

Cirolanid isopod crustaceans from the Townsville region of Queensland, Australia, with descriptions of six new species

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Introduction

The isopod family Cirolanidae contains a large number of species and is an economically important group as its members are known to attack fish species (Hale 1929, Moreira and Sadowsky 1978), although they do not occur as fish ectoparasites as do the Aegidae and Cymothoidae, closely related groups.

Except for the studies of Roman (1970), Jones (1971, 1976) and Eleftheriou and Jones (1976) very few investigations into the ecology of the Cirolanidae, especially of sub-littoral species, have been carried out in sub-tropical and tropical regions. Until recently (Bruce, 1980 a, b, c, d) the cirolanid fauna of Australia had received little attention since Hale's review in 1925.

The aim of the present study was to examine one locality in the tropics (i.e. Townsville, in northern Queensland, Australia) in detail in order to assess the diversity of isopod species in a wide variety of habitats. So far the Serolidae, Gnathiidae, and certain members of the Sphaeromatidae have been considered (Holdich and Harrison, 1980 a, b, c), and this paper deals with the littoral and shallow water Cirolanidae. Some of the cirolanid species found have been reported from other areas of Australia, and from Indonesia and the Indian Ocean. However, of the thirteen species represented in the collections from Townsville (fig. 1) six were previously undescribed.

In order to aid in the identification of cirolanid species from tropical environments, other species, in addition to the new species, have been described fully. This was considered essential by the authors when dealing with a group of isopods with many closely related species—many of which have been poorly described in the past.

Materials and methods

Littoral and sublittoral samples of dead coral, barnacle tests, coralline algae, sponges, bryozoan colonies, ascidian colonies, algal holdfasts, surface scrapings from man-made structures (e.g. boats, jetties and pontoons), rock crevices, semi-permanent wood jetsam, sand and mud were collected manually from, or examined at, a number of sites on the mainland and the offshore continental island (i.e. Magnetic Island) around Townsville in northern Queensland (latitude 19°S). In most cases the samples were examined soon after collection, and the mobile fauna extracted. Where practicable, samples were broken up in 2% formalin under a binocular dissecting microscope—this agitated the infauna thus making extraction easier.

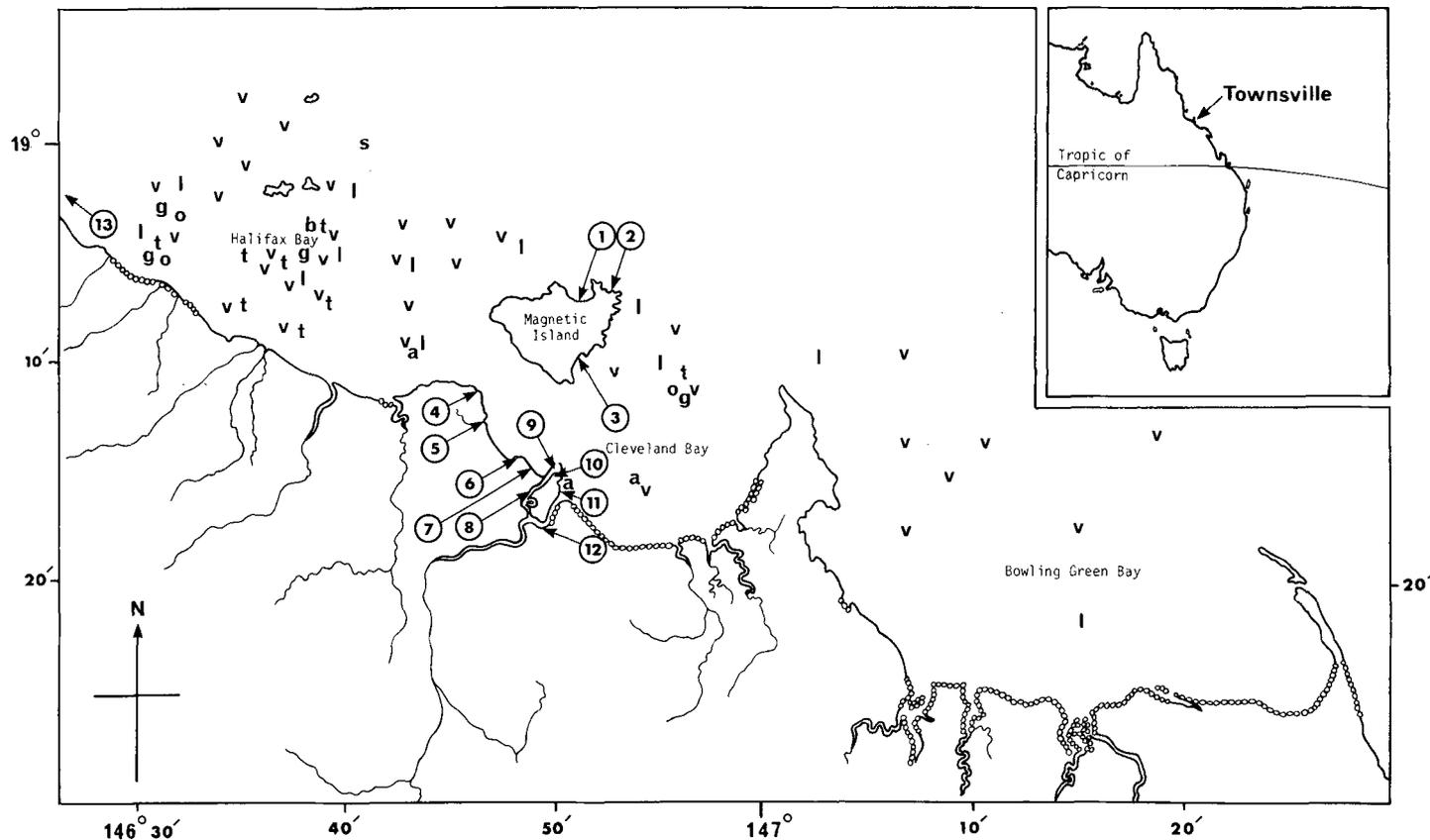


FIG. 1. Known distribution of cirolanids in the Townsville region. Bays Survey: *a*, *Cirolana arcicauda* sp. nov.; *v*, *C. variguberna* sp. nov.; *l*, *C. luticola* sp. nov.; *t*, *C. tumulosa* sp. nov.; *s*, *C. schiodtei* Miers; *b*, *Neocirolana bicrista* sp. nov.; *o*, *Eurydice orientalis* Hansen; *g*, *Eurydice inermis* Hansen. Shore collections: 1, Horseshoe Bay (*Cirolana cranchii* var. *australiense* Hale); 2, Radical Bay (*Pseudolana concinna* (Hale)); 3, Picnic Bay (*C. cranchii* var. *australiense*); 4, Pallarenda (*Excicrolana orientalis* (Dana), *Pseudolana brevifimbria* sp. nov.); 5, Three Mile Creek (*P. brevifimbria*); 6, Kissing Point (*Excicrolana orientalis*, *P. brevifimbria*); 7, The Strand (*Excicrolana orientalis*, *P. brevifimbria*); 8, Ross River Creek (*Cirolana pustulosa* Hale); 9, Townsville Harbour (*C. cranchii* var. *australiense*); 10, 'James Kirby' jetty (*C. pustulosa*); 11, Ross River entrance (*C. cranchii* var. *australiense*); 12, Ross River (*C. pustulosa*); 13, Saunder's Beach (*Pseudolana concinna*, *Excicrolana orientalis*). —o—o—o— = coastal mangroves.

In addition to the samples collected above, a large number of specimens were also available for examination as a result of the routine sampling of sub-littoral particulate substrata by James Cook University Three Bays Survey divers (see acknowledgments). Samples were collected between 1974 and 1977 from Halifax Bay, Cleveland Bay and Bowling Green Bay off the Townsville coast, using a modified Barnett/Hardy suction sampler. Samples were subsequently sieved through a 1.0 or 1.5 mm mesh and preserved. A number of plankton tows were also made during this survey but only one revealed a cirolanid.

All material mentioned below but not designated a museum reference number has been placed in reference collections at Nottingham University or in the custody of N. L. Bruce.

Systematics

(Following Hurley and Jansen 1977)

Order ISOPODA

Sub-order QUATUORDECEMPEDES

Infra-order FLABELLIFERA

Family CIROLANIDAE Harger, 1880

Cirolanidae Harger, 1880, 376; Kossmann, 1880, 111, 112, 114; *et auct.*

Eurydicidae Stebbing, 1905, 10; Barnard, 1914; 1955; Hale, 1925; Pillai, 1967; Jones, 1971.

The term Cirolanidae was first used by Harger in 1880. This name takes precedence over the term Eurydicidae proposed by Stebbing (1905) (see Racovitza 1912).

Genus *CIROLANA* Leach

Cirolana Leach, 1818, 347.

Nelocira Leach, 1818, 347.

Cirolana: *auct.*

Generic diagnosis

Marine or estuarine Cirolanidae with rostral point minute or absent. Antennular peduncle article 1 not articulated at right angles to remainder of antennule (except in *C. corpulenta* Hale, 1925). Antennular peduncle with two or three articles. Mandible with relatively broad incisor edge; lacinia mobilis and 3-articled palp well formed; molar process as a lanceolate blade. Maxillule with inner lobe bearing three pectinate spines; outer lobe with terminal spines. Maxilla with all three lobes bearing setae. Maxillipede with 5-articled palp; endite bearing one to approximately eight coupling hooks (two is 'normal'). Pleopod 1 not hardened as a ventral operculum; all rami except endopod of pleopod 5 setigerous. (*C. pustulosa* is the exception and has endopods of pleopods 3–5 non-setigerous). Endopod of pleopod 2 of male with appendix masculina arising from proximo-internal angle. Pleon of five free terga. Lateral margins of pleonite 5 usually overlapped by pleonite 4. External margin of uropodal exopod usually setose and/or spinose.

Type species—*Cirolana cranchii* Leach, 1818.

Cirolana pustulosa Hale, 1925

Cirolana pustulosa Hale, 1925: 139, 140; Nierstrasz, 1931: 157, 160; Barnard, 1935: 308; Jones, 1976: 215, 216, 220.

Cirolana rustulosa: Roman, 1970: 167, 184, 192, 195 (*lapsus calami*).

Cirolana capitella Barnard, 1955: 54–56.

Description of specimens from Townsville

ADULT MALE (Queensland Museum reg. no. W.7920) (fig. 2 a–l, n–p).

Cephalosome with three transverse tubercles, central obviously bifid. Frontal lamina twice as long as maximum breadth, slightly dilated anteriorly with tip smoothly rounded. Posterior margins of pereonites 2 and 3 with several, and pereonites 4–7 with ten to fourteen conical tubercles. Pleonites 3 and 4 with posterior margins bearing nine simple, conical tubercles. Pleonite 5 with five such tubercles. Telson broader than long with a large conical process near each antero-lateral angle and a straight, tuberculate carina running the full length of the telson either side of the mid-line. Telsonic margins setose along most of their length; apex narrowly rounded bearing six spines.

Appendages. Mandibular lacinia mobilis of curved row of spines surrounded by simple setae. Maxillipedal endite bearing two coupling hooks. Pereopod 1 moderately robust; carpus reduced; merus with a row of five stout, inferior pegs; propodus with inferior margin markedly sinuous, bearing three simple spines and several distal setae. Pereopods 2 and 3 becoming more slender; carpus less reduced than in pereopod 1; merus with three stout inferior pegs; infero-distal margins of ischium, merus and carpus with short, stout, simple spines; superior lobes of ischium and merus with long simple spines. Pereopods 4–7 with distal margins of ischium, merus and carpus bearing simple spines, especially inferiorly and superiorly; inferior margins of these articles, and of propodus, also bearing one to four transverse rows of simple spines. All pereopods only sparsely setose with all dactyli uni-ungulate and bases of posterior pairs not noticeably expanded. Penes absent; vasa deferentia opening directly onto surface. Pleopod 1 with rami sub-equal in length; endopod sub-rectangular, approximately $2\frac{1}{2}$ times as long as broad with a terminal fringe of plumose setae; exopod sub-ovate with terminal fringe of plumose setae. Pleopod 2 with a narrow appendix masculina extending just behind level of ramus and tapering to an acute tip. Pleopods 3 and 4 similar, each with both rami sub-ovate; exopod slightly larger than naked endopod, having terminal and external plumose setae and a median transverse articulation which is medially incomplete. Pleopod 5 similar to pleopods 3 and 4 but endopod slightly truncate. Uropodal basis with dorsal, longitudinal ridge.

OVIGEROUS FEMALE—not observed.

NON-OVIGEROUS FEMALE, 4.45 mm (Queensland Museum reg. no. W.7920) (fig. 2 m).

Differs from male in primary sexual characteristics and in being less setose; dorsal surface of cephalosome bearing very faint indication of central tubercles only; dorsal pereonal and pleonal tuberculation much less pronounced than in male; telsonic carinae not obvious, reduced to several, median tubercles either side of mid-line.

Colour of all specimens in alcohol, cream, lacking chromatophores.

Material examined

Ross River Creek, Townsville. On wood partially embedded in mud on mid and lower shores of north bank downstream from Hayles Wharf. Coll. D. M. Holdich, 14 V 1976; 3 males, 11 non-ovigerous females, 2 juveniles.

Ross River, Townsville. In, and on surface of, wood on mud flat, mid and lower shores. Coll. D. M. Holdich, 27 VI 1976; 11 males, 28 non-ovigerous females, 11 juveniles.

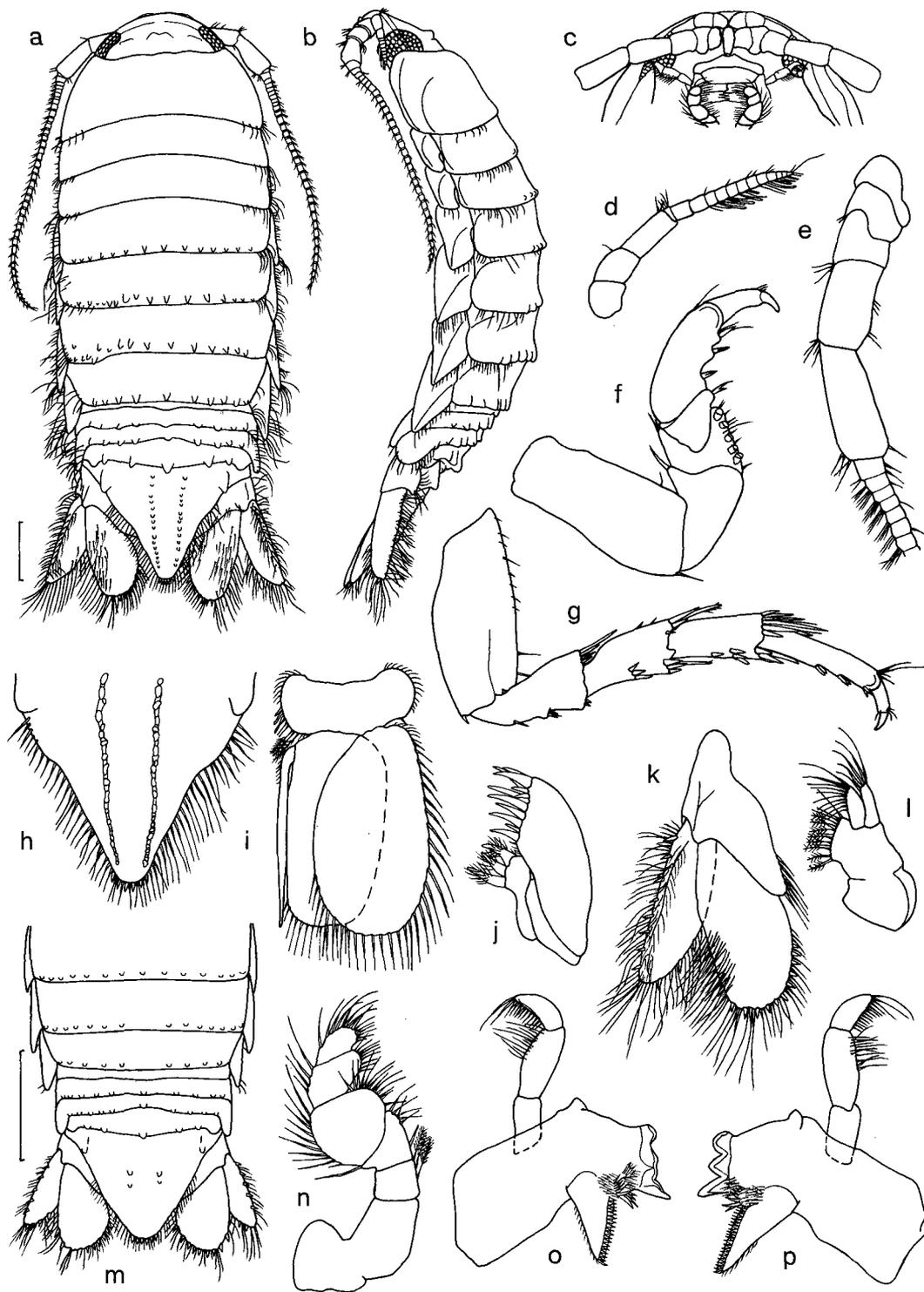


FIG. 2. *Cirolana pustulosa* Hale. Adult male (Q. M.: W.7920). *a*, dorsal; *b*, lateral; *c*, ventral view, cephalosome; *d*, antennule; *e*, antenna, peduncle and proximal flagellum; *f*, pereopod 1; *g*, pereopod 7; *h*, telson; *i*, pleopod 2; *j*, maxillule; *k*, uropod; *l*, maxilla; *n*, left mandible; *o*, right mandible; *p*, right mandible. Non-ovigerous female (Q. M.: W7920). *m*, dorsal view, posterior half. (Scale line represents 1 mm).

Ross River Creek, Townsville. In washing from fixed wood, mid-shore, downstream from car ferry. Coll. D. M. Holdich, 01 VII 1976; 3 non-ovigerous females, 1 juvenile.

Townsville Harbour. In scrapings from moored, ocean-going yacht and in barnacles from steps of 'James Kirby' jetty at mid-shore level. Coll. D. M. Holdich, 20 VII 1976; 4 non-ovigerous females, 1 juvenile.

Remarks

Barnard's description of *C. capitella* (1955: 54–56) fits *C. pustulosa* exactly and the present authors have no hesitation in synonymizing the two. It is strange, however, that Barnard did not compare his *C. capitella* to *C. pustulosa* as he was obviously aware of this latter species, having included it in his key to the sculptured forms (1935: 308). *C. capitella* was described from the coast of Mozambique at Inhambane and in a coastal lagoon at Inharrime.

Hale's holotype of this species was from Cooktown, Queensland, but no habitat details are known. Specimens from Madagascar (Roman 1970), Aldabra Atoll (Jones 1976) and the present specimens, were all from brackish water sites. Roman's specimens were found in a sandbank in a channel draining an area of mangroves, while Jones' specimens occurred in dead coral and mangrove wood.

C. pustulosa appears, therefore, to adopt a cryptozoic existence in regions of variable salinity, and with its present known distribution it must also be expected to occur on the north and west coasts of Australia.

This species is unusual for the genus *Cirolana* in having the endopods of pleopods 3 and 4, as well as that of pleopod 5, naked. This may be a consequence of moving into waters of low salinity, as all freshwater species of Cirolanidae have reduced pleopodal setation.

***Cirolana tumulosa* sp. nov.**

SYNONYMS—none.

Specific description

ADULT MALE (Fig. 3 a–j, l–p).

Dorsal surface of cephalosome and pereon lacking tubercles and setae. Coxal plates of pereonites 2 and 3 lacking furrows; postero-distal angles smoothly arcuate. Coxal plates of pereonites 4–7 bearing oblique furrows extending from postero-distal angles nearly to antero-proximal angles. Postero-distal angles of coxal plates of pereonites 4–7 becoming increasingly acute with margins slightly convex and apices blunt. Antero-lateral angles of pereonites 2–7 isolated by curved furrows. Pleonite 1 obscured by pereonite 7. Pleonite 3 with posterior margin bearing nine small tubercles. Pleonite 4 with two irregular tubercles either side of a blunt median tubercle. Lateral margins of pleonites 2 and 3 acute, apices blunt, not markedly deflected posteriorly. Lateral margins of pleonite 4 broadly rounded, deflected posteriorly, each with an oblique ridge. Telson with a simple, conical tubercle either side of anterior mid-line and two, well-spaced, minute tubercles posterior to each of these. Lateral margins of telson sub-linear with fringe of plumose setae in distal half; terminally bearing six spines as well as setal fringe.

Appendages. Antennule reaching level of posterior margin of cephalosome; flagellum 5-articled. Antennal peduncle sub-equal to setose, 9-articled flagellum which extends to posterior margin of pereonite 1. Frontal lamina separating bases of antennules, pentagonal, twice as long as maximum breadth. Each mandible with

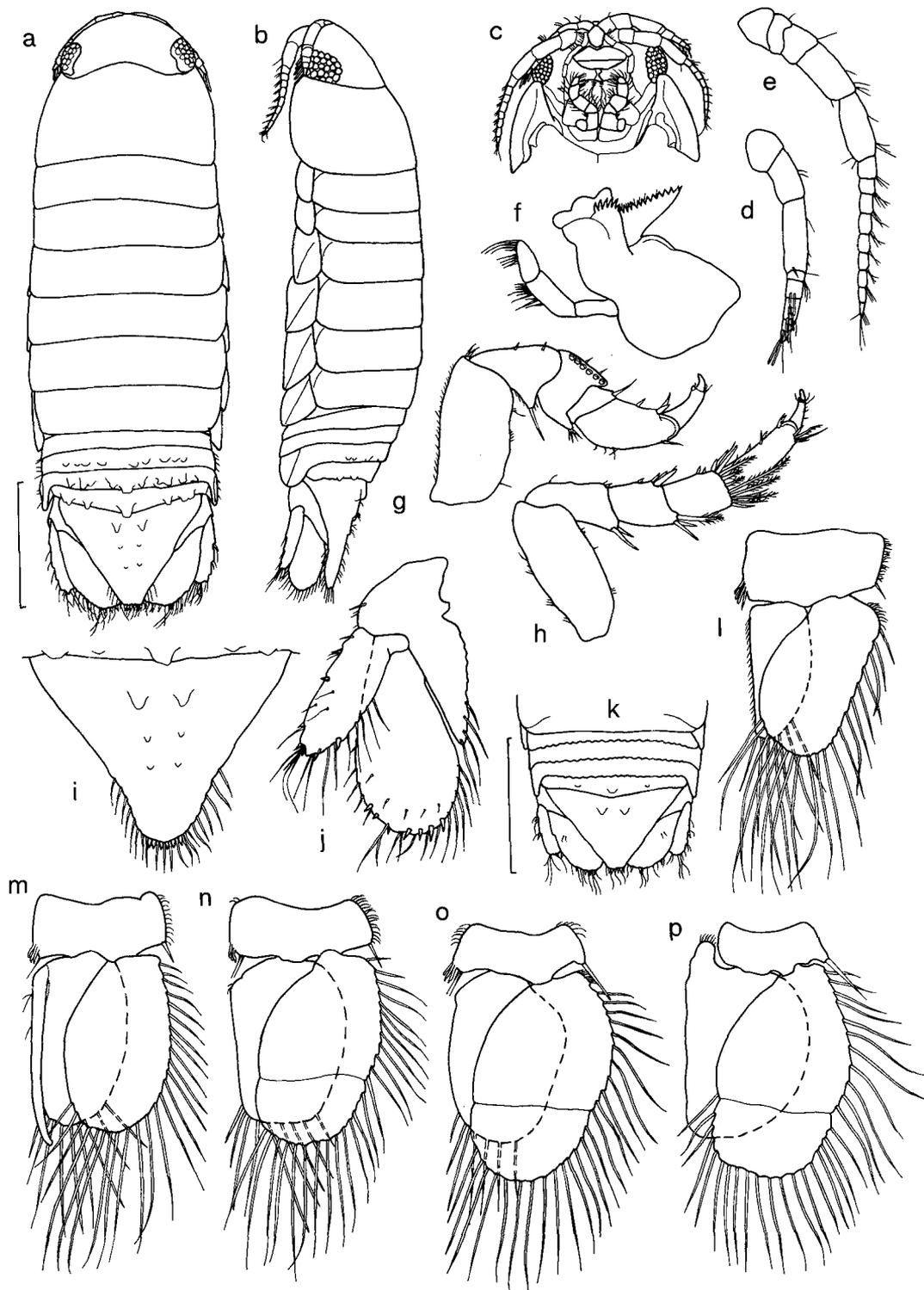


FIG. 3. *Cirolana tumulosa* sp. nov. Adult male holotype (Q. M.: W6333). *a*, dorsal. Adult male paratype. *b*, lateral; *c*, ventral view, cephalosome; *d*, antennule; *e*, antenna; *f*, left mandible; *g*, pereopod 1; *h*, pereopod 7; *i*, telson; *j*, uropod; *l-p*, pleopods 1-5 respectively. Ovigerous female paratype. *k*, dorsal pleon and telson. (Scale line represents 1 mm).

incisor process of three sub-equal, smoothly rounded teeth; lacinia mobilis not surrounded by simple setae; molar process well produced; palp stout. Maxillule outer lobe with approximately twelve simple spines; inner lobe with three sub-equal, curved, densely setose spines. Maxilla with inner lobe bearing two proximal, curved, densely setose spines and approximately five simple setae; middle and outer lobes each bearing approximately five simple setae. Maxillipedal endite with one large distal and one small proximal coupling hook; palp, with article 2 bearing inferior marginal setae and articles 3–5 with inferior and superior, marginal setae. Pereopod 1 moderately robust; ischium with long spine on superior lobe; merus with several short, superior spines, six stout, inferior pegs and several simple, inferior spines; carpus bearing one inferior spine; propodus with several simple, inferior spines. Pereopods 2 and 3 more slender; carpus less reduced than in pereopod 1; ischium with one stout peg on distal, inferior margin; merus with three stout pegs on proximal, inferior margin; superior lobes of ischium and merus with long spines. Pereopods 4–6 with stout, distal, superior and inferior spines on ischium, merus and carpus; in addition, inferior margins of these articles and of propodus bearing one to three separate spines or transverse rows of simple spines. Pereopod 7 similar to pereopod 6 but distal margin of carpus bearing row of long, plumose spines. All pereopods only sparsely setose; all dactyli bi-ungulate, secondary unguis small. Bases of posterior pereopods not expanded. Penes absent, vasa deferentia opening directly onto surface. Pleopod 2 with appendix masculina arising from interno-distal angle of endopod and extending just beyond level of endopod and curving laterally to a rounded apex. Pleopods 3 and 4 sub-similar, each with both rami sub-ovate; exopod slightly larger than endopod, with a complete articulation half-way along its length; rami bearing marginal setae as in pleopods 1 and 2. Pleopod 5 sub-similar to 3 and 4 but naked endopod bearing a proximal, internal, proximally-directed lobe. Uropod with elongate, ovate endopod approximately $1\frac{1}{2}$ times length of elliptical exopod; endopod extending to level of telsonic apex, with a distal row of approximately seven spines and a distal, marginal fringe of short, plumose setae; exopod with approximately three terminal spines, three external spines, and an interno-distal fringe of plumose setae; both rami with only a few non-marginal setae.

OVIGEROUS FEMALE (fig. 3 k).

Differs from male in primary sexual characteristics, presence of brood pouch, and in that the pleonal tuberculation is reduced to three faint tubercles on pleonite 5 and to faint, crenulate, posterior margins on pleonites 2–4; the telson bears one anterior tubercle on either side of the mid-line only.

NON-OVIGEROUS FEMALE—not known.

Colour of all specimens in alcohol, cream, lacking chromatophores.

Material examined

HOLOTYPE—adult male, 4.57 mm (Queensland Museum reg. no. W.6333).

Type locality—Halifax Bay. Soft mud on sandy mud, depth 8.8 m. Coll. P. Arnold, 21 VIII 1974.

ALLOTYPE—ovigerous female, 3.86 mm (Queensland Museum reg. no. W.6334). (The brood pouch of this specimen is filled with epicaridian larvae of a species of epicarid isopod).

Locality—Cleveland Bay. Soft mud on shell/mud, depth 8.9 m. Coll. P. Arnold, 10 VI 1975.

ADDITIONAL PARATYPES

Halifax Bay: Particulate substrata (including sandy mud and soft mud on sandy mud), depth 2.5 m—11 m. Coll. P. Arnold, VIII 1974 to XI 1976; 4 males, 1 ovigerous female, 7 juveniles.

Etymology—*Cirolana* + L. *tumulosa*, i.e. full of mounds.

Remarks

This species bears some resemblance to *C. pustulosa* but differs from it in the form of this pleonal sculpturing, and in having much shorter antennae, relatively shorter uropodal exopods, setose endopods to pleopods 3 and 4, and the tip of the frontal lamina angular, not smoothly rounded. The mandibles are unusual in having sub-equal incisor regions, unlike most cirolanids where the two anterior teeth of the left mandible are less pronounced than those of the right (e.g. fig. 2 o, p). Unlike *C. pustulosa*, *C. tumulosa* was found only in sub-littoral, particulate substrata away from the main coast.

Cirolana arcicauda sp. nov.

SYNONYMS—none.

Specific description

ADULT MALE (fig. 4 d-i, k-m).

Body deeply vaulted, dorsal surface lacking tubercles and setae. Coxal plates of pereonites 2–5 lacking furrows and of pereonites 6 and 7 with oblique, curved furrows. Postero-distal margins of coxal plates of pereonite 2 smoothly arcuate and of pereonites 3–7, becoming increasingly acute. Lateral margins of pereonites 2–7 each with short, straight, median furrow. Lateral margins of pleonites 1 to 4 visible in lateral view; postero-lateral angles of pleonites 1–3 becoming increasingly acute, those of pleonite 3 being very narrow and freely projecting, those of pleonite 4 being blunt. Pleonites 3 and 4 bearing straight, lateral, oblique ridges. Telsonic lateral margins smoothly convex; apex smoothly, widely arcuate, with a margin of setae and four short spines either side of the mid-line. Frontal lamina linear, separating bases of antennules; lateral margins sub-parallel; apex smoothly rounded. Clypeus with antero-lateral margins slightly thickened, central region smooth.

Appendages. Antennules reaching mid level of eyes; 13-articled flagellum just shorter than peduncle. Antennal peduncular article 5 with an infero-distal, densely plumose seta; flagellum of twenty-three articles. Each mandible with incisor process of two unequal, low, anterior teeth, and a narrow, acute, elongate, posterior tooth; lacinia mobilis of a curved row of spines, the distal spines being longer than the proximal spines; molar process narrow, elongate; palp short. Maxillule with outer lobe bearing thirteen long spines, at least one having superior teeth; internal lobe with three stout, densely setose spines. Maxilla with broad inner lobe bearing long, plumose setae; middle lobe with long, internal, simple setae; outer lobe with five long, terminal, simple setae. Maxillipedal endite with two curved coupling hooks. Pereopod I moderately robust; basis with superior and inferior, distal groups of long setae, and several long, superior setae; ischium with distal, transverse row of setae, inferior setae, long infero-distal spines and a pronounced superior lobe bearing a transverse row of long setae; merus with inferior border bearing continuous margin of long, unequal, robust spines; carpus reduced with an infero-distal group of long spines; propodus with three short, simple inferior spines, a simple infero-distal spine and several superior distal and long, infero-distal setae. Pereopods 2 and 3 similar to

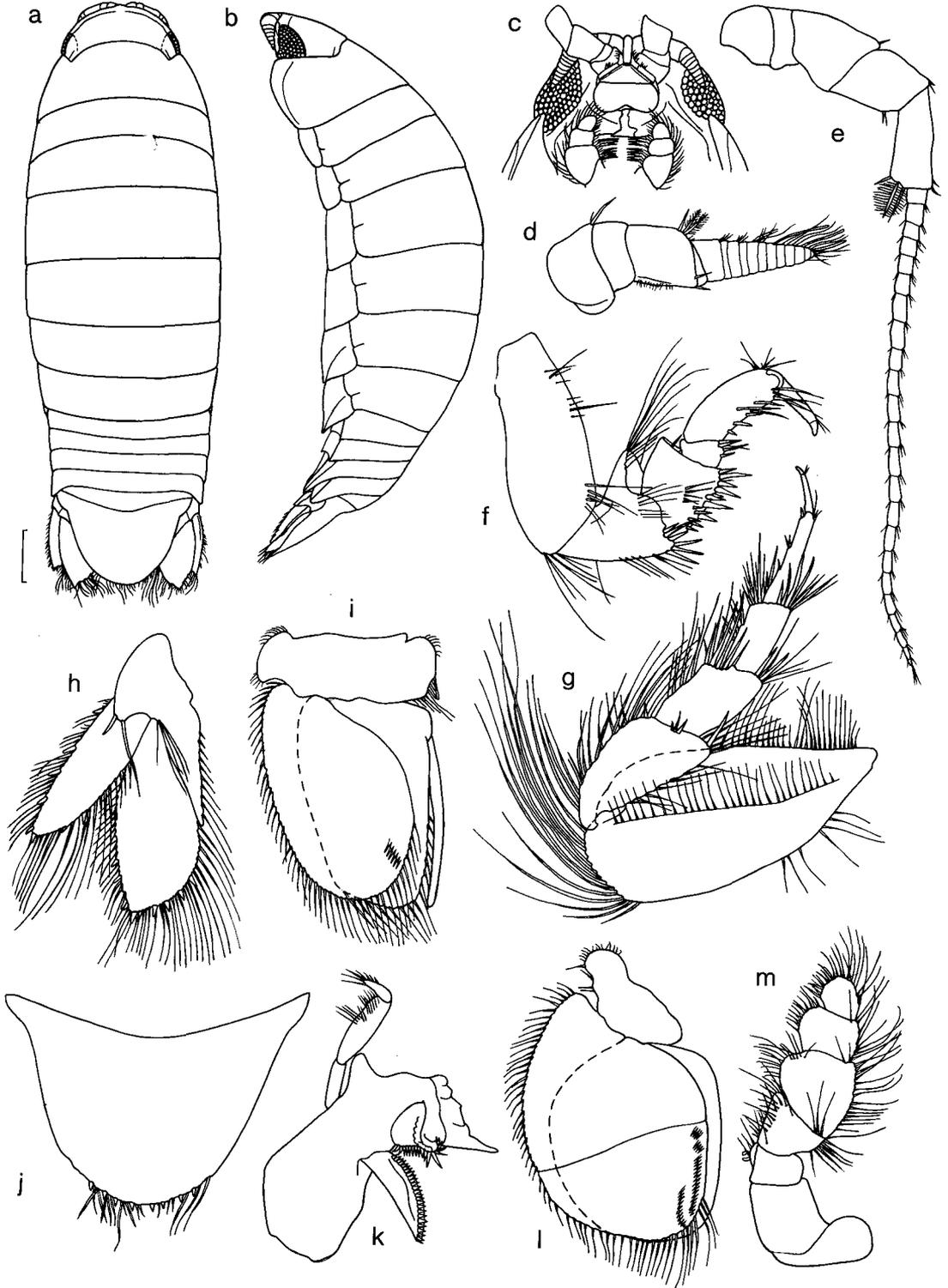


FIG. 4. *Cirolana arcicauda* sp. nov. Non-ovigerous female holotype (Q. M.: W.6335). *a*, dorsal; *b*, lateral; *c*, ventral view, cephalosome; *j*, telson. Adult male allotype (Q. M.: W.6336). *d*, antennule; *e*, antenna; *f*, pereopod 1; *g*, pereopod 7; *h*, uropod; *i*, pleopod 2; *k*, left mandible; *l*, pleopod 5; *m*, maxillipede. (Scale line represents 1 mm).

pereopod 1 but becoming more setose and spines becoming more pronounced; superior meral lobe becoming more pronounced, but ischial lobe low on pereopod 3. Pereopods 4–7 becoming increasingly slender and setose; only pereopods 6 and 7 with bases expanded, bearing medio-longitudinal row of short setae, and a dense infero-distal fringe of long plumose setae; bases of pereopods 4 and 5 with irregular group of infero-distal setae. Pereopod 7 with basis bearing dense, superior fringe of long setae, a medio-longitudinal row of long setae, several infero-proximal setae, and a dense infero-distal fringe of long plumose setae; ischium with several distal spines, the most superior being the longest, and short superior and long inferior setae along full length of margins; merus with long inferior and superior distal spines and setae; carpus with long inferior and distal spines; propodus with three equidistant, inferior groups of short spines, and a superior distal spine and seta; dactylus slender. All pereopods unungulate; bases of posterior pereopods expanded. Penes not observed as male damaged. Pleopod 1 with rami sub-equal in length; exopod sub-ovate, widening distally, with short terminal and external plumose setae; endopod sub-triangular, tapering distally, with short, marginal plumose setae in distal half. Pleopod 2 with rami similar to pleopod 1 but endopod relatively broader and exopod with one interno-distal row of short, embedded spines. Appendix masculina narrow, extending to level of endopod apex and curving laterally; lateral margins sub-parallel, and tip narrowly rounded. Pleopod 3 with rami and setation similar to pleopod 1 but endopod relatively broader and exopod bearing a complete, transverse, median articulation and three interno-distal rows of short, embedded spines. Pleopod 4 similar to 3 but rami relatively broader. Pleopod 5 with both rami broad, sub-ovate; endopod naked; exopod with distal and external border of short plumose setae, a complete, transverse articulation, and four interno-distal rows of short, embedded spines. Uropod with endopod extending just beyond telsonic apex, with four external and five internal spines; exopod with four external and two internal spines; entire margins of both rami, and internal margin of basis, bearing long plumose setae; apex of each ramus extended as an acute projection.

OVIGEROUS FEMALE—not known.

NON-OVIGEROUS FEMALE—differs from male only in primary sexual characteristics.

Colour of all specimens in alcohol, cream, lacking chromatophores.

Material examined

HOLOTYPE—non-ovigerous female, 11.25 mm, + one microslide (Queensland Museum reg. no. W.6335). This specimen is in much better condition than the male described and for this reason has been designated as the holotype.

Type locality—Cleveland Bay, Townsville. Soft mud on shell/mud, depth 2.7 m. Coll. P. Arnold, 05 III 1974.

PARATYPE—adult male, 10.5 mm, + three microslides (Queensland Museum reg. no. W.6336).

Locality—Cleveland Bay, Townsville. Particulate substratum, depth 3 m. Coll. P. Arnold, 11 VI 1975.

ADDITIONAL PARATYPE

Halifax Bay. Muddy sand, depth 2.7 m. Coll. P. Arnold, 25 IV 1976; 1 male.

Etymology—*Cirolana* + L. *arcus* + *cauda* i.e. arced tail.

Remarks

The only other Australian species of *Cirolana* with broadly rounded telsonic apices are: *C. elongata* Milne-Edwards, 1840 (senior synonym of *C. pumicea* Hale, 1925—see Monod, 1934: 8) which is easily distinguished by its indented uropodal endopod; *C. hermitensis* Boone, 1918, which appears distinct but is very poorly described; *C. arcuata* Hale, 1925 which has a broader frontal lamina, and very different pereonal furrowing and pleonal extensions; and *C. serrata* Bruce, 1980. *C. curta* Richardson, 1910 from Indonesia is also similar but differs in having all coxal plates with oblique furrows, rounded uropodal rami, the pleon narrower than the pereon, and in having dorsal chromatophores. *C. albicaudata* Stebbing, 1900, from New Hebrides, Japan (Thielemann 1910) and Ceylon (Barnard 1936) differs from *C. arcicauda* in the form and setation of the pereopods; the number of marginal spines on the uropodal rami; in having the exopod of pleopod 2 more truncate; and in having dorsal chromatophores.

Cirolana variguberna sp. nov.

SYNONYMS—none.

Specific description

ADULT MALE (fig. 5 a–j).

Dorsal surface of body lacking tubercles and setae. Coxal plates of pereonites 2–7 each with a curved, oblique furrow originating from postero-distal angle and extending approximately to centre of coxal plate, except in pereonite 7 where it extends almost to mid-lateral margin of pereonite. Pereonite 1 with curved, lateral furrows. Lateral margins of pereonites 4–7 with short, straight, medial furrows. Lateral margins of pleonites 1–3 acute, closely applied forming a sub-continuous edge, but latero-ventral ridges of pleon visible in lateral view below pleon edge. Lateral margins of pleonite 4 lobed with oblique ridge. Telsonic lateral margins slightly convex, apex obtusely angular bearing six long spines and a fringe of long plumose setae.

Appendages. Antennules extending just beyond mid-points of eyes, and mid-way along antennal peduncle article 5; flagellum 8-articled; all articles bearing aesthetascs, these being very long and numerous terminally. Antennae reaching level of pereonite 5; article 5 bearing a long plumose infero-distal spine, flagellum of twenty-one articles. Frontal lamina separating bases of antennules, very narrow, linear with a slightly dilated tip. Clypeus smooth. Mandible with incisor process of three teeth; two anterior teeth irregularly rounded, posterior tooth elongate, acute; molar process well formed; lacinia mobilis as curved row of spines. Maxillule with outer lobe bearing approximately eleven medially directed spines; inner lobe bearing three subequal, slightly curved, densely setose spines. Maxilla with broad inner lobe bearing five plumose setae; central lobe with terminal and internal border of long, simple setae; outer lobe with two long, terminal, simple setae. Maxillipedal endite with 1 coupling hook; palp articles 2–5 with continuous border of superior and inferior setae. Pereopod 1 with basis bearing small tuft of long setae infero-distally; ischium with several transverse rows of short setae and superior lobe bearing long setae; merus with several transverse rows of long setae, superior lobe bearing long setae and a long, stout, simple spine, and an inferior margin of eight long spines; carpus reduced with one inferior spine; propodus elongate with long inferior spines, long setae, and a short, serrated, infero-distal spine; dactylus elongate. Pereopods 2 and 3

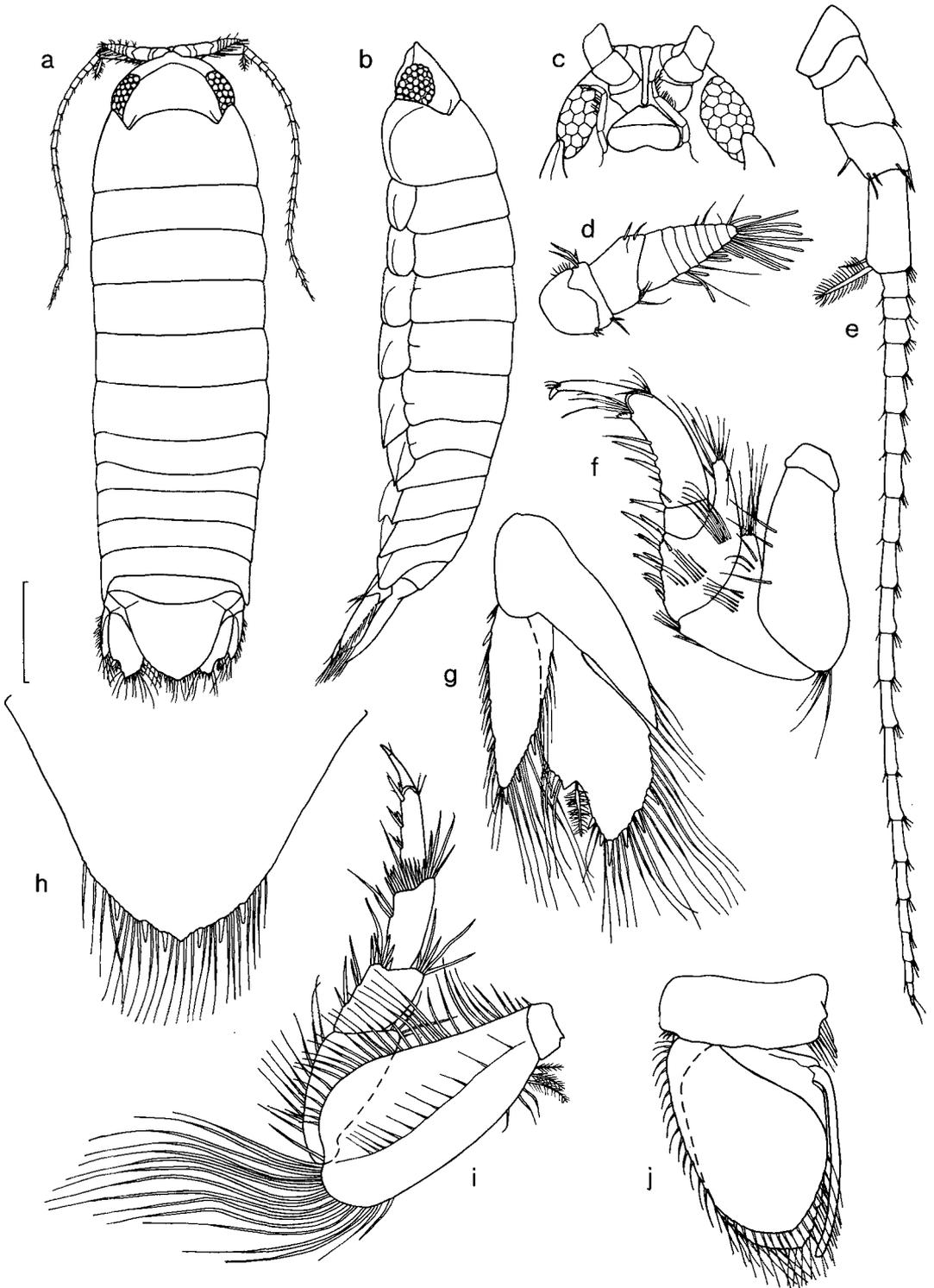


FIG. 5. *Cirolana variguberna* sp. nov. Adult male paratype. *a*, dorsal; *b*, lateral; *c*, ventral view, cephalosome; *d*, antennule; *e*, antenna; *f*, pereopod 1; *g*, uropod; *h*, telson; *i*, pereopod 7; *j*, pleopod 2. (Scale line represents 1 mm).

similar to pereopod 1 but infero-distal margin of ischium with additional serration and one long spine; superior lobe of merus with three spines; carpus not reduced, having an inferior margin of long simple spines; propodus lacking inferior spines. Pereopods 4–7 similar but becoming more slender posteriorly and setation of basis showing marked increase; bases of posterior pairs expanded. Pereopod 7 with basis bearing long infero-distal plumose setae on superior margin and median, longitudinal ridge bearing continuous fringe of plumose setae; ischium with superior-distal and inferior margins bearing long plumose setae; merus with inferior, transverse rows of spines and superior and inferior distal margins bearing long spines; carpus with one inferior group of long setae and entire distal margin bearing a dense, transverse row of long setae (a characteristic of pereopod 7); propodus with three evenly spaced, inferior groups of spines; dactylus elongate. All pereopods un-ungulate, bearing setae as well as spines. Penes absent, vasa deferentia opening directly on to surface. Pleopod 1 with endopod narrow, tapering distally, bearing short terminal and internal plumose setae in distal half; exopod sub-ovate, broadening distally, sub-equal in length to endopod, bearing short terminal and external plumose setae. Pleopod 2 with setation as in pleopod 1; endopod bearing appendix masculina with margins sub-parallel, extending beyond tip of ramus to smoothly rounded apex and curving slightly away from animal's mid-line. Pleopods 3 and 4 similar to 2, but without appendices masculinae; each with both rami lacking articulations. Pleopod 5 with rami sub-equal in distal half, and a faint median, transverse articulation; endopod sub-rectangular, naked, with broad, proximal, internal lobe. Uropod with exopod bearing three external and three long, interno-distal spines and a continuous fringe of plumose setae; endopod extending to level of telsonic apex, with pronounced notch in externo-distal margin bearing a long, plumose spine; endopod margin with one long spine proximal to notch, six spines around apex, and a continuous fringe of long plumose setae around distal margin.

OVIGEROUS AND NON-OVIGEROUS FEMALES

Differ from description of male only in primary sexual characteristics and in presence of brood pouch in the former.

Colour of all specimens in alcohol, cream, lacking chromatophores.

Material examined

HOLOTYPE—adult male, 6.17 mm (Queensland Museum reg. no. W.6337).

Type locality—Halifax Bay. Particulate substratum, depth 11 m. Coll. P. Arnold, 24 XI 1976.

PARATYPE—ovigerous female, 7.02 mm (stained erythrocin B) (Queensland Museum reg. no. W.6338).

Locality—Bowling Green Bay. Mud, depth 13 m. Coll. P. Arnold, 09 III 1975.

ADDITIONAL PARATYPES

Bowling Green Bay: Particulate substrata (soft mud, mud, muddy sand, sand, coarse sand), depth 5.6–18.2 m. Coll. P. Arnold, V 1974–VIII 1975; 3 males, 2 ovigerous females, 7 non-ovigerous females, 3 juveniles.

Cleveland Bay: Particulate substrata (including soft mud on shell/mud), depth 3–11 m. Coll. P. Arnold, VI 1975–X 1975; 1 male, 2 non-ovigerous females, 4 juveniles.

Halifax Bay: Particulate substrata (broken coral, sand, muddy sand, mud, soft mud), depth 2.7–15.5 m. Coll. P. Arnold, VIII 1974–II 1977; 49 males, 43 ovigerous females, 47 non-ovigerous females, 68 juveniles.

Etymology—*Cirolana* + L. *varus* + *gubernum* i.e. crooked rudder (uropodal endopod).

Remarks

This species is easily distinguished by the indented uropodal endopod which is present even in individuals not yet released from the brood pouch. *Cirolana elongata*, which has a slight indentation on the uropodal endopod, is easily separated by the form of the frontal lamina and coxal plates, and the broadly rounded telson.

From the relatively large numbers of *C. variguberna* available for examination it was apparent that this species breeds all the year round—a situation not unusual for shallow water populations in tropical regions—as ovigerous females were taken in most months of the year.

Cirolana luticola sp. nov.

SYNONYMS—none.

Specific description

ADULT MALE (fig. 6 a–c, h, j, l).

Dorsal surface of body lacking tubercles and setae. Coxal plates of pereonites 2–7 with curved, oblique furrows; furrows extending from postero-distal angle almost to mid-anterior margin in pereonites 2 and 3, and from postero-distal angle to approximate mid-region of coxal plates in pereonites 4–7. Postero-distal angles of coxal plates smoothly arcuate in pereonites 2 and 3 but becoming increasingly angular and acute in succeeding pereonites. Lateral margins of pereonite 1 with curved sub-marginal furrow, and of pereonites 4–7 each with a short, straight, median, medially directed furrow. Pleonite 1, except postero-lateral regions, obscured by pereonite 7. Lateral margins of pleonite 2 almost obscured by coxal plates of pereonite 7. Lateral margins of pleonite 3 acute, slightly posteriorly deflected; those of pleonite 4 blunt, rounded, with slight ventro-distal indentation. Lateral margins of pleonites 2–4 each bearing an oblique ridge. Telsonic lateral margins straight, distal region bearing six spines and many long, plumose setae either side of apex. Frontal lamina narrow, linear, separating bases of antennules in ventral view. Clypeus with anterolateral margins thickened, central region smooth.

Appendages. Antennules reaching mid-regions of eyes; 8-articled flagellum shorter than peduncle. Antennae reaching level of pereonite 3; peduncle article 5 with a prominent, infero-distal, densely setose spine; flagellum 20-articled. Mandible with lacinia mobilis as a curved row of spines; molar process slender, proximal margin concave. Maxillule with outer lobe bearing approximately twelve curved, robust spines; inner lobe bearing three sub-equal, densely setose spines. Maxilla with broad inner lobe bearing continuous border of long plumose setae; central lobe with long internal and terminal, simple setae; outer lobe with several long, terminal, simple setae. Maxillipedal endite with one coupling hook; palp articles 2–5 with dense, inferior fringe of short, robust setae, superior margins with border of long setae. Pereopod 1 robust, basis with an infero-distal group of setae; ischium with long, inferior setae, a long, stout, infero-distal spine, and a pronounced superior lobe bearing a transverse row of long, stout setae; merus with long, distal setae, a pronounced superior lobe bearing one long, robust spine and one long, robust seta, and an inferior border of eight prominent, robust spines; carpus reduced with one long, robust, infero-distal spine; propodus with two robust, inferior, median spines, the distal one being twice the length of the proximal, two long, inferior setae, a short, infero-distal, superiorly serrate spine, and a number of long, distal setae. Pereopod 2

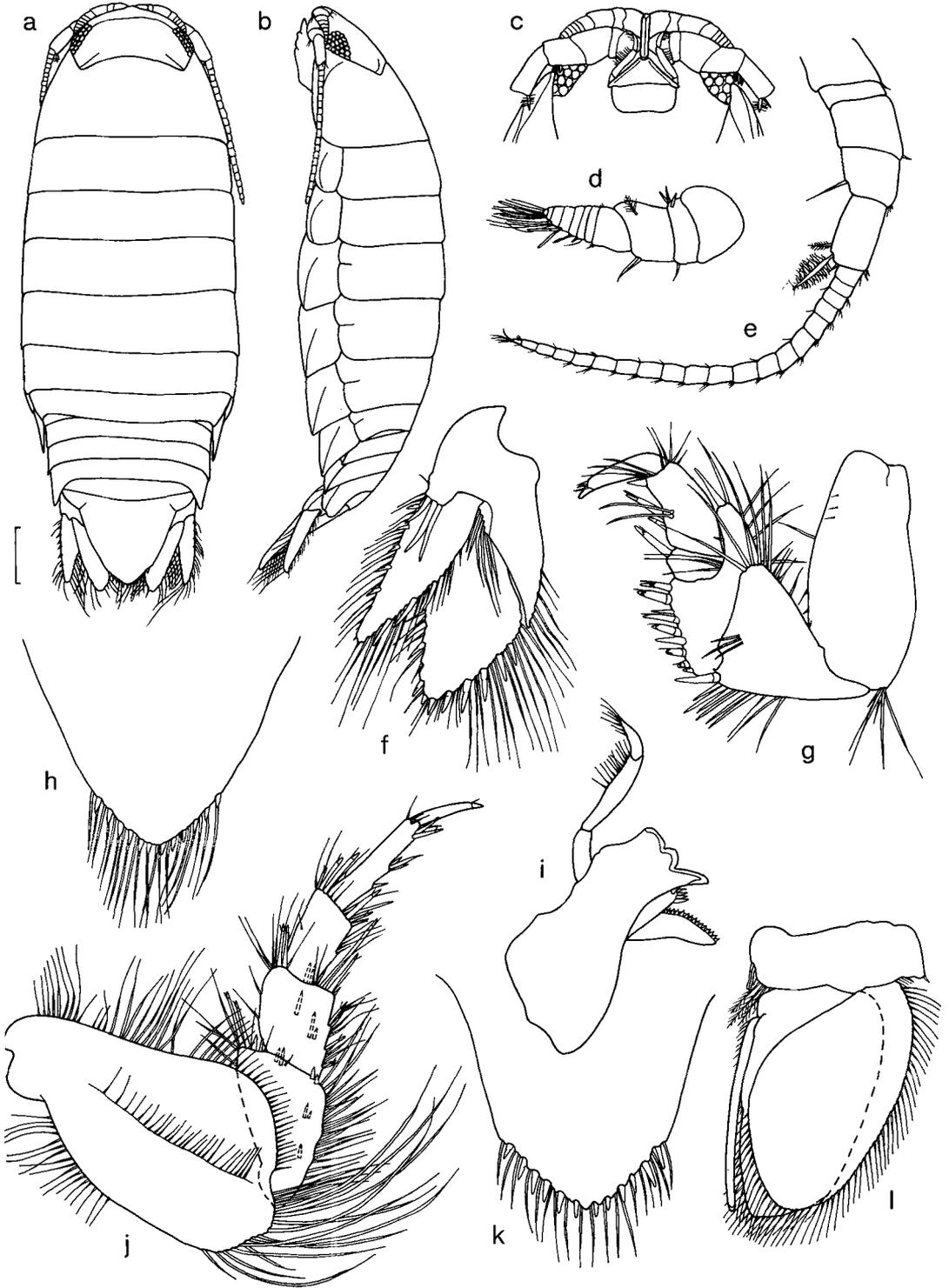


FIG. 6. *Cirolana luticola* sp. nov. Adult male paratype. *a*, dorsal; *b*, lateral; *c*, ventral view, cephalosome; *h*, telson; *j*, pereopod 7; *l*, pleopod 2. Additional adult male paratype. *f*, uropod; *k*, telson. Non-ovigerous female paratype. *d*, antennule; *e*, antenna; *g*, pereopod 1; *i*, right mandible. (Scale line represents 1 mm).

similar to pereopod 1 but the superior lobe of merus bearing three spines not one; carpus relatively longer, bearing five inferior spines; propodus having only the serrate infero-distal spine and several distal, superior setae. Pereopod 3 similar to pereopod 2 but superior lobe of ischium with one long spine as well as setae. Pereopods 4-7 similar but becoming increasingly slender and setose posteriorly and the posterior bases becoming dilated. Pereopod 7 with basis with a superior fringe of long, plumose setae, and a median, longitudinal line of setae, inferior, proximal setae, and an infero-distal fringe of long plumose setae; ischium with two infero-lateral, and three distal, groups of short spines, two long superior, distal spines, and a continuous inferior fringe of, and several superior distal, long setae; merus with two non-marginal groups of spines, three equidistant, inferior groups of spines, infero-distal and superior-distal groups of long spines, and long inferior and superior setae; carpus with long, distal groups of spines, two infero-distal spines, and several short, distal setae; dactylus slender. All pereopods uni-ungulate. Penes absent, vasa deferentia opening directly on to surface. Pleopod 1 with both rami sub-equal in length; exopod sub-ovate, broadening distally with an external and distal border of short plumose setae; endopod and distal border of short plumose setae; endopod tapering slightly to a narrowly rounded apex with a distal border of short, plumose setae. Pleopod 2 with rami similar to those of pleopod 1, but endopod relatively broader, bearing a narrow appendix masculina with a rounded apex. Pleopod 3 with rami sub-equal in length, sub-ovate, endopod tapering distally, exopod broadening distally; setation as in pleopods 1 and 2; exopod with an entire, median, transverse articulation. Pleopod 4 with rami similar to those of pleopod 3 but endopod relatively broader and only sparsely setose; exopod lacking articulation. Pleopod 5 with rami sub-equal, sub-ovate; endopod naked; exopod with entire, median, transverse articulation and external and distal border of short plumose setae. Uropodal exopod reaching level of pleotelsonic apex, bearing five equidistant spines on external margin and three spines on internal margin; endopod with three external and five internal spines; both rami with borders of long, plumose setae.

OVIGEROUS FEMALE—not known.

NON-OVIGEROUS FEMALE

Differs from description of male only in primary sexual characteristics.

Colour of all specimens in alcohol, cream, lacking dorsal chromatophores.

Material examined

HOLOTYPE—adult male, 10.4 mm (Queensland Museum reg. no. W.6339).

Type locality—Halifax Bay. Particulate substratum, depth 14.5 m. Coll. P. Arnold, 26 VIII 1976.

PARATYPE—non-ovigerous female, 7.87 mm (Queensland Museum reg. no. W6340).

Locality—Cleveland Bay. Particulate substratum, depth 11 m. Coll. P. Arnold, 26 X 1974.

ADDITIONAL PARATYPES

Bowling Green Bay: Sand, depth 1.9 m, 16 IV 1974, 1 juvenile. Soft mud, depth 16 m, 22 X 1974, 1 male. Sand, depth 1.9 m, 30 IX 1975, 1 male. Coll. P. Arnold.

Cleveland Bay: Soft mud on shell/mud, depth 8.9 m, 10 VI 1975, 1 non-ovigerous female. Coll. P. Arnold.

Halifax Bay: Particulate substrata (muddy sand, soft mud on sandy mud), depth 2.7 m to 14.5 m, VII 1975 to II 1977; 7 males, 6 non-ovigerous females, 9 juveniles. Coll. P. Arnold.

Etymology—*Cirolana* + L. lutum + icola i.e. mud + dweller.

Remarks

Within the type series slight variation occurs in the form of the telsonic margin either side of the apex (which is smoothly convex in some specimens (fig. 6 h) and obtusely angled in others (fig. 6 k)), and in the form of the lateral margins of pleonite 4, which may lack a ventro-distal indentation.

This new species bears some resemblances to the descriptions of *Cirolana rossi* Miers, 1876 from New Zealand, and to *C. tenuistylis* Miers and *C. woodjonesi* Hale—both from Australian waters. *C. rossi* differs from *C. luticola* in the more elongate, rectangular form of the eyes; the relatively broader frontal lamina; the less pronounced inferior spines on the merus, carpus and propodus of pereopod 1; in the form of the coxal plates and their oblique furrows, and in having very acutely extended lateral margins of its pleonites. In order that no confusion should exist as to the identification of *C. luticola*, *C. tenuistylis* and *C. woodjonesi* the last two species are redescribed below.

***Cirolana tenuistylis* Miers, 1884**

Cirolana tenuistylis Miers, 1884, 303, 304, 666, pl. 33; Hale, 1924, 72; Hale, 1925, 130, 136, 137; Nierstrasz, 1931, 157, 160, 161.

Description of adult male syntype (fig. 7 a-i):

Dorsal surface of body lacking tubercles and setae. Coxal plates of pereonites 2–7 with oblique, curved furrows. Furrow extending from mid-posterior margin to centre of coxal plate in pereonite 2, from postero-distal angle nearly to antero-proximal angle in pereonite 3–5 and from mid-proximal margin postero-distally but not reaching postero-distal angle, in pereonites 6 and 7. Pereonite 1 with sub-marginal, and curved antero-lateral furrows. Lateral margins of pereonites 3–7 bearing straight, medially directed furrows originating mediolaterally in pereonites 4–7 and from antero-lateral angles in pereonite 3. Anterior region of pleonite 1 obscured by pereonite 7. Lateral margins of pleonites 2 and 3 acute with ventro-lateral, pleonal ridges visible in lateral view below pleon edge. Postero-lateral margin of pleonite 4 broadly rounded with straight, oblique ridge. Telsonic lateral margins slightly convex, apex angular, slightly obtuse; distal lateral margins with border of spines and short setae (four spines on one side of apex, but possibly more originally).

Appendages. Antennules reaching anterior margins of eyes; flagellum of ten articles. Antennal peduncle articles 1 and 2 short (remainder of antennae missing from specimen). Frontal lamina narrow, linear, almost separating bases of antennules; proximal region narrow, distal region rhombic but mid-line with a raised ridge slightly constricted medially. Clypeus with antero-lateral margins thickened; central region slightly raised. Mandible with incisor process of three teeth; posterior tooth narrow, elongate. Maxillule with outer lobe bearing approximately seven robust, simple spines alternately long and short; inner lobe bearing three curved, densely setose spines. Maxilla with broad inner lobe bearing full margin of setae; central lobe with long, terminal and internal setae; outer lobe bearing three long, terminal setae. Maxillipedal palp articles 2–5 with continuous margin of long setae; endite bearing two coupling hooks. Pereopod 1 robust; ischium with superior lobe bearing long

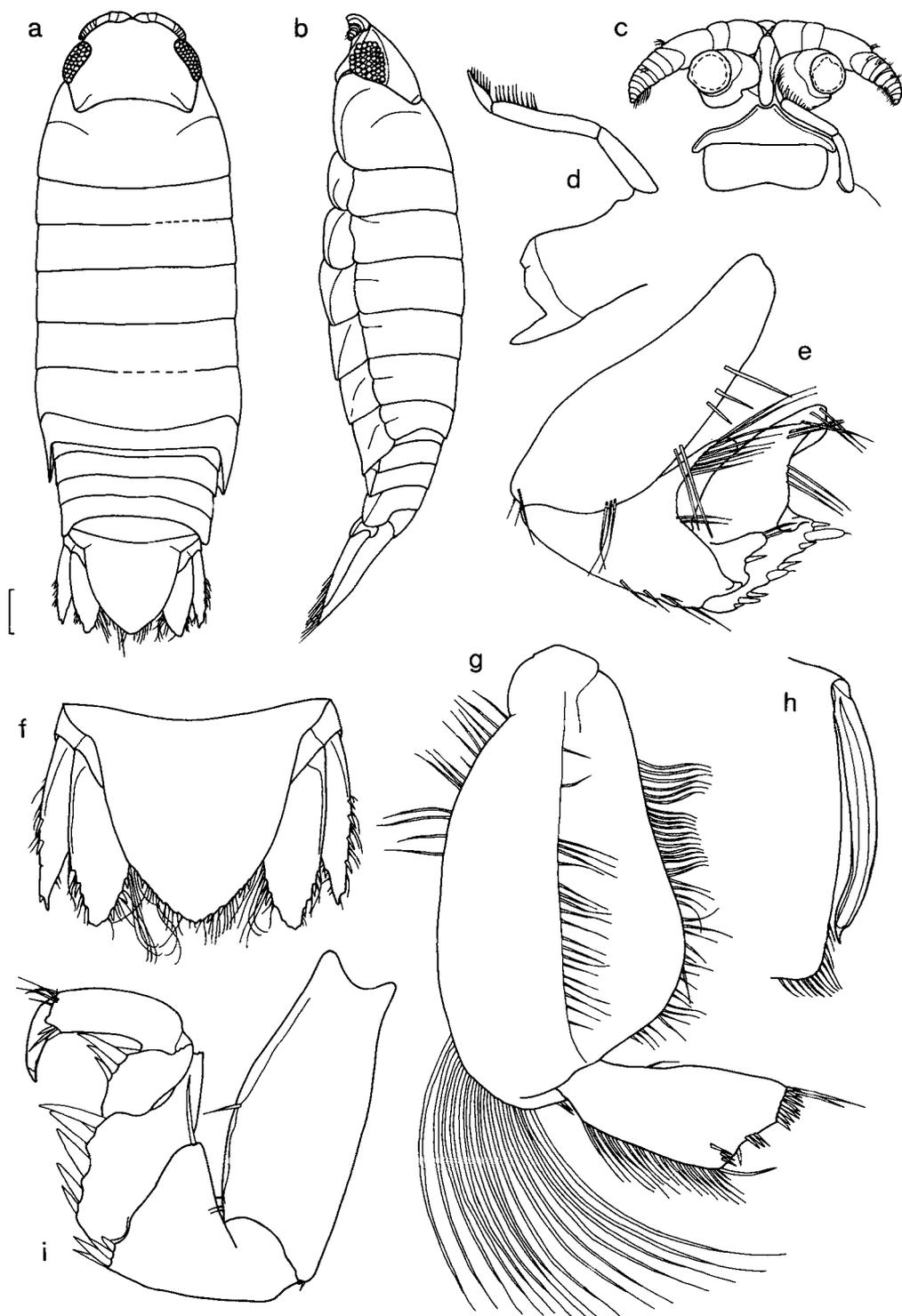


FIG. 7. *Cirolana tenuistylis* Miers. Adult male syntype (B.M.(N.H.) 1882:7). *a*, dorsal; *b*, lateral; *c*, ventral view, cephalosome; *d*, left mandible; *e*, pereopod 1 (damaged); *f*, telson and uropods; *g*, pereopod 7 (basis and ischium); *h*, appendix masculina; *i*, pereopod 3. (Scale line represents 1 mm).

setae, several setae along infero-distal margin; merus with superior lobe bearing long setae, inferior margin with border of short, stout spines (remainder of first pereopods missing). Pereopod 3 with ischium bearing a single long spine on superior lobe and several stout spines on infero-distal margin; merus with superior lobe of five long, stout spines along inferior margin; carpus with slight superior lobe and three long, stout spines on inferior margin; propodus with several distal setae. Pereopod 7 with superior margin of basis bearing continuous fringe of plumose setae, straight medial ridge and infero-proximal border with short, and infero-distal border with long, plumose setae; ischium with complete inferior border of setae and superior distal group of five spines; merus with superior distal spines, long spines infero-distally, and long setae along inferior margin; carpus with long distal and infero-medial spines; propodus with infero-distal and inferior spines. All pereopods observed, uniungulate. Penes as two minute, widely separate papillae. Pleopod 1 with rami sub-equal in length; endopod sub-rectangular, tapering slightly towards apex which bears short, plumose setae; exopod sub-ovate, broad distally, with entire external border and apex bearing short plumose setae. Pleopod 2 with rami sub-equal, sub-ovate, bearing short, plumose, terminal setae, exopod with additional external setae; endopod with appendix masculina extending almost to apex of ramus, curving slightly away from animal's mid-line and tapering only slightly to apex, which is very acute, produced, and curves towards animal's mid-line. Pleopods 3–5 not examined in detail. Uropodal endopods bearing long internal and distal external setae; approximately three spines either side of narrow, rounded apex. Exopod of uropod bearing a long apical tooth and approximately four external spines with short setae and several internal spines and setae.

Colour of specimen in alcohol, cream, lacking chromatophores.

Female—not known.

Material examined

SYNTYPE—adult male, 13.92 mm (British Museum (Natural History) reg. no. 1882: 7).

Locality—Prince of Wales Channel, North Queensland. Sand, depth 7–9 fathoms (12.8–16.4 m). Coll. Dr. Coppinger (H.M.S. 'Alert'), IX 1881.

Remarks

From the habitat data and the fact that both antennae are incomplete, it would appear that this is the male syntype figured by Miers in his original description (1884, pl. 33). Hale (1925, 137) figured a sketch by Calman of a lateral view of 'one of the syntypes' of *C. tenuistylis*. Unfortunately the form of the furrows on the coxal plates and the lateral margins of the pereonal tergites in Calman's sketch does not correspond to the situation found in the present specimen, and the conspecific status of the two specimens must be questioned. While doubt exists, it seems wise to restrict the status of the specimen figured by Miers. The present authors therefore designate the present adult male specimen (B.M.(N.H.) reg. no. 1882: 7) as the lectotype of the species *Cirolana tenuistylis* Miers, 1884; the remaining two syntypes (B.M.(N.H.) reg. no. 1882: 53) becoming paralectotypes.

C. tenuistylis is close to *C. laticola*, especially in the nature of the lateral pereonal furrows, but it differs in having a proportionally broader frontal lamina; in the setation of pereopod 1 and, most importantly, in the form of the appendices masculinae, each being proportionally broader than those of *C. laticola*, being

curved, not straight, with an extended, acute apex (presumably after which the species was named).

C. tenuistylis differs from *C. rossi* in the form of the eyes; the form of the frontal lamina; the lateral pereonal furrowing, and the form of the appendices masculinae.

***Cirolana woodjonesi* Hale, 1924**

Cirolana woodjonesi Hale, 1924, 71–73, pl. 5; Hale, 1925, 137–139; Hale, 1929, 237, 238, 247, 248; Hale, 1940, 228; Nierstrasz, 1931, 157; Naylor, 1966, 184, 194–196; Poore *et al.*, 1975, 33, 64.

Cirolana woodjonsoni: Roman, 1970, 167, 192, 195, 197 (*lapsus calami*).

Description of adult male type (fig. 8 a–i):

Dorsal surface of body lacking tubercles and setae. Coxal plates of pereonites 2–7 with oblique furrows; those of pereonites 2 and 3 being arcuate, extending from posterior margin almost to anterior margin; those of pereonites 4 and 5 being arcuate, extending from posterior margin to centre of anterior half; those of pereonites 6 and 7 being straight, extending from postero-distal angle to mid-coxal plate. Postero-distal angles of coxal plates of pereonite 2 smoothly arcuate; of pereonites 3–7 becoming increasingly acute. Lateral margins of pereonite 1 each bearing an arcuate, sub-marginal furrow; of pereonites 4–7, each with a straight, median, medially directed incision. Postero-lateral margins of pleonites 1–3 acute, slightly freely projecting. Lateral margins of pleonite 4 smoothly rounded with an oblique, straight ridge. Vento-lateral pleonal ridges visible in lateral view below pleon edge. Telsonic lateral margins smoothly convex with long plumose setae in distal half and two short spines either side of apex; apex acute with a short, blunt, median projection. Frontal lamina linear, separating bases of antennules in ventral view; lateral margins convex distally; tip rounded. Clypeus with antero-lateral margins thickened.

Appendages. Antennular flagellum 13-articled. Antennular peduncular article 5 bearing an infero-distal, densely setose spine; flagellum 18-articled. Mandible with incisor process of three unequal teeth, the posterior being the longest and most acute; palp slender, articles 2 and 3 bearing inferior borders of setae. Maxilla with broad inner lobe bearing continuous fringe of long setae; central lobe with long terminal and internal setae; outer lobe with four long, terminal setae. Maxillipedal endite with two coupling hooks. Pereopod 1 moderately robust; basis with long, superior proximal, superior distal, and infero-distal setae; ischium with several inferior, distal setae and a pronounced superior lobe bearing a transverse row of long, stout setae; merus with an inferior border of nine stout spines, and a pronounced, distally directed, superior lobe bearing two long, terminal spines and several setae; carpus reduced with one inferior spine; propodus with inferior border of five spines (the most distal being blunt and superiorly serrate) and several long setae. Pereopod 7 with basis expanded with continuous superior and inferior fringes of plumose setae, a median longitudinal ridge bearing short plumose setae and an infero-distal row of long, robust, plumose setae; ischium with continuous inferior border of long, robust setae and several short, superior distal spines; merus with an inferior border of nine short, and one long, infero-distal spines, and several superior distal setae and short spines; carpus with an inferior border of several long setae and nine spines (those infero-distally being the longest), and a group of long superior distal spines; propodus with three equidistant, inferior groups of short spines. All pereopods spinose; bases of posterior pairs becoming expanded; all dactyli uni-ungulate. Penes as minute,

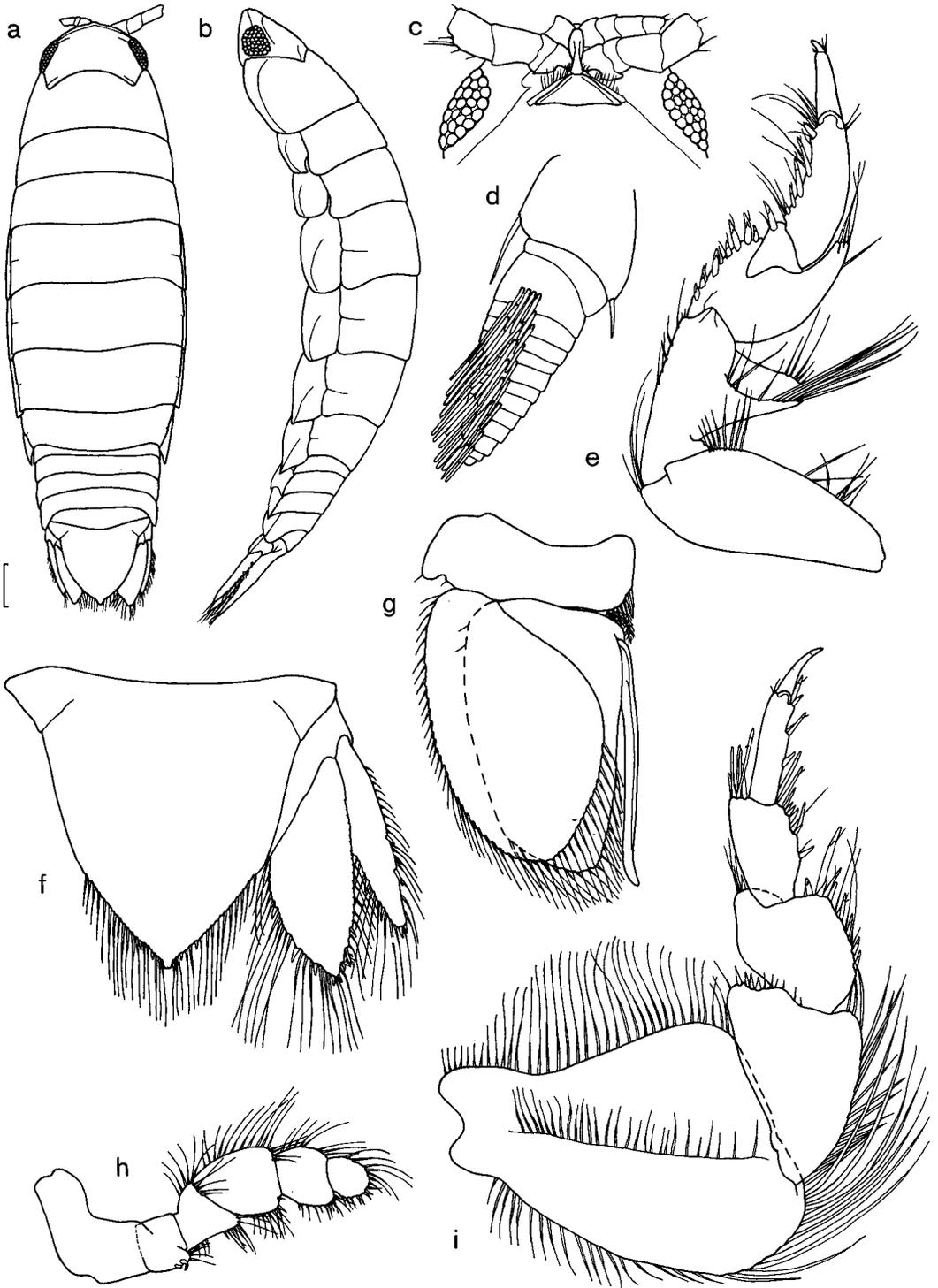


FIG. 8. *Cirolana woodjonesi* Hale. Adult male type (S.A.M.: C.228). *a*, dorsal; *b*, lateral; *c*, ventral view, cephalosome; *d*, antennule (peduncular articles 1 and 2 missing); *e*, pereopod 1; *f*, telson and uropod; *g*, pleopod 2; *h*, maxillipede; *i*, pereopod 7. (Scale line represents 1 mm).

widely separate papillae. Pleopod 1 with rami sub-equal in length; exopod sub-ovate, broadening distally with a continuous external and distal margin of plumose setae; endopod tapering distally to a rounded apex, bearing short, distal, plumose setae. Pleopod 2 with rami similar to pleopod 1 but endopod relatively broader. Appendix masculina narrow with margins sub-parallel, extending just beyond level of endopod apex to narrowly rounded tip which is deflected towards the animal's mid-line. Pleopods 3–5 not examined in detail. Uropod with each ramus lanceolate; exopod with two external, two internal and two terminal spines; endopod with three internal, two external and two terminal spines and a broad, densely setulose seta between external spines; both rami with external borders of short, and internal borders of long, plumose setae.

Colour of specimen in alcohol, cream, lacking chromatophores.

Female—not observed, but apparently differs from description of male only in primary sexual characteristics and in being a little wider (Hale, 1925, 138).

Material examined

Type—adult male, 13.8 mm, plus four microslides (South Australian Museum reg. no. C.228).

Type locality—St. Vincent Gulf, South Australia. From body cavity of a Port Jackson shark. Coll. H. Collyer.

Remarks

The differences between this species and *C. tenuistylis* have never been clearly stated. The furrowing of the coxal plates and lateral pereonal margins is similar when comparing Miers' male specimen, but in *C. tenuistylis* the coxal plate furrows end closer to the plate proximal margins. The eye of *C. woodjonesi* is more circular than that of *C. tenuistylis*. The short projection of the telsonic apex in the *C. woodjonesi* type specimen was not shown by Hale in his illustrations (1924, pl. 5; 1925, 137) and while he did not mention it as a variable character, it must be assumed that it does not occur in all specimens. The basis of pereopod 7 of *C. woodjonesi* is relatively broader than that of *C. tenuistylis*. Comparing the observed types: the basis of *C. woodjonesi* is 1.6 times as long as broad, that of *C. tenuistylis* is 1.8 times as long as broad (that of *C. luticola* is 1.7 times as long as broad).

The setation of pereopod 1 of *C. woodjonesi* differs from that of *C. luticola* in having no infero-distal spine on the ischium; the superior lobe of the merus with 2, not 1, spines, and the inferior margin of the propodus with 4, not 2, spines, in addition to the serrated infero-distal spine. The lateral furrowing of *C. woodjonesi* and *C. luticola* is similar, but in *C. woodjonesi* the furrows on the coxal plates of pereonites 4 and 5 are deflected dorsally at the posterior margin, while in *C. luticola* they extend to the postero-distal angle. The postero-lateral angles of the coxal plates of pereonite 5 in *C. woodjonesi*, unlike those in *C. tenuistylis* and *C. luticola*, are rounded not acute. The frontal lamina of *C. luticola* is relatively narrower than those of *C. tenuistylis* and *C. woodjonesi*.

The major difference, however, between *C. woodjonesi*, *C. tenuistylis* and *C. luticola* is the form of the appendices masculinae, those of *C. woodjonesi* being narrower with a tip characteristically deflected towards the animal's mid-line.

C. woodjonesi differs from *C. rossi* in its more slender form; the form of the frontal lamina; the eyes; the setation of pereopod I; the lateral pereonal furrowing; and the form of the appendices masculinae.

C. woodjonesi has so far been collected from: St. Vincent Gulf, Beachport and Elliston, South Australia (Hale 1924); off Cape Portland, Tasmania (Hale 1925); Port Phillip, Victoria (Hale 1925, Naylor 1966, Poore *et al.* 1975); New South Wales (Hale 1925); Northwest Island, Capricorn Group (Great Barrier Reef) (Hale 1940).

***Cirolana cranchii* Leach, var. *australiense* Hale, 1925**

Cirolana cranchii Leach, var. *australiense* Hale, 1925, 141–143; Hale, 1927, 315.

Cirolana cranchii australiense: Hale, 1929, 247–249.

Cirolana cranchi-australiensis: Nierstrasz, 1931, 158.

Description of specimens from Townsville:

ADULT MALE, 5.7 mm (fig. 9 a–l).

Dorsal surface of body lacking tubercles and setae. Coxal plates of pereonites 2–7 each with oblique, curved furrow extending from postero-distal angle to mid-proximal margin in pereonites 4–7, but almost to antero-proximal angle in pereonite 3, and to mid-anterior margin in pereonite 2. Pereonite 1 and coxal plates of pereonites 2 and 3 bearing additional sub-marginal furrow. Postero-distal angles of coxal plates of pereonites 2 and 3 smoothly arcuate; those of pereonites 4–6 with distal margin straight and posterior margin convex with slight, blunt, apical projection; those of pereonite 7 blunt, lacking apical projection. Anterolateral angles of pereonites 2–7 isolated by oblique furrows. Lateral margins of pleonite 2 acute, posteriorly deflected, just freely projecting; those of pleonite 3 blunt, posteriorly deflected; those of pleonite 4 narrowly rounded, terminating dorsal to those of pleonite 3, not reaching lateral margins of body. Telsonic lateral margins straight; apex narrowly rounded with eight spines and a terminal margin of short, plumose setae.

Appendages. Antennules reaching posterior margins of eyes; peduncle subequal in length to 14-articled flagellum. Antennae reaching level of pereonite 4; flagellum 24-articled. Frontal lamina almost separating bases of antennules; broadly pentagonal, lateral margins sub-parallel. Clypeus short, smooth. Mandibles with incisor process of three uneven teeth; those of left mandible less pronounced than those of right; posterior tooth of each mandible elongate, acute; molar process and palp well formed; lacinia mobilis as a row of simple spines. Maxilla with broad inner lobe bearing two proximal, curved plumose spines and a border of long, simple setae; central lobe bearing long, terminal and internal setae; outer lobe bearing four long simple setae. Maxillipedal endite with two coupling hooks. Pereopod 1 robust; inferior margins of ischium, merus, carpus and propodus lined with a dense fringe of long setae; ischium with superior lobe bearing several simple spines; merus with superior lobe bearing several setae; carpus reduced; propodus with acute inferior spine and stout, blunt, infero-distal spine; dactylus short. Pereopods 2 and 3 similar, each less robust than pereopod 1, lacking inferior setae; ischium with superior lobe bearing simple spines (one, at least, long), and short, infero-distal spines (more pronounced on pereopod 3); merus with inferior margin of stout spines and superior lobe with simple spines; carpus with several infero-distal spines; propodus with two separate, inferior spines and one stout, infero-distal spine; dactylus short. Pereopods 4–7 becoming increasingly slender; each with ischium, merus, carpus and propodus bearing inferior rows of spines; ischium, merus and carpus with superior distal groups of spines. Excepting pereopod 1, all pereopods with few setae; bases of posterior pairs not expanded. All dactyli bi-ungulate; secondary unguis small. Penes absent, vasa

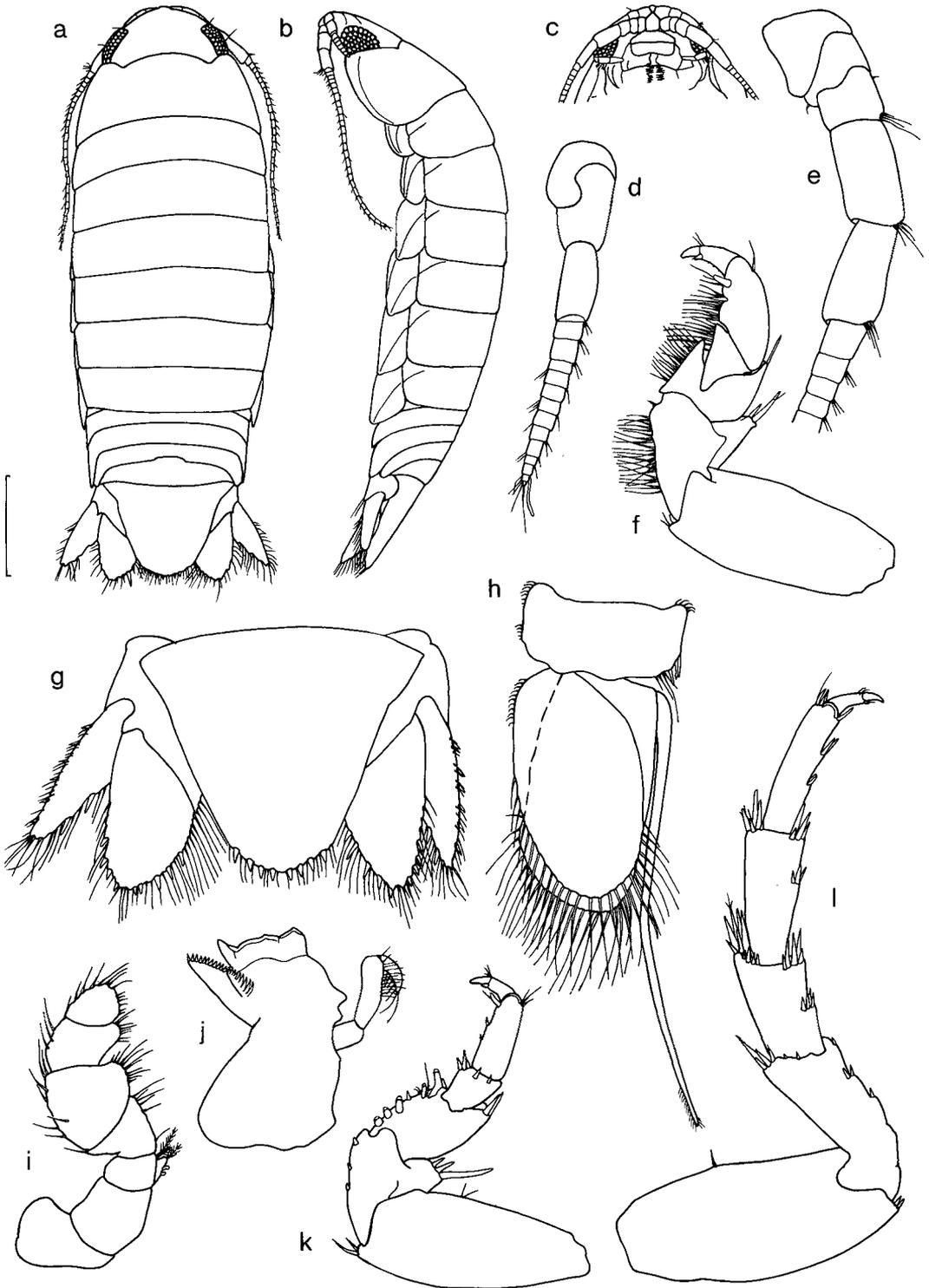


FIG. 9. *Cirolana cranchii* var. *australiense* Hale. Adult male. *a*, dorsal; *b*, lateral; *c*, ventral view, cephalosome; *d*, antennule; *e*, antennal peduncle and proximal flagellum; *f*, pereopod 1; *g*, telson and uropods; *h*, pleopod 2; *i*, maxillipede; *j*, left mandible; *k*, pereopod 2; *l*, pereopod 7. (Scale line represents 1 mm).

deferentia opening directly onto surface. Pleopod 1 with endopod sub-rectangular, twice as long as broad, sub-equal in length to elliptical exopod; endopod with terminal, and exopod with terminal and externo-distal, long, plumose setae. Pleopod 2 with endopod rectangular just larger than elliptical exopod; setation as in pleopod 1; endopod with appendix masculina, twice length of ramus, tapering to a narrowly rounded, setose tip. Pleopods 3 and 4 sub-equal; each with elliptical exopod slightly larger than sub-rectangular endopod, bearing a complete, median, transverse articulation; endopod with terminal, and exopod with terminal and external, margin of long plumose setae. Pleopod 5 similar to pleopods 3 and 4 but exopod relatively wider and endopod naked, relatively smaller, with a slight, proximal, internal lobe. Uropod with both rami lanceolate; exopod with three long, internal, and six short external, spines, short external, and long internal, setae; endopod with plumose setae and four long spines either side of the apex.

OVIGEROUS AND NON-OVIGEROUS FEMALES

Differ from description of male in primary sexual characteristics, the presence of a brood pouch in the former, and by lacking the inferior border of setae on pereopod 1.

Colour of all specimens in alcohol, cream ventrally, cream-brown dorsally due to presence on dorsal surface of cephalosome, pereon and pleon of very fine brown chromatophores.

Material examined

Horseshoe Bay, Magnetic Island. Dead coral, mid-shore. Coll. D. M. Holdich, 25 IV 1976; 2 males and 1 ovigerous female; 1 non-ovigerous female, 1 juvenile.

Kissing Point, Townsville. Rock crevice, mid-shore. Coll. D. M. Holdich, 11 V 1976; 1 non-ovigerous female.

Ross River entrance, Townsville. In washings from wood found in open sand region near stream coming from industrial area, intertidal. Coll. D. M. Holdich, 23 VI 1976; 1 juvenile.

Picnic Bay, Magnetic Island. From semi-permanent wood amongst coral at top of coral zone, mid-shore. Coll. D. M. Holdich, 09 VII 1976; 2 juveniles.

Kissing Point, Townsville. From branch of tree wedged in rocks, mid-shore. Coll. D. M. Holdich, 10 VII 1976; 1 male, 1 ovigerous female (Queensland Museum reg. no. W.7921), 3 non-ovigerous females.

Townsville Harbour. Illuminated side of floating pontoon among barnacles, tubeworms and algae. Coll. D. M. Holdich, 11 VIII 1976; 1 male.

Remarks

Some of the males in the present material had the appendix masculina shorter than that shown in fig. 9h, extending just beyond the level of the endopod apex.

Naylor (1961, 14, 15) referred 5 male specimens of *Cirolana* from the Chatham Islands to Hale's *C. cranchii* var. *australiense* but raised this variety to the level of species as '*Cirolana australiense* n. sp.'. At present some doubt exists whether Naylor's specimens and Hale's specimens are in fact the same species (Bruce, personal observation; Jansen, personal communication) and until this situation has been clarified, it is considered prudent to retain Hale's varietal name for the present specimens, which agree with his description. Naylor (1966, 184, 185) also records '*Cirolana australiense*' from Port Phillip Bay, Victoria, but it is not known whether

these specimens belong to his '*C. australiense* n. sp.' or to Hale's *C. cranchii* var. *australiense*. As Hale's variety was erected for specimens from South Australia, New South Wales and Victoria it seems probable that the latter will be found to be the true situation.

C. parva Hansen, 1890 is very close to *C. cranchii* var. *australiense* but appears to prefer the cleaner waters associated with coral reefs. The only major character separating these two species is the inferior border of setae on pereopod 1 of the adult male of *C. cranchii* var. *australiense*. This is never found in the adult male of *C. parva* but unfortunately may also be absent in *C. cranchii* var. *australiense* (personal observation and Hale, 1925, 142) thus making the separation of these two species difficult. A further observation is that *C. parva* always has a domed telson, never flattened, and never attenuated as in some *C. cranchii*.

Cirolana schioedtei Miers, 1884

Cirolana schioedtei Miers, 1884, 302, 303, 665, pl. 33; Nierstrasz, 1918, 103; Nierstrasz, 1931, 151, 160, 161; Hale, 1925, 148–150.

Description of specimen from Townsville:

NON-OVIGEROUS FEMALE, 15.73 mm (fig. 10 a–l).

Body, anterior to pereonite 5, newly moulted, soft, deformed. Eyes obvious. Dorsal surface of body lacking tubercles and setae. Coxal plates of pereonites 3–7 (at least) with oblique, curved furrows extending from postero-distal angles to mid-proximal margin. Postero-distal angles of coxal plates becoming more acute posteriorly. Lateral margins of pereonites 4–7 (at least) with oblique furrow isolating antero-lateral angle. Lateral margins of pleonite 2 very acute, each with an oblique ridge; those of pleonite 3 acute, each with an oblique ridge, extending ventrally and posteriorly beyond level of other pleonites, freely projecting; those of pleonite 4 short, just acute. Telsonic lateral margins slightly convex bearing long setae; distal half with approximately six long spines either side of acute apex.

Appendages. Antennular flagellum of twenty-nine short, setose articles. Antennal flagellum of fifty-eight articles, proximal articles broader than long, distal articles longer than broad. Frontal lamina broad, widening distally with broadly rounded, freely projecting tip. Mandible with incisor process of three unequal teeth; posterior tooth longest; acute; lacinia mobilis of curved row of spines; molar process and palp well produced. Maxillule with outer lobe bearing nine long, curved setae; those distally being inferiorly crenulate; inner lobe bearing three curved, densely setose spines, the proximal one being the longest. Maxilla with inner lobe bearing border of long setae, those proximally being plumose and longer than remainder; central lobe with terminal and internal, long, simple spines; outer lobe with five long, terminal, simple spines. Proximal, external margin of maxilla with a short row of five plumose setae. Maxillipedal endite with one coupling hook; palp articles 2–5 with continuous inferior margin of long plumose setae; articles 2 and 3 with continuous margin of, and articles 4 and 5 with several, superior setae. Pereopod 1 with basis bearing several short, infero-distal setae only; ischium with superior lobe bearing long setae, inferior margin naked; merus with superior lobe bearing long setae, inferior margin sinuous bearing five stout pegs and several setae, infero-distal, posterior margin bearing a deep, narrow incision; carpus reduced with a single infero-distal spine; propodus with one infero-distal and two inferior, transverse rows of spines, infero-distal row composed of one wide, short spine and several long, slender

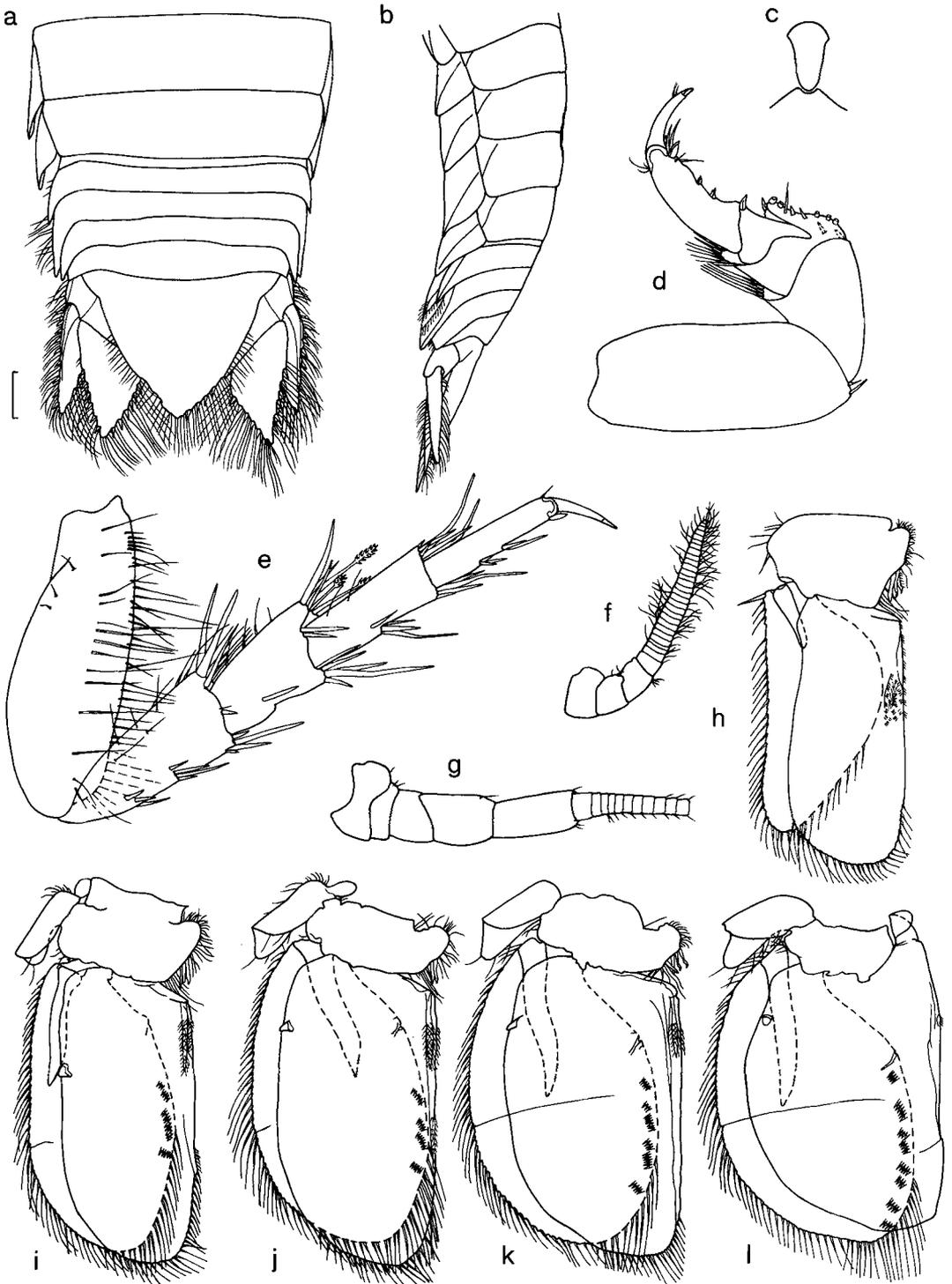


FIG. 10. *Cirolana schioedtei* Miers. Non-ovigerous female. *a*, dorsal, posterior half; *b*, lateral, posterior half; *c*, frontal lamina; *d*, pereopod 1; *e*, pereopod 7; *f*, antennule; *g*, antennal peduncle and proximal flagellum; *h-l*, pleopods 1-5 respectively. (Scale line represents 1 mm).

spines. Pereopods 2 and 3 similar; each carpus less reduced than in pereopod 1 becoming more setose and spinose; inferior margins of merus and carpus bearing long, stout spines. Pereopods 4–7 similar but becoming longer posteriorly. Pereopod 7 with basis bearing superior border, and a longitudinal, medial line of long setae; ischium with distal, superior and inferior groups of very long spines, superior setae, and two equidistant, inferior, transverse rows of long spines; merus with superior setae, very long superior distal spines (some being plumose), very long infero-distal spines, and one inferior, transverse row of long spines; carpus with very long distal superior and inferior spines and one inferior, transverse row of spines; propodus with two inferior, transverse rows of spines and one infero-distal spine. All pereopods unungulate. Pleopod 1 with endopod sub-rectangular with short, terminal setae and an internal region of fine setae and microtrichia in proximal half; exopod with a distal and external border of short, plumose setae and a short, proximal, external, linguiform process. Basis of pleopod 2 prominent, with external fold of cuticle, endopod with internal proximal region of fine setae and microtrichia, and a small, external, sub-triangular lappet; exopod with four unequal, medio-internal rows of short, embedded spines; a long, proximal, external, linguiform process, and a short, external, distal, marginal fold. Pleopod 3 similar to 2, but rami proportionally broader. Pleopod 4 differing from 3 in having six rows of embedded spines and a longer external fold (i.e. partial articulation) on the exopod, and in having both rami proportionally broader. Pleopod 5 similar to 4 but with eight rows of embedded spines on exopod, and endopod naked with a narrow, proximally directed, internal lobe. Uropod with both rami with internal and external borders of long plumose setae; endopod with six long spines either side of apex; exopod with eight long, external, and four internal spines.

Colour of specimen in alcohol, cream, lacking chromatophores.

ADULT MALE

Not observed but apparently differing from female in primary sexual characteristics and in the telson which has 'dorsum obscurely medianly carinate, for the greater part densely set with short hairs, leaving bare the basal area, a narrow median portion, and a narrow marginal part' (Hale, 1925, 149).

OVIGEROUS FEMALE—not observed.

Material examined

Halifax Bay, Townsville. Mud on sandy mud, depth 16.3 m. Coll. P. Arnold, 22 X 1974; 1 non-ovigerous female.

Remarks

This species can be distinguished from all others by the aberrant nature of the pleopods with their folded basal lobes, and external linguiform processes. (Similar linguiform processes occur in *Exciorolana chiltoni* (Richardson) (Monod 1976, 148 as *E. kinkaidi* (Hatch)), *Cirolana schioedtei* has previously been recorded from: Arafura Sea (Miers 1884, Nierstrasz 1931); Torres Straits (Miers 1884); Northern Territory (Hale 1925); Broome, Western Australia (Hale 1925).

Genus *Neocirolana* Hale

Neocirolana Hale, 1925, 153, 154; Jones, 1976, 212.

Generic diagnosis

Marine Cirolanidae with diagnosis as for *Cirolana*, but with a relatively narrow incisor edge to mandible, and antennular peduncle always 2-articled.

Type species—*Neocirolana obesa* Hale, 1925.

Neocirolana bicrista sp. nov.

SYNONYMS—none.

Specific description

ADULT MALE (fig. 11 d-l).

Dorsal surface of cephalosome, pereon and pleon lacking tubercles and setae. Coxal plates of pereonite 2 lacking furrows. Coxal plates of pereonites 3–7 with oblique furrows extending from postero-distal angles to antero-proximal angles. Postero-distal angles of coxal plates of pereonites 2 and 3 smoothly arcuate; those of pereonites 4–7 becoming increasingly acute. Lateral margins of pereonites lacking obvious furrows. Lateral margins of pleonites 1–4 acute, closely applied, forming a continuous margin. Telson with a narrow, straight, smooth carina either side of the mid-line, extending almost full length of telson. Lateral margins of telson slightly convex; apex truncate bearing six blunt spines and a fringe of extremely short setae. Frontal lamina not separating bases of antennules; three times as long as maximum breadth; tip triangular, acute, stem with lateral margins concave.

Appendages. Antennules reaching posterior margins of eyes; flagellum of eight articles. Antennae reaching level of pereonite 3; flagellum of thirteen setose articles. Mandible with incisor process narrow, with three uneven teeth, the posterior one being acute; molar process well produced, wide, with an irregular row of teeth; lacinia mobilis as a curved row of spines; palp long but stout. Maxillule with outer lobe bearing approximately nine simple spines; inner lobe with three straight, densely setose spines, the distal one being the shortest and the proximal one being the longest. Maxilla with broad inner lobe bearing plumose setae; central lobe broad with three long, terminal, simple setae and a row of short simple setae; outer lobe narrow with two long, simple setae. Maxillipedal endite with one coupling hook. Pereopod 1 robust; merus with two long superior setae; carpus reduced with one spine and one seta inferiorly; propodus curved, inferior margin concave with one proximal, and one distal stout spine; dactylus curved, elongate with long unguis. Pereopods 2 and 3 sub-similar, less robust than pereopod 1; each carpus less reduced; ischium and merus each with superior lobe bearing one or two long, simple spines. Pereopods 4–7 sub-similar but becoming more slender posteriorly; each pereopod slender, dactylus and unguis very elongate; inferior and superior distal margins of ischium, merus, carpus and propodus bearing row of spines. Superior distal margin of carpus of pereopod 6 with one spine sub-equal to length of propodus. All pereopods only sparsely setose, uni-ungulate, bases not expanded. Penes absent, vasa deferentia opening directly onto surface. Pleopod 1 with sub-ovate exopod just longer than sub-rectangular endopod; endopod twice as long as maximum width with sinuate external margin and terminal plumose setae half length of ramus; exopod with external and long, terminal, plumose setae. Endopod of pleopod 2 with appendix masculina $1\frac{1}{4}$ times length of ramus, arising from proximo-internal angle and tapering to an acute tip; both rami with setal fringes as in pleopod 1. Pleopod 3 with rami sub-equal, sub-ovate; endopod slightly truncate with sparse terminal setation; exopod with complete articulation half-way along length and short terminal and external setae. Pleopod 4 sub-similar to pleopod 3 but exopod slightly longer than endopod. Pleopod 5 with exopod slightly broader and longer than naked endopod; endopod with proximal, internal, proximally directed lobe; exopod with short, terminal and external setae and a complete articulation half-way along its length. Uropodal exopod with three external spines, three long interno-distal spines and several long, internal, plumose setae; endopod extending to level of telsonic apex,

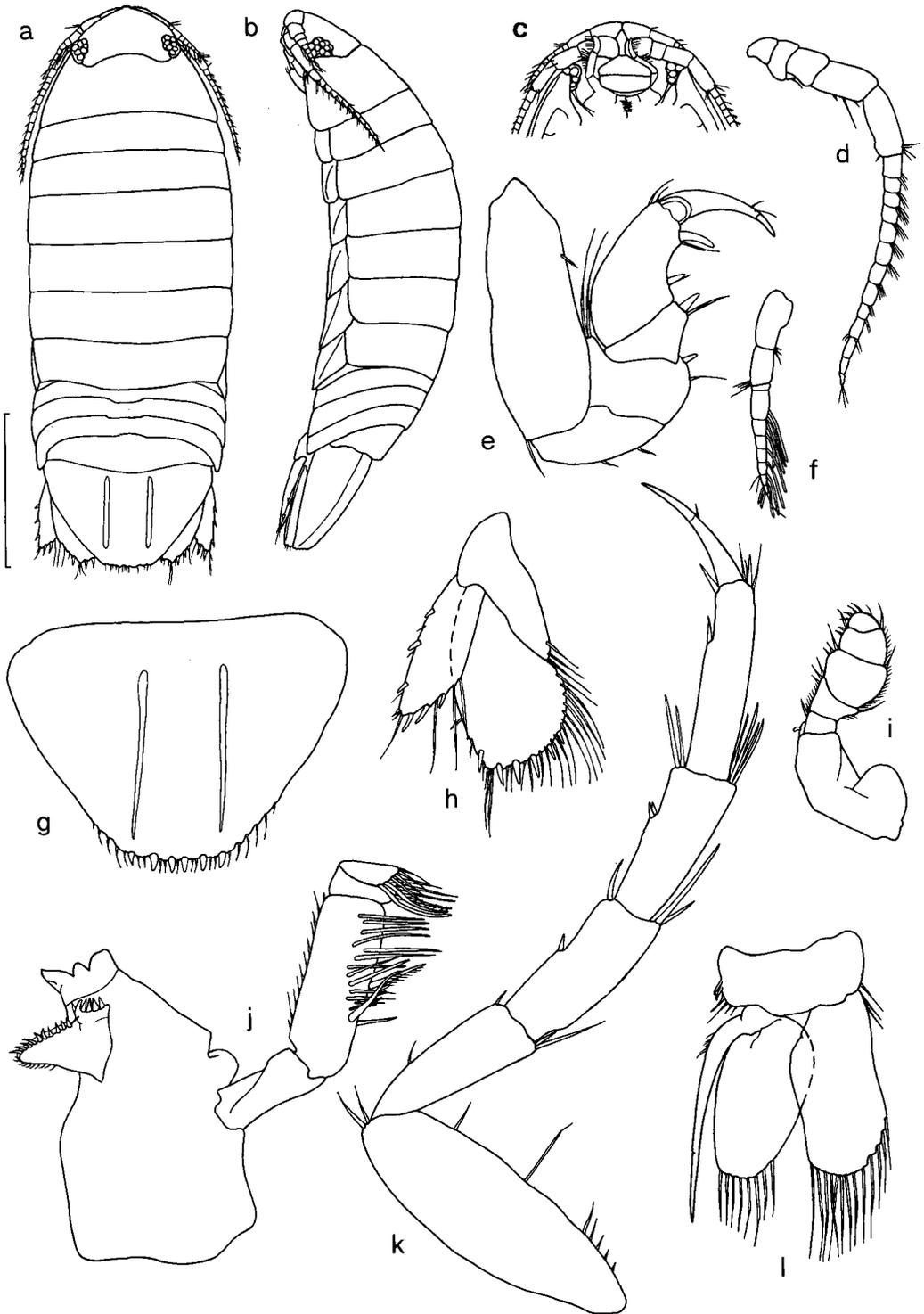


FIG. 11. *Neocirolana bicrista* sp. nov. Non-ovigerous female holotype (Q.M.: W.6330). *a*, dorsal; *b*, lateral; *c*, ventral view, cephalosome. Adult male paratype (Q.M.: W.6331). *d*, antenna; *e*, pereopod 1; *f*, antennule; *g*, telson; *h*, uropod; *i*, maxillipede; *j*, right mandible; *k*, pereopod 7; *l*, pleopod 2. (Scale line represents 1 mm).

with six long, terminal spines and a terminal and interno-distal margin of plumose setae.

OVIGEROUS AND NON-OVIGEROUS (holotype, fig. 11 a-c) FEMALES

Differ from description of male only in primary sexual characteristics and presence of brood pouch in former.

Colour of all specimens in alcohol, cream, lacking chromatophores.

Material examined

HOLOTYPE—non-ovigerous female, 3.68 mm. (Queensland Museum reg. no. W.6330).

This specimen is in much better condition than the male described and has therefore been designated as the holotype.

Type locality—Halifax Bay, Townsville. Particulate substratum, depth 11 m, coll. P. Arnold, 25 V 1976.

PARATYPE—adult male, 3.62 mm, + 3 microslides. (Queensland Museum reg. no. W.6331).

Locality etc. as for holotype.

ADDITIONAL PARATYPES

Locality etc. as above; 1 ovigerous female (Queensland Museum reg. no. W.6332), a second ovigerous female, 1 non-ovigerous female.

Etymology—*Neocirolana* + L. bi + crista i.e. having two crests (on telson).

Remarks

This species is easily distinguished from *N. obesa* Hale, 1925, the only other species in the genus, by its two telsonic ridges and its non-indented uropodal endopods.

Species of *Cirolana* have been described with many of the characters used by Hale in his generic diagnosis of *Neocirolana* e.g. bi-ungulate pereopods, short pleon, basal attachment of appendix masculina to endopod of pleopod 2, well produced inner processes of uropods, and 2-articled antennular peduncle. Jones (1976, 212) suggests that the antennular peduncle may be 3-articled with the third article reduced, but Hale discussed this question and decided that the reduced article was part of the flagellum, as it occurs in some species of *Cirolana* which also possess three obvious peduncular articles (Hale 1925, 147, 148). *Cirolana arcicauda* (fig. 4 d) illustrates Hale's argument. The only remaining single character separating *Neocirolana* from *Cirolana* is the narrow cutting edge of the mandible in Hale's genus (Jones 1976, 212) and Hale obviously considered this to be the most important distinguishing character, as he used it to separate the two genera in his key (Hale 1925, 129). Although *N. bicrista* has uni-ungulate pereopods the presence of species of *Cirolana* with bi-ungulate pereopods suggests that this character can have too much importance attached to it. The presence of the narrow mandibular cutting edge (in conjunction with the 2-articled antennular peduncle) has led to the placement of this new species in the genus *Neocirolana*.

Genus *Exciorolana* Richardson

Exciorolana Richardson, 1912, 201.

Exciorolana: auct.

Generic diagnosis

Marine Cirolanidae with rostral point extended anteriorly; often dilated distally as an inter-antennal plate. Clypeus freely projecting. Antennular peduncular article

1 not articulated at right angles to remainder of antennule. Mouthparts as in *Cirolana*, some species, however, with mandibular palp 2-articled. Pleopod 1 not hardened as a ventral operculum. Endopod of pleopod 2 of male with appendix masculina arising from proximal half of internal margin. Most species with endopods of pleopods 3–5 naked. External margins of basis of pleopods formed as a lobe. Pleon with five free terga. Lateral margins of pleonites 1–5 reaching lateral margins of body. External margin of uropodal exopod naked.

Type species—*Exciorolana orientalis* (Dana, 1853).

Exciorolana orientalis (Dana, 1853)

Cirolana (Eurydice) orientalis Dana, 1853, 773, pl. 51.

Cirolana orientalis: Hansen, 1890, 353, 354, 411, 412, pl. 4; Stebbing, 1900, 633; Thielemann, 1910, 17, 18; Richardson, 1910, 4; Richardson, 1912, 201.

Exciorolana orientalis: Hale, 1925, 156–158; Hale, 1929, 247; Nierstrasz, 1931, 148, 149; Pichon, 1964; Pichon, 1967; Roman, 1970, 174–176, 180, 189, 192, 194, 197; Jones, 1971, 213, 214, 220, 221, 223, 224; Jones, 1974, 202, 209; Jones, 1979, 677–681.

Exciorolana orientalis: Fishelson, 1971, 128 (err. typ.).

Description of specimens from Townsville:

ADULT MALE, 5.0 mm (fig. 12 h–j).

Dorsal surface of body lacking tubercles and setae. Cephalosome with antero-medial extension dilated distally as a sub-quadrate plate. Coxal plates of pereonites 2–7 with curved, oblique furrows extending from posterior margin to antero-proximal angle in pereonites 2 and 3, and from postero-distal angle to mid-proximal margin in pereonites 4–7. Postero-distal angles of coxal plates of pereonite 2 smoothly arcuate; those of pereonite 3 sub-rectangular; those of pereonites 4–7 becoming increasingly acute. Antero-lateral angles of pereonites 4–7 isolated by oblique furrows. Lateral margins of pleonites 3 and 4 acute, slightly freely projecting; those of pleonite 5 sub-rectangular. Telson with a large elliptical depression either side of anterior mid-line; lateral margins slightly convex, naked; apex broadly rounded bearing two short, apical spines and a fringe of short plumose setae. Frontal lamina broad, trapeziform, distally twice as broad as proximally.

Appendages. Antennular flagellum with eight stout articles. Antennal flagellum 15-articled. Mandible with incisor process of three unequal teeth; lacinia mobilis of a curved row of spines; molar process and palp well produced. Maxillular outer lobe with thirteen curved spines, some inferiorly serrate; inner lobe with three sub-equal, densely setose spines. Maxilla with inner lobe bearing fringe of long setae, proximal setae obviously plumose; central lobe with long terminal and internal setae; outer lobe with four long, terminal setae. Maxillipedal endite with one coupling hook. Pereopod 1 moderately slender; basis with several short, infero-distal setae; ischium with several short, superior distal spines; merus with several long, thin, superior distal spines and an inferior row of four blunt pegs and one acute, infero-distal spine interspersed with several short setae; carpus reduced with one blunt, infero-distal spine and a short seta; propodus with inferior border of four equidistant, robust spines and several long, infero-distal setae. Pereopods 2 and 3 similar, differing from pereopod 1 in having a less reduced carpus with three inferior spines, the central one being the largest; merus with six blunt pegs and several short spines on inferior margin, superior lobe with one long, robust, and several long fine, spines; ischium with several infero-distal spines and a long robust spine on the superior lobe. Pereopod 4 robust; basis with several infero-distal setae; ischium with long and short

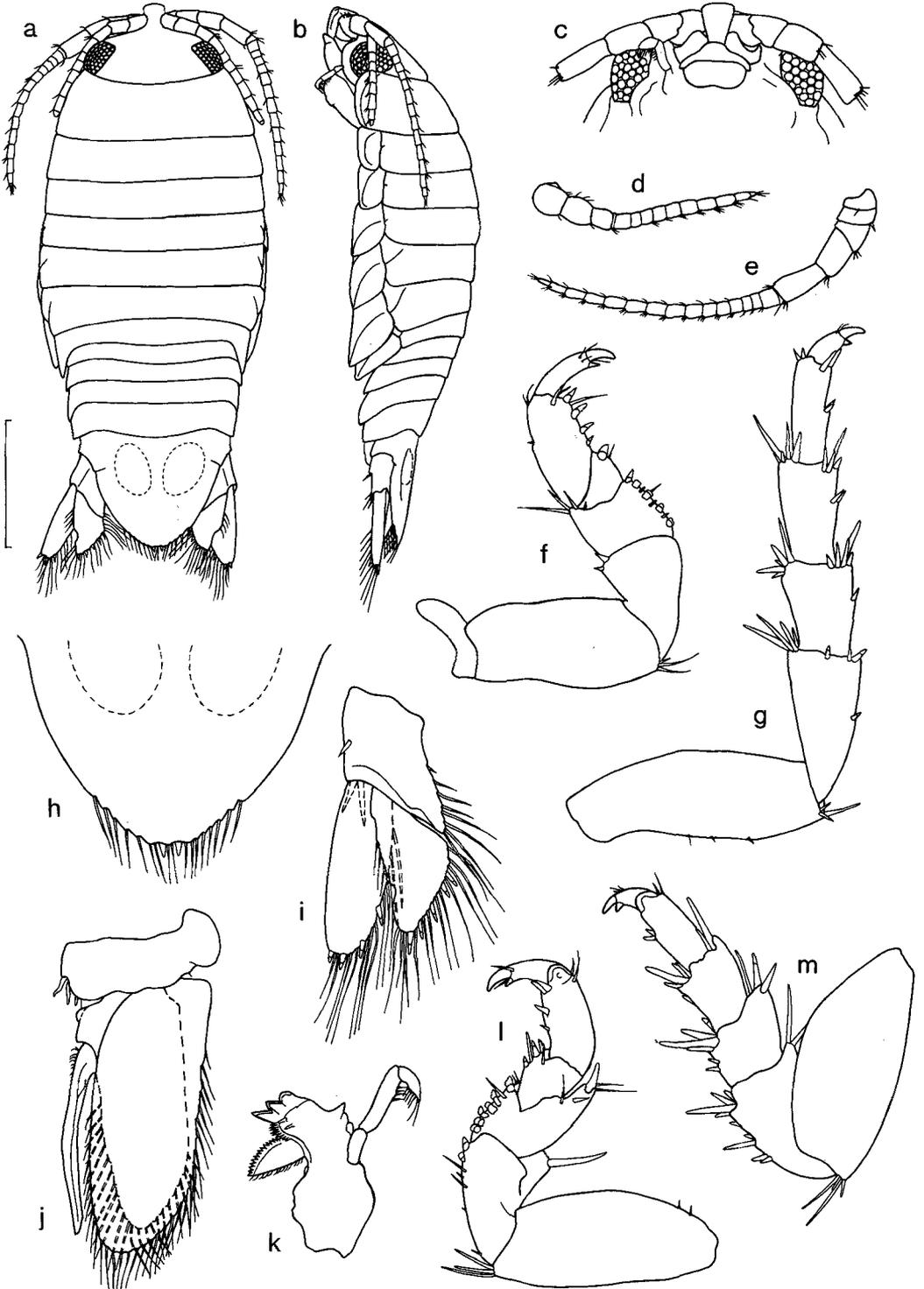


FIG. 12. *Excirolana orientalis* (Dana). Juvenile. *a*, dorsal; *b*, lateral showing reduced pereonite 7; *c*, ventral view, cephalosome. Non-ovigerous female. *d*, antennule; *e*, antenna; *f*, pereopod 1; *g*, pereopod 7; *k*, right mandible; *l*, pereopod 2; *m*, pereopod 4. Adult male. *h*, telson; *i*, uropod; *j*, pleopod 2. (Scale line represents 1 mm).

spines along inferior margin and stout setae on superior lobe; merus with several short, inferior, and long infero-distal and superior distal, spines; corpus with short, inferior, and long infero-distal and superior distal, spines; propodus with two short, infero-medial spines and several short, superior distal setae; dactylus short, bi-ungulate. Pereopods 5 and 6 similar to pereopod 4 but becoming more slender. Pereopod 7 with basis bearing several infero-distal setae; ischium with a short infero-medial, short infero-distal, and long superior distal spines; merus with a short, infero-medial, and long infero-distal and superior distal, spines; carpus and propodus each with one inferior, transverse row of short spines, and long infero-distal and superior distal spines. All pereopods bi-ungulate; bases of posterior pairs not expanded. Penes produced, separate, each twice as wide as long. Pleopod 1 with rami very slender, exopod $2\frac{1}{2}$ times longer than broad, slightly longer than, and almost twice as broad as, endopod; both rami sub-rectangular with narrowly rounded apices and short, plumose terminal and distal external setae. Pleopod 2 with rami similar to pleopod 1 but endopod proportionally broader, bearing an appendix masculina which arises near the proximo-internal angle and extends to level of ramal apex. Appendix masculina broad, tapering only slightly along length, but abruptly at apex, with a narrowly rounded tip. Exopod of pleopod 3 sub-elliptical with terminal and external plumose setae and a median, transverse fold in the external margin; endopod naked, $\frac{2}{3}$ breadth of, and shorter than, exopod, with slight folds in the internal and external margins. Pleopod 4 similar to 3 but rami slightly broader. Exopod of pleopod 5 sub-ovate with external and distal plumose setae and short, transverse fold mid-way along internal and external margins; endopod naked, sub-triangular, smaller than exopod, with short, proximally directed, interno-proximal lobe. Bases of pleopods with external lobes. Uropodal exopod with internal and terminal margin bearing long, plumose setae and four blunt spines; external margin of endopod with several median, plumose setae and a naked, distal indentation, and internal margin bearing fringe of long plumose setae and five long spines.

OVIGEROUS FEMALE—not observed.

NON-OVIGEROUS FEMALE (fig. 12 d–g, k–m).

Differs from male only in primary sexual characteristics.

JUVENILE, 4.28 mm (fig. 12 a–c).

Differs from adults in the reduction of pereonite 7 and in having seventh pereopods short and slender and held transversely against ventral body surface.

Colour of all specimens in alcohol, cream, with entire dorsal surface, frontal lamina, clypeus, and ventral surface of pleon patterned with many small, dark-brown chromatophores. Appendages lacking chromatophores.

Material examined

Kissing Point, Townsville. Sand by rocks round edge of swimming pool, intertidal. Coll. D. M. Holdich, 10 VII 1976; 1 non-ovigerous female.

Strand, Kissing Point, Townsville. Sand, centre of beach, mid-shore. Coll. D. M. Holdich, 16 VII 1976; 1 juvenile.

Pallarenda, Cleveland Bay, Townsville. Coarse sand, upper-shore. Coll. R. Muffley, 04 III 1977; 1 male.

Saunders Beach, north of Townsville. Sand, intertidal. Coll. R. Muffley, 13 VI 1977; 1 non-ovigerous female, 1 juvenile.

Remarks

This species lives in intertidal sand on exposed and semi-exposed shores (Jones, 1971, 223) and appears to have an Indian Ocean–West Pacific distribution, having been recorded from: Sulu Sea (Dana 1853), Nicobar Islands (Hansen 1890), Conflict Group, New Guinea (Stebbing 1900), Phillipines (Richardson 1910), Queensland (Hale 1925), Dutch East Indies (Nierstrasz 1931), Madagascar (Pichon 1964, 1967; Roman 1970), Kenya (Jones 1971), Red Sea (Fishelson 1971), Persian Gulf (Jones 1974) and Penang, Malaysia (Jones 1979).

Genus *Pseudolana* Bruce

Pseudolana Bruce, 1979, 112.

Generic diagnosis

Marine and estuarine Cirolanidae with rostral point minute or absent. Antennular peduncle article 1 not articulated at right angles to remainder of antennule. Frontal lamina very narrow. Clypeus markedly projecting antero-ventrally. Mouthparts as in *Cirolana* but maxillipedal endite always with one coupling hook. Pleopod 1 not hardened as a ventral operculum. Endopod of pleopod 2 of male with appendix masculina arising mid-way along internal margin; endopods of pleopods 3–5 non-setigerous. Pleon with five free terga. Lateral margins of pleonites 1–5 reaching lateral margins of body. External margin of uropodal exopod setose and/or spinose.

Type species—*Pseudolana concinna* (Hale 1925).

Pseudolana concinna (Hale, 1925)

Cirolana concinna Hale, 1925, 152, 153; Nierstrasz, 1931, 157; Bruce, 1979, 112; Bruce, 1980d.
Pseudolana concinna: Bruce, 1979, 12; Bruce, 1980 d.

Description of specimens from Townsville:

ADULT MALE, 4.78 mm (fig. 13 a–m).

Dorsal surface of body lacking tubercles and setae; cephalosome with slight depression posterior to each antennular base. Coxal plates of pereonites 2–7 becoming wider posteriorly; each with posterior margin convex, distal margin slightly convex in pereonites 2 and 3, straight in pereonites 4–6, sinuous in pereonite 7; postero-distal angle sub-rectangular in pereonites 2 and 3, acutely produced in pereonites 4–7. Coxal plates of pereonites 2–6 lacking furrows; those of pereonite 7 with sinuous furrows extending from postero-distal angle to mid-proximal margin. Lateral margins of pereonites 4–7 with short, straight, median, anteriorly deflected furrows. Lateral margins of pleonites 3 and 4 acute, freely projecting, distal margins convex; those of pleonite 3 with oblique ridge. Lateral margins of pleonite 5 acute, distal margin straight. Telson sub-trapeziform with an anterior, transverse depression; and an inset apical border of long plumose setae and six spines.

Appendages. Antennular flagellum with eleven articles extending to level of pereonite 3. Seventeen articulated antennular flagellum extending to level of pereonite 6. Frontal lamina linear, narrow, lateral margins sub-parallel; almost separating bases of antennules. Clypeus projecting markedly as an acute tooth. Mandible with incisor process of three unequal teeth, the posterior being the longest and most acute; lacinia mobilis of curved row of simple spines; molar process and palp well produced. Maxillule outer lobe bearing approximately eleven long spines, some faintly serrate; inner lobe with three long, densely setose spines, the proximal one being the longest.

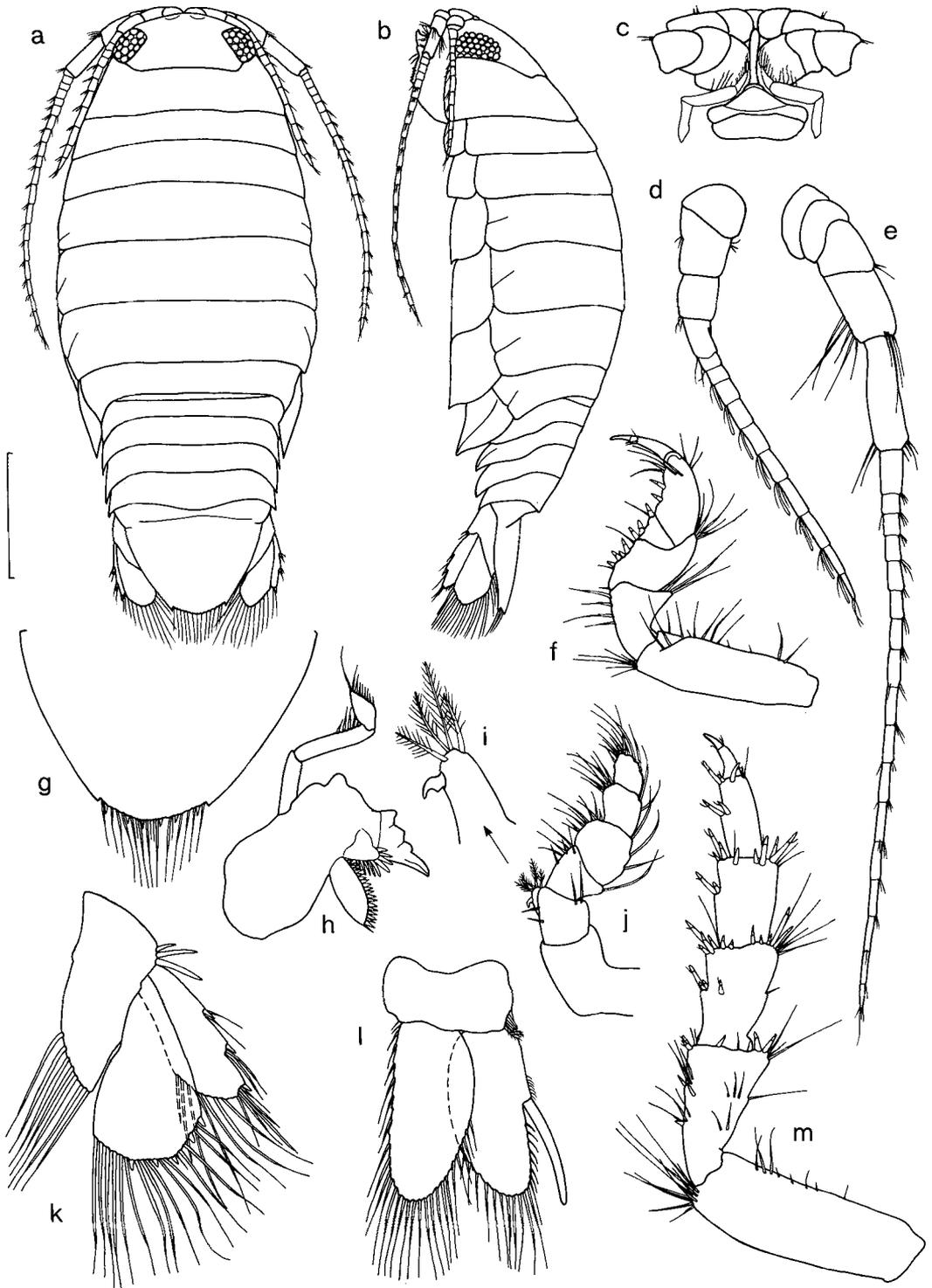


FIG. 13. *Pseudolana concinna* (Hale). Adult male. a, dorsal; b, lateral; c, ventral view, cephalosome; d, antennule; e, antenna; f, pereopod 1; g, telson; h, left mandible; i, maxillipedal endite; j, maxillipede; k, uropod; l, pleopod 2; m, pereopod 7. (Scale line represents 1 mm).

Maxilla with inner lobe bearing border of long setae, those proximally being plumose; central lobe with long terminal and internal setae; outer lobe with four long, terminal setae. Maxillipedal endite with four long plumose setae and one coupling hook. Pereopod 1 with basis slender with long superior and infero-distal setae; ischium and merus with superior lobes, and inferior margin of ischium bearing long setae; inferior margin of merus with four stout spines; that of reduced carpus with three stout spines; propodus with three inferior spines and several long distal setae. Pereopods 2 and 3 sub-equal, slightly more setose than pereopod 1; each carpus not so reduced; each ischium and merus bearing more inferior spines than in pereopod 1. Pereopods 4–7 similar but becoming increasingly longer, more slender, and less setose and spinose. Pereopod 7 with basis bearing several short, superior, and long, infero-distal, setae; ischium with several long setae, stout distal spines and two inferior, transverse rows of spines; merus with superior lobe bearing long setae, one inferior transverse row of spines, and distal margin bearing spines of varying length; carpus with distal spines of varying length and one inferior, transverse row of spines; propodus with distal spines and one inferior, transverse row of spines. All pereopods uni-ungulate; bases of posterior pairs not expanded. Penes widely separate, each twice as long as broad. Pleopod 1 with rami sub-equal in length, narrow; endopod three times as long as broad with long, marginal, plumose setae in distal half; exopod $1\frac{1}{2}$ times breadth of endopod with long, marginal, plumose setae in distal half and short, plumose setae along external margin. Pleopod 2 with rami sub-equal, with setation as in pleopod 1; endopod with appendix masculina extending just beyond apex of ramus. Appendix masculina narrow, tapering slightly to rounded tip. Pleopods 3 and 4 similar, each with rami sub-equal in length; endopod tapering distally, naked; exopod sub-elliptical with long distal and external, plumose setae; external margin of exopod bearing a slight median fold. Pleopod 5 with exopod as in 4; endopod $\frac{2}{3}$ size of exopod, sub-ovate, naked, with narrow, internal, proximal, proximally directed lobe. Uropod with basis bearing three unequal, external spines; endopod with five terminal spines and many long, plumose setae; exopod with three external spines with accompanying long, plumose setae, and a border of distal, internal, plumose setae.

OVIGEROUS FEMALE—not observed.

NON-OVIGEROUS FEMALE

Differs from male only in primary sexual characteristics.

Colour of all specimens in alcohol, cream, with dorsal surface of each pereonite and pleon bearing a transverse row of dark-brown chromatophores. Dorsal surface of cephalosome, antero-dorsal telson, ventral surfaces of cephalosome, pereon, pleon and pereopods, all bearing scattered chromatophores.

Material examined

Radical Bay, Magnetic Island. Mixed fine sand at base of rock, mid-shore. Coll. D. M. Holdich, 27 IV 1976; 1 juvenile.

Saunders Beach, north of Townsville. Coarse sand, upper shore. Coll. R. Muffley, 17 III 1977; 1 male (Queensland Museum reg. no. W.7922).

Saunders Beach, north of Townsville. Sand, intertidal. Coll. R. Muffley, 13 VI 1977; 1 juvenile

Saunders Beach, north of Townsville. Sand, intertidal. Coll. R. Muffley, 15 VIII 1977; 1 male, 1 non-ovigerous female.

Remarks

As the type species of the genus *Pseudolana*, *P. concinna* has the lateral margins of pleonite 5 free, as in members of the two other genera common in intertidal sand, *Exciorolana* and *Eurydice*. *Exciorolana* can be distinguished by its extended, dilated, rostral point, its broad frontal lamina, and the naked external margins to the uropodal exopods. *Eurydice* can be distinguished by having antennular peduncle article 2 articulated at right angles to article 1.

P. concinna has been recorded from Western Australia and New South Wales (Hale 1925) and occurs on suitable beaches along the Australian east coast from Hinchinbrook Island to Tasmania (Bruce, in press). Menzies' record (1962, 123, 124) from Chile was erroneous. His specimens were actually examples of his new species *Cirolana robusta* Menzies, 1962 (Bruce, personal observation).

Pseudolana brevifimbria sp. nov.

SYNONYMS—none.

Specific description:

ADULT MALE (fig. 14 a-n).

Dorsal surface of body lacking tubercles and setae. Cephalosome with slight depression posterior to each antennular base. Coxal plates of pereonites 2-7 becoming wider posteriorly, each posterior margin convex, distal margin slightly convex; postero-distal angles in pereonite 2 arcuate, in pereonites 3-7 with small posterior lobe. Coxal plates of pereonites 6 and 7 each with oblique, curved furrow; furrows extending from postero-distal angle to mid-proximal margin in pereonite 6, and to antero-proximal margin in pereonite 7. Lateral margins of pereonites 4-7 bearing short, median furrows deflected anteriorly. Lateral margins of pleonite 3 rounded, not freely projecting; those of pleonite 4 deflected posteriorly, rounded but with a short oblique ridge and apex indented; those of pleonite 5 acute, reaching lateral margins of body, but almost obscured by margins of pleonite 4 in lateral view. Telson semi-elliptical with anterior, transverse depression; smoothly arcuate apex bearing fourteen spines and a fringe of long plumose setae.

Appendages. Thirteen articulated antennular flagellum extending to level of pereonite 2. Nineteen articulated antennal flagellum extending to level of pereonite 5. Frontal lamina linear, very narrow, dilating slightly towards tip; almost separating bases of antennules. Clypeus projecting markedly as acute tooth. Mandible with incisor process of three unequal teeth; lacinia mobilis of curved row of simple spines; molar process blunt; palp well produced. Maxillular outer lobe with approximately twelve spines, some plumose; inner lobe with three stout, curved, densely setose spines, the proximal being the longest, the distal being the shortest. Maxilla with inner lobe bearing margin of long setae, those proximally being plumose; central lobe bearing border of long, terminal and internal setae; outer lobe bearing four long, terminal setae. Maxillipedal endite with four apical, plumose setae and one coupling hook. Pereopod 1 robust; basis with long infero-distal and superior setae; ischium with superior lobe bearing long, simple spines, a transverse, latero-distal row of simple setae, and several short, inferior, simple spines; merus with superior and latero-distal setation as in ischium but with inferior border bearing four stout, truncate pegs and several simple setae; carpus with two very stout, inferior spines and simple seta; propodus with four stout, inferior spines and several simple setae. Pereopods 2 and 3 similar to pereopod 1 but carpus less reduced, having four stout,

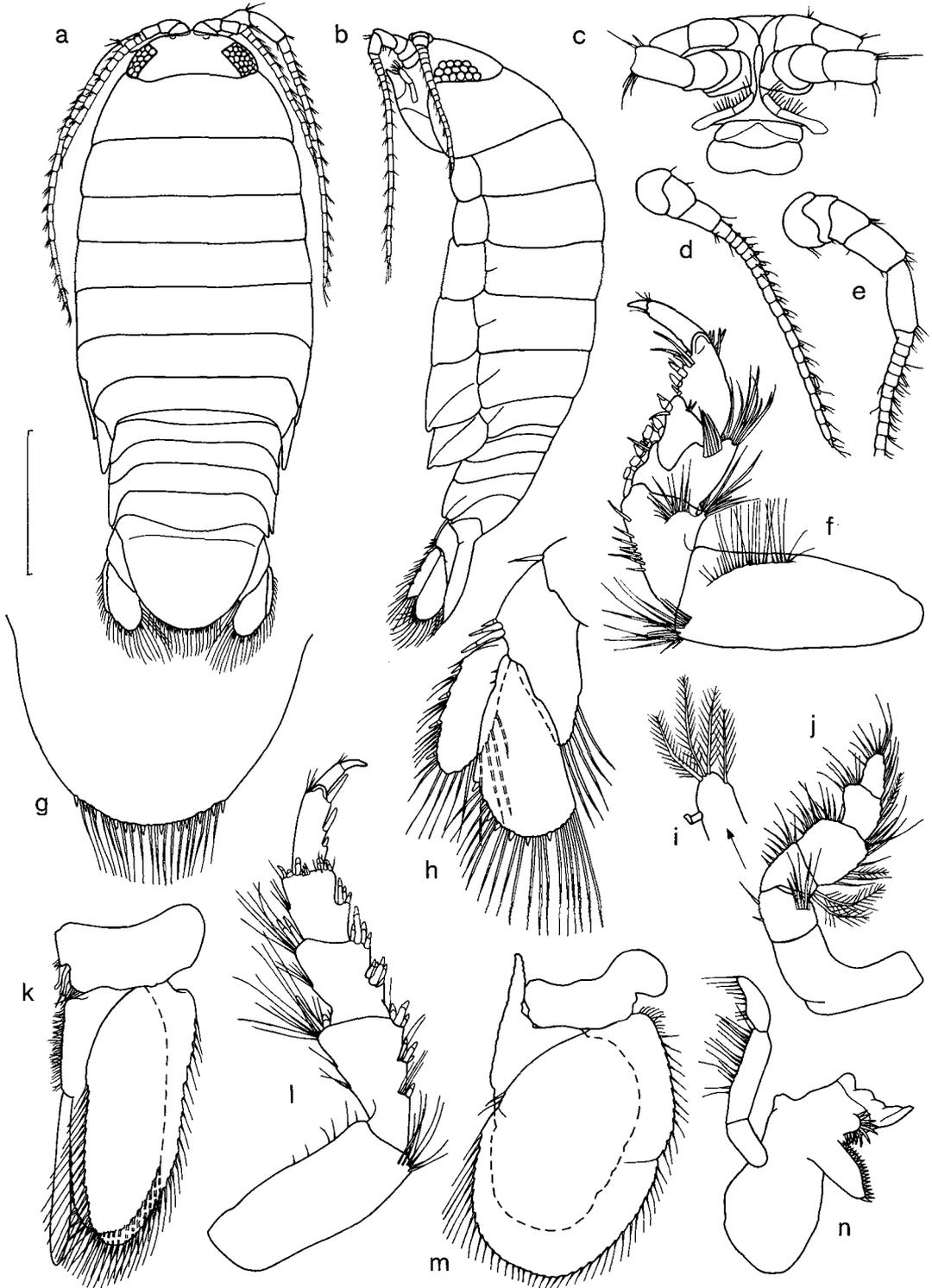


FIG. 14. *Pseudolana brevifimbria* sp. nov. Adult male holotype (Q.M.: 6341). *a*, dorsal; *b*, lateral; *c*, ventral view, cephalosome. Adult male paratype. *d*, antennule; *e*, antennal peduncle and proximal flagellum; *f*, pereopod 1; *g*, telson; *h*, uropod; *i*, maxillipedal endite; *j*, maxillipede; *k*, pleopod 2; *l*, pereopod 7 (not to scale with *f*); *m*, pleopod 5; *n*, left mandible. (Scale line represents 1 mm).

inferior pegs. Pereopods 4–7 similar, but becoming increasingly slender. Pereopod 7 with basis bearing long infero-distal, and several short superior, setae; ischium with three inferior, transverse rows of stout spines and long setae, several superior setae, and long and short spines with long setae on the superior-distal lobe; merus with two inferior, transverse rows of spines, a superior, median group of setae and a superior distal margin bearing long spines and long setae; carpus with two inferior, transverse rows of spines, a superior, median group of setae, and several short, superior-distal spines; propodus with three equidistant, inferior spines. All pereopods uni-ungulate; bases of posterior pairs not expanded. Penes separate, each four times as long as broad. Pleopod 1 with rami sub-equal in length, exopod $1\frac{2}{3}$ times breadth of endopod, semi-ovate external margin straight, distal half of internal margin and entire external margin with long, plumose setae; endopod three times as long as broad, internal margin straight, external margin sinuous, distal border bearing long plumose setae. Endopod of pleopod 2 with internal margin bearing short simple setae proximal to appendix masculina. Appendix masculina straight, clavate, dilated distally with semi-circular tip extending beyond apex of endopod. Pleopod 3 with exopod sub-ovate, larger than endopod, with distal border of plumose setae; endopod sub-triangular, naked, narrowing distally to rounded apex; both rami with short, external, median fold. Pleopod 4 similar to 3 but exopod with internal median fold. Pleopod 5 with rami broader than in pleopods 3 and 4; endopod naked with elongate, interno-proximal, proximally directed lobe. Uropod with basis bearing three unequal spines on distal external margin; endopod with seven apical spines and a terminal fringe of long plumose setae; exopod with terminal fringe of long plumose setae and external border with four spines and short setae.

OVIGEROUS FEMALE—not known.

NON-OVIGEROUS FEMALE

Differs from male only in primary sexual characteristics.

Colour of all specimens in alcohol, pale cream. Dorsal surface of each pereonite with short, median, transverse row of dark chromatophores, and of each pleonite with four widely spaced chromatophores. Dorsal surface of cephalosome with two transverse pairs of chromatophores. Each ischium, merus and carpus of pereopods and basis of each pleopod bearing one chromatophore. Ventral surface of pleon with several chromatophores.

Material examined

HOLOTYPE—adult male, 4.16 mm, + one microslide (Queensland Museum reg. no. W.6341).

Type locality—Pallarenda, Cleveland Bay. Sand, on beach by mouth of 'Three Mile Creek', lower shore. Coll. D. M. Holdich, 03 VIII 1976.

PARATYPES—Strand, Kissing Point, Townsville. Sand, centre of beach, mid-shore. Coll. D. M. Holdich, 16 VII 1976; 1 male.

Pallarenda, Cleveland Bay, Townsville. Coarse sand, upper-shore, Coll. R. Muffley, 04 III 1977; 2 males, 1 non-ovigerous female.

Etymology—*Pseudolana* + L. *brevis* + *fimbria* i.e. with short fringes (on pleon).

Remarks

This species can be distinguished primarily by the lack of the acute, lateral pleonal extensions after which it is named, but it bears certain resemblances to

Cirolana arcuata Hale, 1925. However, it differs from that species primarily in the form of the frontal lamina, the lateral furrowing, and the degree of lateral extension of pleonite 3.

Genus *Eurydice* Leach

Eurydice Leach, 1815, 354, 370.

Slabberina Van Beneden, 1861, 88, 89, 167.

Helleria Czerniavsky, 1868, 81. (not *Helleria*, Van Ebner, 1868—Tyloidea).

Branchuropus Moore, 1902, 167, 168.

Eurydice: *auct.*

Generic diagnosis

Marine Cirolanidae with rostral point minute or absent. Antennular peduncle article 1 extended anteriorly and articulated at right angles to remainder of antennule. Clypeus freely projecting. Mouthparts as in *Cirolana* but maxillipedal endite lacking coupling hooks. Pleon with five free terga. Pleopod 1 not hardened as a ventral operculum. Endopod of pleopod 2 of male with appendix masculina arising mid-way along internal margin. External margin of basis of pleopods not formed as a lobe. Only endopod of pleopod 5 non-setigerous. Lateral margins of pleonites 1–5 reaching lateral margins of body. External margin of uropodal exopod naked.

Type species—*Eurydice pulchra* Leach, 1815.

Eurydice orientalis Hansen, 1890

Eurydice orientalis Hansen, 1890, 369, 370, 413, pl. 6; Richardson, 1910, 8; Nierstrasz, 1930, 3; Nierstrasz, 1931, 147, 148; Hale, 1933, 558; Monod, 1934, 7, pls IV, V a–b; Barnard, 1936, 48; Jones, 1971, 207, 223; Bruce, 1980 a, 110, 128, fig. 1; Bruce, 1980 c, in press.

Description of specimens from Queensland

ADULT MALE (fig. 15 a–l).

Dorsal surface of body lacking tubercles and setae. Coxal plates of pereonites 2–7 with short, median furrows; distal margins straight; posterior margins smoothly convex; postero-distal angles with short, acute projection. Lateral margins of pereonites lacking furrows. Lateral margins of pleonites 2–5 straight, not posteriorly deflected; postero-distal angles very slightly freely projecting, not extended ventrally. Ventro-lateral ridges of pleon visible in lateral view. Telsonic lateral margins smoothly convex, naked; apex truncate with an inset row of short setae and a crenulate border lacking spines. Frontal lamina just reaching bases of antennules; very narrow proximally, dilating distally with a longitudinal median carina. Clypeus projecting markedly as acute tooth.

Appendages. Antennules reaching mid-point of eyes; 4-articled flagellum just longer than peduncle. Antennal flagellum of twenty-six articles extending to level of pleonite 5. Mandible with incisor process of three unequal teeth; lacinia mobilis of curved row of spines; molar process broad; palp long with terminal setae. Maxillule with outer lobe bearing twelve curved spines; inner lobe with three sub-equal, straight, densely setose spines. Maxilla with broad inner lobe bearing row of long setae; central and outer lobes with three long, terminal setae. Maxillipedal palp articles not noticeably lobed. Pereopod 1 slender; basis with infero-distal setae; ischium with two widely spaced, inferior setae and a superior lobe bearing one long spine; merus with a short, infero-proximal, and a short infero-distal, spine, and a superior lobe bearing long setae; carpus reduced with one infero-distal spine and an

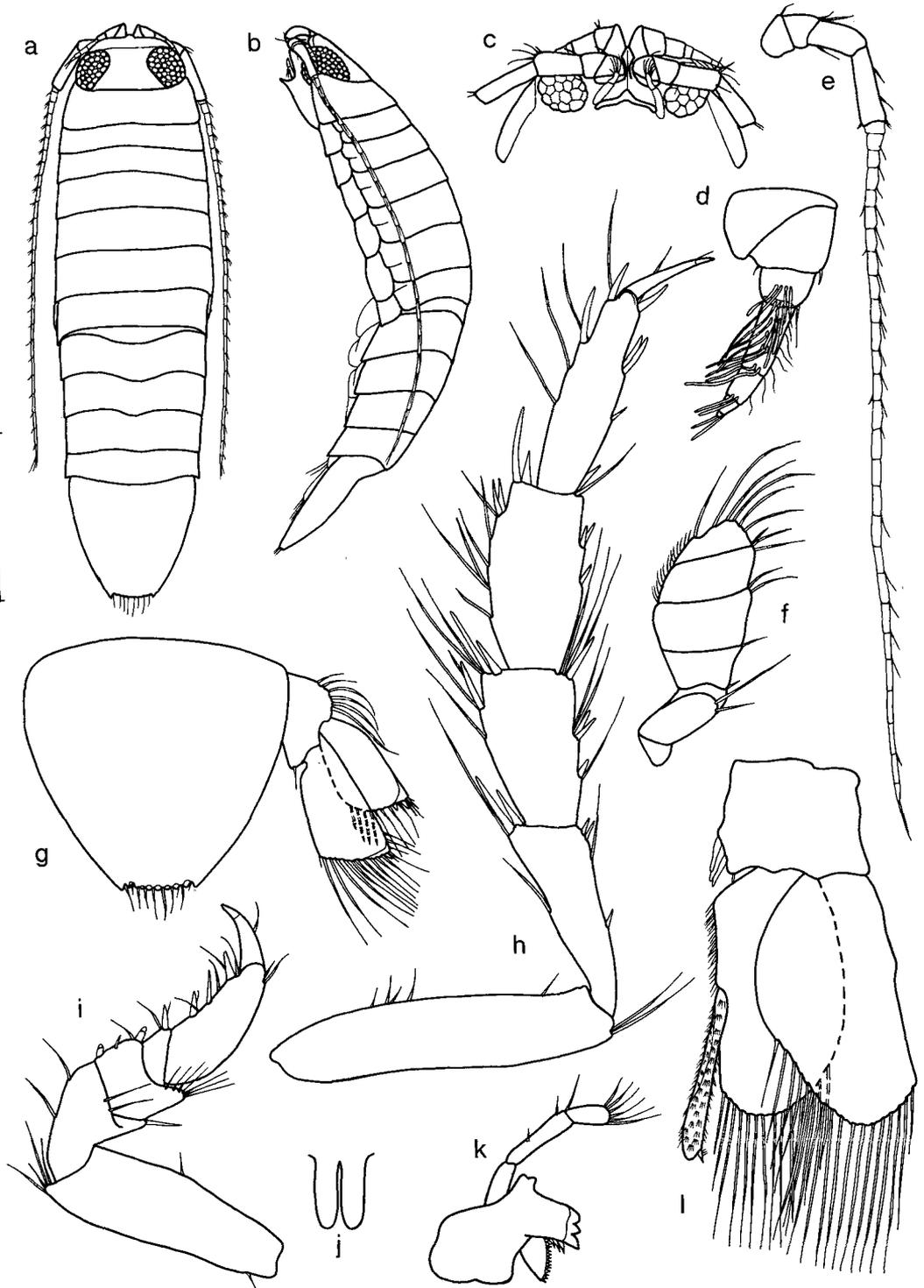


FIG. 15. *Eurydice orientalis* Hansen. Adult male. *a*, dorsal; *b*, lateral; *c*, ventral view, cephalosome; *d*, antennule; *e*, antenna; *f*, maxillipede; *g*, telson and uropod; *h*, pereopod 7; *i*, pereopod 1; *j*, penes; *k*, right mandible; *l*, pleopod 2. (Scale line represents 1 mm).

inferior seta; propodus with two narrow, inferior spines, one broad infero-distal spine, and several long inferior setae. Pereopods 2 and 3 similar to pereopod 1, but ischium with two short, infero-distal spines; merus with three inferior spines; each carpus as reduced as that of pereopod 1; propodus with two stout, inferior spines. Pereopods 4–7 becoming increasingly slender and setose; pereopod 7 almost twice length of pereopod 4 with ischium bearing one infero-median spine and superior and inferior distal spines; merus with two inferior, equidistant, transverse rows of spines, one superior spine, several long superior and inferior setae and long superior and inferior distal spines; carpus similar to merus; propodus with two inferior, transverse rows of spines, one long superior spine, four long superior setae, and long superior and inferior distal spines. All pereopods uni-ungulate; bases of posterior pairs not expanded. Penes separate, each three times as long as wide. Pleopod 1 with both rami narrow, sub-elliptical, bearing terminal fringe of long, plumose setae, endopod just shorter than exopod. Pleopod 2 with appendix masculina $\frac{3}{4}$ times length of endopod, dilating slightly towards semi-circular tip which bears an internal tooth; surface covered in microtrichia. Pleopod 3 with both rami sub-elliptical, with long, terminal fringes of setae; exopod just larger than endopod with complete, transverse median articulation and several externo-proximal setae. Pleopod 4 with endopod similar to that of pleopod 3; exopod just longer than endopod with complete, transverse, median articulation and complete external terminal border of setae; exopod relatively wider than that of pleopod 3. Pleopod 5 with exopod similar to, but relatively wider than, exopod of pleopod 4; endopod smaller than exopod, sub-elliptical, naked, with a narrow, proximally directed, interno-proximal lobe. Uropod with basis not extended internally, with one internal seta and a row of long, external setae; rami sub-rectangular, apices straight, truncate with apical fringe of long plumose setae and several, small, externo-distal spines.

OVIGEROUS FEMALE—not observed.

NON-OVIGEROUS FEMALE

Differs from male only in primary sexual characteristics.

Colour of all specimens in alcohol, cream, with dorsal surface of each pereonite and pleonite bearing a single transverse row of dark brown chromatophores, and dorsal surface of cephalosome, antero-dorsal telson, ventral pereon and pleon, and inferior borders of pereopods, bearing chromatophores.

Material examined

Cleveland Bay, Townsville. In plankton sample from mid-north-east channel. Coll. B. Barnett, V 1976; 1 non-ovigerous female.

Halifax Bay, Townsville. In soft mud on sandy mud, depth 10.8 m. Coll. P. Arnold, 23 XI 1976; 1 male (Queensland Museum reg. no. W.7923), 3 additional males.

Halifax Bay. In particulate substratum, depth 5.5 m. Coll. P. Arnold, 23 XI 1976; 1 non-ovigerous female.

Halifax Bay. In soft mud on sandy mud, depth 10.8 m. Coll. P. Arnold, 23 II 1977; 1 male.

Remarks

This species has previously been recorded from the Java Sea (Hansen, 1890; Nierstrasz, 1931); Phillipines (Richardson, 1910); Celebes and New Guinea (Nierstrasz, 1930); and the Sulu Archipelago (Nierstrasz, 1931); Low Isles (Hale, 1933); Indochina (Monod, 1934); Ceylon (Barnard, 1936); Heron Island—abundant in plankton (Bruce 1980 a); Coral Sea (Bruce 1980 c).

Eurydice inermis Hansen, 1890

Eurydice inermis Hansen, 1890, pl. 5; Hansen, 1905, 359, 373, pl. 35; Macquart-Moulin, 1973, 219–220, 227; Pillai, 1967; Bruce and Jones, 1978, 395–413.

Eurydice (Pelagonice) inermis: Kussakin, 1979, 178.

Description of specimens from Townsville

SUB-ADULT MALE (fig. 16 a–m).

Dorsal surface of body lacking tubercles and setae. Coxal plates of pereonites 2–7 lacking furrows; distal margins straight in pereonites 2 to 4, convex in pereonites 5–7; posterior margins convex in pereonites 2–7; postero-distal angles with short, acute projection. Lateral margins of pereonites 2–7 with short, straight median furrows. Lateral margins of pleonites acutely extended, directed ventrally with apices freely projecting. Vento-lateral ridges of pleon visible in lateral view. Telsonic lateral margins smoothly convex; apex truncate with an inset row of short setae and a crenulate border lacking spines. Frontal lamina extending half-way up bases of antennules, narrow proximally, dilating distally with a median, longitudinal carina.

Appendages. Antennules reaching mid points of eyes; four flagellar articles bearing long aesthetascs. Antennal flagellum of twenty-six elongate articles extending to level of pereonite 5. Mandible with incisor process broad; palp long with terminal setae. Maxillule with outer lobe bearing eleven curved, inferiorly pectinate spines; inner lobe with three sub-equal, densely setose spines. Maxilla with broad inner lobe bearing row of six long setae, the three proximal being densely setose; central and outer lobes with three or four terminal setae. Maxillipedal palp articles not noticeably lobed. Pereopod 1 moderately slender; basis with two infero-distal setae; ischium with two widely spaced, inferior setae, one short, lateral spine and a superior lobe bearing one long spine; merus with three inferior spines and a superior lobe bearing one long spine; carpus reduced bearing one infero-distal spine, one inferior spine, and an inferior seta; propodus with two broad inferior spines, one long, broad, infero-distal spine and several long inferior and superior distal setae. Pereopods 2 and 3 similar to 1 but ischium with two short, infero-distal spines; propodus with one inferior, and one infero-distal spine. Pereopods 4–7 becoming increasingly slender and setose; pereopod 7 slightly shorter than pereopod 6; ischium with long, distal, superior and inferior setae, and several long, superior-distal spines; merus with one superior and one inferior spine, long distal, superior and inferior spines and setae; carpus with two inferior, transverse rows of spines, long superior setae and distal superior and inferior spines; propodus with two inferior and one superior row of spines, distal superior and inferior spines and several long superior setae. All pereopods uni-ungulate; bases of posterior pairs not expanded. Penes short, separate to base. Pleopod 1 with both rami sub-equal in length, sub-elliptical, with long, terminal, plumose setae; exopod $1\frac{1}{2}$ times width of endopod. Appendix masculina of pleopod 2 straight with lateral margins sub-parallel, extending to smoothly rounded tip just beyond ramal apex. Pleopods 3 and 4 similar, each with both rami sub-elliptical; exopod just longer than endopod, bearing a complete,

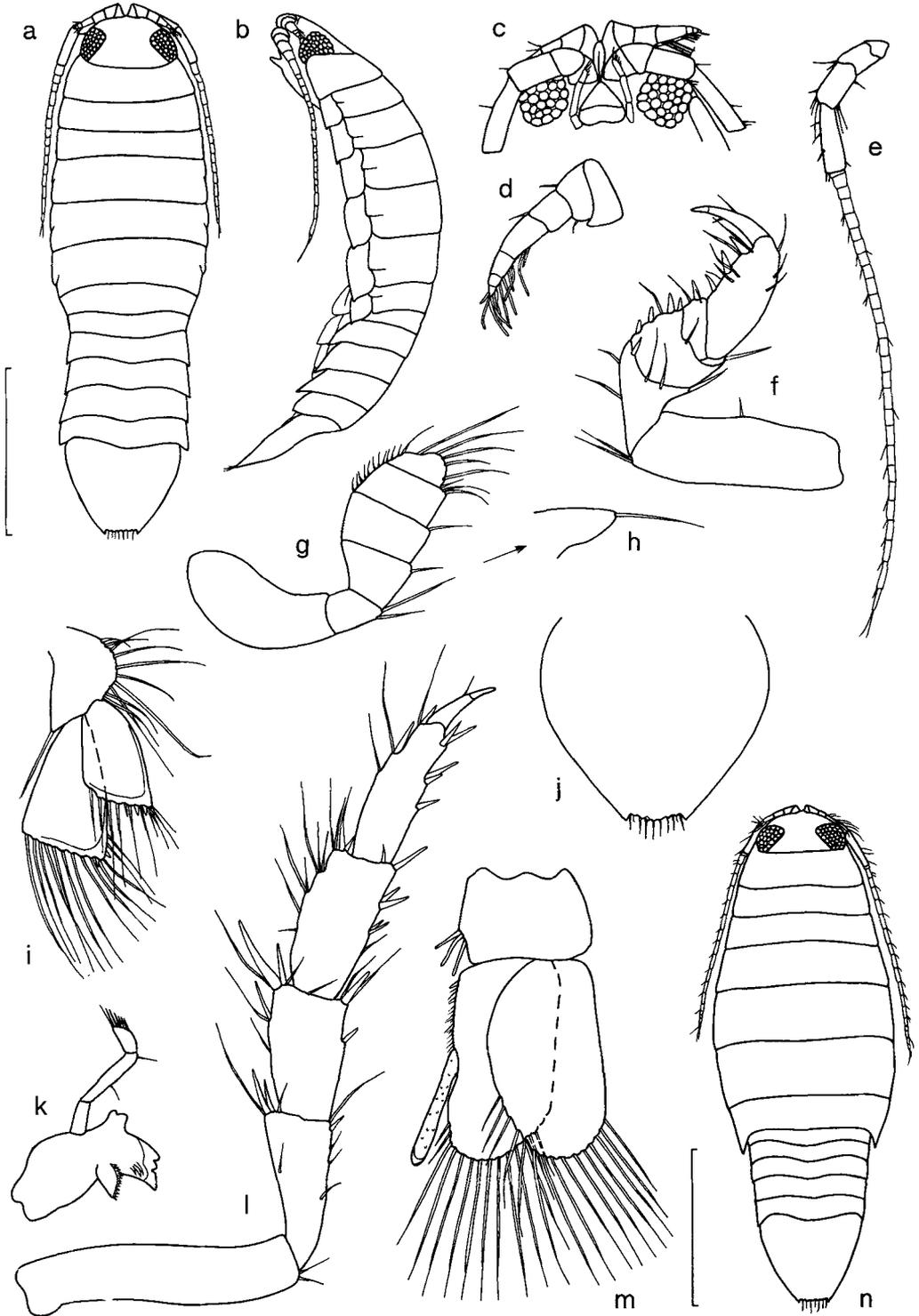


FIG. 16. *Eurydice inermis* Hansen. Sub-adult male (Q.M.: W.7924). *a*, dorsal; *b*, lateral. Second adult male. *c*, ventral view, cephalosome; *d*, antennule; *e*, antenna; *f*, pereopod 1; *g*, maxillipede; *h*, maxillipedal endite; *i*, uropod; *j*, telson; *k*, left mandible; *l*, pereopod 7; *m*, pleopod 2. Ovigerous female (Q.M.: W.7924). *n*, dorsal. (Scale line represents 1 mm).

median, transverse articulation; both rami with long terminal, and exopod with short external, plumose setae. Pleopod 5 with exopod similar to that of 4 but slightly broader; endopod sub-elliptical, naked, with a proximally directed interno-proximal lobe. Uropod with basis not extended internally, with one internal seta and a row of long external setae; rami truncate, with a fringe of long, plumose setae and several small, externo-distal spines.

OVIGEROUS AND NON-OVIGEROUS FEMALES.

Differ from male only in primary sexual characters and in the presence of a brood pouch in the former.

Colour of all specimens in alcohol, cream, with posterior region of pereonal and pleonal tergites and coxal plates, bearing transverse row of dark brown chromatophores. Dorsal surface of cephalosome, proximal articles of pereopods, and pereonal and pleonal sternites, also bearing chromatophores.

Material examined

Cleveland Bay, Townsville. Oblique plankton trawl, mid north east channel. Coll. B. Barnett, 17 V 1976; 1 non-ovigerous female.

Halifax Bay, Townsville. Soft mud on sandy mud, depth 2.5–10.8 m. Coll. P. Arnold, 23 II & 23 XI 1976; 3 males, 12 non-ovigerous females, 1 ovigerous female (Queensland Museum reg. no. W.7924), 6 additional ovigerous females, 1 juvenile.

Near Eddystone Lighthouse, English Channel (50° 11' N, 4° 15' W). Coll. A. M. Norman, 1903; 1 non-ovigerous female (British Museum (Natural History)) reg. no. 1911.11.8.7992).

Remarks

The appendix masculina of the present males lack surface microtrichia, indicating they are sub-adults. This explains the difference in form of the appendix masculina when compared to that described for *E. inermis* by Hansen (1905 pl. 35).

This species is similar to *E. orientalis* but differs in the form of extension of the pleon lateral margins and the length of the antennae (although this latter character is variable).

This species has a wide geographical distribution and has been recorded from Europe, the Indian Ocean (Pillai 1967) and the Red Sea (Bruce and Jones 1978). This is the first time it has been recorded from Australia.

Discussion

Jones (1976, 220) stated that isopods of the genus *Cirolana* prefer hard substrata and are rarely found in sand or mud. Of the seven *Cirolana* species found during the present study, the five sub-littoral species were only found in soft substrata. This appears to contrast with Jones' statement, but it may be that the method of collection is important. Cirolanid species are very good swimmers and it is possible they are often able to avoid collection by grab (the usual method of sampling soft substrata). The present method, however, of using a strong suction current, produces minimum shock disturbance to the surrounding area—thus reducing the likelihood of animals commencing swimming. Perhaps if this technique is employed elsewhere, many more *Cirolana* species will be found in soft sediments.

Littorally, Jones' statement is endorsed by the present study, both littoral *Cirolana* species being found on hard substrata, the intertidal particulate substrata being occupied by members of the genera *Excirolana* and *Pseudolana*. The species of *Neocirolana* was found in sub-littoral particulate substrata as were the two benthoplanktonic species of the genus *Eurydice*. At Heron Island (Bruce 1980a and personal observations) *Cirolana* spp. were found in the shallows and shallow sublittoral areas associated with hard substrata. Only *Eurydice orientalis* and *Cirolana albicaudata* were found associated with sediment. The latter species was also taken from the night plankton.

Bruce (1980a) discussed the state of taxonomic knowledge of Australian cirolanid isopods. That work together with others by the same author (Bruce 1980 b, c, d), by Griffin (1975) and the present study has increased the number of species from 20 in 1946 to 48 species at the time of writing. In addition, the junior author has in his collections 5 described species not previously recorded from Australia, as well as 12–16 undescribed species, thus bringing the total to about 70 species. All but 5 of these are endemic, with as far as is known, a limited distribution. Of the species mentioned 17% are known to occur away from Australian coasts. Bruce (1980 c) suggested that endemism is likely to be high, and that this is not just an artefact due to inadequate sampling.

Of the species recorded from the Philippines by Richardson (1910), none have been found in Australia. A similar situation occurs with regard to the South African cirolanid fauna.

Kensley (1978) listed 35 species of Cirolanidae for South Africa. These are from the intertidal down to 750 m. If the species recorded from Kenya (Jones 1974, 1976) are included, then the total for this region is raised to 49, a number considerably below that for the East coast of Australia. However, the subtidal regions to the north of South Africa are unexplored, and further exploration would probably reveal many new species.

Summary

A wide variety of littoral and sublittoral marine habitats have been sampled in the vicinity of Townsville in N.E. Australia in order to assess the diversity of cirolanid isopods present.

Of the thirteen species represented in the collections six were previously undescribed. The species present were: *Cirolana schioedtei* Miers, 1884 (16 m in mud/sand); *C. pustulosa* Hale, 1925 (mainly littoral habitats such as crevices in wooden installations); *C. cranchii* var. *australiense* Hale, 1925 (mainly littoral cryptic habitats); *C. tumulosa* sp. nov. (3–9 m in soft particulate substrata); *C. arcicauda* sp. nov. (3–10 m in soft particulate substrata); *C. variguberna* sp. nov. (2–18 m in soft particulate substrata); *C. luticola* sp. nov. (2–14 m in soft particulate substrata); *Neocirolana bicrista* sp. nov. (11 m in particulate substrata); *Excirolana orientalis* Dana, 1853 (littoral sand); *Pseudolana concinna* (Hale, 1925) (littoral sand); *Pseudolana brevifimbria* sp. nov. (littoral sand); *Eurydice orientalis* Hansen, 1890 (plankton and 5–11 m in soft particulate substrata); *Eurydice inermis* Hansen, 1890 (plankton and 2–11 m in soft particulate substrata).

The new species are described in detail and additional information is given on the other species—some of which have been poorly described in the past. In addition two closely related species, i.e. *Cirolana tenuistylis* Miers, 1884 and *C. woodjonesi* Hale, 1924 are also redescribed so as to avoid any confusion with the Townsville species.

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References

- BARNARD, K. H., 1914, Contributions to the crustacean fauna of South Africa. 3.-Additions to the marine Isopoda, with notes on some previously described incompletely known species. *Annals of the South African Museum*, **10**, 325-442, pls. 27-39.
- 1935, Report on the Amphipoda, Isopoda, and Tanaidacea in the collections of the Indian Museum. *Records of the Indian Museum*, **37**, 279-319.
- 1936, Isopoda collected by R.I.M.S. Investigator. *Records of the Indian Museum*, **38**, 147-191.
- 1955, Additions to the fauna list of South Africa. Crustacea and Pycnogonida. *Annals of the South African Museum*, **43** (1), 1-107.
- BOONE, P., 1918, Descriptions of ten new isopods. *Proceedings of the United States National Museum*, **54**, 591-604, pls 89-92.
- BRUCE, N. L., 1979, Preliminary diagnosis of a new genus of marine isopod (Flabellifera, Cirolanidae). *Crustaceana*, **37** (1), 112.
- 1980 a, The Cirolanidae (Crustacea: Isopoda) of Australia: Heron Island and the Capricorn Group. *Bulletin of Marine Science*, **30** (1), 108-130.
- 1980 b, The Cirolanidae (Crustacea: Isopoda) of Australia: New species and a new genus from south eastern Australia. *Records of the Australian Museum*, **33** (in press).
- 1980 c, The Cirolanidae (Crustacea: Isopoda) of Australia: The Coral Sea. *Cahiers du l'Indo-pacifique* II (2), 155-173.
- 1980 d, The Cirolanidae (Crustacea: Isopoda) of Australia: The genus *Pseudolana* from the Queensland coasts. *Pacific Science* (in press).
- BRUCE, N. L. and JONES, D. A., 1978, The systematics of some Red Sea Isopoda (family Cirolanidae) with descriptions of two new species. *Journal of Zoology, London*, **185** (3), 395-413.
- CZERNIAVSKI, V., 1868, Materialia ad zoographiam Ponticam comparatam. *Transactions of the Russian Naturalists Society, St. Petersburg*, **1**, 19-136, 8 plates.
- DANA, J. D., 1853, Crustacea. *United States Exploring Expedition*, **13**, 696-805.
- EBNER, V. VON, 1868, *Helleria*, eine neue Isopoden-Gattung aus der Familie der Onisciden. *Verhandlungen der Zoologisch-botanischen Gesellschaft in Wien*, **18**, 95-114, pl. 1.
- ELEFThERIOU, A., and JONES, D. A., 1976, The genus *Eurydice* on the west coast of India. *Journal of Zoology, London*, **178**, 385-394.
- FISHELSON, L., 1971, Ecology and distribution of the benthic fauna in the shallow waters of the Red Sea. *Marine Biology*, **10**, 113-133.
- GRIFFIN, J. G., 1975, A new giant deep-water isopod of the genus *Bathynomus* (Flabellifera: Cirolanidae) from eastern Australia. *Proceedings of the Linnean Society of New South Wales*, **100** (2), 103-109.
- HALE, H. M., 1924, The flora and fauna of Nuyts Archipelago and the Investigator Group. No. 16—The Crustacea. *Transactions of the Royal Society of South Australia*, **48**, 67-73, pls 4, 5.
- 1925, Review of Australian isopods of the cymothoid group. Part 1. *Transactions of the Royal Society of South Australia*, **49**, 128-185.
- 1929, The Crustaceans of South Australia. In: *Handbooks of the Flora and Fauna of South Australia*, Pt. 2., Adelaide, 201-380.
- 1933, Tanaidacea and Isopoda collected by the Great Barrier Reef Expedition, 1928-29. *Annals and Magazine of Natural History Ser. 10*, **11**, 557-561.

- 1940, Report on the cymothoid Isopoda obtained by F.I.S. 'Endeavour' on the coasts of Queensland, New South Wales, Victoria, Tasmania, and South Australia. *Transactions of the Royal Society of South Australia*, **64**, 288–304, pl. 18.
- HANSEN, H. J., 1890, Cirolanidae et familiae nonnullae propinquae. Musaei Hauniensis. *Kongeligt Videnskabernes Selskab Skrifter*, **6**. Raekke, naturvidenskabelig og matematisk Afdeling, **5** (3), 237–426, pls 1–10.
- 1905, Revision of the European forms of the Cirolanidae, a sub-family of Crustacea, Isopods. *Journal of the Linnean Society (Zoology)*, **29**, 337–373, pls 33–35.
- HARGER, O., 1880, Report on the marine Isopoda of New England and adjacent waters. *United States Commission of Fish and Fisheries Part 4. Report of the Commissioner for 1878*, 297–462, pls 1–13.
- HOLDICH, D. M., and HARRISON, K., 1980 a, Morphological variation in the *Serolis minuta*-group (Isopoda: Serolidae) from Australian waters. *Zoological Journal of the Linnean Society*, **68**, 373–386.
- 1980 b, The crustacean isopod genus *Gnathia* Leach from Queensland waters with descriptions of nine new species. *Australian Journal of Marine and Freshwater Research* **31**, 215–240.
- 1980 c, Platybranch sphaeromatids (Crustacea: Isopoda) from the Australian region with description of a new genus. *Records of the Australian Museum* (in press).
- HURLEY, D. E., and JANSEN, K. P., 1977, The Marine Fauna of New Zealand: Family Sphaeromatidae (Crustacea: Isopoda: Flabellifera). *Memoirs of the New Zealand Oceanographic Institute*, **63**, 1–95.
- JONES, D. A., 1971, The systematics and ecology of some sand beach isopods (Crustacea: Eurydicidae) from the coast of Kenya. *Journal of Zoology, London*, **165**, 201–227.
- 1974, The systematics and ecology of some sand beach isopods (Family Cirolanidae) from the coasts of Saudi Arabia. *Crustaceana*, **26** (2), 201–211.
- 1976, The systematics and ecology of some isopods of the genus *Cirolana* (Cirolanidae) from the Indian Ocean region. *Journal of Zoology, London*, **178**, 209–222.
- 1979, The ecology of sandy beaches in Penang, Malaysia, with special reference to *Excirrolana orientalis* (Dana). *Estuarine and Coastal Marine Science*, **9**, 677–682.
- KENSLEY, B., 1978, *Guide to the marine isopods of South Africa*. South African Museum, Durban, 173 pp.
- KOSSMANN, R., 1880, Reise in die Küstengebiete des Rothen Meeres. *Zoologische Ergebnisse einer im auftrage der Königlichen Academie der Wissenschaften zu Berlin, zweite Hälfte, erste Lieferung*, 67–140, pls 1–15.
- KUSSAKIN, O. G., 1979, Marine and brackish water isopod Crustacea. Suborder Flabellifera. Nauka, Leningrad, 472 pp. (In Russian).
- LEACH, W. E., 1815, A tabular view of the external characters of four classes of animals, which Linné arranged under Insecta; with the distribution of the genera composing three of these classes into orders and classes and descriptions of several new genera and species. *Transactions of the Linnean Society (London)*, **11**, 306–400.
- 1818, Cymothoadées. In: Cuvier (Ed.) *Dictionnaire des Sciences Naturelles* Paris, 338–354.
- MACQUART-MOULIN, C., 1973, L'activite natatoire rythmique chez les peracarides benthoplanctonique. Determinisme endogene des rythmes nycthermeaux. *Tethys*, **5** (1), 209–321.
- MENZIES, R. J., 1962, The zoogeography, ecology and systematics of the Chilean marine isopods. *Reports of the Lund University Expedition 1948–49. Lunds Universitets Arsskrift* (n. ser.) (2) **57** (11), 1–162.
- MIERS, E. J., 1876, Descriptions of some new species of Crustacea, chiefly from New Zealand. *Annals and Magazine of Natural History* (4), **17**, 218–229.
- 1884, Crustacea. In: Report of the zoological collections made in the Indo-Pacific Ocean during the voyage of H.M.S. 'Alert' 1881–1882. London, 178–322.
- MONOD, TH., 1934, Isopodes marins des campagnes du 'de Lanessan'. *Institut Océanographique de l'Indochine (Station maritime de Cauda)*, Note 23, 1–22, pls 1–45.
- 1976, Remarques sur quelques Cirolanidés (Crustacés, Isopodes). *Bulletin du Muséum d'histoire naturelle, Paris* (3rd series) No. 358, Zoologie **251**, 133–161.
- MOORE, H. F., 1902, Report on Porto Rican Isopoda. *Bulletin of the United States Commissioner of Fish and Fisheries*, 1900, **20** (2), 161–176, pls 7–11.

- MOREIRA, P. S., and SADOWSKY, V., 1978, An annotated bibliography of parasitic Isopoda (Crustacea) of Chondrichthyes. *Boletim do Instituto Oceanográfico, São Paulo*, **27**, 95–152.
- NAYLOR, E., 1961, Some Isopoda from the Chatham Islands, including two species of *Cirolana* new to New Zealand waters. *Transactions of the Royal Society of New Zealand*, **1** (2), 1–17.
- 1966, Port Phillip Bay Survey 1957–1963. Isopoda. *Memoirs of the National Museum, Victoria*, **27**, 183–198. 377–384, Chart 1.
- NIERSTRASZ, H. F., 1918, Alte und neue Isopoden. *Zöologische mededeelingen. Leiden*, **4**, 103–142, pls 9, 10.
- 1930, Isopoda in Resultat Scientifiques du voyage aux Indes Orientales Néerlandaises de Le. Aa. Rr. Le Prince et la Princesse Léopold de Belgique. *Mémoires du Musée Royal d'Histoire Naturelle de Belgique*, **3** (1), 1–17.
- 1931, Die Isopoden der Siboga-Expedition 3 Isopoda Genuina 2 Flabellifera. *Siboga-Expedition*, **32c**, 123–233, pls 1, 2.
- PICHON, M., 1964, Aperçu préliminaire des peuplements sur sables et sables vaseux, libres ou couverts par les herbiers de Phanérogames marines de la région de Nosy Be. *Cahiers, Office de la recherche scientifique et technique Outre-Mer, Océanographie*, **2** (4), 5–15.
- 1967, Contribution à l'étude des peuplements de la zone intertidale sur sables fins et sables vaseux non fixés, dans la région de Tuléar (Madagascar). *Recueil des travaux de la Station marine d'Endoume, Fascicule hors série, suppl. No. 5, Travaux de la Station maritime, Tuléar*, 57–100.
- PILLAI, N. K., 1967, Littoral and parasitic isopods from Kerala. Families Eurydicidae, Corallanidae and Aegidea—2. *Journal of the Bombay Natural History Society*, **64** (2), 267–283.
- POORE, G. C. B., RAINER, S. F., SPIES, R. B., and WARD, E., 1975, The zoobenthos program in Port Phillip Bay, 1969–73. *Fisheries and Wildlife Paper, Victoria*, **7**, 1–78.
- RACOVITZA, E., 1912, Cirolanides (Ire Serie). *Archives de Zoologie expérimentale générale, Paris*, **10**, 203–329.
- RICHARDSON, H., 1910, Marine isopods collected in the Philippines by the U.S. Fisheries Steamer 'Albatross' in 1907–8. *Department of Commerce and Labor, Bureau of Fisheries Document*, No. 736, 1–44.
- 1912, Descriptions of a new genus of isopod crustacean, and of two new species from South America. *Proceedings of the United States National Museum*, **43**, 201–204.
- ROMAN, M.-L., 1970, Écologie et répartition de certaines groupes d'Isopodes dans les divers biotopes de la région de Tuléar (Sud-ouest de Madagascar). *Recueil des travaux de la Station marine d'Endoume, Faculté des sciences de Marseille. Fascicule hors série suppl. No. 10*, 163–208.
- STEBBING, T. R. R., 1900, On Crustacea brought by Dr. Willey from the South Seas. In: *Zoological Results based on material from New Britain, New Guinea, Loyalty Islands and elsewhere, collected during the years 1895, 1896 and 1897*, part 5. Cambridge, 605–690, pls 64–74.
- 1905, Report on the Isopoda collected by Professor Herdmann, at Ceylon, in 1902. *Ceylon Pearl Oyster Fisheries* (4), Supplementary Report 23, 1–64, pls 1–12.
- THIELEMANN, M., 1910, Beiträge zur Kenntnis der Isopoden fauna Ostasiens. *Abhandlungen der mathematisch-physikalischen Klasse der Königlich-Bayerische Akademie der Wissenschaften*, Suppl. Vol. 2 (3) 1–108, pls 1, 2.
- VAN BENEDEEN, P. J., 1861, Recherches sur les Crustacés du littoral de Belgique. *Mémoires de l'Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique*, **33**, 11–180.