure). This special spermathecal structure is a modification of parts of the sternites on either side of the 7/8 suture. Until the specimen was dissected it was impossible to say whether the 7/8 suture followed the outer or the inner side of γ, although it is reasonable to assume that it should lie on the same side as the opening. The 7/8 suture is not at all clear in front of the spermatheca, but it appears to follow the course indicated by the broken line. A strongly calcified ridge *r* on sternite 8 reinforces the antero-median border of the spermatheca.

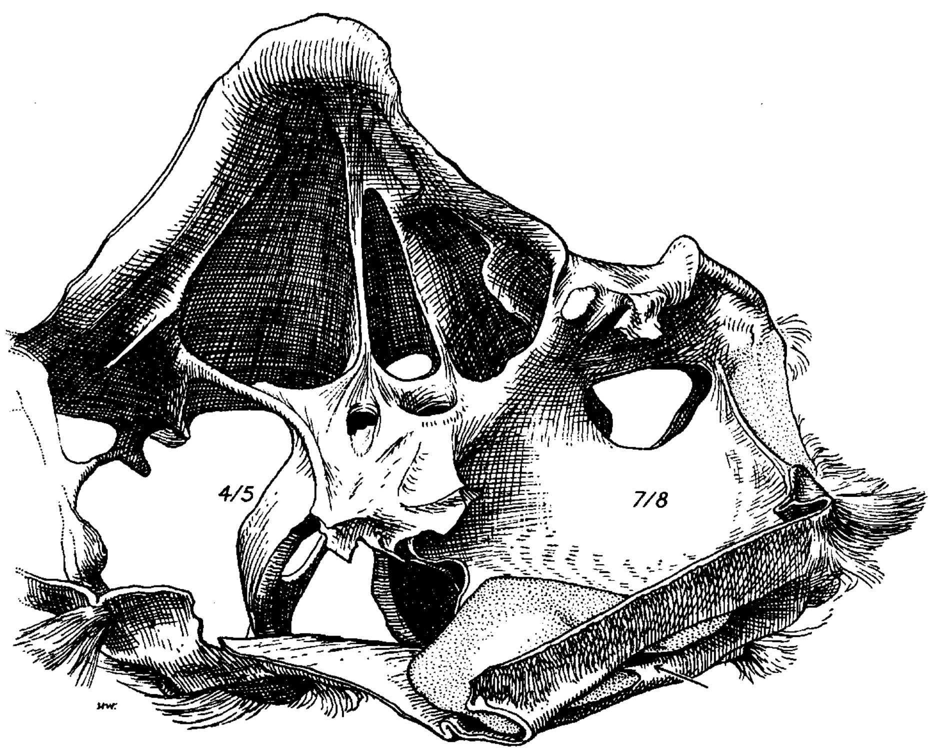
The left half of the specimen was dissected, but I inadvertently cut away too much of the 7/8 endosternite and the two halves of the spermatheca fell apart. They are represented in Text-fig. 14, A and B, from the inside. The membranous lobe α belongs to sternite




TEXT-FIG. 14.—*Paromola alcocki* (Stebbing). Same specimen as in Text-fig. 11. A. Left thoracic sternites 6 and 7, and B, left sternite 8, viewed from the inside, to show details of internal morphology of spermatheca ; × 5. *e*.6 and *e*.7, Endosternites 6 and 7 respectively ; the cut edges *x* and *x'* coincide when the two halves are fitted together. Other lettering as in previous figure.

7, while β + γ belong to somite 8 ; a thin membranous hinge connects α anteriorly with β. The 7/8 suture thus follows the course indicated by the two guide lines in Text-fig. 13, B. The main part of the spermatheca belongs to the last thoracic somite, being in reality a special modification of the antero-ventral corner of the endosternal wall and of the adjacent part of the sternite (it is impossible to say where the sternite ends and the infolding or endosternal wall begins). Immediately posterior to γ are two rounded, strongly calcified white beads, which fit into depressions on endosternite 7 and serve to hinge the two halves of endosternite 7/8 posteriorly. The groove between β and γ leads into a small rather deep pit, where the spermatophores are presumably deposited at the time of copulation. The pit was empty in this specimen (see p. 244). The antero-lateral wall immediately above the pit is exceedingly thin and membranous, the rest of the structure is fairly compact though much less calcified and thinner than the sternite. The rest of the endosternal wall posterior to the spermathecal part is thin and poorly calcified.

Text-fig. 14, A, represents the left sternites 6 and 7 from the inner surface. The membranous lobe α is clearly visible and the small tag at its anterior end is part of its connection with β. The antero-ventral part of endosternite 7 forms a firm hood-like bulge into which the spermathecal part of somite 8 fits, so that the cut margins $x$ and $x^1$ coincide. Endosternite 7 thus roofs over the pit, which is connected to the exterior only by the slit-like opening beneath α. Medial to the hood of the spermatheca, suture 6/7 is seen as a brownish ridge. Only the proximal part of endosternite 6/7 is represented, the distal part having been removed to expose the modified part of endosternite 7/8.

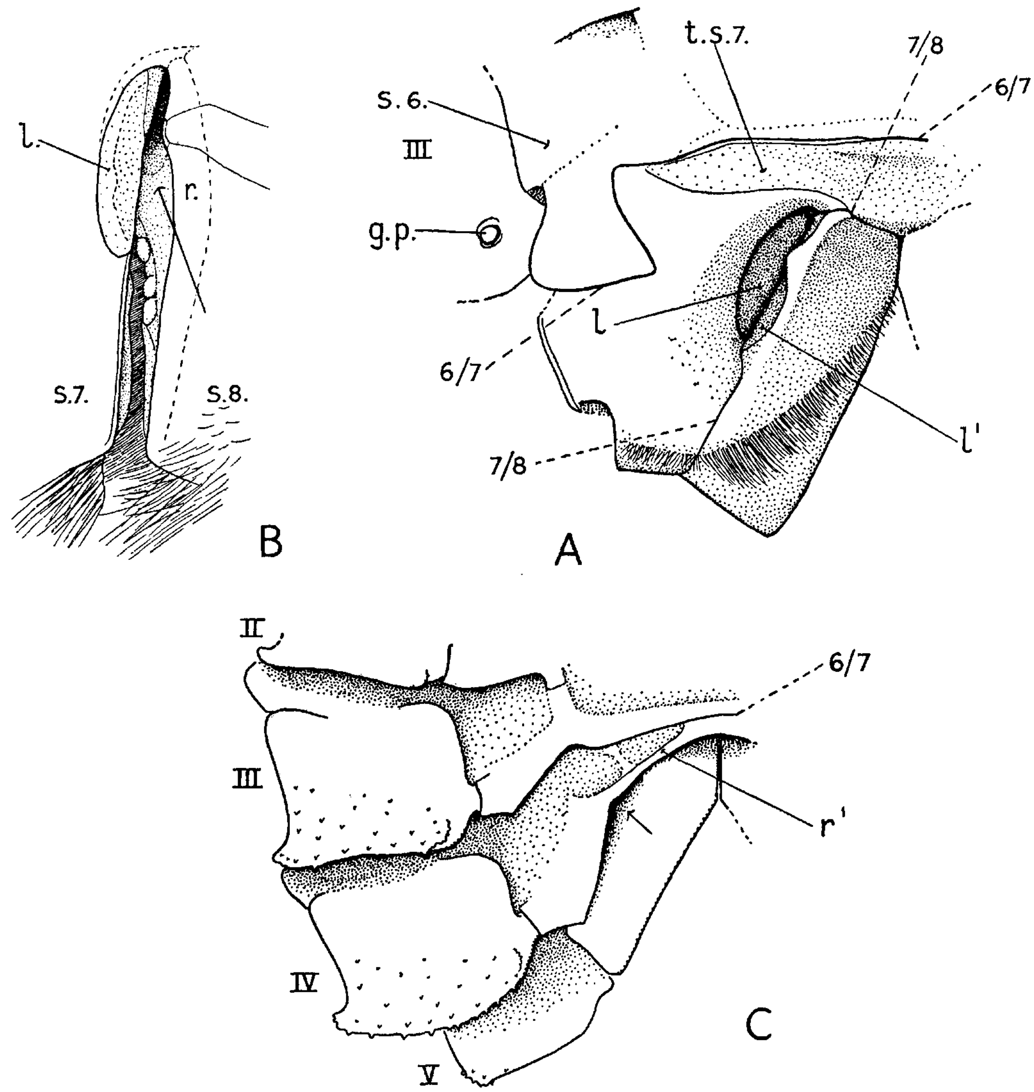



TEXT-FIG. 15.—*Paromola alcocki* (Stebbing). Female from Natal. Posterior part of endophragmal skeleton of right side, in medial aspect; × 4·5. 4/5, Endosternite 4/5 ; 7/8, endosternite 7/8, with antero-ventral corner modified to form spermatheca. The arrow indicates groove leading to spermathecal opening and pit.

The right half of this same specimen was dissected so that the endophragmal skeleton remained intact; all the muscles were removed and a photograph was taken as a record (Pl. I, fig. C). The single endosternal ingrowth from the postero-median margin of sternite 8 was then partially cut away, in order to expose the greater part of endosternite 7/8. From the finished dissection the artist prepared the careful drawing reproduced as Text-fig. 15. The modified antero-ventral corner of endosternite 7/8—the part belonging to somite 8 seen from the outer surface—is soft and membranous and no muscle bands are attached to it (see p. 237).

2. *Paromola cuvieri* (Risso) (Text-fig. 16, A–B ; 17). The figure of the posterior part of the plastron of the female given by Bouvier (1940, fig. 137, p. 191) is not very good—at least in none of the specimens in the B.M. collection is the 7/8 suture similar to his sketch.

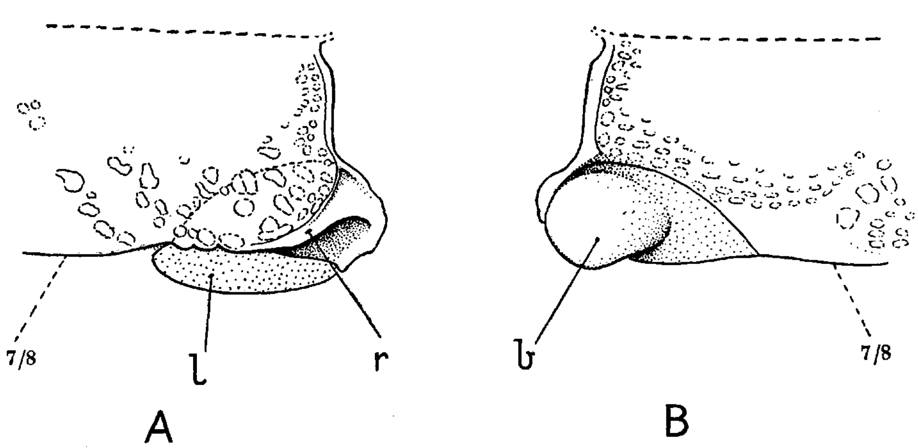
Text-fig. 16, A, represents the right sternites 6, 7 and 8 of an ovigerous female from Naples (reg. no. 98.5.7.902, *c.l.* = 86 mm.), together with the proximal portion of the coxa of pereiopod III to show the position of the genital pore. The 6/7 suture is trans-




TEXT-FIG. 16.—*Paromola cuvieri* (Risso). A. Right thoracic sternites 6–8 of an ovigerous female, *c.l.* = 86 mm., with proximal part of coxa III; × 3. B. Right sternites 7 and 8 of a larger non-ovigerous female, in the region of the 7/8 suture, eased apart to show details in the spermathecal area; × 3. C. *Paromolopsis boasi* Wood-Mason. Immature female, *c.l.* = 12 mm.; right thoracic sternites 5–8 with coxæ II–V; × 14. *g.p.*, Genital opening; *l.*, thin, rather membranous part of sternite 7; *l'.*, brownish rather membranous part of sternite 8 sloping obliquely towards the suture; *r.*, ridge on sternite 8; *r'.*, ridge on sternite 7; *s.6*, *s.7*, *s.8* = thoracic sternites 6–8 respectively; *t.s.7*, thinly calcified antero-median part of sternite 7; 6/7 and 7/8, sutures.

verse throughout most of its course, but bends sharply backwards and slightly inwards in the neighbourhood of pereiopod III. As in *P. alcocki*, the antero-median thinly calcified part (*t.s.7*) is darker in colour than the stronger postero-lateral part (*s.7*) of sternite 7 The 7/8 suture is distinct throughout its course. The external part of the spermatheca is relatively smaller and firmer (*i.e.* less membranous) than in *P. alcocki* (*cf.* Text-figs. 13, A, and 16, A). The wider arc-shaped brownish area *l* belongs to sternite 7, while the narrow oblique brownish marginal area $l^1$ belongs to sternite 8 and is partially concealed by a bulge on the strong reinforcing ridge (shown in white in Text-fig. 16, A).

A larger non-ovigerous female from 130 fm. off the S.W. corner of Ireland (reg. no. 1948.III.19.4, *c.l.* = 100 mm.) was so badly damaged that the left spermatheca was destroyed. That on the right side, which was almost complete, was dissected out and all the soft tissues were removed. Again the pit proved to be empty ; the specimen was much overgrown with *Anomia* and large Serpulids and so presumably had not moulted for some considerable time prior to its capture.* Sternites 7 and 8 were carefully eased apart along the 7/8 suture to the anterior end of the spermatheca, so that the proximal (ventral) parts of the endosternal walls could be seen (Text-fig. 16, B). That arising from sternite 8 bulges outwards (*i.e.* towards sternite 7) and is visible throughout its entire length ; the pit is situated at the extreme anterior end of the spermatheca. Posterior to the modified spermathecal part is a rim beset with 1 + 2 white hard beads which serve to interlock the two halves of endosternite 7/8. Only the posterior part of the endosternal wall arising from sternite 7 is visible (the line-shaded area represents the gap between the two somites).

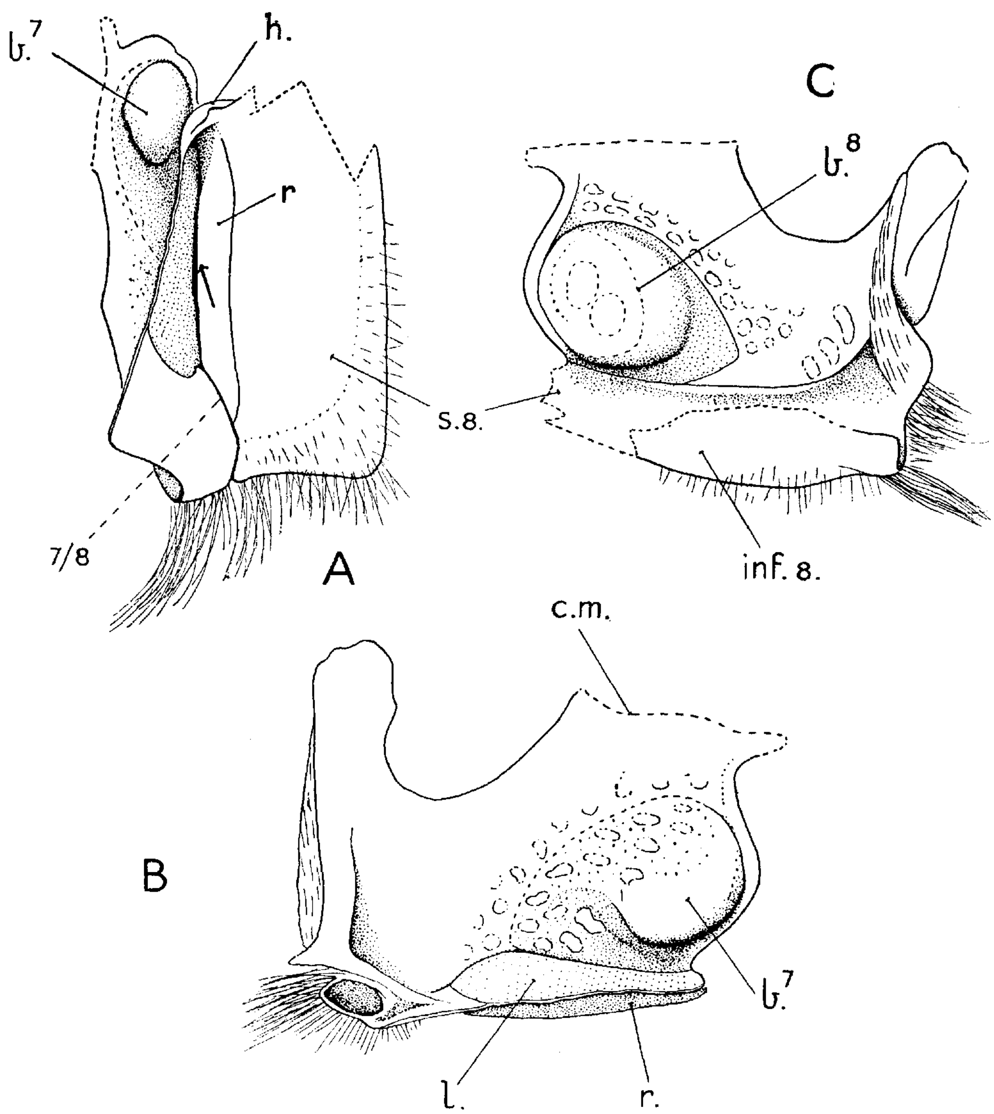



TEXT-FIG. 17.—*Paromola cuvieri* (Risso).—Female, *c.l.* = 100 mm. A. Endosternal wall arising from sternite 7, and B. Endosternal wall arising from sternite 8, viewed face on to show spermathecal parts. *l.*, Thin membranous part of sternite 7 ; *b.*, spermathecal bulge on antero-ventral corner of endosternite 8, which contains the pit or pocket ; *r.*, strong ridge on the spermathecal bulge on endosternite 7 ; 7/8 indicates the position of the 7/8 suture. × 3.

In this species there is a distinct boss or bulge near the anterior end of the ridge on sternite 8 (Text fig. 16, A). Presumably the male intromittent organ is inserted behind the boss which serves to guide it into the pit. In the older female this boss is much less evident, but it shows signs of an old injury and two faint superficial cracks radiate inwards from it towards the median line (Text-fig. 16, B). In this female also, the spermathecal margin of sternite 8 is strongly calcified throughout so that there is no trace of the brownish

* The *Anomia* would have taken some 5–6 months to reach this size, according to my colleague, Dr. Rees.

area $l'$ (*cf.* Text-fig. 16,A and B). This is probably a matter of age or of the length of time that has elapsed since the last moult. The smaller specimen bears numerous but very small, thin, Serpulid tubes, indicating a more recent moult.




TEXT-FIG. 18.—*Homolochunia valdiviæ* Doflein. Female, "J.M." St. 108. A, B and C. Right thoracic sternites 7 and 8 (incomplete), with the ventral part of endosternite 7/8, from three different aspects, to show morphology of the spermatheca. × 7. $b^7$ and $b^8$., The spermathecal swellings or bulges on endosternite 7/8 ; *c.m.*, cut margin of endosternite 7/8 ; *h.*, membranous hinge or connection between sternites 7 and 8 ; *l.*, thin membranous part of sternite 7 ; *r.*, strong oblique ridge on sternite 8 ; *s.*8, sternite 8 ; 7/8, suture between sternites 7 and 8 ; *inf.*, single medial infolding of sternite 8.

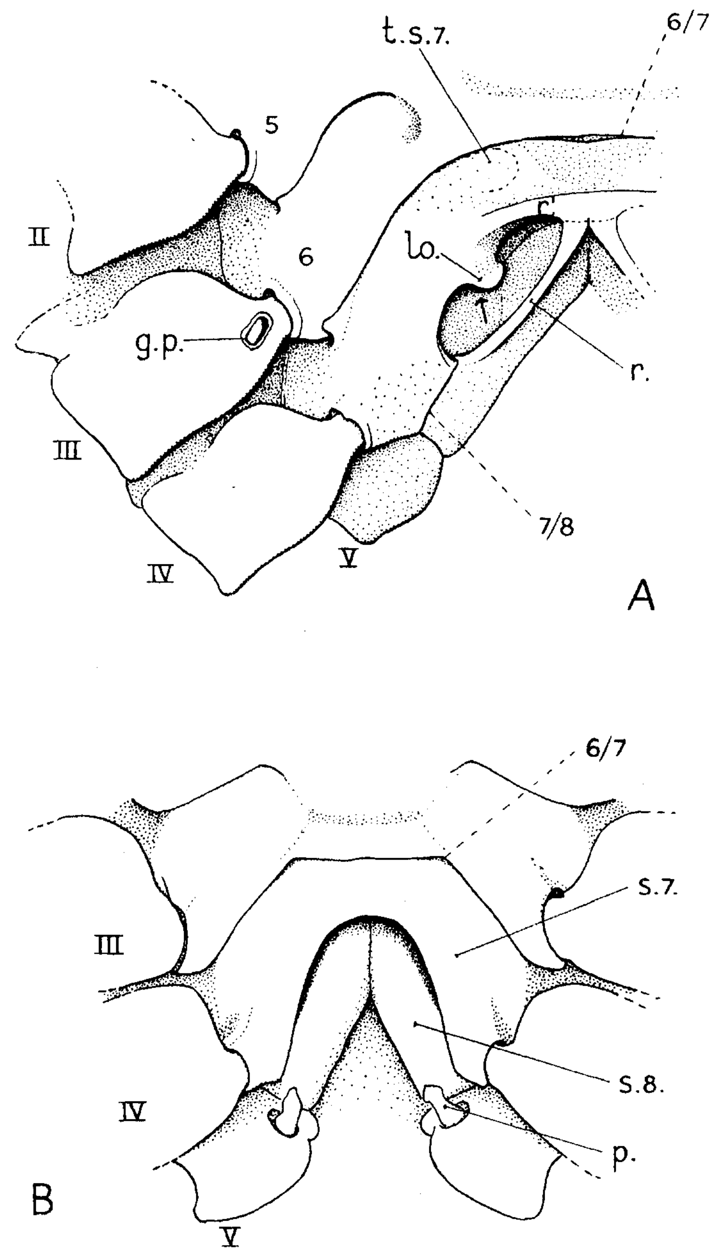
Viewed from the inside (Text-figs. 17, A and B) the spermatheca forms a conspicuous bulge in the antero-ventral corner of the endosternite. The main bulge on the endosternal wall arising from sternite 8, which contains the pit, is rather softer than the rest of the apodeme as in *P. alcocki* (Text-fig. 16, B) That on the endosternal wall arising from endosternite 7 projects in the opposite direction, is firmer walled and reinforced ventrally by a strong ridge *r* which conceals the anterior part of the modified area *l* (Text-fig. 16, A). One function of each apodeme is to serve as points of attachment for the muscles. In the figures these points of insertion of muscle-bands are only indicated on or near the spermatheca to show that none are attached to the soft-walled part on somite 8, whereas a few are attached to the upper (distal) part of the firmer bulge on somite 7.

A dry male specimen in the B.M. collection (Azores ; reg. no. 55.68) had the carapace detached from the rest of the body. Very little dissection was required to expose the 7/8 endosternite which, as was to be expected, shows no trace of special modification ; it is just a thin double septum throughout like all those in front of it.

3. *Homolochunia valdiviæ* Doflein (Text-fig. 18). This is the only other species of the Thelxiopidæ in which the spermatheca was dissected out, the female from " John Murray " Station 108 being already somewhat damaged on the right side.

Externally the spermatheca on the left side is complete and very similar to, though much longer than, that of *P. cuvieri* (*cf.* Text-figs. 16, A, and 18, A)—*i.e.* a greater part of the 7/8 suture is involved. The large, brownish, membranous part *l* belongs to sternite 7 ; the long slit-like opening is close to the strong obliquely sloping ridge *r* on sternite 8, which in this species has no boss. Text-fig. 18, A, represents the right spermatheca after all the soft tissues have been removed ; broken or cut edges are represented by broken lines with the exception of that of sternite 7, which is shown as a double line. Here sternites 7 and 8 are viewed from the ventral surface, so that endosternite 7/8, which is not quite perpendicular to the sternum, is foreshortened. The endosternal wall or septum thus seen is the infolding of sternite 7 ; it is also viewed face on in Text-fig. 18, B, while its partner, the infolding of sternite 8, is represented face on in Text-fig. 18, C. Again the modified spermathecal area forms a conspicuous antero-ventral bulge on both sides of endosternite 7/8. The outer spermathecal wall of somite 8 is much softer in texture than the rest of the septum and no muscles are attached to it (Text-fig. 18, C). In this dissection part of the outer surface of the wall happens to be missing within the dotted line on which the guide line $b^8$ ends and one or two rounded bodies are visible through the remaining thin membrane. These may be spermatophores. The boundary or limit of the spermatheca is indicated by a broken line in Text-fig. 18, A and B, because on this side the modified area has the same texture as, and merges imperceptibly into, the rest of the septum ; part also serves for the attachment of muscles. The bulge is situated in the extreme antero-ventral corner and thus lies mostly in front of the external membranous area *l*.

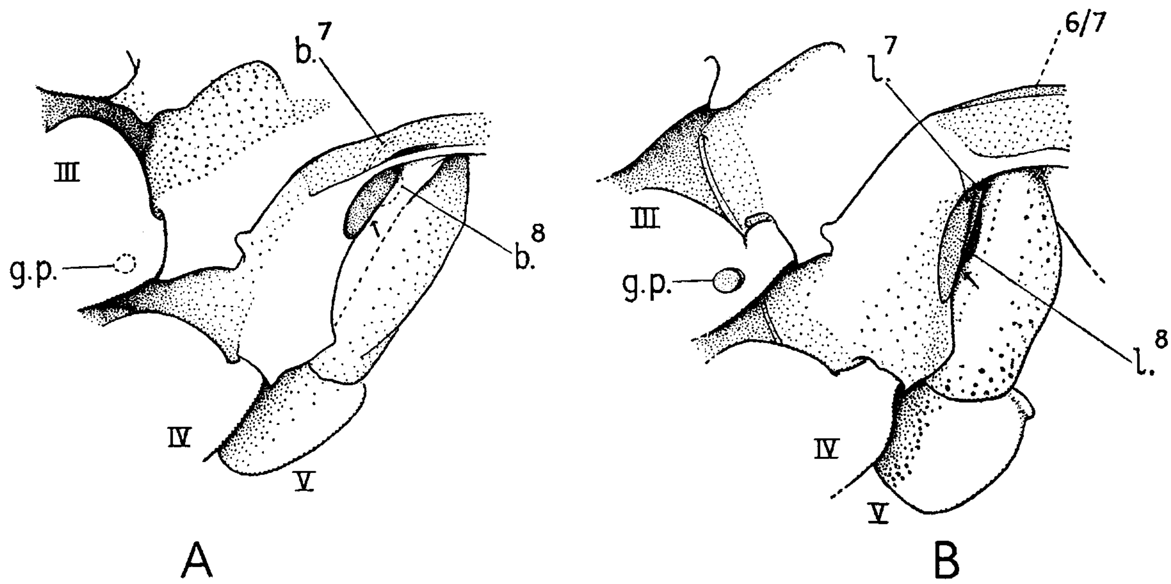
4. *Thelxiope barbata* (Herbst) (Text-fig. 19). Here the spermatheca is more conspicuous externally than in any of the Thelxiopidæ examined. Text-fig. 19, A, represents the right thoracic sternites 5–8, together with the coxæ of pereiopods II–V. The 5/6 suture is visible laterally, near coxa II, but fades out medially. The large brownish membranous area belongs for the most part to sternite 8 and is supported medially by the usual strong ridge *r* and anteriorly by a similar ridge $r^1$ on sternite 7. The short slit-like opening to the spermatheca (indicated by the arrow) is protected and concealed by a strong rounded lobule *lo* on the inner border of sternite 7. Presumably this lobule serves to guide the male copulatory pleopod into the opening. In front of this lobule a thin membranous hinge unites sternite 7 to the membranous part of sternite 8. The difference between the sexes, as regards the posterior third of the sternum, is most marked




TEXT-FIG. 19.—*Thelxiope barbata* (Herbst). A. Right thoracic sternites 5–8 with coxæ II–V of female, *c.l.* = 21 mm., from Madeira, reg. no. 1939.6.15.4 ; × 9. B. Posterior part of sternum of a male, *c.l.* = 14 mm., from Madeira, reg. no. 1939.6.15.5 ; × 12. *g.p.*, Genital opening ; *lo.*, strongly calcified lobe on postero-medial margin of sternite 7, which protects the spermathecal opening ; *p.*, penis or external part of sperm duct ; *r.*, strong ridge on sternite 8 supporting the membranous outer part of spermatheca ; $r^1$., strong ridge on sternite 7 ; *s.*8, sternite 8 ; *t.s.*7, thin brownish antero-median part of sternite 7 of female. (This guide line ends on a slightly raised mound beneath which lies the internal part of the spermatheca.)

in this species (*cf.* Text-fig. 19, A and B). As already mentioned, in the male sternites 8 are sunk beneath the level of sternites 7 and the greater part of the 7/8 suture lies in shadow.

5. *Thelxiope orientalis* (Henderson) (Text-fig. 20, B). On comparing the spermatheca of a slightly immature syntype from Zebu with that of a smallish female of *Th. barbata* from Dry Tortugas (reg. no. 1938.3.19.125, *c.l.* = 16 mm.) it proves to be quite distinct. In the latter specimen, in which the genital pores are visible and perforate, the external part of the spermatheca is conspicuous and exactly as in the larger specimen just described (Text-fig. 19, A). In *Th. orientalis* the spermatheca is as represented in Text-fig. 20, B, where it is seen face on, the specimen being slightly tilted to one side; in *Th. barbata* no sideways tilting of the specimen is necessary, the spermatheca being clearly seen when the abdomen is lifted back. The membranous part in *barbata* belongs to sternite 8 and is much darker brown than the surrounding parts of the sternum. In *orientalis* the rather

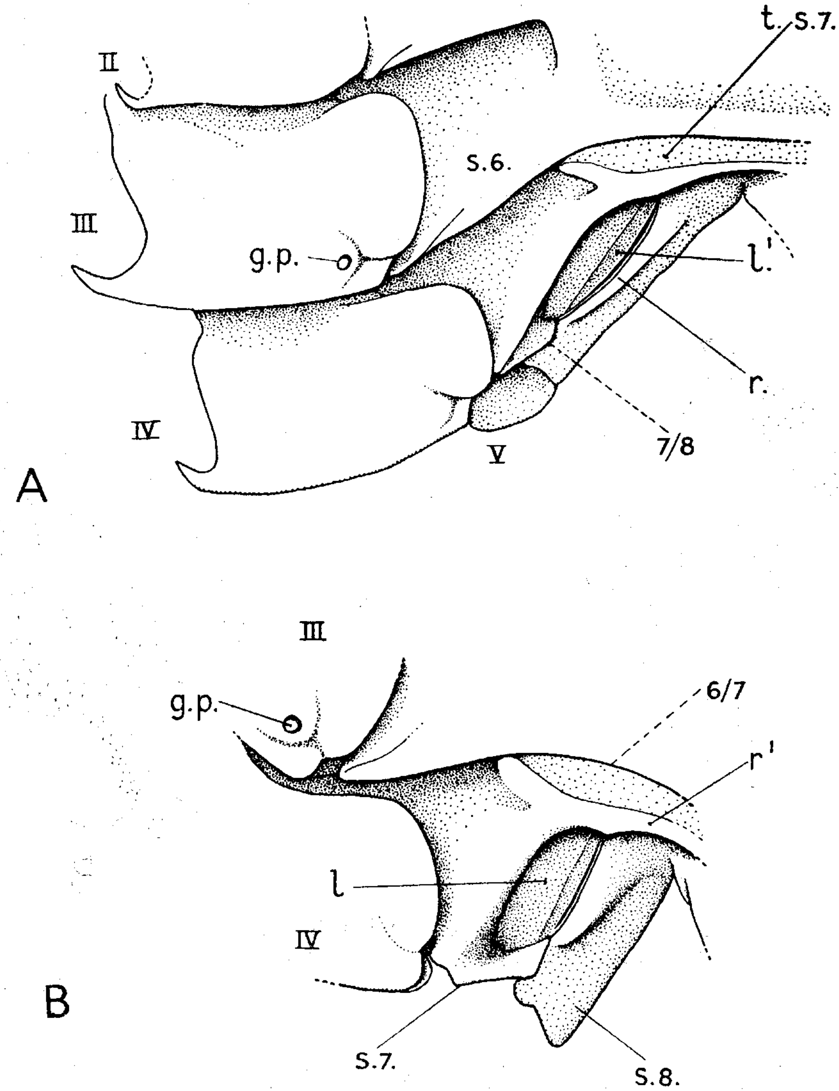



TEXT-FIG. 20.—Right thoracic sternites 6–8 with proximal parts of coxæ III and IV and coxa V of: A. *Thelxiope* (*Homolax*) *megalops* (Alcock). Female. " J. M." St. 35. *c.l.* = 19·5 mm. × 8. B. *Thelxiope orientalis* (Henderson). Female syntype 88.33. *c.l.* = 18 mm., including rostrum. × 10.

membranous area is not so distinct, being paler in colour and more oblique; moreover, it belongs to sternite 7 and, as in *Hypsophrys longipes*, a narrow strip along the median edge is thinner than the rest (Text-fig. 20, B, $l.^7$). This thin flap rests on the oblique outer edge of sternite 8, so as partially to conceal the modified portion of the latter (the guide line $l^8$ ends on the rim of this modified part of sternite 8), as well as the long slit-like opening to the spermatheca. The ridge on sternite 8 is as yet not very well marked. Ovigerous females of *Th. orientalis* were included in the Australian material examined by Rathbun (1923, p. 143), and it would be interesting to know what the fully formed spermatheca is like. Nothing is known of the early development of the spermatheca in *Th. barbata*, but it is unlikely that it would ever pass through a phase similar to that of *Th. orientalis*. Henderson was therefore correct in describing his species as distinct.

6. *Thelxiope* (*Homolax*) *megalops* (Alcock) (Text-fig. 20, A). In this species the spermatheca is much smaller than in either *orientalis* or *barbata*, but it may not be quite fully

developed. Less than half of the 7/8 suture is involved, and the membranous part belongs to sternite 7 ; the ridge on sternite 8 is fairly distinct, but no part of this sternite seems to be specially modified (*i.e.* membranous) externally. The sternum is so poorly calcified that the lateral parts of sternites 6 and 7 are quite thin, and the spermathecal bulge on

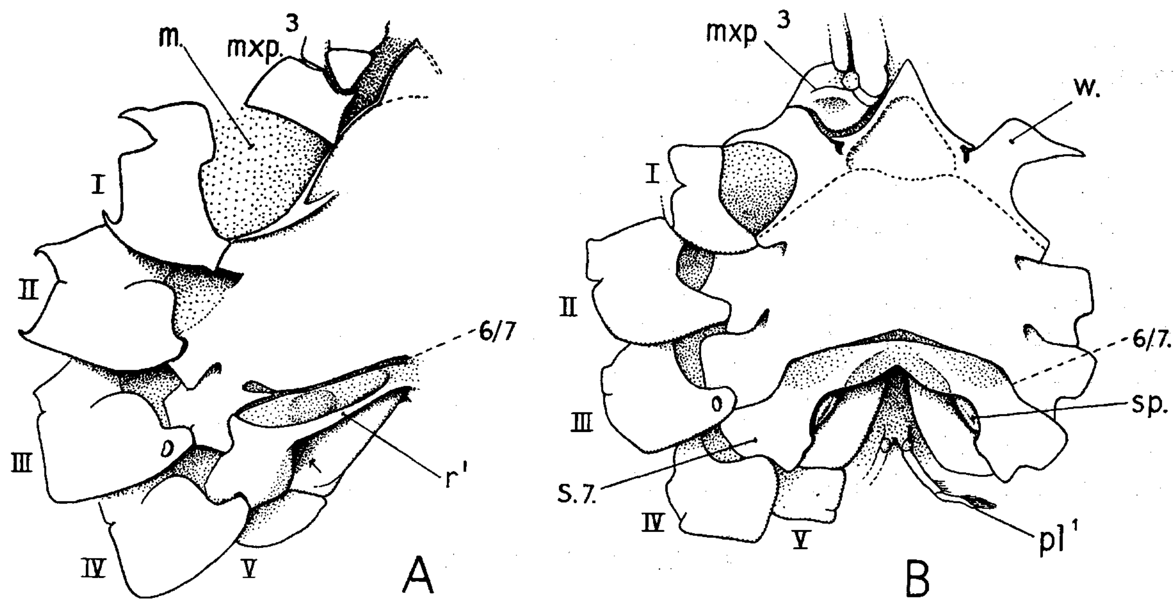



TEXT-FIG. 21.—*Hypsophrys longipes* Alcock and Anderson. Syntype, *c.l.* = 22 mm. A. Right thoracic sternites 5–8 with coxæ II–V, to show external part of spermatheca in its natural oblique position. B. Part of same, tilted to show the spermatheca face on. Both × 8. *g.p.*, Genital opening ; *l.*, the rather opaque, and $l^{1}$., the transparent, part of the spermathecal membranous area ; *r.*, strong ridge on sternite 8 ; $r^{1}$., strong ridge on sternite 7 ; *s.*7 and *s.*8, sternites 7 and 8 respectively ; *t.s.*7, thinly calcified brownish part of sternite 7 ; 6/7 and 7/8, sutures between sternites 6 and 7, 7 and 8.

either side of endosternite 7/8 is visible through the ventral surface (Text-fig. 20, A, $b.^{7}$ and $b.^{8}$). The slit-like opening is indicated by the arrow in Text-fig. 20, A (as also in Text-fig. 20, E).

7. *Hypsophrys longipes* Alcock and Anderson, (Text-fig. 21, syntype, reg. no· 99.I. 20.14, *c.l.* 22 mm. from Travancore). The thinly calcified antero-median part of sternite

7 (*t.s.* 7) is here very distinct, since there is a strong ridge $r^1$ (Text-fig 21, B) immediately behind it. The membranous spermathecal area, though large, is less conspicuous than that of *T. barbata* owing to the fact that the sternal wall slopes obliquely inwards and upwards medial to the ridge $r^1$ (Text-fig. 21, A). When the specimen is tilted to show the spermatheca face on, as in Text-fig. 21, B, the membrane is seen as a large sub-rectangular area incorporating the greater part of the 7/8 suture ; it appears to be divided into two parts, the inner fourth $l^1$ being thinner and darker in colour than the rest. The long slit-like opening is situated very near to the ridge *r* on sternite 8, and the thin part of the membrane rests on the oblique infolded margin of 8. From the medial position of the slit it is clear that the membranous part belongs to sternite 7. The antero-median part of the 7/8 suture—beyond the spermatheca—is presumably concealed by the ridge $r^1$.




TEXT-FIG. 22.—A. *Latreillopsis bispinosa* Hend. Female holotype from off Zebu. *c.l.* = 14 mm., reg. no. 88.33. Right half of thoracic sternum, with the proximal part of maxilliped 3 and coxæ I–V. B. *Latreilla valida* de Haan. Female from off Zebu. *c.l.* = 18·7 mm., reg. no. 88.33. Thoracic sternum or plastron, with the proximal part of maxilliped 3 and coxæ of pereiopods I–V. Both × 6. *m.*, Membrane at base of cheliped ; *mxp.*, maxilliped 3 ; *pl.*[1], first pleopod ; $r^1$., strong ridge on sternite 7 ; *s.*7, sternite 7 ; 6/7 = suture between sternites 6 and 7 ; *sp.*, external part of spermatheca ; *w.*, wing-like expansion of sternum. The broken line indicates a row of fine setæ.

The spermathecæ described so far have all been very similar although the external membranous part may belong either to sternite 7 (*Homolochunia*, *Hypsophrys*) or to sternite 8 (*Thelxiope*) or partly to both (*Paromola alcocki* and the smaller ♀ of *P. cuvieri*). There are, however, certain species in which sternites 8 are sunk below the level of sternites 7 in such a way as to conceal or obscure the spermathecæ (Text-figs. 22, A and B, and 16, C).

8. *Latreillia valida* de Haan (Text-fig. 22, B). Here the spermatheca is set obliquely and is partially concealed by sternites 7. It can be detected when the specimen is moved about under proper lighting conditions under a low power binocular microscope. The details, however, cannot be ascertained without dissection and the available material is insufficient for this.

9. *Latreillopsis bispinosus* Henderson. In this species the ridge $r^1$ on sternite 7 is well developed and the spermatheca can be seen only with difficulty, since it appears to be even more oblique than that of *L. valida.* But an oval body is visible through the thinly calcified antero-median portion of sternite 7. In Text-fig. 22, A, this is indicated though it is perhaps a trifle too near the median line. One female from Cape Natal (Stebbing coll., reg. no. 1928.xii.1, 239, *c.l.* = 11 mm.*) had the sternum rather damaged on the right side. The pocket underneath was found to contain a brownish mass, which was easily removed with a needle. On teasing the mass slightly with a needle, it was seen to be composed of 2 groups each of 4 closely packed ovoid bodies, resembling nutlets in a fruit. A slide was prepared of the contents of one of these bodies and, under a high-power objective, numerous tiny round or disc-shaped bodies, each with 4 (or occasionally 3) rather long rays or flagella, are visible ; these are certainly spermatozoa.

10. *Latreillopsis laciniata* Sakai (1936, p. 54, pl. 2, fig. 3 ; text-fig. 12). An ovigerous female from macclesfield Bank (B.M. coll., 92.8.28.316, *c.l.* = 13 mm.) is referable to this species. The right spermatheca is as represented in Text-fig. 26, A ; the opening lies in deep shadow beneath the projecting rim of sternite 7.

11. *Paromolopsis boasi* Wood-Mason (Text-fig. 16, C). The only available specimen is an immature female from " Investigator " St. 197, 406 fm., reg. no. 1911.1.17.40, *c.l.* 12 mm.* The genital pore on coxa III is not yet formed and the spermatheca, which should lie beneath the ridge on sternite 7 at the point indicated by the arrow may not be fully developed but the 7/8 suture is distinctly widened in this part. This immature sternum is rather reminiscent of that of the male of *Thelxiope* (*cf.* Text-fig. 16, C, and 19, B). It was because I considered Ihle's choice, for his text-fig. 23, B, of a specimen in which the spermatheca is oblique and hidden beneath a ridge, very unfortunate that I made the remark on p. 232, " had he given a good, detailed figure . . . ."

## B. Family DROMIIDÆ.

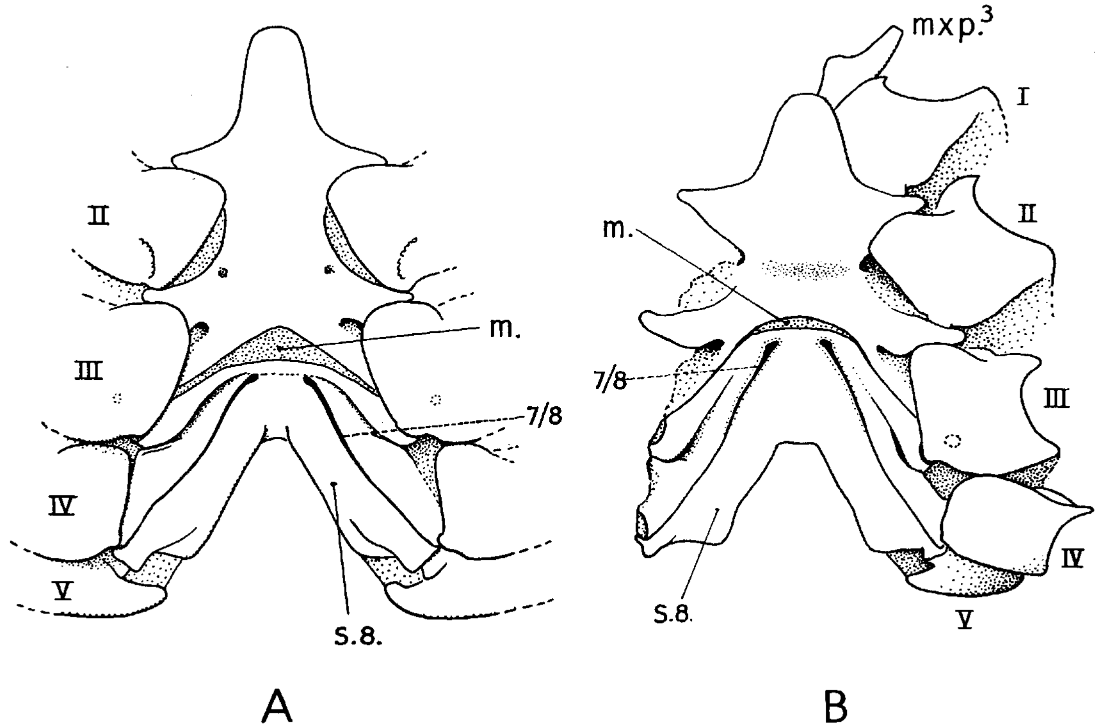
I have examined *Dromia vulgaris* H. M.-Edwards (Text-figs. 23–26 ; Pl. I, fig. B) for comparison with the Thelxiopidæ. I had hoped to obtain at least one male and one female specimen during a recent visit to the M.B.A. Laboratory at Plymouth, but was informed that the species is so rare that, over a period of 40 years, only three ♀♀ have been obtained (' Plymouth Marine Fauna,' 2nd edition, 1931, p. 214). I had, therefore, to do the best I could with the rather scanty preserved material in the British Museum collection.

In the adult female the sternal furrows end widely apart, each on a low mound situated opposite the centre of coxa II and mid-way between the two lateral wing-like outgrowths of the sternum (Text-fig. 24, A). They are forward prolongations and modifications of the 7/8 suture, as a brief study of their development shows, and the whole of the modified part lies in front of the genital pores. This only refers to the external furrow, not to the internal structures described later on. Ihle was the first to suggest that they must have a special sexual function—see *ante* p. 231. In a female from Naples (*c.l.* = 65 mm., reg. no. Norman Colln., 98.5.7.261–2) there is a dark brown oval disc, approximately 11 mm. long by 7·5 mm. wide, glued to the sternum around the anterior end of the left furrow, covering the mound and extending a trifle beyond it anteriorly. A small part of this disc is missing, but I may have removed it when I examined the specimen some years

* The rostral spine is included in the carapace length, unless otherwise stated.

ago. At that time I regarded the sternal furrows as simple external spermathecæ and thought that the male secretion was simply poured in and around the anterior end of the furrow and hardened to form this leathery blotch.

Text-fig. 23, A, represents the sternum of the youngest female in the B.M. collection, together with portions of coxæ II–V ; all setæ have been omitted. The specimen measures only 6·3 mm. in carapace length (Mediterranean, reg. no. 50.8). The genital pores are naturally not yet perforate, though their positions are indicated by slight thinnings in the chitin. The sternum is narrow, as in the adult male, but, unlike that of the adult, it is divided into two parts by a transverse membranous arch between coxæ III, which doubtless

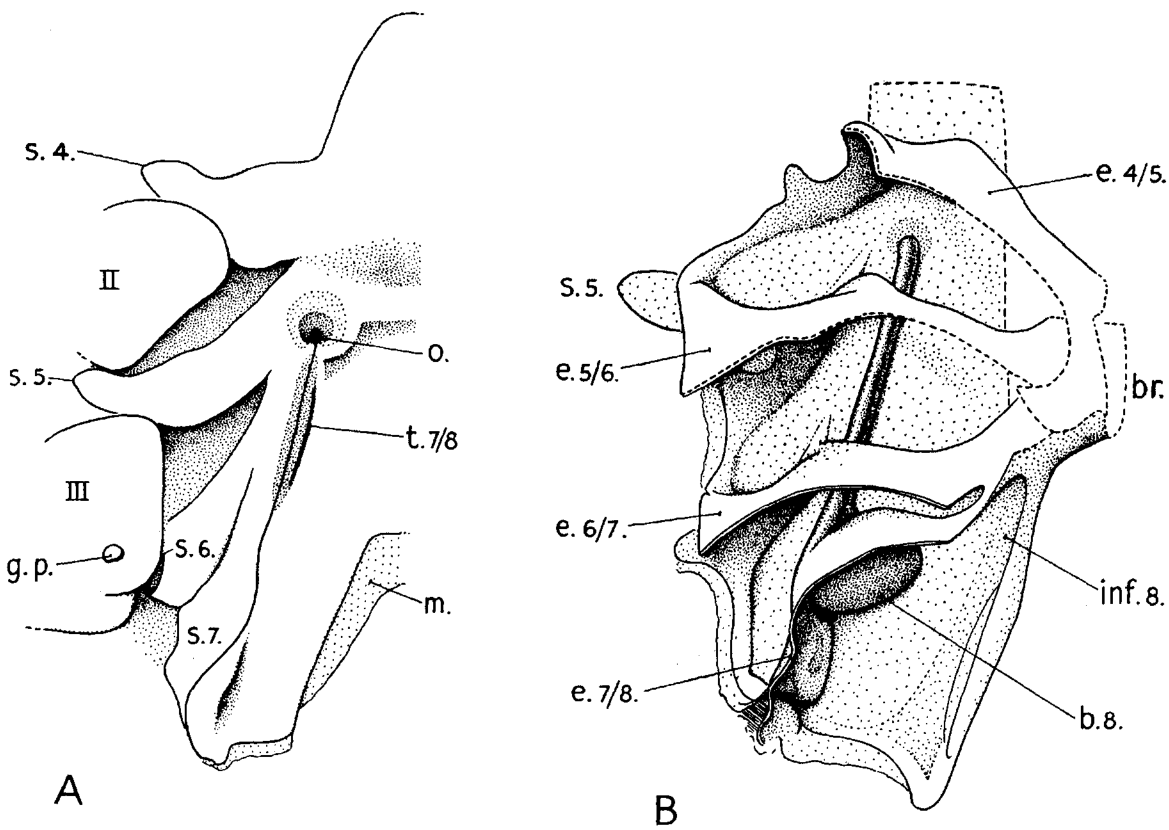



TEXT-FIG. 23.—*Dromia vulgaris* H. M.-Edw. A. Thoracic sternum of very young female (*c.l.* = 6·3 mm.), with coxæ II–V ; × 19. B. Thoracic sternum of an immature female (*c.l.* = 20.5 mm.), with the left coxæ of maxilliped 3 and of pereiopods I–V ; × 5. *m.*, Membranous area separating the anterior and posterior parts of sternum ; *s.*8, sternite 8 ; 7/8, suture between sternites 7 and 8 modified to form the sternal furrow.

corresponds in part at least to the 5/6 suture. The anterior part of the plastron is horizontal, while the posterior part slopes backwards and upwards (*i.e.* dorsalwards) at an angle of about 45°. Two pairs of lateral wing-like processes separating coxæ I/II and II/III respectively belong to sternites 4 and 5. In the posterior part the 6/7 and the 7/8 sutures are visible laterally, terminating as in the adult male, opposite the middle of coxa III. But *already* the anterior third of the 7/8 suture is wider and more conspicuous than it ever is in the male.

Text-fig. 23, B, represents the sternum and the left coxæ II–V of a larger specimen from Sicily (*c.l.* 20·5 mm., dry collection, reg. no. ?) ; the genital pore is not yet perforate though it might become so at the next moult. The membranous area has disappeared laterally, but a narrow median portion still remains. Again the 6/7 suture is short, terminating opposite coxa III, while the sternal furrow has advanced forwards to end on a level with the posterior margin of the second lateral wing—*i.e.* between coxæ II and III; the anterior part of the furrow is wide and conspicuous.

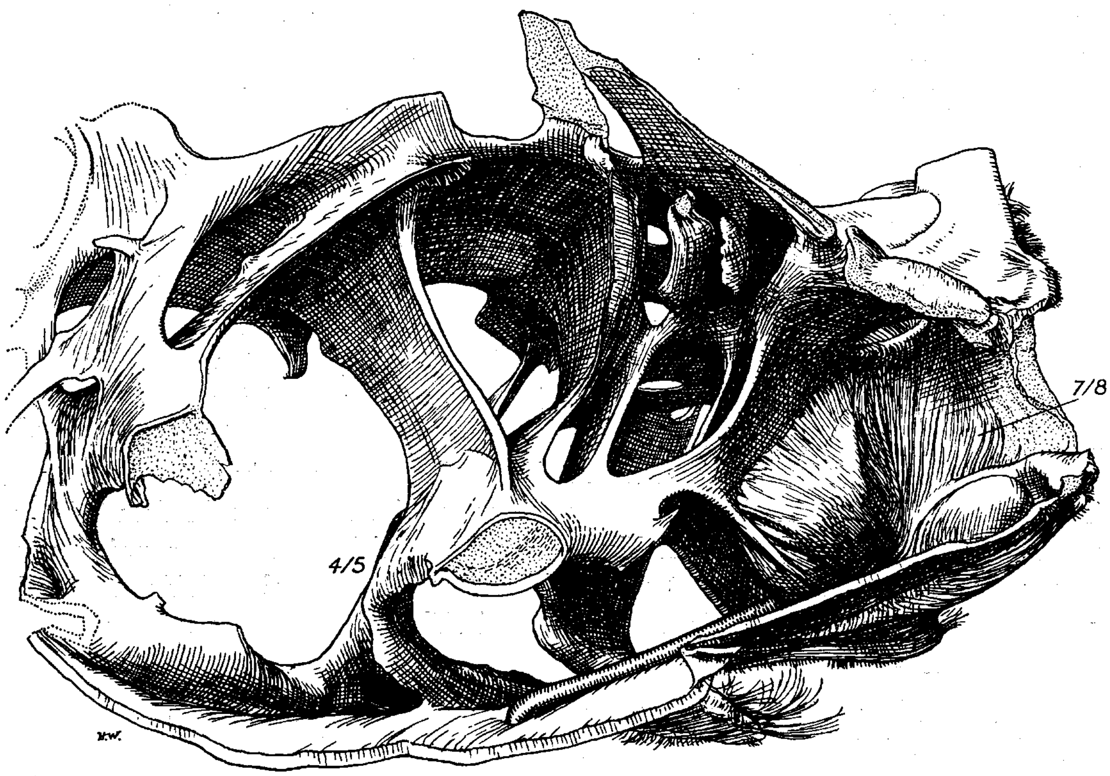
In an ovigerous female from Madeira (*c.l.* = 60 mm.) the adult condition has been reached save that the mound on which each sternal furrow terminates is less pronounced




TEXT-FIG. 24.—*Dromia vulgaris* H. M.-Edw. Ovigerous female, *c.l.* = 60 mm. A. Right half of thoracic sternum, with proximal parts of coxæ II and III, to show sternal furrow; ×3. B. Part of left thoracic sternum viewed from inside, together with portions of the endophragmal system, to show the modified spermathecal part; × 3·5. *b*8., Spermathecal bulge on posterior wall of endosternite 7/8; *br.*, part of the bridge formed by the fusion of apodemes 4/5 to 7/8 and the medial infolding of sternite 8; *e.*4/5–*e.*7/8, endosternites 4/5 to 7/8; *m.*, membrane connecting sternites 8 medially; *o.*, opening at anterior end of sternal furrow; *inf.*8, infolding of sternite 8; *t.*7/8, membranous streak and thinly calcified parts around 7/8 suture or sternal furrow; *s.*4 and *s.*5, lateral wing-like processes of sternites 4 and 5 respectively; *s.*6 and *s.*7, lateral part of sternite 6 and 7 respectively.

than in larger specimens (Text-fig. 24, A). Externally the furrow is a simple suture line throughout its length; there is, however, a small terminal opening surrounded by a thin, rather membranous, area on the slight eminence at the anterior end. Portions of the sternal wall on either side of the anterior third of the suture are poorly calcified and there is a narrow membranous streak along the medial edge of that on sternite 8 (the guide line *t.*7/8 ends on this membranous streak in Text-fig. 24, A, and the thin parts are stippled). There is now no trace of a transverse division of the sternum. Apparently, as growth proceeds, sternites 7 and 8 grow forwards in the neighbourhood of the 7/8 suture, encroaching more and more on the sternites in front (*i.e.* 6 and 5), until the sternal furrows attain their full development.

H. Milne-Edwards (1851, p. 281, pl. 9, fig. 11) gives a good figure of the endophragmal system of *Dromia vulgaris*, viewed from above ; he does not state whether the specimen figured was male or female, and it is impossible to guess which it was from this aspect. I was interested to compare the 7/8 endosternite with that of the Thelxiopidæ, and, after Text-fig. 24, A, had been made, I dissected this unregistered female. When the right half of the endophragmal system had been dissected out and all soft tissues removed, a photo-



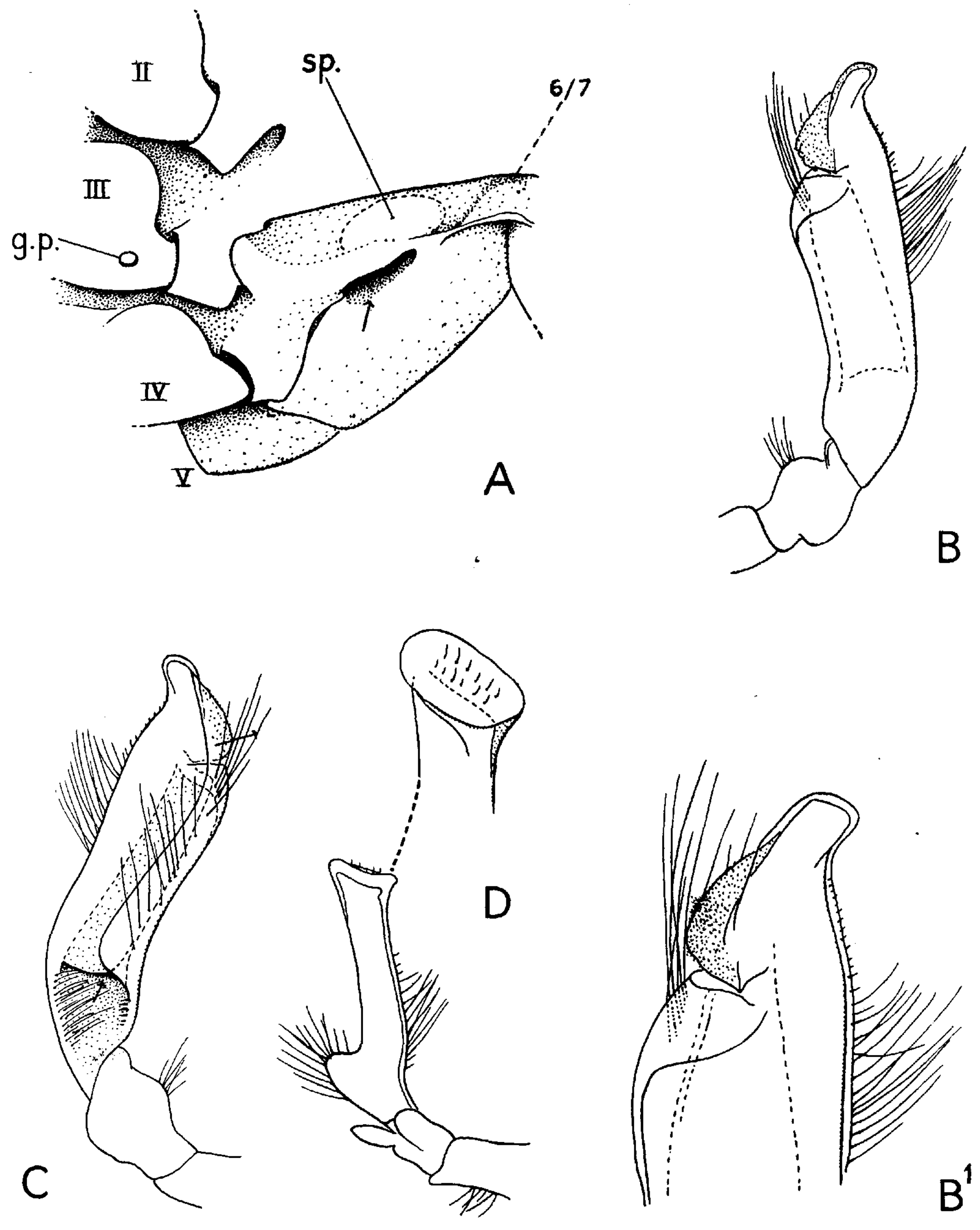

TEXT-FIG. 25.—*Dromia vulgaris* H. M.-Edw. Same specimen as in Text-fig. 24. Posterior part of endophragmal skeleton of right side, in medial aspect, to show how sternite 7/8 is modified to form the spermathecal bulge from which a long tube leads forward to the opening. 4/5, Endosternite 4/5. × 4.

graph was taken as a record, in medial aspect, similar to that of *Paromola alcocki*, reproduced in Pl. I, fig. A. The infolding along the postero-median margin of sternite 8 was then largely cut away in order to expose the 7/8 endosternite, and a second photograph was taken, part of which is reproduced in Pl. I, fig. B, and the artist then made a careful drawing (Text-fig. 25). In *Dromia* the special modification of endosternite 7/8 is much more striking than in the Thelxiopidæ, since it is darker in colour than the rest of the skeletal parts. The left half of the specimen was dissected to show these specially modified parts in more detail. In Text-fig. 24, B, the left half of the sternum is represented from the inside ; it is incomplete anteriorly, its cut or broken edges being shown as broken lines. These two figures, one in medial the other in dorsal aspect, give a good impression of the internal spermathecal structures (Text-figs. 25 and 24, B) In addition to the conspicuous bulge in the antero-ventral corner of endosternite 7/8, which is here mainly on the infolding of sternite 8, there is a new structure—namely, a long, strongly calcified, tubular ridge on the inner face of the sternum *along the entire length of the sternal furrow.* In Text-fig. 24, B, portions of endosternites 4/5 to 7/8 have been cut away to expose the spermathecal structures. These apodemes arch well over the sternum and join medially to form the posterior bridge between the two halves of the endophragmal system; the single medial infolding of sternite 8 is also connected anteriorly with this bridge (Text-fig. 24, B, *inf.*$^{8}$). The bulge is in precisely the same position as the inner part of the spermatheca in the Thelxiopidæ already described, but its outer wall is more strongly calcified than the rest of the endosternal septum, not soft, as in the Thelxiopids (*cf.* photographs, Pl. I, C, B). While the anterior edge of endosternite 7/8 lies, for the most part, posterior to that of endosternite 6/7, its extreme ventral part is apparently continued forwards, well beyond endosternite 5/6, as the tubular ridge already referred to. Perhaps this ridge only serves to reinforce the sternal furrow on the inside; I am inclined to think, however, that the bulge on endosternite 7/8 has the same function as that in the Thelxiopidæ and that the pocket within it communicates with the exterior by means of the opening at the anterior end of the sternal furrow. In this specimen the opening is rather puckered and inconspicuous, but it doubtless could open rather widely, since the surrounding area is membranous. The tubular ridge is doubtless formed by infoldings of sternites 7 and 8 along their sutural margins. In the young females represented in Text-fig. 23, A and B, this ridge is presumably in process of formation and the anterior part of the sternal furrow is rather open. When the ridge or tube has attained its full development, the suture line becomes closed, though the sternal wall around its anterior half may be rather poorly calcified. It would be interesting to follow the development of these special structures in detail, but this cannot be done in the absence of suitably preserved material. Behind the main bulge, in the postero-ventral corner of the 7/8 endosternite, is a very strongly calcified boss, which may be hollow on the side away from the camera in Pl. I, fig. B. This apparently serves to strengthen the tubular ridge posteriorly.

In the male of *Dromia vulgaris* the sternum is much narrower than in the adult female and in this respect it is nearer to that of the very young female. As in the female, there are two pairs of lateral wing-like processes separating coxæ I/II and II/III respectively. On the somewhat concave median portion, opposite coxæ II, is a short transverse row of forwardly directed, long, fine setæ. Behind this is a raised boss richly beset with even longer setæ, which overlap the proximal part of the row in front; the posterior margin of this boss is situated slighty in advance of the middle of coxæ III. Immediately behind this the sternum bends rather sharply and obliquely dorsalwards, again as in the immature female. On this oblique part the short 6/7 and the rather longer 7/8 sutures are visible laterally, much as in the immature female (Text-fig. 23, A). But the 7/8 suture is not in any way modified and ends anteriorly almost on a level with the 6/7 suture and opposite coxa III.

The available material of *D. vulgaris* is insufficient to justify a dissection of the endophragmal system in the male. I have, therefore, dissected an old dry specimen of *D. dehaani* from the Red Sea (*c.l.* = 76 mm.; reg. no. 40.3.20.4) and find that the endophragmal system shows absolutely no trace of the special modifications present in the female. Endosternite 7/8 is just a thin double septum arising from, and extending ventrally exactly the length of, the short 7/8 suture, and there is no trace of the tubular ridge. This was to be expected, since the 7/8 suture is just a short normal suture.

The Thelxiopidea and the Dromiidea thus agree in having the antero-ventral corner of the 7/8 endosternite modified to form an internal spermathecal pit. They differ chiefly




TEXT-FIG. 26.—A. *Latreillopsis laciniata* Sakai. Female. Right thoracic sternum, posterior half, slightly tilted, to show spermatheca. × 7. Arrow indicates the position of the spermathecal opening ; *sp.*, the position of the inner part of spermatheca ; *g.p.*, genital pore ; II–V, coxæ of pereiopods II to V respectively ; 6/7, the suture between sternites 6 and 7. *Thelxiope barbata* (Herbst). Male, Madeira. *c.l.* = 14 mm. B. Right first pleopod, thoracic aspect ; B[1], apex of same further enlarged ; C., same, abdominal aspect ; the lower arrow shows where the second pleopod is inserted ; D., right second pleopod, with apex further enlarged. × 8 and 16.

as regards the position of the spermathecal opening to the exterior, and, correlated with this, the male pleopods also differ in the two sub-tribes. In all the Thelxiopidea that I have examined the spermathecal opening is situated far back on the thoracic sternum, on a level with the genital pore and slightly posterior to the spermathecal pit. In the male the second pleopod is always short, rather stout, with a flat cushion-like apex; the large proximal lobe on the outer side of the distal segment prevents the appendage from going too far when it is interlocked with pleopod 1—*i.e.* its apex would not project beyond that of its partner (Text-fig. 26, C, D). The apex of pleopod 1 is stout and rather elaborate compared with that of *Dromia* and its allies (*cf.* Text-figs. 2, B–E; 8, B–E and 9, D); presumably it enters the spermathecal opening and deposits the spermatophores in the pit. The penis on coxa V is much shorter than in the Dromiidæ. In the higher Dromiidea on the other hand, the actual spermathecal opening is situated far forwards on the sternum and a long narrow channel leads back to the pit. In these Dromiids the second pleopod is specially modified to form a long hollow needle or style which projects well beyond the apex of pleopod 1 when the two appendages are interlocked (Text-figs. 2, D, and 9, D — in the former, pleopod 2 can project further than shown here). In all probability the apex of pleopod 2 passes backwards from the spermathecal opening down the channel towards, or even into, the spermathecal pit and acts as a "hypodermic" needle for injecting the male secretion into the pit. The brownish streaks or blotches present in and around the anterior part of the sternal furrow in some females is presumably the hardened remains of the male secretion after the ova have been fertilized.* In the primitive Dromiidea such as *Dicranodromia* the sternal furrow is short (Text-fig. 1) and the small anterior opening is opposite coxa III which bears the genital pore. The furrow appears to be of the Dromiid type and in all probability the channel leading to the spermathecal pit is very short. It would be extremely interesting to know the internal anatomy of the spermatheca of this primitive form when more specimens are available. I have not seen a male of *Dicranodromia* and, as far as I recall, the pleopods have not been figured.

This morphological study cannot be completed in the absence of living material. The habits of *Dromia* have been studied from time to time in captivity (*e.g.* Dembowska, 1926; Zirpolo, 1926, 1930; Fenizia, 1935), and it is to be hoped that, in the near future, someone will study the copulation of living specimens. It would be interesting to know how the male sexual pleopod fits into the sternal furrow and whether the male secretions are simply poured in and around the opening to form the blotches found in certain females, or (much more probable) whether the sac in endosternite 7/8 does indeed act as a spermatheca; also, how long after copulation oviposition occurs. I am fully aware of the fact that my hypothesis does not tally with Cano's results, which I think need corroboration or refutation. Cano (1891, p. 514, pl. 17, fig. 14) gives a figure of the female genital system of "*Homola spinifrons*" = *Thelxiope barbata*, which has been reproduced by Balss in his recent text-book ('Bronns Tierreich,' vol. V, Lief. 5, p. 631, fig. 700, 1944); Cano asserts that there is a simple sac-like expansion of the oviduct acting as a *receptaculum seminis*, as in the Brachyura. He adds, however, that this *receptaculum seminis* "alcune

* In 1935, J. Linn. Soc. Zool., 39 (no. 266), p. 333, fig. 18, *a–e*, I figured what I thought to be spermatophores protruding from the male genital openings in *Euryrhynchus wrzesniowskii* Miers. Burkenroad informed me about 1938 that these were merely hardened masses of seminal secretion and that ripe male Macrura frequently emit their secretion when put into fixatives. This accounts admirably for the variation in size and shape of these supposed spermatophores.

volte sembra mancare del tutto (*Dromia*), e si sviluppa dopo l'accoppiamento come una breve estroflessione del canale vaginale." He elaborates this in a footnote and adds that this temporary receptacle contains only spermatozoa and does not function as a cement gland. If this is the case it is necessary to ascertain why there should be such elaborate structures in the female throughout the Dromiacea. I would point out that these sternal openings in the Dromiacea are nearer in position to the genital apertures in the Brachyura than are the actual genital openings themselves. The latter, being coxal in Dromiacea, would appear to be far too widely separated to serve comfortably for the reception of the male copulatory pleopods. Why should the spermathecal openings (if such they are) be so far forward in the Dromiidea ? They vary in position throughout the sub-tribe and it may well be that the more globular is the carapace the farther forward are they placed. The Thelxiopidæ are much flatter than are the majority of the Dromiids.

Perhaps Cano laid too much stress on the close superficial resemblance between the Dromiacea and the Brachyura. It is by no means certain whether or not the Dromiacea are Brachyura and they are still sometimes placed with the Anomura (*e.g.* Gurney, 1942, p. 270 and list of contents, p. viii) sometimes with the Brachyura (*e.g.* Bouvier, 1940, p. 186). Certainly they differ considerably from the majority, if not all, of the Brachyura ; this difference is quite marked in the endophragmal skeleton, the Dromiacea having no true "*sella turcica*." As far as I know, the Dromiacea are unique in possessing the special modifications in the female endophragmal system and sternum described in the preceding pages. During a recent visit to the Marine Biological Association's Laboratory, Plymouth, I dissected male and female specimens of various Brachyura, *e.g. Maia*, *Cancer*, *Portunus*, etc., and in none did I find any trace of special endosternal modifications in the female. The differences in the endophragmal systems in the two sexes are all correlated with the fact that the sternum is much narrower in the male than in the female. These differences do not appear to have been mentioned by H. Milne-Edwards (1851) in any of the species studied by him, nor by Pearson (1908) in *Cancer*, nor Cochrane (1935) in *Callinectes*, but they are not relevant to the present paper.

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## EXPLANATION OF PLATE.

FIG. A.—*Paromola alcocki* (Stebbing). Specimen from "J.M." St. 157. × 2/3.

FIG. B.—*Dromia vulgaris* H. M.-Edw. Same specimen as in Text-fig. 22. Dissection of endophragmal skeleton of right side, in medial aspect, to show spermatheca. × 3.

FIG. C.—*Paromola alcocki* (Stebbing). Female from Natal. Dissection of endophragmal skelton of right side, in medial aspect, to show spermatheca. × *circa* 3·5.