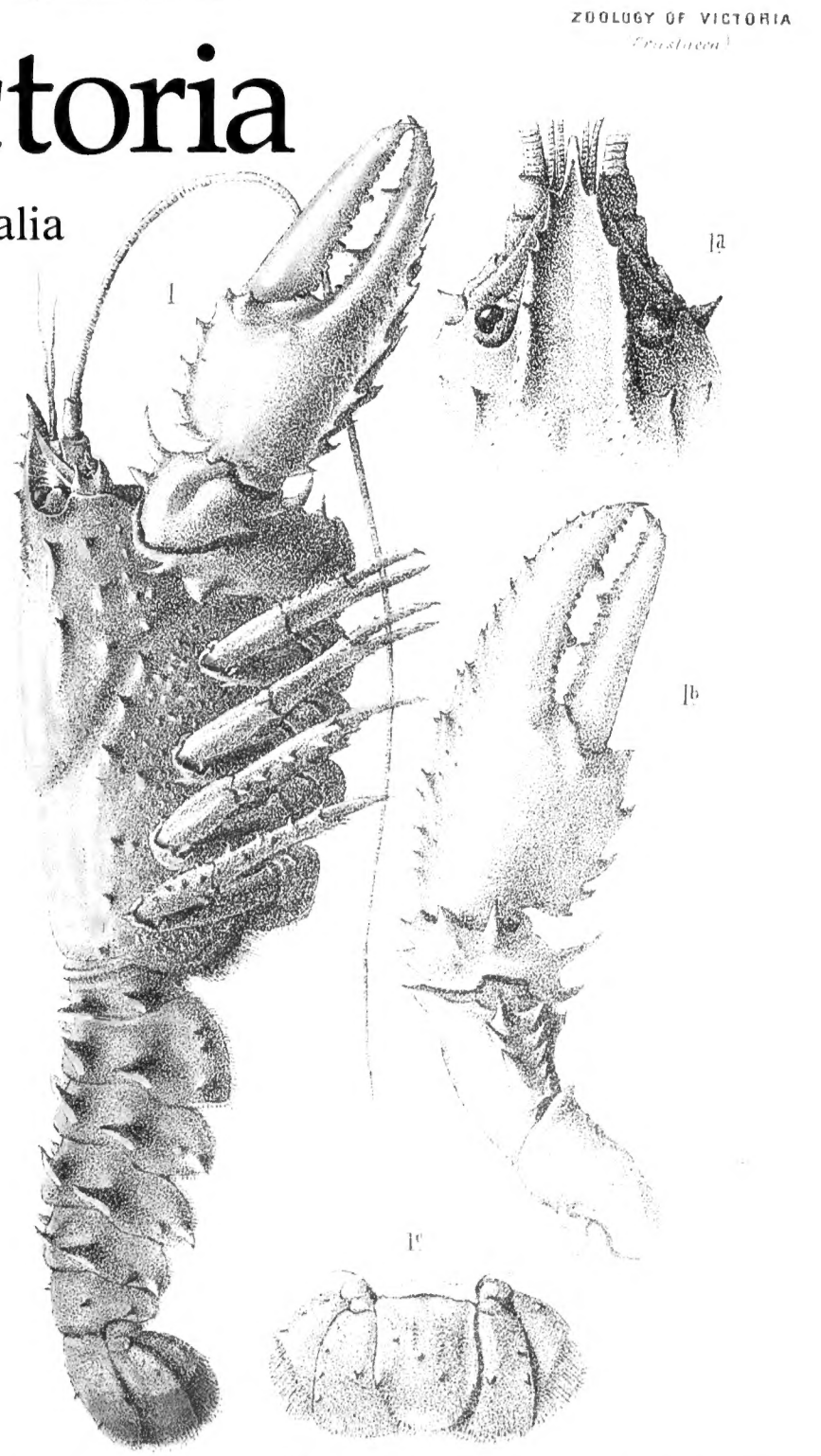
Memoirs of the

Museum of Victoria

Volume 47
Numbers 1 and 2

Melbourne Australia

30 May 1986



Cover: Professor Frederick McCoy was Director of the National Museum of Victoria last century and between 1878 and 1885 published a "Prodromus of the Zoology of Victoria with Figures and Descriptions of the Living Species of all Classes of the Victorian Indigenous Animals". *Euastacus serratus* was figured in McCoy's Prodromus as the Murray Lobster, *Astacoides serratus*, and is redescribed in this volume of the *Memoirs* by Gary J. Morgan.

ISSN 0814-1827

MEMOIRS

of the

MUSEUM OF VICTORIA

MELBOURNE AUSTRALIA

Memoir 47
Numbers 1 and 2

PUBLISHED BY ORDER OF THE COUNCIL
30 MAY 1986

Printed by Brown Prior Anderson Pty Ltd Burwood Victoria

CONTENTS

NUMBER 1

Instructions to Authors

The Museum of Victoria was formed in 1983 by the merger of the National Museum of Victoria (established in 1854) and the Science Museum of Victoria (established in 1870). Among the Museum's objectives are scholarship and education in the fields of natural history, science and technology, and history of human society. The Museum of Victoria publishes two scientific serials to further these objectives, *Memoirs of the Museum of Victoria* (until 1983 *Memoirs of the National Museum of Victoria*) and *Occasional Papers from the Museum of Victoria*.

The *Memoirs* publishes papers on original research in the natural sciences pertinent to Victoria and/or the Museum's collections. All contributions are assessed by independant referees before publication.

The *Occasional Papers* are research documents of sufficient importance to be preserved but which are not appropriate for primary scientific publication. Papers are factual rather than interpretative studies, may be of special local interest or may be longer than a normal scientific paper. Contributions will be refereed if appropriate.

Two copies of the manuscript with accompanying plates and figures should be submitted to the Editor, Museum of Victoria, Swanston Street, Melbourne, Victoria 3000. Authors should consult a recent volume of the *Memoirs* to aquaint themselves with format.

Manuscripts must be typed on A4 paper, double-spaced, on one side of the paper and with ample margins. Text on word-processor floppy disks will be accepted and are preferred. Papers should be arranged as follows: title (including higher classification of zoological taxa); authors' names and addresses; abstract; contents (only if the paper is very long); introduction and main text; acknowledgements; references; index (only if very long); and tables.Captions to text figures and plates must be attached to the manuscript as final pages. Underlining in the text should be restricted to generic and specific names. Measurements must be in the metric system (SI units).

References should be listed alphabetically at the end of the manuscript. Abbreviations must conform with those in *A World List of Scientific Periodicals (1963–4, 4th edition)*, Butterworth: London. References to books must give the year of publication, edition, name of publisher and city of publication. Titles of books and abbreviated names of periodicals should be underlined.

In taxonomic papers synonymies should be of the short form: taxon, author, year, pages, figures. A period and dash must separate taxon and author except in the case of reference to the original description.

Photographs must have clear definition and may be submitted as either glossy or flat prints at the actual size for reproduction. Line drawings for text figures should be in black ink on white card or drawing film. Maximum full-page size is 147 mm wide by 198 mm, single column width is 72 mm. Clear lettering must be inserted. Original drawings up to twice final size are acceptable.

Memoirs of the Museum of Victoria 47(1): 1-57 (1986) ISSN 0814-1827

FRESHWATER CRAYFISH OF THE GENUS *EUASTACUS* CLARK (DECAPODA, PARASTACIDAE) FROM VICTORIA

By Gary J. Morgan

Department of Zoology, Monash University, Wellington Road, Clayton, Victoria 3168, Australia
(Present address: Department of Crustacea, Western Australian Museum, Francis Street, Perth, Western Australia 6000, Australia)

Abstract

Morgan, G.J., 1986. Freshwater crayfish of the genus *Euastacus* (Decapoda: Parastacidae) from Victoria. *Mem. Mus. Vict.* 47: 1-57.

Six Victorian species of *Euastacus*, *E. diversus*, *E. neodiversus*, *E. kershawi*, *E. yarraensis*, *E. bispinosus* and *E. armatus* are redescribed. Two new species, *E. woiwuru* from high country east of Melbourne and *E. bidawalus* from far eastern Victoria are described. External morphological characters, measurement ratios and gastric mill ossicles are employed in the revision. A key to the Victorian species is presented. The condition of the male cuticle partition and spination of the chela, thorax and abdomen are the most useful characters for distinguishing species.

Contents

Introduction

The Australian freshwater crayfish genus *Euastacus* Clark has been taxonomically and phylogenetically examined in several papers, often in association with other genera of the Parastacidae (Clark, 1936, 1941; Riek, 1951, 1956, 1969, 1972; Patak and Baldwin, 1984). Some additional papers described single species of *Euastacus* (Watson 1935, 1936; Monroe, 1977). Francois (1962) and Kane (1964) reviewed the genus in unpublished theses.

The systematics of the Parastacidae have been subject to some controversy in recent years due to errors and omissions in formal descriptions and keys. The genera of parastacids were keyed by Riek (1969). Prior to this study, the systematics of *Euastacus* were summarised by Riek (1969) and one species added by Monroe (1977). The present paper is the first in a series revising the taxonomy of *Euastacus*. Species are divided by Australian states according to their respective type localities and this paper comprises descriptions of eight species occuring in Victoria. The type locality of *E. armatus* is the Murray River and the species is arbitrarily included in the Victorian descriptions. Two species (*E. crassus* and a new species) that overlap slightly into Victoria from New South Wales will be included in the New South Wales paper (Morgan, in prep. b).

Materials and methods

Field.

The known range of *Euastacus* in eastern Australia, from Cooktown in north Queensland to the South Australian-Victorian border, was sampled in 1981-2 to augment the patchy existing collections in Australian museums and other institutions. Inland New South Wales was not sampled extensively due to the large area involved and because *E. armatus* is reasonably well represented in museum collections.

Natural or semi-natural bushland was sampled preferentially, especially in state forests and national parks. Crayfish were collected by baited traps, drop nets and hand held baited strings. Many specimens were obtained by turning rocks in streams and scooping up escaping crayfish by hand net. Digging of specimens from burrows was attempted only where the substrate was suitable and burrows shallow. Observations were made at each site of vegetation and hydrology and brief mention of habitat is made for each species.

Colours of live specimens were recorded before emersion in a solution of 10% formalin and 5% glycerol for fixation. Specimens were transferred subsequently to a 70% ethanol/5% glycerol solution.

Laboratory.

One hundred and twenty external characters and fifteen measurements were recorded for all specimens. Four gastric mill attributes were recorded for selected specimens. Specimens were examined under dissecting microscope and measured with vernier calipers. Characters were derived in part from those used by Clark (1936, 1941), Riek (1951, 1956, 1969) and Francois (1962), though many previously used characters were discarded as of little taxonomic value. Characters are illustrated in Figures 1-2 and selected character states in Figures 3-5.

The term "spine" is used in this study for most cuticular protuberances, even if blunt, since homologous spines on different species may be very sharp or very blunt and may vary in sharpness with growth. The expression "general tubercles" denotes the small protrusions on the lateral branchiostegites (Figs. 1 and 4b). The term "bumps" is used occasionally to describe several small, close, irregular protrusions of the cuticle (e.g., dorsal bumps on propodus).

In some species the dorsal thoracic spines are small, irregularly distributed and difficult to count. The spines are referred to as "just discernible".

The term "medium" is employed to describe sizes (e.g., of spines) between large and small. The term "moderate" usually describes intermediacy in sharpness or shape of spines or other structures.

Postorbital ridge spines (Fig. 1a, c) sometimes are described as an "edge" or "small edge" (Fig. 3m). While no distinct spine is present in the "edge" condition, the character is termed a postorbital spine for uniformity since

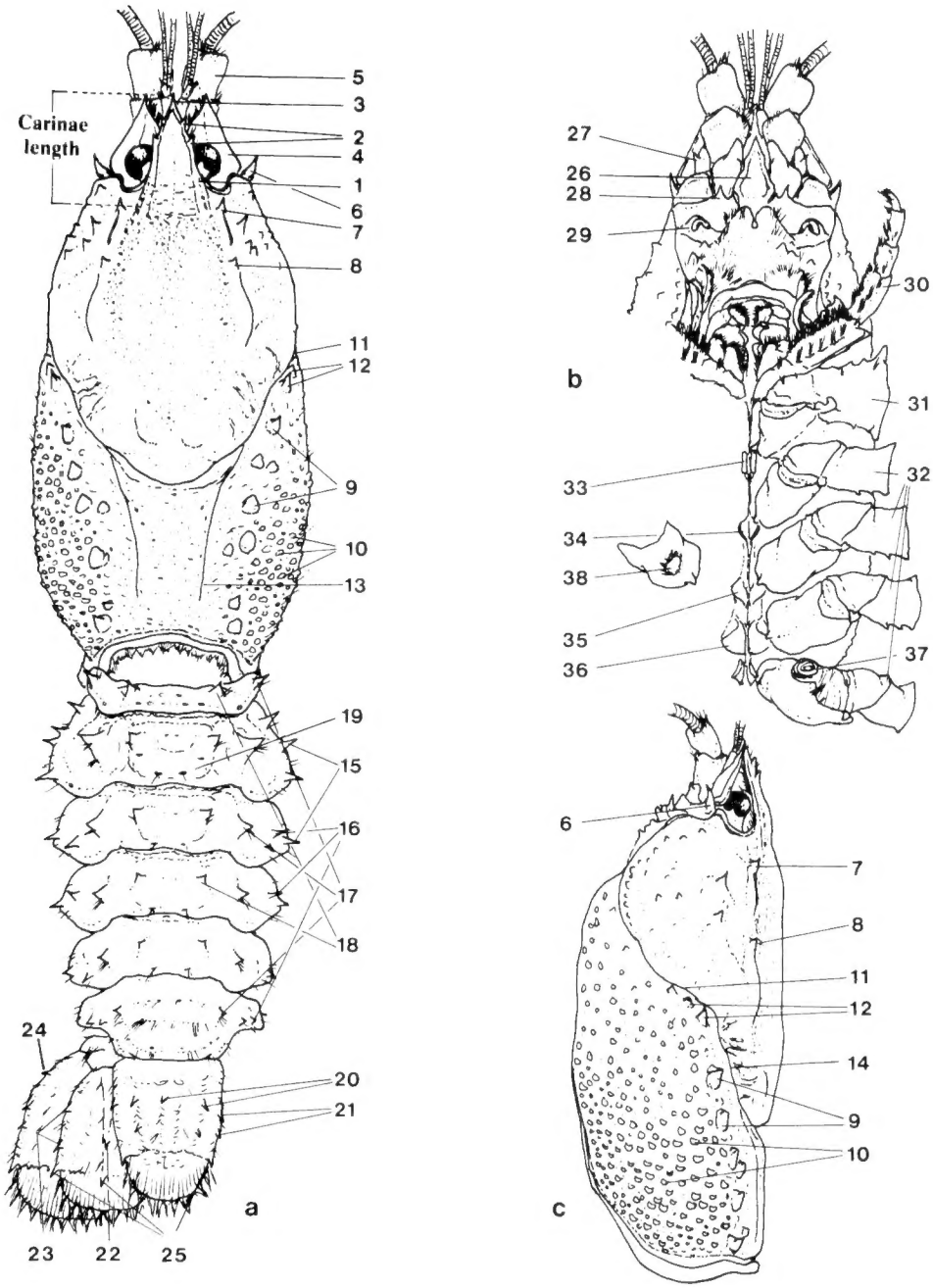


Figure 1. Morphological characters – a, dorsal view cephalothorax and abdomen; b, ventral view cephalothorax; c, lateral view cephalothorax. 1, rostral carina; 2, rostral marginal spines; 3, rostral acumen spine; 4, antennal squame (scale); 5, 3rd antennal segment; 6, suborbital spine; 7, 1st postorbital ridge spine; 8, 2nd postorbital ridge spine; 9, dorsal thoracic spines; 10, general tubercles; 11, cervical groove; 12, cervical spines; 13, branchiocardiac groove; 14, postcervical groove; 15, Li spines; 16, Lii spines; 17, D-L spines; 18, D spines; 19, abdominal boss; 20, telsonic surface spines; 21, telsonic marginal spines; 22, surface spines of uropod inner ramus; 23, marginal spines of uropod inner ramus; 24, marginal spines of uropod outer ramus; 25, standard tailfan spines; 26, interantennal spine (cephalomedial lobe of epistome); 27, basipodite antennal spine; 28, coxopodite antennal spine; 29, opening of green gland; 30, maxilliped 3; 31, great chela (pereiopod 1); 32, pereiopods 2-5; 33, keel processes 1 (Pr1); 34, keel processes 2 (Pr2); 35, keel processes 3 (Pr3); 36, keel processes 4 (Pr4); 37, male genital papilla (pereiopod 5); 38, female genital pore (pereiopod 3).

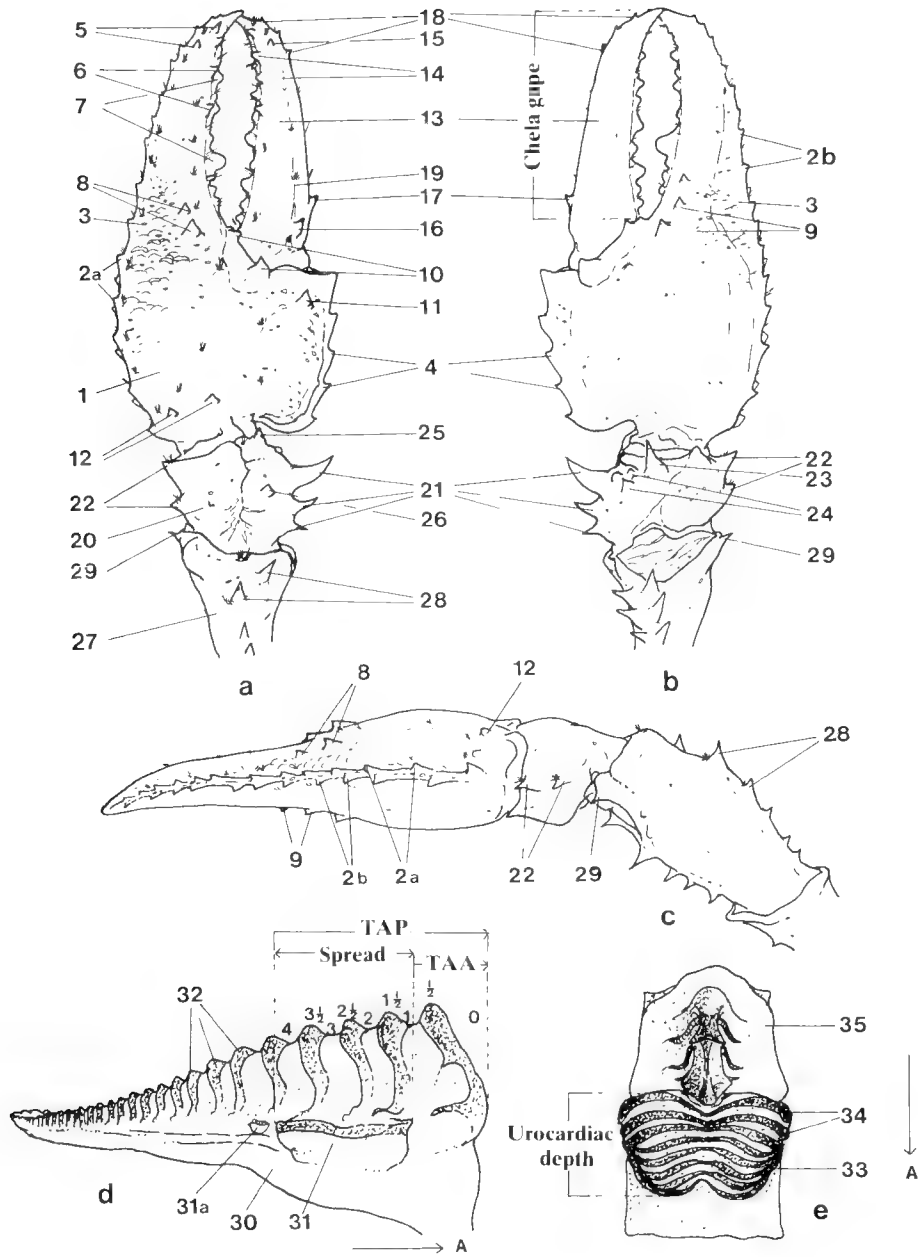


Figure 2. Morphological characters – a, dorsal view left chela; b, ventral view left chela; c, lateral view left chela; d, e, gastric mill ossicles. 1, propodus; 2, lateral propodal spine rows: a dorsal, b ventral; 3, lateral spine ridge; 4, mesal propodal spines; 5, dorsal apical propodal spines; 6, spines above propodal cutting edge; 7, cutting teeth; 8, spines lateral to dactylar base dorsally; 9, spines lateral to dactylar base ventrally; 10, spines at dactylar articulation; 11, spine posterior to dactylar articulation; 12, precarpal spines; 13, dactylus; 14, spines above dactylar cutting edge; 15, extra dorsal apical dactylar spine; 16, dorsal mesal dactylar basal spine; 17, marginal mesal dactylar basal spine; 18, apical mesal dactylar spines; 19, dactylar groove; 20, carpus; 21, mesal carpal spines; 22, lateral carpal spines; 23, ventral carpal spine; 24, ventromesal carpal spines; 25, articulation spine; 26, dorsal carpal spine; 27, merus; 28, dorsal meral spines; 29, outer (distolateral) meral spine. 30, lateral view zygocardiac ossicle; 31, ventral ear; 31a, secondary ear; 32, zygocardiac teeth; 33, ventral view urocardiac ossicle; 34, urocardiac ridges; 35, prepyloric ossicle. A anterior.

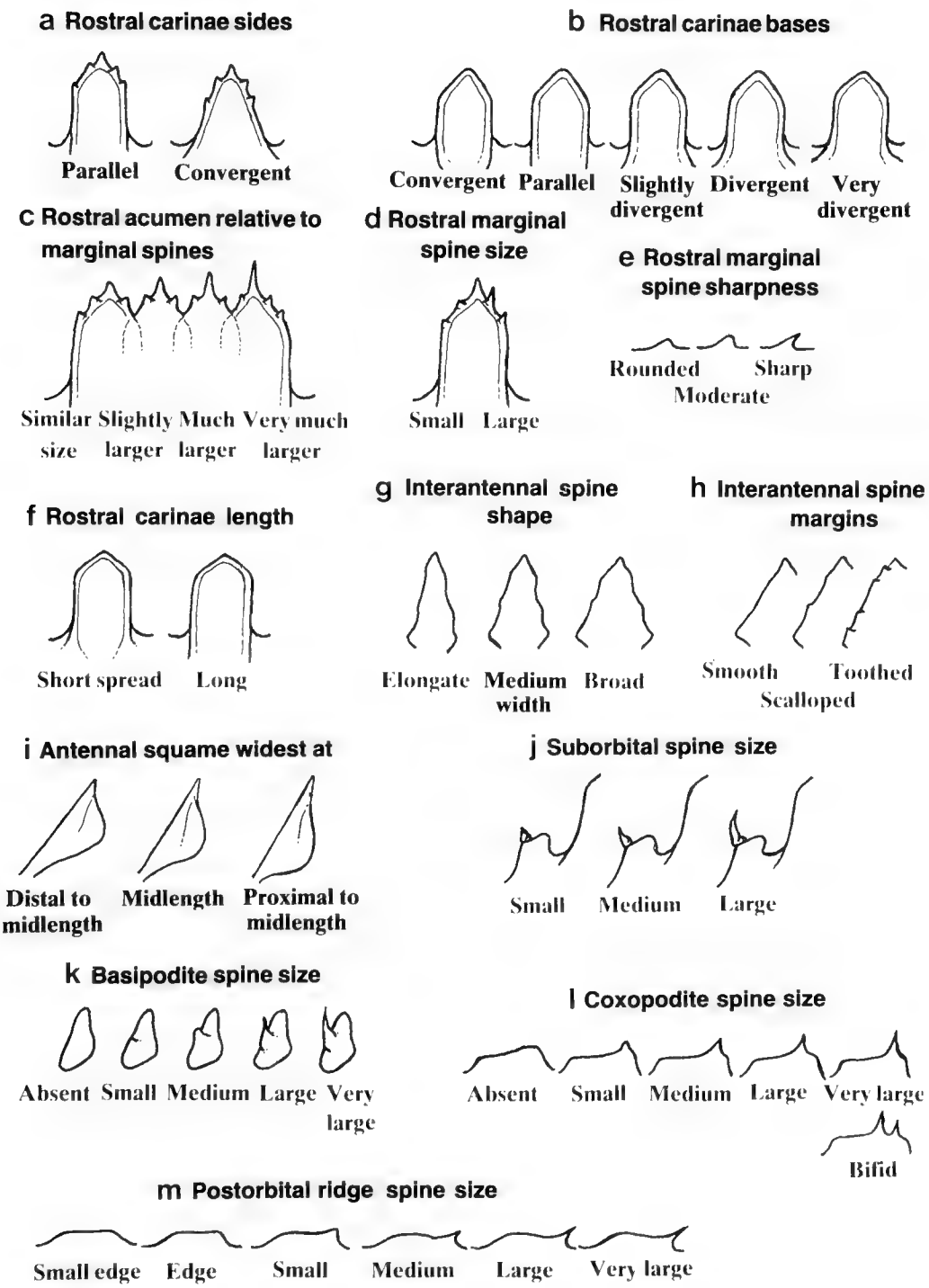


Figure 3. Selected character states.

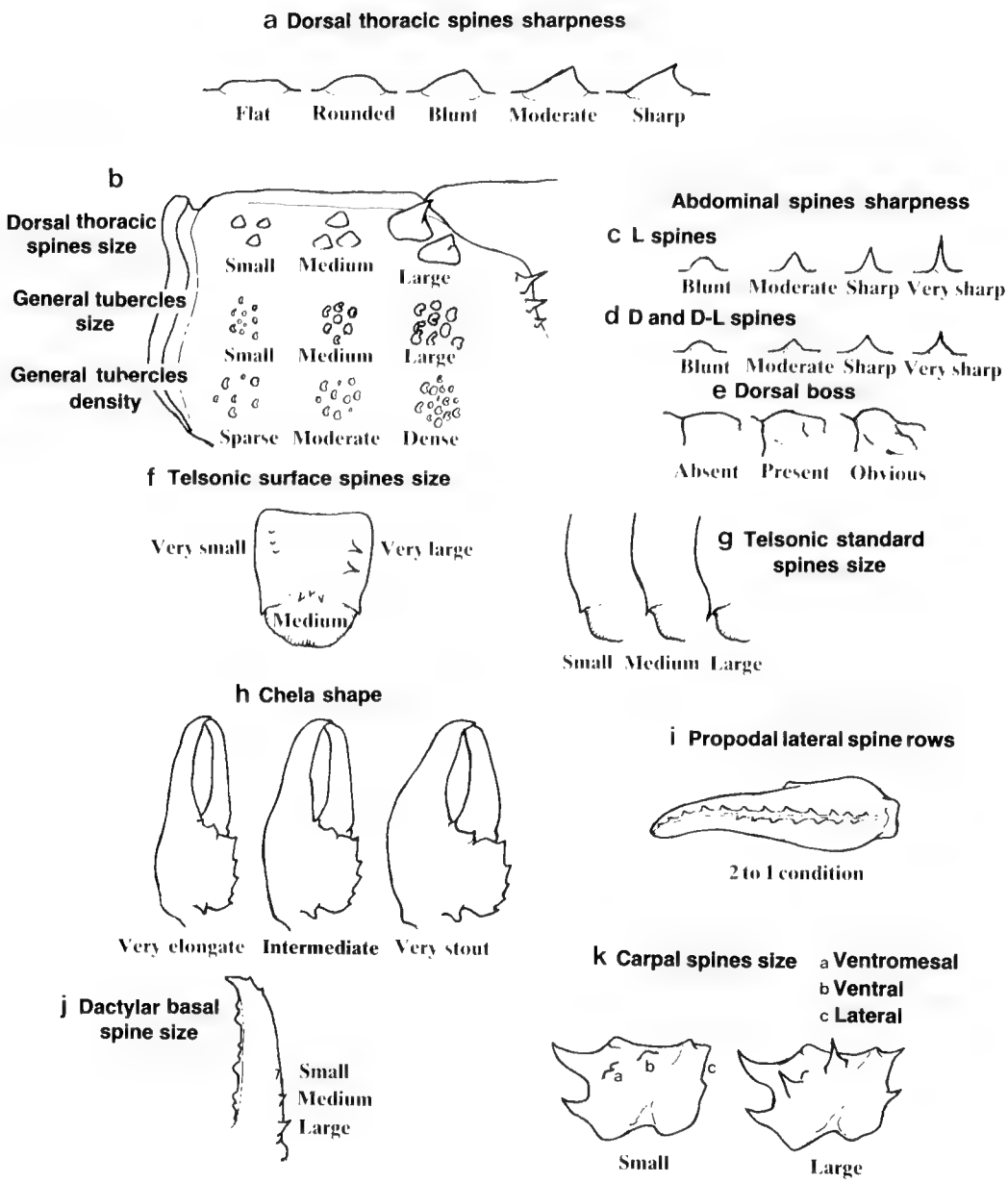


Figure 4. Selected character states (continued).

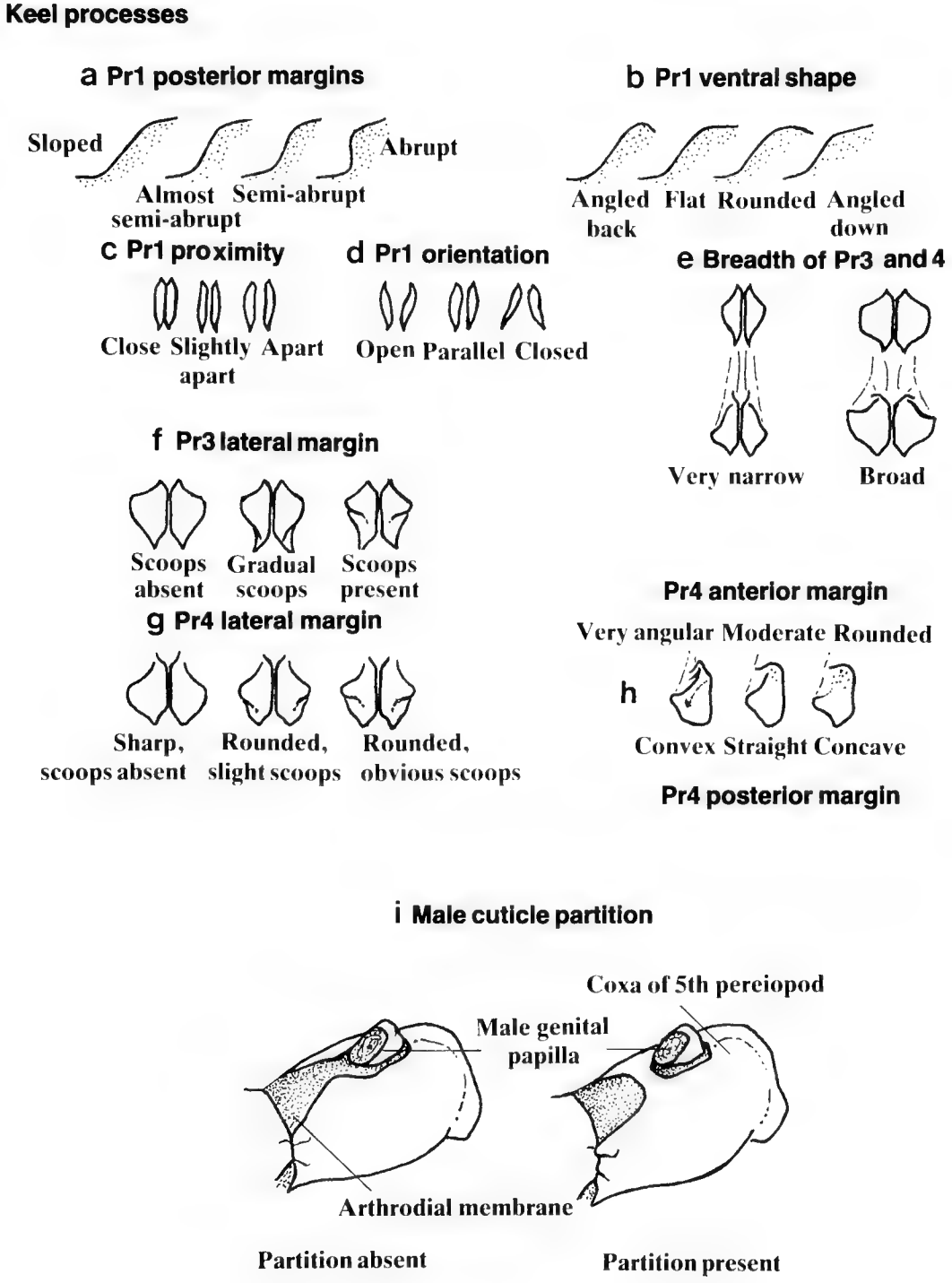


Figure 5. Selected character states (continued).

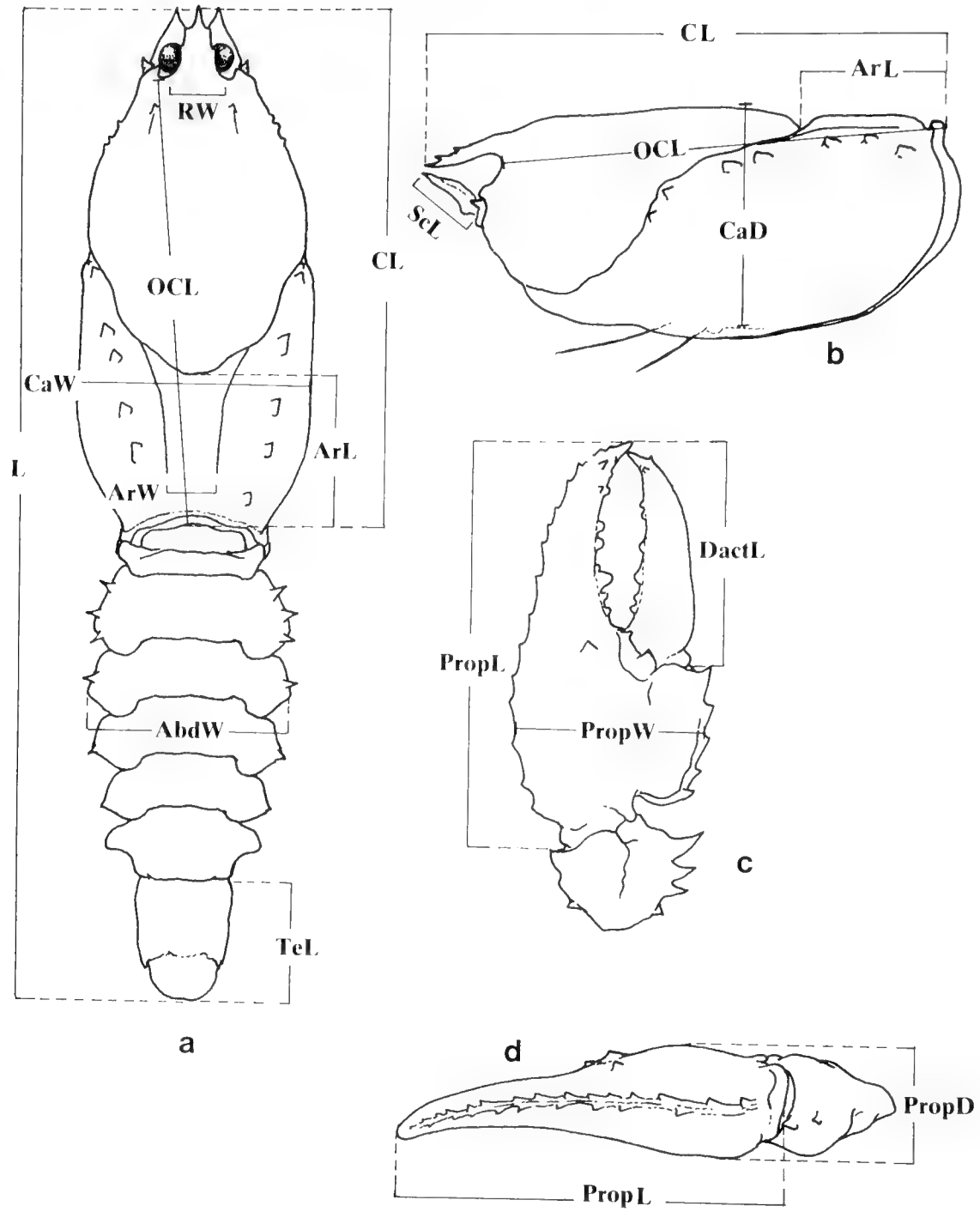


Figure 6. Measurements – a, dorsal view cephalothorax and abdomen; b, lateral view cephalothorax; c, dorsal view left chela; d, lateral view left chela. OCL - occipital carapace length; CL - carapace length; L - total body length; CaW - carapace width; CaD - carapace depth; ArL - areola length; ArW - areola width; RW - rostral width; AbdW - abdominal width; TeL - telsonic length; ScL - scale (squame) length; PropL - propodal length; PropW - propodal width; PropD - propodal depth; DactL - dactylar length.

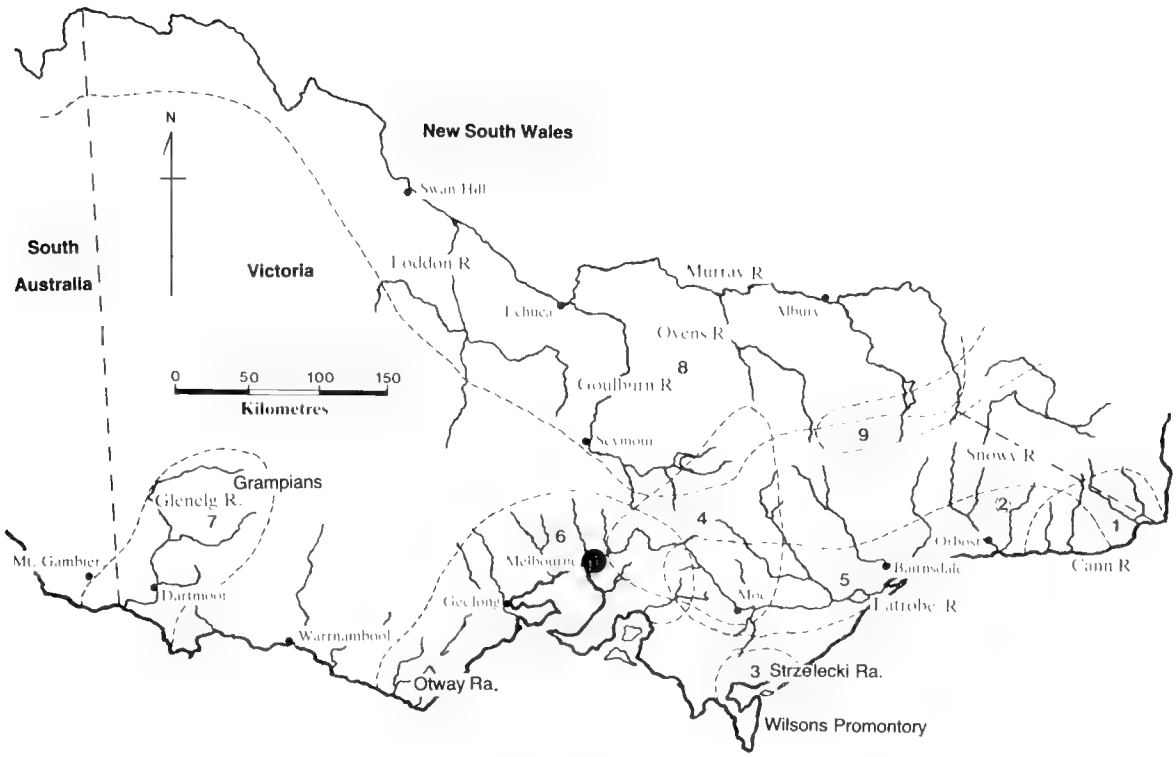


Figure 7. Approximate ranges of *Euastacus* species in Victoria – 1, *E. bidawalus*; 2, *E. diversus*; 3, *E. neodiversus*; 4, *E. woiwuru*; 5, *E. kershawi*; 6, *E. yarraensis*; 7, *E. bispinosus*; 8, *E. armatus*; 9, *E. crassus*.

it is homologous with spines on other specimens. A postorbital spine may decline from large to an edge during growth of a specimen.

A code of abdominal spination is introduced to facilitate descriptions (Fig. 1a): Li (primary lateral) spines protrude from margins of the pleura, D-L (dorsolateral) spines from the pleura/tergum junctions, Lii (secondary lateral) spines between the above rows and D (dorsal) spines from the tergum dorsally.

Tailfan spines are illustrated in Figures 1a and 4f. The standard spines protrude from the posterolateral edges of the calcified telson and uropods and posteromedial edge of the inner uropod ramus. Standard spines are excluded from tailfan spine counts.

The lateral propodal spine rows are regarded as extending from the proximal base of the propodus and hence the 2-to-1 row condition (Fig. 4i) describes the ventral row ending subapically.

The term "scoops" refers to infoldings of the distal edge of the sternal keel processes (Fig. 5f, g).

The male cuticle partition is a strip of cuticle between the genital papilla on the fifth pereiopod and the arthrodial membrane between coxa and basis. When the partition is absent, the membrane extends around the chitinous ring of the papilla (Fig. 5i).

Occipital carapace length (OCL) is used as an index of specimen size. Fitzpatrick (1977) proposed carapace length (CL) to be a preferable measure of crayfish size but specimens of *Euastacus* not infrequently have broken or deformed rostra. Propodal length (PropL) is employed as an index of chela size. Rostral width (RW) is difficult to measure and was taken arbitrarily at approximately halfway through the posterior occipital curve. Propodal width (PropW) was measured at approximately halfway between the proximal and distal edges

of the mesal margin of the propodus. Since dactyli may be broken or slightly deformed, a "theoretical" dactylar length was measured from the base of the dactylus to its apex if it coincided with the apex of the propodus. Measurements are illustrated in Figure 6.

Fourteen ratios were derived from the fifteen measurements and are included in the species' descriptions. The range in values of measured specimens is recorded and allometric trends indicated by "i": ratio increases with growth, "d": ratio decreases with growth, "id": ratio increases in early growth to decrease later, "di": ratio decreases then increases later. These postscripts indicate only general ontogenetic trends and do not imply a neat progression from one extreme to the other. Most ratios are self-evident though two involve inverse relationships of measurements. The ratio OCL/CL is used as a measure of relative rostral length; as the ratio increases the rostrum decreases in length relative to OCL. The ratio OCL/L similarly is employed as an inverse index of relative abdominal length. The measurements CL and L are used above as denominators to avoid ratio values in excess of unity.

Allometric and some geographic variation are incorporated in the descriptions.

Sexual maturity in females is estimated from the state of the gonopores: light setation around closed pores indicates approaching maturity, heavy setae and open pores indicate sexual maturity. Turvey (1980) also employed gonopore setae in determining female maturity. Sexual maturity in males is difficult to estimate from external characters.

Gastric mills were dissected from selected specimens using a fine pair of forceps inserted via the mouth, as described by Francois (1962). Teeth anterior to the posterior margin of the zygocardiac ossicle ear were counted as the TAP; teeth anterior to the anterior margin of the ear were counted as the TAA; subtracting the TAA from TAP gives the tooth spread. The number of urocardiac ridges was counted, excluding the first anterior ridge which is an extension of a more posterior ridge. The mill characters are similar to those described by Francois (1962) with the exception that the first anterior tooth of the zygocardiac ossicle was counted consistently for this study (Fig. 2d, e).

Francois (1962: 24) defined a mill character usually not employed in this study. The "first extra tooth" (not projecting into rugae on the zygocardiac ossicle) appears to be variable in virtually all species and is seldom diagnostic on a specific level. Francois admitted that the character is of "limited taxonomic value", though suggesting it may be of use in "infraspecific relationships". In the case of *E. armatus*, however, the first extra tooth appears to occur invariably between teeth 5 and 6, unlike the positions of all other species.

Numerical techniques were employed as an adjunct to classical taxonomy. The CSIRO TAXON program package was used in polythetic agglomerative classification and ordination of data. The computer results are complex and not reproduced here but the descriptions represent conclusions based upon numerical and classical techniques. The author can be contacted for information on the programs employed and the printouts.

Species descriptions are extensive and adhere to a standard format that will be maintained in papers on *Euastacus* species from other states. For new species, paratypes are designated to "show the range of variation within the species" (Schenk and McMasters, 1956). Holotypes and paratypes are figured preferentially also to a standard format. Descriptions incorporate specimens of all sizes but diagnoses include only specimens larger than 20 mm OCL (> 20 OCL) since diagnostic characters rarely are developed on smaller animals.

Abbreviations.

Sizes of specimens in descriptions are given in millimetres of occipital carapace length and the unit is omitted (e.g., 50 OCL, 30-40 OCL). The scales in figures are in millimetres.

Australian museums are abbreviated: Australian Museum, Sydney (AM), Museum of Victoria, Melbourne (NMV). The following collectors are designated by initials except in citing type localities: E.F. Riek (EFR), J.R.

Kane (JRK), S.J. Harders (SJH), G.J. Morgan (GJM).

PARASTACIDAE Huxley, 1878

Euastacus Clark, 1936

Diagnosis. Carapace with spines or tubercles other than rostral and postorbital, and varying degree of setation; enlarged branchiostegite spines dorsal when present. Anterolateral extension of branchiocardiac groove fused with cervical groove rather high on carapace. Abdomen usually bearing spines (up to 4 rows) but these may be reduced to low bumps. Pleuron of first abdominal somite distinct and partially overlapped by second somite. Telson frequently with dorsal spines, divided laterally by transverse suture, posterior portion membranous. Third maxilliped with ventral surface of ischium bearing single row of stiff setae and prominently produced distolaterally; exopodite reduced, basal segment not reaching apex of ischium. Propodus of chela (1st pereiopod) with ventrolateral margin bearing one or two rows of spines; plane of movement of chela propodus and dactylus oblique; chela dactylus usually with several basal and/or apical mesal spines (at least one apical mesal spine); chela carpus with 2-4 (rarely 5) mesal spines and 1 to several ventral or ventromesal spines, carpus with deeply incised dorsal longitudinal groove. Male genitalia on ventral coxa, consisting of short papilla with calcified ring, not distinctly tubular. Branchial formula 21 +epr; stem of podobranchiae, except on fourth pereiopod, produced laterally in wing-like expansion. [Modified from Riek (1969), Hobbs (1974).]

Type species Cancer serratus Shaw, 1794 (non *Cancer serratus* Forskål, 1775).

Astacoides spinifer Heller, 1865 (by original designation).

Remarks. Clark (1936) established the genus *Euastacus*, designating *Cancer serratus* Shaw as type species. Later (1941), she realised that her initial concept of *Euastacus serratus* included several species and gave *Euastacus elongatus* Clark as type species. This move was invalid and the original designation must stand. *Cancer serratus* Shaw is a junior homonym and its name has been replaced by the next available synonym, *Astacoides spinifer* Heller.

Key to Victorian species of *Euastacus*

Euastacus species are determined by character combinations and hence combinations are required to key species adequately. Specimens <20 mm OCL have been excluded from the key since diagnostic characters rarely are developed. Attention must be paid to grammatical punctuation. Characters in couplets are separated by full stops. There are frequently alternatives within each level of a couplet. The following illustrates use of the full stop, colon and comma –

Spine A present, or if spine absent: B spine present, C spine large and X spines extending beyond half gape of chela. Y spine on dactylus. Z spines absent.

The alternative is that spine A may be present or absent. If the spine is absent, the colon indicates that the subsequent characters apply regarding spines B, C and X, separated by commas. The full stop identifies the end of the alternative; following characters regarding spines Y and Z are applicable regardless of the first alternative (i.e., whether or not spine A is present).

Secondary characters are included in square brackets. These characters are not exclusive to that level but are constant and hence useful in corroborating the primary, diagnostic characters. Chela characters apply to non-regenerate appendages, therefore if chelae differ distinctly in size, the larger should be employed for the key.

1. 1 or more telsonic surface spines present, or if rarely absent: thoracic spines medium sized or large (may be flattened), usually 2 mesal carpal spines and rostral carinae of medium length or long 2

– Telsonic surface spines absent. Thoracic spines absent or just discernible, or if thoracic spines distinct: 3 or more mesal carpal spines and rostral carinae usually short and spread 5

2. Male cuticle partition present. [D abdominal spines absent and distinct abdominal boss present on specimens >60 mm OCL. Usually large spine lateral to dactylar base dorsally. Posterior margins of Pr1 usually sloped] . . . . . *E. kershawi*

– Male cuticle partition absent. [D abdominal spines present, or if absent: rarely a small or medium sized spine lateral to dactylar base dorsally and posterior margins of Pr1 usually abrupt] 3

3. Thoracic spines usually large but flat or rounded (rarely sharp posteriorly). D abdominal spines absent, or small if present and only on anterior somites, often on one side only. Abdominal boss pronounced on specimens >60 mm OCL. [Pr1 abrupt. Usually 2 Li spines per side on somite 2] . . . . . *E. bispinosus*

– Thoracic spines sharp or blunt, rarely rounded. D abdominal spines present, often sharp. Abdominal boss not very pronounced (obscured by broad D spines) 4

4. D abdominal spines usually curved towards anterior on specimens >50 mm OCL. Rostral base usually parallel. General tubercles moderately distributed or sparse. Telsonic spines medium sized or small (sometimes absent). Dorsal mesal dactylar basal spines usually absent. Usually 2 Li spines per side on somite 2. PropW/PropL usually 0.38-0.42. PropD/PropL usually 0.23-0.27. 1st extra zygocardiac tooth between teeth 5 and 6 . . . . . *E. armatus*

– D abdominal spines not strongly curved to anterior. Rostral base usually divergent or very divergent. General tubercles often dense. Telsonic spines usually large. Usually 1-3 dorsal mesal dactylar basal spines. Usually >2 Li spines per side on somite 2. PropW/PropL usually 0.43-0.46. PropD/PropL usually 0.27-0.29. 1st extra zygocardiac tooth usually between teeth 6 and 7 (not 5 and 6) . . . . . *E. yarraensis*

5. Male cuticle partition absent . . . . . *E. crassus*

– Male cuticle partition present 6

6. 2-5 dorsal mesal dactylar basal spines usually reaching distal to midlength of dactylus. Marginal mesal dactylar basal spine usually absent 3-5 (rarely 2) apical mesal dactylar spines, usually reaching mesal basal spines 7

– 1 (rarely 2) dorsal mesal dactylar basal spine(s). 1-2 marginal mesal dactylar basal spines. 2 apical mesal dactylar spines (mesal dactylar basal spines not reaching apical dactylar spines 8

7. Spines above propodal and dactylar cutting edges reaching midlength, proximal to midlength or to full gape. Thoracic spines usually small or absent . . . . . *E. woiwuru*

– Spines above propodal and dactylar cutting edges apical. Thoracic spines medium sized with some small . . . . . *E. neodiversus*

8. Marginal squamal spine(s) present. Dorsal thoracic spines absent . . . . . *E. diversus*

– Marginal squamal spines absent. Dorsal thoracic spines medium-sized . . . . . *E. bidawalus*

Euastacus armatus (von Martens)

Figures 8, 9

Astacus armatus von Martens, 1866: 359-60.

Astacoides serratus.–McCoy, 1867: 189.–1878: 17, pl. 15 (in part, Murray R. locality).

Astacus serratus.–von Martens, 1868: 615 (in part, Murray R. locality, fide Francois, 1962).

Astacopsis armatus (von Martens).–Huxley, 1880: 308, fig. 76.

Astacopsis serratus.–Haswell, 1882: 174 (in part, Murray R. locality).–McCoy, 1888: 225-6.–Ortmann, 1902: 292 (in part, Murray R. locality).–Smith, 1912: 145-7, 149, 157-160, pl. 16 (in part, Murray R. locality).–McCulloch, 1917: 237-8 (in part, Murray R. locality).–Hale, 1927: 75-6 (in part, Murray R. locality).

Astacopsis spinifer.–Spence-Bate, 1888: 195, 205 (in part, Murray R. locality).

Astacopsis spinifera (misspelling).–Faxon, 1898: 670, 675 (in part, Murray R. locality).–1914: 402 (in part).

Euastacus serratus.–Clark, 1936: 12-13, pl. 2, fig. 12(?) (in part, Murray R. locality).–1937a: 35.–1937b: 186.

Euastacus yarraensis.–Clark, 1936: 14-15 (in part, Yea R. locality).–1941: 15-16 (in part, tributaries of Murray R. localities).

Euastacus nobilis.–Clark, 1941: 20-2 (in part, tributaries of Murray R. localities).

Euastacus elongatus Clark, 1941: 12-13, pl. 1.–Riek, 1951: 378, 384-5.

Euastacus armatus (von Martens).–Clark, 1941: 13-15, pl. 2.–Clark & Burnet, 1942: 90-2.–Riek, 1951: 384-5.–Francois, 1960: 217-18.–Riek, 1969: 894.

Material examined. Vic. Alexandra, 6 miles upstream of Seymour (Goulburn R.), 19 Sep 1963, JRK, NMV J6199, 1♂, 1♀; Goulburn R. near Tongala, 30 Sep 1962, JRK, 1♂; Trawool Bridge, Goulburn R., 19 Sep 1963, Rawlinson, NMV J6198, J6208, J6209, 3♀♀; Goulburn R. near Trawool Bridge, 17 Apr 1980, GJM, 1♂, 2♀♀; Goulburn R., Dec 1935, 2♂♂, 4♀♀; Goulburn R. near Jamieson, Jan 1980, 3♂♂, 2♀♀; Yea R. near Devlins Bridge, 16 Apr 1980, GJM, 2♂♂, 2♀♀; Murrundindi R. just east of Murrundindi, 16 Apr 1980, GJM, 2♀♀; King Parrot Ck, tributary of Goulburn R. near Strath Creek, 13-14 Apr 1980, GJM, 2♂♂, 1♀; Jamieson R., Dec 1935, Hordern, NMV J6200, 2♂♂, 2♀♀; Howqua R., 1980, R. England, 1♀; Mitta Mitta R., Dartmouth, NMV J6206, 1♀; Mitta Mitta R., 7 Dec 1977, G. Bennison, NMV J6197, 1♂; Kerang area (Murray R.), Oct 1969, A. Pescott, NMV J6217, 1♀; (2 labels), Yea R., Oct 1935, or Murray R., 1907, 1♀.

NSW and ACT. Murray R., Mar 1910(?), AM P2364, 1♂; Murray R., 21 Jun 1914, 1♂; Murray R. at Echuca, Oct 1935, Harris, NMV J6201, J6216, 1♂, 1♀; Murray R. 14 miles below Albury, K. Frankenburg, NMV J6210, 1♀; Murrumbidgee area, 1970-1972, J. Lake, AM P21832-3, 14♂♂, 14♀♀; Murrumbidgee R., May 1920, Amateur Fishermens Association, AM P4692, 1♀; Murrumbidgee R., Jun 1920, D.G. Stead, AM P4720, 1♀; Murrumbidgee R., Oct 1954, A. Racek, AM P13378-9, 2♂♂; Murrumbidgee R., May 1936(?), AM P10748, 1♀; Murrumbidgee R., Jun 1968, AM P16165, 1♂; Yanco, south-west N.S.W., 9 Feb 1960, J. Buggei, AM P13459-60, 2♀♀; Narrandera, Aug 1902(?), P. Mowbray, AM G3971, 1♀; Cotter R. near Canberra, A.C.T., 14 Dec 1946, EFR, AM P11943-4, 6♂♂, 3♀♀; Cotter R., A.C.T., at stilling pool, Nov 1949, EFR, 3♂♂, 1♀; Creek east of Kandos near Rylstone, west side of Dividing Range, tributary of Macquarie R., R. D. Gauthier, AM P15522-4, 2♂♂, 1♀; Goodridigby R., Jan 1951, EFR, AM P13036, 1♂.

SA. Blanchetown No. 1 Lock, Murray R., 14 Aug 1935, 1♂; Murray R., 1905, 1♀; Murray R., 30 Nov 192?, SAM C691, 1♂.

No locality. NMV, 3♂♂, 3♀♀, 1♀ with label "Skipton, Vic" NMV J6205, must be sited erroneously.

Diagnosis. Male cuticle partition absent. Rostral spines reaching proximal to midlength of carinae (rarely only to midlength). Rostral base usually parallel, carinae medium length to long. Antennal squame widest proximal or very proximal to midlength. Marginal squamal spines absent. Suborbital spine medium sized or large. Large thoracic spines distributed in irregular rows. General tubercles large or medium sized on large animals, moderately distributed or sparse. Usually 2 Li spines on abdominal somite 2, spines medium sized to very large. D abdominal spines large and sharp (>60 OCL), curving towards anterior. Abdominal boss present (>60 OCL) but not obvious. 1-9 telsonic surface spines (rarely absent). Often marginal spines on outer ramus of uropod. Lateral propodal spines in 2 to 1 row condition. 1-3 dorsal apical propodal spines (most >40 OCL). Spines above propodal and dactylar cutting edges apical, rarely to midlength of gape. 5 (rarely 4, 6) mesal prop-

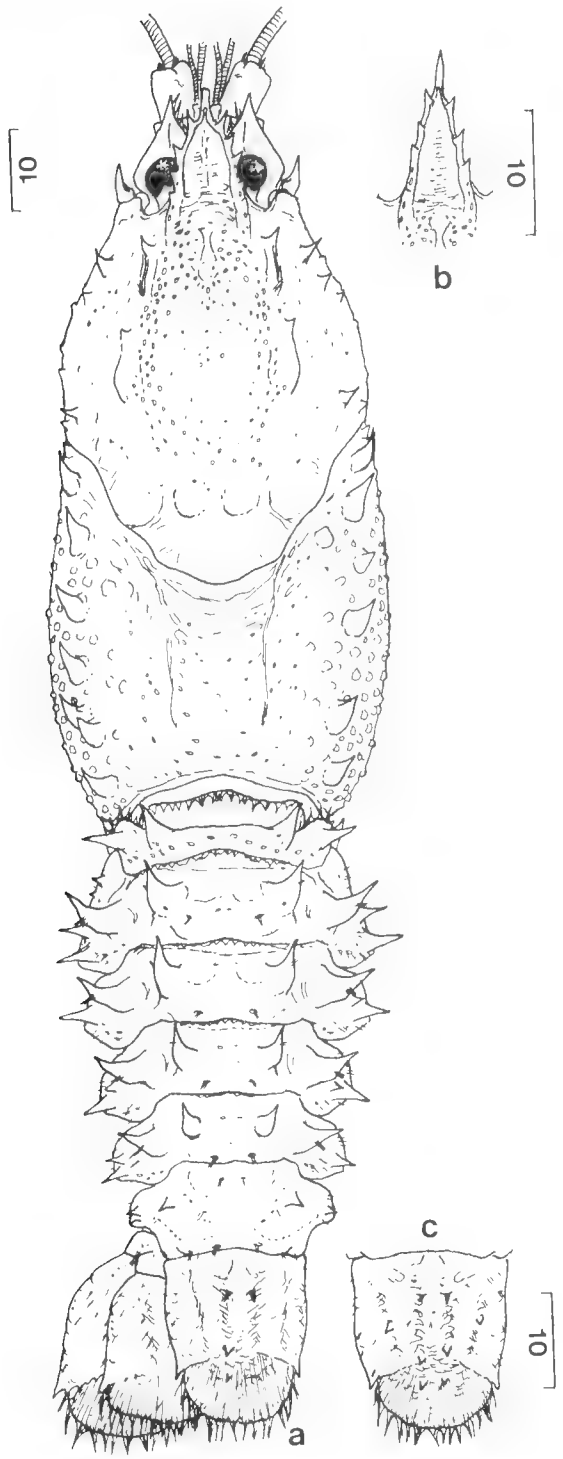


Figure 8. *Euastacus armatus* – (Type not available for illustration) a, dorsal view, ♂, Alexandra, Vic., NMV J6199; b, rostrum, more elongate (allometry), ♀, Kandos, NSW, AM P15523; c, telson, more numerous surface spines (6), ♂, Kandos, NSW, AM P15522.

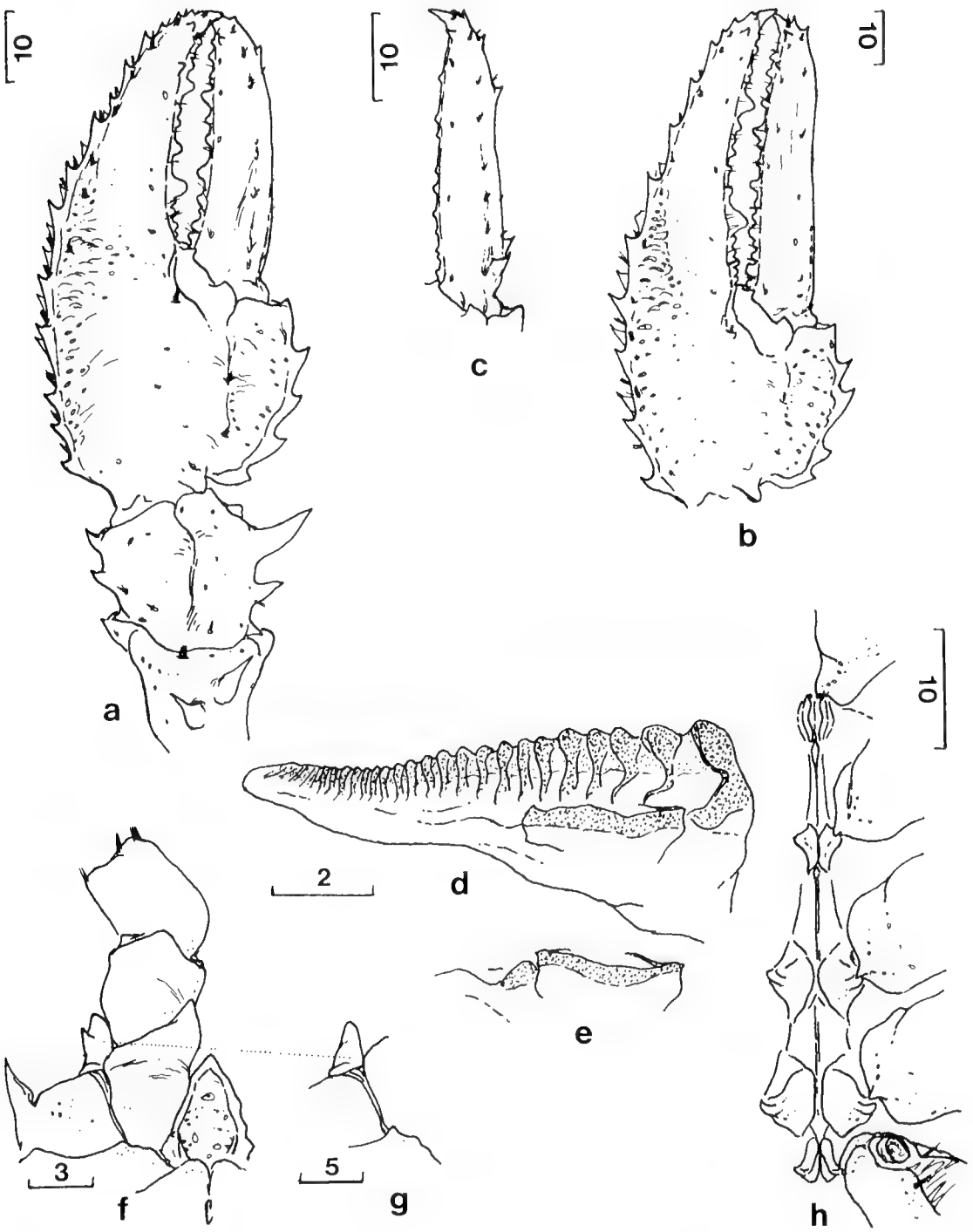


Figure 9. *Euastacus armatus* – a, dorsal view chela, ♂, Alexandra, Vic., NMV J6199; b, chela, ♀, Echuca, Murray R., NMV J874; c, dactylus, 3 apical mesal spines, 1 dorsal and 1 marginal mesal dactylar basal spine (probably regenerate), ♂, Kandos, NSW, AM P15522; d, zygocardiac ossicle, ♀, Echuca, Murray R., NMV J874, type of E. elongatus, Francois collection; e, zygocardiac ossicle, small 2 ear posterior to main ear, ♀, Euston, Murray R., Francois collection; f, ventral view cephalon, ♂, Alexandra, Vic., NMV J6199; g, cephalon, ♀, Echuca, Vic., NMV J874; h, sternal keel, ♂, Kandos, NSW, AM P15522.

odal spines. Dorsal and marginal mesal dactylar basal spines usually absent, 2-3 (rarely 1) apical mesal dactylar spines, 2 mesal carpal spines. Largest ventromesal carpal spine rarely as large as ventral spine. Keel Pr1 sloped (rarely semi-abrupt) and slightly or distinctly apart. TAP count 5.0- 7.0. [1st extra zygocardiac tooth between teeth 5 and 6].

Description. Maximum OCL: 146.2 mm.

Rostrum. Rostrum broad and long, reaching to or distal to end of 3rd antennal segment on most specimens (occasionally between midlength and end of segment). Rostral sides parallel or slightly convergent, distinctly convergent on some specimens <60 OCL. Base usually parallel, sometimes slightly divergent; carinae medium length to long. 3-5 rostral spines per side, reaching proximal to midlength of carinae (rarely only to midlength); spines large or very large distally, usually decreasing in size proximally, and sharp. Acumen spine much larger than marginal spines.

OCL/CL 0.73-0.84 i. RW/OCL 0.14-0.23 d.

Cephalon. Spinose or very spinose, moderately spinose on some animals <60 OCL, poorly spined on some <20 OCL (spines sometimes rounded on large specimens due to abrasion); 1-4 large or medium sized spines, with smaller spines or bumps, ventral to postorbital ridges. 1st postorbital spine usually large, occasionally medium sized; 2nd spine small or medium sized on specimens >60 OCL, sometimes large on smaller animals, always large on specimens <20 OCL. Suborbital spine large to medium sized. Lateral margin of antennal squame straight or slightly convex, rarely slightly concave on specimens <20 OCL; squame widest proximal or very proximal to midlength; marginal spines absent. Interantennal spine usually broad (sometimes of medium width), or very broad on small animals; spine margin slightly or distinctly scalloped. Basipodite spine absent, small or medium sized on specimens >60 OCL and most smaller animals, large on some specimens <60 OCL, large or very large on specimens <20 OCL. Coxopodite spine small or very small, sometimes absent; spine weakly unimodal or serrated.

ScL/OCL 0.14-0.36 d.

Thorax. 3-12 (usually 5-9) dorsal thoracic spines, arranged in 1 or 2 irregular rows; spines large, usually with some medium sized, on specimens >40 OCL, large to small on animals 20-40 OCL; spines very sharp, sharp or moderately pointed, usually with some dorsal spines blunt or rounded, always blunt on small animals. Specimens <20 OCL lacking thoracic spines. General tubercles large to medium sized on specimens >60 OCL, medium to small or tiny on lesser animals; tubercles moderately distributed or sparse. Specimens <20 OCL lacking general tubercles, merely punctate. 1-4 cervical spines; 1st (dorsalmost) and sometimes 2nd large and sharp.

ArL/OCL 0.34-0.40. CaW/OCL 0.55-0.64 i. ArW/OCL 0.15-0.23 d. CaD/OCL 0.49-0.56 d.

Abdomen. D-L spine on somite 1 of specimens >40 OCL and some 20-40 OCL; spine usually large and very sharp, sometimes medium sized and moderately pointed or blunt on small animals. D spine (rarely 2 on one side) on somite 1 of specimens >40 OCL and some smaller specimens; spine usually large and very sharp, smaller and blunter on smaller animals. Somite 2 usually with 2 Li spines, occasionally 3 on one side (4 on one side of one specimen); somites 3-5 of specimens >20 OCL with 1 Li spine; Li spines very large or large and very sharp on specimens >60 OCL and many smaller animals, specimens <40 OCL with medium sized to tiny spines, sharp to blunt. Lii spines absent from somite 2, frequently 1 or 2 on somites 3-6 of specimens >40 OCL; spines large to small, sometimes tiny, and usually very sharp on large animals, often moderately pointed to blunt on specimens <60 OCL. D-L spine on somites 2-6 of specimens >60 OCL and many specimens 20-60 OCL; D-L spines decreasing in size posteriorly, from very large to medium sized or small on large animals, large or small to tiny on small animals; spines very sharp on specimens >60 OCL and some smaller animals; some animals <60 OCL with blunt or very blunt spines. D spine on somites 2-5 of specimens >40 OCL and anterior somites of some smaller specimens; D spines diminishing posteriorly from very large to large on large animals, large or medium sized to small or tiny on specimens

<60 OCL; spines very sharp (sometimes moderately pointed) on large animals, blunter on specimens <60 OCL. Some specimens with tiny D spine on somite 6. D-L and D spines usually strongly curved towards anterior on large specimens; D-L spines of large specimens sometimes developing two points. Specimens <20 OCL lacking abdominal spines. Dorsal boss on specimens >60 OCL but not strongly developed, vague or absent on smaller animals.

AbdW/OCL: ♂ 0.42-0.54 d; ♀ 0.44-0.57 di. OCL/L ♂: 0.35-0.47 i; ♀ 0.35-0.45 i.

Tailfan. Usually 1-9 telsonic surface spines, occasionally absent; spines very large or large on specimens >100 OCL, large to medium sized on specimens 60-100 OCL, medium sized to very small on lesser individuals. Small or medium sized telsonic marginal spine on one side of some specimens. Inner ramus of uropod sometimes with 1 medial surface spine and frequently 1-3 marginal spines; outer ramus often with 1-3 (rarely 4) marginal spines; uropod spines sometimes absent on specimens of all sizes, always absent on specimens <40 OCL; spines usually medium sized or small, rarely large. Standard spines small or medium sized on specimens >80 OCL, medium to large on smaller animals.

TeL/OCL: ♂ 0.27-0.42 d; ♀ 0.28-0.41 di.

Chelae. Chelae elongate to intermediate in shape, often dorsoventrally flattened. Teeth well developed on most specimens >80 OCL.

Propodus: Lateral spine rows in 2 to 1 condition; spines large and sharp. Lateral spine ridge present, usually large or very large on specimens >20 OCL, smaller animals with only a small or vague ridge. Usually 5 mesal spines, occasionally 4 or 6 (7 on some regenerate chelae). 1-3 dorsal apical spines on specimens >80 OCL and on most 40-80 OCL, absent on some specimens <80 OCL and most <40 OCL. Usually 1-3 (rarely 4) spines above propodal cutting edge, spines occasionally absent especially on animals <40 OCL; spines apical (occasionally to midlength of gape) and medium sized or small. Spines usually absent lateral to dactylar base dorsally, sometimes 1 small spine (2 on one specimen) (spines most common on Cotter R. specimens); ventrally, O or 1 (rarely 2) spines lateral to dactylar base, usually small or medium sized, rarely large. Low ridge posterior to dactylar articulation; precarpal spines absent.

PropL/OCL: ♂ 0.91-1.09 i; ♀ 0.85-1.05. PropW/PropL 0.34-0.45. PropD/PropL 0.19-0.28 d.

Dactylus: Usually 1 spine above dactylar cutting edge, sometimes 2-4 (rarely 5), high counts usually on regenerate chelae; some regenerate chelae and some specimens <40 OCL lacking spines; spines apical (rarely to midlength of gape) and medium sized to small. Extra dorsal spines absent. Usually no dorsal or marginal mesal dactylar basal spines, sometimes 1 spine on either chela (usually regenerate), rarely a spine on both chelae (one specimen with 3 marginal spines on a regenerate chela); when present, basal spines usually medium sized or large, frequently somewhat flattened. Usually 2-3 apical spines, occasionally 1 (one small specimen with 4 on a regenerate chela). Dactylar groove absent or vague on specimens >40 OCL, more definite on lesser specimens.

DactL/PropL 0.50-0.60.

Carpus: 2 mesal carpal spines, frequently with small bump distal or proximal to spines; 1st (distal) spine usually much larger than 2nd and only slightly offset ventrally. 2(occasionally 1) lateral carpal spines, large on large specimens, medium sized or small on most specimens <40 OCL. Articulation spine usually absent, sometimes small or tiny on specimens <40 OCL. Dorsal carpal spines absent (low bumps on some regenerate chelae). Ventral spine very large, medium sized or small on some specimens close to or <20 OCL. Largest ventromesal spine large to small, usually medium sized; additional ventromesal spines merely bumps.

Merus: 5-8 large dorsal spines. Outer spine small or medium sized on specimens >80 OCL, medium or large on smaller specimens.

Keel: Pr1: Posterior margins usually sloped, occasionally almost semi-abrupt, rarely semi-abrupt (Kandos specimens with processes more abrupt than most other populations); ventral edges angled down (rarely rounded on small specimens); processes slightly or dis-

tinctly apart and parallel or slightly open. Keel after Pr1 usually pronounced anteriorly near bases of processes; distinct spine absent. Pr2: Open or very open. Keel after Pr2 lacking spines, sometimes weakly saddle-shaped. Pr3: Scoops usually distinct on large specimens, sometimes slight or gradual, absent on some specimens <20 OCL; processes usually rounded, sometimes moderately sharp. Keel after Pr3 low, often rather blunt, spines absent. Pr4: Scoops usually distinct, occasionally slight; posterior edges rounded to moderate curved and slightly convex, approximately straight or, most commonly, irregular; anterior edges angular or very angular. Processes 3 and 4 broad or very broad.

Setation: Light.

Punctation: Usually dense or very dense on cephalon, moderate to dense on thorax.

Gastric Mill: TAP count 5.0-7.0 (often variation between two zygocardiac ossicles of one animal; when TAP counts low, frequently a tiny secondary ear immediately posterior to main ear, effectively extending ear by one tooth); TAA count 1.0-1.5; spread 4.0-6.0. Urocardiac ridges 9-10.

Coloration: Body dorsally dark or medium green or brown, sometimes slightly tinged blue. Thoracic spines usually pale at tips, sometimes all white; general tubercles cream or pale brown. Abdominal somites laterally slightly tinged blue/green; abdominal spines pale orange, cream or white. Carpus of cheliped cream or white, medial groove often green on small specimens, mesal edge often tinged green or blue. Propodus cream or white, often with green or blue mottling on specimens <40 OCL. Fingers white or cream, tips often slightly tinged blue.

Body ventrally orange, brown, green and cream. Carpus of cheliped cream or white, often tinged blue mesally. Propodus like carpus, sometimes orange tinge mesally.

Chelae mottled green and yellow on small crayfish.

Sexes: Males lack a cuticle partition. Females <40 OCL have unopen gonopores. Some females in the 40-100 OCL range are open, the percentage increasing with increasing size. One female >100 OCL has pores with feint setae developing, but unopen. It appears that female maturity occurs from OCLs of 40 to 100 mm (or more) and very large specimens can be immature.

Distribution and biology. The species occurs in the Murray River throughout most of its length and major tributaries in Victoria (including the Goulburn, Yea, Murrundindi, Jamieson, Howqua, Ovens and Mitta Mitta Rivers) and New South Wales (including the Murrumbidgee, Cotter and Macquarie Rivers) (Fig. 7). The range extends over 800 km east-west. The most northerly known site of the species is near Kandos 160 km west of Newcastle, NSW. Presumably the creek flows into the Cudgegong and thence Macquarie and Darling Rivers. This site indicates a north-south range of approximately 450 km. *Euastacus armatus* inhabits large and small streams in a variety of habitats including cleared pasture and dry and wet sclerophyll forests (vegetation usually densest along upper reaches of streams) at altitudes from close to sea level to over 700 m a.s.l. Low elevations may be depopulated with possible extinction of the species in South Australia (Kaires, 1980; Zeidler, 1982). *Euastacus armatus* is sympatric with *Cherax destructor* for much of its range. Females are berried in winter, with hatching in spring and summer (Johnson, 1974).

Remarks. While by no means constant in characters *E. armatus* is remarkably invariable considering the size of its range, the largest for any species of *Euastacus*. Without further information, it seems valid to suggest the continuity of the Murray River drainage as responsible for comparatively free gene flow in *E. armatus*. The species is morphologically similar to *E. yarraensis* but the two can be distinguished by the characters listed in the key to species and in the diagnosis of *E. yarraensis*.

The collections of *E. armatus* are patchy with several of the large museum specimens unlabelled, but it is possible that maturation size varies with habitat. All mature females in the 40-80 mm OCL range were collected from relatively small streams, the Cotter and Howqua Rivers. No mature females smaller than 80 mm OCL have been collected from

large watercourses, including the Murray, Murrumbidgee and Goulburn Rivers. Additionally, a sponge infection of the thorax observed on some Murrumbidgee specimens (AM P21833) appears to have retarded female maturation.

Euastacus armatus has a long taxonomic history as evidenced by the synonymy. The holotype is lodged in the Zoologisches Museum, Berlin. Its type locality is the Murray River.

Euastacus bidawalus sp. nov.

Figures 10, 11

Material examined. Holotype: ♂, OCL 48.0 mm, NMV J4526. Vic., Chandlers Ck, near junction with Cann R., 27 km north of Cann River, (37°20'S., 149°13'E.), 9 Nov 1981, G.J. Morgan and S.J. Harders.

Paratypes: Vic., Mt Drummer, Alfred National Park, 4 Dec 1956, EFR. AM P15313, 2♂♂, 6♀♀.

Other specimens: Vic. Upper Cann R., above Chandlers Ck, 23 March 1968, J.C. Yaldwyn and F.J. Beeman, AM P16191, 3♂♂, 1♀; Gibbs Ck, south of Cann River, 1982, P. Horwitz, 1♀; Dingo Ck, Lind National Park, 4 Jan 1982, P. Horwitz, 1♀; Type locality, GJM and SJH, NMV J5931, 1♀; Karlo Ck tributary, Alfred National Park, (37°32'S., 149°22'E.), 9 Nov 1981, GJM and SJH, NMV J5929, 2♂♂, 2♀♀; Beehive Ck, east of Chandlers Ck, (37°20'S., 149°15'E.), 9 Nov 1981, GJM and SJH, NMV J5928, 1♂; Euchre Ck, Lind National Park, (37°34'S., 148°57'E.), 9 Nov 1981, GJM and SJH, NMV J5932, 2♀♀. NSW. Imlay Ck tributary, south-west of Eden, (37°14'S., 149°44'E.), 8 Nov 1981, GJM and SJH, 2♂♂.

Diagnosis. Male cuticle partition present. Rostral spines rarely proximal to midlength of carinae. Rostral base divergent or very divergent, carinae spread. Antennal squame widest at approximately midlength, marginal spines absent. Suborbital spine small or medium sized. Thoracic spines usually medium sized, distributed in row or thin zone. General tubercles medium sized, moderately distributed or dense. 4-7 Li spines on abdominal somite 2 (>30 OCL), spines usually medium sized to large, sometimes small. D abdominal spines very small and blunt. Abdominal boss absent. Tailfan spines absent. Lateral propodal spines in 2 to 1 or 2 row condition. 1 dorsal apical propodal spine (>30 OCL). Spines above propodal cutting edge apical or to midlength of gape. 5 (rarely 6) mesal propodal spines. Spines above dactylar cutting edge reaching midlength or proximal to midlength of gape. 1 (rarely 2) dorsal mesal dactylar basal spine(s). 1-2 marginal mesal dactylar basal spines. 2 apical mesal dactylar spines. 3 (rarely 4) mesal carpal spines. Largest ventromesal carpal spine rarely as large as ventral carpal spine. Keel Pr1 sloped or almost semi-abrupt and close. TAP count 7.0-9.0.

Description. Maximum OCL: 48.0 mm.

Rostrum: Rostrum short, at most reaching midlength of 3rd antennal segment and frequently not reaching base of segment. Rostral sides slightly convergent, almost parallel on several specimens; base divergent to very divergent and carinae moderately spread or spread. 1(+1)-4 rostral spines per side, higher numbers usually on large specimens; spines usually not reaching midlength of carinae, sometimes to or slightly proximal to midlength; spines medium sized to small and moderately pointed to rounded, sometimes sharp on small specimens. Acumen spine similar to or slightly larger than marginal spines.

OCL/CL 0.80-0.87 i. RW/OCL 0.15-0.20 d.

Cephalon: Spination moderate or poor (very poor on some crayfish <20 OCL) with 1-3(4) medium sized or small spines and tiny bumps ventral to postorbital ridges. 1st postorbital spine small on specimens >30 OCL, medium sized, rarely large, on smaller crayfish; 2nd spine small or edge (one small specimen lacking 2nd spine). Suborbital spine small to medium sized, large on some specimens <20 OCL. Lateral margin of squame straight to slightly convex; squame widest at midlength or slightly proximal or distal to midlength; marginal spines absent. Interantennal spine medium width to broad, very broad on some crayfish <20 OCL; spine margin scalloped, sometimes almost toothed. Basipodite spine small to medium sized on specimens >20 OCL (large on one specimen, absent on another), medium or large on smaller specimens. Coxopodite spine medium/large to small; spine unimodal, bifid or serrated.

ScL/OCL 0.13-0.24 d.

Thorax: Usually 5-8 thoracic spines per side on large animals, in a row or thin zone; spines medium-large to medium-small (often with

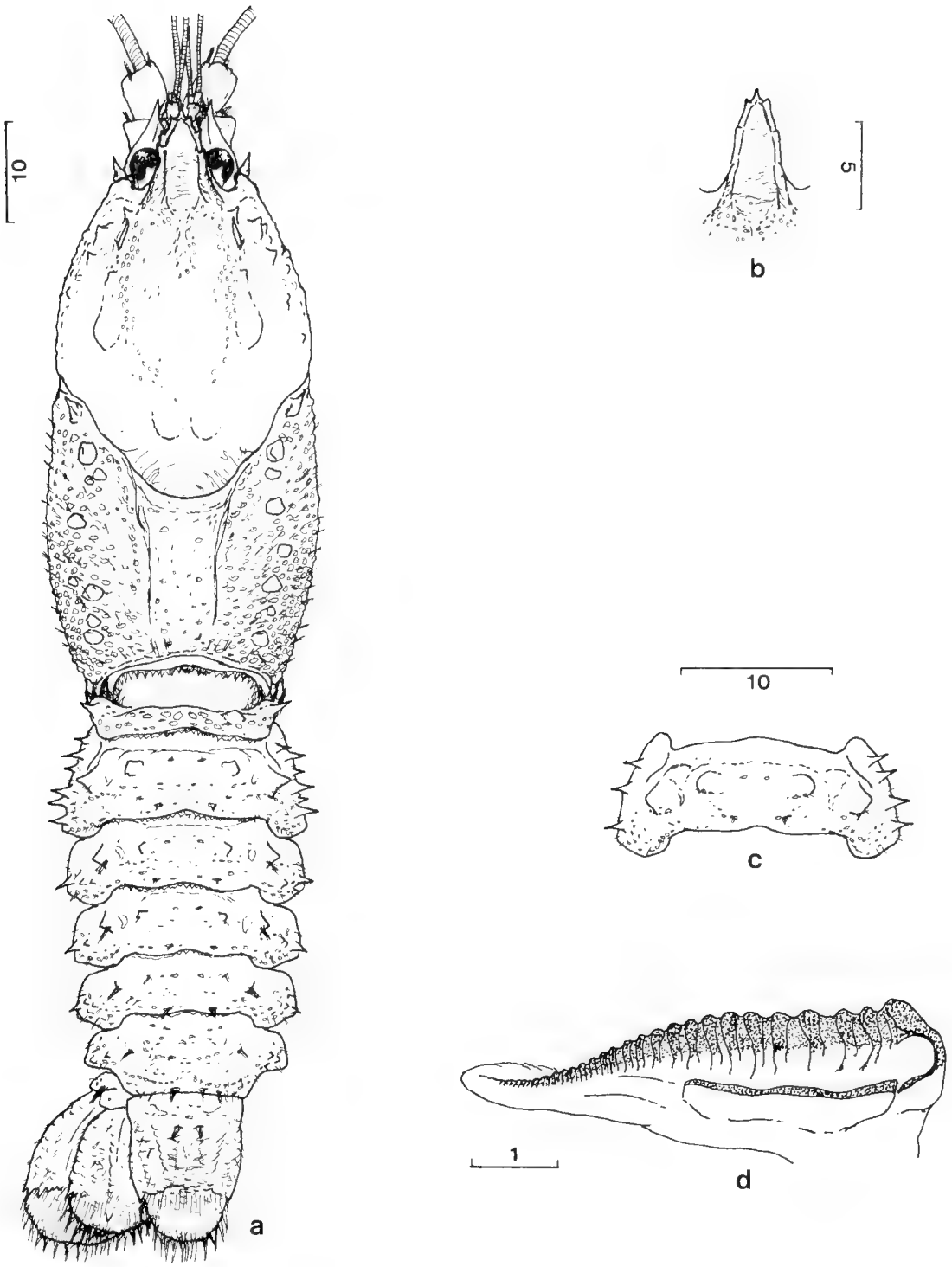


Figure 10. *Euastacus bidawalus* – a, dorsal view holotype ♂, Chandlers Ck, NMV J4526; b, rostrum (allometry), ♀, Chandlers Ck; c, somite 2, fewer spines, F, Gibbs Ck; d, zygocardiac ossicle, holotype ♂.

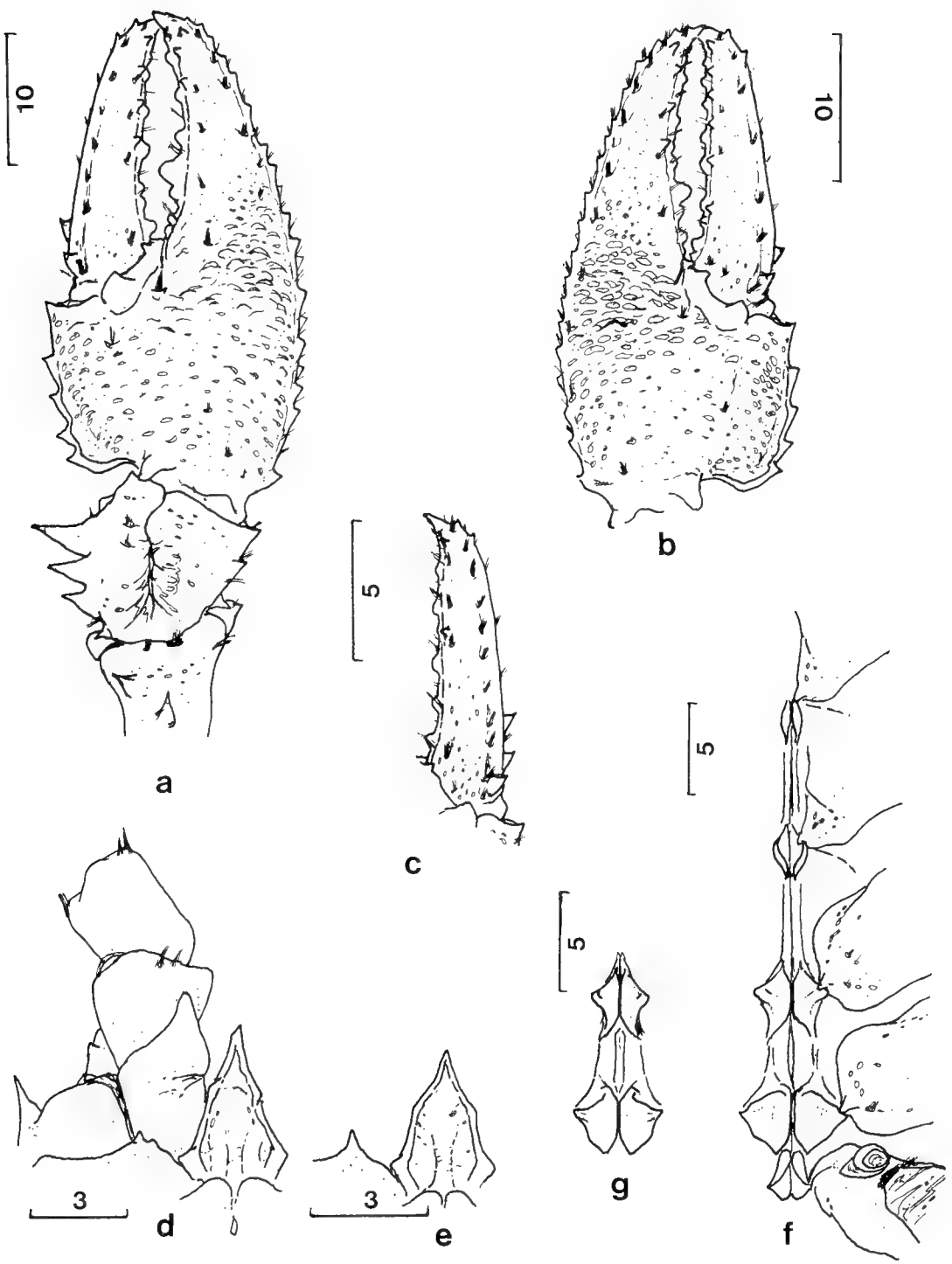


Figure 11. *Euastacus bidawalus* – a, dorsal view chela, holotype ♂; b, chela, more elongate, more numerous spines above cutting edges, small spine lateral to dactylar base, ♂, Karlo Ck, NMV J5929; c, dactylus, 2 marginal mesal basal spines, ♀, Euchre Ck, NMV J5932; d, ventral view cephalon, holotype ♂; e, ventral view cephalon, ♀, Chandlers Ck; f, sternal keel, holotype ♀; g, sternal keel, narrower Pr3 and 4, ♀, Gibbs Ck.

some small spines) and blunt (one specimen with dorsal spines only immediately behind cervical spines); on specimens 20-30 OCL, spines medium-small to small, numbering 2-6 or only just discernible; on specimens <20 OCL, spines just discernible or absent. General tubercles medium sized and moderately distributed to dense on crayfish >30 OCL, usually small or very small and moderately distributed to sparse on smaller animals; very small and very sparse or absent on specimens <20 OCL. Usually 2 cervical spines, occasionally 1 or 3; spines medium/large to medium sized on specimens >30 OCL, medium to small on lesser animals and sharp or moderately pointed on specimens >30 OCL, moderate on crayfish 20-30 OCL and rather blunt on smaller specimens; dorsal spine often larger and sharper than others.

ArL/OCL 0.33-0.38. CaW/OCL 0.57-0.63. ArW/OCL 0.12-0.19 d. CaD/OCL 0.48-0.56.

Abdomen: D-L spine on somite 1 of crayfish >30 OCL and some 20-30 OCL; spine medium sized to tiny and sharp to blunt, size and sharpness increasing with OCL. D spine usually absent on somite 1 (largest specimen with a small blunt spine on one side). 4-7 Li spines on somite 2 of specimens >30 OCL; specimens 20-30 OCL with 2-3(5) spines. 1 Li spine on somites 3-5 of animals >30 OCL and some smaller specimens. Li spines large to medium sized on specimen >40 OCL, medium/large to small on 30-40 OCL crayfish, small or tiny on smaller specimens; spines sharp or very sharp on crayfish >30 OCL, moderately sharp (rarely sharp) to blunt on smaller crayfish. Size and sharpness of Li spines decreasing posteriorly. Lii spines poorly developed, small (rarely medium sized) to tiny on specimens >30 OCL, tiny or absent on smaller specimens; 2 or 3 Lii spines on somites 2 and 3 of most crayfish >30 OCL, rarely on somites 4 and 5, absent from somite 6; spines medium sized to tiny and usually blunt. D-L spine on somites 2-4 of large specimens, spine medium sized to tiny and sharp to blunt. Small or tiny D spine on somites 2-4 of largest animal, only on somite 2 of some 30-40 OCL crayfish; D spines blunt or very blunt (and slightly darker in colour). D and D-L spines poorly developed or absent on crayfish <30 OCL. Specimens <20 OCL lacking abdominal spines. Dorsal boss absent.

AbdW/OCL: ♂ 0.47-0.55 d; ♀ 0.47-0.57 d. OCL/L 0.37-0.43 i.

Tailfan: Tailfan spines absent; slight setal bumps on margins of uropods. Standard spines small to medium sized, medium/large or large on some specimens <30 OCL.

TeL/OCL 0.32-0.42 d.

Chelae: Chelae stout to intermediate in shape on specimens >30 OCL, more elongate on some smaller crayfish. Teeth well developed on specimens >40 OCL and on some 30-40 OCL.

Propodus: Ventral lateral spine row sometimes closely approaching finger tip (almost 2 rows), or gap and then 1-3 spines near apex, or ventral row ending 1/3 or 1/2 length of propodus from distal tip; on specimens <30 OCL, ventral row usually short near midlength of propodus. Lateral spines medium sized to small, rather sharp. Lateral spine ridge medium sized on largest specimen, small on specimens <40 OCL. Usually 5 mesal propodal spines, sometimes 6 on one chela (some regenerate chelae with 4 spines). Dorsal apical spine on animals >30 OCL and many smaller specimens, absent on crayfish <20 OCL. Most specimens >20 OCL with 2-3 spines above cutting edge, some 20- 30 OCL with only 1 spine and one specimen lacking spines; spines apical or reaching midlength of gape (rarely slightly proximal to midlength) and large to medium sized on crayfish >30 OCL, medium to small on lesser specimens. Crayfish <20 OCL lacking spines above the cutting edge. Many bumps lateral to dactylar base dorsally, very rarely a small spine; ventrally, 1-3(4) medium sized or small spines, often vague or absent on crayfish <30 OCL. Precarpal spines usually absent, a small spine sometimes on regenerate chelae.

PropL/OCL: ♂ 0.77-0.88; ♀ 0.73-0.84. PropW/PropL 0.42-0.48 i. PropD/PropL 0.26-0.31

Dactylus: 2-6 medium to small spines above dactylar cutting edge of specimens >30 OCL, reaching to or proximal to midlength of gape; on smaller specimens, 1-6 spines, sometimes

apical; specimens <20 OCL lacking spines above cutting edge. Extra dorsal dactylar spines absent. 1 dorsal mesal dactylar basal spine (2 on one chela of one specimen). Usually 1 marginal mesal dactylar basal spine (rarely 2 or 3 spines on regenerate chelae). Basal spines medium sized to large, rather sharp. 2 apical mesal dactylar spines (one small specimen with 3 spines on one chela). Dactylar groove present, often light on large specimens.

DactL/PropL 0.54-0.62.

Carpus: 3 mesal carpal spines (one specimen with 4 spines on one chela), spines evenly spaced, 1st (distal) slightly or distinctly offset ventrally to others. 2 (rarely 3) lateral carpal spines, medium to large on specimens >30 OCL, often smaller on lesser crayfish. Articulation spine absent or very small, medium sized on some small specimens. Dorsal carpal spines usually absent (sometimes on regenerate chelae). Ventral spine medium/large to very large. Usually 2 or 3 ventromesal spines; largest spine medium/small to large, usually smaller than ventral spine, occasionally similarly sized.

Merus: 5-9 dorsal spines, medium sized to large. Outer spine small to medium sized, occasionally large on specimens <20 OCL.

Keel: Pr1: Posterior margins sloped or almost semi-abrupt; ventral edges usually angled down; processes close (slightly apart on some specimens <20 OCL) and parallel. Keel after Pr1 low, without spines. Pr2: Open. Keel after Pr2 low, sometimes a slight bump immediately posterior to processes. Pr3: Scoops slight or gradual, bases quite rounded, often distinctly concave. Keel after Pr3 low or slightly pronounced, pronounced on some specimens <30 OCL. Pr4: Scoops absent or very slight; posterior edges moderate to sharp and slightly convex to straight; anterior edges angular (rarely moderately curved). Processes 3 and 4 narrow or just broad on specimens >30 OCL, broad on some smaller crayfish.

Setation: Light.

Punctation: Dense or very dense.

Gastric Mill: TAP count 7.0-9.0 (high counts usually on large specimens); TAA count 0.5-1.0; spread 6.0-8.5. Zygocardiac teeth small and close. Urocardiac ridges 8-10, increasing with growth.

Coloration: Body dorsally green/brown or red/brown, paler ventrolaterally. Thoracic spines dark blue or green; general tubercles pale yellow. Rostral carinae dark green. Abdominal somites blue or green laterally; abdominal spines dark with either yellow (Li, D-L) or blue (D) tips when sharp. Carpus of cheliped orange or brown with green or blue mottling, mesal spines green. Propodus similar to carpus, lateral spines cream. Fingers blue/green.

Body ventrally cream and orange. Carpus of cheliped mesally green or blue, laterally orange. Propodus orange, sometimes with green mottling, lateral edge pale, mesal edge green or blue. Fingers with blue tips.

Sexes: Male cuticle partition present. All females examined have unopen gonopores. It must be assumed that onset of female maturity usually occurs at sizes >40 OCL.

Distribution and biology. The species has been collected at elevations between 150 m and 400 m above sea level from easterly and southerly flowing streams from near Mt Imlay south of Eden (New South Wales) to Lind National Park, 20 km west of Cann River (Victoria), a distance of about 90 km. Dry sclerophyll forest and heath vegetated ridges above streams with tree ferns and vines frequently along valleys. *Euastacus bidawalus* is present in cleared areas if a border of vegetation persists along creeks. In the north of its range in New South Wales, the species is sympatric with another new species of *Euastacus* (Morgan, in prep. b).

Etymology. Named after Bidhawal, the major aboriginal language of the species' range (Eades, 1976).

Remarks. The species has been collected from only a small range and does not display marked geographical variation, though specimens from the southern and western parts of the known range commonly have a second marginal mesal dactylar basal spine.

Euastacus bidawalus is similar morphologically to *E. diversus*.

Euastacus bispinosus Clark

Figures 12, 13

Euastacus nobilis kershawi.–Clark, 1936: 16-17 (in part, Glenelg R. locality).–1937a: 35 (in part, inclusive distribution).–1937b: 186.

Euastacus bispinosus Clark, 1941: 22-4, pl. 7.–Clark & Burnet, 1942: 90-2.–Rick, 1969: 895.

Material examined. Holotype: ♀, OCL 119.5 mm, NMV J875, Vic., Glenelg R., H. Pritchard (fide Clark, 1941).

Paratype: Vic., type locality, NMV J873, ♀.

Other specimens: Vic. Glenelg R., Lake Moora Moora, 12 Nov 1963, JRK, NMV J6174, J6176, J6221, J6222, 7♂♂, 11♀♀; Headwaters of Glenelg R., 16 Dec 1966, 1♀; Little Moleside Ck, tributary of Glenelg R. near Dartmoor, 9-11 Nov 1970, 1♂, 3♀♀; Wannon R., Grampians, 23 Nov 1969, EFR, 1♀; 2♂♂, Glenaulin Ck, tributary of Crawford R., (37°59′S., 141°23′E.), 26 Mar 1982, GJM and SJH, 2♂♂; Crawford R., (38°56′S., 141°27′E.), 26 Mar 1982, GJM and SJH, NMV J5934, 1♂, 3♀♀; Rose Ck above Burrong Falls, Grampians, (37°08′S., 142°21′E.), 27 Mar 1982, GJM and SJH, NMV J5933, 6♂♂, 2♀♀; Wannon R., Grampians (37°21′S., 142°30′E.), 28 Mar 1982, GJM and SJH, NMV J5935, 1♂, 3♀♀.

SA. Ewens Ponds, Mt Gambier, 6 Sep 1975, N. Coleman, AM P25029, 1♂, 1♀.

No locality. AM P13219, 2♀♀; NMV, 7♀♀.

Diagnosis: Male cuticle partition absent. Rostral spines apical, rarely to midlength of carinae. Rostral base divergent, rarely parallel; carinae medium length to long. Antennal squame widest slightly proximal to midlength. Marginal squamal spines absent. Suborbital spine small or medium sized (>60 OCL). Thoracic spines large or medium sized and rounded or flat, in irregular row. General tubercles large or medium sized (>60 OCL), moderately distributed or sparse. Usually 2 (rarely 1 or 3) Li spines on abdominal somite 2, spines large and sharp. D abdominal spines usually absent, occasionally small spines anteriorly. Abdominal boss well developed (>40 OCL), boss not distinctly U-shaped. 3-8 telsonic surface spines. Uropod outer ramus usually with 2-6 marginal spines. Lateral propodal spine rows in 2 to 1 condition. 1-2 dorsal apical propodal spines. Spines above propodal and dactylar cutting edges reaching or proximal to midlength of gape (rarely apical). 5 (rarely 4) mesal propodal spines. 1-3 (rarely 4) dorsal mesal dactylar basal spines. Marginal mesal dactylar basal spines usually absent. 2-4 apical mesal dactylar spines. 2 (occasionally 3) mesal carpal spines. Largest ventromesal carpal spine smaller than ventral spine. Keel Pr1 abrupt and close or apart. TAP count 5.5-8.0.

Description: Maximum OCL: 130.3 mm.

Rostrum: Rostrum short of, to slightly overcaching, midlength of 3rd antennal segment on specimens >40 OCL; to midlength or end of segment on most specimens 20-40 OCL and distal to segment on some specimens close to or <20 OCL. Rostral sides usually slightly convergent, sometimes convergent or parallel. Bases usually divergent or very divergent, occasionally parallel; carinae medium length or long. 2-4 rostral spines per side, usually apical or distal to midlength of carinae, occasionally reaching or exceeding midlength; spines small on specimens >80 OCL, small to medium sized on most smaller specimens (rarely large on very small crayfish); spines rounded to sharp. Acumen spine slightly or distinctly larger than marginal spines on specimens > 80 OCL, much larger on lesser individuals.

OCL/CL 0.74-0.91 i. RW/OCL 0.13-0.24 d.

Cephalon: Spination poor or moderate with 1 or 2 spines (frequently rather blunt) and some bumps ventral to postorbital ridges. 1st postorbital spine an edge or small on specimens >60 OCL, often medium sized on smaller animals and large on specimens close to or <20 OCL; 2nd spine a small edge or edge (occasionally absent on specimens >60 OCL), sometimes small on lesser crayfish and medium sized or large on some specimens <40 OCL. Suborbital spine small to medium sized on specimens >60 OCL, larger on smaller specimens. Lateral margin of antennal squame usually distinctly or slightly convex, occasionally straight especially on specimens <20 OCL; squame widest at slightly proximal to midlength on large specimens, distinctly proximal on small crayfish; marginal spines absent (one large specimen with spine on one squame). Interantennal spine elongate to medium width on specimens >60 OCL, usually medium to broad (or very broad) on smaller animals; spine margin toothed or very scalloped; centre often with small spine. Basipodite spine absent

or small (rarely medium sized) on specimens >40 OCL, small to large on smaller animals (sometimes very large on specimens <20 OCL). Coxopodite spine small to medium sized on specimens >60 OCL, medium to large or very large on lesser individuals and usually bifid or serrated, sometimes unimodal.

ScL/OCL 0.12-0.31 d.

Thorax: 2-8 (usually 3-5) dorsal thoracic spines per side; spines large or medium sized on specimens >20 OCL and small on lesser crayfish; spines usually rounded or flat, rarely blunt or sharp posteriorly, and usually distributed in 1 irregular row. General tubercles large to medium sized on specimens >60 OCL, medium to small on specimens 20-60 OCL, very small or absent on smaller crayfish; tubercles moderately distributed to sparse. 1-4 cervical spines per side, usually medium sized or small and moderately pointed or blunt, though dorsal spine sometimes large and sharp.

ArL/OCl 0.33-0.38. CaW/OCL 0.57-0.63. ArW/OCL 0.12-0.19 d. CaD/OCL 0.48-0.56.

Abdomen: Usually D-L spine on somite 1, large and sharp on most specimens >60 OCL, often medium sized or small on smaller animals; specimens <20 OCL lacking spine. D spine absent from somite 1. Somite 2 with 1-3 Li spines, except on specimens <20 OCL; somites 3-5 with 1 Li spine; Li spines very large or large and very sharp on specimens >60 OCL, large to medium sized on specimens 40-60 OCL and medium to tiny, sharp to moderately pointed on lesser individuals. 1-2 Lii spines usually on somites 3-6 of specimens >60 OCL and some small crayfish; Lii spines diminishing in size posteriorly from large or medium sized to small on large specimens, medium or small to tiny on small animals; spines very sharp on specimens >60 OCL, sharp to blunt on lesser individuals. 1 D-L spine on somites 2-6 of most specimens >20 OCL, declining in size to posterior from very large or large to small or tiny on specimens >40 OCL, usually medium sized to tiny on smaller crayfish; spine very sharp on specimens >40 OCL, usually sharp to blunt on smaller animals. D spines frequently absent, but dorsal boss obvious on specimens >40 OCL, especially on somites 2-4; boss not distinctly U-shaped. Some specimens, especially from northern areas (eg. Grampians), with small or tiny (rarely medium sized), usually sharp or moderately pointed D spines on boss of somite 2 and rarely somites 3 and 4; D spine often on one side only. Specimens <20 OCL lacking abdominal spines.

AbdW/OCL: ♂ 0.47-0.57 d; ♀ 0.50-0.59 di. OCL/L 0.35-0.45 i.

Tailfan: 3-8 (usually 4-6) telsonic surface spines on specimens >20 OCL; spines very large to medium sized on specimens >80 OCL, large to small on lesser individuals. Specimens <20 OCL and some slightly larger animals lacking spines. Marginal telsonic spines usually absent, sometimes 1 spine on large specimens. Inner ramus of uropod usually with 1-2 (rarely 3) large or medium sized surface spines, sometimes absent; usually 1-4 large to small marginal spines on inner ramus, occasionally absent especially on small specimens. Outer ramus of specimens >80 OCL usually with 2-6 large marginal spines; smaller specimens with 1-3 spines, or spines absent. Standard spines very small to medium sized on specimens >60 OCL, medium to large on specimens 20-60 OCL, large or very large on smaller animals.

TeL/OCL: ♂ 0.31-0.43 d; ♀ 0.32-0.41 d.

Chelae: Chelae stout to elongate (intermediate in shape or elongate on large animals). Teeth well developed on specimens >60 OCL.

Propodus: Lateral spine rows in 2 to 1 condition, ventral row sometimes almost reaching apex (nearly 2 rows), but usually poorly developed on specimens <20 OCL; lateral spines medium sized to large. Lateral spine ridge present, ranging from vague to obvious. Usually 5, rarely 4, mesal propodal spines. 1-2 (3 on one specimen) dorsal apical spines on specimens >40 OCL and some smaller animals. 2-5 spines above propodal cutting edge on specimens >40 OCL, 1-4 on most specimens 20-40 OCL; spines sometimes apical but usually distributed to or proximal to midlength of gape, sometimes full gape; spines large or medium sized on specimens >60 OCL, medium to small on lesser crayfish. Specimens <20 OCL lacking spines above cutting edge. Usually no spines lateral to dactylar base dor-

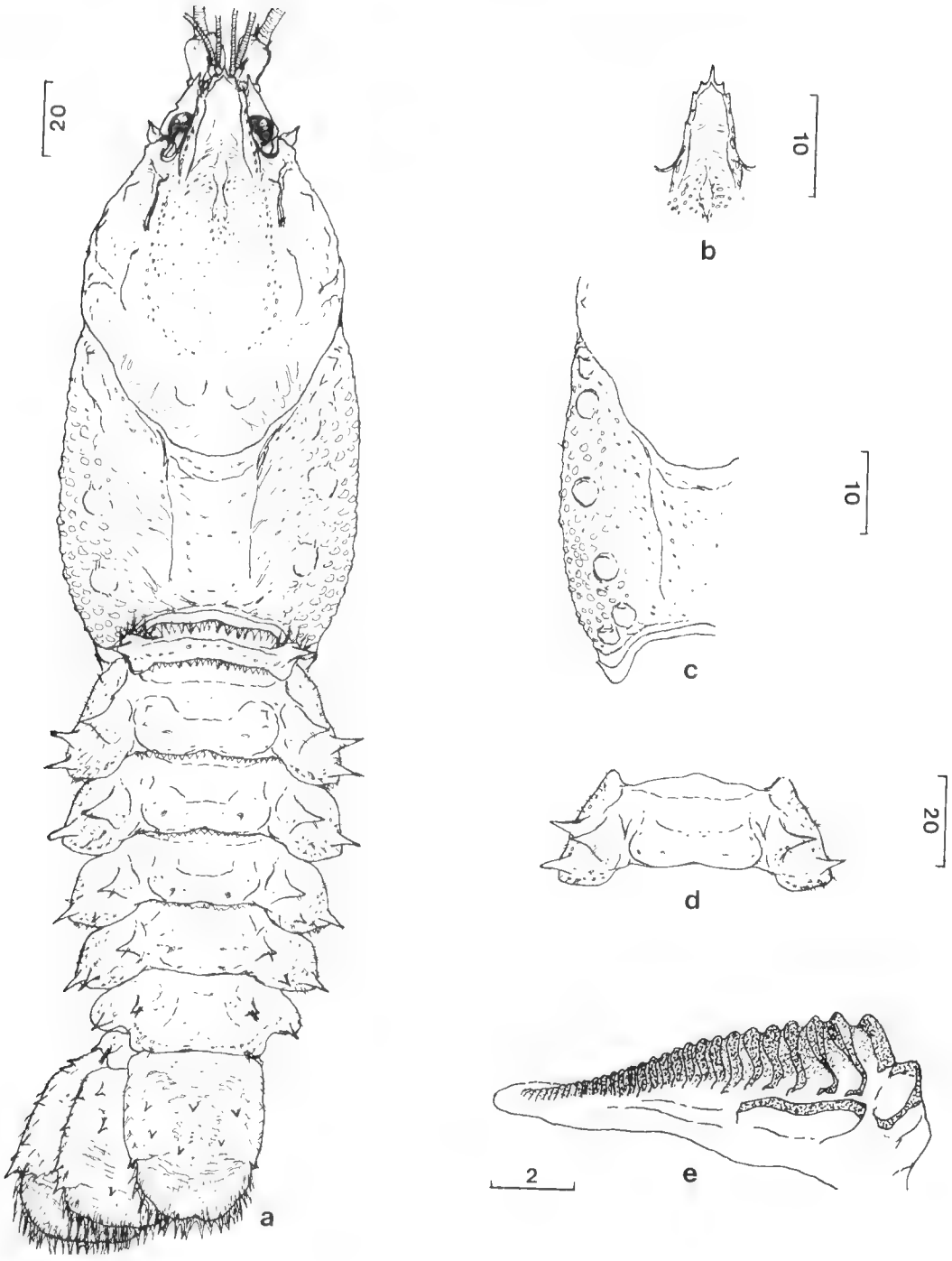


Figure 12. *Euastacus bispinosus* – a, dorsal view holotype ♀, Glenelg R., NMV J875; b, rostrum, more elongate, larger acumen spine, (allometry), ♀, Wannon R., NMV J5935; c, thorax, dorsal spines more pronounced, larger cervical spine, (allometry), ♀, Wannon R., NMV J5935; d, somite 2, no D spines, 1 Li spine on right side, paratype ♀, Glenelg R., NMV J873; e, zygocardiac ossicle, ♂, Glenaulin Ck.

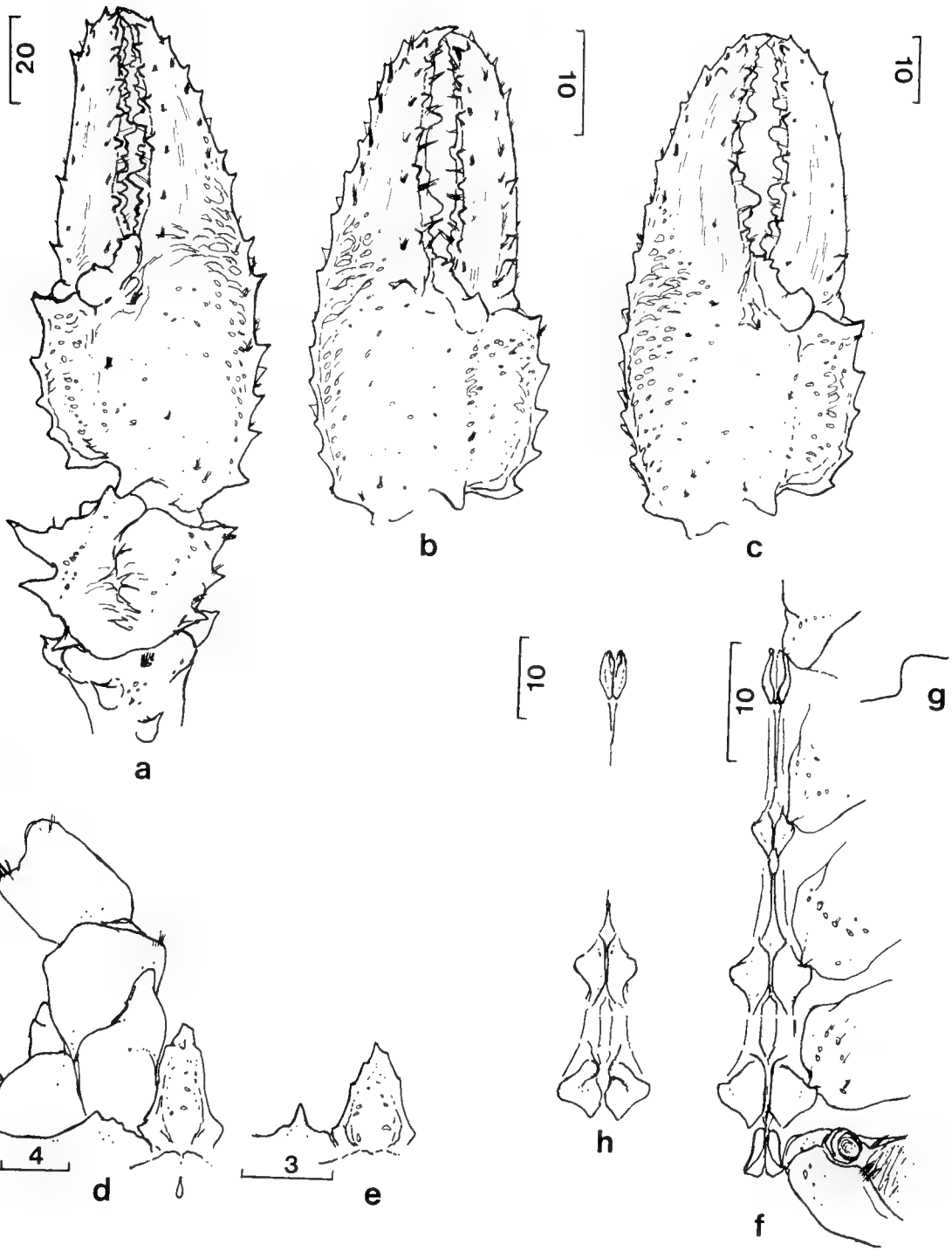


Figure 13. *Euastacus bispinosus* – a, dorsal view chela, holotype ♀; b, chela, 2 dorsal apical propodal spines, more numerous spines above cutting edges, small spine lateral to dactylar base, 3 dorsal mesal dactylar basal spines, ♀, Wannon R., NMV J5935; c, chela, stouter, 1 dorsal mesal dactylar basal spine, ♂, L. Moora Moora; d, ventral view cephalon, holotype ♀; e, ventral view cephalon, ♀, Wannon R., NMV J5935; f, sternal keel, ♂, L. Moora Moora; g, profile Pr1; h, sternal keel, Pr1 closer, Pr3 and 4 narrower, holotype ♀.

sally, sometimes medium sized or small spine usually on one chela only; ventrally, 1-2(3) large to small spines. Proximal spine at dactylar articulation frequently inflated on large specimens. Low ridge sometimes proximal to dactylar articulation. Precarpal spines usually absent, except on some small specimens.

PropL/OCL: ♂ (0.80)0.85-0.99 i; ♀ (0.83)0.85-0.96 i. PropW/PropL 0.37-0.48 id; PropD/PropL 0.22-0.30.

Dactylus: 3-7 spines above cutting edge of specimens >40 OCL, 1-6 on most specimens 20-40 OCL, absent on specimens close to and <20 OCL; spines distributed to or proximal to midlength of gape, sometimes to full gape, (apical on some regenerate chelae); spines large to medium sized on specimens >60 OCL, medium to small on lesser animals. Extra dorsal dactylar spines absent. 1-3 (rarely 4) dorsal mesal dactylar basal spines; marginal mesal basal spines usually absent, occasionally 1 or 2 (rarely 3) spines; basal spines large or medium sized on specimens >60 OCL, medium to small on lesser individuals. 2-4 apical mesal dactylar spines. Basal spines sometimes reaching apical spines, forming irregular row of mesal dactylar spines. Dactylar groove absent or light.

DactL/PropL 0.52-0.60.

Carpus: Usually 2 mesal carpal spines, often with proximal (and sometimes distal) bumps, sometimes 2(+1) or 3 spines; distal spine usually much larger than 2nd. Usually 2 lateral spines, large to medium sized on specimens >40 OCL, medium to small on lesser animals. Articulation spine absent, except on some small specimens. Ventral spine very large or large. Largest ventromesal spine medium/large to small; usually 2 or 3 additional tiny ventromesal spines/bumps.

Merus: 4-7 usually large dorsal spines. Outer meral spine medium sized or small on specimens >40 OCL, large or medium on smaller animals.

Keel: Pr1: Posterior margins abrupt (rarely semi-abrupt); ventral edges flat, rounded or angled back; processes close or apart and usually parallel or open. Keel after Pr1 sometimes with a slight anterior bump. Pr2: Usually open, or very open on specimens <60 OCL. Keel after Pr2 frequently saddle-shaped, sometimes small spine posteriorly. Pr3: Scoops absent or slight; bases usually sharp or moderately rounded, sometimes rounded. Keel after Pr3 usually saddle-shaped, sometimes pronounced posteriorly especially on specimens <60 OCL. Pr4: Scoops absent; posterior edges quite sharp and convex or irregular, sometimes almost straight; anterior edges moderately curved or angular. Processes 3 and 4 narrow or just broad on specimens >100 OCL, usually broad on smaller animals and very broad on most specimens <40 OCL.

Setation: Light.

Punctation: Moderate on specimens >60 OCL, dense on most smaller animals.

Gastric Mill: TAP count 5.5-8.0; TAA count 0.5-1.0; spread 4.5-7.5. Variation primarily due to differences in length of ear. Urocardiac ridges 8-11.

Coloration: Similar to *E. kershawi* dorsally but abdominal spines sometimes more blue tinged or cream and D abdominal spines (when present) dark brown or black; spines on cheliped usually paler, mottling often more distinct on propodus. Similar to *E. kershawi* ventrally, often cream on keel.

Sexes: Males lack a cuticle partition. Females <40 OCL have unopen gonopores. One specimen in the 40-60 OCL range has open gonopores and all females >60 OCL are open, frequently with eggs or attached young. Female maturity appears to occur most commonly at approximately 60 OCL, but some variation is evident.

Distribution and biology. The species inhabits the Glenelg River and its tributaries of western Victoria and is also present in Ewens Ponds south of Mt Gambier, South Australia (Fig. 7). Zeidler (1982) recorded *E. bispinosus* from small coastal streams east of Port MacDonnell (SA) to the Glenelg River. The range extends from close to sea level to altitudes of 320 m and probably slightly greater elevations in areas of the Grampians. Vegetation at low sites includes *Eucalyptus* and *Leptospermum* species, bracken (*Pteridium*), with wet sclerophyll forest and pine plantations in areas. In the Grampians, sites are bordered by heath,

with vines and ferns in some sheltered valleys. Berried females have been collected in November and in "early spring" (Clark, 1937b).

Remarks. *Euastacus bispinosus* is a relatively invariable species and most variation is allometric. Geographic differences are minor but are evident in the development of the D abdominal spine. On most southern specimens, D spines are absent though a dorsal boss is obvious. In the north of the range, particularly from the Grampians area, many specimens bear a small, usually sharp D spine on the boss of somite 2, rarely somites 3 and 4. Frequently the spine is present on one side only.

Euastacus bispinosus most closely resembles *E. kershawi* of Gippsland. The species can be distinguished by characters noted in *Remarks* of *E. kershawi*.

Euastacus diversus Rick

Figures 14, 15

Euastacus diversus Rick, 1969: 908, fig. 20E.

Material examined. *Holotype*: ♂, OCL 28.2 mm, AM P15711. Vic., 30 miles (48 kilometres) north of Orbost, 6 Dec 1956, E.F. Rick.

Allotype: ♀, OCL 29.9 mm, type locality, AM P15712.

Paratypes: Type locality, AM P15713, 3♂♂, 7♀♀.

Diagnosis. As for *E. bidawalus* except:

1-2 marginal squamal spines, sometimes on one squame only. Thoracic spines absent. 2-4 Li spines on abdominal somite 2. 3(+1)-4 mesal carpal spines. TAP count 8.0-9.0.

Description: Maximum OCL: 32.2 mm.

Rostrum: Rostrum rather short, never longer than midlength of 3rd antennal segment, often only to base of segment on large specimens. Rostral sides slightly convergent or almost parallel, base divergent or very divergent and carinae short and slightly spread. 1-2(+1) rostral spines per side, apical or short of midlength of carinae; spines small (medium/small on some specimens <20 OCL), usually rounded, sometimes moderately pointed on very small specimens. Acumen spine similar to or slightly larger than marginal spines.

OCL/CL 0.81-0.86 i. RW/OCL 0.15-0.23 d.

Cephalon: Spination moderate to poor, 1-3 medium or small spines and some tiny bumps ventral to postorbital ridges. 1st postorbital spine small on specimen >30 OCL, small to large on specimens 20-30 OCL, large on specimens <20 OCL; 2nd spine usually absent (one animal with edge). Suborbital spine medium sized to medium/large. Lateral margin of antennal squame concave or straight; squame widest at midlength or slightly distal to midlength; 1-2 large marginal spines, sometimes on only one squame (one very small animal lacking spines). Interantennal spine medium width to broad; spine margins scalloped. Basipodite spine small to medium sized on crayfish >20 OCL, large or very large on small animals. Coxopodite spine small to medium sized and usually bifid.

ScL/OCL 0.16-0.29 d.

Thorax: Dorsal spines absent (one specimen with bump immediately posterior to cervical spines). General tubercles medium sized to medium/large on specimens >20 OCL, small on smaller crayfish; tubercles gradually increasing in size dorsally on branchiostegites. Tubercles dense on specimens close to or >30 OCL, moderate to sparse on smaller animals, absent on one very small specimen. 1st (dorsal) cervical spine usually distinctly larger and sharper than other 4-5 small, blunt spines.

ArL/OCL 0.34-0.37. CaW/OCL 0.55-0.58. ArW/OCL 0.15-0.17 d. CaD/OCL 0.47-0.54 d.

Abdomen: Small or tiny, moderately pointed or blunt D-L spine on somite 1 of most specimens >20 OCL, absent on smaller specimens. D spine absent from somite 1 and subsequent somites (vague bump on somite 1 of largest specimen implying development of small D spine on larger animals). 2-4 Li spines on somite 2, 1 Li spine on somites 3-5 of crayfish >20 OCL; Li spines large and sharp to small or tiny, decreasing posteriorly; smaller specimens lacking, or with tiny blunt Li spines. Lii spines small or tiny and blunt, numbering 1-4 per segment, or absent; large specimens with 2-3 tiny Lii spines or bumps on somite 6. Tiny blunt D-L spine sometimes on somites 2-4. Dorsal boss absent.

AbdW/OCL 0.51-0.54. OCL/L 0.35-0.41 i.

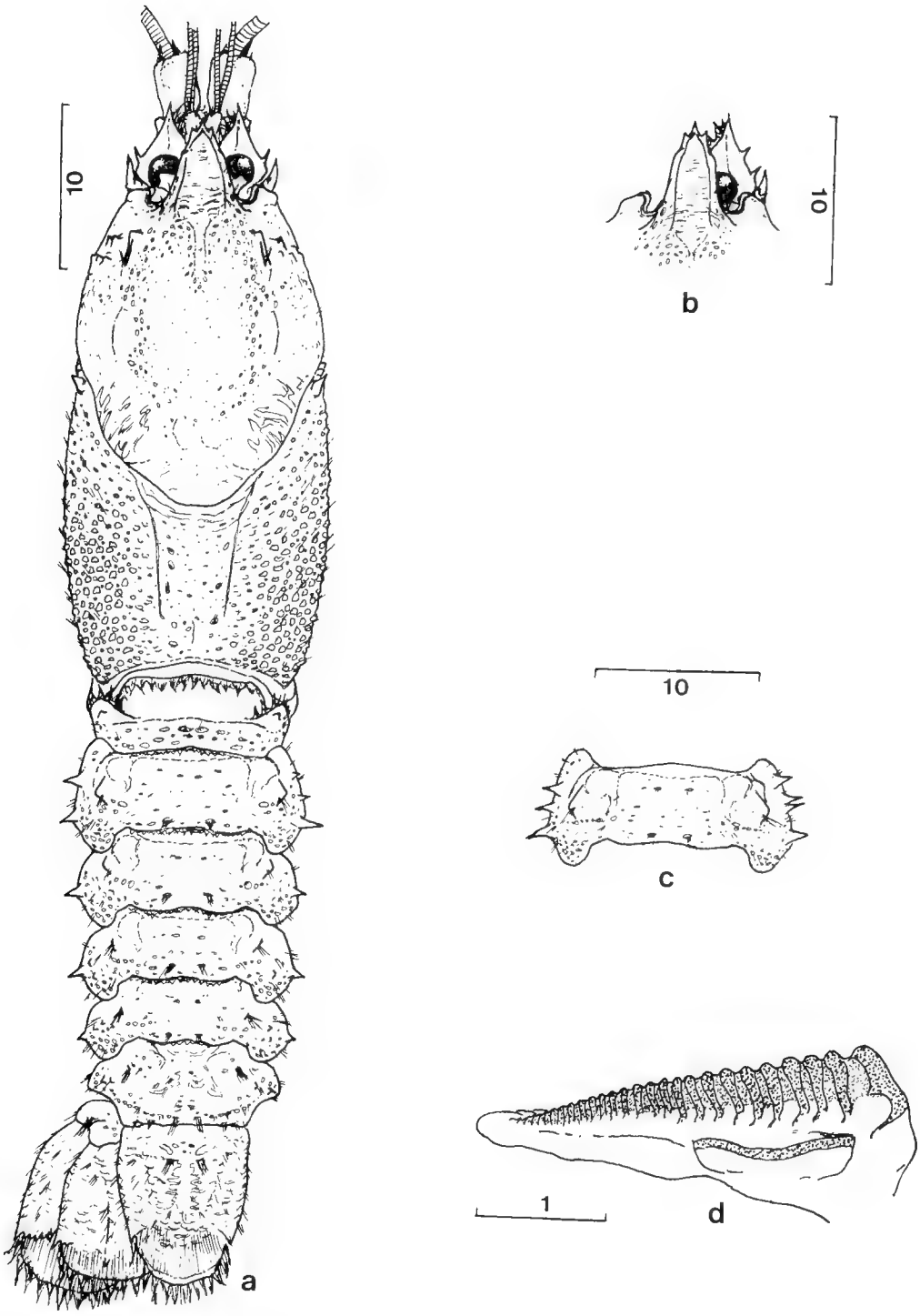


Figure 14. *Euastacus diversus* – a, dorsal view holotype ♂, north of Orbost, AM P15711; b, more elongate rostrum and 2 marginal squamal spines, allotype ♀, AM P15712; c, somite 2, more numerous Li spines, allotype ♀; d, zygocardiac ossicle, holotype ♂.

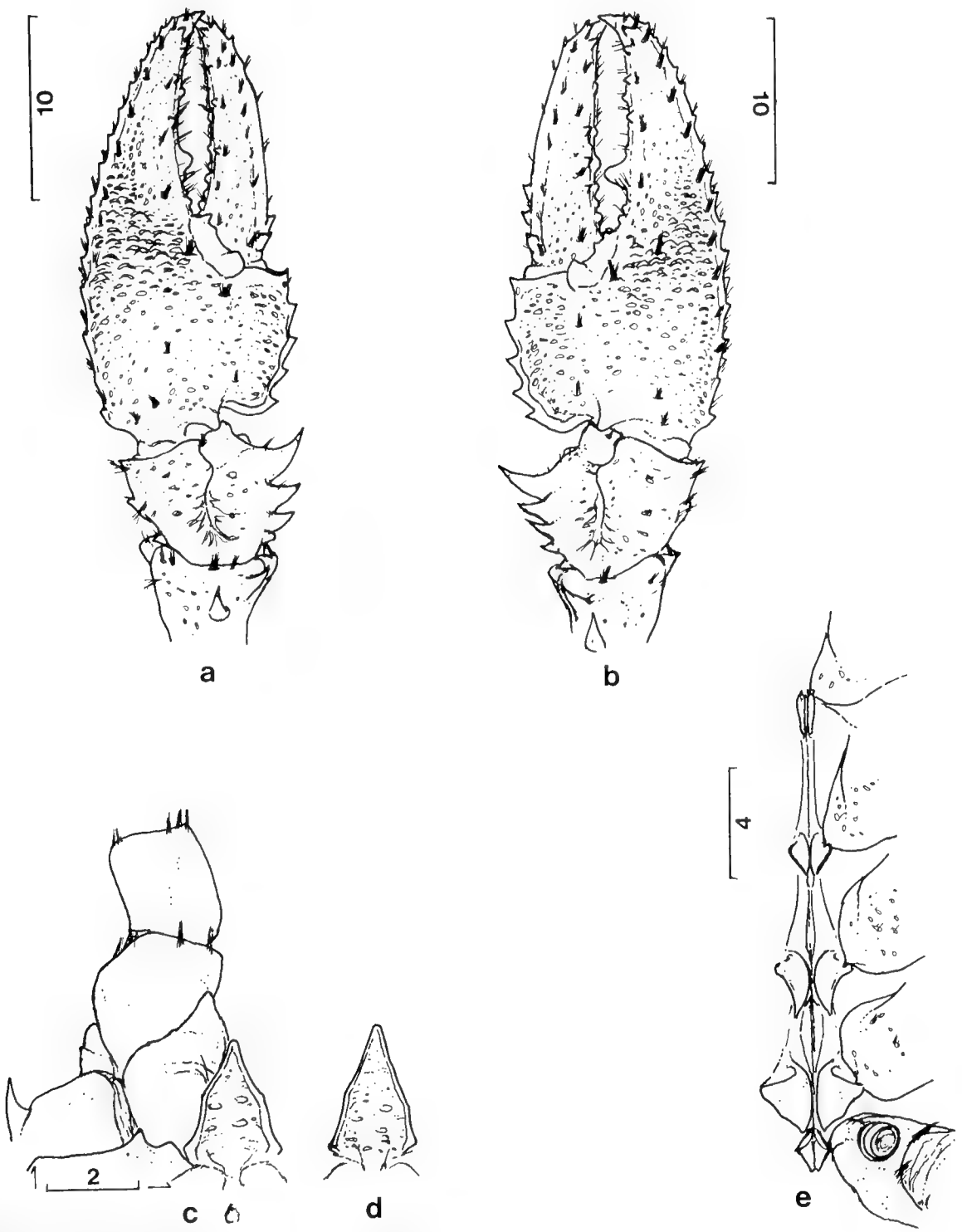


Figure 15. *Euastacus diversus* – a, dorsal view chela, holotype ♂; b, chela, 2 marginal mesal dactylar basal spines, 4th mesal carpal spine larger, paratype ♀, AM P15713; c, ventral view cephalon, holotype ♂; d, interantennal spine, paratype ♀; e, sternal keel, holotype ♂.

Tailfan: Tailfan spines absent; feint setal bumps on margins of uropods. Standard spines medium sized to large, decreasing with increasing OCL.

TeL/OCL 0.35-0.45 d.

Chelae: Chelae fairly stout to elongate, very elongate on smallest specimen. Teeth moderately developed on largest specimens.

Propodus: Lateral spines in 2 to 1 configuration or 2 rows, ventral row well developed on specimens >20 OCL; lateral spines medium sized and rather sharp. Lateral spine ridge small, vague on specimens <20 OCL. Usually 5 mesal spines, some very small and regenerate chelae with 4 or 6 spines. Usually 1 dorsal apical spine, absent on some small specimens. 1-3 spines above propodal cutting edge of crayfish >20 OCL, apical or to midlength of gape and medium sized to large (mesal spines usually largest); smallest crayfish lacking spines above cutting edge. Many bumps or small spines lateral to dactylar base dorsally; ventrally, usually 2-6 low bumps, vague or absent on specimens <20 OCL. Precarpal spines absent, though propodal surface rather bumpy.

PropL/OCL 0.77-0.90 i. PropW/PropL 0.43-0.47 i. PropD/PropL (0.22)0.25-0.30.

Dactylus: 2-5 spines above dactylar cutting edge, reaching proximal to midlength of gape on most specimens >20 OCL; 1 apical spine on some animals close to 20 OCL, absent on specimens <20 OCL; spines medium sized or medium/large, often largest mesally. Extra dorsal dactylar spines absent. 1 dorsal mesal dactylar basal spine (absent on some regenerate chelae); 1-2 marginal mesal basal spines; basal spines medium sized to large and usually sharp. Usually 2 apical mesal spines; 1 spine on small specimens and regenerate chelae. Dactylar spines absent on very small specimen. Dactylar groove present, sometimes deep.

DactL/PropL 0.52-0.60.

Carpus: Usually 3(1 1) or 4 mesal carpal spines, sometimes only 3 spines followed proximally by 1 or 2 bumps. 2 medium sized lateral carpal spines. Articulation spine absent, or tiny on small crayfish. Dorsal carpal spines absent, except on one regenerate chela. Ventral spine large or very large (medium or small on tiny crayfish); largest ventromesal spine medium sized or medium/large, medium or small on specimens <20 OCL.

Merus: 5-8 large dorsal spines. Outer meral spine small to large.

Keel:Pr1: Posterior margins sloped to semi-abrupt; ventral edges angled down or rounded; processes close (slightly apart on the tiny crayfish) and parallel. Keel after Pr1 lacking spines, sometimes a slight bump. Pr2: Very open. Keel after Pr2 low and lacking spines. Pr3: Scoops obviously gradual, bases rather rounded. Keel after Pr3 low on large specimens, slightly pronounced on small animals. Pr4: Scoops absent or slight; posterior edges moderately rounded on specimens >20 OCL, quite sharp on smaller animals and slightly convex or irregular; anterior edges angular. Processes 3 and 4 narrow on large specimens, broad on some small specimens.

Setation: Moderate to moderately heavy on large specimens, rather light on specimens <20 OCL.

Punctation: Dense or very dense.

Gastric Mill: TAP counts of four specimens 8.0-9.0; TAA counts 1.0-1.5; spread 7.0-8.5. Teeth small and close, ear rather long. Urocardiac ridges 7-8.

Coloration: No live specimens of *E. diversus* were examined in this study and Riek (1969) did not record the colours of the animals he collected.

Sexes: Males possess a cuticle partition. All females examined have unopen gonopores. Female maturity probably occurs at sizes >40 OCL and the species possibly grows to a size similar to that of *E. bidawalus*.

Distribution and biology. The species is known only from the type locality north of Orbost (Fig. 7), inadequately recorded by Riek (1969). Habitat was not noted. No specimens could be found on recent sampling excursions.

Remarks. The species is represented by only 13 specimens from the type locality and no geographical variation is evident. The squamal spine number is more variable than recorded by Riek (1969).

Euastacus kershawi (Smith)

Figures 16, 17

Astacopsis kershawi Smith, 1912: 160-1, pl. 19 (Moe R. locality for "Large Gippsland Crayfish").

Euastacus nobilis kershawi.–Clark, 1936: 16-17, pl. 3 fig. 16(?) (in part, several species).–1937a: 35.–1937b: 186.

Euastacus nobilis.–Clark, 1936: 15-17 (?in part, Gippsland localities).–1941: 20-2, pl. 6 (in part, several species).

Euastacus kershawi (Smith).–Riek, 1969: 894.

Material examined. *Lectotype*: ♂, OCL 91.2 mm, NMV J869, Vic., Moe R., Gippsland, Dec 1886, W. Kershaw.

Paralectotypes: ♀, OCL 106.2 mm, ♀ (dissected); type locality, NMV J11922.

Other specimens: Vic. Moe, Gippsland, W. Kershaw, NMV No. 52516, 1♀; Little Moe R., Gippsland, 20 Dec 1878, 1♂; Latrobe R. near Noojee, 5 Nov 1967, A. Neboiss, NMV J6169, J6223, 2♀♀; Near Noojee, 1980, 1♂; Shady Ck, 10 miles north-east of Warragul, 5 Nov 1967, A. Neboiss, NMV J6167, 1♂; Tarago R. near Drouin, 5 Nov 1967, A. Neboiss, NMV J6168, 1♀; Tarago R. tributary, (38°00'S., 145°55'E.), 21 Apr 1982, GJM and SJH, NMV J5837, 1♂; Latrobe R. west of Noojee, (37°53'S., 145°53'E.), 21 Apr 1982, GJM and SJH, NMV J5938, 1♂; Narracan Falls, Narracan, 5 Nov 1969, A. Neboiss, NMV J6226, 1♂; Little Yarra R., NMV J6165, 2♂♂, 1♀; Little Yarra R. near Gilderoy, (3750, 14540), 22 Apr 1982, GJM and SJH, NMV J5936, 3♀♀; Tanjil R. at Willow Grove, Oct-Nov 1980, G. Bennison, NMV J6224, J6225, 3♂♂, 1♀; Western Tyers R., Christmas Ck Road, 3 Feb 1981, 1♀; Caledonia R., 30 miles north of Licola, 3 Jan 1973, L. Windsor, NMV J6166, 1♀; Bemm R., bridge north of Bemm River at junction with Combienbar R., 11 Dec 1978, M. Treasure, NMV J6175, 1♂; Martins Ck in Martins Ck Scenic Reserve, north of Orbost, (37°28'S., 148°34'E.), 10 Nov 1981, GJM and SJH, NMV J5939, 1♀; Gippsland Lakes(?), AM P13220, 1♂.

No locality: NMV, 2♂♂.

Diagnosis. Male cuticle partition present. Otherwise similar to *E. bispinosus*, except:

Rostral spines to or proximal to midlength of carinae. Rostral base convergent or parallel. Suborbital spine medium sized or large. 2-4 Li spines on abdominal somite 2. Abdominal boss U-shaped. Marginal spines on outer ramus of uropod rare. Usually 2 lateral propodal spine rows. 1-3 dorsal apical propodal spines. Spines above propodal and dactylar cutting edges often apical. Keel Pr1 sloped or almost semi-abrupt. TAP count 7.0-9.5.

Description. Maximum OCL: 159.5 mm.

Rostrum: Broad rostrum reaching base or to midlength of 3rd antennal segment on specimens >40 OCL (sometimes not reaching base on specimens >100 OCL), to or distal to midlength of segment on specimens 20-40 OCL, to end or distal to end of segment on smaller animals. Rostral sides usually slightly or distinctly convergent, occasionally almost parallel; base convergent or parallel, divergent on some very small specimens <20 OCL; carinae of medium length or long, 2-5 (usually 3-4) rostral spines per side, usually distributed proximal to midlength or to full carinae length, rarely only to midlength; spines small or medium sized on specimens >40 OCL, medium to very large on smaller animals; spines usually moderately pointed or sharp, sometimes rounded (probably due to abrasion) on very large animals and very sharp on specimens <20 OCL. Acumen spine slightly larger than marginal spines on specimens >80 OCL, slightly to much larger on smaller specimens.

OCL/CL 0.72-0.89 i. RW/OCL 0.14-0.24 d.

Cephalon: Spination poor or moderately poor with 1 or 2 spines and some low bumps ventral to postorbital ridges. 1st postorbital spine an edge on specimens >60 OCL, small or medium sized at 40-60 OCL, medium to very large on smaller animals. 2nd postorbital spine a small edge or edge on specimens >60 OCL (absent on one large animal), frequently small on crayfish 40-60 OCL, small to large on specimens 20-40 OCL and large or very large on specimens <20 OCL. Suborbital spine medium sized to large (one very large animal with small spine, perhaps due to abrasion). Lateral margin of antennal squame slightly or distinctly convex, except on specimens <20 OCL with straight or slightly concave margin; squame widest slightly proximal to midlength on specimens >80 OCL, usually proximal or very proximal on smaller animals; marginal spines absent. Interantennal spine usually broad (occasionally moderately shaped) on specimens >20 OCL, very broad on many smaller animals; spine margin toothed or occasionally very scalloped. Basipodite spine very small or small on specimens >60 OCL, small to large on animals 40-60 OCL, medium sized to very large on smaller specimens. Coxopodite spine small to medium sized on specimens >60 OCL, small to large on lesser animals.

ScL/OCL 0.13-0.39 d.

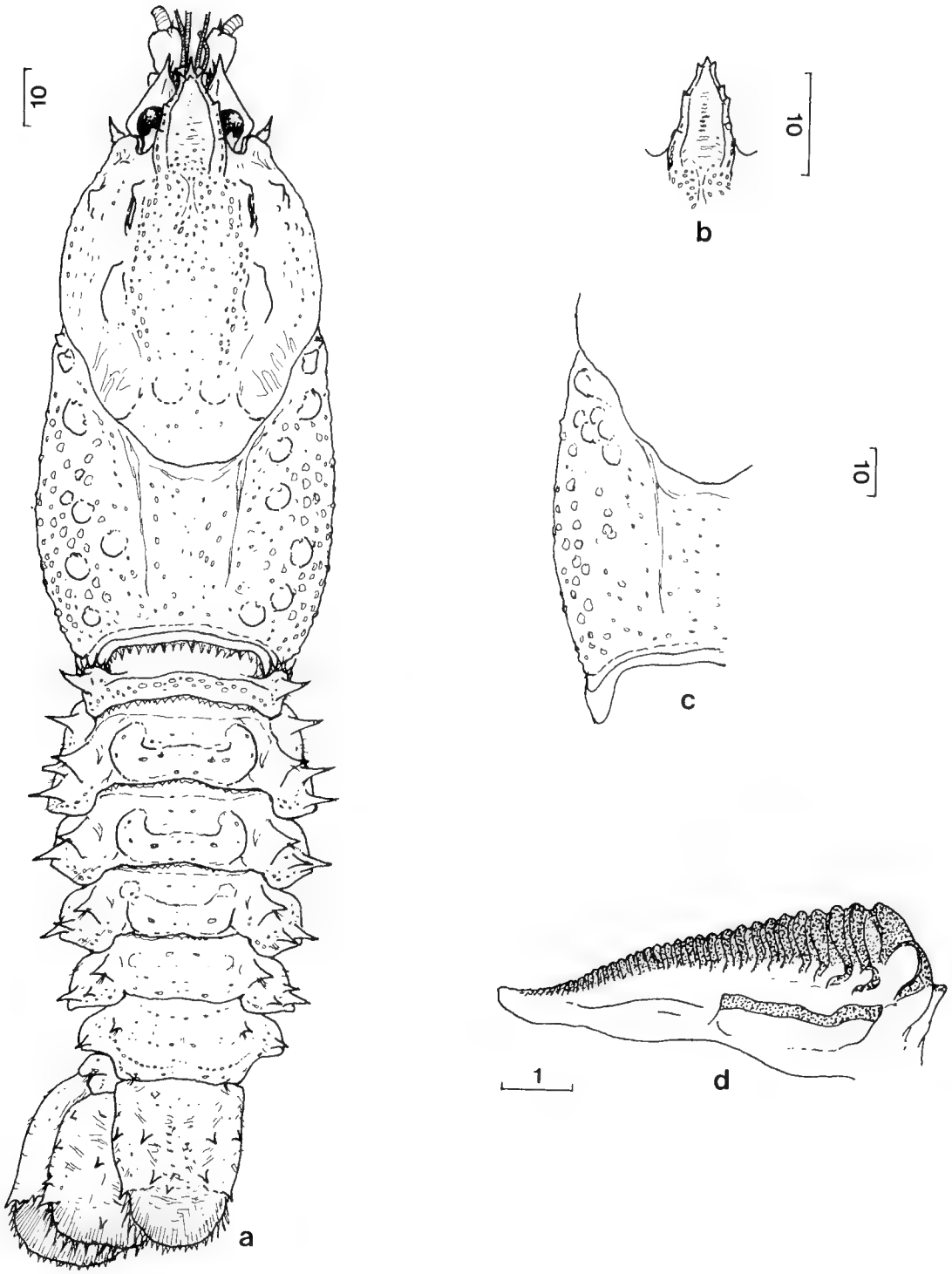


Figure 16. *Euastacus kershawi* – a, dorsal view lectotype ♂, Moe R., NMV J869; b, rostrum (allometry), ♀, Martins Ck, NMV J5939; c, thorax, dorsal spines reduced, paralectotype ♀, Moe R., NMV J869; d, zygocardiac ossicle, ♂, Bunyip R., Francois collection.

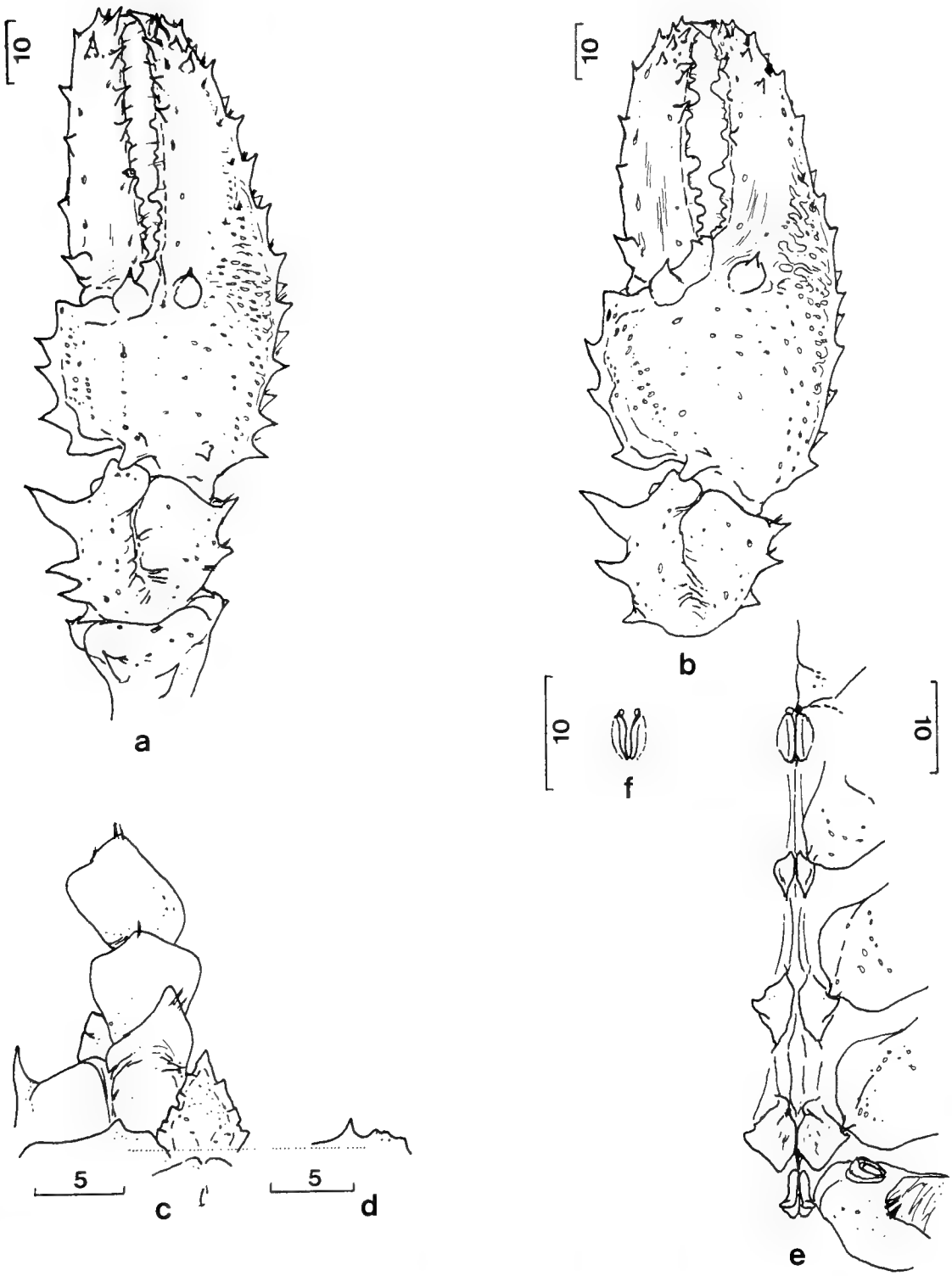


Figure 17. *Euastacus kershawi* – a, dorsal view chela (regenerate?), lectotype ♂; b, chela, stouter, 2 mesal carpal spines, fewer spines above dactylar cutting edge, ♀, Moe R., NMV J2516; c, ventral view cephalon, lectotype ♂; d, coxopodite spine, paralectotype ♀; e, sternal keel, lectotype ♂; f, Pr1, slightly apart, ♂, Bemm R., NMV J6175.

Thorax: 1-10 (usually 3-6) dorsal spines per side, distributed in 1 or 2 irregular rows; spines medium sized or large on specimens >40 OCL and many smaller crayfish, small on specimens close to and <20 OCL; spines blunt, rounded or flat (dorsalmost frequently flat). Specimens <20 OCL often lacking dorsal spines. General tubercles large on specimens >80 OCL, usually medium sized or small on specimens 20-80 OCL, very small or absent on smaller animals; tubercles moderately distributed to sparse. Some very small specimens merely punctate. 1-2 (rarely 3) cervical spines per side; spines small to large, dorsalmost frequently larger and sharper than remaining usually moderately pointed or blunt spines.

ArL/OCL 0.33-0.37. CaW/OCL 0.58-0.62. ArW/OCL 0.16-0.22 d. CaD/OCL 0.48-0.56 d.

Abdomen: Usually D-L spine on somite 1, sometimes absent on specimens <60 OCL, absent on all <20 OCL; spine usually large or very large and sharp, small on some specimens <40 OCL. D spine absent from somite 1. Somite 2 with 2-4 Li spines, rarely 1 on small specimens and 0 on some specimens <20 OCL; somites 3-5 of specimens >20 OCL and some smaller animals with 1 spine. Li spines very large or large and very sharp on specimens >40 OCL, large to tiny and sharp or moderately pointed anteriorly, blunt posteriorly on specimens 20-40 OCL, tiny and blunt or absent on animals <20 OCL. 1 (rarely 2 or 3) Lii spine(s) per side on somites 3-5 of most specimens >20 OCL, one large specimen with 1 Lii spine on somite 2; spines large to small and very sharp on specimens >40 OCL, small or tiny and often blunt on smaller animals. Somite 6 usually with 1, occasionally 2, small Lii spine(s). D-L spine on somites 2-6 of specimens >40 OCL and some smaller animals; spines decreasing in size to posterior from very large, large or medium sized to small or tiny on specimens >40 OCL, medium sized to tiny or absent on smaller animals; D-L spines usually very sharp (occasionally moderate or blunt) on specimens >40 OCL, moderate to very blunt on smaller animals. D spine absent (one medium sized specimen with tiny, very blunt spine on somites 2 and 3). Dorsal abdominal boss well developed and distinctly U-shaped on specimens >60 OCL, present on most specimens 20-60 OCL, vague or absent on animals close to or <20 OCL.

AbdW/OCL: ♂ 0.49-0.57 d; ♀ 0.53-0.62 di. OCL/L: ♂ 0.33-0.46 i; ♀ 0.34-0.41 i.

Tailfan: 4-7 telsonic surface spines on specimens >20 OCL and most smaller animals; spines usually very large or large, occasionally medium sized, with some spines small (spines absent on only one specimen <20 OCL). Usually 1 or 2 large to small marginal telsonic spines, sometimes absent. Inner uropod ramus usually with 1 or 2 large to small surface spines and 1-4 similarly sized marginal spines; occasionally spines absent especially on specimens <40 OCL. One specimen with 1 marginal spine on outer ramus of one uropod; margins usually merely bumpy. Standard spines usually medium sized or medium/large on specimens >60 OCL (small on one very large animal), large on most specimens <40 OCL.

TeL/OCL: ♂ 0.30-0.44 d; ♀ 0.34-0.40 di.

Chelae: Chelae elongate to stout. Teeth well developed on specimens >60 OCL.

Propodus: 2 lateral spine rows on most specimens >20 OCL, sometimes gap between apical 1 or 2 ventral spines and remainder; specimens <20 OCL with 2 to 1 condition, ventral row frequently poorly developed. Lateral spines medium sized or large and sharp. Lateral spine ridge present and frequently large, usually vague on specimens <20 OCL. Usually 5, occasionally 4, mesal spines. 2-3 dorsal apical spines on normal chelae of specimens >60 OCL; smaller animals usually with 1 spine, absent on some specimens close to or <20 OCL. 1-3 (occasionally 4 or 5 on regenerate chelae) spines above cutting edge of specimens >20 OCL; spines apical or to midlength of gape (proximal to midlength on some regenerate chelae) and usually large or medium sized; specimens <20 OCL lacking spines. Usually a large or very large sharp spine lateral to dactylar base dorsally, absent on some medium sized and small animals; ventrally, 1-3 spines, usually large and sharp. Proximal spine at dactylar articulation often inflated. Spines absent posterior to dactylar articulation. Precarpal spines absent (except on one specimen).

PropL/OCL: ♂ 0.76-0.92 i; ♀ 0.78-0.86. PropW/PropL 0.36-0.47 id. PropD/PropL 0.21-0.29 id.

Dactylus: 1-6 (usually 2-4) spines above dactylar cutting edge, absent on some specimens <20 OCL; spines apical or reaching proximal to midlength of gape, occasionally to full gape; spines large to medium sized, small on specimens <20 OCL. 1 extra dorsal apical dactylar spine on all specimens >60 OCL and on most smaller specimens except those <20 OCL; one animal with 2 extra spines. 1-4(usually 2 or 3) dorsal mesal dactylar basal spines, sometimes reaching distal to midlength of dactylus; marginal mesal basal spines usually absent, sometimes 1 or 2 spines especially on regenerate chelae; basal spines large or very large and sharp. 3-4 apical mesal spines (2 on one chela of one specimen), sometimes reaching basal spines. Dactylar groove vague or absent on large specimens, usually present on small animals.

DactL/PropL 0.52-0.61.

Carpus: Normally 2 large mesal carpal spines, usually with 1 or 2 bumps proximal to 2nd spine, occasionally 3 mesal spines; distal spine usually much larger than 2nd, 3rd, if present, usually small. 2 lateral carpal spines, medium sized to very large. Articulation spine absent on all but some specimens <40 OCL. Dorsal spines usually absent (two specimens with a low bump on both carpi). Ventral carpal spine very large. Largest ventromesal spine usually medium sized or small, rarely large; 1 or 2 tiny additional ventromesal spines.

Merus: 5-9 dorsal spines. Outer meral spine medium sized or large, very large on most animals <40 OCL.

Keel: Pr1: Posterior margins usually sloped, almost semi-abrupt on some medium sized and small animals, very rarely semi-abrupt; ventral edges angled down, rarely rounded; processes close or slightly apart (apart on some specimens <40 OCL) and usually parallel, occasionally slightly closed or open. Keel after Pr1 sometimes with very low spine. Pr2: Open or very open. Keel after Pr2 recessed or slightly pronounced anteriorly. Pr3: Scoops absent, slight or gradual (well developed on one specimen), bases sharp to rounded. Keel after Pr3 usually moderately pronounced. Pr4: Scoops usually absent, occasionally slight; posterior edges usually sharp or moderately sharp and sightly convex, straight or irregular; anterior edges angular or very angular. Processes 3 and 4 usually narrow on specimens >100 OCL (one specimen with broad processes), narrow or just broad on specimens 60-100 OCL, broad or very broad on smaller animals.

Setation: Light.

Punctation: Moderate to dense. Thoracic punctation usually sparser than cephalic.

Gastric Mill: TAP count 7.0-9.5; TAA count 0.5; spread 6.5-9.0. Teeth small and close, ear long. Urocardiac ridges 7-11 (frequently difficult to count due to irregular merging of ridges).

Coloration: Body dorsally dark green, green/blue or green/brown. Thoracic spines dark, sometimes black; general tubercles often pale. Lateral abdominal somites often blue; abdominal spines tipped yellow or orange. Carpus of cheliped dark blue/green with some dark mottling, spines tipped orange. Propodus similar to carpus, mesal edge and fingers aquamarine; spine lateral to dactylar base usually cream or orange.

Body ventrally orange, green or blue. Carpus of cheliped green or blue, laterally sometimes orange, spines orange. Propodus orange with midventral mottling, margins and fingers blue or green.

Sexes: Males possess a usually broad cuticle partition. Females <40 OCL have unopen gonopores. One female (OCL51.3 mm) has open pores, but pores on the two 60-80 OCL females examined are unopen. Females >100 OCL are mature. It appears that female maturity may occur over a considerable size range, probably between 50 to 80 or 90 mm OCL.

Distribution and biology. The species occurs at elevations from sea level to 250 m a.s.l. (and probably slightly higher) in southerly flowing streams of Gippsland, Victoria, from near the New South Wales border in the east to mountains approximately 80 km east of Melbourne, a distance of approximately 320 km (Fig. 7). Heavy amateur fishing and land development

may have severely reduced the range of *E. kershawi* in major rivers near human settlement (e.g., Latrobe River). Vegetation along streams is commonly *Eucalyptus* spp. (including *E. regnans*) and tree ferns (*Cyathea*) though sometimes the crayfish is found in dry sclerophyll forest and in cleared pasture if vegetation persists along creek banks. *Euastacus kershawi* is sympatric with *E. yarraensis* in some eastern tributaries of the Yarra and Tarago Rivers and is frequently found in association with *Engaeus* species.

Remarks. A lectotype and two paralectotypes are here selected from Smith's syntype series in the Museum of Victoria. Smith did not designate types in his original publication and all his specimens therefore are syntypic. Riek's (1969) listing of a holotype, allotype and paratype is consequently invalid.

Euastacus kershawi displays little geographical variation across its large range. Infraspecific variation is largely allometric. The species is quite distinct and usually readily recognised yet has caused considerable confusion for past workers. Clark (1936, 1937a, 1937b, 1941) confused *E. kershawi* with *E. woiwuru*, *E. yarraensis*, *E. bispinosus* and *E. neodiversus*. All specimens regarded as *E. kershawi* by Kane (1964) are *E. woiwuru*. Riek (1969) recognised *E. kershawi* but the cited characters distinguishing it from *E. bispinosus* are inaccurate.

Euastacus kershawi can be distinguished from the similar *E. bispinosus* by differences in the male cuticle partition, the spine lateral to the dactylar base dorsally and the profile of the first keel process (Pr1).

Euastacus neodiversus Riek

Figures 18, 19

Euastacus nobilis kershawi.–Clark, 1936: 16 (in part, Wilsons Promontory locality).

Euastacus nobilis.–Clark, 1941: 23 (in part, Wilsons Promontory locality).

Euastacus neodiversus Riek, 1969: 908.

Material examined. Holotype: ♂, OCL 44.9 mm, NMV J4531, Vic., National Park, Wilsons Promontory, in stream on east slope of Sealers Cove Track about 1000 ft above sea level, 25 Nov 1922, J.A. Kershaw.

Paratype: Vic. Top of Vereker Range, Wilsons Promontory, Dec 1912, J.A. Kershaw, NMV J4532, 1♂.

Other specimens: Vic. Sealers Ck tributary, near Mt Ramsay, Wilsons Promontory, Apr 1980, GJM, NMV J6229, 3♀♀; Growlers Ck tributary, Wilsons Promontory, (39°04′S., 146°21′E.), 14 Sep 1982, GJM and SJH, NMV J5958, 1♀; Growlers Ck tributary, Wilsons Promontory, (39°04′S., 146°22′E.), 14 Sep 1982, GJM and SJH, NMV J5955, 1♂, 2♀♀; Lilly Pilly Gully, Wilsons Promontory, (39°03′S., 146°20′E.), 15 Sep 1982, GJM and SJH, NMV J5959, 2♂♂, 2♀♀; Agnes R. at junction with Dingo Ck, (38°36′S., 146°33′E.), 16 Sep 1982, GJM and SJH, NMV J5960, 1♀; Turtons Ck north of Foster, (38°33′S., 146°14′E.), 16 Sep 1982, GJM and SJH, NMV J5957, 3♂♂, 2♀♀; Tarra Valley Park, 12 Apr 1960, J. Coventry, 1♀; Fern Gully, Bulga National Park, (38°25′S., 146°34′E.), 13 Nov 1981, GJM and SJH, NMV J5956, 2♂♂, 2♀♀; Creek in Tarra Valley National Park, (38°27′S., 146°32′E.), 13 Nov 1981, GJM and SJH, NMV J5940, 3♂♂, 1♀.

Diagnosis. As for *E. bidawalus* except:

Rostral base sometimes slightly divergent. 2-5 Li spines on abdominal somite 2. Usually 2 lateral propodal spine rows. 1 apical spine above propodal cutting edge or spine absent. Spines above dactylar cutting edge apical. 2-4 dorsal mesal dactylar basal spines. Marginal mesal dactylar basal spines usually absent (rarely 1). 2-4 apical mesal dactylar spines, forming row with basal spines. Largest ventromesal carpal spine spine usually as large as or larger than ventral spine. TAP count 6.0-7.5.

Description. Maximum OCL: 44.9 mm.

Rostrum: Rather short rostrum, to base of 3rd antennal segment on largest specimen (holotype), between base and midlength of segment on most specimens 20-40 OCL, to or distal to midlength on specimens <20 OCL. Rostral sides parallel or slightly convergent; base slightly or distinctly divergent and carinae of medium length or short, slightly or distinctly spread. 2-4 (rarely 5) rostral spines per side, reaching to about midlength of carinae; spines small on specimens >30 OCL, small to medium sized on specimens 20-30 OCL, distal spines large on smaller animals; spines rounded on specimens >30 OCL, moderately pointed or sharp on most smaller specimens. Acumen spine similar to or slightly larger than marginal spines on specimens >20 OCL, sometimes much larger on smaller animals.

OCL/CL 0.79-0.88 i. RW/OCL 0.15-0.23 d.

Cephalon: Spination moderate to poor, with 2-5 small spines and several low bumps ventral to postorbital ridges. 1st postorbital spine an edge or small on most specimens >20 OCL, medium sized or large on some specimens near 20 OCL and all <20 OCL. 2nd spine usually small edge or edge, small or medium sized on specimens close to and <20 OCL. Suborbital spine small or medium sized, large on some specimens <20 OCL. Lateral margin of antennal squame usually convex, sometimes straight on small specimens; squame widest at slightly distal to midlength on largest specimen, at or slightly proximal to midlength on specimens 20-40 OCL, distinctly proximal on smaller animals; marginal spines absent. Interantennal spine elongate on largest specimen, medium width or broad on smaller animals; spine margin slightly or distinctly scalloped. Basipodite spine small on largest specimen, medium sized on most animals 20-40 OCL, large on some smaller specimens. Coxopodite spine small.

ScL/OCL 0.11-0.28 d.

Thorax: Approximately 6-20 dorsal thoracic spines per side, in zone or 2 irregular rows; spines medium sized, frequently with some small spines, or all small on some animals close to or <20 OCL; spines moderately pointed or blunt, rounded on small specimens. Some very small specimens lacking dorsal spines. General tubercles medium sized on large specimens, medium or small on small animals, very small on some specimens <20 OCL; tubercles dense on most specimens >20 OCL, moderately distributed on small specimens, sparse or very sparse on very small animals; tiny specimens merely punctate. Usually 2-3(4) cervical spines per side, medium sized or small and moderately pointed or blunt; spines usually similarly sized, though dorsalmost spine occasionally slightly larger and sharper than others.

ArL/OCL 0.36-0.39. CaW/OCL 0.51-0.58. ArW/OCL 0.13-0.21 d. CaD/OCL 0.45-0.54 d.

Abdomen: Medium sized or small D-L spine on somite 1 of specimens >30 OCL and some slightly smaller animals; most <30 OCL lacking spine. Tiny D spine on somite 1 of largest animal (holotype), absent on other specimens. Somite 2 with 2-5 (usually 3-4) Li spines, somites 3-5 of specimens >30 OCL and some smaller animals with 1 spine; Li spines decreasing in size posteriorly from large to medium sized on most specimens >30 OCL, medium sized or small to tiny on smaller animals, specimens <20 OCL often lacking spines; Li spines very sharp or sharp on animals >30 OCL, sharp to blunt on smaller specimens. 1-3 Lii spines frequently on somites 2-6 of large specimens, rarely on specimens <30 OCL; spines medium sized to tiny on largest specimen, small or tiny or absent on lesser animals and very sharp to blunt on the largest, moderately pointed to very blunt on smaller specimens. D-L spine on somites 2-4 of specimens >30 OCL and some smaller animals; spine medium sized to tiny and moderately pointed (rarely sharp) to blunt or very blunt; somites 5 and 6 of large specimens sometimes with rudimentary D-L bump. Somite 2 and sometimes 3, of large specimens with D spine; spine small or tiny and moderately pointed to very blunt; largest specimen with D bump on somites 4 and 5. Most specimens <20 OCL lacking abdominal spines. Dorsal boss usually absent, slightly developed on largest specimen.

AbdW/OCL: ♂ 0.48-0.55 d; ♀ 0.52-0.55. OCL/L 0.37-0.44 i.

Tailfan: Spines absent on telson and uropods, margins slightly bumpy at setal bases. Standard spines small or medium sized on specimens >30 OCL, medium or large on lesser individuals.

TeL/OCL 0.33-0.42 d.

Chelae: Chelae usually stout or intermediate in shape, quite elongate on largest specimen and some small animals. Cutting teeth well developed on specimens close to or >40 OCL.

Propodus: Usually 2 lateral propodal spine rows, on some specimens <30 OCL ventral row poorly developed (2 to 1 rows); lateral spines small or medium sized and rather sharp. Lateral spine ridge medium sized to vague, absent on some specimens <20 OCL. Usually 5 mesal spines, sometimes 6, 4 on some small or regenerate chelae. Usually 1 dorsal apical propodal spine on specimens >30 OCL, absent on smaller crayfish. 0 or 1 spine above cutting

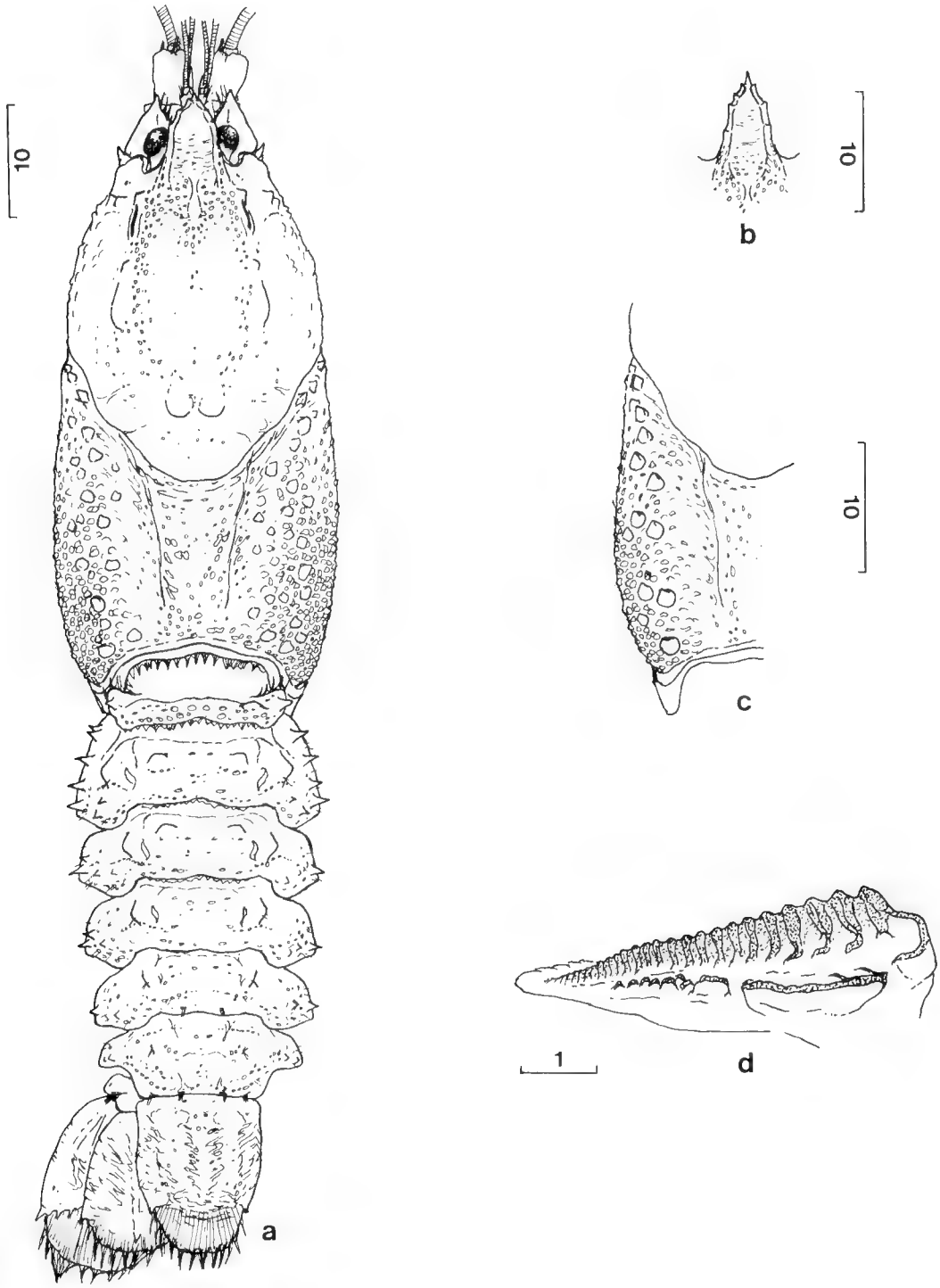


Figure 18 . *Euastacus neodiversus* – a, dorsal view holotype ♂, Wilsons Promontory, NMV J4531; b, rostrum, more numerous and slightly larger spines, ♀, Lilly Pilly Gully, NMV J5959; c, thorax, larger spines, ♀, Lilly Pilly Gully, NMV J5959; d, zygocardiac ossicle, with secondary ears, holotype ♂, Francois collection.

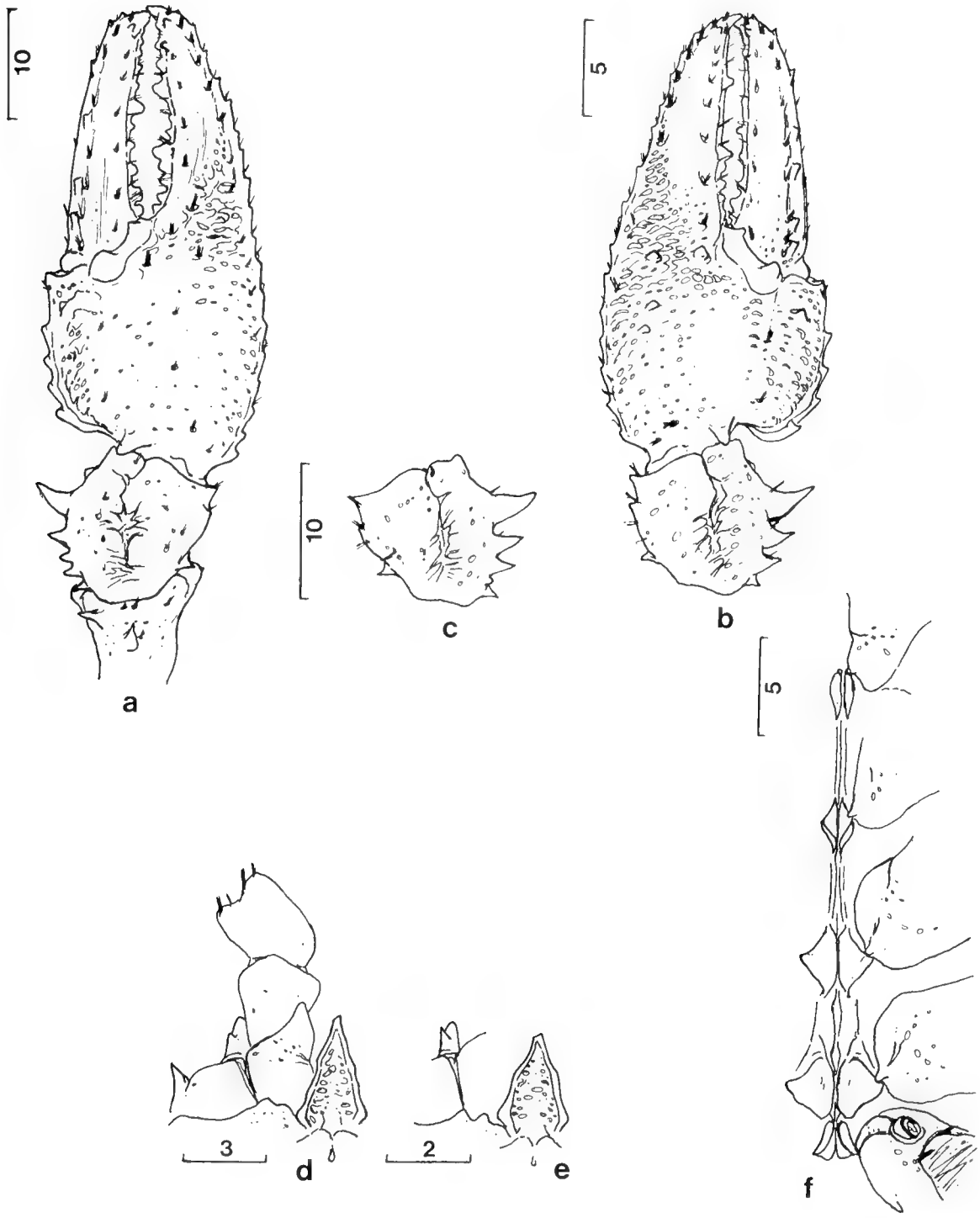


Figure 19. *Euastacus neodiversus* – a, dorsal view chela, holotype ♂; b, chela, spines lateral to dactylar base, 3 mesal carpal spines, more distinct spine posterior to dactylar articulation, ♀, Dingo Ck, NMV J5960; c, carpus, 3(+1) mesal spines, ♂, Growlers Ck, NMV J5955; d, ventral view cephalon, holotype ♂; e, cephalon, paratype ♂, Vereker Ra., NMV J4532; f, sternal keel, holotype ♂.

edge (3 on one regenerate chela of holotype); spines apical and medium sized or small. 0, 1 or 2 medium sized or small blunt spines lateral to dactylar base dorsally with some bumps; ventrally, 1-3 medium sized (rarely large) or small spines. Precarpal spines absent; 1 or 2 low spines or distinct bumps posterior to dactylar articulation.

PropL/OCL: ♂ 0.77-0.97 i; ♀ 0.76-0.82 i. PropW/PropL 0.39-0.50 id. PropD/PropL 0.26-0.32.

Dactylus: Usually 1-2 spines above dactylar cutting edge, absent on some specimens <30 OCL; spines apical and medium sized or small. Extra dorsal dactylar spines absent. 2-4 dorsal mesal dactylar basal spines on normal chelae of specimens >20 OCL and most smaller animals; marginal mesal basal spines usually absent, sometimes 1 spine (2 on some regenerate chelae); basal spines medium sized or small and blunt or flattened. 2-4 apical mesal dactylar spines, forming row of mesal spines with dorsal basal spines (row usually numbering 5-8 spines, 4 on some specimens <20 OCL). Dactylar groove present, frequently deep.

DactL/PropL 0.53-0.60.

Carpus: Usually 3 mesal carpal spines, often with bump proximal to spines and several specimens (including holotype) with 4 spines on one or both chelae; 1st (distal) spine distinctly larger than others and only slightly offset ventrally. 2 (rarely 3) medium sized or small lateral carpal spines. Articulation spine absent, except on small animals. Dorsal carpal spines usually absent, sometimes small blunt spine/bump. Ventral carpal spine very large or large. 2-3 ventromesal spines, largest usually very large or large and similarly sized to or larger than ventral spine; remaining ventromesal spines tiny.

Merus: 6-9 dorsal spines, medium sized or medium/large. Outer spine very small to medium sized on specimens >30 OCL, small to large on lesser animals.

Keel: Pr1: Posterior margins sloped or almost semi-abrupt (semi-abrupt on one specimen); ventral margins angled down (rarely rounded); processes close or slightly apart and parallel. Keel after Pr1 low and devoid of spines. Pr2: Open, or very open on some specimens <20 OCL. Keel after Pr2 usually recessed and lacking spines. Pr3: Scoops absent, very slight or gradual; bases curved to sharp. Keel after Pr3 recessed on large specimens, somewhat pronounced and irregular in profile on small animals; spines absent. Pr4: Scoops absent; posterior edges sharp or curved and slightly convex or straight; anterior margins angular or moderately curved. Processes 3 and 4 narrow on largest animal, just narrow or broad on specimens 20-40 OCL, broad on animals <20 OCL.

Setation: Moderate to light.

Punctation: Dense on cephalon, very dense on thorax.

Gastric Mill: TAP count 6.0-7.5; TAA count 0.0-1.0 (usually 0.0 or 0.5); spread 5.5-7.0. One to several additional, small secondary ears posterior to large zygocardiac ear. Urocardiac ridges 7-13.

Coloration: Body dorsally brown/green, paler ventrolaterally. Thoracic spines dark green; general tubercles pale yellow or green. Rostral carinae blue/green. Abdominal somites laterally dark blue; abdominal spines blue or blue/brown, white tipped when sharp. Carpus of cheliped brown or green, usually mottled, mesal spines blue. Propodus brown with variable blue/green mottling, mesal spines and dorsal bumps blue or green, lateral spines pale blue or cream. Fingers blue/green.

Body ventrally pale blue, green and cream. Carpus of cheliped dark blue/green and white. Propodus white with blue or green mottling, mesal area orange, mesal edge dark blue. Fingers bright blue.

Sexes: Males possess a cuticle partition. No females with open gonopores have been collected. Two of the three specimens in the 30-40 OCL range have deeply incised pores with light setae developing around the margins, indicating the approach of maturity. Females probably mature at approximately 40 OCL.

Distribution and biology. *Euastacus neodiversus* occurs in Wilsons Promontory and the Strzelecki Ranges of southern Victoria (Fig. 7) at elevations of 50 to 600 m a.s.l. Coastal heath and sclerophyll forest occur on ridges and lilly pilly (*Eugenia* sp.), ferns and vines along banks in Wilsons Promontory.

Mountain ash (*Eucalyptus regnans*) and tree ferns (*Cyathea* sp.) are dominant in the Strzeleckis. *Euastacus neodiversus* is often sympatric with *Engaeus* species.

Remarks. The species displays little geographical variation over its small range. Most variation is due to allometry or sexual dimorphism and large specimens are poorly represented in collections. Riek's (1969) diagnostic characters for the species of four mesal carpal spines and dactylar spination are inaccurate.

The range of *E. neodiversus* is divided in two by the low land of Yanakie isthmus. The isthmus appears at present an unsuitable habitat for *Euastacus*, being low lying and bearing patches of coastal heath. Many streams have only temporary flow and it is unlikely that *E. neodiversus* presently ranges along the length of the peninsula. There are virtually no visible differences between populations from the two areas, which is somewhat unexpected. Small specimens from the two regions often differ slightly in the size of the rostral spines and 1st postorbital spine, usually larger on Wilsons Promontory specimens. The differences are very minor and are not evident on specimens larger than 30 OCL. There is distinct infraspecific variation in areola width and length but this does not correspond closely to the two subdivisions of the range.

Wilsons Promontory formed a land bridge with Tasmania during Pleistocene ice ages. The bridge was finally broken approximately 12 000 years ago, isolating the promontory as an island. Over a period of 4 000 years, the sandy isthmus accumulated re-uniting the mainland and island. Hence, for approximately the last 8 000 years, Wilsons Promontory has been joined to the mainland. At some time in the past, perhaps under a wetter climatic regime, *E. neodiversus* inhabited the isthmus, but it cannot be certain whether this occurred prior to 12 000 years ago or in the last 8 000 years.

Euastacus woiwuru sp. nov.

Figures 20, 21

Astacopsis kershawi Smith, 1912: 161, pl. 20 (Narracan R. locality for "Small Gippsland Crayfish").

Euastacus nobilis.–Clark, 1936: 16 (in part, Narracan R. and Thompson R. localities).–1941: 22 (in part, Narracan R., Thompson R., Thorpdale, Ferntree Gully, Belgrave localities).

Euastacus nobilis kershawi.–Clark, 1936: 16 (in part, Thorpdale, Ferntree Gully localities).–1937b: 186, 192, fig.

Euastacus crassus Riek, 1969: 896 (in part, inclusive distribution).

Material examined. *Holotype*: ♂, OCL 56.6 mm, NMV J4527. Vic., Dobsons Ck, near Alpine Road Crossing, Dandenong Mountains east of Melbourne, 9 Jun 1982, P. Horwitz.

Paratypes: Vic. Narracan R., Gippsland, Mar 1890, J.A. Kershaw, NMV J4528, 4♂♂, 1♀; Creek between Mt Evelyn and Wandin North, Sep 1963, JRK, NMV J4529, 2♀♀; Masons Falls, Kinglake, 14 Mar 1963, D. Denning, NMV J4530, 1♀.

Other specimens: Vic. Wandin North, Sep 1963, JRK, NMV J9202, 1♀; Between Mt Evelyn and Wandin North, 8 Sep 1962, JRK, NMV J9239, 1♂; Between Mt Evelyn and Wandin North, 16 Feb 1964, JRK, NMV J9201, 2♂♂; Creek between Ferntree Gully and Upwey, north side of road (Dandenongs), 1962, JRK, NMV J9236, 1♂, 2♀♀; Top of Ferntree Gully, Dandenong Range, Feb 1872, W. Kershaw, NMV J9208, 4♂♂, 2♀♀; Alpine Road, Dandenongs, JRK, NMV J9214, 3♀♀; Alpine Road, Dandenongs, JRK, NMV J9203, 1♂, 2♀♀; Alpine Road, Dandenongs, JRK, NMV J9217, 2♂♂; Mt Dandenong, 20 May 1962, JRK, NMV J9219, 1♀; Ferntree Gully, 26 Mar 1906, G. Sweet, NMV J9212, 1♀; Olinda Falls (Dandenongs), 15 Jan 1963, JRK, NMV J9209, J9213, 1♂, 1♀; Menzies Ck, Emerald, 27 Apr 1963, A. Lo, NMV J9210, 1♀; Woori Yallock Ck tributary near Emerald, 4 Jan 1963, JRK, NMV J9237, 1♂; Sassafras, 23 Mar 1963, JRK, NMV J9204, 1♂; Baynes Ck, Monbulk, 6 Mar 1982, A. Patak, NMV J9241, 1♂; The Basin, Dandenongs, 27 Mar 1982, A. Patak, NMV J9242, 1♂; Ferny Ck, tributary of Dandenong Ck, (37°52′S., 145°18′E.), 20 Apr 1982, GJM and SJH, NMV J5961, 1♀; Olinda Ck above Olinda Falls, (37°50′S., 145°20′E.), 20 Apr 1982, GJM and SJH, NMV J5962, 3♂♂; Sassafras Ck near Kallista, (37°52′S., 145°20′E.), 20 Apr 1982, GJM and SJH, NMV J5965, 4♂♂; Clematis Ck, Sherbrooke State Forest, (37°54′S., 145°20′E.), 20 Apr 1982, GJM and SJH, NMV J5966, 3♂♂, 2♀♀; 1 mile east of Gembrook, 7 Feb 1964, JRK, NMV J9215, 1♂; Diamond Ck, Gembrook, 16 Sep 1979, K. Hortle, 2♀♀; Diamond Ck, Mortimer Park Forest Reserve near Gembrook, (38°00′S., 145°40′E.), 21 Apr 1982, GJM and SJH, NMV J5964, 1♀; Beer Ck, Gilderoy, 10 Sep 1977, L. Metzeling, NMV J9225, 1♀; Don R. north of Launching Place, (37°45′S., 145°37′E.), 22 Apr 1982, GJM and SJH, NMV J5963, 1♂; Blue Jacket Ck, Maroondah Catchment, 10 Mar 1977, D. Robinson, NMV J9230, 1♀; Lilydale, 27 Apr 1964, J. Martin, NMV J9238, 1♀; Masons Falls (Kinglake), 8 Jun 1963, JRK, NMV J9223, 2♀♀; Masons Falls, 14 Mar 1963, D. Denning, NMV J9228, 1♀; Running Ck, Kinglake, 17 Jan 1978, NMV J9227, 4♂♂, 2♀♀; Running Ck, 2 Nov 1978, NMV J9226, 2♂♂, 2♀♀; Kinglake, Jun 1963, JRK, NMV J9207, 1♂; Lake Mt., 4,500 ft, 29 Nov 1962, A. Martin, 2♂♂; Lake Mt., 4,600 ft, 18 Jan 1965, Neboiss, NMV J9235,

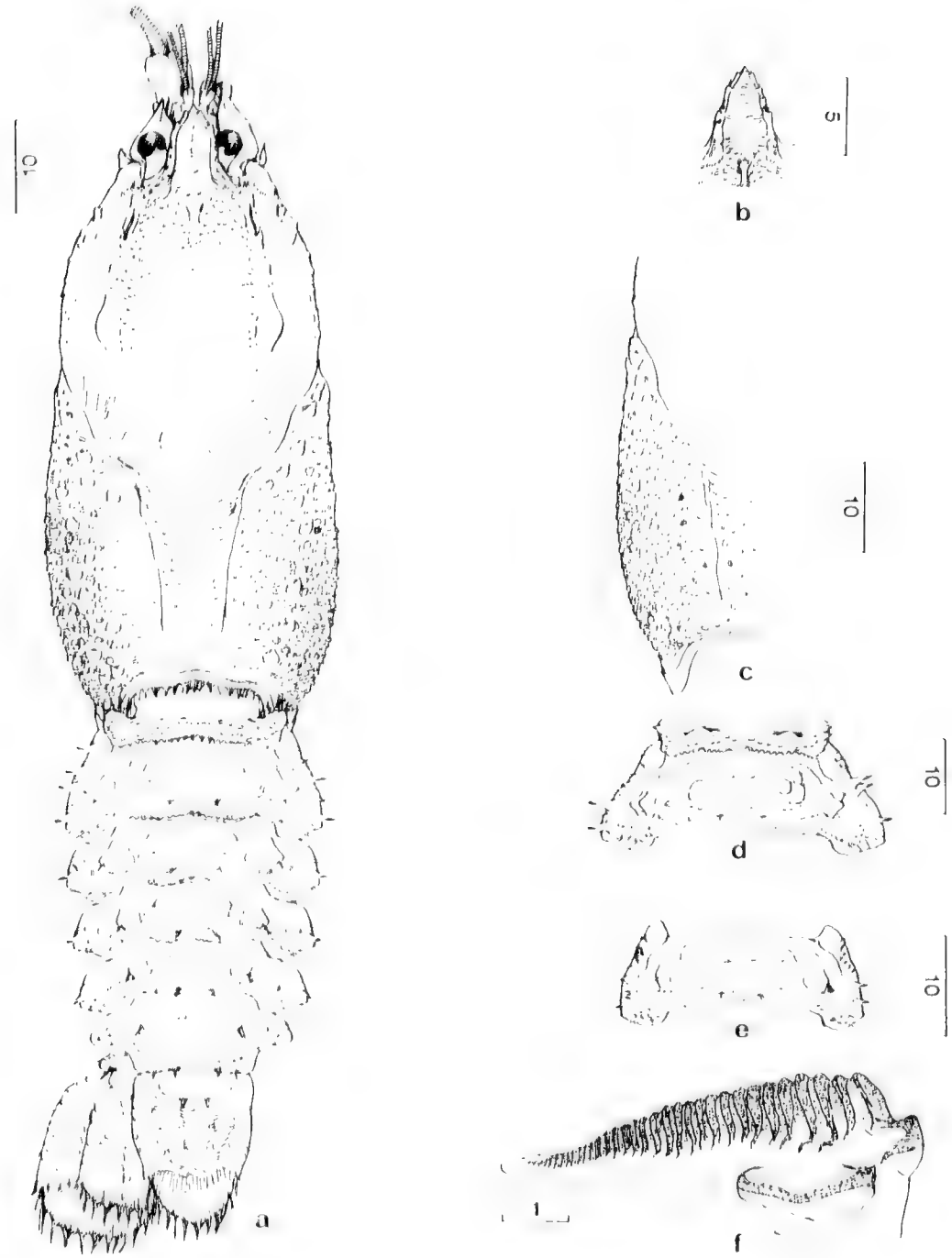


Figure 20. *Euastacus woiwurru* – a, dorsal view holotype ♂, Dobsons Ck, NMV J4527, b, rostrum, carinae not parallel, ♀, Lake Mountain, c, thorax, dorsal spines virtually absent, paratype ♂, Narracan R., NMV J4528, d, somites 1 and 2, D-L and slight D spine on somite 1, double D-L spines and a double D spine on somite 2, somite wide (sexual), paratype ♀, Mt Evelyn Wandin North, NMV J4529, e, somite 2, many small and tiny L-i spines, poor D-L spine, absent D spines, ♂, Lake Mountain , f, zygocardiac ossicle (can be secondary ears posterior to main ear), holotype ♂.

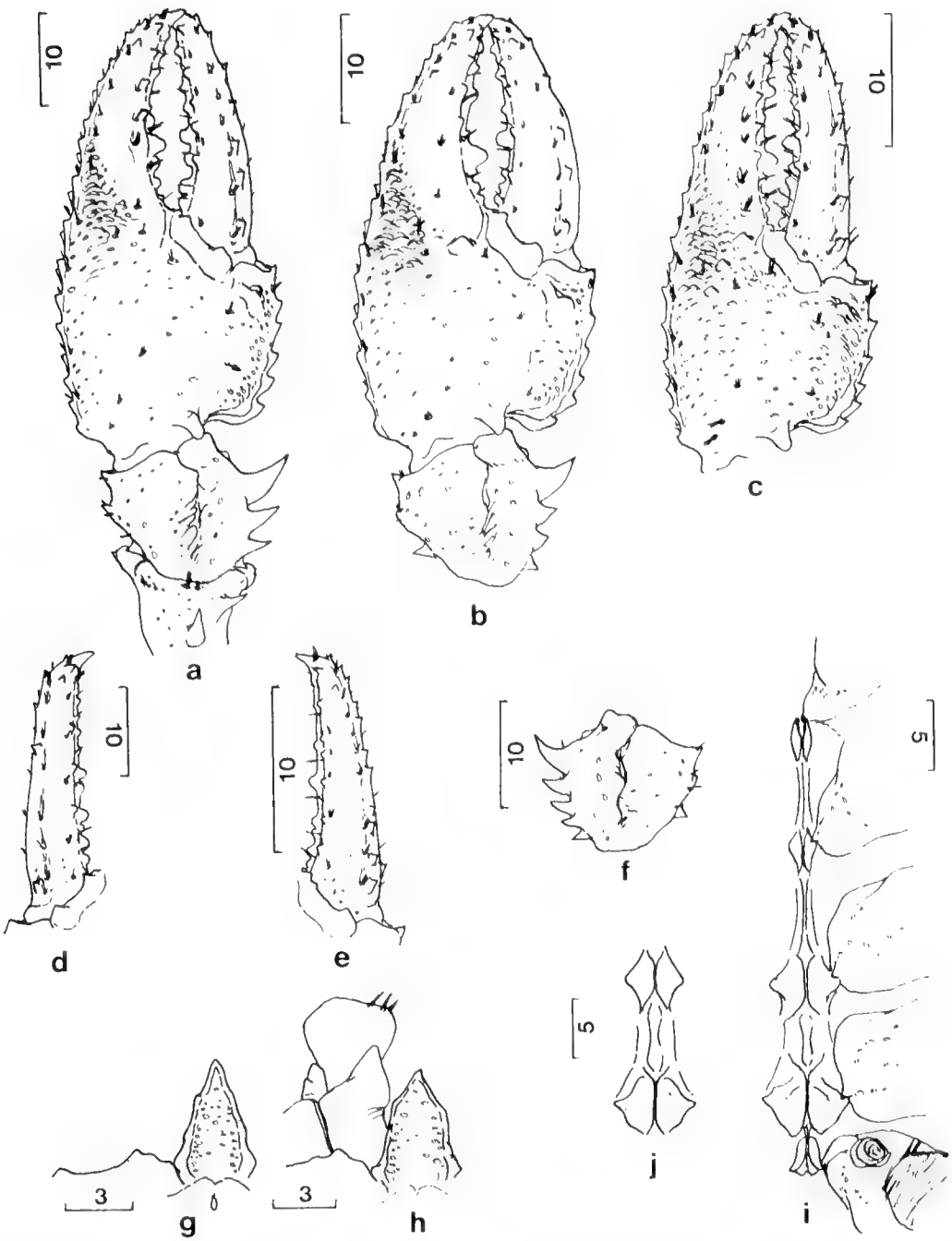


Figure 21. *Euastacus woiwuru* – a, dorsal view chela, holotype ♂; b, chela, very stout, extra dorsal apical dactylar spine, spine lateral to dactylar base, paratype ♂, NMV J4528; c, chela, elongate, larger and more numerous mesal dactylar spines, several spines lateral to dactylar base, ♀, Stirling R., NMV J9244; d, dactylus, fewer spaced mesal spines, paratype ♀, NMV J4529; e, dactylus, many dorsal mesal spines, 1 marginal mesal basal spine (rare), paratype ♀, Masons Falls, NMV J4530; f, carpus, 4 mesal spines (rare), ♂, Don R., NMV J5963; g, ventral view cephalon, (right antenna deformed), holotype ♂; h, ventral view cephalon, paratype ♀, NMV J4529; i, sternal keel, holotype ♂; j, sternal keel, processes narrower, paratype ♀, NMV J4529.

3♀♀; Echo Flat, Lake Mt., 19 Feb 1967, I.B. Muir, NMV J9220, 1♂; Lake Mt. pond, 4 Jun 1980, D. Booth, NMV J9224, 1♂; Echo Flat, Lake Mt., 4 Sep 1980, 1♂; Woods Point, 29 Dec 1963, P. Rawlinson, NMV J9231, 1♀; South Cascade Ck, east slopes of Mt Erica, 11 Apr 1960, J. Coventry, NMV J9234, 2♂♂; Murrundindi R., 15 Mar 1964, JRK and G.O. Kelly, NMV J9206, J9232, 2♂♂, 1♀; King Parrot Ck, May 1963, JRK, NMV J9211, 2♀♀; King Parrot Ck, JRK, NMV J9221, 2♂♂; King Parrot Ck, 4 May 1963, T.O., NMV J9229, 1♂; Snobs Ck, Eildon, 1962, JRK, NMV J9233, 1♀; Stirling R. near Buxton, 6 Mar 1982, A. Patak, NMV J9244, 1♀; Buffalo R. tributary, 6 km south of Dandongadale, 7 Oct 1982, P. Horwitz, 1♀; Narracan R., Narracan, Gippsland, Mar 1890, W. Kershaw, NMV J9222, 1♂; Narracan R., 1♂ (dried); Thorpdale (on Narracan R.), Gippsland, 21 Nov 1888, W. Kershaw, 1♀; Thorpdale, small stream in hills, 1 Dec 1888, W. Kershaw, NMV J9205, 1♂, 1♀; Gippsland, Feb 1906, C. French, NMV J9218, 1♀; Victoria, 23 May 1906, S. Fulton, NMV J9216, 1♂.

No locality. NMV, 4♂♂, 3♀♀.

Diagnosis. As for *E. bidawalus* except:

Antennal squame more frequently widest slightly proximal to midlength. Thoracic spines small, medium sized or absent. 3-9 Li spines on abdominal somite 2. D abdominal spine sometimes medium sized on anterior somites. Usually 2 lateral propodal spine rows. 1-4 dorsal apical propodal spines (>30 OCL). Spines above propodal cutting edge to or proximal to midlength of gape. Rarely 7 mesal propodal spines. Spines above dactylar cutting edge reaching proximal to midlength or full gape. 2-5 dorsal mesal dactylar basal spines. Marginal mesal dactylar basal spines usually absent, occasionally 1 spine. 2-5 (rarely 6) apical mesal dactylar spines, forming row with basal spines. Largest ventromesal carpal spine sometimes slightly larger than ventral spine.

Description. Maximum OCL: 74.5 mm.

Rostrum: Rostrum not reaching base or reaching base of antennal segment 3 on most specimens >30 OCL (rarely almost to midlength of segment); on specimens 20-30 OCL, rostrum to base or midlength of segment; sometimes to end or distal to 3rd segment on specimens <20 OCL. Rostral sides usually parallel or slightly convergent, rarely distinctly convergent; base divergent or very divergent and carinae medium length or short, slightly or distinctly spread. 1-6(usually 2-4) rostral spines per side, distributed to midlength or slightly short of or proximal to midlength of carinae; spines small on specimens >30 OCL, small or medium sized on lesser specimens and sometimes large on very small specimens <20 OCL; spines rounded or very rounded on most large animals, sometimes moderately pointed on specimens <40 OCL, moderate or sharp on specimens <20 OCL. Acumen spine similar size to or slightly larger than marginal spines, much larger on some specimens <20 OCL.

OCL/CL 0.76-0.89 i. RW/OCL 0.13-0.23 d.

Cephalon: Spination moderate to poor, with 1-5 small spines and many low bumps ventral to postorbital ridges. 1st postorbital spine an edge or small on specimens >30 OCL, small to large on smaller specimens. 2nd postorbital spine small edge or edge on specimens >30 OCL, usually small or medium sized on lesser animals; occasional specimens lacking 2nd spine. Suborbital spine small on specimens >40 OCL, small to medium sized on animals 20-40 OCL, occasionally large on smaller specimens. Lateral margin of antennal squame slightly convex or straight; squame widest at or slightly proximal to midlength on specimens >30 OCL, distinctly proximal on smaller animals; marginal spines absent (one large specimen with spine on one squame). Interantennal spine medium width to broad, sometimes very broad on specimens <20 OCL (one specimen from Narracan R. with moderately elongate spine); spine margins usually slightly or distinctly scalloped, occasionally almost smooth or with tiny marginal tooth near spine apex. Basipodite spine usually absent or small (rarely medium sized) on specimens >40 OCL, medium sized to large on most smaller specimens. Coxopodite spine absent or small on most specimens, occasionally medium sized and unimodal, weakly bifid or serrated.

ScL/OCL 0.12-0.25 d.

Thorax: Dorsal spines absent or few small to medium sized dorsal spines posterior to cervical spines, or many spines distributed in zone; frequently spines just discernible. Western forms (e.g., Dandenongs) usually with dorsal spines, eastern and northern specimens usually lacking distinct spines. General tubercles medium sized or medium/large dorsally on most specimens >30 OCL, medium sized to small or very small on lesser animals;

tubercles densely to moderately distributed on specimens >30 OCL and most 20-30 OCL, sparse to very sparse on smaller specimens, absent on some very small animals. 2(rarely 1)-5 cervical spines per side, medium sized or small and usually moderately pointed or blunt; dorsal spine often larger and sharper than others.

ArL/OCL 0.33-0.38. CaW/OCL 0.52-0.60 i. ArW/OCL 0.14-0.20 d. CaD/OCL 0.45-0.56.

Abdomen: D-L spine frequently on somite 1 of specimens >30 OCL and some 20-30 OCL; spine medium sized to small and sharp to blunt; spine sometimes absent or rarely 2 spines on one side. D spine usually absent from somite 1, sometimes small or tiny, blunt or very blunt D spine/bump. Somite 2 with 3 (rarely 2)-9 (usually 3-6) Li spines, specimens from eastern sites frequently with more numerous spines than on western specimens; some specimens <30 OCL with 0-1 spine. Somites 3-5 of specimens >30 OCL and most 20-30 OCL with 1 Li spine. Li spines decreasing in size posteriorly, large or medium sized to small or tiny on specimens >30 OCL, medium or small to tiny on lesser individuals; spines very sharp or sharp on specimens >40 OCL and most 30-40 OCL, moderately pointed or blunt on smaller animals. 1-2 Lii spines sometimes on somites 2-5 of specimens >30 OCL (Lii spines unusual on somite 2); spines medium sized to tiny on specimens >50 OCL, small or tiny on lesser crayfish; spines occasionally sharp, usually moderately pointed to blunt. Somite 6 with 1-2 small or tiny Lii spines on most specimens >30 OCL. D-L spine on somites 2-4 (sometimes 5) of most specimens >30 OCL and some smaller specimens; spines diminishing to posterior from medium sized or small to tiny and usually moderately pointed (rarely sharp) anteriorly to blunt or very blunt posteriorly. Sometimes tiny, blunt D-L spine on somite 6 of large animals. Some specimens >60 OCL with 2 (rarely 3) D-L spines on one, or both, side(s) of somite 2. D spine on somites 2 and 3, occasionally on somite 4, rarely on 5, of most specimens >30 OCL and some smaller specimens; D spines medium sized to small or tiny on large animals, small or tiny on specimens <50 OCL and blunt or very blunt. D spines often only bumps. Specimens <20 OCL usually lacking abdominal spines. Dorsal boss weakly developed on some specimens >50 OCL, absent on smaller animals.

AbdW/OCL: ♂ 0.46-0.54 d; ♀ 0.47-0.65 di. OCL/L: ♂ 0.37-0.46 i; ♀ 0.37-0.45 id.

Tailfan: Tailfan spines absent, feint setal bumps along margins of telson and uropods. Standard spines very small or small on specimens >50 OCL, small to medium sized on animals 20-50 OCL, large on some smaller animals.

TeL/OCL: ♂ 0.29-0.41 d; ♀ 0.32-0.41 di.

Chelae: Chelae stout to elongate, variation between populations. Teeth well developed on specimens >40 OCL.

Propodus: Usually 2 lateral propodal spine rows, 2 to 1 condition on some specimens <30 OCL; lateral spines medium sized to small and rather sharp. Lateral spine ridge usually small or vague. Mesal propodal spines numbering 5 or 6, occasionally 7 (4 on some regenerate chelae). 1-3 (rarely 4) dorsal apical spines on specimens >30 OCL and some smaller animals, eastern and northern specimens commonly with higher counts than Dandenong animals. 2-5 (usually 3-4) spines above propodal cutting edge of specimens >30 OCL and most animals 20-30 OCL; spines to or proximal to midlength of gape (sometimes full gape) and very large or large on most specimens >50 OCL, large to small on lesser individuals (basal spine frequently largest); some specimens <30 OCL and all <20 OCL with 0-1 spine above cutting edge. Frequently 1 (rarely 2) medium sized or small blunt spine(s) lateral to dactylar base dorsally, with several low bumps; ventrally, 1-3 (occasionally 4-5) spines, usually medium sized or small, rarely large. Precarpal spines absent. A low, blunt spine or bump posterior to dactylar articulation.

PropL/OCL: ♂ 0.72-0.92; ♀ 0.71-0.90. PropW/PropL 0.35-0.52 id. PropD/PropL (0.23)0.25-0.33.

Dactylus: 3-9 (usually 4-6) spines above dactylar cutting edge of specimens >30 OCL and most 20-30 OCL, Dandenong specimens usually with lower counts than more northern (e.g., Kinglake) crayfish; spines reaching pro-

ximal to midlength or to full length of gape, spines large or medium sized (rarely small); some specimens 20-30 OCL with only 1 or 2 small spines, rarely apical; specimens <20 OCL lacking spines. 1(rarely 2) extra dorsal dactylar spine(s) often present; Dandenong and Narracan crayfish usually lacking spine, north-eastern populations (e.g., Lake Mountain) usually with spine. Usually 2-5 dorsal mesal dactylar basal spines, reaching distal to midlength of dactylus. Marginal basal spines usually absent; some specimens, especially from Kinglake, with 1 spine (often on one chela only). Basal spines medium sized to small and moderately raised or flattened. 2-5 (rarely 6) apical spines,joining dorsal basal spines in mesal dactylar row. Eastern and Kinglake specimens with most numerous spines, Dandenong specimens frequently with fewer spines and some large specimens from near Wandin with large gaps between basal spines. Specimens <30 OCL often with fewer spines, absent on some very small specimens <20 OCL. Dactylar groove present, sometimes deep.

DactL/PropL 0.53-0.61(0.63).

Carpus: 3 mesal carpal spines, rarely 4 on one chela, some regenerate chelae with proximal spine very reduced i.e., 2(+1) spines. 2, occasionally 3(rarely 1), lateral carpal spines, large or medium sized on specimens >30 OCL, medium or small on lesser individuals. Articulation spine absent on all but smallest specimens. Low dorsal spine/bump occasionally present. Ventral carpal spine very large or large. Largest ventromesal spine medium sized to very large on specimens >40 OCL, sometimes similar to or slightly larger than ventral spine; 1 or 2 small additional ventromesal spines/bumps.

Merus: 5-9 medium sized dorsal spines. Outer meral spine absent or small on specimens >20 OCL, medium sized or large on lesser individuals.

Keel: Pr1: Posterior margins sloped or almost semi-abrupt, occasionally semi-abrupt on small specimens; ventral edges angled down, occasionally slightly rounded; processes close or slightly apart (apart on one specimen from Buffalo R.) and parallel or open. Keel after Pr1 low and lacking obvious spines, anterior sometimes slightly pronounced. Pr2: Almost parallel or open. Keel after Pr2 low, sometimes with a low spine. Pr3: Scoops usually absent, sometimes slight or very gradual, bases sharp to rounded. Keel after Pr3 usually slightly saddle-shaped, 1 or 2 small spines sometimes present. Pr4: Scoops usually absent, rarely slight; posterior edges usually sharp (occasionally moderate) and convex, straight or irregular; anterior edges moderately rounded to angular. Processes 3 and 4 narrow (or very narrow) on specimens >40 OCL, just narrow or broad on smaller animals, very broad on some specimens <20 OCL.

Setation: Usually moderate to light; specimens from Lake Mountain and Buffalo R. more hirsute than western animals.

Punctation: Dense or very dense.

Gastric Mill: TAP count 7.0-9.0; TAA count 0.0-1.0 (usually 0.0 or 0.5); spread 6.5-9.0. Frequently 1 or more small secondary ears posterior to main zygocardiac ear. Urocardiac ridges 9-11.

Coloration: Body dorsally brown or brown/green, paler ventrally. Thoracic spines (when present) usually dark green; general tubercles pale brown, green or cream. Rostral carinae and postorbital spines blue or green. Abdominal somites laterally blue; abdominal spines brown or cream. Carpus of cheliped brown with dark blue or green mottling, mesal spines green or blue with pale tips. Propodus like carpus, mesal and lateral edges often bright blue, spines pale. Fingers blue or green.

Body ventrally cream, blue and orange. Carpus of cheliped orange midventrally, blue and green marginally. Propodus white or pale brown with green or blue mottling, mesally orange or brown, mesal edge blue/green. Fingers bright blue in Dandenongs, usually dark brown or green in east.

Geographical variation in intensity of blues.

Sexes: Males bear a cuticle partition. Females <30 OCL have unopen gonopores. One female near the upper limit of the 30-40 OCL range has open pores. Three of ten females examined in the 40-50 OCL range appear mature and three have setae developing around opening pores. Females >50 OCL have

open gonopores and one is berried. It appears that female maturity usually occurs at sizes between 40 and 60 mm OCL.

Distribution and biology. Euastacus woiwuru inhabits streams in central Victoria from the Dandenong Mountains, east of Melbourne, north-east to Eildon and Dandongadale, east to Woods Point and Erica and south-east to the region of Thorpdale (Fig. 7). Included in this range are tributaries of the Yarra, Murray and Latrobe Rivers and some small coastal streams. The species appears separated from *E. neodiversus* by low country along the Morwell River. *Euastacus woiwuru* usually occurs at altitudes above 200 m a.s.l., occasionally at lower elevations. Specimens have been collected at sites greater than 1 400 m a.s.l., snow covered in winter. Natural vegetation in the species' range includes mountain ash and tree ferns, with dry sclerophyll forest at lower altitudes. Much of the range is cleared and blackberry is common in areas. *Euastacus woiruru* is most common where vegetation is dense. The species is frequently sympatric with *Engaeus* species and has been observed berried in spring (September).

Remarks. Euastacus woiwuru has been collected extensively from the Dandenongs and the species has a long taxonomic history. Clark (1936, 1941), Kane (1964) and Rick (1969) confused *E. woiwuru* with other species, especially *E. kershawi* and *E. crassus*.

Euastacus woiwuru is a variable species and several characters show geographical variation. Some eastern high country specimens (e.g., from Woods Point and Mt Erica) have slightly larger and more extensive rostral spines than do western specimens (e.g., from the Dandenongs). Dandenong specimens usually have better developed thoracic spines than do those animals from sites to the north-east and south. Most eastern forms lack thoracic spines.Eastern specimens frequently bear more numerous Li spines on abdominal somite 2 and more numerous spines above the propodal and dactylar cutting edges than do animals from the Dandenongs. Eastern and northern specimens usually have more numerous mesal dactylar spines. An extra dorsal dactylar spine is more frequently developed on eastern specimens, especially Lake Mountain crayfish, than on Dandenong specimens. Kinglake specimens commonly bear a marginal dactylar basal spine, unusual for the species. Gastric mill TAP counts are usually lower in the north of the range (especially in Murray R. tributaries) than in other areas.

A specimen (NMV J9238) from Lilydale, near Melbourne (presumably from Olinda Ck, a tributary of the Yarra R.) is unusually spiny. The dorsal thoracic, rostral, suborbital and dorsal abdominal spines are atypically large for *E. woiwuru* and converge towards the *E. yarraensis* condition. In most respects, however, the animal is more typical of *E. woiwuru* with three mesal carpal spines, extensive spines above the cutting edges of chelae, a low spine posterior to the dactylar articulation, no telsonic spines and narrow keel processes 3 and 4.

A small specimen from Diamond Ck near Gembrook has poor mesal dactylar spination, large 1st postorbital spines, large rostral acumen spine and no spines above the cutting edges of the chela. These conditions are partly due to the small size of the animal but are extreme nonetheless.

A specimen recently collected from the Buffalo River, south of Dandongadale, is unusual in several respects. The animal is more hirsute than other members of the species, though the Kinglake crayfish approach this condition. The mesal dactylar spines are reduced in number, though dorsal basal spines still extend distal to midlength of the dactylus. The interantennal spine is more elongate than usual.

Euastacus yarraensis (McCoy)

Figures 22, 23

Astacopsis serratus yarraensis McCoy, 1888: 225-7, pl. 16.–Smith, 1912: 159.

Astacopsis serratus.–Smith, 1912: 158-9, pl. 17 (in part, Yarra, Plenty and Curdies Rivers localities).–McCulloch, 1917: 237-8 (in part, Yarra R. locality).–Hale, 1927: 75-6 (in part, inclusive distribution?).

Euastacus nobilis kershawi.–Clark, 1936: 16-17 (in part, Warburton locality).

Euastacus nobilis.–Clark, 1941: 20-2 (in part, Warburton, Yarra R. locality).

Euastacus yarraensis (McCoy).–Clark, 1936: 14-15, pl. 2 fig. 13.–1937a: 35.–1937b: 186.–1941: 15-16, pl. 3 (in part, some locality streams drain Murray R. *E. armatus*).–Clark & Burnet, 1942: 90-2.–Rick, 1969: 894.

Euastacus bispinosus.–Hobbs, 1974: 23, fig. 20.

Material examined. Vic. Yarra R., Asylum Paddock, Kew, Oct 1882, NMV J6152, 1♀; Yarra R., Melbourne, 1♀; Yarra R., 1♂; Plenty R., 11 Jan 1918, Glass, 1♂; Yarra R., Warburton, 27 Nov 1905, Tanderson, NMV J5972, J6158, 3♂♂, 3♀♀; Woori Yallock Ck, JRK, NMV J5996, 1♂; Cockatoo, 26 Jan 1966, A.L. Dyce, AM P15320, 1♂; Plenty R., 30 Mar 1896, Keastland, NMV J5974, 1♂; Badger Ck below Sanctuary, 13 Oct 1963, M. Littlejohn, NMV J5999, 1♂; Badger Ck, Healesville Sanctuary, 8 Mar 1978, P.S. Lake, NMV J5991, 1♂; Badger Ck, Healesville, 21 Mar 1982, A. Patak, 1♀; Badger Ck, Coranderrk Reserve, 1982, L. Pahl, NMV J9242, 1♀; Badger Ck, 1 km east of Sanctuary (37°42′S., 145°35′E.), 22 Apr 1982, GJM and SJH, NMV J5968, 2♂♂; Diamond Ck, tributary of Bunyip R. near Bunyip North, 20 Oct 1963, JRK, NMV J6153, 1♀; Diamond Ck, Feb 1964, JRK, NMV J5981, 1♂; Diamond Ck, Tonimbuk, 6 Apr 1977, 1♂; Bunyip R., Gippsland, Jan 1880, W. Kershaw, NMV J5985, 1♂/♀; Diamond Ck, Tonimbuk, 15 Mar 1983, P. Humphries and P.S. Lake, NMV J9245, 1♂; Bunyip R., near Bunyip, 1 km below junction with Tarago R., 17 Mar 1979, K. Hortle, NMV J5976, 4♂♂; Bunyip R., near Bunyip, 21 Sep 1979, G. Hortle, NMV J5993, 1♂, 2♀♀; Bunyip R., Bunyip, 10 Jul 1979, K. Hortle, NMV J5975, 2♂♂, 3♀♀; Bunyip R., top of road from Princes Highway, 18 Feb 1977, P.S. Lake, NMV J6156, 2♂♂; Beer Ck, Gilderoy, 10 Sep 1977, L. Metzeling, NMV J5995, 1♀; Little Yarra R., near Gilderoy (37°50′S., 145°40′E.), 22 Apr 1982, GJM and SJH, NMV J5967, 2♂♂; Tarago R. near Warragul, Feb 1938, Hill, NMV J6151, 1♀; Labertouche Ck, tributary of Tarago R., 27 Oct 1963, JRK, NMV J5977, 1♀; Labertouche Ck, 1982, P. Horwitz, 1♂; Lerderderg R. headwaters near Blackwood, 15 Oct 1956, NMV J5978, 1♀; Lerderderg R., 14 Dec 1977, 1♂; O'Briens Crossing on Lerderderg R., 3 Jan 1980, P.S. Lake and D. Coleman, 3♂♂; Werribee R. below weir, 30 Jan 1980, P.S. Lake and D. Coleman, 1♂, 1♀; Underbank, Werribee R. 2 miles downstream of weir, 30 Jan 1980, P.S. Lake and D. Coleman, 1♂; Geelong Angling Club, 1 Apr 1942, NMV J5988, 1♀; Forrest, July 1948, Wilhelms, NMV J5984, 1♀; Gellibrand R. near Gellibrand, 30 Mar 1970, A. Neboiss, NMV J5970, J5973, 2♂♂, 2♀♀; Gellibrand R. south of Colac, JRK, NMV J5980, 1♂; Loves Ck Reserve, tributary of Gellibrand R., 12 Nov 1963, JRK, NMV J6154, 3♀♀; Loves Ck, 19 Apr 1963, JRK, NMV J5971, J5990, 2♂♂, 5♀♀; Near Gellibrand, JRK, 15 Oct 1956, NMV J5979, 2♂♂, 2♀♀; Beauchamp Falls, Otways, 3♂♂, 2♀♀; Calder R., Cape Otway, Mar 1971, T. Pescott, NMV J5982, 1♂; Aire R., Otways (38°40′S., 143°32′E.), 24 Mar 1982, GJM and SJH, NMV J5969, 4♂♂, 2♀♀; Kennedys Ck, Cobden, tributary of Curdies R. (site uncertain since Kennedys Ck flows into Gellibrand R. but Cobden is near Curdies R.), Oct 1897, W.A. Hall, NMV J6157, J6159, 1♂, 1♀; Victoria, 1♂.

No locality: NMV R2567, 1♀; NMV, 3♂♂, 3♀♀.

Diagnosis. Similar to *E. armatus* except:

Rostral base rarely parallel, usually divergent. Thoracic spines medium sized or large. General tubercles moderately distributed to dense. 2-5 (usually 3-4) Li spines on abdominal somite 2. D abdominal spines medium sized or small, less distinctly curved towards anterior. 2-17 telsonic surface spines. Spines above propodal and dactylar cutting edges apical or reaching proximal to midlength of gape. 1-3 (rarely 0) dorsal mesal dactylar basal spines. 2-4 apical mesal dactylar basal spines. Occasionally 2 (+1) or 3 mesal carpal spines. Keel Pr1 sloped to abrupt, close or apart. TAP count 4.0-7.0. [1st extra zygocardiac tooth not between teeth 5 and 6].

Description. Maximum OCL: 76.8 mm.

Rostrum: Rostrum quite broad, not reaching base of 3rd antennal segment or reaching midlength of segment on specimens >60 OCL, proximal to midlength or to end of segment on specimens 20-60 OCL, to or distal to end of segment on specimens <20 OCL. Rostral sides usually parallel or slightly convergent, occasionally convergent. Base usually divergent or very divergent (occasionally parallel), carinae medium length or long, 2-5 (usually 3-4) rostral spines per side, usually distributed to or proximal to midlength of carinae (occasionally apical or to full length); spines usually large to medium sized, rarely small on large specimens; moderately pointed or sharp. Acumen spine usually distinctly larger or much larger than marginal spines, rarely only slightly larger than marginals on large specimens.

OCL/CL 0.72-0.87 i. RW/OCL 0.13-0.24 d.

Cephalon: Cephalon very spiny to moderately spiny on specimens >20 OCL, moderately to poorly spined on lesser individuals, with 1-4 spines and several bumps ventral to postorbital ridges. 1st postorbital spine small or medium sized on specimens >60 OCL, small to large on lesser animals and very large on some specimens <20 OCL; 2nd spine an edge or small on specimens >40 OCL, usually medium sized to large on smaller animals. Suborbital spine medium sized to large. Lateral margin of antennal squame straight or convex, slightly concave on some specimens <20 OCL;

squame widest proximal or very proximal to midlength; marginal spines absent. Interantennal spine medium width or broad on specimens >40 OCL, broad or very broad on lesser specimens; margins usually toothed or scalloped; often tiny spine in centre of interantennal spine. Basipodite spine small to large, very large on some specimens <40 OCL. Coxopodite spine small to large, usually unimodal or bifid, occasionally weakly serrated.

ScL/OCL 0.15-0.41 d.

Thorax: 3-11 (usually 5-10) thoracic spines per side on specimens >20 OCL, in thin zone or 1 or 2 irregular rows; spines medium sized or large and moderately pointed or sharp, usually with some blunt spines dorsally; specimens <20 OCL with 1-6 spines, sometimes absent, spines medium sized or small and moderately pointed to flat. General tubercles large to medium sized on specimens >40 OCL, usually medium to small on specimens 20-40 OCL, small or absent on specimens <20 OCL; tubercles dense or moderately distributed on specimens >40 OCL, frequently sparse on smaller animals, very sparse or absent on many <20 OCL. 1-5 (usually 2-3) cervical spines per side, 1st (dorsalmost) and sometimes 2nd usually large and sharp, others medium sized or small and moderately pointed.

ArL/OCL 0.36-0.41. CaW/OCL 0.54-0.64 i. ArW/OCL 0.15-0.21 d. CaD/OCL 0.45-0.57 d.

Abdomen: D-L spine on somite 1 of specimens >20 OCL and some smaller animals; spine usually large or medium sized and sharp, except on small animals. D spine frequently on somite 1, absent on some specimens of all sizes; spine usually medium sized or small and sharp to blunt. On somite 2, 2-5 (usually 3-4) Li spines, 0-1 spines on some animals close to or <20 OCL. Somites 3-5 of specimens >20 OCL with 1 Li spine. Li spines very large to medium sized (small on specimens close to or <20 OCL) and very sharp, moderately pointed on some small specimens, decreasing in size and sharpness posteriorly. 1-2 Lii spines frequently on somites 3-6 (rarely somite 2); Lii spines large to small (tiny on some specimens <40 OCL) and very sharp on large specimens, moderately pointed or blunt on most specimens <40 OCL. D-L spine on somites 2-6 of specimens >40 OCL and most 20-40 OCL; some specimens >40 OCL with 2 D-L spines per side on somite 6. D-L spine very large to small, decreasing in size posteriorly and very sharp on specimens >40 OCL, sharp to blunt on smaller animals. D spine on somites 2-5 of most specimens >40 OCL and some smaller animals; somite 6 of large specimens usually with 1-3 D spines, 5 tiny spines on one specimen. D spines medium sized to tiny and sharp to blunt, decreasing in size posteriorly, though spines on somite 6 frequently sharp. Specimens <20 OCL usually lacking abdominal spines. Dorsal abdominal boss present on large animals, but not obvious; specimens 40-60 OCL with vague boss on somites 2-4, usually absent on specimens <40 OCL.

AbdW/OCL: ♂ 0.46-0.55 d; ♀ 0.50-0.63 i. OCL/L: ♂ 0.35-0.44 i; ♀ 0.35-0.42 i.

Tailfan: 2-17 (usually 4-10) telsonic surface spines on specimens >20 OCL; spines very large or large on specimens >60 OCL and most smaller specimens, though small animals usually with some medium sized and/or small spines; specimens <20 OCL usually lacking spines, sometimes 1 or 2 very small spines. Often 1, sometimes 2, large to small marginal telsonic spines per side. Inner ramus of uropod usually with 1-2 (rarely 3) surface spines, sometimes on one uropod only, and 1-3 extra marginal spines (rarely absent); outer ramus of uropod usually with 1-4 marginal spines; uropod spines large to small, absent on specimens <20 OCL. Standard spines medium sized to large.

TeL/OCL: ♂ 0.30-0.44 d; ♀ 0.33-0.44 d.

Chelae: Chelae elongate to stout, usually intermediate in shape. Teeth well developed on specimens >60 OCL.

Propodus: Lateral spine rows usually in 2 to 1 condition, almost 2 rows on some specimens; ventral row often poorly developed on specimens <20 OCL. Lateral spines large or medium sized (small and blunt on some large specimens, probably due to abrasion). Lateral spine ridge present on specimens >20 OCL, obvious to vague. Usually 5 mesal spines, occasionally 4, rarely 6. Usually 1-2 dorsal apical spines, sometimes absent especially on small crayfish. 2-4 spines above cutting edge on

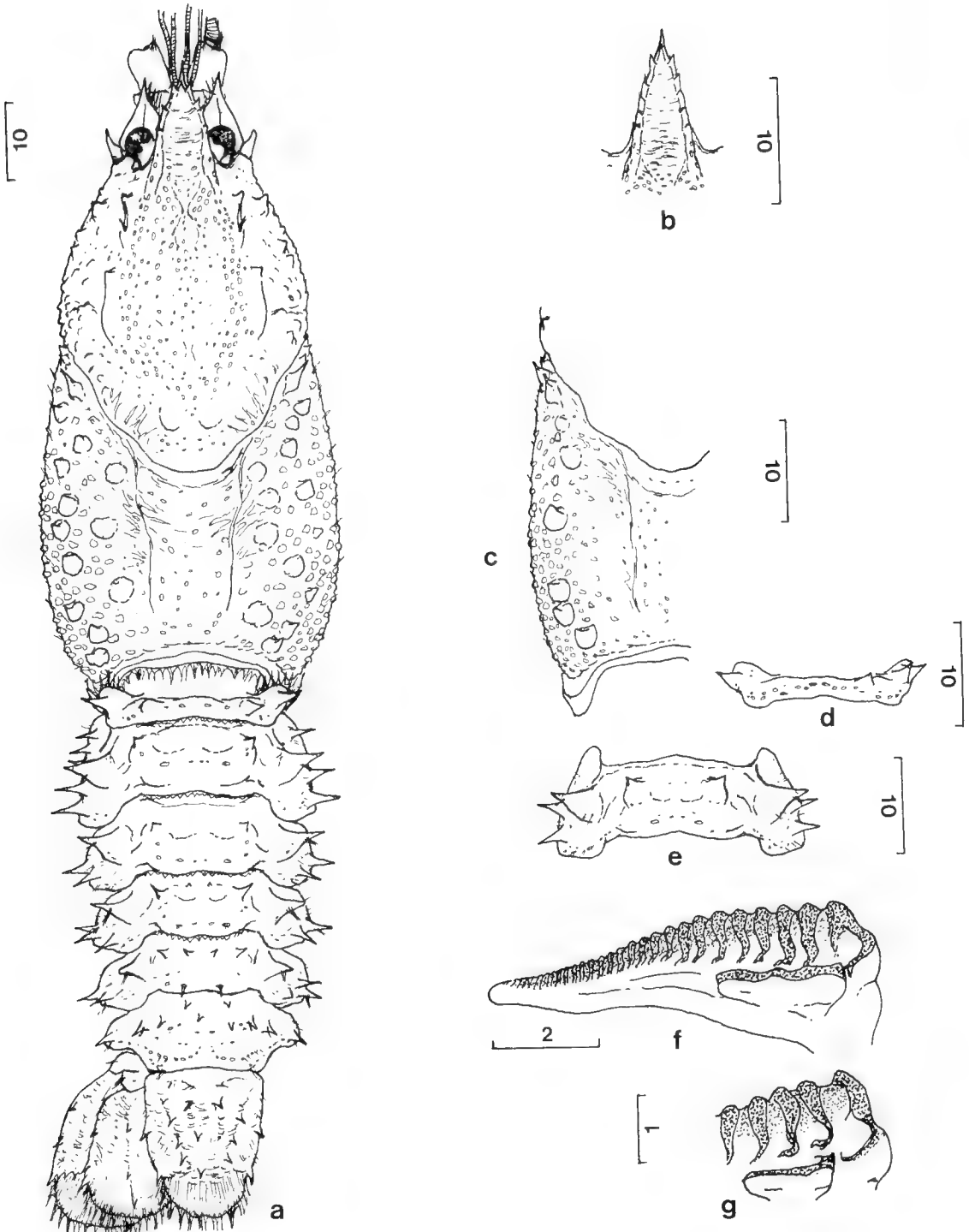


Figure 22. *Euastacus yarraensis* – (Type not available for illustration) a, dorsal view ♂, Plenty R., NMV J5974; b, rostrum, more numerous spines, more elongate (allometry), ♂, Badger Ck; c, thorax, fewer dorsal spines, 2 large cervical spines, ♂, O'Briens Crossing, NMV J9483; d, somite 1, variation in spines, ♂, Badger Ck; e, somite 2, 2 Li spines, ♂, O'Briens Crossing, NMV J9483; f, zygocardiac ossicle, ♂, Plenty R., Francois collection; g, zygocardiac ossicle, shorter ear, ♂, O'Briens Crossing, NMV J9483.

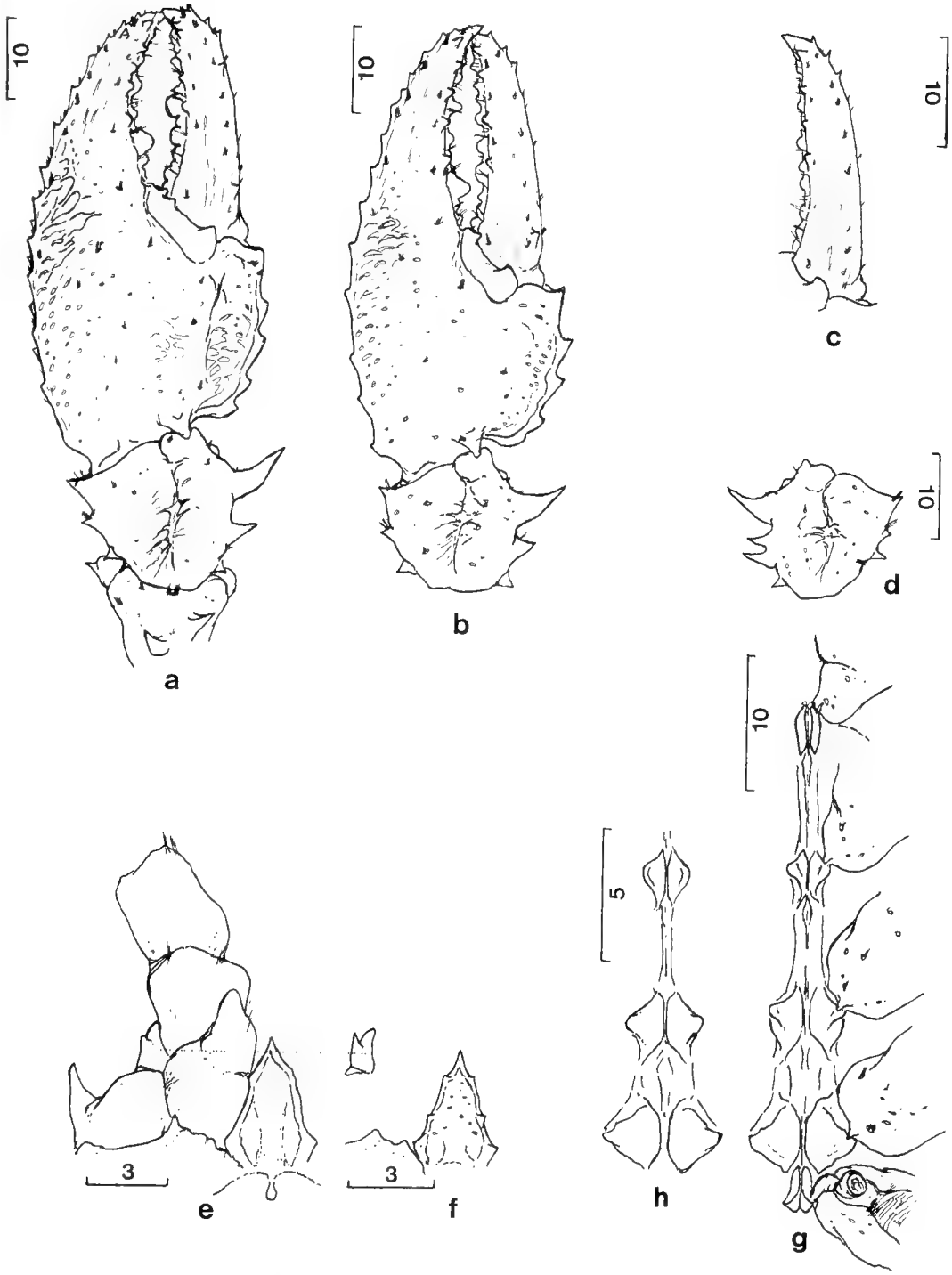


Figure 23. *Euastacus yarraensis* – a, dorsal view chela, ♂, Plenty R., NMV J5974; b, chela, more elongate, 1 apical propodal spine, carpal spines stouter, ♂, O'Briens Crossing, NMV J9483; c, dactylus, no basal spines, ♂, O'Briens Crossing, NMV J9483; d, carpus, 3 mesal spines (rare), ♂, Diamond Ck; e, ventral view cephalon, ♂, Plenty R., NMV J5974; f, cephalon, toothed interantennal spine, larger basipodite spine, ♂, O'Briens Crossing, NMV J9483; g, sternal keel, ♂, Plenty R., NMV J5974; h, sternal keel, processes broader (partly allometry), ♂, Aire R., NMV J5969.

specimens >40 OCL and most 20-40 OCL, some small specimens with 0-1 spine; spines large to small, apical or distributed to or proximal to midlength of gape. Dorsal spines lateral to dactylar base usually absent, sometimes small (occasionally medium sized) spine with several small, low bumps; usually 1-3 large or medium sized spines ventrally, often distributed some distance along finger; spines often small on specimens <40 OCL, absent on most animals <20 OCL. Spines absent posterior to dactylar articulation, except on some regenerate chelae; precarpal spines absent.

PropL/OCL: ♂ 0.75-0.97 i; ♀ 0.74-0.90 (0.95). PropW/PropL 0.37-0.49. PropD/PropL (0.20)0.23-0.31 i.

Dactylus: 2-7 spines above dactylar cutting edge on specimens >40 OCL, sometimes fewer on smaller animals (regenerate chelae often with fewer spines); spines apical or reaching midlength or full chela gape, and medium sized or small. Specimens from western areas (e.g., Otways) usually with more numerous spines than eastern animals. Specimens <20 OCL usually lacking spines above cutting edge. Extra dactylar apical spines absent. Usually 1-3 dorsal mesal dactylar basal spines, sometimes absent; marginal dactylar basal spines usually absent, sometimes 1 or 2 spines especially on regenerate chelae (one large specimen with 3 and 4 marginal basal spines joining apical spines on elongate, probably regenerate chelae). Basal spines large or medium sized on specimens >60 OCL, medium or small on lesser specimens. 2-4 apical mesal dactylar spines, except on some small specimens with 1 spine. Dactylar groove usually present, vague or absent on some large specimens.

DactL/PropL 0.51-0.60.

Carpus: Usually 2 mesal carpal spines, frequently with a bump distal and/or mesal to spines, several specimens with 2(+1) and some with 3 spines, usually on one chela only; 1st (distal) spine usually much larger than 2nd; when 3 spines, 2nd and 3rd contiguous at base. 2 (rarely 1 or 3) lateral carpal spines, large or medium sized on specimens >40 OCL, small on some smaller animals. Small articulation spine sometimes on specimens <40 OCL, medium sized or large on smaller animals. Dorsal carpal spines usually absent, tiny spine on some small specimens. Ventral carpal spine very large. Largest ventromesal spine usually medium sized or small, sometimes large (or very large) and occasionally similarly sized to ventral spine; 2 or 3 additional tiny ventromesal bumps.

Merus: 5-9 large dorsal spines. Outer meral spine small on specimens >60 OCL, small to large on smaller animals, very large on some specimens <20 OCL.

Keel: Pr1: Posterior margins abrupt to sloped; ventral edges rounded, flat or angled down; processes close or apart and parallel or open (rarely closed). Keel after Pr1 usually pronounced anteriorly, sometimes 1 or 2 sharp spines. Pr2: Open or very open. Keel after Pr2 frequently saddle-shaped, sometimes an anterior spine. Pr3: Scoops present or absent, bases usually rounded or moderately curved, sharp on some specimens <20 OCL. Keel after Pr3 quite pronounced especially anteriorly. Pr4: Scoops usually absent, occasionally slight; posterior edges sharp or rounded and slightly convex, straight or irregular; anterior edges moderately rounded or angular (rarely rounded). Processes 3 and 4 usually broad or very broad, occasionally just broad, narrow on one specimen from near Geelong. Specimens from the Otways usually with broader processes than eastern crayfish.

Setation: Moderate to light.

Punctation: Dense or very dense on cephalon, moderate or dense on thorax.

Gastric Mill: TAP count 4.0-7.0; TAA count 0.5-1.0; spread 3.0-6.5. Geographical variation in counts (lowest in Werribee/Lerderderg specimens, highest in eastern specimens) largely due to differences in length of ear. Urocardiac ridges 8-11.

Coloration: Two major colour variants. Body usually blue or blue/green dorsally in Yarra drainage (east), brown or brown/green west of Yarra R. Thoracic spines and general tubercles tipped white in east, pale brown or orange in west. Abdominal somites laterally bright blue in east; abdominal spines white or pale blue in east, pale brown or cream in west. Tailfan spines usually white. Carpus of cheliped bright blue with white tipped spines in

east, green or brown with pale brown or orange spines in west. Propodus white with blue mesal area in east, pale brown, green or cream, often mottled, in west. Fingers white in east, cream or blue/green in west.

Body ventrally white and blue in east, brown, orange, green and cream in west. Carpus of cheliped mesally blue and laterally white in east, green and brown/orange in west. Propodus white with blue mesal edge and white spines in east, pale orange often mottled with cream in west. Fingers white in east, cream (often tinged green) in west.

Some eastern specimens (e.g., from Tarago drainage) with colour similar to that of western forms. Small specimens throughout range similarly green and brown.

Sexes: Males lack a cuticle partition. One female almost 40 OCL (OCL38.7 mm) has open gonopores. All available females >40 OCL except one (OCL41.9 mm) have open pores and many are berried. Female maturity appears to occur at sizes close to 40 mm OCL, with little variation in maturation size.

Distribution and biology. The species inhabits southerly flowing rivers of Victoria from the Bunyip/Tarago system in the east to the Gellibrand River of the Otway region in the west (Fig. 7) at elevations below 300 m a.s.l. Two museum specimens bear the site label of Kennedys Creek, a tributary of the Curdies River near Cobden, but Kennedys Creek is a tributary of the Gellibrand River and lies 20 km to the east of Curdies River. Vegetation in the species range includes dry sclerophyll forest and wattle (*Acacia* spp.), blackberry in semi-cleared areas and tree ferns (*Cyathea*) in some sheltered valleys. *Euastacus yarraensis* is present in some cleared areas, especially if vegetation persists along streams. The species is sometimes sympatric with *E. kershawi*. Berried females of *E. yarraensis* have been collected in September, October and November.

Remarks. Eastern specimens represent the "classic" condition of *E. yarraensis*. Specimens from the Yarra and Tarago drainages are usually vivid blue and white. Some variation is evident, however, as two specimens collected recently from Labertouche and Diamond Creeks, tributaries of the Tarago River near Warragul, were reddish brown, similar to the colours of Lerderderg and Otway specimens. Specimens from the Lerderderg and Werribee Rivers and the Otways are brown or brown/green. Compared to eastern crayfish, specimens from the Otways usually have smaller telsonic and ventral antennal spines, a slightly shorter antennal squame, bumpier dorsal surfaces of chelae, frequently a larger ventromesal carpal spine, more numerous spines above the cutting edges of chelae and frequently broader keel processes 3 and 4. Eastern specimens have gastric mill TAP counts of 5.5-7.0 and spreads of 5.0-6.5; Werribee and Lerderderg specimens, 4.0-4.5 and 3.0-3.5; Otway crayfish, 5.0-6.0 and 4.5-5.5. Tooth counts generally increase from the Werribee area to the east and west.

Larger specimens have been collected from eastern streams than from the west. Females from all sites mature at a similar size and the apparent size differences may be due to collecting bias. It is possible, however, that there is some geographical variation in maximum size.

The holotype of *E. yarraensis* was lodged in the British Museum (Natural History) but has been lost (Riek, 1969). The type locality is the Yarra River, Victoria.

Other species

Euastacus crassus Riek ranges into Victoria along the Victorian Alps from New South Wales and the Australian Capital Territory. *Euastacus crassus* can be distinguished from the small Victorian species (*E. woiwuru, E. bidawalus, E. neodiversus, E. diversus*) by its lack of a male cuticle partition. Very few specimens of *E. crassus* have been collected in Victoria.

An undescribed species of *Euastacus* ranges a few kilometres into Victoria from the southeast corner of New South Wales. Like *E. crassus*, the species lacks a male cuticle partition.

Euastacus crassus and *Euastacus* sp. nov. will be described in the New South Wales paper of this series (Morgan, in prep. b).

General remarks

Euastacus armatus, *E. bispinosus* and *E. kershawi* are spiny species attaining sizes in excess of 100 mm OCL. *Euastacus bidawalus*, *E. diversus* and *E. neodiversus* are less spiny species, possibly not exceeding 50 mm OCL. *Euastacus yarraensis* and *E. woiwuru* are intermediate in size between the above groups; *E. yarraensis* is a spiny species, *E. woiwuru* relatively poorly spined.

Euastacus armatus and *E. yarraensis* are similar species, distinguishable in spination of the abdomen, telson and great chela, rostral shape and gastric mill condition. These species are readily distinguished from *E. bispinosus* by the shape of thoracic and abdominal spines and development of the abdominal boss. *Euastacus kershawi* differs from the other spiny species in possessing a male cuticle partition.

Euastacus bidawalus and *E. diversus* are distinguished from *E. woiwuru* and *E. neodiversus* by the extent of dactylar spination. *Euastacus diversus* is readily recognised by its squamal spination. *Euastacus woiwuru* is a variable species but is distinguishable from *E. neodiversus* in spination of the chela and thorax.

The species-pairs *E. woiwuru-E. neodiversus* and *E. bidawalus-E. diversus* may be considered "species complexes" as defined by Mayr (1969: 47). Phylogenetic relationships within the genus *Euastacus* can be discussed only when all species are described adequately (Morgan, in prep. a, b).

Acknowledgements

I thank Drs G.C.B. Poore and P.S. Lake and Professors H.H. Hobbs, Jr and W. D. Williams for invaluable advice in the course of this study and preparation of the manuscript. The following curators generously made available loan material from their institutions – Dr Poore (Museum of Victoria) and Dr J.K. Lowry (Australian Museum). Mr D. Ross (Cunningham Laboratories, CSIRO) contributed much assistance in the computer analysis of data. Ms S.J. Harders assisted in extensive collection of material.

The study was supported in part by a grant from the Australian Museum. During the course of the study, I received a Commonwealth Post-Graduate Research Allowance. Sampling permits were provided by Victorian National Parks and Fisheries and Wildlife Services.

References

Clark, E., 1936. The freshwater and land crayfishes of Australia. *Mem. natn. Mus. Vict.* 10: 5-58.

Clark, E., 1937a. The freshwater crayfishes and yabbies of Victoria. *Victorian Yearbook 1936-1937*: 33-8.

Clark, E., 1937b. The life history of the Gippsland crayfish. *Aust. Mus. Mag.* 6: 186-92.

Clark, E., 1941. Revision of the genus *Euastacus* (crayfishes, family Parastacidae) with notes on the distribution of certain species. *Mem. natn. Mus. Vict.* 12: 7-30.

Clark, E. & Burnet, F.M., 1942. The application of serological methods to the study of the Crustacea. *Aust. J. exptl Biol. med. Sci.* 20: 89-95.

Eades, D.K., 1976. *The Dharawal and Dhurga languages of the New South Wales south coast. Research and Regional Studies 8.* Australian Institute of Aboriginal Studies: Canberra. 97 pp.

Faxon, W., 1898. Observations on the Astacidae in the United States National Museum and in the Museum of Comparative Zoology, with descriptions of new species. *Proc. U.S. nat. Mus.* 12: 619-34.

Faxon, W., 1914. Notes on the crayfishes in the United States National Museum and the Museum of Comparative Zoology, with descriptions of new species and subspecies. *Mem. Mus. comp. Zool. Harv.* 40: 351-427.

Fitzpatrick, J.F., 1977. The statistical relationships of different techniques of measurements in a crayfish species. Pp. 471-9 in Lindqvist, O.V., (ed.) *Freshwater Crayfish vol. 3.* University of Kuopio: Finland.

Forskål, P., 1775. *Descriptiones animalium, avium, amphibiorum, piscium, insectorum, vermium; quae itinere Orientali observavit P.F. Post mortum auctoris edidit C. Niebuhr. Adjuncta est Materia Media Kahirina atque tabula Maris Rubri geographica.* Hauniae. 164 pp.

Francois, D.D., 1960. Freshwater crayfishes. *Aust. Mus. Mag.* 13: 217-21.

Francois, D.D., 1962. *A revision of the Australian freshwater crayfish genus* Euastacus *(Decapoda, Parastacidae).* Ph.D. thesis, Cornell University.

Hale, H.M., 1927. *The crustaceans of South Australia, Part I.* Government Printer: Adelaide. 201 pp.

Haswell, W.A., 1882. *Catalogue of the Australian stalk- and sessile-eyed Crustacea.* Australian Museum: Sydney. 324 pp.

Heller, C., 1865. Crustacea. *Reise "Novara"* 2: 100-4.

Hercus, L.A., 1969. *The languages of Victoria. A late survey, Parts I and II. Linguistic Series 6.* Australian Institute of Aboriginal Studies: Canberra. 210 pp.

Hobbs, H.H., Jr, 1974. Synopsis of the families and genera of crayfishes (Crustacea: Decapoda). *Smithson. Contr. Zool.* 164: 1-32.

Huxley, T.H., 1878. On the classification and the distribution of the crayfishes. *Proc. zool. Soc. Lond.* 1878: 752-88.

Huxley, T.H., 1880. *The crayfish. An introduction to the study of zoology.* International Science Series 28. 371 pp.

Johnson, H.T., 1974. Biological information on *Euastacus armatus. New South Wales State Fisheries pamphlet, File* 73/2270.

Kaires, R., 1980. Observation on the physiology of the freshwater crayfish *Euastacus armatus* and *Cherax destructor. Aust. Soc. Limnol. Newsl.* 18: 13.

Kane, J., 1964. *Australian freshwater Malacostraca and their epizoic fauna.* M.Sc. thesis, University of Melbourne.

Mayr, E., 1969. *Principles of systematic zoology.* McGraw-Hill: New York. 428 pp.

McCoy, F., 1867. Recent zoology and paleontology of Victoria. *Ann. Mag. nat. Hist. (3)* 20: 189.

McCoy, F., 1878. *Astacoides serratus* (Shaw sp.). *Prodromus Zool. Vict.* 1: 17-18, pl. 15.

McCoy, F., 1888. *Astacopsis serratus* (Shaw sp.) var. *yarraensis. Prodromus Zool. Vict.* 2: 225-7, pl. 16.

McCulloch, A.R., 1917. Studies in Australian Crustacea, 4. *Rec. Aust. Mus.* 11: 231-8.

Monroe, R., 1977. A new species of *Euastacus* (Decapoda: Parastacidae) from north Queensland. *Mem. Qd Mus.* 18: 65-7.

Morgan, G.J., in prep. a. Freshwater crayfish of the genus *Euastacus* Clark (Decapoda, Parastacidae) from Queensland.

Morgan, G.J., in prep. b. Freshwater crayfish of the genus *Euastacus* Clark (Decapoda, Parastacidae) from New South Wales.

Ortmann, A.E., 1902. The geographical distribution of freshwater decapods and its bearing upon ancient geography. *Proc. Am. phil. Soc.* 41: 267-400.

Patak, A. & Baldwin, J., 1984. Electrophoretic and immunochemical comparisons of haemocyanins from Australian fresh-water crayfish (family Parastacidae): phylogenetic implications. *J. crust. Biol.* 4: 528-35.

Riek, E.F., 1951. The freshwater crayfish (family Parastacidae) of Queensland, with an appendix describing other Australian species. *Rec. Aust. Mus.* 22: 368-88.

Riek, E.F., 1956. Additions to the Australian freshwater crayfish. *Rec. Aust. Mus.* 24: 1-6.

Riek, E.F., 1969. The Australian freshwater crayfish (Crustacea: Decapoda: Parastacidae), with descriptions of new species. *Aust. J. Zool.* 17: 855-918.

Riek, E.F., 1972. The phylogeny of the Parastacidae (Crustacea: Astacoidea), and description of a new genus of Australian freshwater crayfishes. *Aust. J. Zool.* 20: 369-89.

Schenk, E.T. & McMasters, J.H., 1956. *Procedure in taxonomy.* Stanford University Press: Stanford. 119 pp.

Shaw, G., 1794. *Zoology of New Holland* 1: 21, pl. 8.

Smith, G., 1912. The freshwater crayfishes of Australia. *Proc. zool. Soc. Lond.* 1912: 144-71.

Spence-Bate, C., 1888. Report on the Crustacea Macrura collected by H.M.S. Challenger during the years 1873-76. *Rep. scient. Results. explor. Voyage Challenger* 24: i-xc, 1-942, pls. 1-148.

Turvey, S.P., 1980. *Aspects of the biology of the freshwater crayfish* Euastacus spinifer *(Heller) (Decapoda: Parastacidae).* M.Sc. thesis, University of Sydney.

von Martens, E., 1866. On a new species of *Astacus. Ann. Mag. nat. Hist. (3)* 17: 359-60.

von Martens, E., 1868. Übrblick der neuholländischen Flusskrebse. *Monats. Akad. Wiss., Berlin* 1868: 615-19.

Watson, K., 1935. A new *Astacopsis* from north Queensland. *Mem. Qd Mus.* 10: 232-5.

Watson, K., 1936. *Astacopsis fleckeri. Mem. Qd Mus.* 11: 52.

Zeidler, W., 1982. South Australian freshwater crayfish. *S. Aust. Nat.* 56: 36-43.

Memoirs of the Museum of Victoria 47(1): 59-73 (1986) ISSN 0814-1827

NEW SPECIES OF *AENIGMATHURA* AND *PSEUDANTHURA* (CRUSTACEA: ISOPODA: PARANTHURIDAE) FROM EASTERN AUSTRALIA

By Gary C.B. Poore and Helen M. Lew Ton

Department of Crustacea, Museum of Victoria, Swanston Street, Melbourne, Victoria 3000, Australia

Abstract

Poore, G.C.B. and Lew Ton, H.M., 1986. New species of *Aenigmathura* and *Pseudanthura* (Crustacea: Isopoda: Paranthuridae) from eastern Australia. *Mem. Mus. Vict.* 47:59-73.

Aenigmathura calliandra and *A. helicia* from coral reefs in north-eastern Australia and *Pseudanthura baeckea* from the central New South Wales shelf are described. A key to species of *Pseudanthura* is presented and some comments on generic relationships within the Paranthuridae are given.

Introduction

In previous papers (Poore, 1978, 1981, 1984a) species of eight paranthurid genera from eastern Australia were described. These are *Accalathura* Barnard, *Aenigmathura* Thomson, *Bullowanthura* Poore, *Colanthura* Richardson, *Cruranthura* Thomson, *Leptanthura* Sars, *Paranthura* Bate & Westwood and *Ulakanthura* Poore. Here, new species of *Aenigmathura* and one of *Pseudanthura* Richardson are considered. Examination of new species of these previously poorly known genera provides an opportunity for discussion of their relationships to each other and to other paranthurid genera.

Following a pattern established by Poore (1984a) specific epithets are taken from genera of the Australian flora and reflect the floral implication of the anthurid genus names. The following abbreviations are used in the figures: MD, mandible; MP, maxilliped; P1-P7, pereopods 1-7; PL1-PL5, pleopods 1-5; U, uropod; UN, uropodal endopod; UX, uropodal exopod; T, telson. Figured specimens of each species are individually labelled a (the holotype), b, c and d. Figures not so labelled are from the holotype. Scale lines are 1 mm and refer to the habitus figures only.

Material for this study is lodged in the Australian Museum, Sydney (AM), the Queensland Museum, Brisbane (QM) and the Museum of Victoria, Melbourne (NMV).

Comments on relationships of some genera of the Paranthuridae

In a revision of the Paranthuridae Poore (1980) treated *Pseudanthura* and *Aenigmathura*, together with *Paranthura* and *Calathura*, as a group of probably unrelated genera. In the light of this study and other recent work (Poore, 1984b) their relationships can now be explored more profitably.

Wägele (1981) regarded *Paranthura* as the genus most closely related to *Colanthura* and *Cruregens*. This view was supported by Poore (1984b) who used *Paranthura* as an outgroup for a cladistic analysis of *Colanthura, Cruranthura, Califanthura* and *Cruregens*, genera with only six pairs of pereopods. *Paranthura* shares with the *Colanthura* group of genera four apomorphies:

1. Pereopod 1 article 6 palm lacking marginal spines;
2. Pereopod 1 with a closely-packed row of mesial setae;
3. Pereopod 1 article 6 cutting edge mesial to thumb; and
4. Antenna 2, flagellum of a single (or short fused) articles.

Accalathura (together with its junior synonym *Zulanthura*) (Kensley, 1982a) can be placed with *Aenigmathura, Calathura* and *Pseudanthura* in a group of genera which differ from other clearly defined groups of genera and

themselves share several features. All possess an elongate tapering maxillipedal endite and an elongate comb of setae on a long third mandibular palp article. The mandibular setal comb is an apomorphic character (few apical setae such as are seen in *Leptanthura*, for example, is the plesiomorphic state). The state of the endite is less clear. While the presence of an endite must be considered more plesiomorphic than its loss (e.g., in *Leptanthura*) the peculiar form seen in these genera might be considered an apomorphy linking them. The actual state of the primitive anthuridean maxilliped remains unresolved. If the primitive state is such as found in *Austranthura* Kussakin the *Accalathura* form is apomorphic and links the four genera.

Accalathura, with more than 20 species, is the largest and most widely distributed genus. Species are found in the Indo-west Pacific from Japan to Australia and Antarctica and west to the Maldive Islands, and on the Atlantic coast of North America. *Pseudanthura* is a deep-water genus, occurring on the outer continental shelf and upper slope of the Atlantic Ocean, and also in the Indo-west Pacific. *Calathura* and *Aenigmathura* are more restricted, the former being found in the North Atlantic and Arctic Oceans, and the latter around Australia only.

Relationships between the four genera are not clear because both *Aenigmathura* and *Pseudanthura* are so highly specialised. *Accalathura* and *Calathura* are similar, differing primarily in the number of articles in the maxillipedal palp. *Aenigmathura* shares with these two (and differs from *Pseudanthura)*: a clear suture between the fourth and fifth articles of the maxillipedal palp (the first palp article, article 3, may not be separate); a prominent proximal thumb on pereopods 1-3; and a short uropodal endopod.

Pseudanthura shares with *Accalathura* and *Calathura* a multiarticulate antenna 1 flagellum, an apomorphic feature. *Aenigmathura* and *Pseudanthura* themselves share fused pleonites 1-5 and fused telson and pleonite 6 but the similarity here could well be superficial and convergent.

Aenigmathura Thomson, 1950

Type species. Aenigmathura lactanea Thomson.

Remarks. Poore's (1981) generic description requires little expansion to accommodate the two new species described here.

Antenna 1 has a flagellum of 4-6 articles. (Poore (1981) figured 4 articles, not 3 as stated). Antenna 2 has a flagellum of 2-5 articles. Pereopods 1-3 are subchelate, article 6 swollen and with a well developed proximal thumb bearing 2 complex spines. Its palm is complexly grooved and rolled mesially and bears lateral and mesial rows of submarginal setae. Scanning-electron-micrographs of the palm of pereopod 1 of a specimen of *A. lactanea* from Western Port, Victoria, illustrate these features, the fused telson and the statocyst pore (Plate 1).

Aenigmathura calliandra sp. nov.

Figures 1-4

Material examined. 3 males, 1 female, 12 juveniles; 4.5-10.8 mm.

Holotype: juvenile, 10.8 mm, QM W8108 (with one slide). Coral Sea, Long Island, Chesterfield Reefs (19°52.2'S., 158°19.2'E.), 15 m, SCUBA, N.L. Bruce, 6 May 1979.

Paratypes: Coral Sea, Long Island, Chesterfield Reefs; type locality, QM W11738 (1 specimen) (with one slide), QM W11740(1), QM W11739(5), NMV J10503(1), NMV J10504(1); reef edge, 2 m, QM W11741(1), QM W11742(1). Cay north of Long Island, Chesterfield Reefs (19°48'S., 158°17'E.), QM W8109(2).

Other material: Coral Sea, Long Island, Chesterfield Reefs, QM W8105(1), QM W11743(1).

Description. Juvenile. Head as wide as long, rostrum about half length of lateral lobes. Pleon a little longer than wide, pleonites with a few long setae on posterior margins. Combined length of pleonite 6 and telson about 1.6 times as long as greatest width, lateral margins of telson parallel over most of its length, apex gently rounded, with long marginal and submarginal setae, a few scattered setae dorsally.

Antenna 1 article 2 with a row of about 6 long setae, article 3 with 2 groups of long setae, flagellum of 5 articles. Antenna 2 flagellum short, of 4 articles. Mandibular palp of 3 articles, article 2 the longest and with single distal seta, article 3 with comb of 7 setae. Maxillipedal palp of 2 articles; article 1 with 2 mesial setae; article 2 with lateral and mesial setae

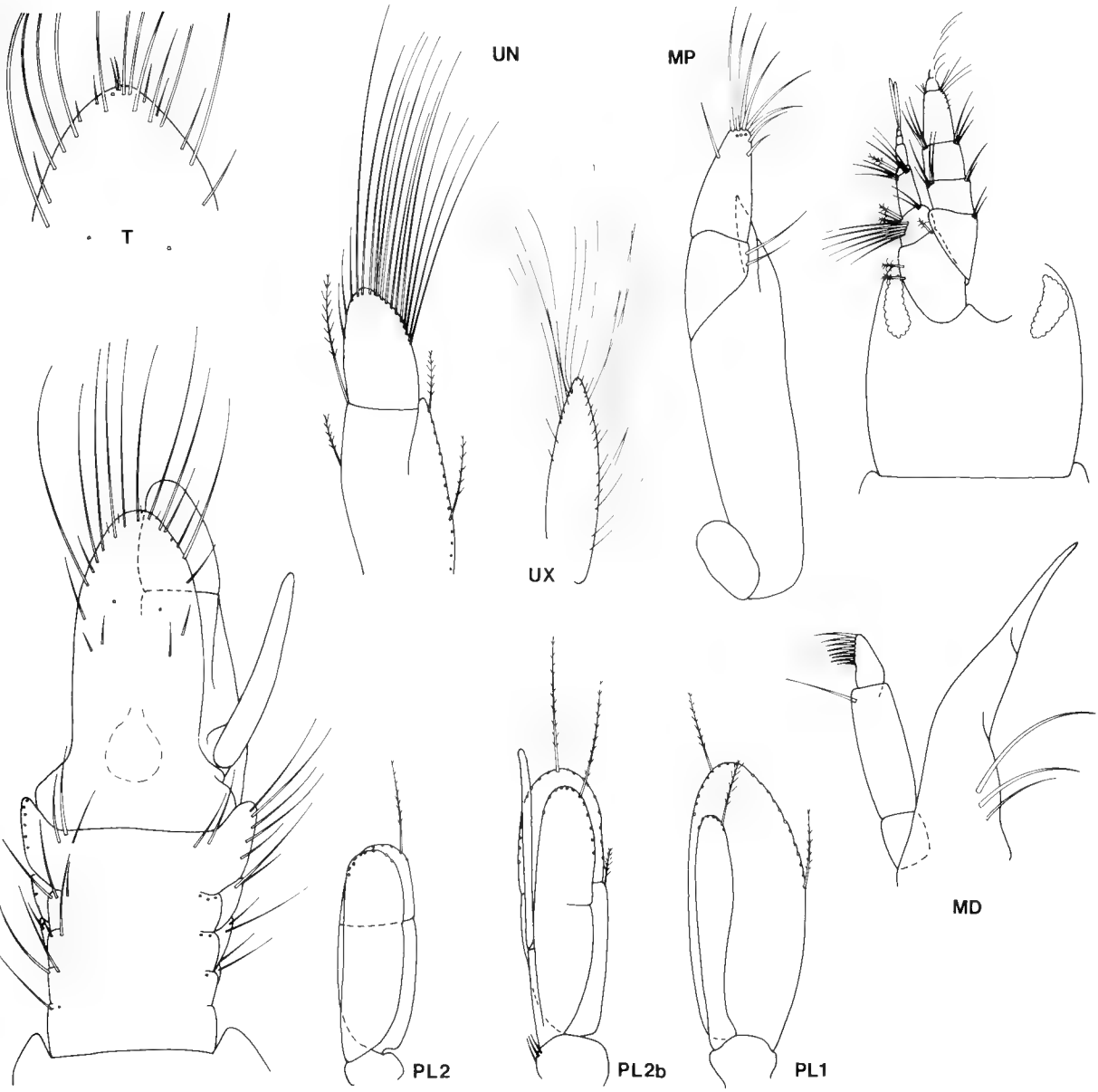


Figure 1. *Aenigmathura calliandra*. Holotype juvenile; b, paratype male, 6.4 mm, QM W11738.

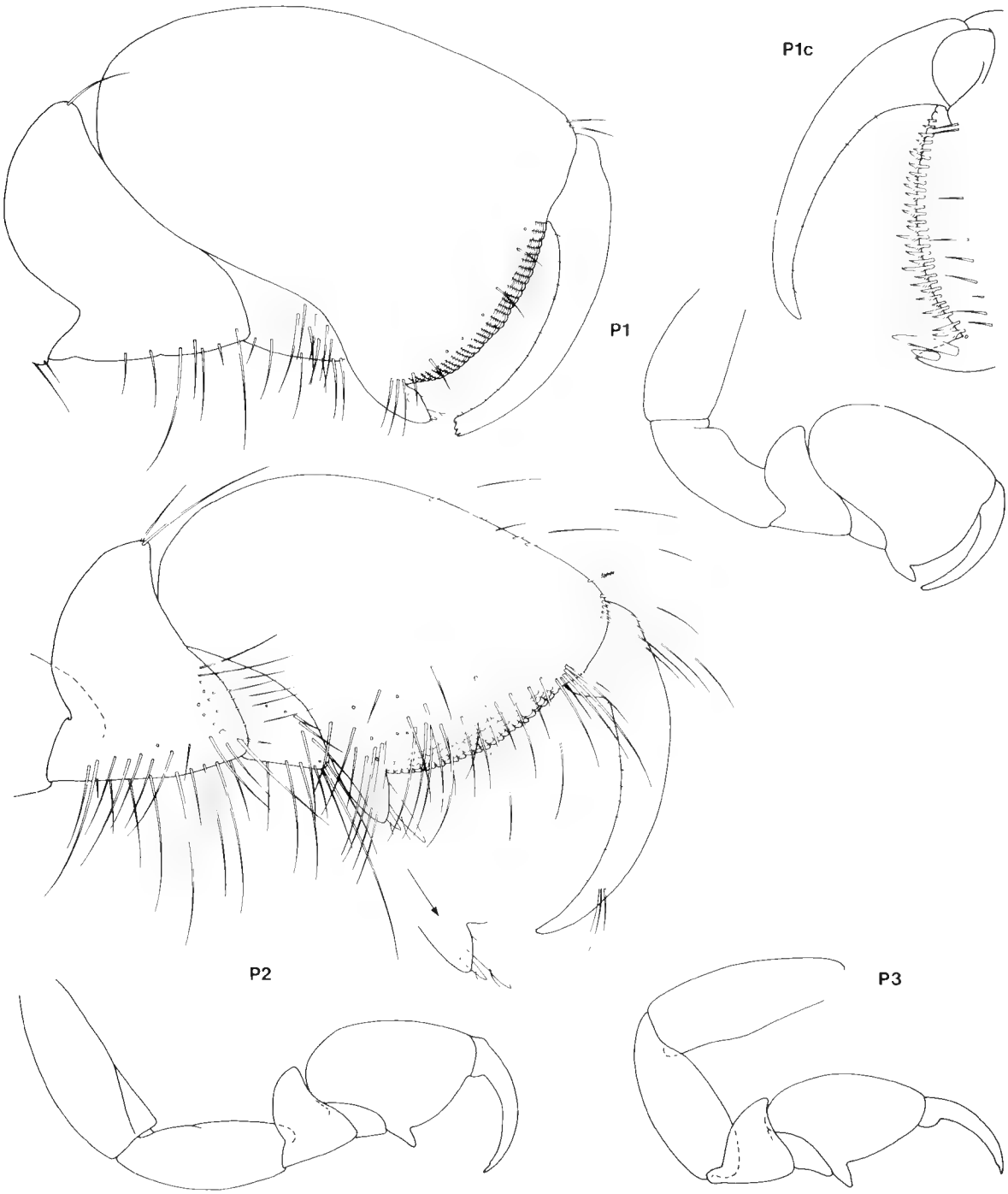


Figure 2. *Aenigmathura calliandra*. Holotype juvenile; c, pereopod 1 palm, lateral view.

Figure 3. *Aenigmathura calliandra*. Holotype juvenile; b, paratype male, 6.4 mm, QM W11738.

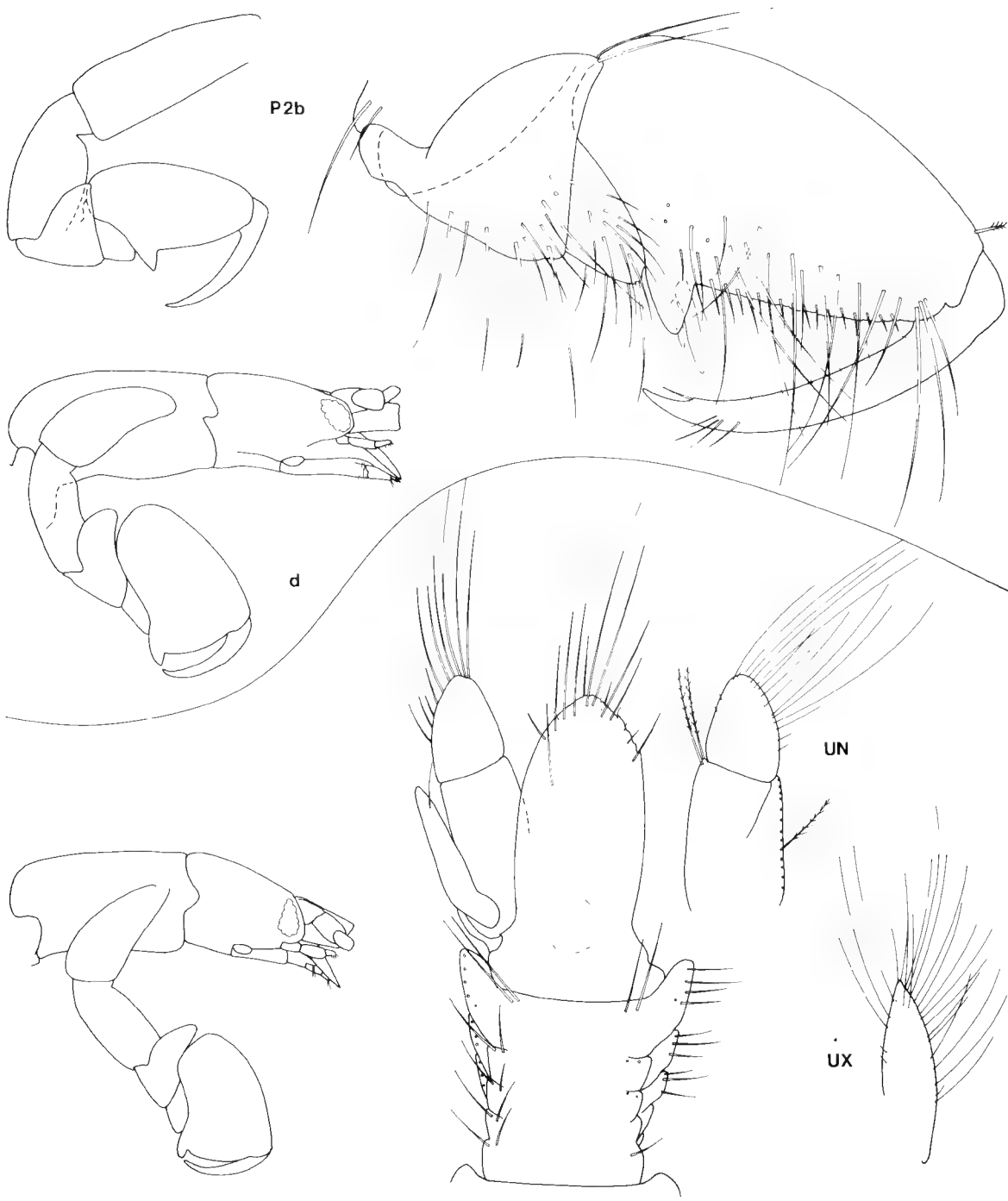


Figure 4. Top half: *Aenigmathura calliandra*. Holotype juvenile; b, paratype male, 6.4 mm, QM W11738. d, female 8.2 mm, QM W11741. Bottom half: *Aenigmathura helica*. Holotype juvenile.

distally, long terminal setae; endite reaching to half way along article 2.

Pereopod 1 article 5 with distal setae on mesial face; article 6 longer than article 2, palm oblique (60°). Pereopods 2 and 3 smaller than pereopod 1; articles 4 and 5 with setae on posterior and distal margins; article 6 palm oblique (35°-45°). Pereopods 4-7 article 5 with 3-4 spines on posterior margin; article 6 with 4-5 spines. Pereopod 4 article 6 length 3 times width.

Uropodal endopod reaching beyond apex of telson, 1.7 times as long as base width, distally with long marginal setae; exopod lanceolate, 4 times as long as greatest width, with long marginal setae.

Male. Antenna 1 flagellum of about 12 articles, all with whorls of aesthetases. Pereopod 1 palm oblique (45°) with dense setae mesially. Pereopods 2, 3 similar to juvenile but palm oblique (5°-10°) and with many mesial setae on article 6. Pereopods 4-7 more elongate. Appendix masculina a simple rod, exceeding apex of exopod of pleopod 2.

Colour. White

Distribution. Coral Sea Territory, Chesterfield Reefs, 2-15 m.

Remarks. Aenigmathura calliandra closely resembles *A. helicia.* Characters useful in the separation of the two species and *A. lactanea* are given after the description of *A. helicia.*

Aenigmathura helicia sp. nov.

Figures 4-7

Material examined. 1 male, 5 juveniles; 5.7-8.5 mm.

Holotype: juvenile, 8.6 mm, NMV J10505 (with one slide). Qld, Lizard Island (14°40'S., 145°28'E.), 8 m, B. Kensley, 11 Jan 1982, (stn BK-126).

Paratypes: Qld, Lizard Island, type locality, QM W11755(2 specimens); Lizard Island, other B. Kensley collections: BK-122, NMV J10506(1 male) (with one slide), NMV J10507(1 male); BK-130, NMV J10508(1); BK-115, NMV J10509(1); BK-125, NMV J10510(1).

Description. Juvenile. As described for *A. calliandra* except: head a little wider than long; antenna 1 article 2 with a row of 4 long setae; antenna 2 flagellum of 5 articles; maxillipedal endite reaching one-quarter way along article 2; pereopods 2 and 3, article 6 palm oblique (25-45°); pereopod 4 article 6 2.5 times as long as wide; uropodal endopod 1.5 times as long as basal width.

Male. Antenna 1 flagellum of about 12 articles, each bearing whorls of aesthetases. Pereopod 1 article 6 palm oblique (45°), with many mesial setae. Pereopod 2, 3 article 5 produced posteriorly, forming a thumb; article 6 palm axial, slightly sinuous with a pronounced 'step' proximally, complex spines absent. Pereopods 4-7 more elongate. Appendix masculina a simple rod, exceeding endopod but not reaching apex of exopod of pleopod 2.

Colour. White.

Distribution. Queensland, Lizard Island, 1-8 m.

Remarks. Aenigmathura helicia and *A. calliandra* differ from *A. lactanea* in the shapes of pereopods 1-3 and male pereopods 2 and 3. The most obvious differences between *A. helicia* and *A. calliandra* are in males. Males of *A. helicia* have modified pereopods 2 and 3, whereas in *A. calliandra* the juvenile shape is retained. The appendix masculina of *A. helicia* does not reach the apex of the pleopodal endopod, whereas in *A. calliandra* it exceeds it. Juveniles are difficult to tell apart and can be most easily separated by differences in relative size of pereopod 1. Figure 4 has comparative lateral views of similarly sized animals drawn to the same scale. The proportions of articles of pereopod 4 also differ slightly.

The species do not overlap geographically.

Pseudanthura Richardson, 1911

Description. Paranthuridae without eyes. Head with small upturned rostrum, strong transverse dorsal groove and distinct ocular bulges. Pereon with dorsolateral grooves. Pereonite 7 no more than one-third length of pereonite 6. Pleonites and telson fused, pleonites 1-5 distinguished by shallow grooves. Telson triangular, slightly domed and without long terminal setae; statocyst absent. Peduncle of uropod inserting on ventral surface of pleonite 6; endopod lying beneath telson, exopod only visible dorsally reduced, lanceolate, no longer than peduncle. Antenna 1 flagellum shorter than peduncle, of

Key to species of *Pseudanthura*

1. Pereonite 6 as long as wide; pereonite 7 less than one-third as long as wide; pleon swollen anteriorly. Pleopod 1 endopod almost as long as exopod and with many marginal setae 2
– Pereonite 6 greater than 1.5 times as long as wide; pereonite 7 more than half as long as wide; pleon narrowest anteriorly. Pleopod 1 endopod at most half as long as exopod and with no more than 2 terminal setae . 3

2. Pereonite 1 with a strong midventral crest; pereopod 1 palm concave. Uropodal exopod reaching to base of endopod; telson margins straight . . . . . *P. recifensis*
– Pereonite 1 without midventral crest; pereopod 1 palm slightly convex or straight. Uropodal exopod not reaching to base of endopod; telson margins sinuous . . . . . *P. albatrossae*

3. Suture between uropodal endopod and peduncle distinct; pleopod 1 endopod half as long as exopod . . . . . *P. baeckea*
– Suture between uropodal endopod and peduncle indistinct or absent; pleopod 1 endopod at most one-third as long as exopod 4

4. Body 18 times as long as wide; pleopod 1 endopod with 1 terminal seta, uropodal exopod one-quarter total length of uropod . . . . . *P. tenuis*
– Body 11 times as long as wide; pleopod 1 endopod with 2 terminal setae; uropodal endopod one-sixth total length of uropod . . . . *P. lateralis*

7-9 articles. Antenna 2 flagellum shorter than last 2 peduncular articles, tapering, of about 10 articles. Mandible with an acute incisor, its palp of 3 articles, the last bearing a comb of 10-15 setae. Maxilla a sharp, barely serrate spine. Maxilliped elongate, with an endite; palp of 2-4 articles. Pereopod 1 subchelate, palm oblique with shallow grooves along its length; dactyl with shallow grooves along its posterior margin. Pereopods 2 and 3 article 6 barely more swollen than in posterior pereopods. Pereopods 4-7 with article 5 rectangular; pleopod 1 exopod operculiform, apex acute; endopod reduced.

Adult male. Flagellum of antenna 1 of 8-12 articles, proximal articles only with whorls of aesthetascs. Pereopod 1 with dense setae on mesial face of articles 4, 5 and 6. Pereopods 2-7 more slender than in juvenile. Pleopod 2, appendix masculina, extending well beyond endopod, curved.

Type species. Pseudanthura lateralis Richardson.

Remarks. Pseudanthura is a clearly defined genus of five species. Kensley (1978) described the genus as having 4 segments in the maxilliped but figured *P. tenuis* and *P. albatrossae* with 5 articles (Kensley, 1978) and *P. recifensis* with 6 articles (Kensley, 1982b).

The species do in fact differ in the degree of fusion of maxillipedal palp articles. In *P. baeckea* sp. nov. the first two articles of the primitive palp are fused as are the last three, that is, there are two palp articles. In *P. recifensis* only the last two palp articles are fused, that is, four are visible. Poore (1978) noted variation in the number of visible maxillipedal articles in *Leptanthura* and suggested that in the Paranthuridae over-reliance on this character was perhaps not warranted. *Pseudanthura*, like *Leptanthura*, is otherwise fairly homogeneous despite this variation in the number of maxilliped articles.

Within *Pseudanthura* it is possible to discern two groups of species, which are clearly sepa-

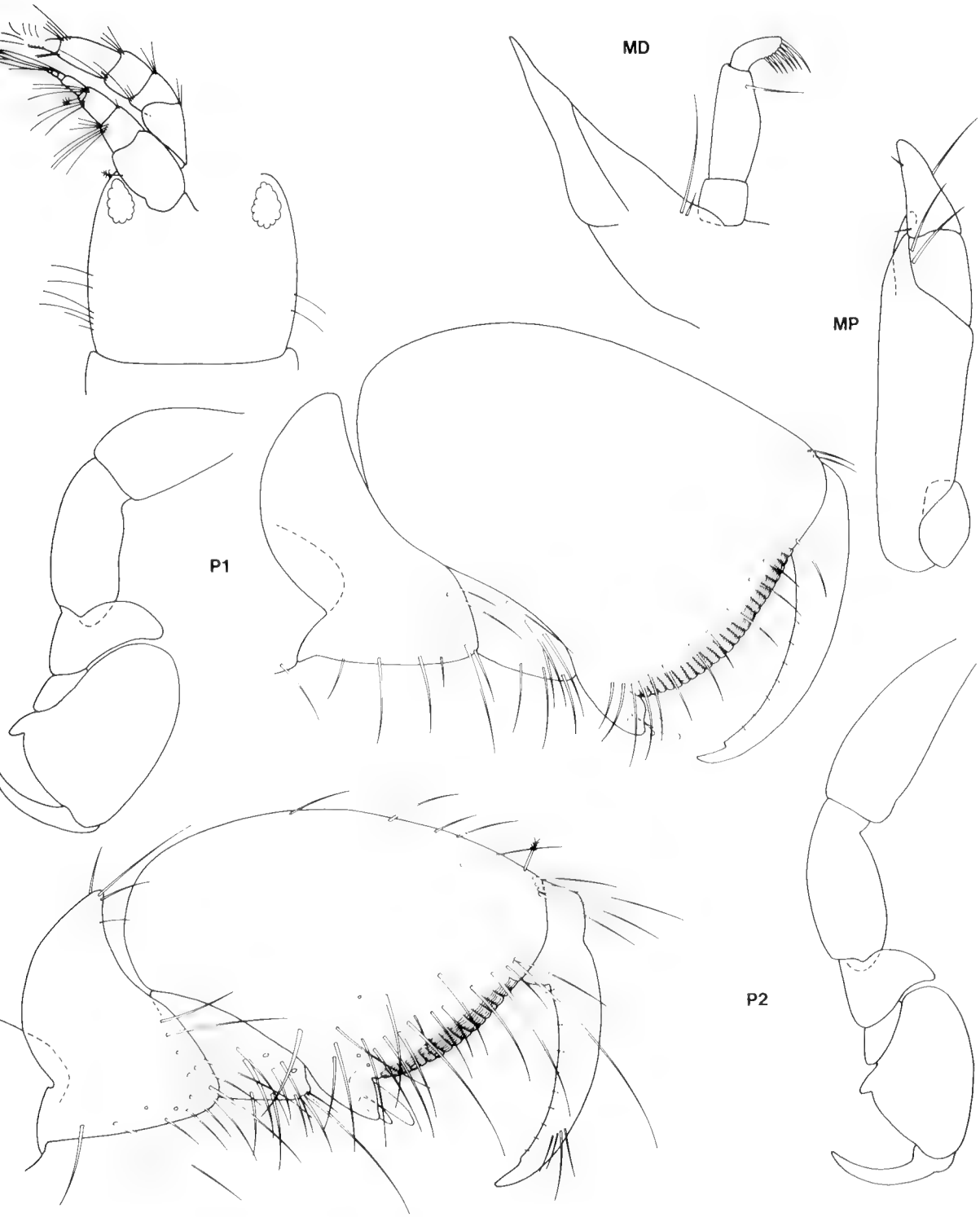


Figure 5. *Aenigmathura helica*. Holotype juvenile.

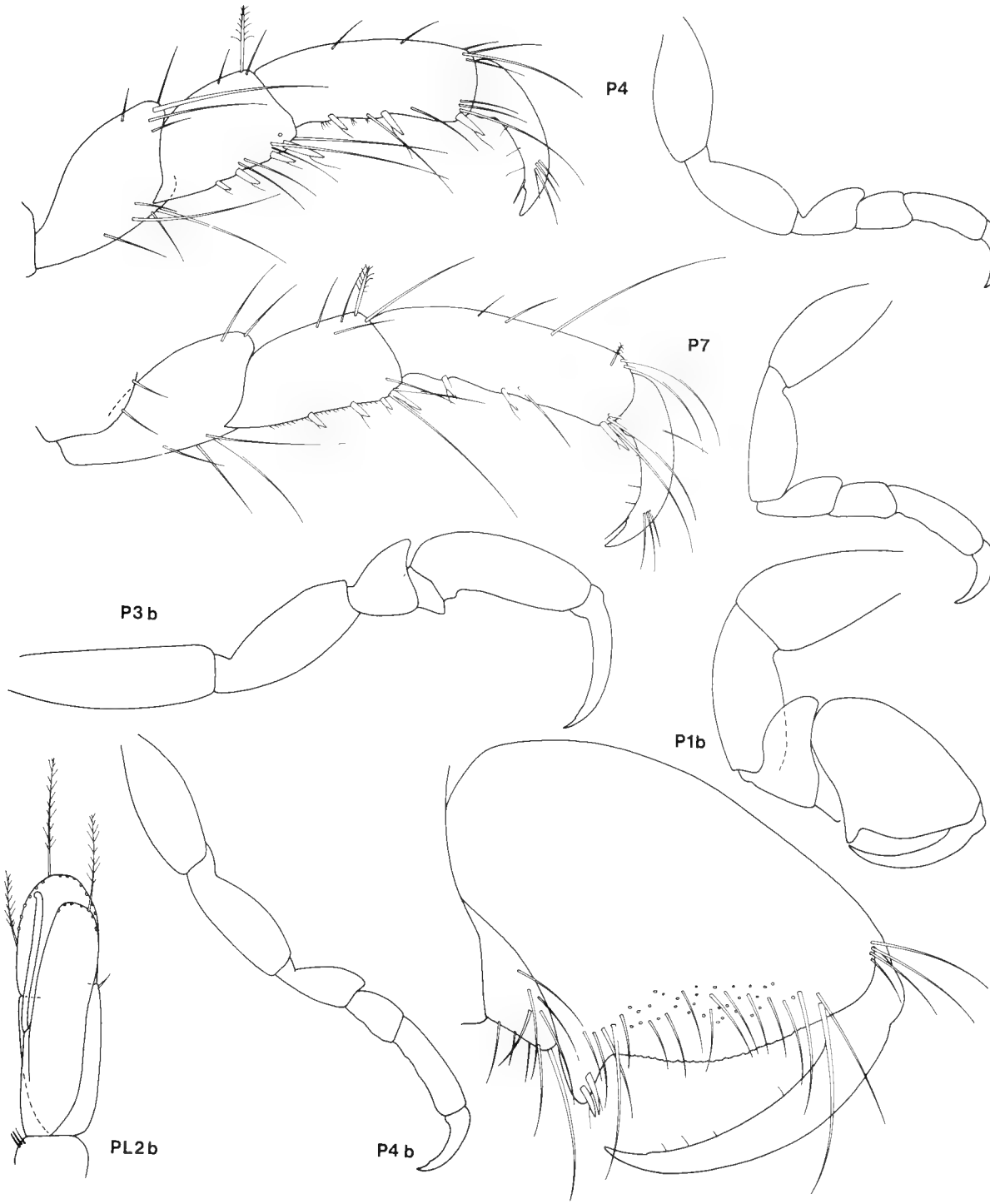


Figure 6. *Aenigmathura helica*. Holotype juvenile; b, male, 8.0 mm, NMV J10506.

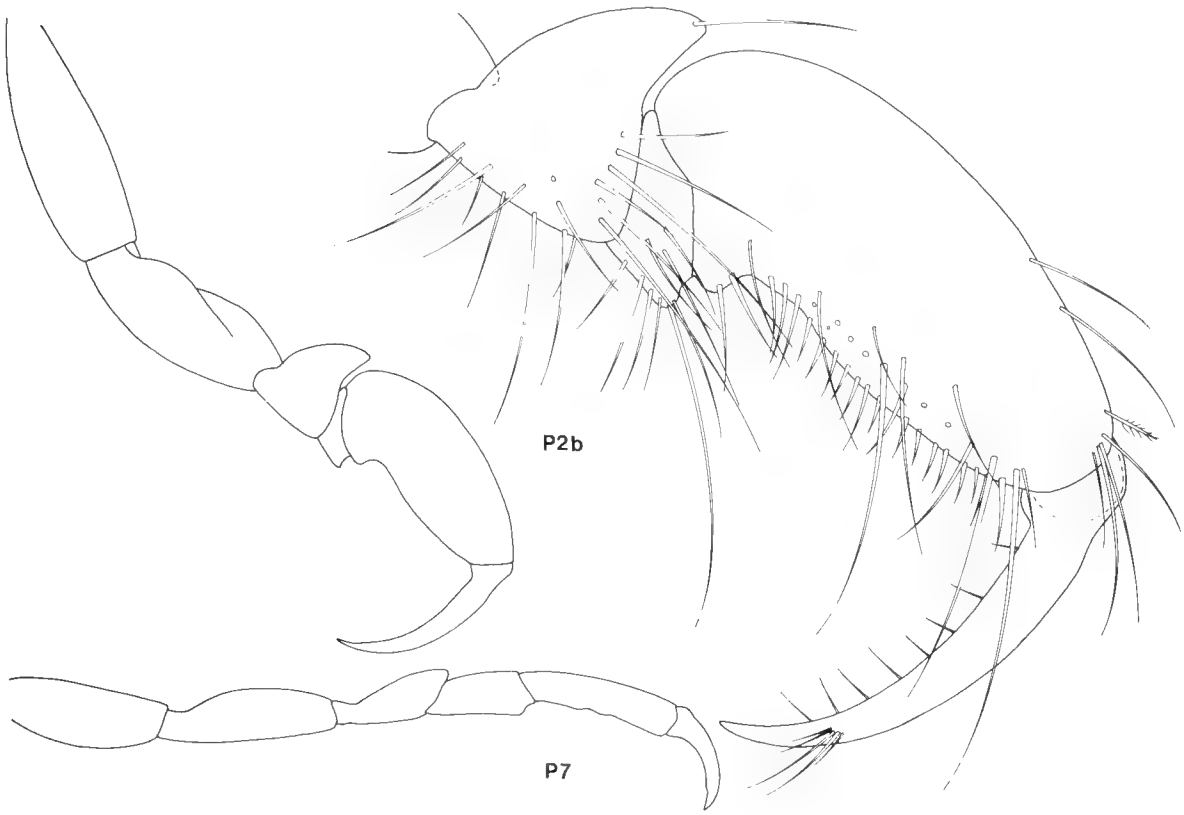


Figure 7. *Aenigmathura helica*. Holotype juvenile; b, male, 8.0 mm, NMV J10506.

rated by the characters used in the first couplet of the key. However, there is no biogeographic evidence to support the idea of two centres of speciation within the genus.

Pseudanthura baeckea sp. nov.

Figures 8-10

Material examined. 2 males, 3 juveniles, 8.0-10.1 mm.

Holotype: juvenile, 10.1 mm, AM P35248 (with one slide). NSW, off Broken Bay, 910 m, (33°31′S., 152°08′E.), NSW State Fisheries on FV 'Kapala', 10 Dec 1980 (stn K80-20-08).

Paratypes: N.S.W.; type locality, NMV J10501(1 specimen); off Broken Bay, 900-920 m, (stn K80-20-09), AM P35249(1 male) (with one slide), NMV J10502(1); off Port Jackson, 79 m, (stn K80-20-11), AM P32651(1).

Description. Juvenile. Body 11 times as long as wide; pereonite 7 half as long as wide; pleotelson longer than pereonite 6. Head as long as wide. Antenna 1 flagellum of 7 articles, shorter than combined length of last 2 articles of peduncle. Antenna 2 flagellum of about 10 articles, as long as fifth article of peduncle.

Mandibular palp articles 2 and 3 subequal; articles 1 and 2 each with distal seta, article 3 with comb of about 14 setae. Maxilliped palp of 2 articles; article 1 with mesial setae distally, article 2 with terminal setae; endite reaching half-way along first palp article.

Pereopod 1 article 5 with small group of setae on both mesial and lateral faces; article 6 palm convex with mesial row of submarginal setae, lateral face with proximal submarginal row of stout setae. Pereopod 2 article 6 with 6 posterior spines; pereopod 3 similar. Pereopods 4-6 of similar size, article 5 with 2 and article 6 with 3-4 spines on posterior margin. Pereopod 7 shorter

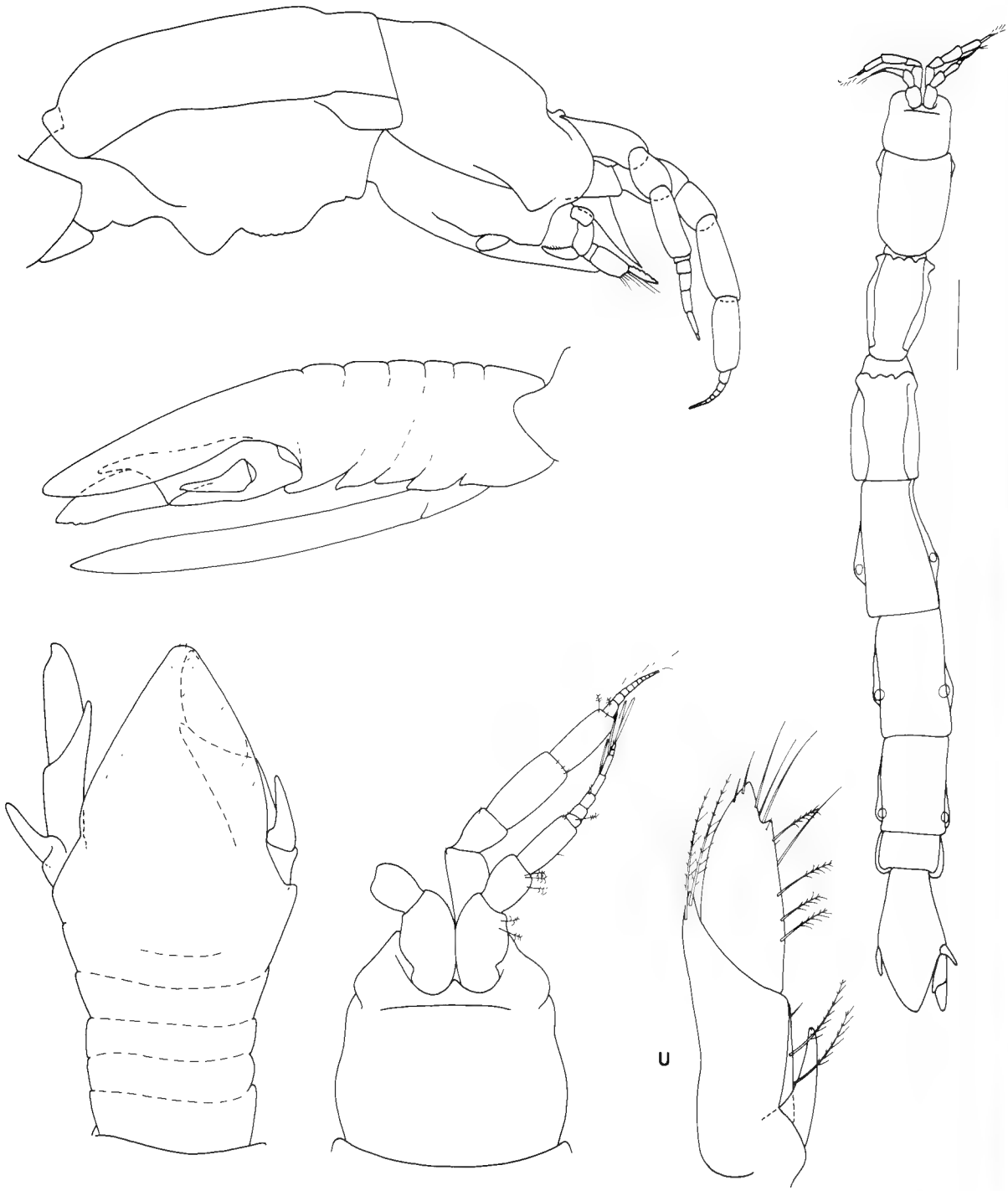


Figure 8. *Pseudanthura baeckea*. Holotype juvenile.

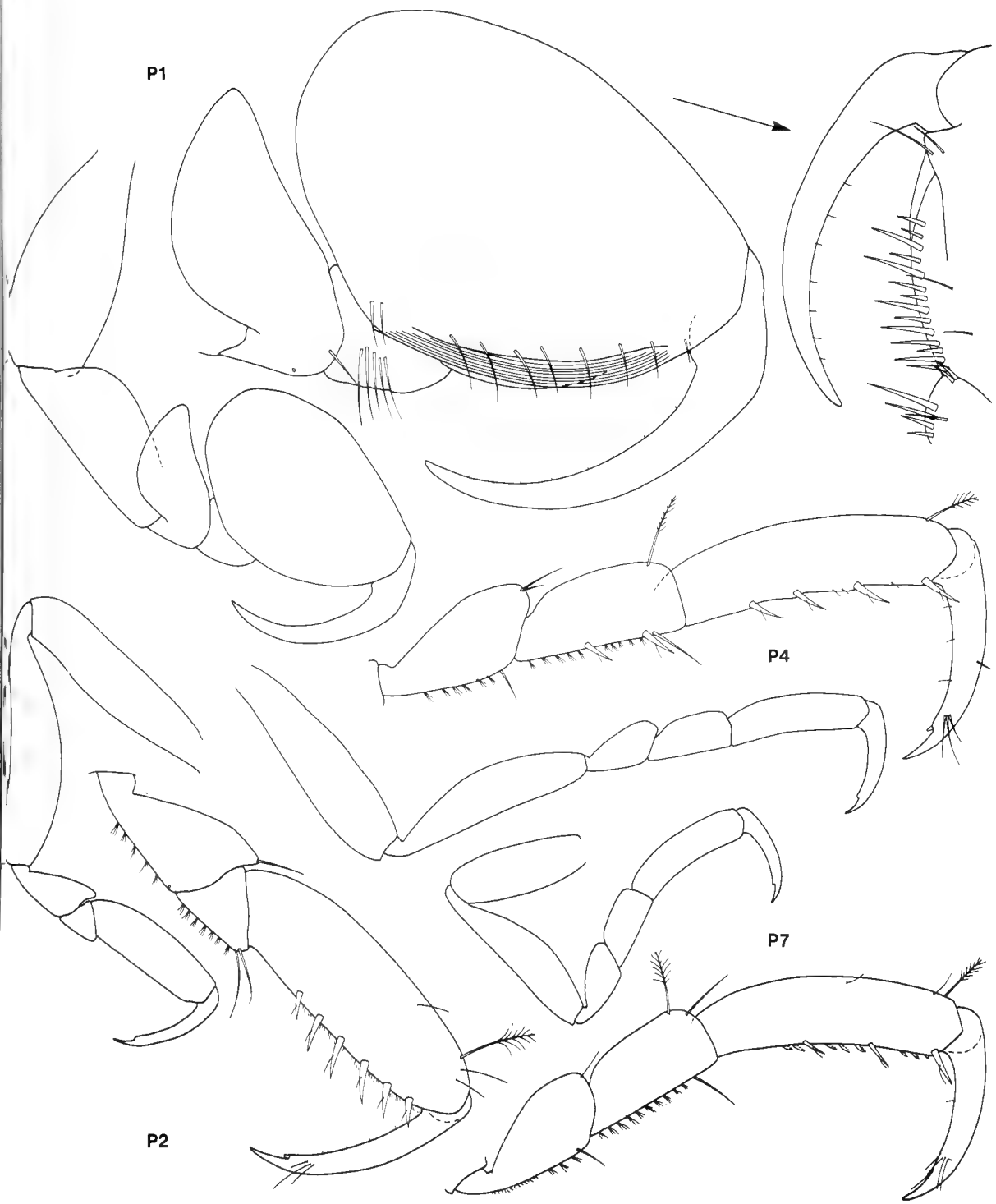


Figure 9. *Pseudanthura baeckea*. Holotype juvenile. Pereopod 1 in mesial view, detail of palm in lateral view.

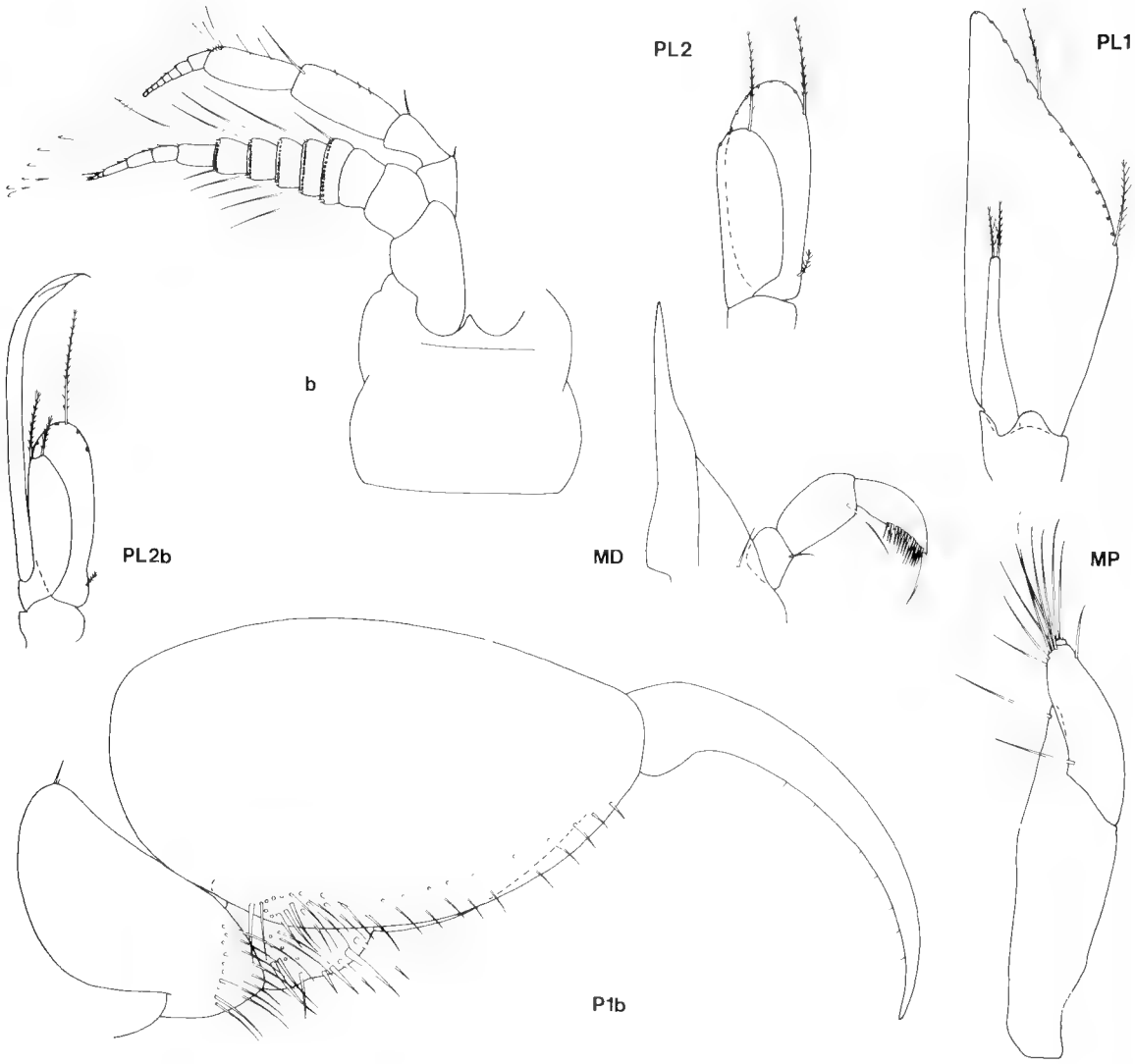


Figure 10. *Pseudanthura baeckea*. Holotype juvenile; b, paratype male, 10.1 mm, AM P35249.

than pereopod 6, article 5 without spines and article 6 with 3 spines on posterior margin.

Pleopod 1 exopod operculiform, apex subacute, with about 16 marginal setae; endopod slender, less than half length of exopod, with 2 terminal setae. Pleopod 2 endopod two-thirds length of exopod, with 3 terminal setae; exopod with proximal lateral seta and 8 marginal setae. Pleopods 3-5 rami subequal, with sparse marginal setae; exopod with proximal lateral seta.

Pleotelson twice as long as greatest width; pleonites 1-5 indicated by shallow, indistinct grooves; uropods inserting half-way along pleotelson. Telson triangular, lateral margins straight, apex subacute; with scattered submarginal setae. Uropodal peduncle and endopod subequal, suture oblique; endopod lateral margin irregular, sparsely setose, apex subacute; exopod shorter than peduncle, lanceolate.

Male. Differing from juveniles in antenna 1

flagellum, swollen proximally and tapering distally, of about 12 articles, proximal articles only with whorls of aesthetases. Pereopods more slender, pereopod 1 with dense mesial setae on articles 4 and 5 and proximally on article 6. Pleopod 2 with curved appendix masculina reaching well beyond exopod.

Colour. White.

Distribution. Central New South Wales, shelf and upper slope, 72-910 m.

Remarks. Pseudanthura baeckea is the only species of the genus known from Australia. It mostly closely resembles *P. lateralis* from which it can be readily distinguished by its long uropodal exopod and the presence of a suture between the uropodal peduncle and the endopod. *Pseudanthura baeckea* is the only species to be recorded from a depth of less than 500 metres.

Acknowledgements

This contribution was made possible through a grant from the Australia Biological Resources Study. We are especially grateful to Graham Milledge who inked all the figures. For the loan of material we thank P. Davie (Queensland Museum, Brisbane) and J. Lowry (Australian Museum, Sydney). For the donation of material to the Museum of Victoria we thank Brian Kensley (Smithsonian Institution). The scanning electron micrographs were done by John Coyne (University of Melbourne, Department of Zoology).

References

Kensley, B., 1978. Two new species of the genus *Pseudanthura* Richardson (Crustacea: Isopoda: Anthuridea). *Proc. biol. Soc. Wash.* 91: 222-33.

Kensley, B., 1982a. Revision of the southern African Anthuridea (Crustacea, Isopoda). *Ann. S. Afr. Mus.* 90: 95-200.

Kensley, B., 1982b. Deep-water Atlantic Anthuridea (Crustacea: Isopoda). *Smithson. Contr. Zool.* 346: 1-60.

Poore, G.G.B., 1978. *Leptanthura* and new related genera (Crustacea, Isopoda, Anthuridea) from eastern Australia. *Mem. natn. Mus. Vict.* 39: 135-69.

Poore, G.C.B., 1980. A revision of the genera of the Paranthuridae (Crustacea: Isopoda: Anthuridea) with a catalogue of species. *Zool. J. Linn. Soc.* 68: 53-67.

Poore, G.C.B., 1981. Paranthurid isopods (Crustacea, Isopoda, Anthuridea) from south eastern Australia. *Mem. natn. Mus. Vict.* 42: 57-88.

Poore, G.C.B., 1984a. *Paranthura* (Crustacea, Isopoda, Paranthuridae) from south-eastern Australia. *Mem. Mus. Vict.* 45: 33-69.

Poore, G.C.B., 1984b. *Colanthura, Califanthura, Cruranthura* and *Cruregens*, related genera of the Paranthuridae (Crustacea: Isopoda) *J. nat. Hist.* 18: 697-715.

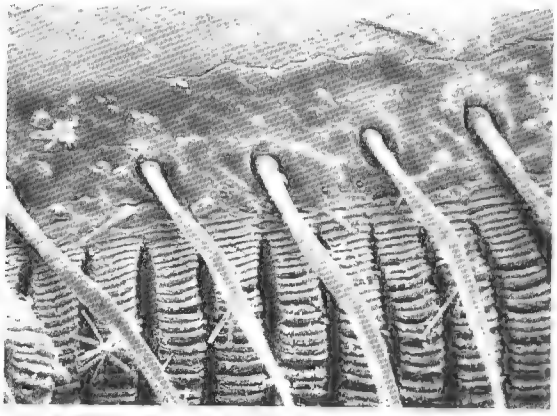
Wägele, J.W., 1981. Zur Phylogenie der Anthuridea (Crustacea, Isopoda) mit Beitragen zur Lebensweise, Morphologie, Anatomie und Taxonomie. *Zoologica Stuttg.* 132: 1-127.

Explanation of plate

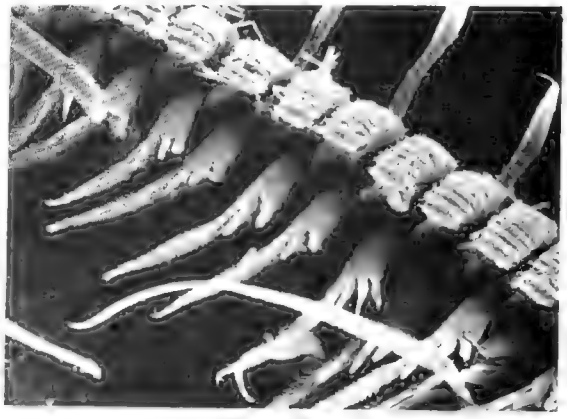
Plate 1. *Aenigmathura lactanea*, juvenile from Western Port, Victoria. a, pereopod 1, distomesial view of palm. b, Pereopod 1, distomesial view of proximal thumb of palm. c, Pereopod 1, detail of mesial aspect of palm. d, pereopod 1, detail of lateral aspect of palm. e, Telson and tailfan. f, detail of statocyst pore.

a

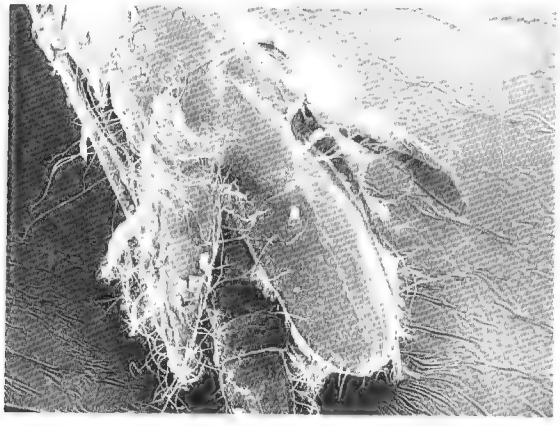
b



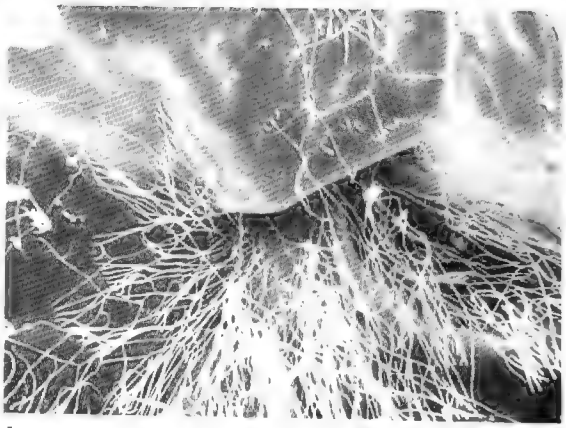
c



d



e



f

Memoirs of the Museum of Victoria 47(1): 75-85 (1986) ISSN 0814-1827

QUANTANTHURA (CRUSTACEA: ISOPODA: ANTHURIDAE) FROM SOUTH-EASTERN AUSTRALIAN AND NEW ZEALAND

By Gary C. B. Poore and Helen M. Lew Ton

Department of Crustacea, Museum of Victoria, Swanston Street, Melbourne, Victoria 3000 Australia

Abstract

Poore, G.C.B. and Lew Ton, H.M., 1986. *Quantanthura* (Crustacea: Isopoda: Anthuridae) from south-eastern Australia and New Zealand. *Mem. Mus. Vict.* 47: 75-85.

A diagnosis of the genus *Quantanthura* Menzies & George is presented and three new species are described: *Quantanthura erica* and *Q. frema* from south-eastern Australia and *Q. raoulia* from southern New Zealand. Relationships between all the described species are discussed.

Introduction

This contribution continues the examination of the anthurid fauna of south-eastern Australia (see Poore and Lew Ton, 1985, for previous contributions). Conventions and abbreviations used are given in Poore (1984). Material used in this study has also come from a survey of Moreton Bay (QUBS) carried out by the University of Queensland, and the Portobello Marine Laboratory, New Zealand. Specific epithets are taken from genera of the Australian and New Zealand flora following a pattern established by Poore (1984).

Quantanthura Menzies & George, 1979

Diagnosis. Integument smooth. Pereonite 7 elongate (three-quarters length of pereonite 6). Eyes present, rarely absent. Antenna 1 flagellum long, of 5-7 articles, the three distal articles each bearing 1 aesthetasc. Antenna 2 flagellum long, of 7-9 articles.

Mandibles symmetrical: incisor, lamina dentata and blunt molar present; palp 3-articled, article 3 one-third length of article 2, with 2-4 terminal setae. Maxilliped with a broad endite which reaches beyond article 2 of the 5-articled palp. Endite distally rounded and bearing a single seta. Palp article 1 wider than long, triangular, without a free mesial margin; article 2 with at least 1 mesiodistal seta; article 3 with a row of mesial setae, produced mesially; article 4 much smaller than 3, subterminal, suture oblique, with 2 apical setae; article 5 minute (obscure on some species), with 4 terminal setae.

Pereopod 1 subchelate, article 6 swollen, palm without a tooth. Pereopods 2 and 3 with article 6 ovoid. Pereopods 4-7 with article 5 more or less pentagonal, with a free disal margin bearing 1 or more spines; article 6 narrower, linear.

Pleon longer than wide, pleonites 1-5 fused dorsally (sutures visible laterodorsally); pleonite 6 free from others and telson. Pleopod 1 exopod operculiform, endopod setose; pleopods 2-5 setose. Uropodal endopod as long as peduncle; marginal lateral setal row continuous. Telson indurate, dorsally convex; apex with discontinuous row of long setae; two basal statocysts.

Males unknown. Submale antenna 1 flagellum with many articles, reaching to end of pereonite 2.

Type species. Quantanthura globitelson Menzies & George, 1972.

Remarks. Quantanthura was previously diagnosed as possessing six maxillipedal articles (Menzies and George, 1972; Kensley and Koening, 1979). The minute terminal seventh article evident on the Australian species, on *Q.*

F

pacifica Wägele and on *Q. remipes* (Barnard) (see Kensley, 1982) has been overlooked on the type species and the two Brazillian species. New drawings of the maxilliped of *Q. globitelson* and *Q. menziesi* supplied to us by B. Kensley (pers. comm.) confirm its presence, although the suture separating it from article 6 is faint.

Nevertheless there do appear to be two groups of species within the genus: 1–*Q. erica* n. sp., *Q. frema* n. sp., *Q. raoulia* n. sp., *Q. pacifica*, *Q. globitelson* Menzies, 1962, and *Q. sinuata* Kensley, 1982; 2–*Q. brasiliensis* Kensley & Koening, 1979, *Q. menziesi* Kensley & Koening, 1979 and *Q. remipes* (Barnard, 1914). The differences between them, largely in the antenna 1, mandibular palp, maxilliped and posterior pereopods, are given in Table 1. But these two groups are not biogeographically separate. The first group contains four south-western Pacific species and two from the Atlantic deep sea. The second group is of Brazilian shelf and South African species.

Quantanthura is most closely related to *Agulanthura* Kensley, with which it shares a similar maxillipedal endite and palp (Wägele, 1981). *Agulanthura* is not a junior synonym of *Malacanthura* as proposed by Kensley (1982) but, like *Quantanthura*, is a specialised genus lying near the stem of the Anthuridae.

Quantanthura erica sp. nov.

Figures 1-3

Material examined. 2 ♀♀, 5 juveniles; 14.3-24.2 mm.

Holotype: ♀, 24.2 mm, NMV J4454 (with one slide). Vic., Western Port, Crib Point (38°20.04'S., 145°14.10'E.), sand, 19 m, 23 Mar 1965 (CPBS stn 61N).

Paratypes: Vic. type locality, NMV J4455(2 specimens). Western Port, CPBS stations: stn 51S, NMV J4456(1); stn 52N, NMV J4457(1).

Additional material: Bass Strait, off Lakes Entrance, BSS stn 207, NMV J8407(2).

Description. Body 13 times as long as wide; pereonite 7 as long as wide; pleon 1.3 times as long as wide, little longer than pereonite 7. Head longer than wide, broader posteriorly, narrower than pereonites. Antenna 1 peduncle with a long marginal seta on article 3 only; flagellum of 6 articles. Antenna 2 flagellum of 8 articles, as long as last 2 articles of peduncle. Mandibular palp articles 1 and 2 with a single distal seta each, article 3 smaller, with 4 terminal setae. Maxilliped endite reaching to half way along article 5 almost to base of article 6; articles 4, 5 and 6 with 1, 3 and 2 mesial setae respectively; article 7 reaching beyond end of article 5, with 4 terminal setae.

Pereopod 1 article 6, 4 times as long as palm; palm oblique, convex, with row of marginal setae. Pereopod 2, distal articles with setose posterior margin and article 5 with setae on anterior margin; article 6 ovoid, with spine two-thirds way along posterior margin. Pereopod 3 similar to 2, but smaller. Pereopods 4-6 with article 5 pentagonal, as long as broad, posterior margin setose, with 2 spines, free distal margin with 2-4 pectinate setae; article 6 broader distally, posteriorly setose and with a distal spine and 3 pectinate setae. Pereopod 7 similar to pereopods 4-6 but article 6 bearing a posterior spine as well as a distal spine.

Uropodal endopod 1.8 times as long as greatest width, with scattered short submarginal setae. Exopod twice as long as greatest width; distoventral lobe acute, dorsal margin sinuous. Telson 1.3 times as long as pleon, 2.5 times as long as greatest width, widest just beyond midpoint; lateral margins curved and tapering to a broadly rounded apex. Apex with about 20 long setae, separated by an apical hiatus; distally numerous short submarginal setae.

Male. Not known.

Distribution. Victoria, Western Port and Bass Strait; sandy sediments.

Remarks. Smaller specimens have a head with parallel lateral margins. The adult size of this species is about twice that of *Quantanthura frema*, adult females reaching 22-24 mm, whereas large juveniles and subadult males of *Q. frema* are 11-13 mm long. Other characters useful in separation of the two species are given after the description of *Q. frema*.

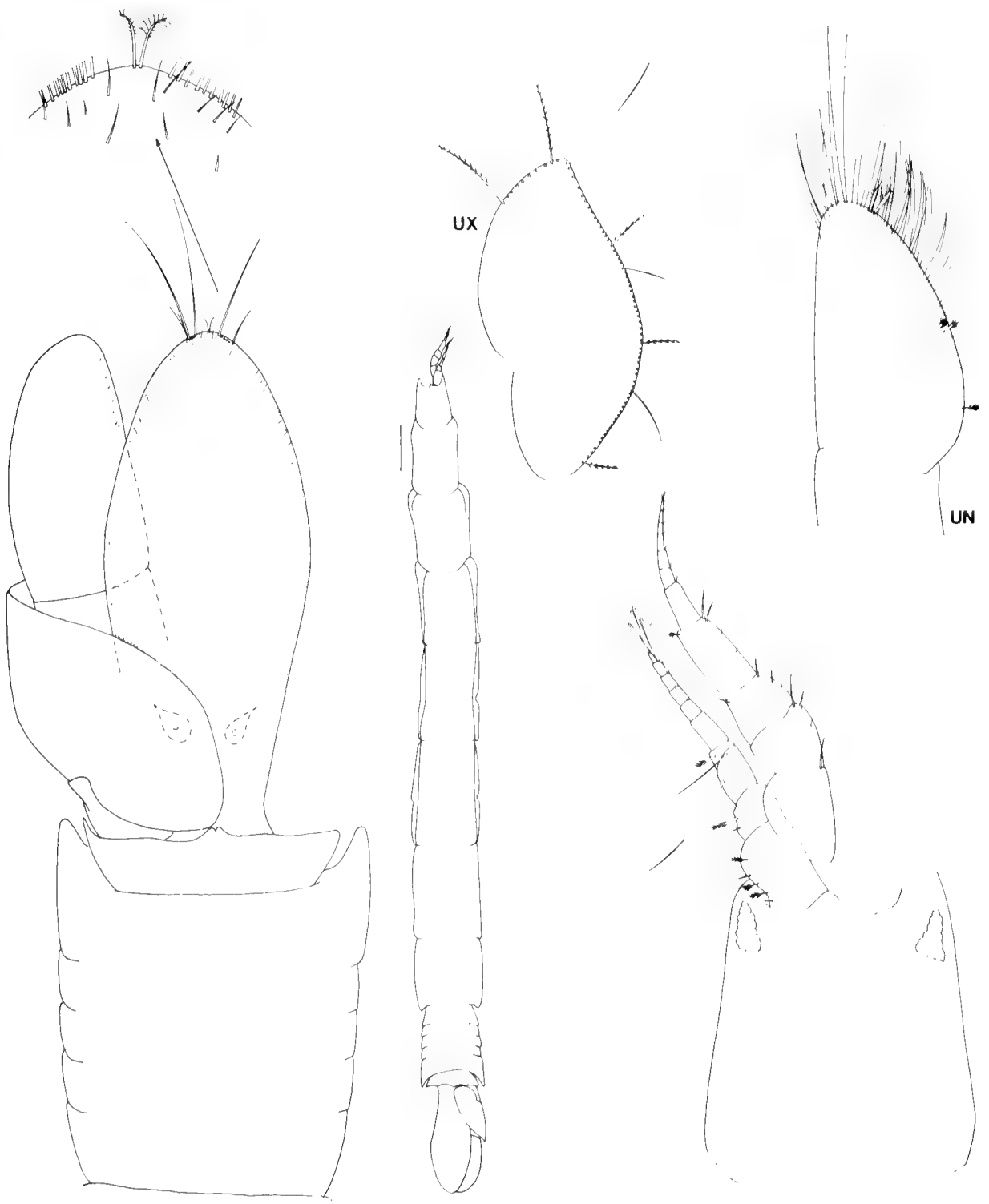


Figure 1. *Quantanthura erica*. Holotype female.

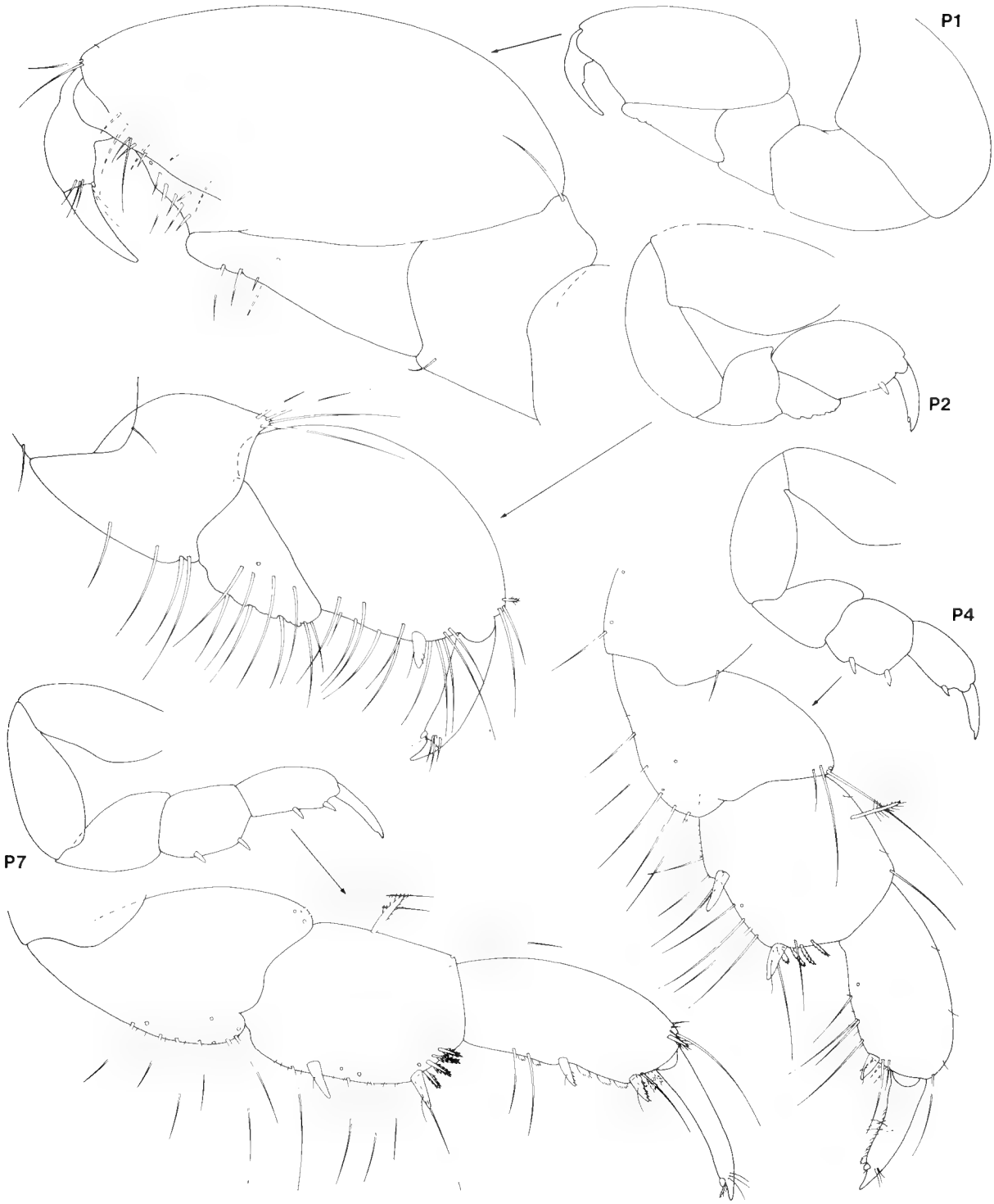


Figure 2. *Quantanthura erica*. Holotype female.

Figure 3. *Quantanthura erica*. Holotype female.

Quantanthura frema sp. nov.

Figures 4, 5

Material examined. 2 submales, 6 juveniles; 10.6-12.6 mm.

Holotype: juvenile, 11.4 mm, QM W10604 (with one slide). Qld, Middle Banks, Moreton Bay, S. Cook and S. Newlands (QUBS station).

Paratypes: Qld, type locality, QUBS stations: QM W6127(1 submale); QM W6134(1); QM W10601(1); QM W10602(1); QM W10606 (1 submale); NMV J4568(1).

Other material: NSW, off Malabar (AMSBS Shipek coll.), AM P24359(1).

Description. Body 15 times as long as wide; pereonite 7 longer than wide; pleon 1.5 times as long as wide, as long as pereonite 7. Head longer than wide, broadest posteriorly, little narrower than pereonites. Antenna 1, peduncle with a long marginal seta on article 3 only; flagellum of 6 articles. Antenna 2 flagellum of 7 articles, as long as last 2 articles of peduncle. Mandibular palp articles 1 and 2 with a single distal seta each; article 3 with 4 terminal setae. Maxilliped endite reaching half way along article 5, to base of article 6; articles 4, 5 and 6 with 1, 2 and 2 mesial setae respectively; articles 6 and 7 both reaching beyond distal end of article 5; article 7 with 4 setae.

Pereopod 1, article 6 3.5 times as long as palm; palm axial-oblique, straight with row of marginal setae. Pereopod 2 article 6 ovoid with spine two-thirds way along posterior margin; long setae only on posterior margin. Pereopod 3 similar to 2 but smaller. Pereopods 4-6 with article 5 pentagonal, longer than broad, posterior margin setose with 2 spines, free distal margin excavate and with 1 pectinate seta; article 6 broader distally, posteriorly setose and with a distal spine and with 3 pectinate setae. Pereopod 7 similar to pereopods 4-6 but article 6 bearing a posterior spine as well as a distal spine.

Uropodal endopod 2.4 times as long as greatest width; submarginal setae absent. Exopod twice as long as greatest width; ventral lobe rounded. Telson 1.7 times as long as pleon; 3.5 times as long as greatest width, widest at midpoint; lateral margins broadly curved and tapering to a narrowly rounded apex. Apex with about 16 long setae; submarginal setae absent.

Male. Not known. Submale, antenna 1 flagellum of many articles.

Distribution. Queensland, Moreton Bay; NSW, off Malabar; sandy sediments.

Remarks. *Quantanthura frema* has a narrower body than *Q. erica*, pereonite 7 is more elongate and the telson is much narrower; the limbs are a little more elongate.

Quantanthura raoulia sp. nov.

Figures 6, 7

Material examined. 1 ♀, 2 juveniles; 6.2-12.9 mm.

Holotype: ♀, 12.9 mm, NMNZ Cr.3340 (with one slide). New Zealand, Otago Harbour (45°51′S., 170°35′E.), 19 m, S.F. Rainer, 12 Dec 1966.

Paratypes: NZ, type locality, NMNZ Cr.3341(2 specimens).

Description. Body 13 times as long as wide; pereonite 7 longer than wide; pleon 1.2 times as long as wide, about as long as pereonite 7. Head longer than wide, broader posteriorly, narrower than pereonites. Antenna 1 peduncle with a long marginal seta on article 3 only;

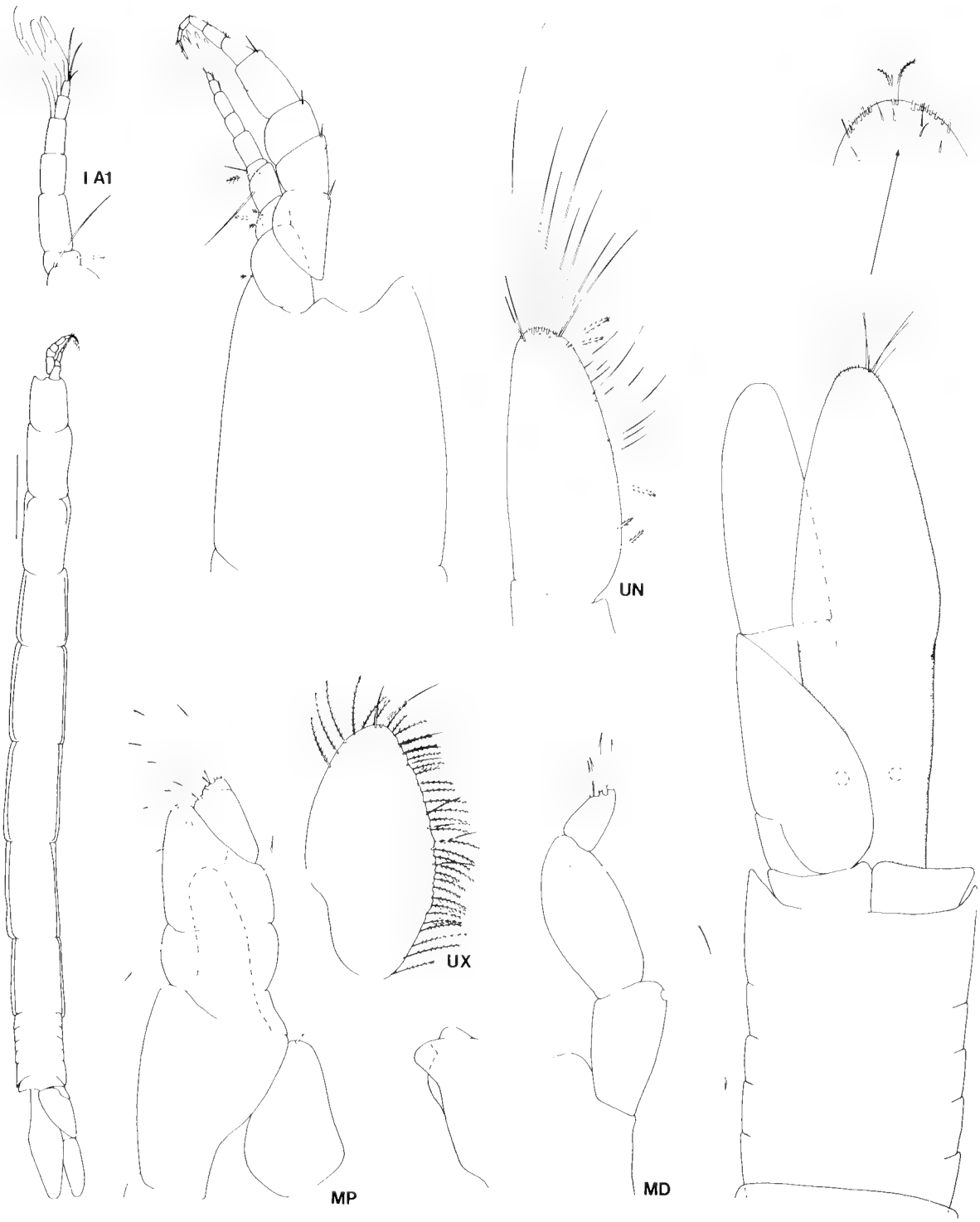


Figure 4. *Quantanthura frema*. Holotype juvenile.

Figure 5. *Quantanthura frema*. Holotype juvenile.

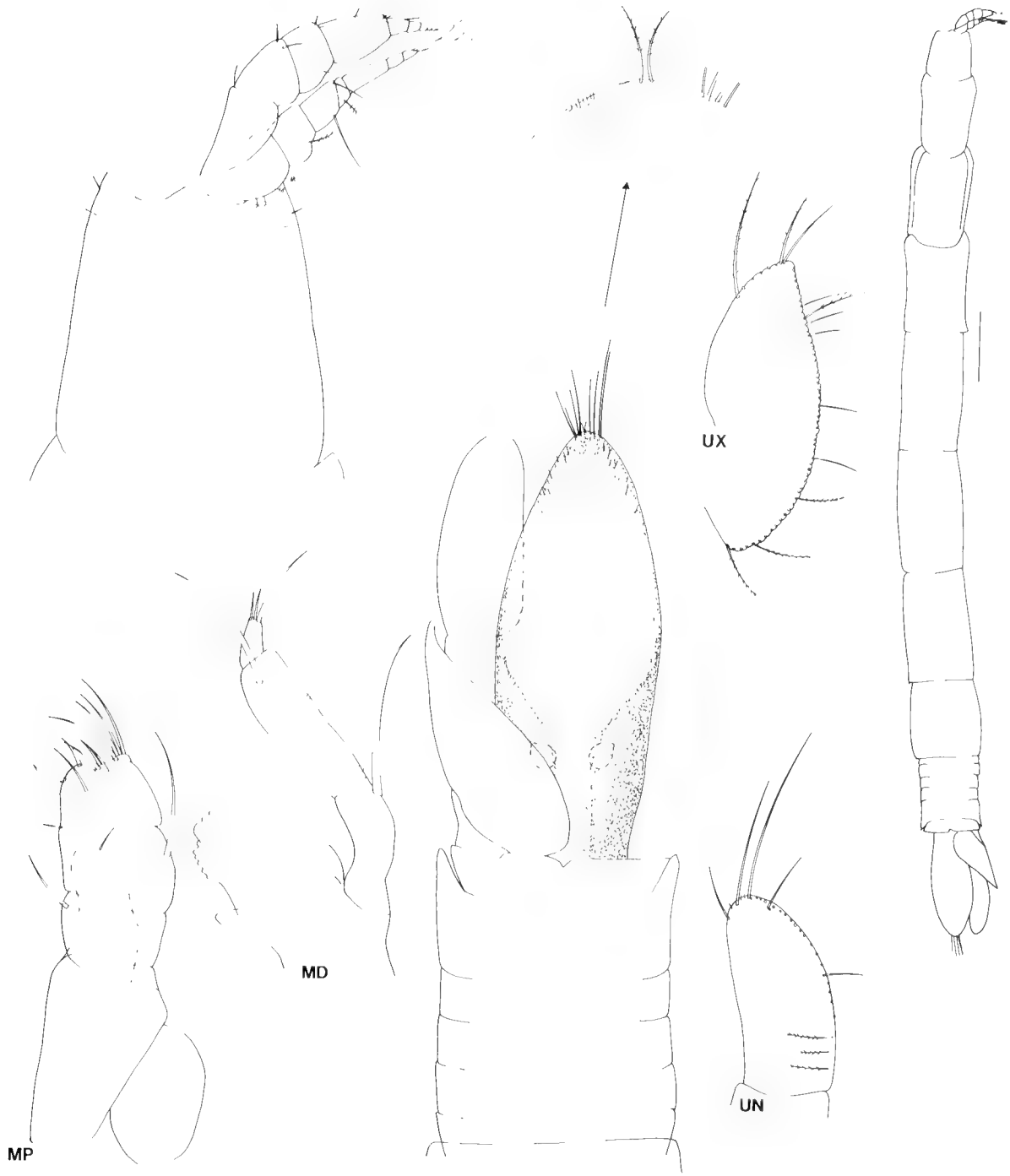


Figure 6. *Quantanthura raoulia*. Holotype female.

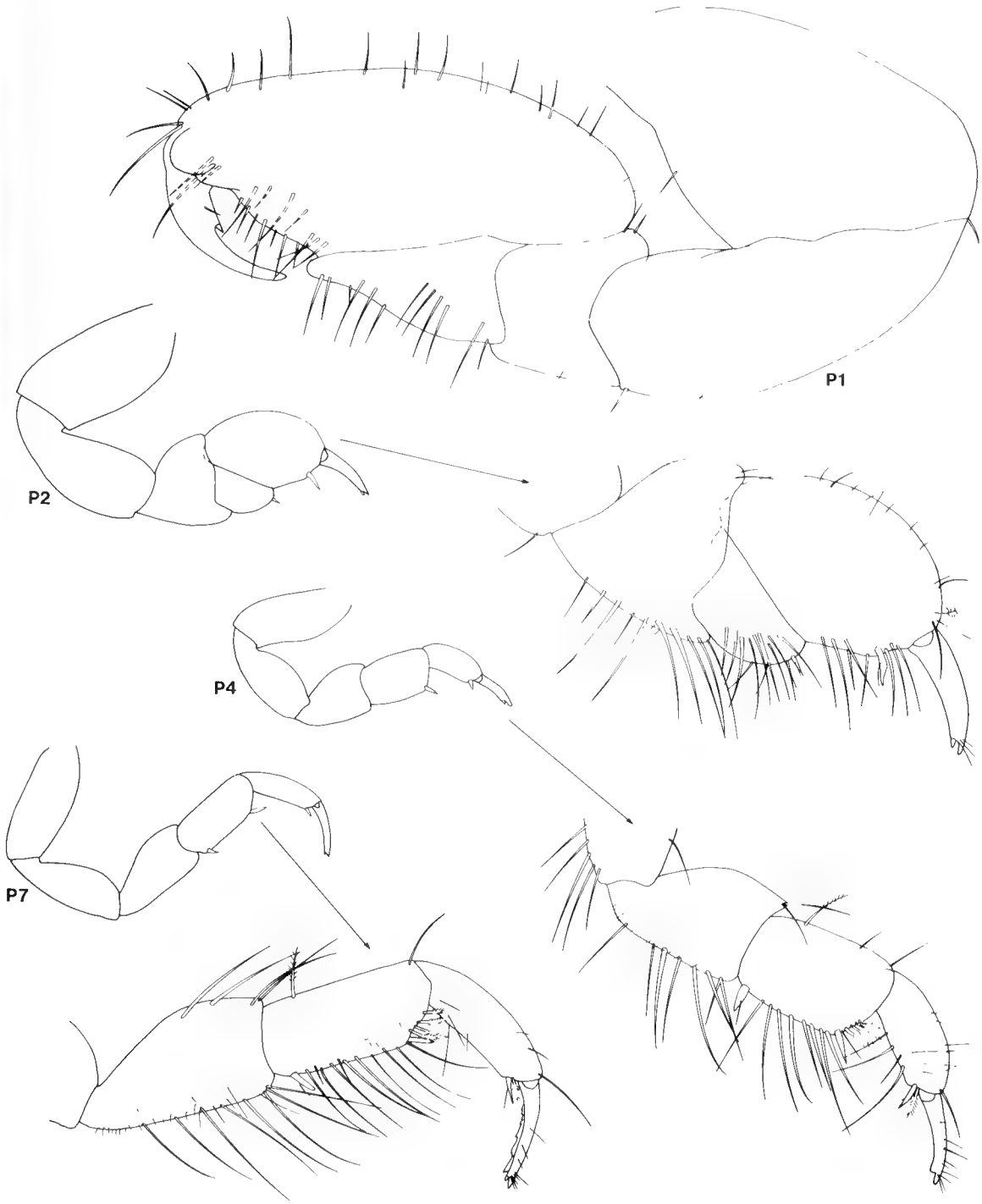


Figure 7. *Quantanthura raoulia*. Holotype female.

Table 1. Comparison of species-groups of *Quantanthura*

Species-group	1	2
Antenna 1		
–long setae on article 2	0	9-11
–long setae on article 4	1	2-4
Mandibular palp		
–lengths of articles 1 and 2	12	2≈1
–long setae on article 2	1	2
Maxilliped		
–articles 4 and 5, long lateral setae	0-1	2-3
Pereopods 4-7		
–posterior margins densely setose	No	Yes

flagellum of 5 articles. Antenna 2 flagellum of 6 articles, shorter than last 2 articles of peduncle. Mandibular palp articles 1 and 2 with a single distal seta each, article 3 smaller, with 3 terminal setae. Maxilliped endite reaching to half way along article 5, almost to base of article 6; articles 4, 5 and 6 with 1, 3 and 2 mesial setae respectively; article 7 reaching beyond end of article 5, with 4 terminal setae.

Pereopod 1 article 6 4 times as long as palm; palm oblique, convex, with row of marginal setae. Pereopod 2, distal articles with setose posterior margin and article 5 with setae on anterior margin; article 6 ovoid, with spine two-thirds way along posterior margin. Pereopod 3 similar to 2, but smaller. Pereopods 4-7 with article 5 pentagonal, longer than broad, posterior margin densely setose with 2 spines, free distal margin with 2-4 pectinate setae; article 6 with a convex anterior margin, posteriorly densely setose and with a distal spine and 3 pectinate setae.

Uropodal endopod twice as long as greatest width. Exopod 2.5 times as long as greatest width; distoventral lobe acute, dorsal margin sinuous. Telson 1.4 times as long as pleon, 2.5 times as long as greatest width, widest at midpoint; lateral margins curved and tapering to a broadly rounded apex. Apex with about 8 long setae, separated by an apical hiatus.

Male. Not known.

Remarks. Quantanthura raoulia from New Zealand most closely resembles *Q. erica* from Australia in its general body form and shape of the telson. The species has fewer articles in the flagella of antennae 1 and 2, pereopod 4 article 5 is longer than broad and the uropodal exopod is much narrower. It differs from the other New Zealand species, *Q. pacifica*, in broader articles on pereopods 2-7 and longer and narrower telson and uropods. *Quantanthura raoulia*is a shallow water species from Otago Harbour while *Q. pacifica* is from depths greater than 420 m on the West Coast.

Acknowledgements

The contribution was made possible through a grant from the Australian Biological Resources Study. We are especially grateful to G. Milledge and H. Handsjuk who inked all the figures. For the loan of material we thank P. Davie (Queensland Museum, Brisbane) and J. Jillett (Portobello Marine Laboratory, Dunedin) and for re-examining type material in the Smithsonian Institution we thank B. Kensley.

References

Kensley, B., 1978. Five new genera of anthurid isopod crustaceans. *Proc. biol. Soc. Wash.* 91: 775-92.

Kensley, B., 1982. Revision of the southern African Anthuridea (Crustacea, Isopoda). *Ann. S. Afr. Mus.* 90: 95-200.

Kensley, B. and Koening, M.L., 1979. Two new species of *Quantanthura* from Brasil (Crustacea, Isopoda, Anthuridae). *Proc. biol. Soc. Wash.* 91: 953-62.

Menzies, R.J. and George, R.Y., 1972. Isopoda Crustacea from the Peru-Chile Trench. *Anton Bruun Rep.* 9: 1-24.

Poore, G.C.B., 1984. *Paranthura* (Crustacea, Isopoda, Paranthuridae) from south-eastern Australia. *Mem. Mus. Vict.* 45: 33-69.

Poore, G.C.B. and Lew Ton, H.M., 1985. *Apanthura, Apanthuretta* and *Apanthuropsis* gen. nov. (Crustacea, Isopoda, Anthuridae) from south-eastern Australia. *Mem. Mus. Vict.* 46: 103-51.

Wägele, J.W., 1981. Zur Phylogenie der Anthuridea (Crustacea, Isopoda) mit Beitragen zur Lebensweise, Morphologie, Anatomie und Taxonomie. *Zoologica Stuttg.* 132: 1-127.

Wägele, J.W., 1985. Two new genera and twelve new species of Anthuridea (Crustacea: Isopoda) from off the West Coast of New Zealand. *N.Z. Jl Zool.* 12: 363-423.

Memoirs of the Museum of Victoria 47(1): 87-104 (1986) ISSN 0814-1827

MESANTHURA (CRUSTACEA: ISOPODA: ANTHURIDAE) FROM SOUTH-EASTERN AUSTRALIA

By Gary C.B. Poore and Helen M. Lew Ton

Department of Crustacea, Museum of Victoria, Russell Street, Melbourne, Victoria 3000, Australia

Abstract

Poore, G.C.B. and Lew Ton, H.M., 1986. *Mesanthura* (Crustacea: Isopoda: Anthuridae) from south-eastern Australia. *Mem. Mus. Vict.* 47: 87-104.

Mesanthura miersi (Haswell) and seven new species, *M. astelia, M. calaena, M. dianella, M. libertia, M. moroea, M. romulea* and *M. stypandra* are described and figured. *Mesanthura maculata* and *M. affinis* are removed from the Australian fauna. Pigment pattern is a reliable specific character in *Mesanthura* and is supported by minor morphological differences in pereopod 1 and telson.

Introduction

This contribution continues a series on the Anthuridae and Paranthuridae from south-eastern Australia (see Poore and Lew Ton, 1985a, for recent titles). *Mesanthura* is the last of the major anthurid genera from the region to be studied (the others are *Apanthura* and *Haliophasma*); several others are present but with only a few species.

The new species described herein are, on the whole, each based on few specimens. Many come from algal epifauna collected using SCUBA; each sample taken in this way usually contains only one or two specimens. None of these samples is quantitative but it is noteworthy that of about a hundred samples taken during a survey of Cape Paterson, Vic., only four contained specimens of *Mesanthura*. No species of *Mesanthura* were found in the large-scale soft-bottom benthos surveys which have revealed many species of other anthuridean genera in Port Phillip Bay, Western Port and Moreton Bay and several lagoons and estuaries. But specimens were found in deep calcareous sediments of Bass Strait.

Barnard (1925) noted that morphological features separating the species of *Mesanthura* are "hard to find". This is true of most related genera. Barnard (1925) separated the species known to him largely on the basis of dorsal pigment patterns with little support from anatomical characteristics. This has been the approach of most subsequent authors. The only exception has been Kensley (1980) who described three colour morphs of *M. protei* and Kensley and Poore (1982) who figured a fourth. In the south-eastern Australian fauna we are able to correlate morphological differences with pigment patterns and now assume that these represent separate species. This is also the case for three species described by Barnard (1925) (Wägele, 1984). Burbanck and Burbanck (1961) analysed differences in colour pattern in populations of *Cyathura polita* from estuaries along the east coast of the USA. The variations found were slight compared to those found in Australian *Mesanthura*.

The first new species, *Mesanthura astelia*, is figured and described here in some detail. Its features are typical of all species of the genus which differ only in subtle ways. The holotype of *M. miersi* (Haswell) is also figured because its pigment pattern is unknown. For all other species only diagnostic features are figured and described. These are pigmentation, form of the first pereopod, particularly the sixth article, and the shape of the telson and uropodal exopod. No key to species is presented. Species can easily be identified using figures 2 and 3 and confirmed using the other figures and diagnoses.

Although morphological features seem to support separation of species based on pigmentation, non-coloured specimens are difficult to identify with certainty. Consequently, three old specimens from the New South Wales shelf in the Australian Museum collections (G2186, P24935 and P24940) remain unidentified. One of these is the specimen attributed to *Anthura affinis* Chilton by Whitelegge (1901).

Australian species of *Mesanthura* typically have a dorsal rectangle of pigment which may have a transverse pair of clear patches. In this they differ from most species described from other parts of the world which often have a clear central area mid-dorsally. This apparent division of the genus on the basis of pigment symmetry is not clear cut but may deserve further investigation. It does mean that relationships between the Australian species and previously described forms are difficult to find.

The following abbreviations used in figures 4-13: MD, mandible; MP, maxilliped; P1-P7, pereopods 1-7; PL1-PL5, pleopods 1-5; UN and UX, uropodal endopod and exopod. Except in figures 1-3 a, b, c refer to alternative views or individuals and are explained in the captions. Survey material complements collections in museums: The Museum of Victoria's Bass Strait Survey (BSS stations) and survey at Cape Paterson (CPA stations); the Australian Museum's Shelf Benthic Survey (AMSBS) and local collections (NSW stations).

Material is lodged in the Museum of Victoria, Melbourne (NMV); the Australian Museum, Sydney (AM); the Tasmanian Museum and Art Gallery, Hobart (TM); and the South Australian Museum, Adelaide (SAM).

Specific epithets for new species have been chosen from genera of the Australian flora and are used as nouns in apposition. This follows a pattern established for *Paranthura* (Poore, 1984).

Problems in nomenclature

Five species attributed to *Mesanthura* have been described from Australia: *M. maculata* (Haswell), *M. miersi* (Haswell), *M. albinotata* Thomson, *M. bipunctata* Thomson and *M. protei* Kensley. The last three are from Western Australia and all differ from the south-eastern species (Thomson, 1951; Kensley and Poore, 1982). Whitelegge (1901) recorded *Anthura affinis* Chilton, 1882, from New South Wales, a species later placed in *Mesanthura*.

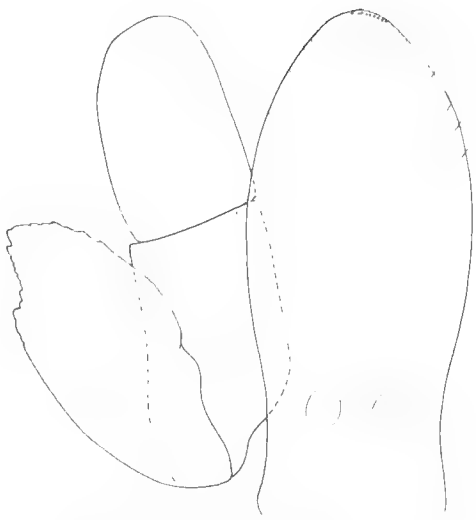


Figure 1. *Mesanthura affinis*, juvenile, Canterbury Museum, tail fan.

The name *Mesanthura maculata* has been widely used following Barnard's (1925) synonymising of *Paranthura miersi* and *Anthura affinis* Chilton from New Zealand with it. Type material of *Haliophasma maculata* Haswell (Haswell, 1881: 477, pl. 18 fig. 2; 1882: 306; 1884: 103) no longer exists but it is clear from the figures and the description that this name refers to a species of *Accalathura* (Paranthuridae). Haswell's (1884) figures 2, 2a, 2c, 2x (not fig. 3 as cited on p.477) correspond with his description and the antennae, pereopods, uropods and telson could be referable to *A. bassi* Poore which is a pigmented species from Victoria. Alternatively, the undescribed species of *Accalathura* from New South Wales (Poore, 1981) could be conspecific with *Accalathura maculata*. The specific epithet *maculata* is therefore not referable to any species of *Mesanthura*.

Mesanthura maculata has been used for specimens from Sri Lanka (Kirtisinghe, 1931; Pillai, 1966), Madagascar (Kensley, 1980) and

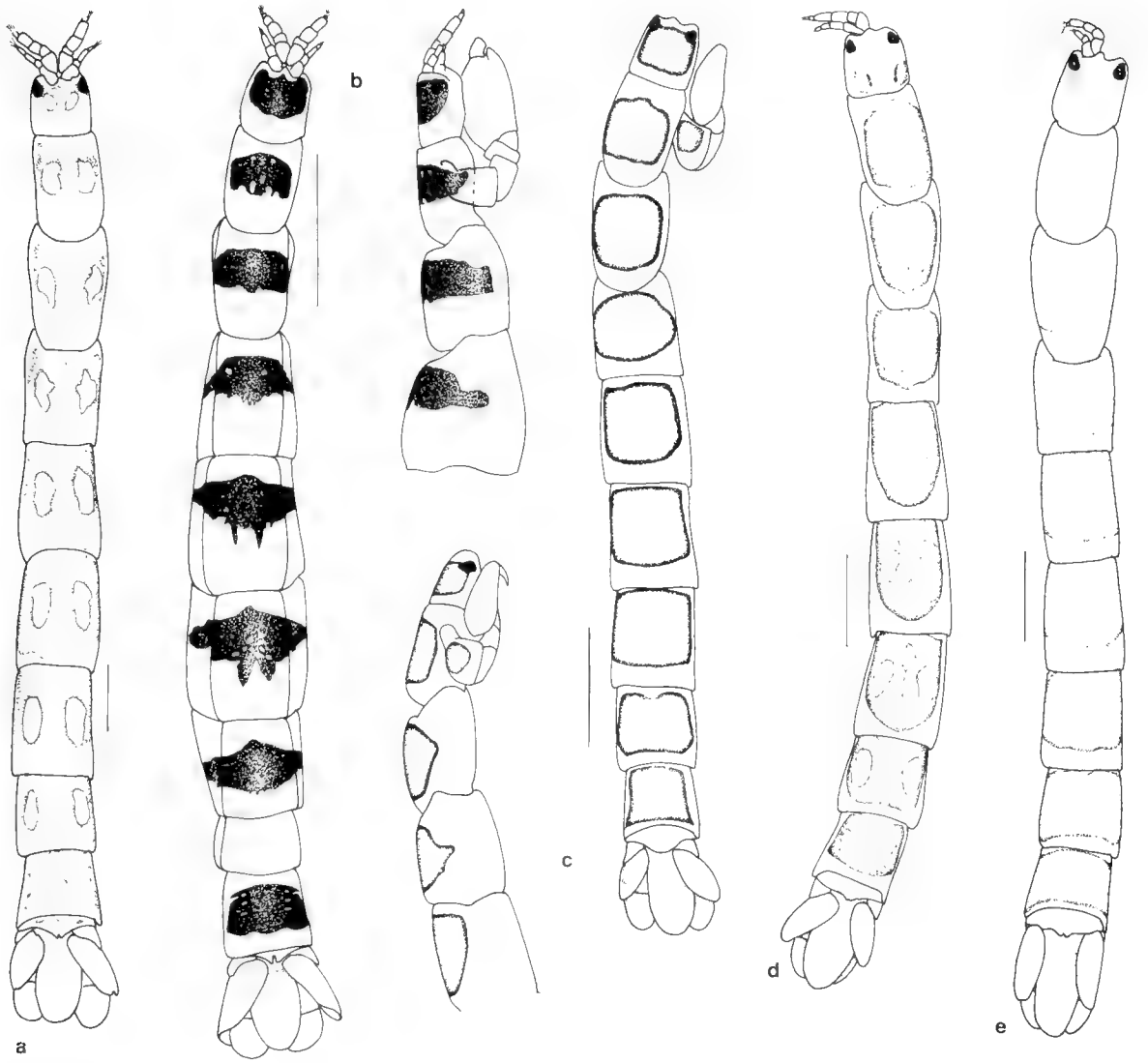


Figure 2. a, *Mesanthura astelia*, holotype juvenile, 14.1 mm; b, *Mesanthura calaena*, holotype juvenile, 6.7 mm; c, *Mesanthura dianella*, holotype juvenile, 7.8 mm; d, *Mesanthura libertia*, holotype juvenile, 12.0 mm; e, *Mesanthura miersi*, holotype juvenile, 11.5 mm.

New Zealand (Hurley, 1961). Their identities remain in doubt. Tubb's (1937) specimen from Lady Julia Percy Island, Victoria, attributed to *M. maculata* is in fact *Apanthura xanthorrhoea* Poore & Lew Ton.

A specimen labelled *Paranthura miersi* in the Australian Museum corresponds moderately well with Haswell's (1884) description and figures. This specimen is here refigured and the name *Mesanthura miersi* becomes the oldest available name for Australian *Mesanthura*.

The identity of New Zealand specimens was confirmed from material in the Canterbury Museum, Christchurch. One female and a smaller juvenile are labelled "*Anthura affinis* Chilton Lyttelton, N.Z. C.C." and "*Haliophasma maculata* Hasw. teste K.H.B." and are associated with two slides prepared by Chilton: "*Anthura affinis* Chilton Lyttelton

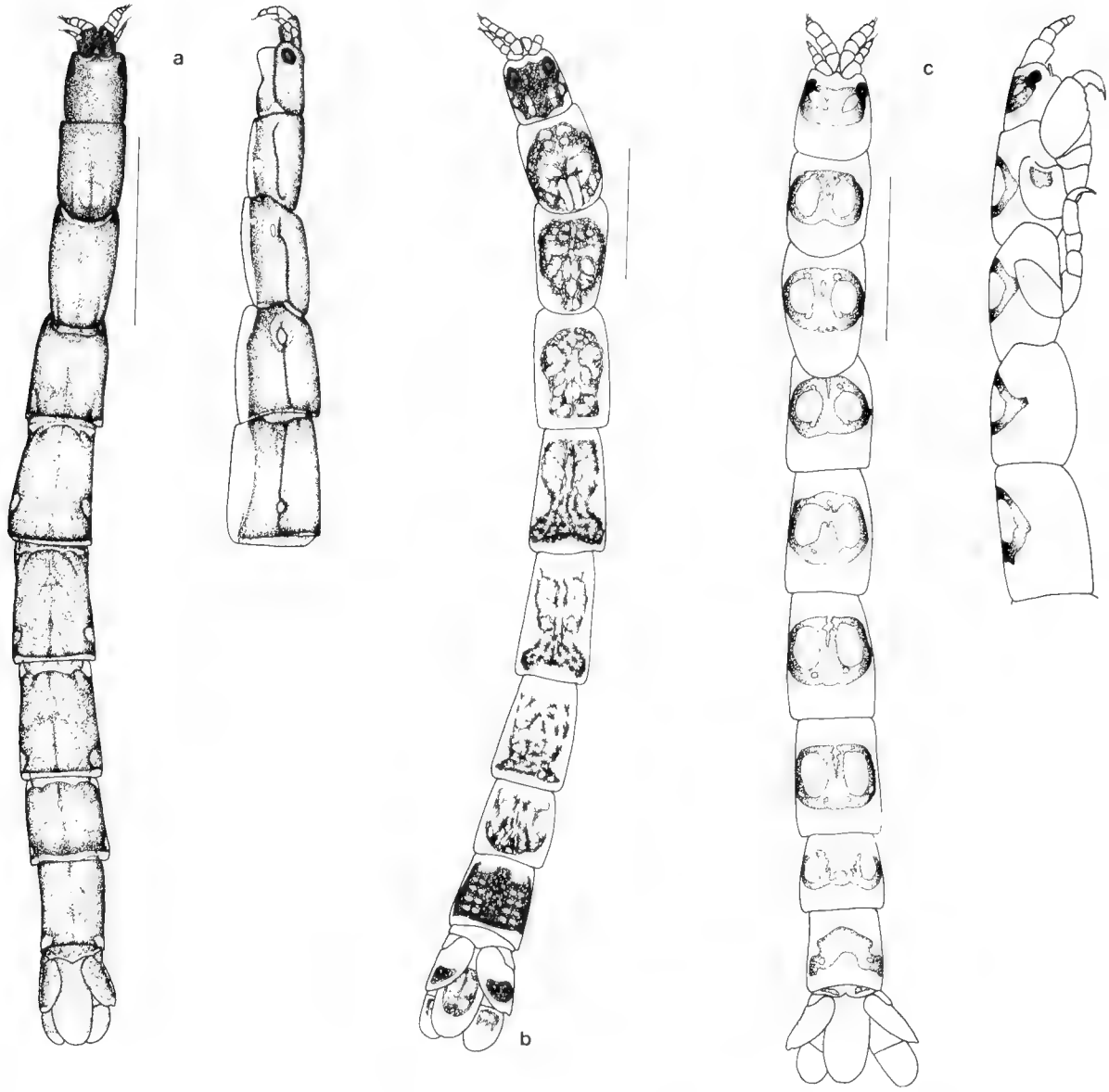


Figure 3. a, *Mesanthura moroea*, holotype juvenile, 5.3 mm; b, *Mesanthura romulea*, holotype juvenile, 7.7 mm; *Mesanthura stypandra*, holotype juvenile, 6.2 mm.

slides A1 and A2". The specimens do belong to *Mesanthura* but the pleon and uropod (Figure 1) do not resemble any Australian species. The specimens may be syntypes of *Anthura affinis*. *Mesanthura affinis* (Chilton, 1883) is a valid name for a New Zealand species but should be deleted from the Australian fauna.

Mesanthura Barnard, 1914

Diagnosis. Integument pigmented (usually in a species-specific pattern). Eyes present. Antenna 1 flagellum of 3 articles, the last 2 with 3 terminal aesthetascs. Antenna 2 flagellum short, of very few short articles. Mandibles symmetrical, sometimes reduced in male; incisor, lamina dentata and blunt molar

present; palp 3-articled, article 3 shorter than 2 with a long row of marginal setae. Maxilliped of 5 articles, endite absent or obsolete; article 5 terminal (suture transverse), about one-half length of article 4, with 3-4 mesial setae.

Pereopod 1 subchelate, article 6 swollen, its palm sometimes with a step, rarely toothed (sometimes palm step opposes a complex surface on the dactyl). Pereopods 2 and 3 only slightly more robust than posterior pereopods. Pereopods 4-7 with article 5 triangular-trapeziform, its anterior margin free.

Pleon short (about as long as pereonite 7), pleonites 1-5 fused, pleonite 6 free. Pleopod 1 exopod operculiform, endopod setose. Pleopods 2-5 setose. Uropodal endopod shorter than peduncle, about as long as wide; exopod with sinuous or notched dorsal margin. Telson with two basal statocysts, apex with long setae, no long dorsal setae.

Male antenna 1 flagellum short and tapering, of about 10 very short discoid articles, each bearing numerous aesthetascs.

Type species. Anthura catenula Stimpson, 1855.

Remarks. Mesanthura shares with *Cyathura* and the *Apanthura*-group of genera (Poore and Lew Ton, 1985a, b) antenna 1 with three terminal aesthetascs, triangular-trapeziform article 5 on pereopods 4-7 and telson with several apical long setae (Wägele, 1981). It is closest to *Cyathura*, sharing a similar terminal article on the maxilliped and squarish uropodal endopod but differs in having five maxillipedal palp articles. It shares a five-articled maxilliped with *Apanthura, Apanthuretta* and *Apanthuropsis* but differs in the uropod, terminal maxillipedal article and mandibular palp. The male antenna 1 flagellum of species of *Mesanthura* differs from those of all these genera by being moderately short, swollen proximally and of about 10 disc-shaped articles. Representatives of all genera (except monotypic *Apanthuropsis*) are pigmented.

Mesanthura astelia sp. nov.

Figures 2a, 4-6

?*Mesanthura maculata*.–Hale, 1929: 245, fig. 238 (not Haswell, 1882).

Material examined. 14 juveniles, 6.9-20.5 mm; 1 ♂, 13.2 mm; 1 ♀, 12.0 mm:

Holotype: juvenile, 14.4 mm, NMV J4169 (with one slide). NSW, Batemans Bay (35°44′S., 150°15′E.), G. Hartmann and G. Hartmann-Schroeder, 4 Jan 1976 (sample 158).

Paratypes: NSW, type locality, NMV J4172(1), AM P35695(1).

Tas., Tinderbox, below LW, J.R. Penprase, 29 May 1974, TM G1713(1 ♂).

Vic., Aireys Inlet, sponges, W.F. Seed, 30 Dec 1963, NMV J4171(1). Shoreham, encrusting calcareous algae, W.F. Seed, 28 Feb 1959, NMV J4173(1).

Bass Strait., BSS stn 152 (39°06.8′S., 144°44.6′E.), 66-68 m, coarse shell, 11 Feb 1981, NMV J4174(1). BSS stn 173 (39°26.3′S., 147°48.7′E.), 49 m, coarse shell, 17 Nov 1981, NMV J4175(1).

Other material. SA, Sellicks Beach, undersides of smooth boulders on reef, H.M. Hale, 27 Jan 1936, SAM(3). Cable Bay, Dr Campbell, 13 Apr 1936, C860(1) [det K.H.B. *M. maculata*]. "The Hotspot," reef 8 km W. of N. end of Flinders Is. (33°40.8′E., 134°22.5′E.), 21 m, large red algae, G.C.B.Poore, 20 Apr 1985 (stn SA-71), NMV J11578(1 ♀). No locality, SAM(2) [det K.H.B. *M. maculata*].

Diagnosis. Head, pereonites and pleon with pigment patches over most of dorsal surface more or less extending laterally as narrow bands. On head and pereonites these patches surround pair of elongate clear areas; on fused pleon the patch posteriorly notched as it is to lesser extent on pereonites 4-7. Male pigmentation similar dorsally but extending laterally as narrow band on pereonites 2-6 and meeting midventrally on pereonite 7.

Pereopod 1 subchelate; article 6 ovoid, its palm with granular projection opposing complexly toothed boss at the base of unguis.

Uropodal exopod notched. Telson moderately acutely tapering to broadly rounded apex.

Description. Integument dorsally pigmented (see *Diagnosis*). Antenna 1 peduncle with 1 lateral seta on each of articles 1 and 3, a single brush-seta on articles 1 and 2; flagellum of 3 articles, together as long as last article of peduncle. Antenna 2 flagellum of very short articles, only half as long as last article of peduncle. Mandible with short molar; lamina dentata with 4 teeth; incisor blunt, palp reaching well beyond incisor, articles 1 and 2 with 1 distal seta, article 3 the shortest, falcate, with long row of 14 spines. Maxilliped with an

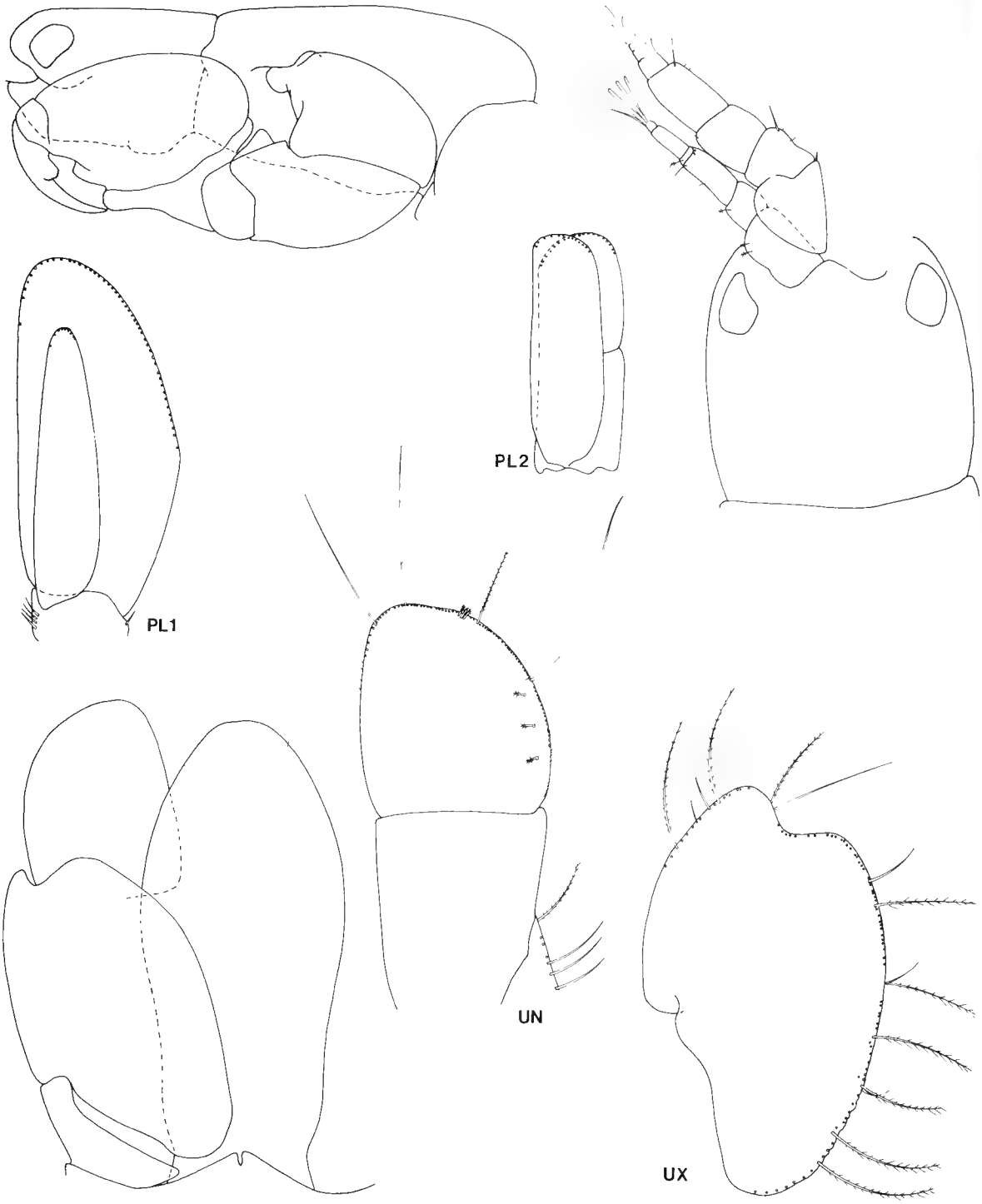


Figure 4. *Mesanthura astelia*. Holotype juvenile, 14.4 mm.

Figure 5. *Mesanthura astelia*. Holotype juvenile, 14.4 mm; a, mesial view of palm and dactyl.

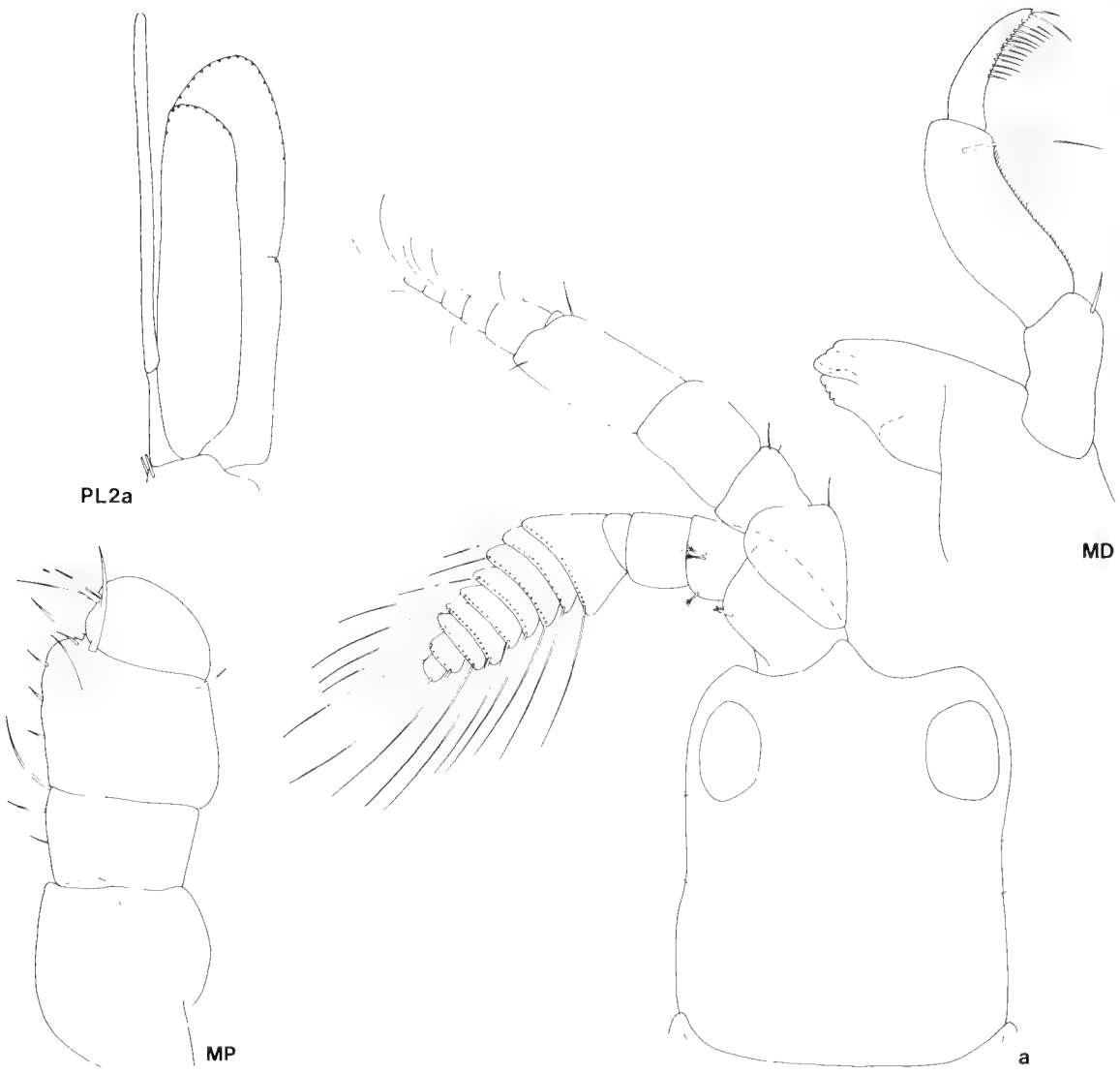


Figure 6. *Mesanthura astelia*. Holotype juvenile, 14.4 mm; a, paratype male.

obsolete endite; articles 3 and 4 wider than long, bearing mesial setae; article 4 with, among others, a strong distal seta at the mesial end of the suture with article 5; article 5 with 4 mesial setae.

Pereopod 1 article 5 distally produced as a granular tooth; article 6 swollen, its palm oblique and bearing a granular projection midway along, submarginal setae mesially and laterally; dactyl with complexly toothed boss at base of long unguis. Pereopod 2 with broad proximal articles; article 5 without free anterior margin, its posterior margin straight; article 6 about 3 times as long as wide, its palm concave and bearing few long setae and tooth at distal margin; dactyl about half as long as article 6. Pereopod 4 article 5 with short anterior margin, its posterior margin expanded and bearing a spine on the free distal margin; article 6 little less than 3 times as long as wide,

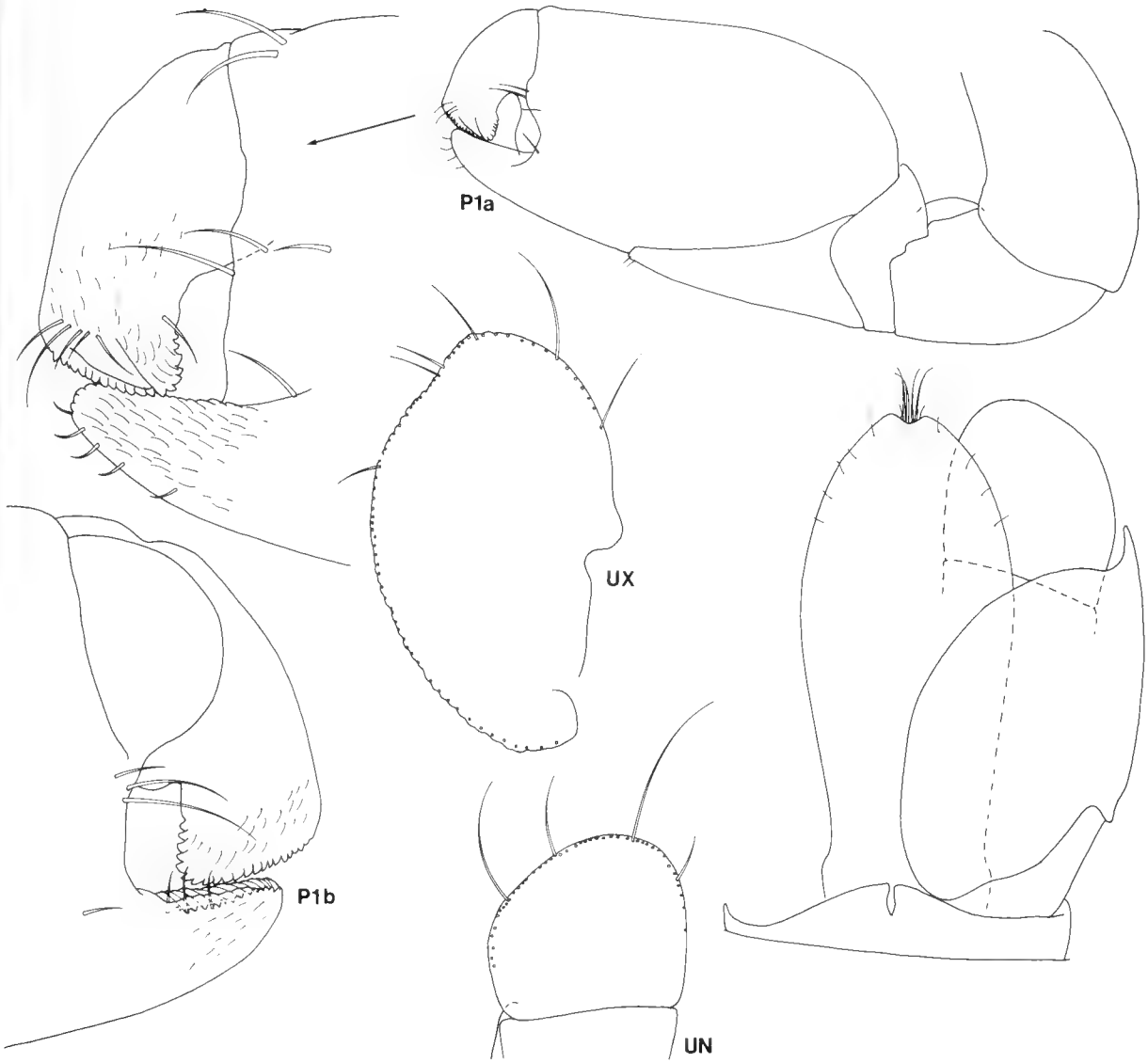


Figure 7. *Mesanthura caleana*. Holotype juvenile, 6.7 mm; a, lateral view; b, mesial view.

its palm concave and with a distal seta; dactyl curved. Pereopods 5-7 similar to pereopod 4, becoming more elongate posteriorly.

Uropodal endopod slightly longer than wide, a dense marginal row of mostly simple setae, and brush-setae submarginally on dorsal surface. Exopod 1.7 times as long as greatest width, ventral distal lobe acutely rounded and separated from the curved dorsal margin by right-angled notch; dense marginal row of mostly plumose setae. Telson about as long as pleon, 2.3 times as long as wide, greatest width about two-thirds way along; distal third moderately acutely tapering to broadly rounded apex; about 16 apical long setae.

Male. Antenna 1 with flagellum of 9 short aesthetasc-bearing articles, not reaching to posterior margin of head. Head with mid ventral projection at base of maxillipeds. Eyes enlarged. Pereopod 1 with dense mesial setae. Appendix masculina a simple rod barely exceeding the exopod of pleopod 2.

Figure 8. *Mesanthura dianella*. Holotype juvenile, 7.8 mm.

Distribution. Tasmania, South Australia, Victoria, Bass Strait, and New South Wales; subtidal-68 m.

Remarks. *Mesanthura astelia* can be confused only with *M. libertia* and *M. stypandra* which both have large clear patches in the dorsal pigment patch.

Mesanthura calaena sp. nov.

Figures 2b, 7

Material examined. 2 juveniles, 1 post-manca.

Holotype: juvenile, 6.7 mm, NMV J4452 (with one slide). Vic., Shoreham, Honeysuckle Point, (38°26′S., 145°03′E.), T. Crawford, 29 Dec 1962.

Paratypes: SA, "The Hotspot", reef 8 km W. of N. end of Flinders Is. (33°40.5′S., 134°22.0′E.), 17 m, bryozoa, G.C.B.Poore, 19 Apr 1985 (stn SA-62), NMV J11573(1 juvenile). Topgallant Is. (33°43.0′S., 134°36.6′E.), 25 m, *Cystophora*, G.C.B.Poore, 21 Apr 1985 (stn SA-80), NMV J11575(1 post-manca).

Diagnosis. Head, pereonites 1-6 and pleon with transverse bands of pigment occupying about middle third of each segment. Pigment patches with few clear areas, their anterior margins fairly even but posterior margins bilobed on pereonites 4 and 5. Pigment extending laterally especially on pereonites 1-3.

Pereopod 1 chelate; article 6 grossly elongated, its palm produced as a prominent tooth

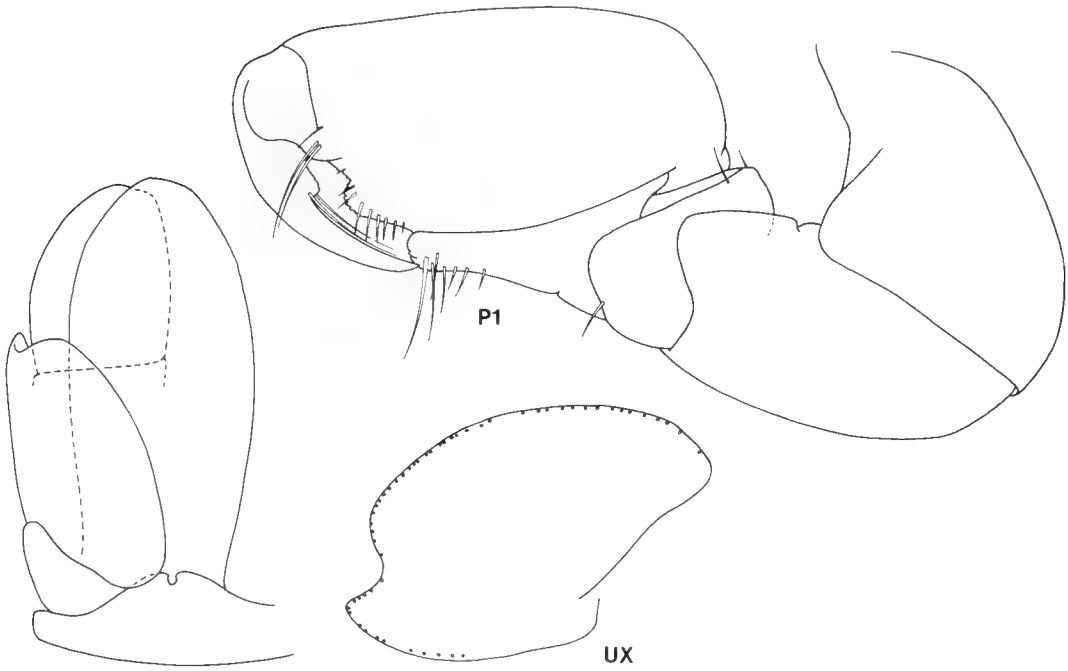


Figure 9. *Mesanthura libertia*. Holotype juvenile, 12.0 mm.

which bears complex grinding surface; dactyl broad, its complexly toothed tip extending beyond unguis and fitting a groove on the fixed finger.

Uropodal exopod not notched. Telson tapering over distal third, with an apical concavity.

Distribution. Victoria and South Australia, subtidal and intertidal.

Remarks. *Mesanthura calaena* is unique among species of the Anthuridae in possession of a chelate first pereopod. There are however no other differences between this specimen and typical *Mesanthura* and separate generic status seems unwarranted.

Mesanthura dianella sp. nov.

Figures 2c, 8

Material examined. 8 juveniles, 4.5-7.8 mm; 2 ♂♂, 7.5-7.8 mm:

Holotype: juvenile, 7.8 mm, AM P32690 (with one slide). NSW, Jervis Bay, off Moona Moona Creek (35°03′S., 150°44′E.), 8 m, on mussel *Trichomya hirsuta* with epizoic algae and sponges on sand covered rocks, J.K. Lowry, 19 Jun 1982 (stn NSW-113).

Paratypes: NSW, type locality, NMV J4167(4). Type locality, 3 m, sponge encrusted bivalves, AM P32688(1). E. of Malabar, Sydney (33°57′S., 151°19′E.), 66 m, gravel-sand, 19 May 1972 (AMSBS stn 4E), AM P22807(2). Same locality, 31 m, gravel-sand, 12 May 1972 (AMSBS stn A1), AM P24349(1). E. of North Head, Sydney (33°49′S., 151°18′E.), 20 m, with sponge *Polymastea craticia*, 19 Feb 1973 (AMSBS stn), AM P22809 (1 ♂).

Diagnosis. Head, pereonites, pleon, telson, uropods and basis of pereopod 1 each with a more or less rectangular dorsal pigment patch occupying greater part of each segment. Patches are without clear areas, their margins well defined. Pigment extends laterally on pereonites 2 and 3 as narrow bands (further in males).

Pereopod 1 subchelate; article 6 elongate-ovoid, its palm oblique, with broadly based proximal projection opposing a boss at base of unguis.

Uropodal exopod obtusely notched. Telson twice as long as wide, widest about two-thirds way along and with broadly rounded apex bearing about 20 setae.

Distribution. New South Wales, 3-66 m.

Remarks. The rectangular dorsal pigment patches characterise *Mesanthura dianella*. The telson has an especially broad apex, its pigment distally truncate.

Mesanthura libertia sp. nov.

Figures 2d, 9

Material examined. 4 juveniles, 4.6-12.0 mm; 2 ♂♂, 10.3 mm:

Holotype: juvenile, 12.0 mm, NMV J4165. Bass Strait, BSS stn 170 (38°52'S., 148°26'E.), 130 m, muddy sand, 15 Nov 1981.

Paratypes: Bass Strait, type locality, 140 m, NMV J4166 (2 ♂♂, 3 juveniles).

Diagnosis. Head with diffuse pigment pattern, concentrated posterolaterally. Pereonites and pleon with an elongate pigment patch; 2 clear areas on pereonite 3, 3 clear areas on pereonites 4-7 (central one contiguous with anterior margin on pereonite 7). Telson and uropods with pigment patches, that on telson paralleling the distal margin.

Pereopod 1 subchelate; article 5 produced; article 6 elongate-rectangular, palm oblique with serrated step; dactyl with slight boss at the base of the unguis.

Uropodal exopod notched. Telson more than twice as long as wide, widest just beyond midpoint, lateral margins evenly convex and tapering to rounded apex.

Distribution. Eastern Bass Strait, 130-140 m.

Remarks. The triplet of clear areas on the posterior pereonite pigment patches separate *Mesanthura libertia* from all others in the region. But *M. miersi* is morphologically similar and of a similar size.

Mesanthura miersi (Haswell)

Figures 2e, 10, 11

Anthura Miersii Haswell, 1884: 1003 (listing only).

Paranthura Miersi Haswell, 1884: 1012, pl. 53 figs. 2-5.

Paranthura miersi.–Barnard, 1925: 145 ("undoubtedly a *Mesanthura*").

Mesanthura maculata.–Barnard, 1925: 144, fig. 9b.

Material examined. Unique.

Holotype: Juvenile, 11.5 mm, AM P3318 (with 2 slides). NSW, labelled "*Paranthura miersii*, Port Jackson".

Diagnosis. "Each of the segments is marked with a large patch of blackish purple" (Haswell, 1884).

Pereopod 1 subchelate; article 5 produced; article 6 elongate-ovoid, palm axial, convex but not stepped; dactyl with a boss at base of unguis.

Uropodal exopod notched. Telson little more than twice as long as wide, widest at about midpoint, lateral margins evenly convex and tapering to a narrow apex.

Distribution. New South Wales. Port Jackson.

Remarks. The presumed type specimen, illustrated here in some detail, has lost most of its dorsal pigmentation. However, the margins of the pigment patches can be seen and distinguish it from the morphologically very similar *M. libertia* from Bass Strait.

Barnard's (1925) figure of a topotypic specimen of *Mesanthura maculata* is consistent with the specimen figured here. This specimen cannot now be found. Whitelegge's (1901) use of *Anthura affinis* Chilton for a specimen from the 'Thetis' collection is possibly synonymous with *M. miersi* (Barnard attributed it to *M. maculata*). Haswell (1884) used both the names *Paranthura Miersi* and *Anthura Miersii* in his paper. The latter appears only in an introductory list of species and is disregarded in favour of the former.

Mesanthura moroea sp. nov.

Figures 3a, 12a

Material examined. 3 mancas; 12 juveniles, 4.5-12.0 mm; 2 ♂♂, 8.8-9.1 mm:

Holotype: juvenile, 5.3 mm, NMV J4449. Vic., 1 km E. of Harmers Haven, 300 m offshore (38°40.0'S., 145°34.5'E.) 5-6 m, sponge epifauna, R. Wilson and C. Larsen, 6 Mar 1982 (CPA stn 15).

Paratypes: Vic., type locality, NMV J4450(1). Harmers Haven, intertidal, algal epifauna, G. Poore, 6 Mar 1982 (CPA Stn 23), NMV J4451(1).

NSW, off Snapper Point, Kailoa (35°34'S., 150°23'E.), 20 m, algae, J.K. Lowry and R. Springthorpe, 24 Apr 1981 (stn NSW-15), AM P32682(1). Morna Point (32°47'S., 152°07'E.), tide pool open to sea, 4 m, dictyotalean alga,

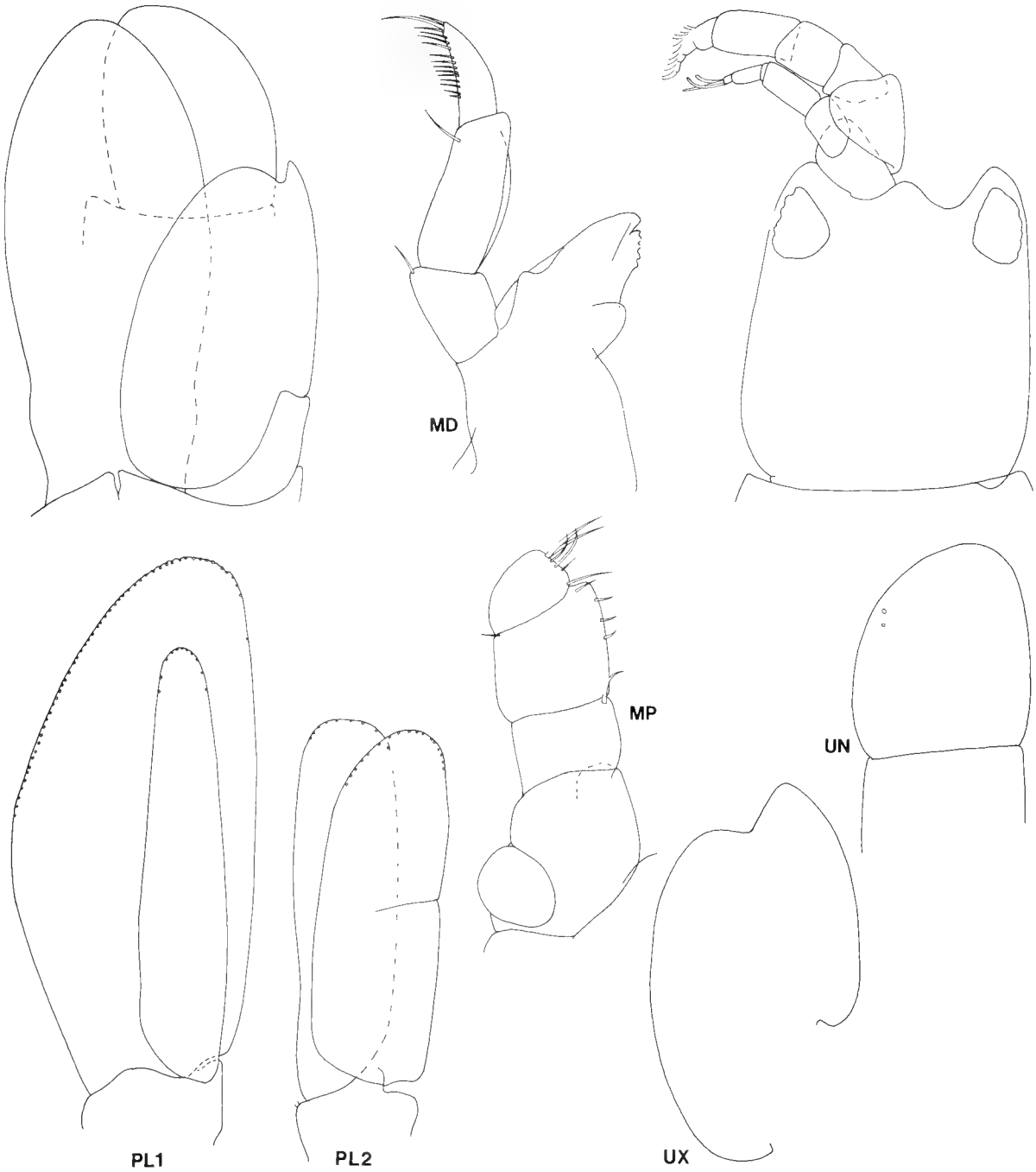


Figure 10. *Mesanthura miersi*. Holotype juvenile, 11.5 mm.

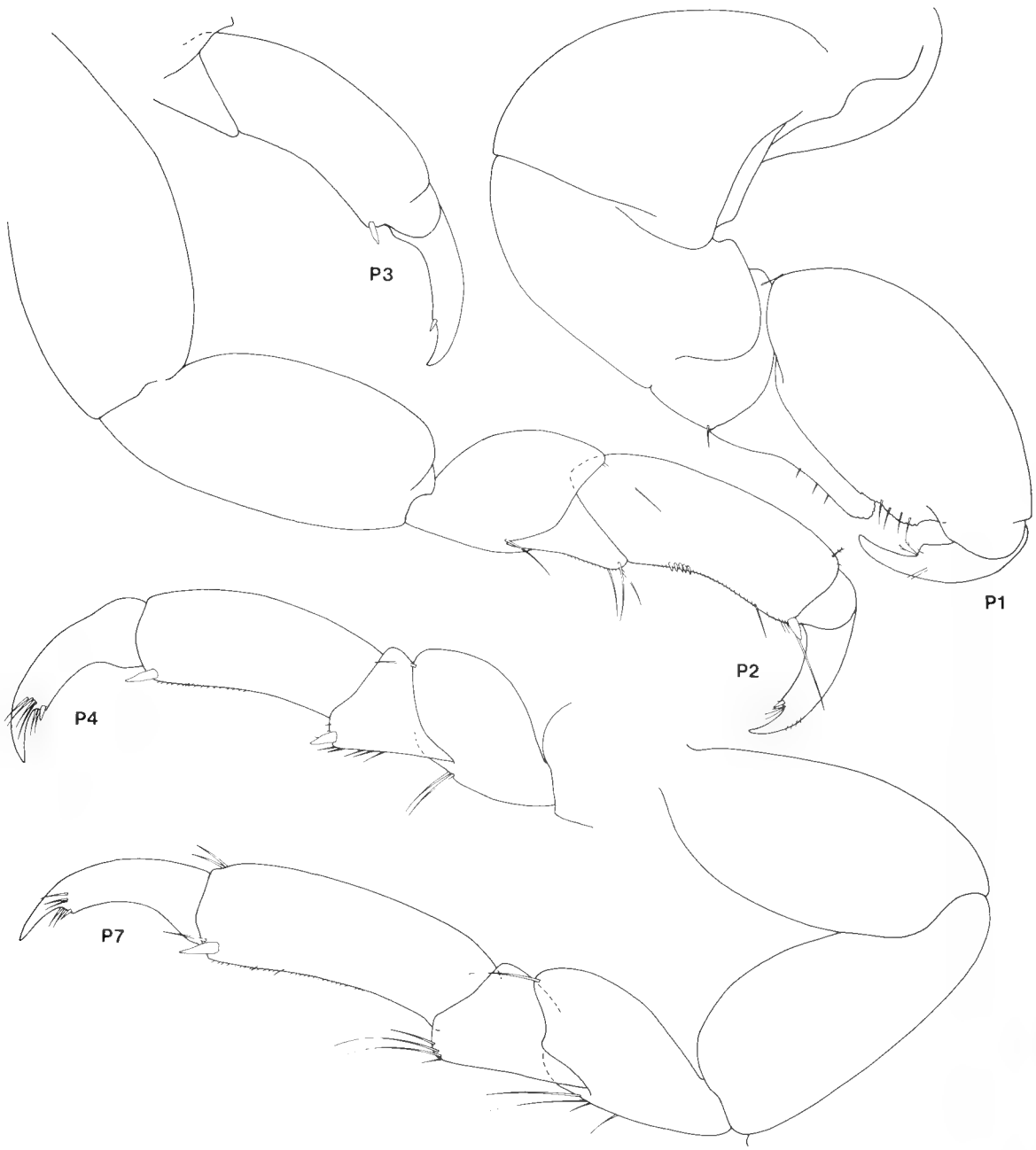


Figure 11. *Mesanthura miersi*. Holotype juvenile, 11.5 mm.

Figure 12. a, *Mesanthura moroea*. Holotype juvenile, 5.3 mm (pereopod 1 detail from paratype juvenile, 10.3 mm NMV J4677). b, *Mesanthura romulea*. Holotype juvenile, 7.7 mm; c, mesial view of palm and dactyl.

J.K. Lowry and G. Poore, 16 Jan 1981, (Stn NSW-142), AM P33833(4). Morna Point, 1 m, *Sargassum*, (stn NSW-141), AM P33885(2). Morna Point, 1-2 m, filamentous red algae (stn NSW-144), NMV J4697(4). Morna Point, 1 m, *Ecklonia* holdfasts (stn NSW-143), AM P33886(2). Morna Point, low tide, *Colpomenia* (stn NSW-138), AM P33884(1).

Other material. Tas. Dover Jetty, 2 m, R.S. Wilson, 27 Apr 1985, NMV J11979(1).

Diagnosis. Pigmentation uniformly dark brown over entire dorsal and lateral surface. Ventrally with longitudinal unpigmented stripe, narrowest on pereonite 1; exopods of pleopod 1 pigmented. First 2 articles of both pairs of antennae and basis of pereopod 1 pigmented; uropods and telson pigmented except apically.

Pereopod 1 subchelate; article 5 barely produced; article 6 elongate, widest distally, palm oblique, with square step (less pronounced on smaller specimens); dactyl simple.

Uropodal exopod notched. Telson more than twice as long as wide, widest at midpoint, lateral margins strongly convex and tapering to broadly rounded apex bearing 8 terminal simple setae.

Distribution. Tasmania, Victoria and New South Wales, shallow subtidal.

Remarks. Mesanthura moroea is distinguished from all other south-eastern Australian species by its dense all-over pigmentation. It is the only species which is difficult to distinguish from one previously described. *Mesanthura nigrodorsalis* Nunomura from Japan is similarly densely coloured and has a similar broad telson and oblique palm on pereopod 1. Nunomura (1977) described much larger specimens than any found locally.

Mesanthura romulea sp. nov.

Figures 3b, 12b

Material examined. 1 juvenile, 7.5 mm; 1 ♂, 7.7 mm:

Holotype: juvenile, 7.7 mm, AM P33881 (with one slide) NSW, Port Jackson, Bottle and Glass Rocks (33°51′S., 151°16′E.), 4 m, soft sediment, R. Springthorpe, 21 Mar 1982 (stn NSW-102).

Paratype: NSW, off Shoal Bay, Port Stephens (32°41′S., 152°09′E.), 2.5 m, *Posidonia australis* on coarse sand, P. Gibbs, 1 Sep 1976, AM P33883(1 ♂).

Diagnosis. Head, pereonites and pleon with extensive dorsal pigment patches, each irregularly perforated with clear areas. Pigment patches on uropod and proximally on telson.

Pereopod 1 subchelate; article 5 with toothed distal lobe; article 6 elongate, its palm oblique and concave with proximal toothed mesial projection; dactyl proximally broad, its posterior margin concave, with proximal toothed area and prominent, complexly toothed boss at base of unguis.

Uropodal exopod with only a shallow notch. Telson 2.5 times as long as wide, lateral margins barely dilating proximally; apex broadly rounded, with 6 apical setae.

Distribution. Central New South Wales coast; bays, subtidal.

Remarks. Mesanthura romulea is the only Australian species with a rather diffuse pigment pattern. Its first pereopod is diagnostic, particularly in having such a complex palm and dactyl.

Mesanthura stypandra sp. nov.

Figures 3c, 13

Material examined. 5 juveniles, 1 ♂, 3.8-6.2 mm:

Holotype: juvenile, 6.2 mm, NMV J4445 (with one slide). Vic., Twin Reefs, near Inverloch (38°41′S., 145°39′E.), gutters near LWM, algae and holdfasts, G. Poore and R. Wilson, 2 Mar 1982 (CPA stn 20).

Paratypes: Vic., type locality, NMV J4446(1). "Harry's Hole" W. of type locality, 9 m, R. Wilson et al., 6 Mar 1982 (CPA stn 8), NMV J4447(1). Aireys Inlet (38°28′S., 144°06′E.), W.F. Seed, Jan 1963, NMV J4448(1).

SA, Giles Point, near boat ramp (35°03′S., 137°46′W.), 0.5 m, tufted algae on limestone reef, G.C.B.Poore, 19 Mar 1985 (stn SA-38), NMV J11576(1 juvenile). "The Hotspot", reef 8 km W. of N. end of Flinders Is. (33°40.5′S., 134°22.0′E.), 17 m, assorted larger algae, S.A.Shepherd, 19 Apr 1985 (stn SA-65), NMV J11577(1 ♂).

Diagnosis. Head and pereonites with transverse dorsal rectangle-oval of pigment perforated essentially by pair of large oval clear areas; this becomes increasingly more diffuse posteriorly. Pleon and pleonite 6 with transverse band of pigment. Uropods, telson and basis of pereopod 1 with small pigmented areas. Dorsal pigment patches on pereonites 1-6 may extend laterally as short bands.

Pereopod 1 subchelate; article 5 with short toothed distal lobe; article 6 ovate, palm

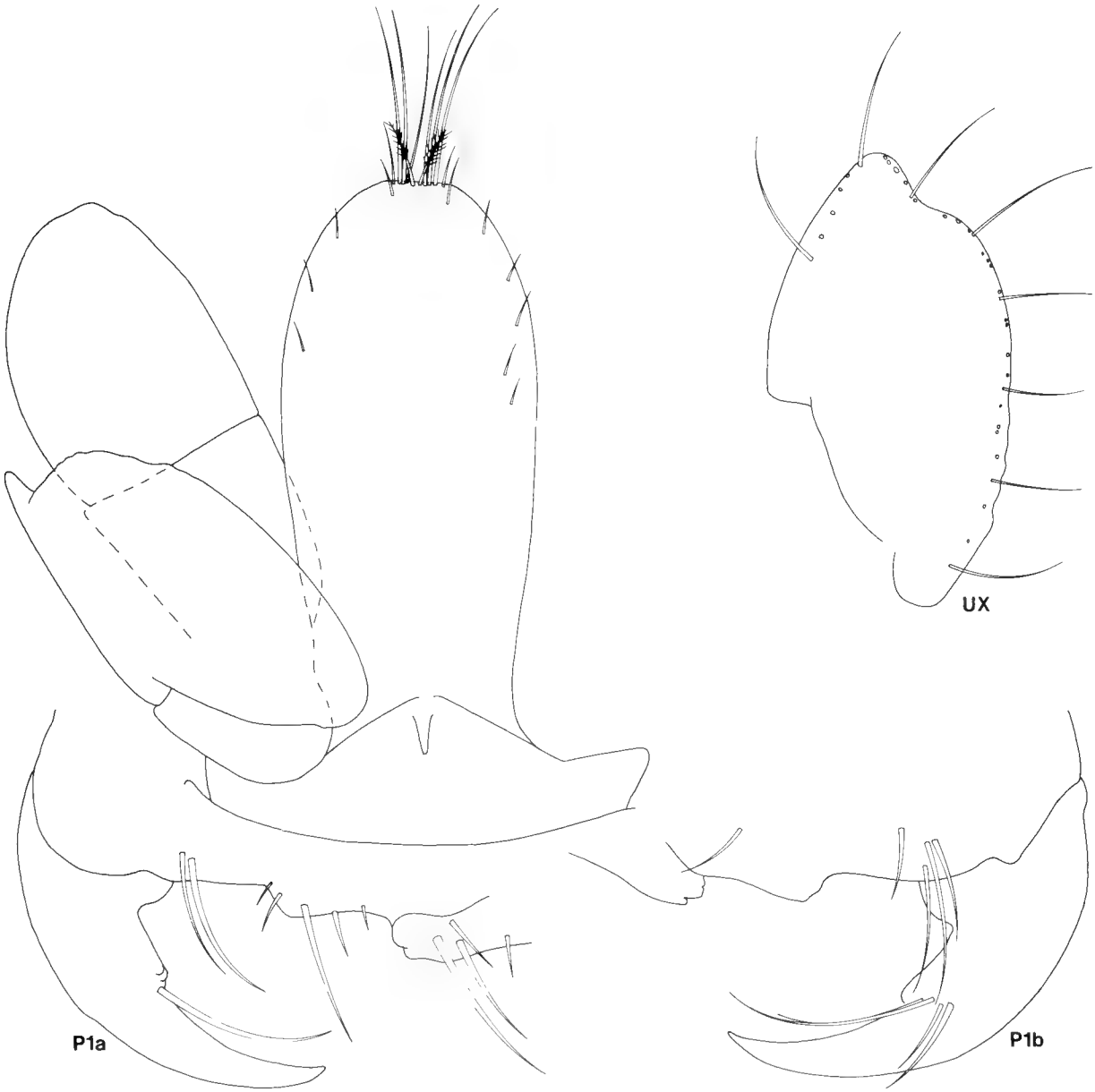


Figure 13. *Mesanthura stypandra*. Holotype juvenile, 6.2 mm; a, lateral view of palm and dactyl; b, mesial view of palm and dactyl.

oblique, with simple convexity; dactyl with simple boss at base of unguis.

Uropodal exopod only slightly excavate distally. Telson little more than twice as long as wide, widest just beyond midpoint, proximally broad, apex broadly rounded, almost truncate.

Distribution. Victoria and South Australia, subtidal.

Remarks. Mesanthura stypandra and *M. astelia* share paired clear areas on the head and pereonites. The latter is much larger and with more extensive pigment areas.

Acknowledgements

This contribution was made possible through a grant from the Australian Biological

Resources Study. We are especially grateful to G. Milledge who prepared figures 2 and 3 and inked all other figures. For the loan of material we thank J. Lowry (Australian Museum), W. Zeidler (South Australian Museum), A. Green (Tasmanian Museum) and T. Kikuchi (Amakusa Marine Biological Laboratory, Japan).

The collections of the Bass Strait Study were made possible by a Marine Sciences and Technologies Grant to the National Museum of Victoria. We are indebted to the Department of Science and Technology for this support and to R. Wilson for processing the samples.

References

Barnard, K.H. 1925. A revision of the Family Anthuridae (Crustacea Isopoda), with remarks on certain morphological peculiarities. *J. Linn. Soc.* 36: 109-60.

Burbanck, W.D. & Burbanck, M.P., 1961. Variations in the dorsal pattern of *Cyathura polita* (Stimpson) from estuaries along the coasts of eastern United States and the Gulf of Mexico. *Biol. Bull. mar. biol. Lab., Woods Hole* 121: 257-64.

Hale, H.M., 1929. *The Crustaceans of South Australia. Part II.* Government Printer, Adelaide.

Haswell, W.A., 1881. On some new Australian marine Isopoda. Pt. 1. *Proc. Linn. Soc. N.S.W.* 5: 470-81.

Haswell, W.A., 1882. *Catalogue of the Australian stalk-and sessile-eyed Crustacea.* Australian Museum, Sydney.

Haswell, W.A., 1884. A revision of the Australian Isopoda. *Proc. Linn. Soc. N.S.W.* 9: 1001-14.

Hurley, D.E., 1961. A checklist and key to the Crustacea Isopoda of New Zealand and the Subantarctic Islands. *Trans. R. Soc. N.Z., Zool.* 1: 259-92.

Kensley, B., 1980. Anthuridean isopod crustaceans from the International Indian Ocean Expedition, 1960-1965, in the Smithsonian Collections. *Smithson. Contr. Zool.* 304: 1-37.

Kensley, B. & Poore, G.C.B., 1982. Anthurids from the Houtman Abrolhos Islands, Western Australia (Crustacea: Isopoda: Anthuridae). *Proc. biol. Soc. Wash.* 95: 625-36.

Kirtisinghe, P., 1931. Note on an isopod (*Mesanthura maculata*) new to the fauna of Ceylon. *Spolia zeylanica* 16: 129-30.

Nunomura, N., 1977. Marine Isopoda from Amakusa, Kyushu (I). *Publ. Amakusa mar. biol. Lab.* 4: 71-90.

Pillai, K.N., 1966. Littoral and parasitic isopods from Kerala: Family Anthuridae – 1. *J. Bombay nat. hist. Soc.* 63: 152-61.

Poore, G.C.B., 1981. Paranthurid isopods (Crustacea, Isopoda, Anthuridea) from south eastern Australia. *Mem. natn. Mus. Vict.* 42: 57-88.

Poore, G.C.B., 1984. *Paranthura* (Crustacea, Isopoda, Paranthuridae) from south-eastern Australia. *Mem. Mus. Vict.* 45: 33-69

Poore, G.C.B. & Lew Ton, H.M., 1985a. *Apanthura, Apanthuretta* and *Apanthuropsis* gen. nov. (Crustacea: Isopoda: Anthuridae) from south-eastern Australia. *Mem. Mus. Vict.* 46: 103-51.

Poore, G.C.B., & Lew Ton, H.M., 1985b. New species of *Cyathura* (Crustacea: Isopoda: Anthuridae) from estuaries of eastern Australia. *Mem. Mus. Vict.* 46: 89-101.

Thomson, J.M., 1951. The fauna of Rottnest Island. X. Anthuridae. *J. Proc. R. Soc. West Aust.* 35: 1-8.

Tubb, J.A., 1937. Lady Julia Percy Island: Report of the Expedition of the McCoy Society for Field Investigation and Research. No. 18. Crustacea. *Proc. R. Soc. Vict.* 49: 408-11.

Wägele, J.W., 1981. Zur Phylogenie der Anthuridea (Crustacea, Isopoda) mit Beitragen zur Lebensweise, Morphologie, Anatomie and Taxonomie. *Zoologica Stuttg.* 132: 1-127.

Wägele, J.W., 1984. Redescription of K.H. Barnard's three species of *Mesanthura* (Crustacea: Isopoda: Anthuridea). *J. nat. Hist.* 18: 389-403.

Whitelegge, T., 1901. Scientific results of the trawling expedition of H.M.C.S. 'Thetis' off the coast of New South Wales . . . Crustacea. Part II. Isopoda. Part 1. *Mem. Aust. Mus.* 4: 203-46.

ISSN 0814-1827

MEMOIRS

of the

MUSEUM OF VICTORIA

MELBOURNE AUSTRALIA

Memoir 47
Number 2
January–May 1986

PUBLISHED BY ORDER OF THE COUNCIL

Printed by Brown Prior Anderson Pty Ltd Burwood Victoria

CONTENTS

NUMBER 2

Memoirs of the Museum of Victoria 47(2): 105-200 (1986) ISSN 0814-1827

REVISION OF THE AUSTRALIAN SPECIES OF THE GENUS *HOMALICTUS* COCKERELL (HYMENOPTERA: HALICTIDAE)

By K. L. Walker

Department of Entomology, Museum of Victoria, 71 Victoria Cres., Abbotsford, Melbourne, Victoria 3067, Australia

Abstract

Walker, K. L., 1986. Revision of the Australian species of the genus *Homalictus* Cockerell (Hymenoptera: Halictidae). *Mem. Mus. Vict.* 47: 105-200.

Australian members of the genus *Homalictus* Cockerell are revised. A total of 39 species, 10 of them new, are recognised. Identification keys, diagnoses, descriptions or redescriptions are provided for all but one species. Distribution patterns are outlined and notes are provided on nesting behaviour, flowers visited and parasites. The genus *Homalictus* is redescribed and the synonymy of the subgenus *Indohalictus* Blüthgen is discussed. A new subgenus, *Quasilictus* , is erected to accommodate the new species *H. brevicornutus* . The following are considered to be new synonyms: *H. formosus* (Rayment), *H. formosulus* Michener of *H. bremerensis* (Rayment); *H. botanicus* (Rayment), *H. portlandicus* (Rayment) of *H. brisbanensis* (Cockerell); *H. rufoaeneus* (Friese), *H. viridinitens* (Friese) of *H. caloundrensis* (Cockerell); *H. occidentalis* (Rayment), *H. codenticalis* (Rayment) of *H. dotatus* (Cockerell); *H. hilli* (Cockerell) of *H. flindersi* (Cockerell); *H. dixoni* (Rayment), *H. hentyi* (Rayment), *H. sevillensis* (Rayment) of *H. megastigmus* (Cockerell); *H. oxoniellus* (Cockerell), *H. mesocyaneus* (Cockerell), *H. raymenti* (Cockerell), *H. tarltoni* (Cockerell), *H. aureoazureus* (Rayment), *H. littoralis* (Rayment) of *H. niveifrons* (Cockerell); *H. exlautus* (Cockerell), *H. hedleyi* (Cockerell), *H. pallidifrons* (Rayment), *H. subpallidifrons* (Rayment), *H. phillipensis* (Rayment) of *H. punctatus* (Smith); *H. limatus* (Smith), *H. humilis* (Smith), *H. burkei* (Cockerell), *H. demissus* (Cockerell), *H. limatiformis* (Cockerell), *H. humiliformis* (Cockerell) of *H. sphecodoides* (Smith); *H. eyrei* (Cockerell), *H. darwinensis* (Cockerell) of *H. sphecodopsis* (Cockerell); *H. saycei* (Cockerell) of *H. tatei* (Cockerell); *H. baudinensis* (Cockerell), *H. kesteveni* (Cockerell), *H. hackeriellus* (Cockerell), *H. pavonellus* (Cockerell), *H. olivinus* (Cockerell), *H. lomatiae* (Cockerell), *H. microchalceus* (Cockerell), *H. subcarus* (Cockerell), *H. williamsi* (Cockerell), *H. suburbanus* (Cockerell) of *H. urbanus* (Smith); *H. transvolans* (Cockerell) of *H. woodsi* (Cockerell). Ten new species are described: *H. atrus, H. brevicornutus, H. exleyae, H. exophthalmus, H. forrestae, H. grossopedalus, H. houstoni, H. imitatus, H. multicavus* and *H. pectinalus* . Males of the following species are described for the first time: *H. behri* (Cockerell); *H. bremerensis; H. callaspis* (Cockerell); *H. caloundrensis; H. cassiaefloris; H. dotatus; H. eurhodopus* (Cockerell); *H. megastigmus; H. murrayi* (Cockerell); *H. scrupulosus* (Cockerell); *H. sphecodoides; H. stradbrokensis* (Cockerell); and *H. tatei. Halictus littoralis* Rayment, 1935 is recognised as a homonym of *H. littoralis* Blüthgen, 1923. *Homalictus appositus* (Rayment) and *H. purpureus* (Rayment) are assigned to *Lasioglossum (Chilalictus)*. Lectotypes have been selected for the following species: *H. cassiaefloris, H. indigoteus, H. niveifrons, H. rowlandi* (Cockerell), *H. saycei, H. urbanus*, and *H. viridinitens*.

Introduction

Bees of the genus *Homalictus* Cockerell are found from Sri Lanka and south-east Asia, eastward across the Pacific to the islands of Marianas and Samoa, although their centre of abundance is in Australia (Michener, 1965; 1980a). Within Australia they occur in all faunal provinces and are most prevalent around flowers of the plant family Myrtaceae. They are not, however, restricted to this family as the floral records show (see Biology).

Cockerell (1919a: 13) erected the subgenus *Homalictus* for three Philippine species of *Halictus* in which "males resembled the females". Michener (1965) concluded that the genus *Halictus* did not occur in the Malayan region, East Indies or Australia and reassigned all *Halictus* species in these areas to *Homalictus* and *Lasioglossum*. Most of the Australian "Halictus" described under the subgenus *Chloralictus* were placed in *Homalictus* (raised to generic rank by Michener) and *Lasioglossum (Chilalictus)*.

Blüthgen (1931: 291) introduced the subgenus *Indohalictus* for certain *Halictus* in the Indomalayan region. Krombein (1951) and Pauly (1980) used this taxon for halictids of the Solomon and Indomalayan Islands respectively and provided additional characters to aid subgeneric recognition. Michener (1965) synonymised the subgenus and (1980a) again commented that every character used showed intergradation with *Homalictus* proper, in particular when applied to the Australian situation.

The first Australian species of *Homalictus* was described (in *Halictus*) by Smith in 1853. Since that time, Cockerell, Friese, Rayment and Michener have described further species with most described by Cockerell from 1905 to 1930. Cockerell (1933) produced a key to all Australian "*Halictus*" and provided the last comprehensive review of the species.

Institutions and collections

The following abbreviations are used for museums and other institutions holding specimens examined in this study.

AMNH	American Museum of Natural History, New York
ANIC	Australian National Insect Collection, Canberra
Berlin	Institut für Spezielle Zoologie und Zoologisches Museum der Humbolt Universitat, Berlin
BPBM	Bernice P. Bishop Museum, Honolulu, Hawaii, USA
BMNH	British Museum (Natural History), London
CAS	California Academy of Sciences, San Francisco
HNHM	Hungarian Natural History Museum, Budapest
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA
MZUS	Musée Zoologique de l'Université, Strasbourg
USNM	National Museum of Natural History, Smithsonian Institution, Washington, DC, USA
NMV	Museum of Victoria, Division of Natural History, Melbourne, Victoria
QDPI	Queensland Department of Primary Industries, Brisbane and Mareeba, Queensland
QM	Queensland Museum, Brisbane, Queensland
UQIC	University of Queensland Insect Collection, Brisbane, Queensland
SAM	South Australian Museum, Adelaide, South Australia
WAM	Western Australian Museum, Perth, Western Australia

Terminology, methods and measurements

The terminology used in descriptions follows Michener (1965) except that the apparent abdomen is called gaster, not metasoma. The basitarsal comb is defined as a row of setae distinct from the surrounding vestiture, along the outer apical margin of each fore basitarsus.

The sexes were associated on the basis of morphological similarity and coincident collection data. None were taken in copula.

For detailed studies on the labrum, galeae, genitalia and gastral sternum VI, these were dissected from the specimens, boiled in 10% (w/v) KOH for approximately 30 minutes, passed through two water washes, acidulated in glacial acetic acid and transferred to a drop of glycerine on a slide. The dissections were preserved in glycerine in microvials attached to the specimen pin.

All drawings were done by the author using a Wild M7 binocular and a Wild 20EB compound microscope. Head, scutal and propodeal drawings were done on the binocular using a squared grid; genitalic and gastral sternum VI drawings on the compound using a camera lucida.

Measurements were made from dried, pinned material using a micrometer eyepiece. Apart from the body length and forewing length (expressed in millimetres), all measurements are relative.

The following abbreviations are used in the text:

BP: Hind basitibial plate
TS: Inner tibial spur on hind leg

Distances:
BL: Body length: distance from antennal sockets to posterior end of gaster
FL: Forewing length: proximal end of costal vein to distal tip of wing
AOD: Antennocular distance: shortest distance from inner eye margin to rim of antennal socket
IAD: Interantennal distance: shortest distance between inner margins of antennal sockets
OAD: Ocellantennal distance: shortest distance between posterior margin of antennal socket and anterior margin of median ocellus
IOD: Interocellar distance: shortest distance between inner margins of rear ocelli
OOD: Ocellocular distance: shortest distance between upper inner margin of eye and ipsilateral rear ocellus
UID: Upper interorbital distance: shortest distance between upper inner margins of eyes
LID: Lower interorbital distance: shortest distance between lower inner margins of eyes

Ratios:
Fg:UID: Ratio of flagellum length to upper interorbital distance in males only
EW:GW: In side view, ratio of greatest width of eye to greatest width of gena

Punctation abbreviations

dense: Interspaces between punctures less than diameter of puncture
close: Interspaces between punctures equal to diameter of puncture
open: Interspaces between punctures greater than 1× but less than 2× diameter of puncture
sparse: Interspaces between punctures equal to or greater than 2× diameter of puncture.

Phenological data (PD)

Months of the year are represented in numerical order, e.g., 1–January; 12–December.

Floral Record (FR)

Biology

Nesting

Information on the nesting behaviour is scanty. Rayment (1935) and Knerer and Schwarz (1976) produced nest diagrams of several species of *Homalictus* but provided little information on colony size or behaviour. Dr T.F. Houston (WAM) has supplied the following notes on *Homalictus* nests and behaviour.

"–Tusmore (Adelaide suburb), 24 Dec. 1965, *Homalictus urbanus* (SAM).

Two nest entrances were found in hard, flat, bare soil near a shed. Females were busy trafficking to and fro. At one stage, 22 females were counted entering a nest before a single

female departed. Many carried pollen. 26 Dec. Small ants attacking one entrance had caused a build up of returning females which hovered around. I killed and removed all ants and at once the bees began entering. 54 were counted entering before one emerged.

At the other entrance, when bee traffic was busy, I placed an aluminium foil disc with a central hole over it. This permitted bees to exit but deterred them from entering. 80 females were counted leaving without any others entering. When the disc was removed, 80 females entered in a space of a few minutes and most (if not all) carried pollen. As insufficient time to collect a pollen load had elapsed between departure of the first females (when the disc was put on) and entry of females, two separate lots of 80 would have been counted. Thus the nest was inhabited by at least 160 females.

–Near Beerburrum, Qld. 10 July, 1968.

Several cells found in soil between roots of fallen eucalypt tree. Nest identified by dead female in one cell.

–Mt Davies Bore, N.W. South Australia. 20 Oct., 1972.

Numerous females found entering and leaving a single entrance amongst leaf litter on creek bank. Soil was sandy loam, dry down to 65 cm where it became moist. Shaft was smooth and regular but unlined. It followed an irregular path down to the moist zone where it was lost. Several branches were also lost before being traced more than a few cm. Adult bees were found in all tunnels. Many escaped but 55 females and 2 males were captured. Only one cell was found (110 cm depth). It was empty and had smooth polished walls. None of the females entering the nest appeared to carry pollen. (*H. urbanus* det. author; specimens in WAM)

–Victory Well, Everard Park Stn. South Australia. 25th Oct., 1972.

I dug a garbage pit in flat sandy loam in the late afternoon. Later numerous halictids were found hovering in the pit and some entered small holes and did not re-emerge. Next morning many more bees were hovering in the pit. A section of the pit wall was excavated. Numerous short tunnels were opened containing one to several females but no cells were found. None of the flying females carried pollen. Most of the bees were *Homalictus* (*H. dotatus* det. author; specimens in WAM) but a few were *Lasioglossum (Chilalictus)*.

–Coward Springs, N.W. of Marree, South Australia. 28th Oct., 1972.

Numerous nest entrances were found in a flat area of ground adjacent to a small stream flowing from a mound spring. Most entrances were concealed beneath small lumps of sand crust but two were in the side of a soil lump. One of these was excavated.

The sand had a dry crust but was damp and cheesy below. The shafts extended vertically to 20 cm depth and had several lateral burrows, mainly at 9-13 cm depth. About 10 females escaped from these burrows but 3 were captured to enable identification. Numerous cells were found between 9-14 cm depth. They were ovoid and more or less horizontal, with smooth, shiny internal walls but were not separable from the surrounding soil. Some were open and being provisioned while others were sealed and contained pollen balls and eggs, small feeding larvae or mature larvae. Pollen balls were subspherical, moist and soft. At least 5 linear cell pairs separated by soil plugs were found. (*H. urbanus* det. author; specimens in SAM)

The internal surfaces of *Homalictus* cells were polished to a degree that they appeared to be wax-lined as is usual amongst halictid bees." The author has found few nest sites but has observed the following: - Anglesea (Victoria), 20 March 1982.

Numerous nest entrances in clay soil on the vertical surfaces of both sides of a boat ramp. Most were *Lasioglossum (Chilalictus)* spp. with *Homalictus sphecodoides* intermixed. Little activity was seen at any nest. A mutillid wasp was observed walking over the nesting site but did not enter nests. In the late afternoon, a number of males of *H. sphecodoides* were seen clinging onto tall grass stems approximately 6 meters from the nest site. Males were randomly positioned throughout the clump of grass and showed no signs of aggregating.

–Sandringham (Victoria), 3 March 1985.

Three single nest sites (each at least 1 metre

apart) were observed in bare areas of white clay soil. The nests were found by spotting swarming clusters of about 20 to 30 males hovering a few centimetres above the nest entrance. At one entrance, three females (without a pollen load) were seen entering – these were not disturbed by the males. Species identified as *H. urbanus*

The nesting observations indicate that *Homalictus* has a communal nesting behaviour similar to that recorded by Cardale and Turner (1966) for *Lasioglossum (Chilalictus) leai*. From the observations provided by Houston and those made on *L. (Chilalictus)* (author's unpublished notes and Schwarz pers. comm.), a number of differences between the nesting behaviour of both genera are worth noting.

The number of females using a single nest entrance varies markedly between genera. Cardale and Turner (1966) recorded between 2 and 23 bees in each nest and the author has found less than 20 bees in nests of *Lasioglossum (Chilalictus)*. Houston observed at least 160 females using the single entrance in the Tusmore nest and other nests of *Homalictus* have contained at least 30 females (Schwarz pers. comm.).

Rayment (1935), Schwarz (pers. comm.) and Walker (unpublished notes) have all observed female guards at the entrances to nests of *Lasioglossum (Chilalictus)* spp.. Flightless macrocephalic males of *Lasioglossum (Chilalictus) erythrurum* in artificial nests have also been observed acting as guards (Schwarz, pers. comm). To date no such female guard bee behaviour or flightless macrocephalic males have been recorded for *Homalictus*.

Brood cells of *Homalictus* usually occur singly at the end of lateral tunnels. Cells of *L. (C.) erythrurum* are often clustered in groups of 8 to 10 and may be lifted out of the soil attached to each other. This is not the case for all *L. (Chilalictus)*. Single cells or linear series of cells (pers. obs.) at the end of lateral tunnels are usual for *L. (C.) lanarium* although the main tunnel shaft of these bees is straight whereas in *Homalictus* and other *L. (Chilalictus)* the main shaft is multi-branched (Schwarz pers. comm.).

Floral Records

Following is a list of flowers visited by *Homalictus* specimens examined in this study. The families and genera within families are presented in alphabetical order and the data from all records has been compiled and incorporated with the following list. These results should not be used to determine oligolectic species, but do indicate a preference of *Homalictus* for the Myrtaceae plant family. The data are presented as such–Family (% visited expressed as: total number of family records/total number of all family records): Genus (number of species of *Homalictus* recorded).

Aizoaceae (>1.0%): *Mesembryanthemum* (1 sp.). Anacardiaceae (1.7%): *Schinus* (3 spp.). Amaranthaceae (>1.0%): *Ptilotus* (1 sp.). Asteraceae (>1.0%): *Helichrysum* (1 sp.). Boraginaceae (>1.0%): *Tournefortia* (1 sp.). Caesalpiniaceae (1.2%): *Cassia* (2 spp.). Campanulaceae (1.4%): *Wahlenbergia* (2 spp.). Chrysobalanaceae (>1.0%): *Parinari* (1 sp.). Combretaceae (2.9%): *Terminalia* (5 spp.). Compositae (2.9%): *Artopheca* (1 sp.), *Helipterum* (1 sp.), *Hypochoeris* (1 sp.), *Ixodea* (1 sp.), *Osteospermum* (1 sp.). Dilleniaceae (>1.0%): *Hibbertia* (1 sp.). Epacridaceae (>1.0%): *Leucopogon* (1 sp.). Euphorbiaceae (1.2%): *Claoxylon* (1 sp.), *Securinega* (1 sp.). Frankeniaceae (>1.0%): *Frankenia* (1 sp.). Goodeniaceae (1.7%): *Goodenia* (1 sp.), *Scaevola* (1 sp.), *Velleia* (1 sp.). Gyrostemonaceae (>1.0%): *Codonocarpus* (1 sp.). Haemodoraceae (>1.0%): *Anigozanthos* (1 sp.). Hydrocotylaceae (>1.0%): *Trachymene* (1 sp.). Labiatae (>1.0%): *Dysophylla* (1 sp.). Loranthaceae (3.4%): *Amyema* (6 spp.). Malvaceae (1.2%): *Hibiscus* (1 sp.), *Lagunaria* (1 sp.). Mimosaceae (4.0%): *Acacia* (7 spp.). Myoporaceae (2.9%): *Eremophila* (4 spp.). *Myoporum* (1 spp.). Myrtaceae (43.8%): *Angophora* (7 spp.), *Callistemon* (4 spp.), *Calothamnus* (1 sp.), *Calytrix* (1 sp.), *Eucalyptus* (22 spp.), *Eugenia* (4 spp.), *Leptospermum* (7 spp.), *Melaleuca* (12 spp.), *Syncarpia* (2 spp.), *Syzygium* (1 sp.), *Thryptomene* (5 spp.), *Tristanopsis* (10 spp). Onagraceae (>1.0%): *Oenothera* (1 sp.). Papilionaceae (4.0%): *Dalbergia* (1 sp.), *Daviesia* (1 sp.),

Dillwynia (1 sp.), *Gastrolobium* (1 sp.), *Hardenbergia* (1 sp.), *Jacksonia* (1 sp.), *Pongamia* (1 sp.), *Swainsonia* (1 sp.). Pittosporaceae (3.4%): *Bursaria* (4 spp.), *Pittosporum* (2 spp.). Portulacaceae (1.2%): *Calandrina* (2 spp). Proteaceae (4.0%): *Banksia* (1 sp.), *Grevillea* (1 sp.), *Hakea* (1 sp.), *Lomatia* (2 spp.). Ranunculaceae (>1.0%): *Ranunculus* (1 sp.). Rhamnaceae (>1.0%): *Alphitonia* (1 sp.). Rosaceae (1.2%): *Cotoneaster* (1 sp.), *Malus* (1 sp.). Rubiaceae (1.7%): *Borreria* (2 spp.), *Canthium* (1 sp.). Rutaceae (>1.0%): *Boronia* (1 sp.). Santalaceae (>1.0%): *Eucarya* (1 sp.). Sapindaceae (4.0%): *Atalaya* (6 spp.), *Heterodendron* (1 sp.). Scrophulariaceae (>1.0%): *Morgania* (1 sp.). Sterculiaceae (2.3%): *Brachychiton* (2 spp.), *Keraudrenia* (1 sp.), *Lasiopetalum* (1 sp.). Strelitziaceae (>1.0%): *Strelitzia* (1 sp.). Tremandraceae (>1.0%): *Tetratheca* (1 sp.). Violaceae (>1.0%): *Dioceirea* (1 sp.). Xanthorrhoeaceae (2.3%): *Xanthorrhoea* (4 spp).

The floral record illustrates the diversity of *Homalictus* forage plants (78 genera). Most of these records represent a single collection in a particular area and therefore the species floral record is partially dependent on what was in flower at that time. An accurate floral record would require repeated visits to the same areas at different times of the year. *Homalictus etenander* is the only species to show a preference for a plant family other than Myrtaceae. Most of the 85 specimens examined were captured on *Amyema* (Loranthaceae). The remainder, however, were recorded on eight different plant families (including Myrtaceae).

Phenological Data

Phenological data is included with each species description. Restricted activity periods should not be inferred from this data as many records represent single catches at a given locality or the species is known from few specimens. In general, apart from the cold winter months, particularly in the south central and south east parts of Australia, *Homalictus* spp. have been recorded flying in most months of the year.

Parasites and associated organisms

Strepsiptera: Evidence of parasitic attack b Strepsiptera on the gaster of adult *Homalictu* was found on a number of specimens: all had single strepsipteran on the dorsal surface of th gaster between the fourth and fifth terga (ex cept for one between the fifth and sixth terga).

Acarina: Large numbers of hypopia nymphs were found on the bodies of som *Homalictus* adults. The mites belonged to th Sarcoptiformes, family Saproglyphidae, an were positioned on the bees in areas (ofte forming layers on top of each other) that woul be difficult to clean. The most favoured posi tions were the vertical posterior surface of th propodeum and on the gastral tergum I. Others were found in the folds at the bases o the wings, on the sides of the propodeum, dorsally on the pronotum and concealed beneath the hind margins of the gastral terga.

Homalictus Cockerell

Figures 1-27

Homalictus Cockerell, 1919a: 13.–Krombein, 1950: 109-10.–1951: 279.–Michener, 1965: 177-81.–1978: 310-11.–1979: 227-9.–1980a: 1-3.–1980b: 423.–Pauly, 1980:–11-15.–Walker, 1981: 32-4.

'Halicti nomioidiformes' Blüthgen, 1926: 465-7.

Indohalictus Blüthgen, 1931: 291.–Krombein, 1951: 279.–syn. by Michener, 1965: 178.–1980a: 2.–Pauly, 1980: 11-15.–Walker, 1981: 35-41.

Diagnosis. Gastral terga of female sharply folded laterally forming a distinct angle at margin between dorsal and ventral surfaces; scopal hairs always plumose (never branched) (cf. Figs 5b-g, e-g); gastral scopa comprised of sternal and tergal hair, sternal hair arranged in single or double transverse rows, hair apically plumose, tergal hair arranged in tufts, not forming transverse rows, shorter than sternal hair of corresponding segment, hair plumose along entire length; femoral scopal hair entirely plumose, originating at basal and apical areas on ventral surface of femora, hairs curved and overlap ventrally (Fig. 5i) (never originating along dorsal surface as in *Lasioglossum* s.lat., Fig. 5h); both sexes with comb of short spines on distal margin of galea (Fig. 5a);

male genitalia with gonobase continuing contours of gonocoxite (Figs. 13-23).

Differs from *Lasioglossum* s.lat. in: Female–(Scopal structure and position) *Homalictus* scopal hair comprises a central shaft along which lateral branches occur (plumose)(Figs. 5b-d), in *Lasioglossum* a basal shaft divides apically into several strands (branched)(Figs. 5e-g). (Primary pollen collecting site) *Homalictus*: gastral scopa; *Lasioglossum*: femoral scopae (cf. Figs. 5h, i). Male–The only diagnostic characters are those mentioned above. However, several other characters will aid separation. Gastral tergum I of *Homalictus* is impunctate except for minute punctures mesially on *H. urbanus*, *H. forrestae* and *H. murrayi*; gastral tergum I of *Lasioglossum* s.lat. is punctate across the entire surface except impunctate in *L. (Austrevylaeus* Michener) (distinguished by second transverse cubital vein narrower than first) and *L. (Australictus)* Michener) (distinguished by coarse reticulation on tergum I and lack of BP). Most (if not all) *Lasioglossum* s.lat. have yellow or white markings on the clypeus; in *Homalictus* only species of the 'dotatus' and 'blackburni' species-groups have similar markings. Apical margin of gastral tergum VII is broad and bilobed in *Lasioglossum* s.lat.; narrow and unilobed in *Homalictus*.

Type species. Halictus taclobanensis Cockerell, 1915b: 488. (by original designation)

Cladistic relationships

Characters utilized in the cladogram (Fig. 1) are listed in Appendix 1.

(1) Inter-generic relationships.

Within the non-parasitic Halictinae, *Homalictus* and *Lasioglossum* are considered to form a monophyletic group based on the inferred synapomorphies of presence of prepygidial fimbria divided by a longitudinal median furrow, the third transverse cubital vein weaker than the first and the labral process of the female posseses a longitudinal keel.

The genus *Nomioides* appears to be the sister-group of these two genera. All share the synapomorphic characters of pre-episternal groove continuing below the scrobal groove and the third submarginal cell being shorter than the first submarginal cell. *Nomioides* has two autapomorphic characters of inner margins of eyes emarginate and presence of flattened, spatulate hairs on gastral sternum III (Yeates, 1981). This genus was used as the out-group for polarising character states used in construction of a cladogram for *Homalictus* (Fig. 1).

During construction of the *Homalictus* cladogram, a number of synapomorphic characters showed homoplasy within *Homalictus* and *Lasioglossum* s.lat.. These characters have not been rejected (in opposition to Hennig, 1965) for use in the cladogram. To reject them would involve identifing them a priori in their reconstructed phylogeny and such identity would be dependent on low resolving power. The resultant analysis would be very weak (Wiley, 1981).

Lasioglossum s.lat. consists of eight subgenera which are united to form a monophyletic group by the synapomorphic characters of female gastral terga rounded laterally without a distinct angle separating ventral and dorsal parts, and male genitalia large and broad with the contours of the gonobase not continuing those of the gonocoxites. The homoplasy of synapomorphic characters between these subgenera and *Homalictus* is as follows.

Male. Three characters (two genitalic) show homoplasy with *Lasioglossum* s.lat.. Genitalia with large ventroapical projections (character 13) is synapomorphic in most *Homalictus* except the '*urbanus*' species-group and the subgenera *H. (Quasilictus)* and *(Papualictus)* and is homoplastic in the subgenera *Australictus*, *Chilalictus*, *Nesohalictus*, *Callalictus* and *Parasphecodes* of *Lasioglossum*. The long gonostyli (23) on the genital capsule occurs in only one species-group ('*blackburni*') of *Homalictus* but is also a synapomorphy for the subgenera *Chilalictus*, *Glossalictus* and *Nesohalictus* of *Lasioglossum*. An incomplete hind basitibial plate (32) is a synapomorphy of several members within a species-group ('*flindersi*') of *Homalictus* and homoplastic for three

subgenera of *Lasioglossum* (*Australictus*, *Callalictus* and *Parasphecodes*).

Female. The character, fore basitarsal comb absent (22) is a presumed synapomorphy of the *Homalictus* '*blackburni*' species-group. The out-group used (*Nomioides*) also lacked this character but the presence of a comb in most of the remainder of the family Halictidae suggests that this state is independently derived in the two groups and in *Lasioglossum (Lasioglossum)*. The dorsal surface of the propodeum defined by carinae (18) is synapomorphic for the *Homalictus* '*flindersi*' species-group and converges with *Lasioglossum (Parasphecodes)*.

Both sexes. The autapomorphy of presence of a tomentum (7) found only in the new subgenus *H. (Quasilictus)* is convergent with the subgenera *Australictus*, *Chilalictus*, *Lasioglossum* and *Pseudochilalictus* of *Lasioglossum*. Character 30, gastral tergum I pitted across the entire surface, is a synapomorphy of two *Homalictus* species (*H. behri* and *H. thor*) and shows homoplasy with all *Lasioglossum* subgenera except *L. (Australictus)* and *L. (Austrevylaeus)*.

The degree of homoplasy between *Homalictus* and *Lasioglossum* highlights the extent of phenetic similarity between the two genera; however, the cladistic analysis further justifies Michener's (1965) decision for separation.

(2) Intra-generic relationships.

The cladogram (Fig. 1) presents a reasoned hypothesis for the phylogenetic relationships within the genus *Homalictus*. The current analysis is based totally on adult morphological characters and the employment of traits at different levels in the cladogram that are not independent but simply increasingly derived states of the same feature (e.g., 36 and 39). It was constructed on 85 characters (listed in Appendix 1), eleven of which (13%) show homoplasy (in particular parallelism). These parallel characters mainly define species and eight of them are sculpture characters. In such characters, species display only a limited number of independently derived states–e.g., Frons sculpture: plesiomorphic state–smooth; independently derived states–reticulate; granulate; or vertical striae. Homoplastic sculpture characters are rarely autapomorphic, rather synapomorphic for members within a species-group. Throckmorton (1962) argued that sharing of a particular character by two species indicates only that they are derived from some common heterozygous population. Such parallel characters may often be expected to be the rule rather than the exception and should be exploited in the construction of primary groups in cladograms.

The proposed cladogram (see Fig. 1) for *Homalictus* is discussed only to the species-group level.

Homalictus differentiated into two sister-groups A and B, with the majority of species in group B. Group A is distinguished by the synapomorphic feature of both sexes subequal in size (character 6) and retained the symplesiomorphic state of hind leg character 5. It contains the two subgenera *H. (Quasilictus)*, with autapomorphic characters 7-9, and *H. (Papualictus)* with synapomorphic characters 10-12. The cladogram for *H. (Papualictus)* was not completed as the subgenus is not represented in Australia.

The synapomorphies of group B are a robust hind tibiae (4) and an area of differentiated hair on the outer surface of the hind tibiae (5). The two branches of B, sister-groups C and D, each have their own synapomorphies. Group C ('*flindersi*', '*sphecodoides*', '*blackburni*' and '*dotatus*' species-groups) is distinguished by ventroapical processes on the male gonocoxites (13); group D ('*urbanus*' species-group) is characterised by male gastral sternum VI with small inverted 'v' projections (14) and labrum with two raised tubercles (15). These synapomorphic characters unite the '*urbanus*' species-group as a clade.

Homalictus rowlandi has been arbitrarily placed along the '*urbanus*' species-group branch. This species is known from only three females and could not be confidently placed into any of the five species-groups. The sister-group C of the '*urbanus*' species-group has a synapomorphy of a male genitalic character and as the male of *H. rowlandi* is unknown, it was thought unwise to speculate on such a character.

Group C divides into the two sister-groups E and F. Group E ('*flindersi*' species-group) is distinguished and forms a clade by the synapomorphies of dorsal surface of the propodeum defined by carinae (18) and the contours of the frons not continuing those of the clypeus (17). Both synapomorphic characters show homoplasy with the subgenus *H. (Quasilictus)*. Within the '*flindersi*' species-group, *H. callaspis* demonstrates a reversal of character 18. The dorsal surface of the propodeum is not defined by carinae, however, weak remnants of carinae are visible on the posterior lateral corners of the dorsal surface. Such remnants are not present in other lineages.

Group F is distinguished by the synapomorphy of a median tubercle, on the labrum, defined by a carina (16). It then divides into two sister-groups, one (G) containing the '*sphecodoides*' and '*blackburni*' species-groups characterised on the synapomorphy of head and propodeum black (21) and the other (H) to the '*dotatus*' species-group clade. This latter clade is distinguished by the synapomorphies of male gastral sternum VI with thickened spines (19) and in both sexes the basal margin of the second submarginal cell is obtusely bent to receive the first recurrent vein (20).

The synapomorphies of the two branches of G, sister-groups I and J, form clades of the '*sphecodoides*' and '*blackburni*' species-groups respectively. Group I is distinguished by the synapomorphic character of male gonocoxal processes with long, simple, tapering setae (25); group J has the synapomorphies of fore basitarsal comb of females absent (polarity previously discussed) (22), male genitalia with long gonostyli (23) and the genae of males possess long, branched hair (24).

Most of the species within each of the five species-groups are united on the basis of various synapomorphic characters or are differentiated by an autapomorphic character and are not further discussed here. The exception occurs within the '*flindersi*' species-group where no synapomorphic character could be inferred to unite *H. exleyae, H. flindersi* and *H. woodsi* (K). These three species unite with *H. callaspis* to form a monophyletic group by the shared synapomorphy of hind basitibial plate, in both sexes, incomplete (32). In *H. callaspis*, the synapomorphic character of the '*flindersi*' species-group (dorsal surface of the propodeum defined by carinae) was shown to be reversed, giving the species an autapomorphic character which diverges it from the three above mentioned species. These three species do not exhibit any character state that can be inferred as apomorphic and common to all three species. Since *H. callaspis* has a restricted distribution, confined mainly to the coastal south-east Queensland area (see Fig. 2a), I hypothesize that it is a peripheral isolate (Wiley, 1981) of this group of four species differentiated stochastically by the reversal of the apomorphic state of character 18. This was perhaps a response to nesting in a sandy environment. The sharp ridges of propodeal carinae may cause the fine grain sand walls of the nest tunnels to crumble while moving about inside as compared to nesting in a more compact alkaline clay soil type. The lack of a synapomorphic character for the other three species would seem to indicate that these species had diverged little from the ancestral lineage of the four species. This is an example of the phenomenon of the "Principle of Deviation" (Hennig, 1966) which states that in every sister-group pair, one group is on a whole more plesiomorphic than the other.

Subgeneric division

Blüthgen proposed the subgeneric name *Indohalictus* in 1931 although characters of the subgenus were detailed in a previous 1926 paper where he divided the genus *Halictus* into two groups, the 'Halicti striaticiptes' and 'Halicti nomioidiformes'. The latter group became the subgenus *Indohalictus*, (see Walker, 1981: 35-41, Figs. 13-16, 21-23, 25, 26 for full discussion.) In brief, the subgenus *Indohalictus* had been distinguished on the basis of the following characters: (1) frontal carina absent; (2) front of head and vertex without close parallel rugulae; (3) scutum and scutellum dull due to fine lineolation; (4) dorsal surface of propodeum with sparse

wrinkling; (5) apex of marginal cell on wing margin; (6) male genitalia with long gonostyli and large ventroapical processes on the gonocoxite.

Michener (1965: 179) synonymised *Indohalictus* with *Homalictus (Homalictus)* for "practical reasons", as it was difficult to use the subgeneric characters with certainty and for most species, only one sex was known. He (1980a) reiterated his opposition to *Indohalictus*, particularly with regards to the Australian species by stating "In future this unit (*Homalictus*) may well be divided into several subgenera, but probably not into the two proposed previously." This study had the advantage of access to numerous specimens which enabled the sexes of most species to be associated. Careful examination of all characters used for subgeneric division showed intergradation in every character with species of *Homalictus* (proper). However, no intergradation occurs between the subgenus, *Quasilictus*, described below for one species and *Homalictus* (proper).

Description of the genus *Homalictus* in Australia

Mainly small bees (<8 mm); venation of forewing complete (Fig. 4b); second r-m (third transverse cubital vein) weaker than first and second and third submarginal cell weakly defined. The first m-cu (first recurrent vein) enters the second submarginal cell or is interstitial with the first r-m (second transverse cubital vein). The second m-cu (second recurrent vein always enters the third submarginal cell and is much weaker than the first m-cu. The pterostigma is shorter than the costal margin of the marginal cell and the apex of the marginal cell in most species is separated from the wing margin.

The head of both sexes is wider than long with the eyes converging below, except in the male of H. megastigmus. The clypeus is at least twice as wide as long and usually convex. The female labrum bears a strong, single median protuberance, with relatively smooth margins.

The antennae are set below the midpoint of the face and are separated by a carina. The interantennal distance is equal to or greater than the antennocular distance. Subantennal sutures enter mediad on the lower margin of the antennal sockets. The eyes are sparsely covered with minute hair.

The anterior articulations of the mandibles are not shifted posteriorly. The malar area is absent and in side view the genal area is as wide as or narrower than the eye, except in *H. exophthalmus*.

The pronotal collar is not elevated and its dorsolateral angles usually project as spines or tubercles with a carina extending from each, to and across the pronotal tubercle.

The malus of the fore tibial strigilis of females is fan-shaped (Fig. 5c), except in *H. sphecodoides* (Fig. 5d).

In both sexes, the dorsal surface of the propodeum is not defined by carinae and gastral tergum I is impunctate, covered with a fine transverse lineolation. In females only, the gastral and femoral scopae are well developed and the fore basitarsus possesses a comb. These characters are noted in the specific descriptions only if they differ.

The BP of both sexes is short, rounded or angulate, in most species the plate is complete although in some the anterior margin is absent and rarely the entire plate is almost absent (*H. callaspis*). The TS of females bears several teeth with the largest always proximal; in males, the teeth are always minute (except *H. ctenander* and *H. brevicornutus*).

The prepygidial fimbria of females surrounds a longitudinal furrow which may appear as a straight line or a triangular area.

The pretarsal claws of females are simple, of males bifid.

Key to the Australian subgenera and species-groups of *Homalictus*

1. Hind tibia of female robust, with area of differentiated hair (short, uniform, erect, branched) on outer surface, under surface with distinct concavity (Fig. 51); Fg:UID greater than 1.0 (except *H. exophthalmus*);

gonobase of male genitalia narrow in comparison to width of gonocoxite (e.g., Figs. 13a, d, h) . . . . . *Homalictus* sensu stricto .. 2

– Hind tibia of female slender, without area of differentiated hair on outer surface, under surface scarcely concave (Fig. 5m); Fg:UID equal to or less than 1.0; gonobase of male genitalia broadly expanded to at least width of gonocoxite (Figs. 23a, b) . . . . . *Quasilictus* subgen. nov.

2. (Females only) Fore basitarsal comb absent . . . . . '*blackburni*' species-group

– (Females only) Fore basitarsal comb present 3

3. Head and propodeum black . . . . . '*sphecodoides*' species-group

– Head and propodeum otherwise 4

4. Labrum with two raised tubercles (Fig. 4i) . . '*urbanus*' species-group

– Labrum sculptured otherwise 5

5. Dorsal surface of propodeum defined by carinae (Figs. 11a-d, f-h) . . . . . '*flindersi*' species-group

– Dorsal surface of propodeum not defined by carinae (Figs. 11k,l) . . . . . '*dotatus*' species-group

Subgenus *Homalictus* Cockerell

Diagnosis. Female: hind tibiae robust, strongly concave beneath, ventral margin of anterior surface sinuate, outer surface with area of short, erect, branched hair contrasting with surrounding vestiture (Fig. 5l); gastral tergum I usually impunctate, covered with fine transverse lineolation (a few species with minute punctures medianly only), terga without tomentous bands of hair (except *H. maitlandi* in which the hair does not form a true tomentum).

Male: middle flagellar segments longer than wide; Fg:UID greater than 1.0:1; TS minutely toothed (except H. etenander pectinate); genitalia with gonobase narrower than width of gonocoxites; volsellae without large ventroapical projections; apical margin of tergum VII narrow, unilobed .

Type species. Halictus taclobanensis Cockerell, 1915b: 488.

Key to the Australian species of the subgenus *Homalictus*

Females

1. Frons, vertex, genae brown, remainder of body light red-brown; dorsal surface of propodeum smooth (Fig. 12q) . . . . . *H. rowlandi*

– Not with above colours; dorsal surface of propodeum with at least some roughening (Figs. 11a-s; 12a-p) 2

2(1). Dorsal surface of propodeum defined at least posteriorly by a raised carina (Figs. 5a-d; 5f-h) 7

– Dorsal surface not defined by carinae 3

3(2). Fore basitarsal comb absent 14

– Fore basitarsal comb present 4

4(3). Dorsal surface of propodeum relatively smooth (Figs. 11k, l); clypeus with light red-brown on at least anterior one third; BP complete . . 19
– Dorsal surface of propodeum distinctly sculptured; clypeus not coloured as above; BP complete or incomplete 5

5(4). Head and propodeum black; BP complete 20
– Head and propodeum not black; BP complete or incomplete 6

6(5). Labrum with two raised tubercles, sometimes joined anteriorly (Fig. 4i); BP complete 29
– Labrum without two raised tubercles; BP incomplete . . . *H. callaspis*

7(2). BP incomplete, defined only anteriorly 8
– BP complete 10

8(7). Frons with granulate reticulation below ocelli (Fig. 6c) . . . *H. woodsi*
– Frons with vertical striae below ocelli (Fig. 6d; 6g) 9

9(8). Scutum closely punctured along posterior margin and around posterior end of parapsidal lines (Fig. 9g); tibiae and tarsi light red-brown . . . . . *H. exleyae*
– Scutum openly punctured along posterior margin and around posterior end of parapsidal lines (Fig. 9d); tibiae and tarsi dark brown . . . . . *H. flindersi*

10(7). Scutum anteriorly with transverse wave-like plicae, directed obliquely, some meeting along midline at obtuse angle, plicae extend posteriorly to level of anterior margin of parapsidal lines (Fig. 9f) . *H. caloundrensis*
– Scutum not as above 11

11(10). Hind femora black or dark brown 12
– Hind femora with some light red-brown 13

12(11). Scutum densely punctured except anteriorly, (Fig. 10m) . . . . . *H. multicavus*
– Scutum sparsely punctured, except in parapsidal areas and in posterior lateral corners (Fig. 9a) . . . . . *H. behri*

13(11). Scutum open-sparsely punctured laterally (Fig. 9h); mid and hind femora light red-brown . . . . . *H. luteoaeneus*
– Scutum dense-closely punctured laterally (Fig. 9b); mid and hind femora dark green, except apical one third light red-brown . . . . . *H. thor*

14(3). Sculpture on dorsal surface of propodeum minutely anastomosed (Fig. 12d); scutum dark green, sometimes tinged with gold or red . . . . . *H. dampieri*
– Sculpture on dorsal surface of propodeum areolate to rugose (Figs. 12b-c; 12e-f); scutum black 15

15(14). Length greater than 5.5 mm 16
– Length less than 5.5 mm 17

16(15). Short, golden, adpressed hair across gastral terga II and III . . . . . *H. maitlandi*
– Without such gastral pubescence . . . . . *H. blackburni*

17(15). Legs black or dark brown . . . . . *H. atrus*
– Legs with light red-brown colour 18

18(17). Coxae, trochanters, basal two thirds of femora dark brown, remainder light red-brown . . . . . *H. cassiaefloris*
– Fore and hind coxae dark brown, mid coxae and remainder of legs light red-brown . . . . . *H. eurhodopus*

19(4). Scutum open-sparsely punctured (Fig. 9l); scutum shining . *H. dotatus*
– Scutum closely punctured (Fig. 9k); scutum with a dull lustre . . . . . *H. sphecodopsis*

20(5). Dorsolateral angles of pronotum projecting as erect lamellae; scutum metallic purple . . . . . *H. ctenander*
– Dorsolateral angles not projecting as erect lamellae; scutum otherwise 21

21(20). Frons coarsely reticulate (Fig. 7a-b) 22
– Frons smooth or with vertical striae (Figs. 7c-g; 7i) 23

22(21). Malus of strigilis comb-shaped (Fig. 4d) . . . . . *H. sphecodoides*
– Malus of strigilis fan-shaped (Fig. 4c) . . . . . *H. houstoni*

23(21). Scutum with most punctures elevated above surrounding surface (volcano like, Fig. 9j) . . . . . *H. brisbanensis*
– Scutal punctures not elevated above surrounding surface 24

24(23). Scutum punctured and with transverse shallow furrows (Fig. 9r) . . . . . *H. punctatus*
– Scutum punctured, but not furrowed 25

25(24). Scutum closely punctured anteromesially and in parapsidal areas (Fig. 9i) . . . . . *H. tatei*
– Scutum sparsely punctured (Figs. 9o-q; 10e) 26

26(25). Frons with strong vertical striae across entire surface (Fig. 7c) . . . . . *H. scrupulosus*
– Frons with or without vertical striae, if present, striae weak and medianly only (Figs. 7d-e; 7g) 27

27(26). Clypeal width equal to or greater than three times the length; scutum tessellate, punctures clearly visible . . . . . *H. megastigmus*
– Clypeal width less than three times the length; scutum reticulate, punctures indistinct 28

28(27). Dorsolateral angle of pronotum (viewed from above) projecting as a small acute spine; dorsal rim of propodeum shining . . . *H. pectinalus*
– Dorsolateral angle of pronotum (viewed from above) projecting slightly as a small rounded tubercle; dorsal rim of propodeum dull . . . . . *H. niveifrons*

29(6). Frons granulate or reticulate, no distinct vertical striae (Figs. 8c-d) . 30
– Frons with distinct vertical striae (Figs. 8e-i) 31

30(29). Frons weakly reticulate; eyes bulbous (in side view EW:GW c. 2.6:1 Fig. 5l); gastral tergum without minute punctures . . . . *H. exophthalmus*

– Frons coarsely reticulate; eyes not bulbous in side view (EW:GW c. 1.5); gastral tergum I mesially with transverse rows of minute punctures . . . . . *H. urbanus*

31(29). Gastral tergum I with minute punctures mesially; posterior vertical surface of propodeum sparsely covered with short, minutely branched hair . . . . . *H. murrayi*

– Gastral tergum I impunctate; vertical posterior surface of propodeum densely covered with long, plumose hair 32

32(31). Scutum mesad of parapsidal lines openly punctured (Fig. 10o) . . . . . *H. holochlorus*

– Scutum mesad of parapsidal lines closely punctured either entirely or mesially only (Figs. 10k-l) 33

33(32). Scutum closely punctured (on basal two thirds) along midline and parapsidal areas only (Fig. 10l); scutum usually blue; coastal Queensland . . . . . *H. stradbrokensis*

– Scutum closely punctured on basal two thirds (Fig. 10k); scutum usually green; south-west Western Australia . . . . . *H. bremerensis*

Males

1. Dorsolateral angles of pronotum projecting as erect lamellae; scutum metallic purple . . . . . *H. ctenander*

– Dorsolateral angles of pronotum not projecting as erect lamellae; scutum otherwise 2

2(1). Dorsal surface of propodeum defined either posteriorly or laterally by a carina (marked with areolate rugae forming a cell-like matrix) . . . 6

– Dorsal surface of propodeum not defined by carinae, marked with rugae or rugulae not forming the above pattern 3

3(2). BP incomplete . . . . . *H. callaspis*

– BP complete 4

4(3). Clypeus with some pale yellow or dull white markings 10

– Clypeus with no pale yellow or dull white markings 5

5(4). Fg:UID greater than 2.0:1 17

– Fg:UID less than 2.0:1 22

6(2). BP complete; gastral sternum VI with a median oval tuft of erect hair (Fig. 24a) . . . . . *H. behri*

– BP incomplete; gastral sternum VI with or without tufts of erect hair 7

7(6). Gastral sternum VI with distinct raised tufts of erect hair (Figs 24b-c) 8

– Gastral sternum VI without tufts of erect hair (Figs 24e-f) 9

8(7). Gastral sternum VI with a small median and large lateral tufts of erect hair (Fig. 24b) . . . . . *H. woodsi*

– Gastral sternum VI with a large median and small lateral tufts of hair (Fig. 24c) . . . . . *H. caloundrensis*

9(7). Femora and tibiae black to dark brown . . . . . *H. flindersi*
– Femora apically and tibiae light red-brown . . . . . *H. exleyae*

10(4). Frons, paraocular areas and supraclypeal area completely covered with short, adpressed hair; antennal flagellum light red-brown; genae with short, branched hair 11
– Frons, paraocular areas and supraclypeal area with or without short, adpressed hair, if present never a complete cover; antennal flagellum black; genae with long, branched hair (sometimes forming a beard) 13

11(10). Scutum closely punctured, dull . . . . . *H. sphecodopsis*
– Scutum openly punctured, shining 12

12(11). Genitalia with apical processes of gonocoxites small and narrow (Fig. 15d-f); Australia except Tasmania (Fig. 3b) . . . . . *H. dotatus*
– Genitalia with apical processes of gonocoxites large and broad (Figs 15g-i); southern Queensland only (Fig. 3b) . . . . . *H. imitatus*

13(10). Frons and scutum green, sometimes tinged with gold . . . *H. dampieri*
– Frons and scutum black 14

14(13). Fore tarsal segments flanged laterally (Fig. 5j) and with long, branched hair 15
– Fore tarsal segments not flanged laterally and with short, simple hair 16

15(14). All tarsi flanged laterally; pronotal tubercle cream-yellow . . . . . *H. grossopedalus*
– Only fore tarsi with segments flanged laterally; pronotal tubercle brown . . . . . *H. latitarsis*

16(14). Trochanters and femora light red-brown . . . . . *H. eurhodopus*
– Trochanters and femora black . . . . . *H. blackburni*

17(5). Fore trochanters covered with long, plumose hair arising from the posterior surface; UID:LID greater than 1.5:1 . . . . . *H. cassiaefloris*
– Fore trochanters not covered with long, plumose hair; UID:LID less than 1.5:1 18

18(17). Head densely covered with short, plumose hair 19
– Head sparsely covered with short, branched hair . . . . . *H. tatei*

19(18). UID:LID about 1.1:1 . . . . . *H. megastigmus*
– UID:LID greater than 1.3:1 20

20(19). Pronotal tubercle and scape basally light red-brown . . . . *H. houstoni*
– Pronotal tubercle and scape black 21

21(20). Gaster black . . . . . *H. sphecodoides*
– Gaster with at least terga II and III light red-brown . . . *H. punctatus*

22(5). Frons with vertical striae . . . . . *H. scrupulosus*
– Frons reticulate 23

23(22). Head and scutum black . . . . . *H. niveifrons*
– Head and scutum green or blue 24

24(23). EW:GW at least 3:1 . . . . . *H. exophthalmus*
– EW:GW not exceeding 2.5:1 25

25(24). Gastral tergum I impunctate 26
– Gastral tergum I with punctures mesially 28

26(25). Scutum densely punctured in parapsidal areas . . . . . *H. multicavus*
– Scutum sparsely punctured in parapsidal areas 27

27(26). Scutum coppery tinged with red; genitalia, in ventral view, with apical processes of gonocoxites broad (Fig. 22a); Queensland . . . . . *H. stradbrokensis*
– Scutum dark green; genitalia, in ventral view, with apical processes of gonocoxites narrow (Fig. 21g); south west Western Australia . . . . . *H. bremerensis*

28(25). Scutum closely punctured in parapsidal areas and along posterior margin 29
– Scutum sparsely punctured mesially and posteriorly . . . . *H. urbanus*

29(28). Scutellum closely punctured; dorsal surface of propodeum about half length of scutellum . . . . . *H. forrestae*
– Scutellum sparsely punctured; dorsal surface of propodeum about same length as scutellum . . . . . *H. murrayi*

Species-groups

'*blackburni*' species-group

Species included: H. atrus; H. blackburni; H. cassiaefloris; H. dampieri; H. eurhodopus; H. grossopedalus; H. latitarsis; H. maitlandi.

Distinguished by the following characters: Females–fore basitarsal comb absent; scutum black (except *H. dampieri*, dark olive green). Males–body sculpture microtessellate. Both sexes- apex of marginal cell terminates on wing margin (except *H. dampieri* male).

Females. Average BL (two groups) c. 6.2 mm, 5.0 mm; width of clypeus less than three times the length (except *H. dampieri*, three times length), slope continues the contours of frons; labrum (Fig. 4h) with lateral margins of basal area flanged, not bordering a recessed area, median tubercle recessed, rounded apically, defined by carina; fore basitarsal comb absent; dorsal surface of propodeum (Figs. 12b-i), with rugae and rugulae, branched and areolate; TS slender with at least three teeth. Males. average BL (two groups) c. 5.6 mm, 4.6 mm; gaster appears long and distally tapered; dorsal surface of propodeum as in female; genitalia (Figs. 18d-i; 19a-f; 20a-f) characterised by large, ventroapical processes on the gonocoxites, long gonostyli, large volsellae.

Distribution. Mainly northern Australia; one species, *H. dampieri* extends to northern New South Wales (Fig. 3b).

'*dotatus*' species-group

Species included: H. dotatus; H. imitatus; H. sphecodopsis.

The gaster of both sexes is lightly pigmented and semi-translucent. Internal nectar air bubbles or gut contents often appear as dark areas on the tergites and have been confused as dark pigmentation. Cockerell (1910, 1929b) described a new species and subspecies mainly on the basis of a 'darker abdomen'.

The wing venation of both sexes provides a reliable character. The first recurrent vein (1st m-cu) enters the 2nd submarginal cell before the 2nd cubital vein (1st r-m) and the basal vein is obtusely bent at the junction point.

Females. Average BL c. 5.2 mm; width of the clypeus at least three times the length, slope continues contours of frons; labrum (Fig. 4f)

with lateral margins of basal area flanged upwards bordering a recessed area, median tubercle raised, apically rounded, defined by a carina; dorsal surface of propodeum (Figs. 11i-l) with rugulae and few interconnectives; TS slender with two or three blunt teeth. Males. average BL c. 4.3 mm; gaster appears long and distally tapered; dorsal surface of propodeum as in female; genitalia (Figs. 15a-i) characterised by large protruding volsellae and apical projections on gonocoxites.

Distribution. Throughout Australia, absent from Tasmania; *H. dotatus* present in large numbers in the drier regions of inland Australia and constitutes the bulk of the *Homalictus* fauna in these areas; other species appear restricted to coastal regions of eastern Australia within the 600-800 mm average rainfall isohyet (Fig. 2b).

'*flindersi*' species-group

Species included: H. behri; H. callaspis; H. caloundrensis; H. exleyae; H. flindersi; H. luteoaeneus; H. thor; H. woodsi.

Females. Average BL c. 6.8 mm; width of clypeus less than three times the length, slope of clypeus at obtuse angle to frons and protruding beyond lower margins of the eyes; basal section of labrum (Fig. 4e) with upturned flange on proximal lateral areas, median area raised, sloping gently to frontal rim, not bounded by lateral carinae; dorsal surface of propodeum (Figs. 11a-d; 11f-h), with areolate rugae, defined laterally and posteriorly by prominent carinae except *H. callaspis* (no carinae, Fig. 11e); TS with two or three, large teeth. Males. average BL c. 5.7 mm, relatively uniform in colour, either dark green or blue; dorsal surface of propodeum as in female; genitalia (Figs. 13d-k; 14a- l) characterised by large 'arm-like' processes (arrowed in Fig. 13d) originating on each gonocoxite which protrude and converge ventrally, distinctive vestiture on 'arm' processes (except *H. behri*, Figs. 13a-c).

Distribution. Mainly coastal within the 600 mm average annual rainfall isohyet; typical Torresian faunal distribution (except *H. caloundrensis* extends south to north-west Victoria and south-eastern South Australia) (Fig. 2a).

'*sphecodoides*' species-group

Species included: H. brisbanensis; H. ctenander; H. houstoni; H. megastigmus; H. niveifrons; H. pectinalus; H. punctatus; H. scrupulosus; H. sphecodoides; H. tatei.

No single character will differentiate this species-group, colour may be used for both sexes as an artificial character: Female–head and propodeum black, scutum dark green or blue (except H. ctenander, iridescent purple). Male–head, scutum and propodeum black, (except *H. ctenander*, iridescent purple), head with short, adpressed hair.

Females. Average BL c. 5.2 mm; width of clypeus variable from less than three times length to greater than three times length; slope of clypeus continues contours of frons; labrum (Fig. 4g) with lateral margins of basal area flanged upwards, not bordering recessed area, median tubercle elevated, apically pointed, defined by carina; dorsal surface of propodeum (Figs. 11m-s; 12a) with rugae and interconnectives; TS well developed with at least four small blunt teeth. Males. average BL c. 4.6 mm; dorsal surface of propodeum as in female; genitalia (Figs. 16a-i; 17a-i; 18a-e) characterised by gonocoxal processes arising apically from the gonocoxite; TS minutely toothed except *H. ctenander* pectinate.

Distribution. Typical Bassian faunal distribution, a few species extend to north Queensland (Fig. 2b, 3a).

'*urbanus*' species-group

Species included: H. bremerensis; H. exophthalmus; H. forrestae; H. holochlorus; H. multicavus; H. murrayi; H. stradbrokensis; H. urbanus.

Distinctive characters of the species-group are as follows: Females– labrum with two raised tubercles. Males–gastral sternum VI coarsely granulate, covered with many small inverted 'v' shape protrusions.

Females. Average BL c. 5.4 mm; width of clypeus greater than twice length but less than three times; slope of clypeus continues the contours of the frons, except in H. exophthalmus convex; labrum (Fig. 4i) as above, in addition, lateral margins of basal area are flanged and

surround a recessed area; dorsal surface of propodeum (Figs. 12j-p) (*H. multicavus* defined posteriorly), with areolate or branched rugae/rugulae; TS with two or three large blunt teeth and shorter than outer spur. Males. average BL c. 4.3 mm; dorsal surface of propodeum as in female; genitalia (Figs. 19g-i; 21a-i; 22a-i) characterised by ventral processes arising from the volsellae; gastral sternum VI as above.

Distribution. Australia, excluding Tasmania; *H. urbanus* occurs throughout Australia (mainland), other species appear restricted within definite boundaries (Fig. 4a).

AUSTRALIAN SPECIES

Homalictus atrus sp. nov.

Figures 3b; 8b; 10h; 12i

Material examined.

Holotype ♀, Paratypes 2 ♀♀, 15°47'S., 145°17'E., Moses Ck, 4 km NE Mt Finnigan, Queensland, 14-16 Oct 1980, J.C. Cardale (ANIC).

Other specimens examined: (1 ♀) (PD: 4,10) (FR: Not recorded) QUEENSLAND: Lockerbie (ANIC).

Diagnosis. A member of the '*blackburni*' species-group, most like *H. blackburni*; distinguished from other members of the genus by the following combination of characters: fore basitarsal comb absent; length <5.5 mm; sculpturing on dorsal surface of propodeum areolate and extends to dorsal rim (Fig. 12i).

Female. BL 4.7-4.9 mm (holotype c. 4.9 mm); FL 3.5-3.7 mm (holotype c. 3.7 mm); head wider than long (57:47); UID:LID as 31:30; clypeus slightly convex, width less than three times length (26:10); antennal sockets separated by distance less than diameter of socket; supraclypeal area slightly raised. AOD:IAD:OAD:IOD:OOD as 11:4:21:8:8. Scape extending to level of anterior margin of median ocellus; dorsolateral angle of pronotum projecting as acute spine; fore basitarsal comb absent; BP complete, bluntly angulate apically; TS with four blunt teeth, decreasing in size with last tooth minute and slightly shorter than outer spur.

Sculpturing. Head smooth (Fig. 8b), frons, clypeus and supraclypeal area reticulate, frons and supraclypeal area impunctate, clypeus with minute sparse hair pits; scutum (Fig. 10h) and scutellum microtessellate, impunctate; dorsal surface of propodeum (Fig. 12i) with branched rugae extending laterally and mesially to rim.

Colour. Head, mesosoma, gaster black; antennal flagellum, pronotal tubercle, fore and mid legs (except coxae, black) dark brown.

Pubescence. Sparse; head and mesosoma almost bare, a few short, erect, simple hairs on frons, vertex, scutum and scutellum; lower paraocular areas, genae, basal two thirds of mandibles and posterior margin of scutellum with short, minutely branched hair; clypeus with a few long, simple hairs along anterior margin; vertical surface of propodeum with long, branched hair; gastral terga III, IV, V with a few short, backwardly inclined, simple hairs.

Remarks. Male unknown. The specific name refers to the colour of the species.

Distribution. North Queensland (Fig. 3b).

Homalictus behri (Cockerell)

Figures 2a; 6b; 9a; 11b; 13a-c; 24a

Halictus behri Cockerell, 1910: 228.–1929b: 2 (Cockerell's suggested synonymy of *H. behri* with *H. woodsi* is not recognised.).–1933: 305.

Homalictus behri.–Michener, 1965: 179.

Material examined.

Holotype ♀, Port Darwin, Nov 1902, Turner Coll. 1910-7 (BMNH)

Other specimens examined: (42 ♀♀, 11 ♂♂) (PD: 1,2,5,10,11) (FR: *Parinari, Dysophylla, Eucalyptus, Thryptomene, Tristanopsis, Borreria*) QUEENSLAND: 1♀ (*H. flindersi* var. a) Mackay, Mar. 1892, 400, Turner Coll., 1910-7 (BMNH), 1♀ (*H. flindersi* var. a) Mackay, Mar. 1900, 400, Turner Coll., 1910-7 (BMNH); Bamaga, Gregory Downs, Townsville, Samford (UQIC); Giru, Mt Webb, Hope Vale Mission (ANIC); Cairns (NMV); Mackay (BMNH). NORTHERN TERRITORY: Cobourg Peninsula, Mt Cahill, Borroloola, Cape Crawford, Victoria River Downs HS, Oenpelli (ANIC); Darwin (SAM, ANIC). WESTERN AUSTRALIA: Mitchell Plateau (ANIC).

Diagnosis. A member of the '*flindersi*' species-group, most like *H. thor*; distinguished from other members of the genus by the following combination of characters: Female–dorsal surface of propodeum defined by carinae; BP complete; vertical striae below ocelli; scutum

(Fig. 9a) with weak transverse plicae anteriorly, openly punctured in parapsidal areas, dense-openly in posterior lateral corners, remainder sparsely punctured. Male–BP complete; gastral sternum VI with median oval tuft of erect hair (Fig. 24a); penis valves of genitalia with longitudinal furrows (Figs. 13a,b).

Female. BL 6.6-7.6 mm (holotype c. 6.7 mm); FL 4.8-5.5 mm (holotype c. 5.0 mm); head wider than long (75:68); UID:LID as 39:35; clypeus less than twice as wide as long (33:18), convex, protruded; antennal sockets separated by distance less than diameter of sockets. AOD:IAD:OAD:IOD:OOD as 13:6:26:11:9. Scape reaching anterior margin of median ocellus; dorsolateral angle of pronotum projecting as a small, blunt spine; dorsal surface of propodeum as long as scutellum, defined by carinae; TS with three blunt teeth and shorter than outer spur; BP complete and rounded.

Sculpturing. Head roughened, frons (Fig. 6b) beneath ocelli with granulated reticulation, weak vertical striae in paraocular areas opposite antennal sockets, on upper frons continuing around eye, and weak transverse striae in front of ocelli; clypeus finely reticulate, openly punctured; scutum (Fig. 9a) with weak transverse plicae anteriorly, openly punctured in parapsidal areas, dense-openly in posterior lateral corners, remainder sparsely punctured; scutellum smooth mesially, finely reticulate, openly punctured; dorsal surface of propodeum (Fig. 11b) with areolate rugae extending to rim; gastral tergum I with minute hair pits.

Colour. Frons, vertex, genae and propodeum dark blue; anterior two thirds of clypeus royal blue, remainder black; scape with light red-brown variable from basal ring to at least half, remainder dark brown; flagellum light brown; scutum and scutellum blue suffused with green; coxae, trochanters, femora, mid and hind tibiae and basal two thirds of basitarsi dark brown to black, inner surface of fore tibiae, and distal section of tarsi light red-brown; gaster steel blue.

Pubescence. Frons, vertex, paraocular areas and supraclypeal area sparsely covered with short, erect, minutely branched hair; clypeus with a few short, forwardly inclined, simple hairs; genae with sparse, long, erect, branched hair; scutum covered with short, minutely branched hair; scutellum with a few long, branched hairs; propodeum dorsally bare, vertical surface with erect, long, branched hair; gastral terga I and II almost bare, lateral margins of terga II and terga III, IV and V with increasing density of short, simple hair.

Male. BL 5.4-5.8 mm; FL 3.9-4.4 mm; head wider than long (60:54); eyes converging strongly below, UID:LID as 35:26; scape not reaching level of median ocellus; Fg:UID as 2.0:1. AOD:IAD:OAD:IOD:OOD as 9:6:19:11:8. BP complete, apically rounded.

Sculpturing. Head roughened, frons with crescent shape transverse striae originating at level of antennal bases, a few transverse striae below ocelli continuing behind eye, transverse striae on vertex; clypeus and supraclypeal area reticulate, openly punctured; scutum anteriorly dull, reticulate, impunctate with several transverse plicae, closely punctured in parapsidal areas and hind margin, medianly shining and sparsely punctured; scutellum shining sparsely punctured; dorsal surface of propodeum, defined by carinae, with areolate rugae extending to rim.

Colour. Frons, vertex, genae and propodeum dark blue; clypeus, supraclypeal area, scutum and scutellum black tinged with dark green; coxae, trochanters and femora dark green-black, mid and hind tibiae dark brown, fore tibiae and all tarsi light red-brown; gaster steel blue, tergum VII black.

Pubescence. Frons, vertex, genae, sides of mesosoma and metanotum with erect, plumose hair; gastral sterna III and IV with transverse row of long golden hair along posterior margin.

Genitalia. Figs. 13a, b, c.
Gastral Sternum VI. Fig. 24a.

Remarks. Specimens of this species were misidentified by Cockerell (1905c, 1910) as *Halictus flindersi* var. a.

Distribution. Northern Australia (Fig. 2a).

Homalictus blackburni (Cockerell)

Figures 3b; 7h; 10b; 12b; 18d-f; 26c

Halictus blackburni Cockerell, 1910: 232.–1933: 305.
Halictus crinitus Friese, 1924: 243. (syn. by Cockerell, 1929a: 12.–1933: 305.)
Homalictus blackburni.–Michener, 1965: 179.
H. crinitus.–Michener, 1965: 180.

Material examined.

Holotype ♀ of *Halictus blackburni*, Mackay, Queensland, May 1899, R.E. Turner, 915, on *Xanthorrhoea* sp. (BMNH).

Lectotype ♂ of *Halictus crinitus*, Mackay, Queensland, Sept. 1899, R.E. Turner, on *Leptospermum* sp. (AMNH). Lectotype designated by Pauly (in press).

Other specimens examined: (175 ♀♀, 64 ♂♂) (PD: 1-5,7-11) (FR: *Eucalyptus, Eugenia, Melaleuca, Thryptomene, Tristanopsis, Xanthorrhoea*) QUEENSLAND: Mackay (BMNH, UQIC, NMV); Townsville (SAM); Beecher, Seaforth, Babinda, Cooktown, Silver Plains Hmsd, Iron Range (UQIC); Mt Webb Nat. Pk (ANIC); Mt Molloy (DPI); Cairns (DPI, UQIC); Gordonvale (BPBM); Moa Is. (UQIC, DPI, SAM). NORTHERN TERRITORY: Katherine, Jabaluka Lagoon, Mt Cahill, Oenpelli (ANIC); Wildman R. (DPI); Mataranka, Coomalie Ck (UQIC); Darwin (UQIC, ANIC); Melville Is. (SAM).

Diagnosis. A member of the '*blackburni*' species-group, most like *H. latitarsis*; distinguished from other members of the genus by the following combination of characters: Female–fore basitarsal comb absent; sculpturing on dorsal surface of propodeum areolate, extending at least half length to rim (not reaching rim) (Fig. 12b); lack of hair bands across gastral terga II and III. Male–BP complete; clypeus with some dull white markings; genae with long, branched hair (almost forming a beard); frons and scutum black; fore tarsal segments not flanged; trochanters and femora black.

Female. BL 5.5-6.2 mm (holotype c. 6.2 mm); FL 3.9-4.5 mm (holotype c. 4.6 mm); head wider than long (70:60); UID:LID as 37:36; clypeus convex, width less than three times length (32:13); antennal sockets separated by distance greater than diameter of socket; supraclypeal area bulbous. AOD:IAD:OAD:IOD:OOD as 10:8:22:10:8. Scape reaching anterior margin of median ocellus; dorsolateral angle of pronotum projecting as small acute tubercle; fore basitarsal comb absent; BP complete, apically rounded; TS with five pointed teeth and slightly smaller than outer spur.

Sculpturing. Head smooth, frons (Fig. 7h), vertex, clypeus and supraclypeal area finely reticulate; clypeus punctured, densely punctured along anterior margin, remainder openly punctured; scutum (Fig. 10b) and scutellum finely reticulate, punctured with small shallow open punctures (scutum) and sparse punctures (scutellum); dorsal surface of propodeum (Fig. 12b) microtessellate, basally with areolate rugae extending at least half length but not reaching rim, laterally a few short rugae.

Colour. Head, mesosoma, propodeum and gaster black; antennal scapes red- brown at basal rim, flagellum brown beneath; tarsi red-brown.

Pubescence. Frons with short, erect, simple hair; vertex, genae, clypeus with branched hair; frons laterally, lower paraocular areas and supraclypeal area with short, plumose, inclined hair; clypeus with a few long, simple hairs along anterior margin; scutum with short, erect, minutely branched hair; scutellum and metanotum with long, branched hair; propodeum bare dorsally, upper vertical lateral surface with row of erect, plumose hair, remainder with long, branched hair; gastral terga I, II almost bare, terga III, IV and V with increasing density of hair.

Male. BL 5.0-5.9 mm; FL 3.6-4.2 mm; head wider than long (60:52); eyes converging strongly below, UID:LID as 34:23; scape not reaching level of median ocellus; Fg:UID as 1.9:1. AOD:IAD:OAD:IOD:OOD as 6:6:19:10:9. BP complete, apically rounded.

Sculpturing. Head smooth, finely reticulate; clypeus with a few shallow punctures; scutum and scutellum finely reticulate, minutely sparsely punctured; dorsal surface of propodeum with areolate rugae medianly extending at least half way to rim, laterally smooth.

Colour. Head black, except clypeus pale yellow with posterior lateral areas black; mesosoma, and gaster black; coxae, trochanters, femora black, basal and apical areas of tibiae red-brown, remainder of tibiae black, tarsi light red-brown.

Pubescence. Frons with short, erect, simple hair; vertex and clypeus with erect, branched hair; frons laterally and supraclypeal area with erect, plumose hair, lower paraocular areas with short, plumose, adpressed hair; genae with long, branched hair (almost forming a beard); scutum with short, erect, simple hair; scutellum along posterior margin and metanotum with a few long, branched hairs; upper vertical lateral surface of propodeum with erect, branched hair; gastral sterna with increasing density of hair, sterna III, IV with sparse complete cover.

Genitalia. Figs. 18d, e, f.

Gastral Sternum VI Fig. 26c.

Remarks. In spite of its wide distribution, there is little variation in this species.

Distribution. Northern Queensland and Northern Territory (Fig. 3b).

Homalictus bremerensis (Rayment)

Figures 4a; 8e; 10k; 12l; 21g-i; 27c

Halictus formosus Rayment, 1930a: 52 (not Dours, 1872: 300).–Cockerell, 1933: 311, syn. nov.

Halictus bremerensis Rayment, 1931a: 171.–Cockerell, 1933: 306.

Homalictus formosulus Michener, 1965: 180, syn. nov.

Homalictus bremerensis.–Michener, 1965: 179.

Material examined.

Holotype ♀ of *Halictus formosus*, Albany, 23 Oct 1929, T. Greaves (ANIC) (Rayment's (1930) species *Halictus formosus* is a junior primary homonym of *Halictus formosus* Dours and is therefore preoccupied; Michener (1965) proposed the specific name *formosulus* when making a new combination of Rayment's (1930) species.)

Holotype ♀ of *Halictus bremerensis*, Bremer Bay, Jan 1916, L. Glauert (WAM).

Other specimens examined: (26 ♀♀, 1 ♂) (PD: 1,10,12) (FR: *Callistemon, Eucalyptus*) WESTERN AUSTRALIA: Walpole, Donnelly R. Crossing on Pemberton/Nannup Rd, Margaret R. on Yallingup Rd, Yallingup, Alexandra Bridge Brockman Hwy (UQIC); Cowaramup, Midland (WAM); Karri Forest, Pemberton (BPBM); Nornalup (SAM).

Diagnosis. A member of the '*urbanus*' species-group, most like *H. stradbrokensis*; distinguished from other members of the genus by the following combination of characters: Female–labrum with two raised tubercles; frons with vertical striae; gastral tergum impunctate; scutum closely punctured on basal two thirds (Fig. 10k). Male–BP complete; Fg:UID < 2.0:1; EW:GW < 2.5:1; frons reticulate; gastral tergum impunctate; scutum sparsely punctured in parapsidal areas; genitalia, in ventral view, with apical gonocoxal processes narrow (Fig. 21g).

Female. BL 5.2-6.5 mm (holotype c. 5.2 mm); FL 3.8-4.6 mm (holotype c. 3.8 mm); head wider than long (69:55); eyes converging below, UID:LID as 30:28; clypeus slightly convex, width less than three times length (30:12); antennal sockets separated by distance less than diameter of socket. AOD:IAD:OAD:IOD:OOD as 15:5:22:11:11. Scape extending to level of anterior margin of median ocellus; EW:GW as 1.4:1; dorsolateral angle of pronotum projecting as small acute spine; TS with two large blunt teeth and one minute distal tooth and half length of outer spur.

Sculpturing. Head roughened (Fig. 8e), frons with vertical striae to level of anterior margin of rear ocelli; vertex with transverse striae extending onto genae; supraclypeal area and basal half of clypeus reticulate, sparsely punctured with small hair pits, anterior half of clypeus smooth and polished, large punctures along anterior margin; scutum (Fig. 10k) reticulate and dull, anterior one third impunctate, remainder closely punctured, except densely punctured along hind margin; scutellum finely reticulate, anteriorly closely punctured, remainder openly punctured; dorsal surface of propodeum (Fig. 12l) with areolate rugae extending mesially to rim, laterally onto vertical surface.

Colour. Frons, paraocular areas, supraclypeal area and basal half of clypeus dark olive green, anterior half of clypeus black; scape black, flagellum dark brown above, light brown beneath; scutum dark green tinged with gold; scutellum blue-green; propodeum dark blue; coxae, trochanters and femora dark brown-black, tibiae and tarsi dark brown suffused with light red-brown patches; gastral terga black with anterior margins dark brown.

Pubescence. Head sparsely covered with erect, minutely branched hair, a few long, simple hairs along anterior margin of clypeus; scutum and scutellum sparsely covered with

both short, backwardly inclined, simple and short, erect, minutely branched hair, a few long, erect, branched hairs on lateral and posterior margins of scutellum; propodeum bare dorsally, posterovertically densely covered with long, erect, plumose hair; gastral terga I and II almost bare except lateral margins and remaining terga with increasing density of short and long, simple, apicad directed hair.

Male. BL c. 3.9 mm; FL c. 3.0 mm; head wider than long (46:41); eyes converging below, UID:LID as 29:20; scape almost reaching level of anterior margin of median ocellus; Fg:UID as 1.9:1; EW:GW as 1.8:1. AOD:IAD:OAD:IOD:OOD as 8:5:16:9:7. BP complete, apically rounded; TS two thirds length of outer spur.

Sculpturing. Frons finely reticulate; clypeus and supraclypeal area smooth and shining (though weakly reticulate), sparsely punctured; scutum and scutellum (shining) finely reticulate, sparsely punctured with minute hair pits; dorsal surface of propodeum with areolate rugae reaching rim.

Colour. Head, scutum and scutellum dark green; propodeum dark green tinged with blue; coxae, trochanters dark brown, remainder of legs brown, except fore tibiae and tarsi light brown; gaster dark brown.

Pubescence. Frons and vertex sparsely covered with short, erect, minutely branched hair; lower paraocular areas, clypeus and genae with short, inclined, branched; scutum and scutellum with both long, erect, minutely branched and short, simple, backwardly directed hair; metanotum and propodeum posterovertically with a few long, erect, branched hairs; gastral terga almost bare, a few short, simple, inclined hairs on terga III to VI.

Genitalia. Figs. 21g, h, i.

Gastral Sternum VI. Fig. 27c.

Remarks. The colour of the female described is the 'usual' form; however, the colour may vary to green-blue or coppery tinged with red.

Distribution. South-west Western Australia (Fig. 4a).

Homalictus brisbanensis (Cockerell)

Figures 2b; 6j; 9j; 11j

Halictus brisbanensis Cockerell, 1918: 117.–1933: 306.
Halictus botanicus Rayment, 1935: 696. syn. nov.
Halictus portlandicus Rayment, 1953: 24, fig. 5. syn. nov.
Homalictus brisbanensis.–Michener, 1965: 179.
Homalictus botanicus.–Michener, 1965: 179.
Homalictus portlandicus.–Michener, 1965: 181.

Material examined.

Holotype ♀ of *Halictus brisbanensis*, Brisbane, Queensland, 17 Sep 1914, H. Hacker (USNM).

Holotype ♀ of *Halictus botanicus*, Botanic Gardens, 20 Feb 1932, Melbourne, Victoria, M.F. Alleyne (ANIC). (Type incorrectly referred to as male in original description.)

Holotype ♀ of *Halictus portlandicus*, Portland, Victoria, 26 Sep 1952, T. Rayment, on *Cryptostemma calendulaceum* (ANIC).

Other specimens examined: (53 ♀♀) (PD: 1-3,5,9-12) (FR: *Artopheca, Amyema, Callistemon, Eucalyptus, Leptospermum, Syncarpia, Tristanopsis, Oenothera*) QUEENSLAND: Mareeba, Herberton (QDPI); Pomona, Biggenden, Kenilworth, Ormiston, Palen Ck, Bunya Mts, Toowoomba, Stanthorpe, Beerwah, Bribie Is. (UQIC); Brisbane (UQIC, QM); Caboolture, Springbrook, Fernvale (SAM). NEW SOUTH WALES: Coffs Harbour, Sydney, Salisbury (UQIC). VICTORIA: Healesville, Woori Yallock (UQIC); Melbourne (UQIC, NMV); Anglesea, Cape Schank (NMV).

Diagnosis. A member of the *'sphecodoides'* species-group; females distinguished from other members of the genus by the following unique character: rim of scutal punctures elevated above surrounding surface.

Female. BL 4.6-5.7 mm (holotype c. 5.0 mm); FL 4.0-4.4 mm (holotype c. 4.2 mm); head wider than long (62:51); UID:LID as 35:36; clypeal width at least three times length (30:9); antennal sockets separated by distance equal to diameter of socket. AOD:IAD:OAD:IOD:OOD as 13:5:19:9:9. Scape reaching posterior margin of median ocellus; TS with four small, blunt teeth and same length as outer spur; BP complete and apically rounded.

Sculpturing. Head relatively smooth, frons finely reticulate laterally, mesially with weak vertical striae (Fig. 6j) extending from above antennal bases to below level of median ocellus; paraocular areas, clypeus and supraclypeal area finely reticulate with sparse punctures on

clypeus; scutum (Fig. 9j) granulate due to coarse reticulation and wide shallow open-sparse punctures with rim of puncture elevated above surrounding surface; scutellum openly punctured; propodeum finely reticulate, dorsal surface (Fig. 11j) with rugae extending laterally to rim and mesially areolate on anterior half only.

Colour. Frons, clypeus, supraclypeal area, scutellum and propodeum black; basal half of scape red-brown, remainder of scape and flagellum brown, scutum blue-green suffused with dull yellow; apical one third of femora, fore and mid tibiae and tarsi and hind tarsi red-brown, remainder of femora, trochanters and hind tibiae dark brown, coxae black; gaster red-brown suffused with dark pigmentation.

Pubescence. Head sparsely covered with short semi-erect, simple hair; scutum sparsely covered with short, backwardly directed hair, a few long, erect, branched hairs on scutellum; metanotum with short, plumose hair mediad.

Remarks. Male unknown. Colour variations in the degree of darkening of the mid and hind legs and an almost entirely brown scape were noted.

Distribution. North Queensland to Victoria; mainly coastal (Fig. 2b).

Homalictus callaspis (Cockerell)

Figures 2a; 6e; 9e; 11e; 14a-d; 24d

Halictus callaspis Cockerell, 1915a: 6.–1933: 306.
Homalictus callaspis.–Michener, 1965: 179.

Material examined.
Holotype ♀, Bribie Is., 2 Nov 1913, H. Hacker (QM).
Other specimens examined: (93 ♀♀, 12 ♂♂) (PD: 1,3,9,11,12) (FR: *Mesembryanthemum*) QUEENSLAND: Fraser Is., Bribie Is., Brisbane, Stradbroke Is., (UQIC); Greenbank (QM); Noosa, Peregian (SAM); Caloundra (UQIC, SAM). NEW SOUTH WALES: Kingscliffe, Brunswick Heads (UQIC).

Diagnosis. A member of the *'flindersi'* species-group; distinguished from other members of the genus by the following combination of characters: dorsal surface of propodeum not defined by a carina; BP incomplete.

Female. BL 5.7-7.2 mm (holotype c. 6.8 mm); FL 3.8-4.4 mm (holotype c. 4.2 mm); head wider than long (72:69); UID:LID as 40:34; clypeus about twice as wide as long (30:15), convex, protruded; supraclypeal area bulbous; antennal sockets separated by distance greater than diameter of socket. AOD:IAD:OAD:IOD:OOD as 13:8:25:14:12. Scape not reaching median ocellus; dorsolateral angle of pronotum produced to a small rounded tubercle; dorsal surface of propodeum shorter than scutellum; TS with three blunt small teeth and shorter than outer spur; BP incomplete, only partially defined anteriorly.

Sculpturing. Head roughened with vertical striae from lower frons and continuing around eye (Fig. 6e); clypeus shining, finely reticulate, openly punctured; scutum (Fig. 9e) and scutellum finely reticulate, with small sparse piliferous punctures; dorsal surface of propodeum (Fig. 11e) with weak radiating rugulae, few interconnectives, most not reaching rim.

Colour. Frons golden green; vertex, genae and propodeum dark green, supraclypeal area coppery; clypeus golden blue suffused with red anteriorly and purple posteriorly; scape black, flagellum black above, light red-brown beneath; scutum and scutellum blue green with a golden tinge; trochanters and femora dark olive green, tibiae black to dark brown, knees and tarsi light red-brown; gastral terga dark brown, light red-brown along anterior margins.

Pubescence. Frons, vertex, lower paraocular areas sparsely covered with erect, branched hair; clypeus and supraclypeal area almost bare, some short, erect, simple hair, a few long, simple hairs along anterior margin of clypeus; genae with erect, minutely branched hair; scutum and scutellum with long, erect, branched hair; etanotum with short, branched, adpressed hair; propodeum almost bare except dorsolaterally and vertically with erect, branched hair; gastral terga with increasing density of short, simple hair from tergum I to VI, a few long, erect, minutely branched hair on terga IV, V, VI.

Male. BL 5.4-6.1 mm; FL 3.4-4.3 mm; head wider than long (63:60); eyes converging strongly below, UID:LID as 41:29; scape not reaching level of median ocellus; Fg:UID as 1.4:1. AOD:IAD:OAD:IOD:OOD as

9:9:19:12:11. BP almost absent, weakly defined along anterior margin.

Sculpturing. Frons, clypeus and supraclypeal area finely reticulate; scutum finely reticulate, with shallow piliferous sparse punctures; scutellum reticulate with few sparse punctures; dorsal surface of propodeum with weak radiating rugulae not reaching rim.

Colour. Body dark green, tinged with blue on metanotum and propodeum, posterior margin of tergites brown; coxae, trochanters, femora dark green, anterior surface of fore tibiae, mid and hind tibiae dark brown, posterior surface of fore tibiae and tarsi light red brown; gastral tergum VII red- brown.

Pubescence. Frons, clypeus and supraclypeal area with short, white, plumose, adpressed hair; vertex, genae, scutum and scutellum with sparse, erect, branched hair; gastral sterna II and III with long plumose hair.

Genitalia. Figs. 14a, b, c, d.

Gastral Sternum VI. Fig. 24d.

Distribution. Coastal south-east Queensland and north-eastern New South Wales (Fig. 2a).

Homalictus caloundrensis (Cockerell)

Figures 2a; 5l; 6f; 9f; 11f; 14e-h; 24c

Halictus caloundrensis Cockerell, 1914a: 505.–1933: 306.

Halictus flindersi leucurus Cockerell, 1914b: 366.–1933: 310. syn. nov.

Halictus caloundrensis leucurus Cockerell, 1915a: 6. (Cockerell decided the subspecies *leucurus* was closer to *H. caloundrensis* than *H. flindersi* and changed the specific name to the former species.)

Halictus rufoaeneus Friese, 1924: 237.–Cockerell, 1933: 320. syn. nov.

Halictus viridinitens Friese, 1924: 237.–Cockerell, 1933: 323. syn. nov.

Homalictus caloundrensis.–Michener, 1965: 179.

Homalictus leucurus.–Michener, 1965: 180.

Homalictus rufoaeneus.–Michener, 1965: 181.

Homalictus viridinitens.–Michener, 1965: 181.

Material examined.

Holotype ♀ of *Halictus caloundrensis*, Caloundra, Queensland 30 Oct 1912, H. Hacker (QM).

Holotype ♀ of *Halictus flindersi leucurus*, Bribie Is., Queensland, 2 Nov 1913, H. Hacker (QM).

Holotype ♀ of *Halictus rufoaeneus*, Botanic Garden, 1897 (AMNH). (The type (head missing) now bears a second label not published by Friese: Australia, Sydney, 14 Sep 1906. Friese identified specimens used in his descriptions by attaching an orange or red label with the word 'typus'. This species was described from a single specimen and it is considered to be the holotype.)

Lectotype ♀ of *Halictus viridinitens*, Botanic Gardens, 1897 (AMNH). (Second label on type as in *H. rufoaeneus*. Described from several specimens but only one syntype could be located. Lectotype designated here.

Other specimens examined: (64 ♀♀, 18 ♂♂) (PD: 1,4,7-12) (FR: *Schinus, Eucalyptus, Melaleuca, Atalaya*) QUEENSLAND: Morven, Amby, Yelarbon, Inglewood, Noosa, Stradbroke Is., Goondiwindi (UQIC); Caloundra, Bribie Is., Brisbane, Southport (QM); Mitchell (SAM). NEW SOUTH WALES: Brunswick Heads, Narrabri, Coonabarabran, Gilgandra (UQIC); Conargo (ANIC). VICTORIA: Mildura, Hattah (NMV). SOUTH AUSTRALIA: Glenelg, Morgan, Loxton, Blanchetown, West Beach (SAM).

Diagnosis. A member of the '*flindersi*' species-group, most like *H. luteoaeneus*; distinguished from other members of the genus by the following unique character: 'wave-like' plicae on anterior half of scutum, directed obliquely, meeting at obtuse angle along midline (Fig. 6f). (additional to male: gastral sternum VI with a large median tuft and small lateral tufts of hair.)

Female. BL 6.4-7.3 mm (holotype c. 6.9 mm); FL 4.4-5.0 mm (holotype c. 4.8 mm); head wider than long (74:69); UID:LID as 42:38; clypeus about twice as wide as long (35:16), gently convex, protruded; antennal sockets separated by distance subequal to diameter of socket. AOD:IAD:OAD:IOD:OOD as 14:7:25:12:10. Scape reaching anterior margin of rear ocelli; dorsolateral angle of pronotum produced to a small rounded tubercle; dorsal surface of propodeum as long as scutellum, defined laterally and posteriorly by strong carinae; TS with three blunt teeth and shorter than outer spur; BP complete, rounded apically.

Sculpturing. Head roughened, small area above antennal bases granulate, in some specimens a few transverse striae beneath ocelli, frons (Fig. 6f) with vertical striae, extending to ocelli and continuing around eyes; clypeus shining, finely reticulate, openly punctured; scutum (Fig. 9f) from anterior margin to level of parapsidal lines with directed obliquely, transverse 'wave-like' plicae, meeting at obtuse angles along the midline, remainder of scutum smooth and sparsely punctured, except at post-

erior end of parapsidal line openly punctured; dorsal surface of propodeum (Fig. 11f) with areolate rugae extending to rim.

Colour. Frons dark olive green; vertex, genae and propodeum dark blue; clypeus royal blue suffused anteriorly with red and along basal suture with purple; supraclypeal area coppery green; scape black, flagellum black above, light red-brown beneath; scutum and scutellum variable golden green (in holotype of H. caloundrensis) to royal blue; trochanters, and femora dark green, tibiae and basitarsi (except knees, light red-brown) dark brown-black, remainder of tarsi suffused with light red-brown; gaster steel blue.

Pubescence. Frons, vertex, paraocular areas and genae with long, branched hair; clypeus and supraclypeal area almost bare, a few long, simple hairs; scutum sparsely covered with long, erect, branched hair; scutellum almost bare, a few long hairs; propodeum bare dorsally, vertically with long, erect, branched hair; gastral terga I and II almost bare, terga III, IV and V with increasing density of short, simple hair.

Male. BL 5.6-6.0 mm; FL 3.8-4.1 mm; head wider than long (67:59); eyes converging strongly below, UID:LID as 39:28; scape not reaching level of median ocellus; Fg:UID as 1.7:1. AOD:IAD:OAD:IOD:OOD as 12:7:21:11:10. BP incomplete, only defined anteriorly.

Sculpturing. Head roughened, frons with vertical striae continuing around hind margin of eye, except above antennal bases coarsely reticulate, several transverse striae below ocelli; vertex with transverse striae; clypeus and supraclypeal area reticulate, openly punctured; scutum with transverse plicae on anterior half meeting at an obtuse angle along midline, parapsidal area and hind margin reticulate with open punctures, mesially reticulate with sparse punctures; scutellum sparsely punctured; dorsal surface of propodeum defined by carinae, with areolate rugae extending to rim.

Colour. Frons, scutum and scutellum dark green; vertex, genae, metanotum and propodeum dark blue; coxae, trochanters and femora black tinged with green, anterior surface of fore tibiae, mid and hind tibiae and tarsi dark brown, posterior surface of fore tibiae and fore tarsi light red-brown; gaster steel blue,tergum VII brown.

Pubescence. Frons, vertex, scutum and scutellum, with erect branched hair; clypeus, supraclypeal area and lower paraocular areas with short, inclined branched hair; gastral sterna II covered with short, plumose hair, sterna III and IV with transverse row of hair along posterior margin and prominent tufts of plumose hair lateral, sterna VI with erect tuft of hair medianly.

Genitalia. Figs. 14e, f, g, h.

Gastral Sternum VI. Fig. 24c.

Distribution. Queensland, New South Wales, north-west Victoria and South Australia (Fig. 2a).

Homalictus cassiaefloris (Cockerell)

Figures 3b; 8a; 10g; 12f; 19d-f; 26f

Halictus cassiaefloris Cockerell, 1914a: 514.–1929a: 12.–1933: 306.–Rayment,1953: 22.

Halictus tenuis Friese, 1924: 240 (not Ellis, 1913: 208). syn. by Cockerell, 1929a: 12.

Homalictus cassiaefloris.–Michener, 1965: 179.

Homalictus tenuis.–Michener, 1965: 181.

Material examined.

Lectotype ♀, Paralectotype ♀, of *Halictus cassiaefloris*, Mackay, Queensland, Dec 1899, *Cassia*, 14a, Turner (BMNH). (Cockerell described this species from two female specimens (syntypes) and attached a 'type' label to each. One has been chosen as a lectotype, the other as a paralectotype and both are designated here.)

Lectotype ♀ of *Halictus tenuis*, Mackay, Queensland, 2 Jan 1900, *Cassia*, Turner (AMNH) (examined). (attached is Cockerell's handwritten label *Halictus cassiaefloris*). Species described from several specimens but only one syntype was located. Lectotype designated here.

Other specimens examined: (10 ♀♀, 4 ♂♂) (PD: 1.9-12) (FR: *Cassia, Terminalia, Securinega, Eucalyptus, Tristanopsis*) QUEENSLAND: Mackay, Kuranda, Redlynch (BMNH); Shiptons Flat (ANIC); Peaches Crossing via Coen (UQIC). NORTHERN TERRITORY: Mataranka (UQIC); Mt. Cahill, East Alligator R. (ANIC). WESTERN AUSTRALIA: Carson escarpement (ANIC).

Diagnosis. A member of the '*blackburni*' species-group, most like *H. eurhodopus*; distinguished from other members of the genus by the following combination of characters: Female–fore basitarsal comb absent; BL <5.5

mm; scutum impunctate; coxae, trochanters and basal two thirds of femora dark brown, remainder light red-brown. Male–Fg:UID >2.0:1; clypeus without yellow or white markings; fore trochanters densely covered with long, plumose hair.

Female. BL 4.2-5.1 mm (lectotype c. 5.1 mm); FL 3.5-4.2 mm (lectotype c. 4.2 mm); head wider than long (53:44); UID:LID as (30:28); clypeus slightly convex, width less than three times length (23:10); antennal sockets separated by distance greater than diameter of socket; supraclypeal area raised. AOD:IAD:OAD:IOD:OOD as 10:5:19:8:8. Scape reaching anterior margin of median ocellus; dorsolateral angle of pronotum projecting as a prominent pointed spine; fore basitarsal comb absent; BP complete, apically pointed; TS with three blunt teeth, decreasing in size distally, distal tooth minute and same length as outer spur.

Sculpturing. Head smooth (Fig. 8a), frons, supraclypeal area and basal two thirds of clypeus weakly tessellate, apical one third of clypeus polished; frons and supraclypeal area impunctate; clypeus roughened with broad, shallow punctures on anterior one third, remainder impunctate; scutum (Fig. 10g) and scutellum finely reticulate, impunctate; dorsal surface of propodeum (Fig. 12f) mesially with areolate rugulae, interspaces reticulate, laterally smooth and polished.

Colour. Body black; scape red-brown, suffused with black apically, flagellum dark brown above, light brown beneath; pronotal tubercle dull white; coxae black, trochanters and basal two thirds of femora dark brown, apical one third of fore and mid femora, apical half of hind femora, tibiae and tarsi light red-brown.

Pubescence. Sparse; frons with short, erect, simple hair; vertex and genae with erect, minutely branched hair; lower paraocular areas with short, plumose, adpressed hair; clypeus and supraclypeal area with short, branched hair, a few long, simple hairs along anterior margin of clypeus; mandibles with erect, simple hair; scutum and scutellum with short, erect, simple hair, a few long, erect, simple hairs along posterior margin of scutellum; metanotum with both long, branched and simple hair; propodeum with short, plumose hair dorsolaterally and vertically; gastral terga I, II, III, almost bare, terga IV, V with short, simple hair; gastral and femoral scopae weakly developed, except dense pubescence on underturned areas of terga.

Male. BL 4.6-4.8 mm; FL 3.8-3.8 mm; head wider than long (53:46); eyes converging strongly below, UID:LID as 31:19; scape not reaching level of median ocellus; Fg:UID as 2.8:1. AOD:IAD:OAD:IOD:OOD as 7:7:19:9:8. Dorsolateral angle of pronotum projecting as prominent pointed spine; BP complete, apically rounded.

Sculpturing. Head smooth, finely reticulate, impunctate; scutum and scutellum, microtessellate, indistinctly punctured with well spaced, minute, piliferous punctures; dorsal surface of propodeum with areolate rugulae mesially, laterally reticulate.

Colour. Head, mesosoma, gaster black; legs dark brown except tarsi light red-brown.

Pubescence. Sparse; frons, vertex with short, erect, simple hair; lower paraocular areas, supraclypeal area and clypeus with short, branched hair, a few long, simple hairs along anterior margin of clypeus; mandibles with erect, branched hair on basal one third; genae with long, branched hair (forming a beard); fore trochanters with long,plumose hair; scutum and scutellum with short, erect, simple hair, a few long, erect, simple hairs along posterior margin of scutellum; metanotum with both long, simple and branched hair along posterior margin; propodeum with short, branched hair on vertical surface.

Genitalia. Figs. 19d, e, f.

Gastral Sternum VI. Fig. 26f.

Remarks. No intraspecific variation was found. Few specimens were examined, but those available were distributed across northern Australia.

Distribution. Across northern Australia (Fig. 3b).

Homalictus ctenander Michener

Figures 3a; 7i; 10a; 12a; 18a-c; 26b

Homalictus ctenander Michener, 1965: 318-319, pl. 14 figs. 10, 12, text figs. 606-608, 628, 629.

Material examined.

Holotype ♀, Allotype ♂, Kerang, Victoria, 29 Mar 1948, R. Trebilcock. (NMV).

Paratypes, 1 ♂, 1 ♀, Kerang, Victoria, 8 Jan 1947, 18 Jan 1947, (respectively), R. Trebilcock. (NMV).

Other specimens examined: (75 ♀♀, 10 ♂♂) (PD: 1-4,10-12) (FR: *Amyema, Eremophila, Eucalyptus, Melaleuca, Pittosporum, Malus, Atalaya, Brachychiton, Strelitzia*) NEW SOUTH WALES: Tenterfield, Wentworth (SAM); Cobar (SAM, UQIC, WAM); Broken Hill, Wilcannia (ANIC). VICTORIA: Mildura (ANIC); Hattah, Lake Kangaroo, Kerang (NMV). SOUTH AUSTRALIA: Mt Serle, Swan Reach, Oodla Wirra, Pondanna Out Stn, Aldinga Scrub, Morgan, Minnipa (SAM); Middleback Range, Lake Gilles Nat. Pk (SAM, WAM); Thurlga Stn (WAM). NORTHERN TERRITORY: Alice Springs (UQIC). WESTERN AUSTRALIA: Eucla (WAM).

Diagnosis. A member of the '*sphecodoides*' species-group; distinguished from other members of the genus by the following unique character: dorsolateral angles of pronotum projecting as erect lamellae (additional–scutal colour metallic purple).

Remarks. H. ctenander differs from all other Australian *Homalictus* by the following characters: Both sexes–tubercle at rear of vertex; dorsolateral angle of pronotum as above; ocello-occipital distance twice interocellar distance. Male–eyes not converging below, UID:LID as 42:47; large mandibles; pectinate inner hind tibial spur.

The species was adequately described by Michener and is not redescribed here, although additional figures are presented.

Female. Head: Fig. 7i; Scutum: Fig. 10a; Dorsal surface of propodeum: Fig. 12a.

Male. Genitalia. Figs. 18a, b, c.
Gastral Sternum VI. Fig. 26b.

Distribution. Mainly dry inland areas of south-eastern and central Australia (Fig. 3a).

Homalictus dampieri (Cockerell)

Figures 3b; 7k; 10d; 18g-i; 26d

Halictus dampieri Cockerell, 1905c: 270.–1910: 228 (description of male).–1912: 385.–1926b: 2.–1933: 308.–Krombein, 1951: 280, pl. 1 fig. 3.

Halictus indigoteus Friese, 1924: 243. syn. by Cockerell, 1929a: 12.–1933: 308.

Halictus strangulatus Friese, 1924: 244. syn. by Cockerell, 1929a: 12.–1933: 308.

Homalictus dampieri.–Michener, 1965: 180.

Homalictus indigoteus.–Michener, 1965: 180.

Homalictus strangulatus.–Michener, 1965: 181.

Material examined.

Holotype ♀ of *Halictus dampieri*, Mackay, Ridg., May 1891, Queensland, G. Turner, (706) (BMNH). Head and gaster missing.

Lectotype ♀ of *Halictus indigoteus*, Mackay, Queensland, Oct. 1900, Turner (AMNH). Described from several female syntypes but only one was located. Lectotype designated here.

Lectotype ♀ of *Halictus strangulatus*, Mackay, Queensland, May 1899, Turner, (706), *Xanthorrhoea* sp. (AMNH). Lectotype designated by Pauly (in press).

Other specimens examined: (1152 ♀♀, 366 ♂♂) (PD: 1,3-5,8-12) (FR: *Terminalia, Amyema, Acacia, Angophora, Callistemon, Eucalyptus, Eugenia, Leptospermum, Melaleuca, Tristanopsis, Jacksonia, Alphitonia*) NEW SOUTH WALES: Moree, Liston (UQIC); Tenterfield (SAM). QUEENSLAND: Brisbane (UQIC, ANIC, SAM, NMV, BPBM); Stanthorpe, Amiens, Palen Ck, Bribie Is., Cedar Ck, Beachmere, Yelarbon, Maryland, Redcliffe, Gatton, Ipswich, Ma Ma Ck, Withcott, Bald Mtn, Landsborough, Helidon, Oakey, Inglewood, Condamine, Chinchilla, Tin Can Bay, Glenmorgan, Gayndah, Munduberra, Biggenden, Eidsvold, Childers, Tansey, Monto, Pomona, Bundaberg, Moura, Biloela, Springsure, Rockhampton, Anakie, Rubyvale, Blackall, Yeppoon, Emerald, Clermont, Proserpine, Mt. Isa, Seaforth, Babinda, Herberton, Tolga, Georgetown, Lakeland (UQIC); Warwick, Roma, Leyburn, Mackay (UQIC, NMV); Bunya Mts, Irvinebark, Almaden, Petford, Chillagoe, Mt Surprise, Mt Molloy, Croydon, Greenvale (QDPI); Mareeba, Laura (UQIC, QDPI); Bowen, Townsville (UQIC, SAM); Mt Carbine (UQIC, QDPI, SAM); Esk, Beerburrum, Wyberba Nat. Pk, Shute Harbour, Marlborough, Kuranda, Cairns, Cooktown (SAM); Hope Vale Mission (ANIC). NORTHERN TERRITORY: Renner Springs, Elliott, Daly Waters, Borroloola, Mataranka, Wildman R., Darwin (UQIC); Mudginberri Hmsd, Mt Cahill, Cape Crawford (ANIC); Dunmarra, Katherine (UQIC, SAM); Roper R. (SAM). WESTERN AUSTRALIA: Kununurra (UQIC); Millstream, Walsh Pt (ANIC); Phillip Range, Onslow (SAM).

Diagnosis. A member of the '*blackburni*' species-group; distinguished from other members of the genus by the following combination

of characters: Female–fore basitarsal comb absent; sculpture on dorsal surface of propodeum minutely anastomosed (Fig. 12d); non black colour. Male–genae with long, branched hair; anterior half of clypeus pale dull yellow; frons and scutum dark green.

Female. BL 4.6-5.9 mm; FL 3.5-4.5 mm (holotype c. 4.4 mm); head wider than long (62:52); UID:LID as 33:34; clypeus slightly convex, width three times length (31:10); antennal sockets separated by distance less than diameter of socket; supraclypeal area bulbous. AOD:IAD:OAD:IOD:OOD as 11:7:21:10:8. Scape reaching level of anterior margin of median ocellus; dorsolateral angle of pronotum projecting as small rounded tubercle; fore basitarsal comb absent; BP complete, apically rounded; TS with three teeth, proximal tooth blunt, distal two sharply pointed and same length as outer spur.

Sculpturing. Head smooth (Fig. 7k), frons, supraclypeal area and basal one third of clypeus weakly tessellate, apical two thirds of clypeus polished; supraclypeal area sparsely marked with hair pits, clypeus with open punctures on anterior half; scutum (Fig. 10d) and scutellum tessellate, sparsely marked with hair pits; dorsal surface of propodeum (Fig. 12d) with transverse lineolation laterally, minutely anastomosed rugulae mesially extending almost to rim.

Colour. Frons, supraclypeal area, mesosoma dark olive green; apical two thirds of clypeus black, remainder dark olive green; scape and flagellum above black, flagellum beneath dark brown; legs black or dark brown; gaster green-blue.

Pubescence. Sparse, head except supraclypeal area with erect, minutely branched hair, basal half of clypeus with similar hair, remainder with simple hair, a few long, simple hairs along anterior margin; scutum and scutellum with short, erect, minutely branched hair, a few long, branched hairs along posterior margin of scutellum and metanotum; propodeum with long, erect, branched hair dorsolaterally and laterovertically; gastral terga I, II, III almost bare, terga IV, V with increasing density of hair.

Male. BL 4.5-5.4 mm; FL 3.4-4.5 mm; head wider than long (60:51); eyes converging strongly below, UID:LID as 33:23; scape not reaching level of median ocellus; Fg:UID as 2.7:1. AOD:IAD:OAD:IOD:OOD as 8:8:19:10:8. BP complete, apically, bluntly acute.

Sculpturing. Head smooth, finely reticulate; clypeus with a few shallow punctures on anterior half; scutum and scutellum finely reticulate, impunctate; dorsal surface of propodeum with minutely anastomosed rugulae mesially extending almost to rim, laterally reticulate.

Colour. Head except clypeus and antennae dark olive green; anterior half of clypeus pale yellow, remainder dark green; antennae dark brown to black; scutum and scutellum brass green; propodeum and gaster dark green; coxae, trochanters, femora black, knees and tibiae red-brown, tarsi light red-brown.

Pubescence. Frons, vertex with erect, minutely branched hair; lower paraocular areas, supraclypeal area and clypeus with inclined, branched hair, a few long, simple hairs along anterior margin of clypeus; genae with long, branched hair (not forming a beard); scutum and scutellum with short, erect, minutely branched hair; metanotum with a few long, branched hairs; propodeum with erect, branched hair on vertical surface; gastral sterna almost bare, sterna IV, V with sparse cover.

Genitalia. Figs. 18g, h, i.

Gastral Sternum VI. Fig. 26d.

Remarks. Colour variation is minimal. Female specimens from Queensland and New South Wales are often tinged with blue, those from north west Australia are sometimes tinged with a bright golden-red colour.

Distribution. North-eastern New South Wales, south-east Queensland and across Northern Australia (Fig. 3b).

Homalictus dotatus (Cockerell)

Figures 2b; 6l; 9l; 11l; 15d-f; 25b

Halictus dotatus Cockerell, 1912: 384.–1933: 309.

Halictus occidentalis Rayment, 1930a: 51 (not Cresson, 1872: 250).–Cockerell, 1933: 317. syn. nov.

Halictus codenticalis Rayment, 1935: 634, pl. 36 (new name for *H. occidentalis* proposed by Rayment, 1935). syn. nov.

Homalictus dotatus.–Michener, 1965: 180.

Homalictus codenticalis.–Michener, 1965: 179.

Material examined.

Holotype ♀ of *Halictus dotatus*, Sydney, 29 Nov 1910, Froggatt (USNM).

Holotype ♀ of *Halictus occidentalis*, Perth, Western Australia, 19 Oct 1929, T. Greaves (ANIC).

Other specimens examined: (2012 ♀♀, 167 ♂♂) (PD: 1-5,8-12) (FR: *Schinus, Ptilotus, Wahlenbergia, Terminalia, Codonocarpus, Amyema, Acacia, Angophora, Callistemon, Eucalyptus, Melaleuca, Tristanopsis, Grevillea, Hakea, Atalaya, Keraudrenia*) QUEENSLAND: Coen, Laura, Mt Carbine, Normanton, Georgetown, Forsayth, Townsville, Sarina, Clermont, Rockhampton, Emerald, Longreach, Springsure, Blackall, Rubyvale, Biloela, Millaroo, Monto, Windorah, Childers, Tansey, Mundubbera, Gayndah, Glenmorgan, Yuleba, Roma, Amby, Mungallala, Charleville, Quilpie, Thargomindah, Cunnamulla, Bollon, Inglewood, Brisbane, Stanthorpe, Warwick, Bunya Mts, Helidon (UQIC); Evelyn (BPBM); Charters Towers, Julia Creek, Mt Isa (UQIC, QDPI); Condamine, Dalby, Leyburn (UQIC, NMV); Miles (ANIC, SAM) Beerburrum, Maryborough, Wallangarra, Jimboomba, Bowen (SAM). NEW SOUTH WALES: Narrabri, Cobar, Coonabarabran, Pilliga Scrub, Nyngan, Sydney (UQIC); Tenterfield, Wilcannia, Wentworth (SAM). VICTORIA: Melbourne, Warracknabeal, St Arnard, Donald, Robinvale (NMV). SOUTH AUSTRALIA: Coward Spring, Immarna, Kyancutta, Lake Gilles Nat. Pk, Wirraminna, Taylorville, Ooldea, Amata, Woomera, Marree, Oodnadatta, Winnipa (SAM). WESTERN AUSTRALIA: Gnowangerup, Kojonup, Katanning, Yallingup, Wickepin, York, Perth, Kalgoorlie, Guilford, Moora, Kellerberrin, Nukarni, Greenmount, Dandaragan, Boulder, Carnamah, Mingenew, Geraldton, Nabawa, Carnarvon, Newman, Broome, Derby, Kununurra (UQIC); Spring Ck, Fitzroy Crossing (NMV); Onslow, Merredin, Meekatharra, Capel, Kimberley (SAM); Menzies, Langi Crossing (CAS). NORTHERN TERRITORY: Darwin, Pine Ck, Mataranka, Borroloola, Daly Waters, Elliott, Renner Springs, Frewana, Wauchope, Barrow Ck, Aileron, Glenormiston, Standley Chasm (UQIC); Dunmara, Wave Hill (SAM); Tennant Ck, Katherine (UQIC, SAM); Maningrida (BPBM); Alice Springs (UQIC, BPBM, CAS); Devils Marbles, Macdonald Downs, Ti-Tree, Ooratippra (CAS).

Diagnosis. A member of the '*dotatus*' species-group, most like *H. imitatus*; distinguished from other members of the genus by the following combination of characters: Female–clypeus light red-brown on anterior two thirds; scutum anteriorly impunctate, remainder open-sparsely punctured; dorsal surface of propodeum with areolate rugulae posteriorly, transverse rugulae anteromesially and parallel rugulae laterally (Fig. 11l). Male–clypeus pale yellow on basal half; scutum openly punctured; frons, paraocular areas and supraclypeal area covered with short, adpressed hair.

Female. BL 4.9-5.4 mm (holotype c. 5.3 mm); FL 3.5-4.0 mm (holotype c. 4.0 mm); head wider than long (56:48); UID:LID as 31:33; clypeus width three times length (30:10); antennal sockets separated by distance greater than diameter of socket. AOD:IAD:OAD:IOD:OOD as 12:6:19:11:6. Scape reaching anterior margin of median ocellus; dorsolateral angle of pronotum projecting as a small blunt tubercle; TS with three rounded teeth and same length as outer spur; BP complete and apically rounded.

Sculpturing. Frons (Fig. 6l) and vertex reticulate; clypeus and supraclypeal area (except reticulate posterior margin of clypeus) smooth, anteriorly with shallow depressions; scutum (Fig. 9l) anteriorly and laterally weakly reticulate, remainder smooth and shining, anteriorly impunctate, remainder covered with shallow open-sparse punctures; dorsal surface of propodeum (Fig. 11l) with areolate rugulae posteromesially, transverse rugulae anteromesially and parallel rugulae laterally, none extend to vertical surface.

Colour. Frons, vertex and genae copper-green; supraclypeal area coppery-red; anterior two thirds of clypeus, scape and flagellum light red-brown, remainder of clypeus dark brown, scutum golden green; margins of pronotal tubercles yellow; scutellum and propodeum dark green; legs orange red-brown, fore and hind coxae brown, mid coxae red-brown, gaster red-brown suffused with dark patches apically.

Pubescence. Frons sparsely covered with short, erect hair, some plumose, adpressed hair in lower paraocular areas; clypeus and supraclypeal area almost bare; scutum and scutellum sparsely covered with short, backwardly directed hair; scutellum with a few erect, branched hairs.

Male. BL 3.7-4.6 mm; FL 2.7-3.4 mm; head wider than long (48:42); eyes converging below, UID:LID as 28:16; scape below level of median ocellus; Fg:UID as 2.7:1.

AOD:IAD:OAD:IOD:OOD as 9:7:15:10:6. BP complete, apically rounded.

Sculpturing. Frons and paraocular areas reticulate; clypeus and supraclypeal area smooth, close-openly punctured; scutum reticulate and impunctate anteriorly, remainder smooth and openly punctured; scutellum sparsely punctured, smooth and shining; dorsal surface of propodeum smooth, a few transverse rugulae posteromesially.

Colour. Frons, vertex, genae, supraclypeal area and basal half of clypeus dark green, remainder of clypeus pale yellow; scape and flagellum red-brown; pronotal tubercle pale yellow; scutum dark green; scutellum and propodeum black tinged with dark green; fore and hind coxae dark green, mid coxae and all legs light red-brown; gaster light red brown.

Pubescence. Frons, supraclypeal area and basal one third of clypeus with short, plumose, adpressed hair but not a complete cover; lower paraocular areas completely covered with similar hair; genae with some erect, branched hair; scutum with short, backwardly directed, simple hair, anterior lateral corners with thick, short, plumose, adpressed hair; scutellum and metanotum almost bare except for a few long, simple hairs.

Genitalia. Figs. 15d, e, f.

Gastral Sternum VI. Fig. 25b.

Remarks. The anterior half of the clypeus in females varies from brown to red- brown while in both sexes dark patches on the gaster are variable, dependent on internal air bubbles and gut contents.

Among the females, colour and pubescence variations are often seen on the head, scutum, coxae and gaster.

The scutal colour of the *H. dotatus* holotype is green and from the large number of specimen examined, this is the 'usual' colour. Some suffusing with blue is the main variation although colours from blue-green to a bright royal blue are found. A few specimens had the frons and scutum red but these specimens are considered unusual.

The pubescence of the female given in the description is considered to be the 'usual' form. Numerous specimens examined did not fit this description and the variations seen were as follows: head bare, scutum usual; head usual, scutum bare; head and scutum bare. Sclerites that are bare show a greater lustre than normal.

The 'usual' colour of the fore and hind coxae in both sexes is dark green except in a series of specimens from southern Queensland and northern New South Wales in which all coxae are bright yellow. All other external characters and the male genitalia match the 'usual' form and they are considered to be a variation within the species.

Distribution. Australia generally excluding Tasmania (Fig. 2b).

Homalictus eurhodopus (Cockerell)

Figures 3b; 7l; 10f; 12e; 19a-c; 26e

Halictus eurhodopus Cockerell, 1914a: 514.–1933: 309.
Homalictus eurhodopus.–Michener, 1965: 180.

Material examined.

Holotype ♀, Cairns, Kuranda, Jan 1902, Turner (BMNH).

Other specimens examined: (35 ♀♀, 5 ♂♂) (PD: 1,4-5,8-9,11) (FR: *Eucalyptus, Tristanopsis, Dillwynia*) QUEENSLAND: Gunnawarra, Dunk Is., Palmerston Nat. Pk, Peaches Crossing via Coen, Iron Range (UQIC); Daintree (QDPI); Eubenangee (NMV); Wongabel St. For., Mt Finnigan, Shiptons Flat, Mt Webb Nat. Pk, Hope Vale Mission, Mission Beach (ANIC); Kuranda (BMNH, NMV); Redlynch, Mackay (BMNH).

Diagnosis. A member of the *'blackburni'* species-group, most like *H. cassiaefloris*; distinguished from other members of the genus by the following combination of characters: Female–fore basitarsal comb absent; BL <5.5 mm; scutum impunctate; legs light red-brown, except fore and hind coxae black to dark brown. Male–Fg:UID >2.0:1; anterior margin of clypeus dull white; genae with long, branched hair (forming a beard).

Female. BL 4.6-5.1 mm (holotype c. 5.1 mm); FL 3.4-3.8 mm (holotype c. 3.8 mm); head wider than long (56:47); UID:LID as 31:31; clypeus slightly convex, width less than three times length (25:10); antennal sockets separated by distance equal to diameter of socket; supraclypeal area raised. AOD:IAD:OAD:IOD:OOD as 11:5:21:8:9.

Scape reaching posterior margin of median ocellus; dorsolateral angle of pronotum projecting as prominent pointed tubercle; fore basitarsal comb absent; BP complete, apically pointed; TS with four blunt teeth, decreasing in size distally, distal tooth minute and shorter than outer spur.

Sculpturing. Head smooth (Fig. 7l), frons, supraclypeal area and basal two thirds of clypeus weakly tessellate, apical one third polished; frons and supraclypeal area impunctate, basal two thirds of clypeus with sparse, small hair pits, remainder of clypeus roughened with broad, shallow punctures; scutum (Fig. 10f) and scutellum finely reticulate, impunctate; dorsal surface of propodeum (Fig. 12e) mesially with areolate rugae extending to rim, a few parallel rugulae laterally.

Colour. Head (except antennae), mesosoma, gaster black; scape red-brown, suffused with black apically, flagellum black above, dark brown beneath; pronotal tubercle dull white; legs light red-brown, except fore and hind coxae black to dark brown.

Pubescence. Sparse; frons, vertex, genae with short, erect, minutely branched hair; lower paraocular areas with short, plumose, adpressed hair; clypeus and supraclypeal area with distinctly branched hair, a few long, simple hairs along anterior margin of clypeus; mandibles with erect, simple hair; scutum and scutellum with short, erect, simple hair, a few long, simple hairs along posterior margin of scutellum; metanotum with both long, branched and simple hair; propodeum with short, plumose hair dorsolaterally and on vertical surface; gastral terga I, II, III almost bare, terga IV, V with short, simple hair; gastral and femoral scopae weakly developed, except dense pubescence on underturned areas of terga.

Male. BL 4.5-4.7 mm; FL 3.2-3.3 mm; head wider than long (47:42); eye converging strongly below, UID:LID as 27:17; scape not reaching level of median ocellus; Fg:UID as 2.7:1. AOD:IAD:OAD:IOD:OOD as 5:5:17:8:7. Dorsolateral angle of pronotum projecting as a pointed tubercle; BP complete, apically pointed.

Sculpturing. Head smooth, finely reticulate, impunctate; scutum and scutellum microtessellate, impunctate; dorsal surface of propodeum mesially with areolate rugulae extending to rim, reticulate laterally.

Colour. Head black, except anterior margin of clypeus dull white, antennal scape red-brown; pronotal tubercle dull white; mesosoma (except pronotal tubercle) and gaster black; fore and hind coxae black, remainder of legs light red-brown.

Pubescence. Sparse; frons, vertex with short, erect, simple hair; lower paraocular areas with short, plumose, adpressed hair; clypeus and supraclypeal area sparsely covered with short, plumose hair; clypeus with long, simple hair along anterior margin; mandibles with long, branched hair on basal two thirds; genae with long, branched hair (forming a beard); scutum and scutellum with short, backwardly inclined hair, a few long, erect, simple hairs along posterior margin of scutellum; propodeum with some erect, branched hair dorsolaterally and upper vertical surface.

Genitalia. Figs. 19a, b,c.

Gastral Sternum VI. Fig. 26e.

Remarks. This species shows little variation except in males the colour of the scape may be as described or entirely black. Conspecificity of variant males was confirmed by examination of genitalia.

Turner seems to have had a number of "Cairns" labels printed and used them for the surrounding districts. He wrote in the exact locality beneath the printed word "Cairns". The correct type locality is Kuranda, not Cairns.

Distribution. North Queensland (Fig. 3b).

Homalictus exleyae sp. nov.

Figures 2a; 6g; 9g; 11g; 14i-l; 24f

Material examined.

Holotype ♀, Paratypes 6 ♀♀, 2 ♂♂, Australia: North Western Australia, 6 km S. of Broome, 15 Dec 1975, E. Exley and R. Storey, on *Eucalyptus* sp. (QM).

Other specimens examined: (19 ♀♀, 16 ♂♂) (PD: 2-4,6-7,10,12) (FR: *Eucalyptus, Melaleuca*) WESTERN AUSTRALIA: Broome, Derby (UQIC); Martins Well, West Kimberley, Cape Bertholet, West Kimberley

(ANIC). NORTHERN TERRITORY: Casuarina Beach, via Darwin, Cobourg Peninsula (ANIC). QUEENSLAND: Moa (Banks) Is., Torres Str. (UQIC, SAM, NMV); Mabuiag Is., Torres Str. (SAM), Mt Webb (ANIC).

Diagnosis. A member of the '*flindersi*' species-group, most like *H. flindersi*; distinguished from other members of the genus by the following combination of characters: Female–BP incomplete; dorsal surface of propodeum defined by carina; frons with vertical striae; scutum closely punctured along posterior margin and around posterior ends of parapsidal lines (Fig. 9g). Male–BP incomplete; dorsal surface of propodeum defined by carinae; gastral sternum VI without tufts of erect hair; femora apically and tibiae light red-brown.

Female. BL 5.6-5.9 mm (holotype c. 5.7 mm); FL 3.9-4.3 mm (holotype c. 4.1 mm); head wider than long (65:59); UID:LID as 34:32; clypeus about twice as wide as long (31:15), convex, protruded; antennal sockets separated by distance less than diameter of socket; supraclypeal area bulbous. AOD:IAD:OAD:IOD:OOD as 12:6:24:12:8. Scape reaching anterior margin of median ocellus; dorsolateral angle of pronotum produced into a small blunt tubercle; dorsal surface of propodeum as long as scutellum, defined by carinae; TS with three small blunt teeth and two third as long as outer spur; BP incomplete, only defined anteriorly.

Sculpturing. Head roughened, frons (Fig. 6g) with weak vertical striae, continuing around eye, except medianly above antennal bases granulate, weak transverse striae beneath ocelli; clypeus shining, finely reticulate, openly punctured; scutum (Fig. 9g) finely reticulate, more so anteriorly, area between parapsidal lines sparsely punctured, lateral to parapsidal lines and hind margin closely punctured; scutellum smooth and sparsely punctured; dorsal surface of propodeum (Fig. 11g) with areolate rugae extending mesially to carina, posterior lateral areas smooth.

Colour. Frons, vertex and genae olive green; clypeus royal blue, suffused with red anteriorly; supraclypeal area coppery green; scape black, flagellum above, dark brown basally, brown apically, beneath light red-brown; mandibles orange yellow, red apically, black basally; scutum and scutellum green-blue; propodeum dark blue; trochanters and basal two thirds of femora dark green, apical one third of femora, tibiae and tarsi light red-brown, hind tibiae and tarsi suffused with brown; gaster steel blue, posterior margins of terga with dark brown.

Pubescence. Frons, clypeus and vertex with short, sparse, simple hair; genae with sparse, long, simple hairs; lower paraocular areas with short, plumose hair; scutum with short, minutely branched hair; scutellum almost bare; propodeum bare dorsally, laterovertically with short, dense, plumose hair, posterovertically with sparse, branched hair; gastral terga I, II and III almost bare, terga IV and V with increasing density of hair.

Male. BL 4.6-5.1 mm; FL 3.4-3.7 mm; head broader than long (57:53); eyes converging below, UID:LID as 33:37; scape not reaching median ocellus; Fg:UID as 1.8:1. AOD:IAD:OAD:IOD:OOD as 9:12:19:11:9. BP incomplete, not defined apically.

Sculpturing. Head roughened, frons with inverted 'U'-shape striae above antennal bases extending to below ocelli, laterally with vertical striae continuing around hind margins of eyes, a few transverse striae below ocelli; vertex with transverse striae; clypeus and supraclypeal area shining, openly punctured; scutum reticulate with transverse plicae anteriorly, medianly sparsely punctured, in parapsidal areas openly punctured; scutellum shining with sparse punctures; dorsal surface of propodeum defined by carinae, with areolate rugae extending to posterior carina mesially, posterior lateral areas smooth.

Colour. Head green, vertex with tinge of blue; scutum and scutellum golden green; propodeum black tinged with blue; coxae trochanters and basal two thirds of femora dark green, apical one third of femora, tibiae and tarsi light red-brown (in some specimens mid and hind tibiae and tarsi suffused with brown); gaster black tinged with dark green, posterior margins of terga brown,tergum VII light brown.

Pubescence. Frons, clypeus, supraclypeal area vertex, genae, scutum and scutellum with erect, branched hair, lower paraocular areas with short, plumose, adpressed hair; gastral sterna III and IV with transverse row of long, white hair along posterior margin.

Genitalia. Figs. 14i, j, k, l.

Gastral Sternum VI. Fig. 24f.

Remarks. I take pleasure in naming this species after Dr E.M. Exley who caught many of the specimens used in this paper and first aroused my interest in Apoidea.

Distribution. Across northern Australia (Fig. 2a).

Homalictus exophthalmus sp. nov.

Figures 4a; 5k; 8d; 10j; 12k; 21a-c; 27a

Material examined.

Holotype ♀, Paratypes 4 ♀♀, 1 ♂, Nyngan, New South Wales, 30 Jan 1971, T.F. Houston, on *Wahlenbergia* sp. (SAM).

Diagnosis. A member of the '*urbanus*' species-group, most like *H. urbanus*; distinguished from other members of the taxon by the following combination of characters: Female–labrum with two raised tubercles; EW:GW c. 3.1:1 (Fig. 5k). Male–Fg:UID <2.0:1; EW:GW c. 3.25:1.

Female. BL 4.5-4.6 mm (holotype c. 4.5 mm); FL 3.0 mm (holotype c. 3.0 mm); head wider than long (56:43); eyes converging below, UID:LID as 35:25; clypeus convex, width greater than twice the length (23:10); antennal sockets separated by distance greater than antennal socket. AOD:IAD:OAD:IOD:OOD as 8:8:17:10:10. Scape extending to level below anterior margin of median ocellus; EW:GW as 3.1:1 (Fig. 5k); dorsolateral angle of pronotum projecting as small rounded tubercle; TS with two large rounded teeth and two thirds length of outer spur; BP complete, rounded apically.

Sculpturing. Head relatively smooth (Fig. 8d), frons finely reticulate; supraclypeal area finely reticulate with a few piliferous punctures, clypeus smooth and polished, sparsely punctured; scutum (Fig. 10j) and scutellum reticulate, scutum mesially and at posterior end of parapsidal lines openly punctured, remainder of scutum and scutellum sparsely punctured; dorsal surface of propodeum (Fig. 12k) with areolate rugae on basal half not reaching rim, laterally a few longitudinal rugulae reaching rim, rim smooth.

Colour. Frons dull blue-green, supraclypeal area dark brown, clypeus brown; scape brown suffused with light red-brown apically, pedicle and flagellum light red-brown; scutum and scutellum blue (holotype), blue-green (paratypes); propodeum black; coxae and trochanters brown, fore and mid femora brown suffused with light red-brown, remainder of legs light red-brown; gaster light red-brown (holotype), suffused with brown patches (paratypes).

Pubescence. Sparse; frons with short, erect, minutely branched hair; vertex with a few long, erect, minutely branched hairs; lower paraocular areas with short, minutely branched, adpressed hair; clypeus and supraclypeal area with a few apicad directed, minutely branched hairs, except anterior margin of clypeus with long, simple hair; scutum and scutellum with both erect, minutely branched and short, simple, backwardly inclined hair; metanotum and posterior margin of scutellum with a few long, erect, branched hairs; propodeum bare dorsally, posterovertically sparsely covered with short, erect, minutely branched hair; gastral tergum I almost bare, remaining terga with sparse cover of short, simple, adpressed hair, a few long hairs on terga IV, V and VI; femoral scopae weakly developed.

Male. BL c. 4.2 mm; FL c. 3.0 mm; head wider than long (42:38); eyes converging below, UID:LID as 32:24; scape not reaching level of anterior margin of median ocellus; Fg:UID as 0.9:1. AOD:IAD:OAD:IOD:OOD as 7:7:14:10:9. In side view clypeus markedly convex; EW:GW as 3.25:1. BP complete, apically rounded; TS with two small teeth and slightly shorter than outer spur.

Sculpturing. Frons, lower paraocular areas, vertex and genae finely reticulate; clypeus and supraclypeal area smooth and polished, both with a few minute punctures; scutum and

scutellum reticulate, sparsely punctured; dorsal surface of propodeum with weak areolate rugulae mesially not reaching rim, remainder smooth.

Colour. Frons, vertex and genae dark green tinged with blue; clypeus and supraclypeal area brown; scutum and scutellum green tinged with blue; propodeum black; coxae, trochanters and basal two thirds of femora brown, remainder of legs light red-brown; gaster brown.

Pubescence. Head and mesosoma almost bare, except a few short, simple or minutely branched hairs on anterior margin of clypeus, vertex, genae, metanotum and vertical posterior surface of propodeum; gastral terga with sparse, short, simple, adpressed hair.

Genitalia. Figs. 21a, b, c.

Gastral Sternum VI. Fig. 27a.

Remarks. The specific name refers to the appearance of the eyes.

Distribution. Central New South Wales (Fig. 4a).

Homalictus flindersi (Cockerell)

Figures 2a; 6d; 9d; 11d; 13h-k; 24e

Halictus flindersi Cockerell, 1905c: 271.–1910: 228 (*Halictus flindersi* var. a).

Halictus hilli Cockerell, 1929a: 2.–1933: 312. syn. nov.

Homalictus flindersi.–Michener, 1965: 180.

Homalictus hilli.–Michener, 1965: 180.

Material examined.

Holotype ♀ of *Halictus flindersi*, Seaforth Jan 1890, 400, Mackay, Queensland, G. Turner, 1892-16 (BMNH). Type is headless. Paratype ♂ labelled *Halictus flindersi* in Cockerell's handwriting, Seaforth Jan 1890, 439, Mackay, Queensland, G. Turner, 1892-16 (BMNH).

Holotype ♂ of *Halictus hilli*, Port Darwin, G.F. Hill (AMNH).

Other specimens examined: (60 ♀♀, 24 ♂♂) (PD: 1-3,5-8,11-12) (FR *Tournefortia, Parinari, Dysophylla, Hibiscus, Acacia, Eucalyptus, Melaleuca, Pongamia*) QUEENSLAND: St Pauls, Moa (Banks) Is., Bamaga, Coen, Cooktown, North West Is., Wilson Is., Heron Is. (UQIC); Dunk Is. (UQIC, NMV); Prince of Wales Is., Fitzroy Is., Stradbroke Is. (NMV); Port Douglas (UQIC, SAM); Kuranda (BMNH); Townsville (ANIC, SAM); Mackay (BMNH, UQIC); Yeppoon, Rockhampton (BPBM); Caloundra, Dunwich, Brisbane (QM). NORTHERN TERRITORY: Paratype ♂ (probably a paratype of *H. woodsi*, but misidentified) Port Darwin, Dec 1902, Turner Coll., 1910-7. (BMNH); Horn Inlet Sir Edward Pellow Group, Cobourg Peninsula, Oenpelli, Mt Cahill, Wessel Island (ANIC). WESTERN AUSTRALIA: Drysdale River (ANIC).

Diagnosis. A member of the '*flindersi*' species-group, most like *H. exleyae*; distinguished from other members of the genus by the following combination of characters: Female–BP incomplete; dorsal surface of propodeum defined by carinae; frons with vertical striae below ocelli; scutum openly punctured along posterior margin and around ends of parapsidal lines (Fig. 9d). Male–BP incomplete; dorsal surface of propodeum defined by carinae; gastral sternum VI without tufts of erect hair; femora and tibiae black to dark brown.

Female. BL 6.1-7.7 mm (holotype estimated c. 6.3 mm); FL 4.3-5.2 mm (holotype c. 4.4 mm); head wider than long (79:67); UID:LID as 41:37; clypeus greater than twice as wide as long (36:15), convex, protruded; antennal sockets separated by distance equal to diameter of socket. AOD:IAD:OAD:IOD:OOD as 15:7:26:12:10. Scape reaching anterior margin of medium ocellus; dorsolateral angle of pronotum projecting as a small acute spine; dorsal surface of propodeum same length as scutellum and defined by carinae; TS with three blunt teeth and shorter than outer spur; BP incomplete, only defined anteriorly.

Sculpturing. Head roughened, frons (Fig. 6d) with vertical striae below ocelli, except small reticulate median area above antennal bases, vertical striae continuing around eye; clypeus and supraclypeal area finely reticulate, openly punctured; scutum (Fig. 9d) finely reticulate, sparsely punctured, except in parapsidal area and hind margin openly punctured; dorsal surface of propodeum (Fig. 11d) with areolate rugae extending to rim.

Colour. Frons variable from purple-blue to dark green; vertex, genae and propodeum variable from dark blue to dark blue-green; clypeus variable from royal blue to golden green suffused with red anteriorly; scape black to dark brown, flagellum dark brown above, red-brown beneath; scutum variable from blue tinged with green (holotype) to golden green; coxae, trochanters, femora and tibiae dark

brown to black, tarsi variable from dark brown (holotype) to light brown; gaster steel blue.

Pubescence. Frons, vertex, supraclypeal area with short, erect, minutely branched hair; clypeus with a few long, forwardly directed, simple hairs; genae with short, erect, branched hair; scutum evenly covered with short, erect, minutely branched hair; scutellum almost bare, a few long, branched hairs; propodeum dorsolaterally and vertically with dense, long, erect, branched hair; gastral terga I and II almost bare, terga III, IV and V with increasing density of short, simple hair.

Male. BL 5.7-6.2 mm; FL 3.8-4.2 mm; head wider than long (65:55); eyes converging strongly below, UID:LID as 38:25; scape not reaching level of median ocellus; Fg:UID as 1.8:1. AOD:IAD:OAD:IOD:OOD as 9:6:21:11:9. BP incomplete, defined weakly anteriorly.

Sculpturing. Head roughened, frons with crescent shaped striae above antennal bases, transverse striae below ocelli continuing past posterior margin of rear ocelli, vertical striae on frons laterally continuing around hind margin of eye; vertex with several transverse striae; clypeus and supraclypeal area reticulate, openly punctured; scutum dull, finely reticulate, medially sparsely punctured, margins of parapsidal lines sparsely punctured, hind margin densely punctured; scutellum shining with few punctures, dorsal surface of propodeum, defined by carinae, with areolate rugae extending to rim.

Colour. Variable. Qld specimens: clypeus, supraclypeal area and frons up to level at least half distance between antennal base and ocelli dark green, remainder of frons, vertex, genae and propodeum dark blue; scutum and scutellum golden green; N.T. specimens: head, scutum, scutellum and propodeum dark blue; All specimens: coxae, trochanters, femora, mid and hind tibiae black to dark brown, fore tibiae and tarsi light brown; gaster black tinged with dark blue, tergum VII red-brown.

Pubescence. Lower paraocular areas with small area of short, plumose, adpressed hair, remainder of head and mesosoma with sparse, short, erect, branched hair; gastral sterna III and IV with transverse row of long hair along posterior margins.

Genitalia. Figs. 13h, i, j, k.

Gastral Sternum VI. Fig. 24e.

Distribution. Coastal and north Queensland and coastal northern Australia (Fig. 2a).

Homalictus forrestae sp. nov.

Figures 4a; 21d-f; 27b

Material examined.

Holotype ♂, Queensland, 11.3 km N. of Barkley Hwy, on Burketown Rd. Burnt out area, some regrowth. At light. 23 Sep 1977. J.A. Forrest (SAM).

Diagnosis. A member of the *'urbanus'* species-group, most like *H. urbanus*; male distinguished from other members of the genus by the following combination of characters: Fg:UID <2.0:1; gastral tergum punctate mesially; scutum in parapsidal areas, hind margin and scutellum closely punctured; dorsal surface of propodeum about half length of scutellum; gastral tergum closely punctured mesially.

Male. BL c. 3.6 mm; FL c. 2.8 mm; head as long as wide (47:47); eyes converging below, UID:LID as 30:20; clypeus protruded; scape not reaching level of anterior margin of ocellus; Fg:UID as 1.4:1; EW:GW as 2.0:1. AOD:IAD:OAD:IOD:OOD as 7:4:17:10:8. Dorsolateral angle of pronotum projecting as small rounded tubercle; dorsal surface of propodeum about half length of scutellum; TS with at least three minute teeth and slightly shorter than outer spur.

Sculpturing. Frons reticulate; clypeus and supraclypeal area smooth and closely punctured; vertex with several weak transverse striae not extending onto genae; scutum reticulate, scutellum weakly reticulate, scutum impunctate on anterior one third, remainder punctured, in parapsidal areas openly punctured, mesially and on scutellum closely punctured; dorsal surface of propodeum with branched rugae extending to rim; gastral tergum I closely punctured mesially.

Colour. Frons and supraclypeal area blue-green; clypeus dark brown; scape and

flagellum above dark brown, flagellum beneath light brown; pronotal tubercle brown, except small distal area dull yellow; scutum and scutellum brass green; propodeum dark blue; coxae, trochanters and femora dark brown, apical margin of femora, tibiae and tarsi light red-brown, mid and hind tibiae suffused with brown; gaster dark brown, except tergum VII red-brown.

Pubescence. Frons on upper half with short, minutely branched hair, lower half of frons, lower paraocular areas, supraclypeal area and lateral margins of clypeus with short, plumose, adpressed hair; vertex with a few long, erect, minutely branched hairs; genae with short, erect, branched hair; scutum and scutellum sparsely covered with both erect, minutely branched and short, simple, backwardly inclined hair; metanotum with a few long, erect, branched hairs; propodeum posterovertically sparsely covered with erect, minutely branched hair; gastral terga with short, simple hair.

Genitalia. Figs. 21d, e, f.

Gastral Sternum VI. Fig. 27b.

Remarks. Female unknown.

Distribution. North-western Queensland (Fig. 4a).

Homalictus grossopedalus sp. nov.

Figures 3b; 5j; 12h; 20d-f; 26h

Material examined.

Holotype ♂, North Queensland, Kuranda, F.P. Dodd, 1916-27 (BMNH).

Diagnosis. A member of the '*blackburni*' species-group, most like *H. latitarsis*; male distinguished from other members of the genus by the following unique character: All tarsal segments flanged laterally.

Male. BL c. 6.1 mm (holotype); FL c. 4.2 mm (holotype); head wider than long (58:50); eyes converging strongly below, UID:LID as 39:28; clypeus slightly convex, width about twice length (25:12); supraclypeal area bulbous; antennal scape almost extending to anterior margin of median ocellus; antennal sockets separated by distance less than diameter of socket; Fg:UID as 2.6:1. AOD:IAD:OAD:IOD:OOD as 9:5:19:10:10. Dorsolateral angle of pronotum projecting as raised rounded lobe; all tarsal segments flanged laterally (Fig. 5j- fore tarsus only); BP complete, apically rounded.

Sculpturing. Head smooth, frons and supraclypeal area finely reticulate, clypeus polished and smooth anteriorly, with fine transverse lineolation posteriorly; frons, supraclypeal area and clypeus impunctate; scutum and scutellum dull, with fine lineolets, producing a circular pattern on each scutal half, entirely on scutellum; dorsal surface of propodeum (Fig. 12h) reticulate, a few transverse rugulae posteromesially, vertical surfaces reticulate.

Colour. Frons, vertex, mesosoma black, except pronotal tubercle pale yellow; supraclypeal area dark brown; basal half of clypeus brown, remainder of clypeus pale-yellow; basal half of scape light red-brown, anterior half and pedicel red-brown, flagellum dark brown; coxae, trochanters and fore femora brown, mid and hind femora and tibiae light red-brown; tarsal segments dull white; gaster dark brown.

Pubescence. Frons, vertex, supraclypeal area and clypeus with both short, erect, branched and simple hair, a few long, simple hairs along anterior margin of clypeus; paraocular areas with short, plumose, adpressed hair; mandibles with erect, branched hair on basal half; genae with long, curled, plumose hair (forming a beard); scutum and scutellum sparsely covered with short, erect, simple hair; metanotum mesially with short, plumose, adpressed hair, a few long, branched hairs laterally; vertical surface of propodeum with erect, branched hair anteriorly; fore coxae and femora, all tarsal segments and sternum between fore and mid coxae with long, plumose hair, remainder sparse; gaster sparse.

Genitalia. Figs. 20d, e, f.

Gastral Sternum VI. Fig. 26h.

Remarks. *H. grossopedalus* and *H. latitarsis* are the only Australian species of *Homalictus* in which the tarsal segments of the males are flanged. Several new species in Papua New Guinea (to be described by Dr A. Pauly) also exhibit this distinctive character. I have

examined these new species and all would be placed in the '*blackburni*' species-group.

Distribution. North Queensland (Fig. 3b).

Homalictus holochlorus (Cockerell)

Figures 4a; 8i; 10o; 12p

Halictus holochlorus Cockerell, 1914a: 507.–1933: 312.
Homalictus holochlorus.–Michener, 1965: 180.

Material examined.
Holotype ♀, Cheltenham, Victoria, French (ANIC).
Other specimens examined: (10 ♀♀) (PD: 1-2,9-10,12) (FR: *Acacia*) QUEENSLAND: Beerwah, Sunnybank (UQIC); Eukey (SAM). NEW SOUTH WALES: Sydney, Heathcote (ANIC); Wentworth Falls (NMV). VICTORIA: Warburton (UQIC); Brisbane Ranges (NMV); Omeo (ANIC).

Diagnosis. A member of the '*urbanus*' species-group, most like *H. stradbrokensis*; female distinguished from other members of the genus by the following combination of characters: labrum with two raised tubercles; frons with vertical striae; gastral tergum I impunctate; scutum mesad of parapsidal lines openly punctured.

Female. BL 5.2-6.1 mm (holotype c. 6.1 mm); FL 4.1-4.4 mm (holotype c. 4.4 mm); head wider than long (61:56); eyes converging below, UID:LID as 42:39; clypeus convex, width less than three times the length (30:12); antennal sockets separated by distance equal to diameter of socket. AOD:IAD:OAD:IOD:OOD as 17:5:22:11:11. Scape extending to level of anterior margin of median ocellus; EW:GW as 1.2:1; dorsolateral angle of pronotum projecting as small acute tubercle; TS with two large, blunt teeth and one small distal tooth and two thirds length of outer spur; BP complete, apically rounded.

Sculpturing. Head roughened (Fig. 8i), frons with vertical striae to level of anterior margin of rear ocelli, except small reticulate area above antennal bases; vertex with several transverse striae extending onto genae; basal two thirds of clypeus and supraclypeal area finely reticulate, sparsely pitted, anterior one third of clypeus smooth and polished with a few large punctures along anterior margin; scutum and scutellum dull, coarsely reticulate, scutum (Fig. 10o) impunctate anteriorly, parapsidal areas and posterior margin closely punctured, mesially openly punctured, scutellum sparsely punctured except along anterior margin margin and midline openly punctured; dorsal surface of propodeum (Fig. 12p) with areolate rugae extending mesially almost to rim, laterally well short of rim.

Colour. Frons, paraocular areas and supraclypeal area dark green tinged blue and gold; basal half of clypeus green tinged with gold, anterior half black; scape and flagellum above black-brown, flagellum beneath brown; scutum, scutellum and propodeum dark green, scutum tinged with blue; coxae, trochanters and femora black, tibiae and tarsi dark brown; gaster dark brown.

Pubescence. Head sparsely covered with short, erect, minutely branched hair, a few long, simple hairs along anterior margin of clypeus; scutum with both short, erect, minutely branched and short, simple backwardly inclined hair; scutellum with short, erect, minutely branched hair; metanotum with a few long, minutely branched hairs along posterior margin; propodeum bare dorsally except a few erect, branched hairs laterally, posterovertically densely covered with long, erect, plumose hair.

Remarks. Male unknown.

Distribution. South-east Queensland, coastal New South Wales and Victoria (Fig. 4a).

Homalictus houstoni sp. nov.

Figures 3a; 7b; 9n; 11n; 16d-f; 25e

Material examined.
Holotype ♀, Paratypes 3 ♀♀, 1 ♂, 64 km E. of Norseman, Western Australia, 10 Jan 1970, T.F. Houston, on *Eucarya* sp. (SAM).

Diagnosis. A member of the '*sphecodoides*' species-group, most like *H. sphecodoides*; distinguished from other members of the genus by the following combination of characters: Female–malus of strigilis fan-shaped; frons coarsely reticulate; scutum punctured on basal two thirds, close-openly laterally and posteriorly, sparse mesially (Fig. 9n). Male-Fg:UID >2.0:1; UID:LID >1.3:1; clypeus

concave anteromesially; head densely covered with short, plumose hair; pronotal tubercle and scape basally light red-brown; gonocoxal processes of genital capsule with large setae (Fig. 16d).

Female. BL c. (holotype) 4.3 mm; FL c. (holotype) 3.6 mm; head wider than long (52:47); UID:LID as 30:28; clypeus width three times the length (27:9); antennal sockets separated by distance equal to diameter of socket. AOD:IAD:OAD:IOD:OOD as 10:4:18:10:6. Scape reaching anterior margin of median ocellus; dorsolateral angle of pronotum projecting as small acute tubercle; TS with four small blunt teeth and same length as outer; BP complete, apically rounded.

Sculpturing. Head roughened, frons (Fig. 7b) coarsely reticulate, in side view reticulation appears to form weak sinuate vertical striae, lower paraocular areas smooth; basal half of clypeus (remainder smooth) and supraclypeal area finely reticulate, punctured, few on supraclypeal area, openly punctured on clypeus; scutum (Fig. 9n) tessellate and dull, except posteromesially smooth and shining though tessellate along midline, anterior one third impunctate, basal two thirds punctured, close-openly laterally and posteriorly, sparse mesially; scutellum smooth and shining (except posterior margin, reticulate) openly punctured; dorsal surface of propodeum (Fig. 11n) with areolate rugae medianly not reaching rim, laterally parallel rugae reaching rim.

Colour. Head (except antennae), scutellum, propodeum black, basal one quarter of scape light red-brown, remainder dark brown, flagellum brown; scutum dark green; fore and hind coxae dark brown, mid coxae light red-brown, trochanters, basal half of fore and mid femora brown, basal two thirds of hind femora dark brown, remainder of legs light red-brown; gaster red-brown, lateral margins of terga II, III, IV with black patches.

Pubescence. Head sparsely covered with short, minutely branched hair, a few long hair along anterior margin of clypeus; scutum and scutellum sparsely covered with short, erect, branched hair, a few long hair along posterior margin of scutellum; propodeum bare dorsally, vertically with erect, branched hair; gastral terga I, II almost bare, terga III, IV and V with increasing density of short, simple hair.

Male. BL c. 4.1 mm; FL c. 3.2 mm; head wider than long (50:44); eyes converging below, UID:LID as 31:24; scape not reaching level of median ocellus; Fg:UID as 2.4:1. AOD:IAD:OAD:IOD:OOD as 7:6:15:9:8. Clypeus concave anteromesially; BP complete.

Sculpturing. Frons coarsely reticulate; supraclypeal area and clypeus smooth and shining, sparsely punctured; scutum finely reticulate anteriorly, remainder smooth and shining, basal two thirds openly punctured; scutellum smooth and shining, a few piliferous punctures; dorsal surface of propodeum with several longitudinal rugae, none reaching rim.

Colour. Head (except antennae), scutum, scutellum and propodeum black, basal one third of scape light red-brown, remainder brown, flagellum light brown; pronotal tubercle light red-brown; fore tibiae, tarsi and mid coxae light red-brown, remainder of legs light brown; gaster red-brown.

Pubescence. Frons on anterior half, lower paraocular areas, supraclypeal area and clypeus with short, plumose, adpressed hair, basal half of frons, vertex and genae with short, simple hair; vertical surface of propodeum with a few short, erect, branched hairs; gastral tergum I almost bare, remainder of terga sparsely covered with short, simple hair; gastral sterna with a few long, branched hairs on lateral posterior margins.

Genitalia. Figs. 16d, e, f.

Gastral Sternum VI. Fig. 25e.

Remarks. The species is named after Dr T.F. Houston who has contributed greatly to the systematic knowledge of Apoidea in Australia and has collected many of the specimens used in this study.

Distribution. Southern Western Australia (Fig. 3a).

Homalictus imitatus sp. nov.

Figures 2b; 15g-i; 25c

Material examined.

Holotype ♂, Prairie Homestead Turnoff, 86 km NNE. of Thargomindah, Queensland, 20 Nov 1979, K.L. Walker, on *Eucalyptus populnea* (QM).

Paratypes 6 ♂♂: 2 ♀♀, same as holotype; 1♂, Charleville, Queensland, 23 Nov 1979, K.L. Walker, on *Eucalyptus camaldulensis*; 1♂, Basalt Ck, 4 km E. of Mitchell, Queensland, 23 Nov 1979, on *Eucalyptus populnea*; 1♂, 48 km N. of Windorah, Queensland, 17 Oct 1968, G. Monteith; 1♂, Blackall, Queensland, 28 Oct 1968, E.M. Exley, on *Amyema miquelii* (all UQIC).

Other specimens examined: (44 ♀♀) (PD: 10-11) (FR: *Amyema*, *Eucalyptus*) QUEENSLAND: Toobeah, St. George, Bollon, Cunnamulla, Thargomindah, Quilpie, Cheepie, Charleville, Mitchell, Roma, Condamine, Miles, Glenmorgan, Blackall, Longreach, Windorah (UQIC).

Diagnosis. A member of the '*dotatus*' species-group, almost identical to *H. dotatus*; male distinguished from other members of the genus by the following combination of characters: BP complete; clypeus with some pale yellow colour; frons, paraocular areas and supraclypeal area covered with short, adpressed hair; scutum openly punctured; genitalia with apical processes of gonocoxite large and broad (Fig. 15g-i).

Male. BL 4.2-4.6 mm (holotype c. 4.6 mm); FL 3.3-3.5 mm (holotype c. 3.5 mm); head wider than long (48:41); eyes converging below, UID:LID as 28:24; scape not reaching level of median ocellus; Fg:UID as 3.0:1. AOD:IAD:OAD:IOD:OOD as 7:7:14:9:6. BP complete, apically rounded.

Sculpturing. Head covered with thick hair but appears to be reticulate, except clypeus and supraclypeal area smooth and openly punctured; scutum reticulate, impunctate anteriorly, remainder smooth and openly punctured; scutellum with few sparse punctures, smooth and shining; dorsal surface of propodeum with a few rugulae posteromesially, weak parallel rugulae laterally.

Colour. Frons, vertex, genae, supraclypeal area and basal half of clypeus dark green, remainder of clypeus pale yellow; scape and flagellum red-brown; pronotal tubercle pale yellow; scutum dark green; scutellum and propodeum black tinged with dark green; fore and hind coxae dark green, mid coxae and all legs light red-brown; gaster light red brown.

Pubescence. Frons, supraclypeal area and basal one third of clypeus with short, plumose, adpressed hair, paraocular areas covered with similar hair; genae with erect, branched hair; anterior one third and posterior margin of scutum with short, plumose, adpressed hair, remainder with short, simple, backwardly directed hair, each side of scutum hair forming a 'whorl' pattern near posterior end of parapsidal lines; scutellum almost bare, with a few long, branched hair; metanotum with short, plumose, adpressed hair.

Genitalia. Figs. 15g, h, i.

Gastral Sternum VI. Fig. 25c.

Remarks. *H. imitatus* was accidently discovered while preparing a series of *H. dotatus* male genitalia. Present data indicates that it occurs sympatrically with *H. dotatus* and is found only in southern Queensland.

Specific identification is by genitalia only, as the external morphology appears to be identical to *H. dotatus*. Initially a hair pattern on the scutum and scutellum was considered diagnostic; however, subsequent examination, in conjunction with male genitalia preparations, proved the pattern may or may not be present in *H. imitatus* while it was never present in *H. dotatus*.

Distribution. Southern Queensland (Fig. 2b).

Homalictus latitarsis (Friese)

Figures 3b; 12g; 20a-c; 26g

Halictus latitarsis Friese, 1909: 188.–Blüthgen, 1926: 470-473.

Halictus mcgregori Cockerell, 1919b: 277. syn. by Blüthgen, 1926: 470.

Homalictus latitarsis.–Michener, 1965: 180.

Type material.

Lectotype ♂ of *Halictus latitarsis*, New Guinea: von Friedrich-Wilhemshafen, 1901, Biro (HNHM), Paralectotypes 2 ♀♀, 'auf *Cordyline* Blüthen', Biro (HNHM, MZUS) (not examined). Lectotype and Paralectotypes designated by Pauly (in press)

Holotype ♀ of *Halictus mcgregori*, Panay, Antique Prov., Culasi, 3 Jun 1918, McGregor (USNM) (not examined).

Other specimens examined: (6 ♂♂) (PD: 11) (FR: *Tristanopsis*) QUEENSLAND: Peaches Crossing via Coen (UQIC).

Diagnosis. A member of the '*blackburni*' species-group, most like *H. grossopedalus*; male distinguished from other members of the genus by the following combination of characters: clypeus with pale yellow on basal half; genae with long, branched hair (forming a

beard); fore tarsal segments (only) flanged laterally.

Male. BL 5.6-5.9 mm; FL 3.9-4.2 mm; head wider than long (56:50); eyes converging strongly below, UID:LID as 32:21; clypeus slightly convex, width twice length (22:11); antennal sockets separated by distance equal to diameter of socket; antennal scape short, reaching to three quarters to median ocellus; Fg:UID as 2.3:1. AOD:IAD:OAD:IOD:OOD as 7:5:18:10:8. Fore tarsal segments expanded laterally (cf. Fig. 5j); BP complete and apically rounded.

Sculpturing. Head smooth, frons finely tessellate, supraclypeal area reticulate, clypeus polished, though finely reticulate; frons and supraclypeal area impunctate, clypeus openly punctured with shallow hair pits; scutum and scutellum dull, covered with fine lineolets, producing a circular pattern on each scutal half, and entirely on scutellum, both sparsely punctured with minute piliferous punctures; dorsal surface of propodeum (Fig. 12g) mesially with branched rugae extending half way to rim, laterally coarsely reticulate.

Colour. Frons, vertex, supraclypeal area, mesosoma black; basal half of clypeus brown-black, remainder pale-yellow; antennae dark brown; pronotal tubercle brown; coxae, trochanters, femora and tibia dark brown, mid tibiae dark brown suffused with red-brown; tarsi and fore tibiae light red-brown; fore tarsal segments dull white mesially; gaster black with a blue sheen.

Pubescence. Frons with both short, branched and simple hair; vertex with erect, minutely branched hair; lower paraocular areas with short, plumose, adpressed hair; clypeus, supraclypeal area and basal two thirds of mandibles with a few erect, branched hairs; genae with long, branched hair (forming a beard); scutum and scutellum sparsely covered with short, erect, simple hair; metanotum with a few long, erect, branched hairs; propodeum with erect, plumose hair dorsolaterally and vertical surfaces; legs with long, plumose hair on coxae, trochanters, fore and hind femora and fore tarsi, similar hair on ventral surface of mesosoma; gaster sparsely covered with short, simple and branched hair.

Genitalia. Figs. 20a, b, c.
Gastral Sternum VI. Fig. 26g.

Remarks. This is the first record of *H. latitarsis* in Australia. Identification was confirmed by Dr A. Pauly who has examined and designated the lectotype.

Only males of the species were taken.

Dr A. Pauly (pers. comm.) provided the following distributional data for the species outside of Australia:

BISMARK ARCHIPELAGO: Hermit Is., Luf.

NEW GUINEA: Bubia.

PHILIPPINES: PALAMAN: Mentalingajan, Pinigisan. BALABAC: Calawan. LUZON: Mt Maquiling. MINDANAO: Momungan.

INDONESIA: SUMATRA: Fort de Kock. KALIMANTAN: Ranau.

Distribution. Cape York Peninsula, Queensland (Fig. 3b).

Homalictus luteoaeneus (Friese)

Figures 6h; 9h; 11h

Halictus luteoaeneus Friese, 1924: 236.–Cockerell, 1929a: 14.–1933: 315.

Homalictus luteoaeneus.–Michener, 1965: 180.

Material examined.

Lectotype ♀, Victoria, von Müller (AMNH). Species described from several syntypes but only one was located. Lectotype designated here. Type in poor condition.

Lectotype. BL c. 7.2 mm; FL c. 4.8 mm; head wider than long (79:68); UID:LID as 33:30; clypeus slightly greater than twice as wide as long (35:16), convex, protruded; antennal sockets separated by distance equal to diameter of socket; supraclypeal area bulbous. AOD:IAD:OAD:IOD:OOD as 15:10:25:12:10. Scape reaching basal margin of median ocellus; dorsolateral angle of pronotum produced into small blunt tubercle; dorsal surface of propodeum slightly shorter than scutellum, defined by carinae; TS with three blunt teeth, basal two long, apical tooth short and shorter than outer spur; BP complete, apically rounded.

Sculpturing. Head roughened, frons (Fig. 6h) with vertical striae, continuing around eye,

except medianly above antennal bases granulate; clypeus shining, finely reticulate, openly punctured; scutum (Fig. 9h) finely reticulate, anteriorly with weak transverse plicae, directed obliquely near midline but not reaching midline, area between parapsidal lines sparsely punctured, parapsidal areas openly punctured, hind margin closely punctured; scutellum smooth, sparsely punctured; dorsal surface of propodeum (Fig. 11h) with rugae extending mesially to carina, posterior lateral areas with weak rugulae.

Colour. Frons, vertex and genae dark green, suffused with golden tinge; clypeus and supraclypeal area green suffused with red; basal half of scape light red-brown, remainder dark brown; flagellum dark brown; mandibles light brown, red apically, black basally; scutum and scutellum dark green, hind margin of former suffused with coppery red; propodeum black; coxae and trochanters dark brown; basal two thirds of fore femora and basal two thirds of anterior surface of mid and hind femora brown, remainder of femora; tibiae and tarsi light red-brown; gaster dark green, anterior margin of terga with dark brown.

Pubescence. (much of the hair has been removed from the type). Head sparsely covered with short, white hair; scutum sparsely covered with short, branched hair; terga I and II bare, terga III, IV and V with increasing density of hair, more so laterally.

Remarks. Apart from the type, no other specimens are known. This species may prove to be a synonym of *H. caloundrensis* but has not been synonymised as the scutal characteristics do not fall within the variations observed for *H. caloundrensis*. The species is redescribed to assist future identifications.

Distribution. Victoria (?).

Homalictus maitlandi (Cockerell)

Figures 3b; 7j; 10c; 12c

Halictus maitlandi Cockerell, 1910: 233.–1933: 315.
Homalictus maitlandi.–Michener, 1965: 180, 338.

Material examined.
Holotype ♀, Cairns, Kuranda, Mar 1902, Turner (BMNH).

Other specimens examined: (6 ♀♀) (PD: 3) QUEENSLAND: Kuranda (BMNH, NMV).

Diagnosis. A member of the '*blackburni*' species-group, most like *H. blackburni*; female distinguished from other members of the genus by the following unique character: short, golden hair across gastral terga II and III and on lateral margins of tergum VI.

Female. BL 6.0-7.0 mm (holotype c. 6.8 mm); FL 4.6-5.3 mm (holotype c. 5.2 mm); head wider than long (76:70); eyes converging below, UID:LID as 42:34; clypeus convex, width at least twice length (36:16); antennal sockets separated by distance less than diameter of socket; supraclypeal area bulbous. AOD:IAD:OAD:IOD:OOD as 15:5:26:9:12. Scape reaching posterior margin of median ocellus; dorsolateral angles of pronotum projecting as a large, rounded tubercle; fore basitarsal comb absent; BP complete, apically bluntly acute; TS with three rounded teeth, proximal two large, distal tooth minute, TS slightly smaller than outer spur.

Sculpturing. Head smooth (Fig. 7j), finely reticulate, impunctate; scutum (Fig. 10c) and scutellum finely reticulate, impunctate; dorsal surface of propodeum (Fig. 12c) mesially with interconnecting longitudinal rugulae almost reaching dorsal rim. Colour. Head (except antennae), mesosoma (except pronotal tubercle dull white), gaster black; antennal scapes red-brown, flagellum black to dark brown; coxae, trochanters, femora black, tibiae and tarsi red-brown.

Pubescence. Head sparsely covered with short, minutely branched hair, anterior margin of clypeus with long, simple hair; scutum almost bare, a few short, erect, simple hairs, except anterior lateral corners covered with dense, short, plumose, golden hair; anterior lateral areas of mesopleuron (beneath tegulae) with plumose, golden hair; scutellum with a few long, branched hairs along posterior margin; metanotum and lateral margins of dorsal surface of propodeum covered with short, plumose, golden hair; gastral terga II, III and lateral margins of tergum IV with short, plumose, golden hair across terga.

Remarks. Turner seems to have had a number of 'Cairns' labels printed and used them for the surrounding districts. He wrote in the exact locality beneath the printed word 'Cairns'. The correct type locality of *H. maitlandi* is Kuranda, not Cairns.

H. maitlandi is the only species in the genus to have apparent basal bands of white tomentum on gastral terga II and III. Michener (1965: 338) explained that the bands of hair were not homologous with a normal tomentum as they arose from the gradular fringe rather than the general tergal surface.

Male unknown.

Distribution. North Queensland (Fig. 3b).

Homalictus megastigmus (Cockerell)

Figures 3a; 7e; 9q; 11q; 17d-f; 25h

Halictus megastigmus Cockerell, 1926a: 219.–1933: 315.
Halictus dixoni Rayment, 1935: 703. syn. nov.
Halictus tarltoni hentyi Rayment, 1953: 27. fig. 3 (nos. 3 & 6). syn. nov.
Halictus sevillensis Rayment, 1953: 27, fig. 3 (nos. 2 & 8). syn. nov.
Homalictus megastigmus.–Michener, 1965: 180.
Homalictus dixoni.–Michener, 1965: 180.
Homalictus hentyi.–Michener, 1965: 180.
Homalictus sevillensis.–Michener, 1965: 181.

Material examined.
Holotype ♀ of *Halictus megastigmus*, Hobart, Tasmania, 22 Jan 1918/55, C.E. Cole (NMV).
Holotype ♀ of *Halictus dixoni*, Ferntree Gully, Victoria, 1932, J.E. Dixon (ANIC). Type incorrectly referred to as male in original description.
Holotype ♀ of *Halictus tarltoni hentyi*, Gorae West, Victoria, 26 Sep 1952, T. Rayment (ANIC).
Holotype ♀ of *Halictus sevillensis*, Seville, Victoria, 20 Sep 1928, T. Rayment (ANIC).
Other specimens examined: (74 ♀♀, 4 ♂♂) (PD: 1-4,9-12) (FR: *Leucopogon, Acacia, Eremophila, Calytrix, Eucalyptus, Leptospermum, Bursaria, Lasiopetalum, Tetratheca*) QUEENSLAND: Cooloola (QM). NEW SOUTH WALES: Ebor, Coffs Harbour (UQIC); Sydney (QM); Bathurst, Brown Mtn, Bungendore, Monga (ANIC). VICTORIA: Kallista, Lower Tarwin, Erica, Ferntree Gully, Frankston, Sandringham, Cape Bridgewater, Reefton, Tambo Crossing, Blackwood (NMV). TASMANIA: Hobart, Ridgeway, St Helens (SAM); Pioneer (ANIC). SOUTH AUSTRALIA: Warren Nat. Pk, Kingscote, Bray Junction, Coorong, Adelaide, Kangaroo Is., Ravine-de-Casoars (SAM). WESTERN AUSTRALIA: Busselton, Porongurup, Walpole, Denmark, Northcliffe (ANIC).

Diagnosis. A member of the *'sphecodoides'* species-group; distinguished from other members of the genus by the following combination of characters: Female–clypeal width greater than three times the length; frons almost smooth; scutum sparsely punctured except openly punctured along posterior margin. Male–Fg:UID c. 2.3:1; UID:LID c. 1.1:1; clypeus without yellow or white markings; head densely covered with short, plumose hair.

Female. BL 4.7-6.2 mm (holotype c. 6.2 mm); FL 3.7-4.9 mm (holotype c. 4.9 mm); head wider than long (68:54); UID:LID as 39:39; clypeus width greater than three times length, (38:11); antennal sockets separated by distance equal to diameter of socket. AOD:IAD:OAD:IOD:OOD distances as 15:5:23:11:11. Scape reaching posterior margin of median ocellus; dorsolateral angle of pronotum projecting as small rounded tubercle; TS with six small, blunt teeth and slightly smaller than outer spur; BP complete, apically rounded.

Sculpturing. Head smooth (Fig. 7e), frons with a few weak vertical striae above antennal bases, clypeus and supraclypeal area finely reticulate; clypeus open-sparsely punctured, supraclypeal area bulbous, with a few punctures; scutum smooth (Fig. 9q), tessellate and punctured, sparsely punctured except posterior margin openly punctured; scutellum polished and shining, minutely openly punctured; propodeum finely reticulate, dorsal surface (Fig. 11q) with parallel rugae, mesially to at least anterior half, laterally to rim.

Colour. Head, antennae, scutellum and propodeum black, scutum waxy, dark blue-black; apical one third of femora, tibiae and tarsi light red-brown, remainder of legs black; gaster red-brown, suffused with brown apically.

Pubescence. Head, scutum and scutellum sparsely covered with short, erect, minutely branched hair, scutellum with long, erect, branched hair along posterior margin; metanotum with short, plumose hair mediad;

vertical surface of propodeum with erect, branched hair; gastral terga smooth and shining, terga I and II almost bare, a few hair on terga III and IV, tergum V with short, branched hair.

Male. BL 4.3-4.7 mm; FL 3.6-3.9 mm; head wider than long (58:47); eyes converging slightly below, UID:LID as 36:32; scape reaching level of median ocellus; Fg:UID as 2.3:1. AOD:IAD:OAD:IOD:OOD as 11:7:17:10:11. BP complete, apically pointed.

Sculpturing. Head finely reticulate, clypeus open-sparsely punctured; scutum with anterior one third reticulate, remainder of scutum and scutellum polished and shining; scutum sparsely punctured, scutellum with a few minute, piliferous punctures; dorsal surface of propodeum weakly areolate with rugulae medianly, laterally with parallel rugulae not reaching rim.

Colour. Head, mesosoma black; coxae, trochanters, basal half of femora dark brown, remainder of legs light red-brown; gastral tergum I dark brown, with anterior one third light red-brown, terga II and III light red-brown, remainder of terga dark brown.

Pubescence. Frons with both long, branched hair and short, simple hair; lower paraocular areas, supraclypeal area and clypeus with short, plumose, adpressed hair (not a complete cover); scutum and scutellum with long, erect branched hair; vertical surface of propodeum with erect, branched hair; gastral sterna II and III with transverse rows of erect, branched hair, remainder of sterna sparsley covered with hair.

Genitalia. Figs. 17d, e, f.

Gastral Sternum VI. Fig. 25h.

Remarks. Intraspecific colour variation is minimal except females from south west Western Australia have the apical one third of the fore femora, tibiae and tarsi are light red-brown and the remainder of the legs are dark brown.

Distribution. South-east Queensland, New South Wales, Victoria, Tasmania, South Australia and south-east Western Australia (Fig. 3a).

Homalictus multicavus sp. nov.

Figures 4a; 8g; 10m; 12n; 22d-f; 27e

Material examined.

Holotype ♀ (QM), Paratypes 2 ♀♀ (UQIC), McIvor R. crossing, 40 km N. of Cooktown, 15-18 Jul 1976, G.B. and S.R. Monteith

Other specimens examined: (7 ♀♀, 2 ♂♂) (PD: 8,11) (FR: *Eucalyptus*, *Thryptomene*) QUEENSLAND: Finch Bay (QDPI); Cooktown (QDPI, UQIC), Port Douglas (UQIC, SAM); Mt Webb (♂♂, ANIC).

Diagnosis. A member of the '*urbanus*' species-group, most like *H. murrayi*; distinguished from other members of the genus by the following combination of characters: Female–labrum with two raised tubercles; dorsal surface of propodeum defined posteriorly only by a carina; BP complete; scutum densely punctured except anteriorly (Fig. 10m). Male–Fg:UID <2.0:1; EW:GW < 2.5:1; gastral tergum impunctate; scutum densely punctured in parapsidal areas.

Female. BL 5.7-6.3 mm (holotype c. 5.9 mm); FL 3.8-4.2 mm (holotype c. 4.0 mm); head wider than long (71:56); UID:LID as 41:36; clypeus more than twice as wide as long (32:14), gently convex, protruded; antennal sockets separated by distance greater than socket; supraclypeal area raised, but not bulbous. AOD:IAD:OAD:IOD:OOD as 14:7:24:12:10. Scape reaching anterior margin of median ocellus; EW:GW as 2.0:1; dorsolateral angle of pronotum projecting as small acute spine; dorsal surface of propodeum as long as scutellum, defined posteriorly only by a carina; TS with two small teeth and about half as long as outer spur; BP complete, bluntly angulate apically.

Sculpturing. Head roughened, frons (Fig. 8g), except medianly (granular), with vertical striae, continuing around eyes, weak transverse striae beneath ocelli and areas along inner margins of eyes finely reticulate; clypeus smooth finely reticulate on basal half, open-sparsely punctured; supraclypeal area finely reticulate, sparsely punctured; scutum (Fig. 10m) dull, anteromesially impunctate, a few transverse weak plicae, anterolaterally with areolate rugae, remainder densely punctured,

finely reticulate between punctures; dorsal surface of propodeum (Fig. 12n) with areolate rugae, extending posteriorly to carina and laterally onto vertical surface.

Colour. Frons and supraclypeal area olive green; clypeus with anterior half black, posterior half golden dark green, suffused with red; vertex, genae and propodeum dark blue; scape black, flagellum black except light red-brown apically beneath; scutum and scutellum dull blue-green with golden tinges laterally; legs black; gaster steel-blue with purple tinges.

Pubescence. Head, scutum and scutellum sparsely covered with short, branched hair; vertical posterior surface of propodeum sparsely covered with erect, minutely branched hair; gastral terga I-IV almost bare, tergum V with short hair.

Male. BL 4.6-5.3 mm; FL 3.2-3.6 mm; head wider than long (63:52); eyes converging below, UID:LID as 36:26; scape not reaching level of median ocellus; Fg:UID as 1.7:1; EW:GW as 2.2:1. AOD:IAD:OAD:IOD:OOD as 8:8:19:12:8. BP complete, bluntly angulate apically.

Sculpturing. Head roughened, frons, except medianly (granular), with weak vertical striae to level short of median ocellus, below median ocellus fine transverse striae continuing around behind eyes; vertex with several transverse strong striae continuing around onto genae; clypeus and supraclypeal area reticulate, openly punctured; scutum reticulate, coarsely so anteriorly, anterior one fifth impunctate, with weak transverse plicae (strong in anterior lateral corners), remainder closely punctured, except in parapsidal areas densely punctured; scutellum reticulate, openly punctured, except along midline densely punctured; dorsal surface of propodeum not defined by carina, with areolate rugae extending onto vertical surface.

Colour. Frons to level of vertical striae green tinged with gold, transverse lineolation area on frons, vertex and genae blue; clypeus and supraclypeal area dark green; scutum and scutellum golden green; metanotum dark blue; propodeum dark green; coxae, trochanters, femora (except apical rim red-brown) dark green, fore tibiae and all tarsi red-brown, mid and hind tibiae red-brown suffused mesially with dark brown; gaster black, tinged with dark green, except tergum VII red-brown.

Pubescence. Frons, vertex, genae and supraclypeal area with erect, branched hair; lower paraocular areas, laterally on clypeus with short, apicad directed, plumose hair, clypeus mesially with short, branched hair; basal one third of mandibles with short, erect, branched hair; scutum and scutellum sparsely covered with short, erect, minutely branched hair; metanotum with a few long, erect, branched hairs; vertical surface of propodeum with short, erect, simple hairs; sterna II, III, IV, and V with cover of long, apicad directed, minutely branched hair.

Genitalia. Figs. 22d, e, f.

Gastral Sternum VI. Fig. 27e.

Distribution. North Queensland (Fig. 3a).

Homalictus murrayi (Cockerell)

Figures 4a; 8h; 10n; 12o; 22g-i; 27f

Halictus murrayi Cockerell, 1905c: 272.–1929b: 2.–1930a: 151-2.–1933: 316.

Homalictus murrayi.–Michener, 1965: 180.

Material examined.

Holotype ♀, Adelaide River, Northern Territory, J.J. Walker, 5138 (BMNH).

Other specimens examined: (136 ♀♀, 16 ♂♂) (PD: 5-8,10-12) (FR: *Terminalia, Anigozanthos, Eremophila, Eucalyptus, Tristanopsis, Bursaria, Borreria, Atalaya, Xanthorrhoea*) QUEENSLAND: Brisbane, Peregian, Morven, Cairns (SAM); Stradbroke Is., Tibrogargan Ck, Torbul Pt, Caloundra, Tin Can Bay, Bingil Bay, Yarraman, Beerwah, Mt Pleasant, Clermont, Telegraph Line Crossing Jardine R., St Pauls, Moa (Banks) Is. (UQIC); Chillagoe, Evelyn, Bamaga (QDPI); Kuranda, Gordonvale, Mossman, Mareeba, Hope Vale Mission (ANIC). NORTHERN TERRITORY: Melville Is. (SAM); Elliot, Dunmarra, Daly Waters, Borroloola Rd at Junction of Stuart Hwy, Borroloola, Katherine (UQIC); Mt Cahill, Koongarra, Nourlangie Ck, Jaja Lagoon, Mt Brockman, Nimbuwah Rock (ANIC). WESTERN AUSTRALIA: Broome (UQIC); Mitchell Plateau, Lone Dingo (ANIC). SOUTH AUSTRALIA: Cradock, Lake Gilles Nat. Pk (SAM).

Diagnosis. A member of the '*urbanus*' species-group, most like *H. multicavus*; distinguished from other members of the genus by the following combination of characters: Female–

labrum with two raised tubercles; frons with vertical striae; gastral tergum I mesially with minute punctures; vertical posterior surface of propodeum covered with short, minutely branched hair. Male–Fg:UID <2.0:1; gastral tergum I with minute punctures mesially; scutum closely punctured in parapsidal areas; scutellum sparsely punctured, about same length as dorsal surface of propodeum.

Female. BL 4.7-5.2 mm (holotype c. 4.7 mm); FL 3.3-3.5 mm (holotype c. 3.4 mm); head wider than long (60:50); eyes converging below, UID:LID as 35:29; clypeus convex, width about twice length (25:12); antennal sockets separated by distance less than diameter of socket. AOD:IAD:OAD:IOD:OOD as 14:4:20:10:9. Scape extending to level of anterior margin of median ocellus; EW:GW as 1.7:1; TS with three teeth, proximal two teeth large, distal tooth small and about half length of outer spur; BP complete, bluntly angulate apically.

Sculpturing. Head roughened (Fig. 8h), frons with vertical striae to level of anterior margin of median ocellus; vertex with several weak transverse striae extending onto genae; clypeus on basal half and supraclypeal area finely reticulate, sparsely pitted, anterior half of clypeus smooth and polished with several large punctures; scutum and scutellum reticulate, scutum (Fig. 10n) impunctate anteriorly, densely punctured in parapsidal areas and along posterior margin, mesially openly punctured, scutellum sparsely punctured, except along anterior margin and midline openly punctured; dorsal surface of propodeum (Fig. 12o) with branched rugae extending laterally onto vertical surface mesially to rim; gastral tergum I with median area of minute punctures.

Colour. Frons and paraocular areas blue; supraclypeal area dark green or grey; basal half of clypeus grey-blue or dark green sometimes tinged with transverse bands of gold, purple and blue, anterior half dark brown to black; scape and flagellum above black, flagellum beneath light brown; scutum and scutellum royal blue suffused with purple or blue-green suffused with gold; propodeum dark blue to black; coxae, trochanters and femora black to dark brown, remainder brown, except apical margins of fore tibiae red-brown; gaster black.

Pubescence. Head sparsely covered with short, erect, minutely branched hair, except genae with erect, branched hair and a few long, simple hairs along anterior margin of clypeus; scutum and scutellum with both short, erect, minutely branched and short, simple, apicad directed hair, a few long, erect, branched hairs along posterior margin of scutellum; propodeum bare dorsally, vertical posterior surface sparsely covered with erect, minutely branched hair; gastral terga with short, simple inclined hair.

Male. BL 4.2-5.0 mm; FL 3.0-3.4 mm; head wider than long (61:50); eyes converging below, UID:LID as 35:24; scape extending almost to level of anterior margin of median ocellus; Fg:UID as 1.7:1; EW:GW as 2.5:1. AOD:IAD:OAD:IOD:OOD as 10:5:18:11:9. BP complete, apically rounded; scutellum about same length as dorsal surface of propodeum; TS with four minute, narrow teeth and two thirds length of outer spur.

Sculpturing. Frons reticulate (a few faint vertical striae); vertex with several transverse striae, barely extending onto genae; clypeus and supraclypeal area finely reticulate, impunctate; scutum and scutellum reticulate, scutum impunctate anteriorly, remainder with indistinct sparse punctures, except mesially posterior margin openly punctured; scutellum sparsely punctured except along midline closely punctured; dorsal surface of propodeum with branching rugae anteromesially only, remainder with longitudinal rugae extending to rim; gastral tergum I with minute punctures mesially.

Colour. Head, scutum and scutellum brass-green, except vertex tinged with blue and anterior half of clypeus black; metanotum and propodeum dark blue; coxae, trochanters and femora dark brown to black, fore tibiae and tarsi light red-brown, mid and hind tibiae and tarsi brown sometimes suffused with light red-brown; gaster dark brown to black.

Pubescence. Frons with short, erect, simple hair; lower paraocular areas, clypeus, supraclypeal area, vertex and genae with short, apicad inclined branched hair; scutum and scutellum with both erect, minutely branched and short, simple hair; posterior margin of scutellum and metanotum with a few long, branched hairs; propodeum bare dorsally, vertical posterior surface sparsely covered with erect, minutely branched hair; gastral tergum I almost bare, a few short, simple hairs mesially, remaining terga with increasing density of short, simple hair.

Genitalia. Figs 22g, h, i.
Gastral Sternum VI. Fig. 27f.

Distribution. Across northern Australia, two specimens from South Australia (Fig. 4a).

Homalictus niveifrons (Cockerell)

Figures 3a; 7d; 9p; 11p; 17a-c; 25g

Halictus niveifrons Cockerell, 1914a: 520.–1933: 317.–Rayment, 1953: 24.

Halictus oxoniellus Cockerell, 1914b: 369.–1933: 317. syn. nov.

Halictus mesocyaneus Cockerell, 1922a: 264.–1933: 316. syn. nov.

Halictus raymenti Cockerell, 1926b: 247.–1933: 319, Rayment, 1931a: 168.–1931b: 252-255, pl. I, blks. I & 3.–1935: 238, 241, 698, pls. 36, 40.–1953: 23, fig. 4. syn. nov.

Halictus tarltoni Cockerell, 1927: 101.–1933: 322.–Rayment, 1931a: 168.–1935: 290-2, pls. 36, 40.–1953: 24, figs. 1, 7. syn. nov.

Halictus aureo-azureus Rayment, 1935: 697, pl. 40. syn. nov.

Halictus littoralis Rayment, 1935: 700, pl. 40 (not Blüthgen, 1923: 248).–1953: 24. syn. nov.

Homalictus niveifrons.–Michener, 1965: 180.

Homalictus oxoniellus.–Michener, 1965: 180.

Homalictus mesocyaneus.–Michener, 1965: 180.

Homalictus raymenti.–Michener, 1965: 181.

Homalictus tarltoni.–Michener, 1965: 181.

Homalictus aureoazureus.–Michener, 1965: 179.

Homalictus littoralis (Rayment not Blüthgen).–Michener, 1965: 180.

Material examined.

Lectotype ♂ of *Halictus niveifrons*, Tasmania, Lea (BMNH). Two male syntypes are glued to a card with a 'type' label below in Cockerell's handwriting. The specimens to the left of the pin is headless, the specimen to the right is complete although the abdomen has come loose and been glued to the card beneath the rest of the body. The second specimen (to the right of the pin) is the Lectotype and I have marked the letter 'L' beneath the specimen.

Holotype ♀ of *Halictus oxoniellus*, Bribie Is., 2 Nov 1913, Queensland, H. Hacker (QM).

Holotype ♀ of *Halictus mesocyaneus*, Bribie Is., Queensland 1 Apr 1918, H. Hacker (QM).

Holotype ♀ of *Halictus raymenti*, Sandringham, Victoria 1926, T. Rayment (USNM).

Holotype ♀ of *Halictus tarltoni*, Brighton, Victoria 20 Sep 1926, T. Rayment, at flowers of *Osteospermum moniliferum* (USNM).

Holotype ♀ of *Halictus aureo-azureus*, Sandringham, Victoria, 16 Dec 1926, T. Rayment (ANIC).

Holotype ♀ of *Halictus littoralis*, (Rayment not Blüthgen) Sandringham, Port Phillip, Victoria, 21 Oct 1926, T. Rayment (ANIC). Michener (1965) incorrectly retained *littoralis* as a valid specific name when reassigning it to *Homalictus*. The name is a primary junior homonym of *Halictus littoralis* Blüthgen, 1923. No new name is required as it is a new synonym of *Homalictus niveifrons*.

Other specimens examined: (87 ♀♀, 50 ♂♂) (PD: 1-5,8-12) (FR: *Osteospermum, Hibbertia, Melaleuca, Boronia*) QUEENSLAND: Fraser Is., Binna Burra (UQIC); Peregian (SAM). NEW SOUTH WALES: Brunswick Heads, Lennox Head (UQIC); Chatswood, Moruya (ANIC). VICTORIA: Anglesea, Ringwood, Mt Evelyn, Dunkheld (NMV); Sandringham, Blacombe Hts, Gorae West (NMV, ANIC); Port Phillip, Seaford (SAM). TASMANIA: Devonport (SAM); Eaglehawk Neck (BMNH). SOUTH AUSTRALIA: Adelaide, Kangaroo Is., West Beach (SAM).

Diagnosis. A member of the '*sphecodoides*' species-group, most like *H. pectinalus*; distinguished from other members of the genus by the following combination of characters: Female–head and propodeum black; frons smooth, a few weak vertical striae below ocelli (Fig. 7d); clypeal width less than three times length; scutum appears impunctate, a few weak sparse punctures (Fig. 9p). Male–Fg:UID <2.0:1; UID:LID >1.3:1; clypeus without yellow or white markings; frons reticulate; head and scutum black.

Female. BL 5.1-5.6 mm; FL 4.0-4.4 mm; head wider than long (61:55); UID:LID as 35:33; clypeal width less than three times length (28:12); antennal sockets separated by distance less than diameter of socket. AOD:IAD:OAD:IOD:OOD as 12:6:20:11:10. Scape reaching posterior margin of median ocellus; dorsolateral angle of pronotum barely projecting as a small rounded tubercle; TS with four small, blunt teeth and half the length of outer spur; BP complete, apically pointed.

Sculpturing. Head smooth, frons (Fig. 7d) finely tessellate and with weak vertical microridges extending from above antennal bases to below level of median ocellus; basal two thirds of clypeus, supraclypeal area and vertex finely reticulate, impunctate, anterior one third of clypeus smooth, a few broad, shallow depressions; scutum (Fig. 9p) finely reticulate, appearing impunctate, though with a few small, sparse punctures; scutellum smooth and shining mesially reticulate on perimeter, punctured with minute sparse punctures; propodeum dull, finely reticulate, dorsal surface (Fig. 11p) with rugulae mesially on anterior half only, reaching rim laterally.

Colour. Vertex, frons, supraclypeal area, scutellum and propodeum black; clypeus black tinged with blue and red; scutum blue (Queensland specimens) or green (southern Australian specimens); legs black; gaster smooth and shining variable from orange red-brown with dark brown-black pigmentation on tergum I and lateral margins of terga to dark brown suffused with light brown patches.

Pubescence. Frons, paraocular areas, vertex and genae sparsely covered with erect, branched hair; clypeus and supraclypeal area with short, simple hair, some long, simple hairs on anterior margin of clypeus; scutum sparsely covered with erect, branched hair; metanotum with some short, plumose hair mediad; propodeum bare dorsally except few long branched hair on extreme lateral margins, similar erect hair on vertical surface; gastral terga with sparse short, simple hair, terga IV and V increasing density.

Male. BL 4.0-5.0 mm (lectotype c. 4.5 mm); FL 2.8-3.6 mm (lectotype c. 3.2 mm); head wider than long (58:52); eyes strongly converging below, UID:LID as 35:26; scape reaching anterior margin of median ocellus; Fg:UID as 1.8:1. AOD:IAD:OAD:IOD:OOD as 8:8:18:10:10. BP complete, apical pointed.

Sculpturing. Head coarsely reticulate, clypeus and supraclypeal area impunctate; scutum reticulate, more coarsely so anteriorly, openly punctured; scutellum shining, with minute sparse punctures; dorsal surface of propodeum reticulate with parallel rugulae extending on anterior half only mesially, to rim laterally.

Colour. Body and legs black, anterior margins of terga suffused with dark brown.

Pubescence. Frons, paraocular areas, supraclypeal area and clypeus covered with short, plumose, adpressed hair; vertex, between rear ocelli and genae with long, erect, branched hair; scutum, scutellum and vertical surface of propodeum sparsely covered with erect, branched hair; gastral sterna with inwardly directed long, branched hair.

Genitalia. Figs. 17a, b, c.

Gastral Sternum VI. Fig. 25g.

Remarks. Rayment (1935, 1953) commented on the close relationships between *Halictus niveifrons*, *H. raymenti*, *H. tarltoni*, *H. aureoazureus* and *H. littoralis* and stated (1953: 24) "It seems that the black male of *H. littoralis* taken in cop., is *H. niveifrons*." He also found all species nesting in burrows, side by side, at Sandringham, Victoria. The reason for dividing these bees into separate species was his belief that gastral colours were species specific. To highlight this point he (Rayment, 1935, pl. 40) produced a colour plate titled "A Chromatic Scale showing the Evolution of Black Bands (on the gaster) in a Chloralictine group of bees." This figured all the above mentioned species and a few species now placed in *Lasioglossum (Chilalictus)*.

Variability within females is restricted to scutal and gastral colour. The cause of gastral variation is not gut contents seen through the gaster, (as is the case in the '*dotatus*' species-group) rather the pigmentation of the sclerites. The colour ranged from light red-brown to completely dark brown suffused with light brown. Scutal colour variation is either blue or green, with northern specimens predominantly blue and southern specimens green.

Males exhibit a cline of increasing size from north to south. No such cline was found in females.

Distribution. Coastal south-east Queensland to Victoria, and into South Australia and Tasmania (Fig. 3a).

Homalictus pectinalus sp. nov.

Figures 3a; 7g; 10e; 11s

Material examined.

Holotype ♀, 17°41'S., 145°26'E., Millstream Falls Nat. Pk, Queensland, 24-25 May 1980, I.D. Naumann & J.C. Cardale (ANIC).

Paratypes 10 ♀♀, 15°47'S., 145°17'E., Moses Ck, 4 km NE. of Mt Finnigan, 14-16 Oct 1980, Queensland, J.C. Cardale, ex. ethanol (ANIC).

Other specimens examined: (6 ♀♀) (PD: 5-6,8,10) (FR: *Acacia, Eucalyptus*) QUEENSLAND: Palmerston Nat. Pk, via Innisfail (UQIC); Mt Finnigan (ANIC); Kirrama Range via Kennedy (QDPI); Kuranda (BMNH).

Diagnosis. A member of the '*sphecodoides*' species-group; female distinguished from other members of the genus by the following combination of characters: head and propodeum black; frons smooth, a few weak vertical striae below ocelli (Fig. 7g); scutum impunctate on anterior one third, remainder with sparse piliferous punctures; dorsolateral angle of pronotum projecting as a small acute spine; dorsal surface of propodeum with areolate rugae mesially, rim smooth and shining (Fig. 11s).

Female. BL 4.2-4.8 mm (holotype c. 4.8 mm); FL 3.3-3.7 mm (holotype c. 3.7 mm); head wider than long (52:43); UID:LID as 31:30; clypeus slightly convex, width less than three times length (25:10); antennal sockets separated by distance less than diameter of socket. AOD:IAD:OAD:IOD:OOD as 11:3:19:8:9. Antennal scape extending to level of posterior margin of median ocellus; dorsolateral angle of pronotum projecting as small acute spine; BP complete, bluntly angulate apically; TS with three small teeth (proximal tooth largest and apically rounded, distal teeth acute) and slightly smaller than outer spur.

Sculpturing. Head smooth, frons (Fig. 7g) with weak vertical striae extending to below level of anterior margin of median ocellus; clypeus and supraclypeal area finely reticulate, impunctate; scutum (Fig. 10e) with fine transverse lineolation on anterior one third, remainder distinctly tessellate, with minute piliferous sparse punctures; scutellum finely reticulate, minutely openly punctured; dorsal surface of propodeum (Fig. 11s) with rugulae, areolate mesially, extending at least half length of dorsal surface, parallel laterally extending to rim, rim smooth and polished.

Colour. Head, scutellum and propodeum black; basal half of antennal scapes red-brown, remainder black, flagellum black above, dark brown beneath; scutum blue (holotype), blue-green with a golden tinge (paratypes); coxae black, mid and hind femora and hind tibiae dark brown, fore femora, tibiae and tarsi red-brown, fore tibiae suffused with dark brown mesially, mid tibiae and tarsi and hind tarsi brown; gaster black suffused with brown.

Pubescence. Sparse; frons with short, erect, simple hair except above antennal bases to level of anterior margin of frontal carina and frons laterally to level of antennal bases with short, erect, branched hair; lower paraocular areas with some short, plumose, adpressed hair; clypeus and supraclypeal area almost bare, a few short, branched and long, simple hairs along anterior margin of clypeus; genae with long, branched hair; scutum sparsely covered with short, erect, simple hair, scutellum evenly covered with similar hair; vertical surface of propodeum with some short, branched hair; gastral terga almost bare, a few short, simple hairs on terga III, IV, V, a few long, minutely branched hair on lateral margins of terga IV, V.

Remarks. This new species superficially resembles members of the '*blackburni*' species-group, but is easily distinguished in the females by the presence of a fore basitarsal comb. The specific name refers to this character.

Male unknown.

Distribution. North Queensland (Fig. 3a).

Homalictus punctatus (Smith)

Figures 3a; 7f; 9r; 11r; 17g-i; 26a

Halictus punctatus Smith, 1879: 36.–Cockerell, 1912: 384.–1922b: 661.–1933: 318.–Rayment, 1931a: 168.

Halictus punctatus exlautus Cockerell, 1905a: 300.–1922b: 661-2.(Cockerell considered Smith's species name *punctatus* was preoccupied by *Nomia punctata* Smith, 1859: 5. He examined the type male of *N. punctata* and stated it "is a male *Halictus*", then recognised that his species *H. punctatus exlautus* "is an individual variation, not a distinct

race" and suggested Smith's specific name *punctatus* (1879) be replaced by *exlautus*. *Homalictus punctatus* (Smith, 1879) is not a preoccupied name.).–1933: 318, syn. nov.

Halictus hedleyi Cockerell, 1910: 231.–1914a: 504.–1933: 312, syn. nov.

Halictus pallidifrons Rayment, 1935: 692, syn. nov.

Halictus subpallidifrons Rayment, 1935: 693, syn. nov.

Halictus phillipensis Rayment, 1935: 700, syn. nov.

Homalictus punctatus.–Michener, 1965: 181.

Homalictus exlautus.–Michener, 1965: 180.

Homalictus hedleyi.–Michener, 1965: 180.

Homalictus pallidifrons.–Michener, 1965: 181.

Homalictus subpallidifrons.–Michener, 1965: 181.

Homalictus phillipensis.–Michener, 1965: 181.

Material examined.

Holotype ♀ of *Halictus punctatus*, Champion Bay, (presumably Western Australia) (BMNH).

Holotype ♀ of *Halictus punctatus exlautus*, Australia (BMNH).

Holotype ♂ of *Halictus hedleyi*, Port Philip (sic! Phillip), Victoria, Coulon (Berlin).

Holotype ♂ of *Halictus pallidifrons*, Ringwood, 5 May 1928, F.E.Wilson (ANIC).

Holotype ♂ of *Halictus subpallidifrons*, 6 miles east of Melbourne, 3 Mar 1929, T. Rayment (ANIC).

Halictus phillipensis, Sandringham, Port Phillip, Victoria, 21 Oct.1926, Rayment. (Rayment, unfortunately, has made an obvious mislabelling error with the type of this species. The handwritten type label is on a specimen in the ANIC, but the characters of this specimen and its locality label do not match those given in the original description. Michener (1965: 180-181) noted this discrepancy and commented the specimen was similar to *Lasioglossum (Parasphecodes) clarigaster*. Rayment labelled a number of specimens as 'Cotype' (though none is a syntype as only the holotype is recorded in the description) and as they match both the original description and locality data, the synonymy has been based on these specimens.)

Other specimens examined: (167 ♀♀, 38 ♂♂) (PD: 1-5.9-12) (FR: *Myoporum, Angophora, Eucalyptus, Leptospermum, Syzygium, Bursaria, Boronia*) QUEENSLAND: Mareeba (QDPI); Tambourine Mtn (QM); Mundubbera, Wallangarra, Bunya Mts, Flatstone Ck, Mistake Mts, Fernvale, Mt Crosby, Helidon, Amiens, Leyburn, Warwick, Glen Aplin, Texas (UQIC); Brisbane (UQIC, QM); Bald Rock Nat. Pk, Birnum Range (SAM). NEW SOUTH WALES: Legume (UQIC, SAM); W. Wyalong (SAM); Wilsons Downfall (QM); Grafton, Warrumbungle Nat. Pk, Narrabri, Llangothlin, Singleton, Bathurst, Bungendore (UQIC); Barraba (ANIC); Sutherland (NMV). AUSTRALIAN CAPITAL TERRITORY: Canberra (ANIC, UQIC). VICTORIA: Healesville (UQIC); Ringwood, Eltham, Cranbourne, Wodonga (ANIC); Woori Yallock (NMV, ANIC); Melbourne (ANIC, NMV); St. Arnaud, Dunkeld, Broadford, Anglesea, Brisbane Ranges, Avenel, Merbein, Orbost, Cann River, Genoa (NMV).

Diagnosis. A member of the '*sphecodoides*' species-group, male most like *H. megastigmus*; distinguished from other members of the genus by the following combination of characters: Female–(character unique) scutum with transverse shallow furrows. Male–Fg:UID <2.0:1; UID:LID >1.3:1; head densely covered with short, plumose hair; gaster with at least terga II and III light red-brown.

Female. BL 4.6-5.8 mm (holotype c. 5.8 mm); FL 3.9-4.6 mm (holotype c. 4.6 mm); head wider than long (65:53); UID:LID as 36:38; clypeus width at least three times length (34:11); antennal sockets separated by distance equal to diameter of socket. AOD:IAD:OAD:IOD:OOD as 14:5:21:10:10. Scape reaching posterior margin of rear ocelli; dorsolateral angle of pronotum projecting as a small acute tubercle; TS with four small, sharply pointed teeth and same length as outer spur; BP complete, apically rounded.

Sculpturing. Head roughened, frons (Fig. 7f) with vertical striae extending from level of antennal bases to level of median ocellus; paraocular areas reticulate, clypeus and supraclypeal area polished and shining; clypeus sparsely punctured; scutum (Fig. 9r) polished, anteriorly and laterally reticulate, open-sparsely punctured and furrowed; scutellum smooth and polished; propodeum dull, finely reticulate, dorsal surface of propodeum (Fig. 11r) with parallel rugae, most reaching rim.

Colour. Head, antennae, scutellum, and propodeum black; scutum blue suffused with green; legs light red-brown, except coxae and trochanters dark brown or black; gastral terga red-brown with dark patches mesially.

Pubescence. Head, except supraclypeal area (bare), sparsely covered with erect, minutely branched hair; scutum, scutellum and metanotum with similar hair except along posterior margin of scutellum and metanotum mediad with short, dense, plumose hair; propodeum bare dorsally, vertical surface with long, erect, branched hair; gastral terga almost bare, except tergum V with backwardly inclined simple hair.

Male. BL 4.3-5.4 mm; FL 3.1-3.7 mm; head wider than long (56:47); eyes strongly con-

verging below, UID:LID as 36:26; scape not reaching level of median ocellus; Fg:UID as 2.4:1. AOD:IAD:OAD:IOD:OOD as 7:9:16:9:10. BP complete, apically rounded.

Sculpturing. Head coarsely reticulate; scutum anteriorly reticulate, remainder polished and smooth, open-sparsely punctured, a few transverse furrows mediad of anterior margin of parapsidal lines; scutellum smooth and shining, minutely openly punctured; dorsal surface of propodeum coarsely reticulate, a few rugulae laterally extending to rim.

Colour. Head, mesosoma black; coxae black, trochanters and basal two thirds of femora dark brown, fore tibiae and tarsi light red-brown, mid and hind tibiae and tarsi light red-brown with large areas suffused with dark brown; gastral terga I, IV, V and VI dark brown, tergum II light red-brown, III similar though with patches of dark brown, ventrally light red-brown.

Pubescence. Frons sparsely covered with erect, branched hair, lower paraocular areas, supraclypeal area and clypeus covered with short, plumose, adpressed hair; scutum and scutellum sparsely covered with erect, minutely branched hair, posterior margin of scutellum with long, erect, branched hair; vertical surface of propodeum with erect, branched hair; gastral sterna with sparse row of erect, branched hair along posterior margins.

Genitalia. Figs. 17g, h, i.
Gastral Sternum VI. Fig. 26a.

Remarks. Smith's (1879) locality for *H. punctatus* is the only record of this species from Western Australia.

Cockerell (1912: 384) noted an error in Smith's (1879) original description of *H. punctatus* which he corrected as follows: "In Smith's description read 'mesothorax (not metathorax) green' ".

Distribution. East coast of Australia excluding Cape York Peninsula and Tasmania (Fig. 3a).

Homalictus rowlandi (Cockerell)

Figures 3b; 8j; 10p; 12q

Halictus rowlandi Cockerell, 1910: 226.–1933: 319.
Homalictus rowlandi.–Michener, 1965: 181.

Material examined.

Lectotype ♀, Paralectotype ♀, Cairns, Kuranda, Queensland, Feb 1902. Turner Coll. 1910-7 (BMNH). Species described from two females (syntypes). Lectotype and Paralectotype designated here. Reason for double locality is same as for *H. maitlandi*. Correct type locality is Kuranda.

Other specimens examined: (1 ♀) (PD: 2.5-6) (FR: Not recorded) QUEENSLAND: Kuranda (BMNH).

Diagnosis. The unique characters of *H. rowlandi* do not allow its placement into any of the five described species-groups. On the basis of sculpture it is closest to the '*blackburni*' species-group but the presence of a comb of setae on the fore basitarsi excludes it from this group. Examination of a male and its genitalic characters may help to elucidate the affinities of this species. Female distinguished from other members of the genus by the following unique characters: frons, vertex, genae brown, remainder of body light red-brown; dorsal surface of propodeum smooth (Fig. 12q), rounds onto the vertical surface so that it is difficult to define.

Female. BL 4.7-4.9 mm (lectotype c. 4.7 mm); FL 3.5-3.9 mm (lectotype c. 3.7 mm); eyes converging below, UID:LID as 32:29; clypeus convex, width less than three times length (30:12); antennal sockets separated by distance less than diameter of socket. AOD:IAD:OAD:IOD:OOD as 10:4:21:8:8. Scape extending to level of posterior margin of median ocellus; TS with three narrow, pointed teeth, decreasing in size distally and slightly smaller than outer spur; BP complete, apically angulate.

Sculpturing. Head smooth (Fig. 8j), frons and supraclypeal area finely tessellate, clypeus reticulate, supraclypeal area impunctate, clypeus indistinctly sparsely punctured with shallow hair pits; scutum (Fig. 10p) and scutellum dull, finely tessellate, impunctate on anterior one third, remainder open-sparsely punctured with minute punctures; dorsal surface of propodeum (Fig. 12q) smooth.

Colour. Frons, vertex and genae dark brown; clypeus and supraclypeal area light yellow-brown; scape light brown, flagellum brown; mesosoma, legs and gaster light red-brown, except fourth axillary and second axillary sclerites of fore and hind wing respectively black to dark brown and posterior margin of terga brown.

Pubescence. Frons, vertex, genae with short, erect, minutely branched hair; lower paraocular areas and supraclypeal area with some short, branched, adpressed hair; clypeus with short, erect, simple hair except a few long, simple hairs along anterior margin; scutum and scutellum with short, simple, semi-adpressed hair, a few long, erect, branched hairs along posterior margin of scutellum; metanotum with erect, minutely branched hair; propodeum bare dorsally, vertical lateral surfaces with erect, branched hair, vertical posterior surface with a few erect, minutely branched hairs; gastral terga almost bare, a few short, simple hairs on terga III, IV, V and VI.

Distribution. North Queensland (Fig. 3b).

Homalictus scrupulosus (Cockerell)

Figures 3a; 7c; 9o; 11o; 16g-i; 25f

Halictus limatiformis scrupulosus Cockerell, 1930b: 35.–1933: 314.

Homalictus scrupulosus.–Michener, 1965: 181.

Material examined.

Holotype ♀, Nanango District, Queensland, Nov 1927, H. Hacker (QM). Two females are glued to a card on the pin carrying the holotype label. The specimen closest to the pin is missing legs and gaster; the other specimen is complete, matches the colour in the original description and is the holotype. (The letter 'H' has been placed beside this specimen.)

Other specimens examined: (12 ♀♀, 4 ♂♂) (PD: 4,9,11) (FR: *Claoxylon, Ranunculus*) QUEENSLAND: Nanango District (QM); Bulborin State Forest, Ma Ma Ck, Mt Tamborine, Cunninghams Gap, Lamington Nat. Pk (UQIC); Bunya Mts (SAM). NEW SOUTH WALES: Tooloom (UQIC).

Diagnosis. A member of the '*sphecodoides*' species-group; distinguished from other members of the genus by the following combination of characters: Female–head and propodeum black; frons with strong vertical striae across entire surface (Fig. 7c); scutum sparsely punctured. Male–clypeus without yellow or white markings; Fg:UID <2.0:1; frons with vertical striae across entire surface.

Female. BL 5.4-5.9 mm (holotype c. 5.7 mm); FL 4.4-4.6 mm (holotype c. 4.6 mm); head wider than long (65:58); UID:LID as 38:35; clypeal width less than three times length, (28:12); antennal sockets separated by distance less than diameter of socket. AOD:IAD:OAD:IOD:OOD as 14:4:23:10:11. Scape reaching posterior margin of rear ocelli; dorsolateral angle of pronotum projecting as small acute tubercle; TS with four small, blunt teeth and same length as outer spur; BP complete, apically pointed.

Sculpturing. Head roughened, frons (Fig. 7c) with vertical striae extending from level of antennal bases to level of anterior margin of rear ocelli; clypeus and supraclypeal area finely reticulate, minutely sparsely punctured; vertex with several weak transverse striae not extending to eyes; scutum (Fig. 9o) and scutellum finely reticulate, sparsely punctured; dorsal surface of propodeum (Fig. 11o) with weak areolate rugulae on anterior half.

Colour. Head, scutellum and propodeum black; scape and flagellum dark brown; scutum blue tinged with green; legs dark brown except inner surfaces of fore tibiae brown; gaster black tinged with brown.

Pubescence. Frons, vertex, supraclypeal area, clypeus and genae sparsely covered with short, simple hair; scutum sparsely covered with short, erect, simple hair; scutellum with erect, branched hair along posterior margin; metanotum with thick, short, erect, branched mediad; propodeum bare dorsally, vertical surface with long, erect, plumose hair; gastral terga I-IV almost bare, tergum V with short, branched hair.

Male. BL 5.1-5.6 mm; FL 3.8-4.1 mm; head wider than long (62:58); UID:LID as 38:32; scape reaching anterior margin of median ocellus; Fg:UID as 1.9:1. AOD:IAD:OAD:IOD:OOD as 11:7:20:10:11. BP complete, apically pointed.

Sculpturing. Head roughened, frons with vertical striae extending from level of antennal bases to anterior margin of median ocellus; clypeus and supraclypeal area smooth, minutely openly punctured; scutum and scutellum reticulate, except smooth mesially on scutum, openly punctured; dorsal surface of propodeum reticulate, a few longitudinal rugulae anteromesially.

Colour. Body black, gaster tinged with brown; fore tibiae and tarsi light red-brown, remainder of legs dark brown.

Pubescence. Frons and paraocular area covered with stout, erect, branched hair (not densely); clypeus and supraclypeal area with a few small, minutely branched hair; vertex almost bare; scutum and scutellum sparsely covered with short, erect, simple hair, a few long, branched hair along posterior margin of scutellum; vertical surface of propodeum with short, erect, branched hair; gastral sterna with distinct rows of long, branched hair along posterior margins.

Genitalia. Figs. 16g, h, i.

Gastral Sternum VI. Fig. 25f.

Remarks. The body colours of the holotype are not usual for this species. Only two female specimens (from a different locality, Ma Ma Ck, Queensland) have been found with similar colours to the holotype. The perfect condition of these three specimens, in particular their entire wing margins and their light brown colour, suggests they are teneral adults. All other specimens matching the sculpture characters of the holotype are black and dark brown.

Distribution. South-east Queensland (Fig. 3a).

Homalictus sphecodoides (Smith)

Figures 3a; 4d; 7a; 9m; 11m; 16a-c; 25d

Halictus sphecodoides Smith, 1853: 58. Cockerell, 1933: 321.

Halictus limatus Smith, 1853: 59.–Cockerell, 1933: 314.–Rayment, 1953: 21. syn. nov.

Halictus humilis Smith, 1879: 36. Cockerell, 1910: 228.–1933: 313. syn. nov.

Halictus burkei Cockerell, 1906: 58.–1933: 306. syn. nov.

Halictus demissus Cockerell, 1916: 371.–1933: 308.–Rayment, 1930b: 54-5.–1935: 298.–1953: 13-14, fig. 25. syn. nov.

Halictus limatiformis Cockerell, 1922a: 263.–1933: 314. syn. nov.

Halictus humiliformis Cockerell, 1922a: 263.–1933: 313.–Rayment, 1947: 105.–1953: 20. syn. nov.

Homalictus sphecodoides.–Michener, 1965: 181.

Homalictus limatus.–Michener, 1965: 180.

Homalictus humilus.–Michener, 1965: 180.

Homalictus burkei.–Michener, 1965: 179.

Homalictus demissus.–Michener, 1965: 180.

Homalictus limatiformis.–Michener, 1965: 180.

Homalictus humiliformis.–Michener, 1965: 180.

Material examined. Holotype ♀ of *Halictus sphecodoides*, VDL (Van Diemen's Land) New Holland (BMNH). Only 'New Holland' was given in the original description but holotype has the additional 'VDL' label. Gaster missing.

Holotype ♀ of *Halictus limatus*, VDL (Van Diemen's Land) (BMNH).

Holotype ♀ of *Halictus humilis*, Australia (BMNH). The type locality for *H. humilis* in Smith's description is 'Champion Bay' (presumably Western Australia) yet the type locality label has only 'Australia'.

Holotype ♀ of *Halictus burkei*, Hobart, Tasmania, 1891-155, J.J. Walker (BMNH).

Holotype ♀ of *Halictus demissus*, Launceston, Tasmania, 1 Nov 1914, F.M. Littler (USNM).

Holotype ♀ of *Halictus limatiformis*, National Pk. Queensland, Dec 1919, H. Hacker (QM).

Holotype ♀ of *Halictus humiliformis*, Ebor, N.S.W., 30 Dec 1915, A.J. Turner (QM).

Other specimens examined: (209 ♀♀, 73 ♂♂) (PD: 1-3,5,7,9-12) (FR: *Schinus, Helichrysum, Wahlenbergia, Ixodea, Goodenia, Lagunaria, Eucalyptus, Gastrolobium, Jacksonia, Banksia, Cotoneaster*) QUEENSLAND: Peregian (QM); Lamington National Pk, Helidon, North Pine River, Brisbane, Teviot Gap (UQIC); Rathdowney (SAM); Bunya Mts (UQIC, SAM). NEW SOUTH WALES: Guyra, Warrumbungle Nat. Pk, Bowning (UQIC); Braidwood (ANIC); Ben Lomond (QM); Wentworth, Chatswood (SAM). AUSTRALIAN CAPITAL TERRITORY: Black Mtn (ANIC). VICTORIA: Torquay (UQIC); Chelsea, Mitta Mitta R., Mt Dandenong, Horsham, Halls Gap, Grampians, Gorae West, Kerang (NMV). TASMANIA: Bronte Pk, Port Arthur (ANIC); Launceston, Hobart (SAM). SOUTH AUSTRALIA: Hawker (UQIC); Adelaide, Belair, Golden Grove, Robe, Mt Lofty, Waitpinga, Glen Osmond, Mt Serle, Mitcham, Tusmore, Victor Harbour, Mt Pleasant (SAM). WESTERN AUSTRALIA: Karridale (WAM); Yanchep (BMNH).

Diagnosis. A member of the '*sphecodoides*' species-group, most like *H. houstoni*; distinguished from other members of the genus by the following combination of characters: Female–(unique) malus of strigilis comb-shaped; (additional) head and propodeum black; frons coarsely reticulate; scutum

punctured close-openly in parapsidal areas, closely along hind margin, remainder sparsely (Fig. 9m). Male–clypeus without yellow or white markings; Fg:UID >2.0:1; UID:LID >1.3:1; head covered with short, plumose hair; pronotal tubercle, scape and gaster black.

Female. BL 4.4-6.2 mm (holotype c. 4.5 mm); FL 3.2-4.3 mm (holotype c. 3.2 mm); head wider than long (59:53); UID:LID as 37:33; clypeus width less than three times the length (26:10); antennal sockets separated by distance less than diameter of socket. AOD:IAD:OAD:IOD:OOD as 12:6:21:11:10. Scape reaching anterior margin of median ocellus; dorsolateral angle of pronotum projecting as small rounded tubercle; malus of strigilis comb-shaped (Fig. 4d); TS with four small, blunt teeth and same length as outer spur; BP complete, apically rounded.

Sculpturing. Head roughened, frons (Fig. 7a) coarsely reticulate, basal one third of clypeus and supraclypeal area finely reticulate, sparsely punctured on former, on latter openly punctured; scutum (Fig. 9m) tessellate anteriorly and laterally in parapsidal areas, elsewhere smooth and shining, close-openly punctured in parapsidal areas, closely along posterior margin, remainder sparsely punctured; scutellum shining and sparsely punctured; propodeum dull, finely reticulate, dorsal surface of propodeum (Fig. 11m) with strong rugae reaching rim.

Colour. Head, antennae, scutellum, propodeum and gaster black; scutum dark blue-green; fore tibiae and tarsi dark brown, remainder of foreleg, and mid and hind legs black.

Pubescence. Frons and vertex sparsely covered with short erect hair; paraocular areas, genae, sparsely on clypeus, sides of mesosoma with long minutely branched hair; scutum and scutellum with a few erect minutely branched hair; gastral terga almost bare, tergum V with short, branched hair.

Male. BL 4.2-5.1 mm; FL 3.1-3.4 mm; head wider than long (50:42); eyes converging strongly below, UID:LID as 30:22; scape not reaching level of median ocellus; Fg:UID as 2.4:1. AOD:IAD:OAD:IOD:OOD as 6:7:15:8:8. BP complete, apically rounded.

Sculpturing. Head coarsely reticulate; scutum finely reticulate anteriorly and laterally, remainder smooth and shining, open-sparsely punctured, except in parapsidal areas openly punctured; scutellum smooth and shining with a few piliferous punctures; dorsal surface of propodeum with strong rugae reaching rim.

Colour. Head, mesosoma and gaster black, except along posterior margins of terga brown; pronotal tubercle black; fore tibiae and all tarsi light brown, mid and hind tibiae dark brown suffused with patches of light brown, remainder of legs dark brown.

Pubescence. Frons, paraocular areas, clypeus and supraclypeal area covered with short, plumose, adpressed hair; metanotum and sides of mesosoma with long branched hair; gastral sterna with rows of short, simple hair along posterior margins.

Genitalia, Figs. 16a, b, c.

Gastral Sternum VI. Fig. 25d.

Remarks. Rayment (1930b: 54-55; 1953: 20) described the males of *Halictus demissus* and *H. humiliformis* respectively. Both specimens were nominated as 'Allotype', but the type status is not valid.

Apart from size variations, species characters are relatively consistent. Smith's (1853: 58) description of *H. sphecodoides* states (female) "anterior tibiae . . ferruginous; the anterior tibiae frequently black". Examination of numerous specimens produced only two with the fore tibiae "ferruginous"; the black form is the more usual.

Distribution. South-east Queensland to Victoria, Tasmania, South Australia and south-west Western Australia (Fig. 3a).

Homalictus sphecodopsis (Cockerell)

Figures 2b; 6k; 9k; 11k; 15a-c; 25a

Halictus sphecodopsis Cockerell, 1905a: 300.–1933: 321.–Rayment, 1953: 22.

Halictus eyrei Cockerell, 1910: 226.–1933: 310. syn. nov.

Halictus claripes Friese, 1924: 235, syn. by Cockerell, 1929a: 12.
Halictus eyrei darwinensis Cockerell, 1929b: 2.–1933: 310, syn. nov.
Homalictus sphecodopsis.–Michener, 1965: 181.
Homalictus eyrei.–Michener, 1965: 180.
Homalictus claripes.–Michener, 1965: 179.
Homalictus darwinensis.–Michener, 1965: 180.

Material examined.
Holotype ♂ of *Halictus sphecodopsis*, Mackay, Queensland, Nov 1891, 710, No. 94.61, Turner (BMNH).
Holotype ♀ of *Halictus eyrei*, Mackay, Queensland, Nov 1899, Turner (7a) (BMNH). Gaster missing.
Lectotype ♀ of *Halictus claripes*, Mackay, Queensland, Mar 1900, Turner (AMNH). Additional label: '*H. eyrei*' in Cockerell's handwriting; Lectotype designated by A. Pauly (in press).
Holotype ♀ of *Halictus darwinensis*, Port Darwin, Northern Territory, 1 Jan 1915, G.F. Hill (AMNH).
Other specimens examined: (320 ♀♀, 54 ♂♂) (PD: 1-3,5-8,10-12) (FR: *Helipterum, Hypochoeris, Angophora, Callistemon, Eucalyptus, Eugenia, Leptospermum, Melaleuca, Syncarpia, Tristanopsis, Xanthorrhoea*). NORTHERN TERRITORY: Wildman R. Arnhem Highway (QDPI); Pine Creek (UQIC); Darwin (UQIC, ANIC). QUEENSLAND: St Pauls Moa (Banks) Is., Coen, Laura, Lakeland, Kirrama Range, Mt Carbine, Tolga, Herberton, Townsville, Yeppoon, Rockhampton, Biloela, Gayndah, Monto, Biggenden, Mundubbera, Beerwah, Bribie Is., Brisbane (UQIC); Mareeba, Cooktown (UQIC, QDPI, SAM); Mt Garnet, Mt Molloy (QDPI); Kuranda (ANIC, SAM); Mackay (BMNH, UQIC, NMV).

Diagnosis. A member of the '*dotatus*' species-group, most like *H. dotatus*; distinguished from other members of the genus by the following combination of characters: Female–anterior half of clypeus light red-brown; dorsal surface of propodeum relatively smooth; scutum, anterior one fifth reticulate, remainder closely punctured. Male–clypeus with anterior two thirds dull white; frons paraocular areas and supraclypeal area covered with short, plumose, adpressed hair; scutum closely punctured.

Female. BL 4.8-5.3 mm; FL 3.5-3.9 mm; head wider than long (58:45); UID:LID as 32:35; clypeus width greater than three times the length (30:8); antennal sockets separated by distance equal to diameter of socket. AOD:IAD:OAD:IOD:OOD as 12:5:19:9:8. Scape reaching anterior margin of median ocellus; dorsolateral angle of pronotum projecting as a small rounded tubercle; TS with three pointed teeth and same length as outer spur; BP complete and apically rounded.

Sculpturing. Head (Fig. 6k) relatively smooth; frons,vertex, supraclypeal area and posterior two thirds of clypeus reticulate, anterior one third of clypeus smooth, marked with shallow depression; scutum (Fig. 9k), anterior one fifth weakly reticulate, remainder of scutum and scutellum closely punctured; dorsal surface of propodeum (Fig. 11k) with areolate rugulae mediad, weak parallel rugulae laterally not extending to rim.

Colour. Frons, vertex, supraclypeal area, posterior half of clypeus, and genae copper-green; anterior half of clypeus light brown tinged with red; scape and flagellum beneath orange-brown, apical one third of scape and flagellum above, brown; margins of pronotal tubercle yellow; scutum green with tinges of golden red; scutellum black with golden sheen; propodeum dark green with tinges of gold; trochanters, femora, tibiae, tarsi and mid coxae orange red-brown, fore and hind coxae dark brown; gaster orange red-brown.

Pubescence. Frons with short, white hair, paraocular areas with short, plumose, adpressed hair; clypeus and vertex with long, simple hair; scutum with sparse, short, white hair, mesially directed obliquely away from mid line, laterally directed inwards, both sets meeting along parapsidal line.

Male. BL 4.1-4.7 mm (holotype c. 4.2 mm); FL 3.0-3.4 mm (holotype c. 3.1 mm); head wider than long (49:42); eyes not converging below, UID:LID as 28:28; scape not reaching level of median ocellus; Fg:UID as 2.2:1. AOD:IAD:OAD:IOD:OOD as 8:6:15:9:6. BP complete, apically rounded.

Sculpturing. Head reticulate; scutum anteriorly reticulate, remainder of scutum and scutellum closely punctured; dorsal surface of propodeum almost smooth, one or two short rugulae mediad, a few parallel rugulae lateral not reaching rim.

Colour. Frons, vertex, genae, scutellum and propodeum dark green; clypeus with anterior two thirds dull white, remainder dark green; scape and flagellum light red brown; pronotal tubercle white; scutum, scutellum and prop-

odeum dark green with a golden tinge; fore and hind coxae dark green, mid coxae and all legs light red brown; gaster orange red-brown.

Pubescence Frons, paraocular areas, supraclypeal area and basal one third of clypeus completely covered with short, plumose, adpressed hair; vertex with short, simple hair; genae with erect, branched hair; scutum with short backwardly inclined simple hair, anterior lateral corners with thick, short, plumose, adpressed hair; scutellum and metanotum with a few long simple hairs.

Genitalia. Figs. 15a, b, c.

Gastral Sternum VI. Fig. 25a.

Remarks. The colours of the body in are consistent with the exception of the clypeus and abdomen. The anterior half of the clypeus in females varies from brown to red-brown while in dark patches on the gaster are variable, dependent on internal air bubbles and gut contents.

Distribution. Coastal Queensland and northern Northern Territory (Fig. 2b).

Homalictus stradbrokensis (Cockerell)

Figures 4a; 8f; 10l; 12m; 22a-c; 27d

Halictus urbanus stradbrokensis Cockerell, 1916: 365.–1933: 323.

Homalictus stradbrokensis.–Michener, 1965: 181.

Material examined.

Holotype ♀, Queensland, Stradbroke Is., H. Hacker (USNM).

Other specimens examined: (72 ♀♀, 13 ♂♂) (PD: 8,10-12) (FR: *Angophora, Eucalyptus, Leptospermum, Xanthorrhoea*) QUEENSLAND: Dunwich, Stradbroke Is., Toowoomba, Caloundra, Cooloola State For., Tewak Ck. via Tin Can Bay, Noosa, Fraser Is., Mt Morgan, Cairns (UQIC); Bribie Is., Glass House Mts, Noosa-Coolum area, Maidenwell (SAM).

Diagnosis. A member of the '*urbanus*' species-group, most like *H. bremerensis*; distinguished from other members of the genus by the following combination of characters: Female–labrum with two raised tubercles; frons with vertical striae; scutum punctured, closely in parapsidal areas, mesad of parapsidal lines and along posterior margin, mesially open except along midline closely; vertical posterior surface of propodeum with long, plumose hair. Male–Fg:UID <2.0:1; EW:GW <2.5:1; frons reticulate; scutum coppery tinged with red, sparsely punctured in parapsidal areas; genitalia, in ventral view, with apical processes of gonocoxites broad.

Female. BL 5.4-6.4 mm (holotype c. 6.3 mm); FL 3.9-4.5 mm (holotype c. 4.4 mm); head wider than long (65:56); eyes converging below, UID:LID as 37:34; clypeus convex, width about twice length (30:14); antennal sockets separated by distance equal to diameter of socket. AOD:IAD:OAD:IOD:OOD as 14:5:22:12:10. Scape extending to level of anterior margin of median ocellus; EW:GW as 2.3:1; dorsolateral angle of pronotum projecting as small blunt tubercle; TS with four blunt teeth, proximal three large, distal tooth minute and about half length of outer spur; BP complete, bluntly angulate apically.

Sculpturing. Head roughened (Fig. 8f), frons with vertical striae to level of anterior margin of rear ocelli; vertex with transverse striae extending onto genae; supraclypeal area and basal half of clypeus finely reticulate, sparsely punctured (a few closely punctured), anterior half of clypeus smooth and polished, several wide, shallow punctures along anterior margin; scutum (Fig. 10l) and scutellum reticulate, scutum anteriorly impunctate, in parapsidal areas, mesad of parapsidal lines and along posterior margin closely punctured, mesially openly punctured, except along midline as in parapsidal areas; scutellum sparsely punctured, except along anterior margin densely punctured; dorsal surface of propodeum (Fig. 12m) with areolate rugae, extending onto vertical surface.

Colour. Frons, paraocular areas and supraclypeal area dark blue-green or blue; clypeus on basal half green tinged with gold, anterior half dark brown to black; scape and flagellum above dark brown, flagellum beneath light brown; scutum and scutellum royal blue tinged with gold; propodeum dark blue; legs dark brown or black; gaster dark brown-black.

Pubescence. Head sparsely covered with erect, minutely branched hair, a few long, simple hairs along anterior margin of clypeus; scutum and scutellum with both erect, minutely branched and short, erect, simple

hair; metanotum and posterior margin of scutellum with some long, erect, branched hair; propodeum bare dorsally, vertical posterior surface densely with long, erect, plumose hair; gastral terga I and II almost bare, remainder sparse, though with increasing density of short, backwardly directed, simple and minutely branched hair.

Male. BL 4.4-5.4mm; FL 3.0-3.5 mm; head wider than long (59:51); eyes converging below, UID:LID as 35:25; scape extending almost to level of anterior margin of median ocellus; Fg:UID as 1.8:1; EW:GW as 2.1:1. AOD:IAD:OAD:IOD:OOD as 9:7:18:10:10. BP complete, bluntly angulate apically; TS two thirds length of outer spur.

Sculpturing. Frons reticulate; clypeus and supraclypeal area shining though finely reticulate, weakly punctured; vertex with transverse striae extending onto genae; scutum reticulate, impunctate anteriorly, remainder openly punctured, except at posterior end of parapsidal lines closely punctured; scutellum finely reticulate, sparsely punctured except along anterior margin openly punctured; dorsal surface of propodeum with areolate rugae mesially, branched elsewhere, extending to rim.

Colour. Frons green tinged with gold; clypeus and supraclypeal area dark green; scutum and scutellum coppery green tinged with red; metanotum and propodeum dark blue; coxae, trochanters, femora dark brown, fore tibiae and tarsi light red-brown, mid and hind tibiae brown suffused with light red-brown; gaster dark brown.

Pubescence. Frons and vertex sparsely covered with erect, minutely branched hair; lower paraocular areas, supraclypeal area, clypeus and genae sparsely covered with both short, apicad directed, branched hair and short, adpressed, plumose hair; scutum and scutellum with erect, minutely branched hair; metanotum and posterior margin of scutellum with some long, erect, branched hair; vertical surface of propodeum with short, minutely branched hair; gastral terga almost bare, some short, simple hair increasing in density from tergum II.

Genitalia. Figs. 22a, b, c.
Gastral Sternum VI. Fig. 27d.

Distribution. Coastal Queensland, predominately in the south-east corner (Fig. 4a).

Homalictus tatei (Cockerell)

Figures 2b; 6i; 9i; 11i

Halictus tatei Cockerell, 1910: 227.–1933: 322.
Halictus saycei Cockerell, 1912: 286.–1933: 320, syn. nov.
Homalictus tatei.–Michener, 1965: 181.
Homalictus saycei.–Michener, 1965: 181.

Material examined.
Holotype ♀ of *Halictus tatei*, Mackay, Mar 1900, Eucalypt, Turner Coll., 1912-111 (BMNH).
Lectotype ♀ *Halictus saycei*, Mackay, Apr 1900, 321, 7c, Turner Coll. 1912-111 (BMNH). Two syntypes were examined, both with 'type' in Cockerell's handwriting. One designated as lectotype.
Other specimens examined: (11 ♀♀, 1 ♂) (PD: 2,3,12) (FR: *Eucalyptus*) QUEENSLAND: Mackay (BMNH, NMV); 40 Mile Scrub via Mt Garnet (QDPI).

Diagnosis. A member of the '*sphecodoides*' species-group; distinguished from other members of the genus by the following combination of characters: Female–frons with weak vertical striae below ocelli (Fig. 6i); scutum punctured, anteromesially and in parapsidal areas closely, remainder open-sparsely (Fig. 9i). Male–clypeus without yellow or white markings; Fg:UID >2.0:1; head sparsely covered with short, branched hair; scutum openly punctured.

Female. BL 4.8-5.1 mm (holotype c. 5.0 mm); FL 3.7-3.9 mm (holotype c. 3.9 mm); head wider than long (58:50); UID:LID as 33:32; clypeus width three times length (30:10); antennal sockets separated by distance less than diameter of socket. AOD:IAD:OAD:IOD:OOD as 13:4:21:9:8. Scape reaching posterior margin of median ocellus; dorsolateral angle of pronotum projecting as small acute spine; TS with six sharply pointed teeth (distal four small) and slightly smaller than outer spur; BP complete, apically rounded.

Sculpturing. Head weakly roughened, frons (Fig. 6i) beneath ocelli with weak vertical striae, not continuing around eye, lateral frons

smooth, finely reticulate; clypeus, supraclypeal area open-sparsely punctured, vertex reticulate; scutum (Fig. 9i) anteriorly weakly reticulate, anteromesially and in parapsidal areas closely punctured, remainder sparsely punctured; dorsal surface of propodeum (Fig. 11i) with weak areolate rugulae medianly, laterally with parallel rugulae extending onto vertical propodeum.

Colour. Head, scutellum and propodeum black; scape dark orange-brown, dark brown distally above, flagellum black above, brown beneath; pronotal tubercle light red-brown; scutum dull, dark green; apical half of fore and mid femora, tibiae, tarsi and apical one third of hind femora light red-brown, trochanters, remainder of femora and hind tibiae dark brown, hind tibiae suffused with red-brown; gaster red-brown suffused with dark brown patches.

Pubescence. Head sparsely covered with short, white hair; scutum, scutellum and metanotum medianly with short, light-brown hair; sides of propodeum with long, branched hair.

Male. BL (estimated) c. 4.3 mm; FL c. 3.2 mm; head wider than long (46:40); eyes converging below, UID:LID as 29:22; scape not reaching level of median ocellus; Fg:UID as 2.1:1. AOD:IAD:OAD:IOD:OOD as 8:6:15:9:7. BP complete, apically rounded.

Sculpturing. Head finely reticulate, weak vertical striae on frons extending from above antennal bases to below level of median ocellus; supraclypeal area impunctate, clypeus sparsely punctured; scutum finely reticulate, close-openly punctured; scutellum smooth and shining, impunctate; dorsal surface of propodeum with areolate rugulae mesially, laterally parallel rugulae not extending to vertical surface.

Colour. Head, mesosoma and propodeum black; scape and flagellum brown; coxae, trochanters, mid and hind tibiae dark brown, fore tibiae and all tarsi light red-brown, mid and hind tibiae suffused with brown.

Pubescence. Head sparsely covered with short, erect, minutely branched hair, some long, simple hairs on anterior margin of clypeus; scutum and scutellum sparsely covered with short, erect, simple hair; posterior margin of metanotum with a few long, erect, branched hairs; vertical surface of propodeum with short, erect, branched hair.

Remarks. In females the amount of black colour on the fore and mid femora is variable.

One male was associated but was missing the gaster.

Distribution. Restricted to central and northern coastal Queensland (Fig. 2b).

Homalictus thor (Cockerell)

Figures 2a; 6a; 9b; 11a)

Halictus flindersi thor Cockerell, 1929b: 12.–1933: 310.
Homalictus thor.–Michener, 1965: 181.

Material examined.

Holotype ♀, Thursday Island, 15 Mar 1929, T.D.A. Cockerell (USNM).

Other specimens examined: (5 ♀♀) (PD: 3-4,7,11) (FR: *Parinari*, *Dalbergia*, *Calandrina*) QUEENSLAND: Bamaga, Coen, Mellwraith Range (UQIC); Iron Range (ANIC).

Diagnosis. A member of the '*flindersi*' species-group, most like *H. behri*; female distinguished from other members of the genus by the following combination of characters: Female–dorsal surface of propodeum defined by carinae; BP complete; scutum (Fig. 9b) with a few weak transverse striae anteriorly, dense-closely punctured laterally and along posterior margin, remainder open-sparsely punctured; mid and hind femora dark green, except apical one third red-brown; gastral tergum I with minute hair pits.

Female. BL 6.7-7 mm (holotype c. 7.0 mm), FL 4.7-5.5 mm (holotype c. 5.5 mm); head wider than long (75:69); UID:LID as 41:38; clypeus less than three times as wide as long (38:12), convex, protruded; antennal sockets separated by diameter of socket. AOD:IAD:OAD:IOD:OOD as 12:6:27:13:9:5. Scape reaching posterior margin of median ocellus; dorsolateral angle of pronotum projecting as a blunt spine; dorsal surface of propodeum defined by carinae, same length as scutellum; TS with four blunt

teeth and shorter than outer spur; BP complete, bluntly angulate.

Sculpturing. Head coarsely roughened, frons (Fig. 6a) with vertical striae and interconnectives, vertical striae continue around eye, transverse striae in front of ocelli, median area above antennal bases reticulate; clypeus shining, variously punctured (dense, open, sparse); scutum (Fig. 9b) with a few weak transverse striae anteriorly, dense-closely punctured laterally and along posterior margin, remainder open-sparsely punctured; scutellum smooth medianly, sparsely punctured; dorsal surface of propodeum (Fig. 11a) with areolate rugae extending to rim; gastral tergum I with distinct hair pits.

Colour. Frons, vertex and genae golden green; clypeus and supraclypeal area copper, former suffused with red; basal half of scape light red-brown, remainder dark brown; flagellum light brown; scutum and scutellum golden green with tinge of blue; propodeum dark green; trochanters and proximal four fifths of fore femora green, proximal two thirds of mid and hind femora brown, remainder of legs light red-brown; gaster steel-blue.

Pubescence. Frons, vertex, paraocular areas and supraclypeal area evenly covered with well spaced, erect, minutely branched hair; clypeus (mainly along anterior margin) with forwardly directed, simple hair; genae with erect, simple hair; scutum sparsely covered with short, erect, simple hair; scutellum with a few long, erect, branched hairs; propodeum bare dorsally, vertical surface with long, erect, branched hair; gastral terga I and II almost bare, terga III, IV and V with increasing density of hair.

Distribution. Cape York Peninsula, Queensland (Fig. 2a).

Homalictus urbanus (Smith)

Figures 4a; 8c; 10i; 12j; 19g-i; 26i

Halictus urbanus Smith, 1879: 35.–Cockerell, 1910: 227.–1933: 322.–Rayment, 1935: 261.–1939: 278.

Halictus urbanus baudinensis Cockerell, 1905b: 307.–1933: 322 syn. nov.

Halictus kesteveni Cockerell, 1912: 286.–1933: 312. syn. nov.

Halictus hackeriellus Cockerell, 1914a: 507.–1933: 312. syn. nov.

Halictus pavonellus Cockerell, 1915a: 5.–1933: 318. syn. nov.

Halictus olivinus Cockerell, 1922a: 262.–1933: 317. syn. nov.

Halictus urbanus lomatiae Cockerell, 1922a: 263.–1933: 322. syn. nov.

Halictus microchalceus Cockerell, 1929b: 13.–1933: 316. syn. nov.

Halictus subcarus Cockerell, 1930a: 152.–1933: 321. syn. nov

Halictus williamsi Cockerell, 1930a: 153.–1933: 324. syn. nov.

Halictus suburbanus Cockerell, 1930b: 45.–1933: 322.–Rayment, 1935: 704. syn. nov.

Homalictus urbanus.–Michener, 1965: 181.

Homalictus baudinensis.–Michener, 1965: 179.

Homalictus kesteveni.–Michener, 1965: 180.

Homalictus hackeriellus.–Michener, 1965: 180.

Homalictus pavonellus.–Michener, 1965: 180.

Homalictus olivinus.–Michener, 1965: 180.

Homalictus lomatiae.–Michener, 1965: 180.

Homalictus microchalceus.–Michener, 1965: 180.

Homalictus subcarus.–Michener, 1965: 181.

Homalictus williamsi.–Michener, 1965: 181.

Homalictus suburbanus.–Michener, 1965: 181.

Material examined.

Lectotype ♀ of *Halictus urbanus*, Champion Bay, Western Australia (BMNH). Head missing. Lectotype designated by A. Pauly (in press).

Holotype ♀ of *Halictus urbanus baudinensis*, Baudin Is., N.W. Australia, J.J. Walker, 675 Collected on the 'Penguin' Expedition. (BMNH).

Holotype ♂ of *Halictus kesteveni*, Kuranda, Cairns, Queensland, Mar 1902, Turner (BMNH).

Holotype ♂ of *Halictus hackeriellus*, Brisbane, Queensland, 13 May 1912, H. Hacker (QM).

Holotype ♀ of *Halictus pavonellus*, Bribie Is., Queensland, 2 Sep 1913, H. Hacker (USNM).

Holotype ♂ of *Halictus olivinus*, Brisbane, Queensland, 3 Mar 1914, H. Hacker (QM).

Holotype ♀ of *Halictus urbanus lomatiae*, Sunnybank, Brisbane, Queensland, 13 May 1912, H. Hacker, on flowers of Lomatia (QM).

Holotype ♂ of *Halictus microchalceus*, Thirroul, New South Wales, 25 Mar (? year), Cockerell (ANIC).

Holotype ♀ of *Halictus subcarus*, Halifax, Queensland, 11-20 Jul 1919, F.X. Williams (MCZ).

Holotype ♀ of *Halictus williamsi*, Halifax, Queensland, 20 Jun–9 Jul 1919, F.X. Williams (MCZ).

Holotype ♂ of *Halictus suburbanus*, National Pk, Queensland, 1000 m, 1 Mar 1921, Turner (QM).

Other specimens examined: (2314 ♀♀, 756 ♂♂) (PD: 1-5,7-12) (FR: *Cassia, Wahlenbergia, Terminalia, Helipterum, Hypochoeris, Frankenia, Scaevola, Trachymene, Amyema, Acacia, Angophora, Calothamnus, Eucalyptus, Leptospermum, Melaleuca, Daviesia, Jacksonia, Swainsonia, Bursaria, Pittosporum, Calandrina, Hakea, Alphitonia, Atalaya, Heterodendron, Morgania, Brachychiton, Hypochoeris*) QUEENSLAND: Dunwich, Rathdowney, Beerwah, Yelarbon, Bulburin St. For.,

Noosa, Tin Can Bay, Bunya Mts, Toogoolawah, Maleny, Cunningham's Gap, Warwick, Kilcoy, Texas, Helidon, Drillham, Macalister, Oakey, Inglewood, Dulacca, Toloom, Goodiwindi, St George, Moonie, Bollon, Cunnamulla, Yowah, Thargomindah, Charleville, Windorah, Carnarvon Gorge, Maryland, Longreach, Blackall, Emerald, Benarkin, Banana, Rockhampton, St Ruth, Ellis Beach, Townsville, Mt Isa, Gregory Downs, Georgetown, Burketown, Innisfail, Bowen, Mt Carbine, Cooktown, Palmer River, Lockerbie (UQIC); Miles, Fernvale, Noosa- Coolum, Eidsvold, Mitchell, Wallangarra, Nanango, Levers Plateau (SAM); Morven, Quilpie, Charters Towers (UQIC, SAM); Brisbane, Bribie Is., Stradbroke Is., Caloundra, Cooloola, Mt. Glorious, Dunk Is. (UQIC, QM); Leslie Dam via Warwick, Condamine, Roma, Amby, Dalby (UQIC, NMV). NEW SOUTH WALES: Woodenbong, Moree, Narrabri, Muswellbrook, Coonabarabran, Bellata, Cobar, Bathurst, Scone, Glen Innes, Goulbourn, Armidale (UQIC); Nyngan (UQIC, SAM); Wilcannia (SAM). AUSTRALIAN CAPITAL TERRITORY: Black Mt. (ANIC, UQIC). VICTORIA: Warracknabeal, Nowa Nowa (NMV). SOUTH AUSTRALIA: Ernabella Mission, Oodla Wirra, Oodnadatta, Curnamona HS, Middleback Range, Lake Gilles, Tomkinson Reserve, Kalamurina Stn, Murray R., Tusmore, Blanche Cup Spng, Amata, Cooper Ck, William Ck, Wild Horse Plains, Lake Palankarinna, Dog Lake, Billa Kalina HS, Coward Springs, Purni Bore, Pernatty Ck, Arthurton, Eyre Peninsula, Broughams Gate, Edeowie HS, Lembina HS, Terowie, Hamilton HS, Myrtle Springs, Monarto, Black Forest, Port Germein (SAM); Whyalla (WAM); Adelaide (UQIC, SAM, WAM). NORTHERN TERRITORY: Alice Springs, Aileron, Barrow Ck, Borroloola Rd junction with Stuart HWY, Simpsons Gap, Daly Waters, Glen Helen, Katherine, Ti-Tree, Tennant Ck (UQIC); Devils Marbles, Macdonald Downs, Ooratippra (CAS). WESTERN AUSTRALIA: Dandaragan, Murchison R. Xing, Merredin, Coolgardie, Gnowangerup, Margaret R. on Yallingup Rd, Derby, Broome Baandee (UQIC); Menzies, Langi Crossing (CAS); Onslow, Kimberley (SAM); Mitchell Plateau (ANIC); Sandfire Flat Roadhouse, Spring Ck on HWY 1 (NMV); Lake Cohen, Yeo Lake, Neale Junction, Mooka HS (WAM).

Diagnosis. A member of the '*urbanus*' species-group, most like *H. forrestae*; distinguished from other members of the genus by the following combination of characters: Female–labrum with two raised tubercles; frons coarsely reticulate; gastral tergum I with transverse rows of minute punctures; scutum impunctate anteriorly, remainder punctured, mesially open, posteriorly close, laterally sparsely (Fig. 10i). Male–dorsal surface of propodeum not defined by carinae; Fg:UID <2.0:1; EW:GW <2.5:1; frons reticulate; scutum sparsely punctured mesially and posteriorly; gastral tergum I punctate mesially.

Female. BL 4.4-5.4 mm (lectotype estimated c. 5.2 mm); FL 3.0-3.6 mm (lectotype c. 3.5 mm); head wider than long (60:50); eyes converging below, UID:LID as 36:32; clypeus slightly convex, width greater than twice length (28:12); antennal sockets separated by distance equal to diameter of socket. AOD:IAD:OAD:IOD:OOD as 13:4:19:12:9. Scape extending to level of anterior margin of median ocellus; EW:GW as 1.5:1; dorsolateral angle of pronotum projecting as small blunt spine; TS with two large apically blunt teeth and three quarters length of outer spur.

Sculpturing. Head roughened (Fig. 8c), frons coarsely reticulate; clypeus and supraclypeal area finely reticulate, clypeus close-openly punctured, supraclypeal area sparsely marked with minute hair pits; scutum (Fig. 10i) and scutellum reticulate, scutum anteriorly impunctate, mesially openly and posteriorly closely punctured, laterally and scutellum sparsely punctured; dorsal surface of propodeum (Fig. 12j) with areolate rugae mesially to rim, branched rugae laterally extending onto vertical surface; gastral tergum I with minute punctures mesially.

Colour. Frons green-blue or green; supraclypeal area and basal half of clypeus brass green, anterior half dark brown; scape and flagellum above dark brown, flagellum beneath light brown; scutum and scutellum blue-green or blue or green tinged with purple, red or gold; propodeum dark green; coxae, trochanters and basal two thirds of femora dark brown, apical one third of femora, fore tibiae and tarsi light red-brown, mid and hind tibiae and tarsi red-brown sometimes suffused with dark brown; gaster dark brown tinged with green.

Pubescence. Head sparsely covered with short, erect, minutely branched hair, anterior margin of clypeus with a few long, simple hairs; scutum and scutellum sparsely covered with short, inclined, minutely branched hair, posterior margin of scutellum with a few long, erect, minutely branched hairs; metanotum with both short, adpressed and long, erect, minutely branched hair; propodeum bare dorsally, vertical posterior surface sparsely covered with erect, minutely branched hair;

gastral tergum I almost bare mesially, a few short, simple hairs laterally, terga II and III with sparse complete cover of short, simple adpressed hair, remaining terga with both short, simple, adpressed and long, backwardly inclined, minutely branched hair.

Male. BL 3.3-4.6 mm; FL 2.6-3.6 mm; head wider than long (53:44); eyes converging strongly below, UID:LID as 32:21; scape not reaching level of median ocellus; Fg:UID as 1.7:1; EW:GW as 1.8:1. AOD:IAD:OAD:IOD:OOD distances as 8:5:17:11:7. BP complete, apically rounded; TS two thirds length of outer spur.

Sculpturing. Frons coarsely reticulate; clypeus and supraclypeal area finely reticulate, open-sparsely punctured; scutum reticulate, impunctate anteriorly, mesially sparsely punctured, laterally close-openly punctured; scutellum finely reticulate, shining, openly punctured; dorsal surface of propodeum with areolate rugulae, extending laterally onto vertical surface, mesially to rim; gastral tergum I with a few minute punctures mesially.

Colour. Head green tinged with gold, vertex sometimes blue; scutum and scutellum brass green sometimes tinged with purple, red or gold; propodeum blue; coxae, trochanters and basal two thirds of femora dark brown, remainder of femora, fore tibiae and tarsi light red-brown, mid tibiae and tarsi red- brown suffused with dark brown; gaster black or dark brown.

Pubescence. Frons with short, simple minutely branched hair on upper half, lower half of frons, paraocular areas, clypeus and supraclypeal area covered (not densely) with short, plumose, inclined hair; vertex with long, minutely branched hair, genae with long, branched hair; scutum and scutellum sparsely covered with short, erect, minutely branched hair, some long, erect, branched hair anterolaterally on scutum, along hind margin of scutellum and on metanotum; vertical surface of propodeum with short, minutely branched hair; gastral terga I, II and III with short, simple hair on lateral areas only, remaining terga with similar hair sparsely across entire surface.

Genitalia. Figs. 19g, h, i.
Gastral Sternum VI. Fig. 26i.

Remarks. *Homalictus urbanus* is the most prevalent species within this genus and is found in all parts of Australia, except Tasmania.

Descriptions of the ten synonymised species all note the similarities between each other and with *H. urbanus*, but are separated on varying colour characters. A few examples are as follows: (Females): *H. baudinensis*, "similar to *urbanus* but the tibiae, tarsi and apical one third of femora bright ferruginous"; *H. lomatiae*, "distinct species on account of the shining blue scutellum, but examination shows that the hind spur, sculpture of area of metathorax and scutellum, &c., are precisely as in *H. urbanus*"; *H. williamsi*, "known from *H. urbanus* by the colour of the mesothorax"; *H. subcarus*, "known from *H. pavonellus* by green mesothorax and clear red hind tibiae". (Males): *H. hackeriellus*, "like *kesteveni*, but head having a yellowish green tinge and mesothorax dull brassy"; *H. olivinus*, "easily known from *H. hackeriellus* by the red tibiae"; *H. microchalceus*, "may be compared with *H. hackeriellus* but distinguished by the colour of the legs".

Examination of over 2 000 specimens of this species demonstrated that intraspecific colour variation is high, even within members of the same population. One of the main colour differences used, was the fore tibial colour either reddish black or clear light red-brown. A female specimen from Alice Springs, Northern Territory (UQIC) had the left fore tibia red black and the right fore tibia light red-brown, showing that both colours are possible within one specimen, let alone the species.

Distribution. Australia, except Tasmania (Fig. 4a).

Homalictus woodsi (Cockerell)

Figures 2a; 6c; 9c; 11c; 13d-g; 24b

Halictus woodsi Cockerell, 1910: 229.–1929b: 2 (Cockerell's suggested synonymy of *H. behri* with *H. woodsi* is not recognised.).–1933: 324.

Halictus behri transvolans Cockerell, 1912: 385.–1933: 305. syn. nov.

Homalictus woodsi.–Michener, 1965: 181.

Homalictus transvolans.–Michener, 1965: 181.

Material examined.

Holotype ♀ of *Halictus woodsi*, Cooktown, Oct 1902, Turner Coll., 1910-7 (BMNH). When the holotype of *H. woodsi* was examined no locality label was attached to the specimen, only the Turner collection label and Cockerell's 'type' label. The holotype of *H. flindersi*, examined at the same time, had two locality labels, one as was given in the original description, the other: Cooktown, Oct 1902. I have assumed that at some time the locality label of *H. woodsi* has been accidentally attached to the *H. flindersi* holotype and have therefore mounted the label on a white card and re-attached it to the *H. woodsi* holotype.

Holotype ♀ of *Halictus behri transvolans*, Mackay, Mar 1900, 757, Turner Coll., 1912-111, (BMNH).

Other specimens examined: (31 ♀♀, 15 ♂♂) (PD: 1,6-7,9-12) (FR: *Eucalyptus, Eugenia, Melaleuca, Borreria*) QUEENSLAND: Warraber (Sue) Is., Mt Webb, Hope Vale Mission (ANIC); Cairns (QDPI); Moa (Banks) Is. (UQIC, SAM); Townsville (BMNH, UQIC). NORTHERN TERRITORY: Cape Crawford, Borradaile, Wessel Island, Horn Inlet (Sir Edward Pellow Group) (ANIC); Darwin (UQIC, BMNH, ANIC). WESTERN AUSTRALIA: Carson escarpement, Drysdale River (ANIC).

Diagnosis. A member of the '*flindersi*' species-group, most like *H. flindersi*; distinguished from other members of the genus by the following combination of characters: Female–dorsal surface of propodeum defined by carinae; BP incomplete; frons with granulate reticulation below ocelli (Fig. 6c). Male–dorsal surface of propodeum defined by carinae; BP incomplete; gastral tergum VI with a small median and large lateral tufts of erect hair (Fig. 24b).

Female. BL 5.9-6.8 mm (holotype c. 6.6 mm); FL 4.0-4.6 mm (holotype c. 4.5 mm); head wider than long (72:61); UID:LID as 39:35; clypeus twice as wide as long (33:15), convex, protruded; antennal sockets separated by distance greater than diameter of socket. AOD:IAD:OAD:IOD:OOD as 13:7:24:13:9. Scape barely reaching level of anterior margin of median ocellus; dorsolateral angle of pronotum projecting as a small blunt tubercle; dorsal surface of propodeum defined by carinae, longer than scutellum; TS with three blunt teeth and marginally shorter than outer spur; BP incomplete, only defined anteriorly.

Sculpturing. Head roughened, frons (Fig. 6c) beneath ocelli with granulate reticulation, lateral margins of frons with vertical striae continuing around eye, weak transverse striae in front of ocelli; clypeus and supraclypeal area finely reticulate, close-openly punctured; scutum (Fig. 9c) finely reticulate (dull sheen), sparsely punctured except openly in parapsidal areas and densely along posterior margin; dorsal surface of propodeum (Fig. 11c) with areolate rugae extending to margin.

Colour. Frons green; vertex, genae and propodeum dark blue, clypeus royal blue; scape black, flagellum dark brown above, red-brown beneath; scutum blue- green; trochanters, femora, tibiae and basal two thirds of basitarsi dark brown to black, remainder of tarsi light brown; gaster steel blue.

Pubescence. Frons, vertex, paraocular areas and supraclypeal area with short, erect, minutely branched hair; clypeus with a few long, forwardly directed, simple hairs; genae with a few long, erect, branched hairs; scutum with short, erect, minutely branched hair; scutellum almost bare, a few long, erect, branched hairs; dorsal surface of propodeum bare, vertical surface sparsely covered with long, erect, branched hair; gastral terga I, II and III almost bare, terga IV and V with increasing density of short, simple hair; gastral and femoral scopae well developed.

Male. BL 5.6-6.2 mm; FL 3.6-4.3 mm; head wider than long (72:61); eyes converging strongly below, UID:LID as 42:20; scape not reaching level of median ocellus; Fg:UID as 1.7:1. AOD:IAD:OAD:IOD:OOD as 11:9:22:13:9. BP incomplete, only defined anteriorly.

Sculpturing. Head roughened, frons with granulate reticulation above antennal bases, transverse striae below ocelli and vertical striae on lateral frons with striae continuing to posterior margin of eye; vertex with several transverse striae; clypeus and supraclypeal area reticulate, close-openly punctured; scutum dull, finely reticulate, sparsely punctured, except along margins of parapsidal lines and hind margin openly punctured; scutellum with few punctures; dorsal surface of propodeum defined by carinae, with areolate rugae extending to rim.

Colour. Frons, vertex, genae and propodeum dark blue; clypeus, supraclypeal area, scutum and scutellum dark green; coxae,

trochanters, and femora dark brown, anterior surface of tibiae light brown, posterior surface of tibiae, femora apically and tarsi light red brown; gaster steel blue, tergum VII red-brown.

Pubescence. Lower paraocular areas with dense, short, plumose hair; clypeus, supraclypeal area and around antennal bases with spaced, short, plumose hair; frons, vertex, genae, scutum and metanotum with erect, branched hair; gastral sterna II, III and IV with transverse row of short hair along posterior margins.

Genitalia. Figs. 13d, e, f, g.

Gastral Sternum VI. Fig. 24b.

Distribution. Northern Australia (Fig. 2a).

Quasilictus subgen. nov.

Diagnosis. Female – hind tibiae slender, scarcely concave beneath, ventral margin of anterior surface relatively straight, outer surface covered with short, minutely plumose, adpressed hair (Fig. 5m); apical two thirds of gastral tergum I covered with close-open punctation; gastral terga II, III, IV with tomentous bands of hair (absent mesially).

Male – middle flagellar segments as wide as long or wider than long; Fg:UID equal to or less than 1.0; TS pectinate; genitalia (Figs 23a-c) with gonobase continuing contours of gonocoxite yet broadly expanded to same width as gonocoxite; volsellae with large ventroapical projections (Fig. 23d); apical margin of gastral tergum VII broad and bilobed.

Type species. *Homalictus brevicornutus* sp. nov.

Remarks. Vestiture on hind tibiae of female allies *Quasilictus* with the New Guinea subgenus *Papualictus* (Michener 1980a: 8) but differs as follows: Male – clypeus less than five times width; mandibles not shifted posteriorly; mandibles not enormously enlarged, or sickle shaped; dorsolateral angle of pronotum not forming a large acute tooth; dorsal surface of propodeum not elevated to form shining, longitudinal elongate bosses.

Homalictus (Quasilictus) brevicornutus sp. nov.

Figures 2a; 5m; 8k; 10q; 12r; 23a-d; 27g

Material examined.

Holotype ♀, Paratypes 8 ♀♀, 4 ♂♂, Batten Point, 15°54′S., 136°32′E., 30 km NE. by E. of Borroloola, Northern Territory, 30 Oct 1975, M.S. Upton. (ANIC).

Other specimens examined: (1 ♂) (FR: Not recorded) WESTERN AUSTRALIA: 6 km W. of Martins Well, West Kimberly, 26 Apr 1977, D.H. Colless. (ANIC).

Diagnosis. *Female*. BL 5.5-6.2mm (holotype c. 6.2mm); FL 3.5-3.9mm (holotype c. 3.9 mm); head wider than long (73:56), eyes converging below, UID:LID as 44:38; clypeus more than twice as wide as long (32:12), protruding, slightly convex in profile; supraclypeal area convex; antennal sockets separated by distance greater than diameter of socket. AOD:IAD:OAD:IOD:OOD as 12:8:22:14:10. Scape reaching just short of level of anterior margin of median ocellus; first three flagellar segments wider than long, remaining segments as long as wide; dorsolateral angle of pronotum projecting as small rounded tubercle; TS slightly longer than outer spur, coarsely pectinate with four blunt teeth, diminishing in size distally, basal three large, distal tooth small; BP complete, apically rounded.

Sculpturing. Head roughened (Fig. 8k), frons coarsely granulate extending to level of anterior margin of rear ocelli, anterior lateral areas almost smooth; supraclypeal area densely punctured, interspaces between punctures smooth and polished, clypeus closely punctured along basal margin, remainder sparsely punctured, interspaces between punctures finely reticulate; vertex with several weak transverse striae, extending onto genae; scutum (Fig. 10q) anteromesially impunctate, finely reticulate, remainder dense-closely punctured, interspaces between punctures smooth and polished; scutellum densely punctured mesially, remainder openly punctured, interspaces between punctures smooth and polished; mesepisternum and metepisternum with irregular striae-reticulated pattern; dorsal surface of propodeum (Fig. 12r) defined by carinae, with areolate rugae; gastral terga close-openly punctured, except

basal one third of tergum I impunctate and fine transverse lineolation on posterior margin of terga.

Colour. Frons, vertex, genae, green-blue; supraclypeal area golden; clypeus brown; scape dark brown, flagellum brown above, red-brown beneath; scutum and scutellum blue-green with golden tinge; propodeum dark blue; legs brown to dark brown; gastral terga red-brown suffused with blue.

Pubescence. Frons, supraclypeal area and genae with short, minutely branched hair; vertex and clypeus with long, erect, minutely branched hair; lower paraocular areas with short, plumose, adpressed hair; scutum and scutellum with both short, simple, apicad directed hair and erect, minutely branched hair except anterior lateral corners of scutum covered with short, plumose, adpressed hair and posterior margin of scutellum with a few long, erect, branched hairs; metanotum covered with short, semi-erect, plumose hair mesially; propodeum bare dorsally except posterior lateral areas with short, branched hair, vertical surface sparsely covered with erect, minutely branched hair; gastral tergum I with short, minutely branched, adpressed hair mesially, incomplete bands of tomentum on terga II, III and IV, remainder with short, simple and minutely branched hair.

Male. BL 5.4-6.2 mm; FL 3.4-3.9 mm; head wider than long (67:55); eyes converging below, UID:LID as 41:31; clypeus slightly convex, more than twice as wide as long (28:12); antennal sockets separated by distance greater than diameter of socket. AOD:IAD:OAD:IOD:OOD as 10:8:19:13:11. Scape not reaching level of anterior margin of median ocellus; flagellum short, first four flagellar segments wider than long, remainder (except last) at least as wide as long; Fg:UID as 1.0:1; TS slightly shorter than outer spur, coarsely pectinate with three acute teeth; BP complete, bluntly angulate apically.

Sculpturing. Frons coarsely granulate; clypeus and supraclypeal area closely punctured, areas between punctures smooth and polished; scutum anteriorly impunctate and reticulate, remainder closely punctured with areas between punctures smooth and polished, parapsidal lines indistinct; scutellum smooth and shining, sparsely punctured except along midline densely punctured; dorsal surface of propodeum defined by carinae, with large, branched, interconnecting rugae; gastral tergum I closely punctured mesially, laterally smooth and shining, remainder of tergites punctate posteromesially only.

Colour. Frons, vertex, genae, supraclypeal area, metanotum and propodeum blue; basal half of clypeus blue-green, anterior half brown; scape and flagellum above dark brown, flagellum beneath light brown; scutum and scutellum dull dark green with a golden tinge; legs brown; gaster dark brown tinged with blue.

Pubescence. Frons, vertex and genae with erect, minutely branched hair; lower paraocular areas, supraclypeal area and clypeus with short, plumose, adpressed hair, a few long simple hairs along anterior margin of clypeus; scutum and scutellum with long, erect, simple hair, a few long, erect, branched hairs along posterior margin of scutellum; metanotum covered with short, semi-erect, plumose hair mesially; propodeum bare dorsally, vertical surface with erect, minutely branched hair; gastral terga with short, simple, adpressed hair, tomentous like hair on lateral margins of terga II, III and IV.

Genitalia. Figs. 23a-d.

Gastral Sternum VI. Fig. 27g.

Distribution. Northern Territory and northern Western Australia (Fig. 2a).

New combinations

Lasioglossum (Chilalictus) appositum
(Rayment) comb. nov.

Halictus erythrurus appositus Rayment, 1939: 281.
Homalictus appositus.–Michener, 1965: 179.

Material examined.
Holotype ♀, White Swamp, New South Wales (ANIC).

Remarks. The morphology of *L. appositum* is typical of *Lasioglossum (Chilalictus)* not *Homalictus*.

Lasioglossum (Chilalictus) purpureum (Rayment) comb.nov.

Halictus doweri purpureus Rayment, 1935: 695.
Homalictus purpureus.–Michener, 1965: 180.

Material examined.
Syntype ♀, Melbourne, Victoria, 3 Mar 1929, F.E. Wilson (ANIC).

Remarks. The morphology of *L. purpureum* is typical of *Lasioglossum (Chilalictus)* not *Homalictus*.

Acknowledgments

The bulk of this study was carried out in the Department of Entomology, University of Queensland, Brisbane, under a postgraduate M.Sc. award. It is with much pleasure that I acknowledge the guidance and encouragement of Dr Elizabeth Exley of that department.

I also gratefully acknowledge Dr Arturs Neboiss and Dr Gary Poore, both of the Museum of Victoria, for the many helpful suggestions they provided and the Museum of Victoria itself for allowing me time to complete my studies on this genus.

I am indebted to the following persons for the loan material used in this study: Dr G.B. Monteith and Mr E.C. Dahms (QM); Dr B.K. Cantrell and Mr R.I. Storey (QDPI); Dr I.D. Naumann and Ms J.C. Cardale (ANIC); Dr E.G. Matthews and Ms J. Forrest (SAM); Dr T.F. Houston (WAM); Ms M.A. Schneider (UQIC); Dr M. Favreau (AMNH); Mr G. Else (BMNH); (the late) Dr P.H. Hurd Jr and Mr G. Hevel (USNM); Dr F. Koch (Berlin); Dr W.J. Pulawski (CAS); Mr C. Vogt (MCZ); Dr G.M. Nishida (BPBM); and Dr A. Pauly (Faculté des Sciences Agronomiques de l'État, Belgique).

Collectors' names are not included with the specimen locality data but I would like to acknowledge the contribution made by the following persons: Dr E.M. Exley, Mr T. Low, Mr I. Yeo, Mr G. Daniels and Ms M.A. Schneider (UQIC); Dr I.D. Naumann, Ms J.C. Cardale, Drs D. Colless and I.B.F. Common, Mr M. Upton and Mr T. Weir (ANIC); Mr R.I. Storey (QDPI); Dr G.B. and Mrs S.R. Monteith and Mr E.C. Dahms (QM); Dr T.F. Houston (WAM); Dr A. Neboiss (NMV); and Messrs Turner, Cockerell and Hacker and Dr C.D. Michener.

I thank Ms H.J. Martin for her meticulous typing of this manuscript. Earlier drafts were read and commented on by Drs C.D. Michener, T.E. Woodward and E.M. Exley and the final draft was examined by Dr T.F. Houston and Ms J.C. Cardale, all of whom I sincerely thank.

References

Blüthgen, P., 1923. Beitrage zur Kenntnis der Bienengattung *Halictus* Latr. *Arch. Naturgesch.* A 89(5): 232-332, 38 figs.

Blüthgen, P., 1926. Beitrage zur Kenntnis der indomalayishen *Halictus* - und *Thrinchostoma* - Arten (Hym; Apidae; Halictini). *Zool. Jb.* 51: 375-698.

Blüthgen, P., 1931. Beitrage zur Kenntnis der indomalayischen *Halictus* - und *Thrinchostoma* - Arten (Hym; Apidae; Halictini). *Zool. Jb.* 61: 285-346.

Cardale, J. C. & Turner, J. W., 1966. Nest structure and biology of *Halictus leai* Cockerell (Hymenoptera: Halictidae). *Proc. R. Soc. Qd* 77(10): 93-7.

Cockerell, T. D. A., 1905a. Descriptions and records of bees - II. *Ann. Mag. nat. Hist.* (7)16: 292-301.

Cockerell, T. D. A., 1905b. Descriptions and records of bees - III. *Ann. Mag. nat. Hist.* (7)16: 301-8.

Cockerell, T. D. A., 1905c. New Australian bees in the collection of the British Museum. *Entomologist* 38: 270-3.

Cockerell, T. D. A., 1906. New Australian bees in the collection of the British Museum - II. *Entomologist* 39: 56-60.

Cockerell, T. D. A., 1910. New and little known bees. *Trans. Am. ent. Soc.* 36: 199-249.

Cockerell, T. D. A., 1912. Descriptions and records of bees - XLIII. *Ann. Mag. nat. Hist.* (8)9: 377-87.

Cockerell, T. D. A., 1914a. Descriptions and records of bees - LIX. *Ann. Mag. nat. Hist.* (8)13: 504-22.

Cockerell, T. D. A., 1914b. Descriptions and records of bees - LXIII. *Ann. Mag. nat. Hist.* (8)14: 361-9.

Cockerell, T. D. A., 1915a. Descriptions and records of bees - LXVIII. *Ann. Mag. nat. Hist.* (8)16: 1-9.

Cockerell, T. D. A., 1915b. Descriptions and records of bees - LXX. *Ann. Mag. nat. Hist.* (8)16: 482-9.

Cockerell, T. D. A., 1916. Some bees from Australia, Tasmania and the New Hebrides. *Proc. Acad. nat. Sci. Philad.* 68: 360-75.

Cockerell, T. D. A., 1918. Some bees collected in Queensland. *Mem. Qd Mus.* 6: 116-20.

Cockerell, T. D. A., 1919a. The metallic-colored halictine bees of the Philippine Islands. *Philipp. J. Sci.* 15: 11-13.

Cockerell, T. D. A., 1919b. The black halictine bees of the Philippine Islands. *Philipp. J. Sci.* 15: 269-81.

Cockerell, T. D. A., 1922a. Australian bees in the Queensland Museum. *Mem. Qd Mus.* 7: 257-279.

Cockerell, T. D. A., 1922b. Descriptions and records of bees - XCIV. *Ann. Mag. nat. Hist.* (9)9: 660-8.

Cockerell, T. D. A., 1926a. Descriptions and records of bees - CXII. *Ann. Mag. nat. Hist.* (9)18: 216-27.

Cockerell, T. D. A., 1926b. New halictine bees from Australia. *Entomologist* 59: 246-7.

Cockerell, T. D. A., 1927. Some Australian bees. *Entomologist* 60: 101-2.

Cockerell, T. D. A., 1929a. Bees, chiefly Australian species described or determined by Dr H. Friese. *Am. Mus. Novit.* 343: 1-20.

Cockerell, T. D. A., 1929b. Bees from the Australian region. *Am. Mus. Novit.* 346: 1-18.

Cockerell, T. D. A., 1930a. Australian bees in the Museum of Comparative Zoology. *Psyche* 37: 141-54.

Cockerell, T. D. A., 1930b. New Australian bees. *Mem. Qd Mus.* 10: 37-50.

Cockerell, T. D. A., 1933. The bees of Australia. *Aust. Zool.* 7: 291-324.

Cresson, E. T., 1872. Hymenoptera Texana. *Trans. Am. ent. Soc.* 4: 153-292.

Dours, J. A., 1872. Hymenoptères nouveau du Bassin Mediterranean. *Revue Mag. Zool.* (2): 293-349.

Ellis, M. D., 1913. Seven new North American bees of the genus *Halictus*. *Ent. News Philad.* 24: 205-11.

Friese, H., 1909. Die Bienenfauna von Neu Guinea. *Ann. Mus. Nat. Hungarici* 7: 179-288.

Friese, H., 1924. Über die Bienen Australiens. *Konowia* 3: 216-49.

Hennig, W., 1965. Phylogenetic systematics. *Ann. Rev. Entomol.* 10: 97-115.

Hennig, W., 1966. *Phylogenetic Systematics.* University of Illinois Press: Urbana.

Houston, T. F., 1970. Discovery of an apparent male soldier caste in a nest of a halictine bee (Hymenoptera: Halictidae), with notes on the nest. *Aust. J. Zool.* 18: 345-51.

Knerer, G. & Schwarz, M., 1976. Halictine social evolution: the Australian enigma. *Science, N.Y.* 194: 445-8.

Krombein, K. V., 1950. The aculeate Hymenoptera of Micronesia II. Colletidae, Halictidae, Megachilidae and Apidae. *Proc. Hawaii ent. Soc.* 14(1): 101-42.

Krombein, K. V., 1951. Additional notes on the bees of the Solomon Islands (Hymenoptera: Apoidea). *Proc. Hawaii ent. Soc.* 14(2): 227-95.

Michener, C. D., 1965. A classification of the bees of the Australian and South Pacific regions. *Bull. Am. Mus. nat. Hist.* 130: 1-362.

Michener, C. D., 1978. The parasitic groups of Halictidae (Hymenoptera, Apoidea). *J. Kans. ent. Soc.* 51(10): 291-339.

Michener, C. D., 1979. The genus *Homalictus* in Fiji (Hymenoptera: Halictidae) *Pac. Ins.* 21(2-3): 227-34.

Michener, C. D., 1980a. The large species of *Homalictus* and related halictines from the New Guinea area (Hymenoptera: Apoidea). *Am. Mus. Novit.* 2693: 1-21.

Michener, C. D., 1980b. A new Philippine *Homalictus* with unusual wing venation (Hymenoptera: Apoidea). *J. Kans. ent. Soc.* 53(2): 423-6.

Pauly, A., 1980. Les espèces indonesiennes du genre *Homalictus* Cockerell (Hymenoptera: Apoidea: Halictidae). *Zool. Meded., Leiden* 55(2): 11-28.

Pauly, A., (in press). Les abeilles de la sous-famille des Halictinae en Nouvelle-Guinée et dans l'Archipel Bismark (Hymenoptera: Apoidea: Halictidae). *Zool. Verh., Leiden.*

Rayment, T., 1930a. A collection of bees from Western Australia. *J. R. Soc. West. Aust.* 16: 45-56.

Rayment, T., 1930b. New and remarkable bees. *Proc. R. Soc. Vict.* 43: 42-61.

Rayment, T., 1931a. Bees in the collection of the Western Australian Museum and the Agricultural Department, Perth. *J. R. Soc. West. Aust.* 17: 157-190.

Rayment, T., 1931b. The wild bees of Australia. *Australas. Beekeeper* 32(10): 252-5.

Rayment, T., 1935. *A Cluster of Bees.* Endeavour Press: Sydney. 752 pp.

Rayment, T., 1939. Bees from the highlands of New South Wales and Victoria. *Aust. Zool.* 9: 263-94.

Rayment, T., 1947. Bees of the Victorian Alps. *Victorian Nat.* 64: 103-7.

Rayment, T., 1953. *Bees of the Portland District.* Portland Field Naturalists' Club, Victoria, Australia. 39 pp.

Smith, F., 1853. *Catalogue of hymenopterous insects in the collection of the British Museum.* British Museum: London. Vol. 1. 197 pp., pls. 1-6.

Smith, F., 1859. Catalogue of hymenopterous insects collected at Celebes by Mr. A. R. Wallace. *Proc. Linn. Soc. Lond.* 3: 4-27.

Smith, F., 1879. *Descriptions of new species of Hymenoptera in the collection of the British Museum.* British Museum: London. XXI + 240 pp.

Throckmorton, L. H., 1962. The problem of phylogeny in the genus *Drosophila*. In: M.R. Wheeler (ed.), *Studies in Genetics. Vol. 2.* University of Texas: Austin.

Walker, K. L., 1981. *Preliminary Studies of the Systematics of the genus* Homalictus *(Hymenoptera: Halictidae) in Australia.* M.Sc. thesis, University of Queensland. 232 pp.

Wiley, E. O., 1981. *Phylogenetics: the Theory and Practice of Phylogenetic Systematics.* John Wiley: New York.

Yeates, D. K., 1981. *The Genus Nomioides Schenck, 1866 (Halictidae: Hymenoptera) in Australia.* B.Sc.(Hons) thesis, University of Queensland. 55 pp.

Index of names

Valid names are given in *italics* and junior synonyms in roman type.

Appendix 1

Characters used in the construction of a cladogram for *Homalictus*.
(Presumed plesiomorphic state is in square brackets [ ].)

Sexes	Apomorphic state	Plesiomorphic state
1. Female	Tergal scopae present	Tergal scopae absent
2. Female	Femoral scopae originating from ventral surface of femur	Femoral scopae originating from dorsal surface of femur
3. Both sexes	Galea with a comb of short spines along the distal margin	Galea with a comb of long spines opposite base of galeal palp
4. Female	Hind tibiae robust	Hind tibiae slender
5. Female	Outer surface of hind tibiae with area of short differentiated hair	Outer surface of hind tibiae without area of short differentiated hair
6. Both sexes	Both sexes subequal in body length	Female body length greater than male
7. Both sexes	Tomentum on gastral terga present	Tomentum on gastral terga absent
8. Male	Genitalia with gonobase as wide as gonocoxites	Genitalia with gonobase narrower than gonocoxites
9. Male	Genitalic volsellae with large ventroapical projections	Genitalic volsellae without large ventrapical projections
10. Male	Dorsal surface of propodeum elevated each side to form shining boss	Dorsal surface of propodeum not elevated
11. Male	Area above pleural signum elevated	Area above pleural signum not elevated
12. Male	Mesepisternum with transverse ridge behind fore coxae	Mesepisternum without transverse ridge behind fore coxae
13. Male	Genitalia with ventroapical processes on gonocoxites	Genitalia without ventroapical processes on gonocoxites
14. Male	Gastral sternum VI with small inverted 'v' projections	Gastral sternum VI smooth
15. Female	Labrum with two raised tubercles	Labrum without raised tubercles
16. Female	Medium tubercle of labrum defined by a carina	Medium tubercle of labrum not defined by a carina
17. Female	Contour of frons does not continue onto clypeus	Contour of frons continues onto clypeus
18. Both sexes	Dorsal surface of propodeum entirely defined by carinae	Dorsal surface of propodeum not defined by carinae
19. Male	Gastral sternum VI with thickened spines	Gastral sternum VI smooth
20. Both sexes	Basal margin of second submarginal cell obtusely bent	Basal margin of second submarginal cell straight
21. Female	Head and propodeum black	Head and propodeum non black metallic colour
22. Female	Fore basitarsal comb absent	[Fore basitarsal comb present]
23. Male	Genitalia with long gonostyli	Genitalia with short gonostyli
24. Male	Genae with long, branched hair	Genae bare
25. Male	Gonocoxal processes with long, simple, tapering setae	Gonocoxal processes without setae
26. Female	Body (except head) non-metallic light red-brown colour	Body metallic dark colour
27. Female	Dorsal surface of propodeum smooth	Dorsal surface of propodeum sculptured
28. Male	Gonocoxal arms of genitalia converging ventrally	Gonocoxal arms of genitalia absent

Appendix 1 (continued)

Sexes	Apomorphic state	Plesiomorphic state
29. Male	Gonocoxal arms of genitalia with long, distinctly shaped hairs	Gonocoxal arms of genitalia absent
30. Both sexes	Gastral tergum I pitted across tergite	Gastral tergum I impunctate
31. Female	Transverse plicae on scutum	Transverse plicae absent on scutum
32. Both sexes	HB incomplete	HB complete
33. Female	Transverse plicae on scutum (a) not meeting along midline; (b) meeting along midline	Transverse plicae absent on scutum
34. Female	Frons with vertical striae only below ocelli	Frons smooth
35. Female	Frons granulate only from below ocelli to level of antennal bases	Frons smooth
36. Female	Scutal punctation in parapsidal areas (a) close; (b) dense	Scutum punctation sparse in parapsidal areas
37. Male	Distal area of genitalic penis valves deeply furrowed	Distal area of genitalic penis valves rounded
38. Female	Scutal punctation mesially (a) open; (b) close; (c) dense	Scutum punctation sparse mesially
39. Male	Sternum VI with distinct hair tufts (a) medially only; (b) large medially, small laterally; (c) small medially, large laterally	Sternum VI without distinctive hair tufts
40. Male	Shape of hairs on gonocoxal arms (a) spiculate (Fig. 12g); (b) cultellate (Fig. 13l); (c) lanceolate (Fig. 13d); (d) spatulate (Fig. h); (e) hooked (Fig. 12k)	Gonocoxal arms without pubescence
41. Both sexes	Dorsolateral angle of pronotum projecting as erect lamellae	Dorsolateral angle of pronotum not projecting as erect lamellae
42. Both sexes	Tubercle at rear of vertex	Tubercle absent at rear of vertex
43. Male	TS pectinate	TS essentially simple
44. Female	Clypeus without lateral projections	Clypeus with small lateral projections
45. Male	Fg:UID >2.0:1	Fg:UID <2.0:1
46. Female	Clypeal width greater than 3× but less than 5× the length	Clypeal width less than 3× length
47. Female	BP apically rounded	BP apically pointed
48. Female	Frons entirely granulate	Frons smooth
49. Female	Malus of strigilis comb shaped	Malus of strigilis fan-shaped
50. Male	Clypeus concave anteromesially	Clypeus slightly convex anteromesially
51. Female	Frons above antennal bases with vertical striae	Frons smooth
52. Female	Scutum densely covered with short hair	Scutum sparsely covered with short hair
53. Female	Scutal punctation not due to impressed points	Scutum punctation due to impressed points
54. Female	Scutum with transverse furrows	Scutum without transverse furrows
55. Female	Scutal punctures with rim elevated	Scutal punctures without rim elevated
56. Female	Frons with vertical striae extending across the entire surface	Frons smooth

Appendix 1 (continued)

Sexes	Apomorphic state	Plesiomorphic state
57. Male	Gonocoxal process of genitalia with spines	Gonocoxal process of genitalia absent
58. Female	TS half length of outer spur	TS about same length as outer spur
59. Female	Dorsolateral angle of pronotum produced as a prominent acute spine	Dorsolateral angle of pronotum rounded
60. Both sexes	Body black colour	Body non black colour
61. Male	Apex of marginal cell not separated from wing margin	Apex of marginal separated from wing margin
62. Female	Propodeal sculpture minutely anastomosed	Propodeal sculpture reticulate
63. Female	Legs black or dark brown	Legs dark green
64. Female	Propodeal sculpture areolate to dorsal rim	Propodeal sculpture reticulate
65. Female	Gastral terga with hair bands	Gastral terga without hair bands
66. Female	Scape reaching level of posterior ocelli	Scape not reaching level of posterior ocelli
67. Male	Fore trochanters with long plumose hair	Fore trochanters almost bare
68. Male	Hind trochanters with long plumose hair	Hind trochanters almost bare
69. Male	Tarsal segments flanged (a) fore tarsi only; (b) all tarsi	Tarsal segments not flanged
70. Male	Metanotum with dense pubescence	Metanotum sparsely covered with hair
71. Male	Tarsal claws enlarged	Tarsal claws small
72. Male	Genal hairs form a beard	Genae sparsely covered with hair
73. Both sexes	Mid coxae red-brown	Mid coxae dark brown
74. Male	Forewing cell 1st Cu bare	Forewing cell 1st Cu with macrotrichia
75. Male	Gonostyli of genitalia triangular in side view	Gonostyli of genitalia rounded in side view
76. Female	Frons sculpture reticulate	Frons smooth
77. Female	Posterior vertical surface of propodeum with dense pubescence	Posterior vertical surface of propodeum almost bare
78. Female	Dorsal propodeal sculpture extending onto lateral surface	Dorsal propodeal sculpture reticulate
79. Male	Dorsal gonocoxal foramen of genitalia narrow	Dorsal gonocoxal foramen of genitalia wide
80. Both sexes	Gastral tergum I pitted mesially	Gastral tergum I impunctate
81. Female	Dorsal surface of propodeum defined posteriorly by a carina	Dorsal surface of propodeum not defined by a carina
82. Female	Anterior lateral corners of scutum with areolate sculpture	Anterior lateral corners of scutum reticulate
83. Male	EW:GW >3:1	EW:GW <3:1
84. Male	Fg:UID <1:1	Fg:UID >1:1
85. Male	Gonocoxites with apically recessed area of pubescence	Gonocoxites not recessed apically

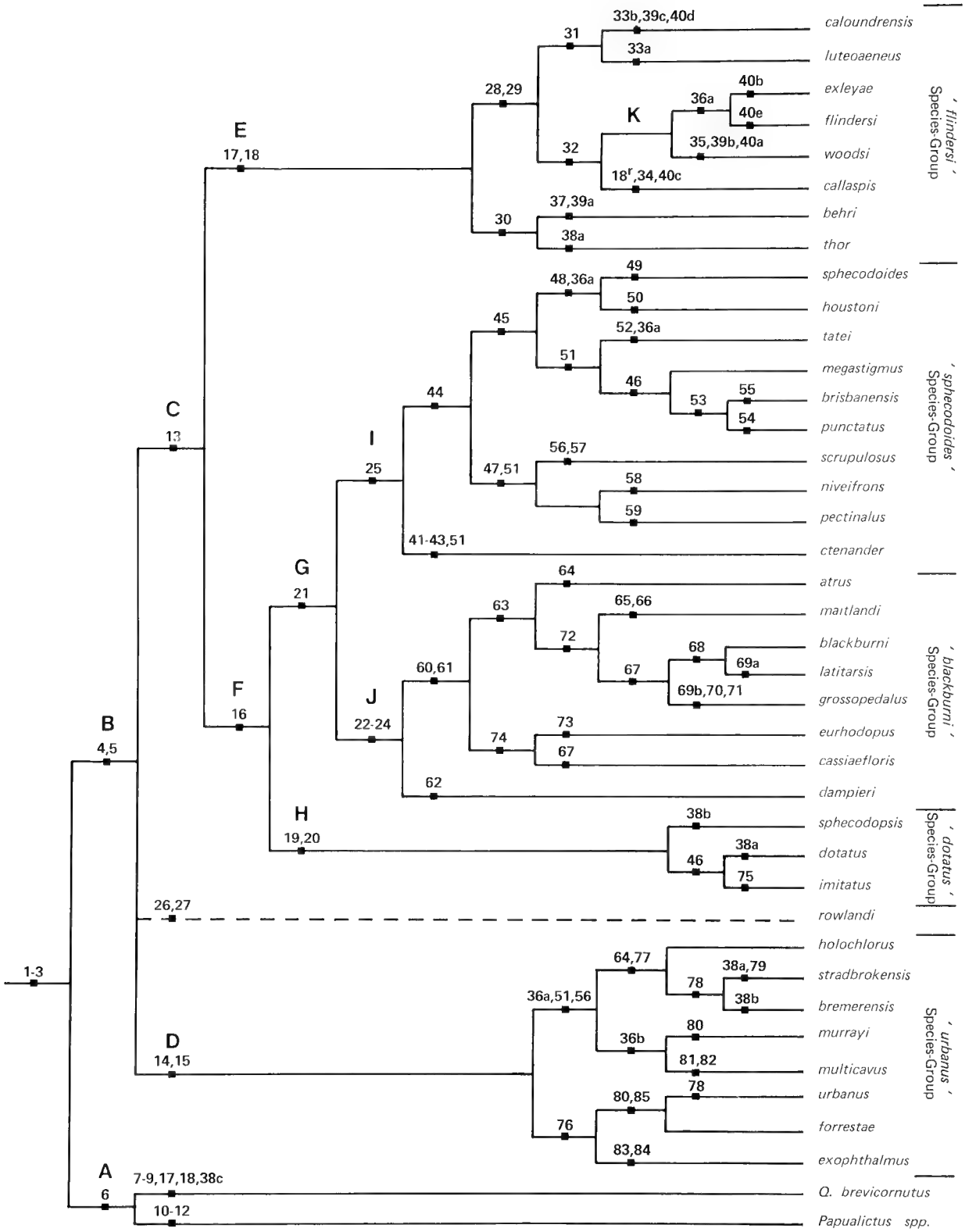


Figure 1. Cladogram illustrating hypothesized relationships among species of *Homalictus*. Numbers refer to apomorphic characters listed in Appendix 1. Letters refer to lineages as discussed in text. (r reversal)

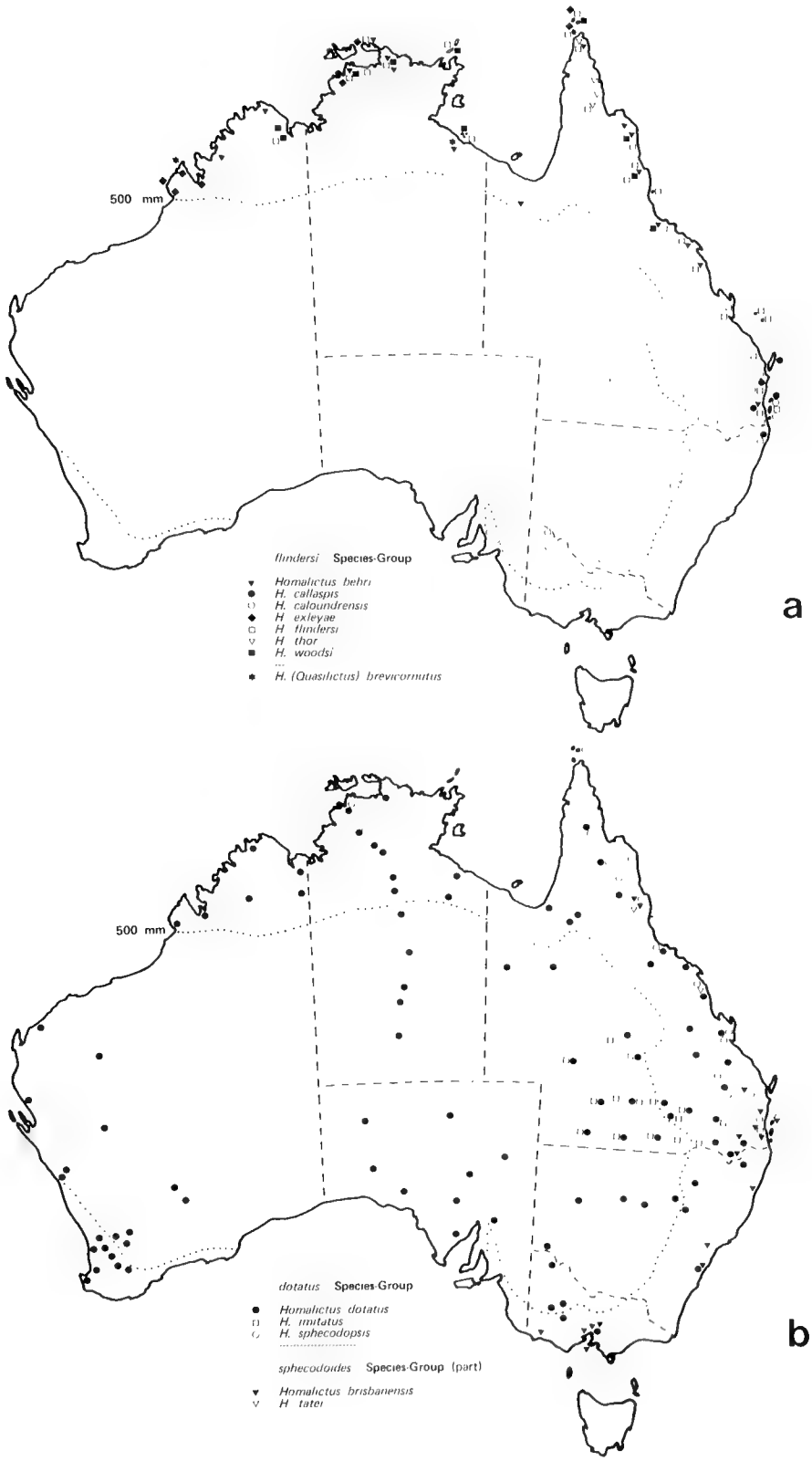


Figure 2. Distribution of *Homalictus* spp. a, '*flindersi*' species-group and *H. (Quasilictus) brevicornutus*; b, '*dotatus*' and '*sphecodoides*' (part) species-groups. 500 mm isohyet is shown.

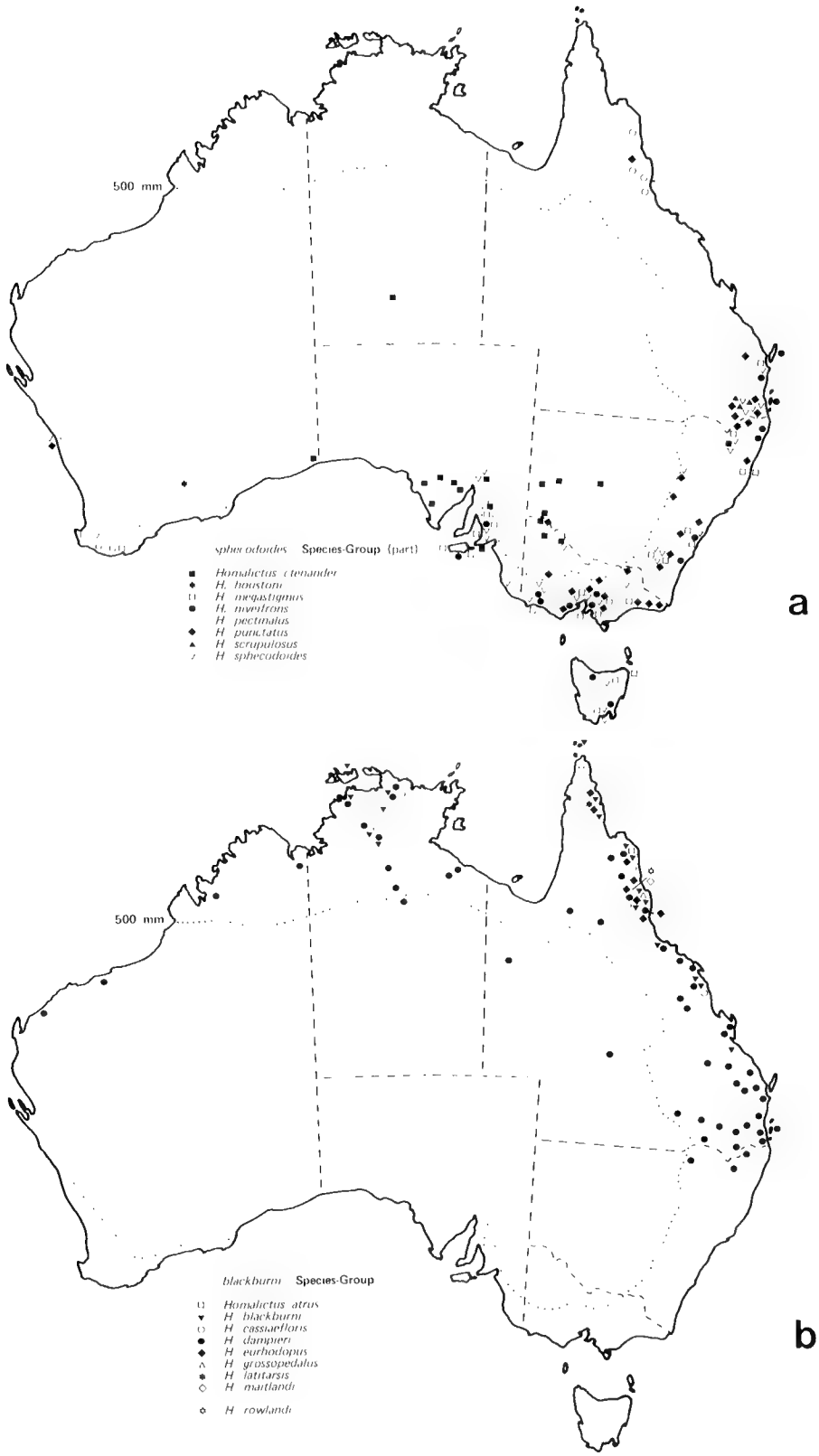


Figure 3. Distribution of *Homalictus* spp. a, '*sphecodoides*' (part) species-group; b, '*blackburni*' species-group and *H. rowlandi*. 500 mm isohyet is shown.

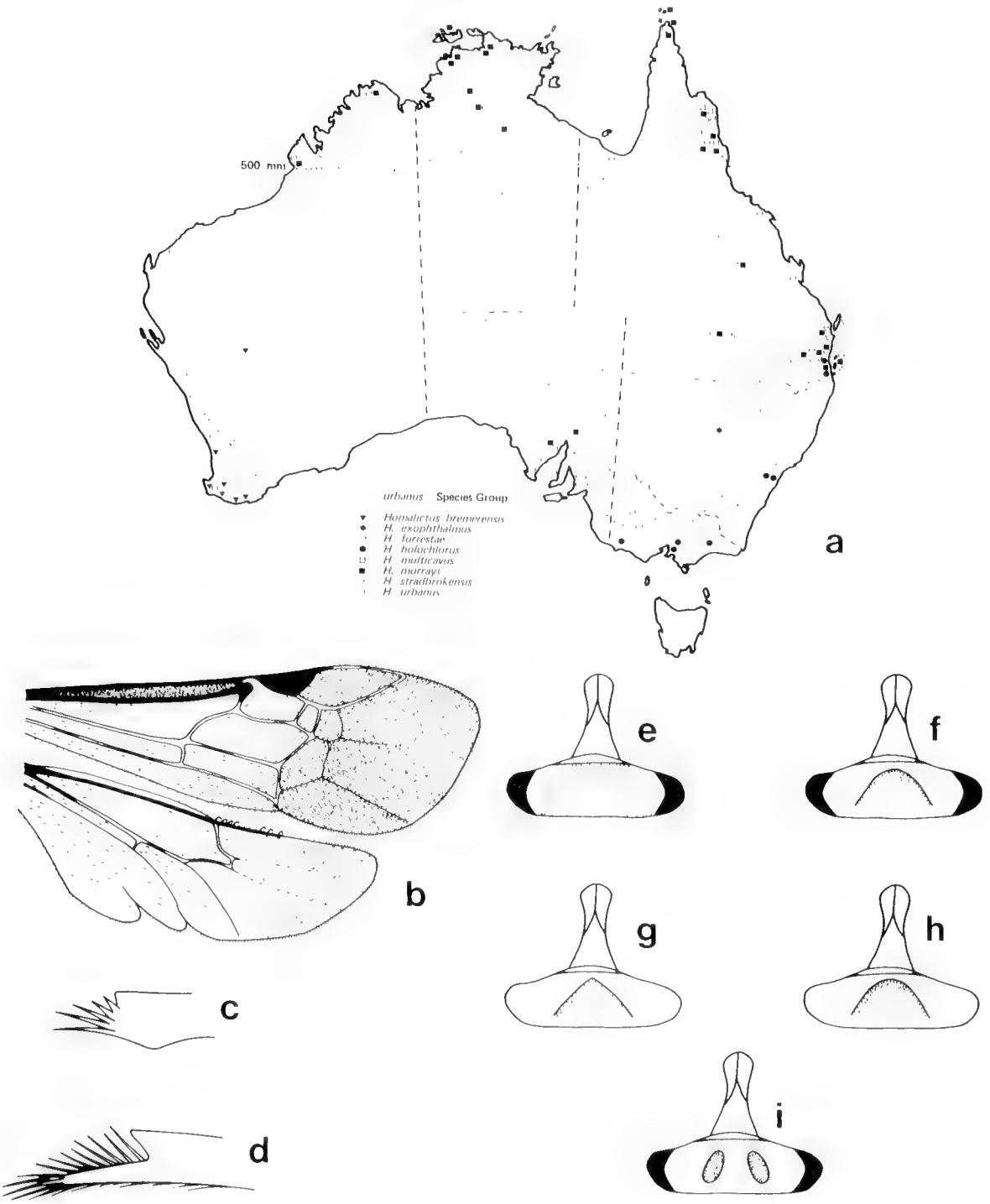


Figure 4. a, Distribution of '*Homalictus urbanus*' species-group. 500 mm isohyet is shown.

Diagrammatic views of: b, right fore and hind wing; c, malus of strigilis (fan-shaped), (lateral); d, malus of strigilis (comb-shaped, *H. sphecodoides*),(lateral).

Diagrammatic dorsal views of species-group labrums (solid black line in middle of basal box represents a carina): e, '*flindersi*' species-group; f, '*dotatus*' species-goup; g, '*sphecodoides*' species-group; h, '*blackburni*' species-group; i, '*urbanus*' species-group.

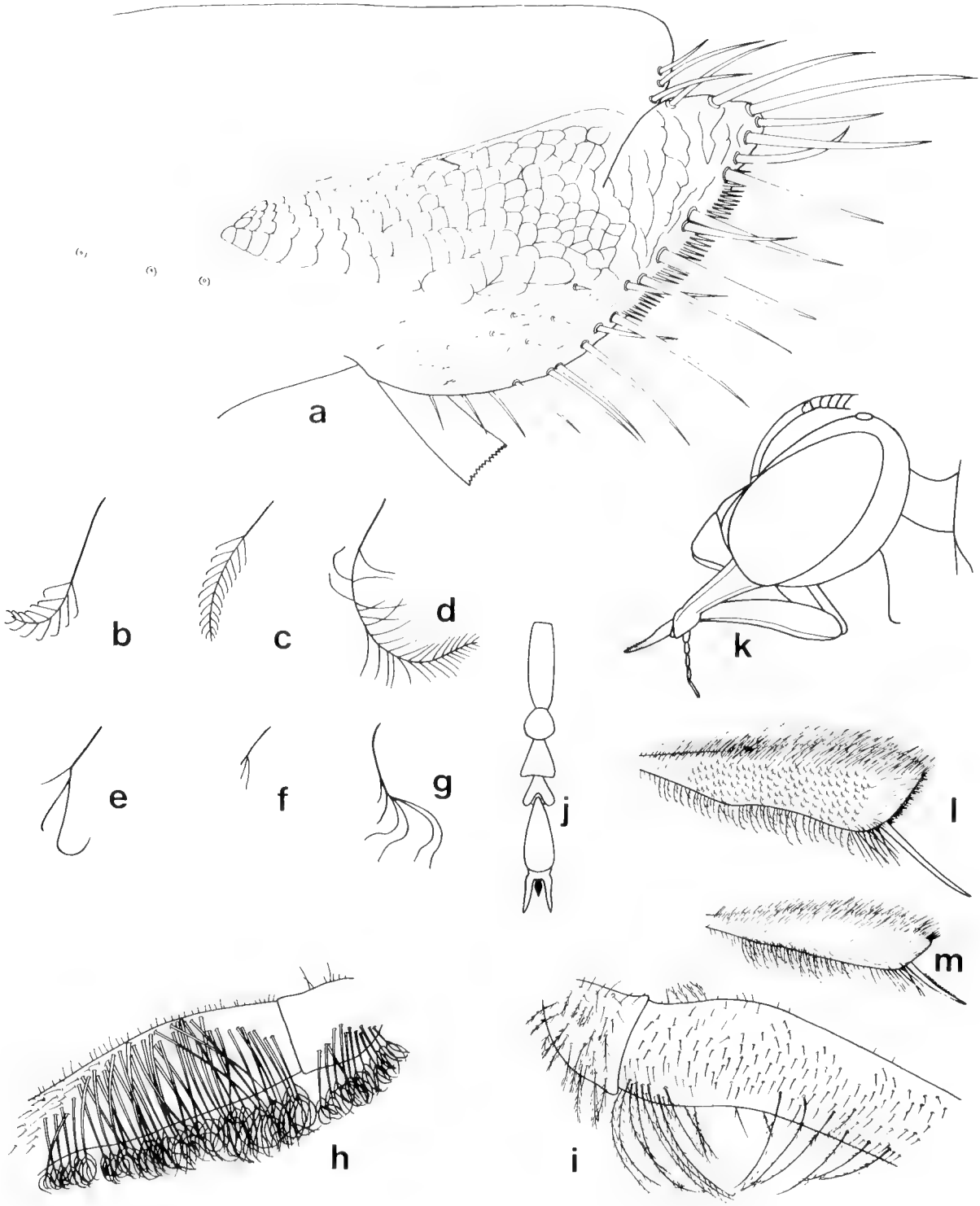


Figure 5. Diagrammatic views of: a, distal area of *Homalictus* sp. galea. b, c, d, sternal, femoral, tergal hairs of *Homalictus* spp.; e, f, g, same of *Lasioglossum* spp.; h, i, hind trochanter and femur showing position of scopal hair in *Lasioglossum* and *Homalictus*; j, fore tarsal segments of male *H. grossopedalus* (hair removed); k, head of female *H. exophthalmus* in side view.

Outer surface of female hind tibia: l, *H. caloundrensis*; m, *H. (Quasilictus) brevicornutus*.

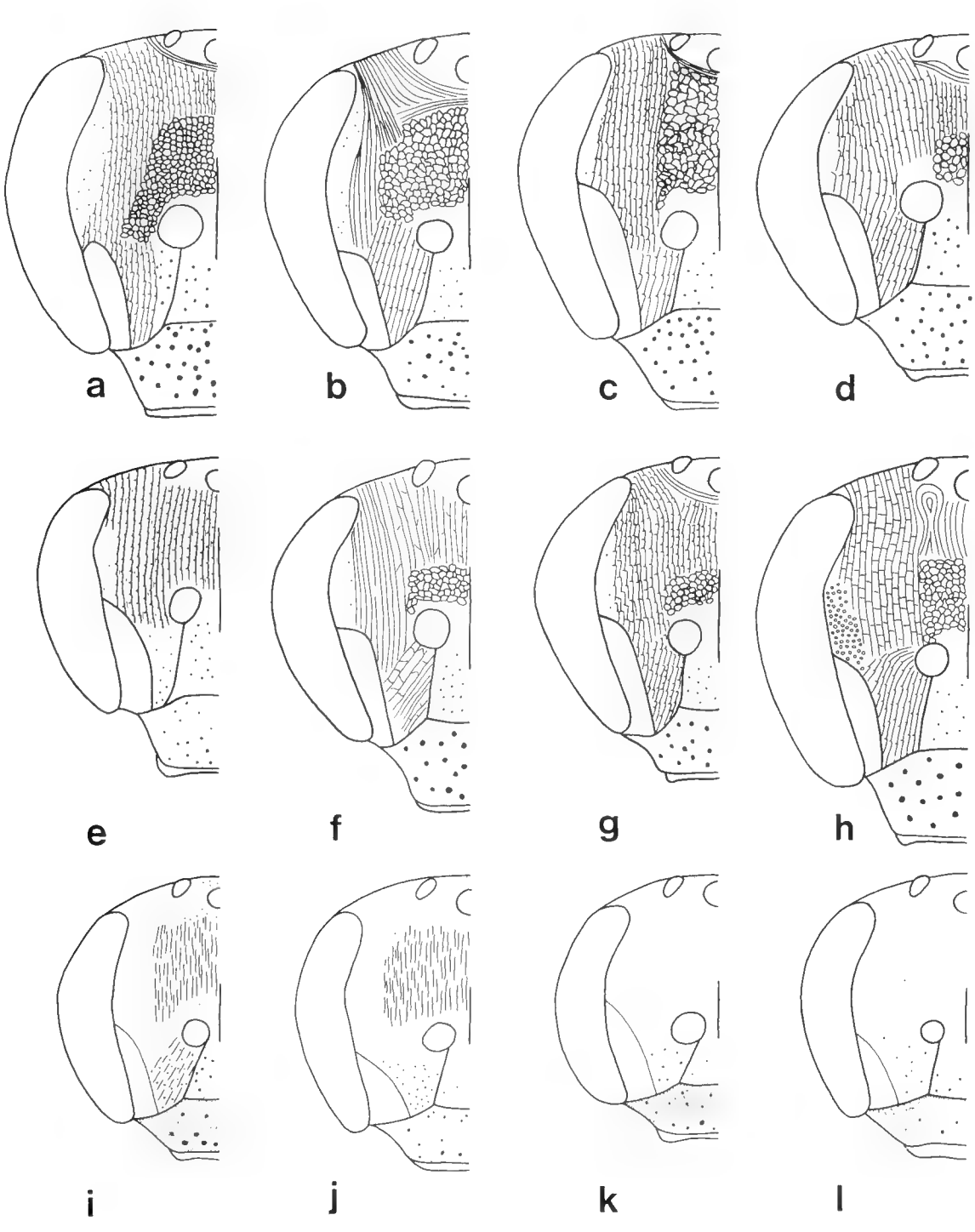


Figure 6. Sculpture on right half of female head (hair removed) of *H. (Homalictus)* spp. (Fine stippling represents reticulate sculpture, heavy spotting as punctures, paraocular area defined by solid line.) a, *H. thor*; b, *H. behri*; c, *H. woodsi*; d, *H. flindersi*; e, *H. callaspis*; f, *H. caloundrensis*; g, *H. exleyae*; h, *H. luteoaeneus*; i, *H. tatei*; j, *H. brisbanensis*; k, *H. sphecodopsis*; l, *H. dotatus*. Scale line equals 0.5 mm.

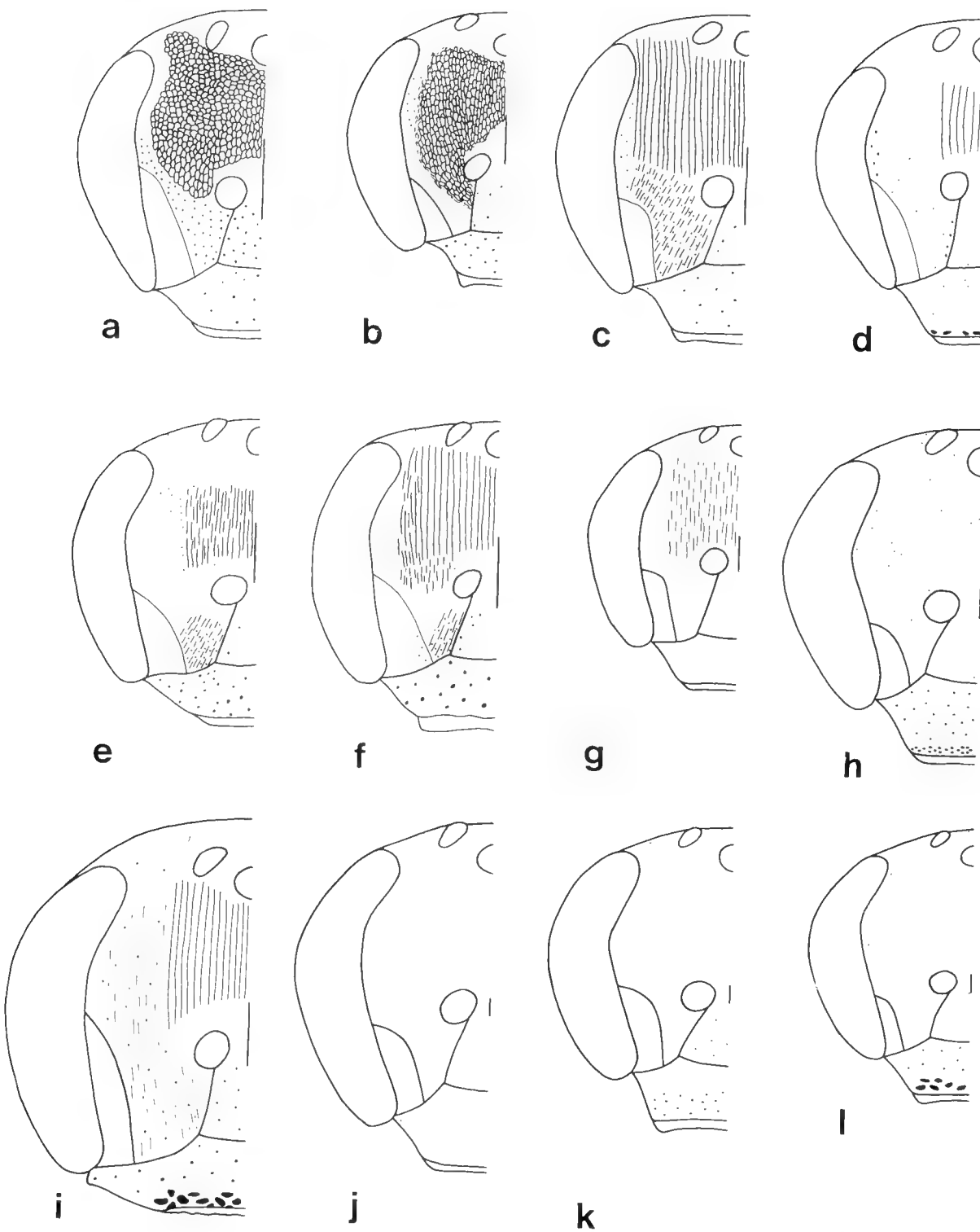


Figure 7. Sculpture on right half of female head (hair removed) of *H. (Homalictus)* spp. (Fine stippling represents reticulate sculpture, heavy spotting as punctures, paraocular area defined by solid line) a, *H. sphecodoides*; b, *H. houstoni*; c, *H. scrupulosus*; d, *H. niveifrons*; e, *H. megastigmus*; f, *H. punctatus*; g, *H. pectinalus*; h, *H. blackburni*; i, *H. ctenander*; j, *H. maitlandi*; k, *H. dampieri*; l, *H. eurhodopus*. Scale line equals 0.5 mm.

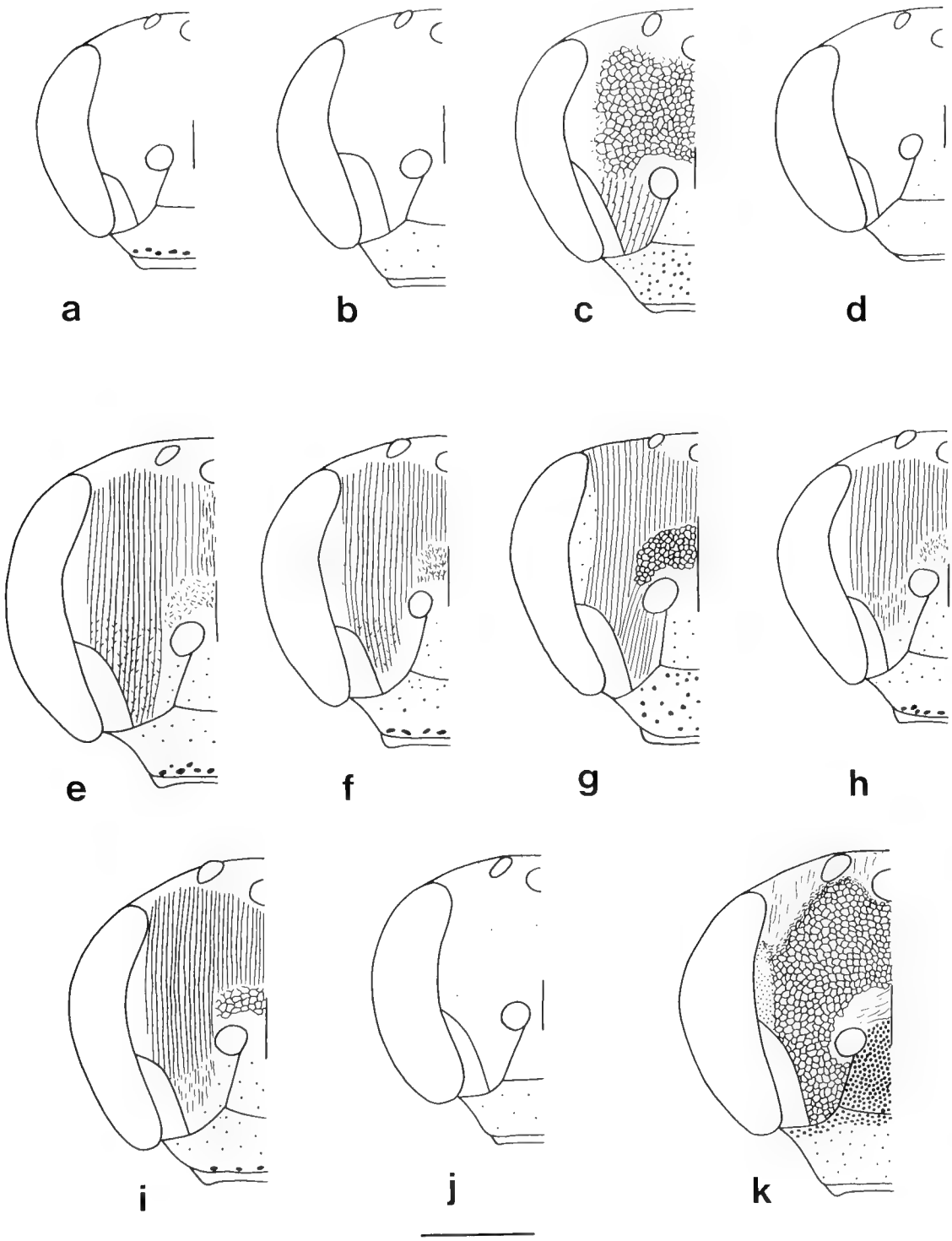


Figure 8. Sculpture on right half of female head (hair removed) of *H. (Homalictus)* spp. (Fine stippling represents reticulate sculpture, heavy spotting as punctures, paraocular area defined by solid line) a, *H. cassiaefloris*; b, *H. atrus*; c, *H. urbanus*; d, *H. exophthalmus*; e, *H. bremerensis*; f, *H. stradbrokensis*; g, *H. multicavus*; h, *H. murrayi*; i, *H. holochlorus*; j, *H. rowlandi*; k, *H. brevicornutus*. Scale line equals 0.5 mm.

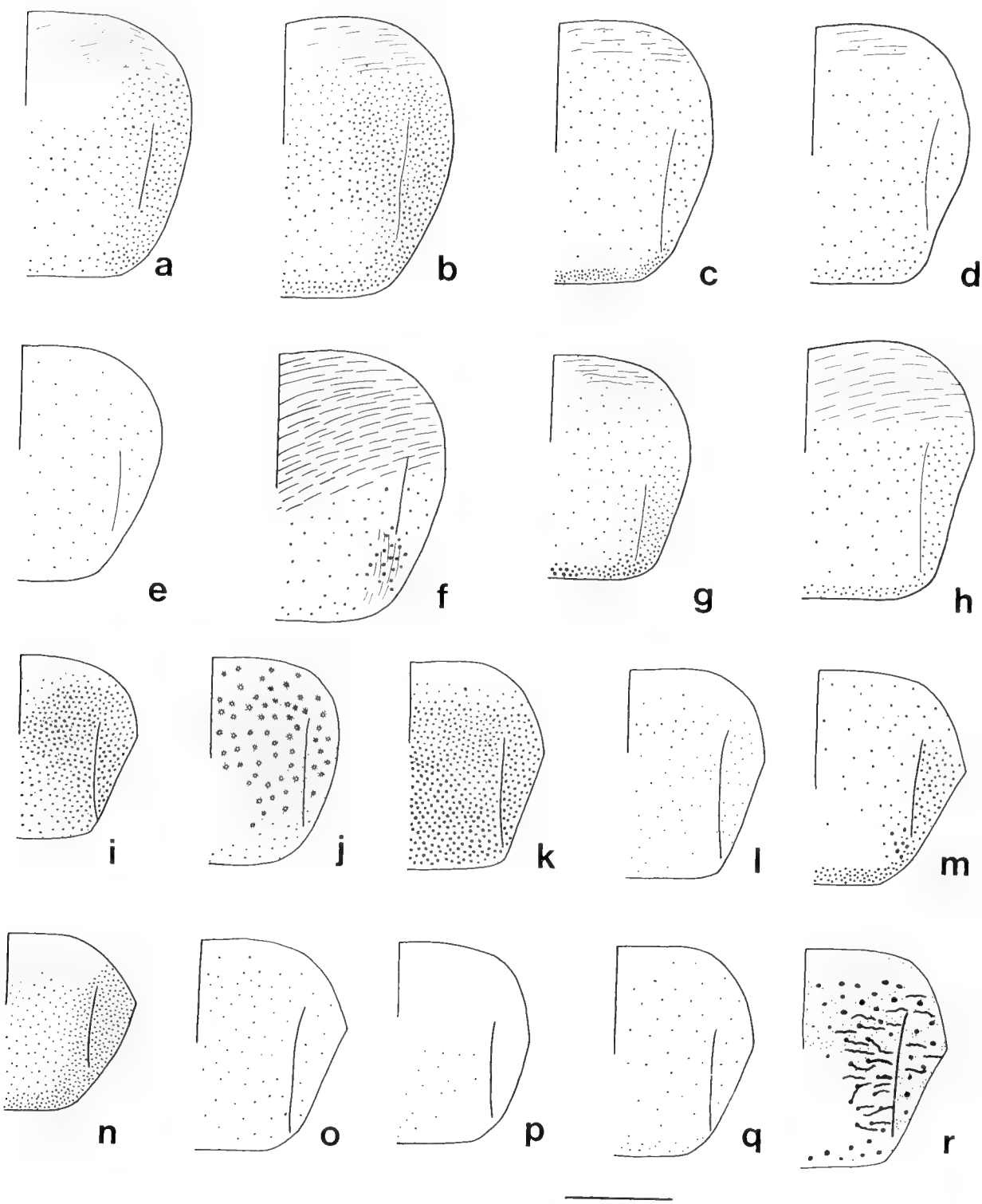


Figure 9. Sculpture on right half of female scutum (hair removed) of *H. (Homalictus)* spp. (Stippling indicates reticulate pattern) a, *H. behri*; b, *H. thor*; c, *H. woodsi*; d, *H. flindersi*; e, *H. callaspis*; f, *H. caloundrensis*; g, *H. exleyae*; h, *H. luteoaeneus*; i, *H. tatei*; j, *H. brisbanensis*; k, *H. sphecodopsis*; l, *H. dotatus*; m, *H. sphecodoides*; n, *H. houstoni*; o, *H. scrupulosus*; p, *H. niveifrons*; q, *H. megastigmus*; r, *H. punctatus*. Scale line equals 0.5 mm.

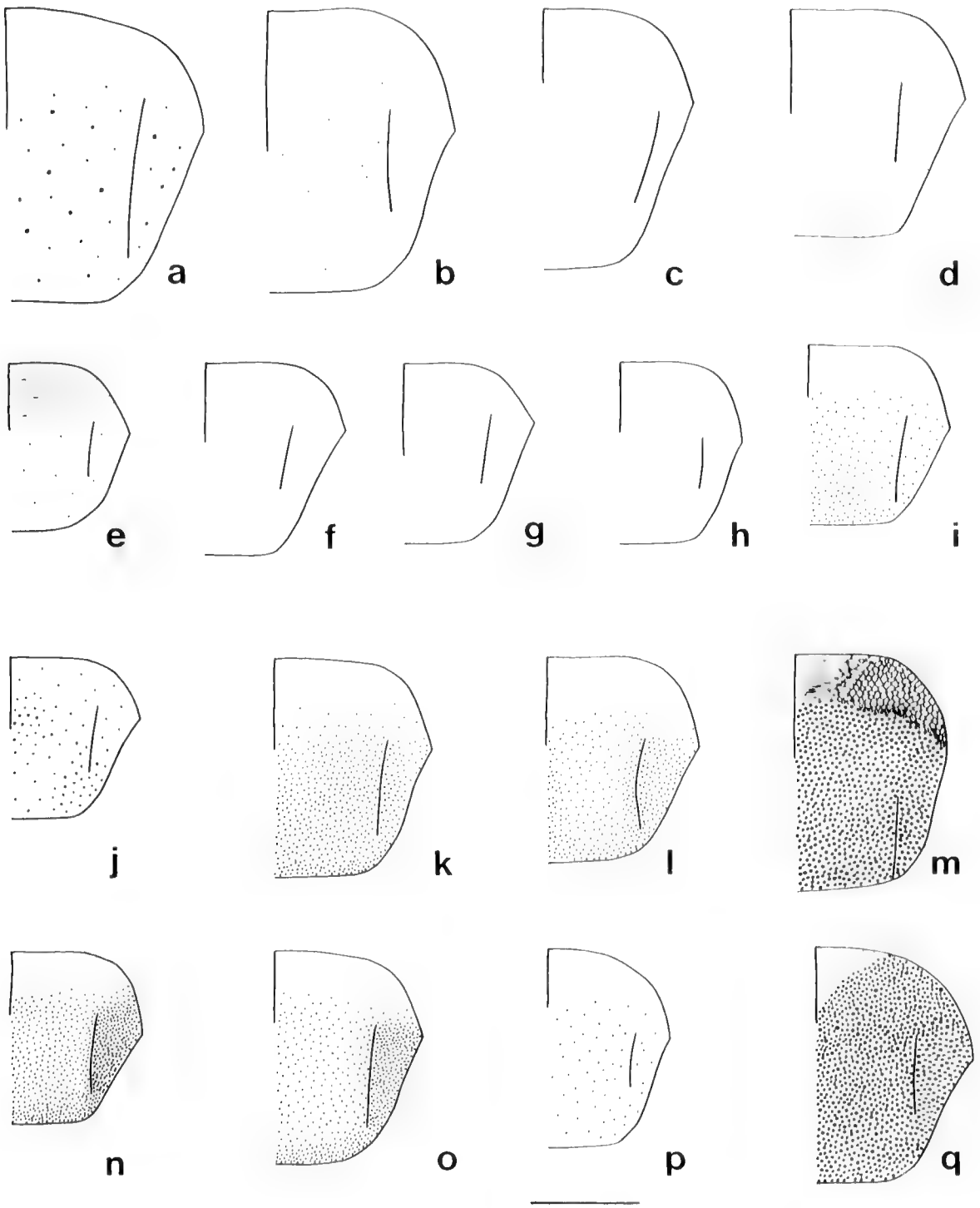


Figure 10. Sculpture on right half of female scutum (hair removed) of *H. (Homalictus)* spp. (Stippling indicates reticulate pattern) a, *H. ctenander*; b, *H. blackburni*; c, *H. maitlandi*; d, *H. dampieri*; e, *H. pectinalus*; f, *H. eurhodopus*; g, *H. cassiaefloris*; h, *H. atrus*; i, *H. urbanus*; j, *H. exophthalmus*; k, *H. bremerensis*; l, *H. stradbrokensis*; m, *H. multicavus*; n, *H. murrayi*; o, *H. holochlorus*; p, *H. rowlandi*; q, *H. brevicornutus*. Scale line equals 0.5 mm.

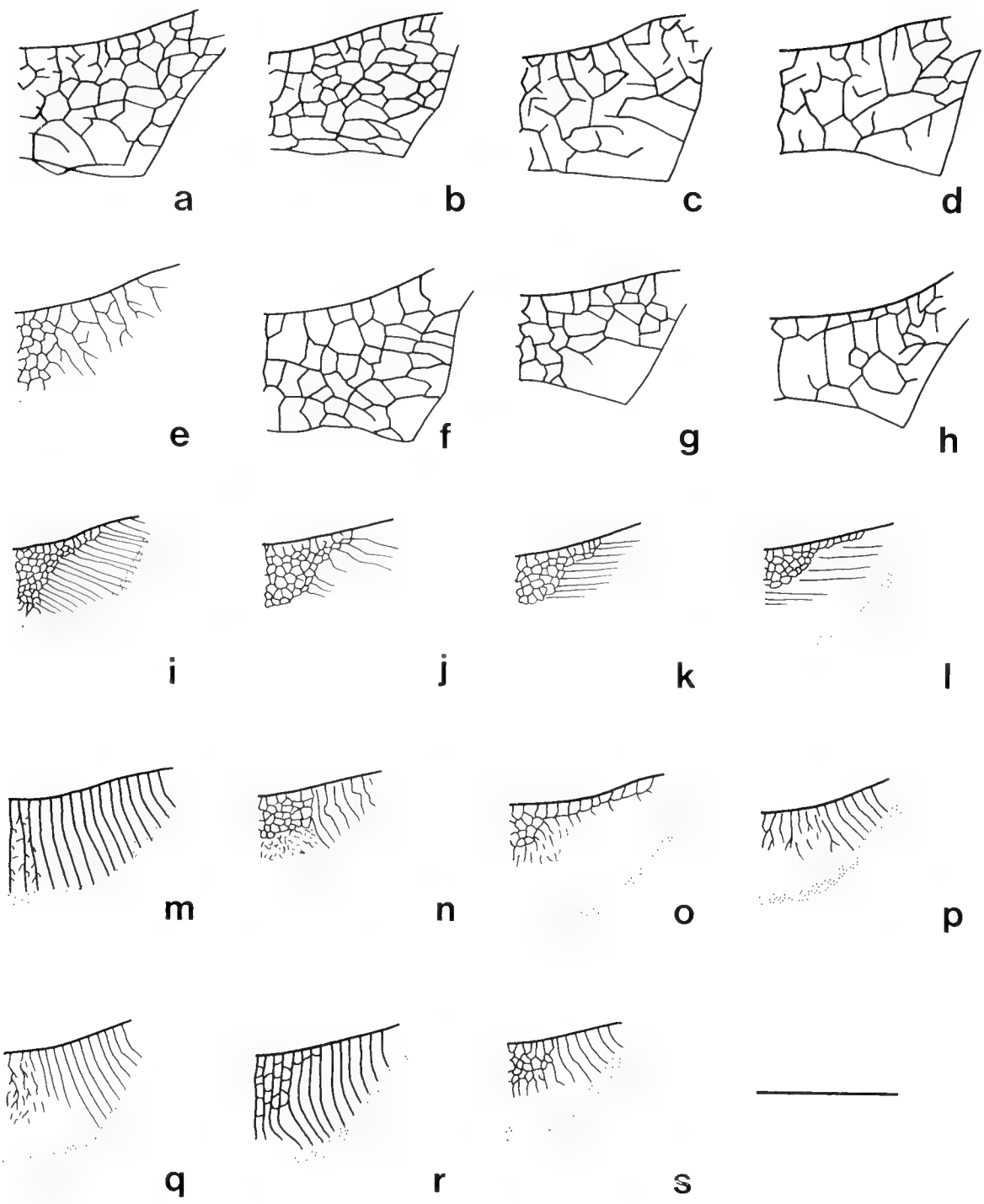


Figure 11. Sculpturing on right half of female dorsal surface of propodeum (hair removed) of *H. (Homalictus)* spp. a, *H. thor*; b, *H. behri*; c, *H. woodsi*; d, *H. flindersi*; e, *H. callaspis*; f, *H. caloundrensis*; g, *H. exleyae*; h, *H. luteoaeneus*; i, *H. tatei*; j, *H. brisbanensis*; k, *H. sphecodopsis*; l, *H. dotatus*; m, *H. sphecodoides*; n, *H. houstoni*; o, *H. scrupulosus*; p, *H. niveifrons*; q, *H. megastigmus*; r, *H. punctatus*; s, *H. pectinalus*. Scale line equals 0.5 mm.

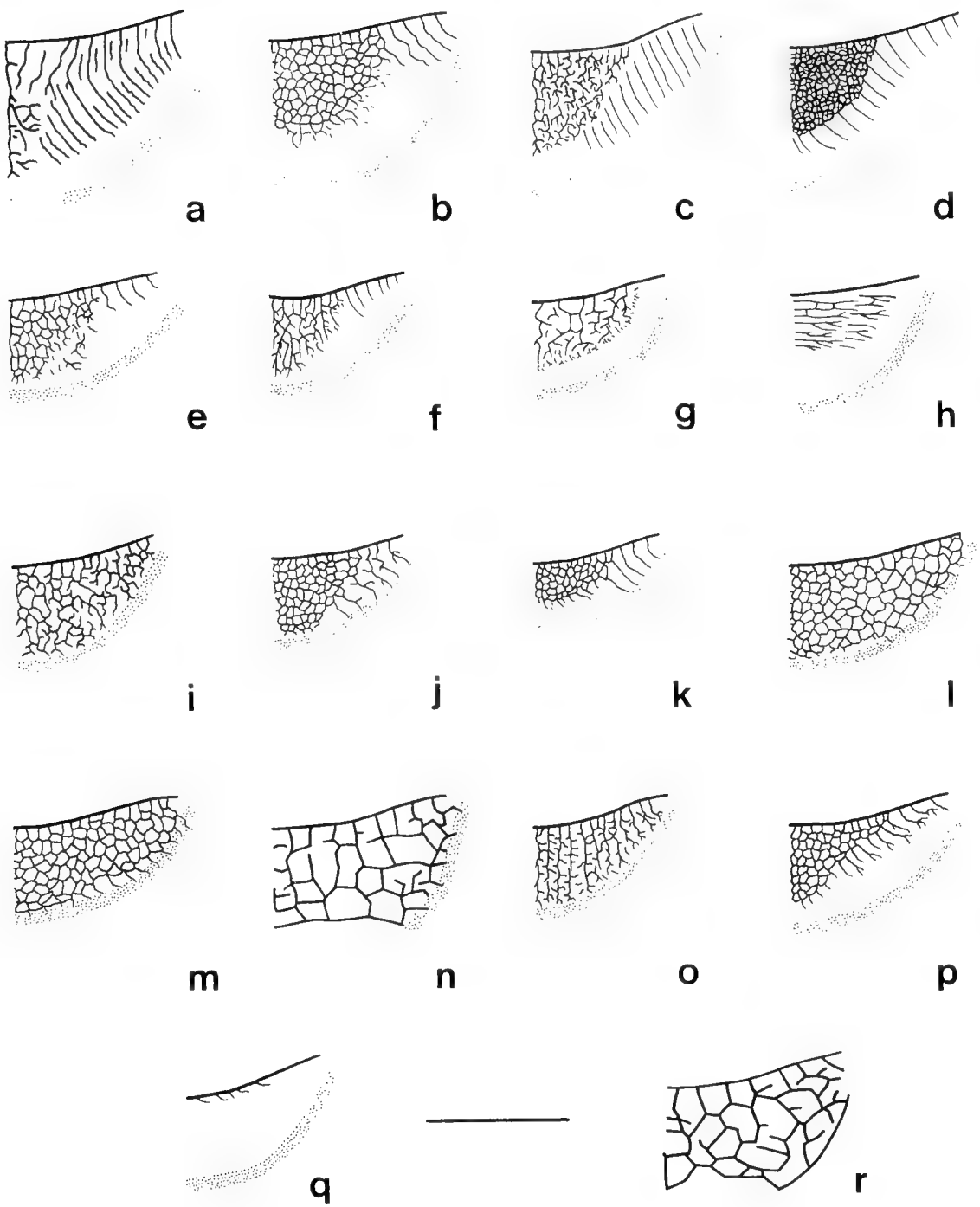


Figure 12. Sculpturing on right half of female dorsal surface of propodeum (hair removed) of *H. (Homalictus)* spp. a, *H. ctenander*; b, *H. blackburni*; c, *H. maitlandi*; d, *H. dampieri*; e, *H. eurhodopus*; f, *H. cassiaefloris*; g, *H. latitarsis*; h, *H. grossopedalus*; i, *H. atrus*; j, *H. urbanus*; k, *H. exophthalmus*; l, *H. bremerensis*; m, *H. stradbrokensis*; n, *H. multicavus*; o, *H. murrayi*; p, *H. holochlorus*; q, *H. rowlandi*; r, *H. brevicornutus*. Scale line equals 0.5mm.

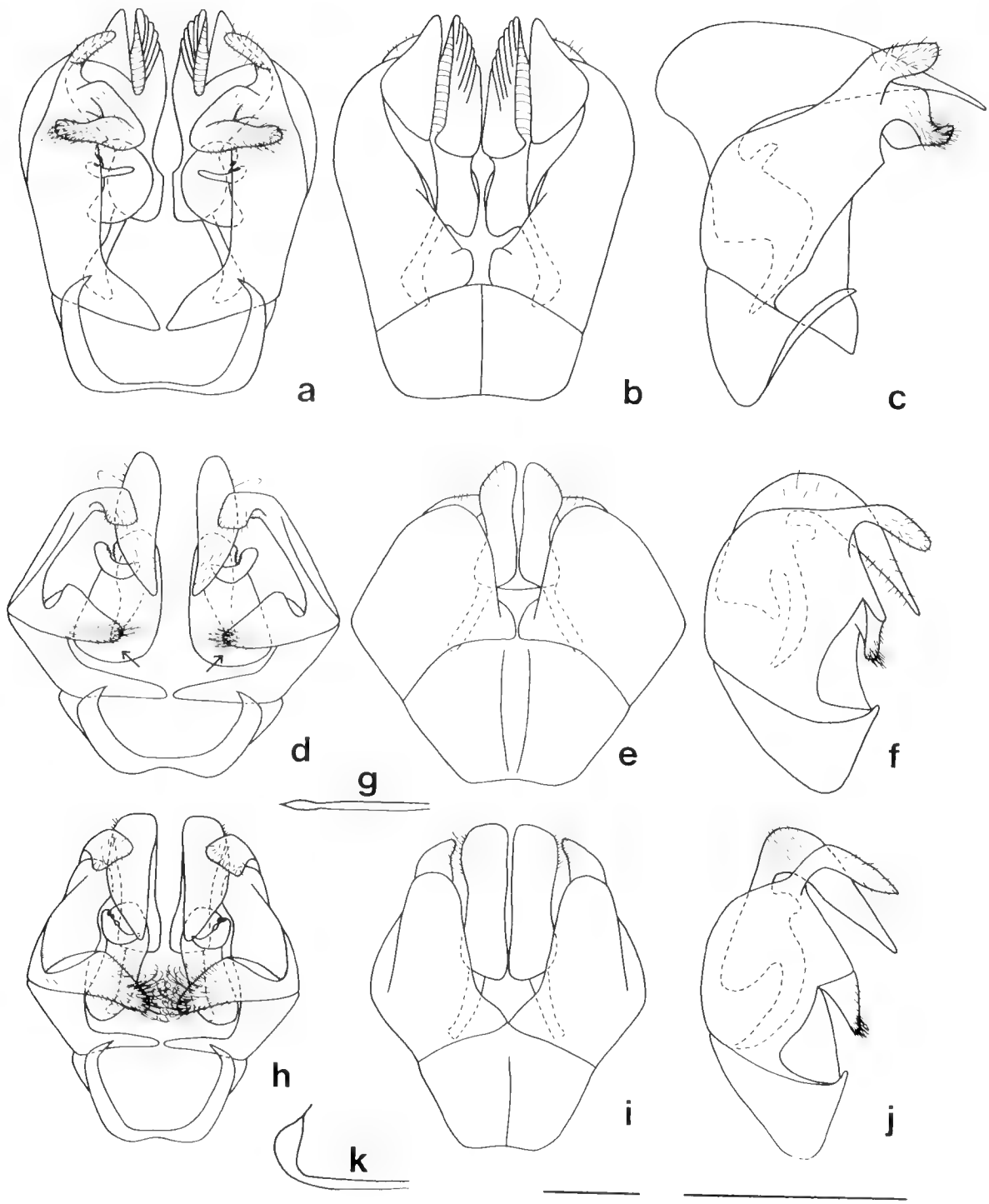


Figure 13. Ventral, dorsal and lateral views of male genitalia of *H. (Homalictus)* spp. plus enlargement of a hair from distal end of a gonocoxal arm (arrowed in d) (no enlargement for *H. behri*). a, b, c, *H. behri*; d, e, f, g, *H. woodsi*; h, i, j, k, *H. flindersi*. Small scale line equals 0.05 mm and refers to Figs. g and k only. Large scale line equals 0.5 mm and refers to remainder.

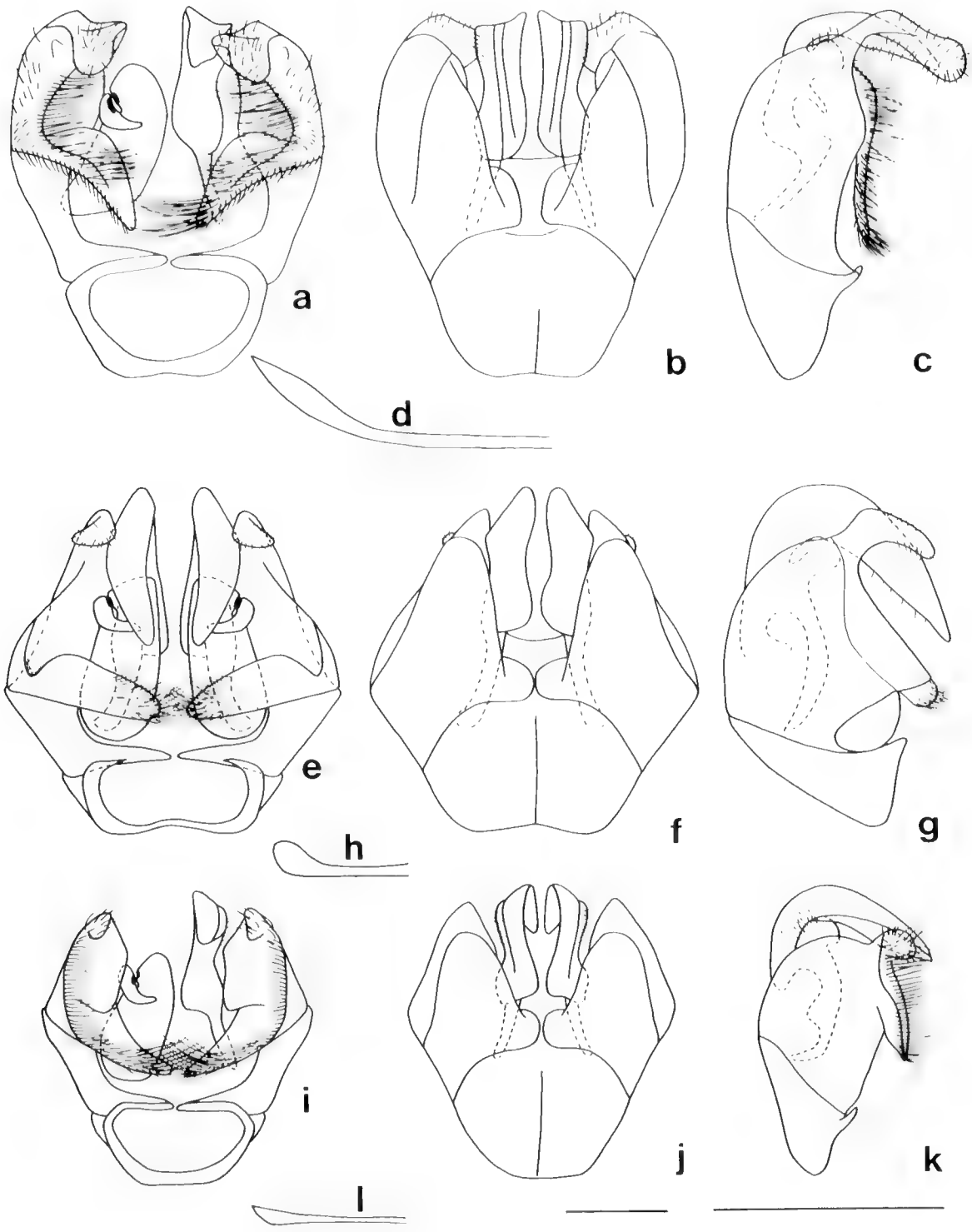


Figure 14. Ventral, dorsal and lateral views of male genitalia of *H. (Homalictus)* spp. plus enlargement of a hair from distal end of a gonocoxal arm. a, b, c, d, *H. callaspis*; e, f, g, h, *H. caloundrensis*; i, j, k, l, *H. exleyae*. Small scale line equals 0.05 mm and refers to Figs.d, h and l only. Large scale line equals 0.5 mm and refers to remainder.

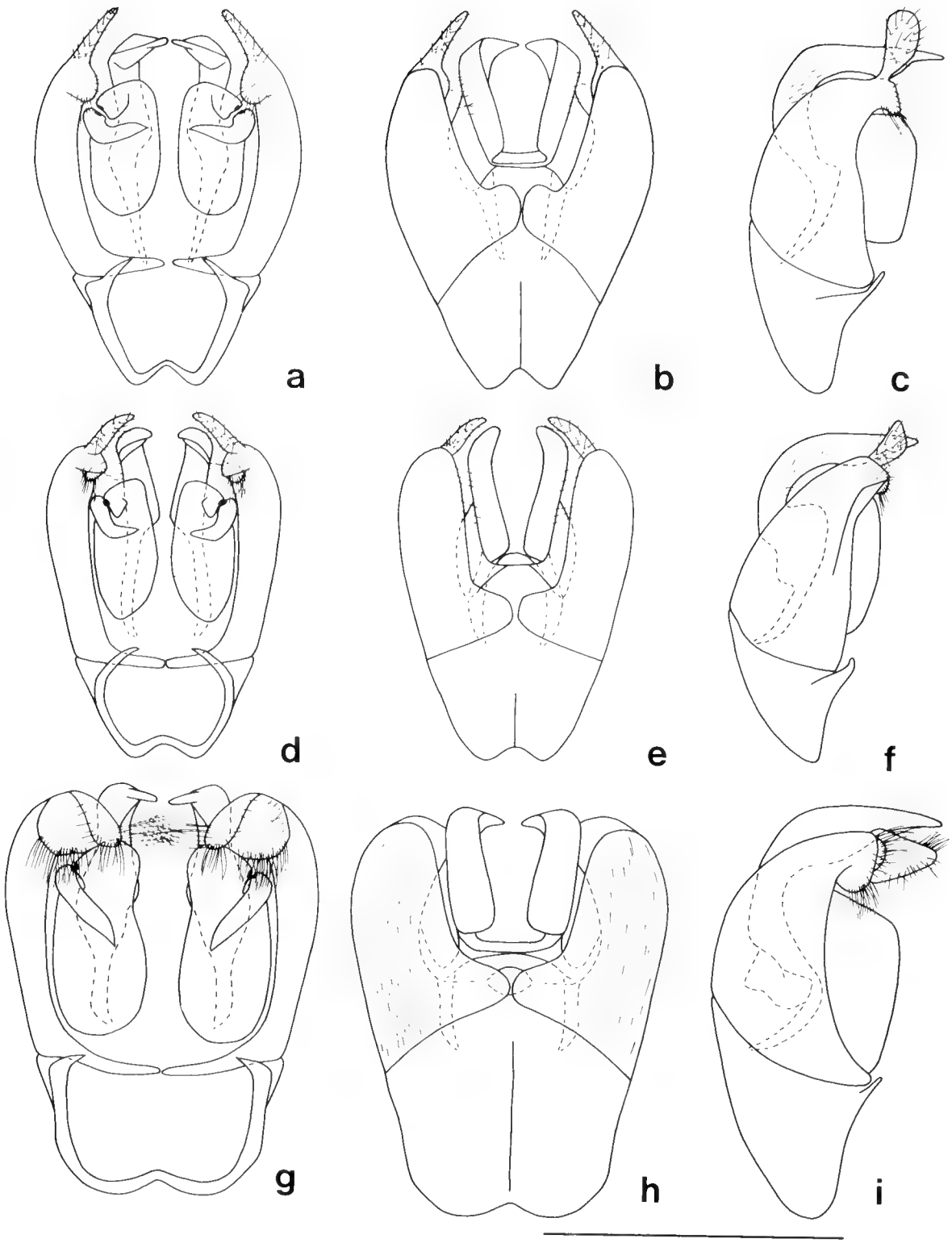


Figure 15. Ventral, dorsal and lateral views of male genitalia of *H. (Homalictus)* spp. a, b, c, *H. sphecodopsis*; d, e, f, *H. dotatus*; g, h, i, *H. imitatus*. Scale line equals 0.5 mm.

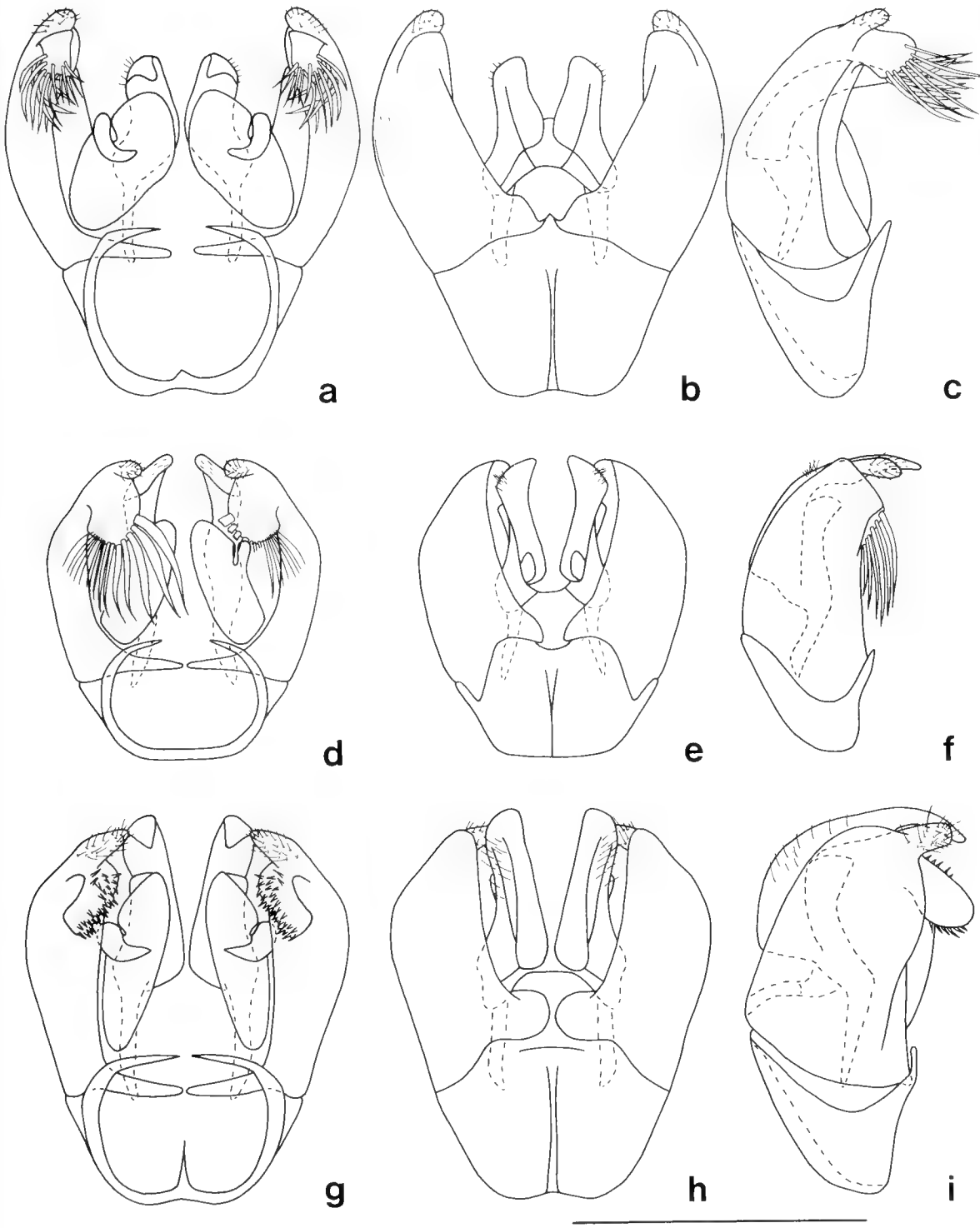


Figure 16. Ventral, dorsal and lateral views of male genitalia of *H. (Homalictus)* spp. a, b, c, *H. sphecodoides*; d, e, f, *H. houstoni*; g,h, i, *H. scrupulosus*. Scale line equals 0.5 mm.

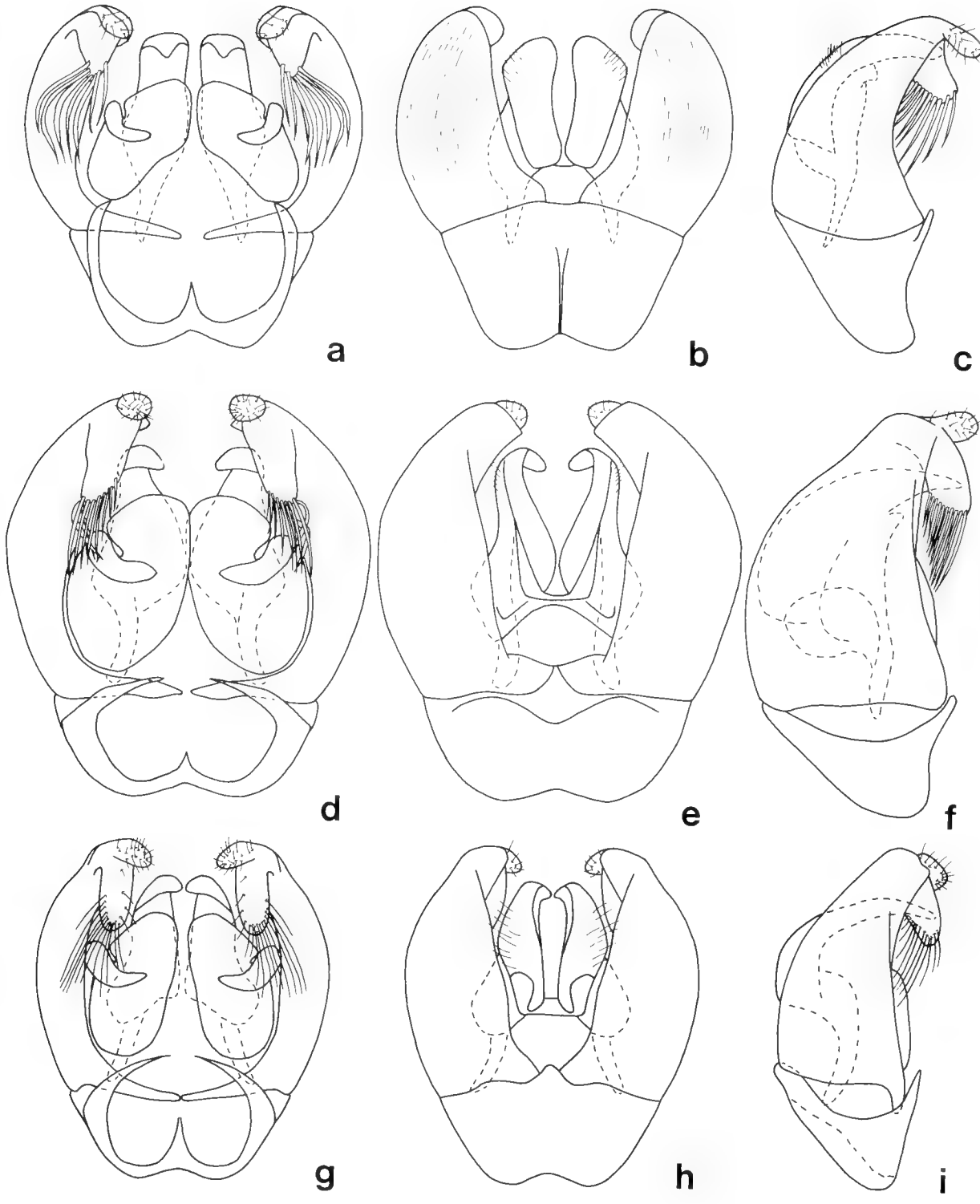


Figure 17. Ventral, dorsal and lateral views of male genitalia of *H. (Homalictus)* spp. a, b, c, *H. niveifrons*; d, e, f, *H. megastigmus*; g, h, i, *H. punctatus*. Scale line equals 0.5 mm.

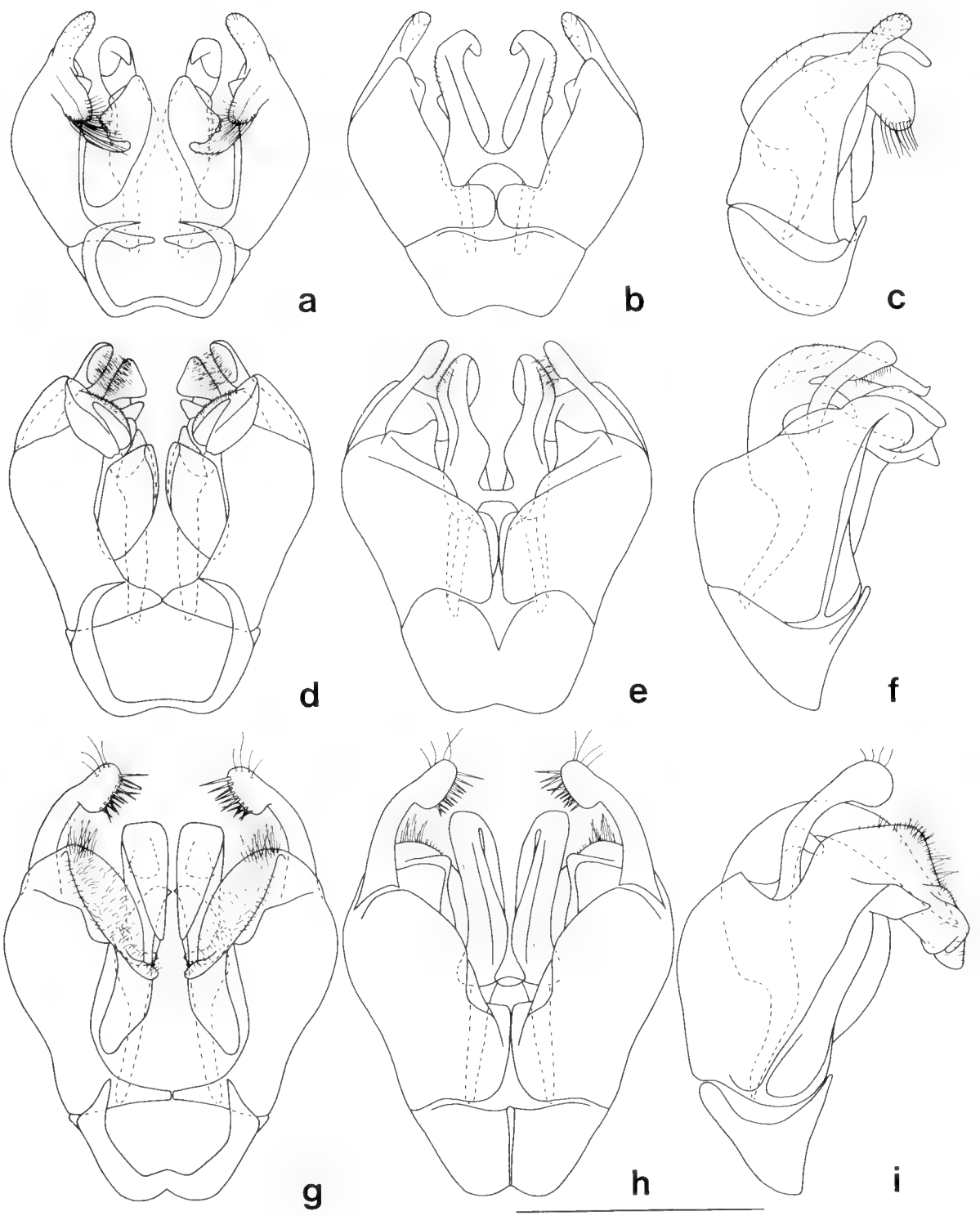


Figure 18. Ventral, dorsal and lateral views of male genitalia of *H. (Homalictus)* spp. a, b, c, *H. ctenander*; d, e, f, *H. blackburni*; g, h, i, *H. dampieri*. Scale line equals 0.5 mm.

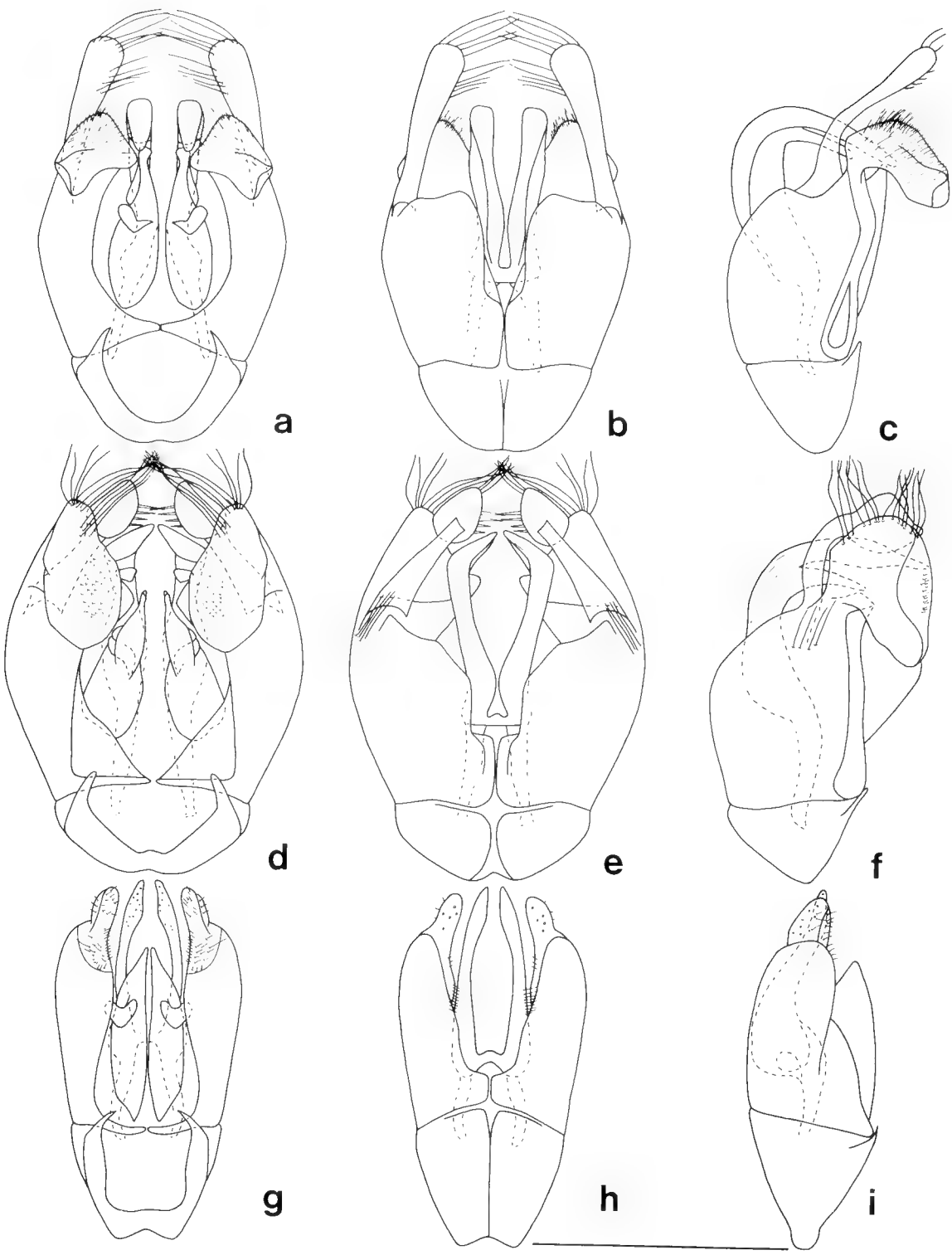


Figure 19. Ventral, dorsal and lateral views of male genitalia of *H. (Homalictus)* spp. a, b, c, *H. eurhodopus*; d, e, f, *H. cassiaefloris*; g, h, i, *H. urbanus*. Scale line equals 0.5 mm.

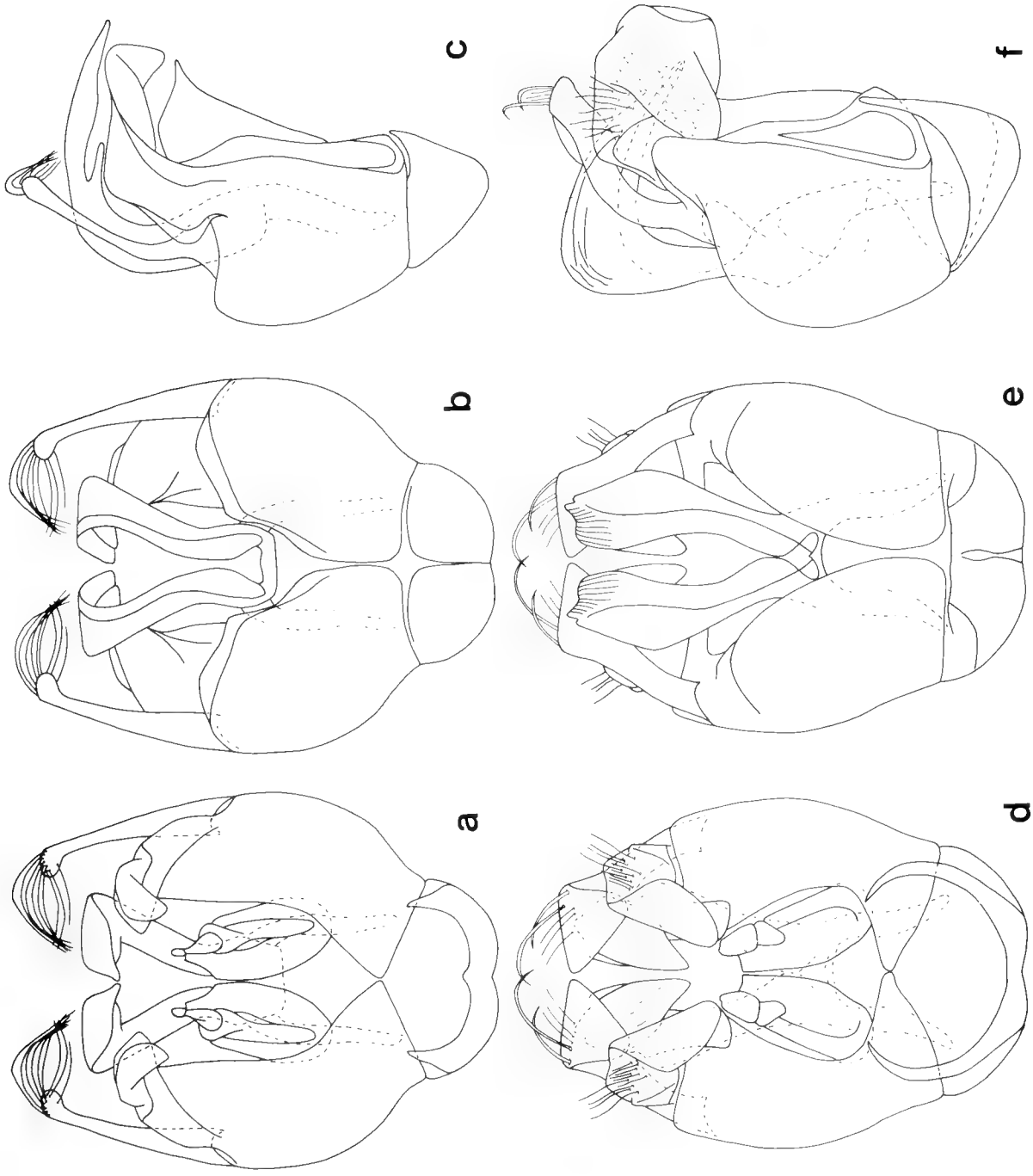


Figure 20. Ventral, dorsal and lateral views of male genitalia of *H. (Homalictus)* spp. a, b, c, *H. latitarsis*; d, e, f, *H. grossopedalus*. Scale line equals 0.5 mm.

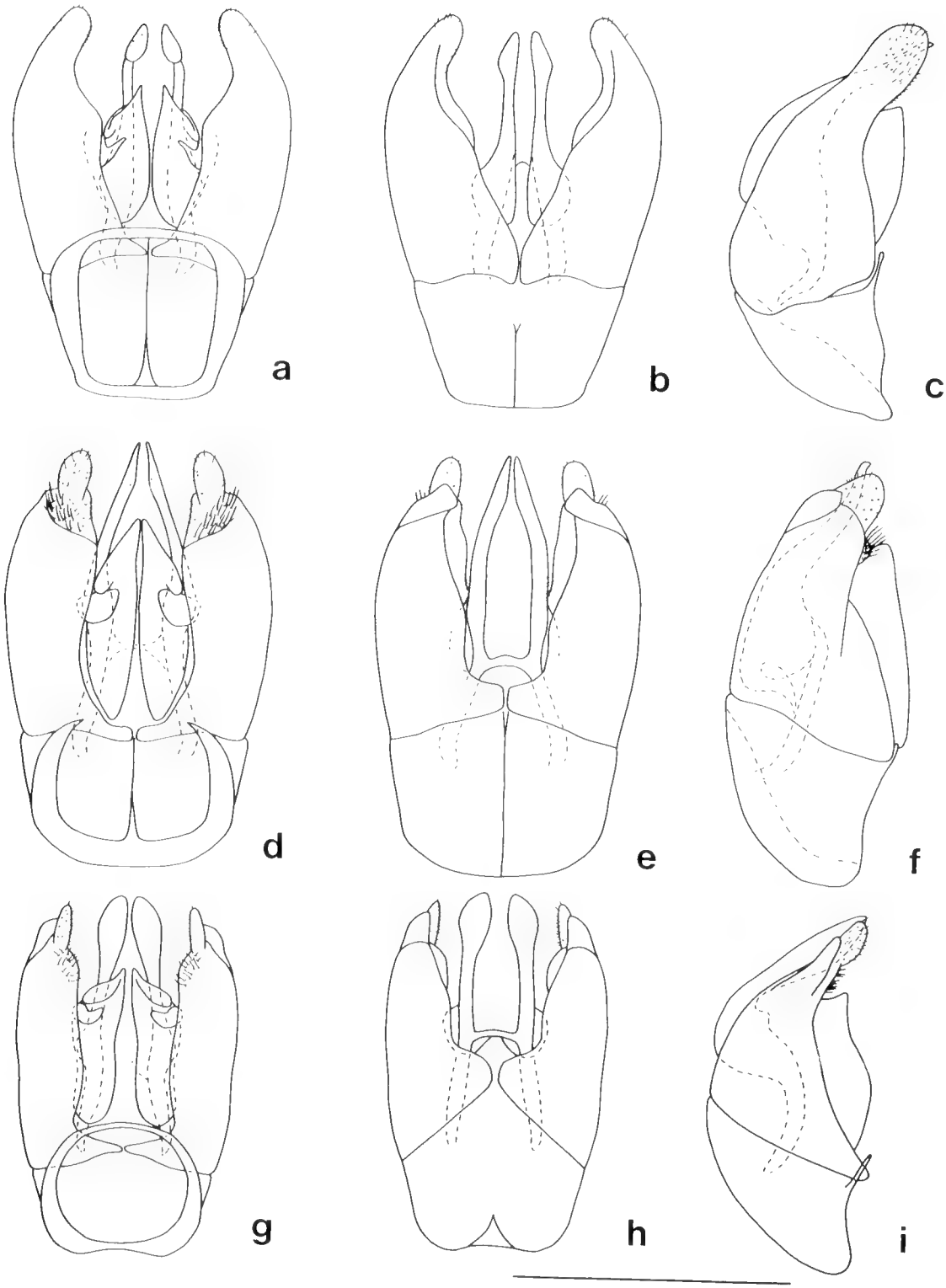


Figure 21. Ventral, dorsal and lateral views of male genitalia of *H. (Homalictus)* spp. a, b, c, *H. exophthalmus*; d, e, f, *H. forrestae*; g, h, i, *H. bremerensis*. Scale line equals 0.5 mm.

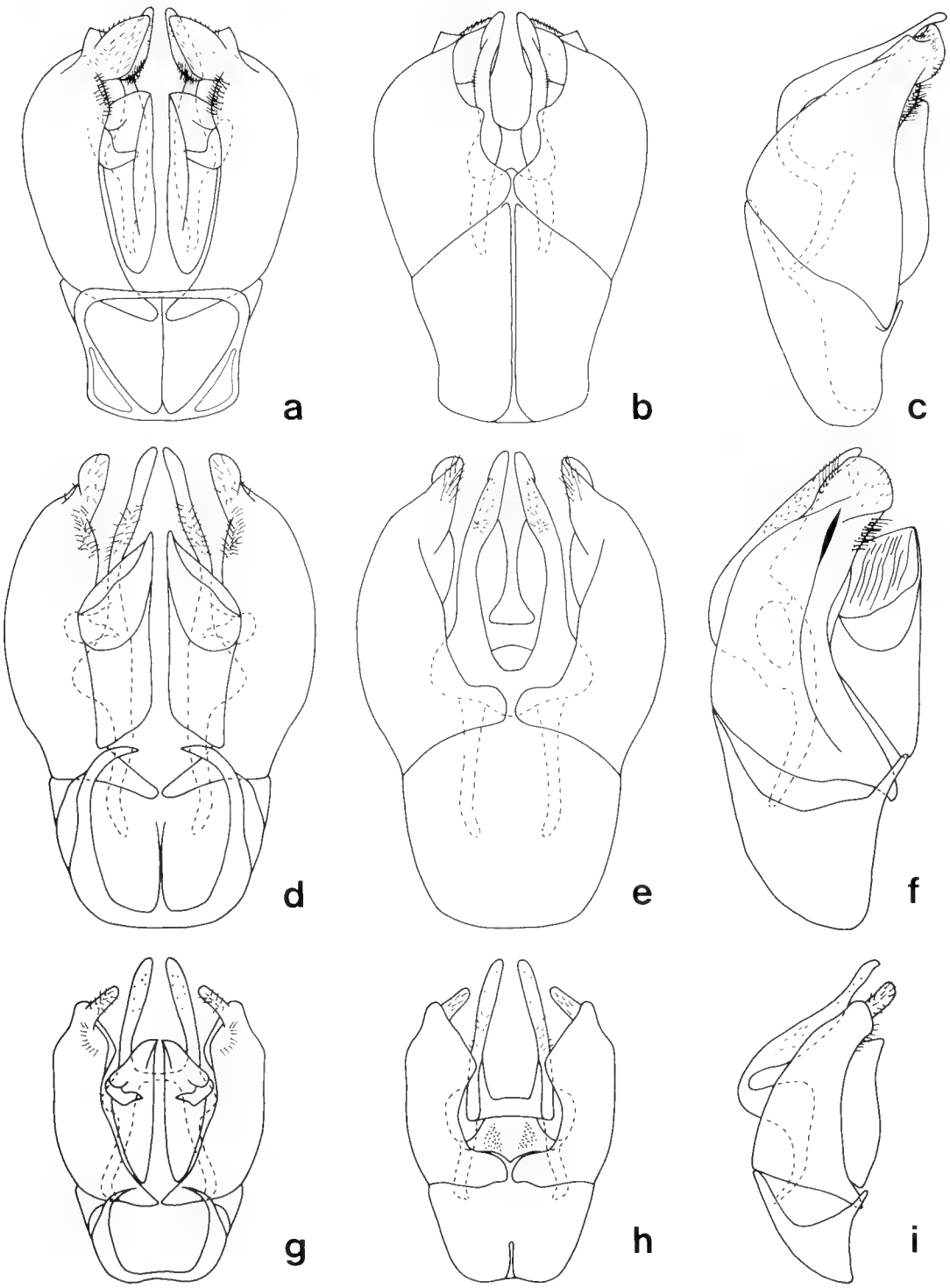


Figure 22. Ventral, dorsal and lateral views of male genitalia of *H. (Homalictus)* spp. a, b, c, *H. stradbrokensis*; d, e, f, *H. multicavus*; g, h, i, *H. murrayi*. Scale line equals 0.5 mm.

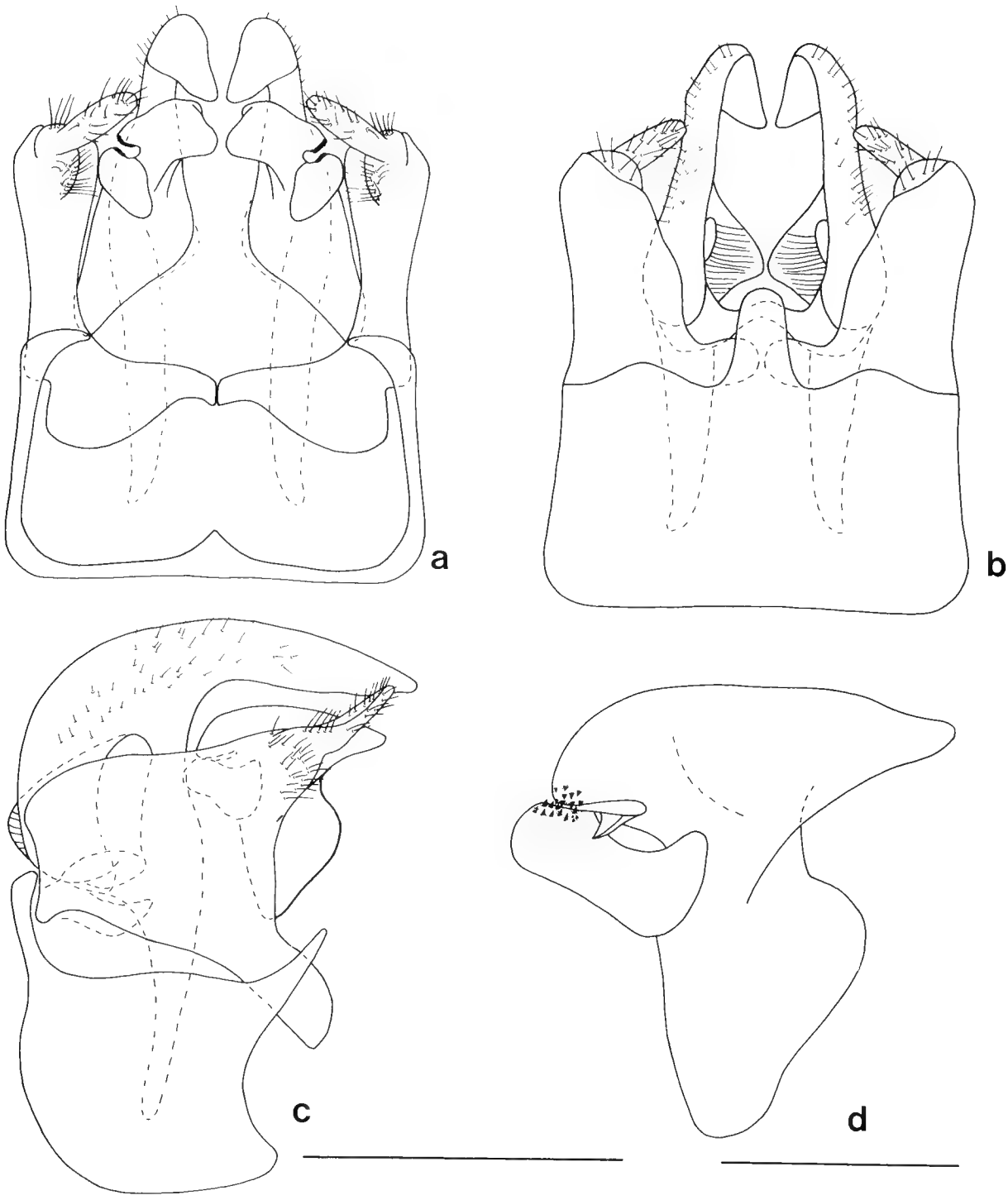


Figure 23. a, b, c, ventral, dorsal and lateral views of male genitalia of *H. (Quasilictus) brevicornutus*. Scale line left equals 0.5 mm. d, lateral view of right volsella. Scale line right equals 0.2 mm.

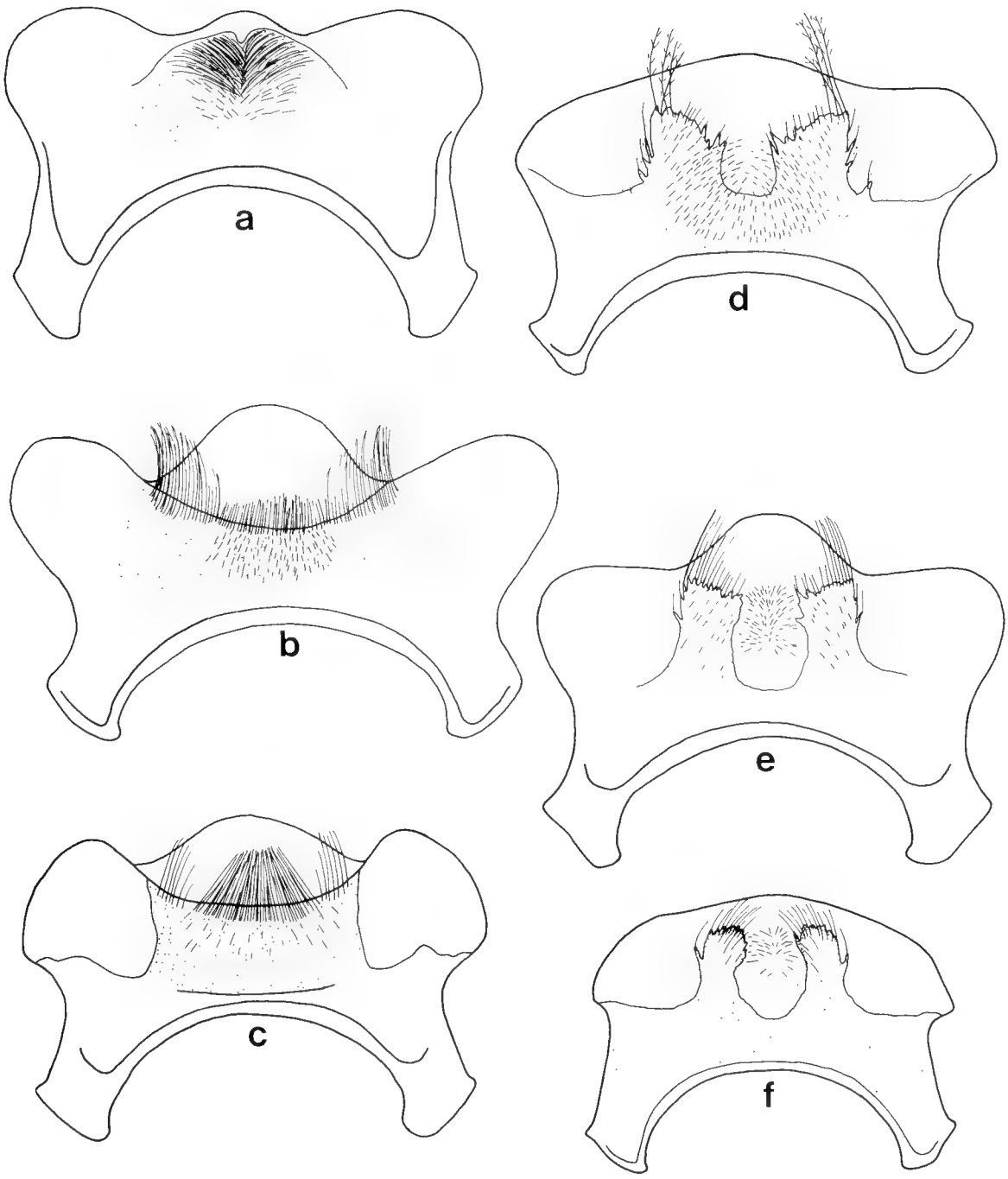


Figure 24. Ventral views of male gastral sternum VI of *H. (Homalictus)* spp. (Stippling indicates areas of dark pigmentation). a, *H. behri*; b, *H. woodsi*; c, *H. caloundrensis*; d, *H. callaspis*; e, *H. flindersi*; f, *H. exleyae*. Scale line equals 0.5 mm.

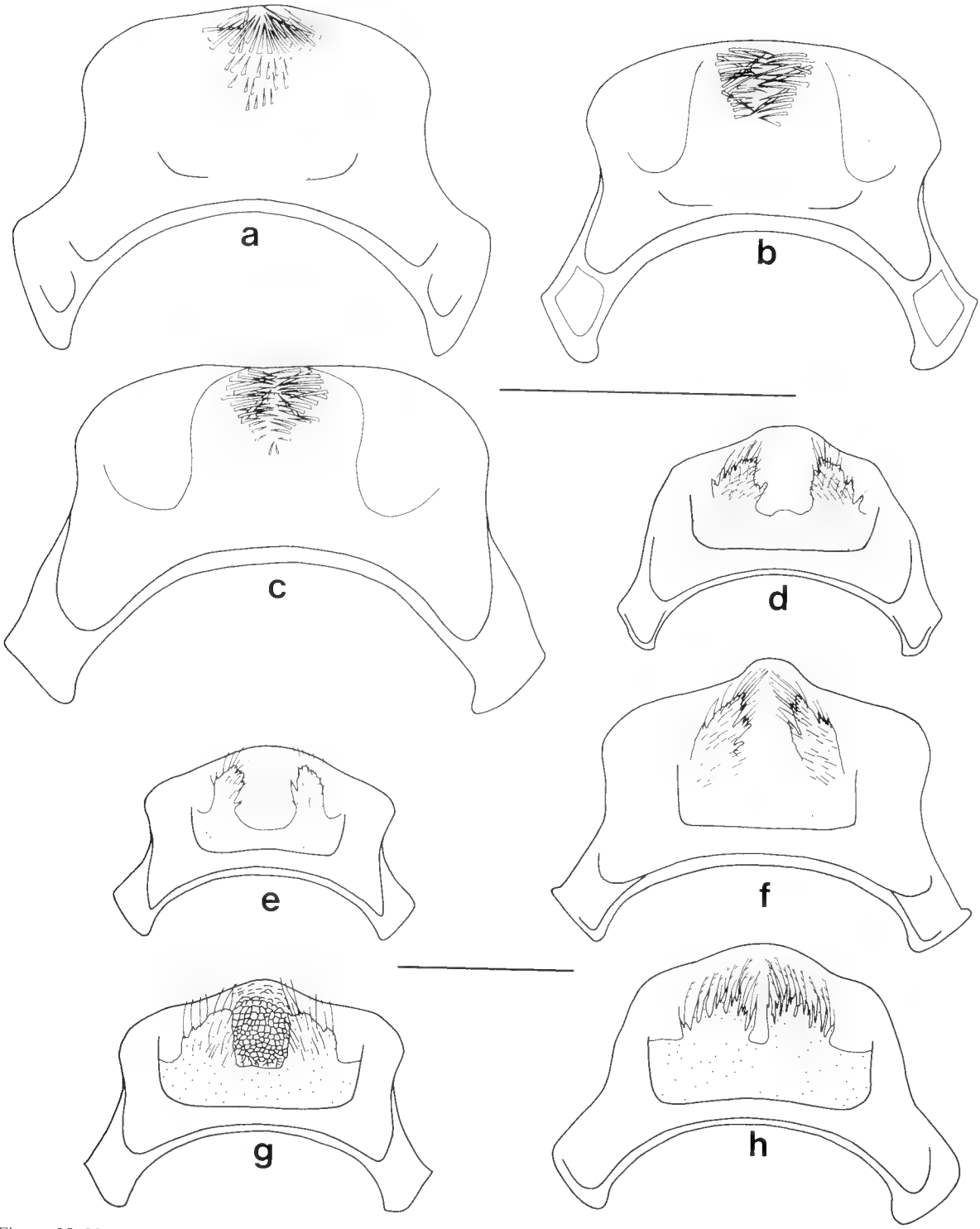


Figure 25. Ventral views of male gastral sternum VI of *H. (Homalictus)* spp. (Stippling indicates areas of dark pigmentation). a, *H. sphecodopsis*; b, *H. dotatus*; c, *H. imitatus*; d, *H. sphecodoides*; e, *H. houstoni*; f, *H. scrupulosus*; g, *H. niveifrons*; h, *H. megastigmus*. Both scale lines equal 0.5 mm; upper refers to Figs. a-c, lower refers to Figs. d-h.

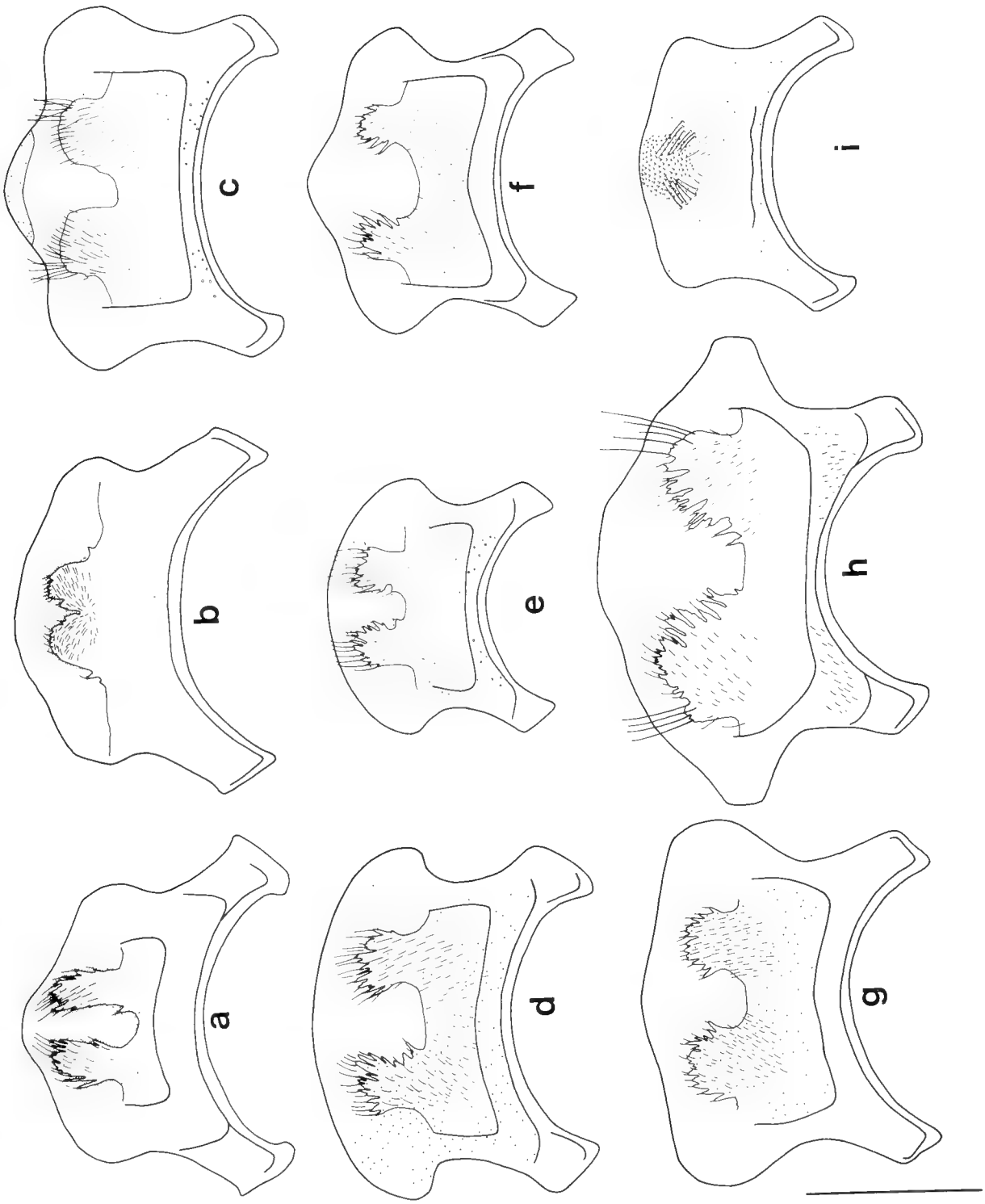


Figure 26. Ventral views of male gastral sternum VI of *H. (Homalictus)* spp. (Stippling indicates areas of dark pigmentation). a, *H. punctatus*; b, *H. ctenander*; c, *H. blackburni*; d, *H. dampieri*; e, *H. eurhodopus*; f, *H. cassiaefloris*; g, *H. latitarsis*; h, *H. grossopedalus*; i, *H. urbanus*. Scale line equals 0.5 mm.

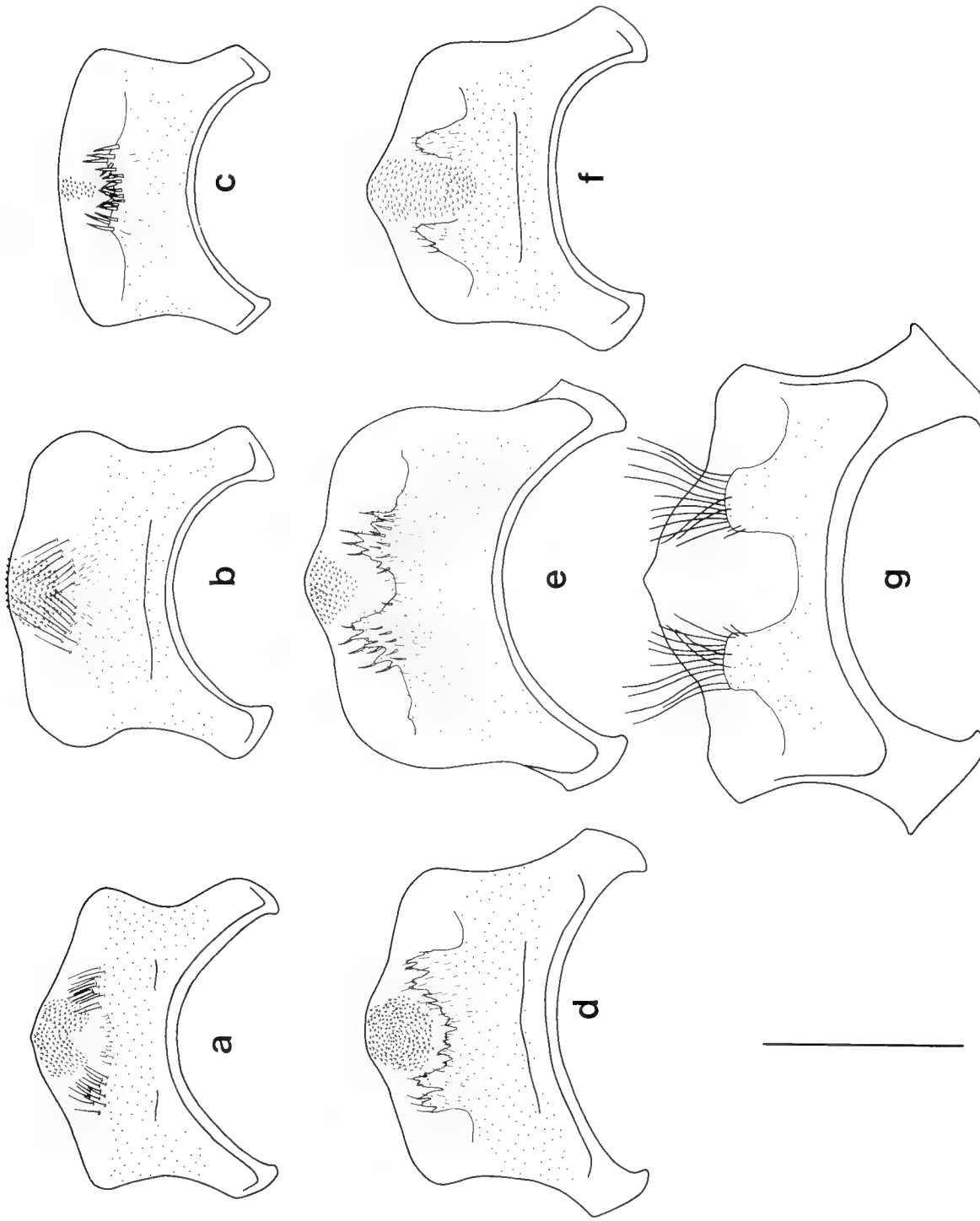


Figure 27. Ventral views of male gastral sternum VI of *H. (Homalictus)* spp. (Stippling indicates areas of dark pigmentation). a, *H. exophthalmus*; b, *H. forrestae*; c, *H. bremerensis*; d, *H. stradbrokensis*; e, *H. multicavus*; f, *H. murrayi*; g, *H. brevicornutus*. Scale line equals 0.5 mm.

Memoirs of the Museum of Victoria 47(2): 201-206 (1986) ISSN 0814-1827

A NEW GENUS AND SPECIES OF MORID FISH FROM SHALLOW COASTAL WATERS OF SOUTHERN AUSTRALIA

By C. D. Paulin

National Museum of New Zealand, Private Bag, Wellington, New Zealand

Abstract

Paulin, C. D., 1986. A new genus and species of morid fish from shallow coastal waters of southern Australia. *Mem. Mus. Vict.* 47: 201-206.

Eeyorius hutchinsi , a new monotypic genus and species is described from specimens collected in shallow coastal waters of Tasmania, Victoria and Western Australia. Affinities lie with *Pseudophycis* and *Lotella* but *Eeyorius* differs from those genera in dentition and otolith shape.

Introduction

The family Moridae is represented in shallow coastal waters of Australia by *Pseudophycis* Günther and *Lotella* Kaup (Paulin, 1983). Both genera are readily distinguished on the basis of otolith shape (Karrer, 1971; Fitch and Barker, 1972) and dentition. Otoliths of *Pseudophycis* can be distinguished from those of *Lotella* by the expanded rather than smooth dorsal margin; a crista superior as long as crista inferior rather than two-thirds length; ostium equal to rather than shorter than cauda; and a flat rather than recessed collum.

Pseudophycis has a band of brush-like teeth whereas *Lotella* has an outer row of large widely spaced teeth and an inner band of smaller teeth (Kaup, 1858; Günther, 1862; Cohen, 1979).

Specimens of Moridae with otoliths characteristic of *Lotella* but with a band of brush-like teeth were reported from Victoria, Australia, by Paulin (1983). These, and a number of additional specimens are here described as a new genus and species.

Methods

Methods of taking counts and measurements follow Paulin (1983). Counts of first dorsal fin rays include the minute rudimentary first ray. Osteological observations were made on a specimen cleared and stained by the trypsin-alizarin technique, and supplemented by radiographs of other specimens.

Specimens examined are deposited in the following institutions: Australian Museum, Sydney (AM); Western Australian Museum, Perth (WAM); Museum of Victoria, Melbourne (NMV); National Museum of New Zealand, Wellington (NMNZ).

Eeyorius gen. nov.

Lotella.–Paulin, 1983: 82 (not *Lotella* Kaup).

Material examined. Pseudophycis bachus, 6 specimens + 4 pairs otoliths, NMNZ P.7730; *P. barbatus* 10 specimens + 2 pairs otoliths, NMNZ P.6783, P.7707; *P. breviuscula* 8 specimens + 1 pair otoliths, NMNZ P.14301; *Lotella rhacinus* 12 specimens + 6 pairs otoliths, NMNZ P.4098, 4640; AM I15330-15; *L. phycis* 6 specimens + 1 pair otoliths, AM I20270-008, WAM P.26004-011.

Diagnosis. Snout obtusely rounded, not projecting beyond mouth. Maxillary extending to beneath rear margin of orbit. Barbel present. Teeth small, pointed, arranged in 5-6 irregular rows forming a brush-like band on jaws. Upper jaw with a graded series, the outer teeth only slightly larger. Lower jaw with teeth of equal size. No teeth on vomer or palantines.

Otolith pointed at both ends, ostium comprises 40.6% of otolith length and is shorter than cauda; Crista superior almost as long as crista inferior (Fig. 1).

Type species. Eeyorius hutchinsi sp. nov.

Table 1. Distinguishing characteristics of *Eeyorius*, *Pseudophycis* and *Lotella*

	Eeyorius	*Pseudophycis*	*Lotella*
Dentition	Brush-like band	Brush-like band	Outer series of large widely spaced teeth
Otolith:			
dorsal margin	smooth	expanded	smooth
crista superior	almost as long as crista inferior	as long as crista inferior	two-thirds length of crista inferior
Ostium	shorter than cauda	equal to cauda	shorter than cauda
Collum	recessed	flat	recessed

Etymology. Named for Eeyore, a literary character who lived in damp places.

Remarks. *Eeyorius* closely resembles *Pseudophycis* in external morphology and dentition and differs from that genus in otolith shape. Otoliths of *Eeyorius* are similar to *Pseudophycis* in thickness and in having a crista superior almost as long as, or as long as the crista inferior but differ in having a relatively smooth unexpanded mid-dorsal region, and an ostium shorter than the cauda.

Eeyorius is perhaps more closely related to *Lotella* but differs from that genus in having a band of brush-like teeth and lacking an outer row of relatively large, widely spaced sharp pointed teeth. *Eeyorius* also differs in having a depressed head, oval in cross section whereas *Lotella* has a rounded head. Otoliths of *Eeyorius* differ from *Lotella* in being thinner, and in having a crista superior almost as long as the crista inferior (Table 1).

The use of otoliths in defining morid genera (Karrer, 1971; Fitch and Barker, 1972; Paulin, 1983) allows reliable identification of the genera which is often difficult using other

characteristics. Because of differences in otolith shape and dentition a new genus is here recognised, intermediate between two presently recognised genera.

To merge *Eeyorius* with either or both *Pseudophycis* or *Lotella* would require division at the subgeneric level and a complete revision of the taxonomy of the family, reducing 18 genera to subgenera within about seven genera, a taxonomy which would be unrealistic.

Karrer (1971) and Paulin (1983) considered that the affinities of *Lotella* possibly lay with the '*Physiculus*-group' of morids rather than the '*Pseudophycis*-group' as considered by Fitch and Barker (1972). Otoliths of *Eeyorius* show affinities with both *Lotella* and *Pseudophycis* as shown in Table 1.

Eeyorius and *Lotella* should both be considered part of the *Pseudophycis*-group of morids and not the *Physiculus*-group.

Osteology.

Neurocranium (Fig. 3a, b). Elongate, flattened dorsally, roughly triangular shape when viewed dorsally. Sutures readily visible. Sensory canals with very thin crests of bone. Premaxillary-ethmovomerine complex with some cartilage present. Prominent otic bullae enclosing very large otoliths and formed from pro-otics and basioccipitals. Circumorbitals (Fig. 3c) thin; preorbital long. First neural spine shorter than second but very broad.

Jaws and suspensorium (Fig. 3d). Maxilla relatively slender, curved, with prominent anterior pedicel for articulation with premaxillary-ethmovomer. Mandible broad, composed of dentary, retroarticular and angular. Quadrate triangular; sympletic blade like; hyomandibular flat with broad thickened regions leading to articular surfaces with the spherotic, pterotic, opercle and symplectic; metapterygoid roughly triangular; mesopterygoid broad, thin; ectopterygoid elongate; palatine complex with a straight anterior projection.

Hyoid arch (Fig. 3f). Interhyal a flattened rod-like bone extending from the medial side of the hyomandibular-symplectic joint to the upper end of the epihyal; epihyal a triangular plate; ceratohyal elongate and broad, anterior and more slender; hypohyals of unequal size, the ventral hypohyal larger.

Figure 2. *Eeyorius hutchinsi*, paratype, 180 mm SL, WAM P.27545-001.

Pectoral girdle (Fig. 3g). Supracleithrum elongate, thin; cleithrum large, its leading edge folded to form a canal; scapula roughy rectangular, thin; coracoid rod-like.

Opercular apparatus (Fig. 3e). Opercle triangular with concave trailing margin bordered by strong points; subopercle flat, blade-like with numerous finger-like projections on trailing margin; interopercle broad, elongate with finger-like projections; preopercle very broad, its leading edge with a strong ridge, posterior to which is a thin roof of bone over the preopercular sensory canal.

Ecyorius hutchinsi sp. nov.

Figure 2

Material examined

Holotype. Vic. Port Phillip Bay (38°09'S., 144°52'E.), poison, 5 Mar 1981, B. Hutchins, WAM P.27128-001, 191 mm SL.

Paratypes. Vic. Wilsons Promontory, Oberon Bay (39°04'S., 146°19'E.), poison, 7.6-12.2 m, 6 Feb 1982, M. Gomon and J. Jones, NMV A2360(6 specimens: 78-261 mm SL), NMNZ P.145781, 180 mm SL). Wilsons Promontory, Leonard Bay (39°01.5'S., 146°17.5'E.), poison, 7.6 m, 20 Feb 1982, R. Wilson, P. Forsyth and I. Floyd, NMV A2542(2: 178, 187 mm SL). Wilsons Promontory, Cape Wellington (39°04.1'S., 146°28.6'E.), poison, 5 Feb 1982, R. Kuiter and M. MacDonald, NMV A2938(2: 184, 191 mm SL). Wilsons Promontory, Norman Point (38°56'S., 146°22'E.), poison, 25 Feb 1982, B. Hutchins, WAM P.27123-001(1: 105 mm SL). Wilsons Promontory, Norman Island (38°56'S., 146°22'E.), poison, 28 Feb 1982, B. Hutchins, WAM P.27126-001(2: 87, 209 mm SL).

Tas. Esperance Point (43°20'S., 147°51'E.), 8 Feb 1982, B. Hutchins, WAM P.27845-001, 002(4: 89-180 mm SL). Port Arthur, (43°09'S., 147°51'E.), 14 Feb 1982, B. Hutchins, WAM P.27549-006(1: 245 mm SL). Bridport (41°00'S., 147°23'E.), 3 Mar 1982, B. Hutchins, WAM P.27564-003(1: 183 mm SL).

WA. Rottnest Island (32°00'S., 115°30'E.), 1 Jun 1982, B. Hutchins, WAM P.27616-003(1: 160 mm SL). Rottnest Island (32°00'S., 115°30'E.), poison, 5 May 1982, B. Hutchins, WAM P.25781-001(1: 145 mm SL).

Description. Meristics and morphometric measurements given in Table 2. Body elongate, compressed, greatest depth at origin of second dorsal; preanal length 2.1 times in standard length. Head broad, depressed oval in cross section about 1.7 times in preanal length and 3.6 times in standard length. Head as broad as body. Body completely covered in small scales. Head with similar scales; snout, lips and branchiostegal membranes naked. Scales extending onto basal third of vertical fin membranes. Eye diameter equal to about two-thirds of snout length, 5.9 times in head length.

Posterior nostril a small simple pore, a short distance in front of eye; anterior nostril with a forward directed tube, immediately anterior to posterior nostril.

Mouth oblique, maxillary reaching vertical from centre of eye. Upper jaw overlapping lower. Chin with a barbel slightly longer than diameter of eye. Interorbital space flat, interorbital distance greater than diameter of eye. Gill rakers relatively short, the longest about two-thirds as long as gill filaments. Pyloric caeca moderately sized.

Lateral line, a continuous tube with about 30 pores, rises sharply above pectoral base then gradually descends in a slightly wavy path to midway down the body and extends on to the caudal peduncle.

First dorsal origin slighty behind pectoral base, first ray minute, longest (3rd) equal in length to snout. Second dorsal commences immediately behind first, height greater than first, uniform throughout length. Anal fin origin immediately behind anus, beneath 10th ray of dorsal. Both dorsal and anal fins enveloped in loose membranes with minute scales. Caudal fin rounded. Pectoral inserted midway down body, rounded, more than half length of head. Ventrals with a flat base, two outermost rays longest, falling short of anus by a distance equal to diameter of eye.

Colour (in formalin and isopropyl alcohol). Head and body brownish grey, slightly paler on ventral surface of head. Fin uniform brownish grey. Buccal and branchial cavities pale.

Etymology. The species is named for Barry Hutchins of the Western Australian Museum's Department of Fishes.

Remarks. *Ecyorius hutchinsi* is known from Port Phillip Bay (38°9'S, 144°52'E) and Wilsons Promontory (39°04'S, 146°19'E) in Victoria, from Port Arthur (43°09'S, 147°51'E) and Bridport (41°00'S, 147°23'E) in Tasmania and from Rottnest Island (32°00'S, 115°30'E) in Western Australia, in depths of 7.5-12.0 m.

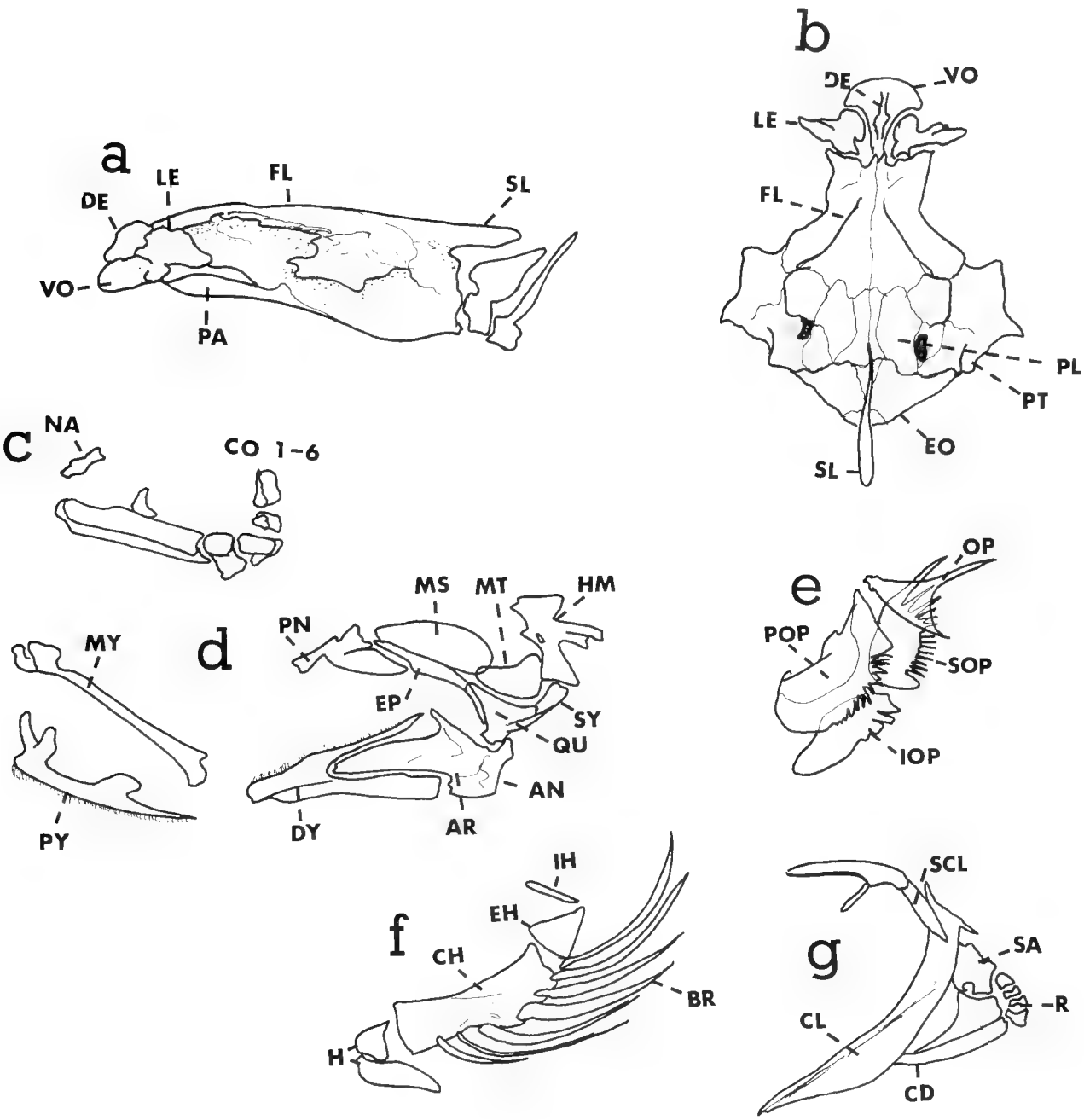


Figure 3. *Eeyorius hutchinsi*, paratype, WAM P.27126-001. Osteology. a, neurocranium, lateral view; b, neurocranium, dorsal view; c, circumorbital, left; d, mandibular and palatine arches, left; e, opercular apparatus, left; f, hyoid arch, left; g, pectoral girdle, left.

Abbreviations: AN, angular; AR, articular; BR, branchiostegal ray; CD, coracoid; CH, ceratohyal; CL, cleithrum; CO, circumorbital; DE, dermothmoid; DY, dentary; EH, epihyal; EO, epiotic; EP, ectopterygoid; FL, frontal; H, hypohyal; HM, hyomandibular; IH, interhyal; IOP, interopercle; LE, lateral ethmoid; MS, mesopterygoid; MT, metapterygoid; MY, maxillary; NA, nasal; OP, opercle; PA, parasphenoid; PL, parietal; PN, palatine; PT, pterotic; POP, preopercle; PY, premaxillary; QU, quadrate; R, radial; SA, scapula; SCL, supracleithrum; SOP, subopercle; SY, symplectic; VO, vomer.

Table 2. Counts and measurements for type specimens of *Eeyorius hutchinsi* sp. nov.

	Holotype	Paratypes (n = 22)	mean
Counts			
1st dorsal fin	6	6	6.0
2nd dorsal fin	52	52-58	54.6
Anal fin	47	43-48	45.7
Pectoral fin	24	24-25	24.8
Vertical scale rows	233	218-240	230.0
Transverse scale rows above lateral line	20	19-22	20.1
Gill rakers	1+6	1-2+5-6	1.1+5.6
Pyloric caeca	10	11-12	11.9
Vertebrae	44	42-44	43.4
Standard length (mm)	194.1	89.0-263.0	
Measurements (percentage of SL)			
Body depth at ventral insertion	18.6	15.5-18.6	17.6
Body depth at anal origin	22.6	18.5-22.6	21.2
Head length	27.2	26.2-28.9	27.1
Orbit diameter	4.6	4.7-5.9	5.1
Snout length	8.2	7.6-9.4	8.2
Maxillary length	13.6	12.5-14.6	13.7
Interorbital width	6.8	5.9-7.4	6.6
Predorsal length	29.7	29.0-32.5	30.8
Preventral length	27.9	22.6-32.3	25.9
Preanal length	46.3	43.6-53.4	47.8
Pectoral fin length	16.3	14.9-17.8	16.3
Barbel length	5.9	4.8-7.1	5.9

Acknowledgements

I thank Barry Hutchins (WAM) for bringing these fish to my attention and for comments on the manuscript; I also thank Martin Gomon (NMV) for the loan of additional specimens, Warwick Wilson (NMNZ) for photography, Frank Climo (NMNZ) for SEMs of otoliths, and Clive Roberts (Victoria University, Wellington) for assistance with radiographs.

The manuscript was read by Dan Cohen (Los Angeles County Museum) and Graham Hardy (NMNZ).

References

Cohen, D.M., 1979. Notes on the morid fish genera *Lotella* and *Physiculus* in Japanese waters. *Jap. J. Ichthyol.* 26: 225-30.

Fitch, J.E. and Barker, L.W., 1972. The fish family Moridae in the eastern North Pacific with notes on morid otoliths, caudal skeletons and the fossil record. *Fish. Bull. U.S.* 70: 565-84

Günther, A., 1862. *Cat. Fish. Brit. Mus.* Vol. IV. 350 pp.

Karrer, C., 1971. Die otolithen der Moridae (Teleostei, Gadiformes) und ihre systematische Bedeutung. *Zool. Jb.* 98: 153-204.

Kaup, J., 1858. Übersicht der Familie Gadidae. *Arch. Naturgesch.* 24: 85-93.

Paulin, C.D., 1983. A revision of the family Moridae (Pisces: Anacanthini) within the New Zealand region. *Rec. natn. Mus. N.Z.* 2: 81-126.

Memoirs of the Museum of Victoria 47(2): 207-211 (1986) ISSN 0814-1827

TYPES OF FLATIDAE (HOMOPTERA) VIII. LECTOTYPE DESIGNATIONS AND TAXONOMIC NOTES ON SPECIES IN THE MUSEUM OF VICTORIA

By John T. Medler

Honorary Associate, Bernice P. Bishop Museum, Honolulu, Hawaii, U.S.A.

Abstract

Medler, J.T., 1986. Types of Flatidae (Homoptera) VIII. Lectotype designations and taxonomic notes on species in the Museum of Victoria. *Mem. Mus. Vict.* 47: 207-211.

Flatidae in the Museum of Victoria purchased from Francis Walker during 1861-1874 were examined. Syntypes of 12 species described by Walker were found, of which 10 species were based on specimens collected by A. R. Wallace during his travels in the Indo-Malaysian Region. Lectotype and paralectotype designation are made. The genitalia of male lectotypes are illustrated, namely: *Nephesa chlorospila* (*Colgar*), *Nephesa deducta* (*Idume*), and *Poeciloptera indocillis* (*Flata ferrugata* Fabricius). A list of the remaining specimens under the generic and specific names used by Walker, with an indication of their present nomenclature, is provided.

Introduction

Specimens of Flatidae in the Museum of Victoria were examined in connection with my research on this family in South-east Asia. I inquired about the specimens after learning from Horn and Kahle (1936) that there was a Francis Walker collection in the Museum of Victoria (formerly National Museum of Victoria).

Certain species described by Walker (1857a, 1857b, 1870) were of considerable importance to my research as they were based on the collections of Alfred Wallace made during his travels in the Indo-Malaysian Region. The type specimens of Walker were not seen by Melichar (1901, 1902) when he wrote his monographic revision of the family. Therefore, it has been necessary to study the Walker and Melichar types to correct misidentifications and synonymies that were made by Melichar.

I especially needed to examine all available specimens of Walker, because in some instances his types were not found in the British Museum (Natural History) collection, or specimens labelled as types did not agree with the original publications. A search for Walker types of Flatidae at the Oxford Museum was not productive. My anticipation that the Walker collection in the Museum of Victoria would be of interest was realized when examination of the specimens revealed the presence of the types reported upon in this article.

The Museum of Victoria collection contains authentic Wallace specimens as evidenced by Walker's handwritten determination and locality labels. Their authenticity as syntypes was verified by checking citations in the original descriptions and making comparisons with data on other syntypes in the British Museum.

The history of the acquisition of Walker material by the Museum of Victoria has been reviewed recently by K. L. Walker (1985). The archives showed that the specimens were purchased from Francis Walker during the period 1861-1874 by Professor Frederick McCoy, first director of the Museum. Also, according to the archives, Australian insects were sent to Walker for identification. Any flatids that may have been represented in this exchange are probably lost, as such specimens have not been found in the Museum of Victoria nor in the British Museum (Natural History).

To preserve the historical status of the labels associated with each specimen, the data are recorded precisely in the following format:

type designation, sex, NMV registration–and numbers (1), (2), (3), etc., indicating the sequence of original labels on the pin from top to bottom. A slash (/) separates the printed or written lines on each label. An exact reproduction of these data is given in the list of types that follows. Lastly, a red label with my handprinted lectotype or paralectotype designation has been attached to each specimen.

As most species of Flatidae must be identified with accuracy by using diagnostic characters of the male genitalia, male specimens were dissected and the genitalia illustrated whenever possible. The dissected male was designated as the lectotype when syntypes existed.

Walker types

The Walker types are listed alphabetically by species, with the original generic determination given in square brackets before the currently accepted genus name. Following each lectotype or paralectotype designation there is a brief comment on the taxonomic status and present disposition of the species.

acutipennis Walker, 1857a: 85, *[Cromna] CROMNA*

Lectotype ♀ (T-8108)–(1) Mal-/ca (2) Wallace (3) Cromna/acutipennis/Sarawak.

The left tegmen is missing. The lectotype appears to be the only survivor of original material; a search in the British Museum revealed no recognizable specimen. The discovery of the lectotype was important because *Cromna* has been misunderstood since its establishment by Walker as a monobasic genus. Subsequently, 11 species of *Cromna* were described by Walker (1851, 1858a, 1858b, 1862, 1870), one species each by Costa (1864) and Montrouzier (1861), and four species by Melichar (1902). These 17 species were distributed among seven genera by Metcalf (1957). *Cromna acutipennis* is superficially similar to certain species of *Lawana* in tegmina shape and venation. Both genera have two lateral spines on the metatibiae. Along with other characters *Cromna* may be distinguished by its acutely pointed head, whereas that of *Lawana* is obtusely conical.

albescens Walker, 1870: 177, *[Nephesa] SEPHENA*

Paralectotype ♀ (T-8109)–(1) M (round label) (2) Mys/Wallace (3) Nephesa/albescens/Mysol.

The lectotype female from New Guinea is in the British Museum. The species was assigned by Distant (1910) to the genus *Sephena*.

amata Walker, 1870: 175, *[Nephesa] PARATELLA*

Paralectotype ♀ (T-8110)–(1) Wag. (round label) (2) Wallace (3) Nephesa/amata/Waigiou.

The lectotype female and a paralectotype (without abdomen) each from Waigiou are in the British Museum. Distant (1910) assigned the species to *Paratella*.

chlorospila Walker, 1870: 173, *[Nephesa] COLGAR*

Lectotype ♂ (T-8111)–(1) N (round label) (2) N. Gui/Wallace (3) Nephesa/chlorospila/N. Guinea. (Dissected)

The lectotype genitalia are illustrated (Fig. 1). I have designated this specimen as the lectotype to stabilize the identity of a common and widespread species of *Colgar* in New Guinea. A syntype male in the British Museum from Mysol is a closely related species. Melichar (1902) intuitively associated this species with *Colgar* (as *Cromna* sensu Melichar). Distant (1910) erroneously assigned *chlorospila* to *Euphanta*, and this error was perpetuated by Metcalf (1957).

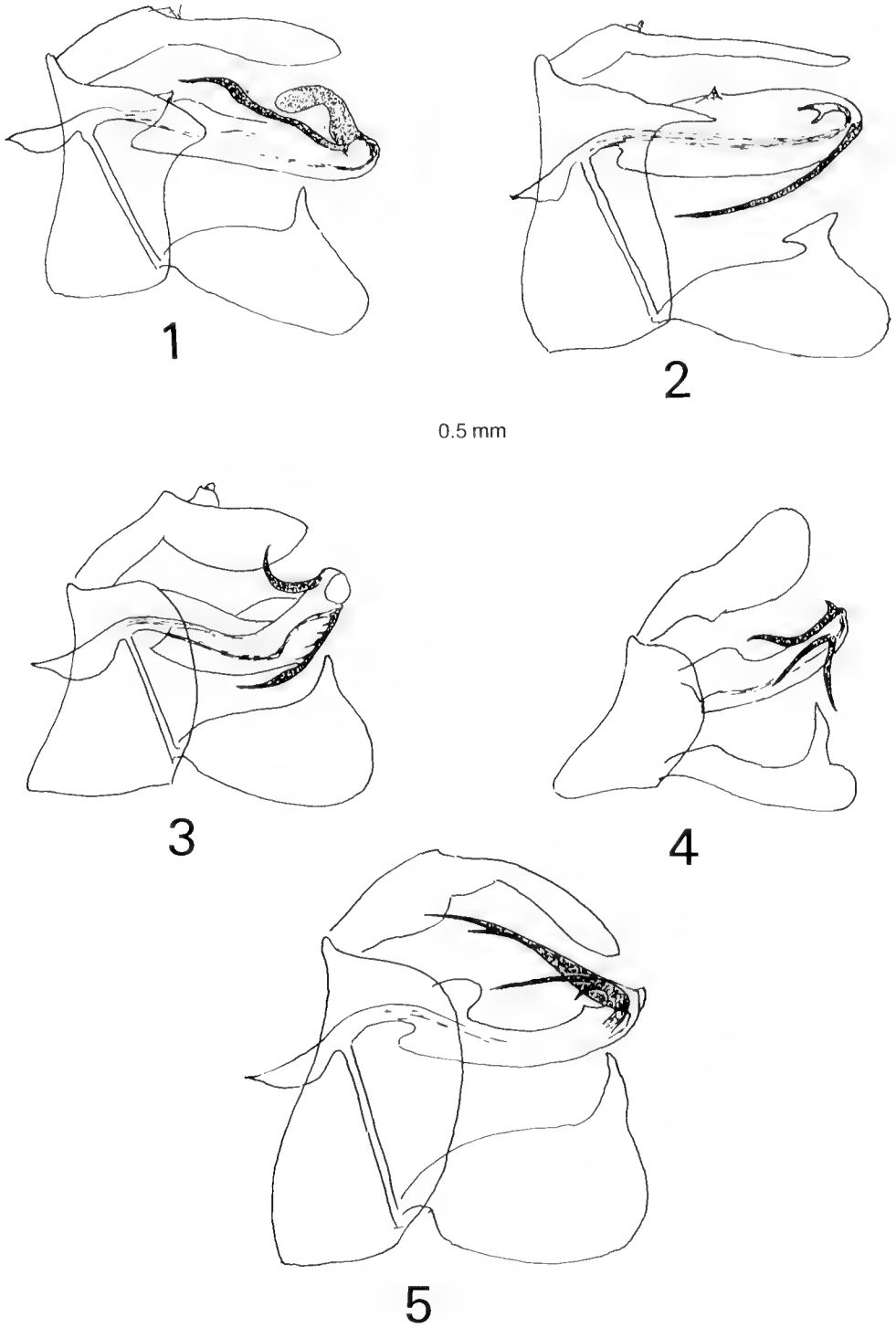
decolor Walker, 1870: 175, *[Nephesa] PARATELLA*

Paralectotype ♀ (T-8112)–(1) Wag (round label) (2) Wallace (3) Nephesa/decolor/Waigiou.

Paralectotype ♀ (T-8113) - (1) M (round label) (2) Mys/Wallace (3) Nephesa/decolor/Mysol.

The lectotype male from Mysol is in the British Museum. The species was transferred to *Paratella* by Distant (1910).

deducta Walker, 1857b: 161, *[Nephesa] IDUME*



Figures 1-5. Left lateral view of male genitalia. 1, *Nephesa chlorospila* Walker. 2, *Neomelicharia cruentata* (Fabricius). 3, *Nephesa deducta* Walker. 4, *Flatoides subrufescens* Walker. 5, *Poeciloptera indocilis* Walker.

P

Lectotype ♂ (T-8114)–(1) SAR (round label) (2) Wallace (3) Nephesa/deducta/Borneo. (Dissected)

The lectotype genitalia are illustrated (Fig. 3). Two paralectotype females from Sarawak are in the British Museum. The genitalia shown are the same as that of the lectotype of *Idume plicata* Melichar (1902). The genitalia figured by Ghauri (1973) are the same also. The presence of one metatibial spine is a distinctive character separating *Idume* from superficially similar species of *Melicharia* with two spines.

hastifera Walker, 1870: 180, *[Colobesthes] NEOCROMNA*, new combination

Lectotype ♀ (T-8115)–(1) M (round label) (2) Mys/Wallace (3) Colobesthes/hastifera/Mysol.

The lectotype may be the only surviving specimen from original material; a search in the British Museum revealed nothing recognisable. Two females in the Budapest Museum identified as *Colgar hastifera* by Melichar (1902) are the same as the lectotype. The species was not recognised by Distant (1910) when he erected the gnus *Necromna*.

helena Walker, 1858: 110, *[Poeciloptera] POECILOFLATA*

Paralectotype ♀ (T-8116)–(1) Celebes/Pfeiffer (2) Poeciloptera/helena/Celebes.

The lectotype female from Celebes is in the British Museum. The species was listed by Metcalf (1957) as a junior synonym of *Poeciloflata viridiana* Donovan. Considerable variation in colour and markings is exhibited by this species but a study of the male genitalia of the variants showed no morphological differences.

indocilus Walker, 1858: 55, [Poeciloptera] FLATA

Lectotype ♂ (T-8117)–(1) Ind (2) Poeciloptera/indocilis/Hindustan. (Dissected)

A female was cited in the original description, but a search in the British Museum produced no specimen that would serve as a syntype. The genitalia are illustrated (Fig. 5). This species was listed by Metcalf (1957) as a junior synonym of *Flata ferrugata* Fabricius.

quadriguttata Walker, 1870: 179, *[Flata] NEODAKSHA*

Paralectotype (no abdomen) (T-8118)–(1) N (round label) (2) N. Gui/Wallace (3) Flata/4 guttata/N. Guinea.

The lectotype, also without abdomen, is in the British Museum. This species is the monobasic type of the genus *Neodaksha* Distant.

rufilinea Walker, 1870: 174 *[Nephesa] PAPUANELLA*

Paralectotype ♀ (T-8119)–(1) M (round label) (2) Mys/Wallace (3) Nephesa/rectilinea/Mysol.

The lectotype female from Mysol is in the British Museum. This species was placed in *Sephena* by Melichar (1902), but properly belongs in *Papuanella* Distant, a genus closely related to *Sephena* auctorum.

subrufescens Walker, 1870: 141, *[Flatoides] UXANTIS*

Paralectotype ♂ (T-8120)–(1) M (round label) (2) Morty/Wallace (3) Flatoides/subrufescens/Morty. (Dissected)

Paralectotype ♀ (T-8121)–(1) M (round label) (2) Mys/Wallace (3) Flatoides/subrufescens/Mysol.

The genitalia are illustrated (Fig. 4). The characters are the same as those of the lectotype in the Stockholm Museum. A paralectotype female from New Guinea is in the British Museum. The species was assigned to *Uxantis* Stål by Melichar (1902).

Additional Walker specimens

Specimens provided by Walker are listed under original generic and specific names. Present nomenclature is given in parentheses.

COLOBESTHES

falcata, (*Colobesthes falcata* (Guerin-Meneville, 1834)). ♂–Sumatra, Wallace coll.

sumifera (unpublished name). ♀–Sumatra, Wallace coll. This specimen has tegmina with white waxy deposits on the dull green membrane. I consider the specimen to be a variant of *Colobesthes falcata* (G-M).

FLATA

aurora, (*Cenestra aurora* (Guerin-Meneville, 1834)). ♀–Java.

flaccida, (*Flatida flaccida* (Walker, 1858)). No abdomen–Malacca.

marginella, (*Flatida marginella* (Olivier, 1791)). ♂–Hindustan.

tenella, (*Cerynia tenella* (Walker, 1851)). No abdomen–Sylhet.

tricolor, (*Flatida tricolor* (White, 1846)). ♀–Sylhet.

NEPHESA

marginella, (*Salurnis dulitana* Lallemand, 1939). ♀–Sarawak, Wallace coll.

rubrosparsa, (unpublished name). 1 ♂, 2♀♀–Ceram, Gilolo, Wallace coll. The male from Ceram was dissected and the genitalia illustrated (Fig. 2). The genitalia are the same as in *Neomelicharia cruentata* (Fabricius, 1803).

POECILOPTERA

candida, (*Lawana candida* (Fabricius, 1798)). ♂–Java.

circulata, (*Bythopsyrna circulata* (Guerin-Meneville, 1844)). ♀–Sumatra, Wallace coll.

maculata, (*Copsyrna maculata* (Guerin-Meneville, 1829)). ♀–Sarawak, Wallace coll.

obscura, (*Bythopsyrna tineoides* (Olivier, 1791)). ♀–Sarawak, Wallace coll.

truncata, (*Flata ferrugata* Fabricius, 1803). ♀–Hindustan.

Acknowledgment

The research was made possible by the help of Dr Arturs Neboiss, Curator of Entomology, Museum of Victoria, to whom I express grateful appreciation.

References

Costa, A., 1864. Descrizione de taluni insetti stranieri all'Europa. *Annali Mus. zool. Napoli* 2: 139-51, pl. 1.

Distant, W.L., 1910. Rhynchota Malayana. Part III. *Rec. Ind. Mus.* 5: 313-38, pls. 21, 22.

Ghauri, M.S.K., 1973. Taxonomic notes on a collection of Fulgoroidea from tea in southern India. *Bull. ent. Res.* 62: 541-4.

Horn, W. and Kahle I., 1936. *Über entomologische Sammlungen.* Entomologische Beihefte aus Berlin-Dahlem. Vol. 3, Part 2, pp. 161-296.

Melichar, L., 1901. Monographie der Acanaloniiden und Flatiden (Homoptera). *Annln naturh. Mus. Wien* 16: 178-258.

Melichar, L., 1902. Monographie der Acanaloniiden und Flatiden (Homoptera) (Fortsetzung). *Annln naturh. Mus. Wien* 17: 1-123. 9 pls.

Metcalf, Z.P., 1957. *General Catalogue of the Homoptera, Fasc. IV, Pt 13, Flatidae.* North Carolina State College: Raleigh. 565 pp.

Montrouzier, X., 1861. Essai sur la faune entomologique de la Nouvelle-Caledonie (Balade) et des îles des Pins, Art, Lifu, etc. Hemipteres. *Annls Soc. ent. Fr.* 1: 59-74.

Walker, F., 1851. *List of the specimens of Homopterous insects in the collection of the British Museum* 2: 261-636, pls. 3, 4.

Walker, F., 1857a. Catalogue of the homopterous insects collected at Singapore and Malacca by Mr. A. R. Wallace, with descriptions of new species. *Proc. Linn. Soc. Lond.* 1: 82-100, pls. 3, 4.

Walker, F., 1857b. Catalogue of the homopterous insects collected at Sarawak, Borneo, by Mr. A. R. Wallace, with descriptions of new species. *Proc. Linn. Soc. Lond.* 1: 141-74, pls. 7, 8.

Walker, F., 1858a. *Insecta saundersiana* 1858: 1-117.

Walker, F., 1858b. *List of the specimens of homopterous insects in the collection of the British Museum 1858.* 307 pp.

Walker, F., 1862. Characters of undescribed species of Homoptera in the collection of F. P. Pasco, F.L.S. *J. ent. Lond.* 1: 303-19, pl. 15.

Walker, F., 1870. Catalogue of the homopterous insects collected in the Indian Archipelago by Mr. A. R. Wallace, with descriptions of new species. *Zool. J. Linn. Soc.* 10: 82-193, 276-330, pl. 3.

Walker, K.L., 1985. Mystery of Francis Walker specimens solved. *Antenna* 9: 78-80.

Memoirs of the Museum of Victoria 47(2): 213-223 (1986) ISSN 0814-1827

TAXONOMIC CHANGES IN CADDIS-FLY SPECIES FROM THE SOUTH-WEST PACIFIC-AUSTRALIAN REGION WITH DESCRIPTIONS OF NEW SPECIES (INSECTA: TRICHOPTERA)

By A. Neboiss

Department of Entomology, Museum of Victoria, 71 Victoria Cresent, Abbotsford, Victoria 3067, Australia

Abstract

Neboiss, A. (1986) Taxonomic changes in caddis-fly species from the South-west Pacific-Australian region with descriptions of new species (Insecta: Trichoptera). *Mem. Mus. Vict.* 47: 213-223.

Three new species of *Agapetus* are described, *A. ablusus* sp. nov. and *A. diacanthus* sp. nov. from Victoria, Australia, and *A. nokowoula* sp. nov. from Vanuatu. Two New Guinea species– *S. productus* Kimmins and *S. apalapsili* Malicky, and one– *S. salomonis* Kimmins from Guadalcanal are transferred from *Synagapetus* McLachlan to *Agapetus* Curtis, but the New Guinea species *S. anoaclana* Malicky is transferred to *Chimarra* Stephens. The generic name *Sciops* McLachlan (Sulawesi and Borneo) is removed from the Australian list by transfer of two species– *S. spinata* Banks and *S. inermis* Banks to the genus *Diplectrona* Westwood. Two other *Diplectrona* Westwood species– *D. bifurcata* Kimmins and *D. bispinosa* Jacquemart are transferred to *Austropsyche* Banks. The New Guinea species *Anisocentropus testaceus* Navás is placed in the genus *Hydropsyche* Pictet. The genus *Neureclipsis* McLachlan is recorded from Australia with a new species *N. napaea* from Victoria; *Tasiagma eremica* sp. nov. is described from Lord Howe Island; *Goera aneityuma* sp. nov. is a new species from Vanuatu; two new species of *Anisocentropus*–*A. hyboma* sp. nov. and *A. pictilis* sp. nov. are described from New Guinea and Woodlark Island respectively and *Symphitoneuria licmetica* sp. nov. is described from New Caledonia.

Introduction

While accumulating information on the caddis-fly fauna of the South-west Pacific-Australian region a number of taxonomic discrepancies were noted which require amendments. There were also some undescribed species either of immediate interest to environmental studies, or which add important information to caddis-fly distributions. These changes and descriptions are presented in this paper.

The following abbreviations are used for repositories of material: ANIC–Australian National Insect Collection, Canberra; BMNH–British Museum (Natural History), London; BPBM–Bernice P. Bishop Museum, Honolulu; IRSN–Institut Royal des Sciences Naturelles de Belgique, Brussels; MCG–Museo Civico di Storia Naturale, Giacomo Doria, Genoa; MCZ–Museum of Comparative Zoology, Harvard University, Cambridge, Mass.; NMV-Museum of Victoria, Melbourne; SAM–South Australian Museum, Adelaide.

All dissected and figured specimens are identified by the author's notebook number with the prefix 'PT-'. Where available, museum type registration numbers are included.

Systematics

Glossosomatidae

Only the subfamily Agapetinae is known to occur in the South-west Pacific-Australian region, however, it is absent from New Zealand and from the western half of Australia. The classification of this group is rather unsettled.

Some species appear under the generic name *Agapetus* Curtis, others as *Synagapetus* McLachlan. The latter was reduced to subgeneric level by Ross (1956) but some authors (Kimmins, 1962; Malicky, 1978) still continue to use *Synagapetus* McLachlan as a valid genus. Comments on classification were made in a paper by Schmid (1959). He agreed with Ross (1956) in subdividing *Agapetus* into three subgenera: *Tagapetus* Ross, *Agapetus* s. s. and *Synagapetus* McLachlan. Schmid (1959) also regarded that all the Australian species are closest to *Agapetus* s. s. in all their features, but has an additional cross-vein sc-r near anastomosis in hindwing. Recent observations show that the cross-vein sc-r is not present in all species. In accordance with Schmid's arguments the South-west Pacific species described as *Synagapetus*–*S. salomonis* Kimmins, 1957 (Guadalcanal), *S. productus* Kimmins, 1962 (Papua New Guinea) and *S. apalapsili* Malicky, 1978 (Irian Jaya) should be referred to Agapetus s. s.

The uniting characters for the South-west Pacific-Australian *Agapetus* s. s. species is a blister-like protuberance on the lateral margin of sternite 5, present in both sexes (not in males only as stated by Ross, 1956), and the widened midleg tibiae and tarsi in females.

Agapetus nokowoula sp. nov.

Figures 1-4

Type material.

Holotype ♂, Vanuatu (New Hebrides), Espirito Santo Island (15°50′S., 166°50′E.), Nokowoula, 1132 m, 12 Sep 1971, G.F. Gross (Genitalia prep. PT-1278 figured)(SAM).

Description. Wing colour uniform dark brownish-black. Abdominal sternite 5 with blister-like protuberance small, oval, domeshaped; strong ventral process on sternite 6, a small one on sternite 7; anterior margin of segment 9 broadly triangular, broad dorsally, superior appendages short and broad, almost rectangular; tergite 10 short, in lateral view broadly triangular; inferior appendages robust, apically with horizontally orientated triangular mesal lobe. Phallus with sclerotized internal rods.

Female unknown.

Length of forewing: ♂ 4.2 mm.

Distribution. Vanuatu (known from the type locality only).

Remarks. This is the first record of the genus from Vanuatu (New Hebrides). The species identity is based on male genital characters.

Agapetus diacanthus sp. nov.

Figures 5, 6

Type material.

Holotype ♂, Australia, Victoria, O'Shanassy River, 20 Jan 1983, A.Neboiss (NMV T-8161); paratypes 30♂♂ collected with holotype (Genitalia prep. PT-1246 figured) (ANIC; BMNH; NMV).

Description. Blister-like protuberance on sternite 5 small, oval, somewhat flattened; sternite 6 with moderately large ventral process; middle of anterior margin of segment 9 extended, broadly triangular; superior appendages elongate, slightly expanded distally; tergite 10 elongate, broad at base, distinct dorsolateral spine near distal end; inferior appendages short, robust, with two mesally directed spines near apex, one situated at dorsal, the other at ventral margin, the lower one distinctly shorter. Phallus with long, sclerotized internal spines.

Female not positively associated.

Length of forewing: ♂ 4-5 mm.

Distribution. Central Victoria.

Remarks. Dark, blackish species, separated from *A. monticolus* Banks by distinct male genitalia.

Agapetus ablusus sp. nov.

Figures 7-12

Type material.

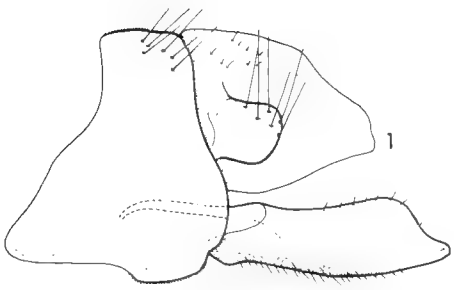
Holotype ♂, Australia, Victoria, Dee River 2 km NW. of Millgrove, 24 Feb 1976, A. Neboiss (NMV T-8178).

Figures 1-4, *Agapetus nokowoula* sp. nov.: 1, male genitalia lateral; 2, male sternites 6 and 7 with ventral processes; 3, phallus lateral; 4, male genitalia ventral.

Figures 5, 6, *Agapetus diacanthus* sp. nov.: 5, male genitalia lateral; 6, male genitalia ventral.

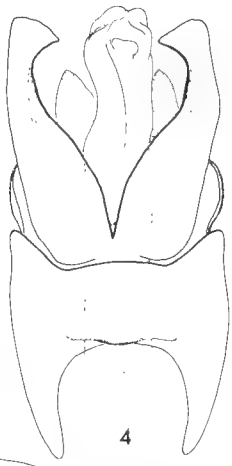
Figures 7-12, *Agapetus ablusus* sp. nov.: 7, male genitalia lateral; 8, male sternite 6 with ventral process; 9, male genitalia dorsal; 10, male genitalia ventral; 11, male wing venation; 12, female abdomen lateral.

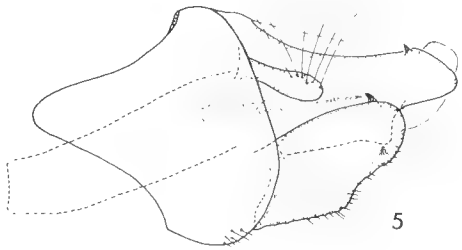
Figures 13, 14, *Hydropsyche testacea* (Navás): 13, female wing venation; 14, female genitalia lateral.

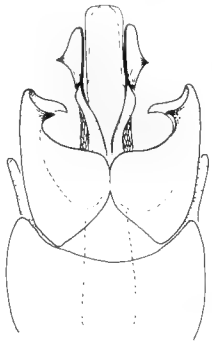

1

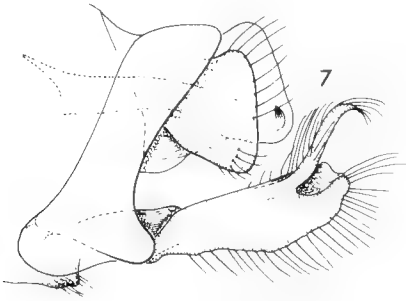
2

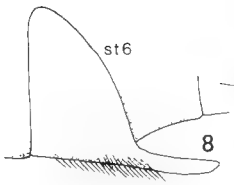

3


4

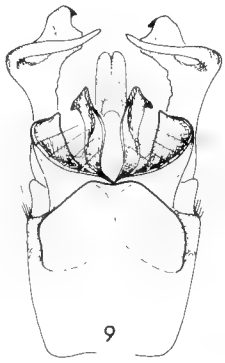

5

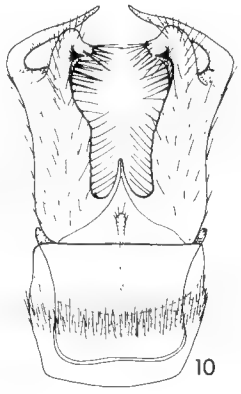

6

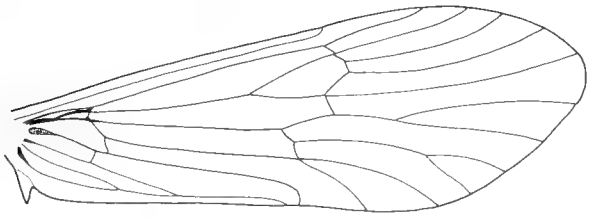

7

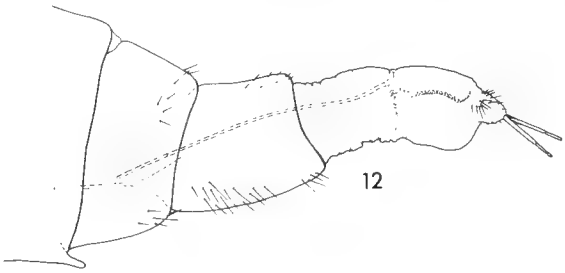


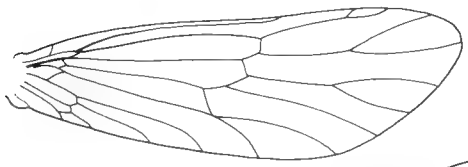
8

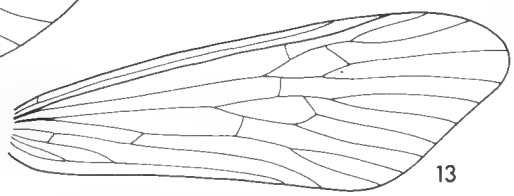

9

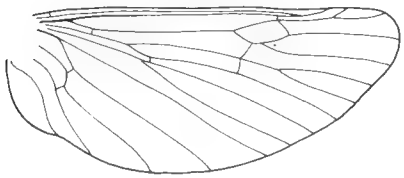

10

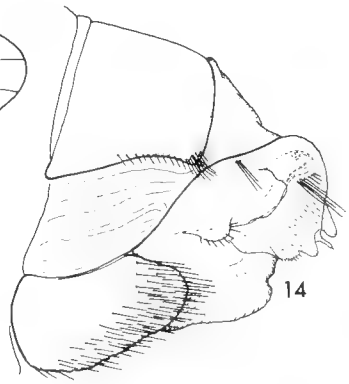

11


12




13




14

Paratypes 2♂♂, collected with holotype (Genitalia prep. PT-1312 figured); 2♂♂, Cement Creek nr Warburton, 22 Feb 1953, A. Neboiss; 4♂♂, 1♀, same loc., 5 Feb 1955, A. Neboiss; 1♂, Millgrove, 9 Jan 1957, A. Neboiss; 3♂♂, Britannia Creek nr Warburton, 27 Jan 1976, A. Neboiss; 2♂♂, 3 km W. of Beenak, 7 Jan 1972, A. Neboiss; 2♂♂, 2♀♀, 3 km SW. of Tanjil Bren, 13 Jan 1981, A. Neboiss; 6♂♂, Upper Acheron River (Acheron Gap), 9 Jan 1957, A. Neboiss (ANIC; BMNH; NMV).

Other material examined. Australia, Victoria–Dandenong Mts. Sassafras Creek; Yea River nr Toolangi; Tarra River, National Park.

Description. The blister-like protuberance elongate-oval; sternite 6 with long, slender ventral process; segment 9 in lateral view narrow, lateral lobe at the base of inferior appendage; superior appendages short, very broad, somewhat triangular; segment 10 short; inferior appendages elongate, dorso-apical angle extended into long, curved, distally pointed process, lower apical section wide with short triangular mesal spine.

Female with distinctly widened and flattened tibiae and tarsi of midlegs, short ventral process on sternite 6; abdomen terminates with a pair of slender, two segmented cerci.

Length of forewing: ♂ 4-5 mm; ♀ 3.8-4.6 mm.

Distribution. Central Victoria.

Remarks. Dark, brownish species, positive identification by distinct male genitalia.

Agapetus productus (Kimmins) comb. nov.

Synagapetus productus Kimmins, 1962:102, fig. 3.

Type material.
Holotype ♂, New Guinea, Papua New Guinea, Kokoda (8°52′S., 147°45′E.), 400 m, Sep 1933, L.E. Cheesman (BMNH). Type not examined.

Material examined. Papua New Guinea, Mt Lamington, 500 m, June 1966, P. Shanahan (BPBM).

Distribution. New Guinea (central highlands).

Remarks. This species, according to Kimmins (1962), is closely related to *Agapetus jafiwi* Ross.

Agapetus salomonis (Kimmins) comb. nov.

Synagapetus salomonis Kimmins, 1957:291, fig. 3.

Type material.
Holotype ♂, Guadalcanal (9°32′S., 160°12′E.), Tapenanje, 10-15 Dec 1953, L.E. Cheesman (BMNH). Type not examined.

Remarks. Kimmins (1957) suggested that this species is nearest to *Agapetus cralus* (Mosely) but differs in more quadrate superior appendages and narrower inferior appendages.

No new material is available

Agapetus apalapsili (Malicky) comb. nov.

Synagapetus apalapsili Malicky, 1978:163, fig. 4A-E.

Type material.
Holotype ♂, New Guinea, Irian Jaya, Apalapsili, 900 m, 15-17 Nov 1971, E. Diehl (Collection Malicky). Type not examined.

Remarks. The description and figures of this species show similarities to *Agapetus latosus* Ross.

No new material is available.

Philopotamidae

Chimarra anoaclana (Malicky) comb. nov.

Synagapetus anoaclana Malicky, 1978:163, fig. 4F-J.

Type material.
Holotype ♂, New Guinea, Irian Jaya, Apalapsili 900 m, 15-17 Nov 1971 (Collection Malicky). Type not examined.

Distribution. New Guinea (Irian Jaya).

Remarks. The author has informed me (in litt. June 1984) that this species has been wrongly included in the genus *Synagapetus* instead of the genus *Chimarra* and asked me to rectify this error.

No new material is available.

Figures 15, 16, *Diplectrona inermis* (Banks): 15, male genitalia lateral; 16, male genitalia ventral.

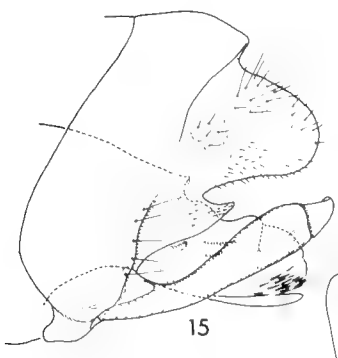
Figures 17, 18, *Diplectrona spinata* (Banks): 17, male genitalia lateral; 18, male genitalia ventral.

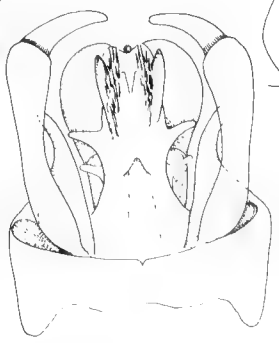
Figure 19, *Austropsyche bispinosa* (Jacquemart): male genitalia lateral.

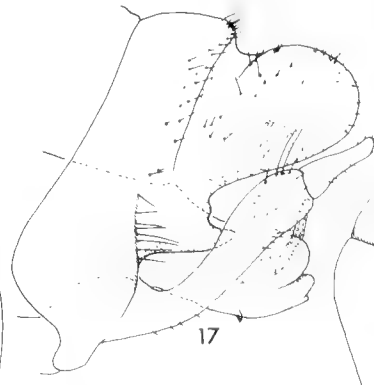
Figures 20, 21, *Austropsyche bifurcata* (Kimmins): 20, male genitalia lateral; 21, male genitalia ventral.

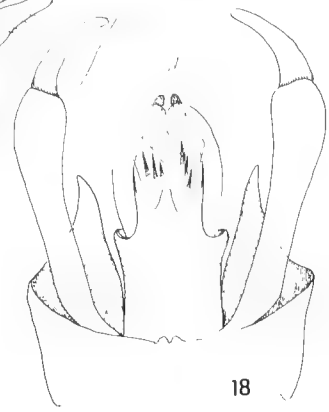
Figures 22-25, *Neureclipsis napaea* sp. nov.: 22, male genitalia lateral; 23, male genitalia ventral; 24, male wing venation; 25, female genitalia lateral.

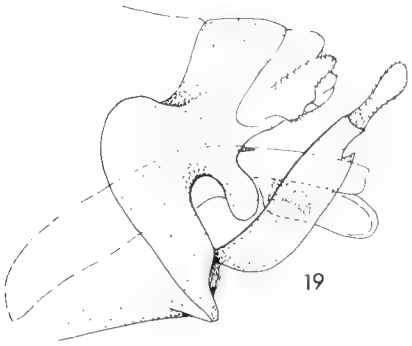
Figures 26-28, *Tasiagma eremica* sp. nov.: 26, male genitalia lateral; 27, male genitalia dorsal; 28, male genitalia ventral.

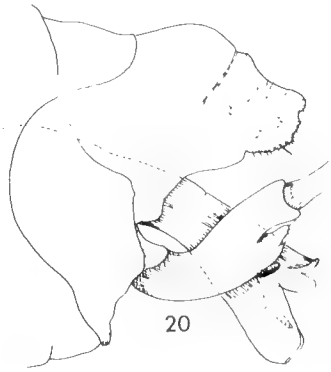

15

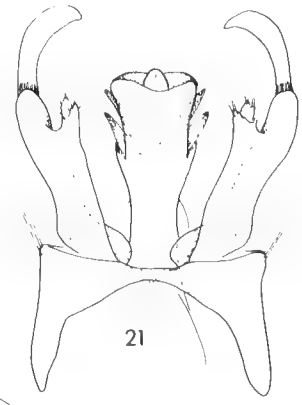

16

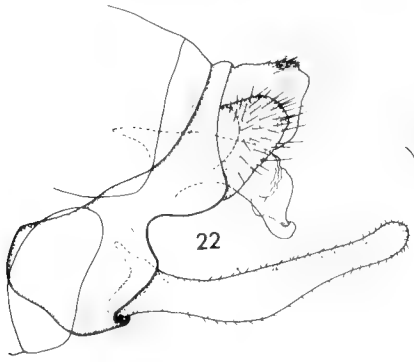

17

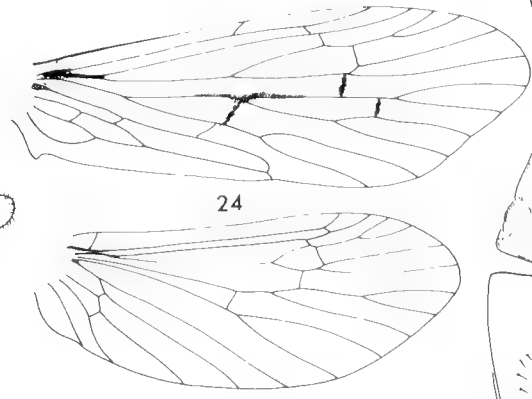

18

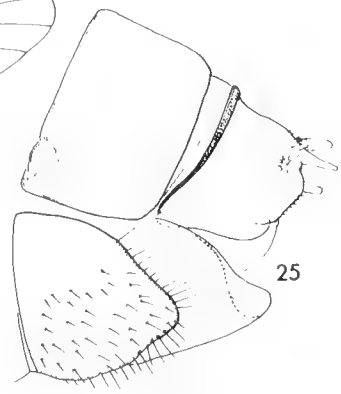

19

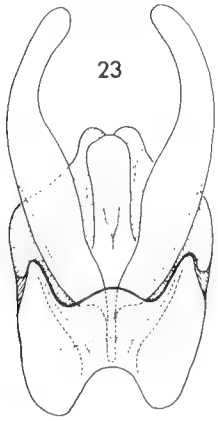

20

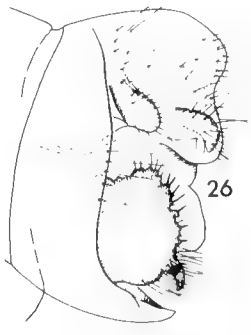

21

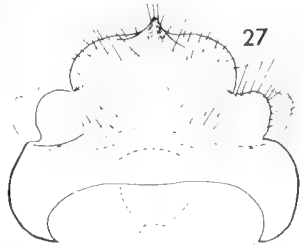

22

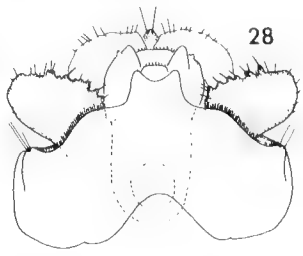

24


25


23


26


27


28

Hydropsychidae

Hydropsyche testacea (Navás) comb. nov.

Figures 13, 14

Anisocentropus testaceus Navás, 1933:104, fig. 93.

Type material.
Holotype ♀, New Guinea, Papua New Guinea, Moroka (9°25'S., 147°35'E.), 1300 m, Jul-Nov 1893, Loria (MCG) (Genitalia prep. PT-1411 figured)

Other material examined. New Guinea, Papua New Guinea, Adelbert Mt. Wanuma, 800-1000 m (4°50'S., 145°25'E.), 24 Oct 1958, J.L. Gressitt (BPBM).

Distribution. New Guinea (known from type locality only).

Remarks. The original figure of forewing clearly indicates that the species does not belong to the genus *Anisocentropus*, but is a member of the family Hydropsychidae. Examination of the holotype confirmed its placement in the genus *Hydropsyche*.

The wing venation is *Hydropsyche*-like, with short discoidal cell in both wings, cross-vein cu in forewing situated well basad of cross-vein m-cu; the postero-lateral angle of abdominal tergite 8 slightly extended downward and covered with group of hairs; a distinct inferior appendage receptacle on tergite 9.

Male unknown.

Length of forewing: ♀ 19.5-20.5 mm.

Diplectrona inermis (Banks) comb. nov.

Figures 15, 16

Sciops inermis Banks, 1939:494, figs. 9, 11.

Type material.
Holotype ♂, Australia, New South Wales, Wentworth Falls, Blue Mts., 3 Jan (1932), P.J. Darlington, Harvard Exped. (ANIC). Type examined.

Other material examined. New South Wales–Katoomba, Cascades (Feb.); Leura (Dec).

Distribution. New South Wales (Blue Mts.).

Remarks. Banks (1939) described two Australian species *Sciops inermis* and *S. spinata*. Both species are characterised by having abdominal segments 6 and 7 with reticulate internal membranous sacks and lateral filaments on sternite 5. These structures are not found in the genus *Sciops* McLachlan but are present and similar to all other Australian species in the genus *Diplectrona* Westwood. Both species are therefore transferred to the latter genus and *Sciops* McLachlan is removed from the Australian faunal list.

The species *D. inermis* (Banks) is recognized by the details of male genitalia, particularly the position of phallic spines as illustrated in Fig. 16.

Female unknown.

Length of forewing: ♂ 6.5 mm.

Diplectrona spinata (Banks) comb. nov.

Figures 17, 18

Sciops spinata Banks, 1939:493, fig. 31.
Diplectrona bourina Mosely, in Mosely & Kimmins, 1953:345, fig. 239, syn. nov.

Type material.
Holotype ♂, Australia, Queensland, McPherson Range, 1000 m, 13 Mar (1932), P.J. Darlington, Harvard Exped. (ANIC). Type examined.
Holotype ♂ of *Diplectrona bourina* Mosely, Queensland, Tambourine Mts. 11-18 Apr 1935, R.E. Turner (BMNH). Type examined.

Other material examined. Queensland–Springbrook (Oct); Killarney, Queen Mary Falls (Oct).

Distribution. Queensland (south-east).

Remarks. The synonymy was already suspected by Mosely (1953) and is here confirmed by comparison of the two types. Species identity based on details of male genitalia.

Female unknown.

Length of forewing: ♂ 6-7 mm.

Austropsyche bispinosa (Jacquemart) comb. nov.

Figure 19

Diplectrona bispinosa Jacquemart, 1965:25, fig. 20.–Neboiss, 1974:14.–1977:73, fig. 363.

Type material.
Holotype ♂, Australia, Victoria, Sassafras, 20 Oct (1922), A.Tonnoir (IRSN). Type mounted on three microscope slides. Type examined.

Distribution. Victoria (east-central mountains).

Remarks. The species has all the characteristics of the genus *Austropsyche*, particularly the shape of segment 9 and the inferior appendages.

Female unknown.

Length of forewing: ♂ 12 mm.

Specimens collected in the Dandenong Ranges, Victoria (Sassafras Creek) confirms previously expressed opinion that the type locality is in Victoria (Neboiss, 1974) and not Tasmania as originally recorded by Jacquemart (1965).

Austropsyche bifurcata (Kimmins) comb. nov.

Figures 20, 21

Diplectrona bifurcata Kimmins, in Mosely & Kimmins, 1953:344, fig. 238.

Type material.

Holotype ♂, Australia, New South Wales, Mt Kosciusco, 1500 m, 24 Jan 1914, R.J. Tillyard (BMNH). Type examined.

Other material examined. New South Wales–Dead Horse Gap (Jan); Australian Capital Territory–Bendora (Dec), Mt Gingera (Jan); Victoria–Kanuka Creek (Mar).

Distribution. South-eastern Australia.

Remarks. The examination of the holotype and several other specimens of this species confirms that it is a member of the genus *Austropsyche*, typified by the shape of segment 9 and the inferior appendages.

Female unknown.

Length of forewing: ♂ 11 mm.

Polycentropodidae

Neureclipsis McLachlan

Neureclipsis McLachlan 1864:30.

Type species. Phryganea bimaculata Linnaeus, 1758.

Diagnosis. The genus is diagnosed by slender maxillary palpi; segments 1 and 2 short, segment 3 long, slender, segment 4 shorter, segment 5 about as long as first four together; antennae stout, basal segment short, bulbous; head with large postero-lateral setal warts.

Forewings elongate, venation complete; forks 1, 2, 3, 4 and 5 present in forewing; forks 1, 2, 3 and 5 in hindwing; discoidal cell present and closed in both wings; cross-vein c-sc present in Australian species.

Spurs 3:4:4; midleg tibiae and tarsi dilated in females.

Remarks. The genus *Neureclipsis* McLachlan is here recorded for the Australian fauna for the first time, otherwise it is widely distributed through Nearctic and Palearctic regions. The general form of male genitalia and the wing venation is characteristic of the genus, except that in the Australian species the cross-vein c-sc is present in forewing and the cross-vein m-cu in hindwing is positioned more basally.

Neureclipsis napaea sp. nov.

Figures 22-25

Type material.

Holotype ♂, Australia, Victoria, Mitta Mitta River 8 km NE. of Benambra, 5 Feb 1974, A. Neboiss (NMV T-8198).

Paratypes 30♂♂, 20♀♀ collected with holotype (ANIC; BMNH; NMV).

Other material examined. Victoria–Gibbo River nr Omeo; Albert River nr Hiawatha; Tanjil River nr Willow Grove; Howqua River nr Merrijig; Cobungra River nr Anglers Rest; Thomson River at Cowwarr, Knapings Clearing and Bells Clearing; Wellington River nr Licola; Macalister-Barkley River junction; Aberfeldy River at Walhalla road bridge; Dargo River nr Dargo (dates range from mid-November to early March).

Diagnosis. Details as in generic description. Male genitalia with inferior appendages moderately robust, slightly curved; apex of phallus curved downward. Female abdominal tergite 9 with narrow sclerotized transversal ridge at basal margin. Other male and female genitalia structures as illustrated in figures 22, 25.

Length of forewing: ♂ 5.5-6 mm; ♀ 6.5-7 mm.

Distribution. Victoria (east-central mountains).

Tasimiidae

Tasiagma eremica sp. nov.

Figures 26-28

Type material.

Holotype ♂, Lord Howe Island (31°33'S., 159°05'E.),

Erskine Valley Station, 10 Nov 1983, G.W. Gibbs (NMV T-8220).

Paratype ♂ collected with holotype (Genitalia prep. PT-1330 figured) (NMV).

Description. Colour greyish-brown, wings without colour pattern and without scale-like setae on main longitudinal veins, otherwise similar to the Australian species. Abdominal segments without processes; distal margin on tergite 9 produced into sharply bipointed lobe; segment 10 raised mid-dorsally to a distinct keel; superior appendages short, rounded; inferior appendages short, broad, darkly pigmented, inner surface densely spinose; phallus short, broad, lower distal margin extended downward into a distinct lobe.

Female unknown.

Length of forewing: ♂ 6 mm.

Distribution. Lord Howe Island (known from type locality only).

Remarks. This species is distinguished from the Australian species *Tasiagma ciliata* Neboiss by details of the male genitalia.

Goeridae

Goera aneityuma sp. nov.

Figures 29-32

Type material.

Holotype ♂, Vanuatu (New Hebrides), Aneityum (20°12′S., 169°45′E.), Red Crest, 400 m, 5 km NE. of Anelgauhat, May 1955, (BMNH) (Genitalia prep. PT-1352 figured).

Paratypes 4♂♂, 10♀♀, collected with holotype (female prep. PT-1353 figured) (BMNH, NMV).

Description. General appearance dark brown, except for head, pronotum and antennae which are pale reddish-brown to ochreous.

Male genitalia, although basically similar to *G. fijiana*, differ in details. Ventral processes of sternites 6 and 7 small, both branches of inferior appendages bluntly rounded at apex, distal margin of sternite 9 extended into broad triangular lobe, however, not recessed on either side, segment 10 in lateral view depressed apically.

Female abdomen terminates with segment 10 formed by laterally somewhat flattened lobes, separated mesally by deep, narrow excision.

Length of forewing: ♂ 5.5-6 mm; ♀ 7.5 mm.

Distribution. Vanuatu (known from type locality only).

Remarks. A group of specimens from Vanuatu (New Hebrides) was noted by Kimmins (1958) as being darker than the specimens of *Goera vunida*(*G. fijiana*) from Fiji. He also commented that there are no significant differences in the male genitalia. The cleared preparations, however, show differences regarded as sufficient for species separation.

Goera fijiana Banks

Goera fijiana Banks, 1924:444.
Goera vunida Mosely, 1941:362, figs. 1-4, syn. nov.

Type material.

Holotype ♂, Fiji, Viti Levu, Nandarivatu (17°34′S., 177°58′E.), W.M. Mann (MCZ 14819). Type examined.

Holotype of *Goera vunida* Mosely, Viti Levu, Vunindawa (17°49′S., 178°19′E.), 31 Mar 1933 (BMNH); paratypes ♂, ♀, collected with holotype, examined.

Distribution. Fiji.

Remarks. The examination of cleared abdominal preparation of the holotype of *G. fijiana* confirmed that *G. vunida* is indeed synonymous with *G. fijiana*, a possibility already expressed by Mosely (1941).

Calamoceratidae

Anisocentropus hyboma sp. nov.

Figures 33-35

Type material.

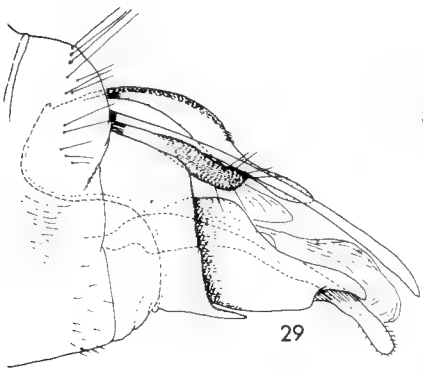
Holotype ♂, New Guinea, Papua New Guinea, Port Moresby (9°30′S., 147°10′E.), Mt Lawes, 400 m, 5 Mar-12 May 1963, W.W. Brandt (ANIC).

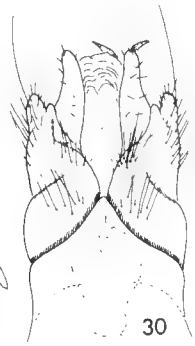
Figures 29-32, *Goera aneityuma* sp. nov.: 29, male genitalia lateral; 30, male genitalia ventral; 31, female genitalia lateral; 32, female genitalia ventral.

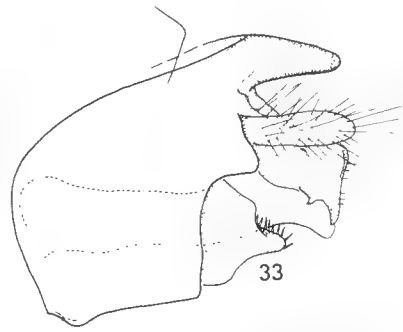
Figures 33-35, *Anisocentropus hyboma* sp. nov.: 33, male genitalia lateral; 34, male genitalia dorsal; 35, female, vaginal sclerite ventral.

Figures 36, 37, *Anisocentropus pictilis* sp. nov.: 36, male genitalia lateral; 37, male wing pattern: c–cream; dg–dark grey; g–light grey with metallic blue sheen; r–russett.

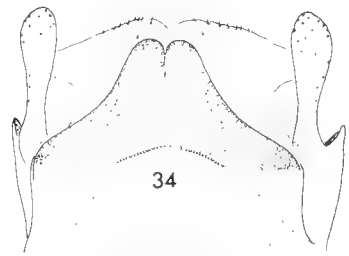
Figures 38-43, *Symphitoneuria licmetica* sp. nov.: 38, male genitalia lateral; 39, male genitalia dorsal; 40, male genitalia ventral; 41, male wing venation; 42, female genitalia lateral; 43, female genitalia dorsal.

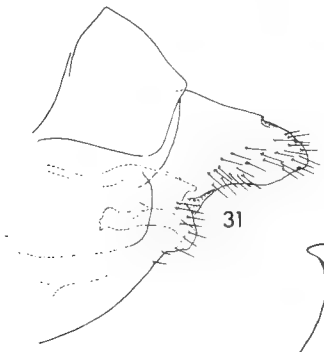

29

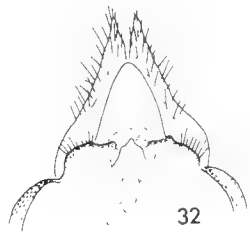

30

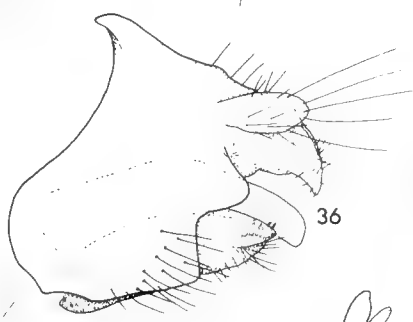

33

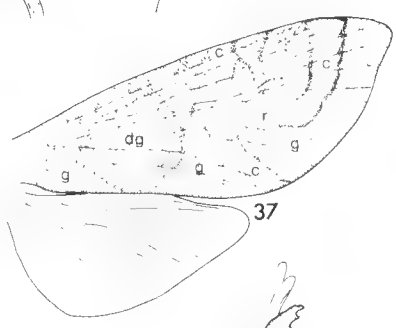

35


34

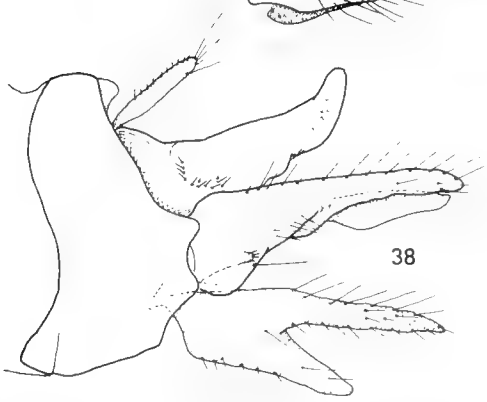

31

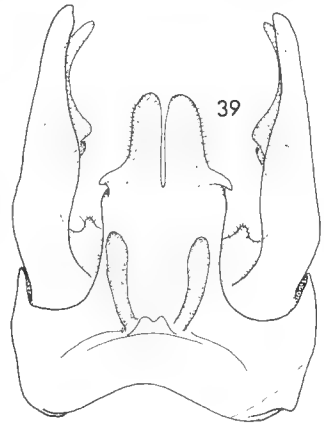

32

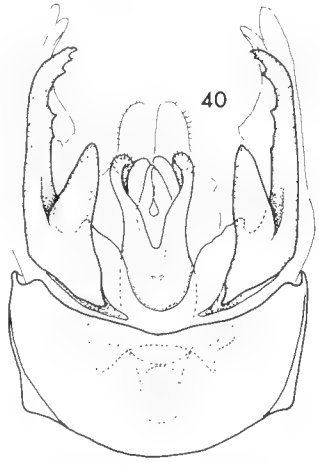

36

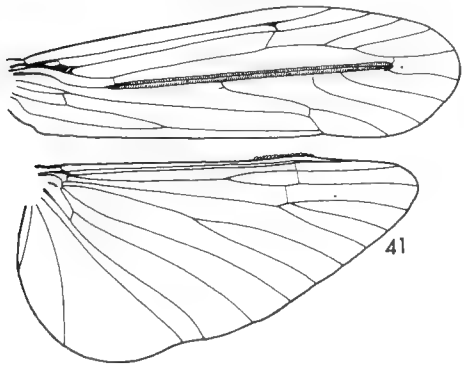


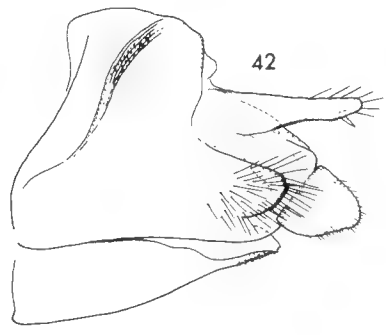
37

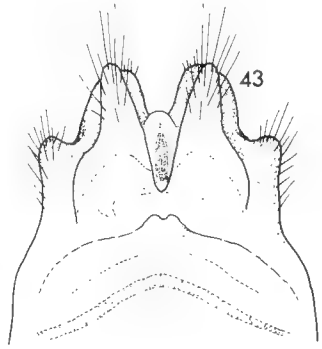

38


39


40


41


42


43

Paratypes 2♂♂, collected with holotype (ANIC, NMV) (genitalia prep. PT-1215 figured).

Description. Head dorsally dark brown, highly shiny with only a few black setae, antennae slender, segments dark brown basally becoming paler distally, each with a narrow ring of snow-white scales; maxillary palpi densely covered with black, erect setae giving a 'bottle brush' appearance.

Forewings dark brown, wing membrane highly shiny, costal half covered with blackish hairs to vein M; wing portion between M and A, particularly distal area, densely covered with short coppery coloured hairs; hindwings dark brown with light sprinkling of coppery coloured hairs.

Male genitalia with distal margin of tergite 9 extended into robust triangular hood-shaped projection, slightly incised mesally, inferior appendages very short.

Female similar in colouration to the male; vaginal sclerite as illustrated in Fig. 35.

Length of forewing: ♂ 8-8.5 mm; ♀ 8.7 mm.

Distribution. New Guinea.

Anisocentropus pictilis sp. nov.

Figures 36, 37

Type material.

Holotype ♂, Woodlark Island, Kulumadau (9°03'S., 152°43'E.), 20 Jan-6 May 1957, W.W. Brandt (ANIC) (genitalia prep. PT-1216 figured).

Description. Forewings with distinct colour pattern of grey with light metallic blue sheen, dull dark grey, russett and cream; an obvious dark grey round marking at basal half of forewing; hindwing uniformly grey.

Antennae about twice the length of forewings, cream, gradually becoming darker near the base.

Female unknown.

Length of forewing: ♂ 10.5 mm.

Distribution. Woodlark Island (known from type locality only).

Remarks. This species closely resembles the New Guinean species *A. io* Kimmins, but differs from the latter by large unicolorous grey circular spot near the base of forewing.

Leptoceridae

Symphitoneuria licmetica sp. nov.

Figures 38-43

Type material.

Holotype ♂, New Caledonia, Mandjelia (20°24'S., 164°32'E.), above Pouebo, 600-750 m, 11-13 May 1984, G. Monteith and D. Cook (NMV T-8222).

Paratypes 1♂, collected with holotype (genitalia prep. PT-1332 figured); 1♀ Aoupinie (21°10'S., 165°18'E.), 20 km NE. of Poya, 650 m, 18-19 May 1984, G. Monteith and D. Cook (genitalia prep. PT-1333 figured); 1♂ Grottes d'Adio (at light), 25 Dec 1965, Biospel. Exped. (SAM).

Description. Wings pale greyish brown with irregular pale spots. Some characters resemble those of the genus *Lectrides*. Forewing venation differs between sexes; in male most of R_{4+5} and M forms a longitudinal fold at midwing; in female venation normal; hindwing venation similar in both sexes, fork 1 absent.

Male genitalia with lateral lobe of segment 9 bluntly bilobed; superior appendages moderately long, rounded apically; segment 10 long, upcurved apically, deeply incised mesally; inferior appendages three-branched, the lower branch large, strongly bipointed, almost as long as the upper branch Phallus short with distinct lateral lobes near the apex.

Female abdominal segment 9 forms laterally extended lobes; a pair of somewhat triangular processes dorsally above segment 10.

Length of forewing: ♂ 11 mm; ♀ 10 mm.

Distribution. New Caledonia.

Acknowledgments

The author is indebted to the curators in charge of the collections of the various institutions for loan of valuable specimens, particularly to Dr R.Poggi, Museo Civico di Storia Naturale, Genoa, to Dr P.C.Barnard, British Museum (Natural History) London and to Dr A.F.Newton, Museum of Comparative Zoology, Harvard University, Cambridge, Mass. for the loan of type material, to Mr I. Henderson of Wellington for presenting the two Lord Howe Island specimens and to Dr G.B.Monteith of Brisbane, for the donation of New Caledonian specimens to the Museum of Victoria collection.

References

Banks, N. 1924. Descriptions of new neuropteroid insects. *Bull. Mus. comp. Zool.* 65: 421-55.

Banks, N. 1939. New genera and species of neuropteroid insects. *Bull. Mus. comp. Zool.* 85: 437-504.

Jacquemart, S. 1965. Contribution à la connaissance de la fauna Trichoptèrologique de la Tasmanie et de la Nouvelle Zélande. *Bull. Inst. R. Sci. nat. Belg.* 41(35): 1-47.

Kimmins, D.E. 1957. Neuroptera and Trichoptera collected by Mr. J. D. Bradley on Guadalcanal Island 1953-54. *Bull. Br. Mus. Nat. Hist. (Entomol.)* 5: 289-308.

Kimmins, D.E. 1958. Miss L. E. Cheesman's expedition to New Hebrides, 1955. Orders Odonata, Neuroptera and Trichoptera. *Bull. Br. Mus. Nat. Hist. (Entomol.)* 6: 237-50.

Kimmins, D.E. 1962. Miss L. E. Cheesman's expeditions to New Guinea. Trichoptera. *Bull. Br. Mus. Nat. Hist. (Entomol.)* 11: 99-187.

McLachlan, R. 1864. On the trichopterous genus *Polycentropus*, and the allied genera. *Ent. mon. Mag.* 1: 26, 30.

Malicky, H. 1978. Beiträge zur Kenntnis der Insektenfauna Sumatras. Teil 7: Köcherfliegen (Trichoptera) aus Sumatra und West Neuguinea. 1. Rhyacophilidae, Glossosomatidae, Stenopsychidae, Goeridae. *Beitr. naturk. Forsch. Südw. Dtl.* 37: 159-73.

Mosely, M.E. 1941. Fijian Trichoptera in the British Museum. *Ann. Mag. nat. Hist.* (11)7: 361-74.

Mosely, M.E. and Kimmins, D.E. 1953. *The Trichoptera (caddis-flies) of Australia and New Zealand.* British Museum (Natural History): London. 550 pp.

Navás, L. 1933. Insecta orientalia. XII series. *Mem. Pont. Accad. Sci. Nuovi Lin.* 17: 75-108.

Neboiss, A. 1974. A critique of a publication by S.Jacquemart on Tasmanian Trichoptera. *Aust. Entomol. Mag.* 2: 13-15.

Neboiss, A. 1977. A taxonomic and zoogeographic study of Tasmanian caddis-flies (Insecta: Trichoptera). *Mem. natn. Mus. Vict.* 38: 1-208.

Ross, H.H. 1956. *Evolution and classification of the mountain caddis-flies.* University of Illinois Press: Urbana. 213 pp.

Schmid, F. 1959. Trichoptères du Pakistan. *Tijdsch. Ent.* 102: 231-53.

CONTENTS

NUMBER 1

NUMBER 2