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# A NEW SPECIES OF *LERISTA* (SCINCIDAE) FROM CENTRAL QUEENSLAND

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*Lerista chordae* sp. nov. from the Desert Uplands Bioregion of central Queensland is a small skink with tetradactyl limbs and a moveable eyelid. It is readily distinguished from its congeners by the combination of fore-limb only 35-52% of hind-limb length; 2 phalanges and 3 subdigital lamellae on the 4th finger; ear aperture similar size or smaller than nostril; normally 20 midbody scale rows; four lines of dark flecks on dorsum; an ill-defined dark dorsolateral zone encompassing two half-scale widths only; an immaculate white vent and tail pale yellow in spirit. The new species occurs in open *Eucalyptus* woodlands characterized by very sandy soils and a sparse to dense ground cover of spinifex or other tussock grasses. The morphologically similar species *Lerista quadrivincula*, known from a single specimen, is redescribed. ❑ *Lerista, skink, new species, desert uplands, central Queensland.*

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The Desert Uplands Bioregion of central Queensland is an area of *Acacia* and *Eucalyptus* woodlands, dune systems and grasslands bordering the Einasleigh Uplands, Mitchell Grass Downs and the Northern Brigalow Belt between Charters Towers, Hughenden and Blackall. It has been little surveyed in comparison with nearby coastal eastern Queensland. Its biodiversity potential has probably been under-appreciated. Recent surveys have resulted in the discovery of a new species of *Ctenotus* (Couper et al., 2002) and a new species of *Lerista*, described herein. This suggests that the inhabitants of the diverse habitats of this bioregion especially the smaller, cryptic species, may be worth closer scrutiny, particularly as pressure for more intensive development for pastoral activity increases.

*Lerista* is the second largest reptile genus in Australia (after *Ctenotus*) with 79 species recognised at the end of 2003. While many species are common and widespread, many others are known from only a few specimens from few or remote localities; *L. bunglebungle* Storr, 1991, *L. praefrontalis* Greer, 1986, *L. quadrivincula* Shea, 1991 and *L. speciosa* Storr, 1990 are recorded solely from the holotype. Knowledge of intra- and inter-specific variation is therefore very patchy within this genus.

As has been pointed out elsewhere (Greer, 1987, 1989, 1990b), the remarkable range of limb reduction within the genus, from the full 5 digit condition to limbs entirely absent, even varying within a species, offers rich possibilities for study of the evolutionary processes driving this condition. The dire situation of *Lerista allanae*, possibly Australia's first reptile species to be driven to extinction by human activities (Covacevich et al., 1996), exemplifies the need for sound taxonomic assessment of cryptic taxa as an aid in determining conservation priorities.

## METHODS

Part of the type series, the first specimens to be identified, was collected during broadscale surveys conducted within the Desert Uplands to assess the patterns of vertebrate assemblage and distribution (Kutt, 2003). Sampling methods are described in Couper et al. (2002). The rest of the type series, including the holotype, was collected by hand opportunistically along the Torrens Creek-Aramac Rd. These specimens were hiding in loose bark or small partly buried branches, in sandy patches in a generally clay-soil terrain.

All body measurements were taken using Mitutoyo electronic calipers. Scales were counted on the right side only of specimens examined. The total number of enlarged nuchals is given. Presacral vertebrae, caudal vertebrae and phalanges were counted on X-ray photographs taken with a Torrex 120D X-ray inspection system using 50kV, 50mA, 50s exposure. Only original tails were included in the morphometric analysis (assessed by X-ray). Abbreviations for body measurements are as follows: snout-vent length (SVL); axilla to groin (AG); original tail length (vent to tip, TL); fore-limb (axilla to tip of longest finger, L1); hind-limb (groin to tip of longest toe, L2); snout-axilla (SA); head width (widest point, HW); head length (tip of snout to posterior margin of parietals, HL); eye to ear (posterior margin of orbit to dorsal anterior margin of ear, EE). Scalation definitions follow Horner (1992). Other abbreviations used: Queensland Museum (QM), South Australian Museum (SAM), standard deviation (SD). For comparison, all species of the *Lerista frosti* group (*L. dorsalis*, *L. flammicauda*, *L. frosti*, *L. quadrivincula* and *L. zietzi*) were examined using museum specimens.

## SYSTEMATICS

The new species is assigned to *Lerista* Bell, 1833, following the revised diagnosis of Greer (1986). It conforms to the *frosti* group (Storr et al., 1999), with moveable eyelids, a 4 + 4 digital formula, 3 supraoculars, 5 supraciliaries, 6 upper labials and midbody scales in 18-22 rows. These plesiomorphic characters are widespread in *Lerista* (Greer, 1986, 1990a) and so membership of the group does not necessarily imply close phylogenetic relationship between group members.

### **Lerista chordae** sp. nov.
(Figs 1, 2)

ETYMOLOGY. Latin *chordae*, strings of a lyre, in reference to the thin black lines on the dorsum.

MATERIAL. HOLOTYPE QMJ81070 Torrens Creek-Aramac Rd, 40km S Torrens Creek (21°05'30"S 145°00'16"E). PARATYPES QMJ72754-5 Bede Stn, 100km NNE of Aramac (22°22'37"S, 145°35'32"E), QMJ74034 Ulva Stn, 100km S of Torrens Creek (21°25'00"S, 145°08'45"E), QMJ81071 22km (road) S of Torrens Creek (20°59'09"S 145°01'54"E), SAMR55681-4 Torrens Creek-Aramac Rd, 40km S Torrens Creek (21°05'30"S 145°00'16"E). See Fig. 3 for map of collection localities.

DIAGNOSIS. Readily distinguished from all other *Lerista* by the combination of smaller size (max. SVL 45.10mm), lower eyelid moveable; ear aperture similar size to nostril; four digits on fore- and hindlimbs, forelimb 35-52% of hindlimb length; 2 phalanges and 3 subdigital lamellae on 4th finger; normally 20 midbody scale rows; 36-38 presacral vertebrae; four lines of dark flecks on dorsum; an ill defined dark dorsolateral zone encompassing two half-scale widths only; an immaculate white vent and tail pale yellow in spirit.

DESCRIPTION. Measurements. SVL (mm) 29.28-45.10 (mean=38.27, SD=5.59, n=9). Proportions (% SVL): AG=61.82–69.55 (mean=65.79, SD=2.34, n=9); TL=112.78-130.08 (mean=119.62, SD=9.20, n=3); L1=9.76–13.63 (mean=11.71, SD=1.24, n = 8); L2=18.76–32.54 (mean=25.82, SD=4.14, n=9); HL=12.17-14.46 (mean=13.15, SD=0.98, n=9), SA=25.68-31.19 (mean=28.56, SD=2.00, n=9). Proportions (% L2): L1=35.62-52.03 (mean=45.48, SD=5.07, n=8). Proportions (% HL): HW=52.42–64.62 (mean=57.11, SD=3.89, n=9); EE=38.91-49.69 (mean=41.80, SD=3.42, n=9).

*Scalation*. Rostral crescent-shaped with triangular medial projection between nasals; nasals separated (n = 7) or in contact (n=2), nostril placed anteriorly and laterally; frontonasal wider than long, saddle-shaped, triangular anteriorly between nasals to meet or just fail to meet rostral, concave posteriorly; frontal longer than wide, somewhat coffin-shaped, contacts frontonasal, prefrontals, first 2 supraoculars and frontoparietals; 3 supraoculars, 2nd the largest; supraciliaries 5, rarely 4 (QMJ81071 one side only), 1st, 3rd and 4th project between prefrontal and 1st supraocular, 1st and 2nd supraocular, 2nd and 3rd supraocular respectively; palpebrals 5 rarely 6 (QMJ72755); frontoparietals paired and distinct; interparietal distinct, angular anteriorly, rounded posteriorly; parietals in broad contact behind interparietal; 2-6 enlarged nuchals; loreals 2, 1st largest; 2 preoculars, 1 presubocular; 2 postoculars, 1 postsubocular; primary temporal in contact with pretemporal, secondary temporal, 5th and 6th supralabials; secondary temporal in broad contact with parietal, primary temporal and point contact with pretemporal; supralabials 6, 4th subocular; infralabials 6, 2 contacting postmental; 2 additional rows of enlarged chin shields; ear opening circular to vertically elliptic, similar size to nostril; midbody scale rows 20, rarely 18 (QMJ81071, SAMR55681); paravertebrals 68-75 (mean=72.33, SD=3.08, n=9); lamellae beneath 4th finger 3 (n=8); supradigitals above 4th finger 2 (n=8); lamellae beneath 4th toe 5, rarely 4 (SAMR55682, QMJ72754 one side only) or 6 (SAMR55682, R55684 one side only); supradigitals above 4th toe 4 rarely 3 (QMJ72755, J81071, SAMR55681 one side only) or 5 (SAMR55684 both sides); lamellae beneath longest toe (3rd) 13-16 (mean 14.44, SD =1.01, n=9); supradigitals above longest toe

FIG. 1. One of the paratypes of *Lerista chordae* in life, Torrens Creek-Aramac Rd (21°05'30"S 145°00'16"E).

(3rd) 9-12 (mean=10.11, SD=0.93, n=9); subcaudals 78-81 (mean=79.33, SD=1.53, n=3).

*Osteology.* Presacral vertebrae 36-38 (mean= 37.33, SD=0.87, n=9) and caudal vertebrae 42 (n =3). Phalangeal formula of fore-limb 0.2.3.4.2 (n =4), hind-limb 0.2.3.5.3 (n=7).

*Holotype.* Measurements and scale counts for the holotype are as follows: Sex: male (determined by dissection); SVL =42.79mm; AG=28.50mm; TL=55.66mm; L1=4.84mm; L2=9.84mm; HL=5.37mm; HW=3.00mm; EE=2.13mm; SA= 12.08mm; nasals separated, enlarged nuchals 6, supraciliaries 5, palpebrals 5, ear opening circular, midbody scale rows 20, paravertebrals 75, lamellae beneath 4th finger 3; supradigitals above 4th finger 3; lamellae beneath 4th toe 5, supradigitals above 4th toe 4, lamellae beneath longest toe (3rd) 15, supradigitals above longest toe (3rd) 12, subcaudals 78. Presacral vertebrae 37, caudal vertebrae 42.

*Colour Pattern (In Spirit).* Dorsal ground colour grey-brown to bronze. Four longitudinal lines of fine dark chocolate brown spots running from nape to base of tail, breaking up into irregular flecking along tail, outer pair sometimes discontinuous (SAMR55681). Chocolate brown dorsolateral band from rostral to base of tail, 2 half-scale widths on flanks, ill-defined, continuing along tail where it breaks up into irregular flecking and tends to merge with dorsal flecks. Head with dark, fine flecks above. A dark vertical medial bar through rostral scale. Pale limbs mottled with dark brown above. Tail very pale yellow in spirit. Ventral surfaces immaculate white, very pale yellow on tail. Supralabials lightly to strongly edged with brown/black, sometimes infralabials also (QMJ72754-5). Lateral scales edged with dark brown/black merging with dark dorsolateral band. Regrown tail may be immaculate pale yellow (SAMR55684). In life, juveniles have bright red tail colouring (brightest on the ventral surface), the colour in adults being pale orange-yellow.

*Variation in Paratypes.* Quantitative variation in scale characters and osteology among paratypes is given above. Paratypes varied in the degree of dark markings, from 2 faint rows of spots on the dorsum, light flecking on the top of the head and no labial edging (SAMR55681) to 4 broken lines dorsally (QMJ81071), heavy flecking on the top of the head (QMJ74034) and heavy edging on the supralabials (QMJ72754 and J75755). Sex was known for only 3 individuals (QMJ81070, SAMR55682 and R55683, examination through incision made for tissue sampling), which were all males. These exhibited wide variability in characters normally associated with sexual dimorphism in *Lerista*. For example, the number of presacral vertebrae is commonly higher in females than males (Greer, 1987, 1990b) while in the 3 known males, these ranged between 36 and

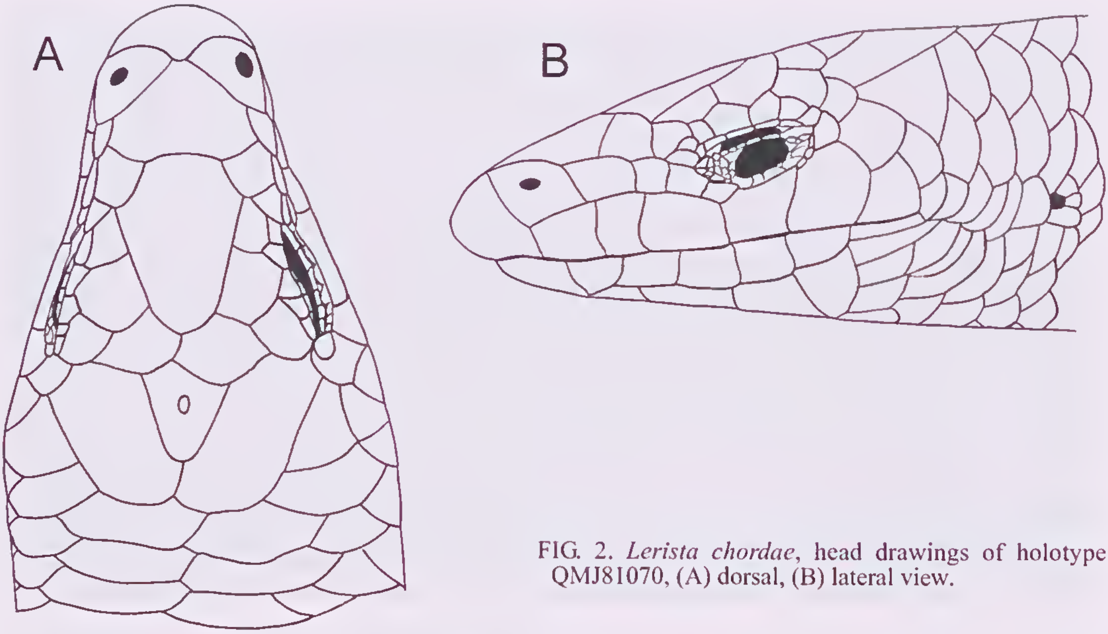

FIG. 2. *Lerista chordae*, head drawings of holotype QMJ81070, (A) dorsal, (B) lateral view.

38, the total range for the species. Consequently, it was thought unnecessarily destructive to determine sex of the other individuals, and therefore any dimorphic characters.

*Comparison with Other Species.* The combination of tetradactyl fore- and hind-limbs and a movable eyelid distinguishes this species from all currently described *Lerista* except *L. dorsalis*, *L. flammicauda*, *L. frosti*, *L. quadrivincula* and *L. zietzi*. Nasals normally widely separated, nostril similar size to ear aperture, short fore-limbs (35-52% of hind-limb) with digital formula 0.2.3.4.2, 3 subdigital lamellae on the 4th finger, dorsum with 4 longitudinal lines of flecks, and narrow, ill-defined dorsolateral band separate this species from *L. flammicauda* and *L. zietzi* (nasals usually in contact, ear aperture larger than nostril, fore-limbs with digital formula 0.2.3.4.3, 52-77% hind-limb with 5-7 lamellae on 4th finger or 63-77% hind-limb with 6-7 lamellae on 4th finger respectively, dorsum either immaculate or 2-4 narrow, discontinuous lines of flecks on nape or rump, dorsolateral band 2 scales wide, solid and sharp-edged or narrow but solid and well-defined dorsally). It is distinguished from *L. dorsalis* and *L. frosti* by an irregular dark dorsolateral stripe (vs. a wide, sharp-edged and solid dorsolateral and its immaculate ventral surface (vs. darkly edged ventral scales). It is further distinguished from *L. dorsalis* by the fore-limb digital formula 0.2.3.4.2 (vs 0.2.3.4.3) and 3 lamellae on the 4th finger vs. 4-6 lamellae. It is distinguished from *L. quadrivincula* by smaller size (maximum SVL 45.10mm vs 51.13mm), fewer presacral vertebrae (36-38 vs 42) and a pale yellow tail differently coloured to the body, immaculate below vs. tail same colour as body, reticulated below. *Lerista quadrivincula* is known from a single specimen from the arid northwest coast of the Pilbara, WA, ~ 2,500km west of the known distribution of *L. chordae*.

DISTRIBUTION. *Lerista chordae* occurs in the Desert Uplands, within an area encompassing a central zone of yellow and red sandy earths (20°-23°S) and, to the immediate west, alluvial sand plains (Fig. 3). It is associated with two open woodland vegetation types (see Habitat).

HABITAT. *Lerista chordae* is a fossorial lizard occurring in open woodlands on sandy soils with a predominantly spinifex or other tussock grass dominated ground cover. It was found in 2 associated regional ecosystems types in the Desert Uplands bioregion. The specimens from Bede Station were trapped in the low, open *Eucalyptus similis* (yellowjacket), *Corymbia brachycarpa*, *C. setosa* (bloodwood) and *C. dallachiana* (ghost gum) woodlands with a moderate to dense spinifex (*Triodia pungens*) ground cover that is mediated by fire-age and grazing intensity (regional ecosystem 10.5.1 and 10.5.2, Sattler & Williams, 1999). This

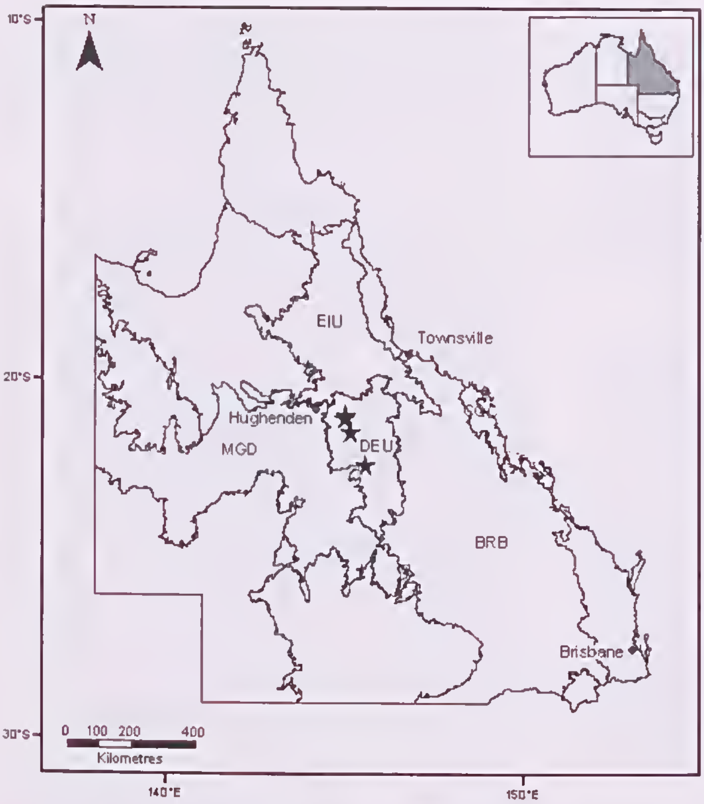

FIG 3. Map of collection localities of *Lerista chordae* in the Desert Uplands bioregion. EIU = Einasleigh Uplands, MGD = Mitchell Grass Downs, DEU = Desert Uplands, BRB = Brigalow Belt. Map sources: AUSLIG (1992), Queensland Herbarium June (2001), Queensland Environmental Protection Agency (1998).

vegetation is widespread and occurs on the extensive, uniform, gently undulating Cainozoic sand deposits along the Great Dividing Range. Another recently described reptile for the Desert Uplands, *Ctenotus rosarium* Couper et al., 2002, also occurs in this vegetation type. The specimens from Bede Station were captured in a pitfall trap from a long unburnt site (>8 years), where the habitat was characterised by dense spinifex cover (>60%).

At Ulva Station and the sites south of Torrens Creek, specimens were located on small sandy rises within old alluvial sand plains. These sandy rises are dominated by mixed bloodwood and gum open woodlands (*Corymbia terminalis*, *C. dallachiana*, *C. plena*) with a variable lower tree storey and shrub layer containing species such as *Grevillea parallela*, *Carissa lanceolata*, *Eremophila mitchelli* and *Acacia* spp. These patches are usually interspersed within more extensive Whites Ironbark (*Eucalyptus whitei*) communities. The ground layer is sparse, frequently dominated by *Triodia pungens*, with other graminoids such as *Aristida* spp., *Paraneurachne muelleri*, *Heteropogon contortus*, and *Eriachne mucronata* (present regional ecosystem 10.3.10 in mosaic with 10.3.9, Sattler & Williams, 1999). The soils consist of deep, unconsolidated sands, much like dune rises. This vegetation type occurs west and adjacent to the Cainozoic sand sheets described above, and on extensive sand sheets on the ancestral floodplains of the Flinders River (now centred on Torrens Creek). The specimen from Ulva Station was hand-captured and found sheltering under a log. At this locality the habitat was characterised by having a moderate tussock grass, forb and litter layer (>50%), and a discrete mid-storey shrub layer.

## DISCUSSION

*Lerista chordae* is morphologically close to *L. dorsalis*, to which it would key in Cogger (2000) by virtue of its 4/4 digital formula, moveable eyelid, ear opening same size as nostril and well-developed dorsal stripes. Its 4/4 digital formula, moveable eyelid, 3 supraoculars, 5 supraciliaries, 6 upper labials and 18-20 midbody scale rows places it in the *L. frosti* group of Storr et al. (1999) along with *L. dorsalis*, *L. flammicauda*, *L. frosti*, *L. quadrivincula* and *L. zietzi*, and the more broadly defined *L. elegans* group of Wilson & Knowles (1988). However, none of the species groups within *Lerista* have been tested genetically so their phylogenetic validity is unknown. Some morphological character states have been used by Greer (Greer et al., 1983, Greer, 1986, 1990a) to redefine some species groups on the basis of synapomorphies, but most remain no more than aids to rapid identification. Work on the evolutionary relationships among species of *Lerista* is in progress using DNA sequence data and morphology (pers. comm. Adam Skinner, SA Museum and University of Adelaide). Preliminary data from both mitochondrial nuclear sequences consistently support the clade ((*L. fragilis*, *L. chordae*), *L. frosti*)) but fail to find a close relationship between these three and *L. dorsalis*. While future work may better resolve relationships, it is clear at the present time that the DNA evidence supports recognition of *L. chordae* as a distinct species from *L. dorsalis*, and further suggests that its nearest relatives are more likely to be northern Australian taxa rather than the geographically remote *L. dorsalis*.

In the light of the DNA information obtained so far, the extra phalanx on the fourth finger of *L. dorsalis* is intriguing. This character separates it from *L. chordae* as well as all other members of the *L. frosti* group. No variation was observed in these characters, in contrast to Greer's (1987, 1990b) findings of up to 9.5% within a species, although our sample sizes are small, as phalanges were not always clearly visible in X-ray photographs (*L. chordae* n = 9; *L. dorsalis* n = 26; *L. flammicauda* n = 4; *L. frosti* n = 7; *L. zietzi* n = 7). Any functional significance of such a small difference is unclear. However, the sequence from *L. dorsalis* to other members of the *L. frosti* group (0.2.3.4.3 → 0.2.3.4.2) fits within the schema of progressive limblessness within *Lerista* given by Greer (1990b).

The type of *L. quadrivincula*, as a member of the *L. frosti* morphological group, was examined for this study. This is the only known specimen of this species. As the type description (Storr, 1990) is brief, a redescription, based on our observations, is included here in the Appendix. No significant inconsistencies between Storr's description and our observations were noted.

A number of potential threats to the populations of *L. chordae* can be identified. The location of specimens in long unburnt spinifex at Bede Station suggests that the persistence of a high ground and litter cover is required by this species. However, introduced Buffel Grass (*Cenchrus ciliaris*), which can alter and increase the fire intensity in spinifex communities is invading these ecosystems (Morgan et al., 2002). Furthermore regional ecosystem 10.3.10 and 10.3.9 in the Torrens Creek region has in recent years been heavily targeted for land clearing, with a further 40% (>100,000ha) proposed (Morgan et al., 2002). Cattle grazing in general can cause dramatic changes to ground cover, which may have some impact on fossorial species (Woinarski et al., 2001). Though these threats are in part speculative and may seem exaggerated, the case of *Lerista allanae*, a species distributed on the eastern edge of the Desert Uplands and now considered probably extinct (Covacevich et al., 1996), suggests that even small reptiles are susceptible to long-term threats of land cover change associated with agriculture.

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## APPENDIX

Redescription of *Lerista quadrivincula* Shea 1991 (original description by Storr, 1990, as *Lerista concolor*, a junior subjective homonym of *Lygosoma (Rhodona) bipes concolor* Werner, 1910, see Shea, 1991). Head scale diagrams are provided in Storr (1990).

*Measurements.* SVL (mm) = 51.13. Proportions (%SVL): AG = 67.40; tail broken; L1 = 11.32; L2 = 22.00; HL = 11.34, SA = 26.58. Proportions (%L2): L1 = 51.47. Proportions (%HL): HW = 63.10; EE = 48.62.

*Scalation.* Rostral crescent-shaped with triangular medial projection between nasals; nasals narrowly separated, nostril placed medially; frontonasal wider than long, saddle-shaped, triangular anteriorly between nasals to meet rostral, slightly concave posteriorly; frontal longer than wide, somewhat coffin-shaped, contacts frontonasal, prefrontals, first 2 supraoculars and frontoparietals; 3 supraoculars, 2nd the largest; supraciliaries 5, 1st, 3rd and 4th project between prefrontal and 1st supraoculars to contact frontal, 1st and 2nd supraocular, 2nd and 3rd supraocular respectively; palpebrals 7; frontoparietals paired and distinct; interparietal distinct, angular anteriorly, rounded posteriorly, overlapped by right parietal; parietals in contact behind interparietal; 4 enlarged nuchals; loreals 2, 1st largest; 2 preoculars, 1 presubocular; 2 postoculars, 1 postsubocular; primary temporal in contact with pretemporal, secondary temporal, 5th and 6th supralabials; secondary temporal in broad contact with parietal, primary temporal and pretemporal; supralabials 6, 4th subocular; infralabials 6, 2 contacting postmental; 2 additional rows of enlarged chin shields; ear opening circular, same size as nostril; midbody scale rows 20; paravertebrals 78; lamellae beneath 4th toe 7; supradigitals above 4th toe 5; lamellae beneath longest toe (3rd) 17; supradigitals above longest toe (3rd) 11.

*Osteology.* Presacral vertebrae 41. Fore-limb phalangeal formula 0.2.3.4.2, hind-limb 0.2.3.5.3.

*Colour Pattern.* Ground colour brown. Four longitudinal lines of discontinuous chocolate brown flecks running from nape to base of tail, breaking up into irregular flecking along tail. Chocolate brown dorsolateral band from nasal to base of tail, two half-scale widths on flanks, ill-defined, continuing along tail where it breaks up into irregular flecking merging with dorsal flecks and reticulate pattern ventrally. Head with sparse dark, fine flecks above. Limbs mottled with dark brown above. Tail same colour as body. Ventral surfaces immaculate except for reticulate pattern on tail. Supralabials edged with dark brown, some edging on infralabials also. Lateral scales mottled with dark brown merging with dorsolateral band.

**_PORTMACQUARIA_ NOM. NOV. PRO _MACQUARIA_ BLOME, 2002 (NEMATODA: CHROMADORIDAE).** *Memoirs of the Queensland Museum 50(2): 132. 2005*:- *Macquaria* Blome, 2002 (free-living marine nematodes) is preoccupied by *Macquaria* Cuvier in Cuvier & Valenciennes, 1830 (Percichthyidae: Pisces) and has to be replaced (ICZN, 1999, Art. 52, 53, 56, 60).

The type locality for this Australian sandy beach nematode genus is Port Macquarie, New South Wales and so the junior homonym is here replaced with *Portmacquaria*.

*Portmacquaria* nom. nov., syn. *Macquaria* Blome, 2002 nec *Macquaria* Cuvier in Cuvier & Valenciennes, 1830. Type species: *Portmacquaria chimaira* (Blome, 2002) comb. nov. (=*Macquaria chimaira* Blome, 2002). The genus is monotypic.

**Acknowledgements**

I thank Christian F. Kammerer, University of Chicago, USA, for making me aware of the homonymy.

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# A REVISION OF THE AUSTRALIAN ODACANTHINE GROUND BEETLES, INCLUDING CHECKLISTS FOR AUSTRALIA AND THE PAPUAN SUBREGION. (INSECTA: COLEOPTERA: CARABIDAE)

MARTIN BAEHR

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The Australian Odacanthinae are revised, except for *Giachinoana* Baehr, *Ophionea* Klug (= *Casnoidea* Castelnau), *Porocara* Sloane, *Renneria* Baehr, and the *brunnea*-group of *Dicraspeda* Chaudoir. New species taxa described are: *Archicolliuris occipitalis*, *A. splendissimus*, *Clarencia breviceps*, *Deipyrus inops*, *Eudalia atrata*, *E. femorata*, *E. latipennis interioris* subsp. nov., *E. minor*, *E. obliquiceps punctifrons* subsp. nov., *E. obliquiceps tozeria* subsp. nov., *E. punctipennis*, *E. reticulata*, *Gestroania setipennis*, *G. storeyi*, *Myrmecodemus lucai* and *M. pilosellus*. *Clarencia angusticollis* (Macleay) and *Eudalia waterhousei* Castelnau are raised from synonymy to full specific status. *Eudalia froggatti* Macleay is moved to *Gestroania* Liebke. *Neoeudalia* gen. nov., is erected for *Eudalia nigra* Sloane. *Myrmecodemus (Trichodemus)* subgen. nov., is erected for *Myrmecodemus pilosellus* sp. nov. To stabilise nomenclature, lectotypes, and associated paralectotypes, are designated for the following taxa: *Anasis howittii* Castelnau, *Clarencia angusticollis* (Macleay), *C. australis* (Chaudoir), *C. clarensii* (Castelnau), *Deipyrus palustris* (Sloane), *Dicraspeda brunneipennis* (Sloane), *D. obscura* (Castelnau), *Eudalia castelnaui* Sloane, *E. latipennis latipennis* (Macleay), *E. waterhousei* Castelnau, *Gestroania froggatti* (Macleay), *Myrmecodemus formicoides* (Sloane), *M. globulicollis* (Macleay), and *M. riverinae* (Sloane). A neotype is designated for *Neoeudalia nigra* (Sloane). Notes are provided about species for which new material or information is at hand. A key to genera of Odacanthinae currently recorded from Australia is provided. Keys are also provided for the Australian species of *Archicolliuris* Liebke, *Clarencia* Sloane, *Deipyrus* Liebke, *Dicraspeda* Chaudoir, *Eudalia* Castelnau, *Gestroania* Liebke, *Myrmecodemus* Sloane, *Ophionea* Klug, and *Porocara* Sloane. Checklists are provided of all odacanthine species recorded from Australia and the Papuan subregion, with some information about distribution. Representatives of all Australian genera and all new taxa described in this paper are figured. ❑ *Coleoptera, Carabidae, Odacanthinae, Australia, New Guinea, checklists.*

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Until recently the Australian odacanthine fauna was believed to be much less speciose than that of other continents (Moore et al., 1987). Despite this apparent species paucity, the Australian fauna is surprisingly diverse and appears to include some of the most plesiotypic Odacanthinae. My collecting in far northern and northwestern Australia convinced me that at least some genera are much more speciose than suspected.

Review of many Australian types and of many unidentified Odacanthinae in Australian museums and other collections found a new genus, a new subgenus and several new species.

Certain previously synonymised species are returned to separate species rank. Recently described genera and species (Baehr, 1986, 1996a,b, 1999, 2003b,c), revaluation of Australian species (Baehr, 2003c), and new records of widespread Oriental species in Australia (Baehr, 2000) are incorporated in a checklist of the Australian odacanthine species.

The *brunnea*-group of *Dicraspeda* Chaudoir (Baehr, 2003c), *Ophionea* Klug (=*Casnoidea* Castelnau), *Porocara* Sloane (Baehr, 1986, 1996b,c), *Renneria kamouni* Baehr and *Giachinoana carinipennis* Baehr (Baehr, 1999, 2003b) are not added to herein.

As Sloane's (1910, 1917, 1923) partial keys to the Australian Odacanthinae are outdated, a new key to all known Australian genera is provided. Keys are also given for the species of all genera that include more than one species. Existing keys for *Ophionea* and *Porocara* (Baehr, 1986, 1996b,c) are repeated or rearranged to cover only the Australian species, because no new data are available. A checklist is provided for the Papuan subregion based mainly on the work of

Darlington (1968, 1971) and Baehr (1995, 1996a,b, 1997b, 1998, 2003a,c).

Types of newly described species are shared with the respective collections, but holotypes and spare paratypes described from material from DPIM, Mareeba, and also paratypes and duplicates of species from my own collecting have been lodged in Queensland Museum.

## MATERIAL AND METHODS

Altogether c. 900 specimens of Australian Odacanthinae were available for this study. About 80 additional specimens of New Guinean and Oriental Odacanthinae were used for comparison.

The male genitalia were removed from specimens soaked for a night in a jar under wet atmosphere, then cleaned for a short while in hot KOH.

For examination of the fine punctuation and microreticulation of the surface a high resolution stereomicroscope with up to 64 × magnification was used, supported by a lamp of high intensity giving natural light that could be focussed. For exact definition of the microsculpture such light is preferable, because fibre-optics lights substantially change perception of the surface structures.

The habitus photographs were taken with a digital camera using SPOT Advanced for Windows 3.5 and subsequently were worked with Corel PhotoPaint 10.

Measurements were taken using a stereomicroscope with an ocular micrometer. Length has been measured from apex of labrum to apex of elytra. Lengths, therefore, may slightly differ from those of other authors. Length of eye includes a small dark coloured ring of ocellae that in some instances is present behind the light area. Length of orbit is taken from posterior margin of eye to 'neck' suture. Length of head is the distance from apex of labrum to 'neck'. Length of pronotum was measured from the most advanced part of base to the most advanced part of apex; width of pronotum at widest part, including those parts of the proepisternum that are visible from above. Length of elytra was taken from the most advanced part of humerus to the most advanced apex of elytra including any apical denticles or spines.

ABBREVIATIONS. *Collections*. ANIC, Australian National Insect Collection, Canberra; BMNH, The Museum of Natural History, London; CBM, Working Collection M. Baehr, München; CFP, Collection S. Facchini, Piazenca; CGT, Collection P. M. Giachino, Torino; CMP, Carnegie Museum, Pittsburgh; CRC, Cooperative Research Centre for Tropical Rainforest Ecology and Management, Cairns; CSM, Collection R. Sciaky, Milano; CTV, Collection L. Toledano, Verona; DEI, Deutsches Entomologisches Institut, Eberswalde; HNMB, Hungarian National Museum of Natural History, Budapest; MCSN, Museo Civico di Storia Naturale, Genoa; MCZ, Museum of Comparative Zoology, Cambridge/Mass.; MNHB, Museum für Naturkunde der Humboldt-Universität, Berlin; MNHP, Museum National d'Histoire Naturelle, Paris; NMNHP, National Museum of Natural History, Prague; MV, Museum of Victoria, Melbourne; MDPI, Queensland Department of Primary Industries, Mareeba; QM, Queensland Museum, Brisbane; SAM, South Australian Museum, Adelaide; UQIC, University of Queensland Insect Collection, Brisbane; ZSM, Zoologische Staatssammlung, München.

*Collectors*. Collectors' names are abbreviated as follows: A. Calder (AC), A. D. Selby (AS), A.J. Watts (AW), B. Cantrell (BC), J. Balderson (BJ), Britton & Misko (BM), J. Bugeja (BU), I.C. Cunningham (CC), J. Cardale (CJ), C. Oke (CO), C. Vallis (CV), M. & G. De Baar (DB), D. Cook (DC), S. De Faveri (DF), G. Dickinson (DG), D. Heiner (DH), D.C. F. Rentz (DR), W. Dressler (DW), D.K. Yeates (DY), E.B. Britton (EB), E.C. Dahms (ED), E.D. Edwards (EE), E.G. Matthews (EM), E.S. Nielsen (EN), E.F. Riek (ER), E. Sutton (ES), Earthwatch/Qld.Museum (EW), F.P.Dodd (FD), Fay & Halfpapp (FH), F.G. Satter (FS), F.E. Wilson (FW), J.G. Brooks (GB), G. Daniels (GD), G. Hangay (GH), G.B. Monteith (GM), H.W. Brown (HB), H.W. Davey (HD), H.W. Grawes (HG), K. Hyde (HK), H. Mitchell (HM), H. Shepherdson (HS), I.F.B. Common (IC), Ian Naumann (IN), J.D. Brown (JB), J.H. Calaby (JC), J.E. Feehan (JF), J. Hasenpusch (JH), J. F. Lawrence (JL), J.H. Taylor (JT), J.W. Schomberg (JS), J.L. Wassell (JW), K.H. Halfpapp (KH), L.P. Kelsey (LK), L.A. Ring (LR), L. Toledano (LT), Lea & Wilson (LW), M. Baehr (MB), M. Mendum (ME), M.S. Moulds (MM), M.S. Upton (MU), N. Gough (NG), N.B. Tindale (NT), O. Hillert (OH), P. Aitken (PA), P.M. Giachino (PG), P.M. Hammond (PH), P. Machacek (PM), P. Zborowski (PZ), R.A. Barrett (RB), R. Kitching (RK), R. Olivieri (RO), R.I. Storey (RS), S. Bílý (SB), Storey, Brown & Jacobson (SBJ), S. Fearn (SF), S.A. Hogenhout (SH), S.R. Monteith (SM), T. Gush (TG), T. Weir (TW), V. Framenau (VF), W.D. Dodd (WD), A. & M. Walford-Huggins (WH), W.J.M. Vestjens (WV).

*Localities*. For New Guinean localities PNG =Papua New Guinea, and IJ means Irian Jaya, the Indonesian part of the island which recently was renamed West Papua.

## TAXONOMIC PRINCIPLES

Male genitalia, which are widely used for the distinction of carabid species, rarely yield good distinctive characters in Odacanthinae. Odacanthine aedeagi, except for those of the most highly evolved species, generally lack complex and/or sclerotised internal structures and the folding of the internal sac is quite simple. The most striking differences are in size, overall shape and sometimes in the shape of their apices. Female stylomeres rarely yield characters even for generic differentiation. Nevertheless, distinction of species is reasonably easy, because most species differ in external structural characters that are generally easy to detect. Besides shape and relative size of head, prothorax, and elytra, chaetotaxy and structure of the surface, in particular striation of the elytra, punctuation, microreticulation, and degree of pilosity, are of major importance. Colouration can vary in certain species, but colouration of appendages and pattern of elytra, if present at all, seem to be fairly constant and can be of some value.

Recognition of insect subspecies is a matter of opinion, or better, a taxonomic hypothesis, when the actual interruption of gene flow between populations is not known. This is especially the case for insular populations. Such decisions are extremely difficult, particularly when the respective taxa either are able and willing to fly over considerable distances, or are easily transported by natural or human carriers. Classifications, therefore, are based mostly on morphological characters, at least where insects of almost unknown habits and life histories are concerned, such as those in the present paper. I use subspecies for taxa that exhibit small morphological differences and are allopatric (or at least allotopic), and I use species for taxa that are more strikingly different and/or are sympatric.

Generic concepts in the Australian Odacanthinae are generally well founded, with a few exceptions. Sloane (1917,1923) who founded the systematics of the Australian Odacanthinae, was uncertain about the affiliation of the many differently shaped species of the *Dicraspeda-Eudalia*-complex and he changed his view several times. Liebke (1938) separated *Dicraspeda* and *Eudalia*, but he also split from *Dicraspeda* the genera *Philemonia* Liebke and *Macrocentra* Chaudoir and arranged them at quite different places in his system. Darlington (1968) adopted the present system, combining *Philemonia* and *Macrocentra* with *Dicraspeda* and separating *Eudalia*. This concept is followed here, but it should be noted that *Dicraspeda* in its present concept is remarkably heterogeneous and could be dismembered in future (Baehr, 2003c).

Comparable problems are faced in *Eudalia* which is also quite diverse and could be divided into two subgenera or genera. This is more likely when the rather aberrant New Guinean *E. anomala* Darlington is taken into consideration.

Liebke (1931, 1938) subdivided *Colliuris* De Geer into various subgenera, most of which are retained. Many have been raised to generic rank, but these decisions were not recognised by all authors, or they were adopted to different degrees. As no thorough phylogenetic work has been done on the *Colliuris*-complex, its division into genera and subgenera is still a matter of opinion. I follow Lorenz (1998).

NOMENCLATORIAL NOTE. A number of specimens of previously described species were designated holotype by P.J. Darlington, probably during his stay in Australia in 1956-58. Some of these designations were apparently done without comparing the original descriptions, and in some specimens, even without reading the labels. Some bear written cotype or even topotype labels, and should not have have been designated holotype. It is difficult to imagine why the rules of nomenclature were neglected by a leading taxonomiust in these instances. As a consequence, nomenclatorial decisions of Darlington *a priori* should be checked very carefully.

## KEY TO AUSTRALIAN GENERA OF THE ODACANTHINAE

1. 4th tarsomeres deeply excised in middle and markedly bilobate . . . . . . . . . . . . . . . . . . . . . . . . 2

   4th tarsomeres not deeply excised in middle and not markedly bilobate . . . . . . . . . . . . . . . . . . . . 3

2. Head elongate, more or less distinctly triangular; prothorax rather tubular, without distinct lateral sulcus; elytra narrow, upper surface depressed, red with black or blue pattern and white spots (in Australian species) (Fig. 38D) . . . . . . . . . . . . . . . . . . *Ophionea* Klug

   Head not elongate, convex; prothorax not tubular, with distinct lateral sulcus; elytra rather short and wide, upper surface not markedly depressed, uniformly black or dark piceous (in Australian species) (Fig. 34D, E) . . . . . . . . . . . . . *Dicraspeda* Chaudoir (part)

3. Head not distinctly narrowed behind eyes; colour of surface brick-red, elytra with serrate, cruciate dark pattern (Fig. 38E) . . . . . . . . . . . *Porocara* Sloane

   Head distinctly narrowed behind eyes; colour of surface different, elytra with different pattern, or unicolourous 4

4. 3rd antennomere very elongate, as long as 4th and 5th together (Fig. 33F, 34A) . . . . . . . *Clarencia* Sloane

   3rd and 4th antennomeres of about equal length . . . . 5

5. Elytra elongate, parallel, upper surface remarkably depressed, apex almost transverse, without any excision (Fig. 33A). . . . . . . . . . . . . . . *Anasis* Castelnau

Elytra usually shorter and less parallel; when elongate, then upper surface not markedly depressed and apex oblique, usually more or less distinctly excised . . . . 6

6. Head with distinct longitudinal sulcus and ridge inside of eye. . . . . . . . . . . . . . . . . . . . . . . . . . . 7

Head without or with indistinct sulcus and ridge inside of eye . . . . . . . . . . . . . . . . . . . . . . . . . . . 11

7. Odd elytral intervals cariniform, external apices of elytra spiniform (Fig. 37B) . . . . . . . . *Giachinoana* Baehr

Odd elytral intervals not cariniform, external apices of elytra not spiniform, at most gently angulate (in Australian species) . . . . . . . . . . . . . . . . . . . 8

8. Pronotum with indistinct lateral margin, or margin not medially bordered by a deep sulcus; elytra glossy black with 2 or 4 small white spots (in Australian species) (Fig. 33B,C) . . . . . . . . . . . . . . *Archicolliuris* Liebke

Pronotum with very conspicuous ridge-like margin, margin medially bordered by a deep sulcus; elytra piceous or black, without white spots . . . . . . . . . 9

9. Elytra deeply punctate-striate in basal third, barely striate in apical two thirds; with deep transverse sulcus in basal third; elytra rather narrow and elongate; lateral margins of pronotum conspicuously sinuate (Fig. 33E) . . . . . . . . . . . . . . . . . . . . *Basistichus* Sloane

Elytra fully striate, or striation becoming gradually weaker towards apex; without or with only shallow transverse sulcus in basal third, in latter case elytra more depressed and rather wide; lateral margins of pronotum barely sinuate . . . . . . . . . . . . . . . . . . . . . 10

10. Surface with dense, elongate, erect pilosity; elytra with shallow transverse depression near apex, 7th interval tumid in apical third; 3rd antennomere sparsely setose; tibiae dark with conspicuous yellow ring (Fig. 38C) . . . . . . . . . . . . . . . . . . . *Neoeudalia* gen. nov.

Surface without pilosity; elytra without transverse depression near apex, 7th interval not tumid; 3rd antennomere glabrous, except for apical setae; tibiae uniformly yellow or dark, without yellow ring (Fig. 34D, E) . . . . . . . . . . . . . . . . *Dicraspeda* Chaudoir

11. 3rd antennomere impilose. . . . . . . . . . . . . . . 12

3rd, and usually also 1st and 2nd antennomeres, pilose. 15

12. Elytral striae impunctate, rather sulcate; head markedly triangular towards base (Fig. 33D) . *Aulacolius* Sloane

Elytral striae punctate, not sulcate; head convex behind eyes . . . . . . . . . . . . . . . . . . . . . . . . . . 13

13. Lateral margin of pronotum medially bordered by a deep sulcus; all odd intervals with a row of many (>10) erect setae (Fig. 38F). . . . . . . . . . . . . *Renneria* Baehr

Lateral margin of pronotum medially not bordered by a deep sulcus; at most 3rd, 5th and 7th intervals with a row of fewer (<5) erect setae . . . . . . . . . . . . . . . 14

14. Elytra ampliate, apically considerably widened and externally angulate or spinose; antenna very elongate, 4th antennomere not pilose (Fig. 36D-F, 37A) . . . . . . . . . . . . . . . . . . . . *Gestroania* Liebke

Elytra not ampliate, apically not or little widened and externally not angulate; antenna shorter, 4th antennomere pilose (Figs 34F, 35, 36A-C) . . . . . . . . . . . . . . . . . . . *Eudalia* Castelnau

15. Elytral striae almost complete; prothorax densely punctate and pilose on disk . . . . . . . . . . . . . . 16

Elytral striae incomplete, either only basal third striate, or but 2 inner striae complete; prothorax in middle impunctate, either glabrous or coarsely, transversely rugose, impilose on disk (Fig. 37D-F, 38A-B) . . . . . . . . . . . . . . . . . . *Myrmecodemus* Sloane

16. Lateral margin of pronotum medially bordered by a deep sulcus; elytral striae punctate-striate (Fig. 34B-C) . . . . . . . . . . . . . . . . . . . . *Deipyrus* Liebke

Lateral margin of pronotum medially not bordered by a deep sulcus; elytral striae only coarsely punctate (Fig. 37C). . . . . . . . . . . . *Lachnothorax* Motschulsky

## **Anasis** Castelnau, 1867

*Anasis* Castelnau, 1867: 15; 1868: 101; Csiki, 1932: 1537; Liebke, 1938: 93; Moore et al., 1987: 276; Lorenz, 1998: 420.

TYPE SPECIES. *Anasis howittii* Castelnau, 1867, by monotypy.

DIAGNOSIS. Body elongate; elytra very elongate, parallel, dorsally remarkably depressed, highly glossy, impilose; elytral apices almost transverse, not at all sinuate.

RELATIONSHIPS. According to shape and structure this is an isolated genus. It may be nearest to *Eudalia* as an early offshoot of the *Eudalia* lineage. This suggestion is supported by the S Vic range of the single species (if correct as reported). Only species of *Eudalia* occur with *Anasis* in mesic Vic. and in adjacent parts of SE Australia.

### **Anasis howittii** Castelnau, 1867
### (Figs 30A, 33A)

*Anasis howittii* Castelnau, 1867: 15; 1868: 101; Csiki, 1932: 1537; Liebke, 1938: 93; Moore et al., 1987: 276; Lorenz, 1998: 420.

TYPE MATERIAL. LECTOTYPE (here designated): ♀ (slightly damaged), Geelong 'Jul' (? uncertain) – Lewis/ *Anasis howittii* Cast./*Anasis Howittii*/Cast./Type/ Holotype T-17960 (MV). Although the specimen is labeled 'holotype', this is questionable, because the description says nothing about the number of examined specimens, only that the species was captured on a flower. Moore et al. (1987) wrote 'syntypes (possible)', but did not indicate that multiple specimens were used in the original study.

Because this species has apparently never been recaptured, and as it remains enigmatic, never having been mentioned in a subsequent paper or key, I am giving a partial redescription.

DESCRIPTION. *Measurements*. Length: 8.1mm; width: 2.35mm. Ratios. Length eye/orbit: 1.0; length/width of head: 1.25; length/width of prothorax: 1.32; length/width of elytra: 1.88.

*Colour* (Fig. 33A). Upper surface chestnut-brown, elytra slightly lighter than fore body, mouthparts, antennae and legs reddish.

*Head*. Eyes large, laterally protruding, orbits moderately convex. Surface with 2 impressions behind clypeus, a triangular central one on frons, and 2 circular ones between eyes. Medially of eye without any ridge and sulcus. Posterior supraorbital seta located well behind eye. Mentum with elongate, triangular tooth, with 2 setae behind tooth, submentum with an elongate seta on either side. Glossa and lacinia not examined due to condition of holotype. Antenna elongate, probably just surpassing base of pronotum. Three basal antennomeres glabrous. Surface glossy, impunctate, impilose, without microreticulation.

*Pronotum*. Elongate, lateral margin gently convex in anterior half, slightly sinuate towards base, margin distinct, forming a sharp ridge. No sulcus inside of margin. Disk slightly convex. Proepisternum narrowly visible from above. Punctation of disk dense and coarse. Surface impilose, without microreticulation, glossy.

*Elytra*. Remarkably elongate, dorsally conspicuously depressed, very gently widened towards apex. Humeri indistinct, obliquely rounded, lateral margin very gently convex, apex almost transverse, gently convex, without any sinuation. Striae complete, coarsely punctate, though not impressed, punctae smaller towards apex. Intervals depressed, impunctate. 3rd interval tripunctate, fixed setae in basal third, middle, and apical third. Surface without microreticulation, very glossy. Hind wings present.

*Lower Surface*. Thorax with coarse, dense punctuation, impilose, glossy; abdomen impunctate. Metepisternum very narrow, elongate, >3 × as long as wide at apex. Terminal abdominal sternum in female quadrisetose.

*Legs*. Narrow, elongate. Tarsi not lobed, 5th tarsomere with a dense fringe of elongate setae below. Claws small, thick, smooth.

*Female Genitalia* (Fig. 30A). Stylomere 2 very elongate, median margin characteristically angled above middle, with elongate, acute apex, with 3 elongate ventrolateral ensiform setae almost completely on the ventral surface, a rather small dorsomedian ensiform seta about middle of stylomere, and a single short nematiform seta arising from a groove below apical third. Base of stylomere 1 with 6 elongate ensiform setae. Lateral plate with dense fringe of stiff nematiform setae at apical rim.

DISTRIBUTION. Type locality only.

### Archicolliuris Liebke, 1931

*Archicolliuris* Liebke, 1931: 291; 1938: 61; Csiki, 1932:1525; Lorenz, 1998: 418.
*Colliuris* De Geer, 1774: 79; Darlington, 1968: 204; Moore et al., 1987: 277.

TYPE SPECIES. *Casnonia bimaculata* Kollar & Redtenbacher, 1842, by original designation.

DIAGNOSIS. Elongate; head posteriorly triangular; pronotum more or less elongate, rather tubular; elytra elongate, dorsally depressed. Head and pronotum without additional setae; elytra with setae on 3rd or 3rd, 5th and 7th intervals. Surface generally glabrous, glossy; elytra usually with 2 or 4 light spots.

### Archicolliuris par (Darlington, 1968)

*Colliuris par* Darlington, 1968: 206; Moore et al., 1987: 277.
*Archicolliuris par* (Darlington); Lorenz, 1998: 418.

TYPES. HOLOTYPE and 5 PARATYPES: Hollandia, July-Sept. 1944, P.J. Darlington (MCZ) (not seen).

DIAGNOSIS. Relatively small, black, quadrimaculate; pronotum moderately elongate; elytra with moderately deep transverse sulcus; surface of head and pronotum with fine though distinct microreticulation.

SUPPLEMENTARY DESCRIPTION. *Measurements* (Table 1).

DISCUSSION. This New Guinean species was recorded from the northern tip of Cape York Peninsula by Darlington (1968). I have not examined type material, but have seen a specimen from New Guinea that agrees well with the description and is distinct from *A. splendissimus* sp. nov. from Cape York Peninsula. As I have not seen any genuine Australian specimen of *A. par*, Darlington's record probably refers to *A. splendissimus* and *A. par* does not occur in Australia.

DISTRIBUTION. ? extreme tip of Cape York Peninsula; New Guinea, New Britain.

RELATIONSHIPS. This species is closely related to *A. splendissimus* sp. nov.

### Archicolliuris splendissimus sp. nov.
(Figs 1, 30B, 33B)

ETYMOLOGY. Refers to the highly glossy surface.

MATERIAL. HOLOTYPE: ♂, Lockerbie, Q. 31.iii.64, I.F.B. Common & M.S. Upton/ *Colliuris par* Darlington, det. T.A. Weir 2000 (ANIC). PARATYPES: ♀, 'Eclectus' Iron Range, Qld 12°45'46"S 143°17'10"E, 10 June 1995, 20m, G. Daniels, mv lamp (UQIC); ♀, Iron Range, Cape York Pen., 11-17.v.1968, G. Monteith (QM); ♀, same data but 28.iv-4.v.1968 (CBM).

DIAGNOSIS. Relatively small, black, quadrimaculate; head short, wide; pronotum short, globose; elytra with deep transverse sulcus in basal third; surface without microreticulation, remarkably glossy.

DESCRIPTION. *Measurements* (Table 1). *Colour* (Fig. 33B). Black, elytra with 4 small circular to slightly elongate light yellow spots, the anterior, larger ones situated in 5th interval, the posterior ones in 5th and 6th intervals. Mandible dark reddish with blackish tip, palpi black with dark reddish basal palpomeres, antennae black with 3 dark reddish basal antennomeres. Basal half of femora reddish, apical half black, tibiae dark piceous, tarsi black.

*Head*. Short, very wide, markedly rhomboidal. Neck very narrow, with deep transverse impression. Eyes large, protruding, though not much separated from orbits which are very gently convex, though remarkably oblique. Surface with 2 deep impressions behind clypeus, frons in middle with a horseshoe like impression, also the anterior supraorbital seta in deep, circular impression. Medially eye with a shallow sulcus, but without ridge. Posterior supraorbital seta in front of posterior margin of eye. Mentum with short, triangular tooth, with 2 setae behind tooth, also submentum with an elongate seta on either side. Apex of glossa transverse, laterally oblique, with 2 elongate median and 2 short lateral setae. Paraglossae free, narrow, glossy. Lacinia elongate, interior margin with a fringe of few spines. Antenna short, not attaining base of pronotum. Three basal antennomeres glabrous. Surface very glossy, impunctate and impilose, without microreticulation.

*Pronotum*. Short, laterally and dorsally convex, near apex and base with deep transverse impressions. Apex not bordered, lateral margin complete though indistinct, base with thick border. median line very shallow. A single marginal seta in front of middle. Proepisternum narrowly visible from above. Disk impunctate, except near apex and base. Surface without microreticulation, highly glossy.

*Elytra*. Short, wide, subrectangular, gently widened towards apex, surface moderately convex. Base oblique, humeri distinct, obtusely rounded, lateral margin gently incised at basal fourth, apex slightly oblique, gently excised, external apical angles distinct, though obtuse. Base narrowly margined towards 4th stria, apex distinctly margined. Surface in anterior third with a deep, irregularly transverse impression, disk humped in front of impression. 7th and 8th striae near apex conspicuously tumid. Striae incomplete, beginning behind base, external striae not attaining apex. Striae not impressed, in basal half coarsely punctate, becoming very inconspicuous towards apex. Intervals depressed, impunctate. Scutellar stria elongate, consisting of about 10 punctures. 1st interval with 2 setae in basal third, 3rd and 5th intervals multipunctate. Surface without microreticulation, very glossy. Hind wings present.

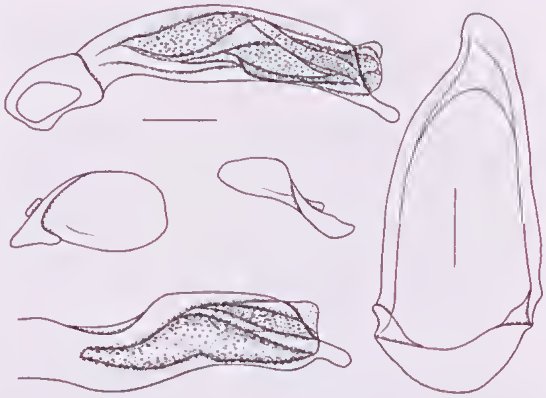

FIG. 1. *Archicolliuris splendissimus* sp. nov. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

*Lower Surface*. Proepisternum and prosternum coarsely punctate in basal half and near sternal suture, proepimeron and mesothorax similarly punctate. Abdomen impunctate. Whole lower surface impilose and very glossy. Metepisternum narrow and elongate almost 3 × as long as wide at apex. Terminal abdominal sternum in male bisetose, in female quadrisetose, and with short pilosity in middle of apex.

*Legs*. Narrow, elongate. Tarsi not lobed, 5th tarsomere with a dense fringe of elongate setae below. Claws smooth. Male anterior tarsus biseriately squamose at apical half of 1st tarsomere and at 2nd and 3rd tarsomeres.

*Male Genitalia* (Fig. 1). Terminal abdominal sternite in middle incised. Genitalia medium sized. Genital ring strongly sclerotised, elongate, slightly asymmetric, parallel, shortly narrowed to the obtusely rounded apex. Aedeagus compact, depressed, laterally remarkably sinuate, sinuation even somewhat angulate, lower surface very gently bisinuate. Apex short, gently

TABLE 1. Measurements and ratios of all Australian species of *Archicolliuris*.

| | N | length (mm) | length eye/orbit | l/w head | l/w prothorax | l/w elytra |
|---|---|---|---|---|---|---|
| *par* | 1 | 6.6 | 1.36 | 1.18 | 1.92 | 1.60 |
| *splendissimus* | 2 | 6.1-6.9 | 1.42-1.48 | 1.15 | 1.46-1.57 | 1.66-1.72 |
| *occipitalis* | 2 | 9.5-10.5 | 0.50-0.51 | 1.69-1.73 | 2.03-2.08 | 1.75-1.77 |

upturned, barely knobbed, slightly turned to right, incision at right side moderately deep. Orificium short. Folding of internal sac very simple. Parameres of rather similar shape, though left paramere much larger than right one, left one with very gently convex apex, right one with wide, rounded apex.

*Female Genitalia* (Fig. 30A). Stylomere 2 comparatively elongate, laterally evenly curved, with acute apex. With 2 large ventrolateral ensiform setae, a rather large dorsomedian ensiform seta situated about in middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 8-9 elongate ensiform setae. Lateral plate with dense fringe of stiff, elongate nematiform setae at apical rim.

*Variation*. Very little variation noted.

DISTRIBUTION. Northern half of Cape York Peninsula.

**Archicolliuris occipitalis** sp. nov.
(Figs 30C, 33C)

ETYMOLOGY. Refers to the very elongate occiput.

MATERIAL. HOLOTYPE: ♀, NE Qld, Roaring Meg Ck, 6km W Cape Tribulation, 22 April 1983, G.B. Monteith, D.K. Yeates/QM Berlesate No. 536, 16.05S 145.24E, Rainforest, 710m, moss (QMT 99168). PARATYPE: 1 ♀, Mt Lewis, Via Julatten, N Qld. 3,500-4,000' 27-28.XI.1965. GM/*Clarencia* sp. det. B.P. Moore 74 (CBM).

DIAGNOSIS. Comparatively large; occiput very elongate; prothorax tubular, elongate, bimaculate or indistinctly quadrimaculate elytra; pronotum with dense transverse striolation.

DESCRIPTION. *Measurements* (Table 1).

*Colour* (Fig. 33C). Black, elytra with 2 small, distinct though irregularly shaped orange spots in basal third on 4th-6th intervals, and with an indistinct small spot in basal third that is composed of 2 narrow reddish lines on 4th and 5th intervals. This spot may be almost completely reduced. Mouthparts and 2 basal antennomeres light reddish, median antennomeres very slightly darker. Basal 2/5 or 1/2 of femora light reddish, apical 1/2 black, though knees and tibiae piceous, tarsi reddish to reddish piceous. Lower surface black, abdomen in middle and near apex also laterally, reddish to piceous.

*Head*. Narrow, very elongate. Neck very narrow, with deep transverse impression. Eyes relatively small, laterally protruding, slightly separated from orbits which are very elongate, and gently convex. Surface with 2 deep irregular impressions behind clypeus that combine to a horseshoe like impression in middle of frons. Medially of eye with a shallow sulcus, but without ridge. Posterior supraorbital seta located far behind posterior margin of eye. Mentum with short, though markedly acute, triangular tooth, with 2 setae behind tooth, also submentum with an elongate seta and a short seta on either side. Apex of glossa transverse, with 2 elongate median and 2 shorter lateral setae. Paraglossae free, narrow, surpassing glossy. Lacinia elongate, interior margin with a fringe of rather few spines. Antenna elongate and remarkably thin, slightly surpassing base of pronotum. Three basal antennomeres glabrous. Surface moderately glossy, impunctate, impilose; basal half with extremely fine and highly superficial microreticulation composed of very transverse meshes and lines. Immediately at base surface covered with transverse sulci.

*Pronotum*. Elongate, tubular, laterally convex, near apex and base with very shallow transverse impressions. Apex bordered, lateral margin complete though indistinct, almost straight, base with thick border. median line very shallow. A single marginal seta situated slightly in front of middle. Proepisternum well visible from above behind middle. Disk with very dense and remarkably coarse transverse sulci. Surface apparently impunctate, with microreticulation at least within sulci, remarkably rugose.

*Elytra*. Moderately elongate, conspicuously widened in apical half, surface moderately convex. Base very oblique, humeri indistinct, very widely rounded, lateral margin distinctly incised at basal fourth, apex very oblique, gently excised, external apical angles distinct, though obtuse, sutural angles produced, slightly disjoined. Base margined towards 4th stria, apex distinctly margined. Surface in anterior third with a deep, irregularly transverse impression, disk gently tumid in front of impression. Striae al most complete, originating near base, attaining apex, but becoming very inconspicuous towards apex. Striae not impressed, in basal half coarsely punctate. Intervals generally depressed, impunctate, though 5th and 6th intervals narrow and convex within the area of the basal transverse impression. Scutellar stria moderately elongate, consisting of 6-8 punctures. 1st interval unisetose in basal third, 3rd interval polysetose, 5th interval with 2-3 setae in basal half. Surface without microreticulation, very glossy. Hind wings present.

*Lower Surface.* Proepisternum, prosternum, and mesepisternum coarsely punctate. Metathorax and abdomen impunctate. Whole lower surface impilose, with very fine microreticulation. Metepisternum narrow and elongate, c. 3 × as long as wide at apex. Terminal abdominal sternum in female quadrisetose and with short pilosity in middle of apex.

*Legs.* Very narrow and elongate. Tarsi not lobed, 5th tarsomere with a dense fringe of elongate setae below. Claws large, smooth.

*Male Genitalia.* Unknown.

*Female Genitalia* (Fig. 30C). Stylomere 2 fairly elongate, laterally evenly curved, with acute apex. With 2 elongate ventrolateral ensiform setae, a rather large dorsomedian ensiform seta situated in middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 9-10 moderately elongate ensiform setae. Lateral plate with dense fringe of elongate, stiff nematiform setae at apical rim.

*Variation.* Little variation noted due to limited material. One specimen almost completely lacks the anterior elytral spot.

DISTRIBUTION. Base of Cape York Peninsula in rainforest at high altitude. Hence, this might be an arboreal rather than hygrophilous species.

RELATIONSHIPS. This species is distantly related to Australian and New Guinean species of *Archicolliuris*, and in shape and structure is more similar to certain Oriental species.

## KEY TO THE AUSTRALIAN SPECIES OF *ARCHICOLLIURIS*

1. Head very elongate, orbit c. 3 × as long as eye; pronotum with extremely dense and coarse transverse wrinkles; elytra with anterior light spot indistinct or absent, though when present, not circular; body length >9mm . . . . . . . . . . . . . . . . . . . . *occipitalis* sp. nov.
   Head much shorter, orbit < 1.5 × as long as eye; pronotum without or with weak transverse wrinkles; elytra with anterior light spot distinct, circular; body length <7mm . . . . . . . . . . . . . . . . . . . . . . . . . 2
2. Head and pronotum with faint though distinct microreticulation; pronotum less orbicular; elytra with less deep transverse sulcus. . . . . . . . *par* Darlington
   Head and pronotum without any traces of microreticulation, highly glossy; pronotum remarkably orbicular; elytra with deep transverse sulcus. . . . . . . . . . . . . . . . . . *splendissimus* sp. nov.

## **Aulacolius** Sloane, 1923

*Aulacolius* Sloane, 1923: 32; Csiki, 1932: 1537; Liebke, 1938: 94; Moore et al., 1987: 276; Lorenz, 1998: 420.

TYPE SPECIES. *Aulacolius triordinatus* Sloane, 1923, by monotypy.

DIAGNOSIS. Elytral striae impunctate though complete, deep and sulcate; body compact; head remarkably elongate, triangular.

### **Aulacolius triordinatus** Sloane, 1923
### (Figs 2, 30D, 33D)

*Aulacolius triordinatus* Sloane, 1923: 32; Csiki, 1932: 1537; Liebke, 1938: 94; Moore et al., 1987: 276; Lorenz, 1998: 420.

MATERIAL. Holotype: ♀, G.F. Hill Darwin, NT/Type/ *Aulacolius triordinatus* Sl. Type/HOLOTYPE *A. triordinatus* Sl., P.D. (ANIC). New records (13 ex.): NT: South Alligator R., 19.12.1999, MB (CBM); Crocodile I., HS (SAM). Qld: Mornington I. Mission, 12.5.1963, 15.5.1963, 23.5.1963, 5.1963, PA & NT (SAM); Stewart R., WD (SAM).

DIAGNOSIS. Head markedly triangular; pronotum short, dorsally convex, with sharp, ridge-shaped lateral borders; elytra short, compact, with complete, deeply impressed, sulcate striae and yellow-spotted apex; several marginal seta on prothorax; numerous setae on intervals 3, 5, and 7; surface absolutely glabrous, shining.

SUPPLEMENTARY DESCRIPTION. *Male Genitalia* (Fig. 2). Terminal abdominal sternite in middle incised. Genitalia comparatively large. Genital ring fairly elongate, barely asymmetric, rather parallel, shortly narrowed to the narrow, acute, triangular apex. Aedeagus very slender and elongate, depressed, laterally barely sinuate, lower surface only immediately near base concave, in apical three quarters gently convex. Apex elongate, very depressed, straight, not knobbed, but remarkably spoon-shaped, slightly turned to right, incision at right side deeper than at left side. Folding of internal sac very simple. Parameres of similar shape, though left paramere much larger than right one both with wide, rounded apex.

FIG. 2. *Aulacolius triordinatus* Sloane. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

*Female Genitalia* (Fig. 30D). Stylomere 2 comparatively elongate, laterally evenly curved, with acute apex. With 2 small ventrolateral ensiform setae, a large dorsomedian ensiform seta situated about in middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 7-8 elongate ensiform setae. Lateral plate with dense fringe of stiff nematiform setae at apical rim.

DISTRIBUTION. Moore et al. (1987) gave distribution as northern NT. New records extend its range to Mornington Island in the Gulf of Carpentaria and lower Cape York Peninsula.

COLLECTING CIRCUMSTANCES. One specimen collected at light.

### **Basistichus** Sloane, 1917

*Basistichus* Sloane, 1917: 415; 1923: 30; Csiki, 1932: 1535; Liebke, 1938: 81; Darlington, 1968: 208; Moore et al., 1987: 276; Lorenz, 1998: 420.

TYPE SPECIES. *Odacantha micans* Macleay, 1864, by original designation.

DIAGNOSIS. Elytra elongate, parallel, with unequal striation.

### **Basistichus micans** (Macleay, 1864)
### (Figs 3, 30E, 33E)

*Odacantha micans* Macleay, 1864: 107.
*Basistichus micans*, Sloane, 1917: 415; Csiki, 1932: 1535; Liebke, 1938: 81; Darlington, 1968: 208; Moore et al., 1987: 276; Lorenz, 1998: 420.

MATERIAL. SYNTYPES: 3 ex., in poor condition, 'Port Denison'. (see Moore et al., 1987: 276) (ANIC). NEW RECORDS (55 ex.): Qld: 15km S Marlborough, 21.i.1982, MB (CBM); 20km N Biggenden, 22.i.1982, MB (CBM); Undara, 12.ii.2000, SB (CBM); Qld 01/31, Mc Leod River, 12km NW Mt Carbine, 12.iv.2001, MB (CBM); 3km E of Lockerbie, Cape York, 30.i.-4.ii.1975, GM (QM); *Odacantha micans* McLeay jun. Port Denison (MV); *Casnonia micans* Sloane, Cooktown (MV); Kuranda, GB (MV); Mutehilba, xii.1936, AS (MV); Cairns, 11.i.50, CO (MV); Townsville, 8.xi.02, FD (MV); *C. micans* Macl. Rockhampton (MV); 70km SW Greenvale, 8-15.xii.1995, AW (SAM); Einasleigh R. via Mt Surprise, 6-7.i.1980, RS (MDPI); 11km WSW of Petford, 17.i.1987, 3-4.iv.1988, RS (MDPI); Tolga, 25.i.1985, JB (MDPI); 7km NE of Tolga, ii.1989, RS (MDPI); Pouth Ck via Georgetown, 8.i.1980, RS (MDPI); Mareeba, 1.ii.1979, KH (MDPI); 27km E Forsyth, 29.xii.1977, RS (MDPI); 12km E Georgetown, 4.xii.1979, RS, JB (MDPI); 6km SE of Mareeba, MDPI, FIT. Site 36, 16.xii.-15.i.1991, 28.iii.-19.iv.1991, vi.-xi.1991, SF (MDPI); 21km E of Mareeba, 21.i.1991, RS (CBM, MDPI); Cairns, 3/50, GB (ANIC); Davies Creek, 10/49 (ANIC); Mareeba-Atherton Rd, 9.vii.65 (ANIC); Cooktown, 1/71, GB (ANIC); 11.45S, 142.35E, Heathlands, 24-28.ii.1993, PZ (ANIC); Bamaga, 28.iii.64, IC, MU (ANIC); Cardstone, 11.ii.1966, HK (ANIC); 17.27S, 145.29E, nr The Crater, 18km N of Ravenshoe, 28-29.xi.1981, BJ (ANIC). - NT: Kakadu NP, Cooinda, 22.-25.iii.1993, LT (CBM); 12.52S, 132.50E, Koongarra 6-10.iii.73, MU (ANIC). - WA: 14.45S, 125.47E, 10km NW by N of Mining Camp, Mitchell Plateau, 11-17.v.83, IN, CJ, DR, BJ (ANIC). According to Moore et al. (1987) and T. Weir (pers. comm.) the types are in very poor condition. As the species is easily distinguished by its external morphology, borrowing the fragile remnants for examination was not considered necessary.

DIAGNOSIS. Head short, wide, with very large, strongly protruding eyes, with a distinct sulcus and ridge inside of eyes; prothorax elongate, with sharp, sinuate lateral margin; elytra narrow, parallel, dorsally convex, deeply striate at base, with a conspicuous transverse impression in basal third, completely glabrous in apical two thirds.

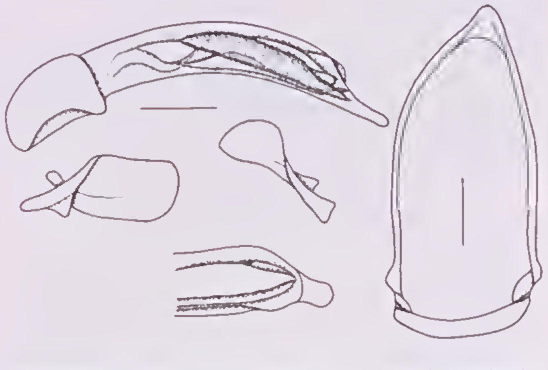

FIG. 3. *Basistichus micans* (Macleay). Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

SUPPLEMENTARY DESCRIPTION. *Male Genitalia* (Fig. 3). Terminal abdominal sternite incised in middle. Genital ring fairly elongate, gently asymmetric, with short basal plate, shortly narrowed to the rather narrow, obtuse apex. Aedeagus rather slender and elongate, laterally little sinuate, lower surface only near base concave, in apical half almost straight. Apex moderately short, very gently knobbed, straight, gently turned to right, and with a very slight notch at the right side. Folding of internal sac very simple. Parameres of fairly dissimilar shape, left paramere much larger than right one and with straight or even slightly concave upper margin, right one short, with obtusely angulate apex.

*Female Genitalia* (Fig. 30E). Stylomere 2 comparatively elongate, laterally moderately curved, with acute apex. With 2 rather narrow, elongate ventrolateral ensiform setae, a rather large dorsomedian ensiform seta situated about in middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 6-7 moderately elongate ensiform setae. Lateral plate with moderately dense fringe of fairly elongate, stiff nematiform setae at apical rim.

DISTRIBUTION. E Qld, N NT, N WA; also in New Guinea. Most labeled specimens were collected at light, some at a considerable distance from water. A small series was collected on surface of ground. Probably a litter-inhabiting species.

### **Clarencia** Sloane, 1917

*Clarencia* Sloane, 1917: 413; Sloane, 1923: 30; Csiki, 1932: 1535; Liebke, 1938: 81; Darlington, 1968: 209; Moore et al., 1987: 276; Lorenz, 1998: 420.

TYPE SPECIES. *Casnonia aliena* Pascoe, 1860, by original designation.

DIAGNOSIS. 3rd antennomere very elongate. Head triangular; prothorax elongate; elytra elongate, dorsally depressed, with a large, light spot in apical half.

### **Clarencia aliena** (Pascoe, 1860)

(Figs 4, 30F)

*Casnonia aliena* Pascoe, 1860: 39; Chaudoir, 1872: 405; Sloane, 1890: 644.

*Clarencia aliena*, Sloane, 1917: 413; Csiki, 1932: 1536; Liebke, 1938: 82; Moore et al., 1987: 276; Lorenz, 1998: 420.

*Casnonia australis* Chaudoir, 1862: 277; Moore et al., 1987: 276; Lorenz, 1998: 420.

*Casnonia clarensii* Castelnau, 1867: 14; 1868: 100; Chaudoir, 1872: 405; Moore et al., 1987: 276; Lorenz, 1998: 420.

MATERIAL. HOLOTYPE: ♀, Type/*Casnonia aliena* Pascoe Type/Moreton Bay/Pascoe Coll./*Casnonia aliena* Pasc. (BMNH). Syntypes of *australis*: ♀, *Australis* Chaud/Ex Musaeo Chaudoir/*aliena* Pascoe Australie, Melbourne (MNHP), 1 ♀, Ex Musaeo Chaudoir/*aliena* Pascoe Australie, Melbourne (MNHP). Syntypes of *clarensii*: ♂, Clarence River Coll. Castelnau/Holotypus *Casnonia (?) clarensii* Castelnau, 1867 (MCSN). NEW RECORDS (14 EX.): Narrabeen, 29.xii.1983, GH (HNMB); Bateman's Bay, 22.i.1963, IC, MU (ANIC); NSW (ANIC). Kilcoy, 10.iv.30 (ANIC); Cooloolabbin Dam, 10km W Yandina, 1.ii.1997, DB (ANIC); 25 mls. W of Tully, 8.iii.1964, IC & MU (ANIC); 40km W Tully, 31.v.1971, ER (ANIC); Rockhampton, 20.ii.1942, CV, ES (QM); 22°02'S 148°03'E, Moranbah, 3km S Bendee, 24.-25.iii.2000, GM & SM (CBM, QM); Qld3, L. Broadwater, 35km SSW Dalby, 16.-17.xii.1998, MB (CBM); *Casnonia aliena* Pascoe (MV).

DISCUSSION. This species was described by Chaudoir (1862) as *Casnonia australis* and by Castelnau (1867) as *C. clarensii*. Chaudoir (1872) recognised that both names refer to the same species. Sloane (1890), also synonymised *C. angusticollis* Macleay, 1888, and was followed by all later authors. Examination of the types and comparison of material from SE Qld and NE NT reveals that Macleay's name refers to a separate species. It is uncertain whether the Melbourne type locality of *C. australis* is correct as no modern material is from that far south.

As the determination label of the 'type' specimen of *C. aliena* in BMNH was written by Pascoe, this specimen is accepted as the holotype. The single original specimen of *C. clarensii* bears a printed label holotype that was attached to the specimen recently.

DIAGNOSIS. Head long; prothorax long, with almost complete transverse striolation; elytra with more deeply excised, but not decidedly quadridentate apex; aedeagus large relative to body size.

SUPPLEMENTARY DESCRIPTION. *Measurements* (Table 2).

*Male Genitalia* (Fig. 4). Very large in comparison to other species of this genus. Genital ring elongate, fairly parallel, slightly asymmetric, shortly narrowed to the wide, obtuse apex. Aedeagus slender and elongate, laterally barely sinuate, lower surface evenly but very gently concave. Apex short, slightly knobbed, suddenly turned to right, and with a distinct notch at the right side. Folding of internal sac very simple. Parameres of similar shape, though left paramere much larger than right one, and with a less sclerotised area along upper margin.

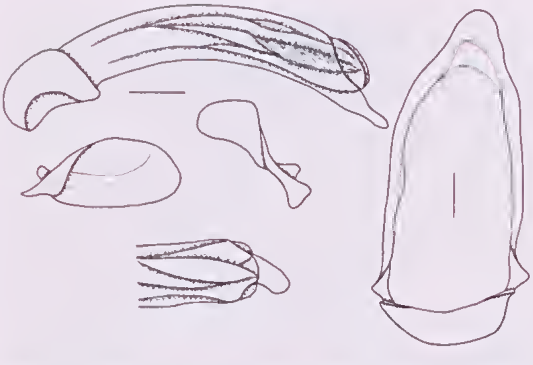

FIG. 4. *Clarencia aliena* (Pascoe). Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

*Female Genitalia* (Fig. 30F). Stylomere 2 comparatively elongate, laterally evenly curved, with acute apex. With 3 elongate ventrolateral ensiform setae, a rather large dorsomedian ensiform seta situated about in middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 6-8 elongate ensiform setae that are characteristically curved towards apex. Lateral plate with dense fringe of stiff, elongate setae at apical rim.

DISTRIBUTION. Coastal eastern Australia from Cairns to S NSW, and perhaps Vic.

COLLECTING CIRCUMSTANCES. Specimens collected by G. Monteith and myself were at light, the latter near a reed-bordered lagoon. On the basis of body shape, this should be a hygrophilous, probably reed-inhabiting, species.

### **Clarencia angusticollis** (Macleay, 1888)
### (Figs 5, 30G)

*Casnonia angusticollis* Macleay, 1888: 446; Sloane 1890: 644.

*Clarencia angusticollis*, Moore et al., 1987: 277; Lorenz, 1998: 420.

MATERIAL. LECTOTYPE (here designated): ♀ (?, damaged), N WA/SYNTYPE/*Casnonia angusticollis* Macl., Kings Sound N WA (ANIC-MMS). PARALECTOTYPES: 2 (sex?, very damaged), N WA (ANIC-MMS). NEW RECORDS (11 ex.): Mornington I. Mission, 12.v.1963, PA & NT (SAM); St Margarets Ck, S of T'ville/*Clarencia aliena* (Pascoe) det. R.I. Storey 1988 (MDPI); Normanton, 3.v. & 5.v. 1963, PA & NT (SAM): Cape Bedford/*Clarencia aliena* Chd. 201. Andr. (MNHB). Goose Lagoon, 16.10S 136.15E, 11km SW by S of Borroloola, 17.iv.1976, JF (ANIC, CBM).

FIG. 5. *Clarencia angusticollis* (Macleay). Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

DIAGNOSIS. This species differs from *C. aliena* (Pascoe) in its much shorter, more oval-shaped and far less rugose pronotum, the shorter basal part of the head, and the much smaller and slenderer aedeagus. Hence, synonymy with *C. aliena* is unjustified and the name is reinstated. From more similar *C. breviceps* sp. nov. it differs by longer prothorax, more deeply excised apex of elytra, and narrower aedeagus with almost straight lower surface.

For better comparison, measurements and ratios are given below and the male genitalia are described and figured for the first time.

SUPPLEMENTARY DESCRIPTION. *Measurements* (Table 2).

*Male Genitalia* (Fig. 5). Much smaller in comparison to *C. aliena*. Genital ring fairly elongate, barely asymmetric, shortly narrowed to the rather narrow, obtuse apex. Aedeagus very slender and elongate, laterally barely sinuate, lower surface only near base concave, in apical half almost straight. Apex moderately short, gently knobbed, slightly turned up, turned to right, and with a slight notch at the right side. Folding of internal sac very simple. Parameres of fairly dissimilar shape, left paramere much larger than right one and with almost transverse apex, right one with obtusely angulate apex.

*Female Genitalia* (Fig. 30G). Stylomere 2 comparatively elongate, laterally evenly curved, with acute apex. With 4 elongate ventrolateral ensiform setae, a rather large dorsomedian ensiform seta situated about in middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 8-9 elongate ensiform setae that arc characteristically curved towards apex. Lateral plate with dense fringe of stiff setae at apical rim.

DISTRIBUTION. Far N Australia from N Qld to the Kimberley, WA.

COLLECTING CIRCUMSTANCES. According to labels, collected at light. Its body form indicates a hygrophilous, reed-inhabiting species.

### **Clarencia breviceps** sp. nov.
(Figs 6, 30H, 33F)

ETYMOLOGY. Refers to the relatively short head.

TYPE MATERIAL. HOLOTYPE: ♂, 12.36S 132.52E Magela Creek, NT 1km NNW of Mudginbarry HS. 25.v.73, Matthews & Upton (ANIC). PARATYPES: 1 ♂, 1 ♀, same data (ANIC, CBM); 1 ♂, 2 ♀♀, 12.48S 132.42E Nourlangie Creek, NT 8km N of Mt Cahill, 21.v.73 at light, EM (ANIC); 1 ♂, NT Batchelor, Lake Bennett 29.xii.96 at light, LT, RO (CBM); 2 ♀♀, NT Kakadu N.P. Cooinda 25-26.xii.96 at light, LT, RO (CBM, CTV); 1 ♂, 1 ♀, NT Kakadu N.P. 22-25.iii.93 Cooinda at light, LT (CBM, CTV); 1 ♂, 1 ♀, NT 1, 3km E Humpty Doo, 3.viii.1995, MB (CBM); 1 ♂, NT m 50 Victoria River Road House 1.i.1997, PG (CGT); 1 ♂, Flying Fish Pt NE Qld, 21.i.65, ED (QM).

DIAGNOSIS. Differs from *C. aliena* (Pascoe) in its much shorter, more oval-shaped and far less rugose pronotum, shorter basal part of the head, and much smaller aedeagus. From more similar *C. angusticollis* (Macleay) it differs by shorter prothorax, less deeply excised apex of elytra, and stouter aedeagus with concave lower surface.

DESCRIPTION. *Measurements* (Table 2). *Colour* (Fig. 33F). Black, apical part of elytra piceous, elytra near apex with 2 large, fairly ill delimited, oval-shaped, yellow spots, situated between about 3rd-7th intervals. Labrum and mandibles reddish, the latter with black inner and outer margins. Palpi dark, antennae piceous, usually with slightly lighter apical part. Basal half of femora light yellow, apical half black to piceous, tibiae light yellow with piceous base and apex, tarsi reddish, though apex of tarsomeres slightly darker. Lower surface of fore body blackish, abdomen in middle and near apex reddish to piceous.

*Head.* Rather narrow and elongate. Neck very narrow, with deep transverse impression. Eyes relatively small, laterally somewhat protruding, slightly separated from orbits which are elongate and very gently convex. Surface with 2 deep, longitudinal impressions behind clypeus. Medially of eye with a shallow sulcus and ridge that extends to behind middle of eye. Posterior supraorbital seta located well behind posterior margin of eye. Mentum with short, acute, triangular tooth, with 2 setae behind tooth, also submentum with an elongate seta and a short seta on either side. Apex of glossa transverse, with 2 elongate median and 2 shorter lateral setae. Paraglossae free, narrow, surpassing glossy. Lacinia elongate, interior margin with a fringe of few spines. Antenna elongate and remarkably thin, surpassing base of pronotum by about one antennomere. Three basal antennomeres glabrous, 3rd antennomere as long as 2 following ones. Surface glossy, impunctate and impilose, without any microreticulation. Immediately at base surface covered with some transverse sulci.


FIG. 6. *Clarencia breviceps* sp. nov. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

*Pronotum.* Elongate, somewhat tubular, laterally little convex, near apex and base with shallow transverse impressions. Apex not bordered, lateral margin complete, ridge-like, almost straight, base with thick border. Apical angles angulate. Median line invisible. A single marginal seta situated slightly in front of middle. Proepisternum narrowly visible from above in middle. Disk coarsely punctate near apex and in basal half, punctures tend to form irregular transverse furrows. Surface without microreticulation, glossy.

*Elytra.* Elongate, slightly widened in apical half, surface depressed. Base slightly oblique, humeri fairly distinct, rounded, lateral margin slightly incised at basal third, apex moderately oblique, gently excised, external apical angles distinct, though obtuse, sutural angles obtuse. Base margined towards position of 3rd stria, apex narrowly margined. Surface in anterior third with a shallow, about v-shaped, transverse

TABLE 2. Measurements and ratios of all Australian species of *Clarencia*.

| | N | length (mm) | length eye/orbit | l/w head | l/w prothorax | l/w elytra |
|---|---|---|---|---|---|---|
| *aliena* | 6 | 8.8-10.1 | 0.55-0.64 | 1.52-1.59 | 1.62-1.75 | 1.94-2.03 |
| *angusticollis* | 6 | 7.3-8.4 | 0.62-0.69 | 1.42-1.48 | 1.52-1.59 | 1.89-1.93 |
| *breviceps* | 6 | 7.6-8.8 | 0.60-0.66 | 1.42-1.49 | 1.58-1.63 | 1.84-2.01 |
| *quadridens* | 4 | 9.8-11.3 | 0.57-0.62 | 1.47-1.52 | 1.57-1.64 | 1.88-1.97 |

impression. Only 5 inner striae, and 8th stria, present, barely surpassing basal half of elytra, inner striae even shorter. Striae originating well behind base, coarsely punctate, punctures becoming inconspicuous posteriorly. Striae not impressed, intervals generally depressed, impunctate, though 4th interval laterally slightly raised. Scutellar stria moderately elongate, consisting of 6-8 punctures. 1st interval bisetose in basal third, 3rd 5th, and 7th intervals polysetose. Surface without any microreticulation, glossy, but with dense, very short, inclined pilosity that is more dense on even intervals. Hind wings present.

*Lower Surface.* Proepisternum, apart from apex, prosternum, mesepisternum, and metepisternum coarsely punctate. Metasternum in middle and abdomen impunctate. Whole lower surface impilose, without microreticulation, glossy. Metepisternum narrow and elongate, c. 3 × as long as wide at apex. Terminal abdominal sternum in male bisetose and glabrous, in female quadrisetose and with short pilosity in middle of apex.

*Legs.* Very narrow and elongate. Tarsi not lobed, 5th tarsomere with a dense fringe of elongate setae below. Claws large, smooth. 1st-3rd tarsomeres of male anterior tarsus sparsely squamose beneath.

*Male Genitalia* (Fig. 6). Much smaller in comparison to *C. aliena*. Genital ring fairly elongate, triangular, barely asymmetric, shortly narrowed to the narrow, obtuse apex. Aedeagus slender and elongate, laterally barely sinuate, lower surface almost evenly but gently concave. Apex moderately short, very gently knobbed, slightly turned up, turned to right, and with a slight notch at the right side. Folding of internal sac very simple. Parameres of slightly dissimilar shape, left paramere much larger than right one and with almost transverse apex, right one comparatively elongate, with more rounded apex.

*Female Genitalia* (Fig. 30H). Stylomere 2 comparatively elongate, laterally evenly curved, with acute apex. With 3 elongate ventrolateral ensiform setae, a rather large dorsomedian ensiform seta situated about in middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with c. 8 elongate ensiform setae that are characteristically curved towards apex. Lateral plate with dense fringe of stiff, elongate setae at apical rim.

*Variation.* Apart from some sexual variation, little variation noted. Males tend to possess narrower and posteriorly less widened elytra.

DISTRIBUTION. Northern part of NT, N Qld.

COLLECTING CIRCUMSTANCES. Most specimens collected at light. This is probably a reed or grass dwelling species that lives at the edges of rivers, swamps and lagoons.

RELATIONSHIPS. Most closely related to *C. angusticollis* (Macleay).

### **Clarencia quadridens** Darlington, 1968
(Fig. 34A)

*Clarencia quadridens* Darlington, 1968: 209; Moore et al., 1987: 277, Lorenz, 1998: 420.

TYPES. HOLOTYPE AND 14 PARATYPES from Hollandia, West New Guinea (MCZ) (not seen). NEW RECORDS (5 ex): Cairns, v.46, viii.49, JB (ANIC); Cairns, 22.iv.1992, OH (CBM); 14.xii.94 Garradunga, JH (MDPI); 12.43S, 143.17E, 9km ENE of Mt Tozer, 5-10.vii.1985, TW, AC (ANIC).

DIAGNOSIS. Elytra with decidedly quadridentate apex.

SUPPLEMENTARY DESCRIPTION. *Measurements.* (Table 2).

DISTRIBUTION. Recorded previously from Australia only from Cairns (Darlington, 1968). As the Australian occurrence noted by Moore et al. (1987) is apparently based on Darlington's record, the specimens noted here are probably the first additional specimens recorded. They show the range of this species in Australia extends down to Innisfail and north to Cape York Peninsula.

COLLECTING CIRCUMSTANCES. Unknown. Probably also hygrophilous, living either on reeds or, according to Darlington (1968: 209), 'under wet leaves or in or under low vegetation'.

### KEY TO THE AUSTRALIAN SPECIES OF *CLARENCIA*

1. Apex of elytra conspicuously quadridentate at suture and external apical angles. NE Qld . *quadridens* Darlington
   Apex of elytra not perceptibly quadridentate . . . . . . 2
2. Head longer and narrower, ratio length/width of head > 1.52; prothorax almost completely transversely striolate; apex of elytra more deeply excised, external angles considerably projecting. . . . . . . . . *aliena* (Pascoe)
   Head shorter and wider, ratio length/width of head < 1.49; prothorax barely or only near base transversely striolate; apex of elytra less excised, external angles little projecting . . . . . . . . . . . . . . . . . . . . . . . . 3
3. Prothorax slightly shorter as a rule, ratio length/width 1.52-1.59; apex of elytra more excised, outer apical angles more advanced . . . . . *angusticollis* (Macleay)
   Prothorax slightly longer as a rule, ratio length/width 1.58-1.63; apex of elytra less excised, outer apical angles less advanced. . . . . . . . . . . . . *breviceps* sp. nov.

### **Deipyrus** Liebke, 1938

*Deipyrus* Liebke, 1938: 104; Csiki, 1932: 1542; Moore et al., 1987: 276; Lorenz, 1998: 420.

TYPE SPECIES. *Lachnothorax palustris* Sloane, 1910, by original designation.

DIAGNOSIS. Easily distinguished by combination of pilose surface, complete elytral striation, very distinct 'neck', conspicuous lateral sulcus and ridge on prothorax, presence of a yellow spot right at apex of either elytron, and presence of 2 dorsal nematiform setae on female stylomere 2.

NOTE: Although the genus was described by Liebke in 1938, the name had already been used by Csiki (1932) in his catalogue, but without giving the citation. Obviously, Liebke must have used this name before, either in printed form, or *in litteris*.

### **Deipyrus palustris** (Sloane, 1910)
### (Figs 7, 30I, 34B)

*Lachnothorax palustris* Sloane, 1910: 396; 1917: 414.
*Myrmecodemus palustris*, Sloane, 1923: 33.
*Deipyrus palustris*, Liebke, 1938: 105; Csiki, 1932: 1542; Moore et al., 1987: 276; Lorenz, 1998: 420.

MATERIAL. LECTOTYPE (here designated): ♀. Cairns/Cotype/11556 *Lachnothorax palustris* Sln., Queensland, Cotype (SAM). PARALECTOTYPES. 1 ♂, 1 ♀, Cairns distr., E. Allen/Cotype (SAM). NEW RECORDS (24 ex.): Qld: Cairns dist. E. Allen/ *Lachnothorax palustris* Sln. Id. by A.M. Lea (MV); Janie Ck. S of Mapoon Mission, Wei, 30.xi.1983, WH (CBM); Kuranda/Coll. Lemoult (IRSBN); Stewart R. i.-ii. 1927, NT (SAM); Cairns/*Lachnothorax palustris* Sln. (SAM); Cairns/French Coll. Kraatz (DEI). - NT: Darwin, HG (MV); ? (unreadable) Saltpan Roper R. Coll. ? (unreadable)/ *Lachnothorax palustris* Sl. (1910) Id. by T.G. Sloane (MV); Groote Eylandt, NT (SAM); Adelaide R., HB (SAM); Roper R., NT (SAM); Roper River, 3.iii.16 (DEI).

FIG. 7. *Deipyrus palustris* (Sloane). Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

DIAGNOSIS. Like *D. inops* sp. nov. but: Legs reddish; antenna reddish; eyes convex, laterally projecting, composed of glossy ommatidia of about equal size.

SUPPLEMENTARY DESCRIPTION.
*Measurements* (Table 3).

*Male Genitalia* (Fig. 7). Terminal abdominal sternite in middle incised. Genital ring fairly elongate, triangular, almost symmetric, with convex basal plate, regularly narrowed to the narrow, triangular apex. Aedeagus slender and elongate, laterally sinuate, lower surface in basal half gently concave, in apical even slightly convex. Orificium very elongate. Apex rather wide, moderately short, very gently knobbed, straight, gently turned to right, and with a short, distinct notch at the right side. Folding of internal sac very simple. Parameres short, of fairly dissimilar shape, left paramere much larger than right one and with convex apex, right one short, with obtusely angulate apex.

*Female Genitalia* (Fig. 30I). Stylomere 2 large, though comparatively short and stout, laterally moderately curved, with fairly acute apex. With 2 small ventrolateral ensiform setae, a medium-sized dorsomedian ensiform seta situated about in middle of stylomere, and 2 short nematiform setae arising from a groove in apical third. Base of stylomere 1 with 6-7 elongate, slender ensiform setae. Lateral plate with dense fringe of elongate, stiff nematiform setae at apical rim.

DISTRIBUTION. NE Qld, N NT.

COLLECTING CIRCUMSTANCES. Little known. One specimen was collected on a salt pan, and since Moore et al. (1987) also record it as living on 'salt marsh', this may be a halophile species, generally or facultatively.

### **Deipyrus inops** sp. nov.
(Fig. 30J, 34C)

ETYMOLOGY. Refers to the small, remarkably depressed eyes.

MATERIAL. HOLOTYPE: ♀, Australia C. Oke Collection/*Myrmecodemus* sp. near *palustris* Sl. det. B.P. Moore (MV). PARATYPE: ♀, same data (CBM).

DIAGNOSIS. Like *D. palustris* (Sloane) but: legs dark; antenna dark; eyes remarkably depressed, laterally not at all projecting, composed of conspicuously rough ommatidia of very unequal size.

DESCRIPTION. *Measurements* (Table 3). *Colour* (Fig. 34C). Surface, including mouthparts, antennae and legs black. Apex of elytra with an inconspicuous, ill defined reddish-orange spot that extends from about 3rd interval to external apical margin and broadly meets the apex.

*Head.* Rather narrow, remarkably oval. Neck very narrow, with deep transverse impression. Eyes of moderate size, though absolutely depressed and laterally not protruding, not separated from orbits which are elongate and rather convex. Colour of eye characteristically dark grey in middle, with a slightly lighter margin. Surface of eyes remarkably rugose, in particular in middle where the ommatidia are conspicuously smaller than at margin. Medially of eye with a fairly deep sulcus that extends to behind middle of eye, but without ridge. Posterior supraorbital seta located well behind posterior margin of eye, but seta difficult to detect within the elongate pilosity of surface. Clypeus on either side with 2 additional setae behind the anterior one. Mentum with elongate, acute, triangular tooth, with 2 setae behind tooth, submentum with several elongate setae on either side. Apex of glossa transverse, with 2 elongate median and 2 shorter lateral setae. Paraglossae free, narrow, surpassing glossy. Lacinia elongate, interior margin with a dense fringe of spines. Antenna moderately elongate, almost attaining base of pronotum, pilose from 1st antennomere. Surface glossy, without microreticulation, though rather dense and coarsely punctate, with very elongate, hirsute pilosity that is inclined anteriorly. Also lateral margin and lower surface of head pilose.

*Pronotum.* Short and very convex, almost hemispherical, near base with shallow transverse impression. Apex not bordered, lateral margin complete, slightly ridge-like, convex, with distinct, rather wide sulcus medially. Base with thick border. Median line shallow. Marginal seta(e) not visible within the elongate pilosity. Proepisternum broadly visible from above. Disk rather densely and coarsely punctate, near apex and base punctuation dense and rugose. Surface without microreticulation, glossy, with very elongate, hirsute, erect pilosity.

*Elytra.* Rather short and wide, somewhat rectangular, laterally gently convex, barely widened in apical half, surface gently convex. Base gently oblique, humeri fairly distinct but rounded, lateral evenly convex and rounded towards sutural angle without any indication of lateral apical angles. Apex, therefore, remarkably convex. Base margined towards position of 4th stria, apex very narrowly margined. Surface in anterior third in middle with very shallow, transverse impression. All striae complete, running from base to apex. Striae slightly impressed, coarsely punctate in anterior half, punctures becoming inconspicuous posteriorly, in apical half striae only linear. Intervals almost depressed, with rather dense, irregular, about biseriate punctuation. Scutellar stria elongate, consisting of about 8 large punctures. No fixed setae visible within the elongate pilosity. Surface without microreticulation, glossy, but with dense, elongate, hirsute, pilosity that is inclined posteriorly. Hind wings present.

*Lower Surface.* Thorax densely and coarsely punctate and with elongate, hirsute pilosity. Abdomen with finer punctures and shorter, slightly denser pilosity. Metepisternum moderately elongate, c. 2 × as long as wide at apex. Terminal abdominal sternum in female tri- or quadrisetose on either side.

*Legs.* Of moderate size. Tarsi not lobed, pilose on upper surface, 5th tarsomere with a dense fringe of elongate setae below. Claws large, smooth. Squamosity of male anterior tarsus unknown.

*Male Genitalia.* Unknown.

*Female Genitalia* (Fig. 30J). Stylomere 2 large, though comparatively short and stout, laterally moderately curved, with fairly acute apex. With 2 small ventrolateral ensiform setae, a medium-sized dorsomedian ensiform seta situated about in middle of stylomere, and 2 short nematiform setae arising from a groove in apical third. Base of stylomere 1 with 6 elongate, slender ensiform setae. Lateral plate with dense fringe of elongate, stiff nematiform setae at apical rim.

*Variation.* Due to limited material very little variation noted.

DISTRIBUTION. 'Australia'.

### KEY TO AUSTRALIAN SPECIES OF *DEIPYRUS*

1. Eyes convex, laterally well projecting; antennae and legs reddish to light brown, tibiae with yellow median ring. . . . . . . . . . . . . . . . . . . . . . *palustris* (Sloane)
   Eyes depressed, not projecting; antennae and legs uniformly black. . . . . . . . . . . . . . *inops* sp. nov.

### **Dicraspeda** Chaudoir, 1862

*Dicraspeda* Chaudoir, 1862: 300; Sloane, 1923: 30; Csiki, 1932: 1536; Liebke, 1938: 88; Darlington, 1968: 210; Moore et al., 1987: 274; Baehr, 1996a: 138; 1997b: 30; 1998: 174; 1999: 116; 2000: 11; 2003b: 101; 2003e: 251; Lorenz, 1998: 420.

TYPE SPECIES. *Dicraspeda brunnea* Chaudoir, 1862, by monotypy.

DIAGNOSIS. Distinct sulcus and ridge inside the eye; distinct sulcus inside the prothoracic margin; elytra impilose (except for fixed setae at 3rd interval), with elytral apex slightly excised and not bearing angulate or even spinose external angles.

DISCUSSION. For a time this genus was confused with the related *Eudalia*, and even Sloane (1917, 1923) was not sure to which genus the quite differently shaped Australian species should be referred. *Dicraspeda obscura* (Castelnau), for example, was referred to *Arame* Andrewes by Sloane (1923). Those species that are today combined to form *Dicraspeda*, are remarkably different in their external shape and structure. When considering the species that occur in New Guinea, the problem becomes even more difficult, because the former genera *Philemonia* Liebke and *Macrocentra* Chaudoir have to be taken into consideration. Today these are included in *Dicraspeda sensu lato*, but certainly they again deviate in shape and structure. Some of these problems are discussed by Baehr (1996a, 1997b, 1998, 1999, 2000, 2003b, 2003e).

Many species that have described from New Guinea fall in the former '*Philemonia*' (Baehr, 1996a, 1997b, 1998), some new Australian records of New Guinean species (Baehr, 2000), and the '*brunnea*-group' of species was revised (Baehr, 2003e). No further taxonomic information about the species of the latter group will be given.

DISTRIBUTION. E and N Australia, New Guinea, Bismarck Archipelago, Solomon Islands, New Hebrides, Moluccan Islands, Greater and Lesser Sunda Islands, Philippines.

### **Dicraspeda brunnea** Chaudoir, 1862

*Dicraspeda brunnea* Chaudoir, 1862: 300; Sloane, 1923: 31, Csiki, 1932: 1536; Liebke, 1938: 89; Darlington, 1968: 211; Moore et al 1987: 274; Baehr, 1996a: 138; 1998: 174; 2003e: 251; Lorenz, 1998: 420.

DISCUSSION. This species was described from Sulawesi and is widely distributed from southernmost Thailand and Indonesia through Sulawesi and the Philippines (Baehr, 1998, 2003e). It was recorded from New Guinea by Darlington (1968) and from N Australia by Moore et al. (1987). Baehr (2003e) noted that these records are probably erroneous, because in New Guinea certain species occur that are different from *brunnea*, and moreover, I have not seen *brunnea* from New Guinea or Australia. For New Guinea, Darlington's records probably refer to either *D. nigripes* Baehr, *D. obsoleta* Baehr or *D. papuensis* Baehr. For Australia, Moore et al's (1987) records probably refer either to *D. sublaevis* (Macleay) that was synonymised with *D. brunnea* by Sloane (1923) but reinstated by Baehr (2003e), or *D. nitida* Sloane or *D. glabrata* Baehr. Therefore, *D. brunnea* probably does not belong to the Australian fauna.

### **Dicraspeda sublaevis** (Macleay, 1888)
(Fig. 34D)

*Eudalia sublaevis* Macleay, 1888: 448; Sloane, 1917: 418.
*Dicraspeda sublaevis* (as *D. brunnea* Chaudoir), Sloane, 1923: 31; Csiki, 1932: 1537; Moore et al., 1987: 274; Lorenz, 1998: 420.
*Dicraspeda sublaevis*, Baehr, 2003e: 253.

NEW RECORDS (37 ex.): QLD: 10km S Georgetown, 30.xii.1979, RS, JB/*Dicraspeda brunnea* Chaudoir Det. R.I. Storey 1988 (CBM, MDPI); Elizabeth Ck., Wrotham Park Stn., via Chillagoe, 6.xii.1990, DG (MDPI); Sellheim, xii/42, JB/*Dicraspeda brunnea* Chd. 1493. (ANIC); Mary Creek, 16.33°S 145.12°E, 4-5.xii.1968, BM (ANIC, CBM); 13.58°S 143.11°E, Mt White, 12.i.1994, PZ, EE (ANIC); Mt Carbine, 5.i.1964, GM (QM). – NT: Humpty Doo, 6km E, 9.ii.-4.iii.1987, RS, GB (CBM, MDPI, QM); 12.52S 132.50E, Koongarra, 6-10.iii.93, MU (ANIC); Katherine env. 10.-14.i.2004, PM (CBM); Horn Islet., Pellew Group, 15-31.i.1968, 15-21.ii.1968, BC/ *Dicraspeda sublaevis* Macl. det. B.P. Moore 1974 (CBM, QM). – WA: Kununnurra, 22.xii.91-6.i.1992, RS (CBM, MDPI). Most specimens were collected at light.

DISCUSSION. Although synonymised with *D. brunnea* for a long period, Baehr (2003c) demonstrated that it is a well characterised, separate species.

DISTRIBUTION. The new records extend the range into N Qld, but only to the western slope of Great Dividing Range.

### **Dicraspeda nitida** (Sloane, 1917)

*Eudalia nitida* Sloane, 1917: 420
*Dicraspeda nitida*, Csiki, 1932: 1537; Moore et al., 1987: 275; Lorenz, 1998: 420; Baehr, 2003c: 253.

NEW RECORDS (67 ex.): QLD: Mt Lewis, via Julatten, 29.xii.1979, RS. NG/*Dicraspeda nitida* Sl. det. B.P. Moore'79 (MDPI); Cape Tribulation, Daintree area, 15-16.xii.1978, RS/*Dicraspeda nitida* Sl. det. B.P. Moore'86 (MDPI); Cape Tribulation, 24.-29.xii.1980, RS, NG (MDPI); Cow Bay, N of Daintree, 25.i.-7.ii.1984, CC (MDPI); 15km WSW of South Johnstone, 19.i.1986, JH (MDPI); 45km NE of Cooktown, 23.xii.1979, RS (MDPI); Bloomfield Range via Cooktown, 24.xii.1979, RS (MDPI); Cape Flattery, 23.-28.xii.1989, RS (CBM, MDPI); Cardstone, 4-16.i.1966, KH (ANIC); 15.47°S 145.14°E, Shiptons Flat, 17-19.x.1980, TW (ANIC); 16.03S to 16.05°S 145.28°E, Cape tribulation area, 21-28.iii.1984, AC, TW (ANIC); 16.19°S 145.24°E, 12km S of Daintree, 27.xi.1981, BJ (ANIC); 15.04°S 145.07°E, Mt Webb N.P., 27-30.iv.1981, AC, JF (ANIC); 15.29°S 145.16°E, Mt Cook N.P., 10-12.v.1981, AC, JF (ANIC); Cairns, ii.50, JB (ANIC); 12.43°S 143.18°E, 11km ENE of Mt Tozer, 11-16.vii.1986, TW, AC (ANIC); Shute Harbour, 3.iii.64, 23.iv.64, IC, MS (ANIC); Barron R., Cairns, 15.i.1993, BU (ANIC); Lake Placid dist. 3.ii.1995, BU (ANIC); 15.28°S 145.15°E, Cooktown, Walker's Bay, 29.i.1995, LR (ANIC); 11.45°S 142.35°E, Heathlands, 22.i.1992, TW, IN (ANIC, CBM); 11.41°S 142.42°E, 14km ENE Heathlands, 8.xii.1992, PZ & WD (ANIC, CBM); 16.03°S to 16.08°S 145.28°E, Cape Tribulation area, 1-11.v.1992, JL (ANIC); 13.58°S 143.11°E. Mt White, 12.i.1994, PZ, EE (ANIC); Rossville env. 25.-27.xii.2003, PM (CBM); Green Hill, Thursday I., 21.5.2003, GM/10°35'S 142°13'E, 80m (QMB); Horn I. 2.5km W of Horned Hill, 19.5.2003, GM/10°36'S 142°18'E, 50m (CBM, QMB); Hammond I., 1 km W village, 20.5.2003, GB/10°35'S 142°13'E, 50m (CBM, QMB); Nelly Bay, Magnetic I. 12.1997, SF (QMB).

DISTRIBUTION. Widely distributed in NE Qld, E of Great Dividing Range, including S Torres Strait Islands. Most specimens collected at light, a few 'in rainforest', some in 'gallery forest litter' and 'vine scrub litter'.

TABLE 3. Measurements and ratios of both Australian species of *Deipyrus*.

| | N | length (mm) | length eye/orbit | l/w head | l/w prothorax | l/w elytra |
|---|---|---|---|---|---|---|
| *inops* | 2 | 8.3-8.5 | 0.71-0.73 | 1.58-1.59 | 1.14-1.16 | 1.47-1.48 |
| *palustris* | 6 | 7.3-8.4 | 0.59-0.67 | 1.36-1.43 | 1.14-1.21 | 1.53-1.58 |

### **Dicraspeda glabrata** Baehr, 2003c

*Dicraspeda glabrata* Baehr, 2003c: 255.

NEW MATERIAL. None.

### **Dicraspeda brunneipennis** (Sloane, 1917)
### (Figs 8, 30K)

*Eudalia brunneipennis* Sloane, 1917: 420.
*Dicraspeda brunneipennis* Csiki, 1932: 1537; Liebke, 1938: 89; Moore et al., 1987: 275; Lorenz, 1998: 420.

MATERIAL. LECTOTYPE (here designated): ♂, Cairns (K) Dodd 04 5/*Eudalia brunneipennis* Sl from Kuranda. Cotype/HOLOTYPE *E. brunneipennis* Sl. PJD (ANIC). NEW RECORDS (6 ex.): Qld: Noah Creek, 16°08'S 145°25'E, 27.vii.1993, HM, RK (CRC); Bellenden Ker Range, Cableway Base Stn, 100m, 17.x.-9.xi.1981, EW (CBM, QM); Cape Tribulation, Daintree area, 15-16.xii.1978, RS/*Dicraspeda* sp. det. B.P. Moore 1979 (MDPI).

DIAGNOSIS. Distinguished from those species bearing a narrow marginal pronotal sulcus and rather convex elytra by prothorax impunctate, elytra non-microreticulate, with barely excised apical margin and always distinctly lighter than the fore body; 4th tarsomeres not deeply excised.

SUPPLEMENTARY DESCRIPTION. *Male Genitalia* (Fig. 8). Terminal abdominal sternite in middle incised. Genital ring comparatively wide, rather triangular, barely asymmetric, with short, acute, triangular apex. Aedeagus small, elongate, fairly depressed, laterally moderately sinuate, lower surface very gently concave. Orificum moderately elongate. Apex short, wide, almost straight, slightly knobbed and spoon-shaped, moderately turned to right, with shallow incisions at both sides. Folding of internal sac rather simple. Parameres of moderately dissimilar shape, left paramere much larger than right one, both with wide, obtusely rounded apex.

*Female Genitalia* (Fig. 30K). Stylomere 2 comparatively elongate, laterally evenly curved, with acute apex, with 3 large ventrolateral ensiform setae, a large dorsomedian ensiform seta situated about in middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with c. 6 ensiform setae of decreasing size, the median ones longest and conspicuously curved. Lateral plate with dense fringe of ensiform setae at apical rim.

DISTRIBUTION. Wet Tropics of NE Qld. The Bellenden Ker and Noah Creek specimens were collected by insecticide fogging in rain forest.

FIG. 8. *Dicraspeda brunneipennis* (Sloane). Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

### **Dicraspeda dubia** (Gestro, 1879)

*Odacantha dubia* Gestro, 1879: 558.
*Philemonia dubia*, Csiki, 1932: 1536 ; Liebke, 1938: 83.
*Dicraspeda dubia*, Darlington, 1968: 212; Moore et al., 1987: 275; Baehr, 1996a: 138; 1997b: 30; 1998: 174; 2000: 11; Lorenz, 1998: 420.

DIAGNOSIS. Distinguished from all species bearing a narrow marginal pronotal sulcus and convex elytra by impunctate prothorax, microreticulate elytra with deeply excised apical margin, and not deeply excised 4th tarsomeres.

DISTRIBUTION. This New Guinean species was recorded in N Qld (Bamaga) by Darlington (1968), a record repeated by Moore et al. (1987). I have not seen *D. dubia* from Australia and since the related *D. longiloba* (Liebke), is recorded from N Qld (Baehr, 2000) I am not sure whether the *D. dubia* record is genuine.

### **Dicraspeda longiloba** (Liebke, 1938)

*Philemonia longiloba* Liebke, 1938: 83.
*Dicraspeda longiloba*, Darlington, 1968: 212; Lorenz, 1998: 420; Baehr, 2000: 11.

DIAGNOSIS. 4th tarsomeres very deeply excised.

DISTRIBUTION. New Guinea and Australia (Baehr, 2000).

### **Dicraspeda obscura** (Castelnau, 1867)
(Figs 9, 30L, 34E)

*Casnonia obscura* Castelnau, 1867: 14; 1868: 100; Chaudoir, 1872: 407; Gestro, 1875: 851.
*Eudalia obscura*, Sloane, 1917: 418.
*Arame obscura*, Sloane, 1923: 31.
*Dicraspeda obscura*, Csiki, 1932: 1537; Liebke, 1938: 89; Moore et al., 1987: 275; Lorenz, 1998: 420.

MATERIAL. LECTOTYPE (here designated): ♂, Rockhampton Coll. Castelnau/Esempl. tipico Coll. Castelnau/*obscura* Cast./*Casn. obscura* Cast. (Castelnau's handwriting)/SYNTYPUS *Casnonia obscura* Castelnau, 1867 (MCSN). PARALECTOTYPES: 1 ♂, 2 ♀♀, same data (MCSN). NEW RECORDS (77 ex.): Qld: 15km N Marlborough, MB (CBM); 20km N Biggenden, MB (CBM); Cairns, Whitfield Rd, 28.i.1974, WH (CBM, CMP); Mt Lewis, 21.i.1976, WH (CBM, CMP); Moa I. Torres Straits, JS (SAM); *Casnonia obscura* (Cast.)/*Casnonia* CS Rockm (MV); Mackay, (MV); Cairns, i.52, JB (MV); Cairns, i.1956, CO (MV); *Casnonia obscura* Cast./Mackay (MV); Mackay (MV); Iron Range, 4.v.1975,mm (MV); Old Bushman Beach, 20km N Townsville, 26-29.ii.1998, AW (SAM); Kuranda/Griffith Collection (SAM); Tolga, i.1980, NG, JB/*Dicraspeda obscura* (Cast.) det. R.I. Storey 1988 (MDPI); Tolga, 7.iii.1983, 23.i.1986, JB (MDPI, QM); 7km NE of Tolga, ii.1988, RS, DF (MDPI); Morehead R. N of Laura, 20.i.1990, FH (MDPI); 15km WSW of South Johnstone, 24.xii.1985, FH (MDPI); Walkamin, 8-15.iii.1985, JB (MDPI); Townsville, JT (ANIC); Cairns, iii.51, GB (ANIC); Archers Ck. iv.74, GB (ANIC); Mt Spec, i.75, GB (ANIC); 3 mi. W of Mossman, 14.iii.64, IC, MU (ANIC); Eungella N.P., 2400 ft. 2.iii.64, IC, MU (ANIC); Yeppoon, 26-29.xii.64, IC, MU (ANIC); 16.47°S, 145.22°E, 24km N by W of Mareeba, 24-25.xi.1981, BJ (ANIC); Lansdown Station, 19.40°S, 146.51°E, 7km S of Woodstock, 16.i.74, RB (ANIC). – NT: Goose Lagoon, 16.10S, 136.15E, 11km SW by S of Borroloola, 17.iv.1976, JF (ANIC); McArthur River, 16.27°S, 136.05E, 48km SW by S of Borroloola, 13.iv.1976, JF (ANIC); 12.52S, 132.50°E, Koongarra, 6-10.iii.73, MU (ANIC); 12.47°S, 132.51°E, 19km NE by E of Mt Cahill, 16.xii.1972, MU (ANIC); Ferguson R., 14.19°S, 131.50°E, 25.vi.1968, ME (ANIC); Tindal, 14.31°S, 132.22°E, 1-20.xii.1867, WV (ANIC); 16°41'S 135°44'E, Cape Crawford, 17-19.iv.2004, GM, DC, 11621 (QMB). – WA: 14.45°S, 125.47°E, 10km NW by N of Mining Camp, Mitchell Plateau, 11.v.83, IN, CJ (ANIC); 14.49°S, 125.50°E, Mining Camp. Mitchell Plat. 9-19.v.1983, IN, CJ, DR, BJ (ANIC); 14.25°S, 126.38°E, CALM Site 13/4, 12km S of Kalumburu Mission, 7-11.vi.1988, TW (ANIC).

DIAGNOSIS. Pronotum coarsely punctate.

SUPPLEMENTARY DESCRIPTION. *Male Genitalia* (Fig. 9). Terminal abdominal sternite in middle deeply incised. Genital ring comparatively narrow, elongate, parallel, slightly asymmetric, with short, acute, triangular apex. Aedeagus small, moderately elongate, fairly depressed, laterally moderately sinuate, lower surface very gently concave. Orificum very elongate. Apex short, wide, almost straight, knobbed and slightly spoon-shaped, moderately turned to right, with shallow incisions at both sides. Folding of internal sac rather simple. Parameres of very dissimilar shape, left paramere much larger than right one, stout, with wide, obtusely transverse apex, right paramere narrow, with convex apex.

*Female Genitalia* (Fig. 30L). Stylomere 2 comparatively elongate, laterally evenly curved, with acute apex. With 2 large ventrolateral ensiform setae, a large dorsomedian ensiform seta situated about in middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 5-6 stout ensiform setae of decreasing size. Lateral plate with dense fringe of very elongate stiff setae at apical rim.

DISTRIBUTION. E Qld, Torres Strait, N NT, and N WA. Most specimens were collected at light. It is uncertain whether this is an hygrophilous species or leaf litter species independent of water.

## KEY TO AUSTRALIAN SPECIES OF *DICRASPEDA*

1. Marginal pronotal sulcus wide; elytra short and wide, depressed (Fig. 34D) . . . . . . . . . . . . . . . . . . 2
   Marginal pronotal sulcus narrow; elytra longer and narrower, rather convex (Fig. 34E) . . . . . . . . . . 4
2. Striae deeply impressed, intervals clearly convex, even near apex . . . . . . . . . . . . . *sublaevis* (Macleay)
   Striae not or barely impressed, intervals depressed, at least near apex . . . . . . . . . . . . . . . . . . . . . . 3
3. Surface of elytra in basal third without perceptible transverse impression, with superficial though distinct microreticulation. . . . . . . . . . . . . *nitida* (Sloane)
   Surface of elytra in basal third with distinct transverse impression, at least in basal half without perceptible microreticulation . . . . . . . . . . . . *glabrata* Baehr
4. Whole pronotum densely and very coarsely punctate; 4th tarsomeres of anterior and median tarsi barely excised . . . . . . . . . . . . . . . . . . . *obscura* (Castelnau).
   Pronotum punctate only near base and apex, punctuation rather fine; 4th tarsomeres of anterior and median tarsi considerably excised . . . . . . . . . . . . . . . . . . 5
5. Excision of 4th tarsomeres of all tarsi very deep, > ¾ of length of 4th tarsomere . . . . . . . *longiloba* (Liebke)
   Excision of 4th tarsomeres less deep, c. ½ of length of 4th tarsomere, in metatarsus excision shallow. . . . . . . 6
6. Elytra without traces of microreticulation, apical margin little excised, external apical angles little projecting; head longer and narrower, eyes barely surpassing curvature of orbit; elytra always distinctly lighter than fore body. . . . . . . . . . . *brunneipennis* (Sloane)
   Elytra with fine microreticulation, apical margin deeply excised, lateral apical angles projecting; head shorter and wider, eyes distinctly surpassing curvature of orbit; elytra little lighter than fore body . . . . *dubia* (Gestro)

FIG. 9. *Dicraspeda obscura* (Castelnau). Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

## **Eudalia** Castelnau, 1867

*Eudalia* Castelnau, 1867: 16; 1868: 102; Sloane, 1917: 415; 1923: 30; Csiki, 1932: 1542; Darlington, 1968: 214; Moore et al., 1987: 273; Lorenz, 1998: 421; Baehr, 1999: 116; 2003b: 101.

TYPE SPECIES. *Odacantha latipennis* Macleay, 1864, by original designation.

DIAGNOSIS. Distinct ridge and sulcus medially of eye absent; deep sulcus inside of the marginal border of pronotum absent; full elytral striation; striae punctate; apex of elytra not or barely excised.

DISCUSSION. *Eudalia* seems to be a genus of convenience which includes quite differently shaped and structured species that are combined more by plesiomorphic than by apomorphic characters. The single New Guinean species, *E. anomala* Darlington, deviates even more and is fairly similar to the Oriental *Andrewesia* Liebke. Two well separated lineages in Australia are 1) the *obliquiceps*-lineage that comprises rather elongate, impilose or scarcely pilose species with smaller, less protruding eyes (*C. obliquiceps*, *C. minor*, *C. castelnaui*, *C. reticulata*, *C. atrata*, *C. femorata*), and 2) the *macleayi*-lineage that comprises short, compact, densely pilose species with large, protruding eyes and short, remarkably convex orbits (*E. macleayi*, *E latipennis*, *E. punctipennis*, *E. waterhousei*).

In some character states *E. nigra* Sloane differs from *Eudalia* and resembles *Dicraspeda*. Hence, it is removed from *Eudalia*, but due to structural differences between it and all other members of *Dicraspeda*, it is given the status of a separate genus.

DISTRIBUTION. Apart from the aberrant New Guinean *E. anomala*, that may merit the erection of a separate genus, *Eudalia* is confined to Australia.

### **Eudalia obliquiceps** Sloane, 1917
(Figs 10-12, 30M, 34F, 35A)

*Eudalia obliquiceps* Sloane, 1917: 418; Csiki, 1932: 1542; Liebke, 1938: 106; Moore et al., 1987: 274; Lorenz, 1998: 421.

*Dicraspeda obliquiceps*, Sloane, 1923: 31.

DIAGNOSIS. Colour uniformly black; elytra without microreticulation, with extremely fine, microscopic pilosity; 3rd and 5th interval with setiferous punctures; legs conspicuously bicoloured.

DISCUSSION. Moore et al. (1987) record this species from Cairns and the type locality (Laura). New material extends the range through Qld, NT and WA. The material also reveals differences between the type and other specimens from northwestern Qld, NT, northernmost WA, Iron Range in Cape York Peninsula, and specimens attributed to *E. obliquiceps* from other localities in northern Qld and northern NSW. Hence, specimens from certain localities in northern Qld and northern NSW that differ more substantially, are described as separate species, whereas specimens from Iron Range and those from NT and northwestern Australia, respectively, are described as separate subspecies of *E. obliquiceps*. This procedure has been chosen, because available representatives of the latter populations are quite uniform in shape and degree of microreticulation, but differ in minor characters of external morphology (degree of punctuation, shape of pronotum), and in shape of male aedeagus.

### **Eudalia obliquiceps obliquiceps** Sloane, 1917
(Figs 10, 30M)

*Eudalia obliquiceps* Sloane, 1917: 418. All citations mentioned above under the species refer to the nominate subspecies.

MATERIAL. HOLOTYPE: ♂, Laura, Q.T.G. 18.7.16/*Eudalia obliquiceps* Sl. Type/HOLOTYPE *E. obliquiceps* Sl. PJD (ANIC). NEW RECORDS (17 ex.): Qld: Kuranda, 20.iii.1973, WH (CBM, CMP); Leo Creek Rd, Mc Illwraith Range, 30km NE of Coen, c. 500m, 29.vi.-4.vii.1976, GM, SM (QM); Archer River X-ing, 70km N of Coen, Cape York Pen., 17.-18.vii.1975, GM (QM); Moreton, Wenlock R., Cape York Pen. 14.ix.1974, GM (CBM, QM); French's Coll./.807 *Eudalia niger* Sl. det. by Sloane vi.13 (MV); Tolga, ii-iii.1980, NG, JB (MDPI); Kalpower X-ing, 75km NW of Laura, 2.iv.1983, RS (MDPI); Old Laura Stn 25km N. of Laura, 3.iv.1983, RS (MDPI); Hann R. via Laura, 2.v.1978, RS, NG (MDPI); Pouth Ck., via Georgetown, 8.i.1980, RS (MDPI); 15.41°S 145.12°E, Annan R., 3km W by S of Black Mt., 17.ix.1980, TW (ANIC); 12.27°S 142.38°E, Moreton, 10.xii.1992, WD, PZ (ANIC).

FIG. 10. *Eudalia obliquiceps obliquiceps* Sloane. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

DIAGNOSIS. Head densely punctate; pronotum narrow, elongate, completely punctuate, bearing almost parallel lateral margins; rather stout, on lower surface evenly curved aedeagus bearing a short apex.

SUPPLEMENTARY DESCRIPTION.
*Measurements* (Table 4).

*Male Genitalia* (Fig. 10). Terminal abdominal sternite in middle very gently incised. Genital ring fairly narrow and elongate, moderately triangular, barely asymmetric, with narrow, acute, triangular apex. Aedeagus slender and elongate, moderately depressed, laterally moderately sinuate, whole lower surface concave. Orificum short. Apex short, fairly wide, straight, gently knobbed, markedly turned to right, deeply incised at right side. Folding of internal sac simple. Parameres of moderately dissimilar shape, left paramere much larger than right one, right paramere elongate, both with rounded apex.

*Female Genitalia* (Fig. 30M). Stylomere 2 medium-sized, moderately elongate, laterally moderately curved, with fairly acute apex. With 3 small ventrolateral ensiform setae, a medium-sized dorsomedian ensiform seta situated about in middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with c. 6 moderately elongate ensiform setae. Lateral plate with comparatively sparse fringe of fairly elongate, stiff nematiform setae at apical rim.

DISTRIBUTION. NE Qld including Cape York Peninsula, W to Georgetown area. One specimen collected at light. Probably a hygrophilous, ground living species.

RELATIONSHIPS. Eye and prothorax shape and additional setiferous punctures on 5th interval suggest closer relationship with *E. o. tozeria* than with *E. o. punctifrons*.

### **Eudalia obliquiceps tozeria** subsp. nov.
(Figs 11, 34F)

ETYMOLOGY. From Mt Tozer.

MATERIAL. HOLOTYPE: ♂12.44°S 143.14°E 3km ENE of Mt Tozer Qld 28.vi-4 vii.1986 T. Weir & A. Calder (ANIC). PARATYPES: 1 ♂, same data (ANIC); 2 ♂♂, 12.43S 143.17E 9km ENE of Mt Tozer Qld 28.vi-4.vii.1986, TW & AC (ANIC, CBM); 1 ♀, West Claudie R., Iron Range, N Qld 3-10.xii.1985, GM & DC, rainforest, 50m (QM).

DIAGNOSIS. Head almost impunctate; pronotum narrow and elongate, lateral margin barely convex, punctate only in basal half; elytra with more than one setiferous puncture on 5th interval.

DESCRIPTION. *Measurements* (Table 4).

*Colour* (Fig. 34F). Surface almost completely black or dark piceous, as in nominate subspecies. Femora and tibiae conspicuously bicoloured.

*Head.* Shape as in nominate subspecies, though eyes laterally slightly more projecting than in nominate subspecies. Surface of head largely impunctate, punctate only near eyes. *Pronotum.* Generally even slightly longer than in nominate subspecies (see Tab. 4), laterally little convex, lateral margin rather straight. Surface punctate only in basal half, and with few punctures within basal transverse sulcus.

*Elytra.* Slightly longer and narrower than in nominate subspecies (Table 4), apex with shallow though distinct excision, 5th interval with a more than one setiferous punctures that extend the latter of which is situated near middle.

*Lower Surface.* As in nominate subspecies. Terminal abdominal sternite in male bisetose and glabrous, in female quadrisetose and with very short pilosity in middle of apex.

*Legs.* As in nominate subspecies, though the single female specimen with only 2 ventrolateral ensiform setae.

*Male Genitalia* (Fig. 11). As in nominate subspecies, but aedeagus slightly more elongate and slender, apex shorter, less markedly tuned to the right side, and slightly upturned, and both parameres decidedly longer.

FIG. 11. *Eudalia obliquiceps tozeria* subsp. nov. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

*Female Genitalia.* As in nominate subspecies.

*Variation.* Little variation noted.

DISTRIBUTION. Iron Ra., N Qld.

RELATIONSHIPS. Shape of eyes and prothorax, and additional setiferous punctures on 5th interval, suggest closer relationship to the nominate subspecies than to *E. o. punctifrons*.

### **Eudalia obliquiceps punctifrons** subsp. nov.
(Figs 12, 35A)

ETYMOLOGY. Refers to the densely punctate head.

MATERIAL. HOLOTYPE: ♂, Adelaide R. NT, H.W. Brown (SAM). PARATYPES: 1 ♀, same data (SAM); 1 ♂, Australien, WA Ord River, 135km N Hall's Creek, 15.ii.1984, MB/*Eudalia obliquiceps* Sl. (CBM);1 ♀, Australien, NT Katherine 7.-8.viii.1995, MB (CBM); 1 ♂, N WA Kununurra 22.xii.1991-5.i.1992, RS (MDPI); 2 ♂♂, 2 ♀♀, 14.04°S 131.59°E, Ferguson R. 31km SE by S of Pine Creek, NT, 14.xi.1979, TW (ANIC, CBM); 1 ♀, Bessie Spring, 16.40°S 135.41°E, 8km ESE of Cape Crawford, NT 12.iv.1976, at light, JF (ANIC); 1 ♂, McArthur River, 16.47°S 135.45°E, 14km S by W of Cape Crawford, NT, 25.x.1975, MU (ANIC); 1 ♀, Dugald R., 60km W Cloncurry, 20.xi.1978, At light, RS (QM); 1 ♀, 15.11°S 143.52°E, GPS Hann River Qld 14.i.1994 at light, PZ & EE (ANIC); 1 ♂ (abdomen destroyed), Australia/Coll. Erben (DEI).

DIAGNOSIS. Distinguished from other two subspecies by completely and coarsely punctate head; pronotum short and wide, lateral margin considerably convex, surface regularly punctate; elytra with 1 setiferous puncture only near base of 5th interval; distinguished from *E. minor* sp. nov. by larger size, denser punctuation of head and

FIG. 12. *Eudalia obliquiceps punctifrons* subsp. nov. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

prothorax, and less angulate subapical excision of aedeagus.

DESCRIPTION. *Measurements* (Table 4).

*Colour* (Fig. 35A). Surface almost completely black, as in nominate subspecies. Femora and tibiae conspicuously bicoloured. *Head.* Shape as in nominate subspecies, though eyes slightly larger in comparison to orbits than in other subspecies, therefore head comparatively shorter and wider (Tab. 4). Surface of head almost completely and rather evenly punctate.

*Pronotum.* Shorter and wider (Table 4), laterally more convex, lateral margin more convex than in other subspecies. Surface almost completely punctate. *Elytra.* Shape and structure as in nominate subspecies, though apex not at all excised, and 5th interval with a single setiferous puncture only in basal fifth.

*Lower Surface.* As in nominate subspecies. Terminal abdominal sternite in male bisetose and glabrous, in female quadrisetose and with very short pilosity in middle of apex.

*Legs.* As in nominate subspecies.

*Male Genitalia* (Fig. 12). As in nominate subspecies, but lower surface slightly of aedeagus less concave, therefore, aedeagus less curved, and apex of right paramere more widely rounded.

*Female Genitalia.* As in nominate subspecies.

*Variation.* Very little variation noted, though males tend to have slightly narrower elytra than females.

DISTRIBUTION. NW Qld, N part of NT, and N WA. Some specimens collected at light in the vicinity of rivers.

### **Eudalia minor** sp. nov.
### (Figs 13, 35B)

ETYMOLOGY. Refers to the small size.

MATERIAL. HOLOTYPE: ♂, Dugald R., 60km W Cloncurry, N Qld. 20.xi.1978, R.I. Storey, at light/*Dicraspeda* sp. det. B.P. Moore 1979 (QMT 99170). PARATYPE: 1 ♂, same data (MDPI).

DIAGNOSIS. Distinguished from *E. obliquiceps* by small size; head sparsely punctuate; prothorax anteriorly impunctate. Further distinguished from eastern subspecies of *E. obliquiceps* by short and convex pronotum bearing convex lateral margins that are distinctly sinuate near base, and from *E. o. punctifrons* by more delicate aedeagus with a remarkably deep and angulate incision near apex.

DESCRIPTION. *Measurements* (Table 4).

*Colour.* Surface blackish or dark piceous, labrum, palpi, antennae, and legs reddish, knees dark.

*Head.* Fairly wide. Neck moderately narrow, with rather deep transverse impression. Eyes large, laterally well protruding, slightly separated from orbits which are shorter than eyes and slightly convex. Behind clypeus with fairly deep elongate, somewhat sinuate groove. Medially of eye with a slight sulcus that extends to about middle of eye, but without ridge. Posterior supraorbital seta located slightly behind posterior margin of eye. Mentum with rather elongate, acute, triangular tooth, with 2 setae behind tooth, submentum with a very elongate seta on either side. Apex of glossa transverse, with 2 elongate median and 2 shorter lateral setae. Paraglossae free, narrow, surpassing glossy. Lacinia elongate, interior margin with a sparse fringe of spines. Antenna elongate, surpassing base of pronotum by at least 2 antennomeres, pilose from middle of 4th antennomere. Surface glossy, without microreticulation, glabrous, with scattered, coarse punctures.

*Pronotum.* Moderately elongate, laterally and dorsally convex, near apex with shallow transverse impression. Apex and base not bordered, lateral margin complete, slightly ridge-like, in anterior half fairly convex, towards base distinctly diverging, without sulcus medially of margin. Median line shallow, anterior transverse sulcus somewhat v-shaped, shallow, coarsely punctate. A single marginal seta situated just in front of middle. Proepisternum narrowly visible from above in middle. Disk in basal two thirds densely and very coarsely punctate, more

FIG. 13. *Eudalia minor* sp. nov. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

scattered so near apex, punctures tend to form irregular transverse sulci near base. Surface without microreticulation, impilose, glossy.

*Elytra*. Rather elongate, somewhat rectangular, laterally gently convex, very slightly widened in apical half, surface gently convex. Base almost transverse, humeri very distinct but rounded, lateral margin very faintly incised at basal third, gently convex and almost evenly rounded towards sutural angle. Lateral apical angles barely indicated, apex oblique and very slightly excised. Base narrowly margined to position of 5th stria, apex coarsely margined. Surface without transverse impression. All striae present, though originating shortly behind base. Striae deeply impressed throughout, coarsely punctate, though punctures becoming smaller posteriorly, but are present even near apex. Intervals convex, even towards apex. Scutellar stria elongate, consisting of about 8 coarse punctures. 3rd interval with 5-6, 5th interval with 1-2 setiferous punctures. Surface impunctate, without microreticulation, with extremely fine, barely visible, sparse pilosity, that is best detected laterally, surface very glossy. Hind wings present.

*Lower Surface*. Thorax and basal half of abdomen with very coarse, moderately dense punctuation. Apical half of abdomen impunctate. Metepisternum elongate, c. 2.5 × as long as wide at apex. Terminal abdominal sternum in male bisetose.

*Legs*. Of moderate size. Tarsi not lobed, impilose on upper surface, 5th tarsomere with a dense fringe of elongate setae below. Claws large, smooth. 1st–3rd tarsomeres of male anterior tarsus with sparse squamosity.

*Male Genitalia* (Fig. 13). Terminal abdominal sternite in middle very gently incised. Genital ring fairly narrow and elongate, moderately triangular, barely asymmetric, with narrow, acute, triangular apex. Aedeagus slender and elongate, moderately depressed, laterally moderately sinuate, whole lower surface rather concave. Orificum short. Apex short, fairly wide, decidedly upturned, gently knobbed, moderately turned to right, deeply incised at right side. Folding of internal sac simple. Parameres of moderately dissimilar shape, both rather elongate, left paramere much larger than right one, both with rounded apex.

DISTRIBUTION. NW Qld. Collected at light near river bank in association with *E. obliquiceps punctifrons*.

RELATIONSHIPS. Closely related to *E. obliquiceps* Sloane and in certain characters similar to *E. o. punctifrons*.

### **Eudalia reticulata** sp. nov.
(Figs 14, 30N, 35C)

ETYMOLOGY. Refers to the microreticulate elytra.

MATERIAL. HOLOTYPE: ♂, Goldsborough NQ 1/65. GB/*obliquiceps* Sl./J.G. Brooks Bequest, 1976 (ANIC). PARATYPES: 1 ♂, same data (CBM); 2 ♀♀, 14.ix.2000, Polly Ck., Garradunga, N Qld, JH (MDPI, QM).

DIAGNOSIS. Colour uniformly black; elytra not pilose, with fine microreticulation; legs not conspicuously bicoloured; 2-3 setiferous punctures on 5th interval. From similar and closely related *E. atrata* also distinguished by slightly smaller size and larger, more protruding eyes, and from *E. femorata* by far less conspicuously coloured legs and shorter, wider elytra.

DESCRIPTION. *Measurements* (Table 4).

*Colour* (Fig. 35C). Surface black or dark piceous, labrum, palpi, and 2 basal antennomeres reddish, rest of antenna dark. Legs dark piceous, femora except for apex, ill delimited reddish.

*Head*. Fairly wide. Neck moderately narrow, with rather deep transverse impression. Eyes large, laterally well protruding, slightly separated from orbits which are shorter than eyes and slightly convex. Behind clypeus with fairly deep elongate, somewhat sinuate groove, and in middle of frons with a shallow V-shaped groove. Medially of eye with a slight sulcus that extends to about middle of eye, but without ridge. Posterior supraorbital seta located well behind posterior margin of eye. Mentum with elongate, acute, triangular tooth, with 2 setae behind tooth, submentum with a very elongate and a short seta on either side. Apex of glossa transverse, with 2 elongate median and 2 shorter lateral setae. Paraglossae free, narrow, surpassing glossy. Lacinia elongate, interior margin with a sparse fringe of spines. Antenna elongate, surpassing base of pronotum by about one antennomere, pilose from middle of 4th antennomere. Surface glossy, without microreticulation, glabrous, with few punctures only near eyes.

*Pronotum.* Moderately elongate, laterally little convex, dorsally convex, near apex with shallow transverse impression. Apex and base not bordered, lateral margin complete, slightly ridge-like, in anterior half gently convex, towards base slightly diverging, without sulcus medially of margin. Median line shallow. A single marginal seta situated just in front of middle. Proepisternum narrowly visible from above in middle. Disk in basal half densely and coarsely punctate, punctures tend to form irregular transverse sulci. Surface without microreticulation, impilose, glossy.

*Elytra.* Rather elongate, somewhat rectangular, laterally gently convex, very slightly widened in apical half, surface gently convex. Base almost transverse, humeri very distinct but rounded, lateral margin very faintly incised at basal third, gently convex and almost evenly rounded towards sutural angle. Lateral apical angles barely indicated, apex oblique and very slightly excised. Base narrowly margined to position of 5th stria, apex coarsely margined. Surface in anterior third with very shallow, transverse impression. All striae present, though originating shortly behind base. Striae slightly impressed throughout, coarsely punctate in anterior half, punctures becoming smaller posteriorly, but are present even near apex. Intervals little convex, in apical half almost depressed. Scutellar stria elongate, consisting of about 8 coarse punctures. 3d interval with 5-6, 5th interval with 2-3 setiferous punctures. Surface impunctate, with very fine, superficial, slightly transverse microreticulation that is even more superficial in basal half, surface glossy. Hind wings present.

*Lower Surface.* Thorax and basal half of abdomen with coarse and moderately dense punctuation. Apical half of abdomen impunctate. Metepisternum elongate, c. 2.5 × as long as wide at apex. Terminal abdominal sternum in male bisetose.

FIG. 14. *Eudalia reticulata* sp. nov. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

*Legs.* Of moderate size. Tarsi not lobed, impilose on upper surface, 5th tarsomere with a dense fringe of elongate setae below. Claws large, smooth. 1st – 3rd tarsomeres of male anterior tarsus with sparse squamosity.

*Male Genitalia* (Fig. 14). Terminal abdominal sternite in middle gently incised. Genital ring fairly narrow and elongate, moderately triangular, barely asymmetric, with narrow, triangular apex. Aedeagus slender and elongate, moderately depressed, laterally little sinuate, lower surface near base concave, in apical half almost straight. Orificum short. Apex short, rather narrow, slightly upturned, rather knobbed, turned to right, with deep but short incision at right side. Folding of internal sac simple. Parameres of dissimilar shape, left paramere much larger than right one, stout, with rounded apex, right paramere rather narrow and elongate, obtusely triangular, with narrowly rounded apex.

*Female Genitalia* (Fig. 30M). Stylomere 2 large, though comparatively short and stout, laterally rather little curved, with short, moderately acute apex. With 3 to 4 fairly elongate ventrolateral ensiform setae, a medium-sized dorsomedian ensiform seta situated above middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 8-9 very elongate ensiform setae. Lateral plate with dense fringe of very elongate, stiff setae at apical rim.

*Variation.* In the male paratype striae slightly deeper towards apex, both females with slightly more distinct elytral microreticulation.

DISTRIBUTION. N Qld.

RELATIONSHIPS. Probably nearest to *E. atrata*.

### **Eudalia atrata** sp. nov.
(Figs 15, 30O, 35D)

ETYMOLOGY. Refers to the black body and legs.

MATERIAL. HOLOTYPE: ♂, 32.08S, 151.27E, Allyn R., Chichester S.F. NSW, 10-11.xi.1981, T. Weir/at light (ANIC). PARATYPES: 6 ♂♂, 8 ♀♀, same data (ANIC, CBM); 2 ♂♂, 2 ♀♀, same data, AC (ANIC); 7 ♂♂, 6 ♀♀, Chichester St. For., NSW, Allyn River Park, 8.xi.1982, JD (ANIC, CBM); 1 ♀, Eccleston, flood debris, 25.vii.21, GA. Hill (ANIC); 2 ♂♂, Upper Williams R. NSW, x.1926, LW/*Eudalia* Sln. says n. sp. near *Dicraspeda*, ? (unreadable), see letter 31.v.27/F. E. Wilson Collection (MV); 1 ♂ (abdomen damaged), Upper Williams R. NSW, x.1925, LW/*Eudalia* sp. nov. M. Liebke determ. (DEI); 1 ♂, 2 ♀♀ (one immature), NSW m 500 Barrington Tops N.P. Allyn R. 24.i.1997 PG (CBM, CGT); 4 ♂♂, NSW Chichester State Forest, 32°07'S, 151°28'E, 17.i.1992/In debris in river, Tom Gush coll. 3284, TG (ANIC, CBM).

DIAGNOSIS. Colour uniformly black; elytra not pilose, with fine microreticulation; legs unicolourous piceous; setiferous punctures from 5th interval absent. Separated from *E. reticulata* under that species above and from *E. femorata* by uniformly dark legs, shorter and wider elytra, more distinct microreticulation, and narrower and longer aedeagus.

DESCRIPTION. *Measurements* (Table 4).

*Colour* (Fig. 35D). Surface black, labrum, palpi, and 2 basal antennomeres more or less dark reddish, rest of antenna dark. Mandibles reddish with black edges. Legs black or dark piceous, only tarsi reddish towards apex.

*Head*. Fairly wide. Neck moderately narrow, with deep transverse impression. Eyes fairly large, laterally moderately protruding, slightly separated from orbits which are slightly shorter than eyes and gently convex. Behind clypeus with fairly deep elongate, somewhat sinuate groove, and in middle of frons with a shallow v-shaped groove. Medially of eye with a slight sulcus that extends to about middle of eye, but without ridge. Posterior supraorbital seta located well behind posterior margin of eye. Mentum with rather elongate, acute, triangular tooth, with 2 setae behind tooth, submentum with a very elongate and a short seta on either side. Apex of glossa transverse, with 2 elongate median and 2 shorter lateral setae. Paraglossae free, narrow, surpassing glossy. Lacinia elongate, interior margin with a sparse fringe of spines. Antenna elongate, surpassing base of pronotum by about one antennomere, pilose from middle of 4th antennomere. Surface glossy, without microreticulation, glabrous, barely punctate or with few punctures only near eyes.

FIG. 15. *Eudalia atrata* sp. nov. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

*Pronotum*. Moderately elongate, laterally little convex, dorsally convex, near apex with shallow transverse impression. Apex and base not bordered, lateral margin complete, slightly ridge-like, in anterior half very gently convex, towards base slightly diverging, without sulcus medially of margin. Median line shallow. A single marginal seta situated just in front of middle. Proepisternum narrowly visible from above in middle. Disk in basal half densely and coarsely punctate, apical half with more scattered punctures or even impunctate, punctures tend to form irregular transverse sulci. Surface without microreticulation, impilose, glossy.

*Elytra*. Rather elongate, somewhat rectangular, laterally gently convex, slightly widened in apical half, surface gently convex. Base almost transverse, humeri very distinct but rounded, lateral margin very faintly incised at basal third, gently convex and almost evenly rounded towards sutural angle. Lateral apical angles barely indicated, apex oblique and very slightly excised. Base narrowly margined to position of 5th stria, apex coarsely margined. Surface in anterior third with very shallow, transverse impression. All striae present, though originating shortly behind base. Striae slightly impressed throughout, coarsely punctate in anterior half, punctures become smaller posteriorly and diminish in front of apex. Intervals little convex, in apical half almost depressed. Scutellar stria elongate, consisting of about 8 coarse punctures. 3rd interval with 3 setiferous punctures, other intervals asetose. Surface impunctate, with very fine, superficial, almost isodiametric microreticulation that is as well developed in basal half

TABLE 4. Measurements and ratios of all Australian species of *Eudalia*.

|  | N | length (mm) | length eye/orbit | l/w head | l/w prothorax | l/w elytra |
|---|---|---|---|---|---|---|
| *o. obliquiceps* | 6 | 7.7-8.8 | 1.30-1.40 | 1.16-1.27 | 1.24-1.25 | 1.66-1.69 |
| *o. tozeria* | 5 | 7.8-8.5 | 1.35-1.42 | 1.12-1.22 | 1.23-1.31 | 1.69-1.75 |
| *o. punctifrons* | 6 | 7.4-8.7 | 1.40-1.60 | 1.05-1.12 | 1.14-1.22 | 1.67-1.73 |
| *minor* | 2 | 6.9-7.3 | 1.47-1.50 | 1.06-1.07 | 1.18 | 1.69-1.73 |
| *reticulata* | 4 | 8.5-8.8 | 1.44-1.45 | 1.09-1.11 | 1.24-1.26 | 1.64-1.70 |
| *atrata* | 8 | 9.3-10.2 | 1.25-1.29 | 1.08-1.14 | 1.26-1.34 | 1.65-1.68 |
| *femorata* | 1 | 9.8 | 1.3 | 1.12 | 1.28 | 1.76 |
| *castelnaui* | 8 | 10.1-11.3 | 1.18-1.30 | 1.03-1.07 | 1.05-1.07 | 1.53-1.68 |
| *macleayi* | 8 | 8.5-9.9 | 1.70-1.90 | 0.99-1.03 | 1.01-1.07 | 1.59-1.65 |
| *l. latipennis* | 8 | 7.7-9.1 | 1.95-2.05 | 0.97-1.00 | 1.00-1.02 | 1.53-1.61 |
| *l. interioris* | 4 | 8.0-8.4 | 2.05-2.20 | 0.96-0.97 | 0.98-1.05 | 1.54-1.59 |
| *waterhousei* | 8 | 8.5-9.9 | 2.00-2.07 | 0.96-1.02 | 1.04-1.08 | 1.58-1.65 |
| *punctipennis* | 8 | 8.2-9.5 | 1.98-2.11 | 0.94-0.98 | 1.03-1.07 | 1.60-1.65 |

as near apex, moderately glossy. Hind wings present.

*Lower Surface.* Thorax and basal half of abdomen with coarse and moderately dense punctuation. Apical half of abdomen impunctate. Metepisternum elongate, c. 2.5 × as long as wide at apex. Terminal abdominal sternum in male bisetose, in female quadrisetose.

*Legs.* Of moderate size. Tarsi not lobed, impilose on upper surface, 5th tarsomere with a dense fringe of elongate setae below. Claws large, smooth. 1st – 3rd tarsomeres of male anterior tarsus with sparse squamosity.

*Male Genitalia* (Fig. 15). Terminal abdominal sternite in middle gently incised. Genital ring fairly narrow and elongate, moderately triangular, barely asymmetric, with narrow, triangular apex. Aedeagus very slender and elongate, moderately depressed, laterally little sinuate, lower surface near base concave, in apical half almost straight. Orificum short. Apex short, fairly narrow, very slightly upturned, gently knobbed, turned to right, moderately incised at right side. Folding of internal sac simple. Parameres of moderately dissimilar shape, left paramere much larger than right one, right paramere stout, both with more or less rounded apex.

*Female Genitalia* (Fig. 30O). Stylomere 2 large, though comparatively short and stout, laterally little curved, with short, moderately acute apex. With 4 fairly elongate ventrolateral ensiform setae, a medium-sized dorsomedian ensiform seta situated above middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 9-10 very elongate ensiform setae. Lateral plate with dense fringe of very elongate, stiff setae at apical rim.

*Variation.* Slight differences noted in shape of pronotum, and in extent of punctuation on head, pronotum, and elytral striae.

DISTRIBUTION. Barrington Tops area, NSW. All specimens collected near river, several sampled at light, some 'in debris in river'. Probably a hygrophilous ground-living species that occurs on or near river banks.

RELATIONSHIPS. Closest to *E. femorata* and less closely related to *E. reticulata*.

### **Eudalia femorata** sp. nov.
(Figs 16, 35E)

ETYMOLOGY. Refers to the colour of the femora.

MATERIAL. HOLOTYPE: ♂, NW Orange, NSW, 13.xii.72, light trap, S. Misko/*Eudalia* spp. det. T. A. Weir 2000 (ANIC).

DIAGNOSIS. Colour uniformly black; elytra not pilose, with fine microreticulation; femora with conspicuously light reddish upper surface; setiferous punctures from 5th interval absent. Distinguished from *E. atrata* under that species above.

DESCRIPTION. *Measurements* (Table 4).

*Colour* (Fig. 35E). Surface black, labrum, palpi, and 2 basal antennomeres reddish, rest of antenna dark. Mandibles reddish with black edges. Legs dark piceous, but upper surface of femora contrastingly light reddish, tarsi reddish.

*Head.* Fairly wide. Neck moderately narrow, with rather deep transverse impression. Eyes fairly large, laterally moderately protruding, slightly separated from orbits which are slightly shorter than eyes and gently convex. Behind clypeus with fairly deep elongate, somewhat sinuate groove, and in middle of frons with a shallow v-shaped groove. Medially of eye with a slight sulcus that extends to about middle of eye, but without ridge. Posterior supraorbital seta located well behind posterior margin of eye. Mentum with elongate, acute, triangular tooth, with 2 setae behind tooth, submentum with a very elongate and a short seta on either side. Apex of

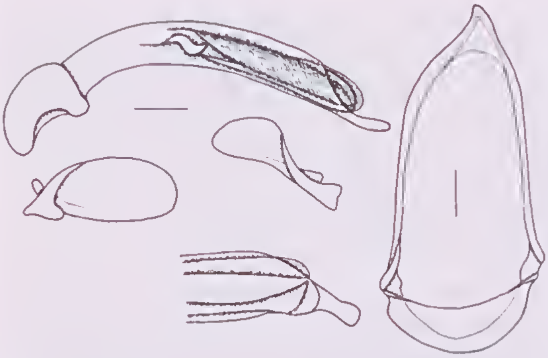

FIG. 16. *Eudalia femorata* sp. nov. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

glossa transverse, with 2 elongate median and 2 shorter lateral setae. Paraglossae free, narrow, surpassing glossy. Lacinia elongate, interior margin with a sparse fringe of spines. Antenna elongate, surpassing base of pronotum by about one antennomere, pilose from middle of 4th antennomere. Surface glossy, without microreticulation, glabrous, with scattered coarse punctures near eyes.

*Pronotum.* Moderately elongate, laterally little convex, dorsally convex, near apex with shallow transverse impression. Apex and base not bordered, lateral margin complete, slightly ridge-like, in anterior half very gently convex, towards base slightly diverging, without sulcus medially of margin. Median line shallow. A single marginal seta situated just in front of middle. Proepisternum narrowly visible from above in middle. Disk in basal half densely and coarsely punctate, apical half almost impunctate, punctures tend to form irregular transverse sulci. Surface without microreticulation, impilose, glossy.

*Elytra.* Elongate, somewhat rectangular, laterally barely convex, not widened in apical half, thus rather parallel, surface gently convex. Base almost transverse, humeri very distinct but rounded, lateral margin barely incised at basal third, gently convex and almost evenly rounded towards sutural angle. Lateral apical angles barely indicated, apex oblique and very slightly excised. Base narrowly margined to position of 5th stria, apex coarsely margined. Surface in anterior third without perceptible transverse impression. All striae present, though originating shortly behind base. Striae well impressed throughout, coarsely punctate in anterior half, punctures become smaller posteriorly but are visible towards apex. Intervals rather convex throughout, even in apical half not depressed. Scutellar stria very elongate, consisting of about 12 coarse punctures. 3rd interval with 3 setiferous punctures, other intervals asetose. Surface impunctate, with very fine, highly superficial, isodiametric to slightly transverse microreticulation that is not becoming stronger near apex, glossy. Hind wings present.

*Lower Surface.* Thorax and basal half of abdomen with coarse and moderately dense punctuation. Apical half of abdomen impunctate. Metepisternum elongate, c. 2.5 × as long as wide at apex. Terminal abdominal sternum in male bisetose.

*Legs.* Of moderate size. Tarsi not lobed, impilose on upper surface, 5th tarsomere with a dense fringe of elongate setae below. Claws large, smooth. 1st – 3rd tarsomeres of male anterior tarsus with sparse squamosity.

*Male Genitalia* (Fig. 16). Terminal abdominal sternite in middle gently incised. Genital ring fairly narrow and elongate, moderately triangular, barely asymmetric, with narrow, triangular apex. Aedeagus slender and elongate, moderately depressed, laterally little sinuate, lower surface evenly concave. Orificum short. Apex short, fairly narrow, very slightly upturned, very gently knobbed, turned to right, moderately incised at right side. Folding of internal sac simple. Parameres of moderately dissimilar shape, left paramere much larger than right one, right paramere stout, both with fairly rounded apex.

*Female Genitalia.* Unknown.

*Variation.* Unknown.

DISTRIBUTION. Only type locality, SE NSW.

RELATIONSHIPS. Closest to *E. atrata*.

### **Eudalia castelnaui** Sloane, 1910
### (Figs 17, 30P)

*Eudalia castelnaui* Sloane, 1910: 395; 1917: 417; Csiki, 1932: 1542; Liebke, 1938: 106; Moore et al., 1987: 273; Lorenz, 1998: 421; Framenau et al., 2002: 123.

*Dicraspeda castelnaui*, Sloane, 1923: 31.

MATERIAL. LECTOTYPE (here designated): ♂, labeled 'LT', Jindabyne 1/06 H.J.C./ 32/*Eudalia castelnaui* Sl. Cotype/HOLOTYPE *E. castelnaui* Sl. PJD (ANIC). PARALECTOTYPES: 1 ♀ (?, damaged), same data, on same card (ANIC); 1 ♂, 2 ♀♀, Jindabyne 1.06. H.J.C./*Eudalia castelnaui* (Cotypes) Sloane/H.J. Carter Coll. P. 20.4.22./Co-type/Syntype T 17961-63 (MV); 1 ♀ (partly damaged), Alps Vict. C. 7. 1904/ *Eudalia castelnaui* Sl. Cotype/PARATYPE (ANIC). NEW

FIG. 17. *Eudalia castelnaui* Sloane. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

RECORDS (39 ex.): VIC: Mitta Mitta River (CBM, QM); Buckland River, Stn 3 (CBM); Wonnangatta River (CBM); Castleburn Creek (CBM) – all leg. VF 11.1998-1.1999 (see Framenau et al. 2002); Tambo Crossing, i.1935, FW (MV); Beechworth, i.1914, CO (MV); Bright, HD (MV); Mt Macedon, HD (MV); Mitchell Gorge, i.1929, CO/*Dicraspeda castelnaui* Sl. (MV).– NSW: *Eudalia waterhousei* (Cast.) Murrumbidgee (MV); *Eudalia Waterhousei* ?? Casteln. Murrumbidgee (MV).

DIAGNOSIS. Completely black (including mouthparts, antennae and legs); elytra not pilose, with very distinct microreticulation; setiferous punctures on 3rd, 5th, and 7th intervals.

SUPPLEMENTARY DESCRIPTION. *Measurements* (Table 4).

*Male Genitalia* (Fig. 17). Terminal abdominal sternite in middle not incised. Genital ring comparatively wide, moderately triangular, fairly asymmetric, with wide, rounded, in certain specimens even asymmetrically oblique apex. Aedeagus large, comparatively stout, moderately depressed, laterally moderately sinuate, lower surface concave in basal half, apically straight or even very gently convex. Orificum moderately short. Apex short, fairly wide, gently upturned, slightly knobbed and asymmetrically spoon-shaped, very markedly turned to right, deeply incised at right side. Folding of internal sac simple. Parameres of moderately dissimilar shape, left paramere much larger than right one, with evenly rounded apex, right paramere short, with more triangular apex.

*Female Genitalia* (Fig. 30P). Stylomere 2 large, though comparatively short and stout, laterally rather little curved, with short, moderately acute apex. With 4 to 5 fairly elongate ventrolateral ensiform setae, one or in some specimens unilaterally even 2 medium-sized dorsomedian ensiform seta(e) situated above middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 9-11 very elongate ensiform setae. Lateral plate with dense fringe of very elongate, stiff setae at apical rim.

*Variation*. Males generally with narrower, longer elytra than females.

DISTRIBUTION. SE NSW, adjacent E Vic. All V. Framenau specimens were collected by hand sampling in sand and gravel and between pebbles on the banks of subalpine and montane streams.

### **Eudalia macleayi** Bates, 1871
(Figs 18, 31A)

*Eudalia macleayi* Bates, 1871: 32; Sloane, 1917: 417; Csiki, 1932: 1542; Liebke, 1938: 106; Moore et al., 1987: 274; Lorenz, 1998: 421.

*Dicraspeda macleayi*, Sloane, 1923: 31.

MATERIAL. HOLOTYPE: ♂, NSW/*Eudalia Macleayi* Bates TYPE/Ex Musaeo H.W. Bates 1892 (MHNP). PARATYPES: 1 ♂, NSW, Recu de W. Bates/*Eudalia Macleayi* Bates (MNHP); 2 ♂♂, NSW/Ex Musaeo H.W. Bates 1892 (MHNP). Both named specimens were labeled by Bates. NEW RECORDS (29 ex.): VIC: Avon R. nr Weirs Cr. (CBM); Howqua R., Stn 1 (CBM); Snowy River, Mc Killops Br. (CBM); Mitta Mitta R. (CBM); Mitchell R., Wuk Br. (CBM) – all leg. VF xi.1998-i.1999 (see Framenau et al. 2002); Tambo Crossing, V, i.1935, FW (MV). - NSW: Bendemeer, 28.xii.1999, LT (CBM); Mulwala/*Eudalia macleayi* Bates, Id. by T.G. Sloane (MV); 35.34°S 149.37°E Shoalhaven R. Ballalaba Bridge, 2.ii.1991, PH (ANIC).

DIAGNOSIS. Elytra black, pilose, with distinct greenish tinge, with conspicuous and remarkably rugose microreticulation; head and prothorax with impunctate, or distinctly less densely punctate areas.

SUPPLEMENTARY DESCRIPTION. *Measurements* (Table 4).

*Male Genitalia* (Fig. 18). Terminal abdominal sternite in middle not incised. Genital ring comparatively wide, parallel, fairly asymmetric, with short, triangular apex. Aedeagus large, elongate, fairly depressed, laterally moderately sinuate, lower surface concave in basal half, apically straight. Orificum short. Apex short, almost straight, slightly knobbed and markedly spoon-shaped, very strongly turned to right, deeply incised at right side. Folding of internal sac simple. Parameres of moderately dissimilar shape, left paramere much larger than right one, both with wide, obtusely transverse apex.

FIG. 18. *Eudalia macleayi* Bates. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

FIG. 19. *Eudalia latipennis latipennis* (Macleay). Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

*Female Genitalia* (Fig. 31A). Stylomere 2 large, though comparatively short and stout, laterally little curved, with short, moderately acute apex. With 3 small ventrolateral ensiform setae, a small dorsomedian ensiform seta situated above middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 10-12 slender, extremely elongate ensiform setae. Lateral plate with dense fringe of very elongate, stiff setae at apical rim.

DISTRIBUTION. E Vic., SE NSW, ACT. All V. Framenau specimens were hand collected in sand and gravel and between pebbles on the banks of subalpine and montane rivers.

### **Eudalia latipennis** (Macleay, 1864)
### (Figs 19, 31B, 35F, 36A)

*Odacantha latipennis* Macleay, 1864: 108.
*Dicraspeda latipennis*, Sloane, 1923: 31.
*Eudalia latipennis*, Castelnau, 1867: 16; 1868: 102; Sloane, 1917: 417; Csiki, 1932: 1542; Liebke, 1938: 106; Moore et al., 1987: 274; Lorenz, 1998: 421.

DISCUSSION. Sloane (1917: 418) suspected that *E. waterhousei* was identical with *E. latipennis* but was not able to compare Castelnau's types. Csiki (1932) followed the suggestion and synonymised the two names. All later authors followed this treatment. However, my examination of the types demonstrates that the two names denote different species.

DIAGNOSIS. Elytra pilose, with wide, distinct, yellow border, with narrow, elongate aedeagus that bears elongate, spoon-shaped apex markedly turned to the right side and, at the same time, distinctly upturned. Some specimens from the interior of Queensland deviate in some characters from the eastern Qld populations, and thus are described as subspecies.

### **Eudalia latipennis latipennis** (Macleay, 1864)
### (Figs 19, 31B, 35F)

*Odacantha latipennis* Macleay, 1864: 108.

MATERIAL. LECTOTYPE (here designated): ♀, (slightly damaged), Pt Denison/ SYNTYPE/*Eudalia latipennis*, Macl. Port Denison (ANIC-MMS). PARALECTOTYPE: 1 (sex ?, damaged), Pt Denison/SYNTYPE (ANIC-MMS). NEW RECORDS (64 ex.): Qld: Qld 17, Reid Creek, 8km NW Gayndah, 9.xi.1990, MB (CBM); Foleyvale Aboriginal Reserve, 20.-25.i.1968, GH (HNMB); Qld 01/38, Burdekin R., 6km E Clarke River Cr., 15.-16.iv.2001, MB (CBM); Qld 01/31, Mc Leod River, 12km N Mt Carbine, 12.iv.2001, MB (CBM); Boulder Creek, 12km N Mossman, 8.i.1982, MB (CBM); Holroyd River, 12km S Coen, 29.xi.1974, WH (CBM, CMP); Stewart R., 5km W of Port Stewart, via Coen, 25.-27.vi.1976, GM & SM (CBM, QM); Archer River X-ing, 70km N of Coen, Cape York Pen., 17.-18.vii.1975, GM (CBM, QM); Moreton, Wenlock R., Cape York Pen., 14.ix.1974, GM (CBM, QM); *Eudalia latipennis* McL. Jun. Burnett River (MV); *Odacantha latipennis* McLeay Junior Port Denison (MV); Gayndah/*Eudalia latipennis* Macl. (MV); Coen, 20.v.67, CO/*Eudalia latipennis* M.L. det. B.P. Moore (MV); Darling R./*Eudalia latipennis* HJC/Griffith Collection (SAM); Coen, 17.xi.1982, SBJ (MDPI); Little Laura R., Laura, 30.iv.1978, RS, NG (MDPI); Old Laura Stn, 25km N of Laura, 3.iv.1983, RS (MDPI); Marina Plains via Musgrave, 17.xi.1982, RBJ (MDPI); Pinnarendi Stn, 60km W of Mt Garnet, 7.xi.1989, DH (MDPI); Bloomfield, 15.v.1986, FS (ANIC); 13.33°S, 143.03°E, Archer River, 28.vii.1982, PZ & EN (ANIC). - NSW: *Eudalia latipennis* Macl. (MV).

DIAGNOSIS. Distinguished from *E. latipennis interioris* by slightly larger size, more regularly punctate pronotum, narrower, laterally less

FIG 20. *Eudalia latipennis interioris* subsp. nov. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

produced yellow margin and distinct microreticulation of elytra.

SUPPLEMENTARY DESCRIPTION. *Measurements* (Table 4).

*Male Genitalia* (Fig. 19). Terminal abdominal sternite slightly incised in middle. Genital ring comparatively narrow, almost regularly triangular, symmetric, with short, obtusely triangular apex. Aedeagus large, elongate, depressed, laterally moderately sinuate, lower surface basally deeply concave, gently convex in apical half. Orificum short. Apex moderately elongate, slightly upturned, slightly knobbed and markedly spoon-shaped, very strongly turned to right, gently incised at right side. Folding of internal sac simple. Parameres of moderately dissimilar shape, left paramere much larger than right one, both parameres elongate, with wide, obtusely transverse apex.

*Female Genitalia* (Fig. 31B). Stylomere 2 large, moderately elongate, rather straight and narrow, laterally little curved, with fairly short, but moderately acute apex. With 4 medium-sized ventrolateral ensiform setae, a fairly small dorsomedian ensiform seta situated above middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 8-9 very elongate ensiform setae. Lateral plate with dense fringe of markedly elongate, stiff nematiform setae at apical rim.

*Variation*. Apart from slight variation of shape and colouration, some sexual differences noted in degree of microreticulation of elytra that is less rugose and more superficial in males.

DISTRIBUTION. E and NE Qld from about Gayndah to tip of Cape York Peninsula, probably also N NSW. Many specimens came to light. I also found some in and on riverbank sand, where specimens were running on the sand at night.

### **Eudalia latipennis interioris** subsp. nov.
### (Figs 20, 36A)

ETYMOLOGY. Refers to the range in interior Qld.

MATERIAL. HOLOTYPE: ♂, Cooper Creek at Windorah, SW Qld. 29.ix.1983, G. B. Monteith (QMT 99169). PARATYPES: 1 ♂, 2 ♀♀, same data (CBM, QM).

DIAGNOSIS. Distinguished from nominate subspecies under that species above.

DESCRIPTION. *Measurements* (Table 4).

*Colour* (Fig. 36A). Similar to nominate subspecies, but yellow apical margin wider and laterally more produced, attains at least middle of elytra.

*Head.* As in nominate subspecies, though orbits even more angulate.

*Pronotum.* Shape as in nominate subspecies, though disk in apical half less regularly punctate, with some glabrous areas.

*Elytra.* Shape as in nominate subspecies, though microreticulation in both sexes less distinct, in males even almost wanting.

*Lower Surface.* As in nominate subspecies.

*Legs.* As in nominate subspecies.

*Male Genitalia* (Fig. 20). Terminal abdominal sternite in middle slightly incised. Genital ring comparatively narrow, triangular, symmetric, with short, obtusely triangular apex. Aedeagus large, elongate, depressed, laterally moderately sinuate, lower surface basally concave, in apical half almost straight. Orificum short. Apex moderately short, straight, markedly knobbed and spoon-shaped, very strongly turned to right, deeply incised at right side. Folding of internal sac simple. Parameres of moderately dissimilar shape, left paramere much larger than right one, both parameres elongate, with wide, obtusely transverse apex.

*Female Genitalia.* As in nominate subspecies, but both available females with 2-3 ventrolateral ensiform setae only.

*Variation.* Microreticulation of elytra more superficial in males.

DISTRIBUTION. Only type locality, SW Qld.

### **Eudalia waterhousei** Castelnau, 1867
### (Figs 21, 31C, 36B, 39A)

*Eudalia waterhousei* Castelnau, 1867: 16; 1868: 102; Macleay 1888: 447; Sloane, 1917: 418; Csiki, 1932: 1542; Moore et al., 1987: 274; Lorenz, 1998: 421.

MATERIAL. LECTOTYPE (here designated): ♀, Arnheim's Land Coll. Castelnau/Typus/*Eudalia waterhousei* Cast./*Eudalia waterhousei* Cast. (Castelnau's handwriting)/Syntypus *Eudalia waterhousei* Castelnau, 1867 (MCSN). PARALECTOTYPE: ♀, same data (MCSN). NEW RECORDS (74 ex.): WA: 15km NNE of Ajana, W.A. Murchison R. (27.49°S 114.41°E) 27.iii.71, MU (ANIC); Murchison R., 27.49°S 114.41°E 28.iii.1971 ER/*Eudalia* 'Ajana' (ANIC); 21.35°S 117.04°E Millstream, 2.xi.70 from gravel at edge of pool at pipe crossing. EB (ANIC); 21.35S 117.04E Millstream, 31.x.70 EB (ANIC); Gascoyne R., 15km N Carnarvon, 13.xii.1984, MB (CBM); Wittenoom Gorge, Hamersley Ra. 2.xii.1984, MB (CBM); Oakover R., 2 ml. ENE of Mt Hodgson, 10.9.1955. JC (ANIC); 68km NW Wittenoom, Hooley Creek, 2.xii.1984, MB (CBM, WAM). - NT: Ormiston Gorge, x.1972 MB (CBM, QM); Palm Creek/Cent. Aust Coll. Hom Exp./Pres 7. 94/*Eudalia waterhousei* Casteln. (MV): Cent. Aust Coll. Hom Exp. Pres 7. 94/Ellery Crk Missionary Plains/*Eudalia waterhousei* Cast. Del. by Blck. (MV); Finke R./McDonnell Rgs. Capt. S.A. White/*Eudalia waterhousei* Cast. C. Australia (SAM); 24.20S 132.53E, Finke R. at Running Water, 15.iii.1995, TW (ANIC, CBM); 24.06°S 132.46°E, Finke Gorge N.P., 13.iii.1995, TW (ANIC); 23.58°S 132.43°E, Ormiston Gorge, West Macdonnells NP, 6-10.iii.1995, TW (ANIC); Arn. Ld F.G W (MV). – Qld: 22.35S 139.43E, 42km NNW of Boulia, Q. 11.v.73, MU (ANIC).

DIAGNOSIS. Elytra pilose, uniformly black or dark piceous, without any greenish tinge, with rugose punctuation forming transverse sulci, with extremely superficial or even absent microreticulation; with comparatively short, compact aedeagus that bears a short, distinctly knobbed, spoon-shaped apex markedly turned to the right side, but not upturned.

SUPPLEMENTARY DESCRIPTION.

*Measurements* (Table 4).

*Colour* (Fig. 36B). Black or dark piceous, apex of elytra sometimes faintly lighter. Palpi and legs uniformly yellow, 3 basal antennomeres yellow, the rest more or less distinctly darker.

*Head*. Short and wide, with large, laterally far projecting eyes and very convex, somewhat angulate orbits. Mandibles elongate and acute. Mentum with acute tooth. Lacinia with dense fringe of stiff setae. Antenna elongate, surpassing base of pronotum by about 2 antennomeres. Surface with coarse, moderately dense, regular punctuation and laterally with several elongate setae, but without any microreticulation, highly glossy. Both supraorbital setae difficult to distinguish between the erect pilosity.

FIG. 21. *Eudalia waterhousei* Castelnau. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

*Pronotum*. Short and wide, laterally convex. lateral margin distinct, ridge-like. Lateral part of proepisternum well visible from above. Surface with dense, regular, and coarse punctuation, without any microreticulation, along lateral margin with a dense row of erect setae, highly glossy.

*Elytra* (Fig. 39A). Rather short and wide, laterally gently convex, slightly widened in apical half, surface depressed. Base almost transverse, humeri very distinct but rounded, lateral margin barely incised at basal third, gently convex and almost evenly rounded towards sutural angle. Lateral apical angles barely indicated, apex oblique and very slightly excised. Base not margined, apex finely margined. Surface in anterior third almost devoid of a transverse impression. All striae complete and well impressed throughout, coarsely punctate or even crenulate, punctures become slightly smaller towards apex. Intervals gently convex, densely punctate, though punctures form very distinct, irregular transverse furrows, hence surface very rugose. Scutellar stria elongate, consisting of about 10 very coarse punctures. 3rd, 5th , and 7th intervals with a series of erect setae and punctures, but setae difficult to distinguish from dense and elongate pilosity. Males with traces only of microreticulation, females with very superficial microreticulation, surface comparatively glossy. Hind wings present.

*Lower Surface*. Head, thorax and most of abdomen with very coarse and dense punctuation. Only last 2 sternites impunctate. Metepisternum elongate, c. 2.5 × as long as wide at apex. Penultimate sternites plurisetose, terminal sternum in male 2-3-setose, in female 4-5-setose on either side.

FIG. 22. *Eudalia punctipennis* sp. nov. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

*Legs*. Of moderate size. Tarsi not lobed, impilose on upper surface, 5th tarsomere with a dense fringe of elongate setae below. Claws large, smooth. 1st – 3rd tarsomeres of male anterior tarsus with sparse squamosity.

*Male Genitalia* (Fig. 21). Terminal abdominal sternite in middle barely incised. Genital ring comparatively narrow, regularly triangular, almost symmetric, with short, obtusely triangular apex. Aedeagus large, comparatively short and compact, moderately depressed, laterally moderately sinuate, lower surface only near base concave, in apical three quarters almost straight. Orificum short. Apex short, straight, markedly knobbed and spoon-shaped, very strongly turned to right, moderately incised at right side. Folding of internal sac simple. Parameres of dissimilar shape, left paramere much larger than right one, fairly elongate, with wide, obtusely transverse apex, right paramere short, with obtusely triangular apex.

*Female Genitalia* (Fig. 31C). Stylomere 2 large, elongate, straight and narrow, laterally little curved, with acute apex. With 3 small ventrolateral ensiform setae, a fairly small dorsomedian ensiform seta situated above middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with c. 6 very elongate ensiform setae. Lateral plate with a very dense fringe of markedly elongate, stiff nematiform setae at apical rim.

*Variation*. Apart from some sexual variation concerning distinctness of elytral microreticulation, very little variation noted.

DISTRIBUTION. N and central NT, WA between Ashburton and Murchison Rivers, SW Qld. I captured specimens at light and in and on sand on the banks of rivers. Some were active on sand at night.

### **Eudalia punctipennis** sp. nov.
(Figs 22, 31D, 36C, 39B)

ETYMOLOGY. For the regularly punctate intervals of the elytra.

MATERIAL. Holotype: ♂; W.W.F. King's Sd., 1895/W. W. Froggatt Collection/Eudalia Kings Sd. N WA, (ANIC). Paratypes: 1 ♂; W.W.F. King's Sd., 1895/W.W. Froggatt Collection (ANIC); 12 ♂♂, 6 ♀♀, WA Ord River, 135km N Hall's Creek, 15.xi.1984, MB (CBM, MV, QM, WAM); 2 ♂♂, 5 ♀♀, WA Ord River, 105km N Hall's Creek, 15.xi.1984, MB (CBM); 1 ♀, WA Upper Panton R. 30.iv.1994 SH (CBM); 1 ♀, NT95/42 West Baines River 23.-24.viii.1995 MB (CBM); 2 ♂♂, NT95/44 Victoria R. 5km W Victoria R. Cr., 24.-25.viii.1995, MB (CBM); 1 ♀, WA95/24 Durack River Cr., 87km W Pentecost R., 11.-12.viii.1995, MB (CBM); 1 ♂, WA Windjana Gorge, 150km E Derby, 23.xi.1984, MB (CBM); 1 ♂, *Eudalia waterhousei* Cast/7608 *Eudalia waterhousei* Cast. NW Australia (SAM).

DIAGNOSIS. Elytra pilose, uniformly black or dark piceous, without any greenish tinge, with rugose punctuation, with superficial microreticulation; moderately short, depressed aedeagus bearing an elongate, straight, slightly knobbed and distinctly spoon-shaped apex that is moderately turned to the right side.

DESCRIPTION. *Measurements* (Table 4).

*Colour* (Fig. 36B). Black or dark piceous, apex of elytra very rarely faintly lighter. Palpi and legs uniformly yellow, 3 basal antennomeres yellow, the rest more or less distinctly darker.

*Head*. Short and wide, with large, laterally far projecting eyes and very convex, somewhat angulate orbits. Mandibles elongate and acute. Mentum with acute tooth. Lacinia with dense fringe of stiff setae. Antenna elongate, surpassing base of pronotum by about 2 antennomeres. Surface with coarse, moderately dense, regular punctuation and laterally with several elongate setae, but without any microreticulation, highly glossy. Both supraorbital setae difficult to distinguish between the erect pilosity.

*Pronotum*. Short and wide, laterally convex. lateral margin distinct, ridge-like. Lateral part of proepisternum well visible from above. Surface with dense, regular, and coarse punctuation, without any microreticulation, along lateral margin with a dense row of erect setae, highly glossy.

*Elytra* (Fig. 39B). Rather short and wide, laterally gently convex, slightly widened in apical half, surface depressed. Base almost transverse, humeri very distinct but rounded, lateral margin barely incised at basal third, gently convex and almost evenly rounded towards sutural angle. Lateral apical angles barely indicated, apex oblique and very slightly excised. Base not margined, apex finely margined. Surface in anterior third almost devoid of a transverse impression. All striae complete and well impressed throughout, very coarsely punctate or even crenulate, punctures become slightly smaller towards apex. Intervals gently convex, densely and very coarsely punctate, punctures rugose though barely forming irregular transverse furrows, apart from near apex. Surface very rugose. Scutellar stria elongate, consisting of about 10 very coarse punctures. 3rd, 5th , and 7th intervals with a series of erect setae and punctures, but setae very difficult to distinguish from dense and elongate pilosity. Microreticulation superficial, but even in males well visible, surface moderately glossy. Hind wings present.

*Lower Surface*. Head, thorax and most of abdomen with very coarse and dense punctuation. Only last 2 sternites impunctate. Metepisternum elongate, c. 2.5 × as long as wide at apex. Penultimate sternites plurisetose, terminal sternum in male 2-3-setose, in female 4-5-setose on either side.

*Legs*. Of moderate size. Tarsi not lobed, impilose on upper surface, 5th tarsomere with a dense fringe of elongate setae below. Claws large, smooth. 1st – 3rd tarsomeres of male anterior tarsus with sparse squamosity.

*Male Genitalia* (Fig. 22). Terminal abdominal sternite in middle barely incised. Genital ring comparatively narrow, irregularly triangular, slightly asymmetric, with short, obtusely triangular apex. Aedeagus large, moderately elongate, remarkably depressed, laterally comparatively little sinuate, lower surface basally gently concave, almost straight in apical half. Orificum short. Apex comparatively elongate, straight, barely knobbed though markedly spoon-shaped, gently turned to right, gently incised at right side. Folding of internal sac simple. Parameres of moderately dissimilar shape, left paramere much larger than right one, with oblique apex, right paramere with obtusely rounded apex.

*Female Genitalia* (Fig. 31D). Stylomere 2 large, elongate, straight and narrow, laterally little curved, with acute apex. With 3 small ventrolateral ensiform setae, a fairly small dorsomedian ensiform seta situated above middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 5-6 very elongate ensiform setae. Lateral plate with a very dense fringe of markedly elongate, stiff nematiform setae at apical rim.

*Variation*. Little variation noted.

DISTRIBUTION. WA N of Great Sandy Desert (Kimberley Division), adjacent NW NT. Common at blacklight; also under stones and slabs on the banks of rivers and ponds; during the night, in and on sand and gravel where it runs very fast.

RELATIONSHIPS. Related to *E. waterhousei*.

### KEY TO AUSTRALIAN SPECIES OF *EUDALIA*

1. Upper surface impilose (except for fixed setae), or with only extremely fine, microscopic pilosity . . . . . . . 2

Upper surface densely pilose . . . . . . . . . . . . . . 9

2. Legs light reddish to yellowish, apex of femora and base of tibiae contrastingly black and surface of elytra without any traces of microreticulation, but with extremely fine, microscopic pilosity; female stylomere 1 with < 3 rather short ventrolateral ensiform setae, stylomere 1 with fringe of < 6 but moderately elongate setae at apical rim (Fig. 30M) . . . . . . . . . . . . 3

Legs black, or piceous, or more or less distinctly bicoloured, though elytra always at least with traces of microreticulation but without any pilosity; female stylomere 1 with > 4 elongate ventrolateral ensiform setae, stylomere 1 with fringe of > 9 extremely elongate setae at apical rim (Fig. 30N,P) . . . . . . . . . . . 6

3. Head short and wide with comparatively large eyes; pronotum short and wide (Table 4), lateral margins considerably rounded, conspicuously sinuate near basal angles, dorsal surface rather convex. . . . . . . . . . 4

Head narrower with slightly smaller eyes; pronotum narrow and elongate (Table 4), lateral margins almost parallel, not sinuate near basal angles, dorsal surface more depressed. . . . . . . . . . . . . . . . . . . . . . 5

4. Body size larger, >7.7mm; pronotum anteriorly more extensively punctate; aedeagus less delicate, apex less upturned, less markedly turned to right side, without a distinct lateral notch; left paramere convex at apex (Fig. 12). . . . . . . . . *obliquiceps punctifrons* subsp. nov.

Body size smaller, <7.3mm; pronotum anteriorly barely punctate; aedeagus delicate, apex decidedly upturned, markedly turned to right side and; left paramere transverse at apex (Fig. 13). . . . . . . . *minor* sp. nov.

5. Head barely punctate; pronotum punctate only in basal half; elytra generally slightly longer (Table 4); aedeagus longer and narrower, lower surface less curved, apex

decidedly upturned, both parameres longer (Fig. 11). . . . . . . . . . . . . . *obliquiceps tozeria* subsp. nov.

Head more extensively punctate; pronotum almost completely punctate; elytra generally slightly shorter (see Tab. 4); aedeagus shorter and stouter, lower surface evenly curved, apex barely upturned, both parameres shorter (Fig. 10). . . . . *obliquiceps obliquiceps* Sloane

6. Pronotum laterally very convex, little longer than wide, margin anteriorly with several short setae; 5th stria with > 5 setiferous punctures; elytra with dense, rugose, distinct microreticulation. . . . . . . *castelnaui* Sloane

Pronotum laterally little convex, considerably longer than wide, margin anteriorly without additional setae; 5th stria without or with 2-3 setiferous punctures only; elytra with much more superficial microreticulation. . . . . 7

7. 5th stria with 2-3 setiferous punctures, towards apex striae still perceptibly punctate; microreticulation of elytra in basal half indistinct, less developed than in apical half; eyes slightly larger and more protruding, ratio length of eye/length of orbit c. 1.45; aedeagus with shorter and wider apex and with deep excision on right side behind apex (Fig. 14) . . . . . . *reticulata* sp. nov.

5th stria without setiferous punctures, towards apex striae barely punctate though distinctly impressed; microreticulation of elytra in basal half about as distinct as in apical half; eyes slightly smaller and less protruding, ratio length of eye/length of orbit < 1.30; aedeagus with longer and narrower apex and with shallow excision on right side behind apex (Fig. 15). . 8

8. Legs uniformly dark; elytra wider, posteriorly distinctly widened, ratio l/w <1.68; intervals more depressed, barely convex towards apex; striae more coarsely punctate, microreticulation of intervals distinct . . . . . . . . . . . . . . . . . . . . . . . *atrata* sp. nov.

Legs dark but upper surface of femora contrastingly light reddish; elytra narrower, almost parallel, ratio l/w 1.76; intervals convex throughout; striae less coarsely punctate, microreticulation of intervals more superficial . . . . . . . . . . . . . . . . . . . . . *femorata* sp. nov.

9. Apex of elytra more or less widely yellow and microreticulation of elytra distinct . . . . . . . . . . . . . 10

Elytra unicolourous or when apex indistinctly yellow, microreticulation of elytra very faint or absent . . . . 11

10. Body size larger, length usually > 9mm; eyes slightly smaller (Table 4); pronotum densely and regularly punctate; yellow apical margin of elytra generally narrower, less produced along lateral margins, and less distinct; microreticulation distinct, surface dull; lower surface of aedeagus more sinuate, apex less knobbed (Fig. 18).. . . . . . . . *latipennis latipennis* (Macleay)

Body size smaller, length < 8.5mm; eyes slightly larger (Table 4); pronotum less densely and regularly punctate, anteriorly with some impunctate areas; yellow apical margin of elytra generally wider, more produced along lateral margins, and more distinct; microreticulation superficial, surface glossy; lower surface of aedeagus almost straight, apex markedly knobbed (Fig. 19). . . . . . . . . . . . . . *latipennis interioris* subsp. nov.

11. Elytra completely black with slight greenish tinge; microreticulation of elytra conspicuous, rugose, punctuation of intervals regular, barely transversely confluent; head with impunctate areas in middle . . . . . . . . . . . . . . . . . . . . . *macleayi* Bates

Elytra blackish or piceous without greenish tinge, sometimes with inconspicuous, narrow, ill defined light apex; microreticulation of elytra faint or absent, punctuation of intervals more irregular, at least in parts transversely confluent; head with dense and regular punctuation, without impunctate areas. . . . . . . . 12

12. Intervals with conspicuously confluent punctures which form irregular transverse sulci (Fig. 39A); microreticulation of elytra extremely superficial or completely absent; aedeagus short and stout, with short, wide apex (Fig. 20). . . . . . . . . . . . . *waterhousei* Castelnau

Punctuation of intervals not much confluent, elytra much more regularly punctate; microreticulation of elytra superficial though distinct (Fig. 38F); aedeagus longer and more delicate, with longer, narrower apex (Fig. 21). . . . . . . . . . . . . . . . . . . *punctipennis* sp. nov.

## **Gestroania** Liebke, 1938

*Gestroania* Liebke, 1938: 89; Csiki, 1932: 1537; Moore et al., 1987: 275; Lorenz, 1998: 420.

TYPE SPECIES. *Casnonia amplipennis* Gestro, 1875, by monotypy.

DIAGNOSIS. Antenna elongate; elytra ampliate, depressed, with sharply angulate or even spinose external apices; 3rd, 5th, and 7th intervals setose; pronotum elongate, sharply margined, dorsally very rugosely punctuate. Pronotum.

DISCUSSION. Although the genus was described by Liebke in 1938, the name had already been used by Csiki (1932) in his catalogue, but without mentioning the citation. The genus is similar to *Giachinoana* Baehr, but is distinguished from the latter by absence of the frontal furrow and ridge near the eye, and by odd intervals not definitely carinate.

### **Gestroania amplipennis** (Gestro1875)
### (Figs 31E, 36D)

*Casnonia amplipennis* Gestro, 1875: 853.

*Eudalia amplipennis* Sloane, 1917: 413.

*Gestroania amplipennis* Liebke, 1938: 89; Csiki, 1932: 1537; Moore et al., 1987: 275; Lorenz, 1998: 420.

MATERIAL. HOLOTYPE: ♀, Swan River Coll. Castelnau/Typus/*amplipennis* Gestro/HOLOTYPE *Casnonia amplipennis* Gestro, 1875/*Gestroania amplipennis* Gestro Det. M. Liebke. Hamburg (MCSN). New records (1 ex.): WA: Nicol Bay/Ex Musaeo H.W. Bates, 1892 (MNHP).

DIAGNOSIS. Distinguished from *G. froggatti* by conspicuously bicoloured femora, dark antenna, and more coarsely crenulate elytral striae; and from *G. setipennis* and *G. storeyi* by the lower number of setiferous punctures on the odd intervals.

SUPPLEMENTARY DESCRIPTION. *Measurements* (Table 5).

*Male Genitalia*. Unknown.

*Female Genitalia* (Fig. 31E). Stylomere 2 moderately elongate, laterally moderately curved, with acute apex. With 2 medium-sized ventrolateral ensiform setae, a arge dorsomedian ensiform seta situated about in middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 7 moderately elongate ensiform setae. Lateral plate with fairly dense fringe of moderately elongate, stiff nematiform setae at apical rim.

DISTRIBUTION. Southern half of WA from Nicol Bay to Perth.

### **Gestroania froggatti** (Macleay, 1888)
(Figs 23, 31F, 36E)

*Eudalia froggatti* Macleay, 1888: 448; Sloane, 1917: 417; Csiki, 1932: 1542; Liebke, 1938: 106; Moore et al., 1987: 274; Lorenz, 1998: 421.

*Dicraspeda froggatti*, Sloane, 1923: 31.

MATERIAL. LECTOTYPE (here designated): ? sex (damaged), NW Austr./SYNTYPE/*Eudalia froggatti*, Macl. Barrior Range N WA. (ANIC-MMS). New records (2 ex.): WA: Kununurra, 22.xii.1991-5.i.1992, RS (CBM, MDPI).

DIAGNOSIS. Distinguished from *G. amplipennis* (Gestro) by completely dark femora, yellow antenna, and less coarsely crenulate elytral striae; and from both, *G. setipennis* sp. nov. and *G. storeyi* sp. nov. by the lower number of setiferous punctures on the odd intervals.

SUPPLEMENTARY DESCRIPTION. *Measurements* (Table 5).

*Male Genitalia* (Fig. 23). Terminal abdominal sternite in middle incised. Genital ring moderately wide, triangular, barely asymmetric, with narrow, triangular apex. Aedeagus slender and elongate, moderately depressed, laterally little sinuate, lower surface concave near base, almost straight in apical half. Orificum short. Apex short, wide, very slightly upturned and knobbed, slightly turned to right, barely incised at right side. Folding of internal sac simple. Parameres of moderately dissimilar shape, left paramere much larger than right one, left paramere stout with almost transverse apex, right paramere with narrow apex.

*Female Genitalia* (Fig. 31F). Stylomere 2 moderately elongate, laterally moderately curved, with acute apex. With 3 medium-sized ventrolateral ensiform setae, a large dorsomedian ensiform seta situated about in middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 7 moderately elongate ensiform setae. Lateral plate with fairly dense fringe of moderately elongate, stiff nematiform setae at apical rim.

FIG. 23. *Gestroania froggatti* (Macleay). Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

DISCUSSION. By comparison with the type of *G. amplipennis* Gestro it became evident that *Eudalia froggatti* Macleay is extremely closely related to this species from which it differs only in minor character states. At the same time, both species are so different in certain remarkable morphological characters from all other known species of *Eudalia* that maintenance of *Gestroania* as a separate genus is well justified.

Moore et al. (1987) record *Eudalia froggatti* only from the type locality. New records now enlarge the range from the southern margin of the Kimberley to its northeastern margin. Nevertheless, this seems still an extremely rare species.

DISTRIBUTION. Kimberley Division, WA. Both non type specimens captured at light.

### **Gestroania setipennis** sp. nov.
(Figs 24, 31G, 36F)

ETYMOLOGY. Refers to the multisetose odd elytral intervals.

MATERIAL. HOLOTYPE: 1 ♂, Greenvale, 70km SW, 22-30.xi.1995, A.J. Watts (SAM). PARATYPES: 1 ♂, Split Rock, 14km S of Laura, Nth Qld, 23-26.vi.1975, GM (QM); 1 ♀, Nth Qld, Pouth Ck. via Georgetown, 8.i.1980, RS (CBM); 1 ♂, Windsor T'land, via Mt Garnet/Qld, 10.ii.1978, RS/*Dicraspeda* sp. n. det. B.P. Moore 1978 (MDPI); 1 ♀, 11.01E 136.45E, Rimbija I. Wessel islands NT, 3-14.ii.1977, TW (ANIC).

FIG. 24. *Gestroania setipennis* sp. nov. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

DIAGNOSIS. Distinguished from *G. storeyi* by completely dark femora, much more coarsely crenulate elytral striae, only angulate but aspinose external elytral apices, and not microreticulate head; and from *G. setipennis* and *G. amplipennis* by the larger number of setiferous punctures on the odd intervals.

DESCRIPTION. *Measurements* (Table 5).

*Colour* (Fig. 36F). Surface black, labrum and mouth parts reddish to dark yellow, antennae completely yellow. Femora completely dark, tibiae and tarsi yellowish.

*Head.* Fairly wide. Neck narrow, with conspicuous transverse impression. Eyes large, laterally protruding, slightly separated from orbits which are about half as long as eyes and gently convex. Behind clypeus with a linear, fairly deep groove. Medially of eye with a slight sulcus, but without distinct ridge. Posterior supraorbital seta located very shortly behind posterior margin of eye. Mentum with elongate, acute, triangular tooth, with 2 pairs of elongate setae behind tooth, submentum with 2 very elongate setae on either side. Apex of glossa transverse, with 2 elongate median and 2 shorter lateral setae. Paraglossae free, narrow, surpassing glossy. Lacinia elongate, interior margin with a sparse fringe of spines. Antenna very narrow and elongate, surpassing base of pronotum by about 3 antennomeres, pilose from middle of 4th antennomere. Surface without microreticulation, or with extremely superficial remnants only, impilose and impunctate, with some elongate wrinkles only near eyes, highly glossy.

*Pronotum.* Comparatively short (in genus), laterally gently convex, widest in front of apical third, dorsally moderately depressed, near apex with shallow triangular impression. Apex and base not bordered, lateral margin complete, slightly ridge-like, in anterior half except for the immediate apex, oblique and almost straight, towards base very slightly diverging, without sulcus medially of margin. Median line shallow. A single marginal seta situated just behind apical third. Proepisternum narrowly visible from above in middle. Disk with extreme dense and coarse, remarkably rugose punctuation. Surface almost devoid of microreticulation, impilose, despite the coriaceous microstructure moderately glossy.

*Elytra.* Moderately elongate, towards apex considerably widened, disk fairly depressed, not raised towards suture. Base oblique, humeri widely rounded, lateral margin oblique in anterior half, very faintly incised at basal third, gently convex and almost evenly rounded towards lateral apical angle. Lateral apical angle angulate, not spinose, apex moderately excised, oblique and evenly concave, sutural angle angulate. Base narrowly margined to position of 4th stria, apex coarsely margined. Surface without any transverse impression. All striae complete and deeply impressed, coarsely punctate-crenulate, punctures become smaller posteriorly, but are still well perceptible at apex. Intervals convex throughout, though not carinate. Scutellar stria elongate, consisting of 9-10 punctures. 3rd, 5th, and 7th intervals each with more than 4 (usually 6-8) setiferous punctures, other intervals asetose, setae light brown, elongate, erect. Intervals impunctate, with coarse, transverse, distinct, though somewhat superficial microreticulation, surface gently glossy. Hind wings fully developed.

*Lower Surface.* Proepisternum, prosternum, and lateral parts of mesothorax and metathorax including metasternum with dense, very coarse punctures. Middle of metasternum and abdomen impunctate, finely microreticulate, abdomen also

TABLE 5. Measurements and ratios of the Australian species of *Gestroania*.

| | N | length (mm) | length eye/orbit | l/w head | l/w prothorax | l/w elytra |
|---|---|---|---|---|---|---|
| *amplipennis* | 2 | 7.8-8.1 | 2.05-2.15 | 1.03-1.05 | 1.26-1.32 | 1.64-1.70 |
| *froggatti* | 2 | 7.4-8.0 | 1.90-1.95 | 1.04-1.05 | 1.25-1.31 | 1.59-1.60 |
| *setipennis* | 4 | 8.2-8.6 | 1.9-2.0 | 1.00-1.04 | 1.18-1.23 | 1.60-1.63 |
| *storeyi* | 6 | 8.3-9.1 | 1.75-2.0 | 1.03-1.05 | 1.27-1.34 | 1.65-1.70 |

slightly strigose. Metepisternum elongate, >2.5 × as long as wide at apex. Terminal abdominal sternum in male bisetose, in female quadrisetose and shortly pilose.

*Legs.* Narrow and elongate. Tibiae sulcate on upper surface, 2 basal tarsomeres sulcate on outer and inner surfaces, though indictinctly so on protarsus. Tarsi not lobed, impilose on upper surface, 5th tarsomere with a fringe of setae below. Claws large, smooth. 1st – 3rd tarsomeres of male anterior tarsus with sparse, slightly asymmetric squamosity.

*Male Genitalia* (Fig. 24). Terminal abdominal sternite in middle gently incised. Genital ring fairly narrow and elongate, moderately triangular, barely asymmetric, with narrow, triangular apex. Aedeagus slender and elongate, moderately depressed, laterally little sinuate, lower surface gently concave throughout. Orificum short. Apex short, fairly wide, not upturned nor knobbed, turned to right, moderately bi-incised at right side. Folding of internal sac simple. Parameres of moderately dissimilar shape, left paramere much larger than right one, left paramere stout with gently rounded apex, right paramere with narrow apex.

*Female Genitalia* (Fig. 31G). Stylomere 2 moderately elongate, laterally moderately curved, with acute apex. With 3 medium-sized ventrolateral ensiform setae, a large dorsomedian ensiform seta situated about in middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 6 moderately elongate ensiform setae. Lateral plate with fairly dense fringe of moderately elongate, stiff nematiform setae at apical rim.

*Variation.* Little variation noted.

DISTRIBUTION. N Qld, Arnhem Land, NT.

RELATIONSHIPS. Although in shape and size this species is extremely similar to *G. amplipennis* and *G. froggatti*, the multisetose intervals demonstrate a closer relationship to *G. storeyi* than to either species.

### **Gestroania storeyi** sp. nov.
(Figs 25, 31H, 37A)

ETYMOLOGY. For Ross Storey.

MATERIAL. HOLOTYPE: ♂, N WA, Kununurra, 22.xii.1991-5.i.1992, R. Storey/*Dicraspeda* spp. det. B.P. Moore 1992 (QMT 99171). PARATYPES: 4 ♀♀, same data (CBM, MDPI); 1 ♀, Katherine Gorge, Jan. 27/1977 N.T., mm/*Dicraspeda* sp. n. det. B.P. Moore 1978 (MDPI).

DIAGNOSIS. Distinguished from *G. setipennis* by conspicuously bicoloured femora, much less coarsely crenulate elytral striae, spinose external elytral apices, and microreticulate head; and from both, *G. setipennis* and *G. amplipennis* by the larger number of setiferous punctures on the odd intervals.

DESCRIPTION. *Measurements* (Table 5).

*Colour* (Fig. 37A). Surface black, labrum, and mouth parts reddish to dark yellow, antenna piceous, apical antennomeres usually slightly lighter. Femora in basal half yellow, in apical half contrastingly black, tibiae except for base and apex, yellow, tarsi infuscate.

*Head.* Fairly wide. Neck narrow, with conspicuous transverse impression. Eyes large, laterally protruding, slightly separated from orbits which are about half as long as eyes and gently convex. Behind clypeus with wide, fairly deep, circular groove the bottom of which may be somewhat striolate. Medially of eye with a slight sulcus that extends to about middle of eye, but without distinct ridge. Posterior supraorbital seta located very shortly behind posterior margin of eye. Mentum with elongate, acute, triangular tooth, with 2 pairs of elongate setae behind tooth, submentum with 2 very elongate setae on either side. Apex of glossa transverse, with 2 elongate median and 2 shorter lateral setae. Paraglossae free, narrow, surpassing glossy. Lacinia elongate, interior margin with a sparse fringe of spines. Antenna very narrow and elongate, surpassing base of pronotum by about 3 antennomeres, pilose from middle of 4th antennomere. Surface with fine though distinct, isodiametric microreticulation, impilose and impunctate, with some transverse wrinkles only on middle of frons, moderately dull.

*Pronotum.* Comparatively elongate, laterally gently convex, widest at apical third, dorsally depressed, near apex with shallow triangular impression. Apex and base not bordered, lateral margin complete, slightly ridge-like, in anterior half very gently convex, towards base slightly diverging, without sulcus medially of margin. Median line shallow. A single marginal seta situated just in front of middle. Proepisternum narrowly visible from above in middle. Disk with extreme dense and coarse, rugose punctuation, punctures tend to form irregular transverse sulci. Surface also with fine, isodiametric microreticulation, impilose, dull.

*Elytra.* Comparatively elongate, towards apex considerably widened, disk depressed, slightly

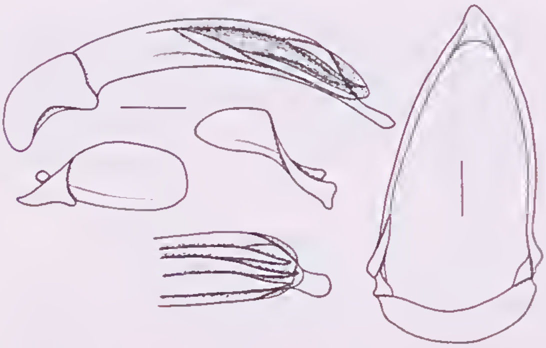

FIG. 25. *Gestroania storeyi* sp. nov. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

raised towards suture. Base oblique, humeri widely rounded, lateral margin oblique in anterior half, very faintly incised at basal third, gently convex and almost evenly rounded towards lateral apical angle. Lateral apical angle spinose, apex deeply excised, oblique and evenly concave, sutural angle shortly spinose. Base narrowly margined to position of 4th stria, apex coarsely margined. Surface without any transverse impression, but in apical half moderately raised towards suture. All striae complete and deeply impressed, finely punctate-crenulate, though punctures become smaller posteriorly and diminish in front of apex. Intervals convex throughout, though not carinate. Scutellar stria elongate, consisting of 9-10 punctures. 3rd, 5th, and 7th intervals each with more than 4 (usually 6-8) setiferous punctures, other intervals asetose, setae light brown, elongate, erect. Intervals impunctate, with very coarse, slightly transverse microreticulation, surface remarkably dull. Hind wings fully developed.

*Lower Surface.* Proepisternum, prosternum, and lateral parts of mesothorax with dense, very coarse punctures. Mesosternum, metathorax, and abdomen impunctate, densely microreticulate, and abdomen also strigose. Metepisternum elongate, >2.5 × as long as wide at apex. Terminal abdominal sternum in male bisetose, in female quadrisetose and shortly pilose.

*Legs.* Narrow and elongate. Tibiae sulcate on upper surface, 2 basal tarsomeres sulcate on outer and inner surfaces. Tarsi not lobed, impilose on upper surface, 5th tarsomere with a fringe of setae below. Claws large, smooth. 1st – 3rd tarsomeres of male anterior tarsus with sparse, slightly asymmetric squamosity.

*Male Genitalia* (Fig. 25). Terminal abdominal sternite in middle gently incised. Genital ring moderately wide, triangular, barely asymmetric, with narrow, triangular apex. Aedeagus slender and elongate, moderately depressed, laterally little sinuate, lower surface gently concave throughout. Orificum short. Apex short, fairly wide, not upturned nor knobbed, turned to right, moderately incised at right side. Folding of internal sac simple. Parameres of moderately dissimilar shape, left paramere much larger than right one, left paramere stout with almost transverse apex, right paramere with widely rounded apex.

*Female Genitalia* (Fig. 31H). Stylomere 2 moderately elongate, laterally moderately curved, with acute apex. With 3 medium-sized ventrolateral ensiform setae, a rather large dorsomedian ensiform seta situated about in middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 5-6 moderately elongate ensiform setae. Lateral plate with fairly dense fringe of moderately elongate, stiff nematiform setae at apical rim.

*Variation.* Slight differences noted in shape of pronotum, and in extent of punctuation on head, pronotum, and elytral striae. The single male also is definitely smaller and has larger eyes.

DISTRIBUTION. N NT, NE WA.

## KEY TO SPECIES OF *GESTROANIA*

1. 3rd, 5th, and 7th intervals each with more than 4 setiferous punctures . . . . . . . . . . . . . . . . . . 2
   3rd interval at most 4-setose, 5th 2-3-setose, 7th unisetose, rarely unilaterally bisetose . . . . . . . . . 3
2. Elytra longer and narrower, ratio l/w >1.65, external and sutural angles distinctly spinose, punctuation of striae finer (Fig. 37A); pronotum longer, anteriorly more incurved; head regularly and completely microreticulate; basal half of femora yellow, apical half contrastingly black; aedeagus (Fig. 24).. . . . . . . . *storeyi* sp. nov.
   Elytra shorter and wider, ratio l/w <1.63, external and sutural angles only shortly angulate, punctuation of striae coarse (Fig. 36F); pronotum shorter, anteriorly little incurved; head not or barely microreticulate; femora unicolourous dark; aedeagus (Fig. 23). . . . . . . . . . . . . . . . . . . . . . . *setipennis* sp. nov.
3. Femora dark, coxae, tibiae and tarsi dark yellowish (Fig. 36E); orbits slightly longer, ratio eye/orbit <1.95; striae of elytra less coarsely punctate, especially in apical half; apex of aedeagus very slightly knobbed (Fig. 22). . . . . . . . . . . . . . . . . . . . *froggatti* (Macleay)
   Legs light yellow, only apical tip of femora dark (Fig. 36B); orbits slightly shorter, ratio eye/orbit >2.05; striae of elytra very coarsely punctate, even in apical half; aedeagus unknown. . . . . . . . *amplipennis* (Gestro)

### **Giachinoana** Baehr, 2003b

*Giachinoana* Baehr, 2003b: 100.

TYPE SPECIES. *Giachinoana carinipennis* Baehr, 2003b, by original designation.

DIAGNOSIS. Distinguished from most Australian genera except *Gestroania* by the sharply angulate external apices of the elytra; distinguished from *Gestroania* by the carinate odd intervals and the distinct sulcus and ridge inside of eye.

### **Giachinoana carinipennis** Baehr, 2003
(Fig. 31I, 37B)

SUPPLEMENTARY DESCRIPTION. *Female Genitalia* (Fig. 31H). Stylomere 2 moderately elongate, laterally moderately curved, with acute apex. With 3 medium-sized ventrolateral ensiform setae, a rather large dorsomedian ensiform seta situated about in middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 5-6 comparatively short ensiform setae. Lateral plate with fairly dense fringe of moderately elongate, stiff nematiform setae at apical rim.

*Variation*. Very little variation noted, neither in size nor in shape and surface structure.

DISTRIBUTION. N NT, NE WA. Sampled at light.

NEW RECORDS. Type species (8 ex.): WA: Kununurra, 22.xii.1991-6.i.1992, RS (CBM, MDPI, QM).

### **Lachnothorax** Motschulsky, 1862

*Lachnothorax* Motschulsky, 1862: 48; Sloane, 1917: 414; 1923: 33; Csiki, 1932: 1542; Liebke, 1938: 103; Darlington, 1968: 214; Lorenz, 1998: 420; Baehr, 1996d: 2; 2000: 11.

TYPE SPECIES. *Lachnothorax biguttatus* Motschulsky, 1862, by monotypy.

DIAGNOSIS. Upper and lower surfaces densely pilose; head short, rounded, lacking a sulcus and ridge medially of eyes; elytra short, conspicuously bimaculate, with coarsely punctate though not impressed striae.

AUSTRALIAN SPECIES. *Lachnothorax tokkia* Gestro 1875 (Fig. 37C).

### **Myrmecodemus** Sloane, 1923

*Myrmecodemus* Sloane, 1923: 33; Csiki, 1932: 1543; Liebke, 1938: 106; Moore et al., 1987: 275; Lorenz, 1998: 420.

TYPE SPECIES. *Casnonia riverinae* Sloane, 1890, by original designation.

DIAGNOSIS. Head globose, with comparatively small, though convex eyes; prothorax globose; elytra short, wide, bearing a transverse impression across basal half; striation incomplete; proepisternum and prosternum fused; elongate, erect setae on head, lower surface of prothorax, and on disk and along the margins of pronotum: , rows of elongate, erect setae on odd intervals.

DISCUSSION. Until now this genus comprised *M. fomicoides* (Sloane), *M. globulicollis* (Macleay) and *M. riverinae* (Sloane). *M. globulicollis* and *M. riverinae* are very closely related, and share with *M. formicoides* the glabrous, impilose surface of head, pronotum, and elytra (apart from fixed setae), the smooth surface of pronotum, and the absence of striae in the apical two thirds of the elytra. One of the new species described herein, although similar in shape and certain other features, differs in all mentioned characters common to the three species. Therefore, for this unique species *Myrmecodemus* (*Trichodemus)* subgen. nov. is erected.

### **Myrmecodemus (Myrmecodemus)** s. str.

*Myrmecodemus* Sloane, 1923: 33.

TYPE SPECIES. *Casnonia riverinae* Sloane, 1890, by original designation.

DIAGNOSIS. See Sloane (1923: 33). Characters of subgeneric value are: surface of head, pronotum, and elytra (apart from fixed setae) impilose, surface of pronotum smooth, without any trace of transverse wrinkles, and apical two thirds of elytra not striate.

DISTRIBUTION. N NT and WA, S inland NSW, N Vic.

### **Myrmecodemus (M.) globulicollis** (Macleay, 1888)
(Fig. 37D)

*Casnonia globulicollis* Macleay, 1888: 447.

*Lachnothorax globulicollis*, Sloane, 1910: 397; 1917: 413.

*Myrmecodemus globulicollis*, Sloane, 1923: 33. Csiki, 1932: 1543; Liebke, 1938: 107; Moore et al., 1987: 275; Lorenz, 1998: 420.

MATERIAL. LECTOTYPE (here designated): ♂ (damaged), N WA/ HOLOTYPE/ *Casnonia globulicollis*, Macl. Barrior Range N WA (ANIC-MMS). NEW RECORDS (5 ex.): NT: Tindal, 14.31S, 132.22E, 1-20.xii.1967, WV (ANIC). - WA: Kununurra, 22.xii.1991-6.i.1992, RS (CBM, MDPI); Fitzroy Crossing, 220 mi. E of Broome, 25.ii.68, EM (ANIC).

DIAGNOSIS. Distinguished from the other species, except for *M. riverinae* (Sloane), by large size and bright red prothorax. From the latter species it is distinguished by purplish black colour and quadrimaculate pattern of the elytra.

DISTRIBUTION. N NT, Kimberley. New records were collected at light.

### **Myrmecodemus (M.) riverinae** (Sloane, 1890) (Fig. 37E)

*Casnonia riverinae* Sloane, 1890: 643.
*Lachnothorax riverinae*, Sloane, 1910: 397; 1917: 413.
*Myrmecodemus riverinae*, Sloane, 1923: 33, Csiki, 1932: 1543; Liebke, 1938: 107; Moore et al., 1987: 275; Lorenz, 1998: 420.

MATERIAL. LECTOTYPE (here designated): ♂, E.P. 7218/? HOLOTYPE (ANIC). PARALECTOTYPES: 2 ♀♀, 2 (?sex, damaged), on same card, E.P. 7218/*Myrmecodemus riverinae* Sl. Id. by T.G. Sloane (ANIC). NEW RECORDS (7 ex.): NSW: N. S. Wales/*Casnonia riverinae* Sl. Id. By A.M. Lea (CBM, MV); *Casnonia riverinae* Sl, NSW (MV). – VIC: Inglewood, 27.xii.35, CO (MV).

DISCUSSION. Moore et al. (1987) noted the 5 type specimens as located in the SAM, Adelaide. This is a lapse because the specimens are indeed in ANIC and were labeled by Sloane himself. The 'Holotype' label is insignificant, because Sloane in his description did not give any information about type designations, and the label was attached later to the specimen. Therefore the specimen bearing the Holotype label is here designated Lectotype.

DIAGNOSIS. Easily distinguished from the other species, except for *M. globulicollis* (Macleay), by large size and bright red prothorax. From the latter species it is distinguished by glossy blue colour and semilunar pattern of the elytra.

DISTRIBUTION. S central NSW, N Vic.

### **Myrmecodemus (M.) formicoides** (Sloane, 1910) (Figs 26, 32A, 37F)

*Lachnothorax formicoides* Sloane, 1910: 397; 1917: 413.
*Myrmecodemus formicoides*, Sloane, 1923: 33, Csiki, 1932: 1543; Liebke, 1938: 108; Moore et al., 1987: 275; Lorenz, 1998: 420.

MATERIAL. LECTOTYPE (here designated): ♀, Port Darwin Dodd .03/*Myrmecodemus formicoides* Sl. Id. by T.G. Sloane/HOLOTYPE *Myrmecodemus formicoides* Sl. PJD (ANIC). PARALECTOTYPE: 1 ♀ (immat.), Port Darwin Dodd .03/*Myrmecodemus formicoides* Sl. Id. by T.G. Sloane (ANIC). NEW RECORDS (4 ex.): NT: NT1, 3km E Humpty Doo, 3.viii.1995, MB (CBM); Humpty Doo, 6km E 9.ii-6.iii.1987, RS/*Myrmecodemus formicoides* Sl. AW-H det. 1987 (MDPI); Oenpelli, from P. Cahill leg. 6.xii.18 (MV); 12.52S, 132.50E, Koongarra, 6-10.iii.73, MU (ANIC).

DIAGNOSIS. Small; pronotum dark, glabrous; distinguished from *M. lucai* by shorter, wider elytra, reddish subhumeral fascia, circular apical spot, shorter eye, and apical part of aedeagus more upturned and more decidedly spoon-shaped.

SUPPLEMENTARY DESCRIPTION.
*Measurements* (Table 6).

*Male Genitalia* (Fig. 26). Terminal abdominal sternite in middle incised. Genital ring fairly elongate, slightly asymmetric, gently triangular, shortly narrowed to the narrow, asymmetrically triangular apex. Aedeagus fairly slender and elongate, depressed, laterally barely sinuate, lower surface conspicuously bisinuate, upturned towards apex. Orificum elongate. Apex elongate, depressed, straight, not knobbed, but decidedly spoon-shaped, very slightly turned to right, incision at right side less deep than at left side. Folding of internal sac simple. Parameres of dissimilar shape, left paramere much larger and also longer than right one, right paramere short and high, both with wide, rounded apex.

*Female Genitalia* (Fig. 32A). Stylomere 2 comparatively short and stout, laterally evenly curved, with acute apex. With 2 small ventrolateral ensiform setae, a fairly small dorsomedian ensiform seta situated above middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 4 short but very stout ensiform setae. Lateral plate with dense fringe of stiff setae at apical rim.

DISCUSSION. Darlington designated one specimen 'Holotype', although Sloane gave no indication about type designations in his description. Thus, Darlington's designation is invalid according to the rules of ICZN and the specimen is here designated Lectotype.

Moore et al. (1987) noted the species only from the type locality. In spite of the new records , this seems to be an extremely rare species.

DISTRIBUTION. NT from W Arnhem Land to Darwin. One specimen from a Barber trap near a small pool in Tropical Savannah Woodland. Probably a hygrophilous, ground-living species.

RELATIONSHIPS. This species is closely related to *M. lucai* and might be taken for the same species, though certain differences in shape and colouration contradict this supposition. Both

FIG. 26. *Myrmecodemus formicoides* (Sloane). Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

species share the same range, although *M. lucai* probably is more widely distributed to the west. At Oenpelli both species were collected together, but even the specimens mounted together on the same card are immediately distinguished.

### **Myrmecodemus (M.) lucai** sp. nov.
(Figs 27, 32B, 38A)

ETYMOLOGY. For Luca Toledano, collector of the main series.

MATERIAL. HOLOTYPE: ♂, NT, Gregory N.P. Timber Creek 30-31.xii.96 at light/al lume Leg. L. Toledano, R. Olivieri (WAM). PARATYPES: 2 ♂, 9 ♀♀, same data (ANIC, CBM, CFP, CSM, CTV); 1 ♀ (damaged), NT Gregory N.P. Victoria Crossing 1-2.i.97 at light/al lume, LT, RO (CTV); 1 ♂, N.T. Kakadu N.P. 22-25.iii.93 Cooinda at light/al lume, LT (CBM); 1 ♀, Australie/Collection E. Rousseau (IRSBN); 2 ♂♂, Oenpili, N.T. from P. Cahill leg. 6.xii.18 (MV); 1 ♀, 15.31S 143.55E GPS 5km SE Hann River bridge, 15.i.1994, at light, PZ & EE (ANIC).

DIAGNOSIS. Small; pronotum dark; surface glabrous; distinguished from *M. formicoides* by longer and narrower elytra, indistinct or even absent subhumeral fascia, elongate apical spot, larger eye, and apical part of aedeagus barely upturned and less decidedly spoon-shaped.

DESCRIPTION. *Measurements* (Table 6). *Colour* (Fig. 38A). Surface blackish, very dark piceous on centre of head and sometimes on basal part of elytra. Labrum, mandibles, palpi, and 3 basal antennomeres more or less dark reddish, rest of antenna dark. Apical spot of elytra light yellow, sharply delimited, square, meeting apical margin. Also lateral margin narrowly yellowish in apical part. Subhumeral fascia absent or very inconspicuous, area of fascia more or less dark piceous, as sometimes the whole base of elytra. Base of elytral epipleura dark, apical ¾ light yellow. Legs light yellow with contrastingly dark knees.

*Head*. Wide, rhomboidal. Neck remarkably narrow. Eyes comparatively small, though laterally protruding, slightly separated from orbits which are by far longer than eyes and gently convex. Behind clypeal suture laterally with shallow, oblique impression, and in middle with more or less distinct v-shaped impression. Medially of eye without any indication of a sulcus. Posterior supraorbital seta located slightly behind posterior margin of eye. Behind posterior seta with 2 additional pores and setae, one of which is situated laterally. Mentum with elongate, triangular, at apex slightly obtuse tooth, with 2 setae behind tooth, submentum with 2 elongate setae on either side. Glossa short, apex transverse, with 2 elongate setae. Paraglossae free, narrow, barely surpassing glossy. Lacinia elongate, interior margin with a sparse fringe of spines. Antenna elongate, surpassing base of pronotum by at least 2 antennomeres, sparsely pilose from 2nd antennomere. Surface highly glossy, without microreticulation, glabrous, impunctate.

*Pronotum*. Short, somewhat globose, laterally convex, dorsally very convex, near apex with shallow, near base with deep and wide, transverse impression. Base thickly bordered, lateral margin complete, slightly ridge-like, gently convex, towards base slightly diverging, without sulcus medially of margin. Median line barely recognisable. A well developed marginal pore and seta situated in apical fifth near margin, disk with some additional elongate erect setae. Proepisternum and proepimeron well visible from above. Disk impunctate (except for elongate setae), without microreticulation, glossy.

*Elytra*. Rather short and wide, somewhat square, widest about in middle, dorsal surface moderately convex. Base moderately oblique, humeri rounded, lateral margin gently and almost evenly convex, but very faintly incised at basal third. Apex wide, lateral apical angles well indicated but obtuse, apex oblique and laterally well excised. Base narrowly margined halfway to scutellum, lateral margin moderately wide, apex coarsely margined. Surface in anterior third with distinct, transverse impression. Striae almost completely absent, only odd intervals marked by rows of conspicuous punctures and elongate erect setae. Surface at base slightly uneven, as odd intervals are faintly raised. Scutellar stria

FIG. 27. *Myrmecodemus lucai* sp. nov. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

barely recognisable. Surface impunctate (except for elongate setae), very glossy, disk without microreticulation, but with very superficial, isodiametric microreticulation along lateral margin and in lateral parts of subhumeral grooves that give the surface a somewhat silky appearance. Hind wings present.

*Lower Surface.* Proepisternum not separated from prosternum. Both impunctate, except for some elongate setae on prosternum, and without microreticulation. Proepimeron with extremely rugose, ridge-like punctuation, apical rim of mesothorax with very coarse punctuation, rest of mesothorax, metathorax and abdomen glabrous, without microreticulation, very glossy. Metepisternum elongate, c. 2.5 × as long as wide at apex. Abdominal sterna quadri- or 6-setose, terminal abdominal sternum in male bisetose and glabrous, in female quadrisetose, with short adpressed pilosity.

*Legs.* Narrow and elongate. Tarsi not lobed, densely pilose on upper surface, 5th tarsomere with a dense fringe of elongate setae below. Claws large, smooth. 2nd-3rd tarsomeres of male anterior tarsus with sparse, asymmetric squamosity.

*Male Genitalia* (Fig. 27). Terminal abdominal sternite in middle incised. Genital ring fairly elongate, slightly asymmetric, gently triangular, shortly narrowed to the narrow, acute, triangular apex. Aedeagus fairly slender and elongate, depressed, laterally barely sinuate, lower surface only immediately near base concave, in apical three quarters gently convex. Orificum elongate. Apex elongate, depressed, straight, not knobbed, but moderately spoon-shaped, very slightly turned to right, incision at right side barely deeper than at left side. Folding of internal sac simple. Parameres of dissimilar shape, left paramere much larger and also longer than right one, right paramere short and high, both with wide, rounded apex.

*Female Genitalia* (Fig. 32B). Stylomere 2 comparatively short and stout, laterally evenly curved, with acute apex. With 2 small ventrolateral ensiform setae, a fairly small dorsomedian ensiform seta situated above middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 4-5 short but stout ensiform setae. Lateral plate with dense fringe of stiff setae at apical rim.

*Variation.* Rather little variation noted in shape of pronotum and distinctness of colouration of subhumeral fascia.

DISTRIBUTION. N Australia from Cape York Peninsula to NT/WA border. Recently caught specimens taken at light, close to river beds or lagoons. Probably a ground-living, hygrophilous species.

RELATIONSHIPS. This species is very closely related to *M. formicoides* with which it apparently shares part of its range.

### **Myrmecodemus (Trichodemus)** subgen. nov.

TYPE SPECIES. *Myrmecodemus pilosellus* sp. nov.

DIAGNOSIS. Surface of head densely punctuate, with elongate, depressed, anteriorly inclined pilosity; pronotum bearing dense, coarse, transverse wrinkles in middle; elytra with remarkably deep impression in anterior third and with a likewise conspicuous boss on either side in front of that impression, surface within impression and along suture striate and altogether coarsely punctate and pilose; rest of elytra (apart from fixed setae) impilose.

### **Myrmecodemus (T.) pilosellus** sp. nov.
(Figs 28, 32C, 38B)

ETYMOLOGY. Refers to the dense pilosity of the head.

MATERIAL. HOLOTYPE: ♂, 13.27S 142.42E, Qld, Mungkan Kandju N.P., Langi Lagoon, 29.vi.-5.vii.1998, T.A. Weir (ANIC). PARATYPES: 1 ♂, Stewart R. Q., WD/J.7710 *Lachnothorax ? formicoides* Sln Qld (SAM); 1 ♀, 13.59S 143.33E Silver Plains, Cape York Pen. Qld 1.iv.1965, JW/*Myrmecodemus* ?? T.A. Weir 1993 (ANIC); 1 ♀, 13.40S 142.40E Qld 2km N Rokeby, 16.xii.1993 at light, PZ (ANIC); 1 ♀, Nth Qld 17.1.2000 Laura, SB (CBM).

TABLE 6. Measurements and ratios of species of the *formicoides*-group and *Myrmecodemus* (*Trichodemus*).

| | N | length (mm) | length eye/orbit | l/w head | l/w prothorax | l/w elytra |
|---|---|---|---|---|---|---|
| *formicoides* | 3 | 4.75-4.90 | 0.62-0.65 | 1.30-1.33 | 1.33-1.34 | 1.45-1.47 |
| *lucai* | 6 | 5.1-5.4 | 0.73-0.83 | 1.26-1.31 | 1.29-1.34 | 1.50-1.54 |
| *pilosellus* | 4 | 4.5-4.8 | 0.51-0.56 | 1.20-1.24 | 1.17-1.21 | 1.45-1.48 |

DIAGNOSIS. Head densely punctuate, pilose; pronotum rugose; elytra apically bistriate, in parts pilose.

DESCRIPTION. *Measurements* (Table 6).

*Colour* (Fig. 38B). Black, elytra with a triangular dirty yellow to light reddish subhumeral fascia and a similarly coloured transverse subapical fascia. Apex behind fascia more or less dark piceous. Base of elytral epipleura dark, becoming yellow towards apex. Labrum, mandibles, and palpi dark piceous with slightly lighter borders. Basal antennomere dark reddish to piceous, 3 following antennomeres darker, almost blackish, rest of antenna again slightly lighter, dark reddish to piceous. Coxae piceous, femora basally light yellow or reddish, apical half (profemur) or apical third (meso- and metafemur) blackish, tibiae light yellow or reddish with the very base and apex dark, tarsi dark. Lower surface black to dark piceous.

*Head.* Wide and short, laterally and dorsally very convex. Neck remarkably narrow. Eyes small, though laterally conspicuously protruding, well separated from orbits which are by far longer than eyes and very convex. Behind clypeal suture laterally with shallow, oblique impression, and in middle with shallow v-shaped impression. Medially of eye without any indication of a sulcus. Posterior supraorbital seta located just behind posterior margin of eye. Shortly behind posterior seta with an additional elongate setae, and another far behind near the 'neck', setae sometimes difficult to recognise within the adpressed setosity. Apex of labrum transverse, 6-setose, setae elongate. Mentum with elongate, triangular, at apex slightly obtuse tooth, with 2 setae behind tooth, submentum with 2 very elongate setae on either side. Glossa short, apex transverse, with 2 elongate setae. Paraglossae free, narrow, not surpassing glossy. Lacinia elongate, interior margin with a sparse fringe of spines. Penultimate palpomere of labial palpus with 2 very elongate setae. Antenna moderately elongate, just surpassing base of pronotum, sparsely pilose from 1st antennomere, densely pilose from middle of 3rd antennomere. Surface of labrum, clypeus and middle of frons behind clypeus glabrous, apart from 2 setae just behind clypeal suture, glossy. Labrum with about isodiametric, superficial microreticulation, rest of surface without microreticulation, though with dense and somewhat rugose punctuation and covered by elongate hairs that are inclined and adpressed anteriorly.

*Pronotum.* Short, somewhat globose, laterally convex, dorsally very convex, near apex with shallow, near base with deep and wide, transverse impression. Base thickly bordered, lateral margin complete, coarse slightly ridge-like, gently convex, towards base slightly diverging, with a shallow sulcus medially of margin in anterior two thirds. Median line distinct, moderately impressed. A well developed marginal pore and seta situated in apical fourth near margin, disk with some additional, very elongate erect setae and several shorter setae. Proepisternum and proepimeron well visible from above. Disk in middle with coarse, very rugose, transverse sulci, impunctate (except for elongate setae), without microreticulation. Apex and base with coarse, rugose punctuation.

*Elytra.* Short and wide, subquadrate, widest about midlength, dorsal surface convex, very uneven. Base little oblique, humeri distinct though rounded, lateral margin gently and almost evenly convex, but very faintly incised at basal third. Apex wide, lateral apical angles well indicated but obtuse, apex oblique and laterally well excised, incurved towards suture. Base coarsely margined close to scutellum, lateral margin extremely narrow throughout, apex finely margined. Surface in anterior third with very deep, transverse impression that is laterally enlarged to form a triangle. In front of impression surface raised to 2 conspicuous humps, behind impression surface evenly convex. Striae only recognisable within the subbasal transverse impression, along suture in posterior two thirds, and at apex, marked by extremely coarse, rugose punctures and dense, moderately elongate, yellow setosity. In other parts of surface striae completely absent, only odd intervals marked by rows of conspicuous punctures and elongate erect setae. Apart from transverse subbasal impression, 2 inner striae, and apex, surface impunctate, impilose (except for elongate setae), without microreticulation, and very glossy.

FIG. 28. *Myrmecodemus pilosellus* sp. nov. Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

Scutellar stria barely recognisable. As a summary; surface of elytra remarkably uneven and differently structured. Hind wings present.

*Lower Surface.* Proepisternum not clearly separated from prosternum, a very inconspicuous, superficial suture only visible in basal half. Both, proepisternum and prosternum impunctate, except for few elongate setae on prosternum, and without microreticulation. Proepimeron with rugose punctuation, mesothorax and metathorax impunctate, without microreticulation, very sparsely setose. Abdomen glabrous, without microreticulation, very glossy. Metepisternum elongate, c. 2.5 × as long as wide at apex. Abdominal sterna quadrisetose in middle, and with a row of 4-6 shorter setae laterally on either side. Terminal abdominal sternum in male bisetose and glabrous, in female quadrisetose, with short adpressed pilosity.

*Legs.* Narrow and elongate. Tarsi not lobed, densely pilose on upper surface, 5th tarsomere with a dense fringe of elongate setae below. Claws large, smooth. 2nd-3rd tarsomeres of male anterior tarsus with sparse, asymmetric squamosity.

*Male Genitalia* (Fig. 28). Terminal abdominal sternite in middle incised. Genital ring fairly elongate, slightly asymmetric, in basal two thirds almost parallel, shortly narrowed to the wide, obtuse apex. Aedeagus fairly slender and elongate, very depressed, laterally barely sinuate, whole lower surface gently convex, even near base barely concave. Orificum moderately elongate. Apex short, wide, depressed, straight, not knobbed, but moderately spoon-shaped, very slightly turned to right, incision at right side slightly deeper than at left side. Folding of internal sac simple. Parameres of dissimilar shape, left paramere much larger and also longer than right one, with almost transverse apex, right paramere very short and high, with wide, rounded apex.

*Female Genitalia* (Fig. 32C). Stylomere 2 comparatively short and stout, laterally little curved, with acute apex. Apparently without ventrolateral ensiform setae, with a small dorsomedian ensiform seta situated above middle of stylomere, and with a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 4 elongate, stout ensiform setae. Lateral plate with moderately dense fringe of elongate, stiff setae at apical rim.

*Variation.* Little variation noted due to scarce material. One specimen has colouration of light areas on elytra and legs light reddish rather than light yellow, perhaps because teneral or effected by preservation.

DISTRIBUTION. Lower Cape York Peninsula. Holotype collected at light in open forest.

## KEY TO AUSTRALIAN SPECIES OF *MYRMECODEMUS*

1. Head, pronotum, and elytra (except for fixed setae) glabrous, impilose; pronotum without transverse wrinkles; elytra without striae in apical two thirds. *Myrmecodemus* s. str. . . . . . . . . . . . . . . . . . 2

   Head densely punctate and pilose; pronotum with coarse transverse wrinkles in middle; elytra with very deep, punctate and pilose impressions in basal third, with 2 punctate and pilose striae along suture. *Trichodemus* subgen. nov. . . . . . . . . . . . . . *pilosellus* sp. nov.

2. Pronotum bright red; body size larger, length >7mm . . 3

   Pronotum black or piceous; body size smaller, length <5.5mm . . . . . . . . . . . . . . . . . . . . . . . . 4

3. Elytra quadrimaculate, with red posthumeral and apical maculae on purplish-black background. . . . . . . . . . . . . . . *globulicollis* (Macleay)

   Elytra with a red fascia in apical half, ground colour of elytra bluish-black. . . . . . . . . *riverinae* (Sloane)

4. Elytra shorter and wider, ratio length/width c. 1.45; subhumeral fascia in the basal impression distinct, pale reddish, subapical yellow spot circular, removed from apical margin; lateral margin of elytra wider, completely and conspicuously yellow (Fig. 37F); eye shorter in comparison to orbit, ratio length eye/orbit c. 0.65; apex of aedeagus more upturned and more decidedly spoon-shaped (Fig. 25). . . . . . . . . . *formicoides* (Sloane)

   Elytra longer and narrower, ratio length/width >1.50; subhumeral fascia in the basal impression absent or extremely indistinct, subapical yellow spot elongate, widely meeting apical margin; lateral margin of elytra narrower, not completely and also less conspicuously yellow (Fig. 38A); eye longer in comparison to orbit, ratio length eye/orbit >0.70; apex of aedeagus barely upturned and less decidedly spoon-shaped (Fig. 26). . . . . . . . . . . . . . . . . . . . . *lucai* sp. nov.

### **Neoeudalia** gen. nov.

TYPE SPECIES. *Eudalia nigra* Sloane, 1910.

DIAGNOSIS. Dense, erect surface pilosity; a shallow transverse impression near apex of elytra, tumid 7th interval in apical third, barely excised apical margin of elytra, sparsely setose 3rd antennomere.

DESCRIPTION. Head large, with large, laterally markedly protruding eyes; labrum anteriorly straight; mandibles elongate; both palpi impilose, maxillary palpus also asetose; terminal palpomeres apically transversely cut; mentum with a large triangular, apically slightly incised tooth; glossa at apex almost transverse, with 2 elongate median and 2 much shorter lateral setae; paraglossae membranous, slightly surpassing and largely separated from glossa; inner margin of lacinia markedly dentate; mentum with 2 elongate setae, submentum with 4 elongate setae, lower surface of head below eyes with an elongate seta on either side; antenna elongate, 2 basal antennomeres impilose, 3rd antennomere with few elongate setae below apical setae, antenna more densely pilose from mid of 4th antennomere, basal antennomere with a single seta; medially of eye with a sulcus which is laterally bordered by a costa; neck well separated from head; surface of head sparsely but coarsely punctate, and with elongate, erect setosity; posterior supraorbital seta difficult to distinguish; prothorax with complete but not sharply raised lateral borders; proepisterna laterally projecting beyond lateral margin and visible from above; mediad of lateral border with well developed sulcus that is medially bordered by an edge; margin and sulcus with a very dense fringe of elongate setae; disk densely punctate near base, with elongate, erect setosity; elytra elongate, not spinose nor sinuate at apex, with one transverse sulcus in anterior third, and another shortly in front of apex; striae complete, coarsely punctate; intervals convex, punctate, 7th interval tumid in apical third; surface with dense, elongate, erect setosity; legs slender; upper surface of tarsi impilose, claws simple; terminal abdominal sternite in male quadrisetose; aedeagus with short, asymmetric, somewhat knobbed apex, and with simple folding of internal sac.

RELATIONSHIPS. Because of certain structural similarities, *Neoeudalia* is most probably related to *Dicraspeda*, *Basistichus*, *Gestroania* and *Giachinoana*, though in some characters it is more plesiomorphic than these genera. Probably, *Neoeudalia* takes a somewhat intermediate position between *Eudalia* and *Dicraspeda* as enumerated below, and it could be regarded a plesiotypic, basic branch of the *Dicraspeda* complex.

*Characters of* Neoeudalia *shared with* Eudalia.
Disk of pronotum densely and coarsely punctate
Elytral striae coarsely punctate
Apex of elytra not excised nor spined

*Characters of* Neoeudalia *shared with* Dicraspeda.
Costa and sulcus inside of eye well developed
Lateral channel of pronotum present

*Characters peculiar to* Neoeudalia.
Surface with remarkably elongate, erect setosity
Head with a pair of elongate setae below eyes
Lateral margin of pronotum not costate, sulcus very coarsely punctate, margin with remarkably dense and elongate fringe of setae
Elytra with a transverse impression near apex
7th interval tumid in apical third
Terminal abdominal sternite in male quadrisetose
Legs very conspicuously bicoloured

DISTRIBUTION. S central NSW, N Vic, S central Qld, and N NT and WA adjacent to border.

### **Neoeudalia nigra** (Sloane, 1900)
### (Figs 29, 32D, 38C)

*Eudalia nigra* Sloane, 1900: 581; 1917: 417; Csiki, 1932: 1542; Liebke, 1938: 106; Moore et al., 1987: 274; Lorenz, 1998: 421.

*Dicraspeda nigra* Sloane, 1923: 31.

MATERIAL. NEOTYPE (here designated): ♀, C.H./ *Eudalia nigra* Sl. Topotype/ HOLOTYPE *E. nigra* Sl. PJD (ANIC). NEW RECORDS (12 ex.): Vic: Hattah, CO (CBM, MV). – Qld: *Eudalia nigra* Sl. Qld (MV); Rockhampton, AL/J.7706 *Eudalia nigra* Sloane (SAM); *Eudalia nigra* Sl. (SAM); 623/Dawson R. (CBM, SAM); 7km NE of Tolga, xii.1988, RS & DF (MDPI); Pinnarendi Stn 60km W of Mt Garnet, 7.ii.1989, DH (QM); Musgrave, 5/72, GB (ANIC). - NT: 12.06S, 133.04E, Cooper Creek, 19km E by S of Mt Borradaile, 31.v.73, EM (ANIC); 1.6km E on Warrawarange Rd., off Stuart Hwy, 10km S. McMillans Rd Darwin, 24.vii.1979, LK (ANIC). – WA: Kununurra, 22.xii.1991-6.i.1992, RS (CBM, MDPI). - ?: CCXI (SAM).

DIAGNOSIS. Antennae completely black; femora yellow; tibiae with contrastingly black apex, black, yellow ringed.

SUPPLEMENTARY DESCRIPTION. *Measurements* (6 ex.). Length, 8.6-9.8mm; width, 3.1-3.55mm. Ratios: length eye/orbit, 2.0; length/width of head, 0.92-0.96; length/width of prothorax, 1.14-1.15; length/width of elytra, 1.63-1.66.

*Colour* (Fig. 38C). Black, only labrum and mouthparts reddish. Antennae black. Femora yellow, apex contrastingly black. All tibiae black, with a contrasting yellow ring below middle. Tarsi black.

*Head.* Eyes very large, markedly protruding, orbits short, moderately convex. Surface with 2 impressions behind clypeus, medially of eye with distinct ridge and sulcus that attain about the middle of eye. Posterior supraorbital seta located shortly behind eye, but difficult to distinguish within the elongate, erect pilosity. Antenna elongate, surpassing base of pronotum by c. 1.5 antennomeres. Two basal antennomeres glabrous, 3rd antennomere with some additional elongate setae below the ring of apical setae. Punctuation of surface coarse, though sparse, pilosity remarkably elongate, erect. Microreticulation absent, surface glossy.

*Pronotum.* Rather short, compact, laterally gently convex, dorsal surface slightly convex. Lateral margin little convex, indistinct, very uneven, not ridge-like. Proepisternum widely visible from above. Sulcus inside margin wide and deep, covered by very coarse punctures and by an extremely dense fringe of elongate setae. Part of this fringe is characteristically directed laterally. Punctuation coarse, dense in basal half, anteriorly sparse. Microreticulation absent, surface glossy.

*Elytra.* Moderately elongate, laterally slightly convex, dorsally depressed. In basal third with a distinct, transverse impression which becomes indistinct towards lateral margin, and with a minor though still distinct transverse depression shortly in front of apex. 7th interval tumid in apical third. Striae complete, well impressed and coarsely punctate till apex. Intervals convex, irregularly punctate. Apex convex, oblique, not or barely sinuate. Whole surface covered with dense, elongate, erect, grey hairs, lateral margin with conspicuous fringe of elongate hairs. Microreticulation absent, surface glossy. Hind wings present.

*Lower Surface.* With moderately dense, on thorax also coarse to very coarse punctuation, impilose, glossy. Metepisternum very elongate >3 × as long as wide at apex. terminal abdominal sternum in female polysetose.

*Legs.* Of average size. Tarsi not lobed, 5th tarsomere with a dense fringe of elongate setae below. Claws smooth.

*Male Genitalia* (Fig. 29). Terminal abdominal sternite in middle slightly incised. Genital ring fairly elongate, moderately triangular, barely asymmetric, suddenly narrowed to the narrow, very acute, triangular apex. Aedeagus comparatively large, slender and elongate, moderately depressed, laterally barely sinuate, whole lower surface concave. Orificum short. Apex short, fairly wide, straight, gently knobbed, markedly turned to right, gently incised at right side. Folding of internal sac simple. Parameres of moderately dissimilar shape, left paramere much larger than right one, with rounded apex, right paramere elongate, with narrower, more angulately rounded apex.

FIG. 29. *Neoeudalia nigra* (Sloane). Male genitalia: aedeagus, parameres and genital ring (scale 0.25mm).

*Female Genitalia* (Fig. 32D). Stylomere 2 large, though comparatively short and stout, laterally little curved, with short, moderately acute apex. With 3 medium-sized ventrolateral ensiform setae, a small dorsomedian ensiform seta situated above middle of stylomere, and a single short nematiform seta arising from a groove in apical third. Base of stylomere 1 with 6-7 slender, elongate ensiform setae. Lateral plate with moderately dense fringe of elongate, stiff setae at apical rim.

*Variation.* Little variation noted due to limited material. As some of the available specimens are old and damaged, little can be said about variation.

DISCUSSION. Apparently the type(s) of this species is/are lost. One specimen was labeled 'Holotype' by Darlington, though it is a topotype which is written on the determination label. Nevertheless, this specimen was labeled by T.G. Sloane himself and as it corresponds with the description, it is heredesignated neotype.

DISTRIBUTION. S central NSW, N Vic, SE and NE Qld, N NT and WA adjacent to border. In Qld this species was only recorded in dry areas west

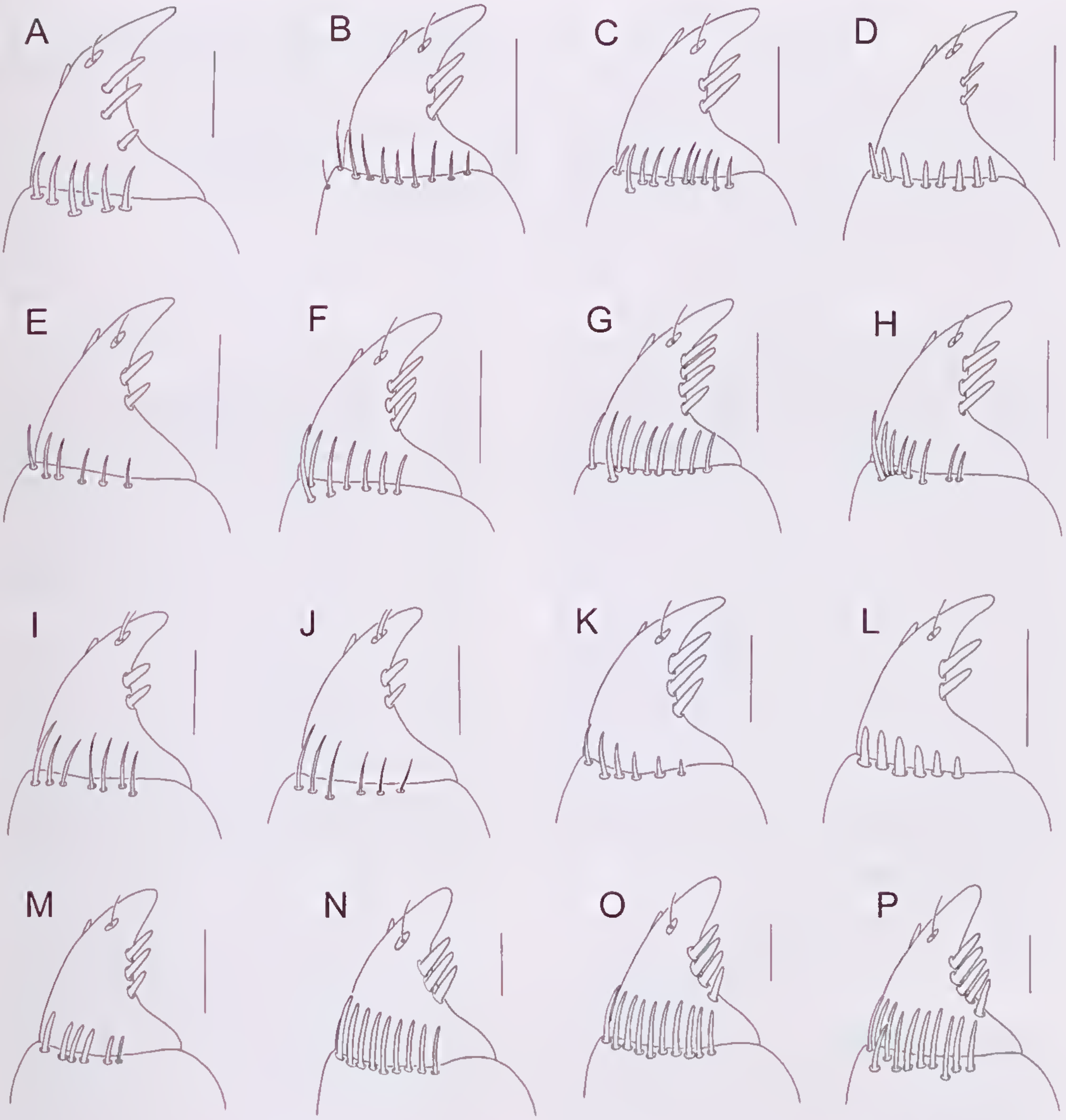

FIG. 30. Female stylomeres 1 and 2 (scales: 0.1mm). A, *Anasis howittii* Castelnau. B, *Archicolliuris splendissimus* sp. nov. C, *Archicolliuris occipitalis* sp. nov. D, *Aulacolius triordinatus* Sloane. E, *Basistichus micans* (Macleay). F, *Clarencia aliena* (Pascoe). G, *Clarencia angusticollis* (Macleay). H, *Clarencia breviceps* sp. nov. I, *Deipyrus palustris* (Sloane). J, *Deipyrus inops* sp. nov. K, *Dicraspeda brunneipennis* (Sloane). L, *Dicraspeda obscura* (Castelnau). M, *Eudalia obliquiceps obliquiceps* Sloane. N, *Eudalia reticulata* sp. nov. O, *Eudalia atrata* sp. nov. P, *Eudalia castelnaui* Sloane.

of the Great Dividing Range. Sloane recorded the species 'under loose bark of a Red Gum tree, having taken refuge from flood water', and 'on the muddy bank of Houlaghan's Creek, ... a single example under a stick'. All specimens from N Qld, NT, and NW Australia were captured at light. Probably a ground-dwelling species on the banks of rivers and lagoons.

### **Ophionea** Klug, 1821
(Fig. 38D)

*Ophionea* Klug, 1821: 298; Sloane, 1917: 415; 1923: 30; Csiki, 1932: 1534; Liebke, 1938: 79; Darlington, 1968: 207; Moore et al., 1987: 277; Lorenz, 1998: 417.

*Ophionaea* Eschscholtz, 1829: 5.

*Casnoidea* Castelnau, 1834: 40; Csiki, 1932: 1534; Darlington, 1968: 207; Moore et al., 1987: 277; Baehr, 1996b: 1044; Lorenz, 1998: 417.

TYPE SPECIES. *Cicindela cyanocephala* Fabricius, 1798 (= *Attelabus indicus* Thunberg, 1784), by subsequent designation.

DISCUSSION. The citation of Darlington (1968), Moore et al. (1987) and others of *Ophionea* as being first described by Eschscholtz (1829) is incorrect, as had been stated by Lorenz (1998). Bousquet (in Löbl & Smetana 2003) noted: 'The genus-group name *Ophionea* was first validated by Klug in 1821. Not only did he describe in length the genus but he included 3 available species: *Attelabus pennsylvanicus* Linnaeus, *Cicindela cyanocephala* Fabricius, and *Attelabus surinamensis* Linnaeus. The type species is *Cicindela cyanocephala* Fabricius, 1798 (= *Attelabus indicus* Thunberg, 1784), by subsequent designation of Hope (1838: 104). it is quite clear that Eschscholtz did not describe a new genus-group taxon under the name *Ophionea* but that he simply used Klug's name under a different spelling'. The type species of *Casnoidea* is *Cicindela cyanocephala* Fabricius, 1798 (= *Attelabus indicus* Thunberg, 1784), by original designation.

### KEY TO AUSTRALIAN SPECIES OF *OPHIONEA*

1. Base of elytra reddish; prothorax coarsely punctate . . . . . . . . . . . . . . . . . . . . . *puncticollis* Sloane
   Base of elytra dark; prothorax not coarsely punctate . . 2
2. Prothorax lacking lateral setae; each elytron with 2 small white spots in anterior third and near apex; dark basal fascia interrupted in middle. . . . . . . *indica* (Thunberg)
   Prothorax with one pair of lateral setae; each elytron with one large white spot only near apex; dark basal fascia not interrupted in middle . . . . . . . . . . . . . . . . . . 3
3. Orbits markedly convex, eyes laterally markedly protruded; prothorax c. 1.5 × as long as wide, widest in middle or in front of it; antenna short, median antennomeres <2 × as long as wide. . . . *thouzeti* Castelnau
   Orbits less convex or almost regularly oblique, eyes laterally less protruded; prothorax >1.67 × as long as wide, widest clearly behind middle; antenna elongate, median antennomeres at least 3 × as long as wide. . . 4
4. Surface of elytra not microreticulate, glossy; light subapical spot small, clearly surpassing posterior border of dark fascia; prothorax >2 × as long as wide . . . . . . . . . . . . . . . . . . . . *australica* Baehr
   Surface of elytra perceptibly microreticulate; light subapical spot very elongate, ending at posterior margin of dark fascia; prothorax <2 × as long as wide . . . . . . . . . . . . . . . . . . . . . . . *storeyi* Baehr

### **Porocara** Sloane, 1917
(Fig. 38E)

*Porocara* Sloane, 1917: 415; 1923: 30; Liebke, 1938: 91; Baehr, 1986: 718; 1996c: 254; Moore et al., 1987: 273; Lorenz, 1998: 421.

TYPE SPECIES. *Porocara punctata* Sloane, 1917, by monotypy.

### KEY TO SPECIES OF *POROCARA*

1. Surface of pronotum and posterior part of head impunctate or nearly so; postmedian vitta of elytra narrow, conspicuously serrate and sinuate; apex of aedeagus virtually not thickened. . . . . *glabrata* Baehr
   Surface of pronotum and posterior part of head coarsely punctate; postmedian vitta of elytra wide, less serrate and sinuate; apex of aedeagus more or less thickened . 2
2. Aedeagus smaller and shorter, length <1.8mm, apex not much upturned and barely curved to right; elytra shorter, laterally less regularly rounded; basal part of lateral borders of pronotum abruptly sinuate . . . . . . . . . 3
   Aedeagus larger and longer, length >2.2mm, apex markedly upturned and curved; elytra longer, laterally regularly rounded; basal part of lateral borders of pronotum not abruptly sinuate. . . . . . . . . . . . 6
3. In fully coloured specimens prothorax, vertex, and most of lower surface black; in teneral specimens at least part of proepipleurae and base of head darker than remaining parts; elytra markedly square, with accentuate humerus, lateral margins almost parallel; microsculpture of elytra very conspicuous, at 10× magnification seemingly isodiametric; lower surface of aedeagus gently curved, apex elongate, not turned down. . . . *nigricollis* Baehr
   Even in fully coloured specimens prothorax, vertex, and most of lower surface not darker than remainder; elytra not square, with less accentuate humerus, lateral margins perceptibly convex; microsculpture of elytra less conspicuous, at 10× magnification distinctly transverse; lower surface of aedeagus gently or markedly curved, apex short or elongate, but when elongate, then apex turned down or aedeagus markedly curved . . . . . . . . . . . . . . . . . . . . . . . . 4
4. Pronotum more densely and regularly punctate, basal part of lateral borders less abruptly sinuate; aedeagus compact, apical part at orificum (as seen from below) distinctly widened, lower surface gently or markedly concave, but when gently concave, then apex short. . . 5
   Pronotum less densely and regularly punctate, basal part of lateral borders abruptly sinuate; aedeagus delicate, apical part at orificum (as seen from below) barely widened, lower surface gently concave, apex elongate . . . . . . . . . . . . *punctata kimberleyana* Baehr
5. Elytra shorter, more square, ratio l/w <1.58; lower surface of aedeagus gently concave, apex short, less club-shaped, almost straight. . . . *punctata punctata* Sloane
   Elytra longer, more egg-shaped, ratio l/w >1.62; lower surface of aedeagus markedly concave, apex longer,

distinctly club-shaped, pointed down
. . . . . . . . . . . . . . . *punctata arnhemensis* Baehr

6. Pronotum densely punctate; basal lobe of aedeagus less curved, apex more upturned though less asymmetric, lower surface of aedeagus barely striate. . *ulrichi* Baehr
Pronotum more sparsely punctate; basal lobe of aedeagus more curved, apex less upturned though more asymmetric, lower surface of aedeagus conspicuously striate . . . . . . . . . . . . . . . . *occidentalis* Baehr

### **Renneria** Baehr, 1999

*Renneria* Baehr, 1999: 116.

TYPE SPECIES. *Renneria kamouni* Baehr, 1999, by original designation.

### **Renneria kamouni** Baehr, 1999
(Fig. 38F)

NEW RECORDS (6 ex.): NT: Tindal, 14.31S, 132.22E, 1-20.xii.1967, WV (ANIC). - WA: Kununurra, 22.xii.1991-6.i.1992, RS (CBM, MDPI, QM).

DISTRIBUTION. N NT, N WA adjacent to NT. Taken at light.

## THE AUSTRALIAN ODACANTHINE FAUNA

The Australian odacanthine fauna includes 16 genera, 50 species, 5 subspecies and 2 doubtfully recorded species that most probably should be excluded from the Australian fauna (see checklist). *Ophionea indica*, which is widely distributed in SE Asia, but not native to Australia has been accidentally introduced by ship. Numbers of indigenous taxa per state are: Vic - 5; ACT - 1; NSW - 7; Qld - 32; NT - 23; WA - 21; unknown - 1.

Therefore, Australian Odacanthinae are predominately tropical, are numerous in the wet tropics, but barely extend to the south or into the drier parts of the continent. They are most speciose in NE Qld, still quite speciose in N NT and N WA, becoming rarer in NSW, Vic and the ACT, and apparently completely absent from SA and Tas. In Vic *Anasis howittii* was recorded from near the coast, but has never been recaptured, so the record might be doubtful. *Neoeudalia nigra* and *Myrmecodemus riverinae* were recently recorded from NW Vic. In WA south of the Great Sandy Desert, *Gestroania amplipennis* (Gestro), is known from the SW, *Porocara occidentalis* and *Eudalia waterhousei* occur in the midwest between the Ashburton and Murchison Rivers. In NT only *Eudalia waterhousei* occurs in the interior, all others being restricted to the coastal North. In Qld only *Eudalia latipennis interioris* and *Neoeudalia nigra*, occur inland. Similarly, in NSW *Neoeudalia nigra* and *Myrmecodemus riverinae*, occur inland, i.e. west of Great Dividing Range, with the other five recorded species either in the northeastern part of the state or in the Australian Alps. In the south, only the streams of the Australian Alps harbour an odacanthine fauna worthy of mention (Framenau, Manderbach & Baehr, 2002), but the few species occurring there can be quite numerous in suitable areas.

The range of *Deipyrus inops*, is so far completely unknown, although I suspect it might occur somewhere in the far north.

It can be seen from the lists of examined material, that quite a large number of species, or even all species of certain genera, are either rare, or are rarely collected, for whatever reasons. This particularly applies to species of *Anasis*, *Archicollinris*, *Gestroania*, *Giachinoana*, *Lachnothorax*, *Myrmecodemus*, *Neoeudalia* and *Renneria*, but also to certain species of other genera. This may be due to either very restricted occurrence, very remote ranges, or to scarcity due to ecological factors. Indeed, only a few species are apparently common, which means: they have been collected either at many localities, or, if their range is more restricted, they are at least common where they occur. Examples of widespread and locally common species are *Basistichus micans*, *Eudalia latipennis*, *E. waterhousei*, *Neoeudalia nigra*, *Ophionea thouzeti*, whereas species like *Deipyrus palustris*, *Eudalia atrata*, *E. castelnaui*, *E. macleayi*, *E. punctipennis* and the members of *Porocara* are generally numerous where they occur. For most species, however, we do not yet know enough about distribution and habits to make any reliable decision.

Nevertheless, some distribution patterns seem evident. In particular in the tropical northern half of Australia two patterns seem to exist: one comprising species of true wet tropical affinities that almost exclusively occur in wet NE Qld, in rain forest, either at the edge of rivers and lagoons (e.g. *Archicollinris* spp., *Dicraspeda brunneipennis*, *D. dubia*, *D. glabrata*, *D. longiloba*, *D. nitida*, *D. obscura*, *Lachnothorax tokkia*); and another group of species that inhabit savannah country or even semiarid areas and extend through the tropical belt of northern Australia, but do not occur east of the Great Dividing Range (e.g. *Dicraspeda sublaevis*, *Eudalia punctipennis*, *E. waterhousei*, *Gestroania setipennis*, *G. storeyi*, *Giachinoana carinipennis*, *Myrmecodemus formicoides*, *M. globulicollis*, *M. lucai*, *Porocara*

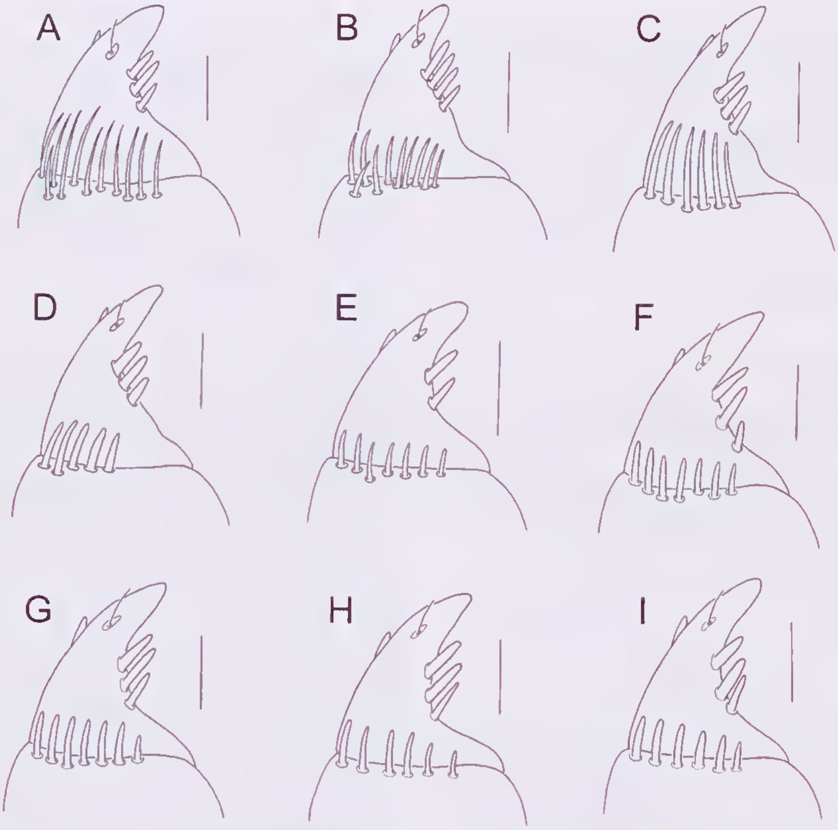

FIG. 31. Female stylomeres 1 and 2 (scales 0.1mm). A, *Eudalia macleayi* Bates. B, *Eudalia latipennis latipennis* (Macleay). C, *Eudalia waterhousei* Castelnau. D, *Eudalia punctipennis* sp. nov. E, *Gestroania amplipennis* (Gestro). F, *Gestroania froggatti* (Macleay). G, *Gestroania setipennis* sp. nov. H, *Gestroania storeyi* sp. nov. I, *Giachinoana carinipennis* Baehr.

spp., *Renneria kamouni*). The ranges of the latter species are usually much more extensive and may extend from N NT to NW Australia, and sometimes also to N Qld W of the Great Dividing Range. *Neoeudalia nigra*, however, has an unusual inland distribution pattern, extending from semiarid country in N Vic and S inland NSW to inland Qld and far N and NW Australia. In Qld it extends to mid-eastern Qld, but there only to the dry country belt that extends along the Tropic of Capricorn to the coast.

With respect to habits, the Australian odacanthine fauna is unique in that most species apparently inhabit sand or gravel banks of rivers and brooks. Plant climbing, 'true' odacanthines, on the other hand are much rarer in Australia compared with the faunas of South Asia, tropical Africa, and South America where they are common. This is easily understood, because wet, swampy habitats and rain forests are scarce in Australia compared with the other large continents. Since all Australian species are winged, they commonly come to light, either directly to the lamp or running about at the margins of the cone of light, though generally not before absolute darkness. It is clear that good flight ability is a prerequisite for beetles living on the margins of water bodies which regularly dry out, as is the case in Australian regions which are semiarid or have a long dry season.

Very little is known about diet, feeding strategies, and life history of any Australian odacanthine species. I observed *Eudalia* and *Porocara* hunting on river banks at night and devouring larvae and adults of mayflies, but to my knowledge, no other information about diet has been recorded. I collected *Eudalia l. latipennis*, *E. punctipennis*, and *E. waterhousei* on fine sand and silt, whereas species of *Porocara* were mainly running amongst pebbles

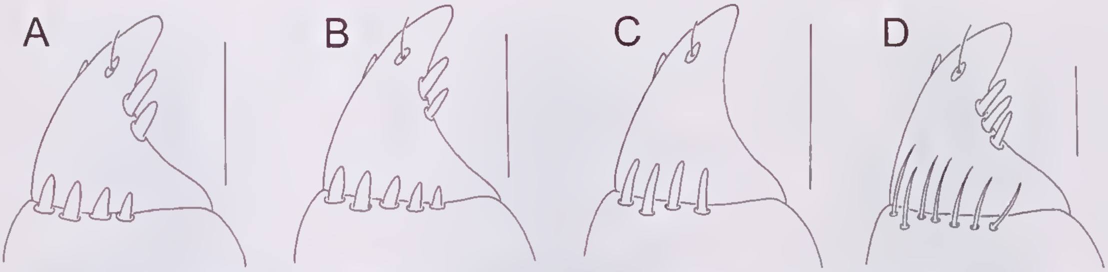

FIG. 32. Female stylomeres 1 and 2 (scales: 0.1mm). A, *Myrmecodemus formicoides* (Sloane). B, *Myrmecodemus lucai* sp. nov. C, *Myrmecodemus pilosellus* sp. nov. D, *Neoeudalia nigra* (Sloane).

and coarse gravel. *Porocara* species are extremely fast runners. *Ophionea* species are true reed climbers as are many *Archicollinris*, though apparently not the Australian species that inhabit rainforest, although we do not know where they live there. Except for the species of the Australian Alps (*Eudalia castelnaui* and *E. macleayi*), almost all species seem to occur at low altitudes, although one species of *Archicolliuris* at least has been captured above 700m. Apart from these sparse details little is known about the other genera. Surprisingly many species occur some distance from water which may suggest rather a life in litter or even on low vegetation independent of open water bodies.

Moore (1965) described the larvae of *Eudalia macleayi* Bates and noted their high similarity to non-Australian *Colliuris*. No other larvae of Australian Odacanthinae have been described.

## COMPOSITION OF THE FAUNA

The Australian Odacanthinae includes very differently shaped species, with different ecological requirements, inhabiting remarkably diverse habitats. No other continent harbours, at the same time, highly evolved, elongate, long-necked reed-climbing species like those of *Ophionea*, *Archicolliuris*, and *Clarencia*; compact, short-headed, fast running, ground-living, nocturnal species like those of *Porocara* and *Eudalia*; and extremely setose, globular species like those of *Deipyrus* and *Myrmecodemus*. Although the diversity of the Australian Odacanthinae is rather high, it is evident that highly developed reed-dwelling species are comparatively rare, whereas primitive ground-living species (and genera) are numerous and speciose. Thus the Australian odacanthine fauna in general is plesiotypic, including probably the most basal extant odacanthine of all, *Porocara*.

The strictly nocturnal *Porocara* occur with cicindelines (*Megacephala* s.l. spp., in particular species from the ripicolous *crucigera*-group), chlaeniines (*Chlaenius* s.l. spp.) and brachinines (*Pheropsophus* spp.) between pebbles, gravel, and sand on the banks of rivers in the Far North. This is perhaps one of the most basic habitats for tropical ground beetles. The serrate-cruciate, red and black colouration of the elytra and the very light colour of the legs are common colour patterns in nocturnal species living in such habitats. This colour pattern probably is well adapted to the reddish sand, as well as to the twilight. *Porocara* specimens running in the night appear like ghosts whisking along, or speaking more biologically, they resemble the fast running tiger beetles or lycosid spiders that occur in the same habitats. So, body shape and colour pattern in *Porocara* may also act as a sort of mimicry, without knowing which model *Porocara* imitates: aggressive spiders or tiger beetles, bombarding *Pheropsophus*, or distasteful *Chlaenius*.

*Grundmannius dispar* Basilewsky, a South African chlaeniine beetle, has exactly the same body shape, colour pattern of the elytra (serrate-cruciate reddish-and-black), bulky head and prothorax, elongate legs and elongate mandibles, as Australian species of *Porocara*. Such similarities seem to corroborate the basic structure of the fauna of the sandy or gravely river banks in tropical, seasonally wet, or even semiarid country.

Apart from colouration, certain species of *Eudalia* are also fairly similar in shape and structure to *Porocara*. These do not match our common concept of odacanthines, but also seem to represent a very basic stock within the subfamily. The species of the *E. latipennis-waterhousei*-lineage in particular are similar in their bulky body shape to *Porocara*, and they live in exactly similar habitats — sand and gravel of river banks in wet to dry savannah country or in

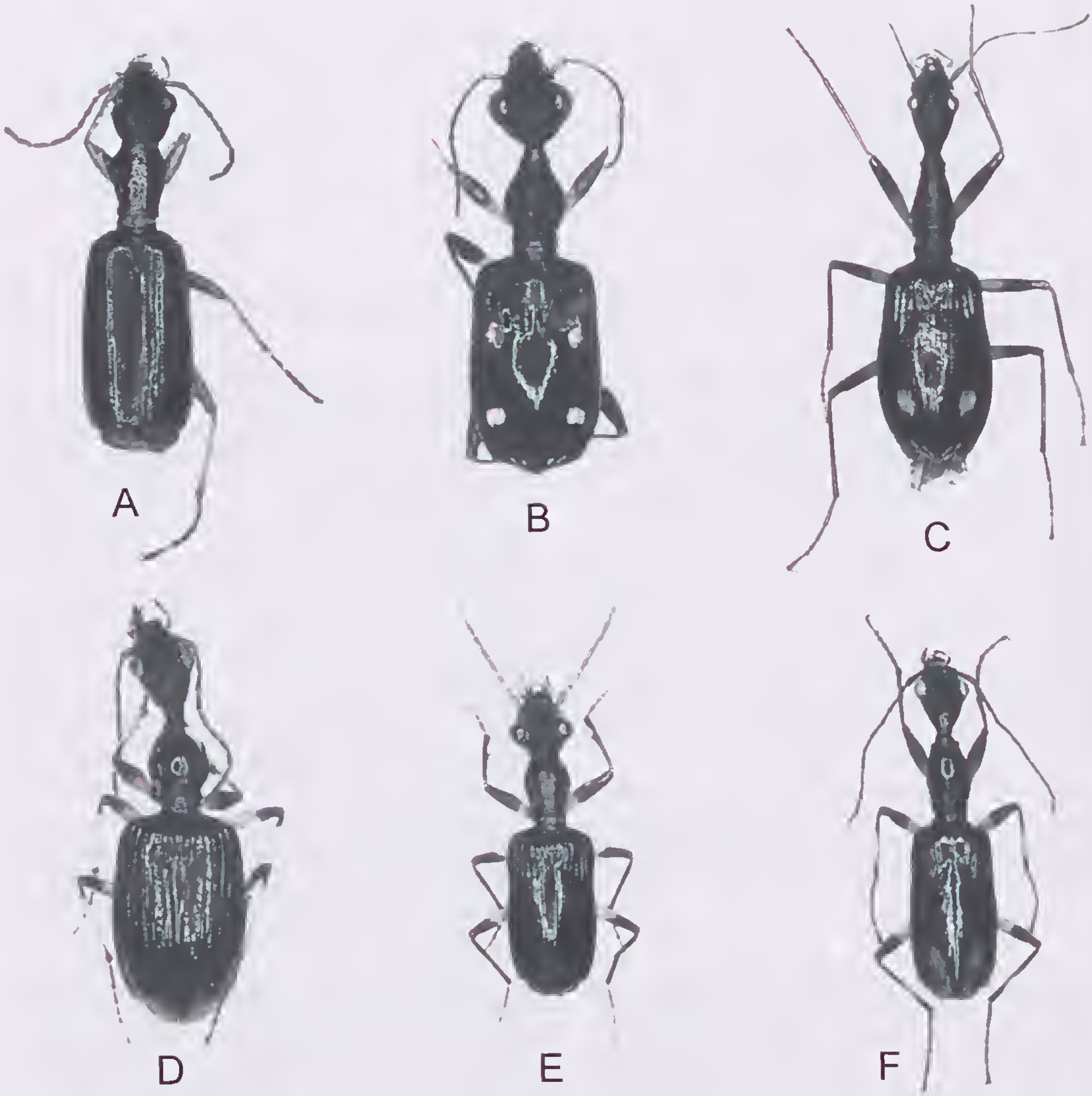

FIG. 33. Habitus of Australian Odacanthinae (length in brackets). A, *Anasis howittii* Castelnau (8.1mm). B, *Archicolliuris splendissimus* sp. nov. (6.9mm). C, *Archicolliuris occipitalis* sp. nov. (10.5mm). D, *Aulacolius triordinatus* Sloane (7.6mm). E, *Basistichus micans* (Macleay) (6.8mm). F, *Clarencia breviceps* sp. nov. (7.9mm).

semidesert. *Dicraspeda*, *Neoeudalia*, *Anasis*, *Renneria* and even *Gestroania* and *Giachinoana*, although the latter three combine species with several apomorpic features, are probably derived from an *Eudalia*-like stock, and most probably their habits are rather similar to those of *Eudalia* (ground-living at river banks).

Some Australian genera are outstanding in certain morphological characters and their systematic position is not easily fixed. Habits of *Aulacolius*, *Basistichus*, *Deipyrus* and *Myrmecodemus* are very little known, although probably they also live on the ground beside water. They all seem to be descended from primitive ancestors, having acquired certain more highly evolved characters. The oriental *Lachnothorax*, which also includes primitive, ground-living species, should also be added to this group.

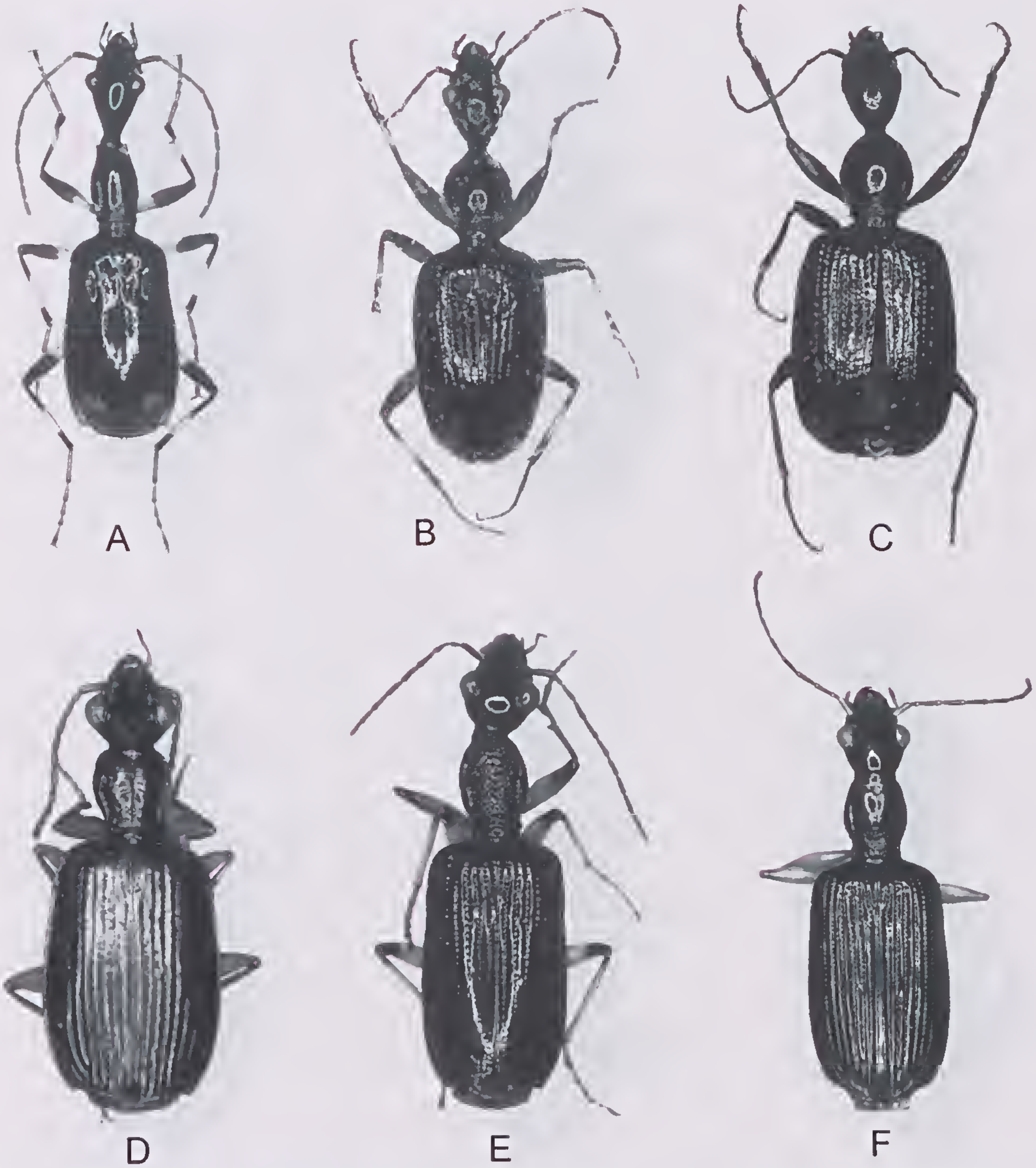

FIG. 34. Habitus of Australian Odacanthinae (length in brackets). A, *Clarencia quadridens* Darlington (11.3mm). B, *Deipyrus palustris* (Sloane) (8.0mm). C, *Deipyrus inops* sp. nov. (8.5mm). D, *Dicraspeda sublaevis* (Macleay) (5.9mm). E, *Dicraspeda obscura* (Castelnau) (6.8mm). F, *Eudalia obliquiceps tozeria* subsp. nov. (8.2mm).

Only three Australian genera belong to the highly evolved odacanthine lineage that matches our idea of typical odacanthines. *Archicolliuris* and *Clarencia* do not reach the extreme degree of adaptation in the structure of their tarsi to life on grass and reeds. However, *Ophionea*, with deeply excised 4th tarsomeres, dense clothing with elongate hairs on the lower surface of tarsi, and conspicuous, probably aposematic, red-and-black colouration, form the most evolved group within the subfamily.

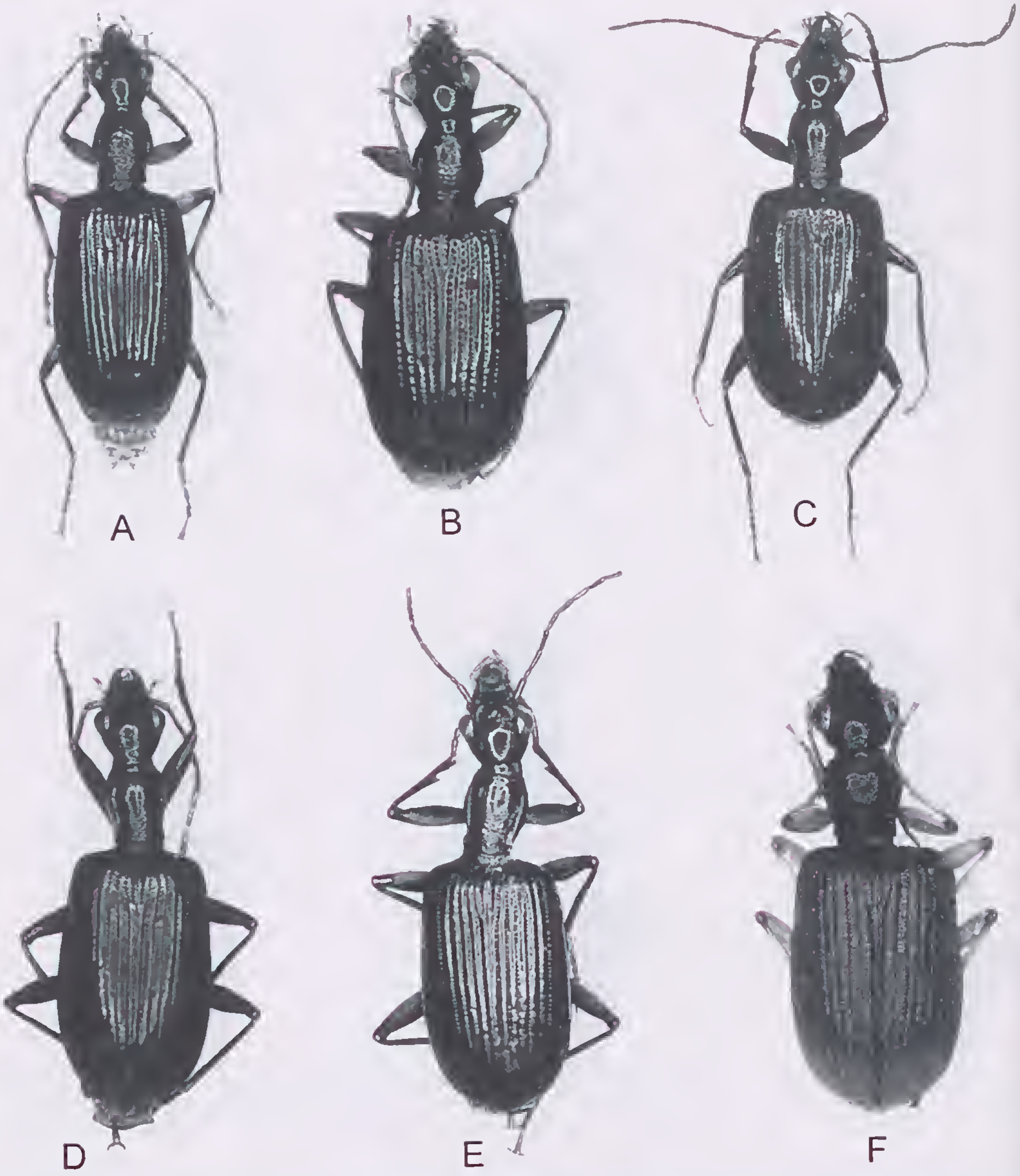

FIG. 35. Habitus of Australian Odacanthinae (length in brackets). A, *Eudalia obliquiceps punctifrons* subsp. nov. (8.5mm). B, *Eudalia minor* sp. nov. (6.9mm). C, *Eudalia reticulata* sp. nov. (8.6mm). D, *Eudalia atrata* sp. nov. (9.7mm). E, *Eudalia femorata* sp. nov. (9.8mm). F, *Eudalia latipennis latipennis* (Macleay) (8.4mm).

*Archicolliuris* and *Ophionea*, however, are widespread in the Oriental Region and are recent immigrants from the north that reached Australia during, or perhaps even after, the Glacial Period (*Archicolliuris*), or at least not before the meeting of the Australian plate with the SE Asian insular belt in late Miocene. The Australian-New Guinean *Clarencia* is probably descendend from a '*Colliuris*'-like ancestor that may have also evolved during this period.

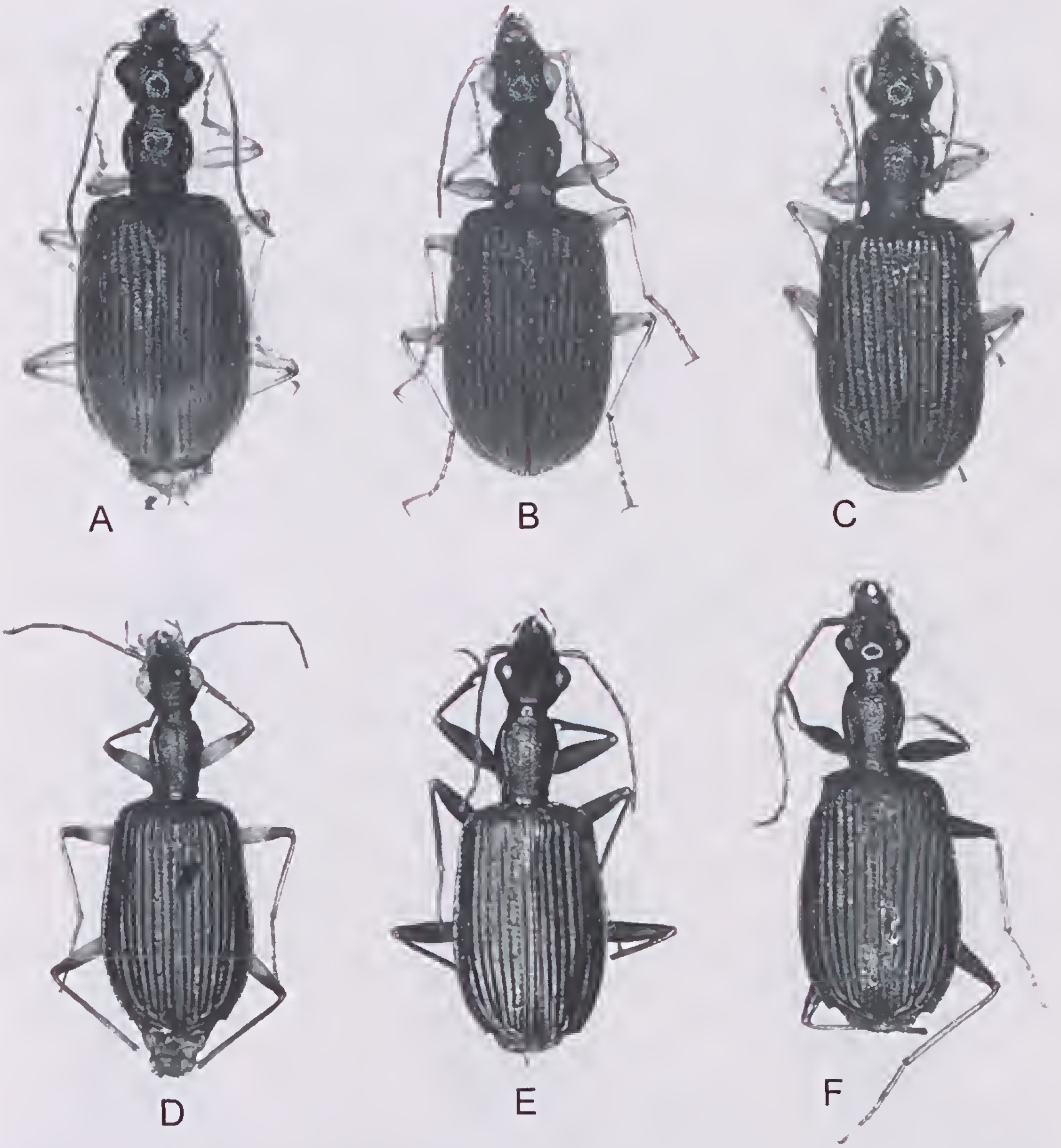

FIG. 36. Habitus of Australian Odacanthinae (length in brackets). A, *Eudalia latipennis interioris* subsp. nov. (8.0mm). B, *Eudalia waterhousei* Castelnau (9.1mm). C, *Eudalia punctipennis* sp. nov. (8.7mm). D, *Gestroania amplipennis* (Gestro) (8.1mm). E, *Gestroania froggatti* (Macleay) (8.0mm). F, *Gestroania setipennis*, sp. nov. (8.4mm).

*Lachnothorax tokkia* and *Dicraspeda longiloba* are recent immigrants to Australia and the latter species, with its deeply excised 4th tarsomeres, belongs to a group of New Guinean centred species within the diverse *Dicraspeda* that in certain aspects is more evolved than any Australian members of the genus.

All other Australian genera are indigenous, systematically rather isolated, and may have originated in this continent. Considering the

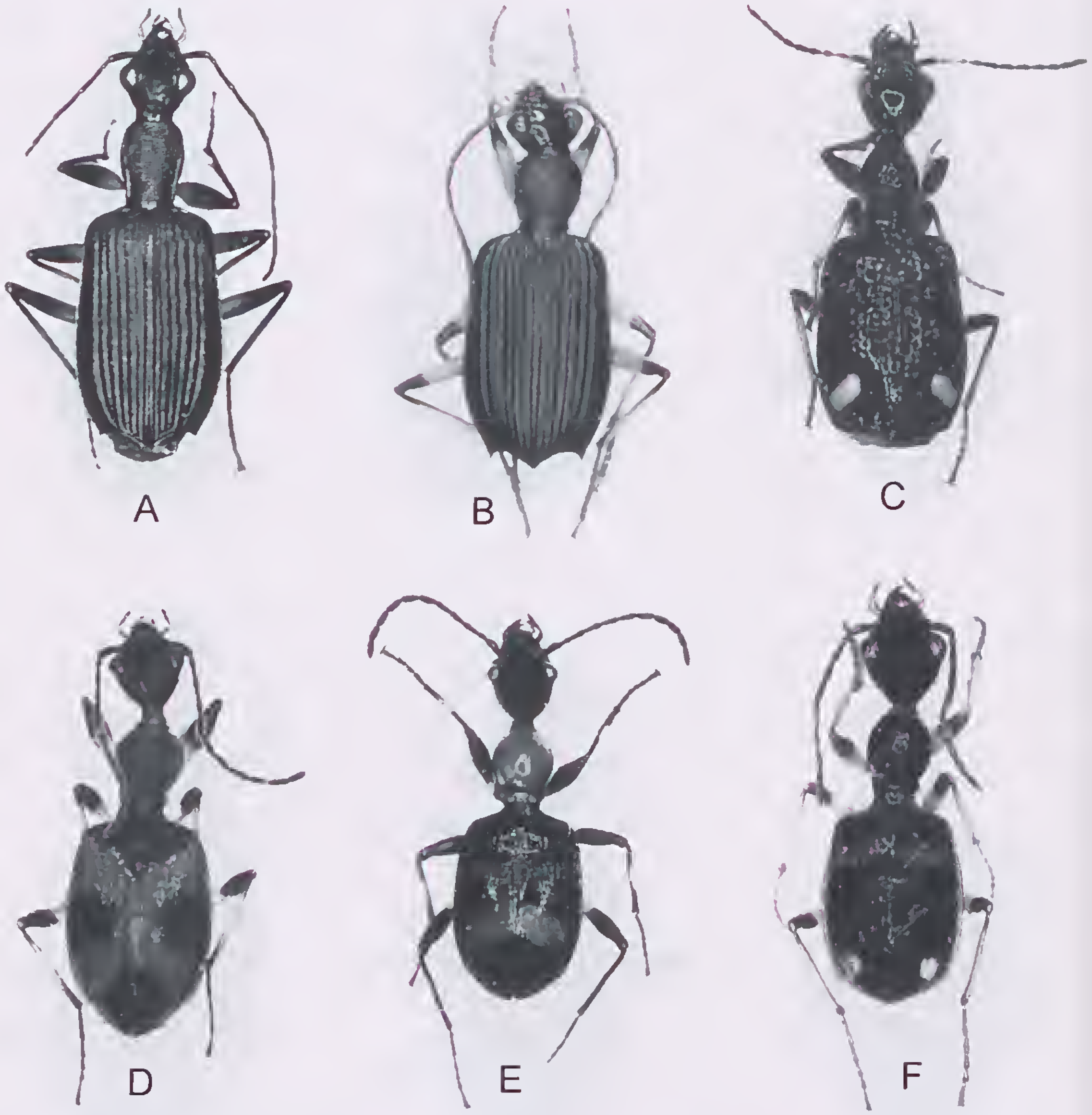

FIG. 37. Habitus of Australian Odacanthinae (length in brackets). A, *Gestroania storeyi* sp. nov. (8.8mm). B, *Giachinoana carinipennis* Baehr (7.1mm). C, *Lachnothorax tokkia* Gestro (5.6mm). D, *Myrmecodemus globulicollis* (Macleay) (7.0mm). E, *Myrmecodemus riverinae* (Sloane) (6.9mm). F, *Myrmecodemus formicoides* (Sloane) (4.9mm).

remarkable plesiotypic structure of several genera, these may be remnants of a very old, basal odacanthine stock, or they may even represent the original stock. This would mean that Australia was where the evolution of odacanthines started.

In this context, and if *Porocara* is the most plesiotypic genus, it should be kept in mind that the habitats where species of *Porocara* occur, namely banks of rivers in tropical wet and dry savannah, are very old ones, generally containing a very old fauna. Among other Carabidae, this Australian river bank fauna includes several plesiotypic genera, e.g. *Megacephala* (*sensu lato*) of Cicindelinae, *Perileptus* of Trechinae, *Tasmanitachoides* of Bembidiinae, *Loxandrus* of

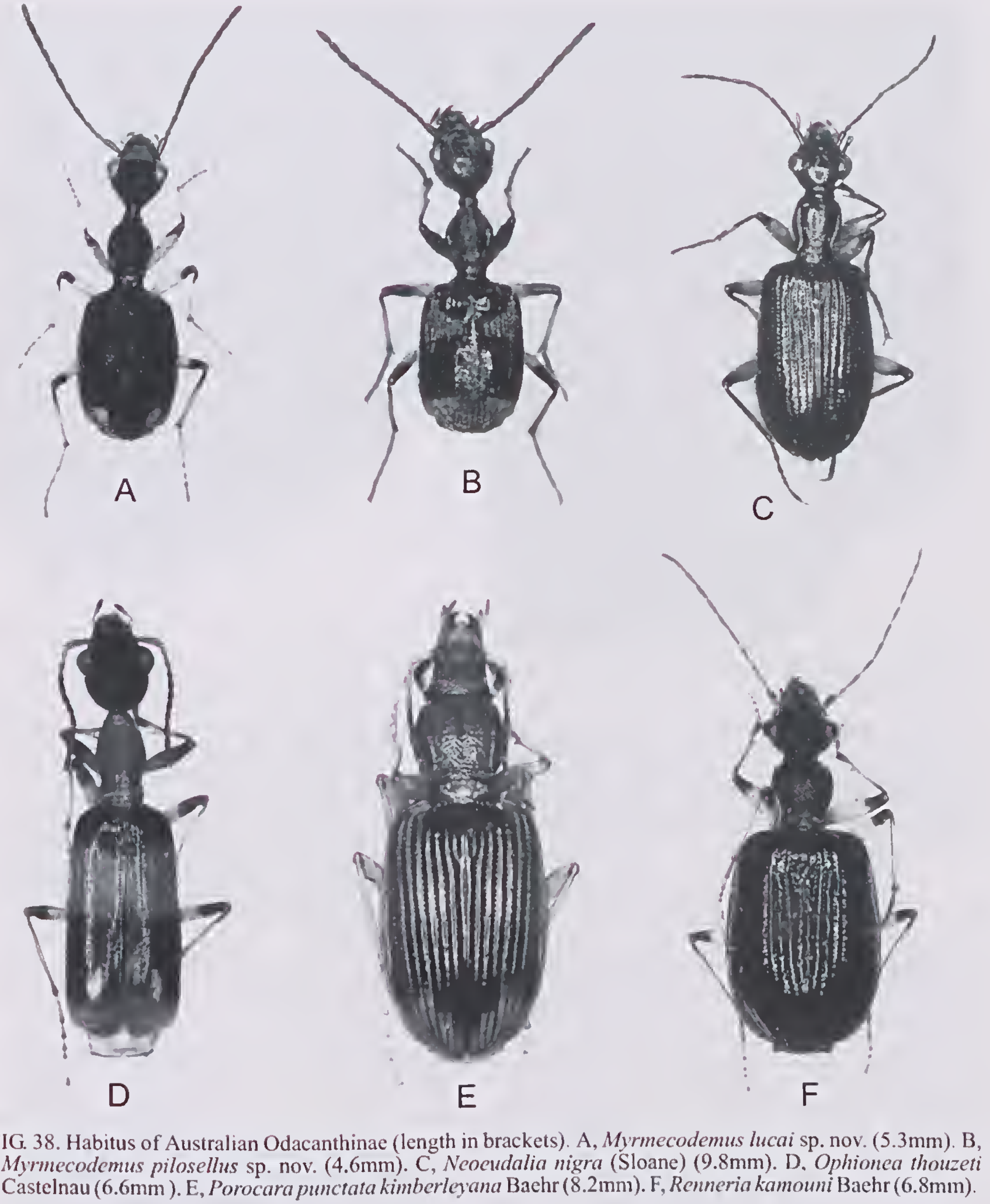

FIG. 38. Habitus of Australian Odacanthinae (length in brackets). A, *Myrmecodemus lucai* sp. nov. (5.3mm). B, *Myrmecodemus pilosellus* sp. nov. (4.6mm). C, *Neoeudalia nigra* (Sloane) (9.8mm). D, *Ophionea thouzeti* Castelnau (6.6mm ). E, *Porocara punctata kimberleyana* Baehr (8.2mm). F, *Renneria kamouni* Baehr (6.8mm).

Pterostichinae and others. In spite of the radical short-term substrate changes that occur periodically due to floods, this seems to be a very stable habitat that has perhaps not changed significantly in its structure through much of the Tertiary.

The Australian odacanthine fauna is surprisingly speciose which is not expected in a continent that is exceptionally dry. The fauna is also surprisingly diverse in morphology and habits, and seems to include the most primitive existing odacanthines of all. Superimposed on

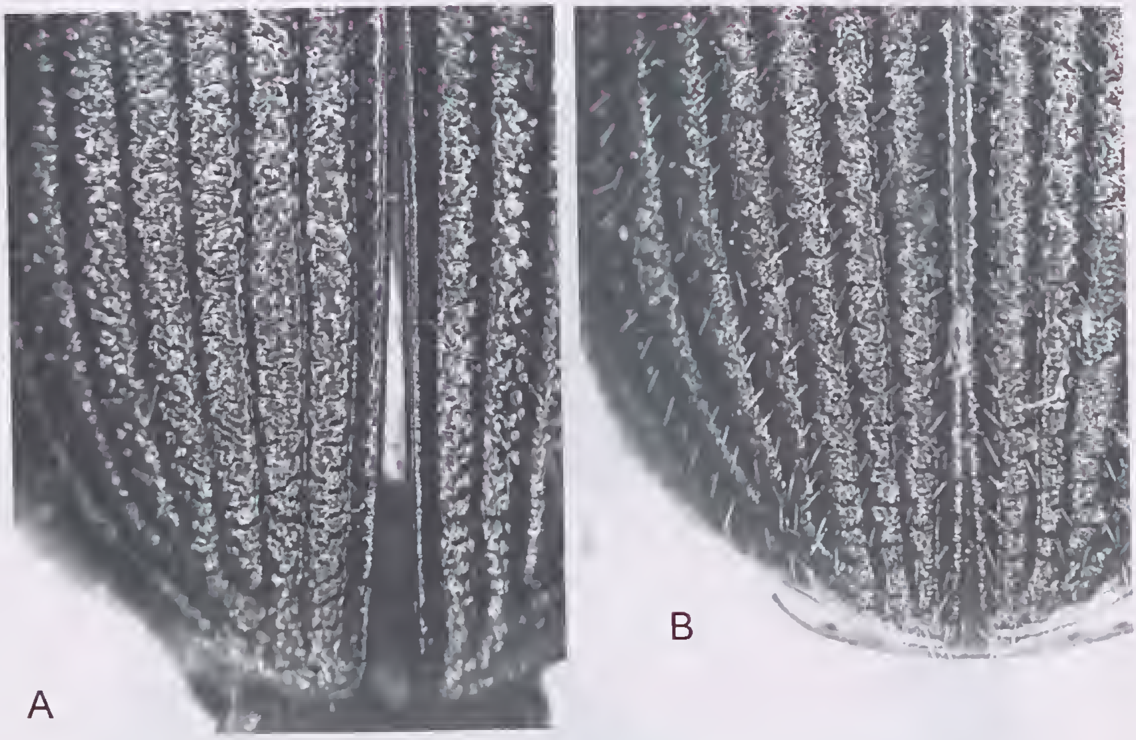

FIG. 39. Structure of elytra. A, *Eudalia waterhousei* Castelnau. B, *Eudalia punctipennis* sp. nov.

this ancient fauna are some 'modern' groups that immigrated more recently from the Oriental Region, but have not yet spread beyond the wet northern tropical and eastern subtropical parts of Australia where they remain restricted to rain forest or swampy areas.

## CHECKLIST OF AUSTRALIAN ODACANTHINAE

This checklist was added to update Moore et al. (1987) which is doubled from 25 to 50 species with 5 additional subspecies (Baehr, 1986, 1996b,c, 1999, 2000, 2003b,c; Framenau et al. 2002; this paper) and additional 2 species whose occurrence in Australia is doubtful. Oriental *Ophionea indica* Thunberg was accidentally introduced to WA by ship (Baehr, 1996b).

For ease of use the checklists are alphabetical, and the most important generic synonyms are added. *Colliuris* has been divided into genera according to the systematic list of extant Carabidae of Lorenz (1998). References to the recorded range of the species are given as states, but with added N (northern), S (southern), W (western), E (eastern) where necessary. The ranges are compiled from information taken from Darlington (1968), Moore et al. (1987), from my papers mentioned above, and from my own collecting and determining experience.

The only species of which I have not seen any Australian specimens are *Archicolliuris par* (Darlington) and *Discraspeda dubia* (Gestro), both New Guinean species that are claimed to occur in Australia at the northern tip of Cape York Peninsula.

| | |
|---|---|
| **Genus *Anasis* Castelnau, 1867** | |
| *howittii* Castelnau, 1867 | S Vic |
| **Genus *Archicolliuris* Liebke, 1931** | |
| *occipitalis* sp. nov. | N Qld |
| [*par* Darlington, 1968 | N Qld] |
| *splendissimus* sp. nov. | N Qld |
| **Genus *Aulacolius* Sloane, 1923** | |
| *triordinatus* Sloane, 1923 | N Qld, N NT |
| **Genus *Basistichus* Sloane, 1917** | |
| *micans* (Macleay, 1864) | N Qld, N NT, N WA |
| **Genus *Clarencia* Sloane, 1917** | |
| *aliena* (Pascoe, 1860) | NE NSW, E. Qld |
| *angusticollis* (Macleay, 1888) | N Qld, N NT, N WA |
| *breviceps* sp. nov. | N NT |
| *quadridens* Darlington, 1968 | N Qld |

**Genus *Deipyrus* Liebke, 1938**
*inops* sp. nov. . . . . . . . . . . . . . . . . 'Australia'
*palustris* (Sloane, 1910) . . . . . . . . . . . . N Qld
**Genus *Dicraspeda* Chaudoir, 1862**
*Macrocentra* Chaudoir, 1869
*Loxocara* Sloane, 1907
*Philemonia* Liebke, 1938
[*brunnea* Chaudoir, 1862)]. . . . . . . . . . [N Qld]
*brunneipennis* (Sloane, 1917) . . . . . . . . . N Qld
*dubia* (Gestro, 1879) . . . . . . . . . . . . . N Qld
*glabrata* Baehr, 2003 . . . . . . . . . . . . . N Qld
*longiloba* (Liebke, 1938). . . . . . . . . . . . N Qld
*nitida* (Sloane, 1917). . . . . . . . . . . . . . N Qld
*obscura* (Castelnau, 1867) . . . N Qld, N NT, N WA
*sublaevis* (Macleay, 1888) . . . N Qld, N NT, N WA
**Genus *Eudalia* Castelnau, 1867**
*atrata* sp. nov. . . . . . . . . . . . . . . . . CE NSW
*castelnaui* Sloane, 1910 . . . . . . . . E Vic, S NSW
*femorata* sp. nov. . . . . . . . . . . . . . . . CE NSW
*latipennis* (Macleay, 1864). . . . . . . . . . . . Qld
*l. latipennis* (Macleay, 1864). . . . . . . . . . N Qld
*l. interioris* subsp. nov. . . . . . . . . . . . SW Qld
*macleayi* Bates, 1871. . . . . . E Vic, ACT, S. NSW
*minor* sp. nov.. . . . . . . . . . . . . . . . . NW Qld
*obliquiceps* Sloane, 1917 . . . . N Qld, N NT, N WA
*o. obliquiceps* Sloane, 1917 . . . . . . . . . . N Qld
*o. punctifrons* subsp. nov. . . NW Qld, N NT, N WA
*o. tozeria* subsp. nov.. . . . . . . . . . . . . . NE Qld
*punctipennis* sp. nov. . . . . . . . . . NW NT, N WA
*reticulata* sp. nov. . . . . . . . . . . . . . . . N Qld
*waterhousei* Castelnau, 1867 . . . . . . . NT, C WA
**Genus *Gestroania* Liebke, 1938**
*amplipennis* (Gestro, 1875) . . . . . . . . . . S WA
*froggatti* (Macleay, 1888) . . . . . . . . . . . N WA
*setipennis* sp. nov.. . . . . . . . . . . . . N Qld, N NT
*storeyi* sp. nov. . . . . . . . . . . . . . . N NT, N WA
**Genus *Giachinoana* Baehr, 2003**
*carinipennis* Baehr, 2003 . . . . . . . . . N NT, N WA
**Genus *Lachnothorax* Motschulsky, 1862**
*Lasiocolliuris* Liebke, 1931
*tokkia* Gestro, 1875 . . . . . . . . . . . . . . N Qld
**Genus *Myrmecodemus* Sloane, 1923**
**Subgenus *Myrmecodemus* Sloane s. str.**
*formicoides* (Sloane, 1910). . . . . . . . . . . N NT
*globulicollis* (Macleay, 1888) . . . . . N NT, N WA
*lucai* sp. nov.. . . . . . . . . . . . . . . . . . . . N NT
*riverinae* (Sloane, 1890) . . . . . . N VIC, SC NSW
**Subgenus *Trichodemus* subgen nov.**
*pilosellus* sp. nov. . . . . . . . . . . . . . . . N Qld
**Genus *Neoeudalia* gen nov.**
*nigra* (Sloane, 1900) . . . . . . . . . . . . . . . . .
. . . . . . . N VIC, SC NSW, Qld, N NT, N WA
**Genus *Ophionea* Klug, 1821**
*Casnoidea* Castelnau, 1834
**Subgenus *Ophionea* s. str.**
*australica* (Baehr, 1996) . . . . N Qld, N NT, N WA
[*indica* (Thunberg, 1784)] . . . . [WA (introduced)]
*puncticollis* Sloane, 1923 . . . . . . . . N Qld, N NT
*storeyi* (Baehr, 1996) . . . . . . . . . N Qld, N WA
*thouzeti* Castelnau, 1867 . . . . . . . . E Qld, N NT
**Genus *Porocara* Sloane, 1917**
*glabrata* Baehr, 1986 . . . . . . . . . . . . . N WA
*nigricollis* Baehr, 1986 . . . . . . . . . . . . . N NT
*occidentalis* Baehr, 1986 . . . . . . . . . . . N WA
*punctata* Sloane, 1917 . . . . . N Qld, N NT, N WA
*p. punctata* Sloane, 1917 . . . . . . . . . . . . N Qld
*p. arnhemensis* Baehr, 1996 . . . . . . . . . . N NT
*p. kimberleyana* Baehr, 1986 . . . . NW NT, N WA
*ulrichi* Baehr, 1996. . . . . . . . . . . . N NT, N WA
**Genus *Renneria* Baehr, 1999**
*kamouni* Baehr, 1999 . . . . . . . . . . . N NT, N WA

## CHECKLIST OF ODACANTHINAE FROM NEW GUINEA, NEW BRITAIN, SOLOMON ISLANDS AND NEW HEBRIDES

Darlington (1968, 1971) enumerated 9 genera (if *Philemonia* and *Macrocentra* are regarded as subgenera of *Dicraspeda*) and 21 species from New Guinea. Occurrences of *Andrewesia apicalis*, *Ophionea indica*, *O. nigrofasciata*, and *Dicraspeda brunnea* are doubtful because they have not been confirmed by specimens.

*Andrewesia apicalis*, *Ophionea indica*, and *O. nigrofasciata* are Oriental species the occurrence of which was doubted by Darlington (1968, 1971) though the last two occur on Sulawesi (Baehr, 2003a). The doubtful status of *Dicraspeda brunnea* is discussed above.

10 genera with 28 species are recorded from New Guinea, 5 from New Britain, 3 from Solomon Islands (of which *Dicraspeda inermis* and *Ophionea brandti* are apparently endemic), and *Dicraspeda hebridarum* is endemic to the New Hebrides.

*Archicolliuris par*, *Basistichus micans*, *Clarencia quadridens*, *Dicraspeda dubia*, *Dicraspeda longiloba*, *Lachnothorax tokkia*, *Ophionea puncticollis*, and *Ophionea thouzeti* are common to New Guinea and Australia. However, as demonstrated in Baehr (2000) and in the present paper, these faunas are not yet adequately recorded, and additional shared species will no doubt be found.

Species in common between Australia and New Guinea are either Australian elements that are only found in southern New Guinea in environments similar to those of northern Australia (*Basistichus micans*, *Clarencia quadridens*, *Ophionea puncticollis*, *O. thouzeti*), or they are northern elements originated in New Guinea (*Archicolliuris par*, *Dicraspeda dubia*, *D. longiloba*), or even more widely through the Oriental region (*Lachnothorax tokkia*).

The checklist shows how little is known of the odacanthine fauna of W New Guinea (Irian Jaya) which is neglected in Darlington (1968) because at that time almost none had been collected there. Since then the situation has improved through the efforts of recent collectors (Baehr, 1995, 1996a, b, 1997b, 1998, 2003c), but the fauna is still far from documented. Little can be said about how well the faunas of the Bismarck Archipelago, Solomon Islands, and New Hebrides are documented, but they are apparently similarly incomplete.

[**Genus *Andrewesia*** Liebke, 1938]
[*apicalis* (Chaudoir, 1872)] . . . ?
**Genus *Archicolliuris*** Liebke, 1931
*papua* (Darlington, 1968) . . . PNG
*par* (Darlington, 1968) . . . PNG, New Britain
**Genus *Basistichus*** Sloane, 1917
*micans* (Macleay, 1864) . . . E PNG
**Genus *Clarencia*** Sloane, 1917
*papua* Darlington, 1968 . . . NG
*quadridens* Darlington, 1968 . . . NG
**Genus *Crassacantha*** Baehr, 1995
*bidens* Baehr, 1995 . . . IJ
**Genus *Dicraspeda*** Chaudoir, 1862
  *Macrocentra* Chaudoir, 1869
  *Loxocara* Sloane, 1907
  *Philemonia* Liebke, 1938
*bispinosa* Darlington, 1968 . . . PNG
[*brunnea* Chaudoir, 1862] . . . ?
*denticulata* Baehr, 1997 . . . PNG
*dubia* (Gestro, 1879) . . . IJ
*hebridarum* Baehr, 1998 . . . New Hebrides
*inermis* Louwerens, 1970 . . . Solomon Is
*intermedia* Baehr, 1997 . . . IJ
*laticollis* Baehr, 1997 . . . IJ
*loebli* Baehr, 1996 . . . PNG
*longiloba* (Liebke, 1938) . . . PNG, New Britain
*minuta* Baehr, 1998 . . . PNG
*nigripes* Baehr, 2003 . . . PNG
*obsoleta* Baehr, 1996 . . . IJ: Biak I.
*papuensis* Baehr, 2003 . . . PNG
*quadrispinosa* (Chaudoir, 1869) . . . NG, New Britain, Solomon Is
*ullrichi* Baehr, 1996 . . . PNG
*violacea* (Sloane, 1907) . . . NG, New Britain
**Genus *Dobodura*** Darlington, 1968
*armata* Darlington, 1968 . . . PNG
**Genus *Eucolliuris*** Liebke, 1931
*fuscipennis* (Chaudoir, 1850) . . . PNG
*rossi* (Darlington, 1968) . . . PNG
**Genus *Eudalia*** Castelnau, 1867
*anomala* Darlington, 1968 . . . NG
**Genus *Lachnothorax*** Motschulsky, 1862
  *Lasiocolliuris* Liebke, 1931
*tokkia* Gestro, 1875 . . . PNG
**Genus *Ophionea*** Klug, 1821
  *Casnoidea* Castelnau, 1834
*brandti* (Baehr, 1996) . . . Solomon Is
*gestroi* Maindron, 1910 . . . PNG, New Britain
[*indica* (Thunberg, 1784)] . . . ?
[*nigrofasciata* Schmidt-Göbel, 1846] . . . ?
*puncticollis* Sloane, 1923 . . . PNG
*thouzeti* Castelnau, 1867 . . . PNG

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# *TEEATTA*, A NEW SPIDER GENUS FROM TASMANIA, AUSTRALIA (AMAUROBIOIDEA: AMPHINECTIDAE: TASMARUBRIINAE)

VALERIE TODD DAVIES

Davies, V.T. 2005 01 10: *Teeatta*, a new spider genus from Tasmania, Australia (Amaurobioidea: Amphinectidae: Tasmarubriinae). *Memoirs of the Queensland Museum* **50**(2): 195-199. Brisbane. ISSN 0079-8835.

Three species of *Teeatta* gen. nov. from Tasmania are described. They are *T. driesseni* (type species), *T. magna* and *T. platnicki*. They are placed with *Tasmarubrius, Tasmabrochus* and *Tanganoides* gen. nov. in the subfamily Tasmarubriinae. *Tanganoides* nov. nom., replacement name is provided here for *Tangana* Davies, 2003 preoccupied in the Orthoptera by Ramme, 1929:309. ❑ *Amphinectidae, Tasmarubriinae, Teeatta, gen. nov., Tanganoides, nov. nom.*

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*Teatta* is the fourth genus of the Tasmarubriinae Davies (2002) to be described from Tasmania. There is sexual dimorphism shown in the colour and shape of the carapace and chelicerae. In males the carapace is longer than wide (1:07), the highest part is the foveal region; the chelicerae are geniculate (Fig. 1A). In females the carapace is darker in colour and noticeably longer than wide (1:0.6), the highest part is mid-carapace; chelicerae are strongly geniculate (Fig. 1B).

## MATERIAL AND METHODS

Almost all the material for the type species was collected by Michael Driessen from pitfall traps (PF). The material for the second species, *T. magna* was hand-collected and contains no males. Further collecting may yield males and at the same time confirm that the paratype from Scotts Peak Dam Rd, south of the type locality, belongs here. Notation of spines follows Platnick & Shadab (1975). The left male palp is described and illustrated. Measurements are in millimetres.

ABBREVIATIONS. *Museums*: AMNH, American Museum of Natural History, New York; QM, Queensland Museum, Brisbane; TM, Tasmanian Museum and Art Gallery, Hobart.

*Morphology*: The usual abbreviations are used for body measurements and eyes. Others in the text: MA, median apophysis; RTA, retrolateral tibial apophysis.

## SYSTEMATICS

### KEY TO GENERA OF TASMARUBRIINAE

1. ♂ palp with long fixed prolateral tegular apophysis pointing forwards . . . . . . . . . . . . . . . . . . . 2

   ♂ palp with tegular apophysis arising in the membraneous area just prolateral to MA or occasionally absent. . . . 3

2. ♂ tegular apophysis about same length as MA. Large retrobasal paracymbium. ♀ lateral epigynal protuberances . . . . . . . . . . . . . . *Tasmarubrius*

   ♂ tegular apophysis very long, extending beyond tegulum, about 1.5× MA. Small paracymbium. ♀ without lateral epigynal protuberances . *Tasmabrochus*

3. ♂ MA short, stout; terminally bifurcate or trifurcate. Tegular apophysis small or absent. ♀ spermathecae anterior to gonopores. Spines on tarsi III, IV . . . . . . . . . . . . . . . . . . . . . . . *Tanganoides*

   ♂ MA slender, unbranched. Tegular apophysis curving across tegulum to embolic base. ♀ spermathecae dorsal to gonopores. Without spines on tarsi III, IV . . *Teeatta*

### **Teeatta** gen. nov.

TYPE SPECIES. *T .driesseni* sp. nov.

ETYMOLOGY. Tasmanian Aboriginal *teeatta*, forest. Gender is masculine.

DIAGNOSIS. Large (6.0-9.0) to very large (17.0-18.0) ground living spiders. Male palp with a very broad grooved embolus and long slender median apophysis. A long sclerotised tegular apophysis, arising in the membranous area prolateral to the median apophysis, is crook-shaped distally and curves across the tegulum to the embolic region (Fig. 1C). This differs in origin and direction from the fixed prolateral tegular apophysis in *Tasmarubrius* and *Tasmabrochus*, which arises on the prolateral tegulum and runs forwards. MA is unbranched differing from that of *Tanganoides*. Like the other genera it also lacks the small tarsal spines found in *Tanganoides*. A prolateral protrusion on the subtegulum locks with the embolic base (Fig. 1E). RTA with low dorsoretrolateral apophysis and large pointed dorsal apophysis. Spermathecae small, situated behind (dorsal to) gonopores; differing from *Tanganoides* where they are anterior to the gonopores.

DESCRIPTION. Three-clawed ecribellates with an almost glabrous carapace, geniculate chelicerae, 2 retromarginal and 2 promarginal cheliceral teeth with an intermediate row of tiny denticles, see Davies (2003, fig. 2A,B). Preening combs on metatarsi II-IV. Short thick embolus, small membranous conductor, long movable MA and long sclerotised tegular apophysis. Small rounded paracymbium. Palpal tibia with distal retroventral apophysis and excavated RTA with 2 apophyses. Epigynum with 'lateral' teeth, emerging posteriorly rather than laterally (Fig. 1H). Gonopores often blocked with acellular material; small spermathecae.

### **Teeatta driesseni** sp. nov.
(Fig. 1).

ETYMOLOGY. For Michael Driessen who collected many spiders from the moorlands of central and western Tasmania.

MATERIAL. HOLOTYPE: ♂, Lake St. Clair, 42°07'S, 146°11'E, PF, 25 Aug. 1999, M. Driessen (QM S55299). PARATYPES: ♀, same locality and collector as holotype, PF, 26 Mar. 1997 (QM S55305); 25♂,14♀, 26 June 2000 (QM S55293); ♂, 17♀, 26 Apr. 2000 (QM S55296); ♀, 6 Mar. 1997 (QM S55297); ♂, 25 Aug. 1999 (QM S55298); ♀, 29 Mar. 2000 (QM S55300); ♂, 30 Sept. 1999 (QM 55301); 3♂, Aug. 1999 (QM S55302); 2♀, 25 Aug. 1999 (QM S55303); ♀, 26 Mar. 1997 (QM S55304); 2♂, ♀, Aug. 1999 (QM S53306); ♂, Aug. 1997 (QM S55307); ♂, Aug. 1999 (QM S55308); 2♂, Aug. 1999 (QM S55309); ♂, Aug. 1999, (QM S55315); ♀, penult. ♂, King William Creek, 42°14'S, 146°15'E, 25 Feb. 1999 (QM S55310); ♀, 2 penult. ♂, same locality, 25 Feb. 1999 (QM S55311); 2♀, 25 Feb. 1999 (QM S55312); ♀, Mar. 1999 (QM S55313); 2♀, ♂, July 1999 (QM S55314).

DIAGNOSIS. Tegular apophysis long, sclerotised (Fig. 1C), arising from membraneous area prolateral to the median apophysis, curving across the tegulum to the embolus.

DESCRIPTION. *Male*. CL 3.9, CW 2.8, AL 3.6, AW 2.3. Light brown carapace, highest at fovea. Dorsal abdomen dark brown with pattern of 6 pairs of pale spots diminishing in size posteriorly. From above PRE slightly procurved, ARE straight; from the front both rows procurved. AME smallest. All eyes ringed in black. Ratio of AME: ALE: PME: PLE is 8:11:10:11. Chelicerae geniculate; 2 retromarginal and 2 promarginal teeth with an intermediate row of small thin denticles between them. Labium slightly wider than long; sternum slightly longer than wide, 1:0.9. Legs 4123 (Table 1).

TABLE 1. *T. driesseni* ♂(♀) Leg lengths.

| | Leg I | Leg II | Leg III | Leg IV |
|---|---|---|---|---|
| Femur | 3.0 (3.2) | 2.5 (2.8) | 2.3 (2.7) | 3.0 (3.3) |
| Patella &Tibia | 3.8 (4.2) | 3.0 (3.3) | 2.7 (2.9) | 3.7 (4.2) |
| Metatarsus | 2.5 (2.5) | 2.1 (2.1) | 2.3 (2.2) | 3.3 (3.3) |
| Tarsus | 1.7 (1.6) | 1.3 (1.3) | 1.0 (1.1) | 1.3 (1.4) |
| Total | 11.0 (11.5) | 8.9 (9.5) | 8.3 (8.9) | 11.3 (12.2) |

Notation of spines. Femora: I, D110, P001; II, D110, P001; III, D110, P001, R001; IV, D110, P001, R001. Tibiae: I, P101, V222; II, P111, V112; III, D010, P111, V212, R001; IV, D001, P111, V212, R111. Metatarsi: I, P012,V221, R002; II, P012, V221, R012; III, D010, P101, V221, R112; IV, D010, P112, V221, R112. Spines on metatarsi III and IV very long and robust. No tarsal spines. Preening combs on metatarsi II-IV.

Male palp (Fig. 1C-F). Cymbium with slight bulge on retrolateral edge, small rounded posterior protrusion and flanged paracymbium; trichobothria in dorsal row. Thick grooved embolus, small membranous conductor, long tapered MA and very long sclerotised tegular apophysis that curves across the tegulum to the embolic region. A prolateral protrusion on the subtegulum locks the embolic base in place. Tibia with ridge-like retroventral apophysis; RTA with low dorso-retrolateral apophysis and large pointed dorsal apophysis (Fig. 1D,E).

Males range in length from 6.7-8.4.

*Female* (QM S55305). CL 4.7, CW 3.0, AL 4.4, AW 2.8. Carapace dark brown, much longer than wide, 1:0.6, highest at midcarapace. From above eye rows slightly procurved, from front both rows procurved. AME:ALE:PME:ALE 7:11:10:11. helicerae strongly geniculate. Labium and sternum both slightly longer than wide. Legs 4123 (Table 1).

Notation of spines. Differs from male in the following leg segments. Femora: IV, D110, R001. Tibiae: I, V222; II, P111, V122; III, D010, P111, V212, R101. Metatarsi: I, P001, V221, R001; III, D010, P112, V221, R112. Two preening combs on metatarsi II-IV on either side of distal spine. Epigynum (Fig. 1G-J) about 1/6 length of the venter. Lateral gonopores with irregular shaped plugs. Lateral teeth. Small spermathecae dorsal to gonopores.Females 8.1-9.4 long.

DISTRIBUTION. Central Plateau of Tasmania.

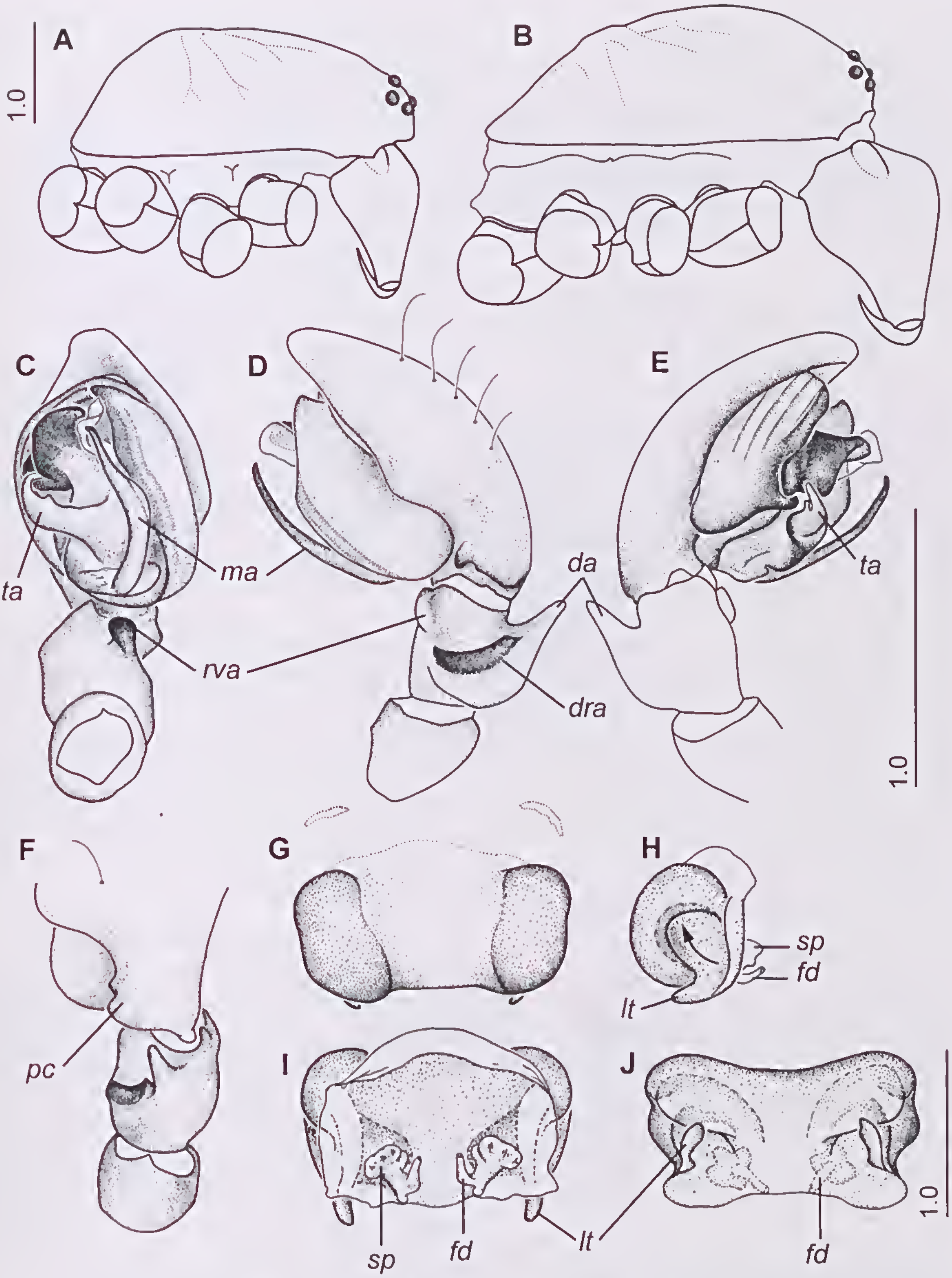

FIG. 1. A-J, *Teeatta driesseni* sp. nov. A,B, lateral carapace (♂ ♀); C-F, ♂ palp (ventral, retrolateral, prolateral, dorsal); G-J, epigynum (ventral, lateral, dorsal, posterior). da = dorsal apophysis of RTA; dra = dorso-retrolateral apophysis of RTA; fd = fertilisation duct; lt = lateral tooth; ma = median apophysis; pc = paracymbium; rva = retroventral tibial apophysis; sp = spermatheca; ta = tegular apophysis.

### **Teeatta magna** sp. nov.
(Fig. 2A-C)

ETYMOLOGY. Latin *magnus*, large.

MATERIAL. HOLOTYPE: ♀, Fern Tree, Mt Wellington, SE Tasmania, 42°55'S, 147°16'E, 22 Apr. 1952, R.Cunningham (TM J151). PARATYPES: ♀, Mt Wellington near Springs, 42°54'S, 147°14'E, unknown collector (TM J152); ♀, Scotts Peak Dam Rd, SW Tasmania, 43°00S, 146°22E, 26 Apr. 1987, R.J.Raven (QM S55295).

DIAGNOSIS. Much larger (16.0-18.0) than *T. driesseni*. Epigynum about 1/10 length of venter. Ventral spines on tibia III and IV V202, differing from *T. driesseni* which has V212.

DESCRIPTION. *Female*. CL 8.1, CW 5.7, AL 10.1, AW 6.5. Carapace dark brown, highest at midlength. Abdominal pattern similar to *T. driesseni*. From above and in front eye-rows procurved. AME:ALE:PME:PLE 9:14:11:12. Chelicerae strongly geniculate; 2 retromarginal and 2 promarginal teeth with intermediate row of small denticles between them. Labium longer than wide 1:0.9. Sternum longer than wide 1:0.8. Legs 4123. I, 17.5; II, 14.3; III, 13.9; IV, 17.8.

Notation of spines. Femora: I, D110, P001; II, D110, P001; III, D100, P001, R011; IV, D210, P001, R001. Tibiae: I, V222; II, V222; III, D001, P111, V202, R011; IV, P111, V202, R011. Metatarsi: I, P001, V222, R001; II, P011, V221, R001; III, D100, P112, V221, R112; IV, D110, P112, V221, R112. Two preening combs on ventral metatarsi II-IV on either side of distal spine. Epigynum (Fig. 2A-C) about 1/10 length of venter. The male is unknown.

DISTRIBUTION. Southern Tasmania.

### **Teeatta platnicki** sp. nov.
(Fig. 2D-I)

ETYMOLOGY. For Norman Platnick , co-collector of the paratype and author of many Australian spiders.

MATERIAL. HOLOTYPE: ♂, W of Strathgordon, just N of Mt Sprent, SW Tasmania, 42°65'S, 146°04'E, 290m, 26Apr.1987, N.Platnick, R.J.Raven, T.Churchill (QM S64277). PARATYPES: ♀, juv, Scotts Peak Dam Rd, 43°00'S, 146°22'E, 26Apr.1987, R.J.Raven (QM S55294); ♂, Olga Valley, SW Tasmania, 42°43'S, 145°47'E, litter, 31 Jan.1977, L.Hill et al. (TM J1454).

DIAGNOSIS. Much smaller than *T. magna*. Tegular apophysis with much longer distal branch (Fig. 2E) than *T. driesseni*. Continuous sclerotisation of RTA from retrolateral to pointed dorsal branch unlike *T. driesseni* where these are separate entities.

DESCRIPTION. *Male*. CL 3.6, CW 2.8, AL 3.1, AW 1.8. Carapace light brown, abdominal pattern similar to other species. Eyes and chelicerae similar to *T. driesseni*. Legs 4123. I, 9.8; II, 8.3; III, 7.6; IV, 10.3.

Notation of spines. Femora: I, D110, P002; II, D111, P011; III, D111, P001; IV, D110, P001, R001. Tibiae: I, P111, V222; II, P111, V122; III, D010, P201, V212, R101; IV, D001, P111, V212, R111. Metatarsi: I, P011, V221, R012; II, D010, P012, V221, R012; III, D010, P112, V221, R112; IV, D010, P112, V221, R112. Preening combs on metatarsi II-IV. No tarsal spines on legs.

Male palp (Fig. 2D-F). Short widely grooved embolus; membraneous conductor; long sinuous MA.

Tegular apophysis crook-shaped, with digitiform branch arising midway. Tibia with retroventral ridge; RTA with continuous sclerotisation between low dorsoretrolateral and long pointed dorsal apophysis.

Paratype male from Olga Valley is 5.8 long, colour and pattern faded.

*Female*. CL 3.5 CW 2.6 AL 3.8 AW 2.5. Coloration, pattern and eyes similar to that of males. Chelicerae strongly geniculate. Legs 4123. I, 8.8; II, 7.3; III, 6.8; IV, 9.4.

Notation of spines. Fewer spines than in male. Femora: II, D110, P001. Tibiae: I, P000; II, P001, V222; III, P201; IV, R001. Metatarsi: I, P001, R001; II, D000, R001. Preening combs as in male. No tarsal spines. Epigynum (Fig. 2G-I) similar to *T. driesseni*. Lateral teeth not obvious.

DISTRIBUTION. SW Tasmania.

## ACKNOWLEDGEMENTS

I thank Elizabeth Turner, Curator of the Tasmanian Museum and the Curator of Arachnids, American Museum of Natural History for loan of material for this study. I am grateful to Michael Driessen for his donation of spiders to the Queensland Museum. Thanks also to the Council of the Australian Biological Resources Study for its financial support of illustrator, Catherine Harvey. Special thanks to John K. Page, Zoolological Record for indicating the homonymy of *Tangana* with an orthopteran.

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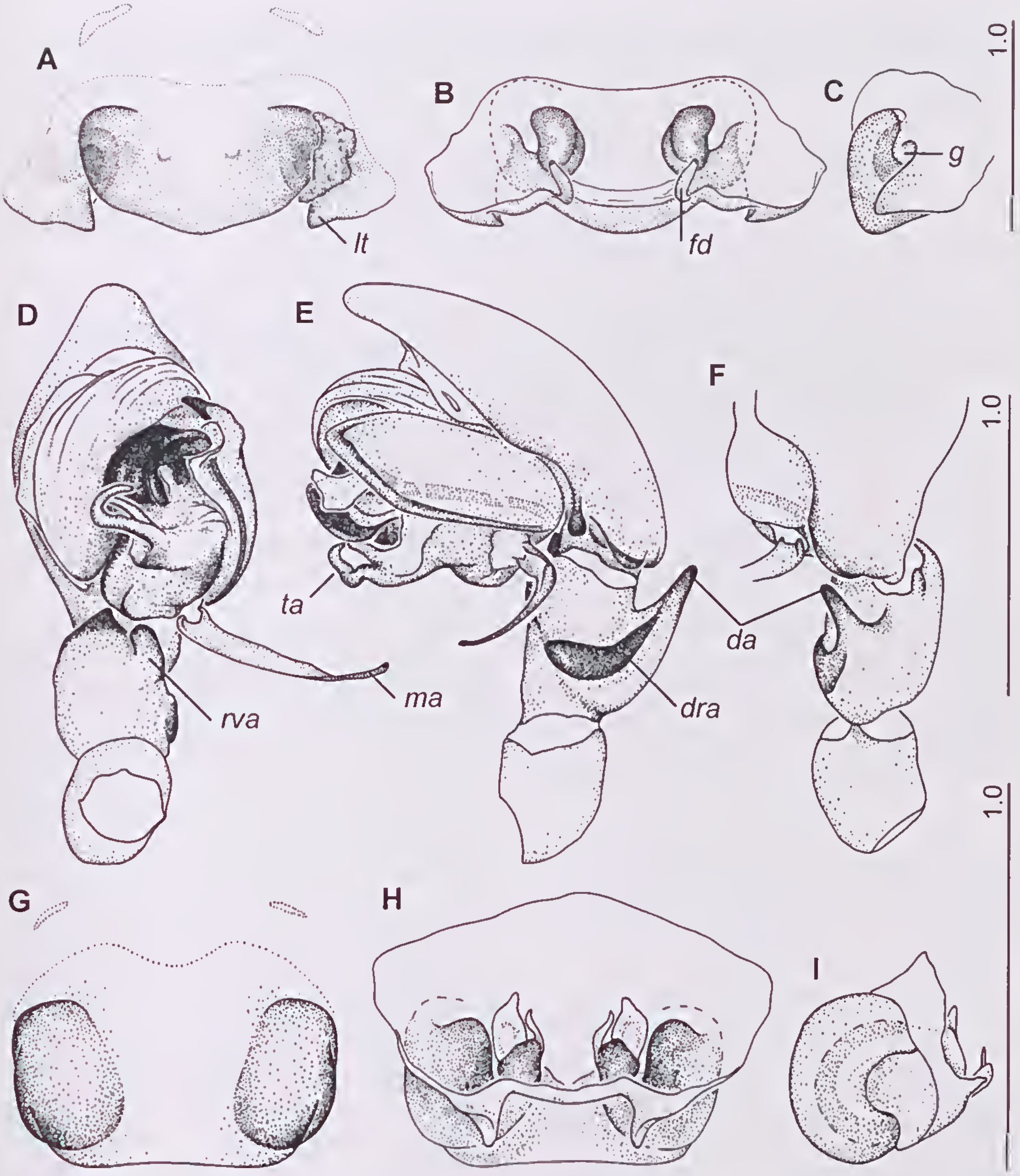

FIG. 2. A-I, *Teeatta* spp. nov. A-C, *T. magna* epigynum (ventral, dorsal lateral); D-I, *T. platnicki*; D-F, ♂ palp (ventral, retrolateral, dorsal); G-I, epigynum (ventral, dorsal, lateral). g = gonopore. Other abbreviations as in Fig.1.

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# *SPECTACULARIA VANOPPENAE* GEN. ET SP. NOV., A NEW HYDROMEDUSA (CNIDARIA: HYDROZOA: DIPLEUROSOMATIDAE) FROM THE GREAT BARRIER REEF

LISA-ANN GERSHWIN

Gershwin, L. 2005 01 10: *Spectacularia vanoppenae* gen. et sp. nov., a new hydromedusa (Cnidaria: Hydrozoa: Dipleurosomatidae) from the Great Barrier Reef. *Memoirs of the Queensland Museum* **50**(2): 201-205. Brisbane. ISSN 0079-8835.

A new genus and species of Hydromedusae is described from the waters off North Queensland. It is placed in the Dipleurosomatidae because of its irregularly branched radial canals, gonads on the radial canals separated from the stomach, hollow marginal tentacles and lack of cirri or cordyli. It differs from all other medusae in its two rows of small, simple, wart-like gonadal papillae. It differs from the other dipleurosomatids in its unique combination of other characters, namely, 5-6 radial canals leaving the stomach, branching dichotomously an irregular number of times; about half as many tentacles as canal branches reaching ring canal, not in correspondence with canal branches; with about 8 globular or heart-shaped stalked clubs between successive tentacles; and lacking ocelli. This report represents the first record of the Dipleurosomatidae in Australian waters. ❑ *Cnidaria, Hydrozoa, Leptomedusae, Dipleurosomatidae, Hydromedusae.*

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The medusae of North Queensland are the best studied in Australia, but are nonetheless quite incompletely known. Mayer (1915) commented that Queensland waters are remarkable for their poverty of medusa species, but a later survey of this area suggested otherwise, producing several new species and many new distribution records (Kramp, 1953).

From 1958 to the late 1960's, John 'Jack' Handyside Barnes, a physician in Cairns, made a comprehensive collection of medusae from the waters of the Great Barrier Reef and coastal North Queensland. Several species have been described from his collection, including the dreaded Irukandji jellyfish, *Carukia barnesi* Southcott, 1967. Kramp (1961a; 1965) published some of the species forwarded by Barnes, but many others remain in the collection unidentified. The purpose of this paper is to describe a spectacular little hydromedusa found by Barnes in 1964, miraculously unrecognized hitherto for its uniqueness.

## MATERIALS AND METHODS

The specimen was found among unidentified material from the J.H. Barnes collection held at the Museum of Tropical Queensland (MTQ). All characters were examined under a dissecting microscope and photographed with a Nikon Cool-Pix 995 held to the ocular. Measurements were made with Max-Cal digital calipers to the nearest 0.01mm and rounded to nearest 0.1mm.

Specimen notes of the J.H. Barnes collection are held in the Reserve Collection of the James Cook University Library and relate to specimens according to numbers preceded by a 'J'.

## SYSTEMATICS

Class HYDROZOA Owen, 1843
Order LEPTOMEDUSAE Haeckel, 1866
Family DIPLEUROSOMATIDAE Russell, 1953

### **Spectacularia** gen. nov.

TYPE SPECIES. *Spectacularia vanoppenae* sp. nov.

DIAGNOSIS. Radial canals 5-6 leaving stomach, branching dichotomously an irregular number of times; with gonads in 2 wart-like rows; with about half as many tentacles as canal branches reaching ring canal; about 8 globular or heart-shaped, stalked clubs between successive tentacles.

### **Spectacularia vanoppenae** sp. nov.
(Figs 1-2)

ETYMOLOGY. For my advisor, Madeleine van Oppen.

MATERIAL. Holotype: MTQG55271 (= JHB J1156), Green Island, 4 January 1964, coll. by L.M. Barnes, at surface, winds NE, South-going current.

DESCRIPTION. Bell sub-hemispherical, absolute bell diameter 23.8mm, constricted marginal diameter 13.7mm. Exumbrellar surface smooth, lacking ridges, furrows, or nematocyst warts. Stomach small, oblong in shape, 2.7mm diameter along longest axis, without a peduncle. Manubrium short, amorphous in cross section, with loosely crenulated, poorly defined lips. Five or six main radial canals leave the stomach, dividing dichotomously an irregular number of times; 47 branches reach ring canal. Gonads in opposite or alternate, small, hollow, wart-like papillae, in two rows, one along each side of midline of each branch, restricted to middle region of branches, distal to second bifurcation and about 3mm proximal to ring canal (Fig. 1). Ring canal narrow. Velum weakly developed, of thin, filmy consistency, about 1.5mm wide. Tentacles 24, hollow, coiled; very short, with coils being about as long as velum is wide. Tentacles typically located between radial canals, rarely on same radii as canals. Tentacle bulbs small, globular to heart-shaped, hollow. Tentacular nematocyst warts primarily concentrated on adaxial side. Margin crowded with globular and heart-shaped, narrow-stalked, small clubs, each terminally frosted with nematocysts, approximately 8 clubs between adjacent tentacles (Fig. 2). Statocysts and ocelli not found. Colour after 40 years in formalin: stomach, gonadal papillae and tentacles opaque pinkish; radial canals and marginal papillae pale, translucent pinkish; mesoglea nearly completely transparent, lacking colour.

*Notes From Living Specimen*. Notes from the specimen catalog of Barnes read, 'Branching radial canals blue-black, serrated. Shape before preservation [hemisphere indicated by sketch]. No similar specimen seen by me previously'.

*Artifacts of Preservation*. Several physical features were noted which are assumed to be artifacts of preservation. The margin of the preserved specimen is curled inward; the presumed bell shape in life is shallowly domed. Several irregular creases are present on the exumbrella; the exumbrella is assumed to be smooth in life. Statocysts and ocelli were not observed; after 40 years in formalin, one might expect that they would be obscured, but this is not always the case. Leptomedusan statocysts are typically visible as minute 'bubbles' on the margin even many years after preservation, even though the statoliths inside are long since disintegrated. Similarly, I have studied specimens from the collections of Mayer, Bigelow and Kramp, which still have faint shadows of ocelli after many years in preservative. Although caution must be exercised in any conclusions pertaining to absence of statocysts and ocelli, the taxonomic conclusions herein are based on structures such as radial canal branching pattern, marginal clubs and gonad form.

*Radial Canal Branching*. The number of radial canals is left open to interpretation, because of the branching pattern. One of the canals is branched at the root, so it could be interpreted as being either one that is branched or two that are fused. For this reason, I have stated the radial canal number as five or six.

REMARKS. *Spectacularia vanoppenae* is distinctive from all other Hydromedusae in the peculiarly wart-like gonadal papillae. Gonadal processes, which have been sometimes referred to as papillae, are present in only a few other hydrozoan species, but, when present, are entirely different from those in *S. vanoppenae*. In *Olindias* spp. (Trachymedusae: Olindiadidae) the papillae are more crowded and more haphazardly arranged, and longer and more digitiform or palmate in shape (Mayer, 1910). In *Ptychogena* spp. (Leptomedusae: Laodiceidae) the papillae are typically longer and more pronounced than those of *S. vanoppenae* and are arranged in an elaborately laterally folded pattern of some sort (Mayer, 1910), whereas those of *S. vanoppenae* are simply in two imperfect rows of dot-like evaginations, one row on either side of the midline of each canal branch. In *Wuvula* spp. (Leptomedusae: Laodiceidae) the papillae are voluminous vesicles containing zooxanthellae and are relatively larger and longer than the papillae of *Spectacularia* (Bouillon et al., 1988). Furthermore, despite any superficial resemblance implied by the term 'papillae', *Spectacularia* could not easily be mistaken for *Olindias*, *Ptychogena*, or *Wuvula*, based on comparison of the papillae or nearly any other character.

Within the Dipleurosomatidae, another species, namely *Dipleurosoma pacificum* Agassiz and Mayer, 1902, is described as having 'slightly papillate' surfaces of the gonads, but it is clear from the remainder of the description and the illustration that the crowded ova give the gonadal surface a lumpy appearance, rather than the truly papillate condition as in the gonad of *S. vanoppenae*. It would be highly unlikely that the two species would be confused.

FIG. 1. *Spectacularia vanoppenae* gen. et sp. nov., holotype, whole medusa; absolute bell diameter is 23.77mm.

Two other features, namely the marginal clubs and the branching of the radial canals, are worthy of comment. First, the marginal clubs are somewhat reminiscent of the marginal clubs of *Olindias*, though in *S. vanoppenae* they are highly irregularly shaped, whereas in *Olindias* they tend to be quite regularly rounded. They would also be unlikely to be confused for the cordyli of the laodiceids, because cordyli are an order of magnitude smaller, more elongate and flask-shaped and are comprised of vacuolated cells. Cordyli are generally interpreted as sensory structures and they lack nematocysts. In contrast, the clubs of *S. vanoppenae* are large, irregularly shaped, dense structures, terminally covered with nematocysts. Second, the branching of the radial canals is clearly of the Dipleurosomatidae form (i.e., irregular) rather than the Laodiceidae or Aequoreidae forms (i.e., regular).

## DISCUSSION

The assignment of *Spectacularia vanoppenae* gen. et sp. nov. to the Dipleurosomatidae is based on the irregular branching and arrangement of the radial canals, the narrow stomach attached directly to the body and the absence of cirri or cordyli. The genus *Spectacularia* does not seem to have a close affinity with any of the other genera in the family (Table 1). Like *Dipleurosoma*, it has more than 4 primary radial canals leaving the stomach. But the two genera differ greatly in the general form of the radial canals and the number of tentacles. Furthermore, *Spectacularia* appears to lack ocelli, which are present in *Dipleurosoma*; even with ocelli, the two species would not be confused. Like *Cannota* and *Cuvieria*, *Spectacularia* has marginal clubs. However, these structures are of a similar form in *Cannota* and *Cuvieria*, namely, small, narrow and evenly spaced, whereas they are entirely different in *Spectacularia*, being globular to heart-shaped and densely crowded.

Perhaps the most similar overall species to *Spectacularia* is *Cuvieria huxleyi* (Haeckel, 1879), in that both species have numerous branches to the canals, far fewer tentacles than canal branches reaching the ring canal and marginal clubs. However, the two species would not be easily mistaken for one another because in

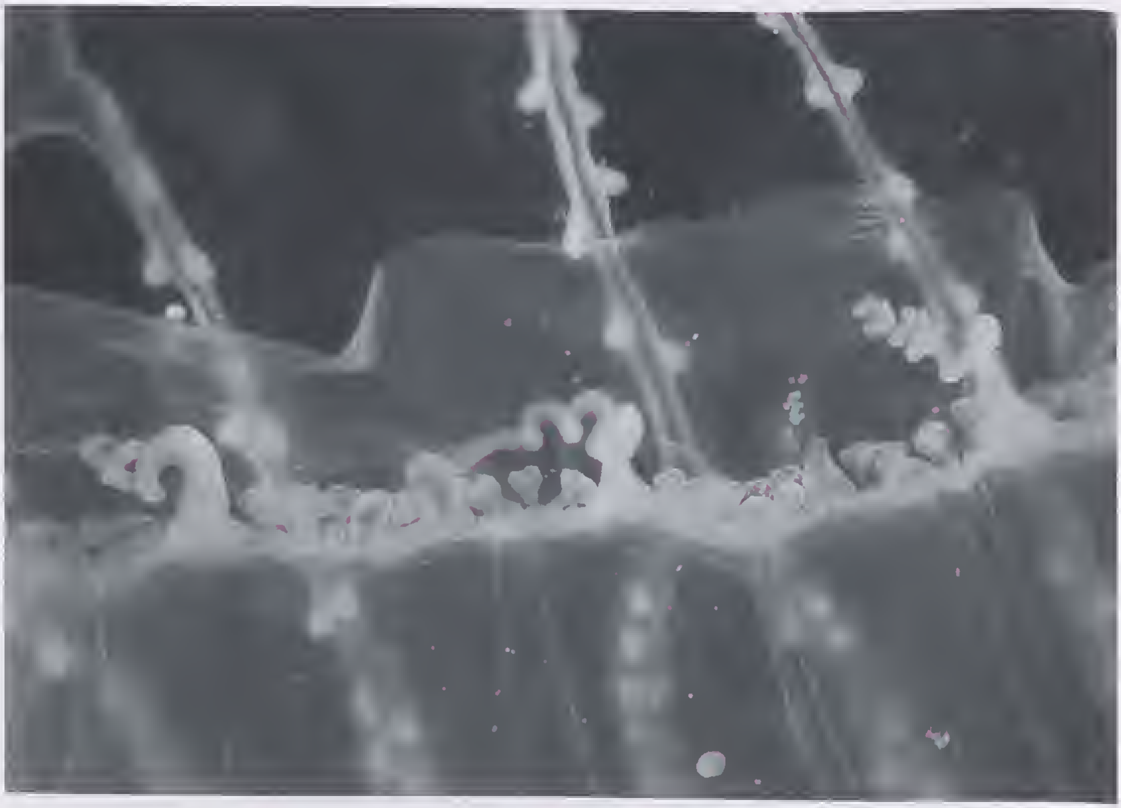

FIG. 2. *Spectacularia vanoppenae* gen. et sp. nov., detail of 6mm section of margin, showing arrangement of tentacles and clubs.

*C. huxleyi* the canal branches arise from the sides of the 4 main radial canals, the gonads reach the ring canal, the tentacles have ocelli and the marginal clubs tend to be in correspondence with the radial canals and branches. In contrast, in *S. vanoppenae* the canal branches arise dichotomously, the gonads do not reach the ring canal, the tentacles appear to lack ocelli and the marginal clubs greatly outnumber the canal branches.

For the genus *Cuvieria*, it is unclear why Bouillon & Boero (2000) spelled the generic name as '*Cuviera*'. In the original illustration by Péron (1807) it is spelled in the former way and subsequent major authors spelled it in the conventional way as well (Mayer, 1910; Kramp, 1961b). It seems that whatever the reason of Bouillon & Boero, the correct spelling of the name should be as in the original, *Cuvieria*.

This report represents the first record of the family Dipleurosomatidae in Australian waters. The nearest other record was that of Bouillon (1984), who reported *Dichotomia cannoides* Brooks, 1903, from the northern coast of Papua New Guinea.

## ACKNOWLEDGEMENTS

I am grateful to the family of Jack Barnes, to Peter Arnold and to the Museum of Tropical Queensland for granting me access to the Barnes Collection and notes. I am appreciative of helpful comments from two anonymous reviewers. Funding was provided by the Great Barrier Reef Research Foundation, James Cook University, CRC Reef and the Robert W. King Memorial Scholarship.

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TABLE 1. Comparison of the characters of the genera in the Dipleurosomatidae. Literature used: Péron, 1807; Boeck, 1866; Haeckel, 1879; Agassiz & Mayer, 1899; Brooks, 1903; Mayer, 1910; Russell, 1953; Kramp, 1961b; Bouillon & Boero, 2000. Abbreviations: radial canals (RC), radial canal origins leaving stomach (RCO), radial canal branches reaching ring canal (RCB).

| | RCO | RCB | Branching | Gonads | Tentacles | Ocelli | Clubs |
|---|---|---|---|---|---|---|---|
| *Cannota* Haeckel, 1879 | 4 | 12 | 2 simple side branches | spindle-shaped on RC and branches | 12, at base of radial canals | absent | present |
| *Cuvieria* Péron, 1807 | 4 | 50-60, or ~70 | 2 main side branches w/ numerous terminal branches | on outermost branches, near ring canal | 16, or 50-100, long | present or absent | present or absent |
| *Dichotomia* Brooks, 1903 | 4 | 32 | bifurcate w/ lateral branches | a single, circumferential structure adjacent to manubrium | ca. 50, of 2 different size classes | not noted | absent |
| *Dipleurosoma* Boeck, 1866 | 5+ | equal to or a few more than leave the stomach | simple or irregularly branched | on proximal or central portion of RC | ca. 100 | adaxial | present or absent |
| *Spectacularia* gen. nov. | 5-6 | 47 | irregularly dichotomous | two rows of minute papillae, central on all branches | about ½ as many as RC branches, located between branches; short | absent | present |

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# A NEW SPECIES OF MEKOSUCHINE CROCODILIAN FROM THE MIDDLE PALAEOGENE RUNDLE FORMATION, CENTRAL QUEENSLAND

TIMOTHY R. HOLT, STEVEN W. SALISBURY AND PAUL M.A. WILLIS

Holt, T.R., Salisbury, S.W. & Willis, P.M.A. 2005 01 10: A new species of mekosuchine crocodilian from the middle Palaeogene Rundle Formation, central Queensland. *Memoirs of the Queensland Museum* **50**(2): 207-218. Brisbane. ISSN 0079-8835.

A new species of mekosuchine crocodilian is described from the middle Palaeogene Rundle Formation, near Gladstone. *Kambara molnari* sp. nov. is the third species of *Kambara* to be recognised in the Australian Palaeogene. The holotype comprises the caudal two thirds of a left mandibular ramus. Referred material includes several fragmentary osteoderms, a proximal phalanx and a procoelous vertebral corpus. Similar to *K. murgonensis*, when complete, the mandibular ramus of *Kambara molnari* had 17 dentary alveoli and 2 shallow, rostrocaudally elongate pits lateral to the articular fossa on the dorsolateral surface of the surangular. Unlike *K. implexidens*, the retroarticular process is 3 times longer than wide in dorsal view, and the retroarticular fossa is divided into 2 smaller fossae by a low, sagittally aligned ridge. The 10th-12th alveoli are confluent. Occlusal grooves for the reception of maxillary pseudocanines are lateral to a point midway between the 7th and 8th, and the 8th and 9th alveoli. Reception pits for maxillary teeth occur between the 12th-17th alveoli. These pits and grooves indicate a partial interlocking occlusal pattern. The partially interlocking occlusal pattern in 2 species of *Kambara* and an indeterminate early Palaeogene crocodilian from Runcorn, SE Queensland, as well as a sagittally aligned ridge on the retroarticular fossa in *K. molnari*, indicate a close taxonomic affinity between Mekosuchinae and Crocodylidae. ❑ *Rundle Formation, Kambara, Eocene, Eusuchia, Crocodyloidea, Mekosuchinae.*

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The origin of Mekosuchinae, a uniquely Australasian group of Cenozoic eusuchian crocodilians, is still unclear. In this regard, fossils from middle Palaeogene deposits play a key role. Prior to the Cenozoic, only fragments from unrelated crocodylomorphs of the Lower Cretaceous deposits at Lighting Ridge (Etheridge, 1917; Molnar, 1980; Molnar &Willis, 2001), southern Victoria (Rich & Vickers-Rich, 1998; Rich, 1996; Vickers-Rich, 1996) and the Winton Formation, near Isisford, Queensland (Molnar & Willis, 1996) have been reported. *Kambara murgonensis* (Willis et al., 1993) and *K. implexidens* (Salisbury & Willis, 1996) are the only described species of mekosuchines from the early Palaeogene. Both come from deposits near Murgon, SE Queensland (Salisbury & Willis, 1996). The imortance of *Kambara* is indicated by the fact that the description of *K. murgonensis* was used in conjunction with the formal naming of the 'Australian radiation of crocodilians' (Willis et al., 1990) as Mekosuchinae (Willis et al., 1993). *Kambara* is the most plesiomorphic of all mekosuchines so far described. Another as yet, unnamed early Eocene crocodilian from the Corinda Formation at Runcorn, SE Queensland was recorded by Willis & Molnar (1991a). It remains unnamed due to the limited, fragmentary material. Another possible early Eocene crocodilian is presented by Riek (1952) but the impressions of skin may not to be of crocodilian origin, and the bone fragments that Riek (1952) described unfortunately seem to have been misplaced (Molnar, 1991). McNamara (1993) also reported on the occurrence of crocodilian osteoderms within the Eocene or possibly early Oligocene vertebrate assemblages from Cape Hillsbrough, north of Mackay.

Herein we describe *Kambara molnari* sp. nov. based on a partial left mandibular ramus from a once 3-4m long crocodilian. The holotype derives from the Rundle Formation, near Gladstone. The first note of crocodilian material from the Rundle Formation was by Hills (1943) who mentioned a digital phalanx (GSQF1972e) and 4 osteoderms (GSQF1972a-d) from what he presumed was a single individual. No additional material was recorded until 1982, when L. Coshell of the Esso oil company found the

QMF12364, presumably during mining operations. This specimen was first mentioned and figured by Molnar (1991), but it was not until Salisbury & Willis (1996) analysis of *Kambara* that comparison with other taxa was conducted. Willis & Molnar (1991) reported on a vertebral corpus (QMF12363) from the Rundle Formation. At the time of writing, this specimen could not be located.

*Institutional Abbreviations.* Prefixes for specimen numbers indicate the following institutions: AR, Archer collection, University of New South Wales, Sydney; GSQ, Geological Survey of Queensland vertebrate collection, Queensland Museum, Brisbane; NTM, Northern Territory Museum, Darwin; SAM, South Australian Museum, Adelaide. QMF, Queensland Museum; UQF, Dept of Earth Sciences, University of Queensland.

*Anatomical Nomenclature.* We follow the nomenclature of Frey (1988), Rauhe (1993), Witmer (1995), Rossmann (2000), Salisbury et al. (1999) Salisbury (2001), Salisbury & Frey (2001) and Salisbury et al. (2003). Tooth orientation follows Smith & Dodson (2003).

## STRATIGRAPHY AND AGE

The geology of The Narrows Graben near Gladstone was first described by Ball (1914, 1946). A more detailed geology was provided by Henstridge & Missen (1982) and Henstridge & Coshell (1984). The Rundle Formation consists of 7 oil shale seams and interbedded claystones, indicating a freshwater sequence. Three paleoenvironments are identified in the Narrows Graben: an alluvial fan (Worthington Beds), lagoonal mud flats (Rundle Formation) and limnic swamps (Curlew Formation). Stratigraphically, the Rundle Formation is subdivided into 7 seams (Fig. 1). The Brick Kiln Seam is most likely to have contained the crocodilian material, although this cannot be confirmed. A dolerite dyke intersects the Brick Kiln Seam and has been K/Ar dated at 26.8 Ma (Henstridge & Missen 1982). Foster (1979) assigned a late Eocene to late Oligocene age based on microspore analysis. Henstridge & Missen (1982) concluded that the best estimate is middle to late Eocene. In addition to crocodilians, the fauna associated with the Rundle Oil Shale includes ostracods, gastropods, fishes and turtles. Oil has been extracted from the Rundle and adjacent Stuart Oil-shales (Moody, 1992).

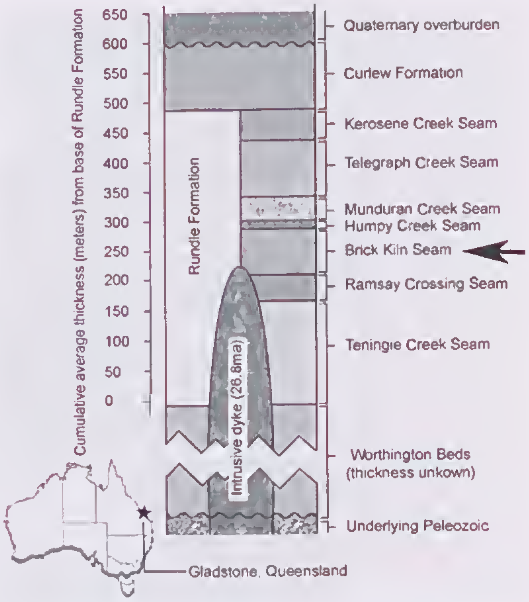

FIG. 1. Idealised stratigraphic section of the Narrows Graben showing horizon containing crocodilian material (arrowed).

## SYSTEMATIC PALAEONTOLOGY

Order CROCODILIA Gmelin, 1700
Suborder EUSUCHIA Huxley, 1875
Superfamily CROCODYLOIDEA Cuvier, 1807
Family INCERTAE SEDIS
Subfamily MEKOSUCHINAE Balouet & Buffetaut, 1987
**Kambara** Willis et al., 1993

TYPE SPECIES. *Kambara murgonensis* Willis et al., 1993.

DIAGNOSIS. See Salisbury & Willis (1996).

### Kambara murgonensis

HOLOTYPE. QMF21115, an almost complete skull from Tingamarra Station, near Murgon, SE Queensland.

REVISED DIAGNOSIS. As in Salisbury & Willis (1996) with the following amendments: Two long, shallow rostrocaudally elongate pits lateral to the articular fossa on the dorsolateral surface of the surangular.

### Kambara implexidens

HOLOTYPE. QMF29662, an almost complete skull from Boat Mountain near Murgon.

REVISED DIAGNOSIS. As in Salisbury & Willis (1996) with the following amendments: surangular lateral to the articular fossa smooth.

### **Kambara molnari** sp. nov.
(Figs 2-5, 7, 8)

ETYMOLOGY. The species name honours Ralph E. Molnar for his contribution to the understanding of Australia's fossil crocodilians.

HOLOTYPE.QMF12364, a partial left mandibular ramus from The Narrows near Gladstone in the Brick Kiln Seam of the Rundle Formation.

REFERRED MATERIAL. GSQF1972a-d, fragmentary osteoderms; GSQF1972e, proximal phalanx; QMF12363, vertebral corpus.

OTHER MATERIAL. Hills (1943) described several fragmentary osteoderms (GSQ QMF1972a-d) and a proximal phalanx (GSQ QMF1972e). It is assumed that this material can be referred to *K. molnari*. This postcranial material offers little additional information.

DIAGNOSIS. Seventeen dentary alveoli; 2 shallow, rostrocaudally elongate pits lateral to the articular fossa on the dorsolateral surface of the surangular; retroarticular process approximately 3x longer than it is wide in dorsal view; retroarticular fossa divided into 2 fossae by a shallow, sagittally aligned ridge; occlusal grooves for the reception of maxillary pseudocanines lateral to a point midway between the 7th and 8th, and the 8th and 9th alveoli; reception pits for maxillary teeth between 12th-17th alveoli; 10th-12th dentary alveoli confluent.

DESCRIPTION. *Preservation*. The holotype is the caudal 2/3 of a left mandibular ramus, comprising all of the dentary caudal to the 7th alveolus the majority of the angular, all of the surangular, the caudal portion of the articular dorsal to the articular fossa and the rostral portion of the splenial (Figs 2, 3). The fragmented specimen has been consolidated using epoxy resin and 2 wooden stick supports along its medial side. The coronoid and mandibular symphysis are not preserved. There are 5 teeth in the dentary.

*Osteology*. General form. Elongate left mandibular ramus, roughly triangular in both lateral and medial view (Figs 2, 3); length approximately 3.5 × the highest point at the caudal end of the specimen in lateral view; maximum caudal height approximately 5 × minimum rostral height; tooth row extending to about half way along the specimen; external mandibular fenestra oval, positioned half way between the tooth row and the retroarticular process, with long axis at 26° to the horizontal plane, bounded by the dentary, surangular and angular; extensive sculpture pitting on the lateral surface in the area caudal to the external mandibular fenestra.

*Dentary*. Seventeen alveoli [numbering of alveoli based on comparisons with *Crocodylus porosus* and other *Kambara* (Salisbury & Willis, 1996; Willis et al., 1993)]; dentary festooned vertically in lateral view; highest part of the dentary (i.e., the second 'dentary crest') between the 9th and 10th alveolus, and 1.5 × higher than at 7th alveolus (i.e., the lowest part of the dentary); margins of the 7th and 8th alveoli raised slightly and positioned laterally in dorsal view; occlusal grooves for reception of maxillary pseudocanines lateral to a point midway between the 7th and 8th, and the 8th and 9th alveoli (Fig. 4); 10th-12th alveoli confluent with each other (Fig. 5); 15th-17th alveoli on the medial margin of the dentary, along the contact with the splenial. Reception pits for maxillary teeth between the 12th-17th alveoli (Fig. 5).

Alveoli similar in mesiodistal length and linguolabial width except for the 16th and 17th (possibly due to the incompleteness of these two alveoli); size of alveoli variable (Fig. 6); 10th-12th alveoli largest, nearly twice size of caudal alveoli.

Longitudinal sulcus on the rostrolateral surface of the dentary, extending from the surangulodentary suture, to the 14th alveolus; dentary forming the dorsorostral portion of the external mandibular fenestra, extending nearly to the dorsocaudal-most angle; suture with the surangular serrated along the dorsal portion of the ramus, extending from the 17th alveolus to the caudal apex of the external mandibular fenestra; along the ventral margin, the planar dentroangular suture extends to the 15th alveolus; nutrient foramina numerous on the lateral side of the dentary.

*Angular*. Angular almost complete, lacking only its rostromedial portion; angular forms the caudoventral portion of the external mandibular fenestra, extending ventrally along the gently concave dentroangular fossa to the 15th alveolus from the rostroventral point of the external mandibular fenestra; dorsal margin parallel to ventral margin rostrally, becoming gradually aligned caudally with the dorsal margin of the retroarticular process; heavy sculpture pitting caudal to the external mandibular fenestra; two small (3.5mm diameter), rostrocaudally aligned nutrient foramina on the ventral surface, the first of which is in line with the caudal apex of the

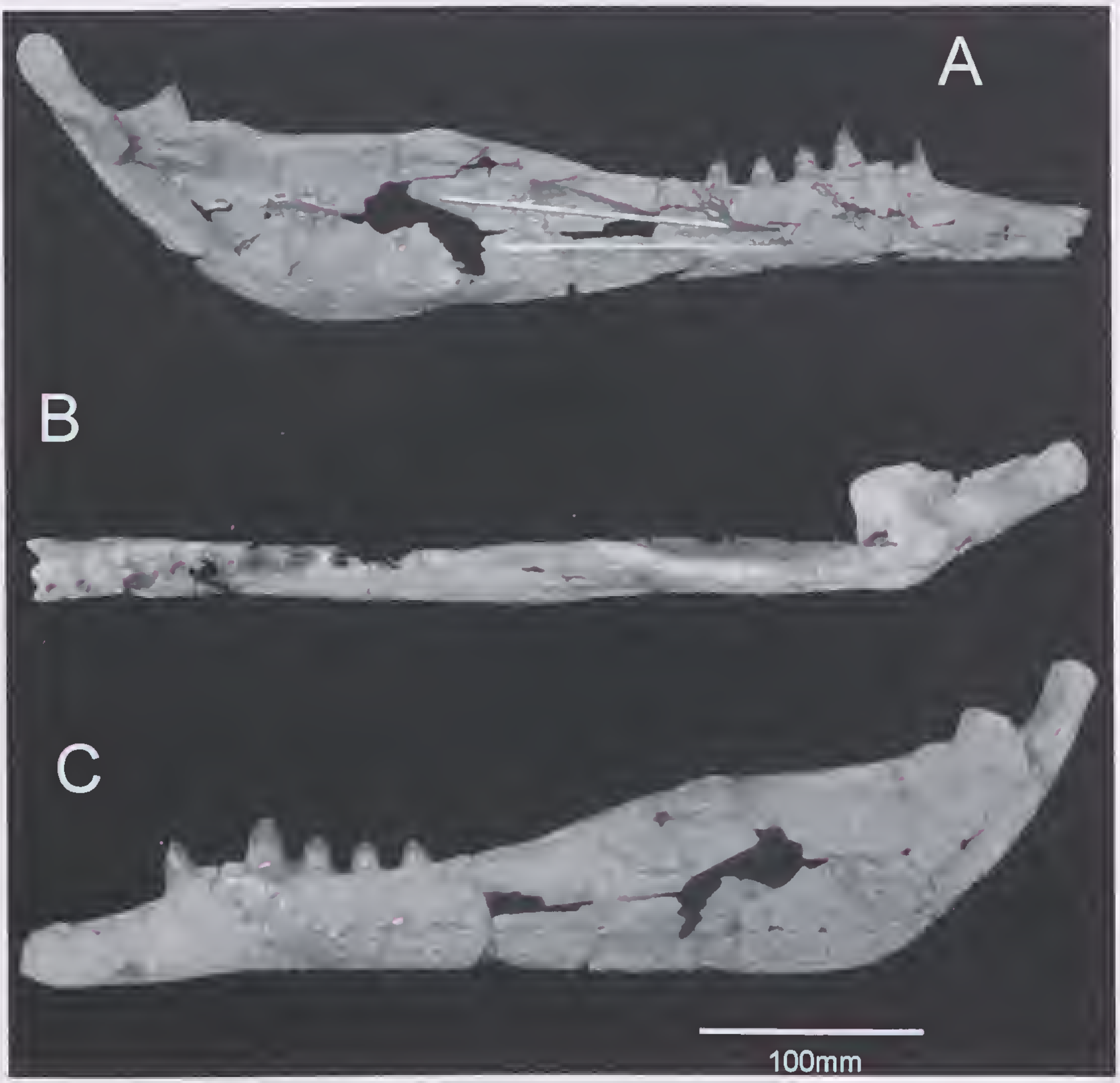

FIG. 2. *Kambara molnari* sp. nov., holotype. Left mandibular ramus in medial (A), dorsal (B) and lateral (C) view.

external mandibular fenestra in either lateral or medial view.

*Surangular*. Complete, except for a few minor pieces; caudal portion contributing to the lateral side of the retroarticular process; dorsal surface parallel to the ventral edge of the tooth row, to the 17th alveolus; ventral edge of the surangular participates in the suranguloangular suture; articular groove on the dentary corresponds with the missing triangular portion of the surangular, slightly ventral to the dorsal margin; surangular forming the dorsocaudal apex of the external mandibular fenestra, contributing to 10% of its border; 2 elongate pits on the dorsocaudal surface lateral to the articular fossa (Fig. 7); caudal pit in line with the articular fossa; rostral pit more elongate and 3 times longer than it is wide in a rostrocaudal direction; caudal pit twice as long as it is wide; heavy pitting on the lateral surface between the external mandibular fenestra and the retroarticular process; small foramen situated 1/3 of the way between the tooth row and the retroarticular process surface, forming a continuation of the sulcus on the dorsal surface of the dentary; surangular forms a planar rostroventral suture with the dentary; suture extends rostrally from the caudal apex of the external mandibular

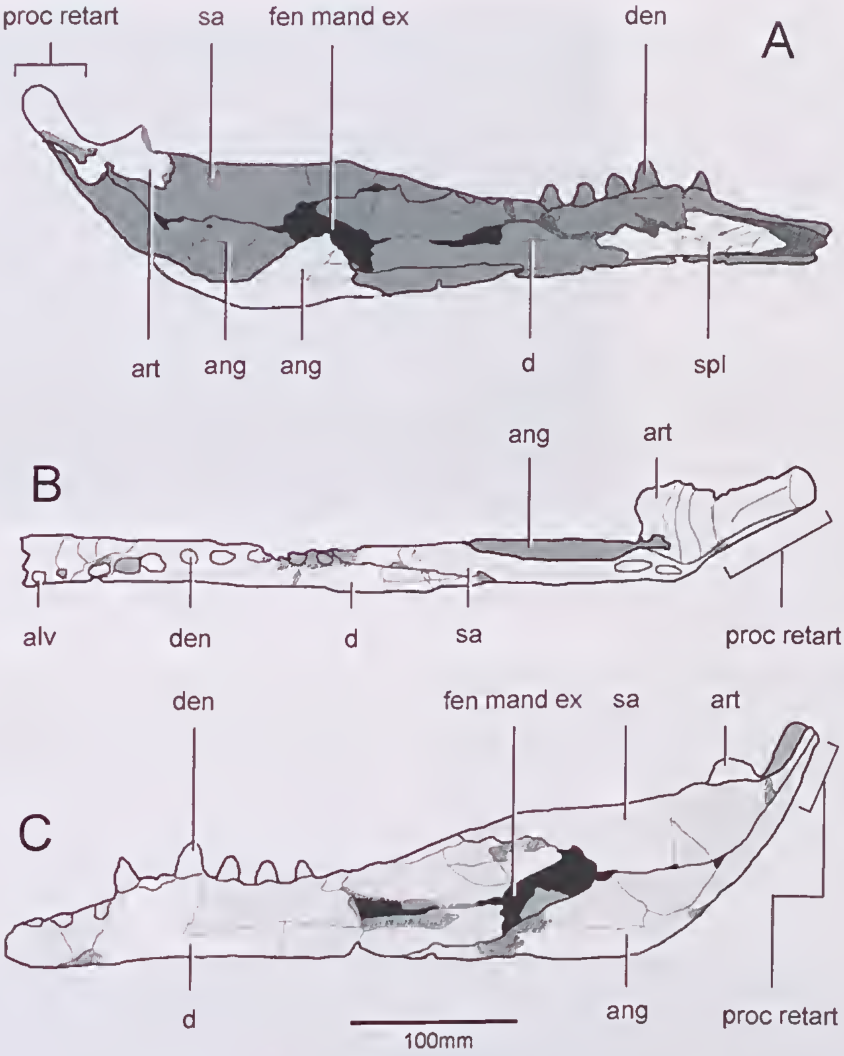

FIG. 3. *Kambara molnari* sp. nov.; Schematic interpretation of the holotype left mandibular ramus. ang= angular; alv= alveoli; art= articular; d= dentary; fos art mand= articular fossa; fos retart= retroarticular fossa; fen mand ext= external mandibular fenestra; proc retart= retroarticular process; sa= surangular; spl= splenial; den= tooth.

fenestra to a point level with the dorsal base of 17th alveolus.

*Articular*. Fragmentary; portion participating in both the articular fossa and the retroarticular fossa remains; articular forms the medial part of the retroarticular process; retroarticular process approximately 2 × as high as the caudal wall of the articular fossa in lateral view; articular fossa subrectangular in dorsal view; lateral margin approximately 2 × the size of the medial margin;, long axis of the articular fossa aligned at approximately 80° to the median plane; siphonal foramen not evident as portion of the articular in which it would occur is not preserved; retroarticular fossa divided by a low, sagittally aligned ridge (Fig. 7); sutures with angular and surangular planar.

*Splenial*. Preserved portion from 7th-11th alveoli and along the ventral half of the ramus to the 14th alveolus; rostral surface tapering gently, extending to the 7th dentary tooth (Fig. 8); medial surface of the splenial smooth, with a few nutrient foramina ventrally; splenial foramen not preserved; indentations on the medial surface of

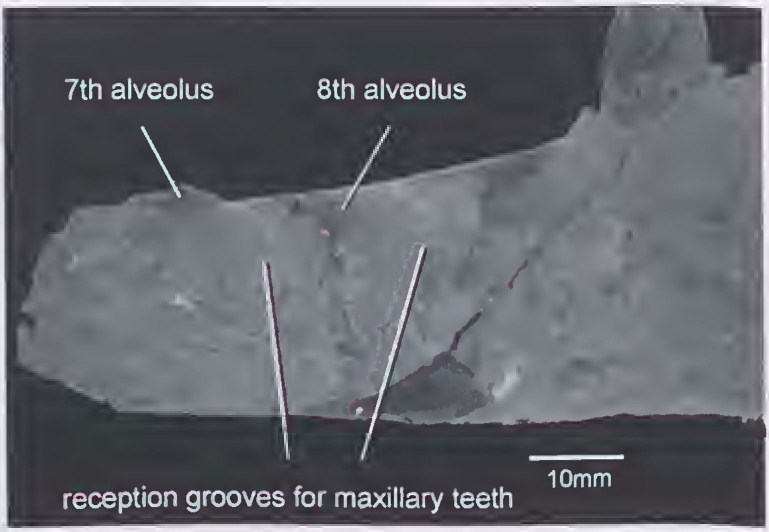

FIG. 4. *Kambara molnari* sp. nov., holotype. Lateral view of the rostral portion of the dentary, showing the 7th and 8th alveoli and their corresponding occlusal grooves for maxillary teeth. Rostral is to the left.

the dentary indicate that the splenial continues to a point close to the 6th alveolus [based on comparison with other *Kambara* specimens (Salisbury & Willis, 1996)]; unlikely that splenial participates in the mandibular symphysis; splenial forms medial margin of the tooth row from the 13th to the 17th alveoli.

*Teeth*. Present in the 10th and 12th-15th alveoli; 10th and 12th teeth are pseudocanines, considerably larger than the others; 13th-15th teeth smaller and more peg-like; carinae present on mesial and distal margins of all teeth.

COMPARISONS. *Referral to Kambara*. The osteology of QMF12364 compares best with material referred to *Kambara*. In light of these similarities, in addition to the skeletonised remains of all species of extant crocodilians and other crocodilian remains from the Australian Palaeogene [namely the Runcorn crocodilian: (Willis & Molnar, 1991a)], QMF12364 was compared with *Australosuchus clarkae* (Willis & Molnar, 1991b), *Pallimnarchus* (Molnar, 1982; Willis & Molnar, 1997), *Baru* (Willis 1997; Willis et al., 1990); *Trilophosuchus rackhami* (Willis, 1993), *Quinkana* (Megirian, 1994, Molnar, 1981; Willis, 1997; Willis & Mackness, 1996), *Mekosuchus* (Balouet & Buffetaut, 1987; Mead et al., 2002;Willis, 1997, 2001), *Volia athollandersoni* (Molnar et al., 2002) and *Harpacochampsa camsfieldensis* (Megirian et al., 1991). The diagnosis of *Kambara* (Willis et al., 1993) was based on the description of the type species and was later emended (Salisbury &

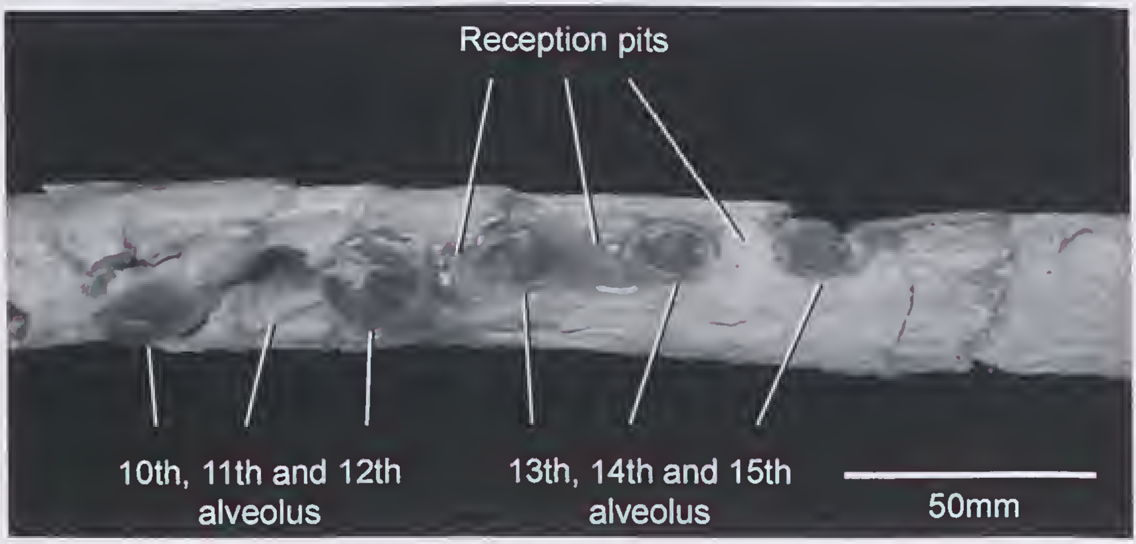

FIG. 5. *Kambara molnari* sp. nov., holotype. Dorsal view of the 9th-17th alveoli, showing confluent 10th-12th alveoli and reception pits for maxillary teeth. Rostral is to the left.

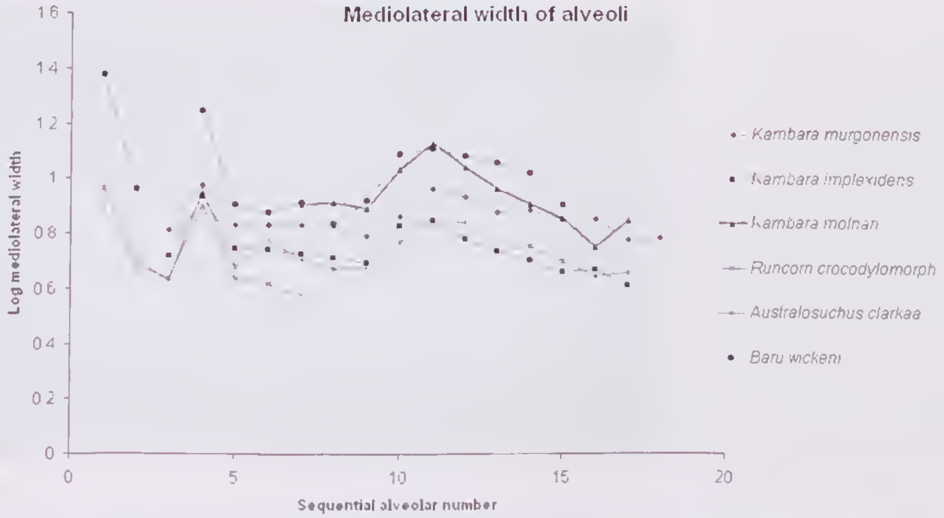

FIG. 6. Graph showing the log transformed width of alveoli in closely related early crocodyloids. Specimens based on: *Kambara murgonensis* (QMF29666); *K. implexidens* (QMF21116); *K. molnari*; (QMF12364); Runcorn crocodylomorph (UQF73195); *Baru wickeni* (NTMP861-14); *Australosuchus clarkae* (QMF18152). Reproduced from Salisbury (1994).

Willis, 1996) following recognition of *K. implexidens*. In relation to QMF12364, these diagnostic features include: medium sized, moderately broad-snouted; mandibular symphysis extending caudally to between the 6th and 7th dentary alveoli; splenial extending anteriorly to between the 6th and 7th dentary alveoli but not entering the mandibular synthesis; 17-18th dentary alveoli; teeth slightly compressed transversely with distinct anterior and posterior carinae. Salisbury & Willis (1996) listed 3 other features of the mandible of *K. implexidens* that they thought diagnostic of the genus pending collection of additional material of *K. murgonensis*: articular fossa deeply notched laterally; short retroarticular process; medial wall of retroarticular fossa concave.

In dorsal view, the preserved tooth row of QMF12364 is in the same plane as the caudal half of the mandibular ramus. This indicates a generalised brevirostrine skull, with proportions similar to the holotype skull of *K. murgonensis* (as opposed to a shorter rostrum, where the medial angle between the tooth row and the caudal half of the ramus would be considerably <180°). Similar to *K. murgonensis* and *K. implexidens*, QMF12364 has 17 dentary alveoli. The morphology of the teeth and the pattern in the width of the dentary alveoli up to the 9th alveolus (Fig. 6) are also similar. In *K. implexidens*, the 10th and 11th alveoli are approximately the same size, with the remainder being considerably smaller. In *K. murgonensis* and QMF12364, the 10th alveolus is smaller than the 11th and 12th. The 11th and

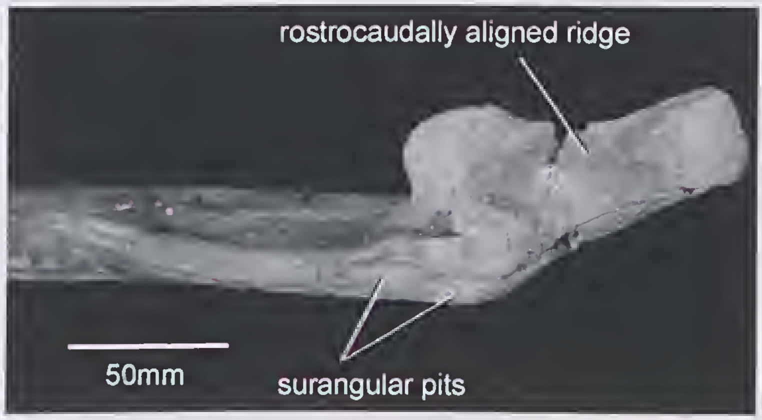

FIG. 7. *Kambara molnari* sp. nov., holotype. Dorsal view of the angular and the caudal portion of the surangular, showing the two surangular pits and the rostrocaudally aligned ridge. Rostral is to the left.

12th are also similar in size, and there is a corresponding decrease in size in the caudal most portion of the tooth row. The major difference between *K. murgonensis* and QMF12364 is in the middle of the dentary (the 10th-12th alveoli). In *K. murgonensis*, the 10th alveolus is closer in size to the 9th, whereas in QMF12364, the 11th is closer in size to the 10th.

The mandibular rostrum is not preserved in QMF12364. Nevertheless, the splenial extended rostrally to a point that is at least level with the caudal margin of the 6th dentary alveolus. Such a condition is consistent for *Kambara*.

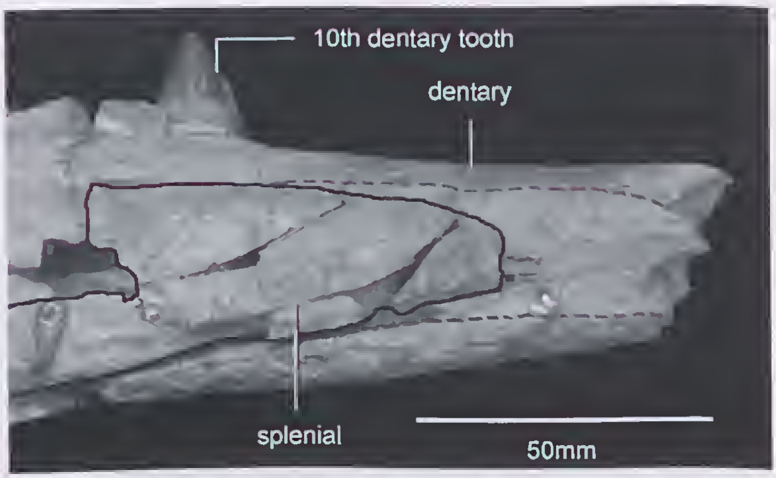

FIG. 8. *Kambara molnari* sp. nov., holotype. Medial view of the splenial. Broken line indicates probable splenial continuation. Rostral is to the right.

In light of these similarities and its close geographical and temporal occurrence, we feel confident in assigning QMF12364 to *Kambara*.

DIAGNOSTIC OSTEOLOGICAL FEATURES. Differences between *K. molnari* and other material assigned to *Kambara* that warrant specific designation include the following.

*Occlusal Pattern*. A major distinguishing features between *K. murgonensis* and *K. implexidens* relates to the way in which the jaws occlude (Salisbury & Willis, 1996). In *K. murgonensis,* the dentary teeth occlude medial to the rostral teeth, whereas in *K. implexidens* they interlock (Salisbury & Willis, 1996). *Kambara molnari* shows what could be considered an intermediate condition. The margins of the 7th and 8th alveoli in *K. molnari* are raised slightly (Fig. 4), with occlusal grooves for maxillary teeth on the lateral surface of the dentary, at positions midway between adjacent alveoli. This indicates that at least in this portion of the rostrum, there was interlocking dentition with the rostral-most maxillary teeth. Reception pits between some of the caudal-most alveoli (12th-17th) also suggest that the teeth interlocked in this part of the rostrum. On the other hand, the 10th-12th alveoli are confluent (Fig. 5), indicating that in this part of the rostrum, the maxillary teeth occluded lateral to those of the dentary. The resulting inferred occlusal pattern is therefore different to those present in either *K. murgonensis* and *K. implexidens*, and is more reminiscent of that seen in several types of Palaeogene crocodyloids and some species of *Borealosuchus* (*Leidyosuchus*) (Brochu, 1997) and *Diplocynodon* (Brochu, 1999).

*Osteology of the Retroarticular Process and the Articular*. The articular and associated retroarticular process is not well known for *Kambara*. The only other specimen besides QMF12364 to have part of the articular preserved is the paratype mandible of *K. implexidens* (QMF30077) (Salisbury & Willis, 1996, figs 8, 9). Based on this specimen, Salisbury & Willis (1996) considered a short retroarticular process as possibly diagnostic of the genus.

In *K. molnari*, the retroarticular process is approximately 3× as long in a rostrocaudal direction as it is wide in dorsal view; a condition that could not be described as 'short'. Salisbury & Willis (1996) also noted that unlike *K. implexidens*, the retroarticular fossa of *K. molnari* was divided into 2 smaller fossae by a sagittally aligned ridge (Fig. 8), similar to the condition seen in *Crocodylus*.

It has also been suggested that the medial wall of the retroarticular fossa being concave may be diagnostic of *Kambara* (Salisbury & Willis, 1996). This hypothesis is again based on the paratype mandible of *K. implexidens*. *K. molnari* also shows this feature (Fig. 7). Therefore while still diagnostic, this feature is no longer restricted to *K. implexidens*.

*Surangular Pits*. The presence of 2 small pits on the surangular of *K. murgonensis* was used as a diagnostic feature of that species by Salisbury & Willis (1996). Similar pits occur in *K. molnari* (Fig. 7). There was no mention in the description of *Australosuchus clarkae* of these pits (Willis &

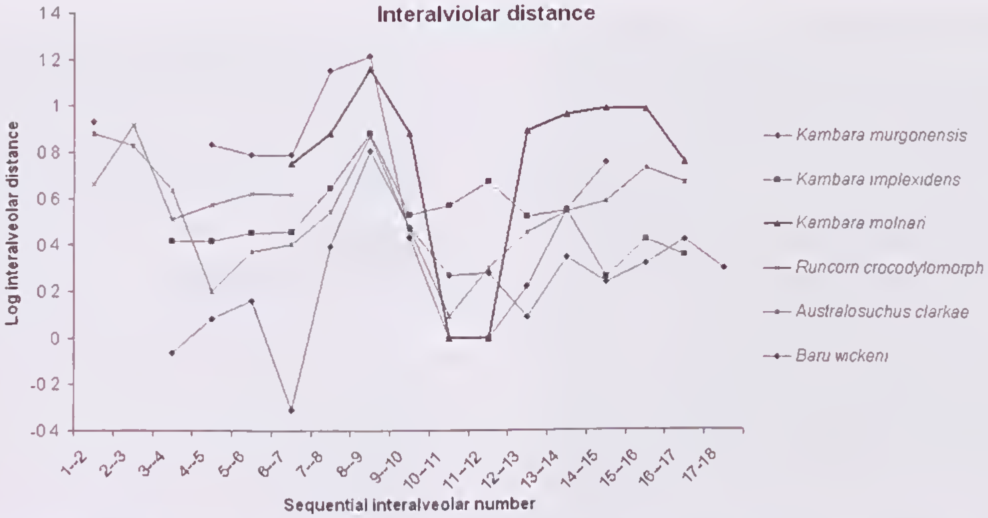

FIG. 9. Graph showing the log transformed interalveolar distances of the holotype of *Kambara molnari* (QMF12364) and other closely aligned crocodyloids. Specimens based on: *Kambara murgonensis* (QMF29666); *K. implexidens* (QMF21116); *K. molnari* (QMF12364); Runcorn crocodylomorph (UQF73195); *Baru wickeni* (NTMP861-14); *Australosuchus clarkae* (QMF18152). Reproduced from Salisbury (1994).

Molnar, 1991b). These pits in a closely related genus may indicate that *K. implexidens* was more plesiomorphic than the other 2 species (as it lacks these pits). We have revised the diagnostic value of these pits, so as to not be confused with the heavy sculpture pitting also present on the surangular.

TAXONOMIC CONCLUSIONS. Based on features discussed above, we erect K*ambara. molnari* sp. nov. and distinguish it by: 1) 17 dentary alveoli; 2) 2 shallow, rostrocaudally elongate pits lateral to the articular fossa on the dorsolateral surface of the surangular; 3) retroarticular process approximately 3 × longer than it is wide in dorsal view; 4) retroarticular fossa divided into 2 fossae by a shallow, sagittally aligned ridge; 5) occlusal grooves for the reception of maxillary pseudocanines lateral to a point midway between the 7th and 8th, and the 8th and 9th alveoli; 6) reception pits for maxillary teeth between the 12th-17th alveoli;7) 10th-12th alveoli confluent.

## DISCUSSION

The recognition of a third species of *Kambara* at Rundle, near Gladstone on the central Queensland coast, extends the range of this genus approximately 250km farther north. Previously, Boat Mountain, near Murgon was the only recorded location for *Kambara*. Although it is unlikely that *K. molnari* was contemporaneous with *K. murgonensis* and *K. implexidens*, its discovery points to high species level diversity for *Kambara* during the Eocene.

Similarities between the depositional environments in which all three species were found additionally indicate that like other mekosuchines, *Kambara* was probably restricted to freshwater habitats. During the early Tertiary, it seems likely that species of *Kambara* were found throughout the inland waterways of Queensland, if not all of eastern Australia if temperature conditions permitted. This distribution is similar to that of *Crocodylus johnstoni* in northern Australian today.

*Kambara molnari* shows features of both *K. implexidens* and *K. murgonensis*. Salisbury & Willis (1996) considered the interlocking dentition seen in *K. implexidens* to be convergent on the condition found in crocodylids and closely allied taxa such as *Brachyuranochampsa* and *Harpacochampsa camfieldensis*. In this light, the overbite seen in *K. murgonensis* and other mekosuchines was considered the ancestral condition for the group. However, the partially interlocking occlusal pattern in *K. molnari* suggests that the condition in *K. implexidens* is not as unusual as initially thought. UQF73195, a rostral dentary fragment from the early Tertiary (late Palaeocene or early Eocene) of Runcorn, SE Queensland also shows features indicative of an interlocking occlusal pattern (Salisbury & Willis, 1996; Willis & Molnar, 1991a). As was suggested by Salisbury & Willis (1996) and later supported by the phylogenetic analysis of Brochu (2001) (based on *Australosuchus clarkae*), the interlocking occlusal pattern (or at least partial) in 3 taxa of early Tertiary Australasian crocodilians may indicate a close taxonomic affinity between Mekosuchinae and Crocodylidae.

The sagittally divided retroarticular fossa in *K. molnari* is a feature only known for *Crocodylus* (Norell & Clark, 1990) and possibly '*Crocodilus' clavis* (Norell & Storrs, 1998). In extant crocodilians, the retroarticular fossa serves as the point of insertion for the *m. depressor* mandibulae, the primary muscle responsible for jaw opening (Busbey, 1989; Schumacher, 1973). The low, sagittally aligned ridge on the retroarticular fossa, as in *Crocodylus* and *K. molnari*, suggests that the insertion of this muscle may have been partially divided. As to whether such a division influenced the action of the muscle during contraction is unclear, and it may or may not be related to an interlocking occlusal pattern. The fact that a rostrocaudally divided retroarticular fossa is absent in several other taxa that possess an interlocking occlusal pattern (e.g., *Tomistoma schlegelii* and *Gavialis gangeticus*) suggests that this is not the case. It is hoped that the collection of further crocodilian material from the Rundle Formation will help elucidate any similarities between *Kambara* and crocodylids, shedding much needed light on the origins of mekosuchines.

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# NEW CHAROPID LAND SNAILS CHIEFLY FROM LIMESTONE OUTCROPS IN NSW (EUPULMONATA: CHAROPIDAE)

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Hyman, I.T. & Stanisic, J. 2005 01 10: New charopid land snails chiefly from limestone outcrops in eastern New South Wales (Eupulmonata: Charopidae). *Memoirs of the Queensland Museum* **50**(2): 219-302. Brisbane. ISSN 0079-8835.

Nineteen new species of Charopidae are described from mainly limestone habitats in eastern New South Wales. Eleven new genera are introduced and some existing genera and species revised. *Rhophodon* Hedley, 1924 is more clearly defined and *R. palethorpei* sp. nov., *R. silvaticus* sp. nov., *R. mcgradyorum* sp. nov. and *R. duplicostatus* sp. nov. are described from limestone and rainforest habitats in NE NSW; *Egilodonta* Iredale, 1937 (type species: *Charopa bairnsdalensis* Gabriel, 1930) is removed from the synonmy of *Rhophodon* and *E. wyanbenensis* sp. nov., *E. bendethera* sp. nov. and *E. paucidentata* sp. nov. are described from restricted limestone localities in SE NSW; *Letomola lanalittleae* sp. nov. is described from restricted limestone localities in the Macleay Valley, NE NSW; *Macrophallikoropa* gen. nov. is introduced for the widespread, moist forest dweller *Helix belli* Cox, 1864 and *M. stenoumbilicata* sp. nov. and *M. depressispira* sp. nov. are described from restricted localities in the Sydney Basin Bioregion; *Allocharopa* Iredale, 1937 (type: *Helix brazieri* Cox, 1868 from the Sydney Basin Bioregion) is shown to be a synonym of *Elsothera* Iredale, 1933; *Egilomen* Iredale, 1937 is redefined and a new diagnosis is presented for the type, *E. cochlidium* (Cox, 1868), which is restricted in distribution; *Whiteheadia* gen. nov. is introduced for *Egilomen globosa* Stanisic, 1990; *Coricudgia wollemiana* gen. et sp. nov. is described from Mt Coricudgy, Wollemi NP; *Decoriropa* gen. nov. is introduced for the widespread *Helix lirata* Cox, 1868; *Marilyniropa jenolanensis* gen. et sp. nov. is described from limestone localities near Jenolan, SE Oberon: *Cralopa* Iredale, 1941 is redefined and revised diagnoses and new distribution details are presented for the widespread *C. stroudensis* (Cox, 1864) and *C. kaputarensis* Stanisic, 1990 from the Nandewar Range; *Gouldiropa* gen. nov. is introduced for *C. carlessi* Stanisic, 1990 which is redefined and restricted in distribution to the northern New England Tableland; *Sharniropa* gen. nov. is introduced for *S. wollondillyana* sp. nov. and *S. borenorensis* sp. nov. from limestones in the Abercrombie and Orange areas of central NSW respectively, and *S. xanana* sp. nov. from limestone outcrops in the southern New England Tableland; *Acheronopa attunga* gen. et sp. nov. is described from limestones in the Manilla-Attunga region of the New England Tableland; *Hedleyropa yarrangobillyensis* gen. et sp. nov. is described from the Yarrangobilly limestones of SE NSW; *Scelidoropa* gen. nov. is introduced for the widespread *S. sarahjaneae* sp. nov. and the narrowly retricted *S. nandewar* sp. nov. from the Nandewar Range; *Diphyoropa* gen. nov. is introduced for *Helix saturni* Cox, 1868 from the Sydney Basin Bioregion and *D. macleayana* sp. nov. from the Macleay Valley, NE NSW. Patterns of morphological variation are analysed and discussed and a phylogenetic hypothesis for the species is presented based on 32 shell characters and 12 anatomical characters. Biogeographic discussions focus on the effects of climate-induced fragmentation and isolation of mesic communities since the Miocene on species distributions and the role of limestone outcrops as important secondary refugia (next to rainforest) for this biota. A conservation priority for these species is outlined. ☐ *Charopidae, systematics, new species, limestone, rainforest, biogeography, New South Wales.*

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The small to minute Charopidae form a significant part of the land snail fauna in Australia. The family occurs in many parts of Australia (Smith, 1984, 1992; Solem, 1983; 1984) but is particularly diverse along the eastern edge of the continent (here defined as the area within approximately 200km of the coastline and stretching from the NSW – Vic Border to approximately Cooktown, NE Qld). In this region charopids are generally found in the litter zone of rainforests (moist and dry) with comparatively few species occurring in adjacent

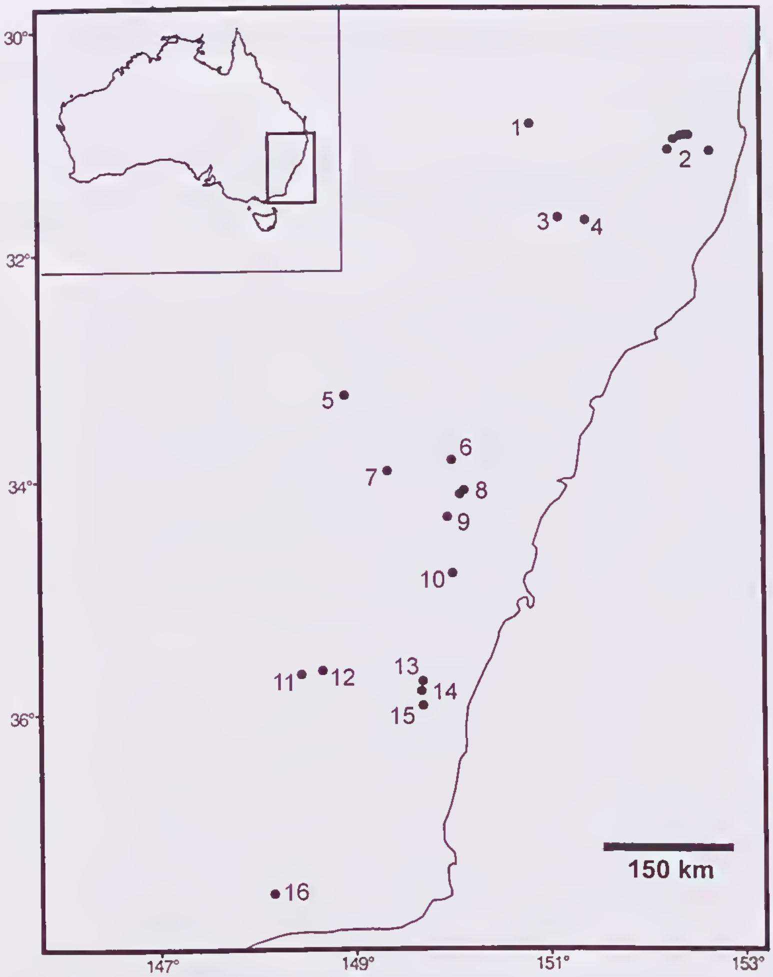


FIG. 1. Limestone localities. 1, Manilla-Attunga; 2, Macleay Valley; 3, Timor; 4. Glenrock; 5, Borenore; 6, Jenolan; 7, Abercrombie; 8, Church Creek-Colong; 9, Wombeyan; 10, Bungonia; 11, Cooleman; 12, Yarrangobilly; 13; Marble Arch; 14, Wyanbene; 15, Bendethera; 16, Buchan.

eucalypt forests (Stanisic, 1990, 1994a). However, within the drier zone of eucalpypt forest and woodland, an archipelago of limestone outcrops forms an important secondary node of diversity for the family.

Stanisic (1990) reviewed 50 species (27 new) belonging to 18 genera from subtropical rainforests in eastern Australia and provided a summary of previous Australian and extralimital taxonomic studies on the group. Only minor additions to the Australian species inventory have occurred subsequently (Stanisic, 1993a,b; 1996). One of the major obstacles preventing more comprehensive reviews of the group in the past has been the dearth of material available for study. These snails are very small (mostly <5mm, and often <3mm in diameter), extremely cryptic in their preferred microhabitat and, as experience has shown, usually very difficult to find alive in great numbers.

Since 1980, the Queensland Museum (QM) has been particularly focussed on collecting Charopidae in eastern Australia and through a program of leaf litter collecting and sorting (mainly to recover dead shells), it has been possible to gain some insight into the true diversity of the family in this region. The QM collections now contain more than 25,000 specimens of Charopidae from eastern Australia belonging to approximately 440 species of which more than 370 require description. [In contrast Smith (1992) listed 130 described species for the entire Australian continent]. The Australian Museum, Sydney (AMS) has important historical holdings of the family from eastern Australia as well as a significant amount of contemporary material but these collections are limited in their geographic scope.

However, in spite of the QM's intense collecting efforts (covering more than 2,000 sites) it is highly probable that there are major gaps in the charopid collection base. A significant number of species in the collections are still represented only by single lots and in some cases single specimens from single localities, flagging the possibility that many more species have yet to be discovered. A particularly critical problem for potential reviewers of material currently held in collections is the relative lack of spirit material for anatomical studies. Preserved animal material is available for less than 50% of species so that recollection of many sites is another necessary prerequisite to monographing the group.

A specialised component of the QM's wide-ranging collecting effort directed at the Charopidae was an investigation of the land snail fauna of limestone outcrops in eastern NSW. This was conducted mainly from 1992-1995 with casual follow-up collecting in the ensuing years. The main aims of that study were to obtain very detailed data on charopid diversity and distribution both within and between the many limestone outcrops that stretch chiefly along the Great Dividing Range from the Ashford Caves, NE NSW to the NSW-Vic Border (Lismund et al., 1986) (Fig. 1). These limestone formations vary in size from large tower-karst to small, barely discernible outcrops of very low relief, but all act as 'moisture sinks' in a sea of dry countryside. Many support rainforest in the form of well-developed dry vine thicket that contrasts markedly with the surrounding sclerophyll vegetation.

In numerous cases the surrounding landscape has been greatly altered by European settlers for farming activities whereas the outcrops have been left largely intact, sometimes even being fenced to prevent entry of cattle. In some examples however, such as those in the Cooma area, scattered Kurrajong trees are the only reminder of what vegetation may have been present on the outcrop in the past. But, even in these cases, charopids continue to eke out a living among the little microhabitat that remains. Consequently, it has been possible to obtain fairly robust data on both species presence and distribution across a wide range of these specialised habitats in spite of the fact that much of the surrounding countryside has been severely altered.

An important contributing factor to the continued survival of these snail communities has been the very nature of the limestone outcrops. Nestled amongst a vegetation community that these days is subject to almost perennial fires, the rock outcrop causes a fire shadow effect which contributes to the survival of both the fire sensitive rainforest vegetation and the associated invertebrate biota.

Many of the charopids occurring in these 'island-like' environments are morphologically, and possibly phylogenetically distant from those living in the adjacent countryside. Others have sister species in non-limestone habitats. Some are extremely localised 'limestone' endemics whereas others have broader and more widespread distributions among the archipelago of limestone outcrops. Other species occur on the outcrops but have their main distribution in non-limestone habitats. This study examines a small subset of this diverse and somewhat enigmatic charopid fauna.

## SCOPE OF STUDY

The charopids examined in this study were chosen on the basis of:

1) being well-differentiated on shell characters but covering a range of shell features (sculpture, rib spacing, umbilical width);
2) being well represented in collections so that the shell measurement datasets would be amenable to statistical analysis; and
3) being well represented by preserved material for dissection.

Beyond these basic criteria every attempt was made to include all available material that appeared to belong to the various grades of conchological organisation chosen for study (putative clades). Hence, in spite of trying to only deal with large and comprehensive datasets, some species are represented by shells only, sometimes in extremely limited numbers. The geographic limitation of the study (restricted to NSW) also means that some extralimital relatives (Qld in particular) have been excluded. Some chiefly non-limestone species have also been included in this study but only in as far as they contribute to a more comprehensive understanding of the systematics.

Due to the difficulty of assessing the relatively brief and comparatively imprecise descriptions of early authors such as Cox (1868) and Iredale (1933, 1937, 1941a,b), many of the detailed morphological comparisons in this study are made only with other taxa dealt with either in this study or with those in Stanisic (1990, 1993a,b, 1996). Where comparisons to charopid taxa outside these studies are made much of the data presented may include previously unpublished information and relies heavily on the observations of one of the authors (JS).

In attempting identification it should be kept in mind that the subset of species dealt with herein represents a small geographic and phylogenetic component of the total family diversity in eastern Australia and that taxonomic concepts may only have limited application. However, many of the species have restricted distributions and in most cases these are considered to be accurate reflections of the species' true range. Hence, given accurate collection data, the likelihood of mis-identification is considered to be low.

## MATERIALS AND METHODS

All material used in this study came from the collections of the Australian Museum, Sydney or the Queensland Museum, Brisbane. Species descriptions were generally based on SEM data from 3 shells, measurements from these 3 shells plus 20more empty shells, and anatomical and radular details from at least three spirit specimens. In addition, all the shells of a species were examined for major variation. However, in spite of careful selection 'wet' material was not available for all of the species, and for some species very few shells were available for SEM and quantitative analysis.

Shells were cleaned in warm dilute bleach, then mounted using silver tape and sputter-coated with gold. Shells were examined and photographed with a Leo 435VP Scanning Electron Microscope. Shells were measured using XTree Gold 2.51 (Johnson et al., 1989-1991). Variables measured were shell height (H) and diameter (D), spire height (SH), aperture height (AH) and width (AW) and umbilical width (U) (see Solem, 1976 for definitions).

Snails were dissected using a Leica MZ8 microscope. Drawings were made using a camera lucida attachment. Radulae were cleaned in warm potassium hydroxide, then mounted on glass slides using carbon tape, then gold-coated and photographed as for the shells. Anatomical and shell terminology largely follows Solem (1984).

Shell and anatomical data were scored using DELTA 1.03T (Description Language for Taxonomy) (Dallwitz et al., 2000). The DELTA files were analysed in PAUP* 4.08b (Phylogenetic Analysis Using Parsimony) (Swofford, 2001) using a heuristic search (100 replicates) with random selective addition and tree-bisection-reconnection. Bootstrap values were calculated using the 'fast stepwise-addition' function in PAUP* with 100 replicates. Trees were viewed in MacClade 3.08a (Maddison & Maddison, 1999). Only taxa for which both anatomical and shell data were available were included in the analysis. Outgroup taxa (*Aaadonta constricta constricta* and *Minidonta hendersoni*, Endodontidae) were scored from Solem (1976).

Unless otherwise stated classification follows Smith (1992).

ACRONYMS AND ABBREVIATIONS USED. *General*: AMS, Australian Museum, Sydney; QM, Queensland Museum; NSW, New South Wales; Qld, Queensland; Vic, Victoria; SF, State Forest; NP, National Park; NR, Nature Reserve; Ra, Range; R, River; SC, spirit or wet collection; RC, dry or reference collection; N, north; S, south; E, east; W, west; NE, northeastern; SE, southeastern.

*Collectors*: DP, Darryl Potter; GI, Glen Ingram; IL, Ian Loch; JC, Jan Chaseling; JS, John Stanisic; MS, Michael Shea; OG, Owen Griffiths; PHC, Phil Colman; WFP, Winston Ponder.

*Habitat Data*: cnvf, complex notophyll vine forest; drf, dry rainforest; ew, eucalypt woodland; JCt, junction; lm, limestone outcrop; lrf, littoral rainforest; mvf, microphyll vine forest; nvf, notophyll vine forest; rf, rainforest; ro, rocky outcrop; snvf, simple notophyll vine forest; strf, subtropical rainforest; trib., tributary; vt, vine thicket; wsf, wet sclerophyll forest; wtrf, warm temperate rainforest.

*Anatomical Data*: dg, prostate; e, epiphallus; g, ovotestis; gd, hermaphrodite duct; gg, albumen gland; gt, talon; h, heart; hv, principal pulmonary vein; i, intestine; kd1, primary ureter; kd2, secondary ureter; kp, pericardial lobe of kidney; kr, rectal lobe of kidney; mc, mantle collar; mg, mantle gland; p, penis; pp, penial pilaster; ppt, preputial tube; pv; penial verge; prm, penis retractor muscle; ss, spermathecal stalk; ut, uterus; v, vagina; vd, vas deferens.

## SYSTEMATICS

### Subclass EUPULMONATA
### Family CHAROPIDAE Hutton, 1884
### Subfamily CHAROPINAE Hutton, 1884
### **Rhophodon** Hedley, 1924

*Rhophodon* Hedley, 1924: 219; Iredale, 1937: 329; Iredale, 1941b: 2, Kershaw, 1955: 30; Burch, 1976b: 133; Smith & Kershaw, 1979:175; Stanisic, 1990: 114; Smith, 1992: 202.

TYPE SPECIES. *Rhophodon peregrinus* Hedley, 1924; by original designation.

DIAGNOSIS. Shell very small to minute, discoidal, flammulated to monochrome,with few to many apertural barriers; spire depressed to flat or very slightly elevated. Protoconch with prominent, slightly curved radial ribs that become more crowded toward the protoconch/teleoconch boundary and very fine, wrinkle-like, discontinuous spiral cordlets. Teleoconch sculpture of very crowded to widely spaced, straight to weakly protractively sinuated radial ribs; secondary sculpture of intersecting microradials and microspirals that form strong beads at their intersection. Umbilicus very wide cup-shaped to saucer-shaped. Kidney weakly bilobed with pericardial lobe elongate, triangular, slightly reflexed at the apex. Penis internally with longitudinal pilasters, occasionaly with additive circular pads.

DISTRIBUTION AND HABITAT. From Mt Booroon Booroon, SE Qld, to the Macleay Valley, NE NSW. Species are obligate closed-forest dwellers living among litter and rocks in warm temperate to subtropical (wet to dry) rainforest.

REMARKS. *Rhophodon* Hedley, 1924 was introduced for 3 Australian charopids with apertural barriers. *Letomola* Iredale, 1941 was subsequently introduced for *Rhophodon contortus* Hedley, 1924 but the author gave no convincing reasons for the separation from *Rhophodon*. Stanisic (1990) redefined *Rhophodon* as a genus of very small to minute charopids with apertural barriers, very wide umbilicus, primarily radial protoconch and prominent radial ribs on the teleoconch. Stanisic (1990) also included three new species and placed the monotypic *Egilodonta* Iredale, 1937 (type species: *Charopa bairnsdalensis* Gabriel, 1930) into its synonymy but maintained *Letomola* as a separate genus. A malleate protoconch, the presence of a supraperipheral sulcus and unusual radular features were considered to be sufficient reasons for its separation from *Rhophodon*.

Smith & Kershaw (1979) and Smith (1992) included the Victorian '*Charopa*' *problematica* Gabriel, 1947 in *Rhophodon* but this species was not examined by Stanisic (1990).

Following the examination of additional new material of '*C*'. *bairnsdalensis* and the discovery of several closely related species in the NSW/Vic Border area, *Egilodonta* is herein reinstated for a group of southern charopids with dentate apertures. These species are conchologically and anatomically cohesive. In particular the position and less exuberant development of the apertural barriers are features that combine to separate these species from *Rhophodon*. The position of '*C*'. *problematica* still needs to be determined. Smith & Kershaw (1979) mention the presence of apertural lamellae in the shell of this species, presumably a major reason for its generic placement by those authors, but these lamellae were not mentioned by Gabriel (1947). Hence, until the type specimen of '*C*'. *problematica* is re-examined this species should be regarded as a doubtful member of *Rhophodon*.

*Rhophodon* Hedley, 1924 is most similar to *Egilodonta* Iredale, 1937 in shell shape, in the protoconch sculpture (the radial ribs on the protoconch become increasingly crowded at the protoconch/teleoconch margin) and in the possession of apertural barriers. However, *Egilodonta* differs from *Rhophodon* in having consistently more widely spaced and thicker teleoconch ribs and consistently fewer apertural barriers that differ in their relative positions on both the palatal and parietal edges of the aperture. In *Egilodonta* there is only a single parietal barrier (positioned almost half way down the parietal wall), compared with at least two barriers (situated approximately one-half and two thirds down the parietal wall) and occasionally an infraparietal trace in *Rhophodon*. *Rhophodon* also usually has at least two palatal barriers (one in *R. silvaticus* sp. nov.) in contrast to the single palatal barrier in all *Egilodonta*.

Anatomically these two genera show little difference in general features of the pallial and reproductive systems (strong elongation) but this could be largely related to convergent shell shape. Shell design in both groups is characterised by many tightly coiled whorls and a very much reduced whorl cross-section. Elongation of structures such as the pericardial kidney lobe and epiphallus have may have developed as a spatial adjustment in response to this shared evolutionary trend in fundamental shell shape.

*Rhophodon* and *Egilodonta* are not only separated by considerable geographic distance (c.600km) but they are also ecologically distinct. *Rhophodon* is an obligate closed forest group inhabiting warm temperate to subtropical rainforest, albeit sometimes on limestone, whilst *Egilodonta* appears to be chiefly a calciphile group with a tendency to also occur in eucalypt woodland.

*Letomola* Iredale, 1941 from the Macleay Valley, NSW (which is sympatric with *R. kempseyensis*) also has apertural barriers. It also has an exsert protoconch and wide umbilicus (similar to *Rhophodon*) but has a more depressed spire, supraperipheral sulcus and malleate protoconch sometimes with fine, widely spaced, thin, curved, radial ridgelets. The teleoconch sculpture is degenerate consisting of broad, shingle-like overlapping sheets. *Letomola* also has fewer barriers than *Rhophodon*.

*Decoriropa* gen. nov. has the same general shell form as *Rhophodon* (discoidal shell with radial protoconch, wide umbilicus and prominent radial ribs on the teleoconch) but lacks apertural barriers and has relatively evenly spaced radial ribs on the protoconch.

Solem (1983) showed that the shape of microprojectons on the apertural barriers could be a useful means of elucidating phylogenetic relationships within those Pacific Island charopids with apertural barriers and Stanisic (1990) showed that this may also apply to Australian species. Specifically, *Letomola* was shown to have quite different apertural microprojections to those of *Rhophodon* spp., which correlated with fundamental differences in conchological and anatomical features between the two groups (Stanisic, 1990). However, the microsculpture of the apertural barriers was not investigated in the current study.

*Rhophodon* species can be distinguished from each other by a combination of shell size and rib spacing on the teleoconch, but most definitively, on the basis of apertural barrier conformation – number, form and position.

### **Rhophodon kempseyensis** Stanisic, 1990
(Figs 2-11; Table 1)

*Rhophodon kempseyensis* Stanisic, 1990: 125, figs 77-79; Smith 1992: 202.

TYPE LOCALITY. Natural Arch, Carrai SF, NSW.

MATERIAL. All NSW: AMSC168611, C308079. QMMO37076, MO37096, MO37151, MO56006. MO49295, MO52724.

DIAGNOSIS. Shell very small, chocolate brown with scattered, radially disposed lighter blotches. Teleoconch with extremely crowded, weakly protractively sinuated, narrow radial ribs. Mean ribs/mm 33. Aperture with three parietal barriers (infraparietal present only as a low trace); palatal barriers four, one at the baso-palatal margin. Penis internally with three to four longitudinal pilasters.

DISTRIBUTION AND HABITAT. W of Kempsey, from the Yessabah limestone outcrop to The Castles limestone outcrop in the Carrai SF; often found in great numbers in leaf and soil litter, or under logs and rocks, on limestone outcrops covered in rainforest.

REMARKS. *Rhophopon kempseyensis* Stanisic, 1990 has very fine and extremely crowded ribs (mean 34.56 ribs/mm on the last whorl). *R. consobrinus* (Hedley, 1924) and *R. peregrinus* (Hedley, 1924) also have crowded ribs, but only about half as many on the last whorl as *R. kempseyensis* (see Stanisic, 1990). *R. duplicostatus* sp. nov. has more crowded ribs than *kempseyensis* (mean 142.3 ribs/mm) but these are very narrow, more like thickened microradials, and are grouped in pairs. *R. silvaticus* sp. nov (mean 38.70 ribs/mm) also has a higher rib count but is smaller with a lower whorl count. *R. palethorpei* sp. nov (mean 13.06 ribs/mm) and *R. mcgradyorum* sp. nov. (mean 8.04 ribs/mm) have considerably lower rib counts. The barrier arrangement in *R. kempseyensis* is very similar to that of *R. palethorpei* (three parietal barriers and four palatal barriers) but differs in having the infraparietal barrier present as a low trace rather than a high crescent shaped lamellae.

Additional fieldwork since the original description of this species has managed to extend the range of *R. kempseyensis* further westward (The Castles) in the Macleay Valley but still always in association with limestone covered in rainforest. *Rhophodon* spp. in general show a strong affinity with rainforest, suggesting that the present day restriction of *R. kempseyensis* to rainforest-covered limestone may be linked to the possible past restriction of this vegetation type to these rocky refugia. Although rainforest now flourishes elsewhere in the local countryside, *R. kempseyensis* has yet to disperse into these non-limestone associated habitats. Stanisic (1990) showed that the radula of *R. kempseyensis* has enlarged and almost spade-like mesocones on the lateral teeth rather than the more typical lanceolate, possibly an adaptation for scraping food from rock surfaces. This may be evidence that *R. kempseyensis* has become specialised to living on limestone.

### **Rhophodon palethorpei** sp. nov.
(Figs 2-11, 34; Table 1)

ETYMOLOGY. For Hugh Palethorpe.

MATERIAL. HOLOTYPE: QMMO70390, Werrikimbe National Park, at Youdales Hut on Kunderang Brook, NSW (31°04'45"S, 152°15'40"E), under fern roots, drf/lm, 4.i.1997, JS, JC. Height of shell=1.30mm, diameter=2.76mm, H/D=0.47, D/U=2.16, number of whorls=5.2, ribs on last whorl=89. PARATYPES: All same locality as holotype. QMMO60151, 3SC/73RC, under fern roots, drf/lm, 4.i.1997, JS, JC; QMMO55962, 10SC, on limestone, drf/lm, 7.i.1995, JS, JC; QMMO55961, 4RC, on limestone, drf/lm, 7.i.1995, JS, JC; QMMO59704, 110RC, AMSC205155, 10RC, on limestone, drf/lm, 7.i.1995, JS, JC; QMMO59706, 1RC, in litter, drf/lm, 7.i.1995, JS, JC.

DIAGNOSIS. Shell very small, dark golden brown with a wide umbilicus. Teleoconch with slightly sinuated, moderately crowded, relatively wide ribs. Mean ribs/mm 13.06. Aperture with

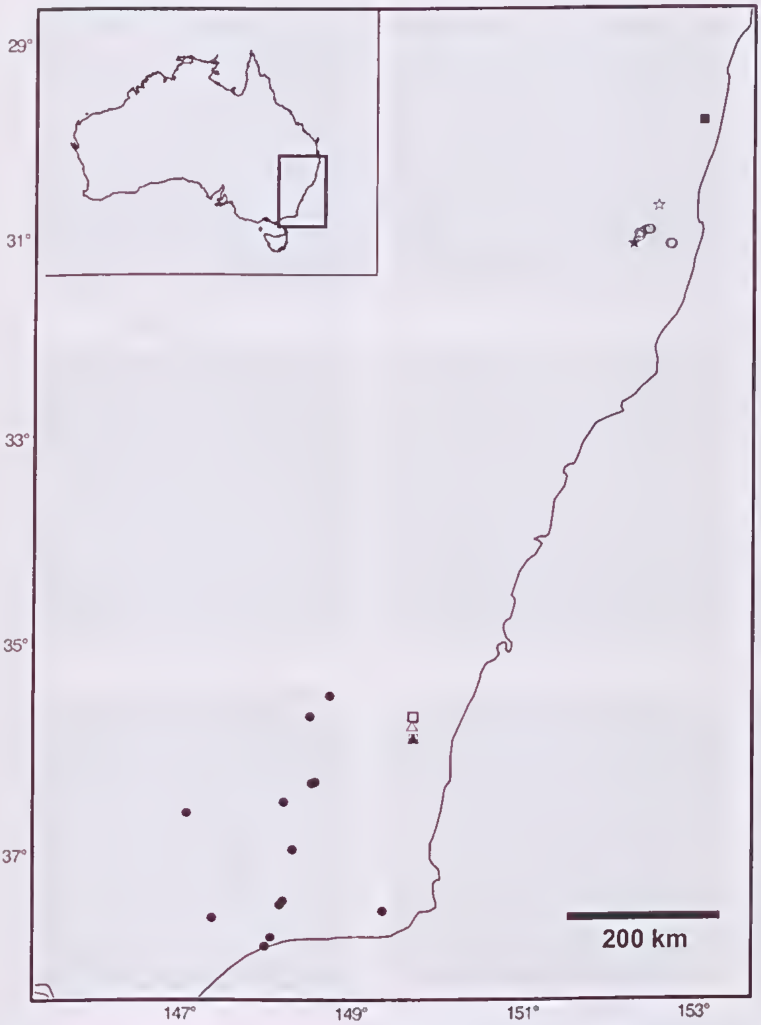


FIG. 2. Distribution of Rhophodon and *Egilodonta*. Key: ○ *Rhophodon kempseyensis*, ★ *Rhophodon palethorpei*, ☆ *Rhophodon silvaticus*, ■ *Rhophodon duplicostatis*, ● *Egilodonta bairnsdalensis*, Δ *Egilodonta wyanbenensis*, ▲ *Egilodonta bendethera*, □ *Egilodonta paucidentata*.

three parietal barriers; four palatal barriers, one at the baso-palatal margin. Penis internally with one round basal pilaster.

DESCRIPTION. Shell very small, brown to golden brown, with 4.3-5.1 (mean 4.65) tightly coiled whorls, the last descending more rapidly. Shell diameter 2.41-3.10mm (mean 2.67mm). Apex and early spire flat. Height of shell 1.05-1.40mm (mean 1.24mm), H/D 0.42-0.50 (mean 0.46). Protoconch exsert of 1.4-1.7 whorls. Apical sculpture of slightly curved, moderately spaced radial ribs, becoming more crowded toward the protoconch/teleoconch border, width of interstices (in multiples of rib width) 7 at apex, 3 at post-nuclear boundary; secondary sculpture of moderately spaced, weak spiral wrinkles. Teleoconch sculpture of numerous slightly protractively sinuated radial ribs, 68-152 (mean 110) on last whorl. Ribs/mm 8.76-13.27 (mean 13.06). Ribs wide, height equal to width; straight in section, rounded on top. Rib interstices on first post-nuclear whorl equal to width of three major ribs; interstices on penultimate whorl equal to width of 2.5 major ribs. Interstitial sculpture of microradial riblets and fine microspiral cords. Microradial riblets low, 4-6 between major ribs on first post-nuclear whorl, 7-8 on penultimate whorls; microspiral cords low, crossing major radials, forming rounded beads at their intersection with microradials. Umbilicus very wide, saucer-shaped, diameter 1.00-1.28mm (mean 1.14mm), D/U 2.16-2.57 (mean 2.36). Sutures impressed, whorls evenly rounded above and below periphery. Aperture ovate; parietal callus present. Three parietal barriers and four palatal barriers present, all crescent-shaped lamellae. Based on 23 measured adults (QMMO70390, MO60151).

Ovotestis containing two clumps of alveoli; with one alveolar lobe per clump. Talon stalk 1-3 times diameter of talon; talon circular. Penis retractor muscle half the length of penis or greater; inserting at junction of penis and epiphallus. Epiphallus longer than penis; wider than vas deferens; pilasters longituduinal; retractor muscle not entwined with epiphallus. Penis sheath present; penis tubular (with a large bulge on one side at base); internally with one round pilaster basally. Vagina shorter than penis.

Pallial cavity with unilobed kidney.

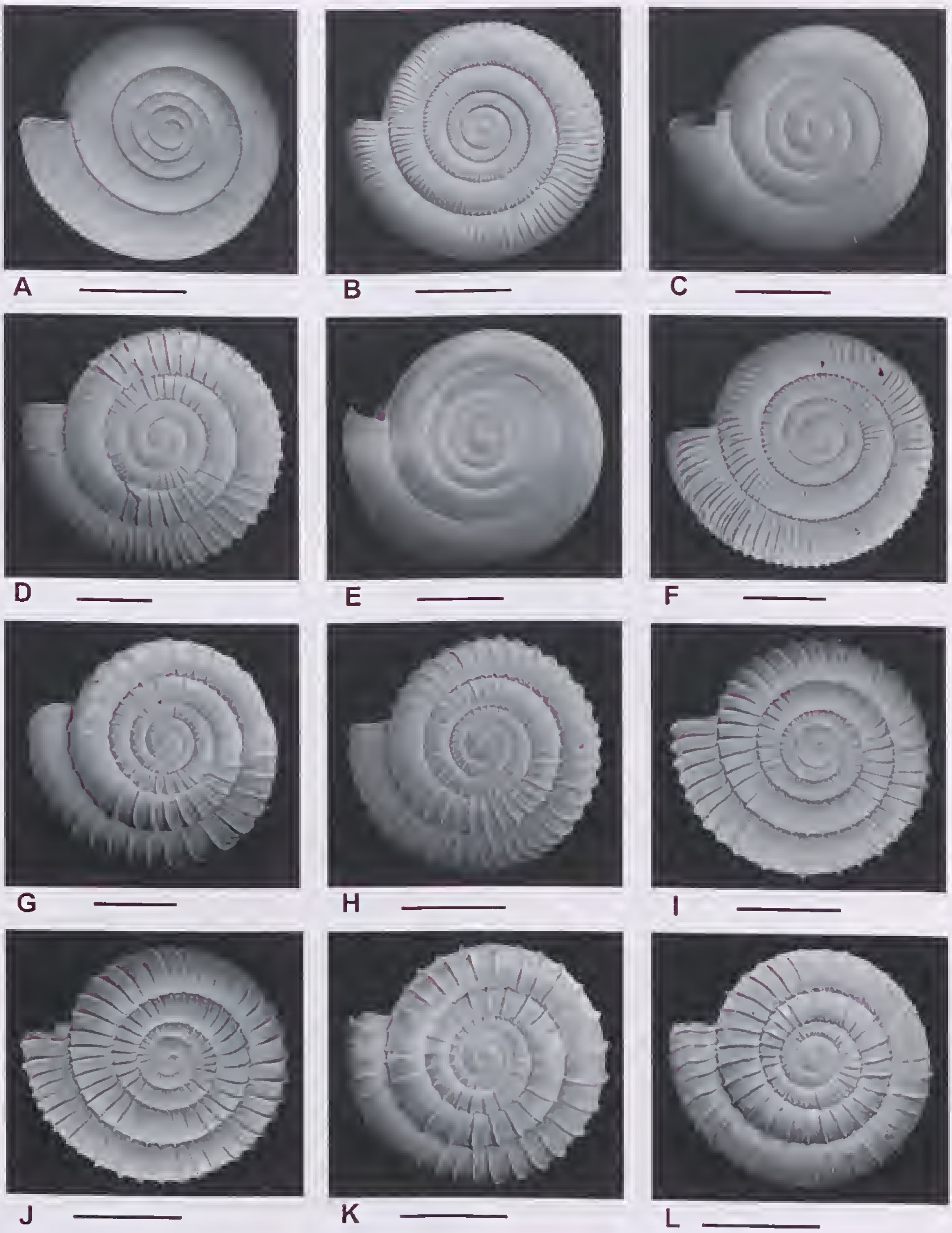


FIG. 3. Dorsal view of shells. A, *Rhophodon kempseyensis*, AMSC153720. B, *Rhophodon palethorpei*, QMMO70390. C, *Rhophodon mcgradyorum*, QMMO70392. D, *Rhophodon silvaticus*, QMMO70391. E, *Rhophodon duplicostatus*, QMMO70393. F, *Egilodonta wyanbenensis*, QMMO70394. G, *Egilodonta bendethera*, QMMO70395. H, *Egilodonta paucidentata*, QMMO49447. I, *Egilodonta paucidentata*, QMMO70396. J, *Egilodonta bairnsdalensis* (Yarrangobilly Caves, Kosciusko National Park), AMSC142959. K, *Egilodonta bairnsdalensis* (Lakes Entrance), AMSC153706. L, *Egilodonta bairnsdalensis* (Alpine Way, Kosciusko National Park), AMSC154808. Scale bars=0.5mm in C, D, E; 0.8mm in F-L; 1mm in A, B.

Radula with central tooth strongly tricuspid, considerably smaller than laterals; lateral teeth tricuspid; mesocone of first lateral tooth slender, slightly diamond-shaped; mesocone of marginal teeth rounded, spade-like; ectocone of outer marginal teeth split into three teeth; endocone occasionally split into two or more teeth. Number of lateral teeth: 7; marginal teeth: 7; radular rows: 123.

Based on 3 dissected specimens (QMMO55962).

DISTRIBUTION AND HABITAT. Known only from the type locality; living on limestone outcrops covered in dry rainforest (vine thicket).

REMARKS. *Rhophodon palethorpei* sp. nov. appears to be very closely related to *R. kempseyensis*. The barrier configuration of the two species is basically the same except that in *R. palethorpei* the infraparietal barrier is much more developed. *R. palethorpei* is also similar in to *R. kempseyensis* in most aspects of shell measurement, but differs most dramatically in having a lower rib count (13.06 ribs/mm compared with 34.56 ribs/mm in *R. kempseyensis*). *R. palethorpei* is readily distinguished from *R. silvaticus* sp. nov. by its larger size, lower rib count and in having a greater number of palatal barriers (four as opposed to one).

The many similarities between the shells of *R. kempseyensis* and *R. palethorpei*, in particular the configuration of the apertural barriers, suggest common ancestry. The two species are now geographically isolated in two different drainage systems: *R. kempseyensis* in the Macleay River valley and *R. palethorpei* in the Kunderang Brook watershed. This may be related to past restriction of rainforest habitats to refugia such as rocky outcrops and the consequent long-term isolation of once conjunct populations. Although *R. palethorpei* is currently known only from one locality, there is a possibility that it also exists on other, yet to be sampled, limestone outcrops along Kunderang Brook.

### **Rhophodon silvaticus** sp. nov.
(Figs 2-7; Table 1)

ETYMOLOGY. Latin *silvaticus*, pertaining to forests; referring to the forest habitat.

MATERIAL. HOLOTYPE: QMMO70391, Thumb Ck SF, slopes of Blue Knob, c.11.5km NW Burrapine, W Macksville, NSW (30°41'45"S, 152°33'15"E), under logs, wtrf, 29.ix.1993, JS, JC. Height of shell=0.67mm, diameter=1.39mm, H/D=0.48, D/U=ratio 2.36, number of whorls=4.1, ribs on last whorl=169. PARATYPES: QMMO49318, 2RC, same data as holotype; QMMO37318, 4SC, same locality data as holotype, under logs on rocky hillside, wtrf, 15.i.1992, JS, JC.

DIAGNOSIS. Minute, golden brown shell with wide umbilicus. Teleoconch with narrow, slightly sinuated, very closely spaced ribs. Mean ribs/mm 38.70. Aperture with two parietal barriers and one palatal barrier. Anatomy unknown.

DESCRIPTION. Shell minute golden brown, with c.4.1 tightly coiled whorls, the last descending more rapidly; shell diameter c.1.39mm. Apex and early spire flat. Height of shell c.0.67mm, H/D c.0.48. Protoconch exsert of c.1.6 whorls. Apical sculpture of slightly curved, moderately spaced radial ribs, becoming more crowded toward the protoconch/teleoconch border, width of interstices (in multiples of rib width) 4 at apex, 3 at post-nuclear boundary; secondary sculpture of moderately spaced, weak spiral wrinkles. Teleoconch sculpture of numerous weakly protractively sinuated radial ribs, c.169 on last whorl. Ribs/mm c.38.70. Ribs narrow, height less than width; straight in section, rounded on top. Rib interstices on first post-nuclear whorl equal to width of 2 major ribs; interstices on penultimate whorl equal to width of 1.5 major ribs. Interstitial sculpture of fine microradial riblets and microspiral cords. Microradial riblets low, 2 between ribs on first post-nuclear whorl; 3 between ribs on penultimate whorl; microspiral cords low, crossing major radials, forming elongated beads at their intersection with the microradials. Umbilicus very wide saucer-shaped, diameter c.0.59mm, D/U c.2.36. Sutures impressed, whorls evenly rounded above and below periphery. Aperture ovately lunate; parietal callus present. Two parietal barriers and one palatal barriers present, all crescent shaped lamellae. Based on the measured holotype (QMMO70391).

Anatomy unknown.

DISTRIBUTION AND HABITAT. Known from the type locality; living under logs among volcanic rocks in temperate rainforest.

REMARKS. *Rhophodon silvaticus* sp. nov. is most similar to *R. kempseyensis* in rib spacing and general satin-like appearance of the shell surface, however it is much smaller, has the teleoconch ribs slightly more widely spaced (ribs/mm =38.70) and possesses only one palatal barrier (four in *R. kempseyensis*). *R. palethorpei* has the teleoconch ribs more widely spaced than those of *R. silvaticus* and like *R. kempseyensis*

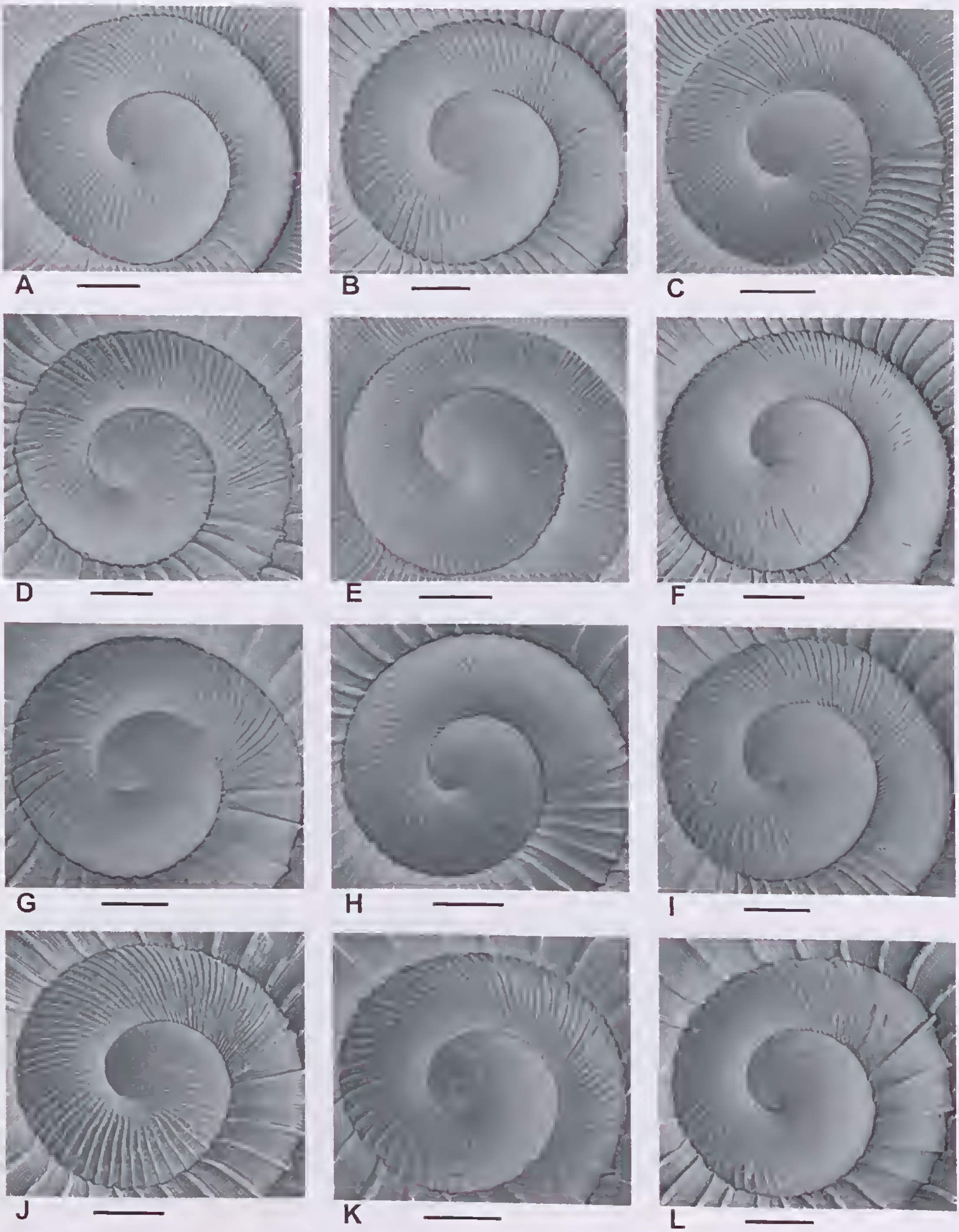


FIG. 4. Protoconch of shells from above. A, *Rhophodon kempseyensis*, AMSC153720. B, *Rhophodon palethorpei*, QMMO70390. C, *Rhophodon mcgradyorum*, QMMO70392. D, *Rhophodon silvaticus*, QMMO70391. E, *Rhophodon duplicostatus*, QMMO70393. F, *Egilodonta wyanbenensis*, QMMO70394. G, *Egilodonta bendethera*, QMMO70395. H, *Egilodonta paucidentata*, QMMO49447. I, *Egilodonta paucidentata*, QMMO70396. J, *Egilodonta bairnsdalensis*, AMSC142959. K, *Egilodonta bairnsdalensis*, AMSC153706. L, *Egilodonta bairnsdalensis*, AMSC154808. Scale bars=0.1mm.

also has four palatal barriers. This is the smallest of the *Rhophodon* group of species, and additional material is needed to adequately define the morphometrics of the shell and to detail the anatomy.

*R. silvaticus* is currently only known from the one locality in the Thumb Creek SF and more fieldwork is needed to confirm its range. There would appear to be no obvious reason why this species is not more widespread in the upper Taylors Arm watershed (Nulla Five Day SF) where similar habitats exist. The microhabitat data (on rocky hillside) suggests that it may have a patchy localised distribution confined to areas with rocky substrate.

### **Rhophodon mcgradyorum** sp. nov.

(Figs 2-7, 33; Table 1)

ETYMOLOGY. For Jim and Audrey McGrady.

MATERIAL. HOLOTYPE: QMMO70392, Bellbird Gully, Gibraltar Ra., NSW, 4.i.1988, G. Annabell. Height of shell=0.99mm, diameter=1.67mm, H/D=0.59, D/U=2.61, number of whorls=4.7, ribs on last whorl=47. PARATYPES: QMMO66108, 3RC, same data as holotype.

DIAGNOSIS. Shell minute, golden brown, with a wide umbilicus. Teleoconch with wide, straight (not sinuated) widely spaced ribs. Mean ribs/mm 8.04. Aperture with 3 parietal and 3 palatal barriers and a baso-columellar barrier; barriers thickened at the apex. Anatomy unknown.

DESCRIPTION. Shell very small, golden brown to yellow, with 4.5-4.9 (mean 4.7) tightly coiled whorls, the last descending more rapidly in front. Shell diameter 1.64-1.69mm (mean 1.67mm). Apex and early spire slightly concave to flat. Height of shell 0.82-0.99mm (mean 0.88mm), H/D 0.50-0.59 (mean 0.53). Protoconch exsert of 1.7-1.8 whorls. Apical sculpture of curved, moderately spaced, radial ribs, becoming more crowded toward protoconch/teleoconch boundary; width of interstices (in multiples of rib width) 6 at apex, 3 at post-nuclear boundary; secondary sculpture of weak, discontinuous spiral cords. Teleoconch sculpture of numerous, protractively sinuated widely spaced radial ribs; 35-47 (mean 42) ribs on last whorl. Ribs/mm 6.79-8.96 (mean 8.04). Ribs relatively broad, height less than width; straight in section, rounded on top. Rib interstices on first post-nuclear whorl equal to width of 4-6 ribs; interstices on penultimate whorl equal to width of 7 ribs. Interstitial sculpture of microradioal riblets and fine microsopiral cords. Microradial riblets low, 12-13 between ribs on first post-nuclear whorl and 20 between ribs on penultimate whorl; microspiral cords low, crossing major radials, forming strong, round to square beads at their intersection with microradial riblets. Umbilicus widely open, saucer-shaped, diameter 0.61-0.64mm (mean 0.63mm). D/U 2.61-2.67 (mean 2.68). Sutures impressed, whorls evenly rounded above and below periphery. Aperture ovately lunate, parietal callus present. Three parietal barriers, one baso-columellar barrier and four palatal barriers present; barriers thickened. Based on 4 measured adults (QMMO70392, MO66108).

Anatomy unknown.

DISTRIBUTION AND HABITAT. Known only from the type locality in the Gibraltar Range NP, east of Glen Innes, NSW; habitat and microhabitat unknown.

REMARKS. The teleoconch ribs of *R. mcgradyorum* sp. nov. are relatively widely spaced compared with other NE NSW *Rhophodon* taxa and the shell bears a greater overall similarity to *R. minutissimus* Stanisic, 1990 from SE Qld. It is, however, distinguished from that species by having only two parietal barriers (three in *R. minutissimus*) and four palatal barriers (three in *R. minutissimus*). The barriers of *R. mcgradyorum* are also comparatively more thickened and lack the blade-like appearance of those in other found in other NE NSW *Rhophodon*. In this respect the barriers resemble those of *R. colmani* Stanisic, 1990 from the Kenilworth SF, SE Qld. However, the latter species differs dramatically from *R. mcgradyorum* in having many more apertural barriers (six palatal) and teleoconch ribs that are broader and much more widely spaced (mean ribs/mm 5.81).

### **Rhophodon duplicostatus** sp. nov.

(Figs 2-7, 34; Table 1)

ETYMOLOGY. Latin *duplico*, double and *costatus*, ribbed; referring to the major rib doublets on the teleoconch.

MATERIAL. HOLOTYPE: QMMO70393, Glenugie SF, slopes of Glenugie Peak (= Mt Elaine), SE Grafton, NSW (29°50'01"S, 153°04'47"E), under rocks on rocky hillside, remnant warm temperate rainforest, 16.i.1992, JS. JC. Height of shell=0.78mm, diameter=1.7mm, H/D =0.46, D/U =2.54, number of whorls=4.7, rib pairs on body 313. PARATYPES: QMMO37344, 7RC, same data as holotype.

DIAGNOSIS. Shell very small, golden brown, with a wide umbilicus. Teleoconch ribs slightly

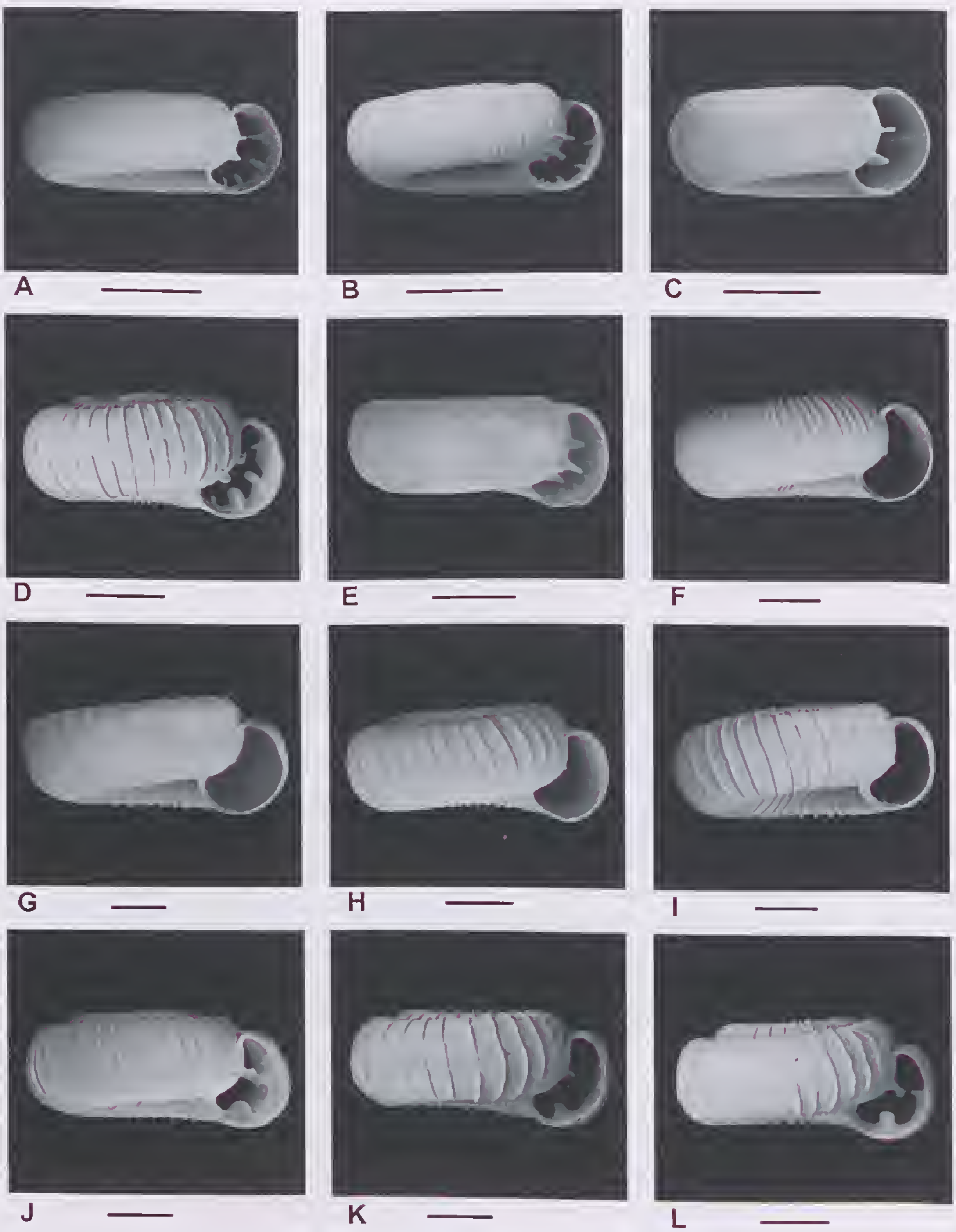


FIG. 5. Lateral view of shells. A, *Rhophodon kempseyensis*, AMSC153720. B, *Rhophodon palethorpei*, QMMO70390. C, *Rhophodon mcgradyorum*, QMMO70392. D, *Rhophodon silvaticus*, QMMO70391. E, *Rhophodon duplicostatus*, QMMO70393. F, *Egilodonta wyanbenensis*, QMMO70394. G, *Egilodonta bendethera*, QMMO70395. H, *Egilodonta paucidentata*, QMMO49447. I, *Egilodonta paucidentata*, QMMO70396. J, *Egilodonta bairnsdalensis*, AMSC142959. K, *Egilodonta bairnsdalensis*, AMSC153706. L, *Egilodonta bairnsdalensis*, AMSC154808. Scale bars=1mm in A, B; 0.5mm in C-L.

TABLE 1. Shell measurements for species of *Rhophodon*. (AH/AW, ratio of aperture height to aperture width; D, shell diameter; D/U, ratio of shell diameter to umbilicus width; H, shell height; H/D, ratio of shell height to diameter; N, number of specimens; NW, total number of whorls; PW, number of protoconch whorls; RIB, number of ribs on last whorl; RIBS/M, number of ribs per mm on the last whorl; SP, spire height; TW, number of teleoconch whorls; UMB, umbilicus width).* indicate actual number of measurements taken.

| Measurement | *Rhophodon kempseyensis* | *Rhophodon palethorpei* | *Rhophodon silvaticus* | *Rhophodon duplicostatus* | *Rhophodon mcgradyorum* |
|---|---|---|---|---|---|
| N | 23 (*22, **13) | 23 | 1 | 3 (*1) | 4 |
| D | 2.45-2.83 (2.628) ± 0.111 | 2.41-3.01 (2.674) ± 0.141 | 1.39 | 1.49-1.7 (1.627) ± 0.118) | 1.64-1.69 (1.672) ± 0.024 |
| PW | 1.3-1.6 (1.514) ± 0.064 * | 1.5-1.7 (1.543) ± 0.059 | 1.6 | 1.5 * | 1.7-1.8 (1.725) ± 0.05 |
| TW | 3.3-3.8 (3.582) ± 0.113 * | 3.2-4.1 (3.704) ± 0.203 | 2.5 | 3.2 * | 2.8-3.2 (2.95) ± 0.173 |
| NW | 4.8-5.3 (5.095) ± 0.143 * | 4.9-5.6 (5.248) ± 0.175 | 4.1 | 4.7 * | 4.5-4.9 (4.675) ± 0.171 |
| H | 1.03-1.24 (1.118) ± 0.059 | 1.05-1.4 (1.239) ± 0.095 | 0.67 | 0.72-0.83 (0.777) ± 0.055 | 0.82-0.99 (0.88) ± 0.075 |
| SP | 0 | 0-0.16 (0.083) ± 0.004 | 0.01 | 0-0.1 (0.003) ± 0.006 | 0-0.04 (0.018) ± 0.021 |
| AH/AW | 1.5-1.4 (1.4) ± 0.08 | 1.06-1.7 (1.32) ± 0.14 | 1.54 | 1.29-1.57 (1.42) ± 0.14 | 1.21-1.41 (1.3) ± 0.11 |
| UMB | 1-1.31 (1.169) ± 0.08 | 1-1.28 (1.136) ± 0.077 | 0.59 | 0.58-0.67 (0.633) ± 0.047 | 0.61-0.64 (0.625) ± 0.017 |
| RIB | 246-358 (288) ± 32.738 ** | 68-152 (110) ± 20.967 | 169 | - | 35-47 (42.25) ± 5.123 |
| RIBS/MM | 28.17-40.27 (34.56) ± 3.678 ** | 8.763-13.27 (13.06) ± 2.084 | 38.7 | - | 6.79-8.96 (8.035) ±0.906 |
| H/D | 0.38-0.47 (0.43) ± 0.03 | 0.42-0.5 (0.46) ± 0.02 | 0.48 | 0.46-0.49 (0.48) ± 0.02 | 0.5-0.59 (0.53) ± 0.04 |
| D/U | 2.08-2.46 (2.25) ± 0.1 | 2.16-2.57 (2.36) ± 0.11 | 2.36 | 2.54-2.6 (2.57) ± 0.03 | 2.61-2.77 (2.68) ± 0.07 |

sinuated, very narrow and extremely crowded, complex, each consisting of a pair of ribs. Ribs/mm c.142.3. Aperture with three parietal and six blade-like palatal barriers present. Anatomy unknown.

DESCRIPTION. Shell minute, golden brown, with c.4.7 tightly coiled whorls, the last descending more rapidly in front. Shell diameter 1.49-1.70mm (mean 1.63mm). Apex and early spire slightly concave. Height of shell 0.72-0.83mm (mean 0.88mm), H/D 0.46-0.49 (mean 0.48). Protoconch exsert of c.1.5 whorls. Apical sculpture of moderately spaced, slightly curved radial ribs, becoming more crowded at protoconch/teleoconch boundary; width of interstices (in multiples of rib width) 5 at apex, 2.5 at post-nuclear boundary; secondary sculpture of weak, discontinuous spiral wrinkles. Teleoconch sculpture of very numerous and extremely crowded weakly protractively sinuated radial ribs that usually occur as doublets. Rib pairs on last whorl 313, ribs pairs/mm 142.3, giving the shell an appearance of being smooth. Height of ribs less than width; ribs straight in section, rounded on top. Rib interstices on the first post-nuclear whorl about the size of the rib doublet (*i.e.* the size of two ribs). Interstitial sculpture of fine microradial riblets and thin microspiral cords. Microradial riblets low, 3-4 between ribs on first post-nuclear whorl and 2 between ribs on penultimate whorl; microspiral cords forming prominent elongate spiral beads at their intersection with the microradials. Umbilicus wide saucer-shaped, diameter 0.58-0.67mm (mean 0.63mm), D/U 2.54-2.60 (mean 2.57). Sutures impressed, whorls evenly rounded above and below the periphery. Aperture ovately lunate, parietal callus present. Three slender parietal barriers present; six very fine palatal barriers present, three in the baso-columellar region; barriers blade-like. Based on 3 measured adults (QMMO70393, MO37334).

Anatomy unknown.

DISTRIBUTION AND HABITAT. *Rhophodon duplicostatus* sp. nov. is known only from the type locality in Glenugie SF, NE NSW; found in litter among volcanic talus in a small patch of remnant warm temperate rainforest.

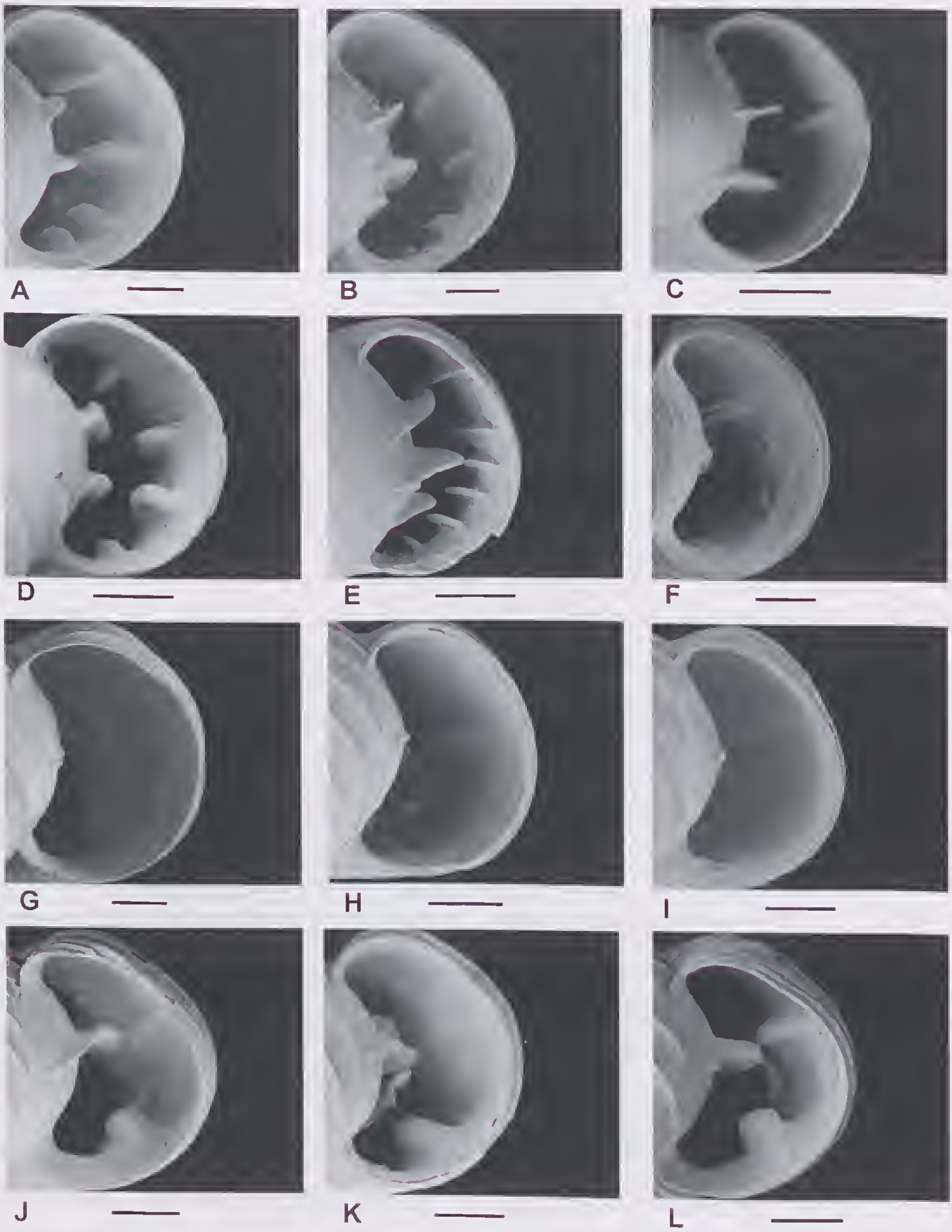


FIG. 6. Aperture of shells, showing apertural barriers. A, *Rhophodon kempseyensis*, AMSC153720. B, *Rhophodon palethorpei*, QMMO70390. C, *Rhophodon mcgradyorum*, QMMO70392. D, *Rhophodon silvaticus*, QMMO70391. E, *Rhophodon duplicostatus*, QMMO70393. F, *Egilodonta wyanbenensis*, QMMO70394. G, *Egilodonta bendethera*, QMMO70395. H, *Egilodonta paucidentata*, QMMO49447. I, *Egilodonta paucidentata*, QMMO70396. J, *Egilodonta bairnsdalensis*, AMSC142959. K, *Egilodonta bairnsdalensis*, AMSC153706. L, *Egilodonta bairnsdalensis*, AMSC154808. Scale bars=0.2mm.

REMARKS. *Rhophodon duplicostatus* sp. nov. has very fine and extremely crowded radial ribs that are almost too dense to count using light microsopy. Under SEM the ribs appear as doublets with each doublet separated by an interstice sculptured with fine, low microradials. In this respect the species cannot be confused with any of its congeners. The apertural dentition of *R. duplicostatus* is also diagnostic in having a proliferation of lamellae in the baso-columellar region. On the basis of having three parietal teeth the species is most readily associated with the *R. kempseyensis-R. palethorpei-R. peregrinus* group of species. The isolation of *R. duplicostatus*, a member of a closed forest group of land snails, on the unusual Glenugie Peak, suggests derivation from an ancestral population inhabiting once more widespread closed forests in NE NSW. Glenugie Peak (= Mt Elaine on early maps) is a pile of volcanic talus supporting a small patch of rainforest amidst an otherwise eucalypt dominated countryside. As a shift to more xeric climates restricted rainforest in the Tertiary (Kemp, 1981; Webb & Tracey, 1981; Adam 1992), mesic communities in the low coastal area around Grafton would probably have been cornered on such local topographic refugia. The refugial status of Glenugie Peak is reinforced by the fact that it is also home to 15 other species of land snails that include several possible endemic species (Stanisic, unpubl. data). This level of overall diversity is high in the context of the local area where site diversity is generally less than 10 species (Stanisic, 1994). According to Floyd (1987), Glenugie Peak is also floristically unusual, thus further emphasising the complex evolutionary history of this refugium. Geological data suggests that other similar refugia (yet to be investigated for land snails) exist closer to the coast in the vicinity of Glenugie SF (e.g. Brown's Knob) and it would not be surprising to find that *R. duplicostatus* has a broader local distribution among these.

### **Egilodonta** Iredale, 1937

*Egilodonta* Iredale, 1937: 328; Gabriel, 1947: 120; Gabriel & Macpherson, 1947:162; Kershaw, 1956a: 142; Burch, 1976b: 133; Smith & Kershaw, 1979: 174; Stanisic, 1990: 114 (in synonymy); Smith, 1992: 202 (in synonymy).

TYPE SPECIES. *Charopa bairnsdalensis* Gabriel, 1930; by original designation.

DIAGNOSIS. Shell minute, discoidal, monochrome golden brown, with relatively few apertural barriers; umbilicus very wide saucer-shaped. Protoconch with prominent, slightly curved radial ribs that become more crowded toward the protoconch/teleoconch boundary and very fine, wrinkle-like, discontinuous spiral cords. Teleoconch sculpture consisting of bold, widely spaced radial ribs whose interstices are sculptured with fine microradial riblets; secondary sculpture of low microradial riblets and microspiral cords that form strong beads at their intersection. Kidney weakly bilobed with pericardial lobe long, triangular. Epiphallus thick and muscular and well differentiated from the vas deferens. Penis internally sometimes with vergic structures.

DISTRIBUTION AND HABITAT. *Egilodonta* ranges from the Bairnsdale region, SE Vic to just south of Braidwood, SE NSW. Species live in the litter and appear associated with limestone habitats, although *E. bairnsdalensis* (Gabriel, 1930) also shows some preference for surrounding eucalypt forest.

REMARKS. On the basis of limited material, Stanisic (1990) synonymised *Egilodonta* Iredale, 1937 with *Rhophodon* Hedley, 1924. The discovery of additional species of Charopidae with dentate apertures from the NSW-Vic Border area has enabled a reassessment of the status of *Egilodonta*. This group of charopids displays a number of consistent differences from the NE NSW species grouped in *Rhophodon*. Bolder and more widely spaced ribs in combination with fewer apertural barriers serve to circumscribe the SE NSW/NE Vic species. Consequently *Egilodonta* is restored to full generic status to include the type and three new species from this region. Inexplicably Solem (1972) placed '*C*'. *bairndalensis* in *Dentherona* Iredale, 1933 (type species: *Helix dispar* Brazier, 1871) without formally documenting the implied generic synonymy.

Distinguishing characters that separate *Egilodonta* Iredale, 1937 and *Rhophodon* Hedley, 1924 have been discussed under the latter genus. Conchological differences among *Egilodonta* spp. are less dramatic than those among *Rhophodon* spp., which may indicate a relative recent separation of *Egilodonta* populations. Apertural dentition, rib spacing, and shell size vary marginally; however, genitalia show considerable variation compared with *Rhophodon* spp. These differences in penial chamber structure (verge and pilasters) most likely relate to species level interactions due to relatively recent microsympatry (see Solem, 1983). Significantly the one species that is truly

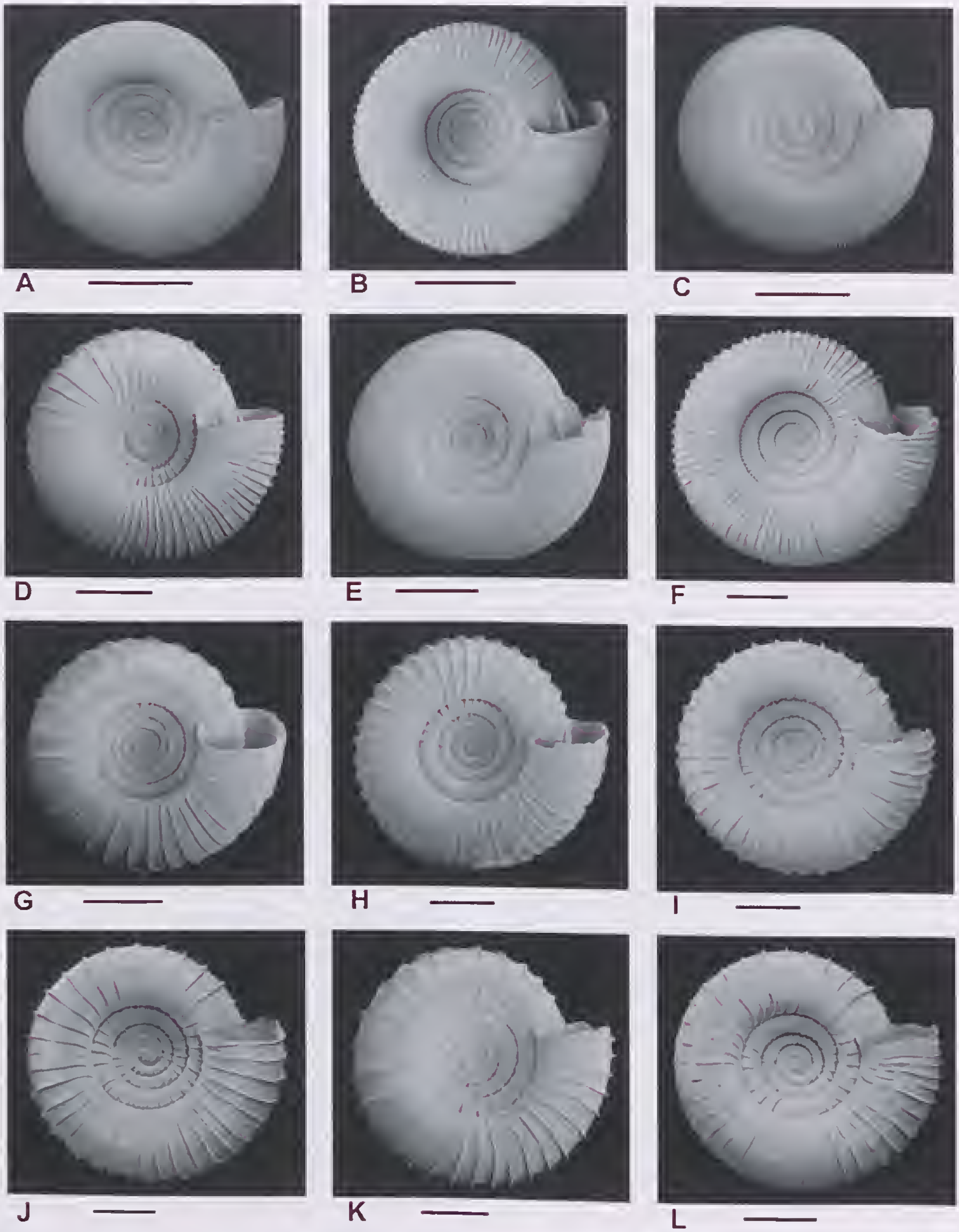


FIG. 7. Ventral view of shells. A, *Rhophodon kempseyensis*, AMSC153720. B, *Rhophodon palethorpei*, QMMO70390. C, *Rhophodon mcgradyorum*, QMMO70392. D, *Rhophodon silvaticus*, QMMO70391. E, *Rhophodon duplicostatus*, QMMO70393. F, *Egilodonta wyanbenensis*, QMMO70394. G, *Egilodonta bendethera*, QMMO70395. H, *Egilodonta paucidentata*, QMMO49447. I, *Egilodonta paucidentata*, QMMO70396. J, *Egilodonta bairnsdalensis*, AMSC142959. K, *Egilodonta bairnsdalensis*, AMSC153706. L, *Egilodonta bairnsdalensis*, AMSC154808. Scale bars=1mm in A, B; 0.5mm in C-L.

allopatric, *E. bairnsdalensis* (Gabriel, 1930), lacks a penial verge. It is probable that *Egilodonta* is still in a stage of comparatively exuberant speciation (in an historical context) compared with the environmentally restricted *Rhophodon*. The most widely collected species is *E. bairnsdalensis* which appears to be a eucalypt woodland species that also takes advantage of limestone habitats. *E. wyanbenensis* sp. nov., *E. bendethera* sp. nov. and *E. paucidentata* sp. nov. appear to be specifically associated with limestone environments based on current evidence, but more fieldwork in surrounding habitat needs to be completed before this association is firmly established.

### **Egilodonta bairnsdalensis** (Gabriel, 1930)
(Figs 2-7, 10-12, 34; Table 2)

*Charopa bairnsdalensis* Gabriel, 1930: 78, pl. 2, figs 11-12.
*Endodonta bairnsdalensis* (Gabriel). Kershaw, 1956a: 137.
*Egilodonta bairnsdalensis* (Gabriel). Iredale, 1937: 329; Gabriel. 1947: 120; Gabriel & Macpherson, 1947:162; Smith & Kershaw, 1979: 174.
*Dentherona bairnsdalensis* (Gabriel). Solem, 1972: 85, figs 17, 18.
*Rhophodon bairnsdalensis* (Gabriel). Stanisic, 1990: 138, figs 89-91; Smith, 1992: 202.

TYPE LOCALITY. Bairnsdale, Vic.

MATERIAL. NSW: AMSC355056, C355058, QMMO65004, MO65017.

DIAGNOSIS. Shell minute, straw-coloured, with a wide saucer-shaped umbilicus. Teleoconch with wide, almost straight, relatively broad, very widely spaced ribs. Mean ribs/mm 5.32. Aperture with one strong parietal barrier, one basal barrier and one palatal barrier. Penis internally with 2-4 longitudinal pilasters; verge absent.

DISTRIBUTION AND HABITAT. The Great Dividing Range from the Bairnsdale area in SE Vic north to the Yarrangobilly Caves, Kosciusko NP, SE NSW; found living among litter in eucalypt woodland. Specimens cited in Stanisic (1990) from Marble Arch are now included in *E. paucidentata* sp. nov.

REMARKS. *Egilodonta bairnsdalensis* (Gabriel, 1930) can be distinguished from *E. bendethera* sp. nov. and *E. paucidentata* sp. nov. by its stronger apertural barriers, slightly wider ribs, the presence of two to four penial pilasters and the absence of a penial verge. *E. wyanbenensis* sp. nov. is readily distinguished by having more crowded ribs on the last whorl. Some individuals of *E. bairnsdalensis* (mostly from around Lakes Entrance, Vic) have no palatal barrier, while others (mostly from around Kosciusko NP) have both basal and palatal barriers with the palatal weakly developed. However, in the absence of other shell (including shell size and shape) or anatomical differences between these populations, they are all included in *E. bairnsdalensis*.

### **Egilodonta wyanbenensis** sp. nov.
(Figs 2-11; Table 2)

ETYMOLOGY. From the type locality.

MATERIAL. HOLOTYPE: QMMO70394, Wyanbene Caves, S Braidwood, NSW (35°48'25"S, 149°41'20"E), lm, in litter, 6.i.1990, JS, JC. Height of shell=0.96mm, diameter=1.99mm, H/D=0.48, D/U=2.16, number of whorls=4.6, ribs on last whorl=66. PARATYPES: QMMO37793, 44RC, AMSC205156, 5RC, same data as holotype: QMMO29270, 34SC/3RC, Wyanbene Caves, S Braidwood, (35°48'25"S, 149°41'20"E), among litter on lm, 6.i.1990, JS, JC.

DIAGNOSIS. Minute straw-coloured shell with wide umbilicus. Teleoconch with moderately broad, slightly sinuated, moderately crowded ribs. Mean ribs/mm 10.32. Aperture with one parietal barrier, one basal barrier and one palatal barrier; barriers very weakly developed. Penis internally with a short verge and no pilasters.

DESCRIPTION. Shell very small, straw coloured, with 4.3-5.1 (mean 4.65) tightly coiled whorls, the last descending more radpidly in front. Shell diameter 1.78-2.39mm (mean 2.14mm). Apex and early spire flat to slightly concave. Height of shell 0.91-1.15mm (mean 1.03mm), H/D 0.43-0.52 (mean 0.48). Protoconch exsert of 1.4-1.7 whorls. Apical sculpture of curved radial ribs, becoming more crowded at protoconch/teleoconch boundary; width of interstices (in multiples of rib width) 6 at apex, 3 at post-nuclear boundary; secondary sculpture of discontinuous, very narrow, spiral wrinkles. Teleoconch seuplpture of moderaretly crowded, slightly protractively sinuated radial ribs; 56-85 (mean 69) ribs on last whorl. Ribs/mm 8.49-13.05 (mean 10.32). Ribs moderately broad, height less than width; straight in section, rounded on top. Rib interstices on first post-nuclear whorl equal to width of 2.5 ribs; interstices on penultimate whorl equal to width of 3 ribs. Interstitial sculpture of fine radial riblets and crowded microspiral cords, about equal in strength. Microradials low, 3-6 between ribs on first post-nuclear whorl, 8 between ribs on penultimate whorl; microspiral cords crossing

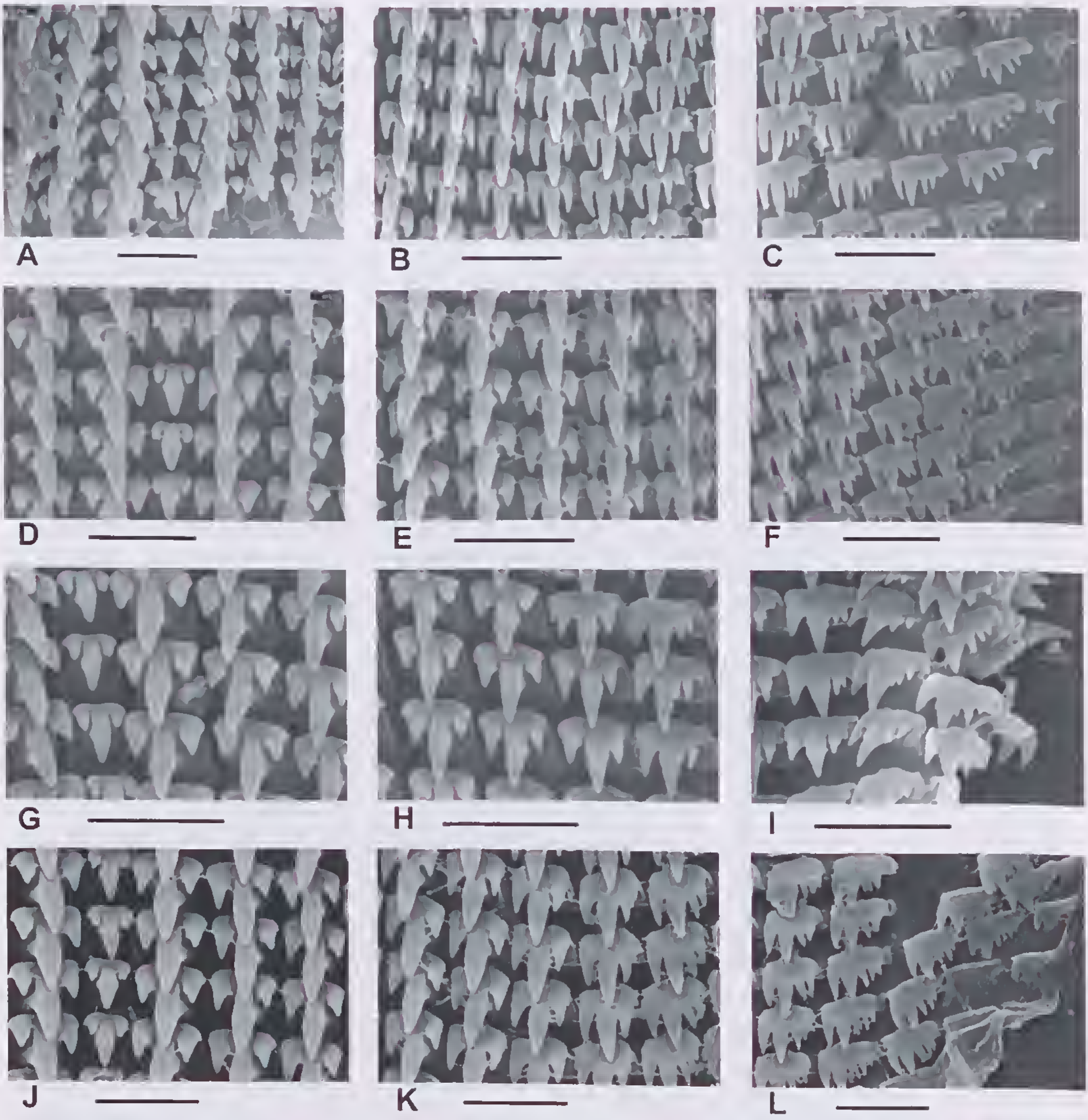


FIG. 8. Radula. A-C, *Rhophodon kempseyensis*, QMMO37096. D-F, *Rhophodon palethorpei*, QMMO55962. G-I, *Egilodonta wyanbenensis*, QMMO29270. J-L, *Egilodonta bendethera*, QMMO70395. Scale bars = 0.01mm.

major ribs and forming strong elongate beads at their intersection with microradials. Umbilicus very wide saucer-shaped, diameter 0.80-1.14mm (mean 0.48mm), D/U2.08-2.31 (mean 2.18). Sutures impressed, whorls evenly rounded above and below the periphery. Aperture ovately lunate, parietal callus present. One slender parietal barrier, a weak basal barrier and one palatal barrier present; all cresent shaped lamellae. Based on 16 measured adults (QMMO70394, MO37793, MO37796).

Genitalia with ovotestis containing two clumps of alveoli; with more than two alveolar lobes per clump. Talon stalk more than 3 times diameter of talon; talon circular. Penial retractor muscle entwined with epiphallus, inserting at junction of the penis and epiphallus. Epiphallus longer than penis, entering penis through a verge; length of verge less than half the length of penis. Epiphallus muscular, reflexed, wider than the vas deferens, internally with longitudinal pilasters. Penis tubular without internal pilasters; sheath present. Vagina tubular, longer than penis.

Pallial cavity with almost unilobed kidney; pericardial lobe elongate, triangular with apex slightly reflexed.

Radula with central tooth strongly tricuspid, considerably smaller than laterals; lateral teeth tricuspid; mesocone of first lateral tooth slender, slightly diamond-shaped; marginal teeth rounded; ectocone of outer marginal teeth split into four or more teeth; endocone occasionally split into two or more teeth. Number of lateral teeth 5; marginal teeth 6; radular rows 110.

Based on 3 dissected specimens (QMMO29270).

DISTRIBUTION AND HABITAT. Known only from the type locality; in litter on weakly vegetated limestone among open eucalypt woodland.

REMARKS. *Egilodonta wyanbenensis* sp. nov. is readily distinguished from *E. bairnsdalensis*, *E. bendethera* sp. nov. and *E. paucidentata* sp. nov. by the more crowded ribs on the teleoconch. Anatomically, *E. wyanbenensis* can be distinguished from its congeners by a combination of the presence of a short penial verge and absence of any penis pilasters. *E. bairnsdalensis* has two to four longitudinal pilasters and lacks a verge; *E. bendethera* has a long penial verge and a single longitudinal pilaster; and *E. paucidentata* has a short penial verge and several longitudinal pilasters.

The Wyanbene Caves locality has been relatively poorly surveyed, and the presence of *E. paucidentata* sp. nov. in the geographically proximate Bendethera and Marble Arch limestone outcrops might suggest that further fieldwork at this site could yet add this species to the inventory.

### **Egilodonta bendethera** sp. nov.
(Figs 2-11; Table 2)

ETYMOLOGY. For the type locality.

MATERIAL. HOLOTYPE: QMMO70395, Moruya, c.60km W at Bendethera Cave, NSW (35°55'54"S, 149°42'12"E), lm/Ficus, Acacia and eucalypt scrub, in litter on limestone rocks, 6.i.1994, JS, JC. Height of shell=0.91mm, diameter=1.64mm, H/D=0.55, D/U=2.34, number of whorls=4.3, ribs on last whorl=27. PARATYPES: QMMO68759, 14RC/14SC, same data as holotype; QMMO68760, 160RC, AMSC205157, 10RC, same data as holotype.

DIAGNOSIS. Shell very small, light golden brown with a wide umbilicus. Teleoconch with broad, widely spaced, protractively sinuated ribs. Mean ribs/mm 4.67. Aperture with one parietal barrier, and one weakly developed basal barrier and one weakly developed palatal barriers. Penis internally with long penial verge and one longitudinal pilaster.

DESCRIPTION. Shell very small, light golden brown, with 4.3-5.8 (mean 5.3) tightly coiled whorls, last descending more rapidly in front. Shell diameter 1.64-2.63mm (mean 2.34mm). Apex and early spire flat. Height of shell 0.91-1.38mm (mean 1.78mm), H/D 0.48-0.55 (mean 0.50). Protoconch exsert of 1.5-1.7 whorls. Apical sculpture of slightly curved, moderately spaced radial ribs, becoming more crowded toward protoconch/teleoconch boundary; width of interstices (in multiples of rib width) 7 at apex, 3 at post-nuclear boundary; secondary sculpture of moderately spaced, discontinuous radial wrinkles. Teleoconch sculpture of bold, widely spaced, almost straight radial ribs, 27-47 (mean 34) on last whorl. Ribs/mm 3.92-6.08 (mean 4.67). Rib height greater than width; straight in section, rounded on top. Rib interstices on first post-nuclear whorl equal to width of 5-6 ribs; interstices on penultimate whorl equal to width of 6 ribs. Interstitial sculpture of fine radial riblets and crowded microspiral cords, about equal in strength. Microradials low, 12 between ribs on first post-nuclear whorl, 25 between ribs on penultimate whorl; microspiral cords crossing major ribs and forming strong round to elongate beads at their intersection with microradials. Umbilicus very wide saucer-shaped, diameter 0.7-1.5mm (mean 0.96mm), D/U 2.19-2.63 (mean 2.44). Sutures impressed, whorls rounded above and below periphery. Aperture ovately lunate; lip sinuous; parietal callus present. One very fine parietal barrier, one basal and one palatal barrier present; barriers low blade-like. Based on 10 measured adults (QMMO70395, MO68759).

Genitalia with ovotestis containing two clumps of alveoli; more than two alveolar lobes per clump. Talon stalk more than 3 times diameter of talon; talon circular. Penial retractor muscle inserting at the junction of the penis and epiphallus. Epiphallus longer than penis; wider than vas deferens, muscular, reflexed, entering penis through a verge; internally with longitudinal pilasters. Penis tubular, internally with one

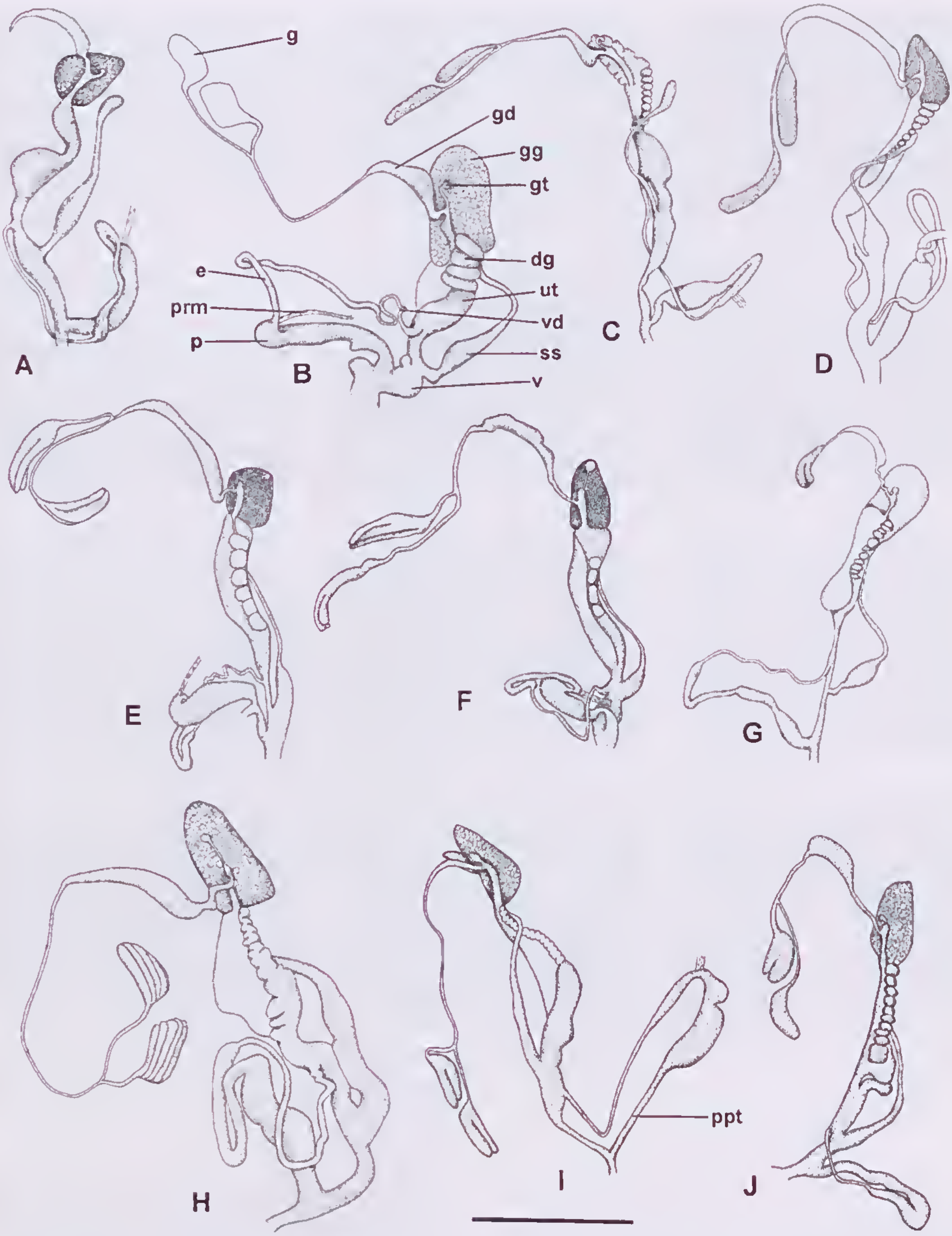


FIG. 9. Reproductive system. A, *Rhophodon kempseyensis*, QMMO37096. B, *Rhophodon palethorpei*, QMMO55962. C, *Egilodonta bairnsdalensis*, AMSC154770. D, *Egilodonta wyanbenensis*, QMMO29270. E, *Egilodonta bendethera*, QMMO70395. F, *Egilodonta paucidentata*, QMMO49447. G, *Letomola contortus*, QMMO56119. H, *Letomola lanalittleae*, QMMO56007. I, *Macrophallikoropa belli*, AMSC162176. J, *Macrophallikoropa stenoumbilicata*, QMMO28661. Scale bar=2mm in A and D, and 1.6mm in all others. Abbreviations: dg, prostate; e, epiphallus; g, ovotestis; gd, hermaphrodite duct; gg, albumen gland; gt, talon; p, penis; ppt, preputial tube; prm, penis retractor muscle; ss, spermathecal stalk; ut, uterus; v, vagina; vd, vas deferens.

longitudinal pilaster and long verge; length of verge greater than half the length of penis; sheath present. Vagina tubular, shorter than penis.

Pallial cavity with complete secondary ureter; kidney almost unilobed with rectal lobe vestigial and pericardial lobe elongate, triangular and with apex reflexed.

Radula with central tooth strongly tricuspid, considerably smaller than laterals; lateral teeth tricuspid; mesocone of first lateral tooth slender, slightly diamond-shaped; marginal teeth rounded; ectocone of outer marginal teeth split into four or more teeth; endocone not split. Number of lateral teeth 6; marginal teeth 7; radular rows 115.

Based on 3 dissected adults (QMMO68759).

DISTRIBUTION AND HABITAT. Known only from the type locality; living in litter on strongly vegetated limestone outcrop (including *Ficus* sp.) among open eucalypt woodland.

REMARKS. *Egilodonta bendethera* sp. nov. is microsympatric with *E. paucidentata* sp nov., to which it bears a strong resemblance. The two species can be distinguished by a difference in shell colour (*E. bendethera* is lighter), and a difference in aperture shape. The whorls of *E. bendethera* are rounded above and below a flattened periphery, giving the aperture a less rounded appearance than *E. paucidentata*. *E. bendethera* is also larger, has wider rib spacing and has a narrower (wide cup-shaped instead of shallow saucer-shaped) umbilicus than *E. paucidentata*. Anatomically *E. bendethera* differs from *E. paucidentata* in that the epiphallus enters the penis through a long verge (more than half the length of the penis), and in having only one penial pilaster. In *E. paucidentata* the verge is considerably shorter (less than half the length of the penis), and there are six penial pilasters. Both species are similar to *E. bairnsdalensis*, but differ in having weaker apertural barriers and less widely spaced teleoconch ribs. *E. bendethera* is readily distinguished from *E. wyanbenesis* by having less crowded ribs on the teleoconch.

## **Egilodonta paucidentata** sp. nov.

(Figs 2-11, 33; Table 2)

ETYMOLOGY. Latin *paucus*, few, and *dentatus*, toothed; referring to the poor apertural dentition.

MATERIAL. HOLOTYPE: QMMO70396, Marble Arch, S of Braidwood, NSW (35°43'19"S, 149°42'12"E), limestone outcrop/remnant rainforest, under rocks and in litter, 11.x.1992, JS, GI. Height of shell=0.95mm, diameter=1.92mm, H/D=0.49, D/U=2.06, number of whorls=4.8, ribs on last whorl = 37. PARATYPES: All NSW. QMMO42081, 5SC/49RC, same data as holotype; AMSC126761, 20+RC, W of Batemans Bay, Deua NP, Bendoura Ra, Reedy Ck, Marble Arch (35°43.6'S, 149°41.4'E), WFP, W.F. (Jr) Ponder; AMSC346063, 20+RC, W of Batemans Bay, Deua NP, Bendoura Ra, Reedy Ck, 5km E of Berlang Camping Ground, Marble Arch (35°43.6'S, 149°41.4'E), MS. OTHER MATERIAL. QMMO49447, MO68004.

DIAGNOSIS. Minute golden brown shell with a wide saucer-shaped umbilicus. Teleoconch with widely spaced, broad, protractively sinuated ribs. Mean ribs/mm 6.51. Aperture with one parietal, one basal and one palatal barrier; barriers weakly developed, blade-like. Penis internally with a short apical verge and six longitudinal pilasters.

DESCRIPTION. Shell discoidal, golden brown, with 4.5-5.5 (mean 5.0) tightly coiled whorls, the last descending more rapidly in front. Shell diameter 1.72-2.26mm (mean 1.99mm). Apex and early spire flat. Height of shell 0.80-1.11mm (mean 0.93), H/D 0.41-0.54 (mean 0.47). Protoconch exsert of 1.2-1.7 whorls. Apical sculpture with prominent, strongly curved radial ribs, becoming increasingly crowded toward prortoconch/teleoconch boundary; width of interstices (in multiples of rib width) 7 at apex, 2 at post-nuclear boundary; secondary sculpture of moderately spaced, discontinuous radial wrinkles. Teleoconch sculpture of bold, widely spaced, protractively sinuated radial ribs; 28-57 (mean 41) ribs on last whorl. Ribs/mm 4.87-8.91 (mean 6.51). Rib height equal to width; straight in section, rounded on top. Rib interstices on first post-nuclear whorl equal to width of 4-5 ribs; interstices on penultimate whorl equal to width of 3-5 ribs. Interstitial sculpture of fine radial riblets and crowded microspiral cords, about equal in strength. Microradials low, 10-13 between ribs on first post-nuclear whorl, 15-21 between ribs on penultimate whorl; microspiral cords crossing major ribs and forming strong elongate beads at their intersection with microradials. Umbilicus very wide, saucer-shaped, diameter 0.85-1.07mm (mean 0.94mm), D/U 1.95-2.32 (mean 2.13). Sutures impressed, whorls rounded above and below a flattened periphery. Aperture ovately lunate; lip sinuous; shiny parietal callus present. One very fine parietal barrier, one basal and one palatal barrier present; barriers low blade-like. Based on 43 measured adults (QMMO70396, MO49447, MO68004, MO42081).

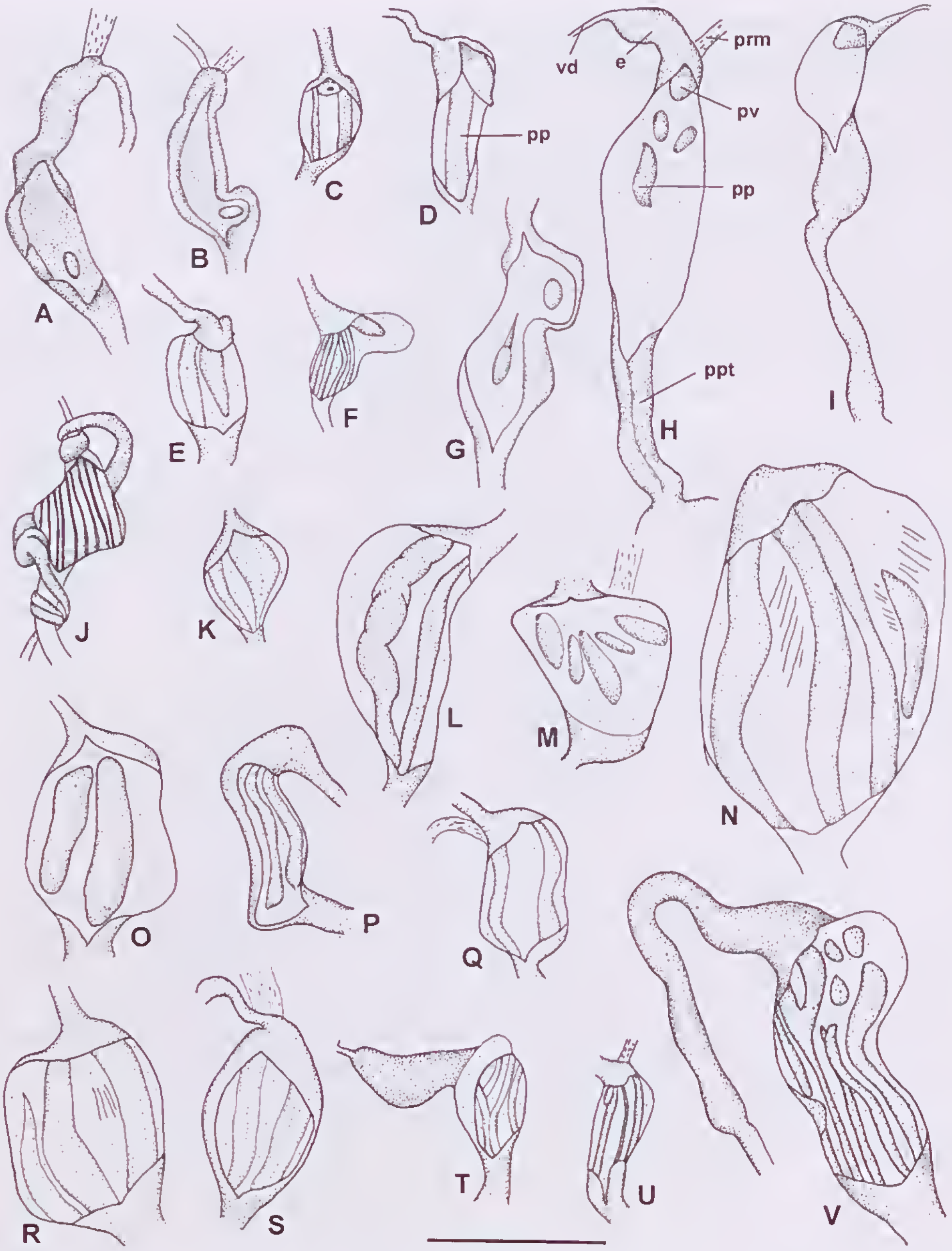


FIG. 10. Penis, dissected. A, *Rhophodon kempseyensis*, QMMO37096. B, *Rhophodon palethorpei*, QMMO55962. C, *Egilodonta bairnsdalensis*, AMSC154770. D, *Egilodonta wyanbenensis*, QMMO29270. E, *Egilodonta bendethera*, QMMO70395. F, *Egilodonta paucidentata*, QMMO49447. G, *Letomola lanalittleae*, QMMO56007. H, *Macrophallikoropa belli*, QMMO16867. I, *Macrophallikoropa stenoumbilicata*, QMMO28661. J, *Elsothera brazieri*, QMMO44810. K, *Decoriropa lirata*, QMMO42109. L, *Coricudgia wollemiana*, QMMO28659. M, *Marilyniropa jenolanensis*, QMMO37465. N, *Gouldiropa kaputarensis*, QMMO49175. O, *Cralopa stroudensis*, QMMO29722. P, *Gouldiropa carlessi*, MO32080. Q, *Sharniropa wollondillyana*, QMMO29241. R, *Acheronopa attunga*, QMMO49218. S, *Hedleyropa yarrangobillyensis*, QMMO39840. T, *Scleridoropa sarahjaneae*, QMMO39974. U, *Scleridoropa nandewar*, QMMO49158. V, *Diphyoropa macleayana*, AMSC162184. Scale bar=1.25mm in L, and 1mm in all others. Abbreviations: e, epiphallus; pp, penial pilaster; ppt, preputial tube; pv, penial verge, vd, vas deferens.

Genitalia with ovotestis containing two clumps of alveoli; more than two alveolar lobes per clump. Talon stalk 1-3 times the diameter of the talon; talon circular. Penis retractor muscle half the length of penis or greater; inserts at junction of penis and epiphallus. Epiphallus present; enters penis through a verge; length of verge less than half the length of penis. Epiphallus longer than penis; wider than vas deferens; pilasters longituduinal; retractor muscle not entwined with epiphallus. Penis sheath present; penis tubular; pilasters longitudinal; 6 pilasters present. Vagina shorter than penis; atrium shorter than penis; preputial tube absent. Pallial cavity with complete secondary ureter; primary ureter normal; kidney almost unilobed; apex reflexed. Mantle gland absent.

Radular morphology unknown.

Based on 1 dissected adult (QMMO49447).

DISTRIBUTION AND HABITAT. Known only from two limestone environments in the Bendoura/Minuma Ranges, S of Braidwood, SE NSW; living in litter on strongly vegetated limestone outcrops that support some remnant rainforest plant species; the surrounding countryside comprises open eucalypt woodland.

REMARKS. Features that differentiate *Egilodonta pancidentata* sp. nov. from other members of the genus are given above. The species is most similar to *E. bairsnsdalensis* in general shell features and was mis-identified as that species by Stanisic (1990). *E. pancidentata* has comparatively weaker apertural barriers and slightly more crowded ribs than *E. bairnsdalenesis*. Anatomically, the presence of a verge in *E. pancidentata* is a major difference from the vergeless condition in *E. bairnsdalensis*. The two species are allopatric and accurate locality data should eliminate the chance of misidentification.

Additional fieldwork needs to be conducted in the vicinity of the limestone localities in order to determine whether this species is an obligate calciphile.

### **Letomola** Iredale, 1941

*Letomola* Iredale, 1941a: 267; Stanisic, 1990: 109; Smith 1992: 110.

*Letomala* (error) Kershaw, 1956b: 9.

TYPE SPECIES. *Rhophodon contortus* Hedley, 1924; by original designation.

DIAGNOSIS. Small to minute charopids, with discoidal shells; colour brown with white radial streaks. Shell with or without apertural barriers; spire flat to depressed. Protoconch strongly exsert with sculpture of irregular pits; sometimes with narrow, very widely spaced, curved radial ribs; spiral cords absent but discontinuous spiral grooves sometimes present. Teleoconch sculpture degenerate, without distinct radial ribs, instead with broad, shingle-like, overlapping radial thickenings; secondary sculpture of low microradial ridges and low spiral cords that form weak beads at their intersection. Umbilicus very wide saucer-shaped to broad V-shaped. Kidney moderately bilobed with apex of pericardial lobe slightly reflexed. Penis internally with longitudinal pilasters and with or without vergic structures.

DISTRIBUTION AND HABITAT. *Letomola* Iredale, 1941 is known only from the Macleay Valley, NE NSW. Species are obligate limestone dwellers usually living in litter or on the rock surface of outcrops among dry rainforest.

REMARKS. Iredale (1941a) introduced *Letomola* for *Rhophodon contortus* Hedley, 1924 without giving clear reasons for the separation from *Rhophodon* Hedley, 1924. Kershaw (1956b) briefly discussed the genus. Subsequently Smith & Kershaw (1979) added *Helix barrenensis* Petterd, 1879 (type locality: Furneaux Group of islands, Bass Strait) without detailed justification for this placement. These authors probably based their decision on the presence of apertural lamellae since other details of the shell do not agree with those of *Letomola*. Smith (1992) maintained this classification. *H. barrenensis* is not discussed here but the fact that it has well developed radial sculpture on the teleoconch (as opposed to the degenerate sculpture of *Letomola*) indicates strongly that it does not belong to *Letomola*. The generic status of this species most probably needs to be determined in a context of the Tasmanian charopids.

In spite of the absence of apertural barriers, the addition of *L. lanalittleae* sp. nov. does not alter the basic concept of *Letomola* as presented by Stanisic (1990). Barriers have developed independently in a number of Australian charopid genera and numbers of barriers vary from species to species. In the case of *L. lanalittleae* barrier loss merely represents an extreme example of reduction. Protoconch sculpture, teleoconch sculpture, and to a lesser degree, general shell form all agree with Stanisic's (1990) view of the genus. A slightly amended diagnosis is presented to accommodate the idiosyncrasies of the new species.

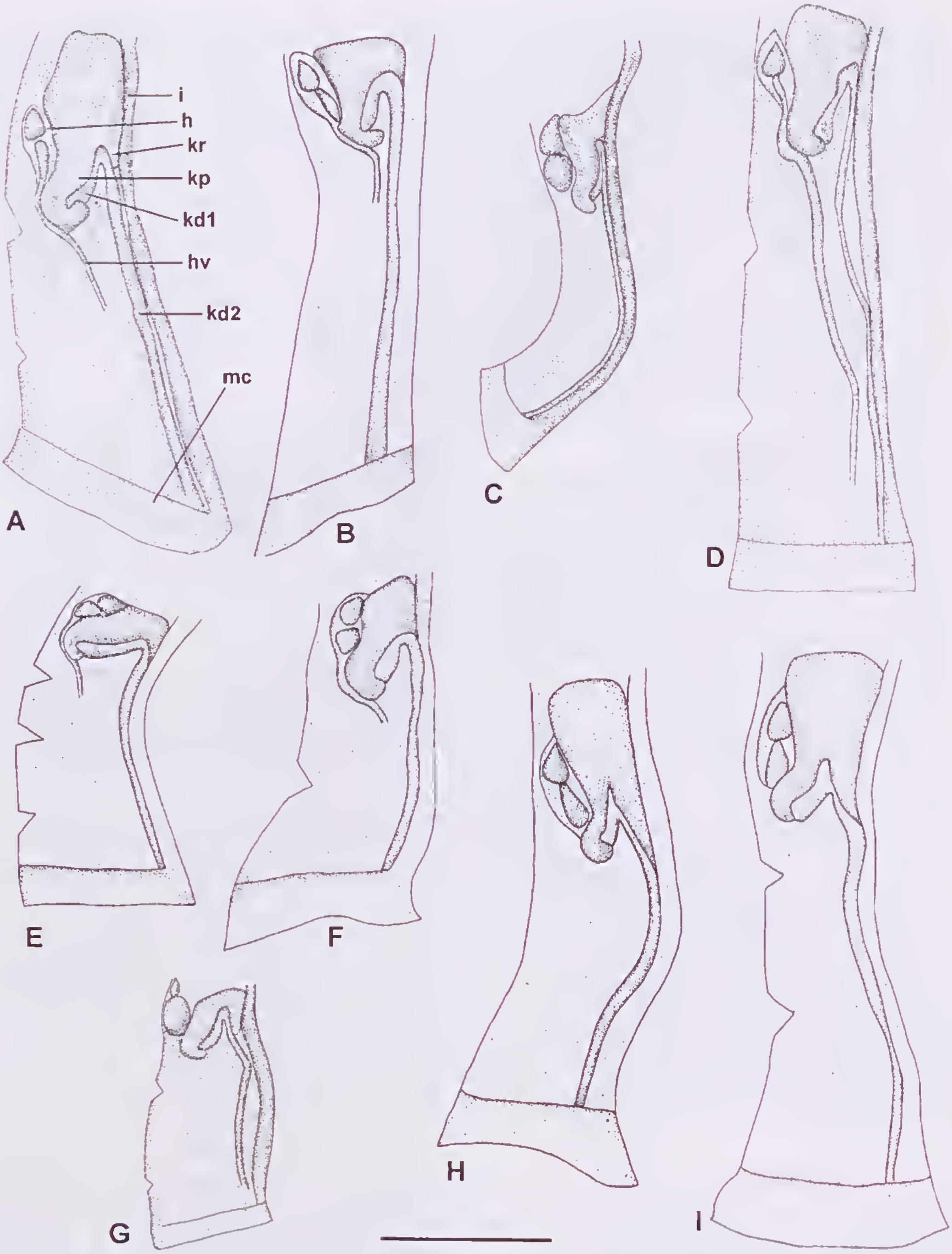


FIG. 11. Pallial cavity. A, *Rhophodon kempseyensis*, QMMO37096. B, *Rhophodon palethorpei*, QMMO55962. C, *Egilodonta bairnsdalensis*, AMSC154770. D, *Egilodonta wyanbenensis*, QMMO29270. E, *Egilodonta bendethera*, QMMO70395. F, *Egilodonta paucidentata*, QMMO49447. G, *Letomola contortus*, QMMO56119. H, *Macrophallikoropa belli*, AMSC162176. I, *Macrophallikoropa stenoumbilicata*, QMMO28661. Scale bar = 1.5mm in B, and 1.2mm in all others. Abbreviations: h, heart; hv, principal pulmonary vein; i, intestine; kd1, primary ureter; kd2, secondary ureter; kp, pericardial lobe of kidney; kr, rectal lobe of kidney; mc, mantle collar; mg, mantle gland.

*Letomola* Iredale, 1941 possesses a number of features that distinguish it from other charopid genera examined in this study. Having a shell with a pitted protoconch, supra-peripheral sulcus and degenerate teleoconch sculpture and a radula with greatly reduced central tooth are a unique combination of features that readily identify *Letomola* among all hitherto described eastern Australian Charopidae. Ecologically *Letomola* is distinguished by living on the limestone karst surface as well as in the interstitial litter. No other charopid is currently known to live on limestone karst in eastern Australia although this is common among groups such as the Hydrocenidae (*Georissa* spp.), Helicinidae (*Pleuropoma* spp.) and Pupillidae (*Gyliotrachela* spp.) (Stanisic, pers. obs.). Solem (1974) suggested that ribs have a universal functional role among land snails of maintaining a dirt free shell surface for the snail as it crawls through moist, adherent litter. In which case the modified (reduced?) shell sculpture of *Letomola* may be related to its tendency to a non-litter lifestyle. A similar pattern is seen in the semi-arboreal charopids, *Lenwebbia protoscrobiculata* Stanisic, 1990 and *Lenwebbia paluma* Stanisic, 1993. Both have a shell with pitted apical sculpture and reduced teleoconch sculpture.

### **Letomola contortus** (Hedley, 1924)

(Figs 9, 11-12, 14-18; Table 2)

*Rhophodon contortus* Hedley, 1924: 220, pl. 32, figs 35-37; Kershaw, 1955: 30.

*Letomola contortus* (Hedley). Iredale, 1941a: fig. 6; Iredale, 1941b: 2; Stanisic, 1990: 110, figs 67-69; Smith, 1992: 193.

*Letomala* (sic) *contortus* (Hedley). Kershaw, 1956b: 9.

MATERIAL. All NSW: QMMO37150, MO19796, MO56119, MO59998, MO52762, AMSC157303, C168612.

DIAGNOSIS. Shell minute, brown with white radial streaks. Whorls tightly coiled with a strong supraperipheral sulcus. Protoconch pitted, without any radial ribs or spiral cords, spire depressed. Teleoconch lacking distinct radial ribs, instead with broad, shingle-like, radially ridged, overlapping thickenings. Umbilicus wide and shallow saucer-shaped. Two apertural barriers (one parietal, one palatal) present. Ovotestis consisting of one clump of alveoli with two alveolar lobes. Penis internally with an apical round pilaster and several longitudinal pilasters basally.

DISTRIBUTION AND HABITAT. Eastern end of the lower Macleay Valley, NE NSW on limestone outcrops among dry rainforest. Found living on roof, walls and in floor litter of limestone caves, or sheltered vertical limestone rock faces.

REMARKS. *Letomola contortus* (Hedley, 1924) is readily identified by its degenerate adult sculpture, very wide umbilicus and the presence of a supraperipheral sulcus. Differences from *L. lanalittleae* sp. nov. are presented under that species (see below). Anatomically *L. contortus* is not very different from other 'dentate' charopids such as those grouped under *Rhophodon* Hedley, 1924 and *Egilodonta* Gabriel, 1930. However, the shell patterns are a dramatic departure from general charopid patterns seen in this study and probably relate to a slightly altered lifestyle not requiring the functional advantages of a ribbed shell. Interestingly this species lives on the limestone karst rather than the litter.

### **Letomola lanalittleae** sp. nov.

(Figs 9-10, 12, 14-18, 33-34; Table 2)

ETYMOLOGY. For Lana Little.

MATERIAL. All NSW. HOLOTYPE: QMMO70397, Kempsey, WNW, c.1.5km E Mt Sebastopol, Kempsey-Carrai Rd, NSW (30°57'00"S, 152°28'40"E), on rocks, drf/lm, 28.xi.1989, JS, DP. Height of shell=1.38mm, diameter=2.86mm, H/D=0.48, D/U=3.62, number of whorls=4.7. PARATYPES: QMMO32292, 19SC/44RC, same data as holotype; QMMO37761, 50RC, Kempsey, WNW, c.1.5km E Mt Sebastopol, Kempsey-Carrai Rd (30°57'00"S, 152°28'40"E), in litter, drf/lm, 28.xi.1989, JS, DP; QMMO56007, 20SC/42RC, Kempsey, WNW, c.1.5km E Mt Sebastopol, Kempsey-Carrai Rd (30°57'00"S, 152°28'40"E), on limestone and in litter, drf/lm, 8.i.1995, JS, JC. OTHER MATERIAL. QMMO49294.

DIAGNOSIS. Shell moderately small, chocolate brown with cream blotches. Whorls tightly coiled with a strong supraperipheral sulcus; Umbilicus wide V-shaped. Spire flat with exsert protoconch. Apertural barriers absent. Pitted protoconch with faint, curved, irregular radial ribs and discontinuous spiral grooves. Teleoconch without pronounced radial ribs, instead with broad, radially ridged, shingle-like overlapping thickenings. Ovotestis containing two clumps of alveoli, with more than two alveolar lobes per clump. Penis internally with round to ovate pilasters.

DESCRIPTION. Shell small, chocolate brown with cream radial streaks, with 4.7-5.6 (mean 5.3) tightly coiled whorls, the last descending very rapidly in front; supraperipheral sulcus present. Shell diameter 2.81-3.74mm (mean 3.40mm).

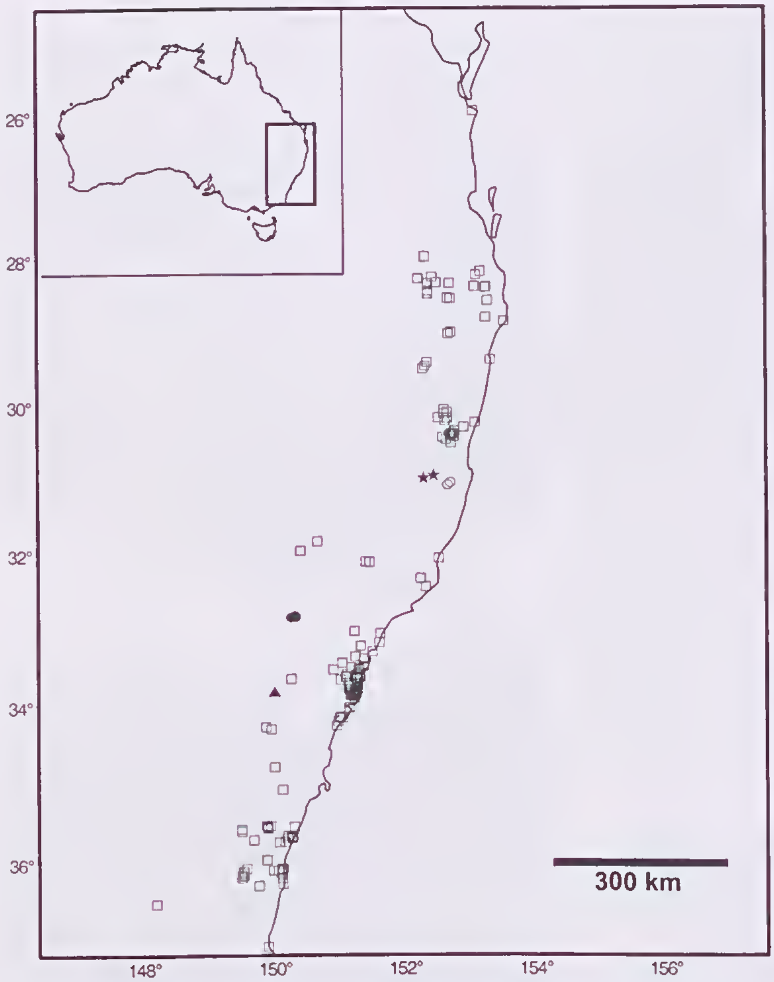


FIG. 12. Distribution of *Letomola* and *Macrophallikoropa*. Key: ○ *Letomola contortus*, ★ *Letomola lanalittleae*, □ *Macrophallikoropa belli*, ● *Macrophallikoropa stenoumbilicata*, ▲ *Macrophallikoropa depressispira*.

Spire flat. Height of shell 1.30-1.74mm (mean 1.48mm), H/D 0.40-0.49 (mean 0.44). Protoconch strongly exsert of 1.5-1.7 whorls. Apical sculpture of irregular pits, with irregularly spaced, curved radial ribs; rib spacing variable, decreasing towards post-nuclear boundary (but not evenly); width of interstices (in multiples of rib width) 15 at apex; 2 at post-nuclear boundary. Scattered, discontinuous spiral grooves also present. Teleoconch sculpture consisting of broad, radially ridged, shingle-like overlapping thickenings. Microsculpture of low microradial radial ridgelets and microspiral cords, about equal in strength; forming weak round beads at their intersection. Umbilicus wide V-shaped, diameter 0.79-1.18mm (mean 1.02mm), D/U 3.08-3.74 (mean 3.35). Base flattened with microradial ridgelets becoming more bladelike. Aperture ovately lunate; parietal callus present; apertural barriers absent. Based on 21 measured adults (QMMO37761, MO32292, MO70397).

Genitalia with ovotestis containing two clumps of alveoli; with more than two alveolar lobes per clump. Talon stalk more than 3 times diameter of talon; talon circular. Penial retractor muscle less than half the length of penis; inserting onto the penis apex. Epiphallus present, longer than penis; wider than vas deferens, entering penis through a simple pore. Penis tubular, pilasters modified (round); penial sheath present. Vagina shorter than penis.

Pallial cavity with kidney moderately bilobed; apex very slightly reflexed.

Radula with central tooth weakly tricuspid; lateral teeth tricuspid; first and second laterals equal in width; mesocone of first lateral tooth rounded at tip; marginal teeth flattened and rectangular; ectocone of outer marginal teeth split into three teeth; endocone not split. Number of lateral teeth 7; marginal teeth 7; radular rows 119. Based on 4 dissected specimens (QMMO56007).

DISTRIBUTION AND HABITAT. *Letomola lanalittleae* sp. nov is known from limestone outcrops among dry rainforest at the western end of the lower Macleay Valley; living on vertical limestone surfaces.

REMARKS. *Letomola lanalittleae* sp. nov. is distinguished from *L. contortus* by its larger size, flat spire (depressed in *L. contortus*), narrower umbilicus and the absence of apertural lamellae (two present in *L.contortus*). Anatomically, *L. lanalittleae* differs by having 2 clumps of alveoli in the ovotestis compared with only 1 in *L.contortus*. The radula of *L. lanalittleae* also has

TABLE 2. Shell measurements for species of *Egilodonta and Letomola*. (Abbreviations as in Table 1).

| Measurement | *Egilodonta bairnsdalensis* | *Egilodonta wyanbenensis* | *Egilodonta bendethera* | *Egilodonta paucidentata* | *Letomola contortus* | *Letomola lanalittleae* |
|---|---|---|---|---|---|---|
| N | 49 (*48) | 16 (*15) | 10 | 42 | 15 | 21 (*20) |
| D | 1.51-2.19 (1.86) ± 0.09 | 1.78-2.39 (2.14) ± 0.157 | 1.64-2.63 (2.34) ± 0.32 | 1.72-2.26 (1.99) ± 0.11 | 1.78-2.23 (2.063) ± 0.133) | 2.81-3.74 (3.4) ± 0.28 |
| PW | 1.5-1.8 (1.66) ± 0.07 * | 1.4-1.7 (1.573) ± 0.088 * | 1.5-1.7 (1.55) ± 0.07 | 1.2-1.7 (1.56) ± 0.1 | 1.5-1.6 (1.527) ± 0.046 | 1.5-1.7 (1.61) ± 0.07 |
| TW | 2.9-4.9 (3.27) ± 0.3) * | 2.7-3.4 (3.073) ± 0.215 * | 2.8-4.2 (3.78) ± 0.46 | 3-4 (3.44) ± 0.2 | 2.2-2.7 (2.467) ± 0.172 | 3.1-4 (3.66) ± 0.25 |
| NW | 4.6-6.6 (4.93) ± 0.3 * | 4.3-5.1 (4.647) ± 0.185 * | 4.3-5.8 (5.33) ± 0.47 | 4.5-5.5 (5) ± 0.19 | 3.7-4.2 (3.993) ± 0.175 | 4.7-5.6 (5.26) ± 0.27 |
| H | 0.73-1.08 (0.89) ± 0.09 | 0.91-1.15 (1.033) ± 0.074 | 0.91-1.38 (1.18) ± 0.16 | 0.8-1.11 (0.93) ± 0.07 | 0.85-1.05 (0.979) ± 0.057 | 1.3-1.74 (1.48) ± 0.11 |
| SP | 0-0.12 (0.03) ± 0.04 | 0-0.02 (0.001) ± 0.005 | 0.01-0.18 (0.07) ± 0.06) | 0-0.14 (0.04) ± 0.04 | 0-0.01 (0.002) ± 0.004 | 0.08-0.42 (0.25) ± 0.1 |
| AH/AW | 1.1-1.62 (1.31) ± 0.12 | 1.29-1.76 (1.5) ± 0.13 | 1.13-1.57 (1.33) ± 0.14 | 1.14-1.76 (1.34) ± 0.12 | 0.97-1.31 (1.18) ± 0.08 | 0.71-1.05 (0.87) ± 0.09 |
| UMB | 0.67-0.95 (0.79) ± 0.06 | 0.8-1.14 (0.985) ± 0.082 | 0.7-1.15 (0.96) ± 0.13 | 0.85-1.07 (0.94) ± 0.05 | 0.64-0.88 (0.783) ± 0.067 | 0.79-1.18 (1.02) ± 0.11 * |
| RIB | 23-50 (33.57) ± 6.53 | 56-85 (69.125) ± 7.83 | 27-47 (34.3) ± 7.04 | 28-57 (40.67) ± 7.07 | - | - |
| RIBS/MM | 2.78-7.27 (5.32) ± 1.11 | 8.49-13.05 (10.32) ± 1.271 | 3.92-6.08 (4.67) ± 0.71 | 4.87-8.91 (6.51) ± 1.02 | - | - |
| H/D | 0.43-0.55 (0.48) ± 0.03 | 0.43-0.52 (0.48) ± 0.03 | 0.48-0.55 (0.5) ± 0.03 | 0.41-0.54 (0.47) ± 0.03 | 0.43-0.53 (0.48) ± 0.03 | 0.4-0.49 (0.44) ± 0.03 |
| D/U | 2.11-2.58 (2.37) ± 0.11 | 2.08-2.31 (2.18) ± 0.07 | 2.19-2.63 (2.44) ± 0.12 | 1.95-2.32 (2.13) ± 0.09 | 2.38-2.79 (2.64) ± 0.13 | 3.08-3.74 (3.35) ± 0.21 * |

the first lateral tooth the same size as the other lateral teeth, whereas in *L. contortus* the first lateral is considerably larger than the others. *L. contortus and L. lanalittleae* are allopatric within the lower Macleay Valley and the considerable shell differences point to either a long period of isolation or a major shift in environmental regime. The larger size of *L. lanalittleae* may be a reflection of its adaptation to a less insular lifestyle above the litter on the limestone rock where living conditions are harsher and requiring of a larger shell. A somewhat analgous phenomenon is seen in populations of littoral zone mollusks where larger individuals can exist higher up on the seashore because they are less prone to dessication. In the case of *Letomola*, the evolution of a larger shell has probably allowed *L. lanalittleae* more flexibility in living space than *L. contortus*.

### **Macrophallikoropa** gen. nov.

ETYMOLOGY. Greek *macro*, long and *phallikos*, penis; referring to the unusually long penial apparatus.

TYPE SPECIES. *Helix belli* Cox, 1864; herein designated.

DIAGNOSIS. Shell minute, discoidal, with tightly coiled whorls. Colour golden brown to very light golden brown, sometimes with darker flammulations. Protoconch exsert; spire slightly elevated to depressed. Protoconch sculptured with narrow, high, continuous spiral lirae; number of lirae 13-20. Secondary apical sculpture of radial elements present as narrow, discontinuous ridgelets (= pressure folds) between the cords. Teleoconch with slightly sinuated to straight, very crowded ribs; interstitial sculpture with microradials and microspirals about equal in strength, forming strong rounded beads at their intersection. Umbilicus wide U-shaped to very wide saucer-shaped. Kidney strongly bilobed. Epiphallus moderately long to very short. Penis with long to very long preputial tube; internally with very short apical verge or apical pore; no other visible thickenings.

DISTRIBUTION AND HABITAT. *Macrophallikoropa* gen. nov. ranges from SE NSW to SE Qld. Species live under logs and rocks in temperate to subtropical rainforest (humid and dry), dry vine thicket and wet to dry sclerophyll forest and occur under a variety of geological regimes ranging from sandstone to basalt and limestone.

REMARKS. *Allocharopa* Iredale, 1937 (type species: *Helix brazieri* Cox, 1868) was introduced to accommodate a number of charopids from New South Wales, Victoria and Tasmania, including *Helix belli* Cox, 1864. One of the key characters given in the generic diagnosis was that the protoconch should be 'radially ribbed as remainder of shell'. Closer inspection reveals that the conglomeration of species included in this genus represents a variety of protoconch types. This is a strong indication that the group is polyphyletic. *H. belli* has a prominent spirally lirate protoconch which immedately separates it from the other species listed by Iredale, 1937 under *Allocharopa*.

As will be shown below, *Allocharopa* is a junior synonym of *Elsothera* Iredale, 1933 and most of the species included in this genus by Smith (1992) will need reallocation. A major revision of all the species is beyond the scope of this study and only *H. belli* and *H. brazieri* (see below) are dealt with herein. It is highly probable that the other species (mostly Tasmanian) will need to be reviewed in the context of that local charopid fauna since many of the southern Charopidae (Tasmanian, Victorian) appear unrelated to the eastern NSW radiation (Stanisic, unpubl. data).

Smith & Kershaw (1979) placed *H. belli* in *Roblinella* Iredale, 1937 (type species *Helix roblini* Petterd, 1879) which was introduced to accommodate a series of species with 'spirally striated nuclear whorls'. These authors did so without giving reasons. As introduced by Iredale (1937), *Roblinella* contains species with dramatically different apical spiral lirae indicating that it is polyphyletic (possibly at least three genera [Stanisic, unpubl. data]). The spirally lirate protoconch of *H. belli* comes closest to that of the type, *R. roblini*, but differs in having more regular and crowded lirae. The very fine teleoconch ribs and coiling pattern of *R. roblini* (loose coiling with tiny umbilicus) are also features that indicate the two species are not congeneric.

On available evidence *H. belli* deserves generic recognition and *Macrophallikoropa* gen. nov. is introduced for this widespread rainforest charopid plus two additional new species from very restricted localities in the Sydney Basin Bioregion.

*Macrophallikoropa* gen. nov. can be distinguished from all other genera in this study by the presence of a spiral protoconch. The studies of Stanisic (1987, 1990, 1993a) show that spiral apical sculpture has developed independently in distantly related groups. In contrast to the apical sculpture of *Setomedea* Iredale, 1941 (low, narrow, moderately spaced, strongly to slightly wavy spiral cords with vague, scattered radial ridges); *Oreokera* Stanisic, 1987 (low, crowded, regular to wavy spiral cords with radial rugosities developing at the protoconch/ teleoconch boundary); *Mussomla* Iredale, 1937 (low, fine to bold, crowded to very crowded spiral cords with curved radial ridges appearing toward the protoconch/teleoconch border); *Sinployea* Solem, 1983 (low, widely spaced radial cords); and *Omphaloropa* Stanisic, 1990 (low, moderately spaced spiral cords that become indistinct toward the inner half of the embryonic whorls), that of *Macrophallikoropa* features spiral cords that are strongly developed, crowded, narrow and high in section. In each of the above genera the lirae and general protoconch appearance seem macroscopically similar, but when viewed by scanning electron microscopy they reveal subtle but significant differences in architectural detail. These seemingly minor differences in protoconch sculpture correspond with major differences in shell form, teleoconch sculpture and anatomy suggesting that they are phylogenetically significant. Iredale (1937, 1941a,b) and Smith & Kershaw (1979) list a number of Australian charopids with a spirally lirate protoconchs, but do not provide adequate detail on microstructural diversity for this level of interpretation.

An additional feature on the protoconch of *Macrophallikoropa* is the presence of short, discontinuous radial elements between the cords. These may represent shrinkage wrinkles associated with a dried periostracum (=pressure folds) in a manner similar to the discontinuous spiral elements shown by Solem (1984) to be present on the apices of species with predominantly radial protoconchs such as *Discocharopa aperta* (Möllendorff, 1888).

The biogeography of this group is intriguing with a widespread species, *M. belli* (Cox, 1864) occurring mainly in the rainforests along the Great Dividing Range from SE NSW to SE Qld, in the sandstone country around Sydney and in several southern limestone localities (Jenolan, Bungonia, Wombeyan, Marble Arch, Wyanbene). Two additional species, *M. depressispira* sp. nov. and *M. stenoumbilicata* sp. nov., occur in restricted habitats at Jenolan Caves and Mt Coricudgy and environs respectively. Much of the area that encompasses these latter distributions is sandstone dominated by sclerophyll forests with rainforest occurring only as small refugia in damp gullies or on rocky outcrops. Jenolan Caves (limestone) and Mt

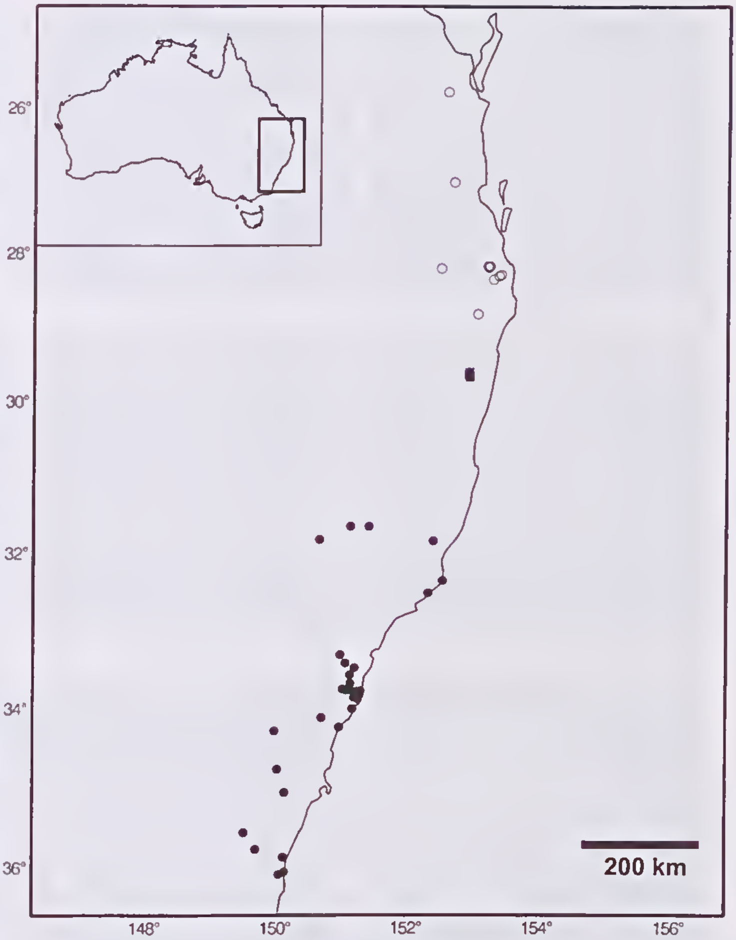


FIG. 13. Distribution of *Egilomen*, *Whiteheadia* and *Decoriropa*. Key: ■ *Egilomen cochlidium*, ○ *Whiteheadia globosa*, ● *Decoriropa lirata*.

Coricudgy (a basalt capped peak) represent two unusual isolated topographies within this sandstone landscape. Both maintain remnant rainforest communities. Judging by the widespread distribution of *M. belli* within currently disconnected coastal rainforests blocks in eastern NSW and SE Qld, this species must have been present in these rainforests at a time when they were more extensive and more strongly interconnected. Presumably as rainforest became climatically restricted and fragmented in distribution from approximately the mid-Miocene onwards, *M. belli* would have continued to exist as isolated populations in widely separated refugia, probably along drainage lines, on mountain tops and in select topographic niches. Presumably also, climatically induced, shorter-term expansion of traditional *M. belli* habitat through the many wet climatic phases in the Plio-Pleistocene would have enabled *M. belli* to once again disperse and also occupy the wetter, non-rainforest habitats it now in does in southern areas, including much of the Sydney Basin Bioregion. *M. depressispira* and *M. stenoumbilicata* appear to represent two climatically isolated derivatives of *M. belli* since they maintain many of the features of that species while also showing a number of significant departures from the ancestral pattern (depressed spire, narrower umbilicus, reduced length of preputial tube, lengthening of the umbilicus).

### **Macrophallikoropa belli** (Cox, 1864) comb. nov.
(Figs 9-12, 14-18; Table 3)

*Helix belli* Cox, 1864: 22; Cox, 1868: 17, pl. 6, fig. 3.
*Endodonta (Charopa) belli* (Cox). Cox, 1909: 11.
*Allocharopa belli* (Cox). Iredale, 1937: 326; Iredale, 1941a: 261; Kershaw, 1956a: 141; Smith, 1992: 181.
*Roblinella belli* (Cox). Smith & Kershaw, 1979: 180.

MATERIAL. LECTOTYPE (herein designated): AMSC205161. Height of shell=0.84mm, diameter=1.67mm, H/D=0.5, D/U=3.04, number of whorls=4.5, ribs on last whorl=175. PARALECTOTYPES: AMSC136899, 26RC, same data as lectotype. KEY MATERIAL. AMSC162176, 16SC/2RC, S of Quirindi, Liverpool Ra, Cedar Brush Nature Res, Cedar Brush Gap, off Warrah Ck Rd, NSW, 4WD Track (31°50.54'S, 150'41.4'E), under logs, rf with broken canopy, 8.xi.1985, IL, JW; QMMO29277, 6SC, Misty Mt., c.19km along Bolaro Mtn Rd, off Batemans Bay-Braidwood Rd, NSW (35°37'S, 149°57'E), wtrf, under logs, 06.i.1990, JS, JC; QMMO16867, 3SC, Lamington NP, Binna Burra, Qld Mt Hobwee circuit, nvf, under logs, 01.x.1985, JS, DP, JC; AMSC171336, 20+RC, Sydney, Bellevue Hill, Cooper Park NSW (33°53.26'S, 151°14.9'E), wsf, 23.v.1982, MS; QMMO10760, 8RC, Dundurrabin, ca.2.3km N, Dundurrabin - Grafton Rd NSW (30°11'S, 152°34'E), mvf, 15.vi.1981, WFP, JS, OG,DP; QMMO42080, 15RC, Marble Arch, S of Braidwood NSW (35°43'S, 149°42'E), lsoc/rrf, 11.x.1992, JS, GI; QMMO10512, 12RC, Mt Warning, NSW, summit (28°24'S, 153°16'E), nvf, 07.vii.1981, WFP, JS, OG, DP. OTHER MATERIAL. Southeastern NSW: QMMO29275, AMSC357398, C357402-4, C357410, C357415, C318486, QMMO29263, MO37985. Sydney Basin: AMSC377544, C318382, C318383, C318385, C318390, C318393, C318398,

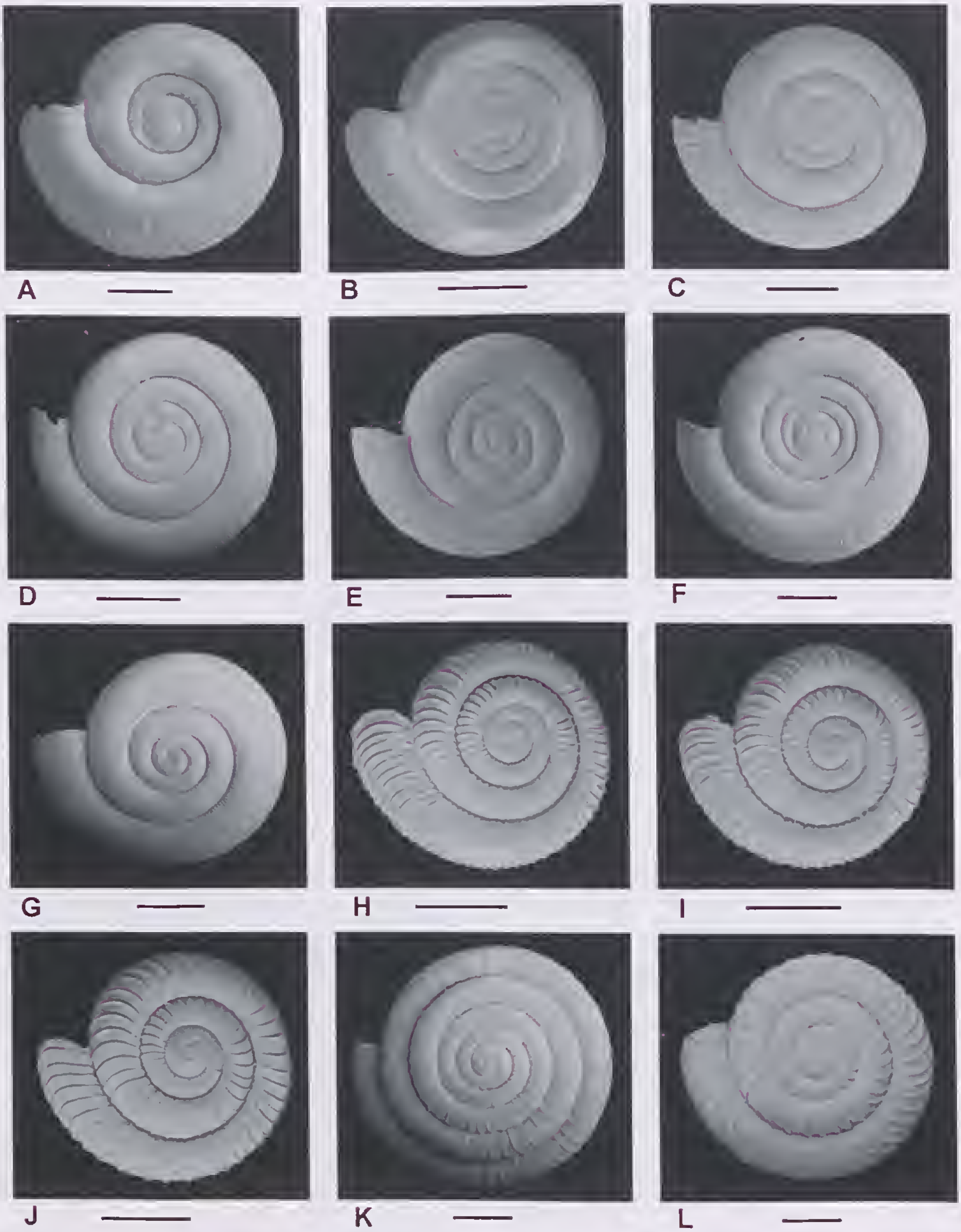


FIG. 14. Dorsal view of shells. A, *Letomola contortus*, AMSC119349. B, *Letomola lanalittleae*, QMMO70397. C, *Macrophallikoropa belli* (Sydney), AMSC171336. D, *Macrophallikoropa belli* (Mt Warning), QMMO10512. E, *Macrophallikoropa stenoumbilicata*, AMSC205162. F, *Macrophallikoropa depressispira*, AMSC205163. G, *Elsothera brazieri*, QMMO28775. H, *Decoriropa lirata* (Taree), AMSC135842. I, *Decoriropa lirata* (Kempsey), QMMO52755. J, *Decoriropa lirata* (Wombeyan Caves), QMMO64764. K, *Coricudgia wollemiana*, AMSC205164. K, *Marilyniropa jenolanensis*, AMSC205165. Scale bars=0.5mm in A, C-F, H; 0.8mm in I-L; 1mm in B,

C318403, C318407, C318422, C318412, C318416, C318417, C318419, C318420, C318425, C318435. C318430, C318431, C318439, C318444, C318432, C318433, C318442, C318438, C318440, C318441, C318443, C318483, C377468, QMMO37777, MO34782, MO31920. Northeastern NSW. QMMO31938, MO37517, MO29739, MO49246, MO52681, MO52699, MO29749, AMSC377871, C377941, C377867, C377840, C162009, QMMO10781, MO10804, MO10820, MO10753, MO16773, MO10892, MO9830, MO10539. SE Qld: AMSC136491, C129240, QMMO10992, MO12863, MO12697, MO6079, MO8364.

DIAGNOSIS. Minute, golden brown to very light golden brown shell, sometimes with darker flammulations. Spire flat, protoconch with crowded spiral lirae. Teleoconch with slightly sinuate to straight crowded ribs; interstitial sculpture with microradials and microspirals about equal in strength, forming strong beads. Umbilcus very wide cup-shaped, mean D/U 2.75. Penis internally with very short penial verge, very long preputial tube. Epiphallus very short.

DESCRIPTION. Shell tiny, golden brown (occasionally with darker flammulations), with 3.8-5.5 (mean 4.46) tightly coiled whorls, the last descending more radidly in front. Sutures impressed, whorls evenly rounded above and below periphery. Shell diameter 1.43-2.22mm (mean 1.76mm). Apex and early spire flat. Height of shell 0.73-1.12mm (mean 0.92mm), H/D 0.48-0.56 (mean 0.52). Protoconch exsert of 1.5-1.8 whorls. Apical sculpture of crowded, narrow spiral lirae; number of lirae 14-20. Secondary apical sculpture of discontinuous radial ridglets that may be periostracal pressure folds. Teleoconch sculpture of very crowded, protractively sinuated radial ribs; 102-248 (mean (179) ribs on last whorl. Ribs/mm 14.69-42.19 (mean 32.65). Ribs medium to narrow; height equal to width; straight in section; rounded on top. Rib interstices on the first post-nuclear whorl equal to width of one to four major ribs; interstices on the penultimate whorl equal to one to three ribs. Interstitial sculpture of fine radial riblets and spiral cords, about equal in strength. Microradials low; 2-7 between ribs on first postnuclear whorl, 3-6 between ribs on penultimate whorl. Microspirals forming strong round to elongate beads at their intersection with the microradials; crossing major ribs. Umbilicus very wide, cup-shaped; diameter 0.42-0.84mm (mean 0.64mm), D/U 2.31-3.43 (mean 2.76). Aperture ovately lunate, with parietal callus. Based on 31 measured adults (AMSC171336, C318439, C205161, QMMO10760, MO10512, MO42080, MO32185).

Genitalia with ovotestis containing 2 clumps of alveoli with 2 alveolar lobes per clump. Talon stalk shorter than or equal to talon diameter; talon circular. Penial retractor muscle less than half the length of the penis inserting at or near the junction of the penis and epiphallus, on either the penis or epiphallus. Epiphallus short wider than epiphallus, entering penis through a verge; length of verge less than half the length of the penis. Penis tubular, internally with an apical verge but without any other noticeable thickenings. Vagina shorter than or equal in length to penis; atrium shorter than penis; long preputial tube present.

Kidney bilobed; apex of pericardial lobe slightly reflexed.

Radula with central tooth strongly tricuspid; lateral teeth tricuspid; first and second laterals equal in width. Mesocone of first lateral tooth slender, slightly diamond-shaped; marginal teeth skewed towards the centre; ectocone of outer marginal teeth split into two teeth; endocone not split. Number of lateral teeth 5; marginal teeth 6; radular rows 78-80. Based on 7 dissected specimens (AMSC162176, QMMO29277, MO16867, MO32185).

DISTRIBUTION AND HABITAT. *Macrophallikoropa belli* is a wide ranging species inhabiting a range of forest types from dry sclerophyll to rainforest on limestone, volcanics and sandstone; found living under logs and rocks.

REMARKS. *Macrophallikoropa belli* (Cox, 1864) comb. nov. is sympatric with *M. depressispira* sp. nov. at the Jenolan Caves limestone locality but can be distinguished from that species by its smaller size, less open umbilicus and flatter spire. *M. belli* differs from *M. stenoumbilicata* sp. nov. by its smaller size and more open umbilicus.

*M. belli* is readily distinguished from other co-habiting charopids through a combination of very small size, spiral protoconch, strongly curved, narrow and very crowded radial ribs, wide cup-shaped umbilicus and the lack of apertural lamellae. Some *Rhophodon* spp. are similar in general shell form (shape, teleoconch ribbing and umbilical width) but are distinguished by having radially ribbed protoconchs and apertural lamellae. *Decoriropa lirata* (Cox, 1864) comb. nov. also has a small discoidal shell with wide umbilicus but has a radial protoconch and widely spaced, bold ribs on the teleoconch. Anatomically the long penial apparatus of *M. belli* is unusual among the eastern Australian Charopidae and hitherto

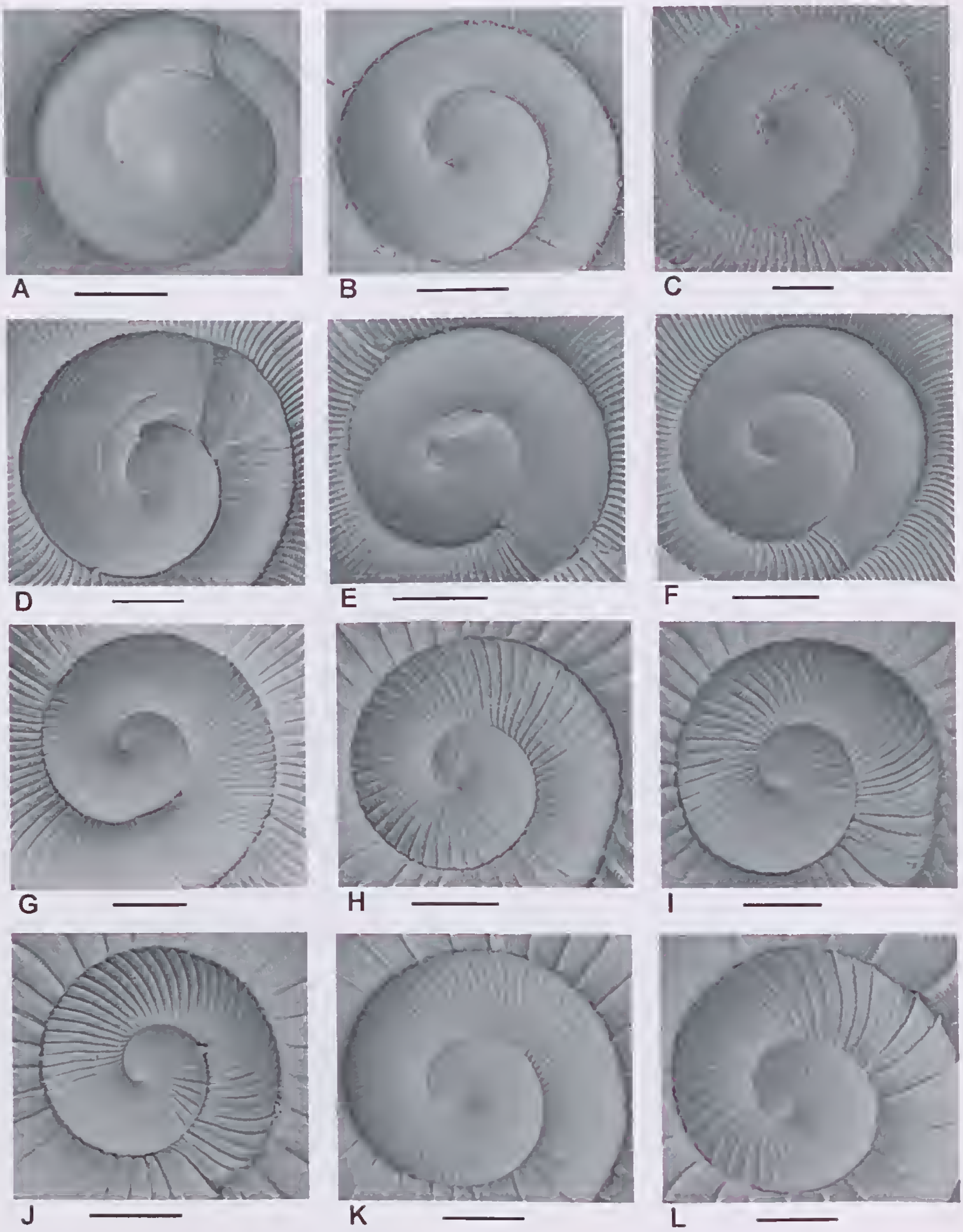


FIG. 15. Protoconch of shells from above. A, *Letomola contortus*, AMSC119349. B, *Letomola lanalittleae*, QMMO70397. C, *Macrophallikoropa belli* (Sydney), AMSC171336. D, *Macrophallikoropa belli* (Mt Warning), QMMO10512. E, *Macrophallikoropa stenoumbilicata*, AMSC205162. F, *Macrophallikoropa depressispira*, AMSC205163. G, *Elsothera brazieri*, QMMO28775. H, *Decoriropa lirata* (Taree), AMSC135842. I, *Decoriropa lirata* (Kempsey), QMMO52755. J, *Decoriropa lirata* (Wombeyan Caves), QMMO64764. K, *Coricudgia wollemiana*, AMSC205164. K, *Marilyniropa jenolanensis*, AMSC205165. Scale bars=0.15mm in A, E, F, H, I; 0.1mm in C, D; 0.2mm in B, G, J-L.

matched only by that of *Rotacharopa densilamellata* Stanisic, 1990. Stanisic (1990) suggested that in the case of *Rotacharopa* this development was organ elongation in response to a marked increase in whorl numbers from the clade average. However, this is not the case in *M. belli* where whorl numbers are fairly similar to both *M. stenoumbilicata* and *M. depressispira* that lack this condition. It could be that this elongated condition is a retained ancestral feature. From a practical viewpoint it is difficult to undertstand how the penial apparatus could function as an eversible organ.

*M. belli* is a relatively widespread species in the context of eastern Australian charopids, especially for a species that inhabits moist rainforest. *Discocharopa aperta* (Mollendorff, 1888) has a wider distribution (Solem, 1989) than *M. belli* but that species also shows a greater environmemtal adaptability in preferring drier habitats such as deciduous vine thickets. But while *M. belli* distribution is largely restricted to wetter environments these do cross a wide range of floristic and geological boundaries, from sclerophyll forest to rainforest and through basalt, limestone and sandstone landscapes. *M. belli* has s significant presence in the Sydney Basin Bioregion where it persists in quite marginal habitats (e.g. Sydney Botanic Gardens) thereby also implying an inherent adaptability. That *M. belli* has been able to disperse into and adapt to this broad set of habitats across a wide geographic area indicates that the species has a long temporal history. In spite of the large amount of material in the AM and QM, few of these specimens are adult. Adult specimens are readily identifiable by the more rapid descension of the last whorl, which effectively elevates the remainder of the shell's spire. Hence, the shell datasets do not allow any rigorous analysis of geographic trends in shell variation. Of the specimens measured those from Marble Arch were distinctive in displaying a slightly more elevated spire and a more closed umbilicus.

Not all available material in the AM and QM has been listed herein. The listing is meant to be a guide to significant datasets, general distribution and key localities for the species. Additional lots, in many cases containing 1-3 specimens and duplicating many of the listed localities, are held in the AM and QM. The sheer quanitiy of material is a poignant indication of the wide-spread distribution of *M. belli* compared with other species discussed herein.

### **Macrophallikoropa stenoumbilicata** sp. nov.
(Figs 9-12, 14-18; Table 3)

ETYMOLOGY. Greek *stenos*, narrow and Latin *umbilicus*; referring to the relatively narrow umbilicus.

MATERIAL. All NSW. HOLOTYPE: AMSC205162, Mt Coricudgy, E Rylstone, southern slope (32°50.82'S, 150°2'E), in litter off road, 2.x.1983, PHC. Height of shell=1.03mm, diameter=1.92mm, H/D=0.54, D/U=3.20, number of whorls=4.2, ribs on last whorl=197. PARATYPES: AMSC162008, 12RC, same data as holotype; AMSC162007, 2RC, Mt Coricudgy, E Rylstone, Hanging Swamp (32°50.2'S, 150°21.2'E), in litter, 2.x.1983, PHC; QMMO28661, 4SC/3RC, slopes of Mt Coricudgy, W of Rylstone (32°51'S, 150°21'E), under logs, temperate rainforest, 15.i.1990, JS, JC; QMMO44706, 1RC, summit, Mt Coricudgy, N Rylstone (32°49'48"S, 150°20'24"E), under rocks, remnant rainforest, 10.i.1993, JS, JC. OTHER MATERIAL. All NSW. QMMO44716, MO44724, MO59873, MO59860.

DIAGNOSIS. Shell minute, golden brown to very light golden brown, sometimes with darker flammulations; whorls tightly coiled. Spire and apex slightly elevated, protoconch with crowded spiral lirae. Teleoconch with almost straight, very crowded ribs. Umbilicus wide U-shaped, mean D/U 3.11. Penial verge absent; moderately long preputial tube present, epiphallus moderately long.

DESCRIPTION. Shell minute, light to golden brown (occasionally with darker flammulations), with 4.0-4.7 (mean 4.33) tightly coiled whorls, the last descending more rapidly in front. Sutures strongly impressed, whorls evenly rounded above and below the periphery. Shell diameter 1.61-1.22mm (mean 1.95mm). Apex and early spire slightly elevated. Height of shell 0.77-1.19mm (mean 1.00mm), H/D 0.48-0.54 (mean 0.51). Protoconch slightly exsert, of 1.5-1.8 whorls. Apical sculpture of crowded, narrow spiral lirae; number of lirae 17. Secondary apical sculpture of discontinuous radial ridglets that may be periostracal pressure folds. Teleoconch sculpture of very crowded, weakly protractvely sinuated radial ribs; 147-197 (mean 171) ribs on the last whorl. Ribs/mm 26.43-32.66 (mean 28.94). Ribs narrow; height equal to width; straight in section, rounded on top. Rib interstices on the first post-nuclear whorl equal to width of three to four major ribs. Interstitial sculpture of fine radial riblets and spiral cords, about equal in strength. Microradials low, forming prominent, elongate beads at their intersection with the microradials. Umbilicus wide U-shaped, diameter 0.53-0.73mm (mean 0.63mm), D/U 3.04-3.20 (mean 3.11). Aperture ovately lunate. Based on 6 measured adults (AMSC162008, C205162).

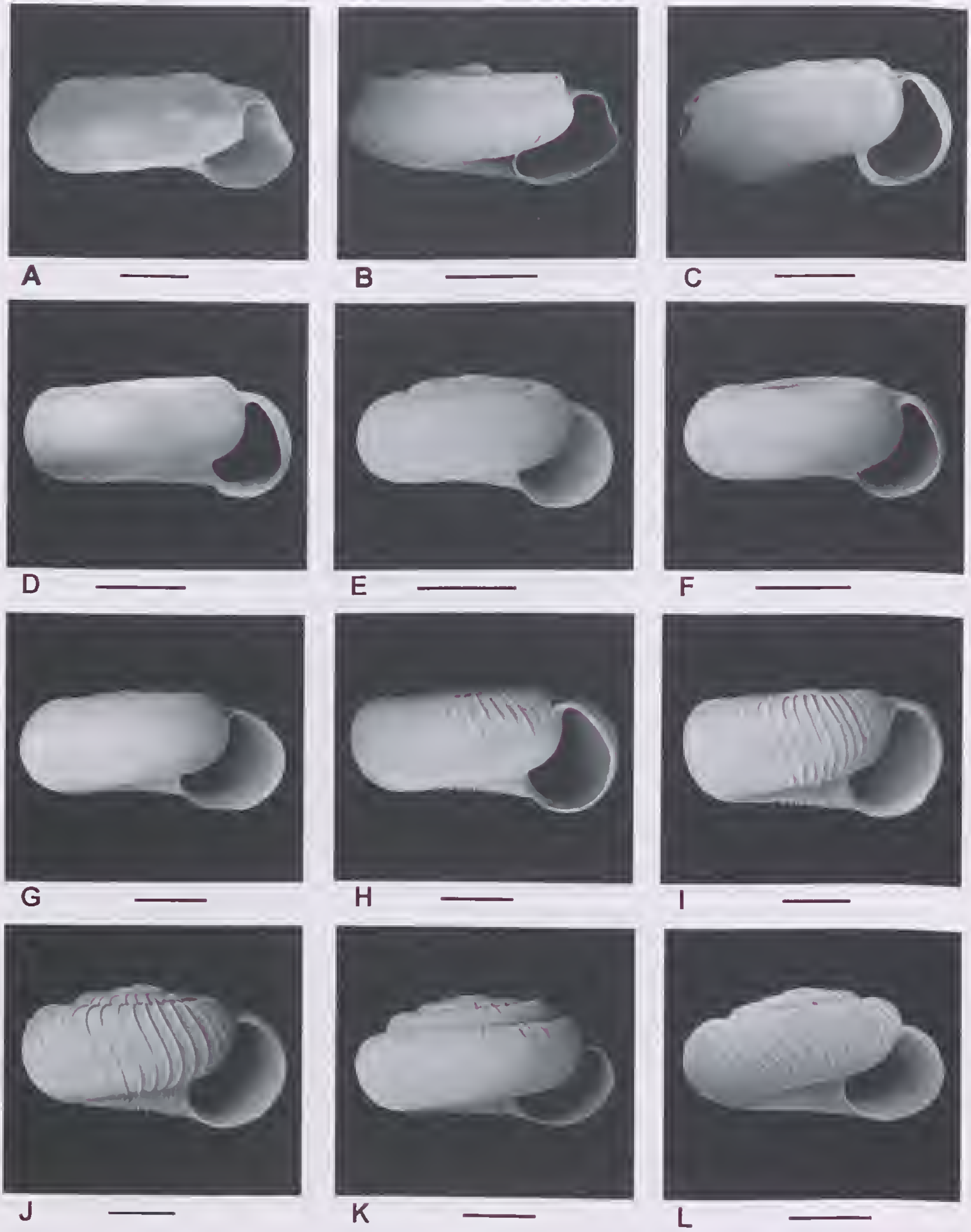


FIG. 16. Lateral view of shells. A, *Letomola contortus*, AMSC119349. B, *Letomola lanalittleae*, QMMO70397. C, *Macrophallikoropa belli* (Sydney), AMSC171336. D, *Macrophallikoropa belli* (Mt Warning), QMMO10512. E, *Macrophallikoropa stenoumbilicata*, AMSC205162. F, *Macrophallikoropa depressispira*, AMSC205163. G, *Elsothera brazieri*, QMMO28775. H, *Decoriropa lirata* (Taree), AMSC135842. I, *Decoriropa lirata* (Kempsey), QMMO52755. J, *Decoriropa lirata* (Wombeyan Caves), QMMO64764. K, *Corieudgia wollemiana*, AMSC205164. K, *Marilyniropa jenolanensis*, AMSC205165. Scale bars=0.5mm in A, C, D, H-J; 0.8mm in E, F; 1mm in B, G, K, L.

Genitalia with ovotestis containing two clumps of alveoli; with two alveolar lobes per clump. Talon stalk shorter than talon; talon circular. Epiphallus moderately long, shorter than penis; wider than the vas deferens, entering penis through a simple pore. Penial retractor muscle inserted on head of penis. Penis tubular, internally without any visible thickenings; moderately long preputial tube present. Vagina shorter than penis, without unusual features.

Kidney bilobed with apex of pericardial lobe weakly reflexed.

Radular morphology unknown.

Based on 3 dissected adults (QMMO42150, MO28661).

DISTRIBUTION AND HABITAT. *Macrophallikoropa stenoumbilicata* sp. nov. is known from rocky refugia on and in the vicinity of Mt Coricudgy at the northern end of the Wollemi NP; found living under logs and rocks in remnant rainforest and eucalypt forest.

REMARKS. The shell of *Macrophallikoropa stenoumbilicata* sp. nov. is larger in size than that of *M. belli*, and has a smaller umbilicus (wide U-shaped), slighly more elevated spire and radial ribs that are only weakly protractively sinuated. Anatomically *M. stenoumbilicata* differs from *M. belli* by lacking a penial verge, having a longer epiphallus and shorter preputial tube. *M. stenoumbilicata* differs from *M. depressispira* sp. nov. by having a smaller shell with more elevated spire (rather than flat to slightly elevated) and an umbilicus that is less excavate (wide saucer-shaped in *M. depressispira*).

*M. stenoumbilicata* is confined to the northern end of the Wollemi NP which is characterised by basalt capped peaks that are scattered among a landscape of Narrabeen sandstone. These peaks support rainforest and wet sclerophyll forest near their summits and southeastern aspects and were probably critical refugia for the survival of this species during the drier climatic phases of the Plio-Pleistocene. Much of this area still needs to be investigated in order to determine the full extent of the species range.

### **Macrophallikoropa depressispira** sp. nov.
(Figs 12, 14-17, 33-34; Table 3)

ETYMOLOGY. Latin *depressus*, low and *spira*, spire; referring to the depressed spire.

MATERIAL. All NSW. HOLOTYPE: AMSC205163, Jenolan Caves, E side Grand Arch near Blue Lagoon, near Devils Coach house (33°49.3'S, 150°1.6'E), in litter, among rocks and grass, 11.xii.1979, WFP, JS . Height of shell=1.14mm, diameter=2.21mm, H/D=0.52, D/U=ratio 2.60, number of whorls=5.0, ribs on last whorl=293. PARATYPES. AMSC124275, many RC, same data as holotype; AMSC63771, 1RC, Jenolan Caves, same data as holotype: QMMO9699, many RC, Jenolan Caves, entrance to the Devils Coachhouse, litter, 13.xii.1979, JS.

DIAGNOSIS. Shell minute, golden brown to very light golden brown, with tightly coiled whorls. Spire concave, protoconch with crowded spiral lirae. Teleoconch with very crowded radial ribs. Umbilicus very wide saucer-shaped, mean D/U 2.57. Anatomy unknown.

DESCRIPTION. Shell minute, golden brown with 4.6-5.2 (mean 4.96) tightly coiled whorls, the last descending more radiply in front. Sutures weakly impressed, whorls evenly rounded above and below periphery. Shell diameter 1.97-2.37mm (mean 2.16mm) Spire depressed (concave). Height of shell 0.90-1.14mm (mean 1.06mm), H/D 0.46-0.52 (mean 0.49). Protoconch slightly exsert of 1.6-1.8 whorls. Apical sculpture of crowded, narrow spiral lirae; number of lirae 13. Secondary apical sculpture of discontinuous radial ridglets that may be periostracal pressure folds. Teleoconch sculplture of crowded, weakly protractively sinuated radial ribs; 165-293 (mean 222) ribs on the last whorl. Ribs/mm 37.97-26.39 (mean 28.94). Ribs narrow, height equal to width; straight in section; rounded on top. Rib interstices on the first post-nuclear whorl equal to width of two to three ribs. Rib interstices sculptured with low radial ridges and low microspiral cords frorming elongate to round beads where they intersect. Microradials between ribs on first postnuclear whorl 3; between ribs on penultimate whorl 2-4. Umbilicus very wide saucer shaped, diameter 0.76-0.91mm (mean 0.84mm), D/U 2.34-2.72 (mean 2.57). Aperture ovately lunate; parietal callus present. Based on 19 measured adults (AMSC124275, C205163, C124275).

Anatomy unknown.

DISTRIBUTION AND HABITAT. *Macrophallikoropa depressispira* sp. nov. is known only from the type locality at Jenolan Caves; found in litter collected from among limestone rocks.

REMARKS. *Macrophallikoropa depressispira* sp. nov. differs from both *M. belli* and *M. stenoumbilicata* in having a larger shell with depressed spire (rather than flat to slightly elevated) and an umbilicus that is more excavate

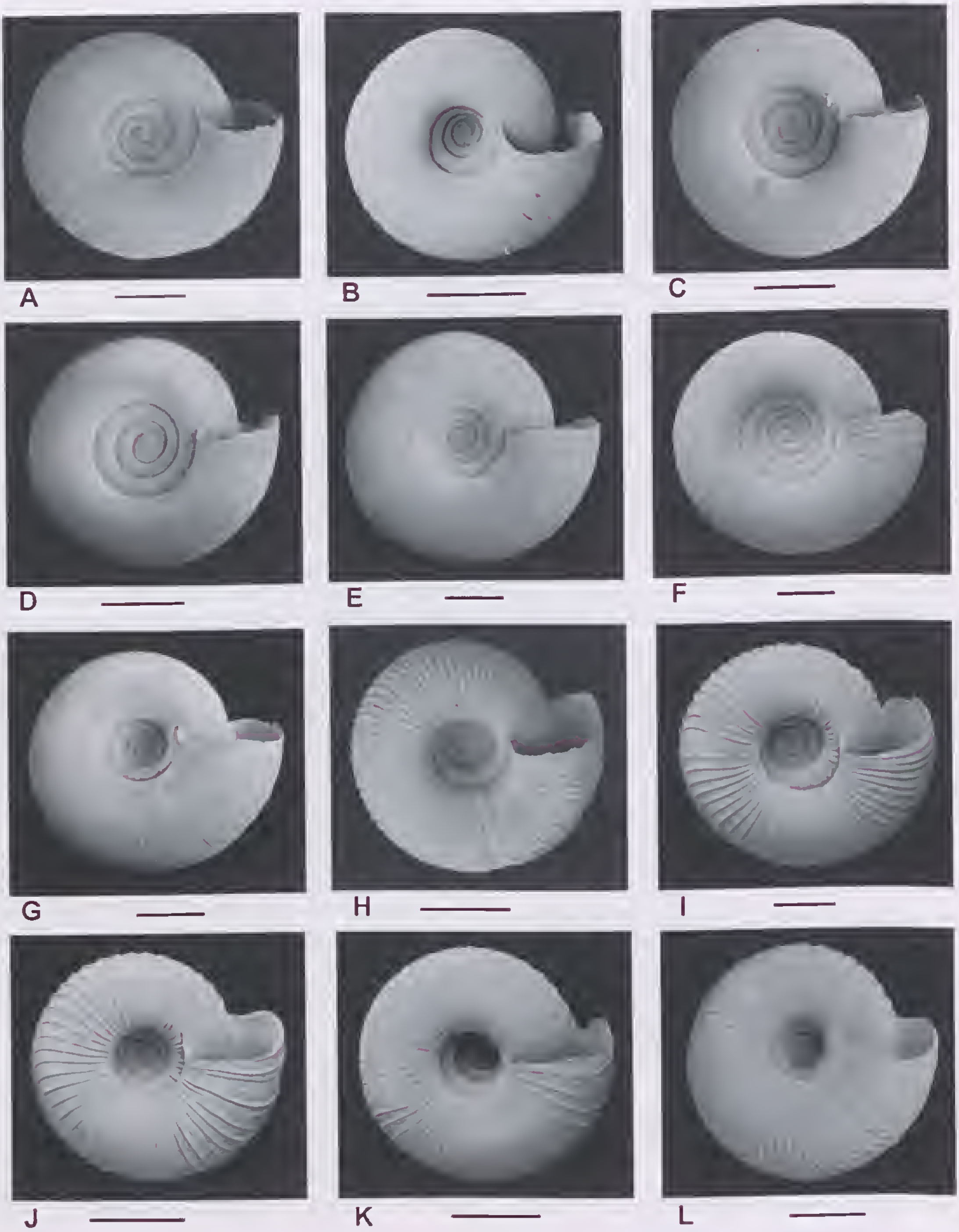


FIG. 17. Ventral view of shells. A, *Letomola contortus*, AMSC119349. B, *Letomola lanalittleae*, QMMO70397. C, *Macrophallikoropa belli* (Sydney), AMSC171336. D, *Macrophallikoropa belli* (Mt Warning), QMMO10512. E, *Macrophallikoropa stenoumbilicata*, AMSC205162. F, *Macrophallikoropa depressispira*, AMSC205163. G, *Elsothera brazieri*, QMMO28775. H, *Decoriropa lirata* (Sydney), AMSC427984. I, *Decoriropa lirata* (Kempsey), QMMO52755. J, *Decoriropa lirata* (Wombeyan Caves), QMMO64764. K, *Coricudgia wollemiana*, AMSC205164. K, *Marilyniropa jenolanensis*, AMSC205165. Scale bars=0.5mm in A, C-F, I; 0.8mm in H, J; 1mm in B, G, K, L.

(wide saucer-shaped). It can be readily distinguished from other sympatric charopids by its protoconch features.

There has been considerable land snail collecting undertaken in the Blue Mountains area and Jenolan Caves area in particular, suggesting that the distribution is accurate and that this species is a true, narrow limestone endemic. No live material of *M. depressispira*, which could be critical to a better understanding of character shifts within the genus, has yet been collected.

## **Elsothera** Iredale, 1933

*Elsothera* Iredale, 1933: 53; Iredale, 1937: 324; Iredale, 1941a: 267; Kershaw, 1956a: 140; Burch, 1976b: 132; Stanisic, 1990: 160; Smith, 1992: 187; Stanisic, 1996: 345.

*Allocharopa* Iredale, 1937: 326; Iredale 1941a: 269; Kershaw, 1956a: 141; Burch, 1976b: 132; Smith, 1992: 181.

TYPE SPECIES. *Helix sericatula* Pfeiffer, 1850; by original designation.

DIAGNOSIS. Shell very small with evenly to loosely coiled whorls. Colour greyish brown with darker streaks or monochrome brown. Protoconch sculpture of thin, regularly spaced, curved radial ribs (sometimes absent) and with prominent to very weak, sometimes discontinuous, microspiral cords. Teleoconch with crowded to moderately widely spaced, protractively sinuated radial ribs. Microsculpture of bladed microradial ribs crossed by low microspiral cords; prominent beads formed at their intersection. Umbilicus ranging from widely open to closed. Epiphallus and vas deferens long and strongly coiled about penial retractor muscle and/or penis. Penis with numerous longitudinal pilasters.

DISTRIBUTION AND HABITAT. *Elsothera* Iredale, 1933 is widespread through central western Qld to eastern and central western NSW, Victoria and eastern South Australia. Records of the genus from Tasmania (Smith & Kershaw, 1979; 1981) need to be verified; living under rocks and logs in wet and dry sclerophyll forest, vine thickets and open eucalypt woodland.

REMARKS. In dealing with *Macrophallikoropa belli* (Cox, 1864) comb. nov. it became apparent that *Allocharopa* Iredale, 1937 was polyphyletic. The mixture of species placed here by Iredale (1937) comprised some with primarily radially ribbed protoconchs (sometimes accompanied by a secondary spiral sculpture) and some, such as *M. belli*, which had strong spiral lirae. While a review of all the 'radially ribbed' species is beyond the scope of this study a cursory study of the type of *Allocharopa* (= *Helix brazieri* Cox, 1868) revealed that it has significant characters (shell and anatomy) in common with *Elsothera* . In particular the protoconch sculpture and unusual epiphallic coiling were similar to *E. sericatula* which is sympatric with the former in the Sydney Basin. These characters are also shared with *E. hewittorum* Stanisic, 1996 from the Qld Brigalow Lands. On these shared characters *H. brazieri* is reassigned to *Elsothera* and *Allocharopa* is relegated to synonymy with *Elsothera*.

In as much as *Helix brazieri* (Cox 1868) is placed in *Elsothera* Iredale 1933 it should be noted that as currently defined (Smith, 1992) this genus probably is polyphyletic and the generic diagnosis herein should be regarded as tentative. The protoconch sculpture within the genus comprises several distinct forms including crowded curved radials with weak, sometimes discontinuous microspiral wrinkles (pressure folds) as seen in in *E. brazieri* (Cox, 1868) comb. nov. and *E. sericatula* (Pfeiffer, 1850); curved radials with distinct continuous, crowded microspiral cords (*E. nautilodea*); and crowded microspiral cords with weak to obsolete microradials (*E. hewittorum* Stanisic, 1996, *E. funerea* (Cox, 1868). In the case of *E. genithecata* Stanisic, 1990 the radial ribs are stronger and more widely spaced and this species may yet be shown to belong to another clade (Stanisic, 1990; 1996; unpubl. data). There is also a considerable variation in shell colour within the genus ranging from grey to greyish brown with darker radial flecks to all brown. *Elsothera* requires revision but this is beyond the scope of this study. A key character that appears to bind the group is the extensive coiling of the epiphallus which in the case of *E. brazieri* is coiled around the penis. This feature has not been seen in any other eastern Australian charopid genus but because of the comparative dearth of anatomical studies within the group, its phylogenetic significance has yet to be fully determined.

### **Elsothera brazieri** (Cox, 1868) comb. nov.
(Figs 10, 14-18, 20-22, 33-34; Table 3)

*Helix brazieri* Cox, 1868: 14.

*Endodonta (Charopa) brazieri* (Cox). Cox, 1909: 13.

*Allocharopa brazieri* (Cox). Iredale, 1937: 326; Iredale 1941a: 269, fig. 6 (part); Kershaw, 1956a: 141; Smith & Kershaw, 1979: 161; Smith, 1992: 181.

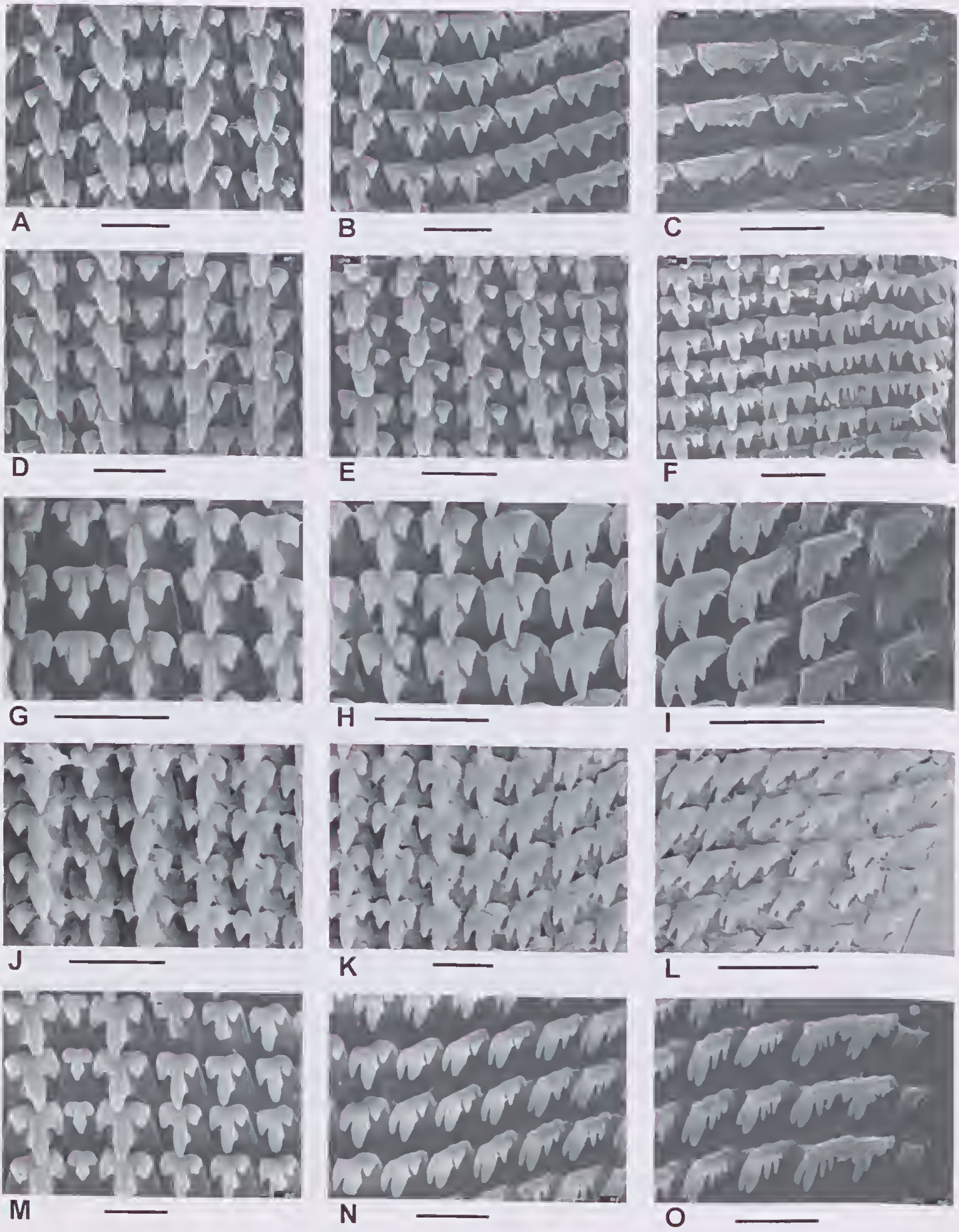


FIG. 18. Radula. A-C, *Letomola contortus*, QMMO56119. D-F, *Letomola lanalittleae*, QMMO56007. G-I, *Macrophallikoropa belli*, QMMO16867. J-L, *Elsothera brazieri*, QMMO44810. M-O. *Decoriropa lirata*, QMMO29722. Scale bars=0.01mm in A-I, M-O; 0.02mm in J-L.

MATERIAL. HOLOTYPE. AMSC63498, Cooks River, Sydney S (33°.55'S, 151°.70'E), under stones in dry places, 1868, J. Brazier. Height of shell=1.69mm, diameter=3.43mm, H/D=0.49, D/U=3.46, whorls=4.4, ribs on last whorl=138. KEY MATERIAL. All NSW. QMMO44810, 5SC, Blue Mountains NP, Federal Pass, Echo Pt-Scenic Rwy, Katoomba, 33°44'06"S, 150°38'42"E, wt6rf/ro, under logs and rocks, 16.i.1993, JS, JC; QMMO28775, 2SC/7RC, Jenolan Caves (33°49'S, 150°01'E), lm, under rocks, 09.i.1990; JS, JC. OTHER MATERIAL. All NSW. Sydney Basin. AMSC159053, C174614, C346733, C348657, C368692, C109350, C154914, C154917, C154926, C318526, C319927, C319931, C319932, C319933, C319934, C319935, C319936, C319937, C319938, C319939, C346810, C148111, C346819, C367089, QMMO16940, MO28668, MO42139, MO42143, MO44782, MO71653, MO34741, MO71657.

DIAGNOSIS. Small very small with evenly coiled whorls. Protoconch with curved, crowded radial ribs that become more crowded at the protoconch/teleoconch boundary and weaker, sometimes discontinuous spiral cords. Teleoconch sculpture of numerous, crowded and prominent curved radial ribs, mean ribs/mm 15.32. Microsculpture of strongly bladed microradial ribs and low, crowded microspiral cords with beads formed at their intersection. Umbilicus wide V-shaped, mean D/U 3.58. Epiphallus long and coiled around penial retractor muscle and basal part of penis. Penis internally with five longitudinal pilasters.

DESCRIPTION. Shell very small, greyish brown in colour with darker radial streaks, 3.8-4.4 (mean 4.17) evenly coiled whorls. Shell diameter 2.72-3.99mm (mean 3.37mm). Spire flat. Height of shell 1.64-1.94mm (mean 1.80mm), H/D 0.49-0.58 (mean 0.52). Protoconch of 1.5-1.8 whorls with primarily radial sculpture consisting of 80-90 regularly spaced, weakly curved radial ribs that become more crowded at the protoconch/teleoconch boundary and very weak, low regularly spaced spiral lirae that cross the radial ribs. Ribs wide, height less than width; spacing uniform; width of interstices (in multiples of rib width) 4-5 at apex. Teleoconch sculpture of bold, protractively sinuated, crowded radial ribs; 136-206 (mean 162) ribs on the last whorl, ribs/mm 13.70-17.96 (mean 15.30). Ribs medium in size height greater than width, straight in section, rounded on top. Rib interstices on the first post-nuclear whorl equal to width of 6-8 ribs; interstices on the penultimate whorl equal to width of 6-7 ribs. Microsculpture of low microradial ribs and stronger microspiral cords that cross the microradials and form strong elongate to round beads at their intersection. Microradials low; 6-8 between ribs on first postnuclear whorl; 10-12 between ribs on penultimate. Umbilicus wide V-shaped, diameter 0.80-1.31mm (mean 0.97mm), D/U 3.05-4.04 (mean 3.57). Sutures weakly impressed, whorls rounded above and rounded below a rounded periphery. Aperture roundly lunate, parietal callus present. Based on 10 measured specimens (QMMO28775, AMSC63498).

Genitalia with ovotestis containing 2 clumps of alveoli; with more than 2 alveolar lobes per clump. Talon stalk narrower than talon diameter; talon circular. Penial retractor inserting onto the penis head. Epiphallus longer than penis, coiled around basal part of penial retractor muscle and basal part pof the penis; wider than the vas deferens. Penis tubular internally with numerous longitudinal pilasters.

Pallial cavity with kidney very weakly bilobed; apex slightly reflexed.

Radula with central tooth strongly tricuspid and smaller than the first lateral; lateral teeth tricuspid.; Ectocone of outer marginal teeth split into four or more teeth; endocone not split. Number of lateral teeth: 4, marginal teeth: 8; radular rows: 85. Based on 2 dissected specimens (QMMO44810).

DISTRIBUTION AND HABITAT. *Elsothera brazieri* is known only from the Sydney Basin and the northern part of the SE Highland Bioregions; living under logs and rocks in temperate rainforest and wet and dry sclerophyll forest.

REMARKS. *Elsothera brazieri is* microsympatric with *E. sericatula* (Pfeiffer, 1850) but is distinguished by having a widely open rather than closed umbilicus, having the radial ribs more widely spaced (coarser sculpture) and in having the epiphallus more strongly coiled and twisted around the penis. *Diphyoropa saturni* (Cox, 1864) comb. nov., which is also widely sympatric with *E. brazieri* in the Sydney Basin, may be confused with the latter judging by identifications on existing museum material. However, *D. saturni* is readily distinguished by the bolder, more widely separate ribs on the teleoconch and in having a protoconch with a bimodal sculpture wherein initial spirals give way to radial ribs and ridges on the latter part of the embryonic whorls. Anatomically, *D. saturni* lacks the coiled epiphallus of *Elsothera* spp.

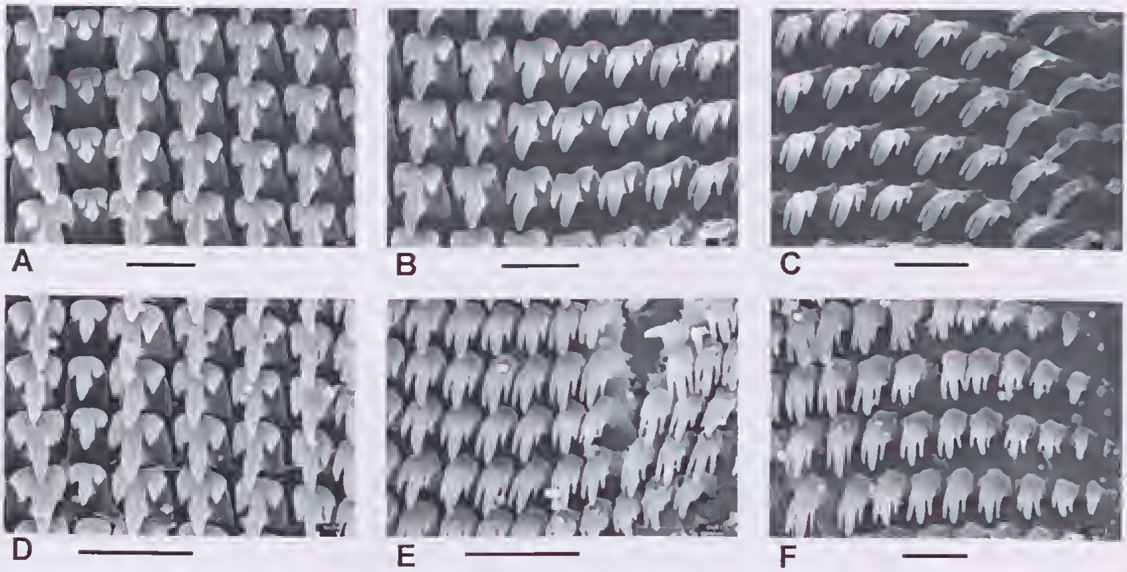


FIG. 19. Radula. A-C, *Coricudgia wollemiana*, QMMO28659. D-F, *Marilyniropa jenolanensis*, QMMO37465. Scale bars=0.01 in A-C, F; 0.02mm in D,E.

Most of the *Elsothera* group have an open umbilicus. *E. nautilodea* (Cox, 1866) and *E. genithecata* Stanisic, 1990 from NE NSW and *E. sericatula* from the Sydney Basin are exceptions. In the present case the major shift in umbilical width from closed in *E. sericatula* to widely open in the *E. brazieri* may be linked to underlying species recognition changes that have occurred under conditions of congeneric sympatry.

Also *E. brazieri* appears to be less abundant in the field than the sympatric *E. sericatula* based on the quantity of material in museum collections. Reasons for this are not immediately obvious.

### **Egilomen** Iredale, 1937

*Egilomen* Iredale, 1937: 328; Iredale, 1941a: 267, 269; Kershaw, 1955: 29; Burch, 1976b: 132; Stanisic, 1990: 193; Smith, 1992: 187.

TYPE SPECIES. *Helix cochlidium* Cox 1868; by original designation.

DIAGNOSIS. Shell very small, colour white. Protoconch with relatively widely spaced, very bold, slightly curved radial ribs (approx. 30) that do not become more crowded, even at the protoconch/teleoconch boundary; spiral elements vague, consisting of discontinuous periostracal wrinkles (?=pressure folds). Teleoconch with broad, widely spaced, weakly protractively sinuated radial ribs; secondary sculpture of prominent crowded, low microspiral cords and relatively less prominent microradials ribs that form strong beads at their intersection. Umbilicus moderately wide U-shaped. Anatomy unknown.

DISTRIBUTION AND HABITAT. *Egilomen* is restricted to the Clarence and Richmond River drainages in NE NSW. However, it would not be surprising if the range of the genus is extended beyond this area. Material in the collections of the QM from the Macleay Valley, NE NSW, appears to fall within *Egilomen* based on protoconch characters (Stanisic, unpubl. data). *Egilomen* prefers dry subtropical rainforest among litter and rocks; historical records suggest that it can also be found in riparian environments.

REMARKS. *Egilomen* was introduced by Iredale (1937) for Charopidae that had a wide umbilicus, smooth protoconch and radial ribs on the teleoconch. *Helix cochlidium* Cox, 1868, as type; *H. lirata* Cox, 1864, *H. barrenense* Pettard, 1879, *H. pexum* Cox, 1868 and *H. saturni* Cox, 1864 were included. However, species included here by Iredale do not have smooth protoconchs and in fact cover an assortment of protoconch sculptures ranging from bold radial ribs, to radial ribs crossed by spiral cords and in one case a uniquely bimodal pattern of spiral and radial elements (*H. saturni*). Stanisic (1990), on the basis of limited comparative material, redefined *Egilomen* to include taxa with a protoconch sculpture of prominent radial ribs with spiral elements reduced or absent and a teleoconch sculpture of bold radial ribs. Anatomically, the defining features were a strongly bilobed kidney and one longitudinal penis pilaster with an accessory circular pad. Stanisic (1990) included only the type and a new species, *E. globosa*. Although not reviewed, Stanisic (1990) suggested that most other species included in *Egilomen* by Iredale (1937) belonged elsewhere.

A redefinition of *Egilomen* was considered necessary in order that other taxa dealt with herein could be placed into appropriate taxonomic context. During the course of this study it became apparent that Stanisic's (1990) interpretation of *Egilomen*, and in particular *E. cochlidium*, was somewhat expansive. In addition, closer inspection of the protoconchs of the types of both *E. cochlidium* and *E. globosa* revealed differences indicating that these two species are generically distinct on the basis of discriminatory criteria used in the current study. Hence, *Egilomen* is herein once again redefined and restricted to include only the type. Revised diagnoses of both *Egilomen* and *E. cochlidium* are presented together with a revised list of 'material studied' for the latter species. Consequently, the distribution of *E. cochlidium* is herein restricted to include only the region surrounding the Richmond and Clarence River drainages. *E. globosa* is not able to be placed in any existing genus and hence is herein reassigned to *Whiteheadia* gen.nov. Two additional species, *H. lirata* and *H. saturni*, previously placed here by Iredale (1941a), are also reviewed and generically re-assigned. *H. pexa* and *H. barrenense* are not considered to belong to any of these groupings but their re-allocation must await further study.

The protoconch of *Egilomen* Iredale, 1937 has bold, widely spaced ribs and vague, discontinuous spiral creases (=pressure folds?). Most significantly however, the ribs on the protoconch show no tendency to become more crowded toward the protoconch/teleoconch boundary. This is a characteristic of many local charopid genera that have radial elements on the protoconch and usually provides a convenient means for locating the nuclear/post-nuclear transition point. This boundary is less easily distinguished in the case of *Egilomen* wherein the apical rib spacing is confluent with the teleoconch rib spacing. In both *E. cochlidium* and *Whiteheadia globosa* (Stanisic, 1990) comb. nov. the spiral elements on the protoconch that are visible at low magnification consist of irregularly spaced, periostracal wrinkles that do not cross the radial elements. However, and most significantly, the latter species has much more crowded radials on the protoconch, and the protoconch-teleoconch boundary is more apparent because the denser apical ribbing contrasts clearly with the more widely spaced teleoconch.e teleoconch. This is considered to represent a generic level difference between the two species. *W. globosa* also differs significantly from *E. cochlidium* in having a partially thickened lip and closed umbilicus.

The shell of *Egilomen* (bold teleoconch ribs and open umbilicus) is most similar to that of *Decoriropa* gen. nov. but the latter has distinct, continuous apical spiral cords and finer, much more crowded apical ribs. *Decoriropa* has shell whorls of a similar profile to that of *Egilomen* but has the umbilicus more widely open and a weak sutural sinus. The absence of apertural barriers readily separates *Egilomen* from both *Rhophodon* and *Egilodonta*, which also have similarly shaped, though much smaller and more widely umbilicate shells (cup to saucer shaped).

The difficulty in dealing with this genus highlights the general problems posed by the availability of very limited material of a series of very tiny species with radially scuptured white shells (Stanisic, unpubl. data). Many are represented by only a few dry specimens, a direct consequence of relying on'litter-sorting' for recovery of material without having located the species' true microhabitat. Such constraints will need to be overcome before a comprehensive revision of this group can be completed.

### **Egilomen cochlidium** (Cox, 1868)
(Fig. 13; Table 3)

*Helix cochlidium* Cox, 1868: 13, pl. 8, fig. 1.
*Egilomen cochlidium* (Cox). Iredale, 1937: 138; Iredale, 1941a: 269; Smith 1992: 187; Stanisic, 1990: 103 (in part), fig. 128a-c, e-g (only).

MATERIAL. LECTOTYPE. AMSC63505, Clarence River, NSW. Height of shell=1.25mm, diameter=2.26mm, H/D=0.55, D/U=3.14, whorls=4 5, ribs on last whorl=30. PARALECTOTYPES. AMSC153714, 2RC, same collection data as lectotype. OTHER MATERIAL. All NSW. AMSC57247, C8737, C152253, C153715, C154732, QMMO56176.

DIAGNOSIS. Shell white, very small, with regularly coiled whorls, mean whorl count 4.5. Apex and early spire flat to weakly elevated, mean H/D 0.55. Teleoconch with broad, widely spaced, weakly protractively sinuated radial ribs,

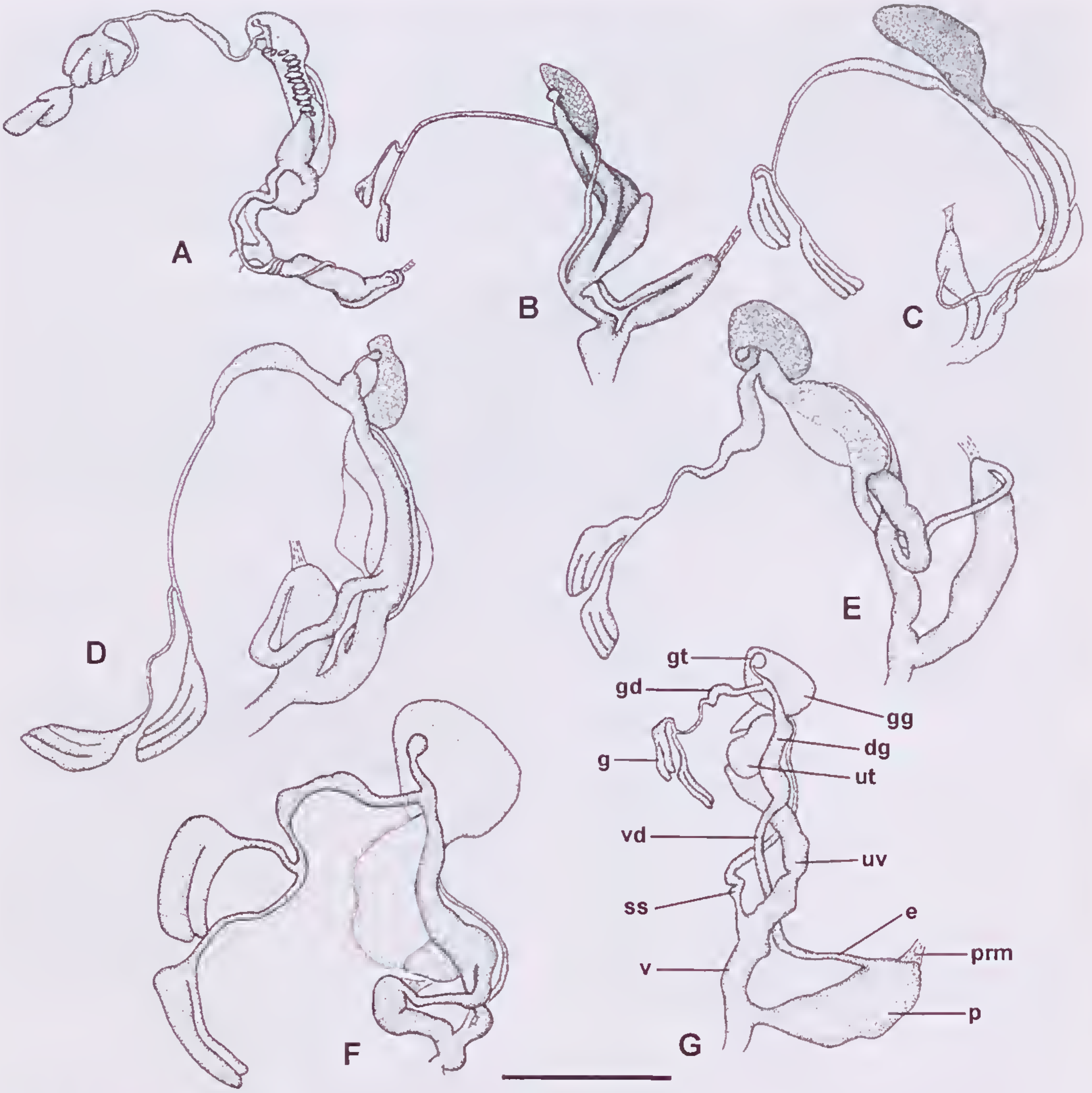


FIG. 20. Reproductive system. A, *Elsothera brazieri*, QMMO44810. B, *Decoriropa lirata*, QMMO42109. C, *Coricudgia wollemiana*, QMMO28659. D, *Marilyniropa jenolanensis*, QMMO37465. E, *Cralopa stroudensis*, QMMO29722. F, *Gouldiropa carlessi*, QMMO32080. G, *Gouldiropa kaputarensis*, QMMO49175. Scale bar=2.5mm in A, C and G, and 1.6mm in all others. Abbreviations: dg, prostate; e, epiphallus; g, ovotestis; gd, hermaphrodite duct; gg, albumen gland; gt, talon; p, penis; prm, penis retractor muscle; ss, spermathecal stalk; ut, uterus; uv, free oviduct; v, vagina; vd, vas deferens.

mean ribs/mm 5.57. Umbilicus moderately wide U-shaped, mean D/U 2.85. Anatomy unknown.

DESCRIPTION. (Amended from Stanisic, 1990). Shell very small, white to light straw yellow, with 4.0-5.1 (mean 4.5) evenly coiled whorls, the last descending in front. Shell diameter 1.91-3.07mm (mean 2.20mm). Apex and early spire flat to slightly elevated. Height of shell 0.95-1.83mm (mean 1.26mm). H/D 0.49-0.61 (mean 0.55). Protoconch flat of 1.5-1.6 whorls. Apical sculpture of slightly curved, relatively widely spaced, broad radial ribs (approx 30), that do not become more crowded at the protoconch/teleoconch boundary; apical spiral elements vague, consisting of discontinuous periostracal wrinkles (? = pressure folds). Teleoconch with bold, broad, widely spaced, protractively sinuated radial ribs, 30-47 (mean 37) ribs on the last whorl. Ribs/mm 4.22-5.99 (mean 5.07). Interstitial sculpture of prominent crowded, low microspirals cords and relatively less prominent microradial ribs that form strong beads at their intersection. Microradial riblets low, 8-12 between each pair of major ribs. Umbilicus moderately wide U-shaped, diameter 0.60-1.03mm (mean 0.82mm). D/U 2.59-3.47 (mean 2.85). Sutures strongly impressed . Whorls flattened below and rounded above a laterally compressed periphery. Aperture ovately lunate, lip simple. Based on 14 measured specimens (AMSC63505, C153714, C8737, C57247, C153715).

REMARKS. Stanisic's (1990) description of *E. cochlidium* included specimens from the Dorrigo area, NE NSW and the Border Ranges of NE NSW and SE Qld that had white shells with radially ribbed protoconchs, bold radials on the teleoconch and widely open umbilici. Although minor differences in coiling pattern, whorl profile and shell appearance were noted, these were considered variations in widespread populations. Specimen lots were small and spirit material was available in only one case. Little material has been added to this data set but in light of the emphasis on subtle differences in shell features, particularly the use of protoconch sculpture as a generic character, these specimens were subjected to closer scrutiny. Re-examination of this material (AMSC57247, C128524, C128637, C128618, C128319, C154735, QMMO10794, MO17291, MO16905, MO17290) has revealed several unrelated species (and possibly genera) on the basis of protoconch sculptural detail alone. These protoconch types are superficially similar to that of *E. cochlidium* in being macroscopically radial but differ in both rib architecture and spacing. In contrast to *E. cochlidium* these species have continuous spiral cords on the protoconch and more closely spaced and more curved apical ribs than that seen in *E. cochlidium*.

An important consequence of the above taxonomic rearrangment is that the anatomy of *E. cochlidium* remains unknown. The anatomical detail presented by Stanisic (1990) refers to an unnamed species from the Dorrigo area, W of Coffs Harbour, NE NSW that will be dealt with elsewhere.

### **Whiteheadia** gen. nov.

ETYMOLOGY. For Thora Whitehead.

TYPE SPECIES. *Egilomen globosa* Stanisic, 1990; herein designated.

DIAGNOSIS. Shell minute, white. Protoconch with numerous, bold, relatively closely spaced, slightly curved radial ribs (approx. 50) that do not become more crowded toward the protoconch/teleoconch boundary; secondary apical sculpture of vague, discontinuous periostracal spiral wrinkles. Teleoconch with prominent, slightly protractively sinuated, moderately widely spaced radial ribs; secondary sculpture of prominent crowded, low microspirals cords and relatively less prominent microradial ribs that form strong beads at their intersection. Umbilicus closed or reduced to a tiny chink. Kidney evenly bilobed; pericardial lobe not reflexed. Penial retractor muscle inserted on the epiphallus some distance from the penis/epiphallus junction. Penis internally with a single longitudinal pilaster and accessory circular pad.

DISTRIBUTION AND HABITAT. From NE NSW to SE Qld; under logs and among rocks in closed forest.

REMARKS. Characters distinguishing *Whiteheadia* and *Egilomen* have been discussed under the latter genus but two unusual characters in *W. globosa* (Stanisic, 1990) comb. nov require special mention. The baso-columellar thickening in *W. globosa* from Mt Guyra is interpreted as intraspecific variation in a disjunct population since all other characters fall within the species concept. Perhaps of greater significance though, is the epiphallic insertion of the penial retractor muscle. Most east Australian charopids hitherto dissected have the penial retractor muscle inserted on or very near to the penis/epiphallus junction. Relatively few exceptions have been noted (Stanisic, 1990) and no coherent phylogenetic pattern for this altered character state has yet emerged.

### **Whiteheadia globosa** (Stanisic, 1990). comb. nov. (Fig. 13)

*Egilomen globosa* Stanisic, 1990: 197, figs 131, 132; Smith, 1992: 187.

MATERIAL. All SE Qld: QMMO19460, MO23300, MO25968.

TYPE LOCALITY. Sidetrack off Mt Archer Rd, Mt Mee SF, SE Qld.

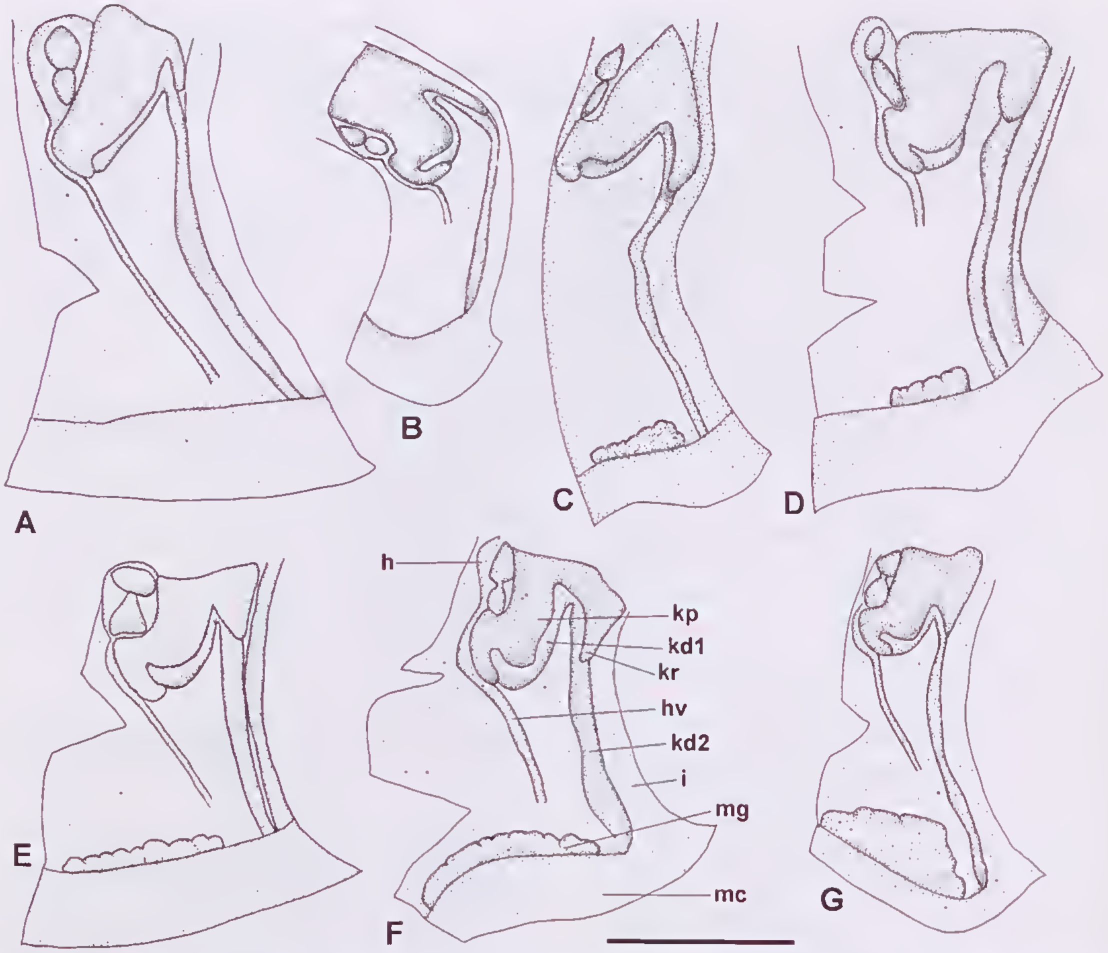


FIG. 21. Pallial cavity. Reproductive system. A, *Elsothera brazieri*, QMMO44810. B, *Decoriropa lirata*, QMMO42109. C, *Coricudgia wollemiana*, QMMO28659. D, *Marilyniropa jenolanensis*, QMMO37465. E, *Cralopa stroudensis*, QMMO29722. F, *Gouldiropa carlessi*, QMMO32080. G, *Gouldiropa kaputarensis*, QMMO49175. Scale bar=2mm in C and G, 1.6mm in D and F, and 1.28mm in all others. Abbreviations: h, heart; hv, principal pulmonary vein; i, intestine; kd1, primary ureter; kd2, secondary ureter; kp, pericardial lobe of kidney; kr, rectal lobe of kidney; mc, mantle collar; mg, mantle gland.

DIAGNOSIS. Shell minute, white, subglobose to globose with elevated spire, mean H/D 0.77. Whorls regularly coiled, mean whorl count 4.63. Teleoconch with numerous, prominent, slightly protractively sinuated, moderately widely spaced radial ribs, mean ribs/mm 9.04. Umbilicus closed or reduced to a tiny chink. Lip thickened, occasionally with a baso-columellar thickening. Penis with a centrally located longitudinal pilaster and an apical, accessory circular pad.

DISTRIBUTION AND HABITAT. From N of Casino (Richmond Range), NE NSW to S of Maryborough (Mt Guyra), SE Qld; under logs and among rocks in subtropical notophyll vine forest, microphyll vine forest and vine thicket.

REMARKS. The combination of tiny, white, strongly ribbed, globose shell that has a predominantly radially ribbbed protoconch and closed to almost-closed umbilicus readily distinguishes *W. globosa* from other eastern Australian charopids hitherto examined (Stanisic, unpubl. data). In general shell form, *W. globosa* resembles *Cralopa stroudensis* (Cox, 1864) but differs in lacking distinct spirals on the protoconch, having less sinuate, less numerous

TABLE 3. Shell measurements for species of *Macrophallikoropa*, *Elsothera*, *Egilomen* and *Decoriropa*. (Abbreviations as in Table 1).

| Measurement | *Macrophallikoropa belli* | *Macrophallikoropa stenoumbilicata* | *Macrophallikoropa depressispira* | *Elsothera brazieri* | *Egilomen cochlidium* | *Decoriropa lirata* |
|---|---|---|---|---|---|---|
| N | 31 (*30) | 6 (*5) | 19 (*18; **17; ***16) | 10 (*9; **8; ***7) | 4 | 55 (*54, **53) |
| D | 1.43-2.22 (1.76) ± 0.22 | 1.61-2.22 (1.945) ± 0.234 | 1.97-2.37 (2.161) ± 0.112 | 2.72-3.99 (3.37) ± 0.37 | 3.89-4.6 (4.203) ± 0.311 | 1.83-2.63 (2.19) ± 0.22 |
| PW | 1.5-1.8 (1.68) ± 0.1 * | 1.5-1.8 (1.683) ± 0.117 | 1.6-1.8 (1.735) ± 0.07 ** | 1.5-1.8 (1.657) ± 0.098 *** | 1.6-1.7 (1.65) ± 0.058 | 1.2-1.8 (0.63) ± 0.09 |
| TW | 2.1-3.7 (2.78) ± 0.44 * | 2.2-3 (2.65) ± 0.327 | 3-3.4 (3.224) ± 0.13 ** | 2.3-2.7 (2.486) ± 0.168 *** | 2.4-3.1 (2.85) ± 0.332 | 1.9-3.6 (2.56) ± 0.35 |
| NW | 3.8-5.5 (4.46) ± 0.43 | 4-4.7 (4.333) ± 0.273 | 4.6-5.2 (4.959) ± 0.173 ** | 3.8-4.4 (4.17) ± 0.21 ** | 4-4.8 (4.5) ± 0.383 | 3.6-5.3 (4.2) ± 0.36 |
| H | 0.73-1.12 (0.92) ± 0.11 | 0.77-1.19 (1.003) ± 0.147 | 0.9-1.14 (1.063) ± 0.068 | 1.64-1.94 (1.8) ± 0.1 * | 2.29-2.67 (2.42) ± 0.175 | 0.92-1.4 (1.13) ± 0.12 ** |
| SP | 0-0.14 (0.06) ± 0.04 * | 0.03-0.13 (0.085) ± 0.036 | - | 0-0.12 (0.015) ± 0.042 ** | 0-0.01 (0.005) ± 0.006 | 0-0.2 (0.08) ± 0.04 |
| AH/AW | 1.05-1.46 (1.27) ± 0.11 * | 0.97-1.27 (1.09) ± 0.12 | 1.09-1.63 (1.33) ± 0.15 | 0.97-1.3 (0.14) ± 0.1 ** | 1.17-1.4 (1.29) ± 0.13 | 1.07-1.43 (1.22) ± 0.08 |
| UMB | 0.42-0.84 (0.64) ± 0.09 | 0.53-0.73 (0.627) ± 0.079 | 0.76-0.91 (0.84) ± 0.04 ** | 0.8-1.31 (0.97) ± 0.16 * | 1.13-1.41 (1.278) ± 0.118 | 0.5-0.91 (0.69) ± 0.11 * |
| RIB | 102-248 (179) ± 31.48 | *147-197 (171) ± 20.671 | 165-254 (218) ± 20.607 *** | 136-206 (162) ± 24.48 * | 65-85 (73.5) ± 9.292 | 36-109 (57.82) ± 16.72 |
| RIBS/MM | 14.69-42.19 (32.65) ± 6.19 | *26.43-32.66 (28.94) ± 2.601 | 37.97-26.39 (32.24) ± 3.172 *** | 13.70-17.96 (15.32) ± 1.773 ** | 4.823-6.301 (5.571) ± 0.652 | 5.775-11.148 (8.310) ± 1.744 |
| H/D | 0.48-0.56 (0.52) ± 0.02 | 0.48-0.54 (0.51) ± 0.02 | 0.46-0.52 (0.49) ± 0.02 | 0.49-0.58 (0.52) ± 0.03 * | 0.56-0.59 (0.58) ± 0.01 | 0.48-0.58 (0.52) ± 0.02 ** |
| D/U | 2.31-3.43 (2.76) ± 0.26 | 3.04-3.2 (3.11) ± 0.07 | 2.34-2.72 (2.57) ± 0.11 * | 3.05-4.07 (3.57) ± 0.3 * | 3.06-3.44 (3.3) ± 0.18 | 2.81-3.81 (3.19) ± 0.25 * |

and more widely spaced ribs on the teleoconch and in lacking a true apertural sinus.

Material obtained subsequent to Stanisic (1990) has not altered either the concept of the species or details of its distribution. However, it has provided information for a more detailed analysis of the species' preferred habitat which shows that while *W. globosa* lives in moist forest in the south it is found in drier rainforest (microphyll vine forest, vine thicket) as its distribution attenuates northwards. And though this may initially suggest that the species has a relatively wide environmental tolerance, personal observation by one of us (JS) indicates that *W. globosa* is environmentally selective at the microhabitat level in the southern part of its distribution. For example, in the Lamington NP, SE Qld *W. globosa* has only been found on the Araucaria Circuit walking track, near Binna Burra which is a much drier rainforest (microphyll vine forest) than the moist notophyll vine forest dominating most parts of Lamington NP. Such local micro-environmental selectivity on the part of *W. globosa* may help explain the apparently patchy distribution of the species over its range.

### **Decoriropa** gen. nov.

ETYMOLOGY. Latin *decorus*, beautiful; referring to the elegant shell.

TYPE SPECIES. *Helix lirata* Cox, 1868; herein designated.

DIAGNOSIS. Shell golden brown, with evenly coiled whorls and a weak apertural sinus. Protoconch with crowded, evenly spaced, curved radial ribs (approx. 60) and numerous regularly crowded, low, continuous spiral cords that cross the radial ribs. Teleoconch with numerous prominent, weakly to strongly protractively sinuated, moderately crowded to widely spaced radial ribs; secondary sculpture of low, thin microradial ribs that have weak periostracal blades, ribs continuous on the major ribs, crossed by generally more prominent microspiral cords that form rounded beads at their intersection with the microradials. Umbilicus moderately wide to very wide U-shaped. Kidney moderately bilobed with strongly reflexed pericardial lobe. Penis with two longitudinal pilasters.

DISTRIBUTION AND HABITAT. NE NSW (near Kempsey) in a broad range of habitats ranging from temperate and subtropical rainforest (humid and dry) to dry vine thickets and wet and dry sclerophyll forest where it lives under logs and rocks.

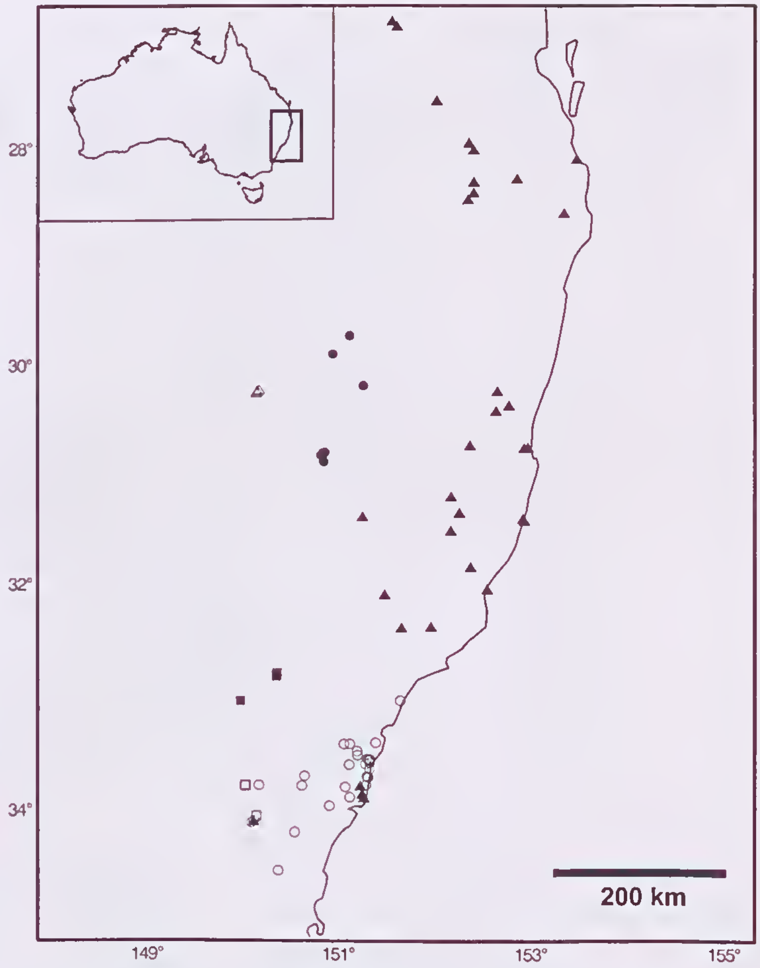


FIG. 22. Distribution of *Elsothera*, *Coricudgia*, *Marilyniropa*, *Cralopa* and *Gouldiropa*. Key: ○ *Elsothera brazieri*, ■ *Coricudgia wollemiana*, □ *Marilyniropa jenolanensis* ▲ *Cralopa stroudensis*, ● *Gouldiropa carlessi*, Δ *Gouldiropa kaputarensis*.

REMARKS. *Decoriropa* has a similar shell profile to *Egilomen* but differs in having more crowded, thinner radials on the protoconch that are crossed by continuous spiral cords (discontinuous periostracal wrinkles in *Egilomen*), and a greater number of ribs on the teleoconch. The shell of *Decoriropa* also bears some similarity to those of *Rhophodon* and *Egilodonta* but lacks apertural barriers and has a smaller, less open (broad V-shaped) umbilicus (mean diameter 0.69mm). Most significantly the apical shell sculpture of these two 'dentate' groups differs from that of *Decoriropa* in having crowded radial ribs that become more crowded at the protoconch/teleoconch boundary (evenly spaced in *Decoriropa*); and apical spiral elements that consist of discrete cordlets that do not cross the radial ribs (continuous cords crossing the radials in *Decoriropa*).

The single species, *D. lirata* (Cox, 1868) comb. nov., occurs across a range of geologies from sandstone to volcanic rocks and limestone. In many ways it shows a similar environmental adaptability to *Macrophallikoropa belli* (Cox, 1864) comb. nov. However, in contrast to the range of that species *D. lirata* does not appear to extend into far northern NSW or SE Qld.

### **Decoriropa lirata** (Cox, 1864) comb. nov.
(Figs 10, 13-18, 20-21, 33-34; Table 3)

*Helix lirata* Cox, 1864: 38: 1868: 13, pl. 8, fig. 1.
*Helix ( Patula ) lirata* (Cox); Cox, 1909: 44.
*Egilomen liratum* (Cox); Iredale, 1937: 328; 1941a: 269.
*Egilomen lirata* (Cox); Smith, 1992: 187.

MATERIAL. NEOTYPE: AMSC427984. Height of shell=1.2mm, diameter=2.24mm, H/D=0.53, D/U=3.03, number of whorls=4.3, ribs on last whorl=70. KEY MATERIAL. All NSW. QMMO29722. 10SC/28RC, Georges R, banks, Warwick Farm (33°55’"S, 150°56’E), degraded ew, under logs, bark and rubble, 31.xii.1989, JS, JC; QMMO42109, 8SC/8RC, Bungonia Gorge, ENE Goulburn (34°48’21"S, 150°00’47"S), lm/ew, 13.x.1992, JS GI; AMSC356052, 3RC, Sydney, Rose Bay, just S of Queens Bch, Hermitage Foreshore Park, off Hermitage Trail (33°51.75’S, 151°16.09’E), under litter at base of retaining wall, 07.i.1999, MS; AMSC154792, 20+RC, S of Braidwood, Wyanbene Caves (35°48.1’S, 149°40.9’E), lm, litter from cave entrance, 17.i.1981, WFP, W.F. Ponder (Jnr); AMSC136842, 12RC, W of Taree, Manning R, Wingham Brush (31°52.25’S, 152°22.85’E), rainforest, in litter, 26.viii.1982, JS; QMMO52755, RC, Kempsey, W, c.4km

W Sherwood, Sherwood-Willi Willi Rd (31°03'24"S, 152°41'06"E), drf/lm, 40m, litter, 28.xii.1993, JS, JC; QMMO64764, 20RC, Wombeyan Caves, NNE Goulburn (34°18'35"S, 149°57'46"E), lm/vt, litter, 13.x.1992, JS, GI; AMSC154791, 3RC, S of Forster, E of Smiths Lake, Bald Head (32.382°S, 152.531°E), under low scrub on dunes, in litter, x.1981, OG; AMSC157311, 13RC, W of Taree, Wingham, Wingham Brush (31.871°S, 152.381°E), leaf litter in subtropical lowland floodplain rf", 05.ii.1982, *MS. OTHER MATERIAL. Northeastern NSW: QMMO12745, MO44830 MO16758, MO16763, MO37514, MO17274, MO31909, MO31935, MO32066, MO37733, MO32072, MO49478, MO56147, MO52701, MO56136, MO56142, MO59891, MO32291, MO37106, MO49395, MO55875, MO55893, MO56012, MO56050, MO56080, MO59794, MO60143, MO60154, MO60477, MO60491, MO60498, AMSC168693, C339712, C411598. Sydney Basin: QMMO29640, MO34783, MO34973, MO37389, MO37818, MO42136, MO44783, AMSC63774, C140472, C319043, C319058, C319059, C319080, C319087, C319088, C319096, C319098, C319118, C319120, C319125, C319126, C345665, C356051, C356080. Southeastern NSW: QMMO29271, MO37791, MO37812, MO37980, MO42124, MO68010, AMSC318792, C63729, C157294, C168663, C157316, C168673, C168676, C358326, C358328, C358330, C346061.

DIAGNOSIS. Shell very small, golden brown with evenly coiled whorls and a weak apertural sinus. Spire and early apex flat to slightly elevated. Teleoconch with numerous prominent, weakly to strongly protractively sinuated, moderately crowded to widely spaced radial ribs (mean ribs/mm 8.31. Umbilicus moderately wide to very wide V-shaped, diameter range 0.50-0.91mm, mean D/U 3.19. Penis with two longitudinal pilasters.

DESCRIPTION. Shell very small, golden brown, with 3.6-5.3 (mean 4.2) evenly coiled whorls, the last descending in front; weak apertural sinus present. Shell diameter 1.83-2.63mm (mean 2.19mm). Apex and early spire flat to slightly elevated. Height of shell 0.92-1.40mm (mean 1.13mm), H/D 0.48-0.58 (mean 0.52). Protoconch of 1.2-1.8 whorls with sculpture of regularly spaced, moderately crowded, curved radial ribs, width of interstices (in multiples of rib width) 2-4 at apex. Secondary sculpture of low, continuous spiral cords (23-24), crossing radial ribs. Teleoconch sculpture of crowded, regularly spaced (increasing near end of last whorl), weakly protractively sinuated radial ribs; 36-109 (mean 58) ribs on the last whorl. Ribs/mm 5.78-11.15 (mean 8.31). Ribs wide, height less than or equal to width, straight in section, rounded on top. Rib interstices on the first post-nuclear whorl equal to width of 4-6 ribs; interstices on the penultimate whorl equal to width of 3-6 ribs. Interstitial sculpture of weak microradial ribs, 4-10 between ribs on first post-nuclear whorl; 7-13 between ribs on penultimate whorl; continuous on major radials, with weak periostracal blades. Secondary microsculpture of more prominent low, microspiral cords that cross the major ribs and form strong tranversely elongate to rounded beads at their intersections with the microradials. Umbilicus very wide V-shaped, diameter 0.50-0.91mm (mean 0.69mm), D/U 2.81-3.81 (mean 3.19). Whorls flattened above and rounded below a weakly rounded periphery, sutures impressed. Aperture ovately lunate ovate, parietal callus present. Based on 55 measured specimens (AMSC356052, C154792, C136842, SC427984, QMMO52755, MO64764, ).

Genitalia with ovotestis containing two clumps of alveoli, with two or more alveolar lobes per clump. Talon stalk 1-3 times the diameter of the talon; talon circular. Penial retractor muscle less than half the length of the penis; inserting at the junction of the penis and epiphallus. Epiphallus longer than penis, narrower than the vas deferens, entering penis through a simple pore; internally with longitudinal pilasters. Penis tubular with sheath, internally with two longitudinal pilasters. Vagina shorter or equal in length to penis.

Pallial cavity with moderately bilobed kidney, pericardial lobe strongly reflexed at apex.

Radula with central tooth strongly tricuspid; lateral teeth tricuspid; marginal teeth skewed towards the centre; ectocone of outer marginal teeth split into three teeth; endocone not split. Number of lateral teeth: 4; marginal teeth: 10; radular rows: 73. Based on 3 dissected specimens (QMMO29722, MO42109).

DISTRIBUTION AND HABITAT. *Decoriropa lirata* is widely distributed ranging from the Wyanbene Caves, SE NSW to the Macleay River valley, NE NSW. The species lives in a variety of forest-types ranging from humid subtropical rainforest to dry rainforest (vine thickets) and littoral rainforest, as well as dry and wet sclerophyll forest. The widespread nature of the distribution and habitat preference suggests an inherent adaptability that is probably a contributing factor to the species' continued survival in suburban Sydney.

REMARKS. *Decoriropa lirata* looks superficially like *Marilyniropa jenolanensis* sp. nov. but can be distinguished by its smaller shell that has narrower whorls (smaller cross section), a weak apertural sinus, more dense ribbing and usually, a less elevated spire. *D. lirata* does not appear to occur on the Jenolan or Tuglow limestones but is found on the nearby Church Creek and Colong Caves limestones where it is sympatric with *M. jenolanensis*. Juveniles of the latter species are easily confused with *D. lirata* but are readily separated by having fewer (approx. 45), less crowded radials on the protoconch. *D. lirata* is also apparently absent from the nearby Abercrombie limestones but is present on the more distant Wombeyan limestones. Specimens from Wombeyan Caves have a lower rib count, slightly higher spire and narrower umbilicus than usual, but otherwise agree with the general concept of the species which is remarkably stable across a wide and variable landscape.

In the absence of type material (Smith, 1992) a neotype was designated. The specimen chosen comes from inner Sydney close to the original type locality (Rushcutters Bay). A key reason for choosing the Bellevue Hill locality was that the species is still readily found there alive.

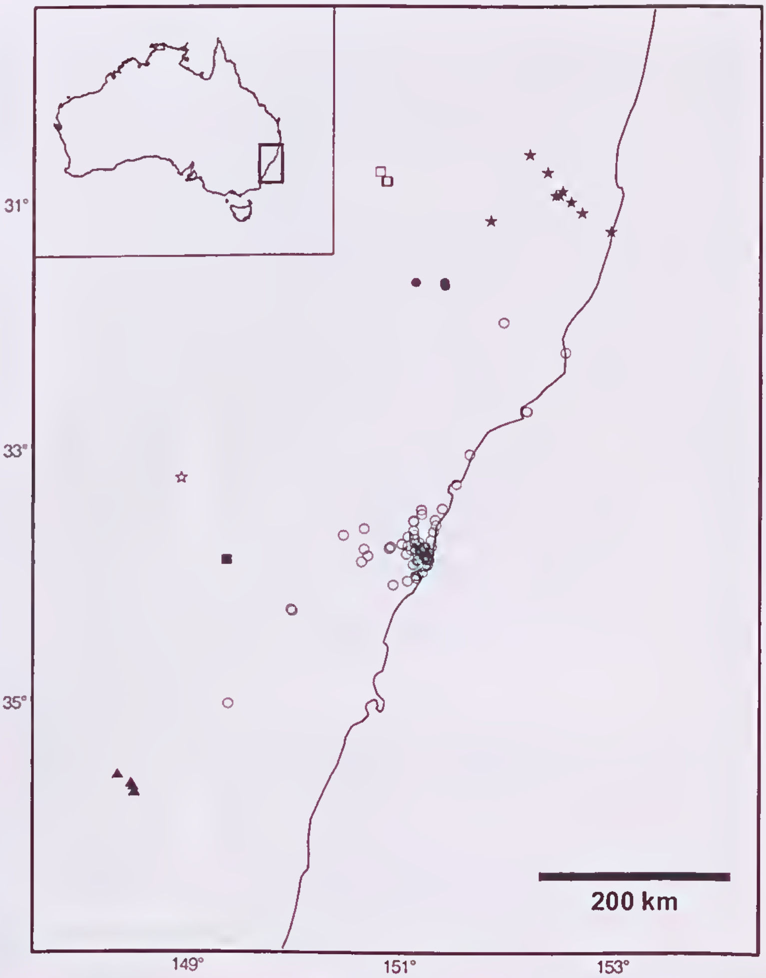


FIG. 23. Distribution of *Sharniropa*, *Acheronopa*, *Hedleyropa* and *Diphyoropa*. Key: ☆ *Sharniropa borenorensis*, ■ *Sharniropa wollondillyana*, ● *Sharniropa xanana*, □ *Acheronopa attunga*, ▲ *Hedleyropa yarrangobillyensis*, ○ *Diphyoropa saturni*, ★ *Diphyoropa macleayana*.

## **Coricudgia** gen. nov.

ETYMOLOGY. For Mt Coricudgy, NSW.

TYPE SPECIES. *Coricudgia wollemiana* sp. nov.; herein designated.

DIAGNOSIS. Shell white with a relatively large number of tightly coiled whorls and moderately elevated spire. Protoconch with very crowded (approx. 90) curved radial ribs and continuous crowded microspiral cords. Teleoconch with weakly sinuated, widely spaced, bold radial ribs; secondary sculpture of prominent microradial ribs with weaker microspiral cords that form rounded beads at their intersection. Umbilicus open U-shaped. Kidney evenly bilobed with large wedge-shaped lobes; pericardial lobe only weakly reflected. Penis with 2 longitudinal pilasters.

DISTRIBUTION AND HABITAT. Restricted range centred on Mt Coricudgy, Wollemi NP, NSW. Mostly found living among rocks in rainforest.

REMARKS. *Coricudgia* gen. nov. displays several shell characters that distinguish it from other E Australian charopids with bold ribs and an open umbilicus. The high whorl count, large number of radial ribs and continuous spiral cords on the protoconch separate it from *Egilomen* (lower whorl number, few apical radials with vague spiral wrinkles) which has a similarly coiled, whitish shell with moderately wide umbilicus and moderately elevated spire. It is distinguished from *Decoriropa* chiefly by the more elevated spire, the greater number of straighter ribs on the protoconch, a greater number of tightly coiled whorls and the much less sinuate ribs on the teleoconch. The greater number of tightly coiled whorls distinguish it from *Cralopa* Iredale, 1941, *Gouldiropa* gen. nov., *Sharniropa* gen. nov. and *Marilyniropa* gen. nov.which all have comparatively fewer whorls, bolder ribs and relatively looser coiling.

### **Coricudgia wollemiana** sp. nov.
(Figs 10, 14-17, 19, 33-34; Table 4)

ETYMOLOGY. For Wollemi NP, the type locality.

MATERIAL. HOLOTYPE: AMSC205164, E of Rylstone, Mount Coricudgy, southern slope, NSW (32°50.82’S, 150°21’E), in litter off road, 2.x.1983, PHC. Height of shell=1.95mm, diameter=3.73mm, H/D=0.52, D/U=3.59, number of whorls=6.1, ribs on last whorl=46. PARATYPES: All NSW. AMSC162143, 18RC, same data as holotype; QMMO28659, 13SC/9RC, slopes of Mt Coricudgy, W of Rylstone (32°51’S, 150°21’E), under rocks, 15.i.1990, JS, JC; QMMO44708, 1RC, Mt Coricudgy, NE Rylstone, summit (32°49’48"S, 150°21’24"E), remnant rainforest, under rocks, 10.i.1993, JS, JC; QMMO59868, 4SC/7RC, Rylstone, E, at Mt Coricudgy (32°51’25"S, 150°21’00"E), wtrf/basalt, under logs and rocks, 01.i.1996, JS, JC; QMMO44725, 1RC/11SC, Mt Coricudgy, NE Rylstone, c.0.1km E summit road, (32°51"00"S, 150°21’12"E), ws/wtrf, on roots of plants under rocks, 10.i.1993, JS, JC. OTHER MATERIAL. QMMO59859.

DIAGNOSIS. Shell very small, white, with moderately elevated spire (mean spire height 0.26mm) and a relatively large number of tightly coiled whorls (mean whorl count 4.9, range to 6.1 whorls). Protoconch with crowded (approx. 90) curved radial ribs and continuous crowded microspiral cords. Teleoconch with weakly sinuated, widely spaced, bold radial ribs, mean rib count 4.1 ribs/mm. Umbilicus open U-shaped, mean D/U 3.49. Penis with two longitudinal pilasters.

DESCRIPTION. Shell very small, white, with 3.6-6.1 (mean 4.9) tightly coiled whorls, the last descending more rapidly in front. Whorls weakly rounded above and rounded below a rounded periphery. Shell diameter 1.62-4.02mm (mean 3.30mm). Apex and early spire weakly elevated. Height of shell 0.83-2.21mm (mean 1.69mm), H/D 0.45-0.55 (mean 0.51). Protoconch of 1.7-1.8 whorls with sculpture of crowded, regularly spaced, slightly curved radial ribs (approx. 90); width of interstices (in multiples of rib width) 3 at apex. Secondary sculpture of continuous spiral cords that cross the radials. Teleoconch with widely but regularly spaced, weakly protractively sinuated, bold radial ribs. Ribs on last whorl 28-47 (mean 40), ribs/mm 3.01-5.50 (mean 4.09). Height of ribs equal to width; straight in section; rounded on top, continuous on major radials. Rib interstices on the first post-nuclear whorl equal to width of 6-7 ribs. Interstitial sculpture of high microradial ribs, 9 between major ribs on first post-nuclear whorl; 16 between ribs on penultimate whorl. Secondary sculpture of low microspiral cords forming strong rounded beads at their intersection with the microradials. Umbilicus open, U-shaped, diameter 0.55-1.15mm (mean 0.94mm), D/U2.95-3.80 (mean 3.49). Aperture broadly ovately lunate, parietal callus present. Based on 10 measured specimens (AMS C162143, C205164).

Genitalia with ovotestis containing two clumps of alveoli, with more than two alveolar lobes per clump. Talon stalk 1-3 times the diameter of the talon; talon circular. Penial retractor muscle less than half the length of the penis; inserting onto the penis head; entering penis through a simple pore. Penis tubular; with two longitudinal pilasters present, one very large and irregular in shape’ the other much smaller and regular in shape). Vagina shorter than penis.

Pallial cavity with strong, evenly bilobed kidney; apex of pericardial lobe weakly reflexed. Mantle gland present.

Radula with central tooth strongly tricuspid; lateral teeth tricuspid; first and second laterals equal in width. Mesocone of first lateral tooth slender, slightly diamond-shaped; marginal teeth skewed towards the centre. Ectocone of outer marginal teeth not split; endocone not split; number of lateral teeth: 7; marginal teeth: 11; radular rows: 100. Based on 2 dissected specimens (QMMO28659).

DISTRIBUTION AND HABITAT. Known only from the Rylstone area, NSW but particularly the upper parts of Mt Coricudgy, Wollemi NP, NSW where the species lives among volcanic rocks in warm temperate rainforest.

REMARKS. *Coricudgia wollemiana* sp. nov. is easily recognisable by its white shell with very high whorl count, tightly coiled whorls and moderately elevated spire. Some specimens attain greater than 6 whorls which is a

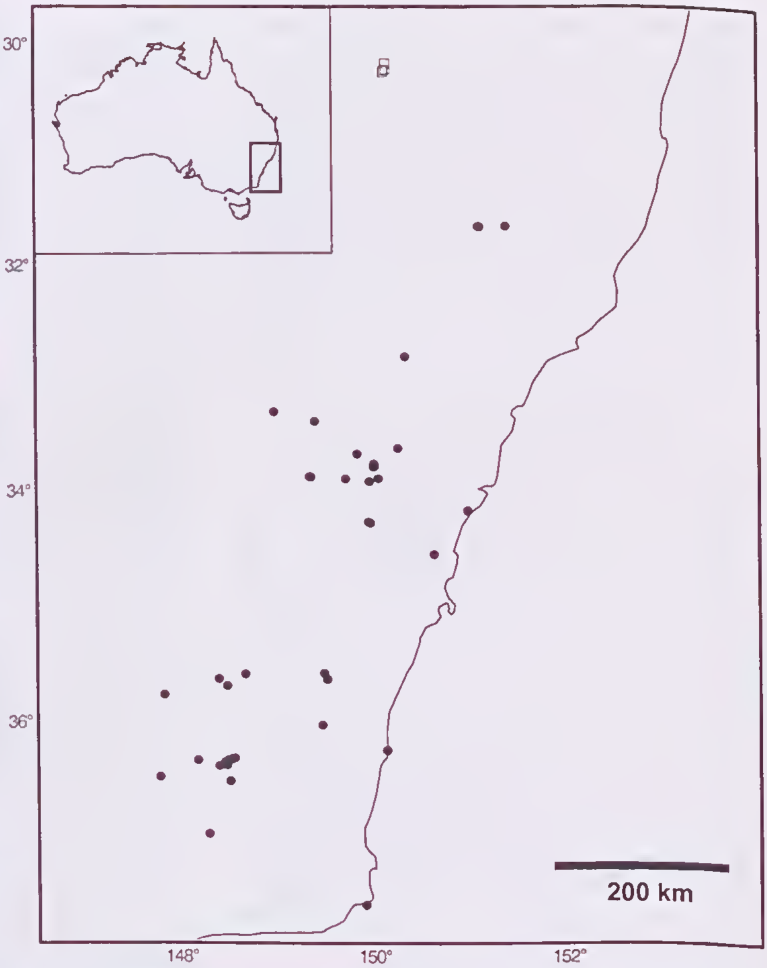


FIG. 24. Distribution of *Scleridoropa*. Key: ● *Scleridoropa sarahjaneae*, □ *Scleridoropa nandewar*.

comparatively high whorl count in the context of moderately sized (i.e. approx. shell diameter 3.5-4.5mm) eastern Australian charopids. However some other, smaller charopids, including some dealt with in this study, e.g. *Rhophodon* spp. and *Letomola* spp., have higher whorl counts. The discovery of this species on the heights of Mt Coricudgy once again points to the unusual nature of this rainforest/volcanic refugium among an otherwise dry sclerophyll/sandstone landscape. Mt Coricudgy is also home to the geographically restricted *Macrophallikoropa stenoumbilicata* sp nov. suggesting that the locality has broad significance as an historical refugium for mesic communities. A single specimen of *C. wollemiana* has also been found at a lowland locality near Capertee but the viability of any lowland populations needs to be more accurately assessed by undertaking additional collecting in the area. It is quite possible that the Capertee specimen was stream drift material washed from the mountain slopes. Relatively little land snail collecting has been undertaken in the Wollemi NP and the full extent of the distribution of *C. wollemiana* has yet to be determined.

## **Marilyniropa** gen. nov.

ETYMOLOGY. For Marilyn Joy McGrady.

DIAGNOSIS. Shell very small, straw to beige in colour, with evenly coiled whorls; apertural sinus absent. Protoconch with evenly spaced, moderately crowded, curved radial ribs (approx. 55) that are crossed by crowded, low continuous spiral cords; radial ribs becoming bolder toward the protoconch/teleoconch boundary. Teleoconch with bold, widely spaced, strongly sinuate ribs (mean ribs/mm 4.62) that become more crowded on the latter half of the last whorl. Umbilicus wide V-shaped. Kidney moderately bilobed, pericardial lobe reflexed. Mantle gland present. Penis with five longitudinal pilasters.

DISTRIBUTION AND HABITAT. Known only from limestone outcrops SSE Oberon, NSW. The single species, *Marilyniropa jenolanensis* sp. nov., lives among limestone talus.

REMARKS. *Marilyniropa* gen. nov. is grossly similar to *Decoriropa* in having an open umbilicus and bold ribbing but differs in having fewer, apical radial ribs, an elevated spire, no apertural sinus and fewer, variably spaced, more curved radial ribs on the teleoconch. Anatomically, *Marilyniropa* differs by having greater number of penial pilasters and shorter epiphallus than *Decoriropa*. Unfortunately it is not possible to put the significance of these character shifts in reproductive anatomy into phyletic context at this time except to say that they do represent major departures from the patterns seen in the somewhat conchologically similar species belonging to *Decoriropa*, *Sharniropa*, *Gouldiropa*, *Acheronopa* and *Cralopa*. The combination of more tightly coiled whorls and larger umbilicus differentiates *Marilyniropa* from the sympatric *Sharniropa* and *Gouldiropa*.

The current restriction of *Marilyniropa* to a few habitats surrounding and including Jenolan Caves, once again highlights the biogeographical importance of these limestones to land snail evolution.

### **Marilyniropa jenolanensis** sp. nov.
(Figs 10, 14-17, 19, 33-34; Table 4)

ETYMOLOGY. For the type locality.

MATERIAL. HOLOTYPE: AMSC205165, Jenolan Caves, NSW (33°49.3'S, 150°1.2'E), 6.vi.1982. O.L. Griffiths. Height of shell=1.77mm, diameter=3.46mm, H/D=0.51, D/U=3.33, number of whorls=4.5, ribs on last whorl=42. PARATYPES: All NSW. AMSC144224, many RC, same data as holotype; AMSC142966, Jenolan Caves, ridge on top of Grand Arch (33°49.24'S, 150°1.32'E), 12.xii.1979, JS. QMMO9730, 101RC, Jenolan Caves, above Grand Arch, lm, litter among rocks, 11.xii.1979, JS; QMMO28777, 2SC/4RC, Jenolan Caves, lm, under rocks, 9.i.1990, JS, JC; QMMO37776. 7RC, Jenolan Caves (33°49'S, 150°01'E), lm, in litter, 9.i.1990, JS, JC; QMMO37465, 4SC/36RC, Jenolan Caves (33°49'S, 150°01'E), lm, on limestone rocks among dirt, 10.i.1990, JS, JC. OTHER MATERIAL. All NSW. QMMO70485, MO70486, MO62450, AMSC63736, C63852, C121716, C124272, C154773, C154774, C154775, C154776, C154777, C157333, C168669, C346748, C346750.

DIAGNOSIS. Shell light brown to beige in colour with evenly coiled whorls, mean whorl count 4.51. Apex flat, early spire elevated, mean spire height 0.25mm, mean H/D 0.48. Protoconch with evenly spaced, moderately crowded, curved radial ribs (approx. 55) that are crossed by crowded, low continuous spiral cords. Teleoconch with bold, moderately widely spaced, strongly sinuate ribs (mean ribs/mm 4.62) that become more crowded on the latter half of the last whorl. Umbilicus wide V-shaped, mean diameter 0.89mm, mean D/U 3.67. Penis with 5 short, longitudinal pilasters.

DESCRIPTION. Shell very small, straw to light golden brown in colour with 4.1-4.8 (mean 4.5) evenly coiled whorls, the last descending in front; apertural sinus not developed. Shell diameter 2.96-3.65mm (mean 3.24mm). Apex flat, early spire weakly elevated. Height of shell 1.33-1.97mm (mean 1.55mm), H/D 0.43-0.55 (mean 0.48). Protoconch with 1.4-1.7 whorls. Apical sculpture of crowded regularly spaced, slightly curved radial ribs (approx. 45); width of interstices (in multiples of rib width) 4-6 at apex. Secondary sculpture of narrow, continuous spiral cords that cross the microradial ribs; ribs becoming bolder toward the protoconch/teleoconch boundary. Teleoconch with prominent, regularly spaced, strongly protractively sinuated radial ribs, 35-61 (mean 47) ribs on the last whorl. Ribs/mm 3.76-6.08 (mean 4.62). Ribs greater in height than width; straight in section; rounded on top. Rib interstices on the first post-nuclear whorl equal to width of 4-7 ribs. Secondary microsculpture of more prominent low, microspiral cords that cross the major ribs and form strong tranversely elongate to rounded beads at their intersections with the microradials. Whorls flattened above and rounded below a rounded periphery, sutures impressed. Umbilicus open, wide V-shaped. Umbilical width 0.73-1.07mm (mean 0.89mm), D/U 3.33-4.05 (mean 3.67). Based on 23 measured specimens (AMSC144244, C205165).

Genitalia with ovotestis containing two clumps of alveoli, with more than two alveolar lobes per clump. Talon stalk 1-3 times the diameter of the talon; talon circular. Penial retractor muscle less than half the length of the penis, inserting at the junction of the penis and epiphallus; epiphallus short. Penis tubular with 5 short, longitudinal pilasters. Vagina shorter than penis.

Pallial cavity with moderately bilobed kidney, pericardial lobe reflexed. Mantle gland present.

Radula with central tooth strongly tricuspid; lateral teeth tricuspid with first lateral slightly wider than second lateral. Mesocone of first lateral tooth slender, slightly diamond-shaped; marginal teeth skewed towards the centre. Ectocone of outer marginal teeth not split; endocone not split. Number of lateral teeth: 4; marginal teeth: 18; radular rows: 100. Based on 1 dissected specimen (QMMO37465).

DISTRIBUTION AND HABITAT. Known only from the Jenolan Caves region (Jenolan, Tuglow and Colong limestones), Blue Mountains, W of Sydney; living among limestone talus.

REMARKS. *Marilyniropa jenolanensis* sp. nov. most closely resembles *Decoriropa lirata* (Cox, 1864) comb. nov. in general appearance but can be distinguished from that species by its larger size, more elevated spire and fewer, more widely

FIG. 25. Dorsal view of shells. A, *Cralopa stroudensis* (SEQ), QMMO16857. B, *Cralopa stroudensis* (Sydney), QMMO29638. C, *Gouldiropa carlessi*, AMSC003640. D, *Sharniropa wollondillyana*, QMMO70399. E, *Sharniropa borenorensis*, AMSC205166. F, *Sharniropa xanana*, QMMO70398. G, *Acheronopa attunga*, QMMO70400. H, *Hedleyropa yarrangobillyensis*, QMMO70401. I, *Scleridoropa saralijaneae* (Yarrangobilly), QMMO70402. J, *Scleridoropa nandewar*, QMMO70403. K, *Diphyoropa saturni*, AMSC205167. L, *Diphyoropa macleayana*, AMSC168685. Scale bars = 0.5mm in J; 0.8mm in A-H, L; 1mm in K.

spaced, bolder apical radial ribs and fewer, less crowded ribs on the teleoconch. *M. jenolanensis* broadly resembles *Sharniropa wolloudillyana* sp. nov. in general appearance of the shell (shape, sculpture) but the latter is larger, has more loosely coiled whorls, smaller umbilicus and bolder, more widely spaced ribs on the teleoconch.

### **Cralopa** Iredale, 1941

*Cralopa* Iredale, 1941a: 267; Kershaw, 1956b: 8; Burch, 1976b: 132; Stanisic, 1990: 147 (in part); Smith, 1992: 184 (in part).

TYPE SPECIES. *Helix stroudensis* Cox, 1864; by original designation.

DIAGNOSIS. Shell very small with moderately loosely coiled whorls, deep sutures and a well-developed apertural sinus. Protoconch with very crowded, relatvely narrow, curved radial ribs (approx. 80) crossed by numerous regularly spaced, crowded, low, continuous spiral cords. Teleoconch with numerous, prominent and very strongly protractively sinuated, crowded radial ribs that have weak periostracal blades. Secondary sculpture of prominent microspiral cords that cross the microradials and form round beads at their intersection. Umbilicus closed or only very slightly open. Kidney moderately to strongly bilobed with strongly reflexed pericardial lobe. Penis wih two longitudinal pilasters.

DISTRIBUTION AND HABITAT. *Cralopa* Iredale, 1941 ranges from southern NSW to SE Qld. The single species lives under logs and rocks in moist rainforest and wet sclerophyll forest.

REMARKS. *Cralopa* was introduced by Iredale (1941a) for *Helix stroudensis* Cox, 1864. Iredale (1941b) added an additional species, *Cralopa intensa* Iredale, 1941. Stanisic (1990) revised *Cralopa* and in doing so reassigned *C. intensa* to *Sinployea* Solem, 1983 and included two additional new species (*C. kaputarensis*, *C. carlessi*) on the basis of shared shell and anatomical characters (closed to almost closed umbilicus, presence of an apertural sinus and large cylindrical penis). Analysis of protoconch sculpture consisted of noting the common presence of prominent radial ribs and low spiral cords. A difference in apical whorl size was noted betwcen both *C. carlessi* and *C. kaputarensis* and *C. stroudensis*, the latter two species having a smaller protoconch than the former species. While conceding the cohesiveness of his new concept of *Cralopa*, Stanisic (1990) did however, make a number of observations relevant to a possible future revision of the genus once additional material became available for study. Notable among these was firstly, that the biogeography of the genus was at odds (east-west) with the general pattern displayed by most other genera reviewed (north-south); secondly, that some individuals of *C. stroudensis* from the limestones of the Macleay Valley, W of Kempsey were unusual for their large size in what was an otherwise conchologically conservative, widespread species; and thirdly, that there was a large degree of variability displayed by *C. carlessi* in material from widespread localities (Wee Jasper area, SE NSW to Inverell, NE NSW). At the time this variability in shell features was considered to be local differences in a species with unusually widespread, disjunct populations. A number of these populations are herein excluded from the definition of *C. carlessi* (see below).

*Cralopa* Iredale, 1941 is redefined on the basis protoconch sculpture. In contrast to *both C. carlessi* and *C. kaputarensis* and *C. stroudensis* have comparatively smaller protoconchs with more numerous and more crowded apical radial ribs (Stanisic, 1990). *Cralopa* is herein restricted to include only the type and *C. kaputarensis* (Nandewar Range Bioregion). *C. carlessi* (herein restricted to localities in the Attunga-Inverell area of the New England Bioregion, NSW) is reassigned to *Gouldiropa* gen. nov. Specimens of *C. stroudensis* from the limestone outcrops of the Macleay Valley, W of Kempsey cited in Stanisic (1990), viz. AMSC121680 [Yessabah], AMSC152198 [Natural Arch], are excluded from the revised definition of *C. stroudensis* and will be considered elsewhere (Stanisic, in prep.).

*Cralopa* Iredale, 1941 as redefined herein differs from that of Stanisic (1990) by the removal of *C. carlessi* Stanisic, 1990. Although the shell of this species bears a number of similarities to that of *C. stroudensis* these must be considered examples of convergent or parallel evolution. The smaller protoconch and denser apical ribbing of *C. stroudensis* and *C. kaputarensis* are considered key characters that serve to generically separate these species from *C. carlessi*. '*Charopa*' *colliveri* Gabriel, 1947 from SE Victoria was included here by Smith & Kershaw (1979) without detailed reasons but presumably on the basis of the reduced umbilicus and bold radial ribs on the teleoconch. A casual inspection of a co-type of '*C.*' *colliveri* in the QM (MO35761) from the Stan Colliver Collection reveals that there are characters such as the

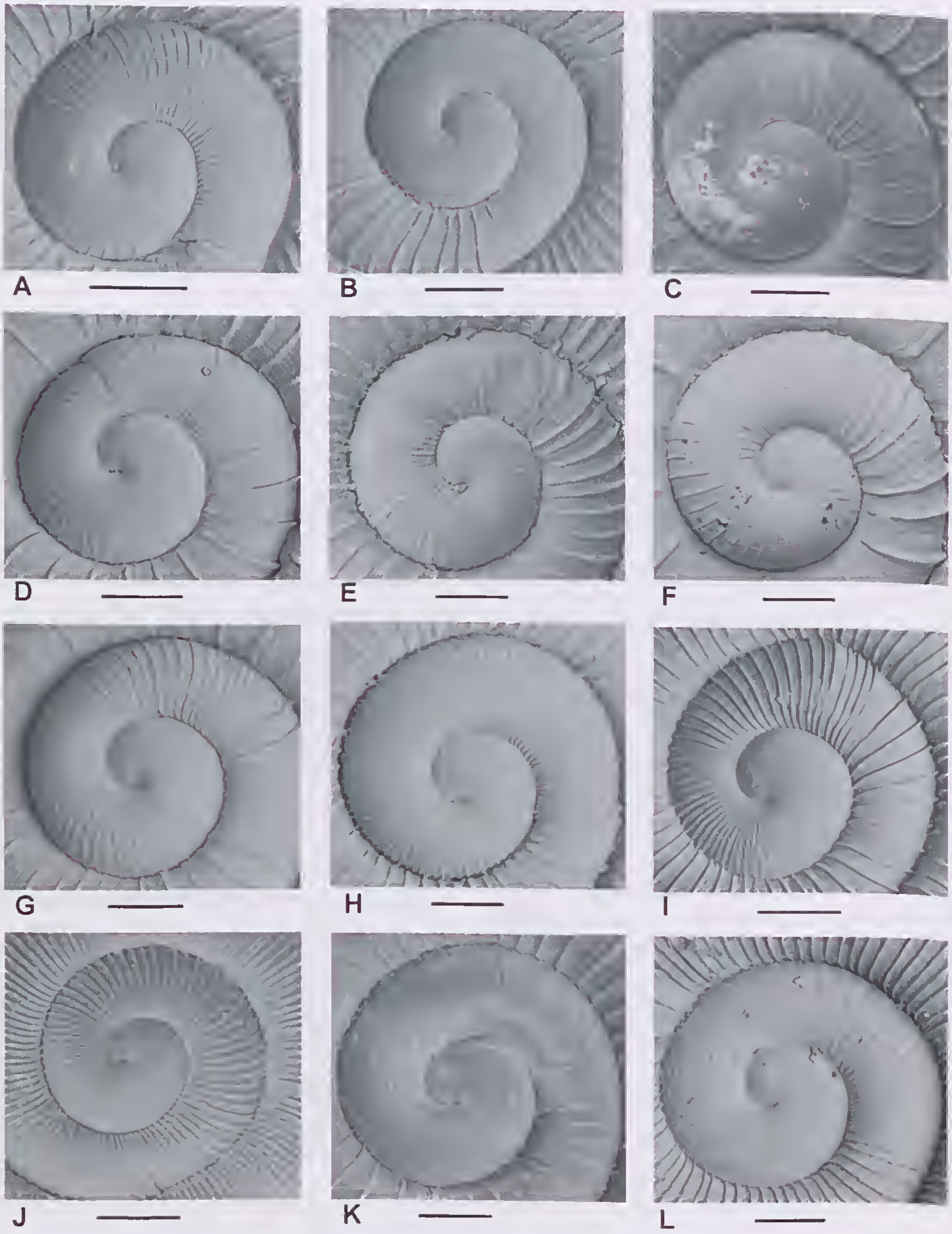


FIG. 26. Protoconch of shells from above. A, *Cralopa stroudensis* (SEQ), QMMO16857. B, *Cralopa stroudensis* (Sydney), QMMO29638. C, *Gouldiropa carlessi*, AMSC003640. D, *Sharniropa wollondillyana*, QMMO70399. E, *Sharniropa borenorensis*, AMSC205166. F, *Sharniropa xanana*, QMMO70398. G, *Acheronopa attunga*, QMMO70400. H, *Hedleyropa yarrangobillyensis*, QMMO70401. I, *Scleridoropa sarahjaneae* (Yarrangobilly), QMMO70402. J, *Scleridoropa nandewar*, QMMO70403. K, *Diphyoropa saturni*, AMSC205167. L, *Diphyoropa macleayana*, AMSC168685. Scale bars=0.15mm in K, L; 0.2mm in A-J.

considerably fewer number of radial ribs on the protoconch, the absence of an apertural sinus and less sinuated radial ribs that suggest this species is not congeneric with *C. stroudensis*. '*C.*' *colliveri* also differs from *C. stroudensis* in the nature of the umbilical closure which in the latter is partially due to reflection of the columellar margin of the aperture over the umbilical opening rather than constriction as is the case in '*C.*' *colliveri*. All these differences indicate generic incompatability, however, the generic placement of this species must await a future review that will probably need to include other Victorian and possibly Tasmanian charopids.

### **Cralopa stroudensis** (Cox, 1864)
(Figs 10, 20-22, 25-29, 34; Table 4)

*Helix stroudensis* Cox, 1864: 20; Tryon, 1887: 25, pl.4, figs 28-29.

*Gyrocochlea stroudensis* (Cox). Hedley, 1924: 217, pl. 3, figs 25-27; Iredale, 1937: 323.

*Cralopa stroudensis* (Cox). Iredale, 1941a: 269; Kershaw, 1956b: 8; Stanisic, 1990: 150, figs 95-97 (part); Smith, 1992: 184.

MATERIAL. HOLOTYPE: AMSC63500, E of Dungog, Stroud, NSW: (32º24.5'S, 151º58'E), Rev. R.L.King. Height of shell=1.62mm, diameter=2.56mm, H/D=0.63, D/U=8.30, ribs on last whorl =109, whorls=4. PARATYPES. AMSC225, 4, same data as holotype. OTHER MATERIAL. NSW: QMMO29638, MO12281, MO16857, MO49237, MO42140, MO20294, MO31855, MO32109, MO36809, MO37544, MO56140, MO38770, MO49239, MO55877, MO55931. SE Qld: QMMO29796, MO45173, MO28453.

DIAGNOSIS. Shell light golden brown, with moderately loosely coiled whorls, a well developed apertural sinus and strongly impressed sutures. Apex and early spire weakly elevated. Teleoconch with numerous, prominent and very strongly protractively sinuated, crowded radial ribs; mean ribs/mm = 10.08. Umbilicus closed or only very slightly open, mean D/U 7.81. Penis with two longitudinal pilasters.

DESCRIPTION. Shell very small, light golden brown, with 2.8-4.3 (mean 4.0) moderately loosely coiled whorls. Whorls weakly rounded to shouldered above and rounded below a weakly rounded periphery, well developed apertural sinus present. Shell diameter 1.63-1.33mm (mean 2.58mm). Apex and early spire very weakly elevated. Height of shell 1.02-1.73mm (mean 1.53mm), H/D 0.53-0.66 (mean 0.66mm). Protoconch of 1.5-1.7 whorls with very crowded, regularly spaced, curved radial ribs (approx. 80); ribs of medium width; height less than or greater than width; spacing uniform; width of interstices (in multiples of rib width) 3-5 at apex. Secondary sculpture of low, crowded microspiral cords that cross the microradials. Teleoconch with prominent, crowded, strongly protractively sinuated, bold radial ribs. Ribs on the last whorl 68-126 (mean 88); ribs/mm 7.90-16.50 (mean 10.83); rib height less than to greater than width; straight in section; rounded on top. Rib interstices on the first post-nuclear whorl equal to width of 3-5 ribs; on the penultimate whorl equal to width of 4-5 ribs. Interstitial sculpture of weak, low to very low microradial ribs; 7-8 between ribs on first post-nuclear whorl; 6-13 between ribs on penultimate whorl. Microradial ribs with weak periostracal blades. Secondary microsculpture of prominent spiral cords that cross the microradials and form round beads at their intersection. Sutures strongly impressed. Umbilicus reduced to a pinhole and partially occluded by a reflection of the columellar edge of the aperture; occasionally closed. Umbilical width when open 0.14-0.44mm (mean 0.34mm), D/U 5.68-11-64 (mean 7.81). Aperture ovately lunate; parietal callus present. Based on 15 measured specimens (QMMO29638, MO16857, MO49237).

Genitalia with ovotestis containing two clumps of alveoli, with more than two alveolar lobes per clump. Talon stalk 1-3 times the diameter of the talon; talon circular. Penial retractor muscle less than half the length of the penis; insering onto the penis head, or at the junction of the penis and epiphallus; enters penis through a simple pore. Penis tubular; two longitudinal; pilasters present.

Pallial cavity with kidney moderately bilobed; apex of pericardial lobe reflexed. Mantle gland present.

Radula with central tooth strongly tricuspid; lateral teeth tricuspid; first and second laterals equal in width, or first lateral wider than second lateral. Mesocone of first lateral tooth triangular, or slender, slightly diamond-shaped; marginal teeth skewed towards the centre. Ectocone of outer marginal teeth not split; endocone not split; number of lateral teeth: 5-6; marginal teeth: 13-14; radular rows: 88-91. Based on 6 dissected specimens (QMMO12281, MO29638).

DISTRIBUTION AND HABITAT. Sydney area, west to the Blue Mountains, central NSW and N to the Bunya Mts, SE Qld; living under logs and rocks in subtropical and warm temperate rainforest.

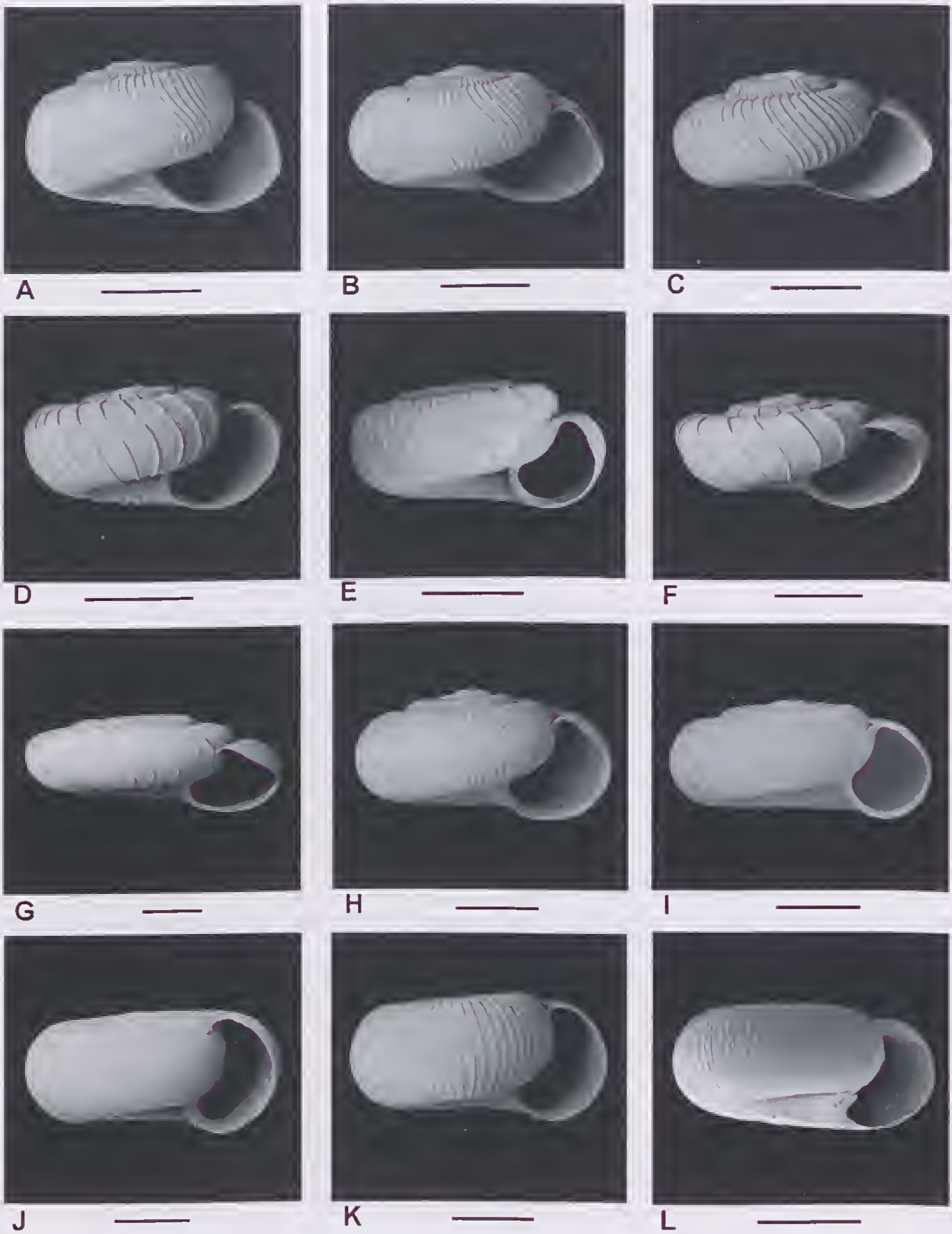


FIG. 27. Lateral view of shells. A, *Cralopa stroudensis* (SEQ), QMMO16857. B, *Cralopa stroudensis* (Sydney), QMMO29638. C, *Gouldiropa carlessi*, AMSC003640. D, *Sharniropa wollondillyana*, QMMO70399. E, *Sharniropa borenorensis*, AMSC205166. F, *Sharniropa xanana*, QMMO70398. G, *Acheronopa attunga*, QMMO70400. H, *Hedleyropa yarrangobillyensis*, QMMO70401. I, *Scleridoropa sarahjaneae* (Yarrangobilly), QMMO70402. J, *Scleridoropa nandewar*, QMMO70403. K, *Diphyoropa saturni*, AMSC205167. L, *Diphyoropa macleayana*, AMSC205274. Scale bars=1mm in A-I, K, L; o.5mm in J.

REMARKS. The definition of *Cralopa stroudensis* presented herein differs from that of Stanisic (1990) by the exclusion of material from the limestones of the Macleay Valley, W of Kempsey. NSW (AMSC121680, C128902, C152198). The Macleay Valley specimens have much less crowded radials on the protoconch (possibly affiliated with *Gouldiropa* ; Stanisic, pers. obs.) but are not dealt with in this study. C. *stroudensis* does, however, occur in the Kempsey region where it has been found in subtropical rainforest and wet sclerophyll forest adjacent to, but not on limestone outcrops.

*Cralopa stroudensis* shows some differences in shell features across its range (teleoconch rib spacing, shell size) but these variations display little geographic consistency and are also within the limits of observed intrapopulation variability. Most significantly this conchological variation is not reflected in any detectable change in reproductive anatomy. Shells of *C stroudensis* can be distinguished from those of some other east Australian charopids with a closed to almost closed umbilicus eg. *Elsothera sericatula* (Pfeiffer, 1849)[Sydney region], *E. nautilodea* (Cox, 1866) [Grafton area, NE NSW], *Whiteheadia globosa* (Stanisic, 1990) comb. nov. [NSW/Qld Border Ranges] and *Gouldiropa* gen. nov. by a combination of the following features: numerous, very crowded radial ribs on the protoconch (fewer and more widely spaced in *W. globosa* and *Gouldiropa*); very crowded, strongly sinuated radial ribs on the teleoconch (more crowded and very weakly sinuated in *Elsothera*, widely spaced and almost straight in *W. globosa*); and a well-developed apertural sinus (absent in *Elsothera*, *W. globosa* and *Gouldiropa*).

### **Cralopa kaputarensis** Stanisic, 1990
(Figs 10, 20-22, 25-29)

*Cralopa kaputarensis* Stanisic, 1990: 153: 98; Smith 1992: 184.

MATERIAL. HOLOTYPE. QMMO16753, Mt Kaputar, summit, NSW (30°16'S, 150°10'E), among grass and litter, 9.xi.1983, JS, DP, PHC. J. Short. Height of shell=0.90mm, diameter=1.66, H/D=0.54, whorls=4.0, ribs on last whorl=80. PARATYPES. All NSW. QMMO16742, 1SC/2RC, Dawson Springs, Mt Kaputar (30"16'S, 150°10'E), under logs, in fern gully, alt. 1300m, 8.xi.1983, JS, DP, PHC, J. Short; QMMO16750, 1RC, Jokers Spring, Mt Kaputar (30°16'S, 150°10'E), edges of rocky creek bed, among lichens, alt. 1100m, 8.ix.1983, JS, DP, PHC, J. Short. OTHER MATERIAL. QMMO49167, MO49175.

DIAGNOSIS. Shell very small, dark brown with moderately loosely coiled whorls and a barely visible apertural sinus; whorls flattened above a rounded periphery. Spire and early apex barely elevated. Teleoconch with numerous, crowded, prominent strongly protractively sinuated radial ribs (mean ribs/mm 13.94). Umbilicus reduced to a slight chink. Penis with two longitudinal and bifurcated pilasters present.

DISTRIBUTION AND HABITAT. From Mt Kaputar, Nandewar Ranges, NSW; in moist woodland living under rocks, logs and among lichen near springs.

REMARKS. *Cralopa kaputarensis* differs from *G. carlessi* by its smaller size, in having a more closed umbilicus and a greater number of radial ribs on theprotoconch and teleoconch. *C. kaputarensis* is still only known from summit area of Mt Kaputar. However, this could be an artefact of collecting effort since most areas in and around these ranges still need to be investigated. Additional specimens collected since 1990 have not altered the species profile of Stanisic (1990).

### **Gouldiropa** gen. nov.

ETYMOLOGY. In honour of the late Stephen Jay Gould.

TYPE SPECIES. *Cralopa carlessi* Stanisic, 1990; herein designated.

DIAGNOSIS. Shell very small, dark brown, with moderately loosely coiled whorls and strongly impressed sutures; apertural sinus absent or only weakly developed. Protoconch with relatively widely spaced, crowded curved radial ribs (approx. 40) and numerous, regularly crowded, low continuous spiral cords that cross the radial ribs. Teleoconch with numerous, bold, weakly to very strongly protractively sinuated, moderately crowded to very widely spaced radial ribs. Interstitial sculpture with microspiral cords stronger than microradial ribs, beading at their intersection barely noticeable, obscured by strength of microspiral cords. Umbilicus closed or only slightly open. Columellar edge of aperture weakly reflected across the umbilical opening. Kidney moderately to strongly bilobed with reflexed apex on pericardial lobe. Penis with two longitudinal pilasters that may be divided.

DISTRIBUTION AND HABITAT. New England Bioregion. Species occur on limestone outcrops associated with vine thicket and in settered moist refugia on volcanic rocks. The species live under rocks among vine thicket and in wet sclerophyll forest.

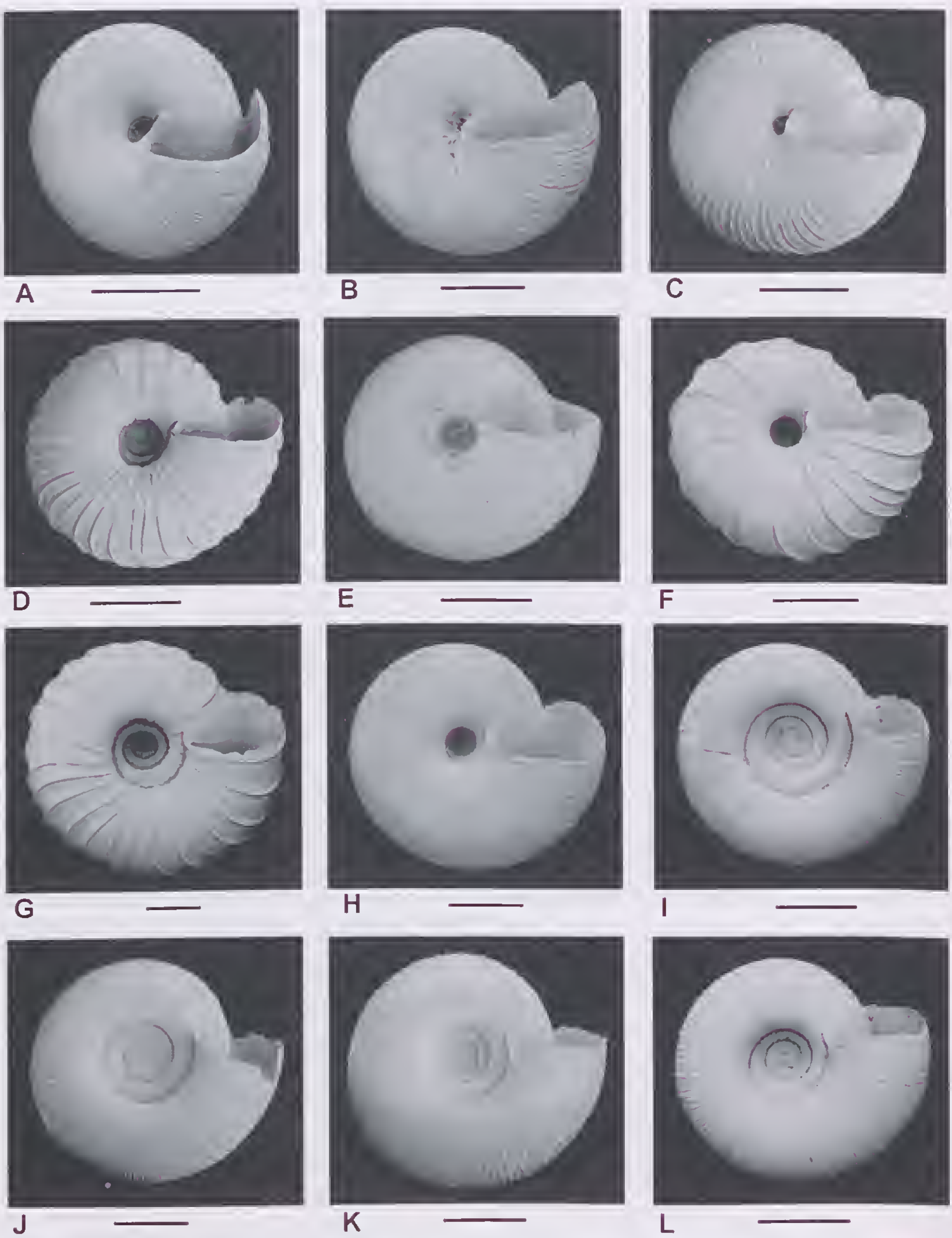


FIG. 28. Ventral view of shells. A, *Cralopa stroudensis* (SEQ), QMMO16857. B, *Cralopa stroudensis* (Sydney), QMMO29638. C, *Gouldiropa carlessi*, AMSC003640. D, *Sharniropa wollondillyana*, QMMO70399. E, *Sharniropa borenorensis*, AMSC205166. F, *Sharniropa xanana*, QMMO70398. G, *Acheronopa attunga*, QMMO70400. H, *Hedleyropa yarrangobillyensis*, QMMO70401. I, *Scleridoropa sarahjaneae* (Yarrangobilly), QMMO70402. J, *Scleridoropa nandewar*, QMMO70403. K, *Diphyoropa saturni*, AMSC205167. L, *Diphyoropa macleayana*, AMSC168685. Scale bars=0.5mm in J; 0.8mm in D; 1mm in A-C, E-I, K, L.

REMARKS. *Gouldiropa* sp. nov. is similar to *Cralopa* but differs most significantly in having fewer and less crowded ribs on the protoconch; fewer and less crowded teleoconch ribs that are bolder and much less sinuated than in *Cralopa*; and in lacking an apertural sinus.

**Gouldiropa carlessi** (Stanisic, 1990) comb. nov.
(Figs 10, 20-22, 25-29, 33-34; Table 4)

*Cralopa carlessi* Stanisic, 1990:156, figs 101-103 (in part); Smith, 1992: 184 (in part).

MATERIAL. HOLOTYPE: NSW: AMSC123538, Inverell (29°46.5'S, 151°6.8'E), C.T.Musson. Height of shell=2.04, diameter=3.62, H/D=0.56, number of whorls=4.5, ribs on last whorl=70. PARATYPES. AMSC153716, C3640, C28496, C123610. OTHER MATERIAL. AMSC164886, QMMO49195, MO52694, MO32090, MO49207.

DIAGNOSIS. Shell very small, brown with moderately loosely coiled whorls and a barely visible apertural sinus; whorls flattened above a rounded periphery. Spire and early apex slightly elevated. Teleoconch with numerous prominent strongly protractively sinuated radial ribs (mean ribs/mm 6.03). Umbilicus very slightly open, diameter range 0.26-0.43mm, mean D/U 5.49. Penis with two longitudinal pilasters.

DESCRIPTION. (Amended from Stanisic, 1990). Shell very small golden brown with 3.8-4.1 (mean 4.0) moderately loosely coiled whorls; apertural sinus very weakly developed. Shell diameter 2.96-3.44mm (mean 3.20mm). Apex and early spire weakly elevated. Height of shell 1.61-1.88mm (mean 1.76mm), H/D 0.49-0.61 (mean 0.56). Protoconch with 1.5 whorls. Apical sculpture primarily radial consisting of approximately 40 regularly and widely spaced, curved radial ribs; ribs with height less than width; width of interstices (in multiples of rib width) 4-8 at apex. Secondary sculpture of continuous, regualrly crowded spiral cords, crossing the radial ribs. Teleoconch with prominent strongly protractively sinuated, variably spaced radial ribs that become more spaced on the last whorl; 46-74 (mean 60) ribs on the last whorl. Ribs/mm 5.14-6.91 (mean 6.03). Ribs wide, height equal to width, straight in section, rounded on top. Interstices on the 1st post-nuclear whorl equal to width of 4-6 ribs; on the penultimate whorl, greater than or equal to width of 6 ribs. Interstitial sculpture of very low microradial ribs and stronger microspiral cords; 10-12 microradials between ribs on 1st post-nuclear whorl; 12-16 between ribs on penultimate whorl. Microspiral cords crossing microradials but not forming distinct beads at their intersection. Umbilicus very narrowly open, U-shaped. Umbilical width 0.26-0.43mm (mean 0.32mm), D/U 5.21-5.77 (mean 5.49). Aperture ovately lunate. Whorls rounded above and below a weakly rounded periphery, sutures moderately impressed; parietal callus present. Based on 8 measured specimens (AMSC3640).

Genitalia with ovotestis containing two clumps of alveoli, with two alveolar lobes per clump. Talon stalk 1-3 times the diameter of the talon; talon circular. Penial retractor muscle less than half the length of the penis, inserting at the junction of the penis and epiphallus. Epiphallus entering penis through a simple pore; shorter than penis; narrower than the vas deferens. Penis tubular, internally with two longitudinal pilasters. Vagina shorter than penis. Based on 8 measured specimens (AMSC3640).

Pallial cavity with moderately bilobed kidney, pericarial lobe reflexed. Mantle gland present.

Radula: central tooth strongly tricuspid; lateral teeth tricuspid; ectocone of outer marginal teeth split into 2-3 teeth; endocone not split. Lateral teeth: 5; marginal teeth: 14; radular rows: 106. Based on 1 dissected specimen (QMMO32080).

DISTRIBUTION AND HABITAT. N New England Tableland, NSW; under rocks on limestone outcrops covered in vine thicket or in moist sclerophyll forest.

REMARKS. *Gouldiropa carlessi* Stanisic (1990) comb. nov. is herein restricted to include only populations from the northern part of the New England Tableland, NSW. Stanisic (1990) considered that this species had an extensive range from Wee Jasper, SE NSW to Inverell, NE NSW wherein intraspecific variability included considerable differences in rib spacing, spire protrusion and umbilical width. That study, however, was constrained by a paucity of material for examination. Since that time additional specimens have become available for scrutiny and have enabled a more detailed analysis of these characters to be undertaken. A closer inspection indicates that a number of species were involved. Unfortunately, and somewhat hastily, some of these were made paratypes for the nominal species, a salutary lesson for using only topotpes in the formal type series. Specimens cited by Stanisic (1990) as coming from limestones on Glenrock Station (AMSC340138, formerly AMSC144200) are assigned to *Sharniropa xanana*. Specimens from SE NSW (Tuglow Caves [AMSC124279],

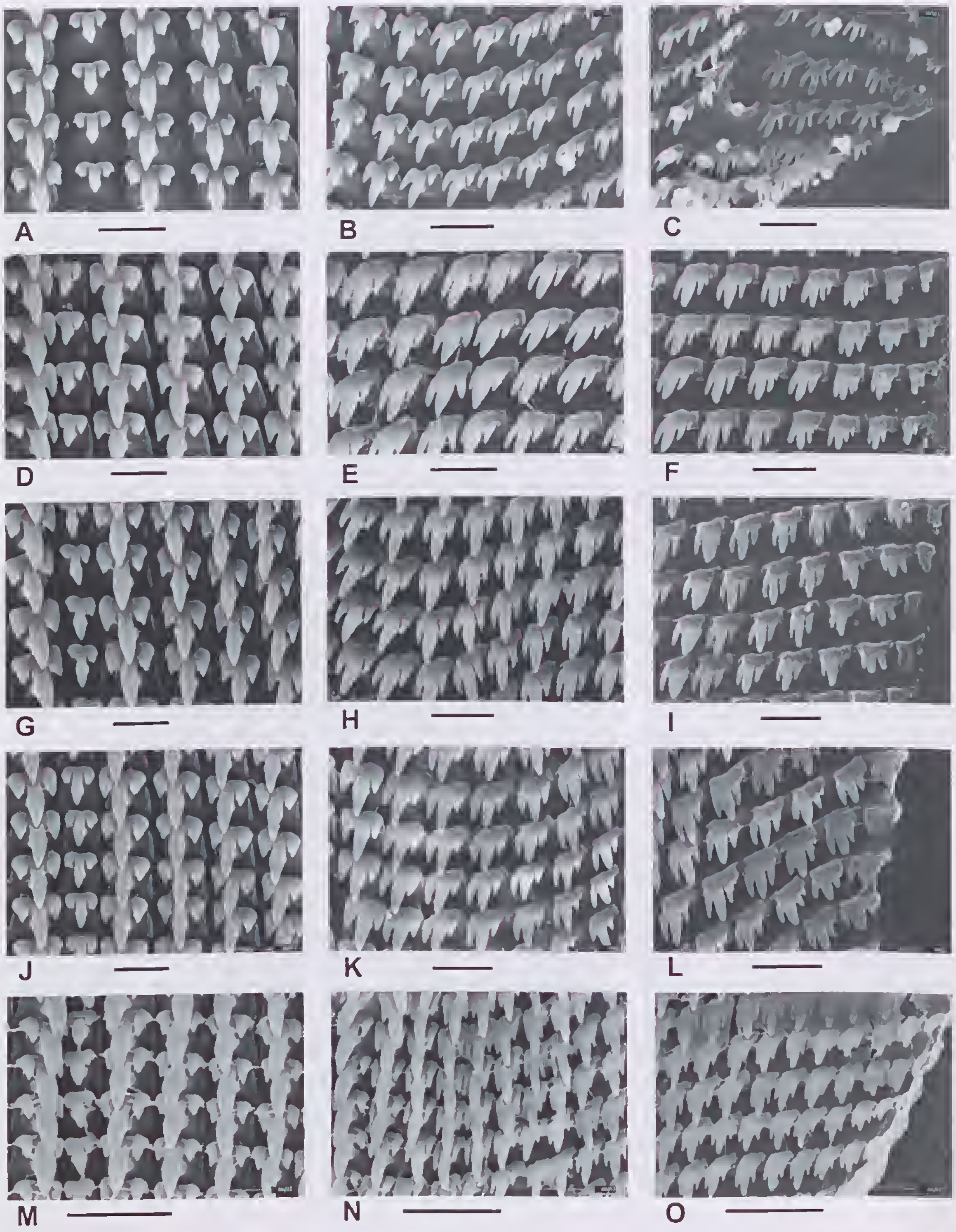


FIG. 29. Radula. A-C, *Cralopa stroudensis*, QMMO29638. D-F, *Gouldiropa carlessi*, QMMO32080. G-I, *Gouldiropa kaputarensis*, QMMO49175. J-L, *Sharniropa wollondillyana*, QMMO29241. M-O. *Acheronopa attunga*, QMMO49218. Scale bars=0.01mm in A-L; 0.02mm in M-O.

Jenolan Caves [QMMO17295], Wee Jasper [AMSC142961] and Wombeyan Caves [AMSC142967]) probably represent several species and are excluded. They will be dealt with elsewhere once more material becomes avilable for study.

*Gouldiropa carlessi* is distinguished from *G. kaputarensis* by its larger size, flatter whorls, slightly more open umbilicus, more elevated spire and by having fewer ribs on the teleoconch. *Sharniropa xanana* from the southern part of the New England Tableland has shouldered whorls, fewer ribs on the teleoconch and a more open umbilicus. *G. carlessi* is sympatric with the similarly shaped *Acheronopa attunga* but is readily distinguished from that species by its smaller size, almost closed umbilicus (widely open in *A. attunga*) and in having more crowded radial ribs on the teleoconch.

### **Sharniropa** gen. nov.

ETYMOLOGY. For Sharn Rose.

TYPE SPECIES. *Sharniropa wollondillyana* sp. nov.; herein designated.

DIAGNOSIS. Shell very small, dark brown, with moderately loosely coiled whorls and strongly impressed sutures; apertural sinus absent. Protoconch with relatively widely spaced, crowded curved radial ribs (approx. 45-50) and numerous, regularly crowded, low continuous spiral cords that cross the radial ribs. Teleoconch with numerous, bold, weakly to very strongly protractively sinuated, crowded to very widely spaced radial ribs. Interstitial sculpture with microspiral cords stronger than microradial ribs, beading at their intersection weak to barely noticeable, obscured by strength of microspiral cords. Umbilicus narrowly open U-shaped. Columellar edge of aperture not reflected across the umbilical opening. Kidney moderately to strongly bilobed with reflexed apex on pericardial lobe. Penis internally with two longitudinal pilasters.

DISTRIBUTION AND HABITAT. N part of the Southern Tableland Bioregion to the S end of the New England Tableland Bioregion; only on limestone outcrops living among limestone talus.

REMARKS. *Sharniropa* gen. nov. differs from *Gouldiropa* mainly in the coiling pattern of the shell. In *Sharniropa* narrowing of the umbilicus is caused by constriction, in *Gouldiropa* it is a combination of constriction and columellar reflection. *Acheronopa* differs in having a greater number of apical radial ribs (approx. 60), a larger, flatter shell with evenly coiled whorls and a wider umbilicus caused by gradual decoiling.

### **Sharniropa wollondillyana** sp. nov.
(Figs 10, 23, 25-29, 31-34; Table 5)

ETYMOLOGY. For the Wollondilly River.

MATERIAL. HOLOTYPE. QMMO70399, Abercrombie Caves, SW Oberon, NSW, (33°54'42"S, 149°21'36"E), remnant vt/ lm, under logs and rocks, 13.i.1993, JS, JC. Height of shell=1.43mm, diameter=2.57mm, H/D=0.56, D/U=4.51, number of whorls=3.9, ribs on last whorl=31. PARATYPES. All NSW. QMMO44771, 48RC, same data as holotype; QMMO29241, 1RC, QMMO37781, 10RC, Abercrombie Caves, SW Oberon, lm, under rocks and in litter, 8.i.1990, JS, JC; AMSC157323, 7RC, SW of Bathurst, Bombah, 100m S of Abercrombie Caves camping ground (33°54.8'S, 149°21.5'E), lm, under rocks and soil on limestone hill, 6.vi.1982, MS; AMSC158364, many RC, S of Blayney, Abercrombie Cave, near Bushranger Cave (33°55'S, 149°21'E), vii.1982, O.L. Griffiths. OTHER MATERIAL. AMSC137245.

DIAGNOSIS. Shell very small, brown with moderately loosely coiled whorls; whorls weakly shouldered above a rounded periphery. Teleoconch with widely spaced, prominent, strongly protractively sinuated radial ribs (mean ribs/mm 3.93). Umbilicus open, very narrow U-shaped: umbilical diameter range 0.55-0.73mm, mean D/U 4.43. Penis with two longitudinal pilasters.

DESCRIPTION. Shell very small, colour brown with 3.7-4.3 (mean 4.0) moderately loosely coiled whorls. Shell diameter 2.27-3.34mm (mean 2.84mm). Apex and early spire barely elevated. Height of shell 1.21-1.54mm (mean 1.43mm), H/D 0.45-0.58 (mean 0.51). Protoconch of 1.5-1.8 whorls with sculpture of approximately 45-50, crowded, curved, regularly spaced radial ribs, ribs of medium width; height equal to width, width of interstices (in multiples of rib width) 6-8 at apex. Secondary sculpture of low continuous, eroded and regularly spaced spiral cords that cross the radial ribs. Teleoconch sculpture of widely and regularly spaced (becoming more crowded at the end of the last whorl), strongly protractively sinuated radial ribs; 26-34 (mean 35) ribs on the last whorl, ribs/mm 2.79-5.00 (mean 3.93). Ribs wide; height greater than width; straight in section; rounded on top; interstices on the first post-nuclear whorl equal to width of 8-10 ribs; interstices on the penultimate whorl equal to width of 8 ribs. Interstitial sculpture of weak microradial ribs 20 between ribs on first post-nuclear whorl; 20 between ribs on

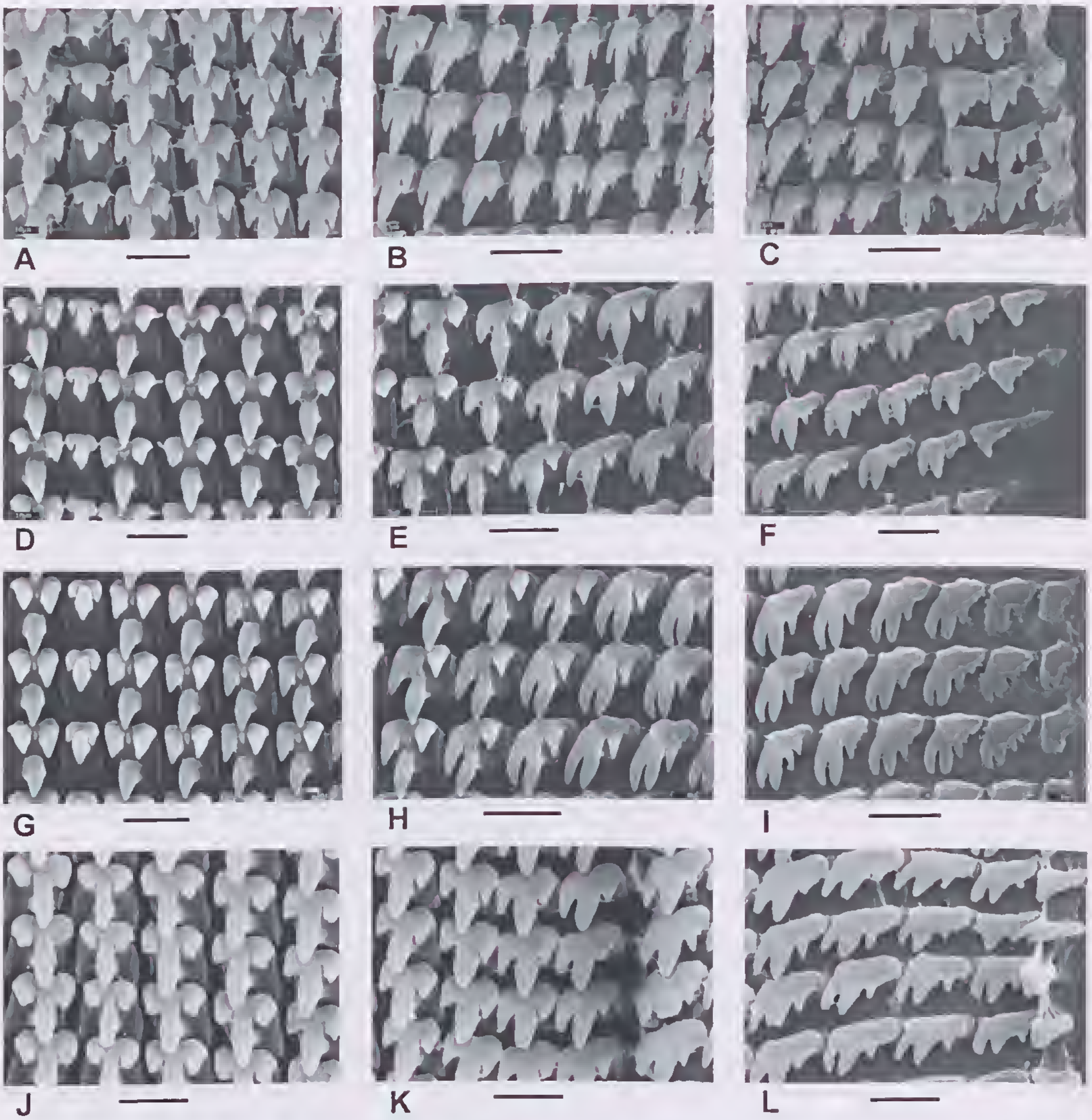


FIG. 30. Radula. A-C, *Hedleyropa yarrangobillyensis*, QMMO39840. D-F, *Scleridoropa sarahjaneae* (Yarrangobilly), QMMO39974. G-I, *Scleridoropa nandewar*, QMMO49158. J-L, *Diphyoropa macleayana*, AMSC162184. Scale bars=0.01mm.

penultimate whorl. Secondary sculpture of more prominent, low microspiral cords with weak beading at their intersection with the microradial ribs. Umbilicus moderately wide U-shaped, diameter 0.55-0.73mm (mean 0.64mm), D/U 3.99-5.03 (mean 4.43). Sutures impressed, whorls weakly shouldered above and rounded below a rounded periphery. Aperture ovately to roundly lunate. Based on 19 measured specimens (QMMO44771, MO70399).

Genitalia with ovotestis containing two clumps of alveoli, with two alveolar lobes per clump. Talon stalk 1-3 times the diameter of the talon; talon circular. Penial retractor muscle less than half the length of the penis, inserting at the junction of the penis and epiphallus. Epiphallus shorter than penis; narrower than the vas deferens; entering penis through a simple pore. Penis tubular, two longitudinal pilasters present.

Pallial cavity with kidney moderately bilobed; apex of pericardial lobe reflexed. Mantle gland present.

Radula with central tooth strongly tricuspid; lateral teeth tricuspid; ectocone of outer marginal teeth not split; endocone not split. Number of lateral teeth: 6; marginal teeth: 12; radular rows: 97. Based on 3 dissected specimens (QMMO29241).

DISTRIBUTION AND HABITAT. Abercrombie limestones, NSW; under logs and rocks.

REMARKS. *Sharniropa wollondillyana* sp. nov. differs from *S. boronorensis* in having fewer radial ribs on the teleoconch and a larger umbilicus. *S. wollondillyana* is superficially similar to the sympatric *Decoriropa lirata* but differs primarily in having fewer apical radial ribs. *D. lirata* is also smaller than *S. wollondillyana*, has a relatively larger umbilicus and more crowded ribs on the teleoconch.

### **Sharniropa borenorensis** sp. nov.
(Figs 23, 25-28; Table 4)

ETYMOLOGY. For the type locality.

MATERIAL. HOLOTYPE: AMSC205166, Borenore Caves, W side of large cave entrance W of Borenore, W of Orange, NSW (33°15.14'S, 148°56.19'E), in soil and grass among limestone boulders, vi.1983, MS. Height of shell=1.50mm, diameter=2.77mm, H/D=0.54, D/U=5.54, number of whorls=3.7, ribs on last whorl=50. PARATYPES. All NSW. AMSC157300, 13RC, same data as holotype; QMMO44745, 12RC, Borenore Caves, c.18.6km WNW Orange (33°15'06"S, 148°55'42"E), lm/ew, in litter iunder rocks, 11.i.1993, JS, JC; QMMO37496, 30RC, Borenore Caves, c.10km W Orange (33°15'S, 148°56'E), remnant vt/lm, among rocks,13.i.1991, JS.

DIAGNOSIS. Shell very small, brown, with moderately loosely coiled; whorls weakly shouldered above a rounded periphery. Teleoconch with crowde, prominent, strongly protractively sinuated radial ribs (mean ribs/mm 7.13). Umbilicus open, very narrow U-shaped; umbilical diameter range 0.50-0.71mm, mean D/U 4.95. Anatomy unknown.

DESCRIPTION. Shell very small, brown, with 3.7-4.2 (mean 4.0) moderately loosely to evenly coiled whorls. Shell diameter 2.64-3.11mm (mean 2.84mm). Apex and early spire barely elevated. Height of shell 1.33-1.54mm (mean 1.42mm), H/D 0.45-0.54 (mean 0.50). Protoconch of 1.5-1.7 whorls with curved, regularly spaced radial ribs; ribs of medium width, height less than width, width of interstices (in multiples of rib width) 5 at apex. Secondary sculpture of low, continuous regular spaced spiral cords that cross the radial ribs. Teleoconch sculpture of crowded, regualrly spaced (but becoming more crowded toward the end of the last whorl), strongly protractively sinuated radial ribs; 50-79 (mean 64) ribs on the last whorl, ribs/mm 5.75-8.09 (mean 7.13). Ribs wide; height equal to width; straight in section; rounded on top. Rib interstices on the first post-nuclear whorl equal to width of 3-4 ribs. Interstitial sculpture of microradial ribs, 5-6 between ribs on first post-nuclear whorl; 8 between ribs on penultimate whorl. Secondary microsculpture of of prominent low, regularly spaced microspiral cords that cross the microradial ribs without froming distinct beads. Umbilicus very narrow U-shaped, diameter 0.50-0.71mm (mean 0.58mm), D/U 4.34-5.54 (mean 4.95). Sutures impressed, whorls weakly shouldered above and rounded below a weakly rounded periphery; Aperture roundly to ovately lunate; parietal callus present. Based on 8 measured specimens (AMSC157300, C205166).

Anatomy unknown.

DISTRIBUTION AND HABITAT. Known only from the type locality at the Borenore Caves limestone outcrop; found under grass amongst limestone boulders.

REMARKS. *Sharniropa borenorensis* sp. nov. is similar to *S. wollondillyana* from the Wombeyan and Abercrombie limestone outcrops. It differs mainly from the latter species in having a greater number of radial ribs on the last whorl (50-79, mean 64 compared with 26-34, mean 35 for *S. wollondillyana)* and a smaller umbilicus.

### **Sharniropa xanana** sp. nov.
(Figs 23, 25-28; Table 4)

*Cralopa carlessi* Stanisic, 1990:156 (in part), figs 101d-e; 102a-c; Smith, 1992: 184 (in part).

ETYMOLOGY. For Xanana Gusmao, President of East Timor.

MATERIAL. HOLOTYPE: QMMO70398, Timor Caves, via Murrurundi, NSW (31°41'S, 151°08'E), lm/remnant vt, in litter, 25.ix1989, JS, DP. Height of shell=1.74mm, diameter=3.34mm, H/D=0.52, D/U=5.96, number of whorls=4.1, ribs on last whorl=18. PARATYPES. All NSW. QMMO37735, 29RC, AMSC205159, 5RC, same data as holotype; QMMO32065, 1 juvenile SC/6RC, in soil among rocks, otherwise same data as holotype. OTHER MATERIAL. QMMO56149, AMSC144200.

DIAGNOSIS. Shell very small, light golden brown, with moderately loosely coiled whorls

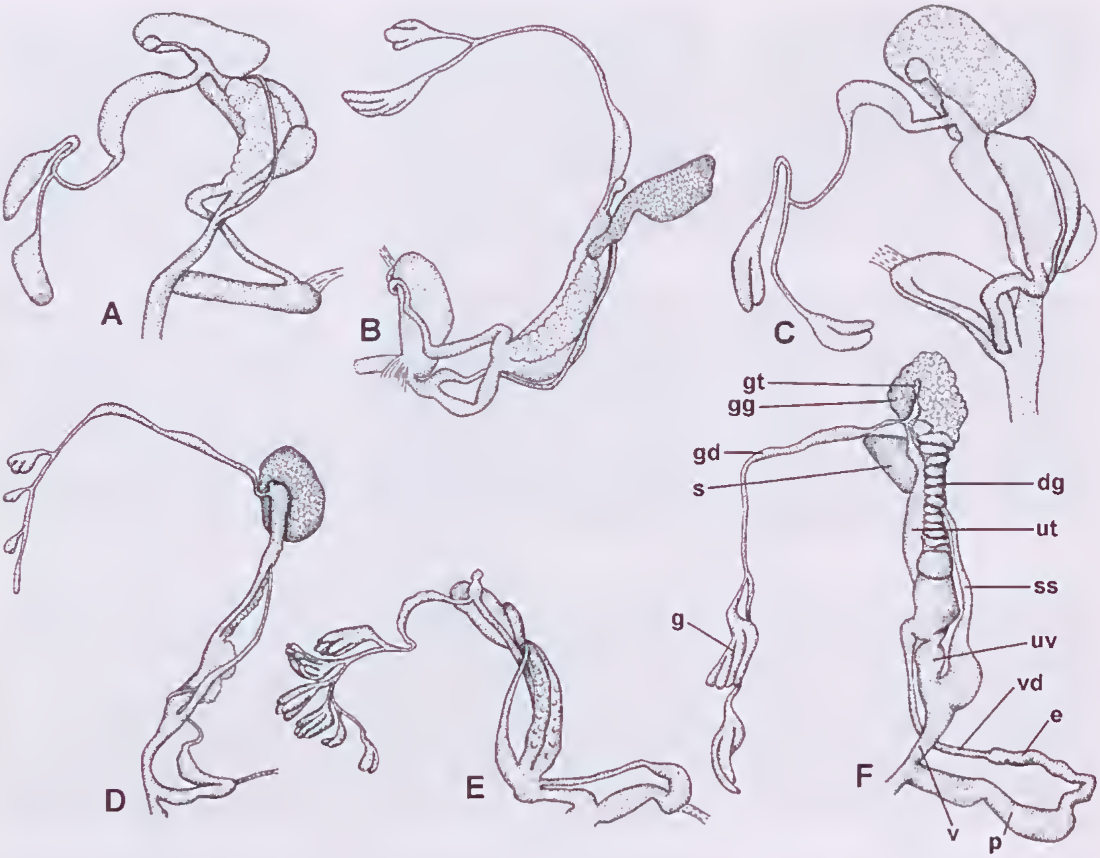


FIG. 31. Reproductive system. A, *Sharniropa wollondillyana*, QMMO29241. B, *Acheronopa attunga*, QMMO49218. C, *Hedleyropa yarrangobillyensis*, QMMO39840. D, *Scleridoropa nandewar*, QMMO49158. E, *Scleridoropa sarahjaneae* (Yarrangobilly), QMMO39974. F, *Diphyoropa macleayana*, AMSC162184. Scale bar=2.5mm in A and C, 2mm in B, and 1.6mm in all others. dg, prostate; e, epiphallus; g, ovotestis; gd, hermaphrodite duct; gg, albumen gland; gt, talon; p, penis; prm, penis retractor muscle; s, spermatheca; ss, spermathecal stalk; ut, uterus; uv, free oviduct; v, vagina; vd, vas deferens.

and a barely visible apertural sinus; whorls strongly shouldered above a rounded periphery. Spire and early apex flat to barely elevated. Teleoconch with relatively few, widely spaced, prominent, strongly protractively sinuated radial ribs (mean ribs/mm 1.86). Umbilicus open, very narrow U-shaped; umbilical diameter range 0.45-0.62mm, mean D/U 6.41. Anatomy unknown.

DESCRIPTION. Shell very small, light golden brown, with 3.9-4.5 (mean 4.09) loosely coiled whorls. Shell diameter 3.04-3.61mm (mean 3.31). Apex and early spire very weakly elevated. Height of shell 1.45-1.86mm (1.60mm), H/D 0.44-0.52 (mean 0.48). Protoconch relatively large with sculpture of approximately 40, regularly and widely spaced, weakly curved radial ribs; ribs of medium width; height less than width; width of interstices (in multiples of rib width) 3-5 at apex. Secondary sculpture of crowded, continuous microspiral cords that cross the microradial ribs. Teleoconch with prominent, regularly spaced, strongly protractractively sinuated, bold radial ribs, 16-25 (mean 19) ribs on the last whorl. Ribs/mm 1.65-2.20 (mean 1.86). Ribs greater in height than width; straight in section; rounded on top. Rib interstices on the first post-nuclear whorl equal to width of 13 ribs; on the penultimate whorl, equal to width of 13 ribs. Interstitial sculpture of very low microradial ribs and stronger microspiral cords; 30 microradials between ribs on first post-nuclear whorl, becoming almost impossible to count on penultimate whorl; beading indistinct due to

TABLE 4. Shell measurements for species of *Coricudgia*, *Marilyniropa*, *Cralopa*, *Gouldiropa* and *Sharniropa*. (Abbreviations as in Table 1).

| Measurement | *Coricudgia wollemiana* | *Marilyniropa jenolanensis* | *Cralopa stroudensis* | *Gouldiropa carlessi* | *Sharniropa borenorensis* | *Sharniropa xanana* |
|---|---|---|---|---|---|---|
| N | 10 (*9; **4; ***3) | 23 | 15 | 10 | 8 | 9 |
| D | 1.62-4.02 (3.304) ± 0.75 | 2.96-3.65 (3.24) ± 0.194 | 1.63-3.13 (2.58) ± 0.35 | 2.66-3.84 (3.21) ± 0.32 | 2.64-3.11 (2.841) ± 0.186 | 3.04-3.61 (3.307) ± 0.204 |
| PW | 1.7-1.8 (1.775) ± 0.05 ** | 1.5-1.7 (1.587) ± 0.069 | 1.5-1.7 (1.59) ± 0.07 | 1.5 | 1.5-1.7 (1.563) ± 0.074 | 1.5-1.7 (1.589) ± 0.06 |
| TW | 1.8-4.3 (3.1) ± 1.253 *** | 2.6-3.2 (2.922) ± 0.165 | 1.3-2.7 (2.38) ± 0.33 | 2.2-2.6 (2.43) ± 0.12 | 2.2-2.7 (2.425) ± 0.158 | 2.3-2.8 (2.5) ± 0.141 |
| NW | 3.6-6.1 (4.9) ± 1.253 *** | 4.1-4.8 (4.509) ± 0.165 | 2.8-4.3 (3.97) ± 0.36 | 3.7-4.1 (3.93) ± 0.12 | 3.7-4.2 (3.987) ± 0.155 | 3.9-4.5 (4.089) ± 0.169 |
| H | 0.83-2.21 (1.691) ± 0.435 | 1.33-1.79 (1.549) ± 0.146 | 1.02-1.73 (1.53) ± 0.17 | 1.31-2.03 (1.74) ± 0.19 | 1.33-1.54 (1.421) ± 0.071 | 1.45-1.86 (1.6) ± 0.133 |
| SP | 0.06-0.47 (0.259) ± 0.14 | 0.11-0.41 (0.25) ± 0.084 | 0.05-.18 (0.13) ± 0.04 | 0.1-0.33 (0.24) ± 0.07 | 0.09-0.21 (0.154) ± 0.038 | 0.06-0.3 (0.211) ± 0.079 |
| AH/AW | 0.75-1.14 (0.92) ± 0.11 | 0.78-0.98 (0.9) ± 0.05 | 0.81-1.11 (0.9) ± 0.08 | 0.77-0.93 (0.84) ± 0.06 | 0.77-0.91 (0.84) ± 0.05 | 0.65-0.79 (0.74) ± 0.05 |
| UMB | 0.55-1.15 (0.938) ± 0.177 | 0.73-1.07 (0.888) ± 0.087 | 0.14-0.44 (0.34) ± 0.07 | 0.26-0.54 (0.36) ± 0.1 | 0.5-0.71 (0.58) ± 0.083 | 0.45-0.62 (0.522) ± 0.059 |
| RIB | 28-47 (40.222) ± 6.36 * | 35-61 (47.087) ± 7.366 | 68-126 (88.73 ) ± 16.45 | 28-74 (56.4) ± 13.62 | 50-79 (63.625) ± 8.193 | 16-25 (19.444) ± 3.206 |
| RIBS/MM | 3.008-5.502 (4.089) ± 0.695 * | 3.764-6.078 (4.616) ± 0.588 | 7.904-16.50 (10.83) ± 2.241 | 3.35-6.85 (5.56) ± 1.13 | 5.746-8.086 (7.125) ± 0.735 | 1.649-2.204 (1.862) ± 0.201 |
| H/D | 0.45-0.55 (0.51) ± 0.03 | 0.43-0.55 (0.48) ± 0.03 | 0.53-0.66 (0.6) ± 0.04 | 0.49-0.58 (0.54) ± 0.02 | 0.45-0.54 (0.5) ± 0.03 | 0.44-0.52 (0.48) ± 0.03 |
| D/U | 2.95-3.8 (3.49) ± 0.23 | 3.33-4.05 (3.67) ± 0.22 | 5.68-11.64 (7.81) ± 1.63 | 5.22-13.23 (9.57) ± 2.55 | 4.34-5.54 (4.95) ± 0.4 | 5.29-7.85 (6.41) ± 0.91 |

strength of microspiral cords. Sutures impressed, whorls strongly shouldered above and rounded below a weakly rounded periphery. Sutures strongly impressed. Umbilicus very small, narrow U-shaped. Umbilical width 0.45-0.62mm (mean 0.52mm), D/U 5.29-7.85 (mean 6.41). Aperture ovately lunate, parietal callus present. Based on 9 measured specimens (QMMO32065, MO37735, MO70398).

DISTRIBUTION AND HABITAT. Limestone outcrops at Timor Caves and Glenrock Stn, NE of Scone, NSW; in litter among limestone talus.

REMARKS. *Sharniropa xanana* sp. nov. differs from its congeners by its strongly shouldered whorls, and relatively sparse teleoconch ribbing. Superficially the species bears a greater similarity to *Acheronopa attunga*. Both have a flattened shell with bold, widely spaced radial ribs. However, *S. xanana* is smaller, has a larger protoconch, fewer, more loosely coiled and more shouldered whorls, microsculpture with comparatively indistinct beading and a more closed umbilicus. This species was considered to be conspecific with *Gouldiropa carlessi* Stanisic, 1990 comb. nov. by Stanisic (1990).

The Timor and Glenrock limestone outcrops are among open woodland. Vegetation on the outcrops is degraded due mainly to human activity (fires, land clearing) but there is evidence that vine thicket may have been present on these in the past (Stanisic, pers. obs.).

## **Acheronopa** gen. nov.

ETYMOLOGY. Greek *Acheron*, river in the nether world; alluding to the underground streams that have formed many of the caverns present in limestone formations.

TYPE SPECIES. *Archeronopa attunga* sp. nov.; herein designated.

DIAGNOSIS. Shell very small, brown, strongly depressed (mean H/D 0.40), with flattened, evenly coiled whorls. Apical sculpture of relatively crowded, curved radial ribs (approx. 60) and numerous, weaker, continuous low microspiral cords. Teleoconch with strongly sinuated, very widely spaced, bold radial ribs. Secondary microsculpture of low microspiral cords and microradial riblets forming beads at their intersection. Kidney moderately bilobed with apex of pericardial lobe reflexed. Umbilicus

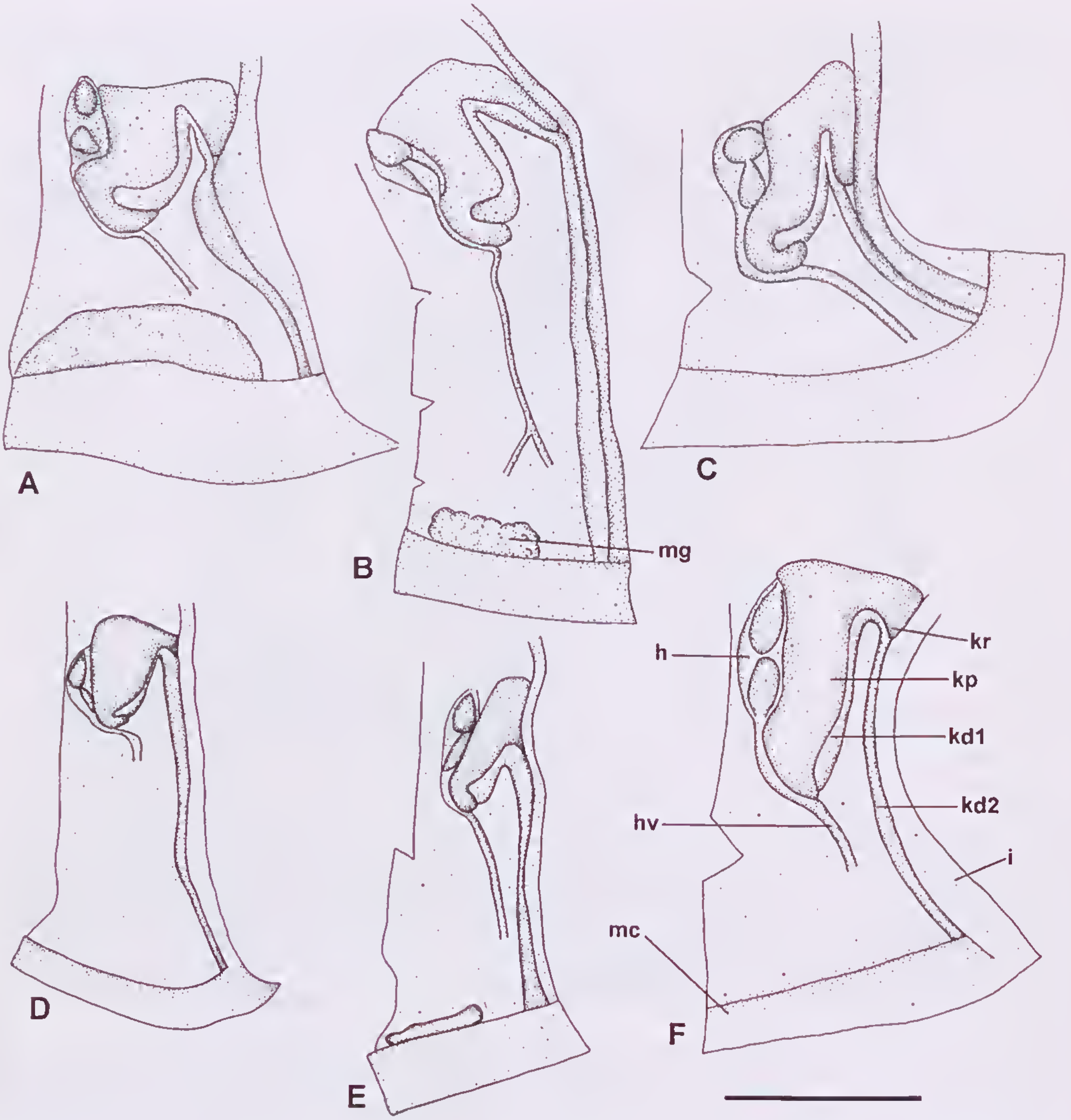


FIG. 32. Pallial cavity. A, *Sharniropa wollondillyana*, QMMO29241. B, *Acheronopa attunga*, QMMO49218. C, *Hedleyropa yarrangobillyensis*, QMMO39840. D, *Scleridoropa nandewar*, QMMO49158. E, *Scleridoropa sarahjaneae*, QMMO39974. F, *Diphyoropa macleayana*, AMSC162184. Scale bar=2mm in A and F, 1.6mm in B, and 1.28mm in all others. Abbreviations: h, heart; hv, principal pulmonary vein; i, intestine; kd1, primary ureter; kd2, secondary ureter; kp, pericardial lobe of kidney; kr, rectal lobe of kidney; mc, mantle collar; mg, mantle gland.

wide V-shaped. Penis with 3 longitudinal pilasters.

DISTRIBUTION AND HABITAT. Yarramanbully limestones near Attunga; between limestone talus on limestone karst covered in remnant vine thicket

REMARKS. *Acheronopa* gen. nov. is most similar to *Sharniropa* gen. nov from the Timor/Glenrock limestone outcrops and *Gouldiropa* gen. nov. However, it differs significantly in having more crowded microradial ribs on the protoconch and in having more flattened whorls.

*Acheronopa* also differs from the sympatric *Gouldiropa* in having an open rather than closed umbilicus and in the more prominent, sparser teleoconch ribbing. The unusually depressed shell shape may be a functional adaptation to living between limestone slabs.

### **Acheronopa attunga** sp. nov.
(Figs 10, 23, 25-29, 31-34; Table 5)

ETYMOLOGY. For the New England town of Attunga.

MATERIAL. HOLOTYPE: QMMO70400, Manilla, c.20.4km ESE, Manilla-Yarramanbully Rd, NSW (30°51'00"S, 150°50'54"E), lm/vt, under rocks in talus pile, 25.ix.1993, JS, JC. Height of shell=1.81mm, diameter=4.27, H/D=0.42, D/U=3.21, number of whorls=4.9, ribs on last whorl=23. PARATYPES: All NSW. QMMO49218, 42SC/49RC, same data as holotype; QMMO49187, 7RC, Manilla, c.6.6km ESE at Amaroo Homestead (30°46'06"S, 150°47'36"E), vt/lm, under rocks abd logs and in litter, 24.ix.1993, JS, JC; QMMO49193, 8RC, Manilla, c.19.9km ESE, Manilla-Yarramanbully Ck Rd (30°50'42"S, 150.51'12"E), lm/vt, under rocks and logs, 24.ix.1993, JS, JC; QMMO52693, 18RC, Manilla, c.20.4km ESE, Manilla-Yarramanbully Rd, (30°51'00"S, 15051'54E), lm/vt, in litter, 25.ix.1993, JS, JC; QMMO32089, 100RC, AMSC205160, 10RC, Attunga, c.12km N, Woodbum-Yarramanbully Rd (30°51'S, 150°51'E), lm, under and between rocks, 26.xi.1989, JS, DP.

DIAGNOSIS. Shell very small, with strongly depressed, evenly coiled whorls. Teleoconch with strongly sinuated, very widely spaced, bold radial ribs, mean ribs/mm 1.72; secondary sculpture of prominent microspiral cords and low radial ridges, forming prominent beads at their intersection. Umbilicus wide V-shaped. Penis with three longitudinal pilasters.

DESCRIPTION. Shell very small, depressed, brown, with 4.6-5.2 (mean 5.0) evenly coiled whorls. Shell diameter 3.92-6.28mm (mean 4.65mm). Apex and early spire depressed. Height of shell 1.59-2.11mm (mean 1.85mm), H/D 0.30-0.48 (mean 0.40). Protoconch of 1.5-1.7 whorls with sculpture of crowded, regularly spaced, slightly curved radial ribs, width of interstices (in multiples of rib width) 5-7 at apex. Secondary apical sculpture of crowded, regularly spaced, continuous microspiral cords. Teleoconch sculpture of strongly sinuated, very widely spaced, bold radial ribs, increasing in spacing toward aperture, ribs on last whorl 20-31 (mean 25), ribs/mm 1.22-2.12 (mean 1.72). Ribs wide, height less than width; straight in section, rounded on top. Rib interstices on the first post-nuclear whorl equal to width of 3-5 ribs; interstices on the penultimate whorl equal to width of 6-8 ribs. Interstitial sculpture of low microradial ribs, 7-9 between major ribs on first post-nuclear whorl; 16-20 between ribs on penultimate whorl. Secondary sculpture of prominent low microspiral cords that cross the major radial ribs and form very strong, raised beads where they intersect with the microradials. Sutures strongly impressed, whorls flattened above and weakly rounded below a flattened periphery. Aperture broadly ovately lunate. Umbilicus open, wide V-shaped, diameter 1.22-1.71mm (mean 1.48mm), D/U 2.89-4.21 (mean 3.16). Based on 23 measured specimens (QMMO49218, MO70400).

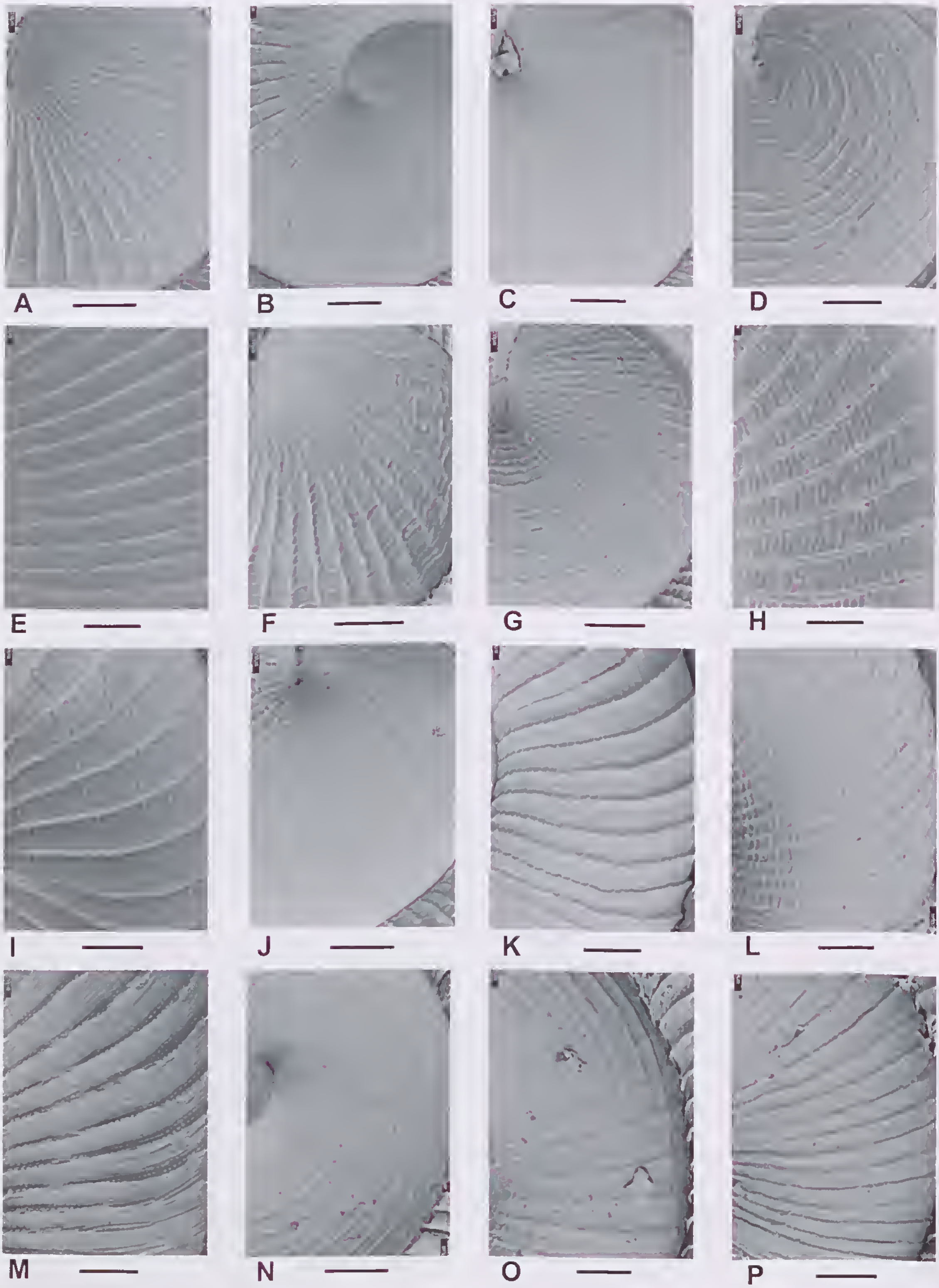
Genitalia with ovotestis containing two clumps of alveoli, with more than two alveolar lobes per clump. Talon stalk 1-3 times the diameter of the talon; talon circular. Penal retractor muscle less than half the length of the penis; inserting at the junction of the penis and epiphallus. Muscle fibres also attached to the base of the penis, close to the vagina/atrium. Epiphallus narrower than the vas deferens, entering penis through a simple pore; shorter than penis. Penis pear shaped, internally with three longitudinal pilasters, one much smaller than the other two. Vagina very short.

Pallial cavity with moderately bilobed kidney, apex of pericadial lobe reflexed. Mantle gland present.

Radula with central tooth strongly tricuspid; lateral teeth tricuspid; first and second laterals equal in width. Mesocone of first lateral tooth slender, slightly diamond-shaped; marginal teeth skewed towards the centre; ectocone of outer marginal teeth not split; endocone not split. Number of lateral teeth: 6; marginal teeth: 18; radular rows: 94. Based on 3 dissected adults (QMMO49218).

DISTRIBUTION AND HABITAT. *Acheronopa attunga* sp. nov. is known only from the Yarramanbully limestones near Attunga; living between limestone talus on limestone karst covered in remnant vine thicket.

REMARKS. *Acheronopa attunga* sp. nov. is most similar to *Sharniropa xanana* sp. nov from the Timor/Glenrock limestone outcrops. However, it differs significantly from that species in being relatively much larger, having more crowded microradial ribs on the protoconch and in having more flattened whorls. *A. attunga* differs from the sympatric *Gouldiropa carlessi* (Stanisic, 1990) comb. nov. most noticeably in having an open rather than closed umbilicus and


A
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in having more prominent, sparser teleoconch ribbing. The unusually depressed shell of *A. attunga* may be a functional adaptation to living between limestone slabs.

### **Hedleyropa** gen. nov.

ETYMOLOGY. Named in honour of Charles Hedley.

TYPE SPECIES. *Hedleyropa yarrangobillyensis* sp. nov.; herein designated.

DIAGNOSIS. Shell very small, light brown in colour. Apex and early spire flat. Protoconch with very densely crowded, curved radial ribs (approx. 90), crossed by low, crowded spiral cords. Teleoconch with protractively sinuated radial ribs and a secondary sculpture of low radial ridglets and more prominent, crowded microspiral cords; microsculpture continuous on the major radials. Kidney moderately bilobed with weakly reflected pericardial lobe. Penis with two longitudinal pilasters.

DISTRIBUTION AND HABITAT. Yarrangobilly limestones, Kosciusko NP, SE NSW and surrounding environs. However, there are other undescribed species in the QM and AM collections from the region which may belong to this genus and it is quite probable that the range of the genus could be extended significantly particularly in other parts of the Kosciusko NP and NE Vic.

REMARKS. *Hedleyropa* gen. nov. is similar to *Cralopa* in having crowded apical radial ribs and numerous bold, relatively crowded sinuated teleoconch ribs, but differs in having a greater number of microradial ribs on the protoconch, no apertural sinus, finer and much less sinuate teleoconch ribs and a very narrow U-shaped umbilicus rather than one closed by columellar reflection. There is also a subtle difference in whorl profile between the two genera with *Hedleyropa* having more rounded whorls compared with that of *Cralopa*.

### **Hedleyropa yarrangobillyensis** sp. nov.
### (Figs 10, 23, 25-28, 30-34; Table 5)

ETYMOLOGY. For the type locality.

MATERIAL. HOLOTYPE. QMMO70401, Yarrangobilly, Yarrangobilly R, c.1km S bridge, NSW (35°39°28"S, 148°27'41"E), lm/ew, under rocks, 8.x.1992, JS, GI. Height of shell=2.20mm, diameter=3.74, H/D=0.54, D/U=4.35, number of whorls=4.5, ribs on last whorl=123. PARATYPES. All NSW. QMMO39973, 1SC/50+RC, same data as holotype; QMMO39840, 5SC, Tumut, c.42.3km SE, Tumut - Yarrangobilly Rd (35°35'16"S, 148°20°04"E), cw, under rocks, 8.x.1992, JS, GI; QMMO49419, 1RC, Yarrangobilly, c.4.4km N turnoff to caves, Tumut - Kiandra Rd (35°41'00"S, 148°28'54"E), ew/lm, under logs and rocks, 03.i.1994, JS, JC; QMMO39975, 5SC/3RC, Yarrangobilly, Yarrangobilly Caves Reserve (35°43'45"S, 148°29'16"E), ew/lm, under rocks, 8.x/1992, JS, GI; AMSC162152, 6RC, Kosciusko NP, Yarrangobilly Caves, Village Cave System [?=Y-110] (35°43.5'S, 148°29.5'E), on wet moss in overhang, 6.vi.1980, Ken Keek.

DIAGNOSIS. Shell very small, with evenly coiled whorls and an almost flat spire. Teleoconch with bold, relatively crowded, protractively sinuated radial ribs mean ribs/mm 9.16). Umbilicus narrow U-shaped, mean D/U 4.3; whorls rounded at the periphery and evenly coiled. Penis with two longitudinal pilasters.

DESCRIPTION. Shell very small, light brown in colour with 4.2-4.7 (mean 4.5) evenly coiled whorls, the last weakly descending in front. Shell diameter 3.21-4.52mm (mean 3.82mm). Apex and early spire low to flat. Height of shell 1.63-2.51mm (mean 1.98mm), H/D 0.48-0.58 (mean 0.52). Protoconch of 1.6-1.9 whorls with sculpture of approximately 90, weakly curved, uniformly spaced radial ribs; ribs of medium width with height less than width; width of interstices (in multiples of rib width) 3-4 at apex. Secondary sculpture of much lower, narrow, low continuous spirals (approx. 37); height of spirals less than width. Teleoconch sculpture of strongly protractively sinuate, variably spaced radial ribs; spacing increasing towards aperture; 86-136 (mean 109) ribs on the last whorl. Ribs/mm 8.17-10.72 (mean 9.16). Rib height equal to width; straight in section; rounded on top; interstices on the first post-nuclear whorl equal to width of 4-6 ribs; interstices on the penultimate whorl equal to 4-5. Interstitial sculpture of low radial ridges, 8-9 between ribs on first

FIG. 33. Protoconch microsculpture. A, *Rhophodon mcgradyorum*, QMMO70392. B, *Egilodonta paucidentata*, QMMO70396. C, *Letomola lanalittleae*, QMMO70397. D, *Macrophallikoropa depressispira*, AMSC205163. E, *Elsothera brazieri*, QMMO28775. F, *Decoriropa lirata* (Taree), AMSC136842. G, *Coricudgia wollemiana*, AMSC205164. H, *Marilyniropa jenolanensis*, AMSC205165. I, *Gouldiropa carlessi* (Inverell), AMSC3640. J, *Sharniropa wollondillyana*, QMMO70399. K, *Acheronopa attunga*, QMMO70400. L, *Hedleyropa yarrangobillyensis*, QMMO70401. M, *Seleridoropa saraljaneae* (Abercrombie Caves), AMSC162165. N-P, *Diphyoropa macleayana*, AMSC168685. Scale bars=30µm in A, D; 40µm in B, C, E, F; 50µm in G, H, J, M, O; 60µm in I, K, L, N, P.

post-nuclear whorl; 8 between ribs on penultimate whorl; crossed by more prominent, very low microspiral cords. Beading weak. Umbilicus narrow U-shaped, diameter 0.70-1.20mm (mean 0.90mm), D/U 3.72-5.05 (mean 4.30). Sutures strongly impressed, appearing weakly channeled; whorls slightly shouldered above and rounded below a rounded periphery. Aperture roundly lunate. Umbilicus open, narrow U-shaped. Based on 20 measured specimens (QMMO39973, MO70401).

Genitalia with ovotestis containing two clumps of alveoli. Talon stalk slightly longer than the diameter of the talon; talon circular. Penial retractor muscle less than half the length of the penis; inserting at the junction of the penis and epiphallus. Epiphallus present; entering penis through a simple pore; slightly shorter than penis; narrower than the vas deferens. Penis tubular with two longitudinal pilasters. Vagina shorter than penis.

Pallial cavity with kidney moderately bilobed; apex reflexed.

Radula with central tooth strongly tricuspid; lateral teeth tricuspid; ectocone of outer marginal teeth not split (but the ectocone of the second last tooth is split into three); endocone not split. Number of lateral teeth: 4, marginal teeth: 15; radular rows: 85. Based on 1 dissected specimen (QMMO39840).

DISTRIBUTION AND HABITAT. Yarrangobilly limestones, SE Talbingo, SE NSW; living among among limestone slabs.

REMARKS. *Hedleyropa yarrangobillyensis* sp. nov. is readily distinguished from other sympatric charopids by a combination of its dense radial ribbing on both the protoconch and teleoconch and the comparatively reduced umbilicus. *Scelidoropa sarahjaneae* sp. nov. has a radially ribbed teleoconch but differs in having a larger flammulated shell with wide cup-shaped umbilicus and a protoconch with microdaradial ribs in the interstices of the major ribs. Anatomically the two species are markedly distinct.

*Hedleyropa yarrangobillyensis* displays a tendency for reduction in the size of the umbilicus. The general shell form (weakly channelled sutures, bold ribbing, numerous apical radial ribs) recalls *Cralopa stroudensis* (Cox, 1864). However, the greater number of apical microradials, weaker sinuosity of the teleoconch ribs, lack of an apertural sinus and narrow but open U-shaped umbilicus all indicate that *H. yarrangobillyensis* is a member of *Hedleyropa*.

### **Scelidoropa** gen. nov.

ETYMOLOGY. Greek *skelidos*, rib; alluding to the interstitial microradial ribs on the protoconch.

TYPE SPECIES. *Scelidoropa sarahjaneae* sp. nov.

DIAGNOSIS. Small, light brown shell with darker radial flammulations with slightly tightly coiled whorls. Spire flat to slightly elevated. Protoconch with crowded, evenly spaced, slightly curved radial ribs (approx. 90). Secondary sculpture of low continuous microspiral cords and low slightly curved microradial ribs that form beads at their intersection. Teleoconch with slightly sinuated, crowded to very crowded ribs; microsculpture of microradial ribs and microspiral cords equal in strength, forming strong beads at their intersection. Umbilicus wide saucer-shaped. Penis with 0-4 pilasters. Kidney almost unilobed. Central radula tooth weakly tricuspid; lateral teeth with a smaller additional cusp between ectocones of the tooth.

DISTRIBUTION AND HABITAT. From SE NSW to the southern edge of the New England Tableland, NSW (Nundle area) and west to the Nandewar Range, NSW. The species live in litter among rocks.

REMARKS. The shell of *Scelidoropa* gen. nov. is quite distinctive among the east coast charopid genera. The flammulated shell with elevated spire, bold and prominent teleoconch ribs and very wide umbilicus are a combination of characters that are seen in other charopid groups. However, the microradial ribs on the protoconch immediately identify it among the east-coast fauna. Species in Victoria that are currently questionably classified in *Pernagera* Iredale, 1939 (Smith, 1992) series also have apical radial sculpture, bold teleoconch ribs and flammulated shells, but, and most significantly, lack the microradial ribs on the protoconch. Some species of *Elsothera* Iredale, 1933, superficially resemble *Scelidoropa* but the latter can be distinguished by its much larger size, bolder, weakly sinuated ribs, wider cup shaped umbilicus and most significantly, by the present of intersitial microradials on the protoconch. Anatomically the two genera are immediately separable by the form of the epiphallus which is long and unusually coiled in *Elsothera* but shorter and more typically reflexed in *Scelidoropa*. The lateral teeth of the radula of

*Scelidoropa* are also distinctive in the context of all the other eastern Australian charopids hitherto reviewed in possessing an additional cusp.

The breadth of the range of *Scelidoropa* is matched only by that of *Macrophallikoropa* gen. nov. However, in contrast to the latter, the species' distributions do not include rainforests and encompass only very localised mesic refugia such as rocky outcrops (limestone and granite). and mountain tops (Mt Kaputar, Mt Coricudgy and Mt Canoblas). The species is absent from the Sydney Basin and the limestones of the Macleay Valley.

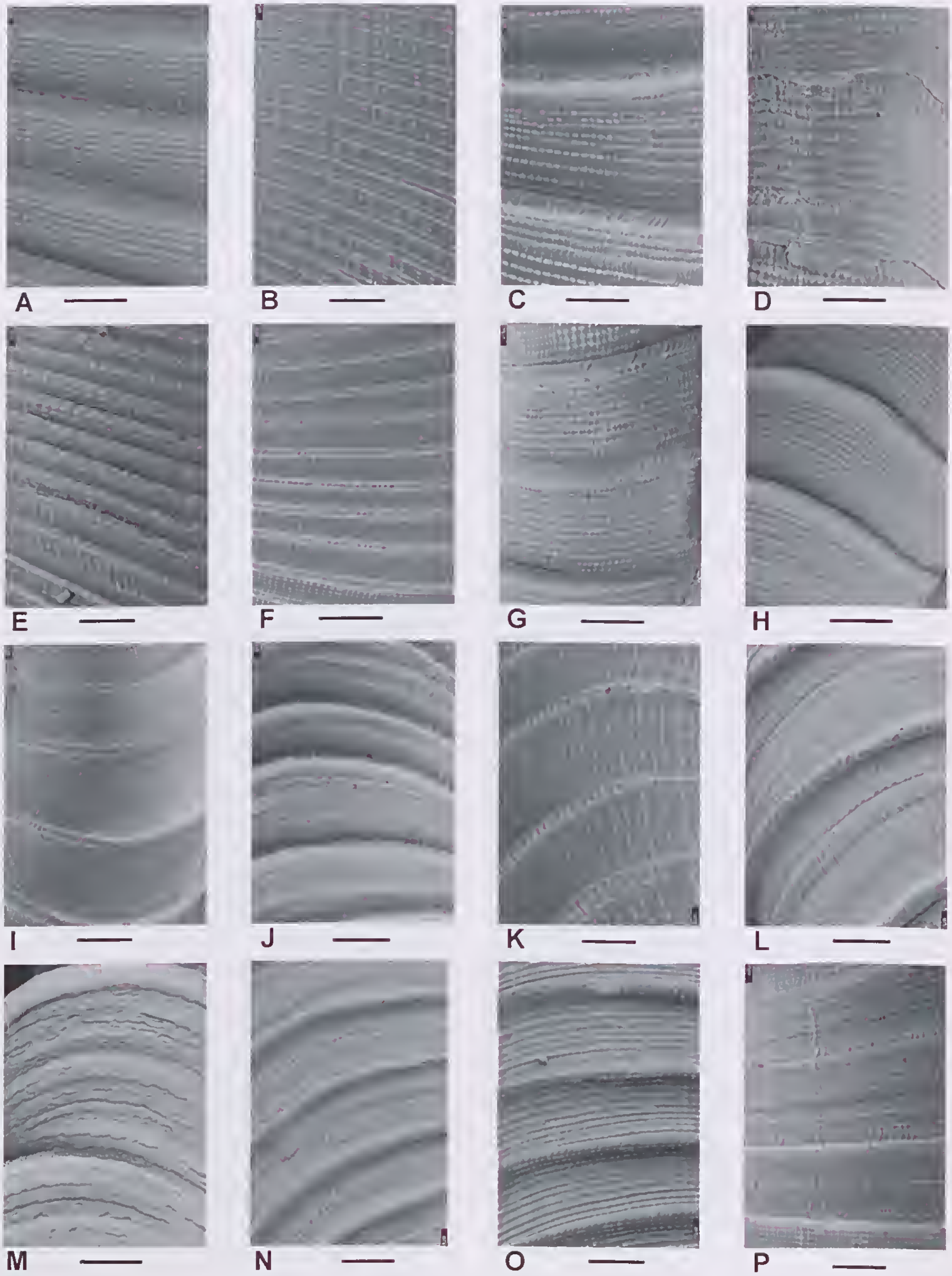
### **Scelidoropa sarahjaneae** sp. nov.
(Figs 10, 24-28, 30-34; Table 5)

ETYMOLOGY. For Sarah Jane Roberts.

MATERIAL. HOLOTYPE. QMMO70402, Yarrangobilly, Yarrangobilly R, c.1km S bridge (35°39'28"S, 148°27'41"E), ew/lm, in litter, 08.10.1992, JS, GI. Height of shell=1.42mm, diameter=3.18mm, H/D=0.45, D/U=2.26, number of whorls=4.6, ribs on last whorl=122. PARATYPES. All NSW. QMMO39974, 13SC/50RC, same data as holotype; QMMO49418, 4RC, Yarrangobilly, c.1km S on Tumut - Kiandra Rd (35°39'30"S, 148°27'42"E), ew/lm, under rocks, 03.i.1994, JS, JC; QMMO49421, 5RC, QMMO52775, 34RC, Yarrangobilly, c.4.4km N T'off to caves, Tumut - Kiandra Rd (35°41'00"S, 148°28'54"E), ew/lm, under logs and rocks, 03.i.1994, JS, JC; QMMO39979, 7SC/50RC, Yarrangobilly, Yarrangobilly Caves Reserve (35°43'45"S, 148°29'16"E), ew/lm, in litter, 08.x.1992, JS, GI; QMMO68013, 50RC, Yarrangobilly, Yarrangobilly R, c.1km S bridge (35°39'28"S, 148°27'41"E), lm, in litter, 03.i.1994, JS, JC; AMSC153724, 1RC, Kosciusko NP, Yarrangobilly Caves, beside trail to River Cave (Y-27) (35.725°S, 148.492°E), in litter, 31.x.1980, WFP, J.Hall; AMSC168695, 1RC, Kosciusko NP, Yarrangobilly Caves, Village Cave System (?=Y-110) (35.725°S, 148.492°E), on wet moss in overhang , 06.vi.1980, Ken Keck; AMSC162150, many RC, Kosciusko NP, Yarrangobilly Caves, beside trail to River Cave (Y-27) (35.725°S, 148.492°E), in litter, 31.x.1980, WFP, J.Hall; AMSC162151, 1RC, Kosciusko NP, Yarrangobilly Caves (35.725°S, 148.492°E), 31.x.1980, WFP, J.Hall. OTHER MATERIAL. NSW: AMSC168626, C355262, C367084, C162140, C355269. Timor Caves: QMMO32063, MO37731, AMSC157326, C171504, C162162, C162185, C355267, C355268, C355266. Mt Coricudgy: QMMO44707, MO28663, MO44714, MO44722, MO59872, AMSC162144. Jenolan Caves: QMMO9687, MO16941, MO28778, MO37772, AMSC63851, MO62446, MO35764, MO44798, AMSC124276, C124277, C157334, C162157, C162168, C121717, C154813, C354933, C355270, C411537, C144225. Wombeyan Caves: AMSC319705, C157317, C355260, C384164. Abercrombie Caves: QMMO29242, MO37780, MO44766, AMSC157322, C158365, C162165. Orange district: QMMO37490, MO39782, AMSC168647, C168697. SE NSW: QMMO68018, MO39986, MO39991, MO49429, AMSC162159, C354882, C168646, C354917, C354923, C354919, C354921, C354926, C355263, C355261, C355265, C357298, C357300, C357301, C162148, C355264, C162147.

DIAGNOSIS. Shell small, golden brown, with darker flammulations. Spire slightly elevated. Teleoconch with crowded, bold slightly sinuate ribs. Mean ribs/mm 10.43. Umbilicus very wide saucer-shaped, mean D/U 2.44. Penis with 4 longitudinal pilasters.

DESCRIPTION. Shell very small, golden brown, with darker flammulations (very faint to very dark), with 3.7-5.3 (mean 4.5) evenly coiled whorls. Shell diameter 2.65-4.27mm (mean 3.35mm). Apex and spire flat. Height of shell 1.30-2.17mm (mean 1.65mm). H/D 0.44-0.54 (mean 0.49). Protoconch: flat of 1.1-1.9 whorls. Apical sculpture of bold, regularly spaced slightly curved radial ribs. Ribs bold, medium to wide; height greater than or equal to width; interstices equal to the width of two to three ribs at apex; equal to the width of 4-6 ribs at post-nuclear boundary; ratio of rib spacing (apex to post-nuclear boundary): 0.3-0.5. Microradials with periostracal blades; 1-3 microradials between major ribs at apex; 6-8 microradials between ribs at post-nuclear boundary. Secondary sculpture of low (height less than width) microspiral cords crossing the major radials and forming beads at their intersection with the microradials. Teleoconch with bold prominent, closely and regularly spaced, slightly protractively sinuated radial ribs. Ribs on last whorl 70-176 (mean 109), ribs/mm 7.10-16.05 (10.43). Ribs medium size, straight in section, rounded on top. Rib interstices on the first post-nuclear whorl equal to width of 4-5 ribs; interstices on the penultimate whorl equal to width of 3-5. Microsculpture of microradial ribs and microspiral cords, about equal in strength. Microradials low, 7-11 between ribs on first postnuclear whorl; 7-11 between ribs on penultimate whorl. Microspirals low; crossing the microradials and forming srong beads at their intersection with the microradial ribs; beading strong, always round, or elongate on the first post-nuclear whorl, becoming round towards the aperture. Umbilicus wide saucer-shaped, diameter 0.93-1.79mm (mean 1.38mm), D/U 2.12-3.55 (mean 2.44). Sutures weakly impressed, whorls rounded above and below a rounded periphery. Aperture narrowly roundly ovate; parietal callus present. Based on 121 measured specimens (AMSC355266, C63851, C162165, C171504, C355260, QMMO39974, MO52781, MO70402).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Ovotestis containing three to seven clumps of alveoli, with more than two alveolar lobes per clump. Talon stalk shorter than talon, or absent; talon circular. Penial retractor muscle half the length of the penis or greater, inserting onto the penis head or at the junction of the penis and epiphallus. Epiphallus present; shorter than or equal to the penis length, wider than the vas deferens; equal in width to penis; internally with two longituduinal pilasters. Penis tubular with 4 longitudinal pilasters. Vagina shorter than or equal length to penis.

Pallial cavity with kidney almost unilobed; apex slightly reflexed. Mantle gland absent, or present (present in one specimen; orange, thick).

Radula with central tooth weakly tricuspid; lateral teeth tricuspid, with an additional smaller cusp formed between the two ectocones. Ectocone of outer marginal teeth split into three teeth, or split into four or more teeth; endocone not split. Number of lateral teeth: 4-6, marginal teeth: 10-11; radular rows: 90-94. Based on 10 dissected specimens (QMMO39974, MO39991, MO32063, AMSC354933, C354923).

DISTRIBUTION AND HABITAT. From the Kosciusko NP in S NSW to the S New England Region, N NSW but is rare in the Sydney Basin.

REMARKS. *Scelidoropa sarahjaneae* sp. nov. differs from *S. nandewar* sp. nov. (Nandewar Range) in having a coarser shell sculpture, elevated rather than flat spire and a relatively smaller umbilicus. *Marilyniropa jenolanensis* gen. et sp. nov. from the Jenolan Caves area bears some superficial resemblance to this species but has more widely spaced ribs, smaller umbilicus and a protoconch without microradial ribs.

The wide distribution of *S. sarahjaneae* broadly mirrors that of some other species discussed in this study. However in contrast to widespread species such as *Macrophallikoropa belli* (Cox, 1864), *Cralopa stroudensis* (Cox, 1864) and *Egilomen lirata* (Cox, 1868) this species is barely represented in the Sydney Basin. Reasons for this are not obvious but *S. sarahjaneae* may have a disliking for sandstone habitats.

### **Scelidoropa nandewar** sp. nov.
### (Figs 10, 24-28, 30-32; Table 5)

ETYMOLOGY. For the Nandewar Range.

MATERIAL. HOLOTYPE: NSW. QMMO70403, Nandewar Ra, Mt Dowe (30°16'54"S, 150°09'48"E), snow gums, 1440m, under logs and bark, 23.ix.1993, JS, JC. Height of shell=1.38mm, diameter=3.07mmm, H/D=2.22, D/U=2.21, number of whorls=4.9, ribs on last whorl=189. PARATYPES. NSW: QMMO49158, 4SC/5RC, same data as holotype, Nandewar Ra, Mt Dowe (30°16'54"S, 150°09'48"E), snow gums, 1440m, under logs and bark, 23.ix.1993, JS, JC; QMMO16743, 3SC/3RC, Dawsons Spring, Mt Kaputar (30°16'S, 150°10'E), 1300m, under moss, 08.xi.1983, JS, DP, PHC, J. Short; QMMO16754, 1RC, Mt Kaputar, summit (30°16'S, 150°10'E), among rocks, grass and litter, 1500m, 09.xi.1983, JS, DP, PHC, J. Short; QMMO49166, 8RC/4SC, Nandewar Ra, c.1.2km SW Mt Kaputar, summit (30°16'36"S, 150°08'48"E), dsf, 1420m, under bark and rubbish, 23.ix.1993, coll JS, JC; QMMO65450, 1SC, Nandewar Ra, Mt Kaputar NP, E of Bark Hut Camping Ground (30°17'30"S, 150°08'18"E), dsf, 1180m, under logs, 23.ix.1993, JS, JC.

DIAGNOSIS. Small golden brown shell with darker flammulations. Teleoconch with very crowded, bold slightly sinuate radial ribs. Ribs/mm c.19.60. Umbilicus very wide saucer-shaped, D/U c.2.21. Penis with four longitudinal pilasters.

DESCRIPTION. Shell very small, light brown, with darker flammulations, having c.4.9 slightly tightly coiled whorls. Shell diameter c.3.07mm, spire and apex flat. Shell height c.1.38mm, H/D c.2.22. Protoconch of c.2.0 whorls with apical sculpture of bold, regularly spaced slightly curved radial ribs. Ribs bold, medium to wide; height greater than or equal to width; interstices equal to the width of 2.5 ribs at apex; equal to the width of 3 ribs at post-nuclear boundary; ratio of rib spacing (apex to post-nuclear boundary): 0.3-0.5. Microradials present; 4 between each pair of major ribs. Secondary sculpture of low (height less than width) microspiral cords that

FIG. 34. Teleoconch microsculpture. A, *Rhophodon palethorpei*, QMMO70390. B, *Rhophodon duplicostatus*, QMMO70393. C, *Egilodonta bairnsdalensis* (Yarrangobilly Caves, Kosciusko National Park), AMSC142959. D, *Letomola lanalittleae*, QMMO70397. E, *Macrophallikoropa depressispira*, AMSC205163. F, *Elsothera brazieri*, QMMO28775. G, *Decoriropa lirata* (Taree), AMSC136842. H, *Coricudgia wollemiana*, AMSC205164. I, *Marilyniropa jenolanensis*, AMSC205165. J, *Cralopa stroudensis*, Sydney. K, *Gouldiropa earlessi* (Inverell), AMSC3640. L, *Sharniropa wollondillyana*, QMMO70399. M, *Acheronopa attunga*, QMMO70400. N, *Hedleyropa yarrangobillyensis*, QMMO70401. O, *Scleridoropa sarahjaneae* (Abercrombie Caves), AMSC162165. P, *Diphyoropa saturni*, AMSC142234. Scale bars=30μm in B and E; 40μm in A, C; 50μm in O; 60μm in D, G, K, L, N, P; 70μm in J; 80μm in H; 100μm in F; 130μm in I, M.

cross the major radials and form beads at their intersection with the microradials. Teleoconch with bold prominent, very crowded and regularly spaced, slightly protractively sinuated radial ribs. Ribs on last whorl c.189, ribs/mm c.19.60. Ribs medium; in size; straight in section, rounded on top. Rib interstices on the first post-nuclear whorl equal to width of 2-3 ribs; interstices on the penultimate whorl equal to width of 2-3 ribs. Microsculpture of microradial ribs and microspiral cords, about equal in strength. Microradials low, 4-5 between ribs on first postnuclear whorl; 3-4 between ribs on penultimate whorl. Microspirals low; crossing the microradials and forming srong beads at their intersection with the microradial ribs; beading strong, always round. Umbilicus wide saucer-shaped, diameter c.3.07mm, D/U c.2.21. Sutures weakly impressed, whorls rounded above and below a rounded periphery. Aperture narrowly roundly ovate; parietal callus present. Based on the measured holotype (QMMO70403).

Genitalia with ovotestis containing 6 clumps of alveoli, with 2-8 alveolar lobes/clump. Talon stalk very short; talon circular. Penial retractor muscle <1/2 penis length; inserting at junction of the penis and epiphallus. Epiphallus shorter than penis; wider than the vas deferens; equal in width to penis; internally with 2 longituduinal pilasters. Penis tubular with 4 longitudinal pilasters. Vagina equal length to penis.

Pallial cavity with kidney almost unilobed; apex reflexed. Mantle gland present (orange in colour).

Radula with central tooth weakly tricuspid; lateral teeth tricuspid, with a smaller additional cusp present between the ectocones. Ectocone of outer marginal teeth split into three teeth; endocone not split. Number of lateral teeth: 4, marginal teeth: 11; radular rows: 88. Based on 1 dissected specimen (QMMO49158).

DISTRIBUTION AND HABITAT. From Mt Kaputar, NSW; wet sclerophyll forest among rocks.

REMARKS. *Scelidoropa nandewar* sp. nov. is similar to the widespread *S. sarahjaneae* but can be distinguished by the more closely spaced ribs, flatter spire and relatively smaller umbilicus. The geographical restriction of *S. nandewar* contrasts with that of *S. sarahjaneae* and highlights the refugial significance of the Nandewar Ranges in land snail evolution.

## **Diphyoropa** gen. nov.

ETYMOLOGY. Greek *diphyes*, double nature; referring to the dual nature of the protoconch sculpture.

TYPE SPECIES. *Helix saturni* Cox, 1864

DIAGNOSIS. Very small brown shell with evenly coiled whorls and flat spire. Protoconch sculpture bimodal with the first two-thirds of the protoconch having broad, irregularly spaced spiral lirae that weaken in the last third wher broad, curved radial ridges develop and eventually dominate. Teleoconch sculpture of prominent, almost straight, moderately widely to closely spaced radial ribs. Umbilicus wide to very wide V-shaped. Kidney moderately bilobed. Epiphallus long. Penis tubular up to five longitudinal pilasters.

DISTRIBUTION AND HABITAT. Southern Tablelands Bioregion to the Macleay Valley, W of Kempsey, NE NSW. Species live under logs, rocks and leaf litter chiefly in eucalypt forest.

REMARKS. *Diphyoropa* gen. nov. is characterised by its unusual apical sculpture that features an initial prominence of spiral cords which give way to a dominance of curved radial ribs and ridges on the last 1/3 of the protoconch. This protoconch sculpture is unusual in the context of apical sculptures of Australian Charopidae (Iredale, 1937, 1941a,b; Kershaw 1955, 1956a,b; Smith & Kershaw, 1979, 1981; Stanisic, 1990) and as such is diagnostic for the genus. However, considering the many intricate variations on grossly similar apical sculptural themes that have been reported in this study, care needs to be taken in interpreting the condition seen in *Diphyoropa* as monophyletic. This peculiar apical sculpture may be merely a grade of organisation similar to the reticulate, spiral or radial patterns that have thus far been reported for many charopid species.

Undescribed taxa in the collections of the QM from other parts of NSW and SE Qld have grossly similar protoconch sculpture to *D. saturni* and *D. macleayana*. These may or may not belong to this clade.

### **Diphyoropa saturni** (Cox, 1864) comb. nov.
(Figs 23, 25-28; Table 5)

*Helix saturni* Cox, 1864a: 35; 1868: 14, pl.6, fig.11.
*Helix costulata* Cox, 1864b:184; non costulata Lamarck, 1822.
*Endodonta (Charopa) saturni* (Cox). Cox 1909: 69.
*Egilomen saturni* (Cox). Iredale, 1937: 328; Iredale, 1941a: 269.

*Dentherona saturni* (Cox). Smith & Kershaw, 1979: 173.
*Dentherona (Dentherona) saturni* (Cox). Smith, 1992: 187.

MATERIAL. LECTOTYPE. AMSC205167. Height of shell=1.18mm, diameter=2.22mm, H/D=0.53, D/U=3.08, number of whorls=4.2, ribs on last whorl=59. PARALECTOTYPE. AMSC136900, same data as lectotype. OTHER MATERIAL. All NSW, Sydney Basin: AMSC8899, C11809, C136900, C154787, C154909, C154919, C154920, C154921, C154924, C154956, C318793, C377420, C318807, C318811, C318908, C318911, C318912, C318913, C318914, C318916, C318918, C318926, C318931, C318932, C318933, C318934, C318935, C318941, C318942, C318943, C318944, C318946, C318947, C319714, C345664, C345675, C345720, C345721, C346756, C346761, C346765, C346767, C346769, C346773, C348735, C354869, C318928, C318929, C318936, C318938, C346771, C63819, C154954, QMMO28233, MO29635, MO29639, MO29721, MO37970, MO34784, MO34785, MO34809, MO34974, MO37390, MO60057, MO28224, MO42125. Lord Howe I: QMMO64125, MO64218, MO64133, AMSC204488, C204496, C204581, C397669, C398539, C400485, C389819, C389821, C389824, C389825, C389826, C389827, C389828, C389829, C389830, C389831, C389832, C389833, C389834, C389835, C390217. Vic.: AMSC155319.

DIAGNOSIS. Shell very small, with evenly coiled whorls and flat spire. Protoconch sculpture bimodal, with the 1st 2/3 of protoconch having broad, irregularly spaced, spiral lirae weakening in the last 1/3 where broad, curved radial ridges develop and eventually dominate. Teleoconch sculpture of prominent, almost straight, widely spaced radial ribs. Umbilicus very wide V-shaped. Penis with several longitudinal pilasters. Epiphallus about half penis length.

DESCRIPTION. Shell very small, light brown in colour with 4.2-4.6 (mean 4.33) evenly coiled whorls. Shell diameter 3.02-3.59mm (mean 3.26mm). Spire flat. Height of shell 1.18-2.03mm (mean 1.70mm), H/D 0.54-0.57 (mean 0.55). Protoconch of 1.6-1.7 whorls with sculpture consisting of broad irregularly spaced, spiral lirae for the first two-thirds of the protoconch; weakening in the latter third of the protoconch where broad curved radial ridges develop and gradually become more prominent than the spirals; spirals crossing radial ridges. Ridges wide height less than width; spacing uniform; width of interstices (in multiples of rib width): 2-3. Teleoconch sculpture of bold, almost straight, moderately widely spaced radial ribs; 58-85 (mean 72) ribs on the last whorl, ribs/mm 6.11-7.93 (mean 7.00). Ribs medium in size, height equal to width; straight in section, rounded on top. Rib interstices on the first post-nuclear whorl equal to width of 6-8 ribs; interstices on the penultimate whorl equal to width of 6-7 ribs. Microsculpture of microradial ribs and stronger microspiral cords that cross the microradials and form strong elongate to round beads at their intersection. Microradials low; 9-11 between ribs on first postnuclear whorl; 11-12 between ribs on penultimate whorl. Umbilicus very wide V-shaped, diameter 0.72-1.27mm (mean 1.04mm), D/U 2.82-3.17 (mean 2.9). Sutures weakly impressed, whorls shouldered above and rounded below a rounded periphery. Aperture roundly lunate, parietal callus present. Based on 6 measured specimens (AMSC142234, C318912, C205167).

Genitalia (not figured) with ovotestis containing two clumps of alveoli; with more than two alveolar lobes per clump. Talon stalk equal to talon diameter; talon circular. Penial retractor muscle less than half the length of the penis; inserting onto the penis head. Epiphallus wider than the vas deferens, equal to a half to two thirds the length of the penis. Penis tubular with a prominent tapering distal; internally, upper chamber with several longitudinal pilasters.

Pallial cavity (not figured) with kidney moderately bilobed; apex slightly reflexed.

Radular morphology unknown.

Based on four dissected specimens (QMMO28233, MO60057, MO28244, MO37390).

DISTRIBUTION AND HABITAT. Sydney Basin Bioregion but extending to the N South-eastern Tablelands Bioregion (Wombeyan Caves). Presumed introduced populations in Victoria and on Lord Howe Island; under rocks, litter and logs, or discarded household debris in urban situations.

REMARKS. *Diphyoropa saturni* (Cox, 1864) comb. nov. was placed in either *Egilomen* or *Dentherona* by various authors (Iredale, 1937; Smith & Kershaw, 1979) without explanation. The protoconch of *Egilomen* has widely spaced thick radial ribs with weak spiral creases while that of *Dentherona* (type: *Helix* (*Charopa*) *dispar* Brazier, 1871) is reticulate with comprising strong radials and somewhat weaker (less raised) spirals. *D. saturni* is almost exclusively confined to the Sydney Basin where it persists in urban situations. Neither sculptural pattern is considered to be generically compatible with the condition in *D. saturni*.

The almost exclusive occurrence of *D. saturni* within the Sydney basin suggests strongly that the extralimital records from Victoria and Lord Howe Island are introductions. A single record from a Gloucester garden, N of Barrington Tops (AMSC154954) could also be a translocation since it is the only record N of the Hunter River in an area where much collecting has taken place in surrounding forests.

*Diphyoropa saturni* has spread prolifically in Lord Howe Island, even outdoing introduced European species such as *Cantareus aspersus* (Muller, 1774) and *Vallonia pulchella* (Muller, 1774). A single specimen of *D. saturni* has been recorded from inner Melbourne, Vic but it could be more prominent in that city and an examination of material in the Museum of Victoria is needed to establish its local abundance more accurately.

Populations do not show much conchological variation throughout the natural range of the species. Locally the species is most likely to be confused with *Elsothera brazieri* (Cox, 1868) which differs from it primarily in having a protoconch with dominant radial ribs throughout that are crossed by weak, continuous spiral cords.

The decision not to figure the anatomy of this species was made to expedite publication. Very little spirit material of this species was available for study, and while this material was of sufficient quality to allow for observation of major anatomical features, it was not suitable for illustration.

### **Diphyoropa macleayana** sp. nov.
(Figs 10, 24-28, 30-34; Table 5)

ETYMOLOGY. For the Macleay Valley.

MATERIAL. HOLOTYPE. AMSC205274, Kempsey, WNW, c.1.5km E Mt Sebastopol, Kempsey-Carrai Rd, NSW (30°57'00"S, 152°28'40"E), drf/lm, 350m, on rocks/in litter, 28.xi.1989, JS, DP. Height of shell=1.59mm, diameter=2.81mm, H/D=0.57, D/V=3.35, number of whorls=4.1,ribson last whorl=106. PARATYPES. All NSW. QMMO56395, 1RC, same data as holotype; QMMO56011, 2RC, Kempsey, WNW, c.1.5km E Mt Sebastopol, Kempsey-Carrai Rd (30°57'00"S, 152°28'40"E), drf/lm, 350m, in litter, 08.i.1995, JS, JC; AMSC168685, 5RC, W of Kempsey, on W side Yessabah Caves limestone outcrop (31.095°S, 152.689°E), in soil under leaf litter in Lantana infested rainforest, iii.1983, MS. OTHER MATERIAL.QMMO37098, MO56399, MO49382, MO55876, MO56392, MO60236, AMSC140247, C140258, C162184.

DIAGNOSIS. Shell very small, with evenly coiled whorls and flat spire. Protoconch sculpture bimodal with the first 2/3 of the protoconch having broad, irregularly spaced spiral lirae weakening in the last 1/3 where broad, curved radial ridges develop and eventually dominate. Teleoconch sculpture of prominent, almost straight, moderately widely spaced radial ribs. Umbilicus very wide V-shaped. Penis tubular with upper chamber muscular and lower part short, thin, tapering; internally with 5 longitudinal pilasters; epiphallus as long as main section of penis.

DESCRIPTION. Shell very small, light brown, with c.4.1 evenly coiled whorls. Shell diameter c.2.8mm. Spire flat to slightly depressed. Height of shell c.2.81mm, H/D c.0.57. Protoconch of c.1.8 whorls with bimodal sculpture consisting of broad irregularly spaced, weakly curved, spiral lirae for the first two-thirds of the protoconch; weaking in the latter third of the protoconch where broad curved radial ridges deveolop and become more prominent than the spirals; spirals crossing radial ridges. Ridges wide, height less than width; spacing uniform; width of interstices (in multiples of rib width): 3-6. Teleoconch sculpture of bold, almost straight, closely spaced radial ribs; c.106 ribs on the last whorl, ribs/mm c.13.4. Ribs medium in size, height equal to width; straight in section; rounded on top. Rib interstices on the first post-nuclear whorl equal to width of 4-5 ribs; interstices on the penultimate whorl equal to width of 3-4 ribs. Microsculpture of microradial ribs and stronger microspiral cords that cross the microradials and form strong elongate to round beads at their intersection. Microradials low; 36 between ribs on first post-nuclear whorl; 48 between ribs on penultimate whorl. Umbilicus very wide V-shaped, diameter c.0.84mm, D/U c.3.35. Sutures weakly impressed, whorls shouldered above and rounded below a rounded periphery. Aperture roundly lunate, parietal callus present. Based on the measured holotype.

Genitalia with epiphallus equal to penis length. Penis tubular internally with 2 longitudinal pilasters. Pallial cavity with kidney moderately bilobed; apex slightly reflexed.

Radula with central tooth strongly tricuspid, only slightly smaller than first lateral tooth; lateral teeth tricuspid. Mesocone of lateral teeth slender, slightly diamond-shaped. Marginal teeth tricuspid; ectocone of outer marginal teeth not split; endocone not split. Number of lateral teeth: 8; marginal teeth: 5; radular rows: 98.

Based on 2 dissected specimens (AMSC162184).

TABLE 5. Shell measurements for species of *Acheronopa*, *Hedleyropa*, *Scleridoropa* and *Diphyoropa*. (Abbreviations as in Table 1).

| Measurement | *Acheronopa attunga* | *Hedleyropa yarrangobillyensis* | *Scleridoropa euryscopa* | *Diphyoropa saturni* | *Diphyoropa macleayana* |
|---|---|---|---|---|---|
| N | 23 | 20 (*19; **17) | 119 | 5 | 1 |
| D | 3.92-6.28 (4.654) ± 0.468 | 3.21-4.52 (3.82) ± 0.354 | 2.65-4.27 (3.35) ± 0.32 | 3.02-3.59 (3.264) ± 0.274 | 2.81 |
| PW | 1.5-1.7 (1.6) ± 0.067 | 1.6-1.9 (1.671) ± 0.077 ** | 1.1-1.9 (1.71) ± 0.09 | 1.6-1.7 (1.66) ± 0.055 | 1.8 |
| TW | 3-3.6 (3.37) ± 0.177 | 2.3-3.1 (2.806) ± 0.205 ** | 2-3.6 (2.78) ± 0.27 | 2.5-2.9 (2.7) ± 0.187 | 2.3 |
| NW | 4.6-5.2 (4.97) ± 0.172 | 4.2-4.7 (4.476) ± 0.156 ** | 3.7-5.3(4.48) ± 0.26 | 4.2-4.6 (4.36) ± 0.219 | 4.1 |
| H | 1.59-2.11 (1.845) ± 0.159 | 1.63-2.51 (1.981) ± 0.209 | 1.3-2.17 (1.65) ± 0.18 | 1.62-2.03 (1.806) ± 0.182 | 1.59 |
| SP | 0.11-0.41 (0.263) ± 0.078 | 0.12-0.41 (0.208) ± 0.076 | 0-0.32 (0.11) ± 0.07 | 0-0.01 (0.002) ± 0.004 | - |
| AH/AW | 0.65-0.88 (0.74) ± 0.05 | 0.83-1.07 (0.96) ± 0.07 | 1.09-1.45 (1.26) ± 0.07 | 1.18-1.44 (1.3) ± 0.11 | 1.23 |
| UMB | 1.22-1.71 (1.477) ± 0.142 | 0.7-1.2 (0.896) ± 0.125 | 0.93-1.79 (1.38) ± 0.18 | 0.98-1.27 (1.102) ± 0.145 | 0.84 |
| RIB | 20-31 (25) ± 3.162 | 86-136 (108.9) ± 13.408 * | 70-176 (109.29) ± 21.34 | 58-85 (74.2) ± 11.032 | 106 |
| RIBS/MM | 1.216-2.118 (1.721) ± 0.238 | 8.170-10.72 (9.156) ± 0.736 * | 7.102-16.05 (10.43) ± 2.082 | 6.113-7.933 (7.216) ± 0.699 | 13.4 |
| H/D | 0.3-0.48 (0.4) ± 0.04 | 0.48-0.58 (0.52) ± 0.03 | 0.44-0.54 (0.49) ± 0.02 | 0.54-0.57 (0.55) ± 0.01 | 0.57 |
| D/U | 2.89-4.21 (3.16) ± 0.27 | 3.72-5.05 (4.3) ± 0.36 | 2.12-3.55 (2.44) ± 0.18 | 2.82-3.17 (2.98) ± 0.16 | 3.35 |

DISTRIBUTION AND HABITAT. Macleay River Valley, NE NSW; living in litter in a range of vegetation types including eucalypt woodland and dry rainforest on limestone. Closer to the coast *D. macleayana* occurs in eucalypt forest and littoral rainforest.

REMARKS. *Diphyoropa macleayana* sp. nov. is smaller than *D. saturni* and has more crowded ribs on the teleoconch. However a key difference exists in the reproductive anatomy in which the epiphallus of *D. macleayana* is as long as the penis compared with an epiphallus half to two-thirds the length of the penis in *D. saturni*. *D. saturni* also has a distal tapering extension of the penis which is not seen in *D. macleayana*. Elongation of both the penis and in particular the epiphallus together with the bimodal protoconch sculpture are key departures from the more typical patterns seen in eastern Australian charopids hitherto invesitgated. An analagous situation of combined conchological/anatomical character shifts was reported for *Rotacharopa* Stanisic, 1990 by Stanisic (1990). However, with so much of the charopid fauna yet to be studied, it is difficult to gain a true phylogenetic perspective of the significance of these features.

## PHYLOGENETIC ANALYSIS

The characters and character states (Table 6) forming the data matrix (Table 7) lead to the strict consensus tree of the 250 most parsimonious trees (length 127, consistency index 0.56, retention index 0.65) (Fig. 35), with bootstrap values shown for each clade.

In the strict consensus tree, the *Rhophodon*, *Letomola*, *Elsothera* and *Scleridoropa* clades were well supported, with bootstrap values of 90% or greater. *Macrophallikoropa* was also moderately well supported (bootstrap value of 80%). These groups were therefore accepted as genera. Most other clades in the tree were poorly supported. The remaining taxa were either placed into monotypic genera, or united in genera with taxa not included in the analysis (based on shell characters).

Two exceptions to this are *Cralopa* and *Egilodonta*. *Cralopa* was not well supported by bootstrap values. One species (*carlessi*) was removed from this group into a new genus; however, the other two taxa were retained in *Cralopa*. There are at least two undescribed species that appear to be closely related to *C. kaputarensis* (JS, pers. obs.), and a study of these,

TABLE 6. List of characters and character states used in the phylogenetic analysis.

| Character number | Character | States |
|---|---|---|
| 1 | Shell colour | 1: absent, 2: flecked, 3: flammulated, 4: plain |
| 2 | Coiling pattern | 1: loose, 2: even, 3: tight. |
| 3 | Whorl profile above periphery | 1: flattened, 2: rounded, 3: shouldered |
| 4 | Supraperipheral sulcus | 1: absent, 2: present |
| 5 | Apertural sinus | 1: absent, 2: shallow, 3: deep |
| 6 | Spire height | 1: apex and early spire elevated, 2: apex depressed and early spire elevated, 3: apex and early spire flattened, 4: apex and early spire depressed |
| 7 | Protoconch shape | 1: exsert, 2: flattened |
| 8 | Umbilicus shape | 1: cup or saucer shaped, 2: V-shaped, 3: U-shaped, 4: closed |
| 9 | D/U ratio | 1: less than 3, 2: 3-4, 3: 4-4.5, 4: more than 4.5 |
| 10 | Protoconch radial ribs | 1: absent, 2: present |
| 11 | Protoconch – regular radial ribs | 1: absent, 2: present |
| 12 | Protoconch microradials | 1: absent, 2: present |
| 13 | Protoconch spirals | 1: absent, 2: present |
| 14 | Protoconch pits | 1: absent, 2: present |
| 15 | Protoconch radial ribs – spacing | 1: evenly spaced, 2: increasing towards teleoconch, 3: decreasing towards teleoconch |
| 16 | Protoconch radial ribs – number | 1: 45 or fewer, 2: 46-65, 3: 66-85, 4: 85 or more |
| 17 | Protoconch spirals – form | 1: wrinkles, 2: threads, 3: lirae |
| 18 | Protoconch spirals – crossing radial ribs | 1: spirals do not cross radial ribs, 2: spirals cross radial ribs |
| 19 | Teleoconch radial ribs | 1: absent, 2: present |
| 20 | Teleoconch rib count | 1: low (69 or fewer), 2: medium (70-149), high (149 or more) |
| 21 | Teleoconch radial rib width | 1: narrow, 2: medium, 3: wide |
| 22 | Teleoconch rib curvature strength | 1: strong, 2: weak |
| 23 | Teleoconch rib sinuation | 1: convex, 2: concave, 3: straight |
| 24 | Kidney | 1: almost unilobed, 2: moderately bilobed, 3: strongly bilobed |
| 25 | Secondary ureter | 1: closed, 2: open |
| 26 | Epiphallus and vas deferens junction | 1: bulbous, 2: no-bulbous |
| 27 | Epiphallus coiling | 1: simple, 2: complex |
| 28 | Penis pilasters | 1: simple longitudinal, 2: circular, 3: absent |
| 29 | Number of longitudinal pilasters | 1: 1 pilaster, 2: 2 pilasters, 3: 5 or more pilasters, 4: 3-4 pilasters |
| 30 | Vergic structure | 1: absent, 2: absent |
| 31 | Ovotestis – general shape | 1: many follicles in line along duct; 2: few follicles arranged in clumps (usually 2) |
| 32 | Ovotestis lobes | 1: 1 lobe, 2: 2 lobes, 3: more than 2 lobes |
| 33 | Preputial tube | 1: absent, 2: absent |
| 34 | Radula – lateral tooth structure | 1: continuous, 2: discontinuous |
| 35 | Radula – central tooth structure | 1: tricuspid, 2: almost unicuspid |
| 36 | Radula – marginal teeth | 1: saw-like (Rectangular), 2: similar in shape to laterals |
| 37 | Apertural barriers – microdentition | 1: triangular, 2: rectangular |
| 38 | Parietal barrier A | 1: absent, 2: present |
| 39 | Parietal barrier B | 1: absent, 2: present |
| 40 | Parietal barrier C | 1: absent, 2: present |
| 41 | Palatal barrier A | 1: absent, 2: present |
| 42 | Palatal barrier C | 1: absent, 2: present |
| 43 | Palatal barrier E | 1: absent, 2: present |
| 44 | Basal barrier A | 1: absent, 2: present |

TABLE 7. Data matrix for the phylogenetic analysis.

| Species | Character | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| *Minidonta hendersoni* | 4 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | ? | 2 | ? | 2 | 2 | ? | - | - |
| *Aadonta constricta constricta* | 3 | 3 | - | 2 | 1 | 1 | 1 | 3 | 4 | 1 | 1 | 1 | 2 | 1 | - | - | 2 | - | 2 | ? | 1 | ? | 3 |
| *Rhophodon kempseyensis* | 3/4 | 3 | 2 | 1 | 1 | 4 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 3 | 2 | 1 | 1 | 2 | 3 | 1 | 2 | 2 |
| *Rhophodon palethorpei* | 4 | 3 | 2 | 1 | 1 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 3 | 2/3 | 1 | 1 | 2 | 2 | 3 | 2 | 2 |
| *Egilodonta bairnsdalensis* | 4 | 3 | 2 | 1 | 1 | 3/4 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 3 | 4 | 1 | 1 | 2 | 1 | 3 | 2 | 2 |
| *Egilodonta wyanbenensis* | 4 | 3 | 2 | 1 | 1 | 3/4 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 3 | 4 | 1 | 1 | 2 | 1 | 2 | - | 2 |
| *Egilodonta bendethera* | 4 | 3 | 2 | 1 | 1 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 3 | 2 | 1 | 1 | 2 | 1 | 3 | 2 | 2/3 |
| *Egilodonta paucidentata* | 4 | 3 | 2 | 1 | 1 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 3 | 1/3 | 1 | 1 | 2 | 1 | 3 | 2 | 2/3 |
| *Letomola cantortus* | 3 | 1 | - | 2 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | - | - | - | - | 1 | - | . | 1 | 2 |
| *Letomola lanalittlae* | 3 | 1 | - | 2 | 1 | 4 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | ? | - | - | 1 | - | . | 1 | 2 |
| *Macrophallikoropa belli* | 3 | 3 | 2 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | - | - | 3 | - | 2 | 3 | 1/2 | 2 | 2 |
| *Macrophallikoropa stenoumbilicata* | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 3 | 2 | 1 | 2 | 1 | 2 | 1 | - | - | 3 | - | 2 | 3 | 1 | - | 1 |
| *Elsothera brazieri* | 2 | 2 | 3 | 1 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 3/4 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| *Elsothera sericatula* | 1 | 2 | 3 | 1 | 1 | 1/3 | 2 | 4 | - | 2 | 1 | 1 | 2 | 1 | 1 | ? | 2 | 2 | 2 | 3 | 2 | ? | 2/3 |
| *Whiteheadia globosa* | 1 | 2 | 3 | 1 | 1 | 1 | 2 | 4 | - | 2 | 1 | 1 | 2 | 1 | 1 | ? | 1 | 1 | 2 | 1 | 3 | 1 | 1/3 |
| *Coricudgia wollemiana* | 4 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 4 | 2 | 2 | 2 | 1 | 3 | 1 | 3 |
| *Decoriropa lirata* | 4 | 2 | 1 | 1 | 2 | 1/3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 3 | 1 | 1 |
| *Marilyniropa jenolanensis* | 4 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 3 | 1 | 3 |
| *Cralopa stroudensis* | 4 | 1 | 3 | 1 | 3 | 1 | 2 | 3/4 | ? | 2 | 1 | 1 | 2 | 1 | 1 | 3 | 2 | 2 | 2 | 2 | 3 | 1 | 1 |
| *Gouldiropa carlessi* | 4 | 1 | 2 | 1 | 2 | 1 | 2 | 3 | 4 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 3 | 1 | 1 |
| *Gouldiropa kaputarensis* | 4 | 1 | 1 | 1 | 2 | 1 | 2 | 3/4 | ? | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 1 | 1 |
| *Sharniropa wollondillyana* | 4 | 1 | 3 | 1 | 1 | 1 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 3 | 1 | 1 |
| *Acheronopa attunga* | 4 | 2 | 1 | 1 | 1 | 4 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 3 | 1 | 1/3 |
| *Hedleyropa yarrangobillyensis* | 4 | 2 | 3 | 1 | 1 | 1/3 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 4 | 2 | 2 | 2 | 2 | ? | 1 | 1 |
| *Scleridoropa saralijaneae* | 3 | 2 | 2 | 1 | 1 | 3 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 2 | 4 | 2 | 2 | 2 | 2 | 3 | 2 | 2/3 |
| *Scleridoropa nandewar* | 3 | 2/3 | 2 | 1 | 1 | 3 | 2 | 1 | ? | 2 | 1 | 2 | 2 | 1 | 2 | 4 | 2 | 2 | 2 | ? | 3 | - | 2/3 |
| *Diphyoropa saturni* | 4 | 2 | 3 | 1 | 1 | 3 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 3 | 1 | 2 | 2 | 3 | - | 3 |

| Species | Character | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 |
| *Minidonta hendersoni* | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | ? | 1 | ? | ? | ? | 1 | ? | ? | ? | ? | ? | ? | ? | ? |
| *Aadonta constricta constricta* | 1 | 2 | 2 | 1 | 1 | ? | ? | 1 | ? | 1 | ? | ? | ? | 1 | ? | ? | ? | ? | ? | ? | ? | ? |
| *Rhophodon kempseyensis* | 1 | 1 | 2 | 1 | 1 | 4 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| *Rhophodon palethorpei* | 1 | 1 | 2 | 1 | 2 | - | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| *Egilodonta bairnsdalensis* | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 1 |
| *Egilodonta wyanbenensis* | 1 | 1 | 2 | 1 | 3 | - | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 1 |
| *Egilodonta bendethera* | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 1 |
| *Egilodonta paucidentata* | 1 | 1 | 2 | 1 | 1 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 1 |
| *Letomola contortus* | 2 | 1 | 2 | 1 | 1/2 | 4 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | |
| *Letomola lanalittlae* | 2 | 1 | 2 | 1 | 2 | - | 1 | 2 | 2 | 1 | 1 | 2 | 1 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| *Macrophallikoropa belli* | 3 | 1 | 2 | 1 | 3 | - | 2 | 2 | 2 | 2 | 1 | 1 | 2 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| *Macrophallikoropa stenoumbilicata* | 3 | 1 | 2 | 1 | 3 | - | - | 2 | 2 | 2 | ? | ? | ? | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| *Elsothera brazieri* | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 |
| *Elsothera sericatula* | 1 | 1 | 1 | 2 | 2 | - | 1 | 2 | 2 | 1 | 1 | 1 | 2 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | ? |
| *Whiteheadia globosa* | 3 | 1 | 2 | 1 | 1/2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | ? |
| *Coricudgia wollemiana* | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 |
| *Decoriropa lirata* | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1/2 |
| *Marilyniropa jenolanensis* | 2 | 1 | 2 | 1 | 1 | 3 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 |
| *Cralopa stroudensis* | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| *Gouldiropa carlessi* | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 |
| *Gouldiropa kaputarensis* | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 |
| *Sharniropa wollondillyana* | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 |
| *Acheronopa attunga* | 2 | 1 | 2 | 1 | 1 | 4 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 |
| *Hedleyropa yarrangobillyensis* | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 |
| *Scleridoropa saralijaneae* | 1 | 1 | 2 | 1 | 1 | 4 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 |
| *Scleridoropa nandewar* | 1 | 1 | 2 | 1 | 1 | 4 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| *Diphyoropa saturni* | 2 | 1 | 2 | 1 | 1 | 3 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 |

when more material becomes available, may show that the latter should be in a separate genus, leaving *Cralopa* as a monotypic taxon.

*Egilodonta* had a bootstrap value of 46%. There was greater support for the group [*Egilodonta* + *Rhophodon*], which had a bootstrap value of 74%. These groups have been united before (Stanisic, 1990). However, the 4 *Egilodonta* taxa are united by characters such as wide rib spacing on the teleoconch and a penial

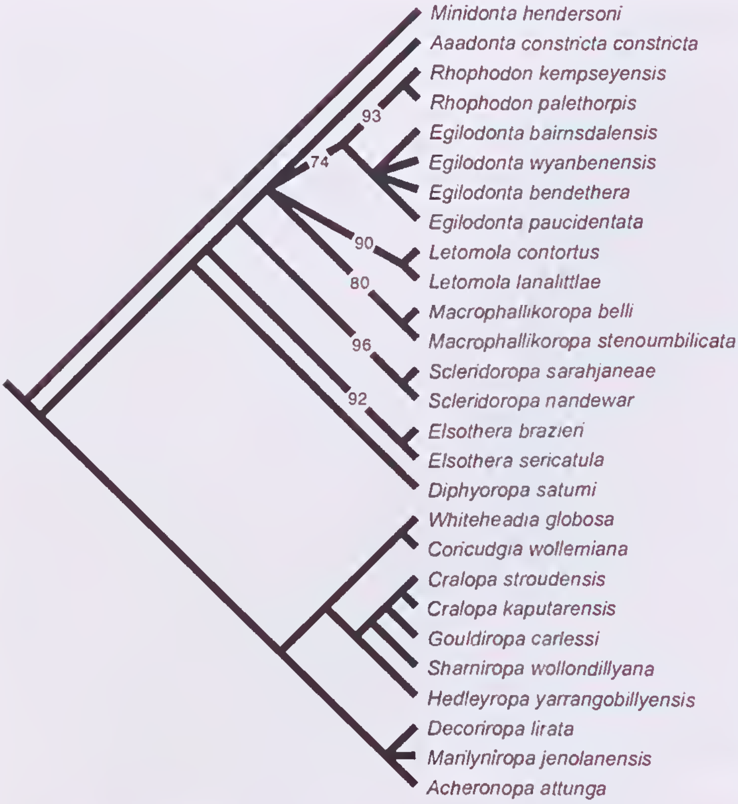

FIG. 35. Strict consensus tree of 27 taxa comprised of the 250 most parsimonious trees (length 127, consistency index 0.56, retention index 0.65). Bootstrap values are marked at the base of each clade.

verge, and are widely separated geographically from the other *Rhophodon* taxa. For these reasons, *Egilodonta* is established as a separate genus.

This study contains only a small cross-section of the Australian charopid fauna, and some of the low branch support may be due to the fact that key taxa are missing from the analysis. Until more Australian charopid taxa are described or thoroughly revised, many relationships within the group will remain unresolved.

## DISCUSSION

The study of the eastern Australian Charopidae is still in its infancy and the descriptive task that faces researchers cannot be overstated. Stanisic (1990) analysed conchological and anatomical variation in 50 species of eastern Australian Charopidae and attempted to place these into regional and local context. In doing so the inadequacy of many previous species descriptions and generic diagnoses based solely on comparatively gross shell charecters (Iredale, 1937, 1941a,b; Smith & Kershaw, 1979, 1981) was exposed. Only the studies of Solem (1984) [on two northern Australian species] and Smith & Kershaw (1985) [on three Tasmanian species] were considered of sufficient standard to enable detailed comparisons to be undertaken with species extralimital to that study. The current study has attempted to build on the work of Stanisic (1990) and consequently has resulted in a change in some of the taxonomic concepts developed in the earlier study.

The species included in the current study were specifically selected on the basis that the species were generally well differentiated on shell features. As a result, they comprise only a limited range of morphotypes among a very large east-coast fauna. Remarks on the relative significance of patterns of morphological variation need to be tempered by the knowledge that additional 'unusual' forms will emerge as this fauna is investigated. This is especially so in regard to the many species occurring on the high mountains of the Wet Tropics, NE Qld (Stanisic et al., 1994b) which display a range of shell variation greater than seen in the remainder of the east coast fauna (Stanisic, 1993a; unpubl. data).

Intergeneric variation is discussed under the relevant generic treatments but inferred relationships between genera are still largely tentative. In summary, it would appear that quite different lineages appear to have developed grossly similar patterns of shell form (size, shape and sculpture) probably in response to environmental selection. Living among seasonally dry, limestone talus would seem to favour species with dentate apertures and those with bold postnuclear sculpture. Anatomical variation was largely conservative with little in the way of identifiable character shifts. Where such shifts did occur (*Macrophallikoropa*, *Diphyoropa*) these coincided with major shifts in shell patterns, particularly protoconch sculpture. Subtle differences in shell features such as fine structure of protoconch sculpture, architecture of post-embryonic sculpture, whorl profile and coiling pattern provided a means of discriminating between the grossly convergent patterns and in identifying significant generic level trends. Most useful was the difference in protoconch sculpture. A casual review of the generic taxa previously reviewed by Stanisic (1990, 1993a, b; 1996) shows that in nearly all cases, this feature is generically diagnostic. In two exceptions, *Cralopa* and *Egilomen*, greater attention to differences in protoconch sculpture would have avoided some of the problems rectified in this study. It would appear that this single feature will be a key guide to generic level classification within this family but needs to be interpreted in microscopic rather than macroscopic detail. Hence, terms such as radial or spiral are in themselves of limited use.

## BIOGEOGRAPHY

The Charopidae are a Gondwanan group (Stanisic, 1998a) which has historically been regared as having greatest diversity in the moist forests of southeastern Australia. However, significant charopid faunas have been reported from the high mountains of the Queensland Wet Tropics (Stanisic et al., 1994) and the semi-arid Brigalow Lands of Qld (Stanisic, 1998b). In each of these cases though, the charopids are associated with rainforest refugia reinforcing the contention of Stanisic (1990) that the association of charopids and rainforests in eastern Australia has had a long history, probably extending beyond the Miocene. Our knowledge of rainforest evolution since the Miocene (A.P. Kershaw, 1981; Webb & Tracey, 1981; Kershaw & Nix, 1988; Nix, 1991) suggests that rainforest has been contracting in the face of increased continental aridity. Rainforests were more widespread when Australia was wetter, possibly extending into the interior of the continent (Martin, 1981), and hence it is reasonable to speculate that the charopid fauna would have been more widely distributed. Martin (1987, 1997) has shown that rainforest was present in the inland Lachlan and Darling Rivers as recently as the early to mid-Pliocene. As climatic conditions on the Australian continent shifted to a drier regime, rainforest receded into moist refugia and the overall range of the Charopidae would have contracted. At the individual species level this climate-induced restriction of rainforest would have led to the fragmentation of populations in the first instance and extinctions in many cases. The surviving Charopidae are now found mainly in suitable refugia.

This longterm isolation of such fragmented charopid populations would have provided numerous opportunities for allopatric speciation. Subsequent dispersal and recolonisation may have occurred as climatic conditions (and hence vegetation systems) fluctuated between wet and dry. Allopatric speciation in the Charopidae has been documented in the larger rainforest massifs (Stanisic 1987, 1993a,b). But the phenomenon should be even more pronounced in areas where small patches of rainforest were separated by the rapidily developing, drier eucalypt communities. Hitherto there has been little published evidence to show the effects of climatic change on the distribution of snails that exist in the 'drier' areas of eastern Australia.

Rainforest is used here in a broad sense to include dry vine thickets and scattered remnants sometimes represented by only a few key floristic elements. In semiarid areas rainforest survives chiefly on rocky outcrops, in gully heads and along watercourses mainly because these habitats provide a more stable moisture supply than the surrounding countryside. Rock outcrops in particular are important microhabitats for both rainforest plants and land snails. These 'rock piles' may consist of basalt talus, granite boulders or limestone karst, and preserve environmental moisture in the crevices between the rocks They also provide important shelter from fire. Limestone outcrops are particularly significant for land snails in eastern Australia (Stanisic, 1997 a,b). Besides providing shelter and moisture, the limestone also provides a ready supply of calcium for shell production. Collecting has shown that in the majority of cases these outcrops are snail-rich 'islands' in a sea of otherwise snail-poor countryside. They often support quite distinctive land snail communities of which examples have been highlighted by Stanisic (1997a,b).

The rainforest on many of these outcrops may be the result of recent opportunistic seeding but in others the association may have greater continuity. Such is probably the case in the Macleay Valley where rainforest, besides growing on the limestone outcrops, is also a dominant floristic feature of the surrounding countryside. And, probably not through mere coincidence, here there is a proliferation of land snails in numbers not seen elsewhere in eastern Australia (Stanisic, 1997a). Not all limestone outcrops have as spectacular faunas as those in the Macleay Valley, but they are distinctive nonetheless. In some cases, less than half a dozen species may be present, but they may still include restricted endemics.

Because this study covers a very small component of a much larger and undescribed charopid fauna, biogeographic hypotheses emerging from this work remain limited. Nevertheless one fact is evident from this studyand that is that limestone outcrops have been important historical refugia for the Charopidae in E NSW. They have been of primary importance where some genera have relied on this archipelago of habitats for survival. This appears to be true for *Egilodonta*, *Letomola*, *Achenoropa*, *Sharniropa* and *Marilyniropa*. In both *Letomola* and *Sharniropa* allopatric speciation following fragmentation of a wider ancestral population that probably encompassed non-limestone areas is indicated. Isolation of species has probably been longterm. In contrast *Achenoropa attunga* and *Marilyniropa jenolanensis* are localised limestone endemics, in each case scattered across several geographically proximate, but nonetheless isolated limestone outcrops. They may be recently fragmented populations of limestone dwellers that have yet undergone speciation. In contrast, *Egilodonta* exemplifies the principle of population fragmentation followed by allopatric speciation.

In other groups the limestone outcrops appear to have formed a small but nonetheless integral part of a wider network of mesic refugia in which these tiny litter snails were able to withstand the vagaries of a drying landscape. Such is the case with *Macrophallikoropa*, *Scelidoropa* and *Rhophodon* where species also occur outside the limestone outcrop archipelago. *Macro- phallikoropa belli* has the most widespread distribution of the species investigated herein, yet has restricted sister species on the Jenolan Caves limestones and on the volcanically capped Mt Coricudgy. The biogeo- graphic importance of the Jenolan outcrops is further highlighted by the presence of the restricted *Marilyniropa jenolanensis*.

The widespread distributions of such species as *Decoriropa lirata*, *Macrophallikoropa belli* and *Scelidoropa sarahjaneae* across the limestone archipelago suggests that the the adaptability of individual species may also have been influential in the determination of some of the distribution patterns discussed herein.

At a regional level, general trends are few. Perhaps such trends will become more obvious when additional species are studied. The absence of the otherwise widespread *Scelidoropa sarahjanae* from much of the Sydney Basin (in contrast to situation with *D.lirata*, *Cralopa stroudensis* and *M. belli*) is unusual and needs to be further investigated.

Secondary areas of biogeographic significance appear to be volcanic peaks such as Mt Coricudgy (*Macrophallikoropa stenoumbilicata*, *Coricudgia wollemiana*), Mt Kaputar (*Scelidoropa nandewar*, *Cralopa kaputarensis*) and Glenugie Peak (*Rhophodon duplicostatus*). Again these refugia preserve mesic communities chiefly because they are largely rocky outcrops that conserve moisture.

The lack of many major radiations within this study is probably a function of the choice of species chosen for study whereby highly differentiated forms were selected. However, it probably also reflects the relictual nature of this fauna. Many charopids have quite localised distribututions and opportunistic survival in such small refugia appears to have been relatively commonplace. At the same time there would have been many instances of extinction.

## CONSERVATION

Some of the larger limestone outcrops (e.g. Jenolan, Wombeyan) mentioned in this study have been afforded legislative protection because of their value as caving sites and this security has provided an inadvertent safe haven for the resident biota. But many lesser known outcrops have no formal protection at all and the plight of their fauna, including the unusual charopids, is uncertain. As this study has shown, many of the limestone-associated charopids are localised endemics, often restricted to single outcrops. A conservation strategy that aims to preserve this fauna by listing all limestone outcrops on the National Estate should be considered.

## ACKNOWLEDGEMENTS

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# A NEW CANDONINAE GENUS (CRUSTACEA: OSTRACODA) FROM SUBTERRANEAN WATERS OF QUEENSLAND, WITH A CLADISTIC ANALYSIS OF THE TRIBE CANDONOPSINI

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*Pioneercandonopsis hancocki* gen. nov., sp. nov. was collected from subterranean waters of Pioneer Valley, Queensland, and it is the first subterranean ostracod from this state. The new genus belongs to the tribe Candonopsini Karanovic, in press b, which also includes *Candonopsis* Vávra, 1891, *Caribecandona* Broodbakker, 1983, and *Cubacandona* Broodbakker, 1983. Characteristics of the hemipenis and prehensile palps suggest that *Pioneercandonopsis* is more closely related to the latter two genera than to *Candonopsis*. A cladistic analysis based on two sets of morphological characters was performed on all 32 species of the tribe Candonopsini, with *Cryptocandona dudichi* (Klie, 1930) chosen as outgroup taxon. Resulting cladograms support a monophyletic origin for the Candonopsini and close phylogenetic relationship between the new genus and *Caribecandona* and *Cubacandona*. ❑ *Pioneercandonopsis, new genus, Candonopsini, Candoninae, cladistic analysis.*

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A total of 19 freshwater free-living ostracods are known from Queensland (Sars, 1889; De Deckker, 1978, 1979, 1981, 1983; De Deckker & McKenzie, 1981) and all are surface water inhabitants. The subterranean ostracod fauna of Queensland is completely unexplored. Recently, the Queensland Department of Natural Resources and Mines started an extensive sampling of the subterranean waters of Pioneer Valley. I had the opportunity to examine these samples and discovered the new ostracod described in this paper. This is the first subterranean ostracod recorded from Queensland and is also the 10th ostracod genus described from Australian subterranean waters. The other 9 genera are from groundwaters of Western Australia (Karanovic & Marmonier, 2003; Karanovic, 2003a, b, in press a, b). All 10 genera belong to the Candoninae Kaufmann, 1900. This subfamily has 11 extant genera in Australia (10 endemic, plus *Candonopsis* Vávra, 1891), with an additional 20 genera worldwide.

Initially, the Candoninae was divided into tribes Namibcypridini Martens, 1992 with two genera, and Candonini Kaufamnn, 1900 containing 16 genera (Martens, 1992). However, discovery of a highly diverse Candoninae fauna in WA, with striking morphological features, necessitated revision of the Candoninae with the aim of better understanding the phylogenetic relationships between genera. Karanovic (in press a, b) described the Humphreyscandonini Karanovic, in press a, and Candonopsini Karanovic, in press b. The former tribe includes 7 genera known only from subterranean waters of the Pilbara region (WA), while the Candonopsini encompasses *Candonopsis*, *Caribecandona* Broodbakker, 1983, and *Cubacandona* Broodbakker, 1983. The new genus from Queensland is assigned to this tribe.

The Candonopsini contains 32 Recent species. *Candonopsis* is the largest, with 24 species, and is divided (Karanovic, in press b) into *Candonopsis s. str.* and *Abcandonopsis* Karanovic, in press b. The latter subgenus is an Australian endemic with 3 subterranean species: 2 from Kimberley and one from the Murchison Region (Karanovic, in press b). *Candonopsis s. str.* has 5 species in Australia, 4 endemic to subterranean waters of the Murchison Region (Karanovic & Marmonier, 2002). The remaining *Candonopsis* species are in Europe, South America and Africa. *Cubacandona* and *Caribecandona* are less diverse and have more restricted distributions. *Cubacandona* was represented only by the type species, *C. cubensis* (Danielopol, 1978), from Cuba (Danielopol, 1978, 1980), but Karanovic (in press b) assigned *Candonopsis* species from South America to that genus. All 3 species of *Caribecandona* are found in subterranean waters of the West Indies (Broodbakker, 1983).

*Cubacandona* and *Caribecandona* share 3 very important morphological characteristics: 2 extensions of the lateral lobe of hemipenis, almost symmetrical prehensile palps and a very short terminal segment of the mandibular palp. In contrast, *Candonopsis* has only 1 extension of the lateral lobe, extremely asymmetrical prehensile palps and a long terminal segment of the mandibular palp. With respect to these characteristics, the new genus is more closely related to the Central and South American genera than it is to *Candonopsis*, but shares several setal reductions with the subgenus *Abcandonopsis* and some other *Candonopsis s. str.* species. To test the phylogenetic relationships in the Candonopsini, a cladistic analysis was performed. This analysis was based on species-level taxonomy, because this is more likely to represent evolutionary relationships (Walker-Smith & Poore, 2001) and included all 32 species of the tribe.

## MATERIAL AND METHODS

TAXONOMIC METHODS. Samples were collected with haul-nets (mesh size 250 or 350 µm) from bores. Haul-nets are actually simple plankton nets of a different size suitable for the bore, which can range from 30-180 mm in diameter. Weighed nets were lowered down into the bore with one bottle screwed on its distal part then hauled through the water column, usually a number of times. Animals were stained with the 'Rose Bengal' dye, for easier sorting.

For observation under the light microscope, ostracods were dissected in a mixture of distilled water and glycerol (1:1) with fine entomological needles (mark 000). Dissected appendages were mounted in Faure's medium and observed using a Leica DMLS brightfield compound microscope with C-plan achromatic objectives. All drawings were prepared using a drawing tube attachment on the same microscope. For the Scanning Electron Microscopy (SEM), soft parts were taken from their valves and then dehydrated in a graded series of ethanol: 70%, 80%, 95% and 100%. In each of the grades, soft parts were left for about 15 minutes. The carapace was kept in the 100% ethanol for only a few minutes. After that, the soft parts and carapace were mounted on a SEM stub using double-sided adhesive tape. All samples were sputter coated with gold and observed under the LEO FEG VPSEM microscope with in-lens detectors, working distance between 2-6mm, and accelerating voltage between 2-5kV.

In the systematics, the length of all segments was measured along the midline, and length ratios are presented beginning with the proximal segment. Appendage terminology follows Martens (1998), while chaetotaxy of all limbs follows Broodbakker & Danielopol (1982), revised for the antenna by Martens (1987). I follow Martens' (1987) terminology except that the shortest claw on the male terminal segment is considered homologous with the female GM claw, while the longest one is homologous with the female Gm claw. Setae on the third thoracopod are labeled according to Meisch (1996), while setae on the antennula are labeled according to Karanovic (in press c). Lobes on the hemipenis are designated according to Danielopol (1969). In front of the abbreviations for the setae on the endopodal segments of the 3rd thoracopod and setae on the 1st thoracopod, the letter 'T' was added so that they are not confused with abbreviations for the hemipenis given below.

ABBREVIATIONS. a - lateral lobe on hemipenis; A1 - antennula; A2 - antenna; CB1, CB2 - setae on the antennular coxobasis; b - medial lobe on hemipenis; d1, d2, dp - setae on the basal segment of the third thoracopod; En1-6 - endopodal segments of the antennula; En a, b, c, d - endopodal setae on the antennula; Ex1, 2 - exopodal setae on the antennula; Fu - furca; G1, G2, G3, GM, Gm - antennal claws; H - height; L - length; LV - left valve; Md - mandibula; Mxl -maxillula; QM - Queensland Museum; RV - right valve; Ta, Ta', Tb, Td - setae on the first thoracopod; Tc, Tf, Tg, Th1, Th2, Th3 - setae on endopodal segments of the third thoracopod; T1, T2, T3 - first, second and third thoracopods; t1, t2 - medial setae on the second endopodal segment of the antenna; W - width; WAM - Western Australian Museum; Y, ya, y1, y2, y3 - aesthetases; z1, z2, z3 - apical setae on the second endopodal segment of the antenna.

CLADISTIC METHODS. A total of 32 species of the Candonopsini are included in the cladistic analysis, while *Cryptocandona dudichi* (Klie, 1930) was chosen as an outgroup taxon. According to Baltanás et al. (2000), *Cryptocandona* Kaufmann, 1900 represents a primitive lineage in the Candoninae. All known species of *Cryptocandona* have the highest number of setae found in the Candoninae on the A1, A2, and all thoracopods, which makes them closely related to the Candonopsini. However, the characteristics of Md, the prehensile palps, furca and hemipenis exclude *Cryptocandona* from the Candonopsini and the genus is placed in the Candonini (Martens, 1992). *Cryptocandona dudichi* was chosen because it was recently redescribed in detail (Namiotko et al., 2001) and both sexes are known.

The morphological characters used in this analysis were selected from information in the literature. Characters were polarised so that the outgroup taxon values all remained zero. This gives the least increase in the length of the overall cladogram (Kitching et al., 1998). The '0' state also means a plesiomorphic character state, while '1' means an apomorphy. Unknown or missing values are coded '-'. Only the carapace shape and the total number of the A1 segments were multistate characters (with states 0, 1, and 2); all other characters used in this analysis were binary. Carapace shape was coded as a non-additive (representing unordered multistate character as a linked series of binary character) character, while the total number of segments on A1 was coded as additive (representing ordered multistate character as a linked series of binary characters).

Two data matrices were created, characters coded, optimised and weighted using the computer program WinClada, version 1.00.08 (Nixon, 2002), and then analyzed using NONA, version 2 (Goloboff, 1999). All 24 characters from the first data matrix were analyzed as equally weighted, using the heuristic and the Rachet Island Hopper searches with the WinClada default parameters. For the heuristic search the default parameters are: hold 100; mult*1; hold/1 (hold 100 trees in memory, perform tree bisection and reconstruction (TRB) branch swapping on 1 random additional replicates and hold 1 starting tree in memory). For the Rachet Island Hopper search the default parameters are: 200 replications; 1 tree to hold; 3 characters to sample; 10 random constraint level and amb-poly= ( amb- collapses a branch if the ancestor and descendant have different states under same resolutions of multistate characters or of '-'; poly=treats trees as collapsed). Characters in the second data matrix were weighted so that the highest weight (1) was given to the characters from 0-15. Those were characters of the tribe, genera, subgenera, and some characters of the species groups. Characters 16-27 were weighted 0.75, majority of these are homoplastic. The lowest value (0.5) was given to the characters from 28-33, i.e. to the carapace shape and to the almost all ambiguous characters. When analysing with the Rachet Island search the same default parameters were used, while for the Heuristic search the following options were chosen: hold 10000; mult*100; hold/10. On all trees obtained unsupported branches were collapsed and characters were optimised using the fast optimisation option in WinClada.

## REFERENCE SOURCES FOR THE OUTGROUP AND INGROUP TAXA (*indicates original paper is a reference source).

1. *Cryptocandona dudichi* (Klie, 1930): Namiotko et al. (2001);
2. *Candonopsis (Abcandonopsis) aula* Karanovic, in press b*;
3. *C. (A.) indoles* Karanovic, in press b*;
4. *C. (A.) williami* Karanovic & Marmonier, 2002*: Karanovic (in press b);
5. *C. (Candonopsis) africana* Klie, 1944*: Rome (1962); Martens (1984);
6. *C (C.) anteroarcuata* Rome, 1962*;
7. *C. (C.) boni* Danielopol, 1978*: Danielopol (1980);
8. *C. (C.) bujukuensis* Löffler, 1968*
9. *C. (C.) dani* Karanovic & Marmonier, 2002*;
10. *C. (C.) hummelincki* Broodbakker, 1983*;
11. *C. (C.) kingsleii* (Brady and Roberston, 1870): Petkovski (1977)
12. *C. (C.) kimberleyi* Karanovic &Marmonier, 2002*;
13. *C. (C.) mareza* Karanovic &Petkovski, 1999*;
14. *C. (C.) murchisoni* Karanovic &Marmonier, 2002*;
15. *C. (C.) nama* Daday, 1913*;
16. *C. (C.) navicula* Daday, 1910*: Klie (1935); Rome (1962); Karanovic (in press b);
17. *C. (C.) putealis* Klie, 1932*;
18. *C. (C.) scourfieldi* Brady, 1910: Petkovski & Meisch (1995);
19. *C. (C.) solitaria* Vávra, 1895*: Klie (1936)
20. *C. (C.) sumatrana* Klie, 1932*: Harding (1962); Victor & Fernando (1978); Karanovic (in press b);
21. *C. (C.) tenuis* (Brady, 1886)*: Sars (1896); Karanovic and Marmonier (2002);
22. *C. (C.) thienemanni* Schäfer, 1945*;
23. *C. (C.) trichota* Schäfer, 1945*;
24. *C. (C.) urmilae* Gupta, 1988*;
25. *C. (C.) westaustraliensis* Karanovic & Marmonier, 2002*;
26. *Cubacandona cubensis* (Danielopol, 1978*): Danielopol (1980); Broodbakker (1983);
27. *C. anisitsi* (Daday, 1905)*: Klie (1930);
28. *C. columbiensis* (Méhes, 1913)*;
29. *C. falclandica* (Vávra, 1898)*;
30. *Caribecandona trapezoidea* Broodbakker, 1983*;
31. *C. auricularia* Broodbakker, 1983*;
32. *C. ansa* Broodbakker, 1983*.

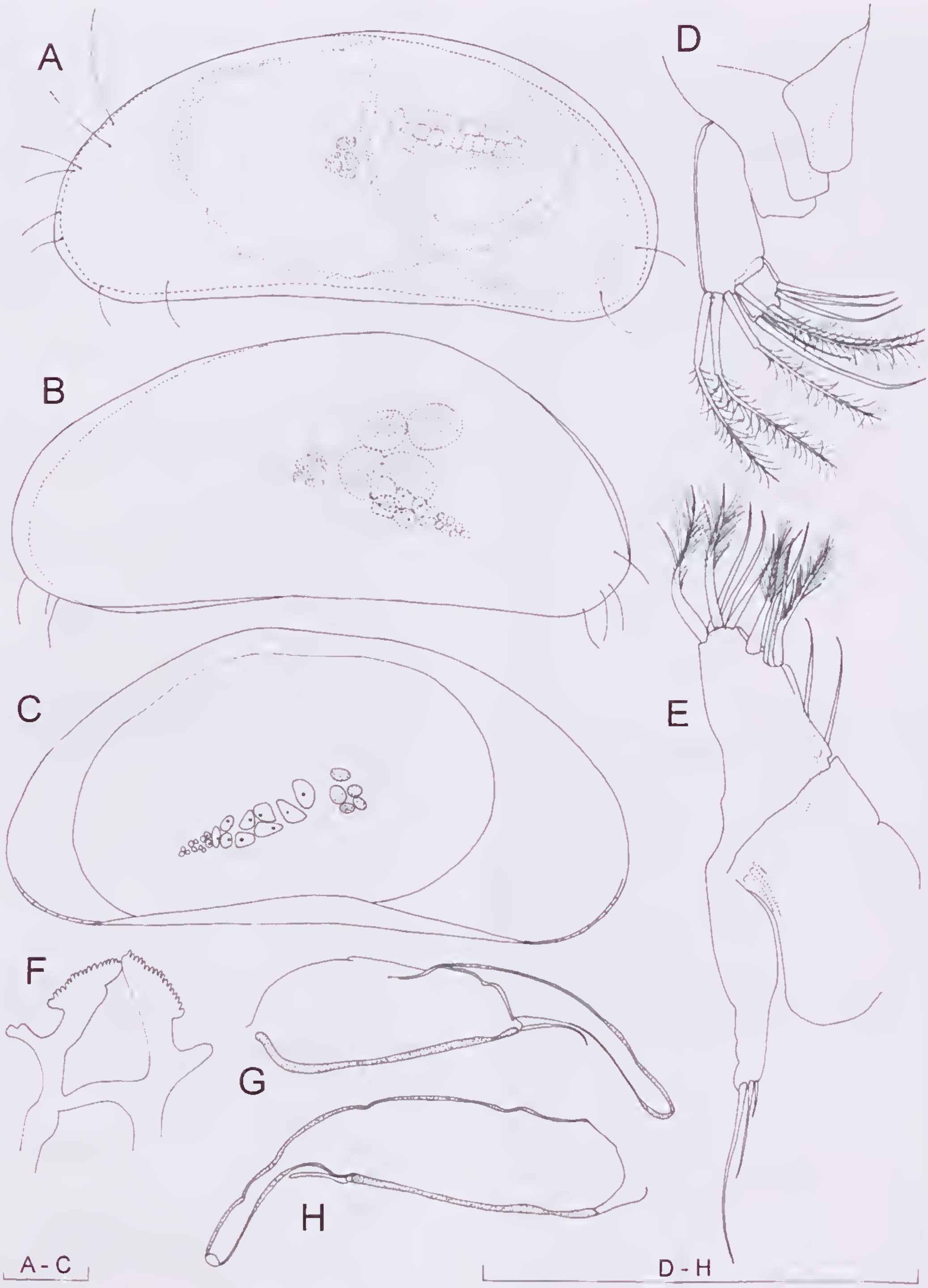

FIG. 1. *Pioneercandonopsis hancocki* gen. et sp. nov. A, G, H, Holotype (♂); B-F, Allotype (♀). A, carapace, lateral view from the left side; B, carapace, lateral view from the left side; C, LV, internal view; D, Mxl palp and three endites; E, T1; F, rake-like organ; G, left prehensile palp; H, right prehensile palp. Scales=0.1mm.

## SYSTEMATICS

### Family CANDONIDAE Kaufmann, 1900
### Subfamily CANDONINAE Kaufmann, 1900
### Tribe CANDONOPSINI Karanovic, in press b

### **Pioneercandonopsis** gen. nov.

TYPE SPECIES. *Pioneercandonopsis hancocki* sp. nov.

ETYMOLOGY. Prefix *Pioneer* (after the Pioneer Valley, Queensland where the species was collected) and the genus name *Candonopsis*. Gender feminine.

DIAGNOSIS. Carapace subreniform, surface smooth (Fig. 5A,B). Calcified inner lamella narrow posteriorly, wider anteriorly. Muscle scar imprints typical for Candoninae, although poorly visible. A1 4-segmented. Segments En2, En3, En4 and En5 fused. Small suture and seta En3a between En3 and En4. A2 in females with 4-segmented endopod, while 5-segmented in males. Male sexual bristles (t2 and t3). Claws G1 and G3 male A2 reduced into setae; z1 and z2 transformed into claws, former one considerably shorter; z3 seta-like (Fig. 5C). Md with 6 rays in vibratory plate. Md-palp 4-segmented; second segment with 1 seta externally, 3+2 setae in bunch internally; penultimate segment with 3 setae extero-distally. Terminal segment of Md-palp with broadly fused central claw (Fig. 5D); L:W of same segment equals 1.1:1. Mxl palp with rectangular terminal segment, and with 6 appendages. T1 with symmetrical palps, subterminal sclerified structures thin, only 1 well developed, another 1 very small and hardly visible (Fig. 2D). T2 5-segmented, basal segment without any seta. T3 5-segmented; basal segment with all setae (dp, d1 and d2); setae Te and Tg present, while seta Tf missing; terminal segment with 2 long (Th2 and Th3) and 1 short seta (Th1). Fu without posterior seta, anterior setae present (Fig. 5F), both claws present and long. Hemipenis with all lobes developed. Lobe 'a' with 2 extensions: 1 dorsal and 1 distal; dorsal much smaller than distal. Lobe 'h' small and rounded; lobe 'b' with 1 ventral, finger like part. Part 'g' very poorly sclerified. Zenker's organ with 7 whorls of spines. Genital field rounded, without extensions.

### **Pioneercandonopsis hancocki** gen. et sp. nov.
(Figs 1-5)

ETYMOLOGY. For Peter Hancock, Department of Natural Resources and Mines who collected the material.

MATERIAL. Holotype ♂ (dissected on slide, QM W27255), allotype ♀ (dissected on slide, QM W27256); paratype ♂ (dissected on slide, WAM C33460); paratype ♂ and 2 paratype ♀ (all on SEM stub, WAM C33461); 1 paratype ♂, 3 paratype ♀ and 15 juveniles (nauplius larvae) (all in a test tube in 70% ethanol, QM W27257); 1 paratype ♂, 2 paratype ♀ and 15 juveniles (nauplius larvae) (all in a test tube in 70% ethanol, WAM C33462).

TYPE LOCALITY. Australia, Queensland, Pioneer Valley, Bore No. 125004B, 148°35'24"E ; 21°08'39"S; 26 June 2003; collector P. Hancock.

DESCRIPTION. Holotype (♂). Carapace subreniform in lateral view (Fig. 1A). L of carapace 0.69mm. Dorsal margin evenly arched with greatest H slightly behind middle, equaling 46.5% of L. Posterior and anterior margins broadly rounded, frontal slightly wider. Ventral margin straight. Inner calcified lamella anteriorly =26% of total L, while posteriorly =12% of total L. Marginal pore canals short, straight, dense. Valve surface smooth, covered only with long sparse hairs (small pits visible on Fig. 5B are caused by the SEM, and they are not characters of the species). Carapace decalcified due to poor conservation.

*A1*. 4-segmented. Exopod reduced in 2 very long setae (Ex1 and Ex2) both longer than L of all endopodal segments combined. Only CB1 seta present, while CB2 absent. Endopod of 3 segments. Segments E2, En3, En4 and En5 fused. En1 with seta En1a. On fused segments only seta En3a. Segment En5 with 1 long seta (En5a) 2 short setae (En5b, En5c). External α-seta very short. Terminal segment with long seta En6b, while both En6c and En6d short. Aesthetase ya 3.38 times longer than terminal segment. L ratio of endopodal segments 1.4:2.6:1.

*A2* (Fig. 2C). Endopod 5-segmented. Exopod of plate with 1long and 2 short setae. Males bristles (t2 and t3). Claws G1 and G3 reduced into setae: former one 3.45 times longer than terminal segment, latter one 2.6 times longer than same segment. Claw G2 1.56 times longer than first endopodal segment. Setae z1 and z2 transformed into claws: z1 0.8, while z2 1.55 times longer than first endopodal segment; z3 seta-like and 2 times longer than terminal segment. Claw Gm very long, 1.44 times longer than first endopodal segment, GM only as long as terminal segment. Aesthetase Y 0.5 times longer than first endopodal segment.

*Md*. Vibratory plate with 6 rays. Palp 4-segmented. First segment internally with 2 long and 1 short plumed setae. Alpha seta not observed. Second segment internally with 3 setae in bunch, plus 1 additional seta, while beta seta

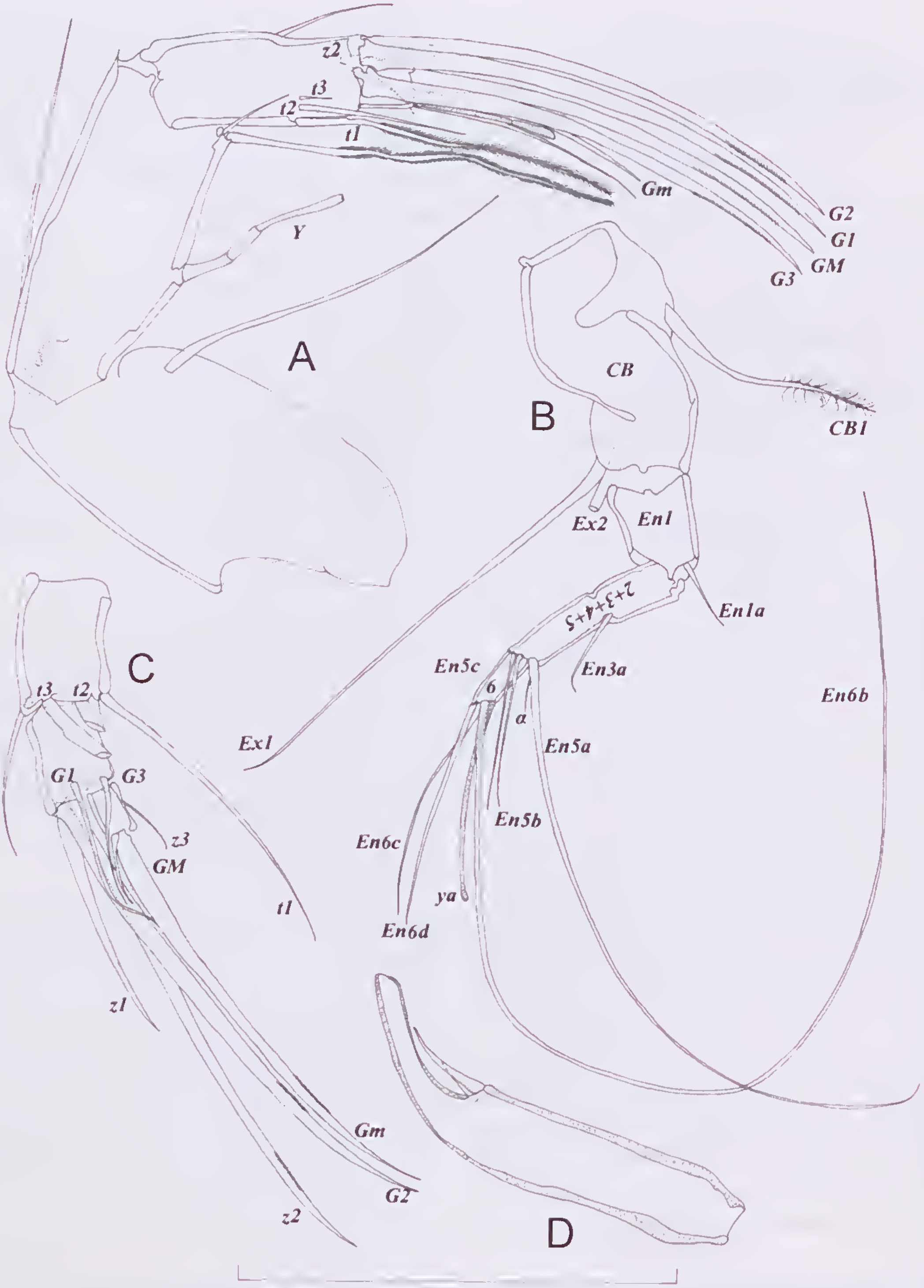

FIG. 2. *Pioneercandonopsis hancocki* gen. et sp. nov. A, B, Allotype (♀); C, Holotype (♂); D, Paratype (♂, 0.71mm, WAM C33460). A, A2; B, A1; C, 3 distal segments of A2; D, left prehensile palp. Scale=0.1mm.

not observed. Externally same segment with 1seta not reaching distal end of penultimate segment. Third segment of Md-palp extero-distally with 3 subequally long setae; distally with 2 setae (1of which being gamma seta) and 2 setae intero-distally. Terminal segment almost as long as wide. Terminal, central claw broadly fused with segment and distally plumed. Terminal segment with one additional weak claw externally and one seta internally.

*Mxl.* Palp 2-segmented. First segment only slightly dilated distally, and with 4 setae, all plumed. Terminal segment rectangular, with 6 appendages: 2 claws and 4 setae.

*T1.* Palps symmetrical (Fig. 1G, H); fingers long and slightly hook-shaped.

*T2* (Fig. 4C). 5-segmented. Basal segment without any seta. First endopodal segment with 1 very short seta, 2nd segment bare, penultimate segment with only 1 seta. Terminal segment with 2 short setae and claw which 1.2 times longer than 3 distal segments combined. Claw serrated.

*T3.* 5-segmented. Basal segment with dp, d1 and d2 setae. Seta Te present, while seta Tf absent. Penultimate segment with seta Tg. Terminal segment with 2 long and 1 short seta, L ratios of 3 setae equal 1:1.7:2.4. All setae terminally plumed. Endopodal segments 2 and 3 each with 3 rows of fine setae.

*Fu* (Fig. 3A). Posterior seta absent. Anterior seta very small and hardly visible. L ratios of anterior furcal margin, anterior and posterior claws equal 1.2:1:1. Claws serrated, ramus curved. Furcal attachment (Fig. 4D).

*Hemipenis* (Fig. 4A). Lobe 'a' with 2 extensions: dorsal 1, finger-like and small, distal 1 big, rounded and chitinised around margin. Lobe 'h' small and rounded. Lobe 'b' rounded dorsally, ventrally with small, finger-like part. Part 'g' very poorly sclerified. Inner tube coiled 2 times, ejaculatory process indistinct.

*Zenker's organ* (Fig. 4B). Of 5+2 whorls of spines.

Allotype (♀). Carapace L=0.7mm. Very similar to male, subreniform but with more pronounced point of the greatest H, which equals 0.48% of L (Fig. 1B, C)

*A2* (Fig. 2A). Endopod 4-segmented. Three t-setae present. Seta z1 absent. Claws G1, G2 and G3 long, 1.4 times longer than first endopodal segment; GM 1.3 times longer than first endopodal segment, while Gm 5 times longer than terminal segment.

*Rake-like organ* (Fig. 1F). With numerous (17 and 18) small teeth.

*T1* (Fig. 1E). With Tb and Td setae and 3 setae in vibratory plate. Setae Ta and Ta' not observed.

*Fu and genital field* (Fig. 3B). L ratios of anterior furcal margin, anterior and posterior claws equal 1.3:1.26:1. Claws serrated. Genital field rounded and without any extensions.

*A1* (Fig. 2B); Md (Fig. 3C); Mxl (Fig. 1D); T2 and T3 (Fig. 4E) same as in male.

*Variability.* Except a small variation in the carapace length, no other variability was noticed.

## CLADISTIC ANALYSIS

Using the heuristic search, the computer program NONA produced 5 equally parsimonious trees after the analysis of the first data matrix (Table 1). The same results were obtained with the Rachet Island Hopper search. All trees were 43 steps long with the consistency index, Ci=60, and retention index, Ri=79. On 3 cladograms, the Candonopsini was subdivided into 2 clades: one containing *Cubacandona*, *Caribecandona* and *Pioneercandonopsis*, and supported with synapomorphies of characters 12 and 23; the other containing all 24 species of *Candonopsis* and defined by the synapomorphy of character 11. One such tree (Fig. 6) is also a consensus tree. The strict consensus of all 5 trees was 53 steps long, with Ci=49 and Ri = 67, and it was less informative. The tree in Fig. 6 clearly defined *Candonopsis* (with both subgenera) and *Caribecandona* as monophyletic groups. *Pioneercandonopsis* and each of the *Cubacandona* species appeared as separate branches (clades) in the Candonopsini.

Characters and their coding corresponding to the Table 1 matrix are as follows:

0, surface: smooth (0), ornamented (1); 1, lateral view: symmetrical (0), asymmetrical (1); 2, dorsal view: LV=RV (0), LV>RV (1); 3, total number of segments on A1: seven (0), six (1), four (2); 4, En2a seta: present (0), absent (1); 5, male sexual bristles: present (0), absent (1); 6, z1 seta in males: long (0), short (1); 7, G2 claw in females: shorter than G1 (0), as long as G1 (1); 8, number of setae on second segment of Md-palp: two (0), one (1); 9, number of strong claws on terminal segment of Md-palp: two (0), one (1); 10, type of fusion of terminal claw on Md-palp: narrow (0), broad (1); 11, L:W ratio of terminal segment of Md-palp: less than 3:1 (0), more than 3:1 (1); 12, prehensile palps: asymmetrical (0), symmetrical (1); 13, subterminal sclerified structures on prehensile palps: both well developed (0), only one well

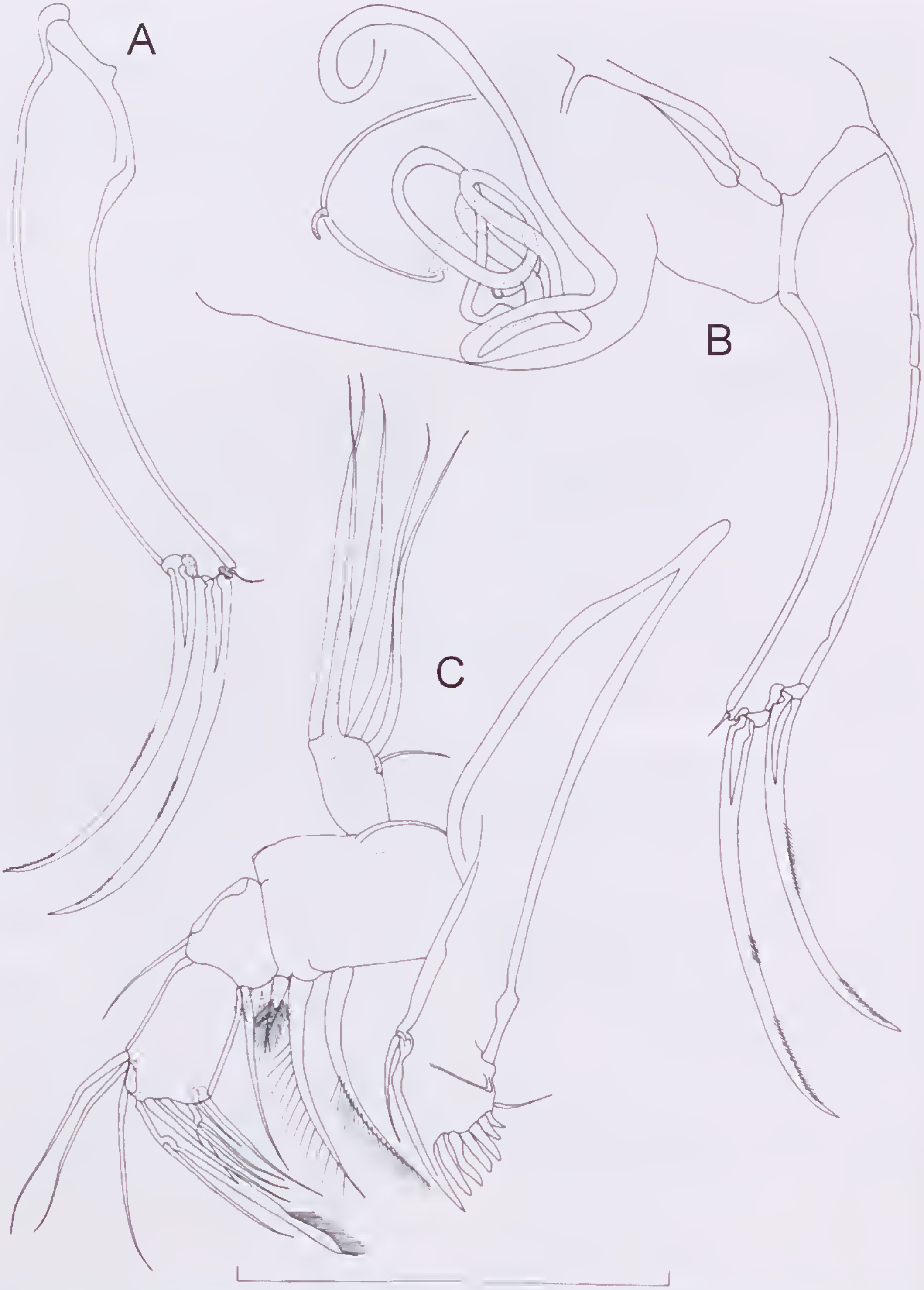

FIG. 3. *Pioneercandonopsis hancocki* gen. et sp. nov. A, Holotype (♂); B, C, Allotype (♀). A, Fu; B, Fu and genital lobe; C, Md. Scale=0.1mm.

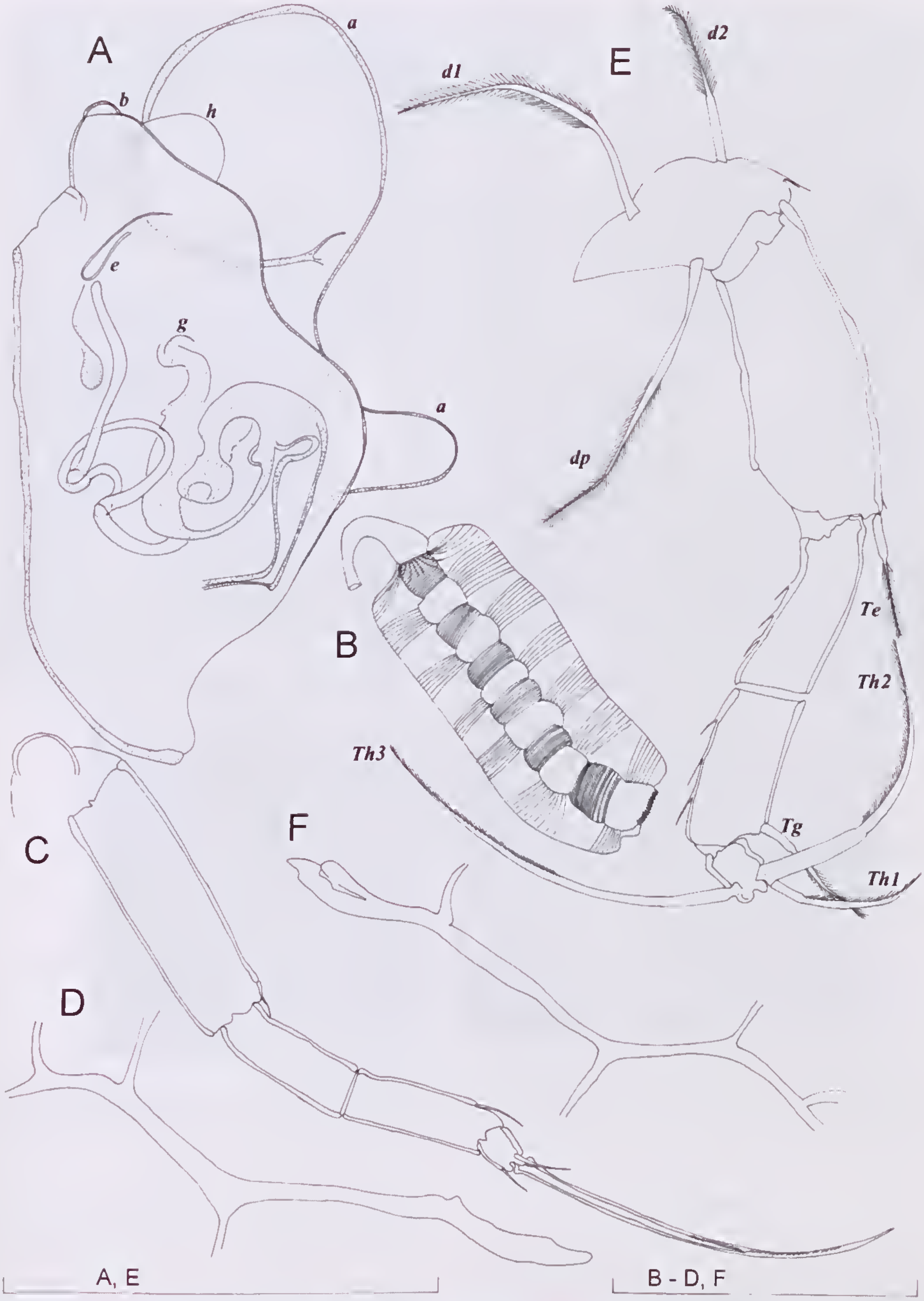

FIG. 4. *Pioneercandonopsis hancocki* gen. et sp. nov. A-D, Holotype (♂); E-F, Allotype (♀). A, hemipenis; B, Zenker's organ; C, T2; D, Furcal attachment; E, T3; F, Furcal attachment. Scales=0.1mm.

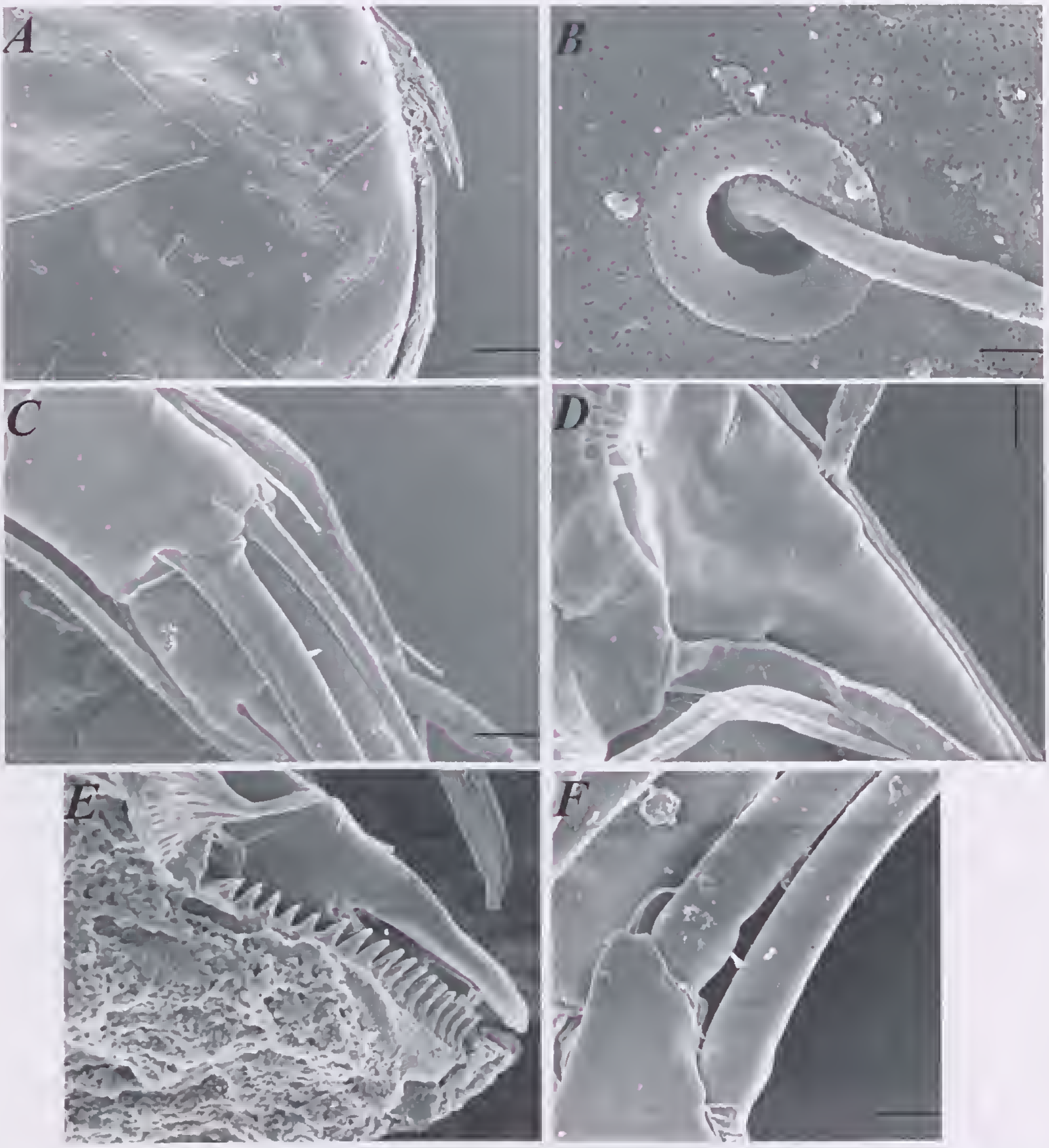

FIG. 5. Scanning Electron Microphotographs. *Pioneercandonopsis hancocki* gen. et sp. nov. A, B, E, Paratype (♀, 0.68mm, WAMC33461); C, D, F, Paratype (♂, 0.72mm, WAMC33461). A, carapace surface, frontal part; B, seta on the carapace surface; C, detail of A2; D, detail of terminal segment of Md palp; E, rake-like organ; F, detail of Fu. Scales: A=11.2μm; B=666.6nm; C=4.9μm; D=3.2μm; E=3.69μm; F=5.6μm.

developed (1); 14, basal seta on T2: present (0), absent (1); 15, seta on second segment T2: present (0), absent (1); 16, Td2 seta: present (0), absent (1); 17, Te seta: present (0), absent (1); 18, Tf seta: present (0), absent (1); 19, number of short setae on terminal segment T3: two (0), one (1); 20, posterior furcal seta: present (0), absent (1); 21, posterior furcal claw: well developed (0), reduced (1); 22, spines on furcal claws: absent (0), present (1); 23, number of 'a' lobe extensions: one (0), two (1); 24, internal hemipenis ducts: not coiled (0), coiled (1).

The heurisitc analysis of the weighed characters from the second data matrix (Table 2)

TABLE 1. Data matrix for the species of the tribe Candonopsini and the outgroup. Characters correspond to the Fig. 6.

| Taxon | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Cryptocandona dudichi* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *C. (A.) aula* | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | - | - | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | - | - |
| *C. (A.) indoles* | 0 | 0 | 1 | 0 | 1 | - | - | 1 | 0 | 1 | 1 | 1 | - | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| *C. (A.) williami* | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| *C. (C.) africana* | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| *C. (C.) anteroarcuata* | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| *C. (C.) boui* | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| *C (C.) bujukuensis* | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| *C. (C.) dani* | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| *C. (C.) hummelincki* | 0 | 0 | 0 | 0 | 1 | - | - | 1 | 0 | 1 | 1 | 1 | - | - | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | - | - |
| *C. (C.) kingsleii* | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| *C. (C.) kimberleyi* | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| *C. (C.) mareza* | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| *C. (C.) murchisoni* | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| *C. (C.) nama* | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| *C. (C.) navicula* | 0 | 0 | 0 | 0 | 1 | - | - | 1 | 0 | 1 | 1 | 1 | - | - | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | - | - |
| *C (C.) putealis* | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| *C. (C.) scourfieldi* | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| *C. (C.) solitaria* | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| *C. (C.) sumatrana* | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| *C. (C.) tenuis* | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| *C. (C.) thienemanni* | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 |
| *C (C.) trichota* | 0 | 0 | 0 | 0 | 1 | - | - | 1 | 0 | 1 | 1 | 1 | - | - | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | - | - |
| *C. (C.) urmilae* | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| *C. (C.) westaustraliensis* | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 |
| *Cub. cubensis* | 0 | 0 | 0 | 0 | 1 | 1 | 1 | - | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 |
| *Cub. anisitsi* | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 |
| *Cub. columbiensis* | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 |
| *Cub. falclandica* | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 |
| *Carib. trapezoidea* | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 |
| *Carib. auricularia* | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 |
| *Carib. ansa* | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 |
| *Pioneer. hancocki* | 0 | 0 | 0 | 2 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |

revealed 8849 equally parsimonious trees with L=21, Ci=80 and Ri=90. The strict consensus of all trees had the same length, Ci and Ri values. On the other hand, the Rachet Island Hopper analysis found only one most parsimonious tree, presented in the Fig. 7. This tree also had L=21, Ci=80 and Ri=90, and it is very similar to the strict consensus of 8849 trees except that it better resolves the relationships in the *Candonopsis* clades.

Characters and their coding corresponding to the Table 2 matrix are as follows:

0, Posterior fureal seta: present (0), absent (1); 1, number of strong claws on terminal segment of Md-palp: two (0), one (1); 2, type of fusion of strong claws on terminal segment of Md-palp: narrow (0), wide (1); 3, z1 seta in males: long (0), short (1); 4, number of short setae on terminal segment T3: two (0), one (1); 5, number of 'a' lobe extensions: one (0), two (1); 6, number of segments on T3: five (0), four (1); 7, subterminal selerified structures on prehensile palps: both well developed (0), only one well developed (1); 8, L : W ratio of terminal segment of Md-palp: less than 3:1 (0), more than 3:1 (1); 9, dorsal view: LV=RV (0), LV>RV (1); 10, total number of segments on A1: seven (0), six (1), four (2); 11, number of setae on second segment of Md-palp: two (0), one (1); 12, lateral view: symmetrical (0), asymmetrical (1); 13, spines on fureal claws: absent (0), present (1); 14, En2a seta: present (0), absent (1); 15, G2 claw in females: shorter than G1 (0), as long as G1 (1); 16, basal seta on T2: present (0), absent (1); 17, seta on second endopodal segment of T2: present (0), absent (1); 18, Td2 seta: present (0), absent (1); 19, Tf seta: present (0), absent (1); 20, Te seta: present (0), absent (1); 21, Ta' seta: present (0), absent (1); 22, number of setae on A2 penultimate segment externally: two (0), one (1); 23, prehensile palps: asymmetrical (0), symmetrical (1); 24, internal hemipenis duets: not coiled (0), coiled (1); 25, posterior fureal claw: well developed (0), reduced (1); 26, male sexual bristles: present (0), absent (1); 27, surface: smooth (0), ornamented (1); 28, carapace shape: subtriangular (0), subreniform (1), subtrapezoidal (2); 29, posterior margin: narrower than anterior (0), wider or equal to anterior (1); 30, CB2 seta: present (0), absent (1); 31, En2d seta: present (0), absent (1); 32, En3b seta: present (0), absent (1); 33, En4b seta: present (0), absent.

## DISCUSSION

The Candonopsini has at least 2 evolutionary branches: 1 with *Candonopsis* Vávra, 1891, and the other with *Caribecandona*, *Cubacandona* and *Pioneercandonopsis*. The first branch, presented as a separate clade in all cladograms

TABLE 2. Data matrix for the species of the tribe Candonopsini and the outgroup. Characters correspond to the Fig. 7.

| Taxon | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Cr. dudichi* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *C. (A.) aula* | 1 | 1 | 1 | 1 | 1 | 0 | 0 | - | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| *C. (A.) indoles* | 1 | 1 | 1 | - | 1 | - | 0 | - | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 0 | - | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| *C. (A.) williami* | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| *C. (C.) africana* | 1 | 1 | 1 | - | 1 | 0 | 0 | 1 | 1 | 0 | 0 | - | 0 | 1 | - | - | - | 0 | 0 | 0 | 0 | - | - | 0 | 1 | 0 | 0 | 0 | 1 | 1 | - | - | - | - |
| *C. (C.) anteroarc.* | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| *C. (C.) boui* | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | - | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| *C. (C.) bujukuensis* | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | - | 0 | 1 | - | 1 | - | 0 | 0 | 0 | 0 | - | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | - | - | - | - |
| *C. (C.) dani* | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| *C. (C.) hummelincki* | 1 | 1 | 1 | - | 1 | - | 0 | - | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | - | - | 0 | - | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| *C. (C.) kingsleii* | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| *C. (C.) kimberleyi* | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 1 | 0 |
| *C. (C.) mareza* | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| *C. (C.) murchisoni* | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 |
| *C. (C.) nana* | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | - | 1 | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | - | - | - | - |
| *C. (C.) navicula* | 1 | 1 | 1 | - | 1 | - | 0 | - | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | - | 0 | - | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| *C. (C.) putealis* | 1 | 1 | 1 | - | 1 | 0 | 0 | 1 | 1 | 0 | 0 | - | 0 | 1 | - | 1 | - | 0 | 0 | 0 | 0 | - | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | - | - | - | - |
| *C. (C.) scourfieldi* | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| *C. (C.) solitaria* | 1 | 1 | 1 | - | 1 | 0 | 0 | 1 | 1 | 0 | 0 | - | 0 | 1 | - | - | - | 0 | 0 | 0 | 0 | - | - | 0 | 1 | 0 | 0 | 0 | 1 | 1 | - | - | - | - |
| *C. (C.) sumatrana* | 1 | 1 | 1 | - | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| *C. (C.) tenuis* | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| *C. (C.) thienemanni* | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | - | 1 | - | 0 | 1 | 0 | 0 | - | - | 0 | 1 | 0 | 0 | 0 | 0 | 0 | - | - | - | - |
| *C. (C.) trichota* | 1 | 1 | 1 | - | 1 | - | 0 | - | 1 | 0 | 0 | 0 | 0 | 0 | - | 1 | - | 0 | 0 | 0 | 0 | - | - | - | - | 0 | - | 0 | 0 | 0 | - | - | - | - |
| *C. (C.) urnilae* | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | - | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | - | 1 | 1 | 0 |
| *C. (C.) westaustral.* | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| *Cub. cubensis* | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | - | 0 | 0 | 1 | 0 | 1 | - | 1 | 1 | 0 | 0 | 1 | 0 | 2 | 1 | 0 | 1 | 1 | 0 |
| *Cub. anisitsi* | 1 | 1 | 1 | - | 1 | 1 | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | - | - | - | 0 | - | 0 | 0 | - | - | 1 | 0 | 0 | - | 0 | 2 | 1 | - | - | - | - |
| *Cub. columbiensis* | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | 1 | - | 0 | 1 | - | 0 | - | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | - | - | - | - |
| *Cub. falclandica* | 1 | 1 | 1 | - | 1 | 1 | 0 | 1 | 0 | 0 | 0 | - | 0 | 0 | - | 1 | - | 0 | - | 0 | 0 | - | - | 1 | 0 | 0 | 0 | 0 | 1 | 1 | - | - | - | - |
| *Car. trapezoidea* | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 0 |
| *Car. auricularia* | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| *Car. ansa* | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 0 |
| *Pioneer. hancocki* | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |

(Figs 6, 7), is defined with a long terminal segment on the Md-palp, a synapomorphy of all 24 Recent species of Candonopsis. In addition, all species are characterised with 2 symplesiomorphies: the asymmetrical prehensile palps, and only 1 extension of the lobe 'a' on the hemipenis. However, compared with other Candoninae the palps and the hemipenis in *Candonopsis* are very characteristic and have little in common with other Candoninae. Within *Candonopsis* several distinct clades occur on all resulting cladograms. The largest is defined by one synapomorphic character (presence of a spine on the furcal claws), and it includes almost all African, the only Central American and almost all Australian species of *Candonopsis s. str.* This correlates with Klic's (1932) zoogeographical groupings of the species based on the appearance of the furcal claws, in which almost all species from the tropics and subtropics have a spine at least on one of the furcal claws, while European species have both claws spineless. The exceptions are 1 species from Lake Tanganyika (*C. anteroarcuata* Rome, 1962) and 1 from the Murchison Region (*C. westaustraliensis* Karanovic & Marmonier, 2002). The Australian species has, in addition, a reduced posterior furcal claw. *Abcandonopsis*

Karanovic, in press b is a clade defined by only 1 autapomorphic character - asymmetrical valves in dorsal view. All other features of this subgenus are homoplastic. For example, the 3 known species of *Abcandonopsis* have many setal reductions that are also recorded in *Pioneercandonopsis hancocki* sp. nov., *C. (C.) thienemanni* Schafer, 1945 and *C. (C.) kimberleyi* Karanovic & Marmonier, 2002. Because all these species are subterranean inhabitants, some of the setal reductions may well be stygomorphies. A clade containing *Candonopsis (C.) scourfieldi* Brady, 1910; *C. (C.) boui* Danielopol, 1978, *C. (C.) urmilae* Gupta, 1988; and *C. (C.) marcza* Karanovic & Petkovski, 1999 is supported with the symplesiomorphic state of the character number 7, i.e. a short claw G2 on the female A2. This claw is long in all other representatives of the tribe. The smallest clade in *Candonopsis* includes Australian *C. (C.) murchisoni* Karanovic & Marmonier, 2002 and *C. (C.) dani* Karanovic & Marmonier, 2002. Although, the connecting character (asymmetry of the valves in the lateral view) is homoplastic in the tribe, and it is found in all *Caribecandona* species, and in *C. (C.) urmilae* Gupta, 1988, the two Australian species are indeed more closely related to each other than either is to any other representative of *Candonopsis* (Karanovic & Marmonier, 2002).

The second branch in Candonopsini is supported with 2 synapomorphic characters: 2 extensions of the lobe 'a' on the hemipenis, and almost symmetrical prehensile palps. Also, all species have a small terminal segment of the Md-palp. *Pioneercandonopsis* is a clade defined by 2 autapomorphies: 4-segmented A1 and only 1 seta externally on the second segment of the Md-palp. The reduction of A1 segments more closely relates *Pioneercandonopsis* to *Caribecandona* than to *Cubacandona*. However, in the former genus, A1 is 6-segmented, the posterior furcal claw is reduced and the valves are asymmetrical in the lateral view. The new genus and two genera from South and Central America occur as a monophyletic clade in Fig. 6, but in Fig. 7, the clade does not include *Cubacandona cubensis* (Méhes, 1913) or *C. anisitsi* (Daday, 1905). According to Méhes' (1913) drawings, *C. cubensis* has 2 strong claws on the terminal segment of the Md-palp, which gives it an isolated position in the tribe. *Cubacandona anisitsi* stands apart because it has both subterminal selcrified structures well developed (Daday, 105).

*Cubacandona columbiensis* and *C. anisitsi*, together with about a dozen other species of the Candonopsini, are insufficiently described. Because of this, many characters are unknown (and coded '-') in the second data matrix (Table 2) and in the cladistic analysis treated as ambiguous. Many ambiguous characters and a great number of homoplasies in the tribe Candonopsini produced confusing cladograms. Therefore, characters from the second data matrix (Table 2) were weighted in accordance to their taxonomic importance. The resulting cladogram (Fig. 7) is very similar to the one obtained after the analysis of the first data set (Fig. 6). The difference is that some newly introduced characters (chaetotaxy of the A1, A2 and T1) better resolve phylogenetical relationships in the *Candonopsis* clades. This suggests that a better understanding of the morphology of the insufficiently described taxa would certainly contribute to the cladogram resolution. However, both trees correlate with the present systematics of the tribe Candonopsini with the exception of the genus *Cubacandona*, which seems to be a polyphyletic genus.

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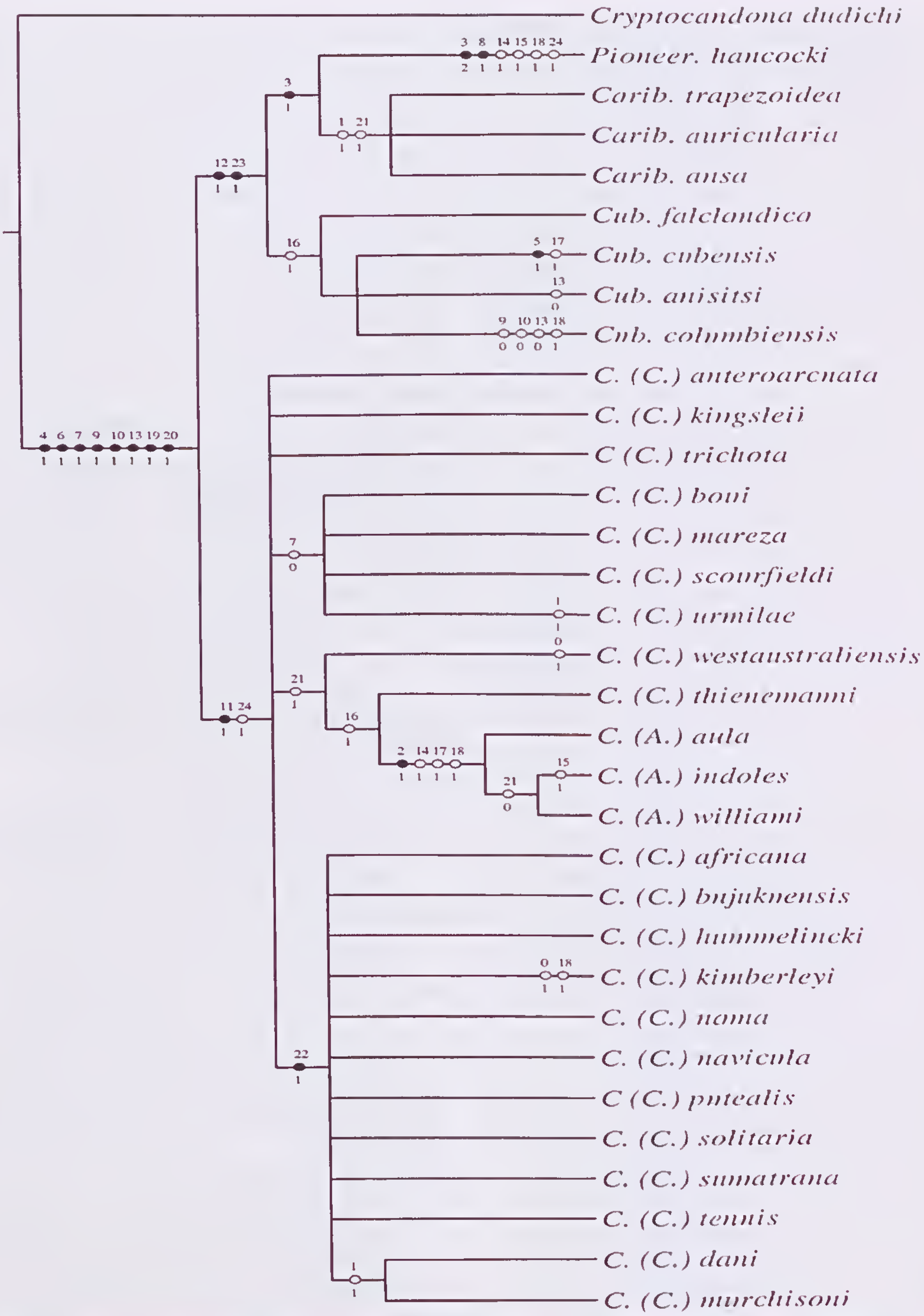

FIG. 6. Cladogram of the tribe Candonopsini based on 24 characters. Number above the hash-marks correspond to the character, numbers below are character states. Black dots are apomorpies, white dots are homoplasies.

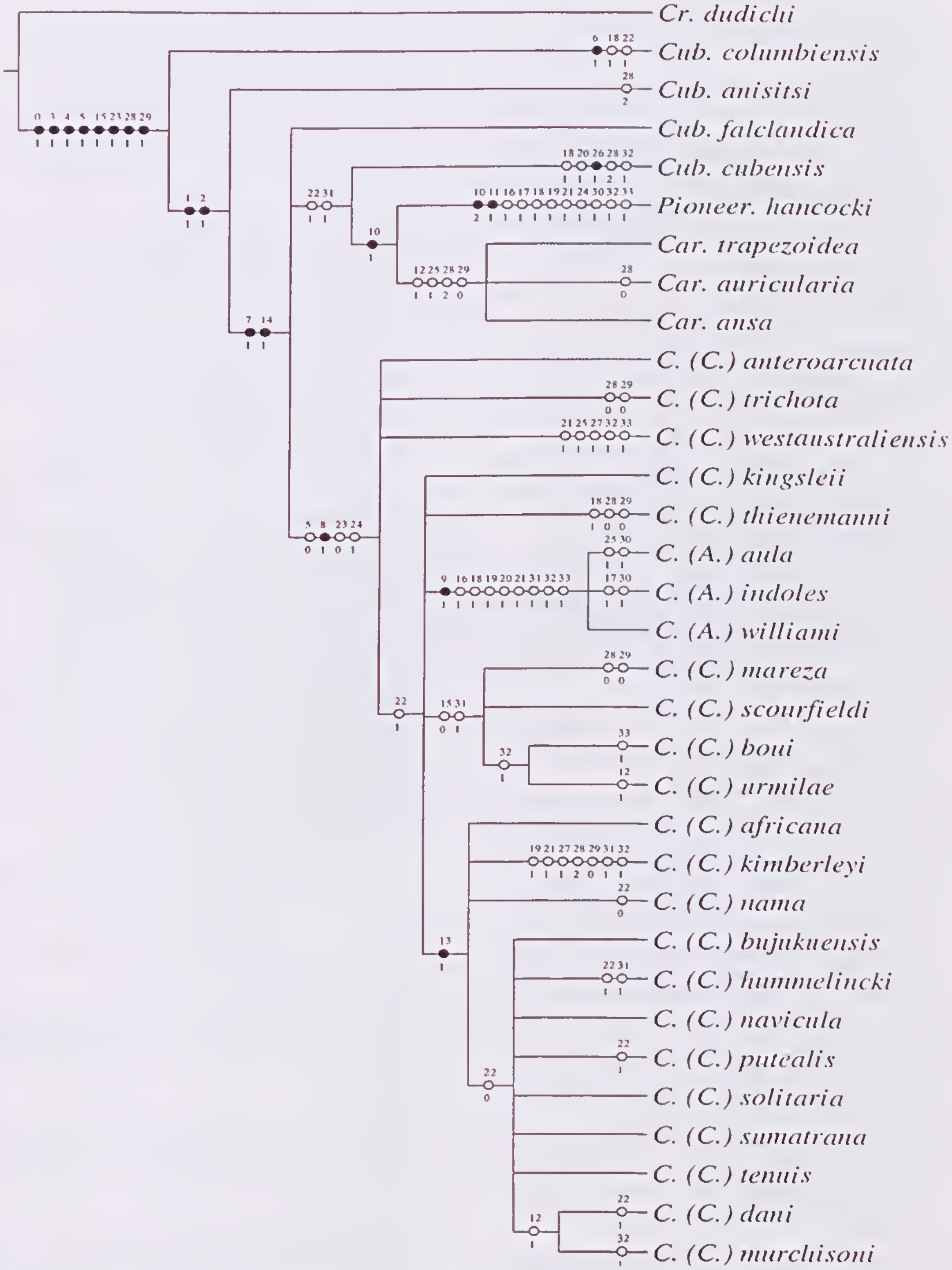

FIG. 7. Cladogram of the tribe Candonopsini based on 33 weighted characters. Number above the hash-marks correspond to the character, numbers below are character states. Black dots are apomorpies, white dots are homoplasies.

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# NEW BIOGEOGRAPHICAL INFORMATION ON QUEENSLAND CHONDRICHTHYANS

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Kyne, P.M., Johnson, J.W., Courtney, A.J. & Bennett, M.B. 2005 01 10: New biogeographical information on Queensland chondrichthyans. *Memoirs of the Queensland Museum* 50(2): 321-327. Brisbane. ISSN 0079-8835.

New information is presented on chondrichthyan fishes. *Mobula japanica* (Müller & Henle, 1841) is reported for the first time from Australian waters from two specimens, one from Lake Macquarie, New South Wales and one from Fraser Island, Queensland. *Squaliolus aliae* Teng, 1959 and *Asymbolus analis* (Ogilby, 1885) are reported for the first time from waters off Queensland, and aspects of the biology of *A. analis* are discussed. Significant southern range extensions are reported for *Aetomylaeus nichofii* (Schneider, 1801) and *Dasyatis leylandi* Last, 1987. Southern range extensions are also reported for *Carcharhinus amboinensis* (Müller & Henle, 1839) and *Carcharhinus cautus* (Whitley, 1945) and these species are recorded for the first time from Moreton Bay. Northern range extensions are reported for *Hypnos monopterygius* (Shaw & Nodder, 1795) and *Orectolobus maculatus* (Bonnaterre, 1788). Comments are also made on the distribution of *Dipturus australis* (Macleay, 1884) and *Myliobatis hamlyni* Ogilby, 1911. ❑ *Biogeography, Chondrichthyes, Queensland waters, Elasmobranchii, Squaliolus, Orectolobus, Asymbolus, Dasyatis, Aetomylaeus, Myliobatis, Mobula.*

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Australian waters support a diverse chondrichthyan fauna, with at least 296 known species (Last & Stevens, 1994), while additional species are still being recorded, for example, *Isurus paucus* Guitart Manday, 1966 (Stevens, 1995) and *Isistius plutodus* Garrick & Springer, 1964 (McGrouther, 2001). Over half of these species have been recorded from Queensland waters or the Australian Exclusive Economic Zone adjacent to Queensland (Last & Stevens, 1994). Despite the diversity of fauna in this state, there exists a paucity of data concerning the basic biology of most Queensland chondrichthyans. Limited published research is available on the life history of tropical elasmobranch species from the Gulf of Carpentaria and other northern regions (e.g. Stevens & McLoughlin, 1991; Salini et al., 1992), inshore species from the Townsville region (e.g. Simpfendorfer, 1998), *Hemiscyllium ocellatum* (Bonnaterre, 1788) from the southern Great Barrier Reef (e.g. Heupel et al., 1999) and *Aptychotrema rostrata* (Shaw & Nodder, 1794) from Moreton Bay (e.g. Kyne & Bennett, 2002). Similarly with life history data, obtaining information on a species' geographical and bathymetric distribution is essential for understanding ecology, for management purposes, and in defining levels of interactions with fisheries. Information concerning the biogeography of many species in Queensland waters continues to expand and to be refined with the collection and identification of new material.

This paper presents information on new chondrichthyan material deposited in the Queensland Museum, including that taken by Queensland Department of Primary Industries (QDPI) trawl surveys. A number of range extensions are documented as well as a new record for Australia.

## MATERIALS AND METHODS

*A. analis*, *D. australis*, *D. leylandi* and *A. nichofii* were captured by demersal otter trawl as part of a QDPI project on the bycatch of the Queensland East Coast Trawl Fishery. *D. leylandi* and *A. nichofii* were collected by a 13.6m commercial trawler fitted with twin 4-seam Florida Flyer nets; net body mesh size of 5.0cm; codend mesh size of 4.4cm; headrope length was 7.3m. Specimens of *A. analis* and *D. australis* were taken by a 17.1m commercial trawler fitted with three 2-seam Florida Flyer nets; net body mesh size of 5.0cm; codend mesh size of 4.4cm; headrope length was 12.8m or

21.9m (depending on nets fitted at the time). Capture details for specimens collected by other methods are given with the specimen information.

Specimens were identified using Last & Stevens (1994) and Last (1999). Measurements and mass were recorded and maturity assessed (following Bass et al., 1973) in the laboratory. The following abbreviations are used for institutions: AMS, Australian Museum, Sydney; CSIRO, CSIRO Marine Laboratories, Hobart; QM, Queensland Museum, Brisbane. Methods and abbreviations for measurements of sharks follow Compagno (2001). Additional measurements for batoids are DW (disc width) and DL (disc length). Those for *Mobula japanica* follow Notarbartolo-Di-Sciara (1987).

## SPECIES RECORDS AND DISCUSSION

### **Squaliolus aliae** Teng, 1959

MATERIAL. QMI32529; ♂, 134mm TL (Fig. 1A) was captured by trawl 30-40 miles N of Cape Moreton, Qld, 26°21-31′S, 153°28′E, at 183-201m depth on 23/04/2000. AMS I43064-001; ♂, 130mm TL was captured by plankton tow in the Coral Sea, 12°44-50′S, 153°52-55′E, at 120-150m depth on 16-17/05/1995.

REMARKS. *Squaliolus aliae* is probably the smallest known living shark species (Last & Stevens, 1994). It was known on the Australian east coast by AMS I20515-001, ♀, 98mm TL, E of Sydney, NSW, 33°44′S, 151°52′E, demersal trawl, 457m, 24/11/1977; and AMSI30411-001, ♀, 213mm TL, E of Kiama, NSW, 34°42′S, 151°16′E, demersal trawl, 474m, 21/11/1978. This species is also reported from NW WA (Last & Stevens, 1994). Regionally, it is reported from Japan, Taiwan and the Philippines (Last & Stevens, 1994).

A close relative, *Squaliolus laticaudus* Smith & Radcliffe, 1912, has a nearly circumtropical distribution, but has not yet been confirmed from Australian waters. *S. laticaudus* has a larger eye (eye length, EYL, 73.4-85.6% of interorbital space, INO, 61.0%-81.7% of preorbital length, POB) than *S. aliae* (EYL 46.3-69.9% INO, 42.6%-66.4% POB) (Sasaki & Uyeno, 1987). QMI32529 has an EYL 58.4% INO and 51.0% POB and AMSI43064-001 an EYL 48.6% and 52.3% POB). Sasaki & Uyeno (1987) provided 2 further characters to separate these species. Firstly, in *S. aliae* the upper margin of the orbit is chevron-shaped, while in *S. laticaudus* it is nearly straight. The chevron-shaped upper margin is clear in QMI32529 and AMS I43064-001. Secondly, a pair of papillae is present on the lip of the upper jaw in *S. aliae* and absent in *S. laticaudus*. Due to damage to the mouth of QMI32529 and the effects of fixation this feature was not useful in identifying these specimens. However, given the size and shape of the upper margin of the eye, both specimens are *S. aliae*, as are the 2 NSW specimens (AMS I20515-001, EYL 63.7% INO; AMS I30411-001, EYL 56.8% INO).

### **Orectolobus maculatus** (Bonnaterre, 1788)

MATERIAL. Collected by demersal trawl by P. Duncan off north Qld: QMI31417, immature ♂, 845mm TL, off Hardline Reefs, 20°46′S, 151°20′E, 218m, 09/08/1999; QMI31438, immature ♂, 445mm TL, off Calder Island, 20°46′S, 151°28′E, 215m, 10/08/1999.

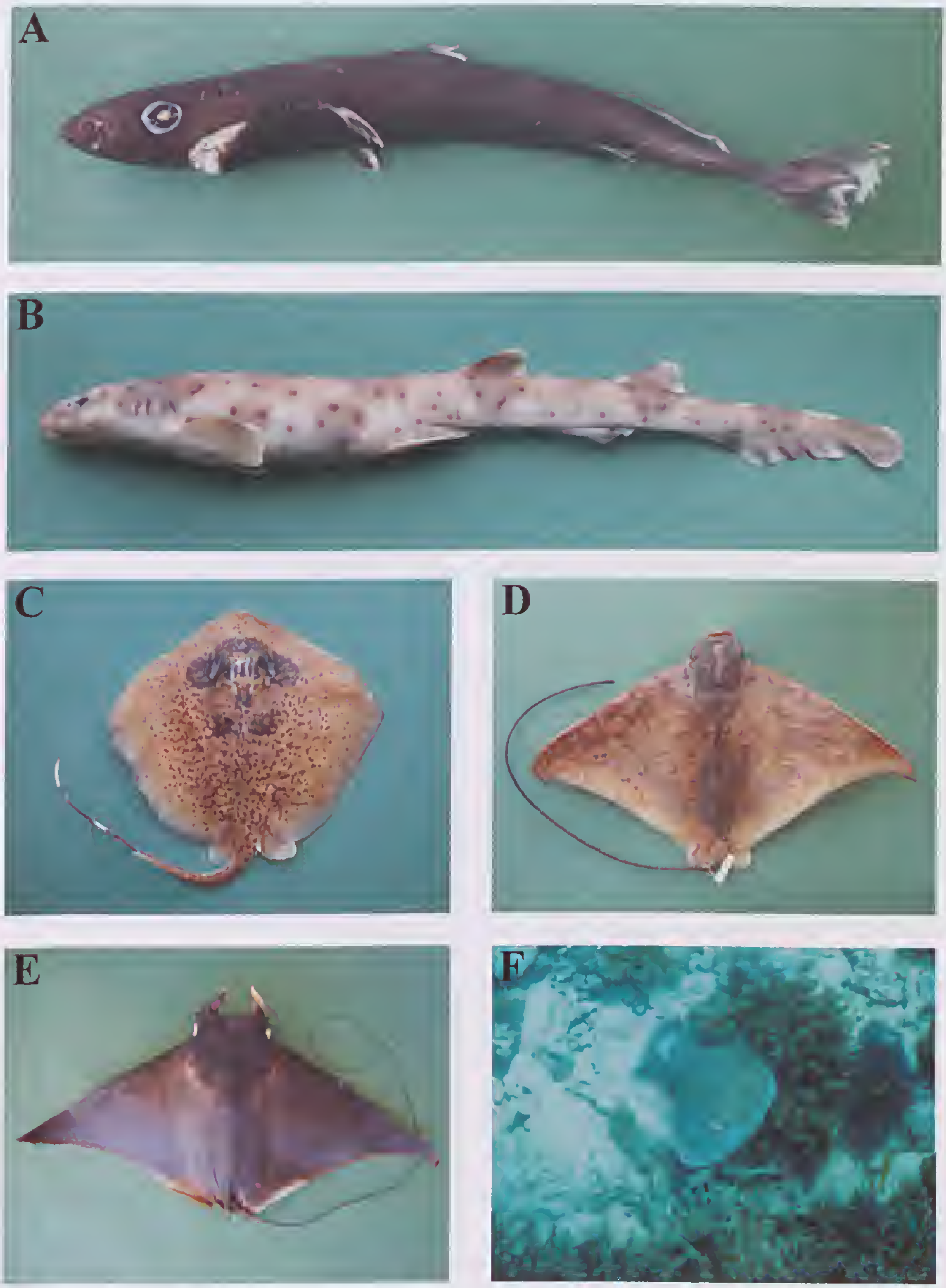
REMARKS. *Orectolobus maculatus* was known from the S coast of Australia between SE Qld and SW WA, excluding Tasmania. Further records from Japan and the South China Sea require confirmation (Last & Stevens, 1994). The records presented here significantly increase the N distribution , recording it for the first time from the Great Barrier Reef region. Furthermore, the known bathymetric range is increased from a depth of 110m to 218m.

### **Asymbolus analis** (Ogilby, 1885)

MATERIAL. Captured by demersal otter trawl from S Qld waters in depths of 85-159m. QMI32876, mature ♂, 458mm TL, 27°02′S, 153°37′E, 137m, 13/03/2001; QMI33353, immature ♀, 329mm TL, mass 110g, 27°10′S, 153°38′E, 135m, 29/07/2002; and QMI33354 (Fig. 1B), immature ♂, 300mm TL, mass 81g, 27°47′S, 153°49′E, 86m, 24/07/2002. 10 specimens were dissected to obtain life history data (see details below). OTHER MATERIAL. AMS IB8255, I26023-001, I26023-001, I34747-001, I35418-001, I35423-001, I35423-002, I40476-001.

REMARKS. These specimens are consistent with many of the diagnostic features outlined in Last & Stevens (1994) and Last (1999). They have a greyish background colouration, overlain

FIG. 1. A, *Squaliolus aliae*, QM I32529, 134mm TL, lateral view. B, *Asymbolus analis*, QM I33354, 300mm TL, lateral view. C, *Dasyatis leylandi*, QM I33352, 130mm DW, dorsal view. D, *Aetomylaeus nichofii*, QM I33854, 343mm DW, dorsal view. E, *Mobula japanica*, QM I33855, 1088mm DW, dorsal view. F, *Hypnos monopterygius*, photographed on the south side of Heron Island Reef, Great Barrier Reef, November 1995 (Photo: M. Prekker).


A
B
C
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with saddle-like blotches, dark brownish spots and whitish flecks, and densely packed denticles, giving the skin a rough appearance. These specimens may be distinguished from the sympatric *Asymbolus rubiginosus* Last, Gomon & Gledhill, 1999, another dark-spotted *Asymbolus* species, by a shorter caudal fin (range of CDM, the dorsal margin of the caudal fin, of the three specimens 19.0-20.6% TL vs 23.7-26.6% TL in *A. rubiginosus*), and a larger, broadly semicircular, posterior nasal flap.

The Queensland specimens, however, differ from some characters outlined in Last (1999). The range of the head length (HDL) of the 3 QM specimens (17.3-18.0% TL) falls within the range of HDL given for *A. rubiginosus* (16.7-18.0% TL) and outside that for *A. analis* (18.1-19.0% TL). Furthermore, the interdorsal space (IDS) (12.1-13.1% TL) falls within the ranges given for both *A. rubiginosus* (IDS 12.9-15.1% TL) and *A. analis* (IDS 10.7-12.5% TL). Interdorsal space for *A. analis* in Last (1999) is given as 'much less than 1.5 times total length of first dorsal fin'. Relative proportions of this feature are used to separate *A. analis* from *Asymbolus pallidus* Last, Gomon & Gledhill, 1999 and *Asymbolus occiduus* Last, Gomon & Gledhill, 1999, 2 other dark-spotted *Asymbolus* species. However, the IDS of the QM specimens range from 1.46-1.71 times D1L. It appears that interdorsal space and head length proportions are more variable than previously thought, and may not be useful for *Asymbolus* species identification. Additional AMS material examined (n=8) supported this suggestion, with the range of IDS 1.36-1.66 D1L and the range of HDL 16.7-19.6% TL for specimens from NSW.

*Asymbolus analis* is endemic to the east coast of Australia, and was previously thought to be confined to NSW and Vic. waters from Port Macquarie S to Lakes Entrance. These records provide the first account of *A. analis* from Queensland waters, and examination of additional NSW material extends its bathymetric distribution from 79m reported in Last & Stevens (1994) to 199m. *Asymbolus* includes eight species restricted to Australian waters (Last, 1999) and an undescribed species from New Caledonia (Séret, 1994).

Last & Stevens (1994) reported that ♂ *A. analis* mature at 520mm TL, but provide no information on ♀ size at maturity. Of the 3 ♂ QM specimens , one was immature at 300mm TL and the others were mature at 458 and 460mm TL, lowering the previous maturity estimate by at least 60mm. Five ♀ of 278-329mm TL were all immature; while 5 ♀ of 455-470mm TL were all mature.

TABLE 1. Maximum ovum diameter (MOD) and number of yellow-yolked ova ≥ 5mm diameter for five mature ♀ *Asymbolus analis*.

| Capture date | TL (mm) | MOD (mm) | Ova number |
|---|---|---|---|
| 15/03/2001 | 455 | 19 | 12 |
| 14/09/2001 | 460 | 17 | 8 |
| 16/09/2001 | 470 | 24 | 7 |
| 13/10/2001 | 460 | 20 | 7 |
| 14/10/2001 | 470 | 23 | 15 |

Mature females had a single functional ovary. None of the 5 mature females were carrying eggcases in their oviducts, but all had a number of ripe ovarian ova with maximum ovum diameters ranging from 17-24mm (Table 1). Oviducal glands were well-developed and expanded in all mature females with an average diameter of 27.3mm (range 25-29mm). The large ripe ova during the 3 months in which mature female *A. analis* were captured (March, September and October) suggests that the species may not have a well-defined reproductive season, similar to the situation reported for some other scyliorhinid sharks (e.g. Horie & Tanaka, 2000).

### **Carcharhinus amboinensis** (Müller & Henle, 1839)

MATERIAL. QM I33857; ♀, 1195mm TL, 940mm FL, 840mm PCL, mass 13.3kg was captured by handline by R. Pillans 800m off Shorncliffe Jetty, Moreton Bay, 27°19′S, 153°05′E, at 4m depth on 27/12/2002. It is most likely to be immature, as females are known to mature at about 215cm TL (Last & Stevens, 1994).

REMARKS. *Carcharhinus amboinensis* has been reported from the E North Atlantic and the Indo-West Pacific and locally in tropical and subtropical waters from Carnarvon, WA to Bundaberg, Qld (24°45′S, 152°24′E) (Last & Stevens, 1994). This provides the first record of *C. amboinensis* S of Bundaberg and the first record from Moreton Bay, not having been previously reported by Johnson (1999). This species is reasonably common within Moreton Bay (R. Pillans, pers. comm.), although not well represented in the QM collection. It is similar to the bull shark *C. leucas* (Valenciennes, in Müller & Henle, 1839), possibly leading to confusion in the field with this more abundant species.

### **Carcharhinus cautus** (Whitley, 1945)

MATERIAL. QM132158; ♀, 670mm TL, 535mm FL, 490mm PCL) was collected from the shoreline adjacent to Toondah Harbour, Cleveland, Moreton Bay, 27°32′S, 153°17′E, on 24/05/2000. The shark was found dead, but showed no signs of hook or net capture; QM133856; ♀, 1260mm TL, 1060mm FL, 950mm PCL, mass 12.5kg) was captured by handline by R. Pillans off Green Island, Moreton Bay, 27°26′S, 153°14′E, at 5m depth on 06/03/2002. Given its size, and the fresh mating scars, this specimen was most likely mature, as both sexes are reported to mature at 800-850mm TL (Last & Stevens, 1994).

REMARKS. Known only from S New Guinea, the Solomon Islands and tropical Australia between Carnarvon, WA and Bundaberg, Qld (24°45′S) (Last & Stevens, 1994). These are the first records of *C. cautus* south of Bundaberg and the first records from Moreton Bay, not having been previously reported by Johnson (1999).

### **Dipturus australis** (Macleay, 1884)

MATERIAL. QM133853; ♀, 358mm TL, 258mm DW, 212mm DL, mass 320g) was captured by demersal otter trawl off Moreton Island, 27°13′S, 153°39′E at 135m depth on 28/07/2002. Other specimens are QM111903, from 26°40′S, 153°15′E and I11904 from 27°44′S, 153°27′E.

REMARKS. This species is reported to be 'the most common skate on the continental shelf of central eastern Australia' (Last & Stevens, 1994), being recorded from off Moreton Bay S to Jervis Bay, NSW. Last & Stevens (1994: 347) stated that 'records of this species from prawn trawl catches from southern Queensland require validation.' This specimen, taken by a commercial prawn trawler, confirms that the Queensland trawl fishery interacts with this species. Despite its apparent common occurrence off NSW, this species appears to be uncommon in Queensland waters.

### **Hypnos monopterygius** (Shaw & Nodder, 1795)

MATERIAL. An individual (Fig. 1F) was observed by MBB off the reef edge on the S side of Heron Island, Great Barrier Reef (23°27′S, 151°55′E) in November 1995. It was initially buried in coral/sand substrate at 4m depth but was disturbed by a boat anchor. It proceeded to swim and settle again amongst *Acropora* coral.

REMARKS. This species is endemic to tropical and warm temperate Australia, from Broome, WA to St Vincents Gulf, SA and from Eden, NSW to Caloundra, S Qld. The species is absent from the immediate area between SA and NSW (Last & Stevens, 1994). This observation extends the N distribution of the species on the E coast and provides the first record from the Great Barrier Reef.

### **Dasyatis leylandi** Last, 1987

MATERIAL. QM133352, immature ♂, 225mm TL, 130mm DW, 108mm DL, mass 70g, and, immature ♂, 315mm TL, 173mm DW, 146mm DL, mass 160g) (Fig. 1C) were captured by demersal otter trawl in Hervey Bay, 25°07′S, 152°39′E. at 11m depth on 14/06/2002.

REMARKS. *Dasyatis leylandi* had previously been recorded from N Australia between Monte Bello Islands, WA and Townsville, Qld (19°15′S, 146°49′E), as well as New Guinea (Last & Stevens, 1994). These records represent a significant range extension for the species on the E coast (~1,200km). The species appears to be relatively common on scallop trawling grounds between Hervey Bay and Gladstone (Peter Kyne, unpubl. data).

### **Aetomylaeus nichofii** (Schneider, 1801)

MATERIAL. QM133854; ♀, 343mm DW, 530mm TL, mass 450g) (Fig. 1D) was captured by demersal otter trawl in Hervey Bay, 25°13′S, 152°43′E, at 8m depth on 11/06/2002. QM 112534, immature ♂, 245mm DW, 514mm TL, off Brampton Island, 20°48′S, 149°16′E, 22m, 13/08/1957; AMS I34389-027, immature ♂, 350mm DW, 690mm TL, off Shoalwater Bay, 22°21′S, 150°45′E, 43m, 25/10/1993.

REMARKS. Last & Stevens (1994) report that *A. nichofii* has an Indo-West Pacific distribution from S Japan to Australia and W to India. In Australia it occurs in tropical waters from Bonaparte Archipelago, WA to Cairns, Qld (16°54′S, 145°47′E). The above specimens significantly expand its southern range (by ~1,600km).

### **Myliobatis hamlyni** Ogilby, 1911

MATERIAL. QM133318; ♀, 440mm DW, 945mm TL) was collected by demersal trawl by P. Duncan off Swain Reefs, 20°40′S, 151°20′E at 210-220m depth on 07/08/1999.

REMARKS. Previously known only from the holotype (QM11567) caught off Cape Moreton, Qld (approximately 27°02′S, 153°28′E) in January 1911 (no other collection details are available), and CSIRO H2578-01 from E of Swansea, NSW (33°05′S, 151°58′E) collected at 117-121m on 09/11/1994. CSIRO H3860-01 from SW of Shark Bay, WA (26°47′S, 112°35′E) at 346-347m on 03/01/1991 is closely related to

FIG. 2. *Mobula japanica*, AMSIB8021, whole specimen before head was removed. Note diagnostic characters of species, white tip to dorsal fin, short cephalic lobes, long tail and spiracles situated above insertion of pectoral fins (Photo: Athel D'Ombrain, courtesy of the Australian Museum, Sydney).

*M. hamlyni*. This western form was identified as *M. hamlyni* in Last & Stevens (1994) but now appears to be distinct from that species (Peter Last, pers. comm.). *Myliobatis hamlyni* therefore appears to be restricted to E Australia.

Last & Stevens (1994) and Compagno & Last (1999) reported that *M. hamlyni* is doubtfully distinct from the W Indian Ocean *Myliobatis aquila* (Linnaeus, 1758) or the W Pacific *M. tobijei* Bleeker, 1854. The relationship between the 3 species needs further assessment, as does the relationship between the east and west coast forms.

### **Mobula japanica** (Müller & Henle, 1841)

MATERIAL. AMSIB8021 is the head of a specimen collected inshore by net fishermen from Lake Macquarie, NSW (32°59′S, 151°35′E) on 04/04/1968. QMI33855; immature ♂, 1088mm DW) (Fig. 1E) was found beach-washed on Eurong Beach, Fraser Island (25°31′S, 153°08′E) on 17/08/2000.

REMARKS. A series of photographs and measurements of the complete NSW animal, together with the head, were sent to the AMS by Athel D'Ombrain. The identification of the specimen has been verified from the head and original photographs (Fig. 2), showing a short head and cephalic lobes, a very long wire-like tail, a white dorsal fin tip, elliptical spiracles situated above the level of the pectoral fins, and a statement in the original correspondences from Mr D'Ombrain, 'A spine was cut from base of tail'. Within *Mobula*, only *M. japanica* and *M. mobular* possess a caudal stinging spine. *M. mobular* is closely related and morphologically similar to *M. japanica*, however, the former appears to be endemic to the Mediterranean Sea (Notarbartolo-Di-Sciara, 1987; Hemida et al., 2002).

The sex of the individual was not reported, but from the photographs appears to be female. The collector reported a 'width of disc' of 74 inches (1880mm), a 'length overall' of 114 inches (2896mm), a 'total length without tail' of 41.5 inches (1054mm) and a 'tail' of 72.5 inches (1842mm).

Collection of the first Qld specimen was reported by Hobson (2001) who also provided photographs of the fresh specimen. Full morphometric details are available from JWJ. Many of the proportional dimensions differ slightly from those presented in Notarbartolo-Di-Sciara (1987), with numerous measurements falling outside the lower end of the ranges given for material examined. The Queensland specimen has a greater relative disc width, and the tail far exceeds the maximum relative length given by Notarbartolo-Di-Sciara (1987). *Mobula japanica* has a long tail relative to other *Mobula* species, however this is a less reliable diagnostic feature, given the tail's susceptibility to damage.

*Mobula japanica*, which has a circumtropical distribution in warm temperate and tropical seas, is known from the Atlantic, Pacific and Indian Oceans. Regionally, it has been recorded from New Zealand, but reports from Australia needed confirmation (Last & Stevens, 1994). These records confirm that 4 species of mobulid rays occur in Australian waters: *Manta birostris* (Donndorff, 1798) and *Mobula eregoodootenkee* Garman, 1913 appear to be reasonably common in Qld waters; *Mobula thurstoni* (Lloyd, 1908) is known from a single record off Mackay, Qld (Last & Stevens, 1994). All species are rarely caught and are not well represented in museum collections.

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# FRUCTIFICATIONS AND FOLIAGE FROM THE MESOZOIC OF SOUTHEAST QUEENSLAND

GARY A. PATTEMORE AND JOHN F. RIGBY

Pattemore, G.A. & Rigby, J.F. 2005 01 10: Fructifications and foliage from the Mesozoic of southeast Queensland. *Memoirs of the Queensland Museum* **50**(2): 329-345. Brisbane. ISSN 0079-8835.

Several new fructifications and foliage specimens are described from four sites, in three southeast Queensland Early to Middle Mesozoic basins. This includes *Paraxylopteris* gen. nov., a likely pteridosperm fructification. Discovery of *Paraxylopteris* implies that inclusion of the foliage *Xylopteris* in *Dicroidium* cannot be supported. Pteridosperm remains described from the upper Ipswich Basin include the female fructification, *Umkomasia geminata*, the male fructification, *Pteruchus dubius*, and the foliage *Dicroidium feistmantelii*. It is likely that these remains were from the same plant. Also described are several conifer, cycadalean, equisetalean, lycopod and pteridophyte remains. Sedimentary conditions at the time of preservation are discussed. ❑ *Coniferophyta, Mesozoic, palaeobotany, Pteridophyta, Pteridospermophyta, Queensland.*

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The Triassic and Jurassic floras of Gondwanaland, their habitats, distribution and evolutionary development are not well known and for better understanding detailed knowledge of the fruiting bodies of component species is required. This contribution describes specimens either identified as belonging to new species, or that extend our knowledge of species already described. Specimens have been collected from 4 localities in the Triassic Esk Trough and Ipswich Basin, and the Jurassic Nambour Basin.

The Ipswich Coal Measures contain abundant fossil plants (Jack & Etheridge, 1892; Shirley, 1898; Jones & de Jersey, 1947a). Jones & de Jersey (1947a) divided their study between the Ipswich Coal Measures around the city of Ipswich, and the Brisbane series of the Ipswich Coal Measures, now the Tingalpa Formation (Cranfield et al., 1976). At least one of the study sites of Jones & de Jersey (1947b), within the Brighton Beds near Shorncliffe, was included as part of the Ipswich Coal Measures. It is now assigned to the younger Marburg Formation equivalent in the Nambour Basin (McKellar, 1994). Fossil plants of the Esk Trough have not been extensively studied but previous investigations include those of Walkom (1924, 1928), Holmes (1987), and Rigby (1977). Jones & de Jersey (1947a) compared the Esk Trough and Ipswich Basin floras. The fossil plants of the Nambour Basin have been studied, by Woods (1953), Webb (1980) and Jones & de Jersey (1947b).

## LOCALITIES AND GEOLOGY

LOCALITY 1. ESK TROUGH. 152°31'04"E, 27° 18'34"S. (GR523792, Caboolture 1:100 000 sheet area) on the western shore of Wivenhoe Dam, in the Brisbane Valley (Fig. 1B), Esk Formation, Anisian (Murphy et al., 1979).

Jell & Lambkin (1993) described the first insect recorded from the Esk Formation from this site.

The stratigraphy at this outcrop consists of 2 main units, a lower unit comprising fossiliferous shales, sandstones and mudstones concordantly overlain by an upper massive, poorly sorted, matrix supported conglomerate. Sediments appear to be locally derived from the adjacent Palaeozoic blocks. These deposits form part of an alluvial fan complex with finer floodplain and braided steam deposits of the lower unit overlain by the upper conglomerate unit, a likely debris flow.

LOCALITY 2. IPSWICH BASIN, CASTLE HILL. 152°47'59"E, 27°37'50"S. (GR803437, Ipswich 1:100 000 sheet area), east of Ipswich, just south of the suburb of Blackstone, in the Blackstone Formation of Carnian age (Cranfield et al., 1989). This site is on the NNW facing ridge of a hill known locally as Castle Hill, but is referred to by Cameron (1923) and Denmead (1955) as Blackstone Hill (Fig. 1A). The site extends from the top of Thomas Street to the outcropping conglomerate mapped by Staines (1963) as basal Moreton Basin.

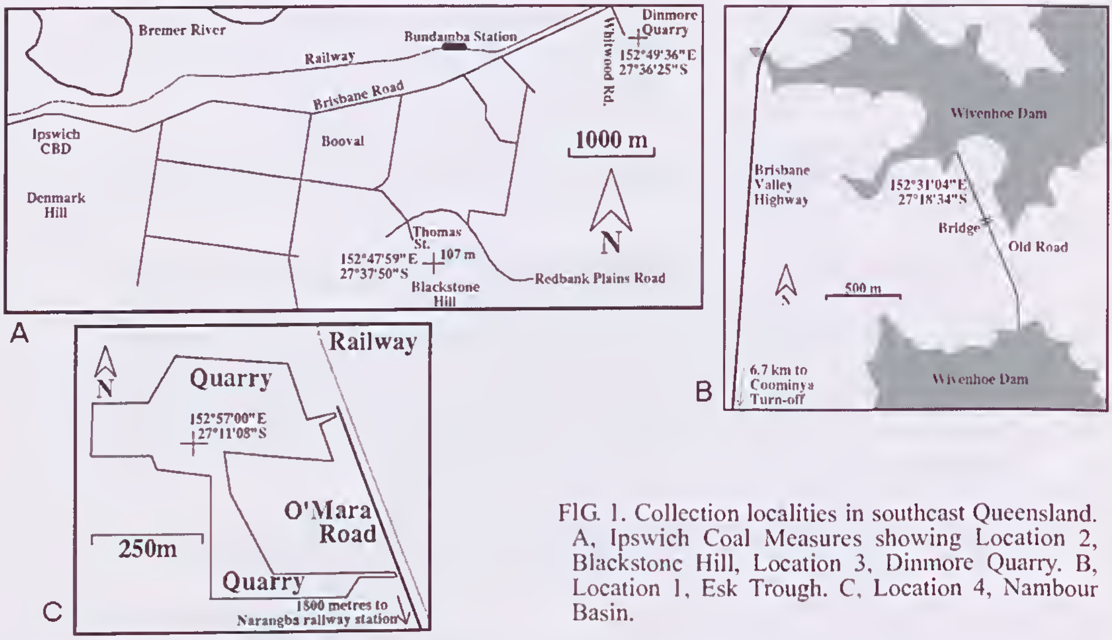

FIG. 1. Collection localities in southeast Queensland. A, Ipswich Coal Measures showing Location 2, Blackstone Hill, Location 3, Dinmore Quarry. B, Location 1, Esk Trough. C, Location 4, Nambour Basin.

Blackstone Hill forms the uppermost preserved sequence of the Blackstone Formation in this area (Cranfield et al., 1976). It is dominantly grey to light brown shale ranging from clayey to sandy and contains numerous laminae of argillaceous sandstone. Shales and minor sandstone beds are generally well indurated, fissile and are commonly fossiliferous. These deposits formed in a slowly aggrading fluvial environment in a distal levee to a proximal flood plain associated with a meandering river.

LOCALITY 3. IPSWICH BASIN, DINMORE QUARRY. A number of fossil leaves and fructifications have been examined from a site east of Ipswich, in the suburb of Dinmore, at 152°49'36"E, 27°36'25"S (GR829463, on the Ipswich 1:100 000 sheet area) (Fig. 1A). This locality is about 3km NNE of Blackstone Hill. There is a fossiliferous Tertiary Redbank Plains Formation outcrop 150 m north of this site, and a mine dump located 100m south contains fossiliferous shale of the Carnian Blackstone Formation (Rigby & Playford, 1988). The second locality is a mixture of strata from a number of horizons so is not significant stratigraphically.

The Dinmore Quarry is a small, shallow excavation with outcropping grey to dark grey fossiliferous shale, which probably represents the uppermost Tivoli Formation (Pattemore, 1998). Freshwater bivalved crustaceans in the shale (Rigby & Playford, 1988), suggest a flood plain lake. Its size and position relative to a fluvial channel is unclear but it received enough fine sediment to promote carbonaceous shale development instead of coal, indicating a not too distal position. More than 70 plant species have been reported from the Quarry in a widely dispersed literature (Tenison-Woods, 1888; Shirley, 1898; Walkom, 1915, 1917a, 1917b; Jones & de Jersey, 1947a; Jacob & Jacob, 1950; Townrow, 1962a, 1962b, 1967; Hill et al., 1965; Herbst, 1974, 1975, 1978, 1979; Webb, 1980, 1982).

LOCALITY 4. NAMBOUR BASIN. 152°57'00"E, 27°11'08"S (GR952929, Caboolture 1:100 000 sheet area), O'Mara Road quarry (Fig. 1C), 2 km NNW of Narangba, 35km NNW of Brisbane.

McKellar (1981a, 1981b, 1994) noted the sediments in the quarry are Toarcian of the uppermost Landsborough Sandstone and correlate with an outcrop of the Brighton Beds, also uppermost Landsborough Sandstone, 15km SE, from where Jones & de Jersey (1947b) described a Jurassic flora. The quarry sediments were deposited in a braided fluvial environment. Our specimens are preserved in an argillaceous sandstone with high clay content. This unit formed as a crevasse splay deposit in a distal levee to proximal flood plain associated with a seasonally large braided river system (Pattemore, 2000). The pteridosperm fructification, *Knezourocarpon narangbaensis* Pattemore, 2000, has been identified from this site.

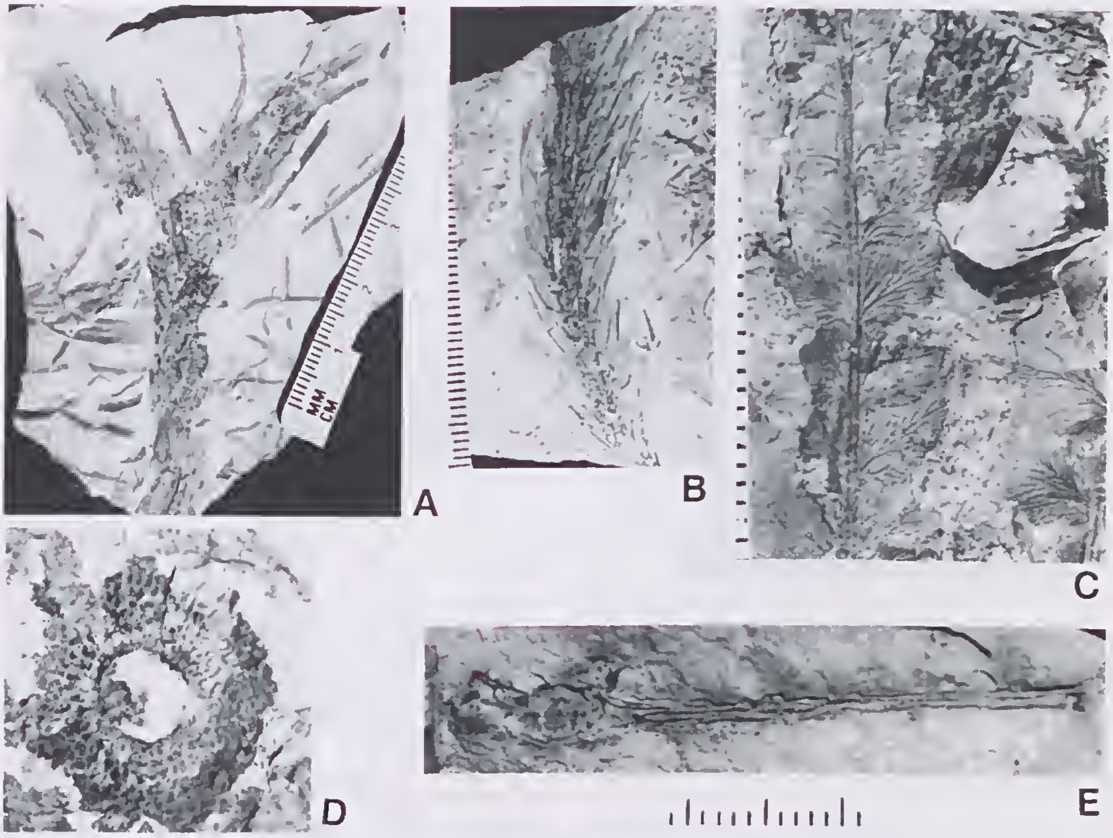

FIG. 2. A, B, Lycopod incertae sedis, Nambour Basin, QMF39298, QMF39267. C, *Lobifolia dejerseya* Retallack, Gould & Runnegar, 1977, QMF42345 (on left), QMF42346 (on right), Esk Trough. D, *Equisetites* sp. A, QMF42341, Esk Trough. E, Equisetalean cone sp. A., QMF42336, Esk Trough. All scales in mm; scale below E applies to D, E.

## MATERIAL AND METHODS

Most specimens from the Ipswich and Nambour Basins were collected by R. Knezour. All specimens are in the Queensland Museum (QM). All specimens are preserved as compressions or impressions and unless otherwise stated, have no preserved carbonaceous material.

## SYSTEMATIC PALAEOBOTANY

### Division LYCOPHYTA
### Order LEPIDODENDRALES (unclassified)

### **Lycopod** incertae sedis
(Fig. 2A-B)

MATERIAL. Locality 4, Nambour Basin: QMF39227, 39267 (Fig. 2B), 39269, 39298 (Fig. 2A).

DISCUSSION. Stem fragments clothed thickly with typical strap-like lycopod leaves, maximum 20mm in length, 1.5mm in breadth. They are typical of stem fragments from Palaeozoic arborescent lycopods. *Pleuromeia* is the only genus of arborescent lycopods known from the Mesozoic of Gondwanaland. This genus has a single unbranched trunk. QMF39298 (Fig. 2A) is a fragment of a dichotomously branched lycopod stem, hence our attribution of it to the Palaeozoic Lepidodendrales. We have also seen arborescent lycopod trunk fragments in the Triassic Tingalpa Formation, coeval with the Ipswich Coal Meassures, outside our study area, suggesting that SE Qld may have been a refugium for Palaeozoic lycopods well into the Mesozoic.

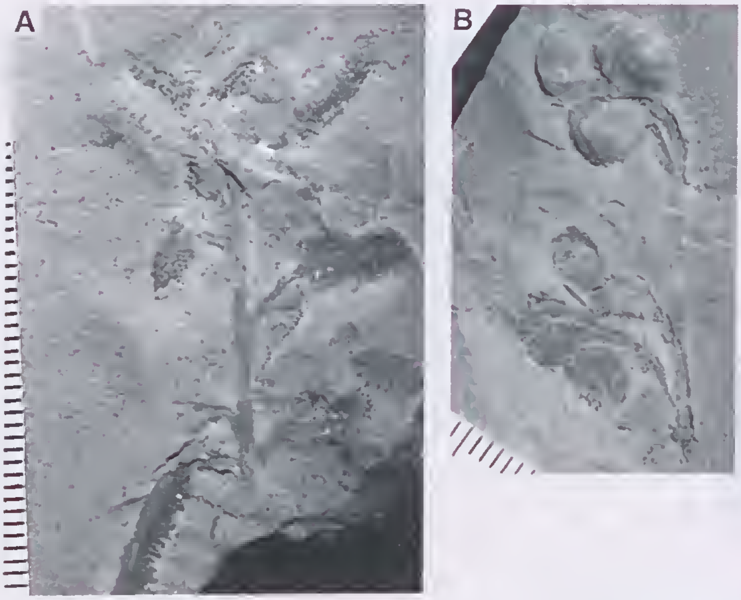

FIG. 3. A, *Pteruchus dubius* Thomas, 1933, emend. Townrow, 1962b, Ipswich Basin, Loc. 2, QMF42568. B, *Umkomasia geminata* (Shirley, 1898) Rigby, In Playford et al. 1982, QMF42544. Scales in mm.

### Division SPHENOPHYTA
### Order EQUISETALES
### Family EQUISETACEAE

**Equisetites** Sternberg, 1833

TYPE SPECIES. *Equisetites münsteri* Sternberg, 1833.

**Equisetites** sp. A
(Fig. 2D)

MATERIAL. Locality 1, Esk Trough: QMF42341.

DESCRIPTION. Nodal diaphragm, 14-16mm in diameter, with a hollow centre, 5mm in diameter, surrounded by 1mm wide ring of stem material with a pitted texture, and an outermost ring. The outermost ring with irregular hexagonal mesh pattern coherent for the entire ring, hexagons slightly elongate, 0.5-1.0mm long, and bounded by a toothed margin.

DISCUSSION. The hexagonal mesh pattern, which is the only distinguishing character, may have been superimposed during burial or fossilization. If so, this specimen is identical with diaphragms found in other species which have been defined on other structures, including *Cingularia typica* Weiss, 1876, *Equisetites rotiferum* Tenison-Woods, 1883, *Phyllotheca brookvalensis* Townrow, 1955, *E.* sp. cf. *E. lateralis* Phillips, in Morris, 1845, *E. multidentatus* Ôishi, 1932, *E.* sp. 2, and *E.* sp. 3 (numbered species of Sze et al., 1963). *Equisetites woodsii* Jones & de Jersey, 1947b, has a nodal diaphragm associated with a strobilus featuring hexagonal sporangiophores.

**Equisetalean cone** sp. A
(Fig. 2E)

MATERIAL. Locality 1, Esk Trough: QMF42336.

DESCRIPTION. Stem 30mm long broadening upwards into an oval shaped structure, 10 × 5mm, having an apparently chaotic internal form, 2mm wide, longitudinally ribbed with 3-4 ridges. Head without ovules or parts readily identifiable as bracts, with a series of irregularly spaced depressions, some with remnants of desiccated sporangial sacs containing small ovoid sporangia grouped into chains. There appears to be 3-4 stalks or leaflets, about 4mm long on top of the head.

COMPARISON. This specimen is similar to *Equisetostachys pedunculatus* Kon'no, 1962, which however lacks the apparent stalks or leaflets at its apex.

### Division PTERIDOPHYTA
### Order FILICALES
### Family DICKSONIACEAE

**Lobifolia** Rasskazova & Lebedev, in Lebedev & Rasskazova, 1967

TYPE SPECIES. *Lobifolia novopokrovskii* (Prynada, in Vakhrameev & Doludenko, 1962) Rasskazova & Lebedev, in Lebedev & Rasskasova, 1967.

### **Lobifolia dejerseya** Retallack, Gould & Runnegar, 1977
(Fig. 2C)

MATERIAL. Locality 1, Esk Trough: 7 sterile specimens, QMF42345, 42346 (Fig. 2D), 42347, QMF42351 - 42353, 42400, and 4 fertile specimens 42348 - 42350, 42367.

DESCRIPTION. Frond bipinnate with rachis up to 4-5mm wide. Pinnae sub-opposite to alternate, >60mm long with adjacent pinnae about 20mm apart; pinnae rachis 1mm wide reducing to 0.5mm distally, branching from about 70° to almost perpendicular. Rachis longitudinally striated. Pinnules variable in size and shape, sub-opposite to alternate, rounded triangular, inclined to the pinnae rachis at about 50° to nearly perpendicular, 5-(8)-10mm long and 3-(4.5)-6mm wide, closely spaced. Margins generally entire, slightly crenate in places. Pinnule apices pointed, acute to obtuse. Basiscopic margin strongly convex, decurrent at the base; acroscopic margin slightly concave, constricted at the base. Fertile pinnules smaller, apparently borne on a separate frond, stouter and rounder than the sterile pinnules, with many tending toward semi-circular. All other features agree with the sterile pinnules including venation. Pinnae >75mm long; pinnules distally merging to form a pointed acute apex. Fertile pinnules 1.5-(4)-4mm long, 2-(3.5)-4mm wide.

COMPARISON. Despite poor preservation these specimens can be identified as *Lobifolia dejerseya*. *Cladophlebis* sp. A and *Todites* sp. C of Anderson & Anderson (1983) probably also belong in this species.

### Division PTERIDOSPERMOPHYTA
### Class CORYSTOSPERMALES
### Family CORYSTOSPERMACEAE Thomas, 1933

### **Umkomasia** Thomas, 1933

TYPE SPECIES. *Umkomasia macleanii* Thomas, 1933.

### **Umkomasia geminata** (Shirley, 1898) Rigby, in Playford, Rigby & Archibald, 1982
(Fig. 3B)

*Beania geminata* Shirley, 1898: 16, pl. 20, fig. 1a-c.
gymnospermous seeds, in Walkom, 1917b: 16-17. pl. 20, figs 1-5.
Megasporophyll, in Jones & de Jersey, 1947a: 56, text-fig. 52.
*Umkomasia* sp. A, in Holmes, 1982: 17, fig. 7G.
*Umkomasia geminata* Rigby, in Playford et al., 1982: 5, figs 1-3, 7-9.

MATERIAL. Locality 2, Ipswich Basin: 14 specimens, QMF42528 - 42531 and their respective counterparts QMF42532 - 42535, 42536 - 42538, 42540 - 42543, 42544 (Fig. 3B), 42583, 42589 and counterpart 42593.

DESCRIPTION. Panicle, open, with probably irregular branching. Largest specimen incomplete, 130mm long. Cupules numerous, with some incomplete specimens bearing more than 30 cupules. Rachides up to 5mm wide. Branches, up to 40mm long, 2mm wide, each bearing up to 8 cupules arranged oppositely. Cupules, elliptical, 5mm × 4.5mm to 17mm × 11mm, most swollen, suggesting an enclosed ovule, other details unclear. Pedicels up to 1mm wide. Specimen QMF42583 appears to have a juvenile, unfurling frond crozier.

COMPARISON. This collection of specimens includes numerous attached cupules which display much size variation. However, there is little doubt that all these specimens belong to the same species as they are very similar in all other characteristics. Previous descriptions of this species, as listed in the above synonymy are based on fewer specimens and thus it should be expected that more natural variation be found in this larger collection. Some specimens in the present collection are larger than specimens figured previously suggesting previously examined specimens were fragmentary. Anderson & Anderson (2003) figured *Umkomasia* sp. 1, *Umkomasia* sp. 3, and *Umkomasia* sp. 4, all of which appear of similar morphology and size, may also belong in *U. geminata*.

DISCUSSION. This fructification is likely to be associated with the male fructification, *Pteruchus dubius* (discussed below), and the foliage *Dicroidium feistmantelii* (discussed below), which all occurred together at this locality in significant numbers. The liklihood that our attribution of *Dicroidium* to *Umkomasia* follows the discovery in South Victoria Land, Antarctica, of *U. uniramia* by Axsmith et al. (2000) attached to fronds of *Dicroidium odontopteroides* (Morris, 1845) Gothan, 1912.

### **Pteruchus** Thomas, 1933, emend. Townrow, 1962b

TYPE SPECIES. *Pteruchus africanus* Thomas, 1933.

### **Pteruchus dubius** Thomas, 1933, emend. Townrow, 1962b
(Fig. 3A)

MATERIAL. Locality 2, Ipswich Basin: 22 specimens, QMF42545, 42547 and counterpart 42576, 42548 and counterpart 42550, 42551, 42553 - 42555, 42557 and

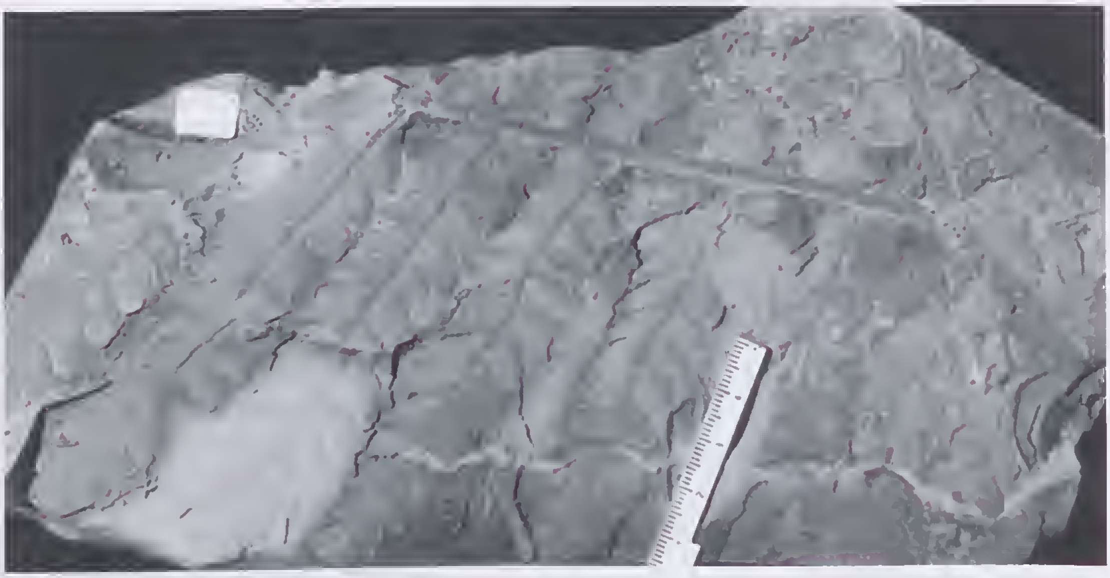

FIG 4. *Dicroidium feistmantelii* (Johnston, 1894) Gothan, 1912, QMF42594, Ipswich Basin, Loc. 2. Scale in mm.

counterpart 42558, 42559 - 42563, 42565 - 42566, 42567 and counterpart 42568 (Fig. 3A), 42569 - 42573, 42574 and counterpart 42575.
Locality 3, Ipswich Basin: 1 specimen held in the private collection of A. Thomson of Brisbane, Queensland.

DESCRIPTION. Fructifications large pinnatafid forming open panicules with rachis up to 150mm long, 4.5mm wide. Pinnules petiolate, with adjacent to sub-opposite branching at 50-80°. Petioles up to 13mm long, 0.5-1.5mm wide. Each pinnule bore a single terminal sporangial head. Some pinnules bifurcate with each branch bearing a head. Some fructifications bore >30 sporangial heads 5-38mm long and 5-8mm wide. Each elliptical to ovate sporangial head bore numerous (>100) pendulous sporangia crowded on the underside of the head. The sporangia are about 2.5mm long, and about 0.5mm wide, but their shape and attachment is unclear. The adaxial surface of each head has a slightly rugose texture and may have been crenate.

DISCUSSION. Specimens of the ovuliferous fructification *Umkomasia geminata* and the foliage *Dicroidium feistmantelii*, which are described herein from Locality 2, are preserved along with *P. dubius* in significant numbers. All of these almost certainly belonged to the same plant.

COMPARISON. These specimens are consistent with *Pteruchus dubius* as described and figured by Thomas (1933) and Townrow (1962b). A specimen identified as *P.* cf. *africanus* by Jones & de Jersey (1947a: 55) which was discovered near our Locality 2 was referred to *P. dubius* by Townrow (1962b). Some of the studied specimens are larger than those described by Townrow (1962b). The wide range of sporophyll sizes is probably due to a larger number of specimens available and reflects different growth stages, as all other features are similar.

The obscure specimen described as *Calamostachys australis* by Shirley (1898: 25, pl. 18) occurs on the same slab as *Beania geminata* (Shirley, 1898: 16-17, pl. 20) which has since been recombined in *Umkomasia geminata* (Rigby, in Playford et al. 1982). This suggests that *C. australis* may be a poorly preserved *Pteruchus* sp.

### **Dicroidium** Gothan, 1912, emend. Townrow, 1957

TYPE SPECIES. *Dicroidium odontopteroides* (Morris, 1845) Gothan, 1912.

DISCUSSION. The species of this genus are highly variable in form, as illustrated by Retallack (1977) and Anderson & Anderson (1983). These authors have in different ways, developed nomenclatural systems that attempt to cater for this variability. However, several of the names proposed by these authors are invalid with respect to the International Code of Botanical Nomenclature. Given this, for the purposes of this work, the nomenclature of these authors is not used. This is not to suggest that the general thrust of the various arguments presented by these authors is of no value.

Anderson & Anderson (1983) suggested *Dicroidium* was a plant with a reticulate evolutionary history, which freely hybridised across Gondwanaland. They illustrated aberrant specimens of *Dicroidium* as evidence of hybridisation between two populations at one site, Birds River, South Africa. This appears to be the only site in Gondwanaland currently known with a strong suggestion of hybridisation. Aberrant fronds are rare elsewhere and are generally attributed to deformities because of physical damage. The issue of variability in *Dicroidium* species and the reasons for this requires further examination in the light of the work by Jacob & Jacob (1950) who showed that preserved cuticle of *Dicroidium* fronds from the Ipswich area implied the presence of more species than is suggested by megascopic frond morphology.

Our specimens have considerable morphological variation. They do not have preserved cuticle, which has been demonstrated as important consideration (Jacob & Jacob, 1950) when examining boundaries or continua between species.

### **Dicroidium feistmantelii** (Johnston, 1894) Gothan, 1912

(Fig. 4)

MATERIAL. Location 2, Ipswich Basin - 16 specimens, QMF42539, 42546, 42549, 42552, 42556, 42564, 42577 - 42582, 42585 and counterpart 42586, 42588 and counterpart 42592, 42590, 42594 (Fig. 4).

DISCUSSION. Our specimens are conspecific with *D. feistmantelii* as described and/or figured by Gothan (1912), Antevs (1914), Jacob & Jacob (1950), Hill et al. (1965), Jain & Delevoryas (1967) and Rigby (1977). They are also indistinguishable from *Zuberia feistmantelii* (Johnston, 1894) Frenguelli, 1944 as figured by Frenguelli (1944), and *Thinnfeldia feistmantelii* Johnston, 1894, by Johnston (1894, 1896) and by Walkom (1917a, pl. 2, fig. 2; 1924, pl. 17, fig. 1F). Our specimens are preserved together with *Umkomasia geminata* and *Pteruchus dubius*, which are likely to be the ovuliferous and microsporangiate fructifications respectively, associated with this foliage.

### **Xylopteris** Frenguelli, 1943

TYPE SPECIES. *Xylopteris elongata* Frenguelli, 1943.

### **Xylopteris argentina** (Kurtz, 1921) Frenguelli, 1943

(Fig. 5B)

MATERIAL. Location 3, Ipswich Basin: 35 specimens, QMF42405 - 42413, 42420 - 42423, 42426 and counterpart 42510, 42494 - 42500, 42502 - 42505, 42511 - 42514, 42518 (Fig. 5B), 42519 - 42523.

DESCRIPTION. Frond pinnate, with a leaf-like rachis, 1.5-2mm wide, which bifurcates once, occasionally twice, more or less symmetrically, at <25°. Pinnules apparently borne only on the ultimate segments of the rachis, narrowly linear, margins entire, apex acute, pointed, up to 70mm long, 0.5-1.5mm wide, with a faint median vein.

DISCUSSION. The strap-like rachides are similar to *Sphenobaiera pontifolia* Anderson & Anderson, 1989, but are distinguished by their distally borne pinnules. Townrow (1962a) described 2 specimens of *X. elongata* (Carruthers, 1872) Frenguelli, 1943, from the Ipswich Coal Measures, which had smaller and more numerous branches positioned over the entire length of their rachides. No carbonaceous material was preserved in any of the specimens examined herein. Our specimens are consistent with *X. argentina* of Retallack (1977), and *Dicroidium elongatum* var. *argentina* (Kurtz, 1921) Anderson & Anderson, 1983. The later combination may be untenable given the likely male fructification associated with *X. argentina* foliage, *Paraxylopteris queenslandensis* gen. et sp. nov. (described below), which, if attached, would preclude the combination of *Xylopteris* in *Dicroidium*.

### **Xylopteris spinifolia** (Tenison-Woods, 1883) Frenguelli, 1943

(Fig. 5A)

MATERIAL. Location 2, Ipswich Basin: 3 specimens, QMF42584 and counterpart 42587, 42591 (Fig. 5A).

DESCRIPTION. Frond bipinnate, up to 130mm long, with bifurcating rachides up to 3mm wide. Pinnae, up to 40mm long, branching at about 50°. Opposite to sub-opposite pinnules, up to 13mm long, branching at about 30°, with a distinct median vein. Pinnae have three or fewer pinnules per side of the pinnae midrib.

COMPARISON. These specimens compare well with specimens of this species described and figured by Frenguelli (1943), Hill et al. (1965) and Retallack (1977).

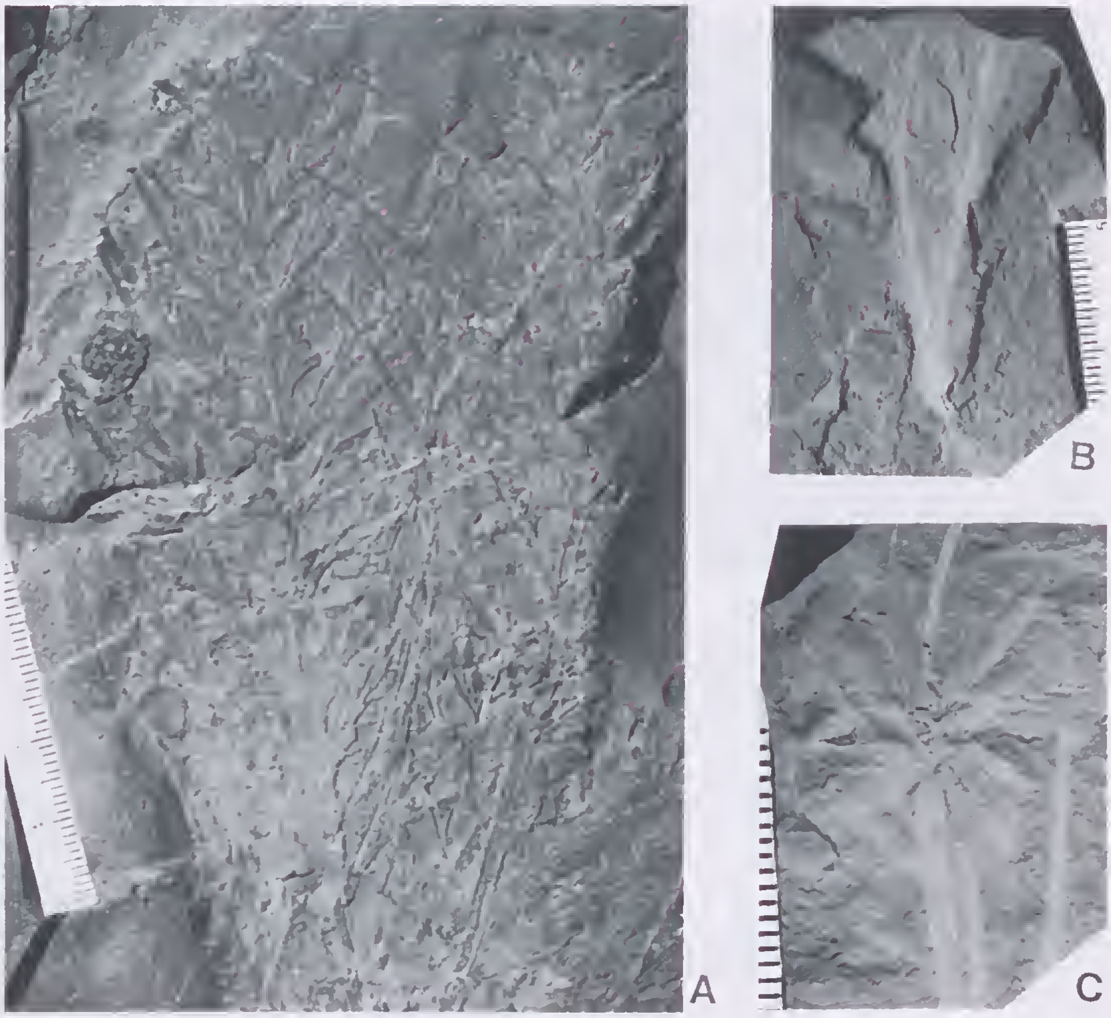

FIG 5. A, *Xylopteris spinifolia* (Tenison-Woods, 1883) Frenguelli, 1943, QMF42591, Ipswich Basin, Loc. 2. B, *Xylopteris argentina* (Kurtz, 1921) Frenguelli, 1943, QMF42518, Ipswich Basin, Loc. 3. C, *Antevsia extans* (Frenguellli, 1944) Townrow, 1960, Ipswich Basin, Loc. 3. All scales in mm.

### **Paraxylopteris queenslandensis** gen. et sp. nov.
(Fig. 6)

MATERIAL. Locality 3, Ipswich Basin: 1 specimen (holotype), QMF42425.

ETYMOLOGY. The generic name refers to the specimen's similarity with *Xylopteris*, while the specific name refers to Queensland, the Australian State in which it was discovered.

DIAGNOSIS. Genus monotypic. Frond pinnate consisting of a long strap-like rachis and strap-like pinnules. Sterile pinnules are grouped basally and branch probably sub-alternately. Strobulus terminal on rachis, elongate and slightly ovate. Within the strobilus, and forming the basic structure of the strobilus, the rachis thrice bifurcates (or branches) and gives rise to numerous small, probably bilateral branches, each of which bore several very small pendulous(?) sporangia.

DESCRIPTION. Pinnate frond segment, 70mm long, consisting of a leaf-like rachis, 1.5mm wide, with four bilaterally branched pinnules, grouped about 40mm from the likely terminal strobilus. Slightly ovate strobilus, 21mm long and 7-9mm wide. The strap-like rachis bifurcates or branches at a very acute angle three times within the fertile section of the pinnae. Sporangia are preserved in a very crowded and confused

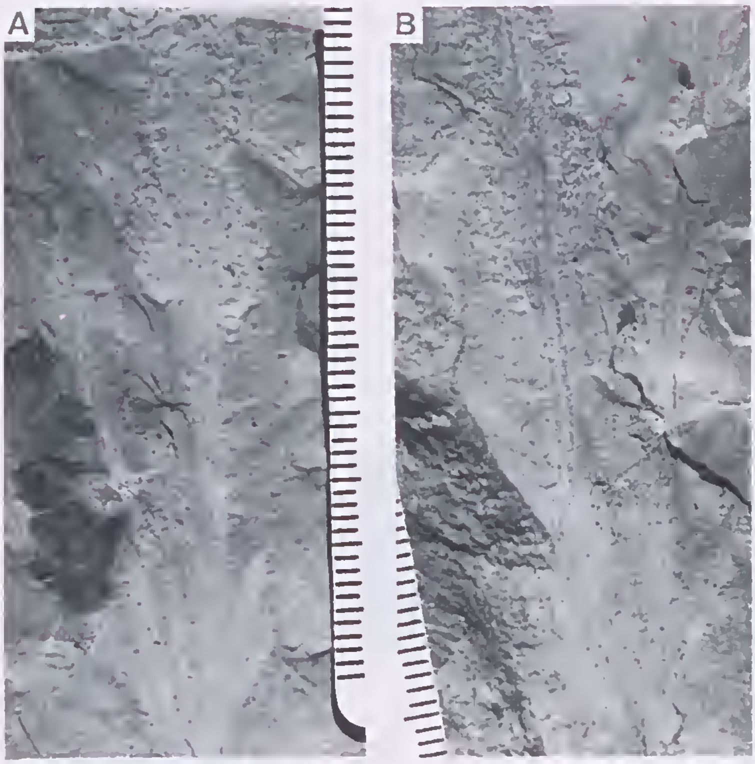

FIG. 6. *Paraxylopteris queenslandensis* gen. et sp. nov. Holotype: A, part, QMF42425; B, counterpart, QMF42415, Ipswich Basin, Loc. 3. Scales in mm.

manner but appear to consist of numerous very small branches up to 9mm long, branching probably bilaterally from the strap-like rachis at about 30°. Details of these small branches are unclear but they appear to have been delicate bearing several very fine, hair-like pollen sacs probably pendulously.

COMPARISON. The general form of these specimens is remarkably similar to the foliage *Xylopteris argentina* (Kurtz, 1921) Frenguelli, 1943, discussed above, which is abundant at this site. It seems very likely that these specimens are the male fructifications of this species, given their very similar morphology of the sterile pinnae and that they occur at the same locality.

This specimen varies considerably from *Pteruchus* as diagnosed by Townrow (1962b). It had a considerably less robust structure than *Pteruchus*, with the stobilus probably forming part of an otherwise vegetative frond. Unlike *Pteruchus*, which had a well developed sporophyll head (or bract) beneath which sporangial material was attached, the rachis in this specimen appears to have formed the sporophyll head. Given this apparently less well developed fructification it seems possible that this specimen represents an evolutionary point between more developed pteridosperms and the pteridophytes. If these fructifications were attached to *Xylopteris* foliage then this precludes the combination of *Xylopteris* into *Dicroidium* by Anderson & Anderson (1983).

## PELTASPERMACEAE
## Thomas, 1933

### **Antevsia** Harris, 1937

TYPE SPECIES. *Antevsia zeilleri* (Nathorst, 1908) Harris, 1937.

### **Antevsia extans** (Frenguelli, 1944) Townrow, 1960
### (Fig. 5C)

MATERIAL. Locality 3, Ipswich Basin: 12 specimens, QMF42402 - 42404, 42424 (Fig. 5C), 42493, 42501, 42506 - 42509, 42526 - 42527.

DESCRIPTION. Sporangia symmetrical, four-lobed, peltate borne terminally on a short pedicel about 7mm long and about 0.5mm wide. The complete fructification probably bore around 12 such sporangia branched from a stem in an unclear arrangement. The pedicel was attached centrally to the structure with four lobes radiating from this central point, lobes elongate and slightly obovate, 6-(8)-10mm long and 2.5-3mm wide, with pointed bases and apices.

COMPARISON. These specimens are almost certainly the same as those described and figured by Walkom (1915: 31, pl. 3, figs 3-4) as equisetaceous tubers. This author believed the pedicel to be a root, however these specimens clearly show sporangia mounted terminally on a pedicel branching from a stem. Townrow (1960) combines these 'equisetaceous tubers' in *A. extans* and his description and figures of this species compare well with the specimens described herein. *Antevsia* sp. A of Anderson & Anderson (1983, pl. 23, figs 3-4) from the Molteno Formation of the Karoo Basin, South Africa, probably also belongs in *A. extans*.

DISCUSSION. The shape of the sporangial material, which probably had an almost circular cross-section before compression, is more indicative of a dehiscing pollen sac. There is also the possibility that these specimens were cupules which encapsulated a large seed. Only one large seed was identified with these specimens, Pteridosperm seed sp. A (Pattemore, 1998: 98, QMF42492), but its size and shape renders this interpretation most unlikely. No seeds of this size were identified in any of the studied material, nor have they been described in the literature concerned with the Carnian sediments of southeast Queensland.

Townrow (1960) refered *A. extans*, the foliage, *Lepidopteris stormbergensis* (Seward, 1903) Townrow, 1956, and the ovuliferous fructification, *Peltaspermum thomasii* Harris, 1937 to the same plant. Some fragmentary foliage, which were possibly referable *L. stormbergensis,* were also found with the studied *A. extans* specimens (Pattemore, 1998: 95, QMF42427 and counterpart 42517). These fructifications are numerous and are found along with many specimens of *Xylopteris argentina* and a specimen of *Paraxylopteris queenslandensis* gen. et sp. nov., but there is no observed physical connection between these specimens.

## CYCADOPHYTA
## Genera of Uncertain Family

### **Nilssonia** Brongniart, 1825

TYPE SPECIES. *Nilssonia brevis* Brongniart, 1825.

### **Nilssonia eskensis** Walkom, 1928

DISCUSSION. Anderson & Anderson (1989) elected not to employ *Nilssonia* and questionably combined *N. eskensis* from the Esk Trough into *Halleyoctenis multilineata* (Shirley, 1898) Anderson & Anderson, 1989, which includes specimens with pinnule attachment ranging from lateral to slightly dorsal. The specimen as described and figured by Walkom (1928) has pinnules attached to the upper surface of the rachis (strongly dorsally). We consider the removal of this species to another genus to be inappropriate.

### **Pterophyllum** Brongniart, 1828

TYPE SPECIES. *Pterophyllum longifolium* Brongniart, 1828.

### **Pterophyllum multilineatum** Shirley, 1898

DISCUSSION. This species known from the Ipswich Basin, with laterally attached pinnae typically found in modern cycads, was combined into *Halleyoctenis multilineata* (Shirley, 1898) Anderson & Anderson, 1989 and grouped with *Nilssonia* specimens which had dorsally attached pinnae as in *Nilssonia eskensis*. This combination is questioned on the grounds that lateral and dorsal pinnae attachment is of at least generic significance consistent with the description and figures of *P. multilineatum* of Shirley (1898) and Walkom (1917b).

### **Yabeiella** Ôishi, 1931

TYPE SPECIES. *Yabeiella brackebuschiana* (Kurtz, 1921) Ôishi, 1931

### **Yabeiella mareyesiaca** (Geinitz, 1876) Ôishi, 1931
(Fig. 7A,E)

MATERIAL. Locality. 3, Ipswich Basin: 1 specimen, QMF42525 (Fig. 7A, E).

DESCRIPTION. Leaf, narrowly elliptical, margin entire, 160mm long, up to 28mm wide with a prominent midrib, 2.5mm wide basally and tapering to 1.5mm wide distally, lamina attached laterally to the midrib. Veins curve arcuately from the midrib then extend across the lamina at 70° without curvature, bifurcating, coalescing and rarely anastomosing, curving into a marginal vein distally. Most bifurcation and coalescence of veins occurs near the midrib or marginal vein. Venation density, 18 veins per 10mm. Marginal vein prominent about 0.8mm wide.

DISCUSSION. Our specimen is identical with specimens figured by Geinitz (1876) as *Taeniopteris mareyesiaca*, Walkom (1917a) as *Taeniopteris dunstanii*, both Jones & de Jersey (1947a) and Anderson & Anderson (1989) as *Y. mareyesiaca*. Webb (1980) identified this species from the Esk Trough.

### **Linguifolium** Arber, 1917, emend. Retallack, 1980

TYPE SPECIES. *Linguifolium lillieanum* Arber, 1917

### **Linguifolium tenison-woodsii** (Etheridge, in Jack & Etheridge, 1892) Retallack, 1980
(Fig. 7C,D)

*Angiopteridium ensis* Oldham, in Tenison-Woods, 1883: 119.
*Angiopteridium tenison-woodsii* Etheridge, in Jack & Etheridge, 1892: 375.
*Taeniopteris tenison-woodsii*; Shirley, 1898: 23, pl. 9, fig. 2.
*Taeniopteris tenison-woodsii*; Walkom, 1917b: 32-34.
*Linguifolium tenison-woodsii*; Retallack, 1980: 50-51, fig. 7F-H.

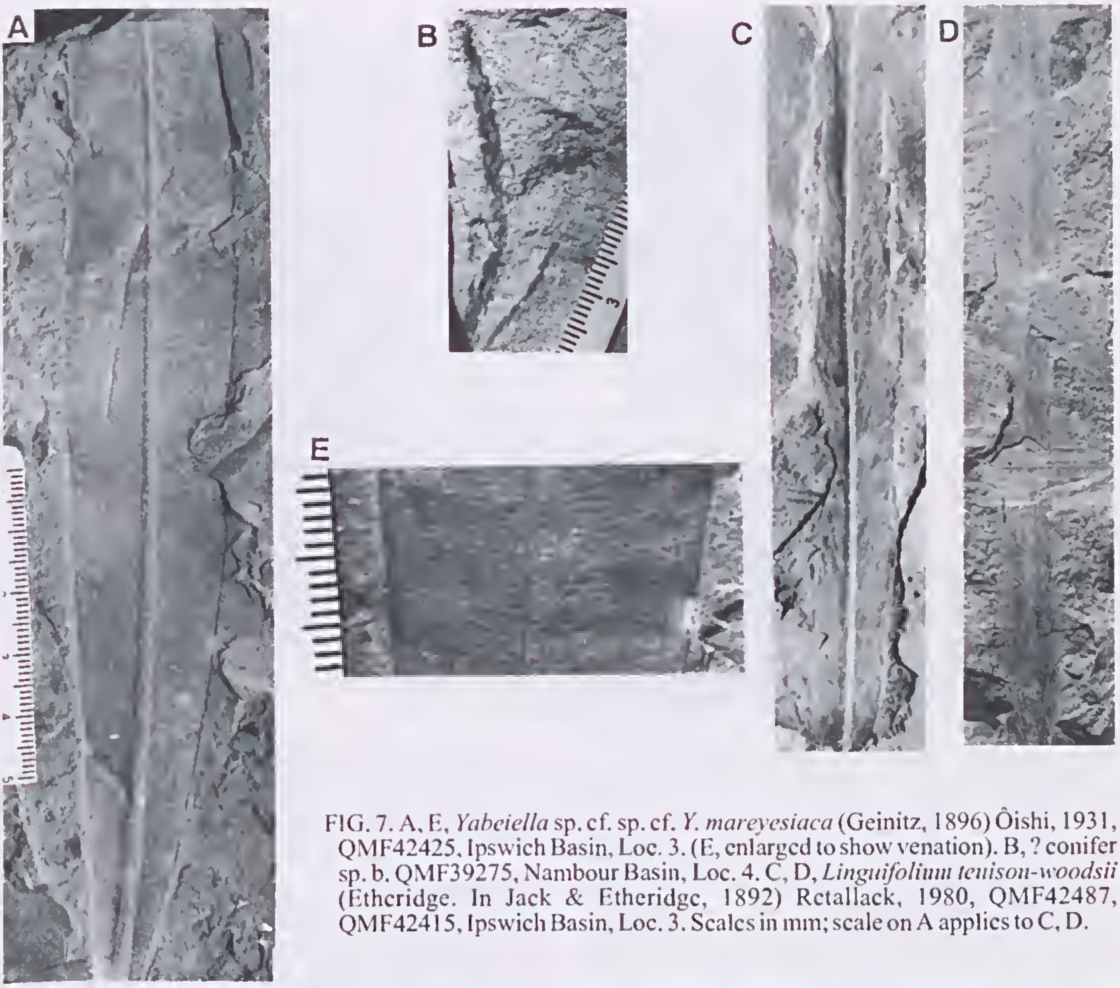

FIG. 7. A, E, *Yabeiella* sp. cf. sp. cf. *Y. mareyesiaca* (Geinitz, 1896) Ôishi, 1931, QMF42425, Ipswich Basin, Loc. 3. (E, enlarged to show venation). B, ? conifer sp. b. QMF39275, Nambour Basin, Loc. 4. C, D, *Linguifolium tenison-woodsii* (Etheridge. In Jack & Etheridge, 1892) Retallack, 1980, QMF42487, QMF42415, Ipswich Basin, Loc. 3. Scales in mm; scale on A applies to C, D.

The synonymy lists only citations necessary for the identification of the species. The Indian species described as *Stengerites ensis* Oldham, in Oldham & Morris, 1863 was later used, but not recombined as *Taeniopteris ensis* by Feistmantel (1876). Feistmantel (1877) recombined Oldham's specimens into *Angiopteridium ensis*. Tenison-Woods (1883) identified a specimen as *Angiopteridium ensis* which Etheridge (in Jack & Etheridge, 1892) recognised as differing from the Indian species, and named it *Angiopteridium tenison-woodsii*. Shirley (1898) recombined, described and figured for the first time, the Australian species as *Taeniopteris tenison-woodsii*. Arber (1913) subsequently erected the genus *Linguifolium*, which was used by Retallack (1980).

MATERIAL. Locality 3, Ipswich Basin: 8 specimens, QMF42415 (Fig. 7D), 42616 - 42418, 42487 (Fig. 7C), 42488, 42489, 42524.

DESCRIPTION. Leaf narrowly linear, 7mm wide, with the largest incomplete specimen 65mm long, margin entire, midrib prominent, longitudinally striated, about 0.8mm wide, with lamina laterally attached. Neither leaf apices nor bases are preserved. Veins branch from the midrib at 20°-40°, simple or once forked, recurving slightly to terminate at the margin at a slightly more acute to slightly less acute angle than that made with the midrib, in places the angle between the venation and the margin is so acute as to appear to be almost forming a marginal vein. Venation density varies considerably between specimens from 6-16 veins per 10mm.

DISCUSSION. Specimens vary considerably both in terms of venation density and geometry. Most specimens are identical with: *Taeniopteris tenison-woodsii* (Etheridge, in Jack and Etheridge, 1892) Walkom, 1917a as described by Walkom (1917a, 1928); *Doratophyllum tenison-woodsii* (Etheridge, in Jack & Etheridge

1892) Jones & de Jersey 1947a; and *Linguifolium tenison-woodsii* as figured by Retallack (1980) also Anderson & Anderson (1989). Venation in some specimens ranges to identical with that of *L. gracile* Anderson & Anderson, 1989. Given the venation density and geometrical variation in the specimens examined herein, *L. gracile* is a junior synonym of *L. tenison-woodsii*.

### **Zamites** Brongniart, 1828

TYPE SPECIES. *Zamites gigas* (Lindley & Hutton, 1834) Morris, 1843.

### **Zamites queenslandi** (Walkom, 1917b) Webb, ex Anderson & Anderson, 1989
(Fig. 8A)

MATERIAL. Locality 1, Esk Trough: 8 specimens. QMF42338, 42339 and its counterpart 42340 (Fig. 8B). 42381 - 42383, 42386 - 42388.

DESCRIPTION. Frond pinnate, >85mm long, >20mm wide, rachis 1-1.8mm wide. Pinnae slightly oblanceolate to elliptical, 6-13mm long, 3.5-4mm wide distally, 2.5-3.5mm wide near base, attached dorsally, extending from the rachis at 70-90°, closely spaced but not overlapping; most pinnae broaden distally and have slightly bulbous bases. Venation dense, approximately 5 veins per mm, dichotomising, slightly divergent.

DISCUSSION. Webb (1980) referred *Otozamites queenslandi* Walkom, 1917b to *Z. queenslandi* on the ground that pinnules had poorly developed auriculate bases. This view of the difference between *Zamites* and *Otozamites* is consistent with Seward (1969), and Taylor & Taylor (1993). Anderson & Anderson (1989) formalised the combination with *Zamites*.

## Division CONIFEROPHYTA
## Order CONIFERALES
## Family VOLTZIACEAE

### **Heidiphyllum** Retallack, 1981

TYPE SPECIES. *Heidiphyllum elongatum* (Morris, 1845) Retallack, 1981.

### **Heidiphyllum** sp. cf. **H. elongatum** (Morris, 1845) Retallack, 1981

MATERIAL. Locality 1, Esk Trough: 5 specimens, QMF42332 - 42335, 42337. Locality 3, Ipswich Basin: 1 specimen, QMF42419 (?).

DESCRIPTION. Leaves linear oblanceolate, some slightly falcate, length 30-100mm, all specimens incomplete, width up to 10mm, constricting abruptly distally to form a rounded acute apex, narrowing to about 2mm at their sessile base, margins entire, veins dichotomous and parallel for most of their course but converge slightly toward the apex terminating at the apical margin. Veins evenly spaced with a density of 1-2 per mm. Some veins may merge in the apical region close to the apical margin.

DISCUSSION. Specimens are not well preserved but they conform with the description of Anderson & Anderson (1989). Specimens of *Phoenicopsis elongatus* Morris, 1845, as described by Walkom (1917b, 1924) and Hill et al. (1965), probably belong here. Our specimens are compared with the species as they are fragmentary and it is possible that some of these fragments could be ginkgoalean foliage, but the very few visible apices and bases of our, and Pattemore's (1998) specimens are indicative of *Heidiphyllum*. One fragmentary specimen from Locality 3, Ipswich Basin, is tentatively referred here.

## Family PODOCARPACEAE

### **Rissikia** Townrow, 1967

TYPE SPECIES. *Rissikia media* (Tenison-Woods, 1883) Townrow, 1967.

### **Rissikia** sp. cf. **R. apiculata** Townrow, 1967
(Fig. 8D)

MATERIAL. Locality 4, Nambour Basin: QMF39268, 39270.

DESCRIPTION. Foliage fragments poorly preserved with stem thickness up to 1mm, shoot length up to 50mm. Specimen QMF39268 has branched shoots apparently incomplete, 10mm long, shoot branching arrangement unclear. Leaves linear, inserted spirally 5-8mm long, <1mm wide, 1.5-2mm between leaves, bases slightly decurrent, no or minimal leaf-width contraction basally. Leaves covering the entire length of each fragment, branched acutely, recurved away from the stem. Cross-sectional detail unclear, leaf thickness probably <1mm.

COMPARISON. Specimens are consistent in features with *Rissikia* as diagnosed by Townrow (1967). The description of specimens of *Elatocladus* Halle, 1913, by Townrow (1967: 131), includes shoots with laterally ranked petiolate leaves. *Elatocladus* includes foliage with petiolate leaves or leaves with distinctly constricted bases (Seward, 1969; Anderson & Anderson, 1989: 450), whereas *Rissikia* has no or minimal leaf base contraction (Townrow, 1967: 103). The specimens described herein do not exhibit bilaterally ranked leaves and appear to have only

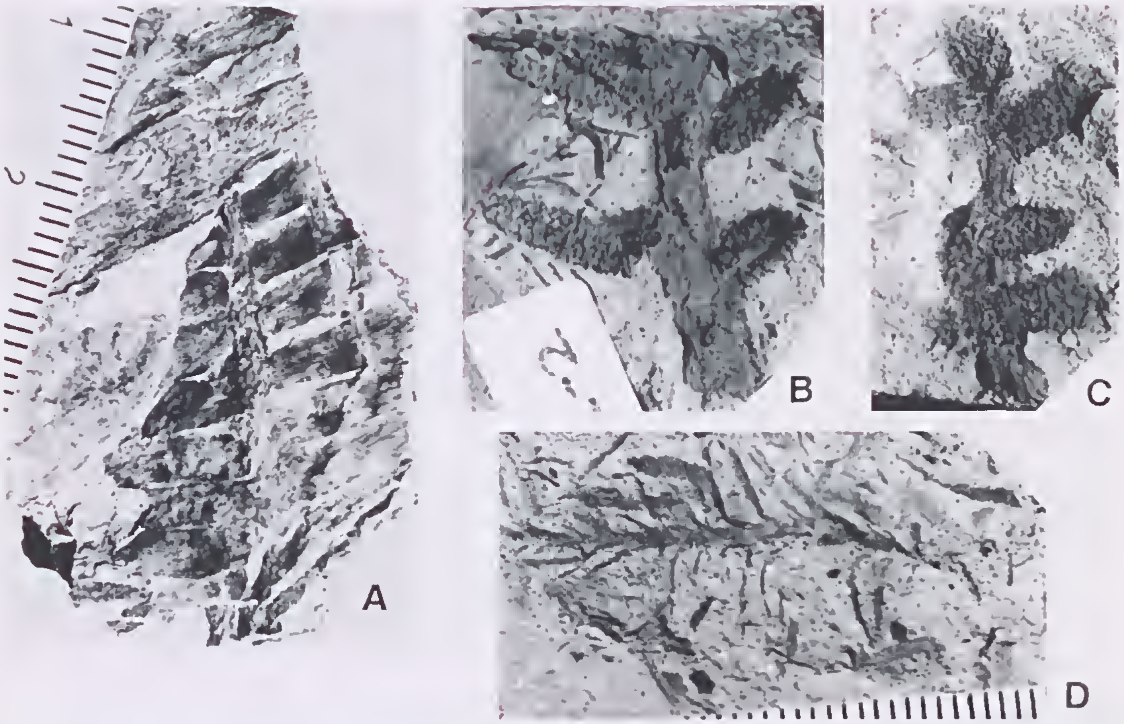

FIG. 8. A, *Zamites queenslandi* (Walkom, 1917b) Webb, ex Anderson & Anderson, 1989, QMF42340, Esk Trough, Loc. 1. B,C, conifer cone sp. a, QMF39278, QMF39279, Nambour Basin, Loc. 4. D, *Rissikia* sp. cf. *R. apiculata* Townrow, 1967, QMF39270, Nambour Basin, Loc. 4. Scales in mm; scale on D applies to B-D.

minimal (if any) leaf base contraction. In these and other features they are most similar to *R. apiculata* but differ in the diagnosed leaf spacing for this species, namely 5mm (Townrow, 1967: 113), and the branching shoots. Townrow (1967: 119) does not include branched shoots in *Rissikia* although this is not included as a diagnostic feature of the genus. *Mataia* Townrow, 1967, does include branched shoots however *Mataia* leaves are diagnosed as thin and fragile, and although spirally mounted, they twist at the base to form into two rows. The specimens examined herein do not show any such tendency.

### CONIFERALES incertae sedis

### conifer cone sp. a
(Fig. 8B, C)

'Obscure? Fructifications', in Arber, 1917: 65, pl. 13, figs 2,3,5,6.

MATERIAL. Locality 4, Nambour Basin: 28 specimens, QMF39228, 39230, 39234, 39235, 39247, 39256, 39261, 39278 (Fig. 8B), 39279 (Fig. 8C), 39280 - 39283, 39285, 39291 - 39294, 39312 - 39313, 42595 - 42596, 42610.

DESCRIPTION. Probable male fructification, appears bipinnate and leafless, with several, small, ellipsoidal, sessile, and apparently woody cones. Cones up to 12mm long, 5mm wide, branching at 70-90° from an apparently leafless stem. Stems have a compressed diameter of up to 9mm, and appear to have been bipinnate, with an unknown branching arrangement for primary and secondary stems. Cones grew on both primary and secondary stems in what was probably an irregular spiral arrangement. Ultimate shoots have a terminally mounted cone (Fig. 8C). Some cones appear to have been clustered with a few cones branching at a single node. Bracts, 1.5-2mm long, 0.8-1mm wide, were spirally arranged and branch acutely from a thick central core 1.5-3mm wide. The shape of the bracts is unclear and preservation is too poor to describe sporangial material.

COMPARISON. Male cones identified as 'obscure? Fructifications' by Arber (1917) and listed herein as synonymous, are smaller, but otherwise are identical.

*Rissikia* is based on foliage, male and female fructifications, pollen and cuticle. Our specimens are similar in size and form with the male cones of *Rissikia*, however the bipinnate branching structure on which they grew is unlike that of *Rissikia*. They are, however, preserved together in significant numbers with *Rissikia* sp. cf. *R. apiculata* (see above), and with the exception of the below mentioned possible female cone, they are the only two conifer-like plant remains in a sedimentary horizon containing abundant plant remains. Given the significant difference of the bipinnate branching and the lack of preserved cuticle in our specimens, they cannot be referred to an existing or new species of *Rissikia*. Additionally, given the closely packed bracts it seems unlikely that these cones could be interpreted as the leaf bases of vegetative short shoots. Further, the primary and secondary stems show no evidence of leaf scars.

### ?conifer sp. b
(Fig. 7B)

MATERIAL. Locality 4, Nambour Basin: 5 specimens, QMF39274 and counterpart 39275 (Fig. 7B), 39295 - 39297, 39306.

DESCRIPTION. Specimens are narrowly linear, up to 55mm long, 3mm wide, with unknown attachment. One specimen and possibly a second were branched. Obovate, spirally attached bracts, about 2mm long, <1.5mm wide. Leaves/bracts were adpressed to or very acutely branched from a thin central stalk and appear to be slightly domed away from the stem axis. No seeds were positively identified within the structure or nearby to the specimen.

DISCUSSION. Specimens are very poorly preserved. These occur along with the foliage and likely male conifer cone, 'conifer cone sp. A'(discussed above). In available features, they appear most like the ovuliferous cones of *Rissikia*, with the exception of their branching. If seeds were identified with these, their likely association with the above conifer specimens would have to be considered.

Arber (1917: 60-61, pl. 8, fig. 1) identified a specimens as *Pagiophyllum peregrinum* Lindley & Hutton, 1833, from the mid-Mesozoic of the South Island, New Zealand, which appear similar but had thicker stems than our specimens.

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This is a contribution to project IGCP 467, Triassic times/trans-Panthalassan correlations.

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# REVISIONS OF AUSTRALIAN GROUND-HUNTING SPIDERS: II. ZOROPSIDAE (LYCOSOIDEA: ARANEAE)

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Four new genera (*Megateg*, *Krukt*, *Birrana*, *Kilyana*) and 24 new species (*Megateg bartholomai*, *Megateg covacevichae*, *Megateg elegans*, *Megateg gigasep*, *Megateg lesbiae*, *Megateg paulstumkati*, *Megateg ramboldi*, *Megateg spurgeon*, *Krukt cannoni*, *Krukt ebbenielseni*, *Krukt megma*, *Krukt piligyna*, *Krukt vicoopsae*, *Birrana bulburin*, *Kilyana bicarinatus*, *Kilyana campbelli*, *Kilyana corbeni*, *Kilyana dougcooki*, *Kilyana eungella*, *Kilyana hendersoni*, *Kilyana ingrami*, *Kilyana kroombit*, *Kilyana lorne*, *Kilyana obrieni*) are described from eastern Australia. Along with the Western Australian genus *Huntia* Gray & Thompson, 2001 and the New Zealand *Uliodon* Koch, 1873, these new genera are placed in the expanded concept of the Zoropsidae, here first formally recorded from Australia. The male Zoropsidae are defined by the combination of dorsal scopula pad on the cymbium, pedal tibiae cracked and strong paired spines on tibiae and metatarsi I and II. The Zoropsidae also include the Griswoldiinae which are transferred from the Miturgidae and Zorocratidae . The genera here transferred to the Zoropsidae are found in North America, Africa, Madagascar, Sri Lanka and now Australia and New Zealand; hence, the family is worldwide. The Zoridae have been found to have a grate-shaped tapetum and are hence transferred to the Lycosoidea. ❑ *Araneomorphae, Lycosoidea, Zoropsidae, taxonomy, Australia.*

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Zoropsidae (Fig. 1) resemble Huntsman spiders (Sparassidae) and have not been reported from Australia. The family includes only *Zoropsis* Simon, 1878 from Europe and North America (introduced, see Griswold & Ubick, 2001), *Akamasia* Bosselaers, 2002 from Cyprus, and *Takeoa* Lehtinen, 1967 from Japan (Bosselars, 2002). Simon (1892) admitted *Acanthoctenus* Keyserling, 1876, *Zorocrates* Simon, 1888 and *Raecius* Simon, 1892. Those genera have had a long and complex history and passed from the Drassidae (Simon, 1878), elevated to the Zoropsidae (Bertkau, 1882; Simon, 1892), synonymised with the Zoridae (part, Lehtinen, 1967, part), Ctenidae or Miturgidae (part, Lehtinen, 1967 & Griswold, 1993), some transferred to the Zorocratidae (Griswold et al., 1999, part) and now back to the Zoropsidae (Levy, 1990; Griswold, 1993). Restoration of the Zoropsidae (Levy, 1990) was given phylogenetic support in an analysis of lycosoid families (Griswold, 1993). The Stiphidiidae has been excluded from the Lycosoidea (Griswold et al., 1999). Inclusion of the Psechridae & Oxyopidae within the Lycosoidea (Homann, 1971 & Griswold, 1993) has resisted falsification using partial mitochondrial 12S and 16S ribosomal DNA sequences (Fang et al., 2000); however, the sample set was limited and yielded little data to contribute further to this study. Griswold (2002) revised *Raecius* (Zorocratidae) and Bosselaers (2002) added *Akamasia* and made a cladistic analysis of the Zoropsidae. Silva (2003) examined higher level relationships of ctenoids, including the Zoropsidae, and the preferred cladogram represented dramatic changes in family affinities. However, apart from minor transfers of ctenids, most of the significant higher level changes in the cladogram were not implemented.

The transfer of genera from Simon's Zoropsidae to diverse families bears brief explanation. Lehtinen's (1967) transfer of *Zoropsis* to the Zoridae was spurious, as testified to by his inclusion of the 3-clawed *Zoica*, later (Lehtinen & Hippa, 1979) transferred to the Lycosidae. The relationships of *Acanthoctenus* and the Zorocratidae, on the other hand, were well supported by Griswold (1993) but the nomenclatural implications accepted only by Griswold et al. (1999). However, throughout all, the absence of a explicit concept of the Miturgidae (cf. Lehtinen, 1967) has been the core of the problem. Hence, it was to that family that the species here described were assigned by Davies (1976, 1977).

The quest for miturgid monophyly was partially addressed by the removal of problematical

Australian taxa. Raven et al. (2001) placed the erstwhile miturgid *Amauropelma* Raven & Stumkat, 2001 into the Ctenidae and Raven & Stumkat (2003) separated the Australian miturgid *Mituliodon* Raven & Stumkat, 2003 from the New Zealand zoropsid *Uliodon* L. Koch, 1873. However, the group was still paraphyletic; unplaced miturgoids (Davies, 1976, 1977) more closely resembled *Zoropsis* than *Miturga*. Unlike *Miturga* itself, the miturgoids had strong claw tufts, strong paired spines ventrally on the anterior legs and have little or no leg scopula. Nevertheless, it was clear that the spiders belonged to the Lycosoidea along with the Miturgidae but not close to them. Similarly, the Australian *Huntia* Gray & Thompson, 2001 (and *Bengalla* Gray & Thompson, 2001) was described and left unplaced within the Lycosoidea. Resolution of the affinities of those miturgoids was only possible through a phylogenetic hypothesis using the Miturgidae, Ctenidae, Zoridae, Pisauridae, Lycosidae and the Zoropsidae.

## MATERIALS AND METHODS

Methods are similar to those used in Raven & Stumkat (2003) except as follows. Eye descriptions are made from directly above or in front and measurements are taken from above. Cheliceral dentition is given as the number of retromarginal teeth and promarginal teeth, e.g., r=4, p=3. Wherever possible, it was the left male palp that was drawn and scanned. Scanned material were either critical-point or air dried from alcohol-preserved material and then sputter-coated with gold before examination in an Hitachi S-530 scanning electron microscope, sometimes using a Robinson (T) backscatter detector. Epigynes were photographed in alcohol and then either cleared in lactic acid and drawn or gold-coated for examination with the scanning electron microscope. The four new genera here described are somatically similar; hence a full generic description is given only for *Megateg*, gen. nov. Characters consistent for the genus are generally described only there and omitted from species descriptions. *Spination*. This follows our previous method.

ABBREVIATIONS. ALE, anterior lateral eyes; ALS, anterior lateral spinnerets; AME, anterior median spinnerets; Cons. Pk, Conservation Park; e, embolus; cc, epigynal cleat; l, paraembolic lamellae; ma, median apophysis; MEQ, mid-eastern Queensland; NEQ, northeast Queensland; NP, National Park; PLE, posterior lateral eyes; PLS, posterior lateral spinnerets; PMS, posterior median spinnerets; pv, proventral; RCH, retrocoxal hymen; RTA, retrolateral tibial apophysis;rv, retroventral; SEQ, southeast Queensland; SF, State Forest.


FIG. 1. *Kilyana hendersoni*, sp. nov., ♀, habitus.

Institutions. BMNH, Natural History Museum, London; CBB, collection B. Baehr; MNHP, Musée National d'Histoire Naturelle, Paris; NHMW, Naturhistorisches Museum, Wien, Austria; NMSA, Natal Museum, South Africa; OMD, Otago Museum, Dunedin; QM, Queensland Museum, Brisbane; WAM, Western Australian Museum, Perth; SAM, South Australian Museum, Adelaide; AMS, Australian Museum, Sydney.

TERMINOLOGY. *Basodorsal process, male palpal cymbium* (Fig. 23B). In *Krukt*, the base of the cymbium is basally constricted into a low ridge or conical process.

*Epigynal cleats*. Raised half-domed ridges posteriorly on the epigyne (Figs 12E, 32C); pockets of Griswold (1993). The function is unclear.

*Epigynal plug*. Griswold (pers. comm.) suggested that an epigynal plug may be a useful character in defining a subgroup within the Lycosoidea. It was reported in the ctenid *Amauropelma* (Raven, Stumkat, & Gray, 2001) and is here reported in *Uliodon*, *Krukt*, *Megateg* and *Kilyana*, as well as in an undescribed Australian tengellid. Suhm et al. (1996), however, reported the plug, which they showed was generated by the bulbus gland in the male palpal bulb, to be in 14 entelegyne families of Orbiculariae, the dionycines, Amaurobioidea and Lycosoidea although they did not consider all of its occurrences homologous.

*Paracymbial discontinuity or flange, male palp* (Fig. 18A). In some male lycosoids, the retrolateral margin of the cymbium has a basal groove which extends for part or much of the basal edge. The smooth, uniformly curving rate of the retrolateral cymbium margin is disrupted by a distal widening thought to be the precursor, or the vestige, of a groove. That widening is termed the paracymbial discontinuity or flange.

*Epigynal scape*. Median septum of the epigyne which may form an uncut ridge but is not movable as in, for example, the linyphiid *Laperousea* or the araneid *Eriophora*.

NON-AUSTRALIAN MATERIAL.

Ctenidae – *Acanthoctenus gaujoni* Simon, 1906: MNHN; *Asthenoctenus borelli* Simon, 1897: MNHN; *Ctenus gigas* Franganillo, 1931: BMNH; *Ctenus malvernensis* Petrunkevitch, 1911: MNHN; *Cupiennius* sp.: BMNH; *Phoneutria* sp.: BMNH; *Vulsor* sp.: MNHN.

Miturgidae – *Zealoctenus cardoensis* Forster & Wilton, 1973 type: OMD.

Psechridae – *Psechrus sinensis* Berland & Berland, 1914, types: MNHN.

Tengellidae – *Lauricius hemicloeinus* Simon, 1888: MNHN; *Tengella albolineata* (F.O.P.-Cambridge, 1902): BMNH; *Titiotus californicus* Simon, 1897: MNHN.

Zoridae – *Zora spinimana* (Sundevall, 1833) QM.

Zoropsidae (*formerly Miturgidae) – *Devendra seriatus** (Simon, 1898): MF, MNHN; *Griswoldia disparile** (Lawrence, 1942): NMSA 4561; *Griswoldia punctata** (Lawrence, 1942): NMSA 18782, NM4311, NMSA 14380; *Griswoldia robusta** (Simon, 1898): MNHN; *Griswoldia urbensensis** (Lawrence, 1942): NMSA 3369; *Phanotea peringueyi** Simon, 1896: MNHN.

Zorocratinae – *Camptostichomma manicatum* Karsch, 1891: MNHN; *Uduba dahli* Simon, 1903: BMNH; *U. madagascariensis* (Vinson, 1863): MNHN; *Zorocrates badius* Simon, 1895: MNHN; *Z. fuscus* Simon, 1888: BMNH; *Uliodon albopunctatus* L. Koch, 1873, type F: NHMW; *Uliodon cervinus* L. Koch, 1873, type F: NHMW; *Uliodon frenatus* (L. Koch, 1873): BMNH, MNHN; *Zoropsis media* Simon, 1878: BMNH; *Z. spinimana* (Dufour, 1820): MNHN, CBB.

CLADISTICS. *Data*. The Hennig86 data set presented by Griswold (1993) were used as the base matrix.

ANALYSES. The analysis of Griswold (1993) was duplicated to ensure a consistent starting point. In those data, five genera were represented by more than one species. However, as we proposed to add a number of genera represented monotypically in the cladogram, the potential (in)stability was of interest. To see how those taxa in Griswold's original matrix would 'behave' when represented monotypically, six taxa (*Devendra seriatum*, *Griswoldia urbensensis*, *Phanotea* sp. 1, *Phanotea* sp. 2, *Uduba dahli* and *Zoropsis* 'France') were removed and the analysis repeated. Optimally, taxa should be added to trees to make the analysis more 'total'; only one tree resulted from the 26 taxon analysis. It was similar to the initial tree (used by Griswold, 1993) but *Campostichomma* was widely separated from the other zorocratids as the sister group to *Mituliodon* plus the Pisauridae-Lycosidae clade. The change indicated the instability of the data set when genera were represented monotypically.

The dataset of Griswold (1993) was then manually converted and imported into DELTA 1.04 (Dallwitz et. al., 1998); that allowed easier scoring and checking of characters. (Neither the data set nor manuscript of Silva (2003) were known at that time.) We then used the Nexus Data Editor (Page, 1998) to translate the data from DELTA back to Hennig86 format; however, that resulted in unpredicted data corruption. Instead, we used DELTA 1.04 and the Action Set 'tohen' (translate DELTA into Hennig86 format). The full multispecies original data set was used. Although Griswold et al. (1999) recinded the inclusion of *Stiphidion* in the Lycosoidea because it was found to belong to another group, it was kept in this data set. To those data, we added species representing several genera: *Kilyana hendersoni*, sp. nov., *Huntia deepensis* Gray & Thompson, 2001, *Krukt piligyna*, sp. nov., *Megateg elegans*, sp. nov., *Birrana bulburin*, sp. nov., *Amauropelma trueloves* Raven & Stumkat, 2001, *Bengalla* sp., a new Australian tengellid; *Miturga lineata* Thorell, 1878, *Diaprograpta* sp., both in the Miturgidae, and the zorid *Argoctenus* sp. 'Q4'. Several characters were added and some characters used by Griswold (1993, e.g., cribellum, tarsal organ, embolus tip) were modified to accommodate the states in the added taxa, some were deleted (e.g., calamistrum); and in several, the sequence of states (in unordered characters) was changed (for cosmetic reasons).

At the outset, *Devendra*, *Griswoldia*, *Huntia* and *Phanotea* were listed in the Miturgidae (Platnick, 2003).

The matrix is presented as Appendix 1.

All characters were treated as unordered and equally weighted. Although the use of unordered characters is notionally an acceptance of the Principle of Indifference (Wilkinson, 1992), most characters used here could not be ordered although some are easily polarised.

NONA 2.0 (Goloboff, 1997) was used through Winclada 1.00.08 (Nixon, 2002) with the settings mult*1000, with 1000 replications and 25 starting trees per replications. Non-homoplasious synapomorphies are represented by black squares and homoplasious synapomorphies by black dots.

CHARACTERS. (Those without comment are unchanged from Griswold, 1993).

**0.** Male tibial crack: *0*, absent; *1*, present. A fine crack appears on the leg tibiae of male lycosoids (Fig. 22F). It is very close to the base, often a ventral or lateral spine occurs on its distal side. The crack is evident with a dissecting microscope but is often more readily seen on the retrolateral side. Griswold (1991) identifed this character in the Lycosoidea. Griswold (1993) found the tibial crack to be so homoplasious in the cladogram and accepted that to constrain it to a single apomorphy would have resulted in 7 extra steps.

**1.** Cymbium dorsally with dense scopulate patch: *0*, absent or not dense scopula; *1*, present. This character has been modified to refer only to a dense ovoid area of scopula forming a more of less flattened outer surface. It is presumbably what Bosselaers (2002) termed a bristle pad but it is not bristles (see Fig. 33E,F). A number of taxa have modified hairs on the cymbium including *Argoctenus* and Psechridae. The hairs on the upper legs in lycosoids are densely grouped, thickened and brush-like for part of their length and bluntly tipped. However, hairs dorsally on the cymbium of the psechrids (*Fecenia* and *Psechrus*) are bristle-like and not forming a flattened outer pad. Hence, the lycosoid cymbial pad is considered another synapomorphy of the group excluding *Zorocrates*, *Devendra*, and *Campostichomma* and with a secondary loss in one species of *Griswoldia* (*G. robusta*).

**2.** Apical cymbium : *0*, elongate or clearly conical; *1*, truncate or little longer than bulb. Despite figuring a wide diversity of cymbial shapes, Griswold (1993) coded very few. Our research indicates that the cymbium is not only rich in characters but that the characters are highly consistent and hence informative. Taxa described all have a deep (in dorsoventral plane) cymbium with some modification of the tip. In *Zoropsis* (Levy, 1990), *Krukt* and *Megateg*, the cymbium is deep, apically truncate and indented. In *Kilyana*, it is apically coniform but twisted (Fig. 41A). In *Megateg* (Fig. 9A) and *Zoropsis* (Levy, 1990), the margin is broadly rounded and to a greater or lesser extent the cymbium prolaterally extends below the bulb. The plesiomorphic condition is considered that found in *Tengella* in which the apical cymbium is long and conical.

**3.** Male abdominal shield : *0*, absent; *1*, present. In all four genera here described, *Zoropsis*, and the New Zealand *Uliodon*, a pair of transverse slit-like 'sigilla' are evident on the anterior face of the abdomen just above the pedicel (Fig. 3A,B). They are present in both males and females but are more evident in males as they are the foci of an oval biconcave scute or sclerotisation. It is associated with 4 large paired sigilla dorsally on the abdomen. The character is absent in the miturgids, *Miturga*, *Mituliodon tarantulina* (L. Koch), *Diaprograpta*, and all known Australian Corinnidae, Clubionidae, Cycloctenidae, Pisauridae, Ctenidae, and Zoridae. A similar condition is here reported in *Argyroneto* (Cybaeidae) and the philodromid *Thanatus formicinus* (Clerck, 1757). In these genera, four sigilla are evident in the semicircle dorsal of the pedicel; however, the 'sigilla' are small and oval but males have no associated sclerotisation. Both males and females (CBB) of *Coelotes inermis* (L. Koch, 1855) have small rectangular sigilla in a similar position but the surrounding area is not sclerotised and is not sexually dimorphic. On dissection of *Megateg*, no muscles were evident internally at that point and hence the term 'sigilla' is incorrect. The shield/scute appears simply to have two eye-like sockets.

However, an additional feature is associated with the sigilla in male zoropsids. The sigilloid scars are present in both males and females but only in males is there sufficient sclerotisation to be deemed a scute. This sclerotisation is considered autapomorphic and on the suggestion of Griswold (in litt.) is termed a shield.

Dorsal sigilla are the attachment sites of dorso-ventral muscles passing vertically through the abdomen. They occur in most spiders but are not universal (Marples, 1968). They are plesiomorphically present and large in mygalomorphs and Mesothelae (Millot, 1933, 1936), and hypochiloids (Marples, 1968). None of the sigilla identified by Millot or Marples have muscle attachments on the abdomen wall so low and close to the pedicel as here noted. Millot (1933, 1936) and Marples (1968) showed only an infracardiac ligament attaching to the posterior wall of the heart at a position near that of the centre of the anterior abdominal plates.

In most spiders, the dorsal sigilla are often not readily evident and are hence quite small. Marples (1968) noted that, in araneomorphs, the number of dorso-ventral muscles varies from 4 pairs to none. Also, dorso-ventral muscles are not always lost in the same sequence. The distinction here is that the sigilloid scars are enlarged and quite evident and in that state they are also evident anteriorly on the abdomen.

**4.** Male palpal tibia with retrolateral apophysis: *0*, present; *1*, absent (*Psechrus* & Lycosidae). Subdorsal tibial apophysis (Fig. 34D). The presence of a retrolateral tibial apophysis (RTA) on the palp of males took on special significance when Coddington & Levi (1991) drew attention to it following Griswold (1990) and elaborated by Griswold (1993). However, distinction was not made in the position of the tibial apophysis. Clearly, the dorsal apophysis of the Nicodamidae (Harvey, 1995) presents even a mere definitional problem: a dorsal retrolateral tibial apophysis. In most groups with a tibial apophysis, the base of the apophysis is clearly evident and lateral when viewed ventrally. However, in a number of other groups, notably *Zoropsis*, the New Zealand *Uliodon*, and some species of genera described here, the tibial apophysis is commonly set so high on the tibia that from ventral view the base is not evident. That condition is considered significant but not here fully surveyed.

**5.** Male palpal tibia with retroapical cuticle unsclerotised: *0*, absent; *1*, present (Trechaleidae).

**6.** Male palpal tibia with ventral apophysis in addition to retrolateral: *0*, absent; *1*, present in *Uduba*, *Campostichomma*, *Raecius*, *Zorodictyna*, Australian tengellid, *Bengalla*, *Stiphidion*.

**7.** Cymbial dorsobasal projection: *0*, absent; *1*, present in *Zorodictyna*, *Huntia*, *Krukt*, *Ctenus*. Initially, this character appears quite informative but within the Australian zoropsids here revised it is present only in *Krukt* and absent in its unequivocal sister genus, *Megateg*.

**8.** Subtegulum/tegulum interlocking lobes: *0*, present; *1*, absent. Tegular-subtegular interlocking lobes were first reported (Griswold, 1993) in the Lycosoidea. In *Megateg elegans* and *M. bartholomai*, prolaterally the subtegulum has small basal lobe which sits inside the basal extension of the embolus (Fig. 3C,D) and is here presumed to qualify at least functionally as an interlocking lobe. However, Platnick (1999) noted that some species of the liocranid *Agroeca* Westring have a form of the lobe also involving part of the embolus but being much more anterior than in lycosoids we considered it was not homologous.

**9.** Separate tegular conductor: *0*, present; *1*, absent in *Krukt*, *Megateg*, *Birrana*, *Kilyana*, *Uduba* and *Trechalea*. Griswold (1993) considered a conductor was absent if 'No part of the palpal bulb serves to guide or protect [the] embolus'. Bosselaers (2002), on the other hand, considered that a hyaline or sclerotised appendage, immovably attached to the tegulum and facing the embolus tip is considered to be a 'conductor'. Apart from embolar support being provided by the groove formed by the ventral cymbial tip, conduction for the embolus in genera here revised is (presumably) provided from two different sources. In *Megateg ramboldi* and *M. elegans*, a long tegular grooved process (albeit shallow) arises from the base of the embolus but extends well past the embolus tip. These appear as tegular lobes and only doubtfully serve any guiding function for the embolus. Equally, in *Kilyana hendersoni*, a long fimbriate paraembolic guide arises from the base of the embolus and parallels it only for the basal half but the embolus is very long and conduction at the tip seems only possible by the cymbial groove. The second kind of conduction lies in the grooved distal ridge of the median apophysis of *Kilyana ingrami* (Fig. 49C,D). Here, we take the concept implicit in Griswold and adapted by Bosselaers. In the Australian zoropsids, save for *Huntia*, a tegular process (but not the median apophysis) arising near the embolus tip and serving a conduction function is absent. That transfer of the conduction function is considered a synapomorphy of the Australian zoropsids, save for *Huntia*. Characters coding the different kinds of conductor used by Griswold are not used here as the establishment of homology is assumption rich. That problem also arises in the coding of the median apophysis which is nonetheless accepted here.

**10.** Median apophysis : *0*, present; *1*, absent only in *Psechrus*, *Stiphidion*, *Uliodon*.

**11.** Median apophysis, position on tegulum: *0*, median, insertion near middle of tegulum; *1*, retrobasal, insertion near proximal margin of tegulum only in two *Phanotea* species and *Amauropelma*.

**12.** Median apophysis, shape: *0*, convex, club- or hook-shaped, narrow, convex on all surfaces or with concavities forming only narrow grooves; *1*, cup-shaped, prolateral surface a deep oval concavity that is closed distally, retrolateral surface arched, convex (*Devendra*, *Campostichomma*, *Raecius*, *Huntia*, *Griswoldia*, *Phanotea* and the three ctenid genera).

**13.** Concave Median apophysis: *0*, simple (*Devendra*, *Campostichomma*, *Raecius*, *Acanthoctenus*, *Amauropelma*); *1*, bimarginate, concavity with inner and outer rims, these separated at apex of apophysis (*Huntia*, *Griswoldia*, *Phanotea*, *Phoneutria*, *Ctenus*).

**14.** Convex Median apophysis: *0*, hooked or bent distally; *1*, large, swollen, with 2 apical lobes, bilobate (*Trechalea*, *Rhoicinus*, *Miturga*, *Diaprograpta*); *2*, triangular in cross section, simple (*Uduba*, *Bengalla*, *Lycosidae*).

**15.** Hooked Median apophysis: *0*, simple; *1*, bifid (*Zoropsis*, *Kilyana*, *Megateg*, *Krukt*, *Birrana*, *Miturga*, *Diaprograpta*).

**16.** Median apophysis, angle: *0*, longitudinal; *1*, transverse (*Uduba*, Lycosidae).

**17.** Tegulum: *0*, oval (most genera); *1*, bifid, divided into separate proapical and retroapical processes (*Uduba*); *2*, notched probasally so that subtegulum is visible in ventral view (Trechaleidae, *Miturga*, Lycosidae).

**18.** Distal tegular process (DTP): *0*, absent; *1*, present (Lycosidae, Pisauridae, Trechaleidae).

**19.** Tegular lobe or process (sclerotised tegular projection, STP) arising near embolus base: *0*, absent; *1*, present (*Fecenia*, *Zorocrates*, *Raecius*, *Birrana*, *Megateg*, *Pisaura*, *Ctenus*, *Miturga*).

**20.** Paraembolic vane or lamina, i.e. median membranous region of tegulum (between base of median apophysis and embolus): *0*, simple, convex; *1*, with vane (projection, MTP) arising near embolus base (*Takeoa*, *Zoropsis*, *Birrana*, *Krukt*, *Megateg*, *Uliodon*, *Zorodictyna*). In *Megateg*, typically, there are four membranous laminae on the bulb, three are universal, one is present in all but one species. In addition, consistently present distally on the embolus is a lamina which is also found in *Zoropsis lutea* (Thorell, 1875) (but not in *Z. media* Simon or *Z. rufipes* (Lucas)) that Levy (1990) named a translucent embolic lamina (see Fig. 19A,B). Griswold (1995) reported the character (no. 6 in his analysis) in three species of *Phanotea* (*P. cavata*, *P. xhosa*, *P. digitata*) as one of the synapomorphies of the group. In *Megateg*, it extends back from the embolus tip folds basally and then makes a small semicircular lamina dorsally, i.e., between the embolus and cymbium. The second is a large rounded wing-like lamina extending almost completely for the retrobasal edge of the median apophysis and sometimes curling ventrally around the median apophysis. Such a lamina has not been previously noted in the Lycosoidea (MTP of Griswold, 1993). The third is a large lamina arising entally adjacent to the base of the embolus and extending distally between the embolus and median apophysis; it varies in shape from a broad rounded wing to almost a triangular spike. It is the membranous tegular process (P) of Levy (1990). Griswold (1993) also reported it *Zorodictyna* and *Takeoa*. The fourth, almost global, lamina is small, rounded and triangular and arises entally of the base of the median apophysis. It is similar in size, shape and position to the P of Levy (1990).

Of the Australian zoropsids, only *Huntia* Gray & Thompson, 2001 has a conductor in the sense of a lamina that arises from the tegulum near the embolus tip. In that at least *Huntia* is allied to *Devendra* and *Zorodictyna*. A conductor is present in New Zealand Uliodon but it lacks a sclerotised median apophysis.

**21.** Embolus base: *0*, fixed, with sclerotised attachment to main body of tegulum; *1*, flexibly attached to tegulum by membranous cuticle (*Mituliodon*, *Diaprograpta*, *Bengalla*, Lycosidae, Pisauridae, Trechaleidae, *Uduba*, *Kilyana*, *Huntia*).

**22.** Embolus arising from basal lobe (EL): *0*, absent, with embolus origin gradually tapering from tegular surface; *1*, present with embolus base bulbous or lobate, whether or not firmly or flexibly attached to tegulum (*Mituliodon*, *Miturga*, *Diaprograpta*, *Argoctenus*, *Bengalla*, Lycosidae, Pisauridae, Trechaleidae, *Uduba*, *Kilyana*, *Zorocrates*, *Campostichomma*).

**23.** Basal lobe of embolus with process (ELP): *0*, present, with lobe or protuberance; *1*, absent, basal lobe smoothly curved (*Mituliodon*, *Miturga*, *Sossipus*, *Bengalla*, *Argoctenus*).

**24.** Embolus, direction of curve (left bulb, ventral view): *0*, clockwise; *1*, counter-clockwise (Lycosidae, Pisauridae, Trechaleidae, *Uduba*).

**25.** Embolus : *0*, stout, tapering to apex, convex or flattened (*Tengella*, *Devendra*, *Raecius*, *Zorodictyna*, *Huntia*, *Amauropelma*, *Griswoldia*, *Phoneutria*, *Austrotengella*, *Uliodon*); *1*, slender, curved spine (most genera); *2*, broad, concave, apex divided into dorsal (ED) and ventral (EV) lobes (*Takeoa*, *Phanotea* (part), *Ctenus*); *3*, a broad thin flange (*Zoropsis* (part), *Phanotea* (part); *4*, thin spine and apical recurved in keel (*Megateg*, some *Zoropsis*).

**26.** Epigyne, configuration: *0*, clearly divided by longitudinal epigynal fold (EPF) into median sector (MS) and paired lateral lobes (LL); *1*, MS and LL fused, not divided longitudinally into 3 parts.

**27.** Lateral lobes, shape: *0*, convex, unmodified; *1*, concavity or pocket; *2*, tooth.

**28.** Lateral lobes teeth, kind: *0*, short, median (Ctenidae); *1*, long median (some *Phanotea*); *2*, on posterior margin (*Rhoicinus*).

**29.** Median sector (MS) of epigynum: *0*, median lobe (ML); swollen with a lobe or protuberance; *1*, unmodified, flat or gently convex.

**30.** Median lobe (form, convex MS): *0*, scape, projecting ventrad with abrupt posterior margin; *1*, a swollen lobe extending to posterior margin (Ctenidae); *2*, median longitudinal swellings.

**31.** ML scape (kind): *0*, simple, broadly attached anteriorly (*Tengella*); *1*, an erectile scape, narrowly attached anteriorly (*Zoropsis*).

**32.** Posterior divot or fossa on scape: *0*, present; *1*, absent.

**33.** Shape of copulatory duct (CD): *0*, short, broad, length less than vulva (*Zorodictyna*); *1*, longer than or equal to vulva; *2*, very long, length greater than vulva and looped back on itself (*Uduba*).

**34.** Inner margin of epigynal groove (EG): *0*, absent; not apparent on dorsal surface of epigynal plate; *1*, inner bulge separate from vulva; *2*, broad bulge, leading to copulatory duct (CD); *3*, narrow, approximately parallel to copulatory duct extending posteriorly to near fertilisation duct (FD).

**35.** Head of spermatheca (that part with pores): *0*, small, narrow, smaller than BS (*Mituliodon*); *1*, large spherical, larger than BS; *2*, absent, no porose area (*Uduba*).

**36.** Base of spermatheca chambered (BS, area just before FD, internal structure): *0*, simple, spherical or tubular; *1*, chambered.

**37.** Base of spermatheca with pronounced lobe (BS, external shape): *0*, simple (*Raecius*); *1*, pronounced lobe; *2*, long, sinuate (*Mituliodon*).

**38.** Fertilisation duct (FD, position): *0*, posterior; *1*, median.

**39.** Posterior eye row shape: *0*, nearly straight, OAL:OQL less than 1.2; *1*, recurved, OAL:OQL more than 1.2.

**40.** ALE and PME in line: *0*, no; *1*, yes (Ctenidae).

**41.** PLE behind PME, ratio of PER to OQP less than 1.6 (Lycosidae): *0*, no; *1*, yes.

**42.** ALE relative to AME: *0*, about same size; *1*, clearly smaller; *2*, clearly bigger. Large lateral eyes (Fig. 5). In most groups with recurved eye rows, the smaller eyes are either the laterals (e.g., Ctenidae, Cycloctenidae, Zoridae) and/or the front row (e.g., Lycosidae, Pisauridae), or all eyes are of a similar size (e.g., Miturgidae, Sparassidae). In the Zoropsidae, the synapomorphic and common condition (all Australian zoropsid genera here included, except *Kilyana* where it is variable) is that the anterior lateral eyes (at least) are clearly larger than the anterior median eyes. The direction the eyes 'look' does not seem, as initially thought, to convey additional information.

**43.** Tapetum: *0*, canoe-shaped; *1*, grate-shaped; *2*, diffuse, blotchy. Although the character is taken from Griswold (1993), we were unable to confirm that *Stiphidion* has a grate-shaped tapetum. On the other hand, we did note that, contrary to Homann (1971), at least one zorid genus *Argoctenus* does have a grate-shaped tapetum.

**44.** Ratio of male tibia I to carapace width: *0*, less than 2.7; *1*, more than 3.

**45.** Tarsus, dorsal trichobothria, rows: *0*, 2 or 3 irregular rows; *1*, 1 row.

**46.** Dense claw tufts obscuring pretarsus: *0*, absent; *1*, present. Claw tufts. Here taken to be clusters of finely fimbriate hairs with broadly rounded or flared tips arising from a separate pad (see Raven, 1986, 1994) ectally beside each claw (Figs 22A-E, 40A,B). The hairs usually enlarge distally. Hence, the extended scopula of, for example, *Miturga lineata* Thorell, do not qualify.

**47.** Diamond-shaped hair cluster below tufts (Fig. 40) : *0*, absent; *1*, present. In Zoropsinae, below the claw tufts, an additional cluster of highly fimbriate hairs occurs in a triangular area on the distal ventral tarsi centred around the apex of the tarsus. The hairs are optically darker and apically taper to smooth elongate filaments (Figs 22C, 40D). The wider distribution of these filamentous scopuliform hairs is not known.

**48.** Claws on leg I, number: *0*, 3; *1*, 2. In at least one genus (considered to be a tengellid), the number of claws on the first and fourth legs differ. The more apomorphic condition (2 claws) is present on leg I and the plesiomorphic condition (3 claws) is present on the leg IV. So we have modified the character from Griswold (1993) to reflect the more apomorphic state. Raven (1985) discussed anterior-posterior leg differences in the Mygalomorphae.

**49.** Scopula on leg I: *0*, absent; *1*, present.

**50.** Tarsal organ, form: *0*, aperture simple, oval to round; *1*, keyhole-shaped; *2*, stellate, margin forming several inward-pointing lobes; *3*, a long elevated rod with apical aperture. Tarsal rod (Figs 3F, 38B). A tarsal rod set at about 40-50° is present from about the mid-point of the pedal tarsi to just basal of the mid-point in *Megateg*, *Krukt* and *Birrana*. In some cases, the rod is present only on one tarsus (e.g., III) but is presumably broken off on other legs as its presence is indicated by a large, ovoid, pallid region which is the base. The rod is set at about 70-80° to the cuticle and under hydraulic control. The rod is not present on the palpal tarsi of either males or females nor is a tarsal organ also evident. Unlike *Amauropelma* (see Raven, Stumkat & Gray, 2001), the tarsal rod or organ of zoropsids is the same relative position on all leg tarsi. In *Krukt* and *Megateg*, the rod is very long with the aperture on the undersurface of the tip and at the base of a spine-like apex (Fig. 3F), whereas in *Birrana* (Fig. 38B) it is much shorter with the aperture terminally on truncated tip.

**51.** Trichobothrial base, texture of hood: *0*, transversely striate; *1*, with fine longitudinal striations to smooth.

*Spination*. Both Griswold (1993) and Bosselaers (2002) used spination of both males and females to a different extent in their data sets. Our approach has been to identify spines in unusual positions or configurations. Griswold (1993) scored the number of spine pairs ventrally on tibae I, II. Bosselaers (2002) divided that into the scores for males and females and added a number of characters based on spines, continuing the separation of males and females without noting the almost complete correlation. Neither author noted the significance of the robustness of the tibial spines but only the number of pairs. Hence, four pairs of weak spines appear no different in their data matrices to the strong spines seen here (Fig. 34C). Equally, the spines of *Megateg* (and others) are on decidely raised bases; the condition is most evident in females but weaker in males. The stronger paired spines are more often found in hunting spiders but can be found in groups (e.g., *Clubiona*, pers. obs.) which are otherwise only weakly spined. Significant among those strong spines is the proventral femoral spine (character 52). However, more common in the hunting spiders is the reduction, often to total absence, in dorsal and lateral spines on tibiae I, II in females. Hence, the presence of spines in these positions may yet prove quite informative. Equally, as we here found, males of females with reduced spines themselves may have a higher dorsal and lateral spine complement on legs I, II and as such may represent the plesiomorphic condition of the higher group (see Raven, 1985, on biserial dentition of male Barychelidae).

In all four new genera herein, tibiae and metatarsi I and II have strong paired spines ventrolaterally (Fig. 34C). On the tibiae, the spines are in 4 pairs from the base to subdistal and all also have an additional unpaired distal spine proventrally. The metatarsi consistently have 3 pairs of strong spines. In *Uliodon*, the spination is the same but the extra anterodistal spine is absent on the tibiae.

All four Australian zoropsid genera described here show similar patterns of leg spination and useful common features can be seen. Females: a strong proventral spine on femora I (character 52); as well as prolaterally, dorsally and retrolaterally; spines only retrolaterally on patellae III, IV; spination of legs I and II (Fig. 34C) varies only on femora with only ventral paired spines on tibiae (pv5rv4) and metatarsi (v2.2.2). In males, spines are also present prolaterally and retrolaterally on tibiae and metatarsi I and II and one retrolateral spine occurs on all patellae.

Proximobasal ventral tibial spine. Paired ventral spines on tibia I, II typically do not occupy the full length of the tibia. In the Australian Zoropsidae, the spine complement lacks the distal pair and the most basal pair are set on the tibia basal of the area defined by the dorsal extent of patella (Figs 33A, 34B). The most basal spine ventrally on the tibia is inside that area also in *Zoropsis spinimana*, the miturgid *'Odo' gracilis*, the New Zealand *Uliodon*, as well as in new genera here described and in *Zora spinimana*.

As part of our as yet unpublished work on Australian cursorial spider families we found, in most Australian miturgids, the spination on tibiae I, II is 3 weak pairs ventrally. In some, up to 4 spines may occur in a transverse line basally. Only 2 pairs of weak spines are present ventrally on the metatarsi. The same is true is the Australian zorids with two exceptions: on tibiae I, II, in *Elassoctenus*, from 5-7 pairs of spines and in *Hestimodema* only 2 pairs of spines may be present. However, in all cases, in zorids and miturgids only two pairs of spines are present on metatarsi I, II (see Raven et al., 2002). Hence, the condition used here and also reported by Bosselaers (2002) of the metatarsi I, II having 3-5 strong paired spines is unusual and considered a synapomorphy within the higher in-group.

52. Femur I with proventral spines : *0*, absent in *Tengella*, Psechridae, Lycosidae, Pisauridae, Miturgidae s.strict., Ctenidae except *Amauropelma*, *Stiphidion*, *Senoculus*, *Tapillinus*, Zoridae; *1*, widely present in higher in-group but also present in the zorid genus *Hestimodema*.the amaurobiid *Dardurus*. On the lower half of femur I, basally and prolaterally, is a distinct enlarged spine in the distal fifth. A prolateral spine is also present above it (Fig. 33D): the proventral spine is distal to it and in a line ventral to that. In *Megateg*, *Krukt*, *Zoropsis*, *Uliodon* and *Kilyana*, the spine is present only on femur I. In females, the spine is noticeably enlarged and on a low mound, even more so than the strong paired spines ventrally on tibia I, II. That condition is also present in *Griswoldia*.
53. Female tibia I, lateral spines: *0*, present; *1*, absent. Within the higher in-group, present only in *Takeoa*, *Zoropsis*, *Huntia* and *Phanotea peringueyensis*.
54. Spines on tibia I, female, on raised bases (Fig. 34C): *0*, absent; *1*, present through much of the higher in-group but not in *Phanotea*, at least. The distinction of this character is that the paired ventral spines in females are large and on raised bases. In other groups with numerous paired spines on the tibia (e.g., Zoridae), the spine bases are like other spines whereas in the in-group, the spine bases are enlarged.
55. Pairs of ventral spines on tibia I of both sexes: *0*, 4; *1*, 4 with extra anteroventral just behind apical pair; *2*, 5; *3*, 7 or more; *4*, 3; *5*, 6 pairs.
56. Metatarsi I, II, no. of ventral spine pairs: *0*, 2 or weak; *1*, 3 or more, strong.
57. Male tibia I, dorsal spines: *0*, absent; *1*, 1; *2*, 2 or more. Different states often occur within the same family.
58. Female tibia I, dorsal spines: *0*, absent; *1*, present only in *Dolomedes*, *Pisaura*, *Senoculus* and *Tapillinus*.
59. Male metatarsus I or II, lateroapical pairs of spines: *0*, absent; *1*, present.
60. Nursery web: *0*, no; *1*, yes only in *Dolomedes*, *Pisaura*.
61. Egg sac carried on spinnerets: *0*, no; *1*, yes in Lycosidae.
62. Retrocoxal hymen : *0*, present; *1*, absent only in *Senoculus*, *Dolomedes*, *Pisaura* and *Tapillinus*.
63. Female with dorsal spigots on PMS (Fig. 3E) : *0*, absent; *1*, present. In araneomorph spiders, spigots are present apically on the posterior median spinnerets in females. In some genera, notably the four here described, *Zoropsis*, and the New Zealand *Uliodon*, as well as an undescribed Australian 'tengellid', *Campostichomma* and *Griswoldia*, the spigots form two lines along the dorsal surface (Figs 3E, 21C, 39C, 42E) similar to that in female Centrothelinae (Lamponidae, Platnick, 2000) but the spigots in the zoropsids are not so enlarged. The character is present in some species (e.g. *M. elegans*, *M. covacevichae*) of all genera described here but is not without homoplasy. It is also present in the sparianthine sparassid *Thelcticopis rubristernis* Strand, 1911 (pers. obs., RJR) but absent in *Neosparassus salacius* (L. Koch). The character is absent in the miturgids, *Miturga*, *Mituliodon tarantulina* (L. Koch), *Diaprograpta*, and all known Australian Corinnidae, Clubionidae, Cycloctenidae, Pisauridae, Ctenidae and Zoridae.

    Associated with the dorsal spigots on the PMS are the spinnerets being set on a raised base. The condition is diagnostic of the sparassid subfamily Sparianthidinae (Simon, 1897). In alcohol, the spinnerets of these Australian zoropsids are often spread apart but almost invariably they can be readily seen to be on a raised common base (Fig. 32E). The condition is present in males and females herein described; however, a very wide survey has not been conducted. Their presence in the Sparianthidinae should be taken to test the hypothesis of non-relationship as at least *Thelcticopis* also has a cymbial scopula.
64. Cribellum colulus: *0*, cribellum present; *1*, wide fleshy colulus; *2*, colulus narrow.
65. Trochanter notches: *0*, deep; *1*, broad, very shallow; *2*, absent. Two descriptors are used: the relative width to depth which is greater on legs I, II than on III, IV (i.e. notch is shallower); the symmetry of the notch which can be lop-sided (deeper on trailing edge, Fig. 34A) on legs I, II.

## RESULTS

Ten equally parsimonious trees were found (and shown with unsupported nodes collapsed): length 295, consistency index 0.30; retention index 0.66. The fast optimisation setting in

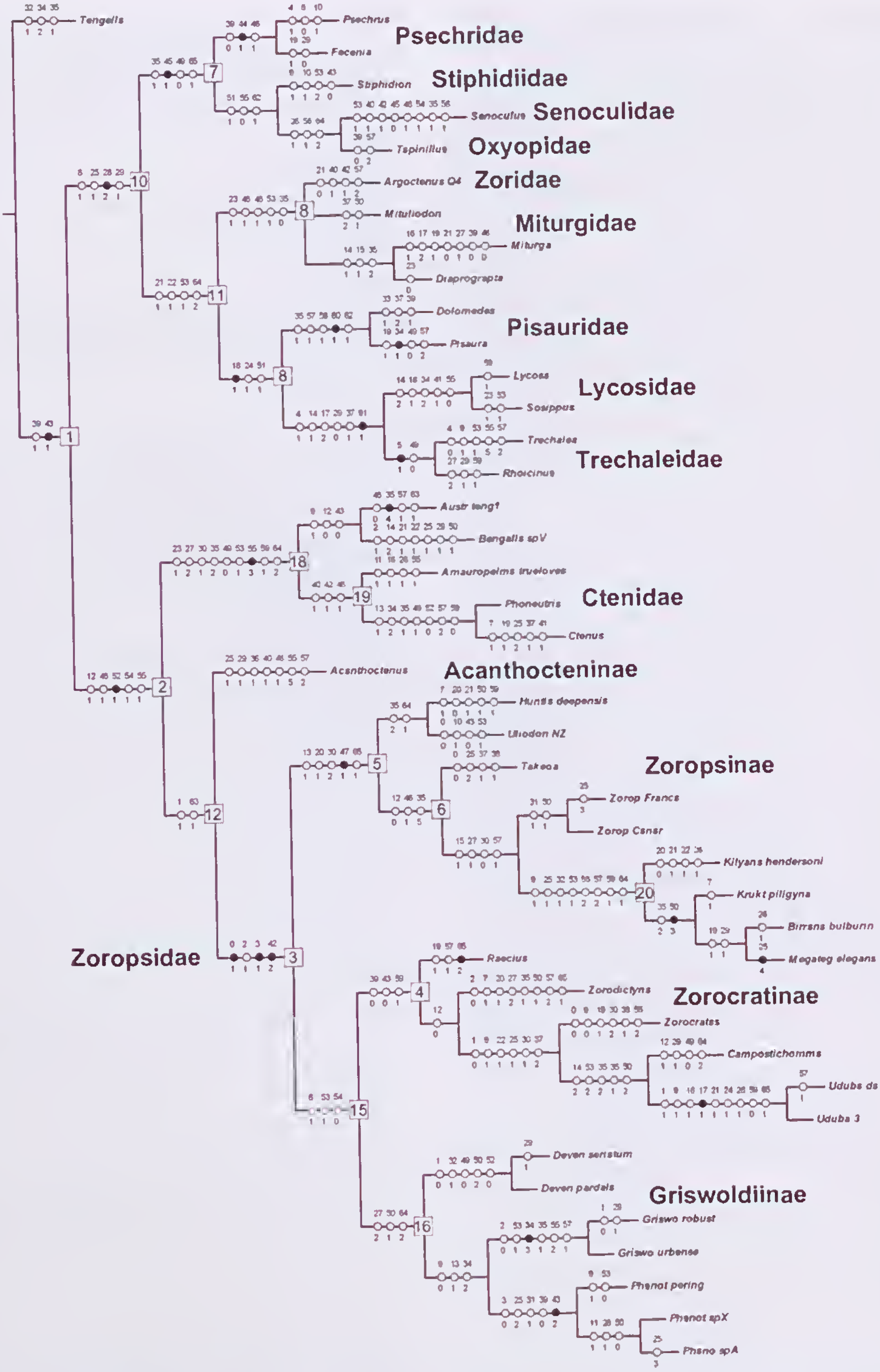

FIG. 2. Cladogram of Zoropsidae and other lycosoids. Non-homoplasious changes are marked with a black rectangle; homoplasious changes optimised towards tree's root are marked with a black circle.

Winclada was taken and a nelsen consensus tree produced (length 330, consistency index 0.27; retention index 0.60. (PAUP*4 was also used with the same resulting trees.)

In the consensus tree here found, within the 'higher lycosoids' (Griswold, 1993, fig. 87), Psechridae, Stiphidiidae, Senoculidae, Oxyopidae together form a clade, as do Pisauridae, Trechaleidae plus Lycosidae. The Miturgidae (sensu Raven & Stumkat, 2003) and Zoridae vary in position but remain basal. The higher ctenids, *Phoneutria* and *Ctenus*, form a clade but the basal ctenid, *Amauropelma*, groups lower on the cladogram. Consistently, Zorocratidae form a clade and the Australian and New Zealand zoropsids form a clade with *Takeoa* and *Zoropsis*.

In stark contrast, Silva (2003)'s preferred tree showed *Tengella* remote from the other tengellids and sister genus of *Zorocrates* supported only by two highly homoplasious characters (oval PLE and 'loss' of the male tibial crack). Despite substantial support for controversial groupings (e.g., Eutichirinae remote from the Miturgidae as currently placed but clustering with the Clubionidae), Silva (2003) placed no significance on these groups and restricted her taxonomic changes to the Ctenidae which indeed was the proclaimed focus of the paper. (Many were characters clearly chosen because they were taken to be significant with the Ctenidae but had implications in her 'outgroup' taxa.) Notwithstanding the fact that characters used by Silva (2003) & Griswold (1993) overlap only by around 25%, that Silva (2003) included 6 families not used by Griswold (1993) and reduced the number of representative taxa in the Zoropsidae, Zorocratidae and Griswoldiinae, it is hardly surprising that a radically different placement of the many groups resulted. As we noted above, the simple reduction of genera represented by multiple species in the data set of Griswold (1993) to single species representation resulted in the polyphyly of the Zorocratidae. Different data sets produce different cladograms even if one is inclusive within the other.

Further integration of Silva's (2003) characters into those used here is not possible because most states were not well documented or illustrated and in some cases were incorrectly coded, e.g. number of tarsal claws (character 110) does not allow for the different states on legs I and IV noted in character 111.

*Choice of Trees*. Of the 10 trees, 8 were strongly pectinated with single species or genera repetitively placed as the sister group of many taxa; the other two trees showed sister groups of similar sizes. Of those two, only one, the preferred tree, shows *Devendra* as monophyletic and at least the ctenids *Amauropelma*, *Ctenus* and *Phoneutria* as monophyletic. That preferred tree (Fig. 2) also shows the Zorocratidae (sensu Griswold, 1993, based on the most parsimonious tree with 'nelsen' consensus) as monophyletic and the Miturgidae plus Zoridae are newly seen as monophyletic. The Miturgidae still group with the 'higher' lycosoids and remain remote from *Phanotea*, *Devendra*, *Griswoldia*.

Significant differences between this cladogram and that of Griswold (1993) are that the Zorocratidae are now part of the zoropsoid complex and within the Lycosoidea. This cladogram shows that the Zoropsinae, Zorocratinae and Griswoldiinae are monophyletic and the sister group is the Ctenidae. Of minor difference, the relationships between zorocratid genera are preserved save that *Zorodictyna* and *Raecius* are not sister groups.

## CONCLUSIONS

The Zoropsidae are now expanded substantially and considered to include three subfamilies: Zoropsinae, Zorocratinae and Griswoldiinae, the latter two are new placements. The characters upon which the group is based are the tibial crack in males (#0, with presumed reversals in *Takeoa*, *Uliodon* and *Zorocrates*), anterior abdominal shield in males (#3, with a presumed reversal in *Phanotea*), the truncate apical cymbium (#2, with presumed reversals in *Griswoldia* and *Zorodictyna*), and the ALE being relatively larger than the AME (#42). The position of *Acanthoctenus* is contentious as only one character was used that would unite it with other ctenids, the ctenoid eye condition. We propose that a cladogram that includes more ctenid taxa would unite *Acanthoctenus* with them and not as the sister group of the zoropsoids. Hence, *Acanthoctenus* is maintained in the Ctenidae. Two characters found in *Acanthoctenus* are shared with the Zoropsidae — scopula on the dorsal cymbium of males (#1) and spigots dorsally in rows on the PMS of females (#63).

The cladogram supports the transfer of the Zoridae to the Lycosoidea, indicated by the presence of a grate-shaped tapetum. Also, the Miturgidae are the sister group of the Zoridae and shown to be more closely related to lycosids and pisaurids than the Zoropsidae and Ctenidae.

## SYSTEMATICS

### Family ZOROPSIDAE BERTKAU, 1882

Zoropsididae [sic.] Bertkau, 1882: 337.
Uliodoninae Lehtinen, 1967: 316. Synonymised by Raven & Stumkat (2003).

DIAGNOSIS. Male Zoropsidae differ from those of Miturgidae in the dense scopula dorsally on male palpal cymbium, pedal tibia with basal fracture, 4-5 pairs of strong spines on raised bases on tibiae I, II and a sclerotised plate on the anterior abdomen. Most female zoropsids have spigots dorsally on the posterior median spinnerets but all have strongly paired spines on raised bases on tibiae and metatarsi I, II. Other characters used in the diagnostic description are more equivocal.

Males with dense scopula dorsally on male palpal cymbium, pedal tibia with basal crack, except *Takeoa*; tibial apophysis, if present, more dorsal than retrolateral; eyes in two recurved rows; 2-3 claws; claw tufts present or absent. Cribellum present or absent. Spigots present dorsally on PMS of females; apical PLS short, domed. Femur I, especially of females, with enlarged spine proventrally; 4 pairs of strong spines ventrally on tibia and 3 pairs on metatarsi I, II. Trochanters weakly but distinctly notched. Labium wider than long or as long as wide.

SUBFAMILIES.
Zoropsinae.
*Akamasia* Bosselaers, 2002 (Cyprus); *Birrana* gen. nov. (Qld); *Huntia* Gray & Thompson, 2001 (WA and Vic); *Kilyana* gen. nov. (Qld, NSW); *Krukt* gen. nov. (N Qld); *Megateg* gen. nov. (N Qld); *Takeoa* Lehtinen, 1967 (Japan); *Uliodon* L. Koch, 1873 (New Zealand); *Zoropsis* Simon, 1878 (Holarctic, introduced to North America).
Zorocratinae.
*Campostichomma* Karsch, 1891 (Sri Lanka); *Raecius* Simon, 1892 (equatorial Africa); *Uduba* Simon, 1880 (Madagascar); *Zorocrates* Simon, 1888 (USA, Mexico, Central America); *Zorodictyna* Strand, 1907 (Madagascar).
Griswoldiinae.
*Devendra* Lehtinen, 1967 (Sri Lanka); *Griswoldia* Dippenaar-Schoeman & Jocqué, 1997 (South Africa); *Phanotea* Simon, 1896 (South Africa).

RELATIONSHIPS OF AUSTRALIAN ZOROPSIDS. All 4 new genera described here share the combination of 2 recurved eye rows with lateral eyes the largest, a broad carapace, (distinct & strong) claw tufts, 2 claws, strong paired spines on tibiae and metatarsi I, II, legs I & II laterigrade, tibial apophysis more dorsal than retrolateral on the male palp, and a dense scopula dorsally on the cymbium. All have a form of tegular-subtegular interlocking lobes on the male palp. They also share two other characters of significance. The spinnerets are on a raised conical base, similar to but not quite so pronounced as in the sparassid Sparianthidinae. Second, males have a sclerotised scute with a paired depression on the front surface of the abdomen. The depression in males is generated by transverse anterior sigilla also present in females. Females also have spigots in two lines along the dorsal surface of the PMS.

*Megateg* and *Krukt* share a long tarsal rod and leg scopula weak or absent. *Megateg* has long male palpal tibia, extensive basal tegulum, short distal embolus, no basodorsal process on cymbium, and the epigyne is a flat plate with convergent grooves around a low ridge and often with basolateral 'cleats'. The embolus is short and simple, varying from a narrow spike to a grooved sheath; however, apically it reflexes back strongly and continues along the leading edge of embolic lamina. The median apophysis is always mobile and a scooped retrolateral plate with a small apical hook. The tegulum is consistently dominant and basal and the sperm duct smoothly follows the outer edge from the retrodistal origin to the embolus. The cymbium is always apically truncate with an extensive dorsal scopula. A distinct retrobasal discontinuity is present in some species. The tibial apophysis is simple, often large and retrolateral to dorsal.

Of the two genera in southern Queensland and northern New South Wales, *Kilyana* lacks a tarsal rod (but a scopula is present but weak in females and stronger in males) whereas *Birrana* has a tarsal rod.

### KEY TO GENERA OF AUSTRALIAN ZOROPSIDAE

| | | |
|---|---|---|
| 1. | Males (males of *Huntia murrindal* Gray & Thompson, 2001 unknown) | 2 |
| | Females | 6 |
| 2. | Tarsal rod present (Fig. 3F) | 3 |
| | Tarsal rod absent | 5 |
| 3. | Palpal tibia much longer than wide (Figs 6, 12D) | *Megateg* |
| | Palpal tibia little or hardly longer than wide (Figs 25A, 37A) | 4 |
| 4. | Tegulum small, retrolateral (Fig. 23A) | *Krukt* |
| | Tegulum large, basal (Fig. 36A) | *Birrana* |
| 5. | Two claws and claw tufts (Fig. 40A) | *Kilyana* |
| | Three claws and tufts absent | *Huntia deepensis* |
| 6. | Two claws and claw tufts (Fig. 40A) | 7 |
| | Three claws and tufts absent | *Huntia murrindal* |
| 7. | Tarsal rod present (Fig. 3E) | 7 |
| | Tarsal rod absent | *Kilyana* |
| 8. | Tarsal rod short (Fig. 38B) | *Birrana* |

Tarsal rod long (Fig. 3F) . . . . . . . . . . . . . . . . . 9

9. Epigyne with lateral cleats weak or absent (Figs 11B); single simple receptaculum (e.g., Fig. 14B) . . . . . . . . . . . . . . . . . . . . . . *Megateg*, part

Epigyne with distinct lateral cleats (Fig. 12G): receptaculum variable . . . . . . . . . . . . . . . . . 10

10. Epigyne with narrow hirsute scape-like septum (Fig. 23D). . . . . . . . . . . . . . . . . . . *Krukt piligyna*

Epigynal scape absent or not narrow and hirsute . . . 11

11. Epigyne very flat, 2-dimensional; lateral cleats low (Fig. 12E, 14A, 19C). . . . . . . . . . . . . . . *Megateg*, part

Epigyne strongly raised with strong deep lateral cleats (Figs 26D, 29D, 32C) postero-laterally . . . *Krukt*, part

### **Huntia** Gray & Thompson, 2001

*Huntia* Gray & Thompson, 2001: 164.

TYPE SPECIES: *Huntia deepensis* Gray & Thompson, 2001.

DIAGNOSIS. Tibial crack present. Third claw reduced; claw tufts absent. Palpal conductor present. Tarsal organ short, distal or central rod.

INCLUDED SPECIES. *H. deepensis* Gray & Thompson, 2001; *H. murrindal* Gray & Thompson, 2001.

REMARKS. The female of *Huntia murrindal* Gray & Thompson, 2001 differs from that of *H. deepensis* by its tarsal rod. However, the male is unknown and using this key would key to *Megateg*. If the diagnostic conductor in the male of *H. deepensis* is consistent in *H. murrindal* that character would distinguish the two genera.

DISTRIBUTION. WA and Victoria (Fig. 20).

### **Megateg** gen. nov.

TYPE SPECIES: *Megateg ramboldi*, sp. nov.

ETYMOLOGY. An arbitary combination of letters; the gender is female.

DIAGNOSIS. *Megateg* differs from *Zoropsis* in the absence of a cribellum and having both anterior and posterior median eyes smaller than their respective lateral eyes. Males of *Megateg* are readily distinguished from those of *Krukt* in the long palpal tibia and the basally extensive tegulum and the flared apex of the embolus; females differ in that the epigyne is low with paired lateral grooves whereas females of *Krukt* have an elevated scape or septum medially. It differs from *Miturga* in the combination of two recurved eye rows, a broad carapace, distinct and strong true claw tufts, a crack basally on the pedal tibiae of males, a retrodorsal rather than retrolateral tibial apophysis on the palp, a dense scopula dorsally on the cymbium and a long tarsal rod. The synapomorphy of *Megateg* is the combination of the long tarsal rod and the flared apical tip of the embolus back into which the sperm duct recurves.

DESCRIPTION. *Carapace*: broadly pear-shaped; lateral profile gently curved from posterior margin to just anterior to fovea and gently curved down to short vertical clypeus. Carapace outline like *Heteropoda* (Sparassidae); caput delineation indistinct save for pigmented Y; other striae indicated only by short black setae. Pilosity: uniform cover of short fine brown hairs; long bristles along clypeal edge; shorter black bristles in radial strial lines. Fovea short, deep, longitudinal with triangular dark zone anteriorly; fovea starts just behind widest carapace. Margins not rebordered. Colour yellow brown with brown radial marks with 3 pallid ovoid areas on margin. Hair types simple, not feathery. Eye region not forming a black mask. *Eyes*: 8 in two clearly recurved rows; median eyes clearly smaller than laterals. AME on common tubercle set forward of clypeus; eyes look forward and to side at about 45°; about 1.2 diameters apart. ALE inset, on low tubercle, look forward and to side; with short curving ridge ectally, close to AME. MOQ a long quadrangle, wider behind than in front. PME small, pallid, subcircular, raised, and look up; about 2 diameters apart. PLE on low tubercle, look back and to side; ca. 3 diameters from PME. Front row straight; clypeus = ca. 2 × AME diameter. Group occupies 0.5-0.68 of headwidth (front width: back width: length, ca. 3: 4: 2). Tapetum grate-shaped in *Megateg ramboldi*.

*Chelicerae*: short, large with distinct boss. Dentition: p=2-4, r=3-4. Fang without processes, long, transverse; strong teeth near fang base; no enlarged fang setae. In males, chelicerae smaller but with relatively longer groove. *Labium*: slightly longer than wide, anteromedially domed, basally constricted with marginal teeth; not rebordered and without other grooves; uniformly but lightly hirsute. *Maxillae*: about twice length of labium, basally narrowly truncate, anteriorly enlarged, medially laterally constricted. Short, indistinct scopula on rounded anterior ental edge; serrula short, slightly curved. *Sternum*: broad, flat, subcircular, not extending between coxae IV; intercoxal sclerites at III/IV. Uniformly hirsute. Pedicel unsclerotised.

*Legs*: I & II laterigrade. Coxae similar; precoxal sclerites larger anteriorly than posteriorly, distinct on all coxae. Femora I, II clearly thicker than III, IV; less so or not in males. Trochanters with shallow asymmetrical notches on II-IV (e.g., Fig. 34A), I not notched. Retrocoxal hymen on coxa I ovoid, subcentral, similar in males and females. Scopula absent or weak on metatarsi & tarsi I, II of males and females. Tarsi in males and females short (I = 0.4 of metatarsus length), not flexible, cylindrical for length. Female palpal tarsi apically conical but arched in lateral view. No single elongate setae distally on patellae and tibiae of legs. Leg hairs simple. Males with relatively longer legs; trochanters like female. *Spines*: females with very long, strong proventral spine on femora I (e.g., Fig. 33D); four pairs of strong spines on raised bases overlapping ventrally on tibiae I, II (e.g., Fig. 34C); 3 strong pairs ventrally on metatarsi I, II, with basal two pairs very long with short distal pair; no spines laterally on tibiae I, II, retrolateral femora I, II, patellae I-II, or on leg tarsi. Spines present dorsally laterally and ventrally on tibiae III, IV and laterally and ventrally on metatarsi III, IV; distal whorl short on metatarsi III, IV. Preening combs absent. *Males*: with many long erect hairs on tibiae to tarsi. Spines on I, II like female but more slender and shorter; patellae I, II with retrolateral spines; tibiae I, II also with dorsal and lateral spines; metatarsi I, II also with lateral spines. Tibial crack in males orthogonal to long axis (e.g., Fig. 22F), most basal ventral tibial spine pair proximal of crack. *Trichobothria*: in two irregular rows or bands for length of tibiae; very long hairs on metatarsi and tarsi in band along dorsal surface; base with 3-5 transverse ridges (e.g. Fig. 38B). *Tarsal organ*: an elongate rod with apical aperture (Fig. 3F), set in large soft ovoid base at basal 1/3-2/5 of tarsus. *Claw tufts* (Fig. 22A-E): small, dense, cluster on ental side of claws; tufts shorter than claws. Two claws each with one moderately long and 1-2 smaller teeth basally; claws not obscured by hairs. Metatarsi with unilobate membrane distally. Female palpal claw without tuft; *ca.* five moderately long teeth; palpal patella with deep narrow distal invagination for distal 5/6 in females, distal 1/3 in males.

*Abdomen*: dorsally brown with darker brown foliate pattern; scutes absent but males with large shallow pair of depressions in sclerotised shield on anterior face (e.g., Fig. 3A); pilosity as for carapace; venter pallid. Tracheal spiracle indistinct, near spinnerets. *Spinnerets* (Fig. 17A-F): broad, triangular to wide rectangular, hirsute colulus. In females, spinnerets on raised base similar to Sparianthinae. ALS short, broad, truncate, coniform, apical segment distally reniform with two large spigots entally, 2-3 smaller spigots medially and a field of 30-40 smaller spigots. PLS of similar length but *ca.* 0.5 diameter of ALS, apical cone short, domed with 1-2 large spigots apically. In females, PMS short, triangular in lateral view with two rows of spigots along true dorsal surface (e.g., Fig. 3E); in males, bases of ALS separated and PMS are simple cylinders but with 3 large spigots apically.

*Epigyne*: with median septum and lateral cleats basally or cleats absent; a longitudinal copulatory fossa leads directly to small simple spermathecae posteriorly.

*Male Palp*: tibia longer than wide with glabrous ventral concavity for distal third; tibial apophysis is retrodorsal (base is not visible from ventral view, Fig. 10D), simple, with predistal dark sclerotised zone and without unsclerotised areas or laminas, and process is not socketed. Cymbium deep, partially encloses bulb laterally; dense distal scopula (e.g., Fig. 33C) oval for 2/3 length; no basidorsal process; cymbium distally indented; with retrobasal dorsal concavity with deep U-shaped invagination presumably to receive probasal dorsal tibial sclerite. Bulb with large basal trilobate tegulum for basal 1/3-1/2; median apophysis short, hooked scoop retrolaterally; conductor absent; distal embolus short, hooked, prodistally with distal flared apex with translucent dorsal wing. Median apophysis and embolus bases widely separated and each free; embolus extends back as long scythe-like hook; subtegulum large with subtle notch (interlocking lobe, Fig. 3C,D) against tegulum.

DISTRIBUTION AND HABITAT. From rainforest between the Bloomfield River, north of Cairns, to Hinchinbrook Island in the south; only in northeastern Queensland.

INCLUDED SPECIES. *M. bartholomai*, sp. nov.; *M. covacevichae*, sp. nov.; *M. elegans*, sp. nov.; *M. gigasep*, sp. nov.; *M. lesbiae*, sp. nov.; *M. paulstumkati*, sp. nov.; *M. ramboldi*, sp. nov.; *M. spurgeon*, sp. nov.

RELATIONSHIPS. As with other groups found in rainforests of the Wet Tropics World Heritage Area of Queensland, e.g. the zodariid *Tropasteron* (Baehr, 2003), interrelations of species of both *Megateg*, gen. nov. and *Krukt*, gen. nov., within the region resist full elucidation. Males of all *Megateg* species for which they are known have the palpal tibia bowed or straight (*M. elegans*). Of the former group, males of *M. bartholomai* and *M. spurgeon* share a very large tibial apophysis; in other species, it is small. In *M. ramboldi*, *M. covacevichae* and *M. paulstumkati*, the submarginal palpal lamina is large that is taken to be the synapomorphy of the group. Lateral epigynal cleats are found in females of *M. spurgeon*, *M. ramboldi*, and *M. elegans* but since they are also found in the sister genus *Krukt*, gen. nov., their presence in *Megateg* is considered plesiomorphic. Males of *M. lesbiae* and *M. gigasep* are unknown and hence those species are considered to form a basal polytomy with *M. elegans*. Hence, the cladogram of *Megateg* is: (*M. lesbiae-M. elegans-M. gigasep* ((*M. covacevichae-M. ramboldi-M. paulstumkati*)(*M. bartholomai-M.spurgeon*))).

BIOGEOGRAPHY. Most species occur in montane rainforests of the Wet Tropics World Heritage Area and most are endemic to adjacent forests. However, *M. elegans* is widespread from Cape Tribulation south to about Ravenshoe but with disjunct outliers just south at Walter Hill Range. It also appears to be the lowland complement, if not sister species, of the mountain top *M. ramboldi*. The simple vulva of *M. lesbiae* (known only from females) unequivocally associates the species with *Megateg* and shares with the Walter Hill Range material of *M. elegans* the most southerly known extent of the genus.

In most localities, only one species of *Megateg* is present. However, the Mt Spurgeon area includes three species *M. bartholomai*, *M. spurgeon* and *M. paulstumkati*, of which only the latter is endemic to Mt Spurgeon which must be considered a centre of diversity.

## KEY TO SPECIES OF *MEGATEG*

Males (males of *Megateg lesbiae* and *M. gigasep* unknown)

1\. Tibial apophysis large, heavy (Figs 6D, 9D) . . . . . . 2

Tibial apophysis slender, tapers distally (Fig. 6A,C) . . 3

2\. Embolus with strong basal thorn (Fig. 9B) . . . . . . . . . . . . . . . . . . . . . *M. bartholomai*

Embolus without basal thorn (Figs 18B, 19A) . . . . . . . . . . . . . . . . . . . . . *M. spurgeon*

3\. Palpal tibia cylindrical, clearly not bowed (Fig. 6A,B) . 4

Palpal tibia clearly bowed laterally (Fig. 6C,E). . . . . 5

4\. Embolus apically a long slender spike (Fig. 12A,B); palpal tibia with retrobasal cluster of long thick blunt bristles (Fig. 6H) . . . . . . . . . . . . . *M. elegans*

Embolus apically wider or truncate (Fig. 7A); palpal tibia basally without cluster of thick blunt bristles (Fig. 6A) . . . . . . . . . . . . . . . . . . . *M. ramboldi*

5\. Palpal tibia longer (Fig. 6C); median apophysis distally broad with apical lamina (Fig. 10B). . *M. covacevichae*

Palpal tibia shorter (Fig. 6E); median apophysis tapers to slender hook; vane is basal (Fig. 15B) . *M. paulstumkati*

Females

1\. Median scape very broad with sinuous lateral ridges posteriorly (Fig. 13A,B) . . . . . . . . . . *M. gigasep*

Median scape not broad or no sinuous ridges posteriorly . 2

2\. Lateral cleats on epigyne present (Fig. 12E), sometimes indistinct (Fig. 14A) . . . . . . . . . . . . . . . . . . 5

Lateral cleats clearly absent (Figs 9F, 16A). . . . . . . 3

3\. Large black epigyne with medial groove widely separating lateral lobes (Fig. 9F) . . . . *M. bartholomai*

Epigyne pallid, lateral grooves close or convergent . . 4

4\. Epigynal ridges join or form U-shape posteriorly (Fig. 11B). . . . . . . . . . . . . . . . . . *M. covacevichae*

Epigyne, lateral grooves form biconcave lens (Fig. 16A) . . . . . . . . . . . . . . . . . . . . . . *M. paulstumkati*

5\. Paramedian groove on epigyne distinct (Fig. 10C) . . . 6

Paramedian groove on epigyne absent or transverse and indistinct (Fig. 14A) . . . . . . . . . . . . . *M. lesbiae*

6\. Paramedian grooves distinctly converge posteriorly (Fig. 19C) . . . . . . . . . . . . . . . . . . . . *M. spurgeon*

Paramedian grooves flask-like, widest medially or predistally (Figs 8A, 12E) . . . . . . . . . . . . . . . 7

7\. Median septum with long anterior neck (Fig. 12E) . . . . . . . . . . . . . . . . . . . . . . . . . *M. elegans*

Median septum bulbuous with shorter anterior neck (Fig. 8A) . . . . . . . . . . . . . . . . . . . . *M. ramboldi*

### **Megateg ramboldi** sp. nov.
### (Figs 3A,B,D, 4, 5E, 6A,B, 7-8; Table 1)

ETYMOLOGY. For Dr Gerhard Rambold, University of Bayreuth.

MATERIAL. HOLOTYPE. ♂, Bellenden Ker Ra, Summit TV Stn, 17°16'S 145°51'E, NEQLD, rainforest, pitfall, 1-30 Apr 1982, S.Montague, QM S31174. PARATYPES. Bellenden Ker Ra, sieved litter: Centre Peak Summit, 17°16'S 145°51'E, 1560m: 4 ♀♀, 10-12 Apr 1979, G. Monteith, QM S31175 (allotype), S27866-8; 1 ♂, 2 ♀, 28 Oct 1983, G.Monteith, D. Yeates, G. Thompson, QM S32952, S31184; 6 ♀♀, 29 Apr-2 May 1983, G.Monteith, D.Yeates, QM S31183, S31180, S27859, S31181; 2 ♀♀, 1-7 Nov 1981, Earthwatch Qld Museum, QM S27857; 1 ♀, same data but 17-24 Oct 1981, QM S27865; 1 ♂, 8 Oct 1991, G.Monteith, H.Janetzki, D.Cook, QM S31182; 3 ♀♀, Cable Tower 3, 17-24 Oct 1981, Earthwatch Qld Museum, QM S26231; 1 ♀, same data but summit, 25 Oct- 7 Nov 1981, QM S26230. Mt Bartle-Frere, Earthwatch Qld Museum expedition: 1 ♀, NW-centre Peak ridge, 17°23'S 145°48'E, 7-8 Nov 1981, QM S39532; 2 ♀♀, 0.5km north of South Peak, 17°24'S 145°49'E, sieved litter, 6-8 Nov 1981, QM S39533; 1 ♂, Sth Peak Summit, 6-8 Nov 1981, QM S39534. All in rainforest in NEQld.

DIAGNOSIS. Differs from *M. elegans* in males lacking a retrobasal setal cluster on the cylindrical palpal tibia and females have a medial pair of smoothly biconvex ridges forming the septum whereas in *M. elegans*, the distal quarter of the septum quickly widens.

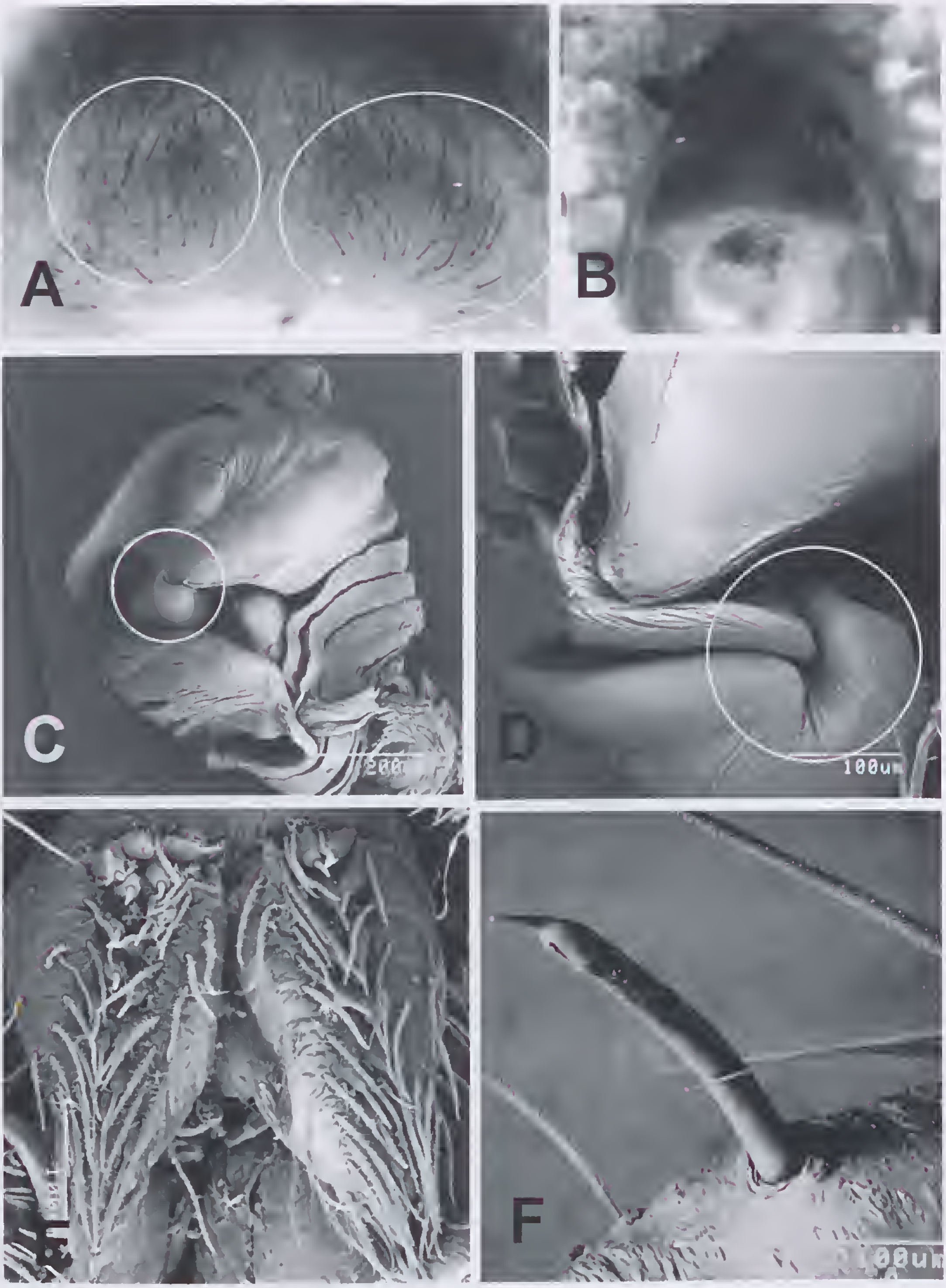

FIG. 3. *Megateg ramboldi*, sp. nov., A-D, ♂, anterior face of abdomen showing sclerotised shield, encircled (A). C, D, ♂ palpal bulb with interlocking lobe encircled. E, *Krukt piligyna*, sp. nov., ♀, posterior median spinnerets, dorsal view. F, *Megateg elegans*, sp. nov., ♀ tarsus I, tarsal rod, lateral view.

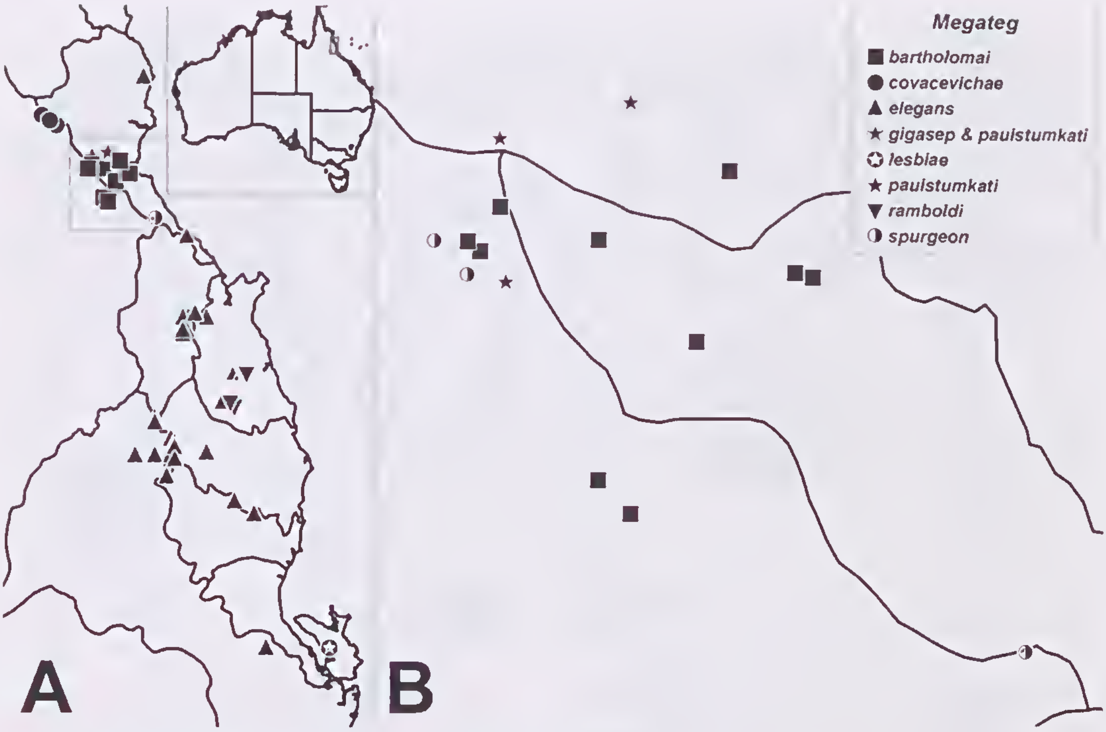

FIG. 4. *Megateg*, distribution map, showing drainage basin ridges.

DESCRIPTION. Holotype ♂. Carapace 5.08 long, 4.20 wide. Abdomen 4.04, 3.16 wide. Total length, 9.2.

*Eyes*: AME:ALE:PME:PLE, 11:14:10:12. Eye group front width: back width: length, 65:90:42. Interspaces: AME-AME, 0.9; AME-ALE, 0.4; PME-PME, 1.8; PME-PLE, 1.1.

*Chelicerae*: p=3, r=3.

*Spines*: I: fe pv1p2d4r3; pa r1; ti p3d2r3v2.2.2.2; me v2.2.2. II: fe pv1p3d3r4; pa r1; ti p3d2r3v2.2.2.2; me p2r2v2.2.2. III: fe p4d4r4; pa r1; ti p2d2r3v2.2.2; me p4r4v2.2.2. IV: fe p4d3r3; pa r1; ti p2d2r2v2.2.2; me p4r3v7. Palp: fe p1d2.

*Legs*: scopula absent; tibial fracture on I, II prolaterally distinct, grooved retrolaterally, not evident retrolaterally on III, IV. Trochanteral notches shallow, deeper in back of notch than front.

*Palp*: tibia cylindrical, longer than wide; 8-10 long setae on retrobasal corner, cluster of long hairs below tibial apophysis but more retrobasally and glabrous around it, prolaterally of that; with ventral, low, distal collar and higher prodorsal collar. Tibial apophysis a small dorsal (base not evident viewed ventrally), sinuous, blunt blade; from ventral, brush obscures apophysis but face of blade parallel to eye; from side, knife-like with basal enlargement. *Cymbium*: scopula extends along sloping surface; basodorsal process absent; paracymbial discontinuity absent but much cymbium evident wide of bulb. *Bulb*: median apophysis scooped

TABLE 1. Leg measurements of *Megateg ramboldi*, holotype male and allotype female.

| Male | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 5.08 | 4.54 | 3.85 | 4.54 | 2.46 |
| Patella | 1.92 | 1.92 | 1.08 | 1.54 | 1.08 |
| Tibia | 5.08 | 4.15 | 2.69 | 4.08 | 1.08 |
| Metatarsus | 5.69 | 4.31 | 3.38 | 4.92 | 1.08 |
| Tarsus | 1.69 | 1.54 | 1.31 | 1.85 | |
| Total | 19.46 | 16.46 | 12.31 | 16.93 | 5.70 |
| Female | I | II | III | IV | Palp |
| Femur | 3.46 | 3.31 | 2.85 | 3.69 | 1.54 |
| Patella | 1.92 | 1.85 | 1.54 | 1.54 | 1.00 |
| Tibia | 2.92 | 2.69 | 1.85 | 2.85 | 1.08 |
| Metatarsus | 2.46 | 2.31 | 1.85 | 3.61 | 1.15 |
| Tarsus | 1.00 | 1.00 | 1.00 | 1.15 | |
| Total | 11.76 | 11.16 | 9.09 | 12.84 | 4.77 |

FIG. 5. *Megateg*, cephalothorax and abdomen, dorsal view. A, *M. elegans*, sp. nov., ♂. B, *M. covacevichae*, sp. nov., ♂. C, *M. paulstumkati*, sp. nov., ♂. D, *M. lesbiae*, sp. nov., ♀. E, *M. ramboldi*, sp. nov., ♀.

with simple cetal hook with basal hyaline lamella; base regular, crescentic, small. Embolus short, wide, hooked with hyaline extension distally. Small, hyaline, leaf-shaped process plus small triangular process between base of embolus and median apophysis.

Allotype ♀ QMS31175. Carapace 5.84 long, 4.64 wide. Abdomen 5.84, 4.44 wide. Total length, 12.

*Eyes*: AME:ALE:PME:PLE, 10:13:9:12. Eye group front width: back width: length, 77:110:44. Interspaces: AME-AME, 1.8; AME-ALE, 1.2; PME-PME, 3.1; PME-PLE, 1.6.

*Chelicerae*: as for male.

*Spines*: I: fe pv1 strong, p1d2r1; pa 0; ti v2.2.2.2; me v2.2.2. II: fe p3d3r1; pa 0; ti v2.2.2.2. me v2.2.2. III: fe p3d3r2; pa 0; ti p2d2r2v2.2; me p4r5v2.2.2. IV: fe p3d3r1; pa r1; ti p2d2r2v5; me p4r4v7. Palp: fe p1d2; pa 0; ti p2; ta p3.

*Legs*: scopula on tarsi I, II weak. Paired claws with 2-3 teeth. Tarsal rod at basal 1/3 of tarsi.

*Epigyne*: a pair of sinuous lateral hoods; long, narrow, median septum, reniform when viewed axially from front (Fig. 8B).

DISTRIBUTION AND HABITAT. High altitude (>700m) rainforest at Bellenden Ker Range and Mt Bartle Frere, NE Qld.

## **Megateg bartholomai** sp. nov.

(Figs 4, 9; Table 2)

ETYMOLOGY. For Dr Alan Bartholomai, Director, of the Queensland Museum from 1969 to 1999.

MATERIAL. HOLOTYPE. ♂, Upper Cow Ck, 1.5km NE of Mt Spurgeon, 16°26'S 145°13'E, NEQLD, 15-21 Oct 1991, G.Monteith, H.Janetzki, D.Cook, L.Roberts, QM S31109. PARATYPES: Allotype, ♀, as for holotype, QM S31110. 1 ♂, as for holotype, QM S31111; 4 ♂♂, Mossman Bluff Track, 5-10km W Mossman, Site 8, 16°28'S 145°22'E, flight intercept trap, 1-17 Jan 1989, G.Monteith, G.Thompson ANZSES Expedition, QM S31145, S31152; 1 ♂, same data but 20 Dec 1989-15 Jan 1990, QM S16548; 2 ♂♂, same data but 16°25'S 145°20'E, 20-24 Dec 1989, QM S31147, 31151; 1 ♂, same data but Site 7, 16°28'S 145°22'E, 16-30 Dec 1988, QM S31150; 1 ♀, same data but site 10, 16°39'S 145°34'E, flight trap, 17-31 Dec 1988, QM S31133; 2 ♀♀, Mt Demi, summit, 16°30'S 145°19'E, pitfall, 17 Dec 1995-25 Jan 1996, G. Monteith, G.Thompson, Ford, QM S41358; 1 ♂, Mt Lewis, 16°35'S 145°17'E, sieved litter, 12 Oct 1980, G. Monteith, QM S31143; 1 ♀, Mt Lewis Rd, 22km from highway (Site 3), 16°35'S 145°17'E, pitfall, 18 Dec 1989-13 Jan 1990, G.Monteith, G.Thompson, ANZSES Expedition, QM S31192; 2 ♀♀, Mt Lewis, 2.5km N, 16°34'S 145°16'E, sieved litter, 3 Nov 1983, D.Yeates, G.Thompson, QM S31191; 1 ♀, Mt Lewis, 5.5km N, 16°34'S 145°16'E, sieved litter, 8 Sep 1981, G.Monteith, D.Cook, QM S31153; 4 ♂♂, Mt Spurgeon, 2k SE, 16°27'S 145°12'E, NEQLD, 20 Dec 1988-4 Jan 1989, G.Monteith, G.Thompson, ANZSES Expedition, QM S31146, S31156, S31144; 1 ♂, Pauls Luck, Carbine Tableland, 16°27'S 145°16'E, pitfall, 28-30 Nov 1990, G.Monteith, H.Janetzki, D.Cook, QM S31154; 1 ♀,

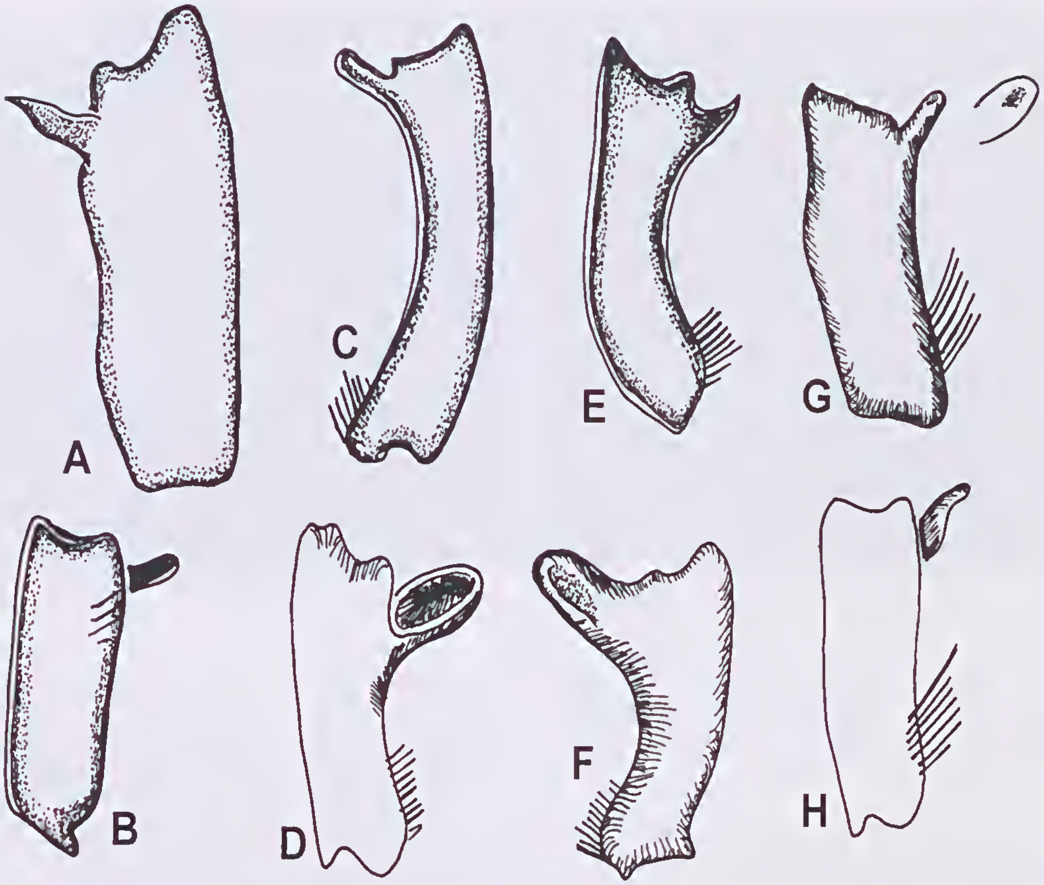

FIG. 6. *Megateg*, ♂ palpal tibia, left. A, B. *M. ramboldi*, sp. nov., dorsal (A) and ventral (B) views. C, *M. covacevichae*, sp. nov., dorsal view. D, F, *M. spurgeon*, sp. nov., ventral (D) and dorsal (F) views. E, *M. paulstumkati*, sp. nov., ventral view. G, H, *M. elegans*, sp. nov., ventral view, paratype, Upper Boulder Creek (G); H, QM S39045. Scale line = 1mm (B-G), H = 0.8mm.

Platypus Ck, Pauls Luck Track, 13km W Mossman, 16°27'S 145°16'E, pitfall, 1-16 Jan 1990, ANZSES expedition, QM S31193. All in NEQld and rainforest, except as noted.

DIAGNOSIS. Males are unique in the large triangular thorn on the basal embolus and the large scooped tibial apophysis. Females differ from those of *M. paulstumkati* in the full transverse copulatory groove.

DESCRIPTION. Holotype ♂ QM S31109. Carapace 4.20 long, 3.32 wide. Abdomen 3.00, 2.56 wide. Total length, 7.4.

*Colour*: carapace yellow brown with narrow dark submarginal band, darker on striae. Abdomen dorsally mostly yellow brown with dark 'shoulders', two pairs dark 'eyes', and mottled black tip above spinnerets; ventrally yellow

TABLE 2. Leg measurements of *Megateg bartholomai*, holotype male and allotype female.

| Male | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 3.01 | 3.01 | 2.92 | 3.46 | 1.46 |
| Patella | 1.15 | 1.15 | 1.15 | 1.31 | 0.69 |
| Tibia | 4.00 | 3.61 | 2.38 | 3.15 | 1.08 |
| Metatarsus | 3.92 | 3.00 | 2.77 | 4.08 | 1.23 |
| Tarsus | 1.92 | 1.46 | 1.31 | 1.77 | |
| Total | 14.00 | 12.23 | 10.53 | 13.77 | 4.46 |
| **Female** | **I** | **II** | **III** | **IV** | **Palp** |
| Femur | 2.54 | 2.69 | 2.23 | 2.92 | 1.31 |
| Patella | 1.31 | 1.38 | 1.15 | 1.31 | 0.85 |
| Tibia | 2.46 | 2.31 | 1.85 | 2.61 | 0.69 |
| Metatarsus | 2.00 | 1.92 | 1.69 | 2.85 | 0.92 |
| Tarsus | 0.77 | 0.69 | 1.00 | 1.38 | |
| Total | 9.08 | 8.99 | 7.92 | 11.07 | 3.77 |

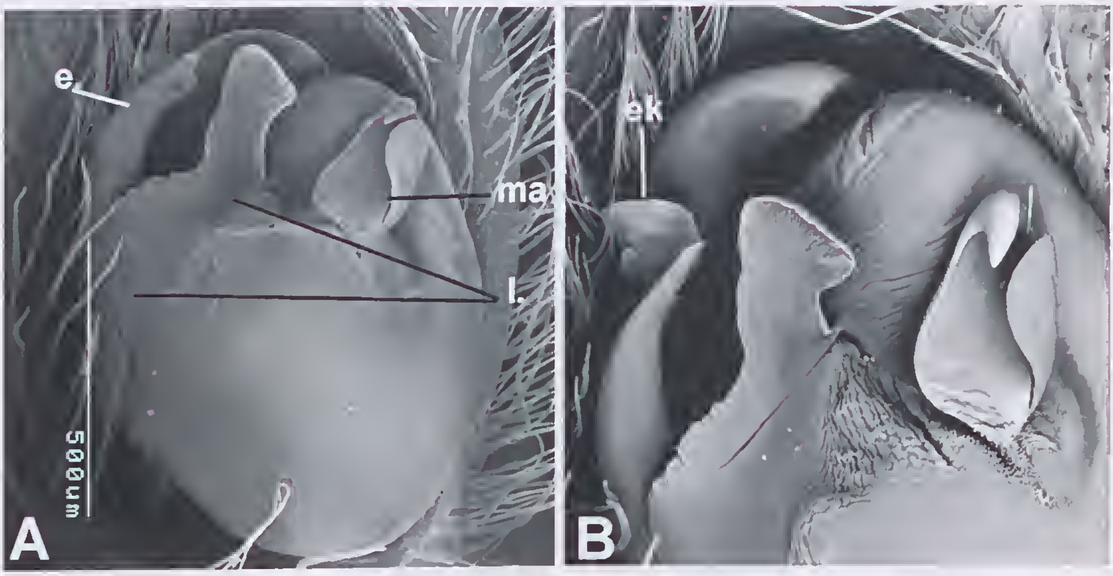

FIG. 7. *Megateg ramboldi*, sp. nov., ♂ palpal bulb, scanning electron micrograph, ventral view. A, bulb; B, distal bulb.

brown with transverse black flecks. Legs yellow brown with dark ring apically on all leg femora and 2 dark rings ventrally on femur IV and dark bands on distal tibia III, IV.

*Eyes*: AME:ALE:PME:PLE, 10:14:8:13. Eye group front width: back width: length, 55:71:36. Interspaces: AME-AME, 0.7; AME-ALE, 0.3; PME-PME, 1.7; PME-PLE, 0.7.

*Chelicerae*: p=3, r=3-4 teeth.

*Spines*: I: fe pv1 strong, p2d3r4; pa r1; ti p2d3r3v2.2.2.2; me p2r2v2.2.2. II: fe pv1 weak, p3d3r4; pa r1; ti p2d3r3v2.2.2.2; me p4r3v2.2.2. III: fe p4:d3r4; pa r1; ti p2d2r2v2.2.2; me p4r4 v 2.2.2. Distal III & IV met with close paired laterals. IV: fe p4d3r3; pa r1; ti p2d2r2 v.2.2.2; me p4r5v7 unpaired. Palp fe d3r1.

*Legs*: scopula absent or at most very thin on tarsi I. Tibial fracture I-IV distinct pro- and retrolaterally. Trochanteral notches shallow, deeper in back of notch to front, twice as wide as deep.

*Palp* (Fig. 9A-D): tibia long, concave for length retrolaterally; basally, tibia with raised mound of 20-30 long, thick, dark, curved setae in cluster; scoop set wide, tibia distally incrassate. Tibial apophysis broad, converging slightly apically with thicker apex. Tibia with sclerotised collar opposite tibial apophysis tip and two large sclerotised collar-like processes, one distal, one retroventrally against base of cymbium. *Cymbium*: scopula extends over distal half; basodorsal process small and triangular, arising from discontinuously excavate surface; another triangular process retrolaterally and a small conical mound ventral of that; latter two flank a tibial collar. Paracymbial discontinuity a distinct, triangular, glabrous mound. *Bulb*: median apophysis small, roughly rectangular with apical hook, opposed by thin translucent short, scooped tegular vane, base irregular, large, cordate; embolus a wide, flat flange with one of two short conical processes prolateral of median apophysis. Translucent unsclerotised process between median apophysis and embolus (in line between) and one prolateral off base of median apophysis. Tegulum extensive, a broad collar occupying *ca*. 300° of bulb.

Allotype ♀ QMS31110. As for male except as follows. Carapace 4.56 long, 3.72 wide. Abdomen 5.56, 4.52 wide. Total length, 10.4.

*Colour*: carapace brown with irregular darker areas centrally & on margins. Abdomen like male with light flecking across abdomen. Legs extensively banded (amaurobiid basic pattern); distal and ventral femora, lateral patellae, distal tibiae and metatarsi.

*Eyes*: AME:ALE:PME:PLE, 11:16:7:13. Eye group front width: back width: length, 64:91:41. Interspaces: AME-AME, 0.9; AME-ALE, 0.3; PME-PME, 2.2; PME-PLE, 1.0.

*Chelicerae*: p=3, r=3.

*Spines*: I: fe pv1 strong, p1d2r1; pa 0; ti v2.2.2.2; me v2.2.2. II: fe p1d3r1; pa 0; ti v2.2.2.2; me

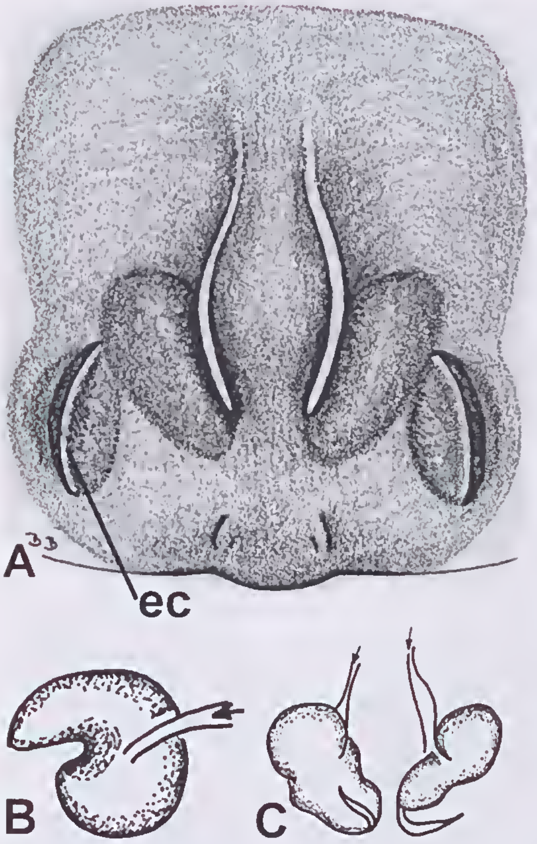

FIG 8. *Megateg ramboldi*, sp. nov., ♀. A, epigyne. B, C, vulva, axial view from front (B), ventral view (C).

v2.2.2. III: fe p3d3r3; pa 0; ti p2d2r2v2.2.2. me p4r4v2.2.2. IV: fe p2d2r1; pa r1; ti p2d3r2v5; me p5r6v6. Palp: fe p1d2; pa 0; ti p2; ta p3.

*Legs*: scopula on tarsi I, II weak. Claws short with 3-4 teeth. Tarsal rod long, in apical 1/3.

*Epigyne* (Fig. 9F,G): a cordate plate with two narrow curved grooves; vulva a pair of spheres.

DISTRIBUTION AND HABITAT. High altitude (>700m) rainforest at Mt Spurgeon, Mt Demi, Mt Lewis, Mossman Bluff, and Pauls Luck Track, west of Mossman, NE Qld.

### **Megateg covacevichae** sp. nov.
(Figs 4, 5B, 6C, 10, 11; Table 3)

ETYMOLOGY. For Jeanette Covacevich, Senior Curator, Reptiles, Queensland Museum, 1966-2002.

MATERIAL. HOLOTYPE: ♂, Mt Windsor Tbld, Whypala SF, 16°15'S 145°02'E, notophyll vine forest, pitfall, Summer 92/93, S.Burnett, QM S24541. PARATYPES: allotype, ♀, as for holotype, QM S24549; 3 ♀♀, as for holotype, QM S33140, S33146, S33156; 1 ♀, Windsor Tableland, 5.7 km past barracks, 16°14'S 145°00'E, NEQLD, rainforest, sieved litter, 23 Nov 1997, G. Monteith, QM S43024. 1 ♀, Mt Lewis Rd, old Barracks area, 16°35'S 145°17'E, 13 Jan 1990, ANZSES expedition, QM S31194. OTHER MATERIAL. 5 juvs., taken with holotype, QM S32949.

DIAGNOSIS. Differs from *M. paulstumkati* and *M. bartholomai* in males having a much longer palpal tibia and the tip of the tibial apophysis is broadly rounded rather than a pointed taper; females differ in that the median septum ridges are clearly closer distally than proximally.

DESCRIPTION. Holotype ♂. Carapace 4.16 long, 3.20 wide. Abdomen 3.00, 2.56 wide. Total length, 7.5.

*Colour*: carapace yellow brown with brown around fovea, along strial ridges and submarginally; dark vee in front of fovea, along caput edge and in diagonal line lateral of PLE. Legs with dark bands on distal femora to metatarsi and 2 extra below femora. Sternum, maxillae and labium yellow brown. Abdomen entirely darkly mottled.

*Eyes*: AME:ALE:PME:PLE, 8:15:9:15. Eye group front width: back width: length, 53:74:35. Interspaces: AME-AME, 0.8; AME-ALE, 0.3; PME-PME, 1.5; PME-PLE, 0.7.

*Chelicerae*: p=3, r=3.

*Spines*: I: fe pv1p2d3r2; pa 0; ti p3d3r3v2.2.2.2; me v2.2.2. II: fe pv 1 strong, p3d3r3; pa r1; ti p3d3r3v2.2.2.2; me p1r2r2v2.2.2. III: fe pv1p3d3r4; pa r1; ti p2d2r2v2.2.2; me p4r3v2.2.2. IV: fe p4d3r3; pa r1; ti p2d2r2v.2.2.2; me p5r5v7 unpaired. Palp: fe pv1p1d1.2. Tibiae & metatarsi I, II with spines overlapping. Metatarsus I long, bowed.

*Legs*: long; scopula absent. Tibial fracture I-IV distinct prolaterally. Trochanteral notches shallow, I, II & on IV, deeper on III. Tarsal rod at 3/8 from base. Tufts small, entire. 3-4 teeth on claws. RCH not evident.

*Palp*: tibia much longer than in *M. paulstumkati*; bowed, concave, prolaterally; basal mound low, setose. Tibial apophysis a broad, blunt, flat blade. *Cymbium*: scopula extent=2/3; basal cymbium prodorsally indented asymmetrically opposite more dorsal lobe on tibia, forms small, square, rounded process on retroventral corner; margin indented retrobasally, wide for most of basal half; margin open apically. Bulb: median apophysis a rectanguloid groove with one corner apically hooked, with irregular, extensive, rectangular base margin; embolus narrow, tapered flange;

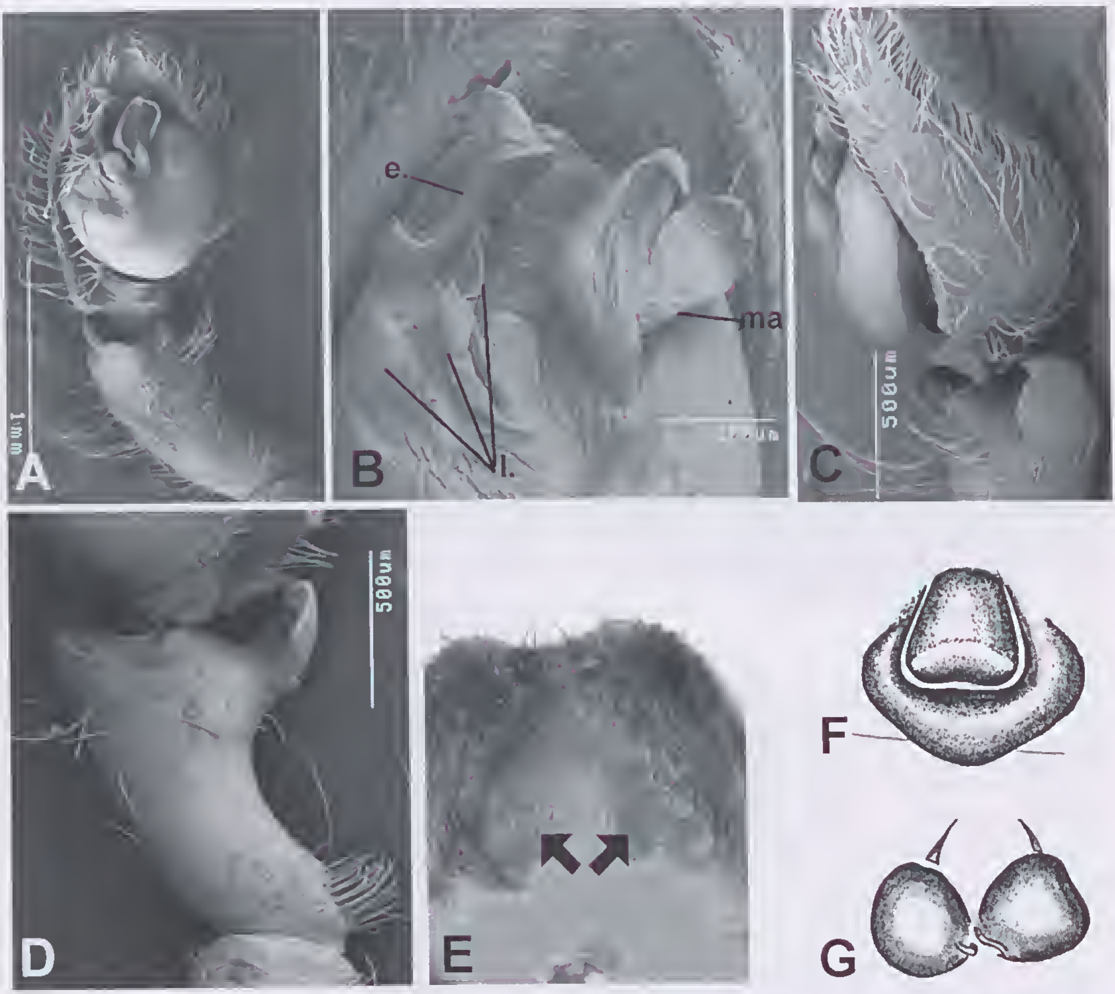

FIG. 9. *Megateg bartholomai*, sp. nov. ♂ palp, A-D; ♀, E, F. A, C, D, palpal tibia, cymbium and bulb (B), ventral (A, B, D) and retrolateral view (C); E, anterior shield, abdomen, showing attachment discs (arrows). F, epigyne; G, vulva.

TABLE 3. Leg measurements of *Megateg covacevichae*, holotype male and allotype female.

| Male | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 4.08 | 3.54 | 3.15 | 4.00 | 2.07 |
| Patella | 1.31 | 1.38 | 1.08 | 1.15 | 0.92 |
| Tibia | 5.00 | 3.77 | 2.46 | 3.38 | 1.54 |
| Metatarsus | 5.07 | 3.92 | 3.08 | 4.38 | 1.00 |
| Tarsus | 2.07 | 1.61 | 1.38 | 1.85 | |
| Total | 17.53 | 14.22 | 11.15 | 14.76 | 5.53 |
| Female | I | II | III | IV | Palp |
| Femur | 1.92 | 2.31 | 2.15 | 2.54 | 0.92 |
| Patella | 1.23 | 1.31 | 1.00 | 1.15 | 0.61 |
| Tibia | 2.07 | 1.77 | 1.54 | 2.23 | 0.77 |
| Metatarsus | 1.77 | 1.38 | 1.77 | 2.69 | 0.85 |
| Tarsus | 0.77 | 0.77 | 1.00 | 1.23 | |
| Total | 7.76 | 7.54 | 7.46 | 9.84 | 3.15 |

translucent vane set just behind embolus; large, u-shaped tegulum.

Allotype ♀. As for male except as follows. Carapace 4.00 long, 3.20 wide. Abdomen 4.24, 3.36 wide. Total length, 9.

As for male except: shorter-legged. No posterior sternum extension but post-sternal cuticle sliver is free. Legs more strongly marked (but vary to less marked in other specimens). Two dark stripes down each chelicerae.

*Eyes*: AME:ALE:PME:PLE, 8:11:9:12. Eye group front width: back width: length, 51:85:37.

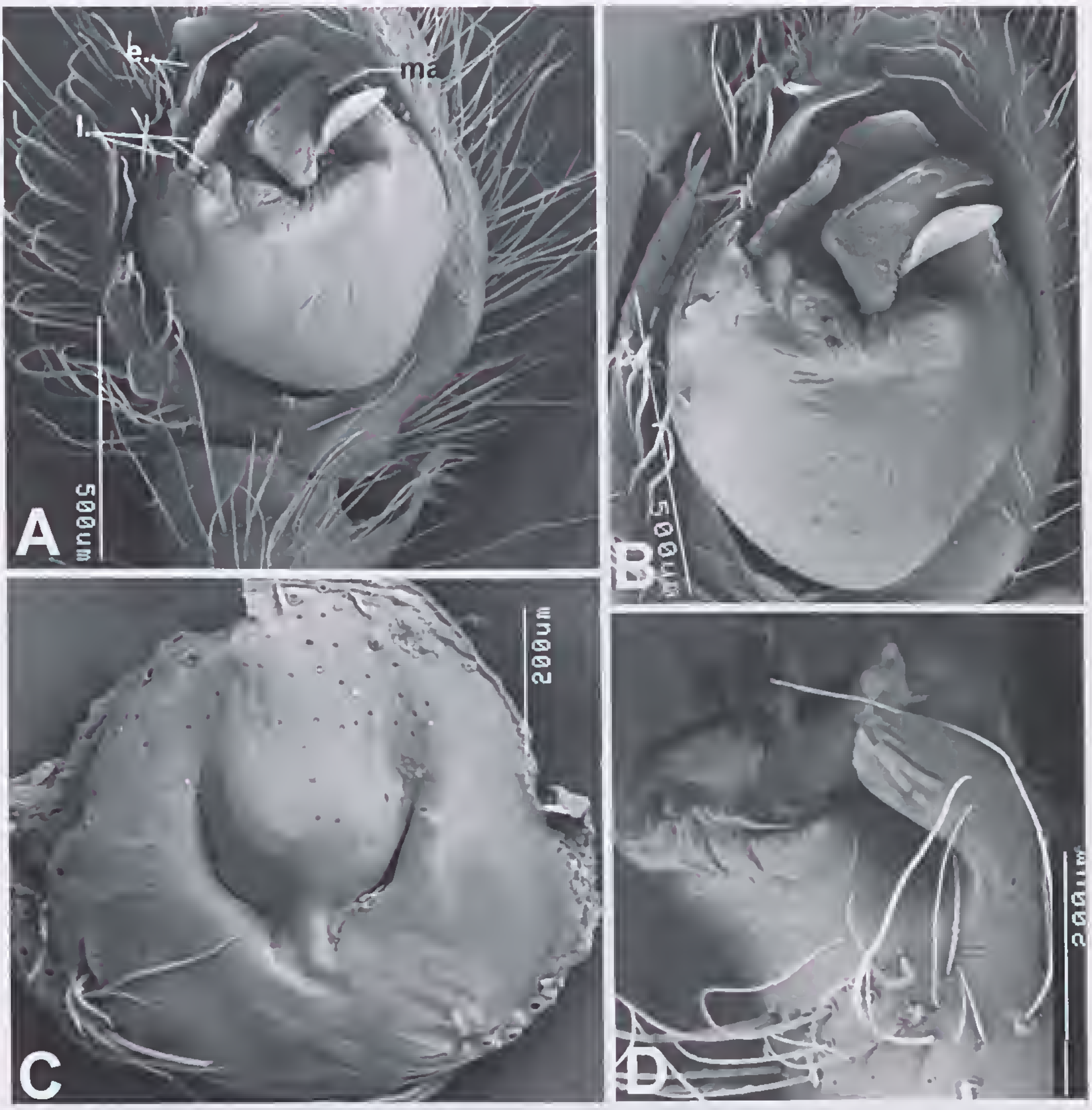

FIG. 10. *Megateg covacevichae*, sp. nov., ♂ palpal tibia (D), cymbium and bulb (B). A-C, ventral view. C, ♀, epigyne; D, palpal tibia, retrolateral view.

Interspaces: AME-AME, 1.3; AME-ALE, 0.6; PME-PME, 2.5; PME-PLE, 1.2.

*Spines*: I: fe pv1p1d2r1; pa 0; ti v2.2.2.2; me v2.2.2. II: fe p2d2r1; pa 0; ti v2.2.2.2; me v2.2.2. III: fe p3d3r3; pa r1; ti p2d2r2v2.2.2; me p4r4v2.2.2. IV: fe p2d3r1; pa r1; ti p2d2r2v6; me p4r3v6. Palp: fe p0d1.2; pa 0; ti p2; ta p3.

*Legs*: scopula absent; 2-3 large teeth on claws. Rod at basal 1/3.

*Epigyne*: ovoid with two convergent shallow grooves in V-shape; vulva simple.

DISTRIBUTION AND HABITAT. High altitude (>700m) rainforest at Mt Windsor Tableland and Mt Lewis, norteastern Queensland.

### **Megateg elegans** sp. nov.
(Figs 3F, 4, 5A, 6G,H, 12, 33E,F; Table 4)

MATERIAL. HOLOTYPE: 1 ♂, Cape Tribulation, 5km W (Site 10), 780m, 16°05'S 145°26'E, stick brushing, 29-30 Sep 1982, G.Monteith, D.Yeates, G.Thompson, QM S31113. PARATYPES: Allotype, ♀, as above, QM S31114. 2 ♀♀, as above, QM S31115; 1 ♂, Davies Ck Rd, 17°03'S 145°36'E, sieved litter, 17 Dec 1989, G.Monteith,

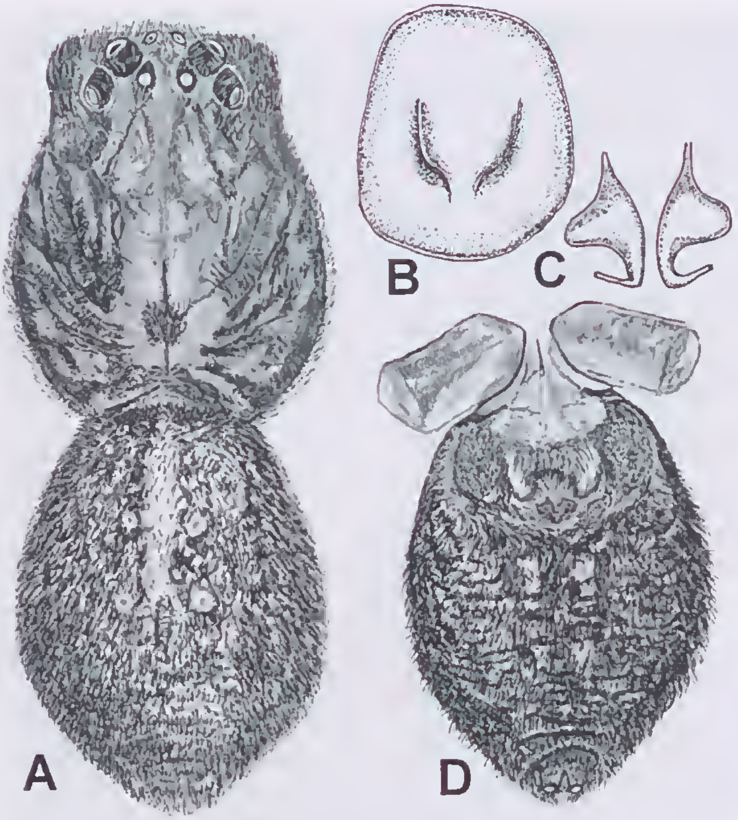

FIG. 11. *Megateg covacevichae*, sp. nov., ♀. A, cephalothorax and abdomen, dorsal view. B, epigyne; C, vulva; D, abdomen, ventral view.

G.Thompson, QM S31134; 1 ♀, Hugh Nelson Ra (GS3), 17°27'S 145°29'E, pitfall, 6 Mar-4 Apr 1995, P. Zborowski, QM S39079; 1 ♀, Isley Hills, 17°03'S 145°42'E, sieved litter & moss, 1 Dec 1993, G.Monteith, H.Janetzki, QM S39082. Lambs Head, 17°02'S 145°39'E: 3 ♀♀, sieved litter (*Agathis*), 10 Nov 1981, Earthwatch, Qld Museum, QM S31179; 1 ♀, pitfall, 10 Dec 1989-8 Jan 1990, G.Monteith, G.Thompson, H.Janetzki, QM S31177. Longlands Gap (BS1), 17°28'S 145°29'E: 2 ♀♀, flight intercept trap, 30 Nov 1995-3 Jan 1996, L. Umback, QM S39080, 39087; 1 ♂, flight intercept trap. 5-27 Feb 1996. L. Umback, QM S39083. Massey Ck (BS3), 17°37'S 145°34'E, L. Umback: 2 ♂♂ +1 ♂, pitfall, 31 Jan-27 Feb 1996, QM S39084, S39088; 1 ♀, flight intercept trap, 31 Jan-27 Feb 1996, QM S39115; ♀, pitfall, 30 Nov 1995-3 Jan 1996, QM S39095; 1 ♀, pitfall, 2 Aug-4 Sep 1995, QM S39104; ♀, pitfall, 4 Jul-2 Aug 1995, P. Zborowski, QM S39090; 2 ♀♀, pitfall, 6 Mar-5 Apr 1995, P. Zborowski, QM S39091, S39108; 2 ♀♀, pitfall, 1 Dec 1994-3 Jan 1995, P. Zborowski, QM S39121, S39122; 1 ♂, 2 ♀♀, pitfall, 3-4 Feb 1995, P. Zborowski, QM S39089, S39045. 1 ♂, Massey Ck, 12km SW Millaa Millaa, 17°36'S 145°33'E, pitfall, 1 Dec 1993-25 Feb 1994, J. Hasenpusch, QM S31135; 1 ♀, same data but, sieved litter, 4 May 1983, G.Monteith, D.Yeates, QM S31122. 2 ♀♀, Massey Ra, 4km W, center of Bellenden Ker, 17°16'S 145°49'E, NEQLD, 9-11 Oct 1991, G.Monteith, H.Janetzki, D.Cook, QM S31178; 1 ♀, Massey Ra, 17°16'S 145°49'E, sieved litter, 2 May 1983, G.Monteith, D.Cook, QM S31159. Mt Bartle-Frere, W Base, 17°23'S 145°46'E: 2 ♂♂, 1 ♀, flight intercept trap & pitfall trap, 25 Nov 1994-10 Jan 1995, G. Monteith, J. Hasenpusch, QM S31137, S31158; 3 ♂♂, same data but pitfall, 10 Jan-31 Mar 1995, QM S31136. Mt Edith (GS2), 17°06'S 145°37'E, flight intercept trap, P. Zborowski: 1 ♂, 31 May-30 Jun 1995, QM S39120; 1 ♂, 3 Jan-4 Feb 1995, QM S39078; 1 ♀, pitfall, 1 Dec 1994-3 Jan 1995, QM S39123. Mt Fisher (BS2), 17°34'S 145°34'E, pitfall & flight intercept trap, L. Umback: 2 ♂♂, pitfall, 30 Nov 1995-3 Jan 1996, QM S39086, S39046; 2 ♂♂, same locality but 1 Dec 1994-3 Jan 1995, P. Zborowski, QM S39126; 1 ♀, 2 Aug-4 Sep 1995, QM S39094; 1 ♂, 2-30 Nov 1995, QM S39124; 2 ♀♀, same data but litter, 27 Apr 1982, G.Monteith, D.Yeates, D.Cook, QM S31125; 1 ♂, 1 ♀, Mt Fisher, Kjellberg Rd, 17°32'S 145°33'E, pitfall, 1 Dec 1993-25 Feb 1994, J. Hasenpusch, QM S31117; ♂, 2 ♀♀, Mt Fisher, Whiteing Rd, 17°33'S 145°34'E, sieved litter, 5 May 1983, G.Monteith, D.Yeates, QM S31119, S31138; 2 ♀♀, Mt Formartine South, 10km N. Kuranda, 16°43'S 145°37'E, pitfall, 23-24 Nov 1990, G.Monteith, G.Thompson, QM S31176; 1 ♂, Mt Haig (GS1), 17°06'S 145°36'E, flight intercept trap, 31 May-30 Jun 1995, P. Zborowski, QM S39125; 1 ♂, same data but 29 Sep-31 Oct 1995, L. Umback, QM S39092; 1 ♀, Palmerston NP (NQ 11), 17°35'S 145°42'E, NEQLD, pitfall, 30 Oct 1991-24 Jul 1992, R.Raven, P.Lawless, M.Shaw, QM S24725; 1 ♂, Ravenshoe, 17°36'S 145°29'E, 15 Jul 1976, P. Filewood, QM S31142; 1 ♂, Vine Ck Rd, 17°41'S 145°32'E, sieved litter, 24 Nov 1994, G. Monteith, QM S31139; 1 ♂, Malaan Ra, 2km S Palmerston Hway, 17°36'S 145°24'E, pitfall, 10 Jan-7 Mar 1995, G. Monteith, J. Hasenpusch, QM S31120; 1 ♂, Mareeba, 22km SE, 17°07'S 145°36'E, sieved litter, 4 Nov 1983, D.Yeates G.Thompson, QM S31124. All in NEQ. OTHER MATERIAL. QM S32694, QM S31141, QM S31140, QM S20775, QM S31121, QM S31118, QM S31083, QM S41115.

DIAGNOSIS. Males differ from those of *M. ramboldi* in the more slender median apophysis, spine-like embolus and cluster of bristles retrobasally on palpal tibia; females differ from

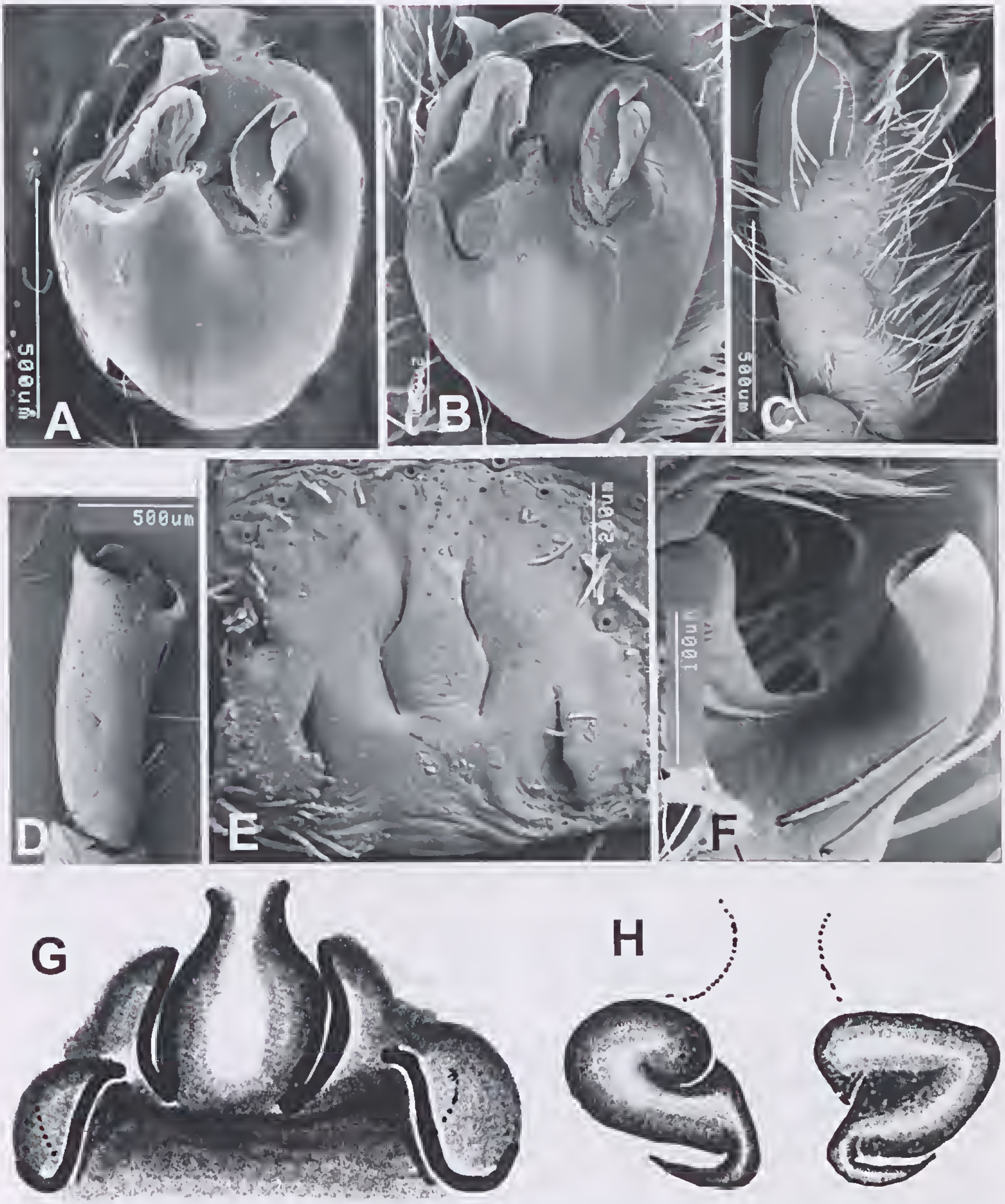

FIG. 12. *Megateg elegans*, sp. nov. A-F, ♂, palpal tibia (C, D), cymbium and bulb (A, B); A, D, E, Massey Range; B, C, F, Boulder Creek. E, ♀, epigyne. F, tibial apophysis. All ventral views. G-H, ♀, QMS 31178; G, epigyne; H, vulva.

those of *M. ramboldi* in having the lateral epigynal grooves further apart than each is from the lateral cleats.

DESCRIPTION. Holotype ♂. Carapace 4.40 long, 3.60 wide. Abdomen 4.00, 2.96 wide. Total length, 8.8.

*Colour*: carapace & chelicerae orange brown; darker shoulders over boss, striae slightly darker, caput with faint dark lines, in front of fovea a dark triangle directed back. Abdomen yellow brown, dark brown mottled shoulders, light brown mottling breaks predominantly pale abdomen. Legs without mottling, concolorous with carapace, except with darker areas under femur III, IV. Abdomen ventrally mostly pallid with brown flecking darkest around spinnerets. Sternum without pattern.

*Carapace*: light pile of fine black hairs, not obscuring surface, longer bristles around fovea and on carapace.

*Eyes*: back eye row much wider and occupies 0.73 of headwidth. Front edge of PLE is just behind back edge of PME, i.e. nominally 3 rows. Eye directions: AME look forward, ahead, slightly up and ca. 30° to side; ALE similar but less up and less to side; PME only up and slightly to side, on mound PLE, to side and back and slightly up. Interspaces: AME:ALE:PME:PLE, 6:8:5:7. AM-AM=5, AM-AL=3, PM-PM=10, PM-PL=13. Group front width: back width: length, 39:53:15.

*Chelicerae*: p=3 small spaced teeth, r=3-4 spaced teeth.

*Legs*: scopula absent or at most very thin on tarsi I.

*Spines*: I: fe pv1 strong, p2d3r3, pa r1, ti p3d3r4v2.2.2.2, me p1v2.2.2. II: fe proventral 1 strong, p2d3r4, pa r1, ti p3d3r3v2.2.2.2, me p2v2.2.2. III: fe p4d3r4, pa r1, ti p2d2r2v2.2.2, me p2d1r1v2.2.2.2. IV: fe p4d3r2, pa r1, ti p2d2r2v2.2.2, me p4r5v2.2.2.2. Palp: fe p1d1r1, rest 0.

*Spinnerets*: ALS short with coniform tip. PMS short cylindrical. PLS more slender than ALS. All with domed apical segments. Colulus a wide, flat, setose area.

*Palp*: tibia viewed from below, much longer than wide, straight, with glabrous area in distal ventral third; basal retrolateral edge with oval area of distinct, long, thick bristles; retrolateral tibial apophysis arises subdistally in line with tuft (*i.e.* almost off dorsal face); retrodorsal edge saddle-shaped; apophysis elongate, sinuous. Two rounded flattened keels on distal ventral and prodorsal edges of tibia. *Cymbium*: scoop-shaped, narrows strongly basally with small process flanked by two basal cymbial processes; retrolateral base gradually slopes up to extensive scopulate area extending to tip; retrobasal edge excavate in profile; excavation extends to tip widen cymbial edge pro- than retrolaterally. *Bulb*: tegulum dominant basally; median apophysis a small scoop with small apical hook directed ventrally; embolus arises prolaterally, distinct, long tip just above laminar vane.

TABLE 4. Leg measurements of *Megateg elegans*, holotype male and allotype female.

| Male | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 4.08 | 4.00 | 3.38 | 3.69 | 1.85 |
| Patella | 1.38 | 1.54 | 1.23 | 1.15 | 1.08 |
| Tibia | 5.08 | 4.08 | 2.61 | 3.46 | 1.00 |
| Metatarsus | 4.85 | 3.23 | 3.00 | 4.31 | - |
| Tarsus | 1.92 | 1.23 | 1.23 | 1.85 | 1.00 |
| Total | 17.31 | 14.08 | 11.45 | 14.46 | 4.93 |
| **Female** | **I** | **II** | **III** | **IV** | **Palp** |
| Femur | 2.54 | 2.54 | 1.85 | 3.23 | 1.15 |
| Patella | 1.69 | 1.61 | 1.15 | 1.08 | 0.77 |
| Tibia | 2.69 | 2.38 | 1.85 | 2.69 | 1.00 |
| Metatarsus | 2.23 | 2.23 | 1.85 | 3.15 | - |
| Tarsus | 0.85 | 0.92 | 0.85 | 1.23 | 0.92 |
| Total | 10.00 | 9.68 | 7.55 | 11.38 | 5.84 |

Allotype ♀ QM S31114. As for male except as follows: Carapace 4.72 long, 3.76 wide. Abdomen 5.20, 3.60 wide. Total length, 10.4.

*Colour*: carapace dark red brown with darker margins, strial margins of caput black; foveal area a dark triangle, dark irregular lines on caput, long brown bands vertically on chelicerae. Legs orange brown with darker areas on femur-metatarsi; strongly marked (not banded) areas on ventral femora, coxae & sternum. Abdomen dorsally mottled brown & black, anteriorly an elongate brown dome fringed with black then pallid borders posteriorly merging into dark chevrons on either mottling; ventrally predominantly mottled.

*Carapace*: pile of golden hairs not obscuring cuticle plus uniformly placed short black setae centrally around fovea, onto caput and amongst eyes.

*Chelicerae*: p=3-4, r=3-4.

*Eyes*: AME:ALE:PME:PLE, 5:6:5:6. Eye group front width: back width: length, 37:47:20. Interspaces: AME-AME, 1.0; AME-ALE, 0.6; PME-PME, 2.4; PME-PLE, 1.5.

*Legs*: trochanteral notches shallower than in male, asymmetrical-deeper in back of notch than in front; tarsal rod present; scopula weak on tarsi I, II, distal 1/3 and weak on metatarsi I, II.

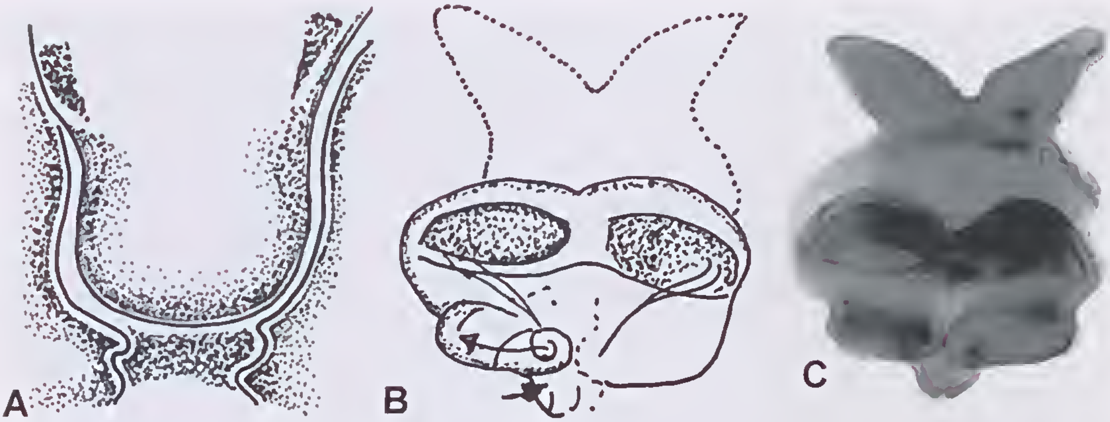

FIG. 13. *Megateg gigasep*, sp. nov., ♀. A, epigyne; B, C, vulva.

*Spines*: I: fe pv1p1d2r1; pa0;ti v2.2.2.2; me v2.2.2. II: fe p2d3r1, rest as for I. III: fe p3d3r2; pa r1; ti p2d2r2v2.2.2; me p4r4v2.2.2. IV: fe p2d2r1; pa r1; ti p2d2r2v5; me p4r4v2.2.2. Palp: fe p1d2; pa0; ti p2d1; ta d1p3.

*Claws*: legs as in male. Palpal claw with 3-4 teeth.

*Epigyne*: small, lightly sclerotised with pair of narrow crescent hoods, one pair outer and near furrow, one pair inner and central, a narrow medial ridge posteriorly. Vulva simply s-shaped.

DISTRIBUTION AND HABITAT. A relatively widely distributed species in rainforest from Cape Tribulation south to about Ravenshoe, NE Qldland. *M. elegans* is the lowland sister species of *M. ramboldi*, known only from Bellenden Ker Range and Mt Bartle-Frere, the highest peaks of the Wet Tropics World Heritage Area.

REMARKS. Material from Upper Boulder Ck, Walter Hill Range, are excluded from the type series; geographically, they represent the southern most known extent of the species. The epigyne is most like that of *M. elegans* with extensive lateral cleats overlapping strongly with lateral ridges. The tibial apophysis, like that of *M. elegans*, has a retrobasal setal cluster. However, the embolus is intermediate between the spike of *M. elegans* and broad sheath of *M. ramboldi*.

TABLE 5. Leg measurements of *Megateg gigasep* sp. nov. holotype female.

| | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 2.69 | 2.63 | 2.50 | 3.25 | 1.44 |
| Patella | 1.56 | 1.38 | 1.25 | 1.38 | 0.75 |
| Tibia | 2.50 | 2.19 | 1.69 | 2.69 | 0.88 |
| Metatarsus | 2.00 | 1.81 | 2.13 | 3.56 | |
| Tarsus | 0.81 | 0.81 | 1.31 | 1.31 | 1.06 |
| Total | 9.56 | 8.82 | 8.63 | 12.19 | 4.13 |

### **Megateg gigasep**, sp. nov.
(Figs 4, 13; Table 5)

ETYMOLOGY. An arbitary combination of letters.

MATERIAL. HOLOTYPE: ♀, Karnak to Devils Thumb (site 4), 8-12km NW Mossman, 16°23'S 145°17'E, 26 Dec 1989-15 Jan 1990, ANZSES expedition, QMS53563.

DIAGNOSIS. Females have the broadest septum of the genus.

DESCRIPTION. Holotype ♀ QM S53563. Carapace 4.45 long, 3.32 wide. Abdomen 5.32 long, 3.64 wide. Like *Megateg lesbiae* but:

*Colour*: carapace yellow brown with black edges, black areas between fovea and edge and triangular black foveal area. Abdomen dorsally mottled , ventrally pallid with irregular grey zones medially. Legs fawn, femora with dark transverse bars forming two pallid bands.

*Spines*: tibiae I, II with 4 spines pro- and retro-ventrally on I, II.

*Spinnerets*: large, triangular, fleshy colulus; 3 large spigots evident dorsally on PMS.

*Epigyne*: broad, rounded median septum with two lateral triangular 'ears' anteriorly; lateral cleats impinge on posterior margin of septum; vulva consists of two flattened spheres on each side.

DISTRIBUTION AND HABITAT. Montane rainforest between Karnak and Devils Thumb, NW of Mossman, NE Qld.

TABLE 6. Leg measurements of *Megateg lesbiae*, holotype female.

| | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 2.31 | 2.54 | 2.31 | 2.85 | 1.31 |
| Patella | 1.31 | 1.15 | 1.00 | 1.08 | 0.61 |
| Tibia | 2.31 | 2.15 | 1.69 | 2.38 | 0.85 |
| Metatarsus | 1.92 | 1.77 | 1.85 | 3.08 | 0.77 |
| Tarsus | 0.69 | 0.77 | 0.69 | 0.92 | |
| Total | 8.54 | 8.38 | 7.54 | 10.31 | 3.54 |

### **Megateg lesbiae**, sp. nov.
(Figs 4, 14; Table 6)

ETYMOLOGY. For Lesbia Dobson, staunch supporter of the Queensland Museum.

MATERIAL. HOLOTYPE: ♀, Upper Gayundah Ck, Hinchinbrook I, 18°22'S 146°13'E, NEQLD, rainforest at 10m altitude, 9-11 Nov 1984, G. Monteith, D. Cook, QM S31160. PARATYPES: 2 ♀♀, same data, QM S31123.

DIAGNOSIS. Females have the most subtle epigyne of the genus — a broad flat plate with two small lateral cleats and a medial indistinct pair of transverse ridges.

DESCRIPTION. Holotype ♀. Carapace 4.40 long, 3.56 wide. Abdomen 3.68, 3.20 wide. Total length, 4.2.

*Eyes*: AME:ALE:PME:PLE, 8:15:8:14. Eye group front width: back width: length, 65:90:40. Interspaces: AME-AME, 1.3; AME-ALE, 0.8; PME-PME, 2.8; PME-PLE, 1.0.

*Chelicerae*: p=3, r=3.

*Spines*: I: fe pv1p1d2; pa 0; ti v2.2.2.2; me v2.2.2. II: fe p2d3r1; pa 0; ti v2.2.2.2. me v2.2.2. III: fe p3d3r1; pa r1; ti p2d2r2v2.2.2. me p5r5v2.2.2. IV: fe p3d3r1; pa r1; ti p2d2r2v2.2.2; me p5r6v7. Palp: fe p1d2; pa 0; ti p2d1; ta p3.

*Legs*: no scopula on tarsi I, II.

*Epigyne*: originally covered by thin and hirsute (from cymbial scopula?) epigynal plug; a broad, wide central depression with very widely set small crescentic cleats laterally between which a pair of indistinct transverse ridge marking copulatory fossae; simple, ovoid spermathecae with fertilisation duct posteriorly.

DISTRIBUTION AND HABITAT. Lowland (10m) rainforest at Upper Gayundah Ck, Hinchinbrook Island, NE Qld.

### **Megateg paulstumkati**, sp. nov.
(Figs 4, 5C, 6E, 15, 16, 17; Table 7)

ETYMOLOGY. For Paul Stumkat, Senior Technician, Queensland Museum, 1984-2002.

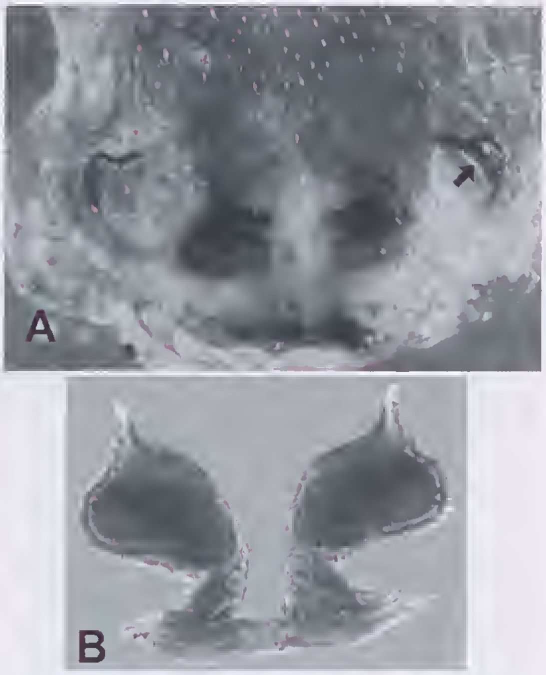

FIG. 14. *Megateg lesbiae*, sp. nov., ♀. A, epigyne; B, vulva.

MATERIAL. HOLOTYPE: 1 ♂, Devils Thumb to Paul's Luck Site 12, 16°23'S 145°17'E, NEQLD, pitfall, 27 Dec 1989-15 Jan 1990, ANZSES expedition, QM S31171. PARATYPES: Karnak-Devils Thumb, 8-12km NW Mossman, 16°23'S 145°17'E, 26 Dec 1989-15 Jan 1990, ANZSES expedition: 1 allotype ♀, Site 9, QM S31172; 3 ♂♂, site 7, QM S31188; 2 ♂♂, Site 8, QM S31185; 1 ♂, Site 9, QM S31187; 2 ♂♂, site 9a, QM S31186; 5 ♂♂, QM S31173. 1 ♂, Devils Thumb, 12km WNW Mossman, Site 11, 16°23'S 145°17'E, pitfall, 27 Dec 1989-15 Jan 1990, ANZSES expedition, QM S25897. 2 ♂♂, Mt Spurgeon, 16°24'S 145°13'E, rainforest, pitfall, 15-20 Oct 1991, G.Monteith, H.Janetzki, D.Cook, L.Roberts, QM S20516; 3 ♂♂, Mt Spurgeon, 7km N of (camp 2), 15°28'S 145°13'E, pitfall, 17-19 Oct 1991, G. Monteith, D. Cook, L. Roberts, QM S31189. All in NEQld.

DIAGNOSIS. Females differ from those of *M. elegans* in the bowed (in ventral view) palpal tibia with distinctly pointed RTA; females differ in that the epigyne lacks lateral cleats and unlike in *M. covacevichae* the short epigynal ridges are as wide apart anteriorly as posteriorly.

DESCRIPTION. Holotype ♂. Carapace 4.32 long, 3.60 wide. Abdomen 3.80, 2.64 wide. Total length, 8.2.

*Eyes*: AME:ALE:PME:PLE, 10:13:8:12. Eye group front width: back width: length, 60:76:36. Interspaces: AME-AME, 0.7; AME-ALE, 0.5; PME-PME, 1.7; PME-PLE, 1.2. Centres of ALE

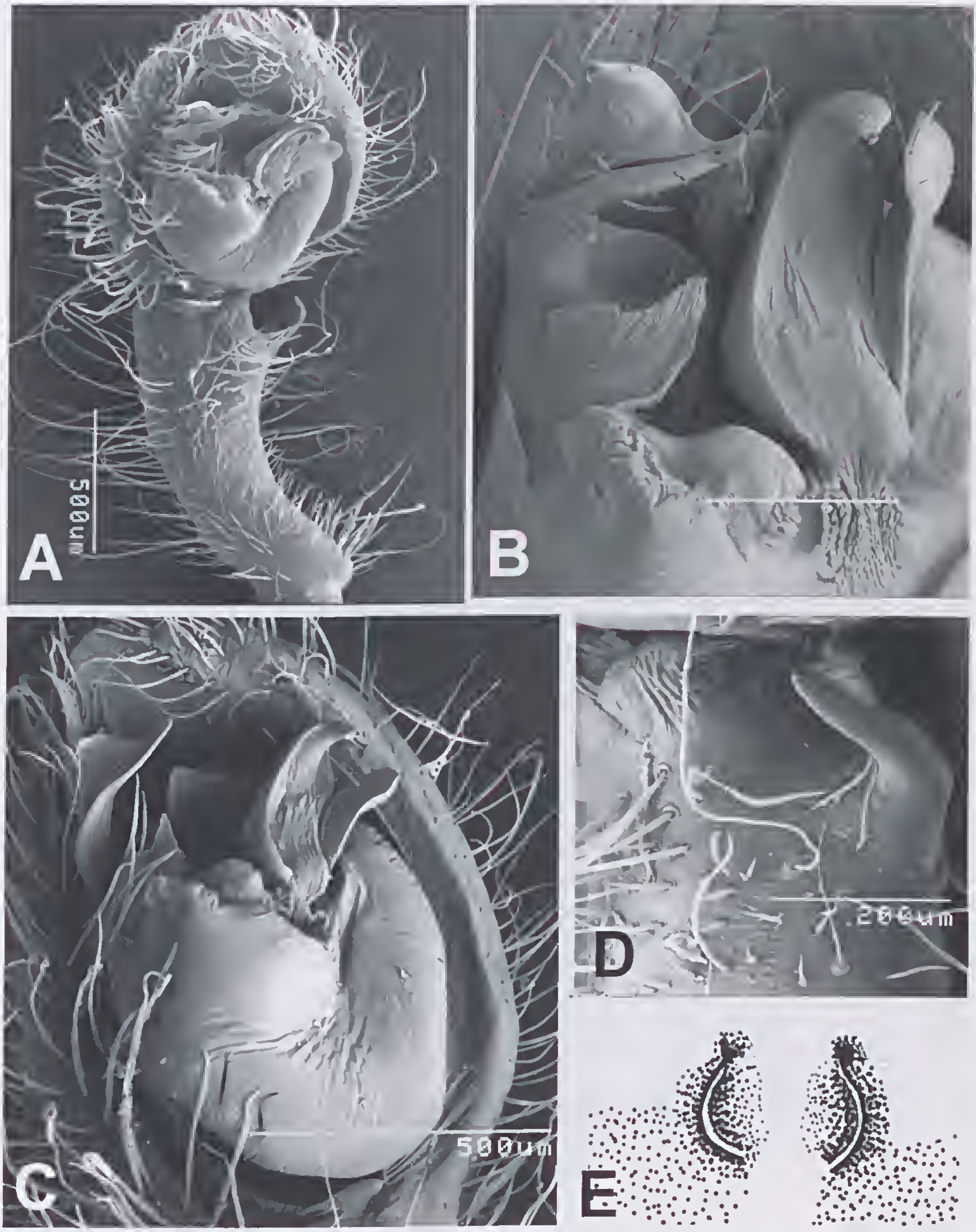

FIG. 15. *Megateg paulstumkati*, sp. nov., ♂ palpal tibia, cymbium and bulb (B, C), ventral (A-C) and tibial apophysis, retrolateral view (D); E, ♀ epigyne.

just behind back edge of AME. Front edge of PLE is in line behind back edge of PME.

*Chelicerae*: p=3, r=3.

FIG. 16. *Megateg paulstumkati*, sp. nov., ♀. A, epigyne; B, vulva.

*Spines*: I: fe pv1 strong, p2d3r4; pa r1; ti p3d3r3v2.2.2.2; me v2.2.2 . II: fe pv1 weak, p3d2r3; pa r1; ti p3d3r3v2.2.2.2; me p4r3v2.2.2. III: fe p4d3r4; pa r1; ti p2d2r3v2.2.2; me p3d1r3v2.2.2. IV: fe p4d3r3; pa r1; ti p2d2r2v.2.2.2; me p4r5v8. Palp: fe p1d2r1.

*Legs*: scopula absent; tibial fracture I-IV prolaterally and retrolaterally distinct. Trochanteral notches shallow, deeper in back of notch to front.

*Palp*: tibia much longer than wide bowed with retrolateral saddle; cluster of short hairs on retrobasal mound, diagonally opposite face glabrous; 3 distinct sclerotised collars distally. Tibial apophysis a long, elegant, tapering hook.

TABLE 7. Leg measurements of *Megateg paulstumkati*, holotype male and allotype female.

| Male | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 3.61 | 3.61 | 2.69 | 3.92 | 1.85 |
| Patella | 1.54 | 1.69 | 1.23 | 1.46 | 0.85 |
| Tibia | 4.92 | 4.00 | 3.00 | 3.54 | 0.77 |
| Metatarsus | 4.92 | 3.92 | 2.69 | 4.61 | 0.85 |
| Tarsus | 1.85 | 1.69 | 1.38 | 1.77 | |
| Total | 16.84 | 14.91 | 10.99 | 15.30 | 4.32 |
| **Female** | **I** | **II** | **III** | **IV** | **Palp** |
| Femur | 2.85 | 2.92 | 2.54 | 3.08 | 1.46 |
| Patella | 1.46 | 1.31 | 1.08 | 1.31 | 0.61 |
| Tibia | 2.92 | 2.31 | 1.92 | 2.46 | 0.85 |
| Metatarsus | 2.31 | 1.92 | 2.23 | 3.15 | 0.92 |
| Tarsus | 0.69 | 0.92 | 1.00 | 1.61 | |
| Total | 10.23 | 9.38 | 8.77 | 11.61 | 3.84 |

*Cymbium*: scopula extends for 2/3. From above (dorsal), small triangular process basal retrolaterally forming saddle opposing spur and rounded mound on prolateral side; basodorsal process absent; paracymbial discontinuity a slight bulge evident basally. *Bulb*: median apophysis a long, wide scoop tapering to simple point; basally a hyaline flange with sclerotised basal edge; base irregular, small. Embolus sigmoidal with hyaline scoop along upper (inner edge) distally. Two hyaline opposed processes arise from base of embolus.

Allotype ♀ QMS31172. As for male except as follows. Carapace 4.80 long, 3.96 wide. Abdomen 5.68, 4.48 wide. Total length, 10.8.

*Eyes*: AME:ALE:PME:PLE, 11:13:8:12. Eye group front width: back width: length, 50:97:39. Interspaces: AME-AME, 1.0; AME-ALE, 1.0; PME-PME, 2.3; PME-PLE, 1.3.

*Spines*: I: fe pv1 strong, p1d2r1; pa 0; ti v2.2.2.2; me v2.2.2. II: fe p2d3r1; pa 0; ti v2.2.2.2; me v2.2.2. III: fe p3d3r2; pa r1; ti p2d2r2v5; me p5r5v2.2.2. IV: fe p2d3r1; pa r1; ti p2d2r2v5; me p5r4v6. Palp: fe d3; pa 0; ti p2d2; ta p3d1r1.

*Scopula*: tarsi I, II weak/absent. Metatarsi I, II in distal 1/3, weak/absent.

*Epigyne*: externally two lobes with crescentric ridges and medial flat septum; copulatory fossae are anterior lateral of septum and ducts are slenderly biconvex in cross-section with narrowest dimension in vertical plane joining spermathecae dorsally; spermathecae reniform.

*Abdomen*: colulus broad, triangular, fleshy.

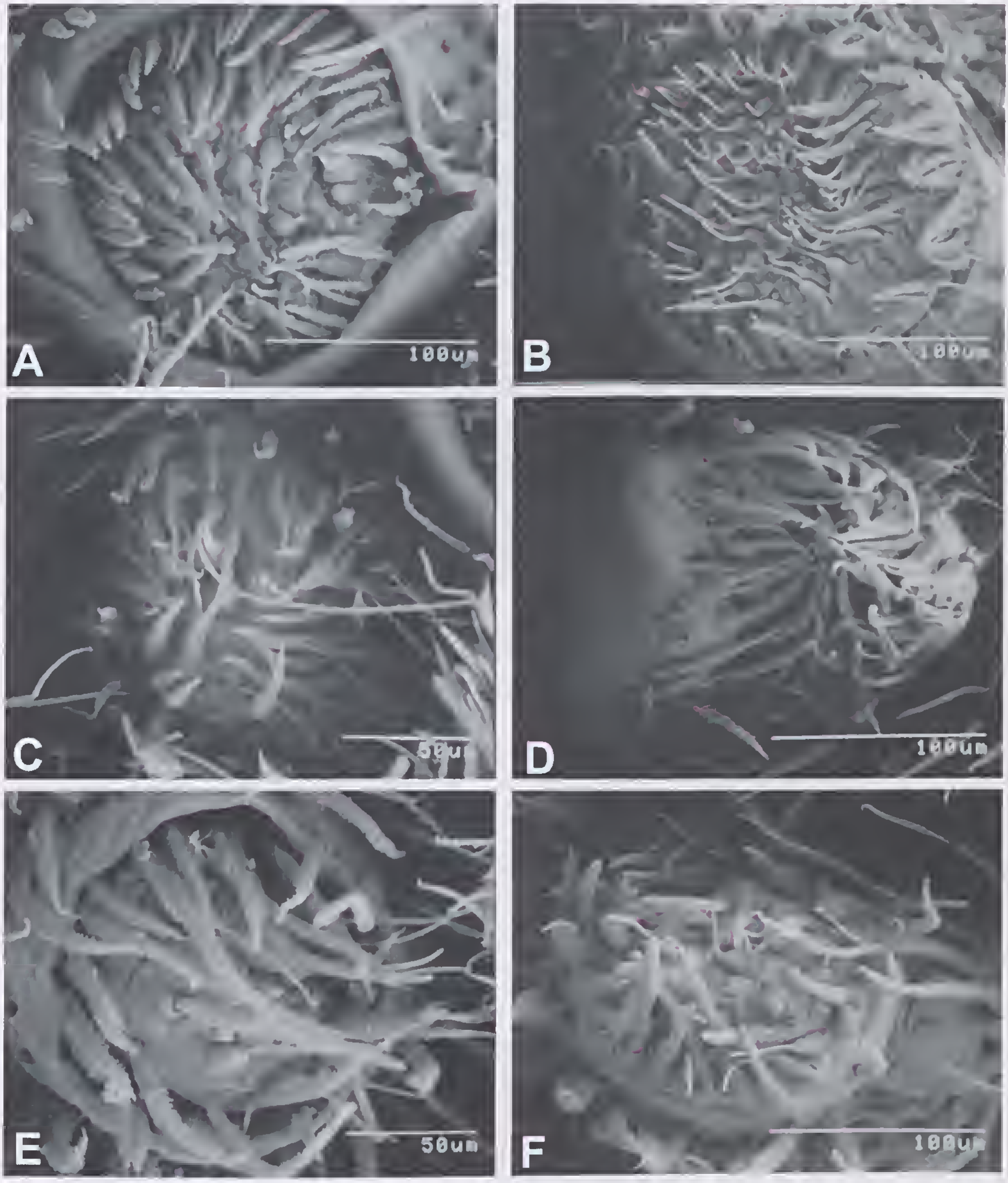

FIG. 17. Spinnerets, *Megateg paulstumkati*, sp. nov., scanning electron micrographs, apical view. A, C, E, ♂ QM S31189; B, D, F, ♀ QM S31155. A, B, ALS; C, D, PMS. E, F, PLS.

DISTRIBUTION AND HABITAT. High altitude (>700m) rainforest, Karnak to Devils Thumb, 8-12km NW of Mossman and Mt Spurgeon, NE Qld.

### **Megateg spurgeon** sp. nov.
(Figs 4, 6D,F, 18, 19; Table 8)

ETYMOLOGY. From the type locality.

MATERIAL. HOLOTYPE: ♂, Mt Spurgeon, 2.5km S, 16°28'S 145°12'E, open forest, pitfall, 13-21 Oct 1991, G.

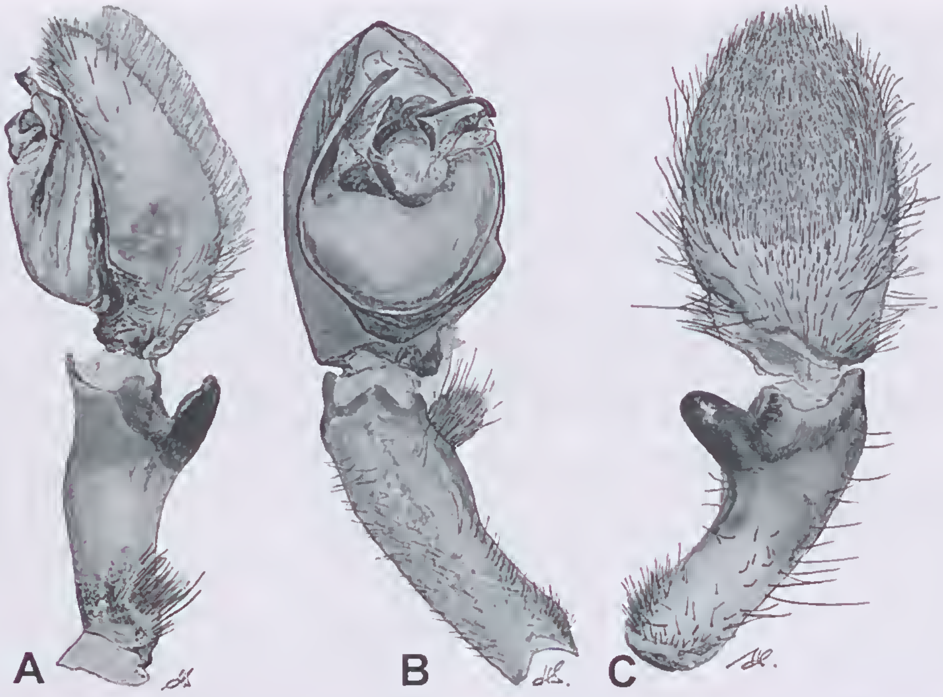

FIG. 18. *Megateg spurgeon*, sp. nov., ♂, palpal tibia, cymbium and bulb; retrolateral (A), ventral (B), dorsal (C) views.

Monteith, H. Janetzki, QM S31148. PARATYPES: 3 ♂♂ 1 ♀, Black Mt, 16°39'S 145°29'E, 29-30 Apr 1982, G Monteith, D. Yeates, D. Cook, QM S31155, 31149; 1 ♂, as for holotype, S31157; 1 ♀, 2 ♂♂, Mt Spurgeon, 3km S, 16°27'S 145°11'E, NEQLD, open forest, human dung trap, 20-22 Nov 1997, G Monteith, D. Cook, QM S41840, S43995, S44748; 1 ♂, Mt Spurgeon (trap 6), open forest, pitfall, 19 Nov 1997-8 Feb 1998, G. Monteith, D. Cook, QM S44659.

DIAGNOSIS. Males resemble those of *M. bartholomai* but differ in lacking the thorn basally on the embolus (Fig. 18B), having relatively longer palpal tibia with distally concave RTA and weaker retrobasal constriction in the cymbium; females resemble those of *M. covacevichae* in the convergent median septum but differ in having lateral epigynal cleats.

DESCRIPTION. Holotype ♂. Carapace 4.61 long, 3.56 wide. Abdomen 3.33, 2.67 wide. Total length, 8.5.

*Colour in alcohol*. Carapace orange brown with dark shadows on margin and dark radiating interwoven bands centrally. Eye region not darker. Abdomen dorsally with irregular longitudinal dark streaking broken anteriorly by 2 pairs of large sigilla surrounded by pallid zone. Anterior plate triangular, distinct dark orange-brown. Legs yellow brown with dark shadows on distal femora forming irregular wide nads ventrally; dark shadows also on distal tibiae. Coxae dorsally yellow brown, ventrally also with shadows distally. Abdomen ventrally mottled; chelicerae orange brown with wide dark median shadows.

*Carapace*. Uniformly hirsute with fine white hairs with small brown bristles along caput and through eye group. Chilum divided. Fovea long, deep. Eyes on common tubercle overhanging eye group.

*Chelicerae*. Slender but fangs long; p=2, r=3.

*Eyes*. AME:ALE:PME:PLE, 8:9:6:9. Eye group front width: back width: length, 40:56:28. Interspaces: AME-AME, 0.6; AME-ALE, 0.5; ALE-PLE, 1.3; PME-PLE, 1.9; PME-PME, 0.8.

*Legs*. All tibiae widely fractured. Trichobothria: two rows on tibiae for length; one straight row, lengthening distally on metatarsi and two rows on tarsi.

*Spines*. I: fe pv1p2d3r4; pa r1; ti p3d3r3v2.2.2.2; me p3r3v2.2.2. II: fe pv1p3d3r4; pa r1; ti p3d3r3v2.2.2.2; me p3r3v2.2.2. III: fe pv1p3d3r3; pa r1; ti p2d2r2v2.2.2; me p1.2.2r12.1.2v2.2.2. IV: fe p4d3r3; pa r1; ti

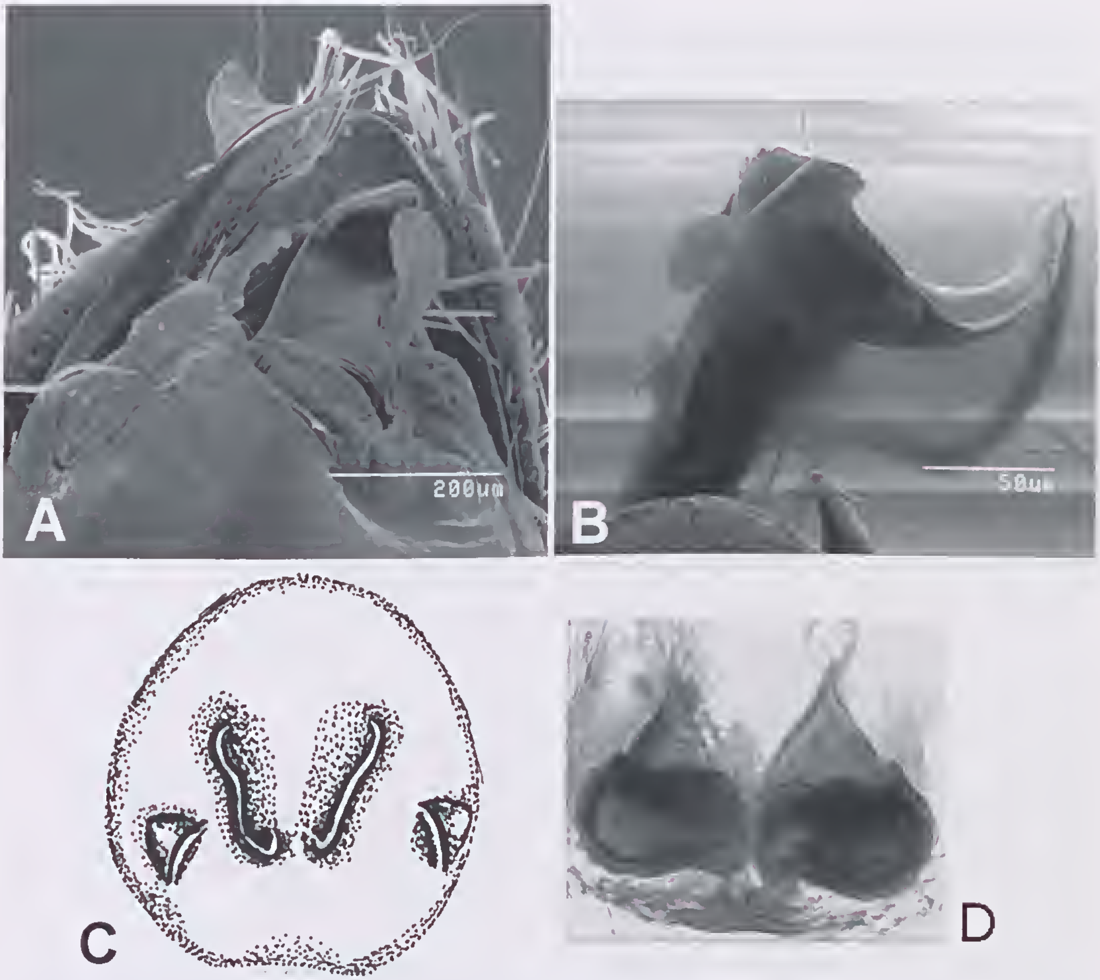

FIG. 19. *Megateg spurgeon*, sp. nov.. A, B, ♂ bulb; apical bulb, ventral view; B, embolus, axial view. C, D, ♀ QM S31148 . C, epigyne; D, vulva.

p2d2r3v2.2.2; me p1.1.1.2r2.2.2v2.2.2. Palp: fe p1d1.2; rest, 0. Most basal spine on tibiae I, II proximal of fracture.

*Claws.* Short, with 3-4 large teeth. Small dense tufts below claws.

*Abdomen.* Anterior overhang with sclerotised plate with two wide circular pits.

*Spinnerets.* Invaginated.

*Palp* (Figs 18A-C, 19A,B). Tibia distinctly bowed, long, with large, heavy, subdistal-lateral RTA with concave distal face; cluster of long strong bristles retrobasally; tibia with two distal rounded lobes proventrally and dorsally. Cymbium basally with small locking process on dorsal edge arising from darkly sclerotised glabrous area. Retrobasal corner with rounded lobe. Retrolateral basal third distinctly narrow with broad glabrous edge and distally marked by distinct discontinuity. Apical cymbium narrowly truncate but with wide gap between edges. Tegulum basally dominant, broad, sclerotised; distally with long keel behind median apophysis and embolus. Spermatic duct sweeps from distoretrolateral edge around base to embolus. Median apophysis small, roughly triangular, narrowly attached and hence very mobile, with rolled distal edge forming rounded distal hook; with small membranous lamella along posterior edge. Embolus a long paddle with basal thorn, distinctly paddle-like with small dorsal semicircular vane. A scooped V-shaped vane at

TABLE 8. Leg measurements of *Megateg spurgeon* sp. nov. holotype male and allotype female.

| Male | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 3.94 | 3.94 | 3.28 | 4.11 | 2.11 |
| Patella | 1.72 | 1.44 | 1.33 | 1.44 | 0.94 |
| Tibia | 4.89 | 3.78 | 2.56 | 3.61 | 1.39 |
| Metatarsus | 4.94 | 3.67 | 3.17 | 4.50 | |
| Tarsus | 2.28 | 1.56 | 1.61 | 1.61 | 1.28 |
| Total | 17.77 | 14.39 | 11.56 | 15.27 | 5.72 |
| Female | I | II | III | IV | Palp |
| Femur | 2.78 | 2.89 | 2.78 | 3.56 | 1.50 |
| Patella | 1.67 | 1.56 | 1.28 | 1.56 | 0.89 |
| Tibia | 2.61 | 2.22 | 1.78 | 2.89 | 0.89 |
| Metatarsus | 2.17 | 2.00 | 2.06 | 3.33 | |
| Tarsus | 0.78 | 0.89 | 1.22 | 1.22 | 1.11 |
| Total | 10.01 | 9.56 | 8.84 | 12.56 | 4.39 |

base of embolus but not attached to it; small triangular vane between embolus and median apophysis.

Allotype ♀. Carapace 4.44 long, 3.50 wide. Abdomen 5.44, 4.17 wide. Total length, 11.0.

*Colour in alcohol*. Carapace like male but orange brown with more extensive darker areas. Abdomen dorsally with darker shoulders, lighter mottling and 3 dark chevrons posteriorly. Legs orange brown with darker femora distally and ventrally; dark bands on lateral patellae to metatarsi; coxae ventrally dark distally. Dark shadow centrally on sternum.

*Eyes*. AME:ALE:PME:PLE, 9:12:8:12. Eye group front width: back width: length, 60:89:39. Interspaces: AME-AME, 1.0; AME-ALE, 0.7; ALE-PLE, 2.1; PME-PLE, 2.4; PME-PME, 1.4.

*Chelicerae*. p=2, r=3.

*Legs*. Scopula weak, laterally in two bands on metatarsi and tarsi I, II. *Trichobothria*: two rows on tarsi.

*Spines*. Strong proventral femoral spine. I, II: fe pv1p1d2r2; pa0; ti v2.2.2.2; me v2.2.2. III: fe p3d3r2; pa0; ti p2d2r2v2.2.2; me p1.1.1.2d1r1.1.2v2.2.2. IV: fe p3d3r1; pa r1; ti p2d2r2v2.2.2; me p1.1.1.2.r1.2.2v2.2.2. Palp: fe d1.2; pa0; ti p2d1; ta p2.1.

*Claws*. Palpal claw long, 6-8 long teeth.

*Spinnerets*. All on protuberant base. Spigots on PMS only distal, not dorsal.

*Epigyne* (Fig. 19C,D). A pair of shallow grooves define low but strongly V-shaped septum with very low, indistinct, cleats off posterior lateral corner and set at about half-length of lateral ridges. Copulatory fossae are longitudinal slits with long wide flared connection to each small medially constricted spermathecae.

DISTRIBUTION AND HABITAT. High altitude rainforest at Mt Spurgeon and Black Mountain, NE Qld.

## **Krukt**, gen. nov.

TYPE SPECIES. *Krukt piligyna* sp. nov.

ETYMOLOGY. An arbitary combination of letters; the gender is female.

DIAGNOSIS. Very similar in somatic morphology to *Megateg* but differs in that males have a short palpal tibia, a small retrobasal tegulum, relatively long basal embolus, conical basodorsal process on cymbium, and in females the epigyne is a narrow scape with large raised lateral cleats; the copulatory duct folds posteriorly then anteriorly, flattens and passes close to ventral surface folding and twisting posteriorly into a flat collariform spermatheca on each side.

The synapomorphy of *Krukt* is the basodorsally narrowed cymbium.

DESCRIPTION. As for *Megateg* except:

*Epigyne*: with large broad raised median septum and lateral cleats basally; a longitudinal copulatory fossae leads directly to small simple posterior spermathecae.

*Male Palp*: tibia as long as wide; tibial apophysis is retrodorsal (base not visible from ventral view). *Cymbium*: scopula extends over distal half; retrobasal corner with deep cutaway area both soft and pallid, forming basal edge directed at tibial apophysis; viewed retrolaterally bilobed with basal incursion; dorsally basal cymbium strongly narrowed, basally with heel; sclerotised ridge prolaterally with *ca.* 1/3 of base; basodorsal process a rounded heel; paracymbial discontinuity absent but pallid glabrous cutaway. *Bulb*: median apophysis a large hook, hooked portion *ca.* half total length extends to adjacent to base of median apophysis; base irregular, small. Embolic origin very broad tapering quickly and wide, not filiform to tip. Conductor absent; small, thin, foliate paraembolic lamina in all species and adjacent membranous tegular process.

*Spinnerets*: females with two lines of spigots dorsally on PMS; males have three large spigots apically. ALS with two large contiguous spigots entally and a field of 20 smaller elsewhere.

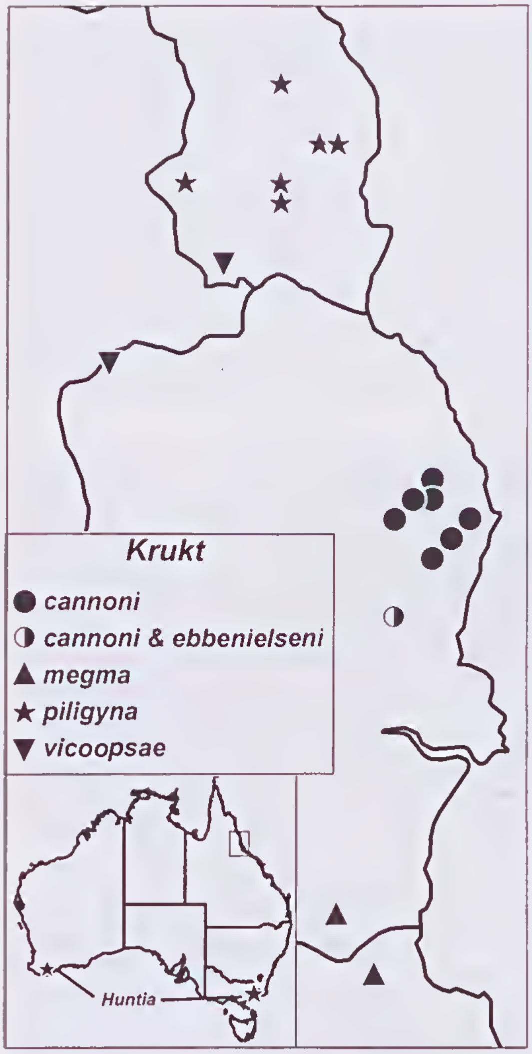

FIG. 20. *Krukt* and *Huntia*, distribution map.

INCLUDED SPECIES. *K. cannoni*, sp. nov.; *K. ebbenielseni*, sp. nov.; *K. megma*, sp. nov.; *K. piligyna*, sp. nov.; *K. vicoopsae*, sp. nov.

DISTRIBUTION AND HABITAT. Montane rainforest in the Wet Tropics World Heritage Area of North Queensland.

RELATIONSHIPS. In males of *Krukt*, up to 2 embolic lamina (*K. piligyna*, *K. ebbenielseni*) are present; males of *Megateg*, have up to 3 (see Characters) so the more numerous condition in *Krukt* is taken to be plesiomorphic. In the other three species (*K. cannoni*, *K. megma*, and *K. vicoopsae*), only one embolic lamina is present and in *K. megma* it is very tiny. That reduced number of lamina is taken to be apomorphic and shares the same distribution as the conical form of the basodorsal process on the male palpal cymbium. The cladogram then for *Krukt* is: (*K. gigasep-K. piligyna- K. ebbenielseni* (*K. cannoni-K. megma-K. vicoopsae*)).

## KEY TO SPECIES OF *KRUKT*

Males

1. Cymbium with basodorsal process (Figs 25A,B, 32B,D) . 2
Cymbium basodorsally rounded or truncate (Fig. 28A) . 4

2. Basodorsal process on cymbium distinctly curved in dorsal view (Fig. 25A). . . . . . . . . . . . *K. cannoni*
Basodorsal process on cymbium straight in dorsal view (Fig. 30A) . . . . . . . . . . . . . . . . . . . . . . . . 3

3. Median apophysis with small apical hook and small retrobasal process (Fig. 32A,B) . . . . . . *K. vicoopsae*
Median apophysis large, dominated by hook (Fig. 29A) . . . . . . . . . . . . . . . . . . . . . . . . . . *K. megma*

4. Tegulum with extensive unsclerotised area and extends posteriorly over tibia (Fig. 28C, D) . . . *K. ebbenielseni*
Tegulum with small unsclerotised area and lies within cymbium (Fig. 23A,B) . . . . . . . . . . . *K. piligyna*

Females (based on epigyne, females of *K. ebbenielseni* unknown)

1. Median scape clearly constricted anteriorly (Fig. 26D). 2
Median scape not constricted anteriorly (Fig. 24A) . . 3

2. Cleats lateral of scape (Fig. 26D). . . . . . . *K. cannoni*
Cleats posterior to scape (Fig. 13A) . . *Megateg gigasep*

3. Scape very wide, cleats lateral of scape (Fig. 29D, 31A, C) . . . . . . . . . . . . . . . . . . . . . . . . . . *K. megma*
Scape narrow, cleats posterior and lateral of scape (Fig. 24A). . . . . . . . . . . . . . . . . . . . . . . . . . . . . 4

4. Scape narrow, hirsute (Fig. 24A). . . . . . . *K. piligyna*
Scape with large lateral fold; scape widely divided medially (Fig. 32C) . . . . . . . . . . . . *K. vicoopsae*

### **Krukt piligyna** sp. nov.
(Figs 3E, 20-24, 32E; Table 9)

ETYMOLOGY. Latin, hirsute (*pili*), genitalia (*gyna*) alluding to the diagnostic hirsute scape of females.

MATERIAL. HOLOTYPE: 1 ♂, Mt Finnigan, 15°49'S 145°17'E, NEQ, under rocks, 9 Nov 1974, L. Roberts, V.E. Davies, J. Covacevich, QM S31166. PARATYPES. Allotype: 1 ♀, as for holotype but, L. Roberts, V.E. Davies, QM S31167. Mt Finnigan, 15°49'S 145°17'E, 1110m, rainforest: 1 ♀, as for S31167, QM S31168; 5 ♂♂ 3 ♀♀, pitfall, 28-30 Nov 1985, G.Monteith, D.Cook, QM S32963; 1 ♂ 2 ♀♀, sieved litter, 21 Apr 1982, G.Monteith, D.Yeates, D.Cook, QM S32962; 1 ♂, summit, pitfall, 3-5 Dec 1990, D. Cook, G. Thompson, L. Roberts, QM S32964; 2 ♂♂, summit, 28-30 Nov 1985, G. Monteith, D. Cook, L. Roberts, QM S32966; 1 ♂, pitfall, 19-22 Apr 1992, G.Monteith, D.Yeates, D.Cook, QM S32965; 1 ♂ 2 ♀♀, site 2, 15°48'S 145°17'E, pitfall, 4 Dec 1990-17 Jan 1991, Qld Museum & ANZSES, QM S32970; 1 ♂ 2 ♀♀, site 3, 15°48'S 145°17'E, pitfall, 4 Dec 1990-17 Jan 1991, QM ANZSES, QM S32095; 2 ♂♂ 6 ♀♀, site 4, 15°48'S

145°17'E, pitfall, 4 Dec 1990-17 Jan 1991, QLD Museum & ANZSES, QM S32971; 1 ♂ 1 ♀, site 5, pitfall, 4 Dec 1990-17 Jan 1991, QLD Museum & ANZSES, QM S32969; 4 ♂♂ 4 ♀♀, sieved litter, 30 Nov 1985, G.Monteith, D.Cook, QM S31161; 1 ♂ 2 ♀♀, site 3, 15°48'S 145°17'E, pitfall, 4 Dec 1990-17 Jan 1991, QM ANZSES, QM S31162; 1 ♂ 1 ♀, stick brushing, 21 Nov 1998, G Monteith, QM S49954; 1 ♂ 1 ♀, same data, QM S49958. Big Tableland, 15°43'S 145°17'E, A.N.Z.S.E.S. expedition: 1 ♂ 1 ♀, flight intercept trap, 20 Dec 1990-8 Jan 1991, QM S32968; 1 ♀, same data, QM S32967; 5 ♂♂, pitfall, 20-21 Dec 1990, QM S31163,4; 3 ♂♂ 1 ♀, same data but, site 5, 16°39'S 145°34'E, pitfall, 20 Dec 1989-15 Jan 1990, QM S31132, 31131. 1 ♂, Mt Sampson, 15°48'S 145°12'E, pitfall, 27 Dec 1990-19 Jan 1991, A.N.Z.S.E.S. expedition, QM S31130; 2 ♀♀, Mt Hartley, 15°46'S 145°20'E, 6 Nov 1974, J.Covacevich, D.Joffe, V.E.Davies, QM S32961; 1 ♂, same data but pitfall, 8 Dec 1993-2 Feb 1994, L.Roberts, QM S31165; 2 ♂♂, same data but 8 Nov 1995-17 Jan 1996, G Monteith, D. Cook, L. Roberts, QM S43950. All in northeastern Queensland.

TABLE 9. Leg meaurements of *Krukt piligyna*, holotype male and allotype female.

| Male | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 2.54 | 2.31 | 1.92 | 2.15 | 1.00 |
| Patella | 1.00 | 1.23 | 0.85 | 0.77 | 0.61 |
| Tibia | 2.31 | 1.77 | 1.61 | 1.85 | 0.46 |
| Metatarsus | 2.38 | 1.69 | 1.85 | 2.85 | 1.15 |
| Tarsus | 0.92 | 0.85 | 1.00 | 1.15 | |
| Total | 9.15 | 7.85 | 7.23 | 8.77 | 3.22 |
| Female | I | II | III | IV | Palp |
| Femur | 2.31 | 1.92 | 1.85 | 1.92 | 1.23 |
| Patella | 1.38 | 1.23 | 0.92 | 1.15 | 0.77 |
| Tibia | 1.85 | 1.85 | 1.46 | 1.92 | 0.69 |
| Metatarsus | 1.46 | 1.61 | 1.46 | 2.23 | 0.85 |
| Tarsus | 0.69 | 0.69 | 1.08 | 1.00 | |
| Total | 7.69 | 7.30 | 6.77 | 8.22 | 3.54 |

DIAGNOSIS. Males differ from those of all other species in the deep retrobasal groove on the cymbium (Fig. 23B); females differ from those of all other species in the narrow hirsute epigynal scape (Fig. 23D).

DESCRIPTION. Holotype ♂ QM S31166. Carapace 3.72 long, 2.96 wide. Abdomen 2.92, 2.16 wide. Total length, 6.8.

*Eyes*: AME:ALE:PME:PLE, 9:11:7:11. Eye group front width: back width: length, 47:69:31. Interspaces: AME-AME, 0.7; AME-ALE, 0.2; PME-PME, 1.9; PME-PLE, 1.2.

*Chelicerae*: p=3, r=3.

*Spines*: I: fe pv1 strong, p1d3r3; pa r1; ti p3d3r3v2.2.2.2; me p2r2v2.2.2. II: fe p2d3r3; pa r1; ti p2d3r3v2.2.2.2; me p3r3v2.2.2. III: fe p2d3r2; pa r1; ti p3d2r3v2.2.2; me p3r3 v 2.2.2. IV: fe p2d3r1; pa r1; ti p2d2r2 v.2.2.2; me p3r3v7. Palp: fe pv1p1d3.

*Legs*: scopula absent. Tibial fracture on I distinct, pro- and retrolaterally on I-IV. Trochanteral notches shallow, symmetrically shaped. Claw tufts thin, narrow.

*Palp* (Fig. 23A-C): tibia stout with sclerotised distal collar and rounded dorsal process locking with base of cymbium; tibial apophysis moderately long triangle with basal lobe. *Cymbium*: scopula extends over distal half; retrobasal corner with deep cutaway area both soft and pallid, forming basal edge directed at tibial apophysis; viewed retrolaterally bilobed with basal incursion; dorsally basal cymbium strongly narrowed, basally with heel; sclerotised ridge prolaterally with c.1/3 of base; basodorsal process a rounded heel; paracymbial discontinuity absent but pallid glabrous cutaway. *Bulb*: median apophysis a large hook, hooked portion *ca.* half total length extends to adjacent to base of median apophysis; base irregular, small. Embolic origin very broad tapering quickly near tip. Membranous tegular process distinct, long, banana-like.

Allotype ♀ QMS31167. Carapace 3.76 long, 2.92 wide. Abdomen 4.92, 3.80 wide. Total length, 8.8.

*Eyes*: AME:ALE:PME:PLE, 8:13:6:12. Eye group front width: back width: length, 55:81:38. Interspaces: AME-AME, 1.1; AME-ALE, 0.5; PME-PME, 2.4; PME-PLE, 1.2.

*Chelicerae*: p=3, r=3.

*Spines*: I: fe pv1 strong, p1d1r1; pa 0; ti v2.2.2.2; me v2.2.2. II: fe p1d3r1; pa 0; ti v2.2.2.2; me v2.2.2. III: fe p2d3r2; pa r1; ti p2d2r2v2.2.2; me p3r4v2.2.2. IV: fe p2d3r1; pa r1; ti p2d2r2v2.2.2; me p4r4v2.2.2. Palp: fe d3; pa 0; ti p2; ta p3.

*Legs*: scopula absent.

*Epigyne* (Figs 23D, 24A): externally a long narrow hirsute scape for length lies between two large rounded lateral lobes with large cleats off posterior corners; scape not movable. Copulatory fossae are anterior lateral of lobes, a broad flat duct folds posteriorly, turns anteriorly becoming broader as it passes close to ventral surface and posteriorly where it twists up to curved collar-like receptaculum; medially, deeply U-shaped ridge formed by dorsal extension of scape appears to join with insemination ducts but

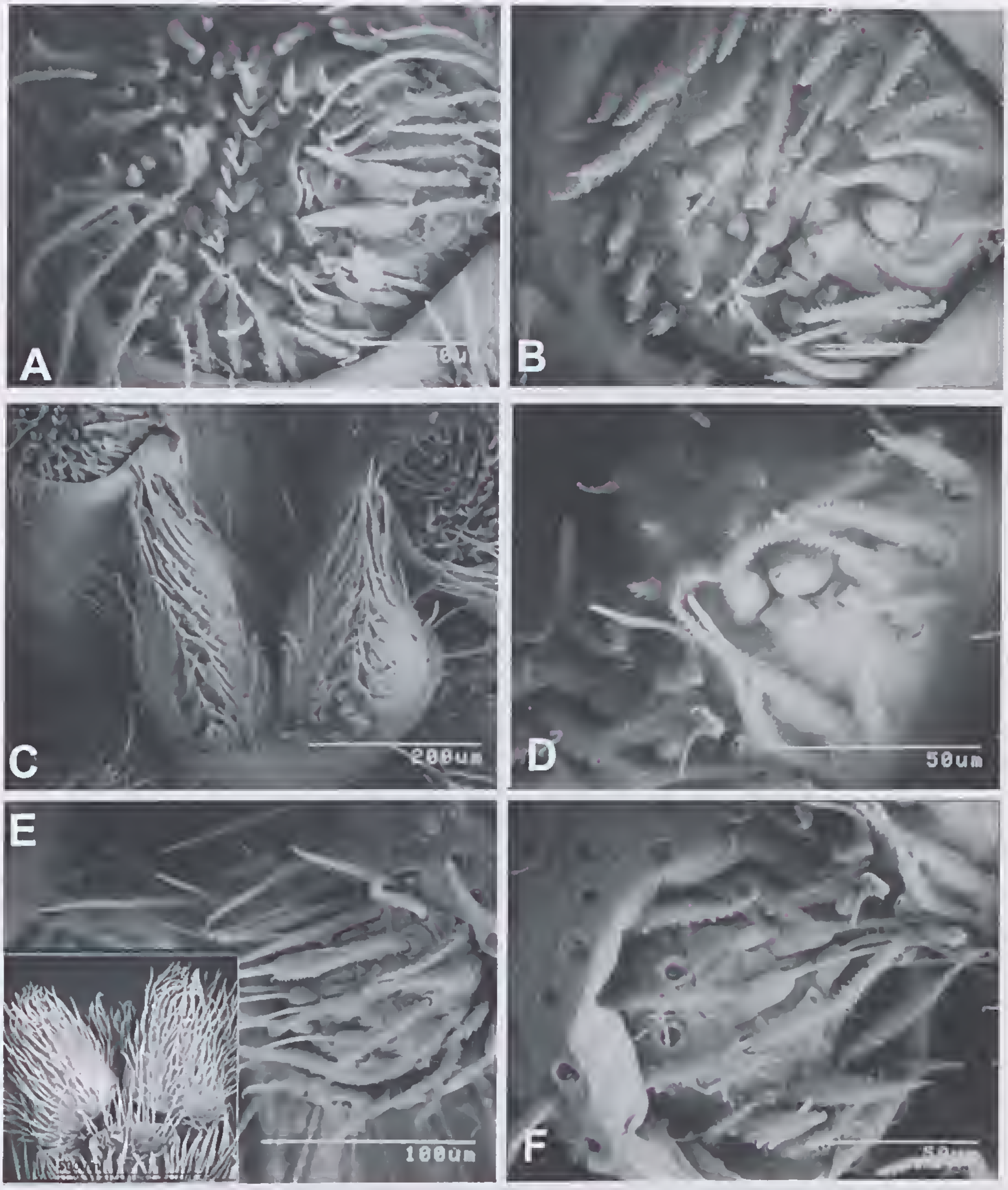

FIG. 21. Spinnerets, *Krukt piligyna*, sp. nov., QM S31162, scanning electron micrographs, apical view. A, C (dorsal), E, ♀; B, D, F, ♂. A, B, ALS; C, D, PMS; E, F, PLS; inset of E shows broad triangular fleshy colulus.

in fact is simply external. Lateral cleats have no internal connection.

DISTRIBUTION AND HABITAT. High altitude (>700m) rainforest at Mt Finnigan and nearby Mts Hartley and Sampson, NE Qld.

## **Krukt cannoni**, sp. nov.
(Figs 20, 25-28; Table 10)

ETYMOLOGY. For Lester Cannon, Senior Curator of Invertebrates, Queensland Museum, 1976-2002.

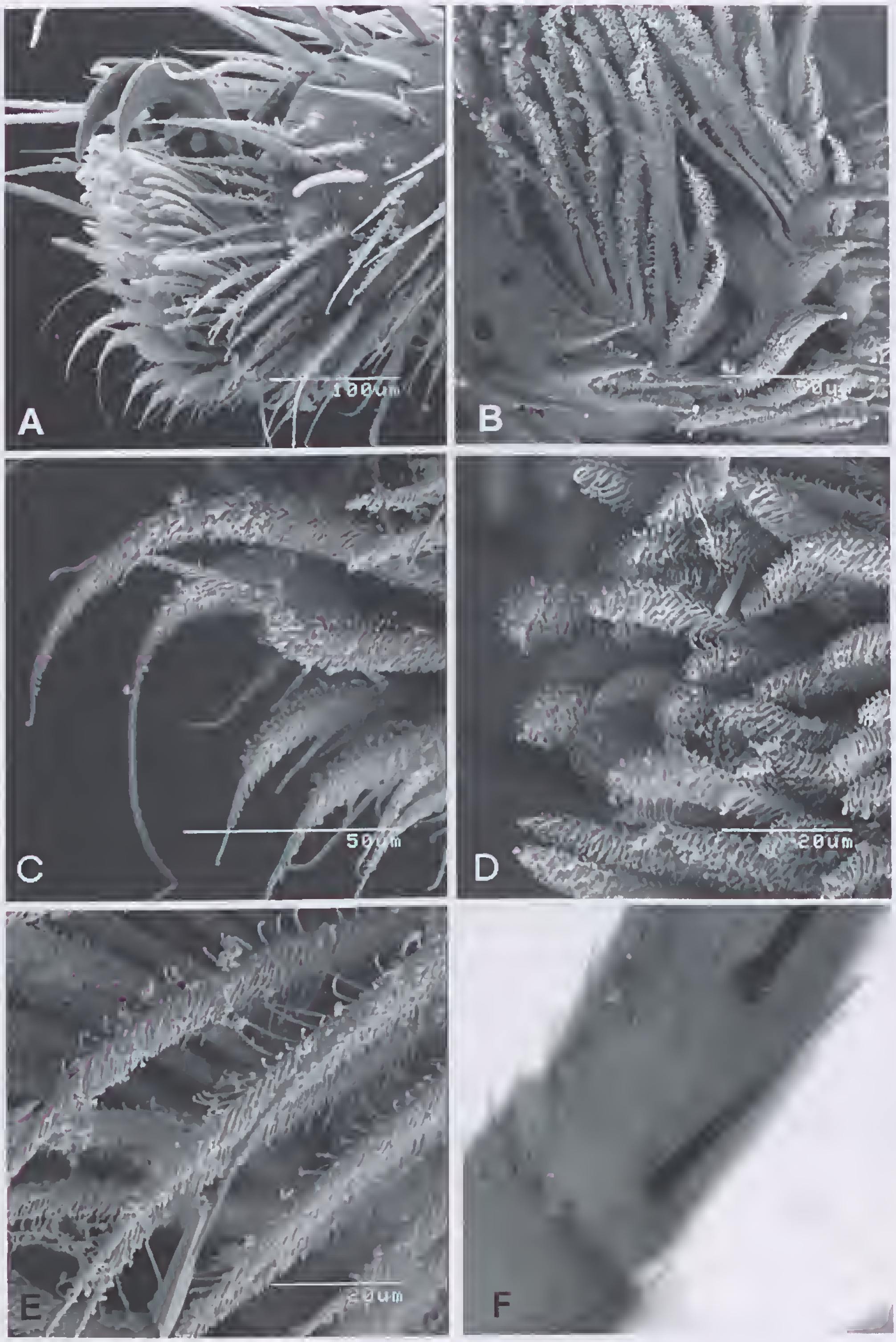

FIG. 22. Claw tufts, *Krukt piligyna*, sp. nov., ♀, leg I, scanning electron micrographs. A, retrolateral view; B, axial view; C, E, ventral tapering hairs; D, scopula hairs; F, ♂ tibia I photomicrograph showing crack, prolateral view.

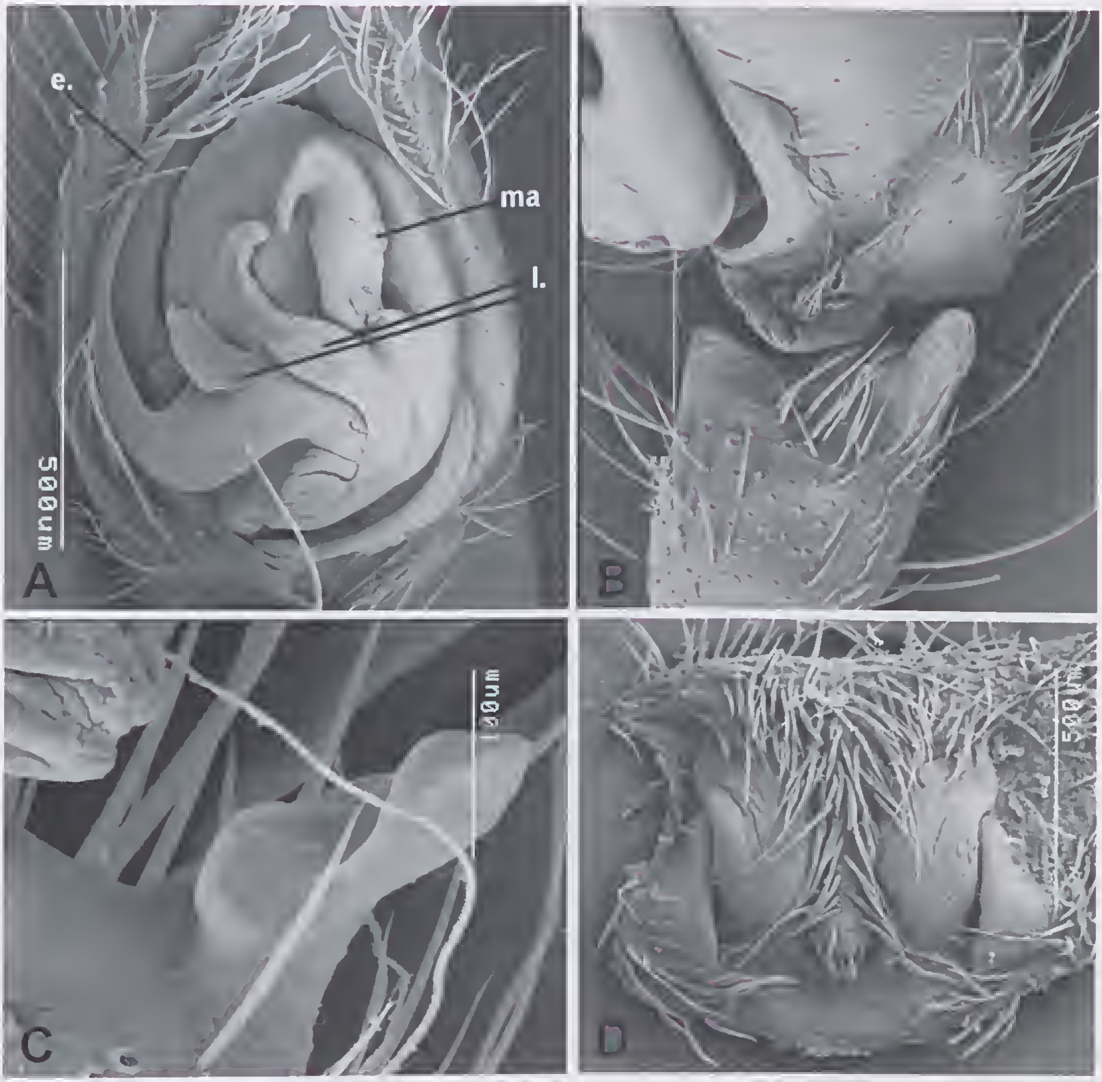

FIG. 23. *Krukt piligyna*, sp. nov., ♂, A-C, ♀, D. A, palpal bulb, ventral view; B, palpal tibia and cymbium, retrolateral view; C, tibial apophysis, ventral view; D, epigyne, ventral view.

MATERIAL. HOLOTYPE: ♂, Mt Sorrow summit, Cape Tribulation, 16°06'S 145°26'E, rainforest, sieved litter, 19 Oct 1980, G. Monteith, QM S31390. PARATYPES. allotype ♀, as for holotype, QM S31391; 2 ♀♀, as for holotype, QM S31392; ♀, Cape Tribulation, 3km W (Site 6), 16°05'S 145°27'E, rainforest, sieved litter, 19 Sep 1982, G. Monteith, D. Yeates, G. Thompson, QM S32958; 1 ♂, Mt Halcyon, 16°03'S 145°25'E, pitfall, 22-24 Nov 1993, G.Monteith, H.Janetzki, D.Cook, L.Roberts, QM S32959; 1 ♀, Roaring Meg valley, 16°04'S 145°25'E, rainforest, litter, 21 Nov 1993, G.Monteith H.Janetzki, QM S32960. Mt Hemmant, 16°07'S 145°25'E, rainforest: 2 ♂♂, pitfall, 25-27 Nov 1993, G.Monteith, H.Janetzki, D.Cook, L.Roberts, QM S32955; 1 ♀, 1 ♂, sieved litter, 25 Apr 1983, G.Monteith, D.Cook, QM S32954, 32953. Mt Pieter-Botte, 16°04'S 145°24'E, rainforest: 1 ♂, 2 ♀♀, pitfall, 21 Nov-8 Dec 1993, G.Monteith, H.Janetzki, QM S32950; 1 ♂ 1 ♀, pitfall, 2-8 Dec 1993, G.Monteith, H.Janetzki, QM S32956; 1 ♂, 0.5km E, 16°05'S 145°23'E, sieved litter, 5 Oct 1982, G.Monteith, D.Yeates, G.Thompson, QM S32957. 1 ♂, Thornton Peak, 16°10'S 145°23'E, 24-27 Sep 1984, G. & S. Monteith, sieved litter & moss, 20-22 Sep 1981, G.Monteith, D.Cook, QM S31170. All in NE Queensland.

DIAGNOSIS. Differs from most other species in short male palpal tibia and *K. ebbenielseni* and *K. vicoopsae* by absence of cymbial cutaway and

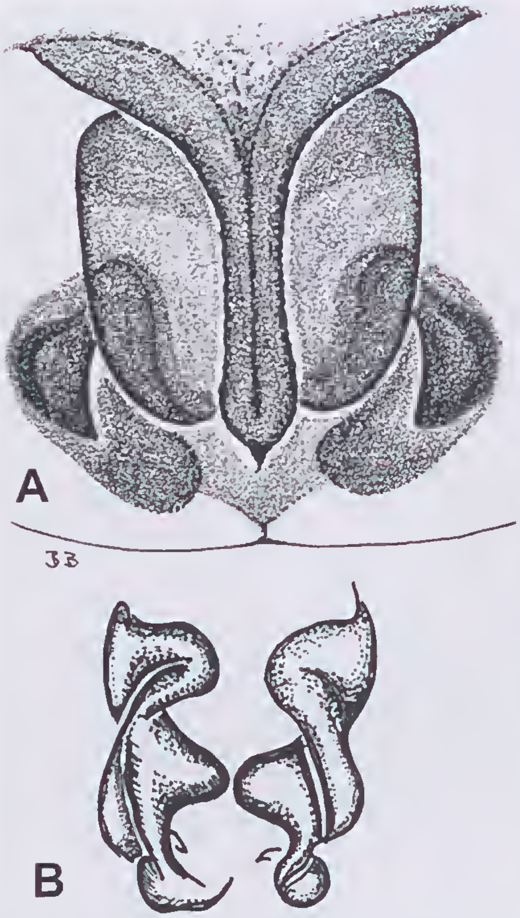

FIG. 24. *Krukt piligyna*, sp. nov., ♀. A, epigyne; B, vulva.

from *K. ebbenielseni* in normal tegulum shape and from all others in basodorsal cymbium process being hooked and from *K. vicoopsae* in lacking a basal tibial apophysis lobe and having the lateral epigyne lobes pointed.

DESCRIPTION. Holotype ♂. Carapace 3.84 long, 2.92 wide. Abdomen 2.96, 2.08 wide. Total length, 7.0.

*Colour*: carapace yellow brown with darker areas on margins, caput, interstrial ridge posterior lateral of PLE & behind AME. Legs with 3 incomplete rings on femora, one on patellae, two on tibiae, none on metatarsi. Abdomen dorsally mottled orange with irregular ovoid pallid area anteriorly, mottling darker posteriorly. Ventrally pallid with few transverse dark areas. Sternum fawn with dark band medially and on margins; elsewhere pallid.

*Eyes*: AME:ALE:PME:PLE, 8:6:13:11. Eye group front width: back width: length, 50:67:31. Interspaces: AME-AME, 0.7; AME-ALE, 0.3; PME-PME, 1.9; PME-PLE, 1.8.

*Sternum*: narrow, broken, ventral sternal extension.

*Spines*: I: fe pv1 strong, p1d3r3; pa r1; ti p2d3r3v2.2.2.2.0; me p3r3v2.2.2. II: fe p1d3r3; pa r1; ti p2d3r3v2.2.2.2.0; me p3r3v2.2.2. III: fe p2d3r3; pa r1; ti p2d2r2v2.2.2; me p1.2.2r2.1.2v2.2.2. IV: fe p2d3r1; pa r1; ti p2d2r2v.2.2.2; me p5r2.2.2v2.2.2. Palp: fe p1d1.2, rest 0.

*Legs*: scopula absent; tibial fracture on I-IV prolaterally and retrolaterally distinct; trochanteral notches shallow.

*Palp* (Figs 25A-C, 26A-C): tibia *ca.* 1.5× longer than wide, barrel-like with sclerotised collar (as in all species) around distal edge; tibial apophyis a large but short twisted blunt process, retroventrally with small separate (not on same lobe) digitiform lobe. *Cymbium*: scopula extends just over half; basodorsal process viewed from above (back of cymbium) a distinct triangular extension narrowing to small teat clearly hooked to retrolateral corner, below basodorsal process clearly sclerotised. Paracymbial discontinuity retrobasally with small sclerotised corner. *Bulb*: median apophysis base small, short, rectanguloid, converging quickly to large apical hook; embolus origin large, tapering quickly to narrow scoop.

Allotype ♀. As for male except as follows: Carapace 4.04 long, 3.20 wide. Abdomen 4.48, 3.16 wide. Total length, 4.8.

*Colour*: carapace brown with dark brown markings, legs strongly banded. Abdomen dorsally dark mottled with paler oval area anteriorly, ventrally darkly mottled.

*Eyes*: AME:ALE:PME:PLE, 9:13:9:13. Eye group front width: back width: length, 59:82:38. Interspaces: AME-AME, 1.0; AME-ALE, 0.3; PME-PME, 1.7; PME-PLE, 1.2.

*Spines*: I: fe pv1 strong, p1d1r1; pa 0; ti v2.2.2.2; me v2.2.2. II: fe p2d3r1; pa 0; ti v2.2.2.2; me v2.2.2. III: fe p3d3r2; pa r1; ti p2d2r2v2.2.2; me p1.2.2r2.1.2v2.2.2. IV: fe p2d2r1; pa r1; ti p2d2r2v1.2.2; me p5r2.2.2v6 paired. Palp: fe d1.2; pa 0; ti p2r1; ta p3.

*Legs*: scopula absent; claws with 3-4 teeth; tufts united; tarsal rod at basal 2/5.

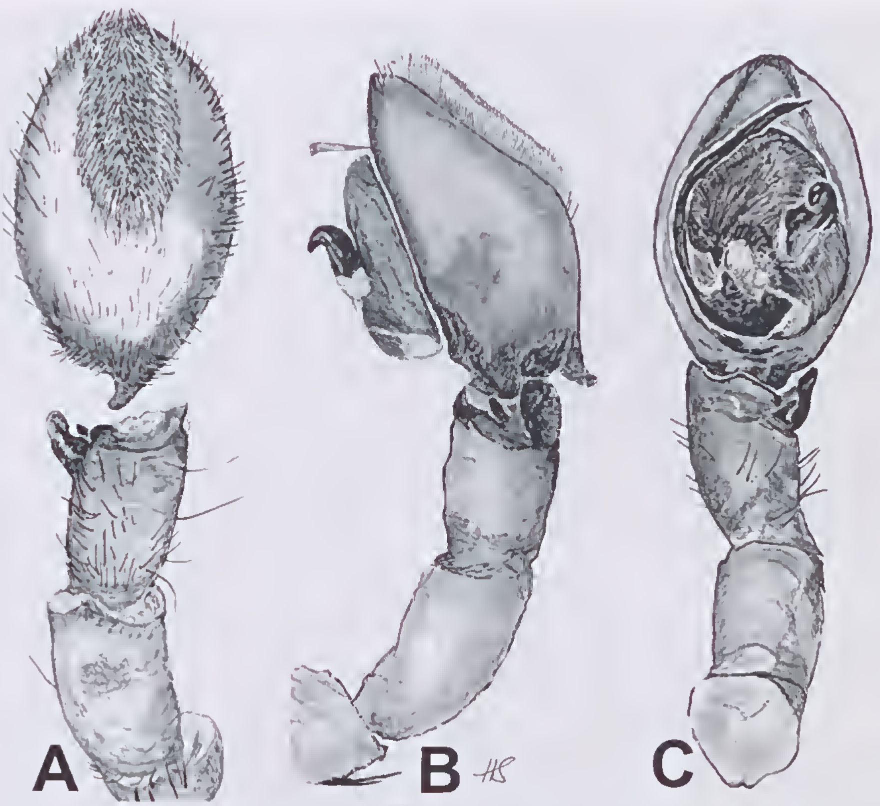

FIG. 25. *Krukt cannoni*, sp. nov., ♂, palpal tibia, cymbium and bulb; dorsal (A), retrolateral (B), and ventral (C) views.

*Epigyne* (Figs 26D, 27C-E): a broad domed central scape widening at mid-basal area and lateral grooves adjacent to diagonal ridge.

TABLE 10. Leg meaurements of *Krukt cannoni*, holotype male and allotype female.

| Male | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 2.31 | 2.23 | 2.31 | 2.61 | 1.08 |
| Patella | 1.00 | 1.08 | 1.00 | 1.08 | 0.61 |
| Tibia | 2.46 | 2.07 | 2.07 | 2.69 | 0.54 |
| Metatarsus | 2.31 | 2.15 | 1.77 | 3.38 | 1.00 |
| Tarsus | 1.00 | 0.92 | 1.00 | 1.38 | |
| Total | 9.08 | 8.45 | 8.15 | 11.14 | 3.23 |
| **Female** | **I** | **II** | **III** | **IV** | **Palp** |
| Femur | 2.23 | 2.38 | 2.00 | 2.31 | 1.23 |
| Patella | 1.31 | 1.23 | 1.15 | 1.23 | 0.69 |
| Tibia | 2.15 | 1.92 | 1.54 | 2.38 | 0.77 |
| Metatarsus | 1.85 | 1.77 | 1.92 | 3.08 | 1.00 |
| Tarsus | 0.92 | 0.85 | 1.00 | 1.15 | |
| Total | 8.46 | 8.15 | 7.61 | 10.15 | 3.69 |

DISTRIBUTION AND HABITAT.High altitude (>700m) rainforest at Mt Sorrow, Roaring Meg Valley, Mt Hemmant, Mt Pieter-Botte, Mt Halcyon, west of Cape Tribulation, and Thornton Peak, NE Qld.

### **Krukt ebbenielseni** sp. nov.
(Figs 20, 28; Table 11)

ETYMOLOGY. For the late Dr Ebbe Nielsen.

MATERIAL. HOLOTYPE: ♂, Thornton Peak, 16°10'S 145°23'E, NEQLD, 24-27 Sep 1984, G. & S. Monteith, QM S31169. PARATYPES: ♂, Thornton Peak, 16°10'S 145°22'E, 955m, Nov 1975, M. Gray, AM KS9163.

DIAGNOSIS. Males are unique in the genus in the posteriorly produced but ventrally extensively unsclerotised tegulum.

DESCRIPTION. Holotype ♂. Carapace 3.68 long, 2.80 wide. Abdomen 2.80, 1.92 wide. Total length, 6.8.

*Eyes*: AME:ALE:PME:PLE, 8:11:7:12. Eye group front width: back width: length, 48:70:34.

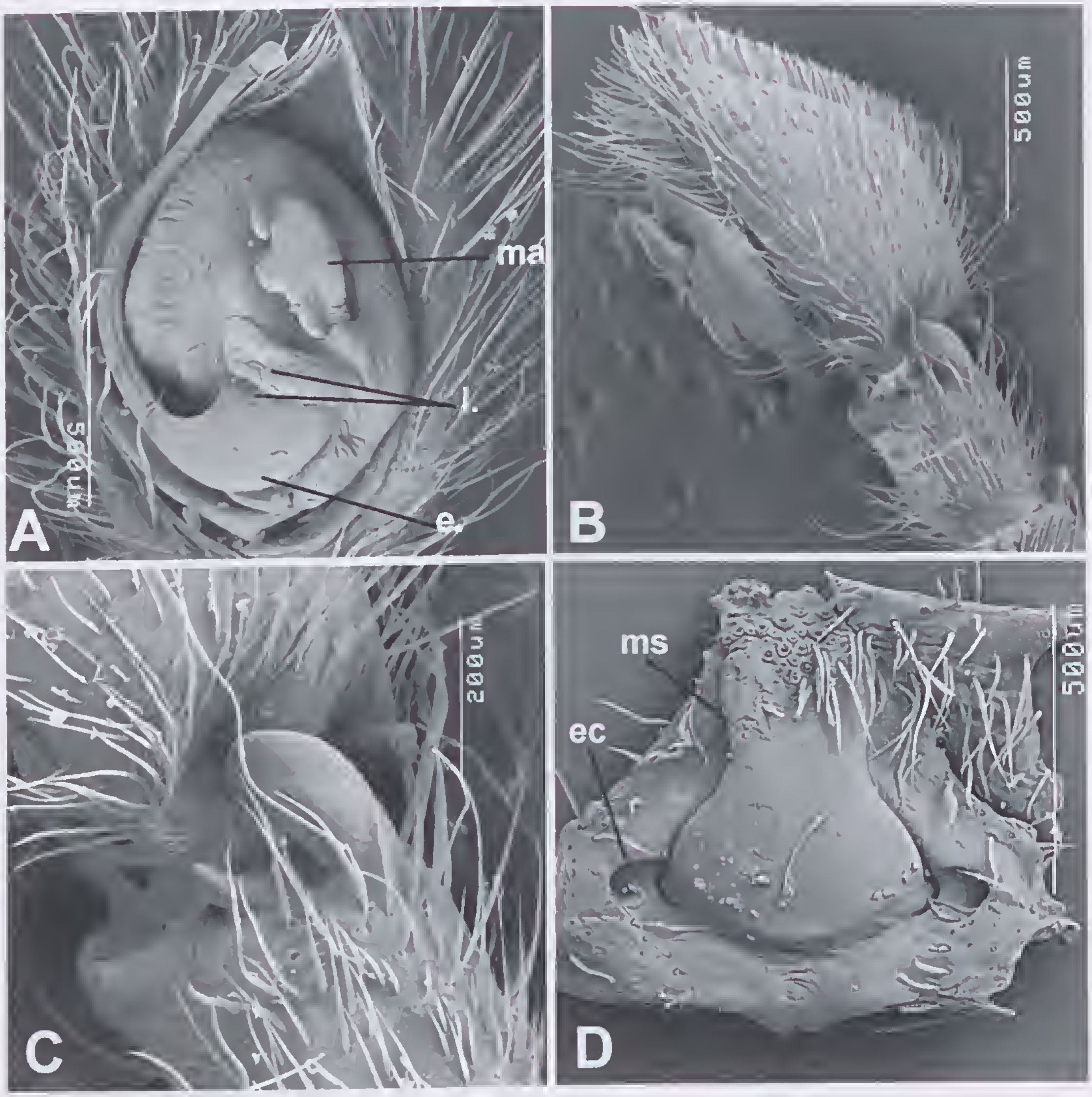

FIG. 26. *Krukt cannoni*, sp. nov., ♂, A-C, ♀ D. A, palpal bulb, ventral view; B, palpal tibia and cymbium, retrolateral view; C, tibial apophysis, retrolateral view; D, epigyne, ventral view.

Interspaces: AME-AME, 0.7; AME-ALE, 0.3; PME-PME, 1.9; PME-PLE, 1.2.

*Spines*: I: fe pv1 strong, p1d3r2; pa r1; ti p2d1r3v2.2.2.2; me p1r1v2.2.2. II: fe p2d3r3; pa r1; ti p2d3r2v2.2.2.2; me p1r3v2.2.2. III: fe p3d3r3; pa r1; ti p2d2r2v2.2.2; me p4r5v2.2.2. IV: fe p3d3r1; pa r1; ti p2d2r2v.2.2.2; me p5r6v2.2.2.2. Palp: fe p1d2r1.

*Legs*: tibial fracture prolaterally and retrolaterally distinct on I & II. Trochanteral notches: shallow, I, II deeper in back of notch to front; III, IV symmetrical.

*Palp* (Fig. 28A-E): tibia stout with rounded distal heels prolaterally and prodorsally; tibial apophysis large, scooped with ventral corner folded. *Cymbium*: scopula extends to distal half; retrobasally indented; basodorsal process broad, rounded; paracymbial discontinuity absent. *Bulb*: median apophysis large, wide with broad, apical hook, base roughly crescentic; small then becomes extensive; embolus arises medially off prolateral side.

*Female*: unknown.

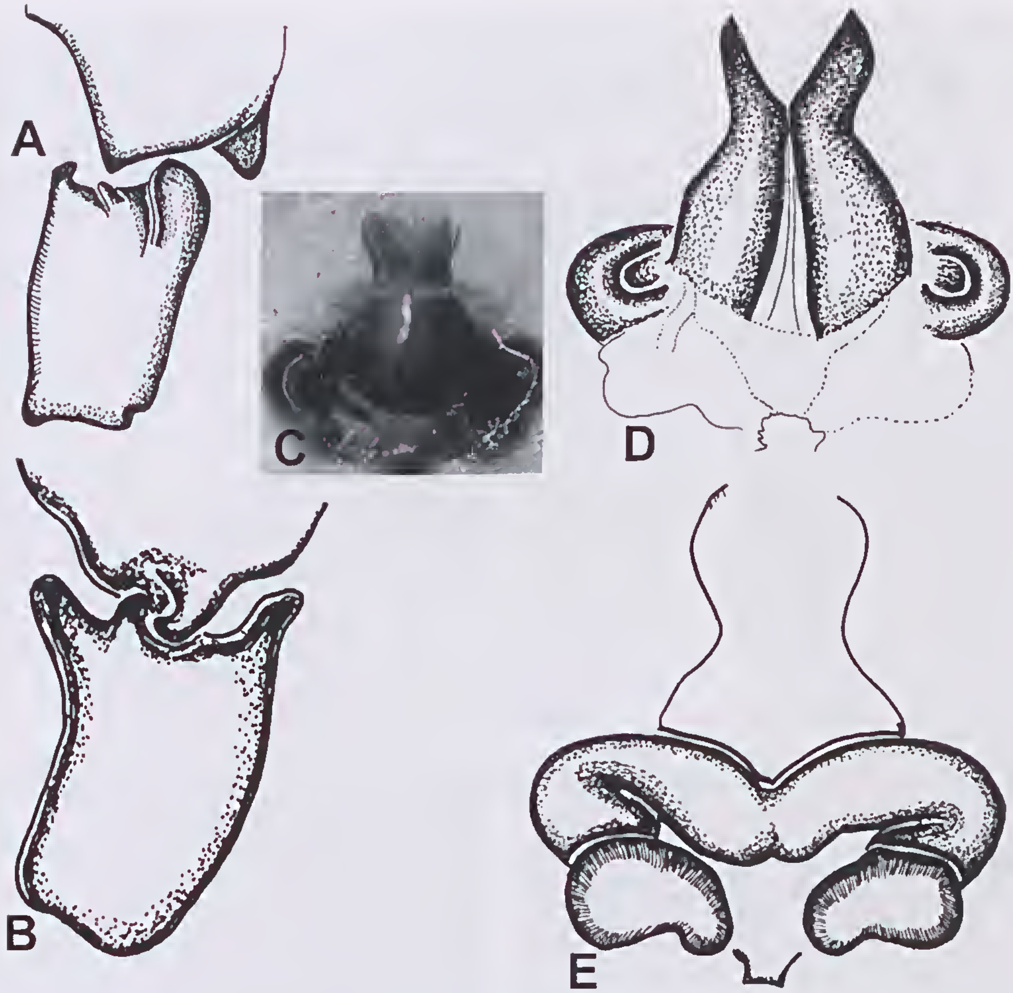

FIG. 27. *Krukt cannoni*, sp. nov. A, B, ♂ palpal tibia and cymbium base, retrolateral (A) and retrodorsal (B) views. C-E, ♀; C, D, epigyne, photomicrograph (C); E, vulva.

DISTRIBUTION AND HABITAT.High altitude (>700m) rainforest at Thornton Peak, NE Qld.

TABLE 11. Leg measurements of *Krukt ebbenielseni*, holotype male.

| | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 2.69 | 2.54 | 2.61 | 3.31 | 1.54 |
| Patella | 1.23 | 1.23 | 1.15 | 1.23 | 0.61 |
| Tibia | 2.92 | 2.54 | 2.00 | 2.92 | 0.69 |
| Metatarsus | 2.69 | 2.31 | 2.31 | 3.46 | 1.38 |
| Tarsus | 1.08 | 1.15 | 1.00 | 1.38 | |
| Total | 10.61 | 9.77 | 9.07 | 12.30 | 4.22 |

### **Krukt megma** sp. nov.
(Figs 20, 29-31; Table 12)

ETYMOLOGY. An arbitary combination of letters.

MATERIAL. HOLOTYPE: ♂, Mossman Bluff Track, 5-10km W Mossman (Site 5), 16°28'S 145°22'E, NEQLD, rainforest, pitfall, 16-30 Dec 1988, G.Monteith, G.Thompson, ANZSES Expedition, QM S16650. PARATYPES. Allotype ♀, as for holotype, QM S58221; 1 ♂, Mossman Bluff Track, 5-10km W Mossman (Site 1), 16°28'S 145°22'E, 250m, flight intercept trap, 1-16 Jan 1989, G.Monteith, G.Thompson, ANZSES Expedition, QM S31129; 1 ♀, same data but (Site 4), 16°25'S 145°20'E, 800-1000m, pitfall, 20 Dec 1989-15 Jan 1990, QM S32882; 3 ♂♂ 1 ♀, same data but, site 5, 16°39'S 145°34'E, 760m, pitfall, 20 Dec 1989-15 Jan 1990, QM S31132, S31131.

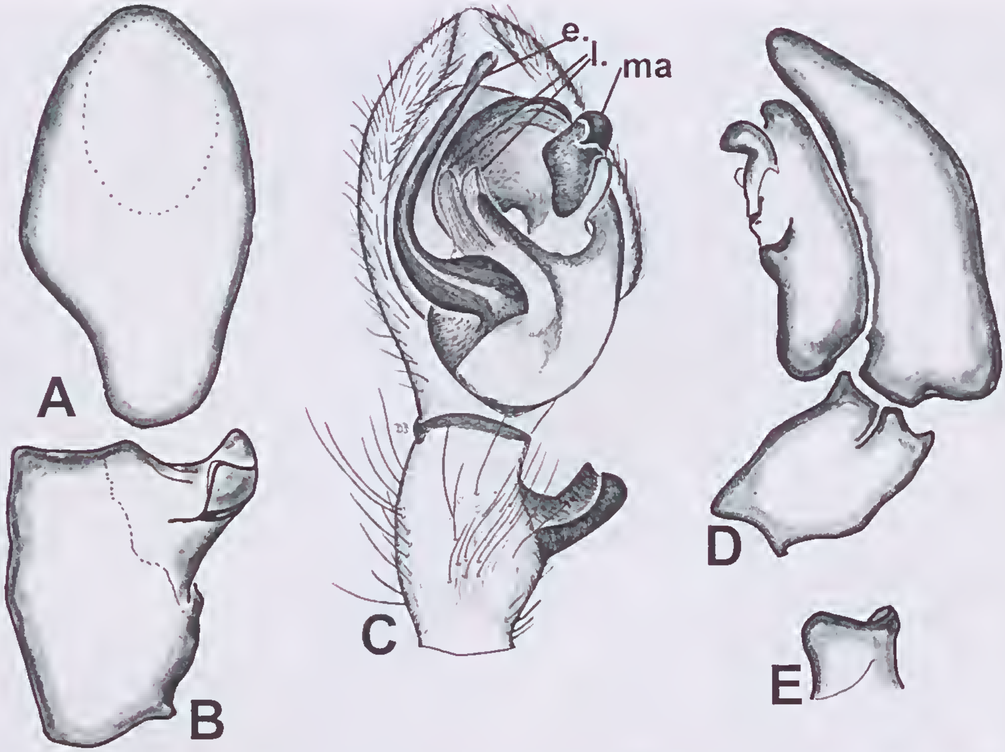

FIG. 28. *Krukt ebbenielseni*, sp. nov., ♂ palpal tibia, cymbium and bulb; dorsal (A), ventral (B, C), retrolateral views (D), tibial apophysis, retrodorsal view (E).

DIAGNOSIS. Males are easily separated from those of other congeners by the very large central median apophysis; females are also easily recognised by the short wide parallel-sided scape in the epigyne.

DESCRIPTION. Holotype ♂. Carapace 3.52 long, 2.80 wide. Abdomen 5.00 long, 3.88 wide.

*Colour in alcohol*. Carapace orange brown with darker margins in posterior half; centrally with reticulate dark areas forming pallid hemispheres along margin. Eye region not dark. Chelicerae yellow brown with 2 dark stripes. Abdomen dorsally yellowish with dark anterior shoulders and more mottling in posterior half with large almost entirely pallid anterior area.

*Carapace*. AME on common tubercle overhanging clypeus.

*Spines*. I: fe pv1p1d3r2; pa 0; ti p2d1r3v2.2.2.2; me p2r2v2.2.2. II: fe p2d3r2; pa0; ti p3d2r3v2.2.2.2; me p2r2v2.2.2. III: fe p2d3r2; pa0; ti p2d2r2v2.2.2; me p1.2.2r2.1.2v2.2.2. IV: p3d3r1; pa r1; ti p2d2r2v2.2.2; me p1p1p1p2r1.1.2.2v2.2.2. Palp: fe p1d1.2; rest, 0.

*Palp* (Figs 29A-C, 30A-C). Tibia short, barrel-shaped with large blade-like RTA at half-length; tibia distally with collar and single dorsal lobe; collar absent from retroventral edge. Cymbium with narrow dorsal scopula; very narrow base/junction with tibia; in posterior half, cymbium narrows strongly to basodorsal overhanging process. Tegulum with small marginal basal component, distally large plate. Embolus with very large wide base, tapers quickly to narrow tip; a small triangular lamella at base of embolus; embolus entirely mobile. Median apophysis a large, curved hook narrowly attached to tegulum and mobile.

Allotype ♀. *Colour in alcohol*. Carapace like male but orange brown with more extensive darker areas. Abdomen dorsally with darker shoulders, anterior shields distinct. Legs red brown; dark bands on distal femora, tibiae and metatarsi; coxae ventrally dark distally. Bipartite dark shadow centrally on sternum with dark spots marginally opposing coxae.

*Eyes*. AME:ALE:PME:PLE, 7:9:5:8. Eye group front width: back width: length, 41:57:25.

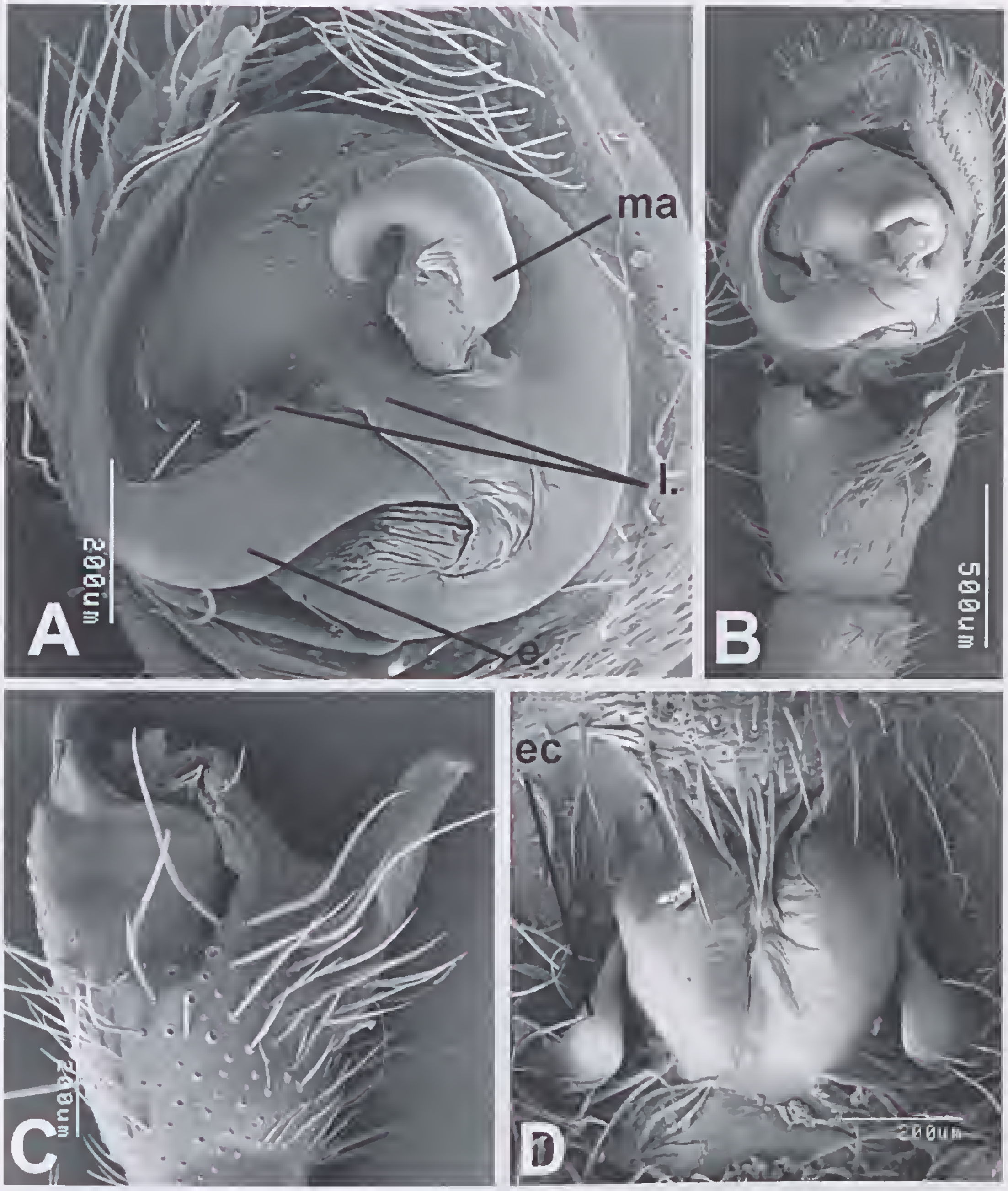

FIG. 29. *Krukt megma*, sp. nov., scanning electron micrographs. A-C, ♂ palp; A, bulb, ventral view; B, C, patella, tibia (C), cymbium and bulb (B), ventral view. D, ♀ epigyne.

Interspaces: AME-AME, 0.7; AME-ALE, 0.4; PME-PLE, 1.9; PME-PME, 1.6.

*Legs*. Scopula absent. Tarsal rod at basal third.

*Spines*. Strong proventral femoral spine on I. I: fe pv1p1d2r1; pa0; ti v2.2.2.2; me v2.2.2. II, as I but fe p2d3r2. III: fe p2d3r2; pa0; ti p2d2r2v2.2.2; me p1.2.2r2.1.2v2.2.2. IV: fe p2d3r1; pa r1; ti p2d2r2v2.2.2; me p1.1.1.2.r2.2.2v2.2.2. Palp: fe d1.2; pa0; ti p2d1; ta p2.1.

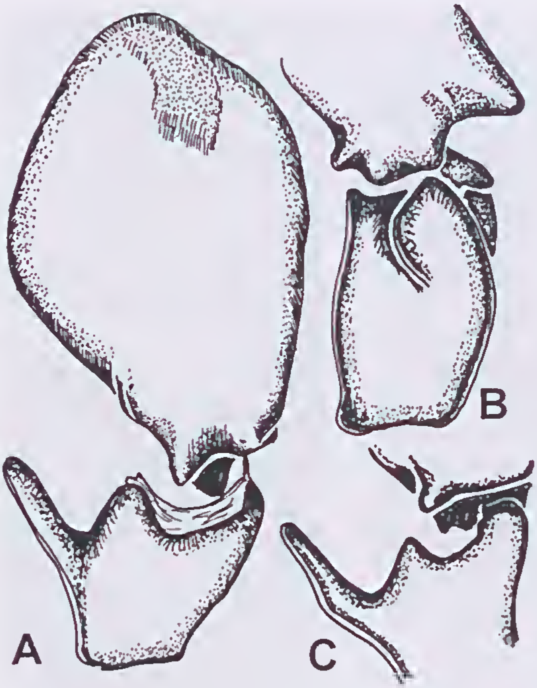

FIG. 30. *Krukt megma*, sp. nov., A-C, ♂ palpal tibia and cymbium. A, dorsal view; B, retrolateral view; C, inclined dorsal view.

*Claws*. Paired claws with 2-3 teeth. Palpal claw long, 5 teeth, shortest basally.

*Spinnerets*. All on protuberant base. PMS with 1 line of 3-4 spigots dorsally and 4-6 large spigots apically.

TABLE 12. Leg measurements of *Krukt megma* sp. nov. allotype female.

| | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 2.24 | 1.92 | 2.08 | 2.52 | 1.16 |
| Patella | 1.20 | 1.16 | 0.96 | 1.00 | 0.44 |
| Tibia | 1.92 | 1.76 | 1.32 | 2.00 | 0.64 |
| Metatarsus | 1.56 | 1.48 | 1.64 | 2.72 | |
| Tarsus | 0.76 | 0.60 | 1.12 | 1.12 | 0.80 |
| Total | 7.68 | 6.92 | 6.84 | 9.36 | 3.04 |

*Epigyne* (Figs 29D, 31A-C). A low flattened plate with long biconvex grooves and small lateral cleats. Vulva similar to *K. piligyna*.

DISTRIBUTION AND HABITAT. Mossman Bluff Track, 5-10km W Mossman, in rainforest at 250-1000m altitude, NE Qld.

### **Krukt vicoopsae** sp. nov.
(Figs 20, 32A-D,F-G, 33A-D; Table 13)

ETYMOLOGY. For Victoria Coops, Library Technician, Queensland Museum, 1981- 2002.

MATERIAL. HOLOTYPE: ♂, Mt Boolbun Sth, 15°57'S 145°08'E, rainforest, litter, 6 Nov 1995, G. Monteith, QM S31126. PARATYPES: allotype ♀, Mt Boolbun Sth, 15°57'S 145°08'E, rainforest, 4-6 Nov 1995, G. Monteith, D. Cook, L. Roberts, QM S31128; 1 ♀, same data but litter, 6 Nov 1995, G. Monteith, QM S38158; 1 ♀, same data but dung, pitfalls, & intercepts, 4-6 Nov 1995, G. Monteith, QM S31127; 1 ♂, Mt Misery, summit, site 3, 15°52'S 145°14'E, flight intercept trap, 6 Dec 1990-17 Jan 1991, Qld Museum & ANZSES Expedition, QM S40893. All in north-eastern Queensland.

DIAGNOSIS. Males differ from those of *Krukt megma* in the much smaller tibial and median

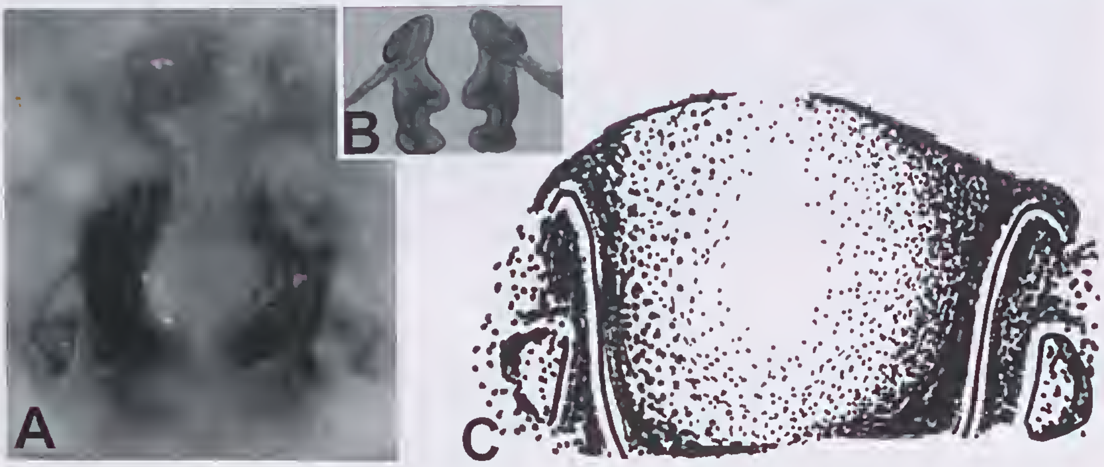

FIG. 31. *Krukt megma*, sp. nov., ♀. A, C (axial view), epigyne; B, vulva.

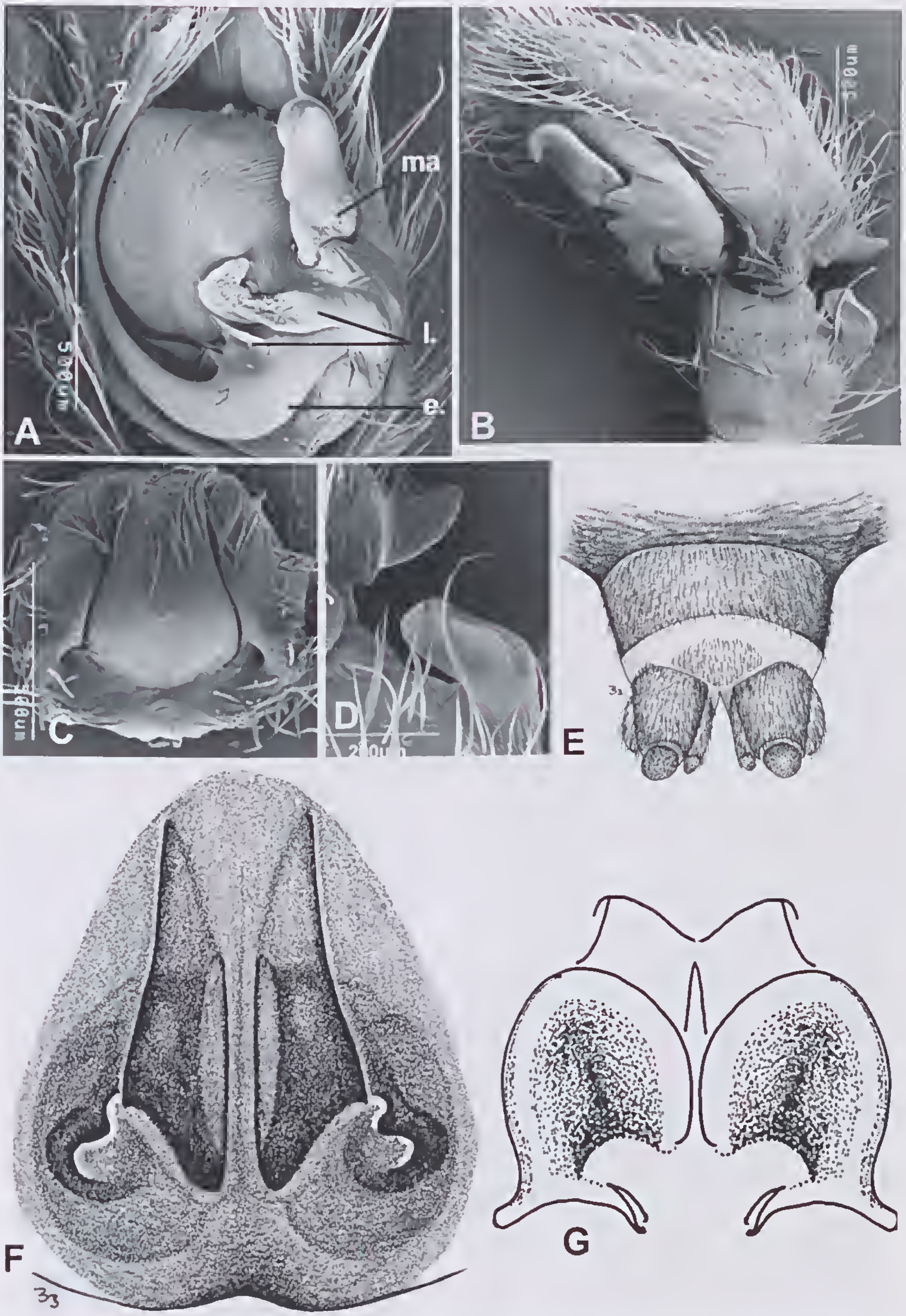

FIG. 32. A-D, F-G, *Krukt vicoopsae*, sp. nov. A-D, scanning electron micrographs; A, B, D, ♂ palp; A, bulb, ventral view; B, D, tibia, cymbium and bulb (D), retrolateral view. C, F, G, ♀; C, F, epigyne; G, vulva. E, *Krukt piligyna*, ♀, spinnerets, ventral showing extended common base.

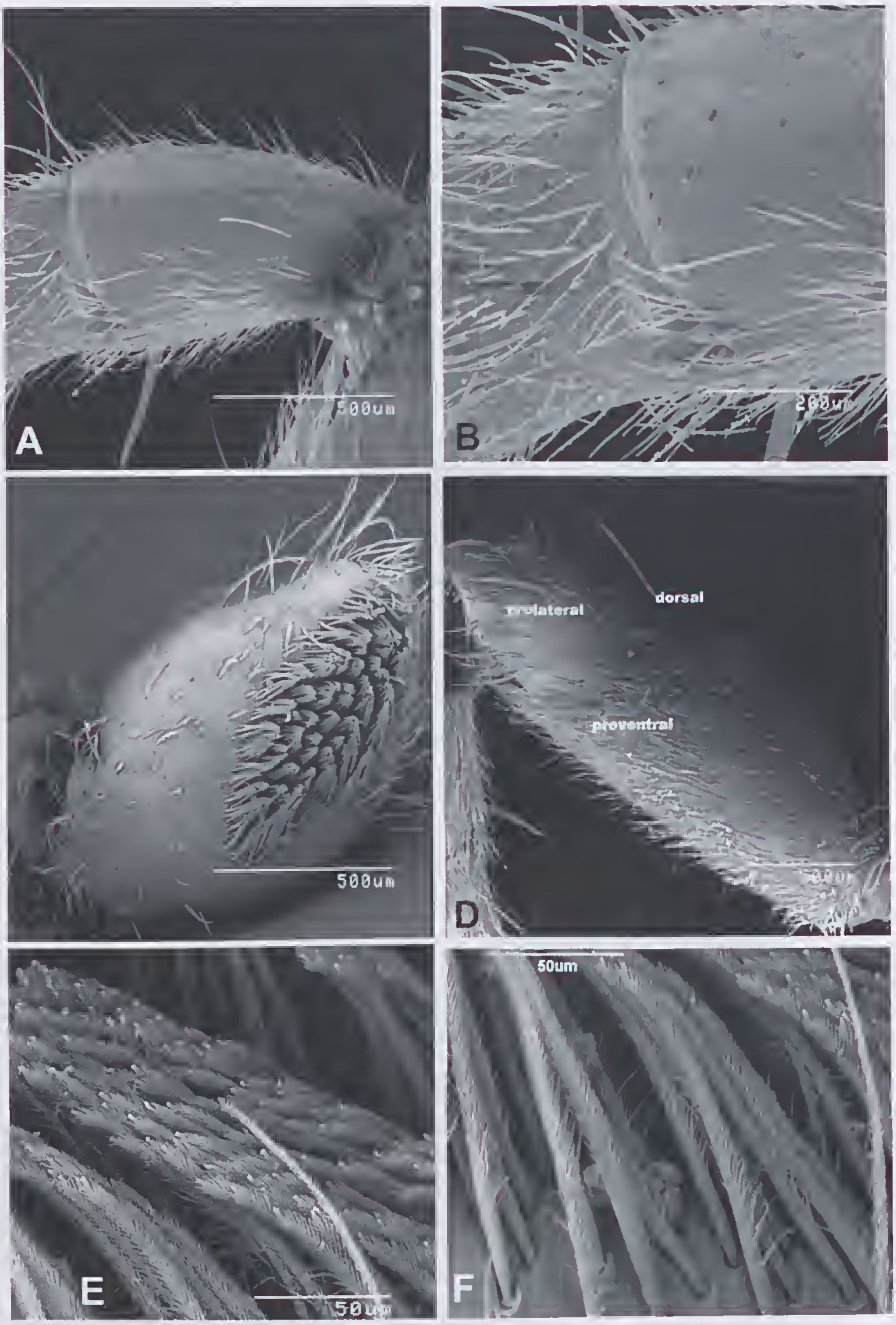

FIG. 33. A-D, *Krukt vicoopsae*, sp. nov. A, B, ♂ tibia I showing basal groove marking crack; C, scopula on dorsal cymbium; D, prolateral femur I showing proventral spine. E, F, *Megateg elegans*, sp. nov., scopula hairs on dorsal cymbium.

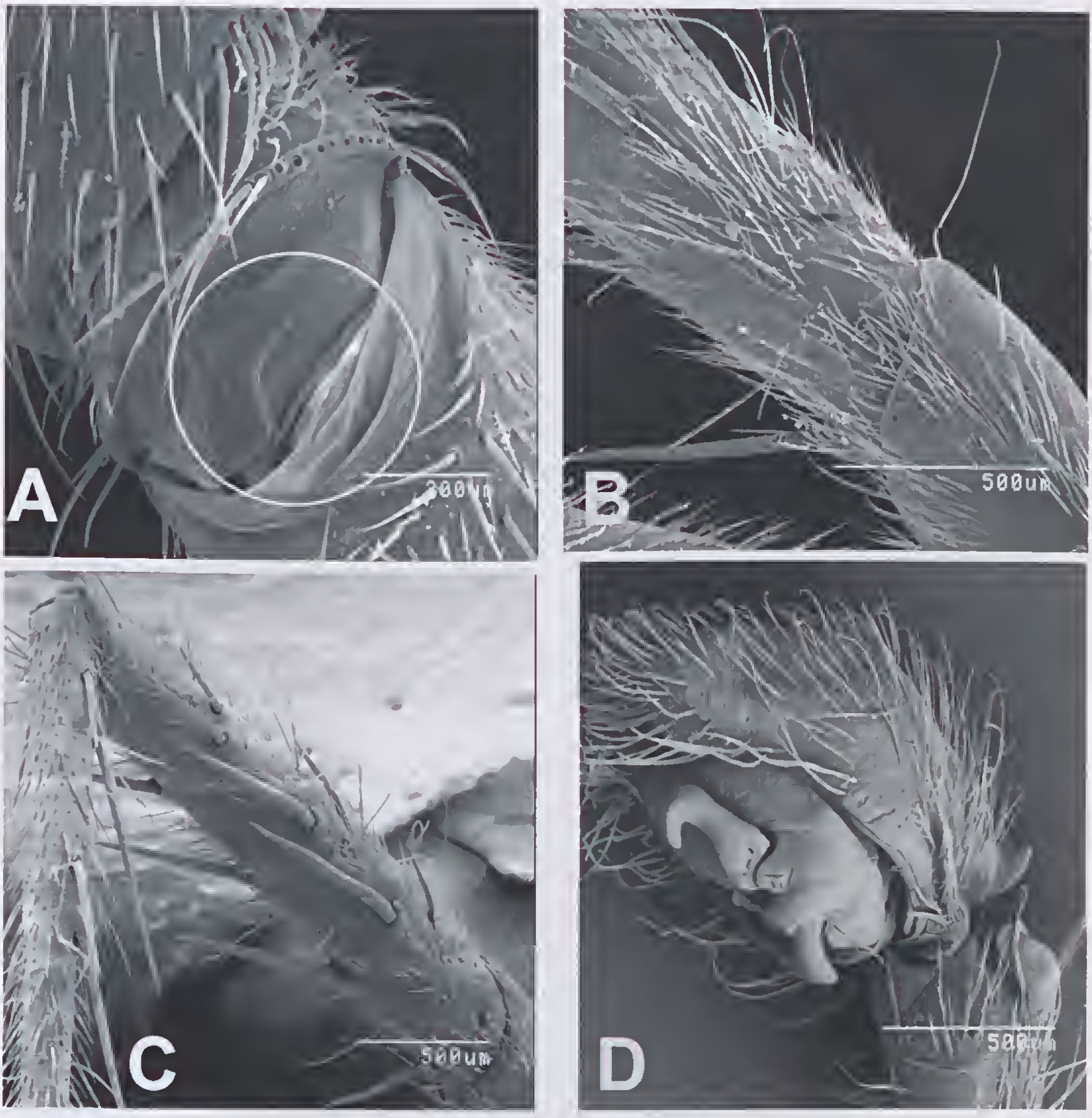

FIG. 34. A-D, *Krukt vicoopsae*, sp. nov., ♂, scanning electron micrographs. A, trochanteral notch, ventral view; B, patella and tibia I, prolateral view, showing elongate apical seta on patella; C, tibia and metatarsus I, ventral view; D, palpal tibia, bulb and cymbium showing basodorsal cymbial process.

apophyses and females differ from those of *K. piligyna* in the broad glabrous epigynal scape.

DESCRIPTION. Holotype ♂ QMS31126. Carapace 4.16 long, 3.28 wide. Abdomen 3.52, 2.44 wide. Total length, 8.0.

*Eyes*: AME:ALE:PME:PLE, 9:11:9:12. Eye group front width: back width: length, 54:47:37. Interspaces: AME-AME, 0.7; AME-ALE, 0.5; PME-PME, 1.7; PME-PLE, 1.0.

*Spines*: I: fe pv1 strong, p3d3; pa r1; ti p2d2r2v2.2.2.2; me p2r2v2.2.2. II: fe pv1 strong, p2d3r2; pa r1; ti p3d3r3v2.2.2.2; me p3r3v2.2.2. III: fe p3d3r2; pa r1; ti p2d2r2v2.2.2; me p3r4 v 2.2.2. IV: fe p2d3r1; pa r1; ti p2d2r2 v.2.2.2; me p4r3v6 unpaired. Palp: fe p1d3.

*Legs*: scopula absent. Tibial fracture: I-IV, prolaterally distinct, not evident retrolaterally. Trochanteral notches shallow, deeper in back of notch to front.

TABLE 13. Leg measurements of *Krukt vicoopsae*, holotype male and allotype female.

| Male | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 3.15 | 3.15 | 2.61 | 3.23 | 1.46 |
| Patella | 1.31 | 1.38 | 1.00 | 1.15 | 0.85 |
| Tibia | 3.15 | 2.77 | 2.31 | 3.08 | 0.77 |
| Metatarsus | 3.00 | 2.61 | 2.61 | 4.23 | 1.31 |
| Tarsus | 1.23 | 1.08 | 1.00 | 1.46 | |
| Total | 11.84 | 10.99 | 9.53 | 13.15 | 4.39 |
| Female | I | II | III | IV | Palp |
| Femur | 2.69 | 2.61 | 2.38 | 3.08 | 1.08 |
| Patella | 1.38 | 1.38 | 0.92 | 0.77 | 0.61 |
| Tibia | 2.31 | 2.00 | 1.61 | 2.31 | 0.77 |
| Metatarsus | 1.92 | 2.00 | 1.69 | 3.08 | 1.08 |
| Tarsus | 0.92 | 0.85 | 0.92 | 1.00 | |
| Total | 9.22 | 8.84 | 7.52 | 10.24 | 3.54 |

*Palp* (Fig. 32A,B): tibia stout but longer than wide, medially barrel-shaped, glabrous area on pro-distal ventral corner; low sclerotised collar on proventral corner, and prolateral and triangular collar process. Tibial apophysis basally broad, twisting in apex, axe-like process with face of axe prolateral, with edge pointing ventrally. *Cymbium*: distinct, broad, sclerotised ridge on retroventral corner; scopula extends to distal 3/5ths; from above, a gradual teat-like process pointing posteriorly; basodorsal process horn-like; paracymbial discontinuity a slight mound. *Bulb*: median apophysis a broad, simple hook, with small irregular base; embolus originates basal orthogonally and tapers gradually to long fine tip; hyaline blade-like process above base of embolus.

Allotype ♀ QMS31128. As for male except as follows. Carapace 4.52 long, 3.40 wide. Abdomen 7.60, 5.12 wide. Total length, 12.8.

*Eyes*: AME:ALE:PME:PLE, 11:14:8:14. Eye group front width: back width: length, 63:89:40. Interspaces: AME-AME, 0.5; AME-ALE, 0.5; PME-PME, 2.1; PME-PLE, 1.1.

*Spines*: I: fe pv1 strong. p1d1; pa 0; ti v2.2.2.2; me v2.2.2. II: fe p2d3r1; pa 0; ti v2.2.2.2. me v2.2.2. III: fe p2d3r2; pa r1; ti p2d2r2v2.2.2; me p4r4v2.2.2. IV: fe p2d3r1; pa r1; ti p2d2r2v5; me p5r6v7. Palp: fe p1d2; pa 0; ti p2; ta p3r1.

*Legs*: scopula absent; paired claws with 2-3 teeth.

*Epigyne* (Fig. 32C,F,G): with broad medial ridge with distinct partial division. Ridge ends at centre of sclerotized ovoid area with lateral ridges overlapping ends of medial ridge. Vulva like *K. piligyna* but posteriorly so large as to almost conceal anterior portion of spermathecae.

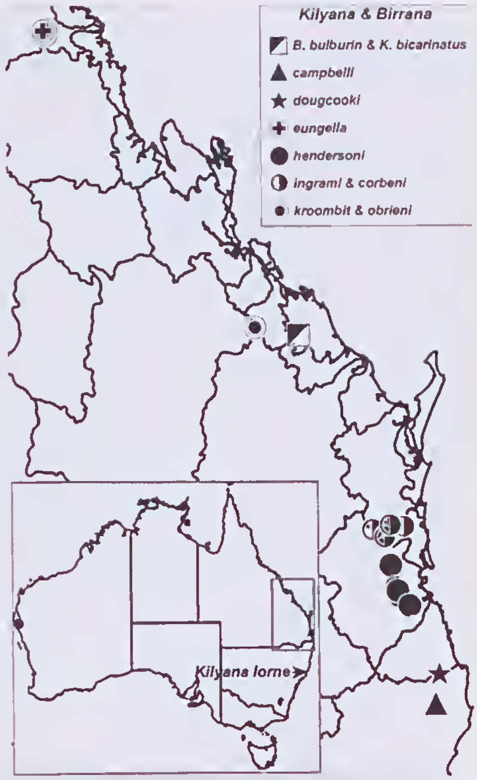

FIG. 35. *Birrana* and *Kilyana*, distribution map.

DISTRIBUTION AND HABITAT. High altitude (>700m) rainforest at Mt Boolbun South, NE Qld.

## **Birrana** gen. nov.

TYPE SPECIES. *Birrana bulburin* sp. nov.

ETYMOLOGY. Aboriginal *birrana*, throwing stick alluding to the tarsal rod, the gender is feminine.

DIAGNOSIS. Differs from *Kilyana* in the presence of a tarsal rod and from *Megateg* and *Krukt* in the shorter rod; males differ from those of *Megateg* in the short male palpal tibia and small RTA and of *Krukt* in the small RTA and extensive tegulum; females differ from those of *Megateg* in the presence of a median scape, from those of *Krukt* in the absence of basolateral cleats, and from those of *Huntia* in having claw tufts and lacking lateral teeth.

DESCRIPTION. As for species.

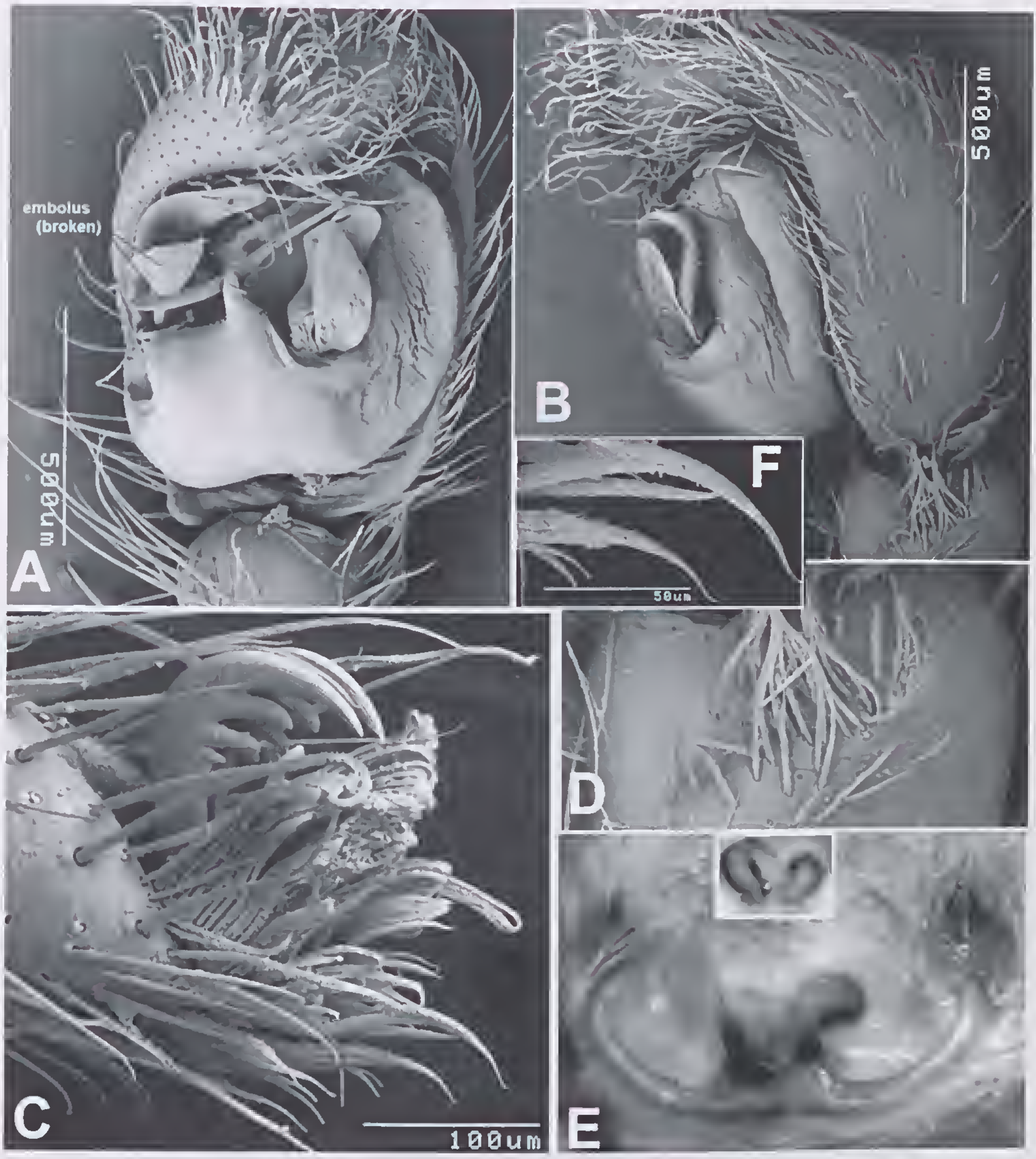

FIG. 36. *Birrana bulburin*, sp. nov., A-E, ♂. A, B, palpal tibia, cymbium & bulb; ventral (A) and retrolateral view (B); C, palpal tibia, retrolateral view; D, tarsus I showing claws & claw tufts with ventrodistal hairs. E, ♀ epigyne and vulva (inset).

REMARKS. *Birrana* is somatically very similar to *Megateg* but the male palpal bulb shows strong similarities to *Kilyana hendersoni*, sp. nov.

INCLUDED SPECIES. *Birrana bulburin* sp. nov.

## **Birrana bulburin** sp. nov.
(Figs 35-38; Table 14)

ETYMOLOGY. Aboriginal word for the type locality.

MATERIAL. HOLOTYPE: ♂, Bulburin SF, 24°30'S 151°35'E, SE.Q, rainforest, pitfall, 1 Jun-5 Oct 1974, G.& S. Monteith, QM S31408. PARATYPE. Allotype, ♀, as for holotype, QM S31409.

DIAGNOSIS. As for genus.

DESCRIPTION. Holotype ♂. Carapace 3.48 long, 2.80 wide. Abdomen 2.68, 2.40 wide.

*Colour*: carapace yellow brown with dark margins on undulating inner edge; central region darker with black margins laterally and posteriorly, dark margins near caput edge and diagonal from PLE. Abdomen dorsally fawn with dark shoulders, darker areas on abdomen light, mottled as pattern evident. Legs with double bands on distal femora, distal patellae, tibiae and metatarsi but bolder on III, IV. Abdomen ventrally with irregular dark flecks centrally. Sternum yellow-brown with slight radial tip shadows. Black stripes down chelicerae; reddish brown dagger mark anterior on abdomen.

*Eyes*: almost in 3 rows, 2 4 2. AME:ALE: PME:PLE, 6:6:8:8. Front of ALE cut back edges of AME; front edge of PLE behind back edge of PME; eyes of back row largest. AM-AM=6, AM-AL=6, PM-PM=8, PM-PL=9, AL-PL= 5. Group front width: backwidth: length, 37:47:21. ALE closer to PLE than AME.

*Chelicerae*: r= 3 small.

*Spines*. I: fe pv1p1d3r1; pa r1; ti p2r3pv5rv4; me p2r2v2.2.2. II fe, p2d3r2; pa r1; ti p2r3pv5rv4; me p3r3v2.2.2. III: fe p4d3r2; pa r1; ti p2d2r2v2.2.2; me p1.2.2r1.1.2v2.2.2. IV: fe p2d3r1; pa r1; ti p2d2r2v.2.2.2; me p1.1.1.1.1r1.1.1.2v2.2.2. Palp: fe p1d1.2.

*Legs*: scopula absent. Tarsal rod at basal 1/5th, low on I, II; raised, distinct on III, IV. Tibial crack I-IV prolateral and retrolateral distinct. Trochanteral notches shallow, symmetrical, 3× wider than deep but becoming shallower from IV to almost indistinct on I.

*Claws*: with 2 long and 1 short tooth on all.

*Abdomen*: anterior face with pair of concave 'scutes'.

*Palp* (Figs 36A,B, 37A,B): tibia with only small conical mound retrolaterally, most distinct dorsally. *Cymbium*: asymmetrically folded to form short shallow groove on retro-apical corner; margin wide, distally narrow elsewhere with thin darkly sclerotised retromargin; probasally with distinct rounded lobe dorsal scopula for distal 1/3. Tegulum mirrored C-shape, deep basally with short thorn opposite base of median apophysis. Median apophysis a rectanguloid scoop with a small twisted pair of hooks, twisted in opposed planes with (bivalve) shell-like translucent shield at its retrobase; median apophysis free, surrounded by tegular ring distal of tegulum is weakly sclerotised. Subtegular tongue narrow, transverse with long sclerotised groove behind embolus. Embolus originates proapically in gradual curve to retro-corner opposite cymbial groove.

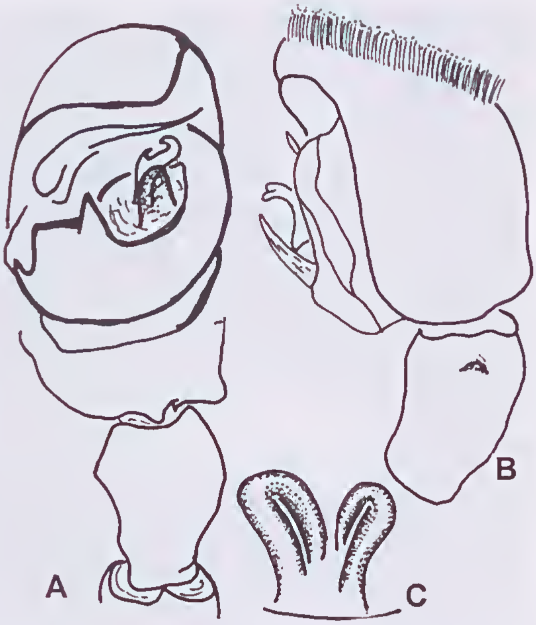

FIG. 37. *Birrana bulburin*, sp. nov., A, B, ♂ palpal tibia, cymbium & bulb; A, with patella, ventral view; B, retrolateral view; C, ♀ vulva.

Allotype ♀. Carapace 4.00 long, 3.20 wide. Abdomen 4.40, 3.68 wide.

*Colour*: As male but legs more boldly banded, most evident mottling on ventral femora. Deep Y-shaped dark mark on sternum, inner corners and edges of coxae dark.

*Chelicerae*: 3p, 3r.

*Eyes*: AME: ALE: PME: PLE, 4:4:6:6. Front of ALE well behind back of AME. Front edge of PLE is behind back of PME. Interspaces: AM-AM=1.3; AM-AL=1.8; PM-PM=2.8; PM-PL=2.5; AL-PL=2.8. Group front width: back width: length, 34:44:18.

*Legs*: scopula weak to absent on tarsi I, II. Tarsal rod low on I, a distinct lobe on IV. Claw tufts strong, similar on all.

*Spines*: I: fe pv1p1d1; pa 0; ti pv5rv4; me v2.2.2. II: as for I but fe p1d1. III: fe p2d2r1; pa r1; ti p2d1r2v2.2.2; me p2.1.2r1.2.2v2.2.2. IV: fe p2d2r1; pa r1; ti p2d2r2v5; me p1.1.1.2r1.1.2.2v7. Palp: fe d1.2; pa 0; ti p2d1; ta p3d1r1.

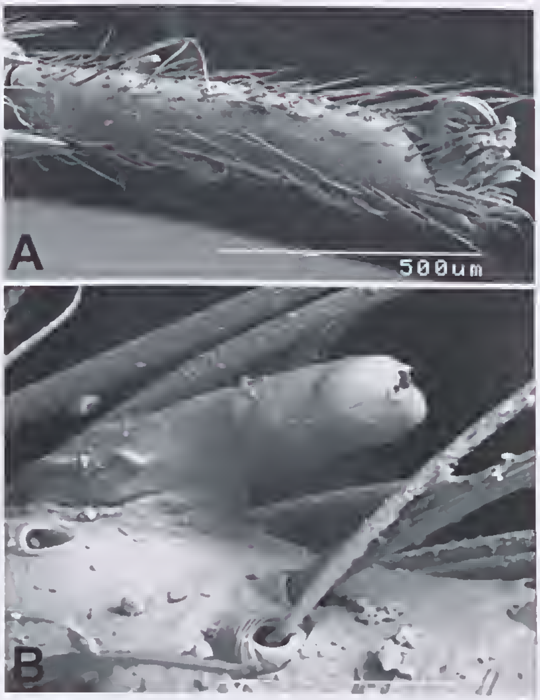

FIG. 38. *Birrana bulburin*, sp. nov., ♂. A, tarsus I showing claws & tarsal rod (B), retrolateral view.

*Claws*: with 2-3 short teeth on palp & legs.

*Epigyne* (Fig. 36E): broad, ovoid with wide, transverse recurved ridges posteriorly, lateral ovoid depression and short broad posterior median ridge; internally, a short broad lobe folding back on itself.

DISTRIBUTION AND HABITAT. Rainforest at Bulburin State Forest, SE Qld.

CLADISTICS. *Birrana* is considered the sister group of *Megateg* and *Krukt* with which it shares the tarsal rod albeit clearly shorter. *Huntia murrindal* also possesses a tarsal rod but without males the homology of the rod cannot be established. Baehr (2003) found a similar overall pattern in *Tropasteron* with unresolved relationships of the Wet Tropics species having a sister group in the Eungella region.

BIOGEOGRAPHY. For some spider groups, the Bulburin forests are where northern taxa reach their most southern and disjunct distribution and the northern limit of some southern taxa. Baehr (2003) found that in the Zodariidae, that point was at more northern at Eungella, west of Mackay.

TABLE 14. Leg measurements of *Birrana bulburin*, holotype male and allotype female.

| Male | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 2.00 | 2.07 | 2.00 | 2.23 | 1.15 |
| Patella | 1.00 | 1.08 | 1.00 | 1.00 | 0.54 |
| Tibia | 2.23 | 1.77 | 1.46 | 2.00 | 0.54 |
| Metatarsus | 1.85 | 1.61 | 1.61 | 2.61 | 0.92 |
| Tarsus | 0.85 | 0.77 | 0.69 | 1.08 | |
| Total | 7.93 | 7.30 | 6.76 | 8.92 | 3.15 |
| Female | I | II | III | IV | Palp |
| Femur | 2.07 | 2.00 | 2.00 | 2.38 | 1.08 |
| Patella | 1.23 | 1.08 | 1.00 | 1.31 | 0.61 |
| Tibia | 1.92 | 1.69 | 1.31 | 2.00 | 0.69 |
| Metatarsus | 1.61 | 1.31 | 1.46 | 2.46 | 0.92 |
| Tarsus | 0.77 | 0.92 | 0.77 | 1.00 | |
| Total | 7.60 | 7.00 | 6.54 | 9.15 | 3.30 |

### **Kilyana** gen. nov.

TYPE SPECIES. *Kilyana hendersoni*, sp. nov.

ETYMOLOGY. A random combination of letters; the gender is masculine.

DIAGNOSIS. Differs from *Krukt*, *Megateg*, and *Birrana* in the absence of a tarsal rod and from *Huntia* Gray & Thompson, 2001 in the presence of claw tufts and only two claws.

DESCRIPTION. As for *Megateg* but: *Legs*. Scopula present and usually distinct on tarsi I-IV of females, but only weak on metatarsi I, II. Males have scopula on palpal cymbium dorsally and in some species also tarsi. All pedal tibiae basally cracked. 2 claws; strong separate claw tufts; with additional cluster of finely fimbriate hairs in diamond-shaped area below claws. Tarsal organ set at distal quarter of tarsus, low with ovoid aperture. Bothria with 6 transverse ridges; trichobothria in single irregular line on tarsi.

*Spines*. Females, legs I, II: tibia proventrally 5, retroventrally 4 thick spines on raised based; metatarsi with 3 pairs of strong spines ventrally.

*Male Palp*. Tibia smaller than patella; tibial apophysis weak to absent, single to tripartite, sometimes simply a long deep groove, apophyses retrolateral to retrodorsal in position. Cymbium with dorsal scopula, apically truncate and asymmetrical and forming a channel retrodistally in which embolus lies. Tegulum large, roughly mirrored L-shape and ventral. Median apophysis large, free and sometimes with conducting groove along distal edge; in some species a weakly sclerotised spine-like process arises retrobasally beside median apophysis. Embolus originates probasally as flattened cordate plate and quickly tapers to grooved whip traversing bulb but without conductor; a subtegular tongue-like conducting groove lies distal and parallel to embolus. In females, the enlarged base of the embolus can be found broken off ectally in copulatory groove. In *Kilyana hendersoni*, an additional sclerite, also mapping the embolus, has long filiform lateral hairs.

*Epigyne*: basically a flattened plate with transverse copulatory groove; vulva simple C-shaped or S-shaped.

*Spinnerets*: PMS of females dorsally with long row of spigots. Colulus broad triangular fleshy and hirsute.

DISTRIBUTION AND HABITAT. Rainforests of SE Qld and N NSW.

INCLUDED SPECIES (All new). *K. bicarinatus*; *K. campbelli*; *K. corbeni*; *K. dougcooki*; *K. eungella*; *K. hendersoni*; *K. ingrami*; *K. kroombit*; *K. lorne*; *K. obrieni*.

CLADISTICS. Two groups are readily evident in *Kilyana*. The conformation of the male palpal bulbs and tibial apophyses in *K. corbeni* and *K. ingrami* are very similar: synapomorphies are the large single, scooped, sail-like median apophysis (e.g., Fig. 49A) and tripartite tibial apophysis (e.g., Fig. 49F). The second group includes *K. bicarinatus*, *K. hendersoni*, *K. kroombit*, and possibly *K. lorne*. Their synapomorphy is that the tibial apophysis is simply a long retrolateral groove. To some extent, the tibial apophyses of *K. obrieni* and, to a lesser extent, *K. campbelli* are similar in that the processes form a broad open valley which could be considered homologous with the groove. That latter wider group shares the presence of a bipartite median apophysis with the second lobe flexibly joined to the base of the main lobe. The presence of long groove on the distal edge of the median apophysis (Figs 43B, 49C,D) of *K. bicarinatus* and *K. ingrami* in which the embolus lies is considered a conductor analogue and homoplasious within the group. To maintain otherwise would require many homoplasies in *K. corbeni* and *K. ingrami* which differ primarily in the presence of the groove. The tibial apophysis of *Birrana* is very subtle and may be taken to be a reduced form of the groove. However, a parallelism would be required to explain the tarsal rod in *Birrana* (albeit shorter) and *Megateg* plus *Krukt*. The form of the male palpal bulb of *Birrana* also shares the sausage-shaped transverse tegulum and the elongate transverse embolus. At present, these are considered parallelisms. Hence, the cladogram of *Kilyana* is:
(*corbeni-ingrami*)(*dougcooki*((*campbelli-lorne-obrieni*)(*bicarinatus-hendersoni-kroombit*))).

## KEY TO THE SPECIES OF *KILYANA*

Males (using palp; males of *Kilyana eungella* unknown)

1. Retrolateral tibial apophysis weak or a longitudinal groove (Figs 41C, 43C, 47E) . . . . . . . . . . . . . 2
   Retrolateral tibial apophysis with 3 strong processes, one with or without large apical spine (Figs 45E, 46C, 49E) 6
2. Retrolateral tibial apophysis a groove for length of tibia (Figs 41C, 43C, 51D) . . . . . . . . . . . . . . . . . 3
   Retrolateral tibial apophysis not a groove but a pair of short convergent spines separated by depression (Fig. 47E) . . . . . . . . . . . . . . . . . . . *K. dougcooki*
3. Median apophysis masssive, dominant and apically bifid (Fig. 43A) . . . . . . . . . . . . . . . *K. bicarinatus*
   Median apophysis small, much smaller than tegulum (Figs 41A, 51A, 53A) . . . . . . . . . . . . . . . . 4
4. Basal half of embolus cradled by long filamentous process (Fig. 41B) . . . . . . . . . . . *K. hendersoni*
   Basal half of embolus without juxtaposed long filamentous process (Fig. 53A) . . . . . . . . . . . . 5
5. Retrolateral tibial apophysis with distal spinose process adjacent to cymbial groove (Fig. 53D, E). . . . *K. lorne*
   Retrolateral tibial apophysis distally with truncate aspinose process (Fig. 51C) . . . . . . . . *K. kroombit*
6. Median apophysis a large scooped plate (Figs 46A, 49A) . . . . . . . . . . . . . . . . . . . . . . . . . . . 7
   Median apophysis not large and scooped (Figs 45D, 54A) . . . . . . . . . . . . . . . . . . . . . . . . . . . 8
7. Median apophysis with distal edge deeply grooved (Fig. 49C) . . . . . . . . . . . . . . . . . . . *K. ingrami*
   Median apophysis without groove on distal edge (Fig. 46B) . . . . . . . . . . . . . . . . . . . . . *K. corbenii*
8. Median apophysis a large central dominant complex process (Fig. 54A-C) . . . . . . . . . . . . . *K. obrieni*
   Median apophysis a small retrolateral hook (Fig. 45A,D) . . . . . . . . . . . . . . . . . . . . . *K. campbelli*

Females (using epigyne; females of *K. campbelli* unknown)

1. Medial copulatory ridge wide, distinct (Figs 42A, 44B). 2
   Medial copulatory ridge short or indistinct (Figs 52A, 55B) . . . . . . . . . . . . . . . . . . . . . . . . 7
2. Medial copulatory ridges form Vee (Fig. 44B) . . . . . . . . . . . . . . . . . . . . . *K. bicarinatus*
   Medial copulatory ridge straight, recurved, or paired lateral procurved ridges. . . . . . . . . . . . . . . . . . . . 3
3. Medial copulatory ridge straight with large lateral lumens . . . . . . . . . . . . . . . . . . . . . *K. hendersoni*
   Medial copulatory ridge recurved, or paired lateral procurved ridges. . . . . . . . . . . . . . . . . . . . 4
4. Medial copulatory ridge single and recurved . . . . . . 5
   Copulatory ridges paired lateral and procurved . . . . 6

5. Medial copulatory ridge deeply recurved (Fig. 46D) . . . . . . . . . . . . . . . . . . . . . . . . *K. corbeni*
   Medial copulatory ridge not so recurved (Fig. 50A,B,D) . . . . . . . . . . . . . . . . . . . . . . . *K. ingrami*
6. Copulatory ridges deep, form semicircles (Fig. 47F); vulva ducts convoluted (Fig. 47G) . . . . *K. dougcooki*
   Copulatory ridges less deep not so recurved (Fig. 48C,D); vulva ducts simply form overlapping circle (Fig. 48A,B) . . . . . . . . . . . . . . . . . . . . . . . *K. eungella*
7. Medial copulatory ridge very short, a recurved circle (Fig. 52C) . . . . . . . . . . . . . . . . . *K. kroombit*
   Medial copulatory ridge short, straight (Fig. 55B) . . . . . . . . . . . . . . . . . . . . . . . . *K. obrieni*

### **Kilyana hendersoni** sp. nov.

(Figs 1, 35, 39-42; Table 15)

ETYMOLOGY. The specific epithet is a patronym in honour of Dr Ian Henderson, who kindly sponsored the research of the Queensland Museum.

MATERIAL. HOLOTYPE: ♂, Upper Brookfield, 27°30'S 152°55'E, SE.QLD, rainforest, litter, 1 Nov 1981, R. Raven, V. Davies, QM S31340. PARATYPES: Mt Glorious, 27°20'S 152°46'E, rainforest: 1 ♀, sieved litter, 20 Sep 1979, G. Monteith, QM S32984; 1 ♀, V.E. Davies, QM S32991; 1 ♀, flight intercept trap, Jan-Mar 1982, A. Hiller, QM S32989; ♂, barracks, 27°18'S 152°45'E, pitfall & intercept traps, 7 Dec 1991-6 Mar 1992, G. Monteith, QM S43399; 2 ♂♂, 13 Apr-26 May 1983, malaise trap, A. Hiller. ♂, Mt Mee, 27°03'S 152°41'E, rainforest, pitfall, 29 Nov 1991-8 Jan 1992, D.J. Cook, QM S30305; 1 ♀, Mt Nebo, 27°23'S 152°47'E, ex mud wasp nest, 28 Dec 1979, H. Evans, QM S32732; 1 ♀, Mt Nebo, 1/2 way down track in Reserve, 27°24'S 152°47'E, *Araucaria* notophyll vineforest, Dec 1980, A. Rozefelds, QM S39049. Upper Brookfield, 27°30'S 152°55'E, rainforest, litter: 1 ♀, 12 Jan 1982, QM S32987; 1 ♂ 1 ♀, 9 Nov 1975-27 Feb 1976, G.& S. Monteith, QM S32983; allotype ♀, QM S31341; 1 ♂, 14 Jul 1981 or 1 Nov 1981, R. Raven, V. Davies, QM S31342; 2female, 17-31 Aug 1981, R. Raven, V. Davies, QM S32985. All in SE.Q. OTHER MATERIAL: QM S53413, QM S32986, QM S31343, QM S32988.

DIAGNOSIS. Males are easily recognised by the deeply grooved tibial apophysis and the filamentous brush paralleling the embolus; females are unusual in the large circular lateral depressions in the epigyne.

DESCRIPTION. Holotype ♂. Carapace 5.28 long, 3.76 wide. Abdomen 4.56, 3.12 wide.

*Colour*: Carapace orange brown with darker 'wedges' along striae, most evident posteriorly; hoary white hairs in band from PLE back to caput margin. Abdomen yellow brown speckled with 2 pair darker sigilla anteriorly, becoming darker brown posteriorly; ventrally yellow brown with black hair and pigmentation medial quadrangle flanked by 6-8 small but distinct black irregular markings. Legs orange brown without darker annulations; sternum, labium and all coxae yellow to orange brown.

*Eyes*: AME:ALE:PME:PLE, 12:12:12:14. Eye group front width: back width: length, 64:89:39. Interspaces: AME-AME, 0.8; AME-ALE, 0.6; PME-PLE, 1.6; PME-PME, 1.1. Centres of ALE cut back edge of AME. Front edge of PLE along back edge of PME.

*Chelicerae*: p=2-3; r=3.

*Spines*: I: fe pv1p2d3r4; pa r1; ti p3d3r3pv5rv4; me p3r3v2.2.2. II: fe pv1p3d3r4; pa r1; ti p2d3r3pv5rv4; me p3r3v2.2.2. III: fe p3d3r5; pa r1; ti p2d2r2v2.2.2; me p2r3v2.2. IV: fe p4d3r2; pa r1; ti p2d2r2v2.2.2; me p3r3v2.2.2. Palp: fe p1d2r1.

*Legs*: scopula absent or at most very thin on tarsi I, II. Tibial crack I-IV prolaterally distinct; dark & grooved retrolaterally on I, II; not evident retrolaterally on III, IV. Trochanteral notches shallow, deeper in back of notch to front.

*Palp* (Fig. 41A-C): patella incrassate with distinct prolateral mound. Tibia short with deeply intucked groove for length retrolaterally; retrobasally with scooped process, retrodistally with tapering, slender spur. Cymbium squat, almost rectangular, deep; scopula dorsally for distal half; basodorsal process small, triangular. Paracymbial discontinuity absent. Tegulum wide, short; median apophysis a deep, broad, scooped hook with basal fold; leaflike; hyaline process arising basally; median apophysis base large, extensive, dominates bulb. Distal to embolus a tapering process with feathery filaments for its distal length. Embolus arises beside median apophysis & distal tegulum with bulbous origin quickly tapering to long slender tip; elongate triangular tapering subtegular tongue for basal half of embolus.

Allotype ♀: as for male except as follows.

*Carapace*: 5.92 long, 4.64 wide. Abdomen 8.48, 6.32 wide.

*Colour*: carapace like male but darker areas less distinct. Abdomen dorsally yellow brown with slightly darker areas posteriorly forming series of diamonds medially. Sternum orange brown, labium & maxillae dark brown, coxae yellow brown. Abdomen ventrally yellow brown with irregular dark medial area. Legs red brown without annulations.

*Chelicerae*: 3p, 3r.

*Eyes*: AME:ALE:PME:PLE, 11:14:13:15. Eye group front width: back width: length, 88:116:45. Interspaces: AME-AME, 1.5; AME-ALE, 1.3; PME-PLE, 2.3; PME-PME, 1.7. Centres of ALE

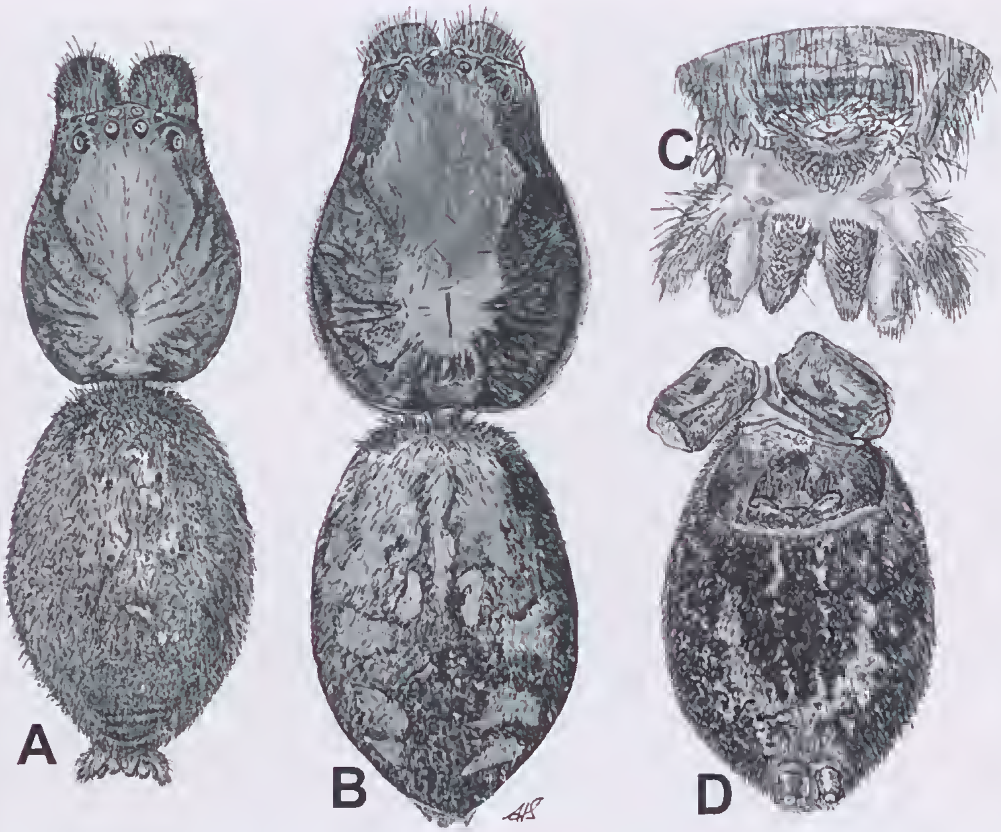

FIG. 39. *Kilyana hendersoni*, sp. nov., ♀. A, B, cephalothorax and abdomen, dorsal view; C, spinnerets, dorsal view showing PMS with biserial row of spigots dorsally; D, abdomen, ventral.

behind back edge of AME. Front edge of PLE is just behind back edge of PME.

*Spines*: I: fe pv1p1d3r2; pa 0; ti pv5rv4; me v2.2.2. II: fe pv1p2d3r3; rest as I. III: fe p4d3r4; pa r1; ti p2d2r2v2.2.2; me p5r4v2.2.2. IV: fe p3d3r1; pa r1; ti p2d2r2v5; me p4r4v7. Palp: fe d3; pa r1; ti p2; ta p3d1r1.

*Legs*: scopula distinct on tarsi I-IV, distal but distinct on metatarsi I, II; absent elsewhere.

*Claws*: 3 long teeth on palp & legs.

*Epigyne* (Fig. 42A-D,F): wide short, curled hoods laterally with broad medial mound and short transverse ridge.

DISTRIBUTION AND HABITAT. Rainforest around Brisbane and Mt Glorious.

REMARKS. Material from Mt Archer is excluded from the type series because it includes only females and is at the most outlying point.

TABLE 15. Leg measurements of *Kilyana hendersoni*, holotype male and allotype female.

| Male | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 3.77 | 3.77 | 3.46 | 4.08 | 1.92 |
| Patella | 1.77 | 1.85 | 1.61 | 1.54 | 1.08 |
| Tibia | 3.85 | 3.23 | 2.46 | 3.23 | 0.92 |
| Metatarsus | 3.31 | 3.23 | 3.08 | 4.31 | 1.77 |
| Tarsus | 1.46 | 1.38 | 1.15 | 1.69 | |
| Total | 14.16 | 13.46 | 11.76 | 14.85 | 5.69 |
| Female | I | II | III | IV | Palp |
| Femur | 3.23 | 3.38 | 3.00 | 3.92 | 1.77 |
| Patella | 2.07 | 1.92 | 1.61 | 1.77 | 1.00 |
| Tibia | 3.08 | 2.69 | 2.15 | 3.00 | 1.00 |
| Metatarsus | 2.69 | 2.46 | 2.54 | 4.15 | 1.31 |
| Tarsus | 0.92 | 1.08 | 0.85 | 1.31 | |
| Total | 11.99 | 11.53 | 10.15 | 14.15 | 5.08 |

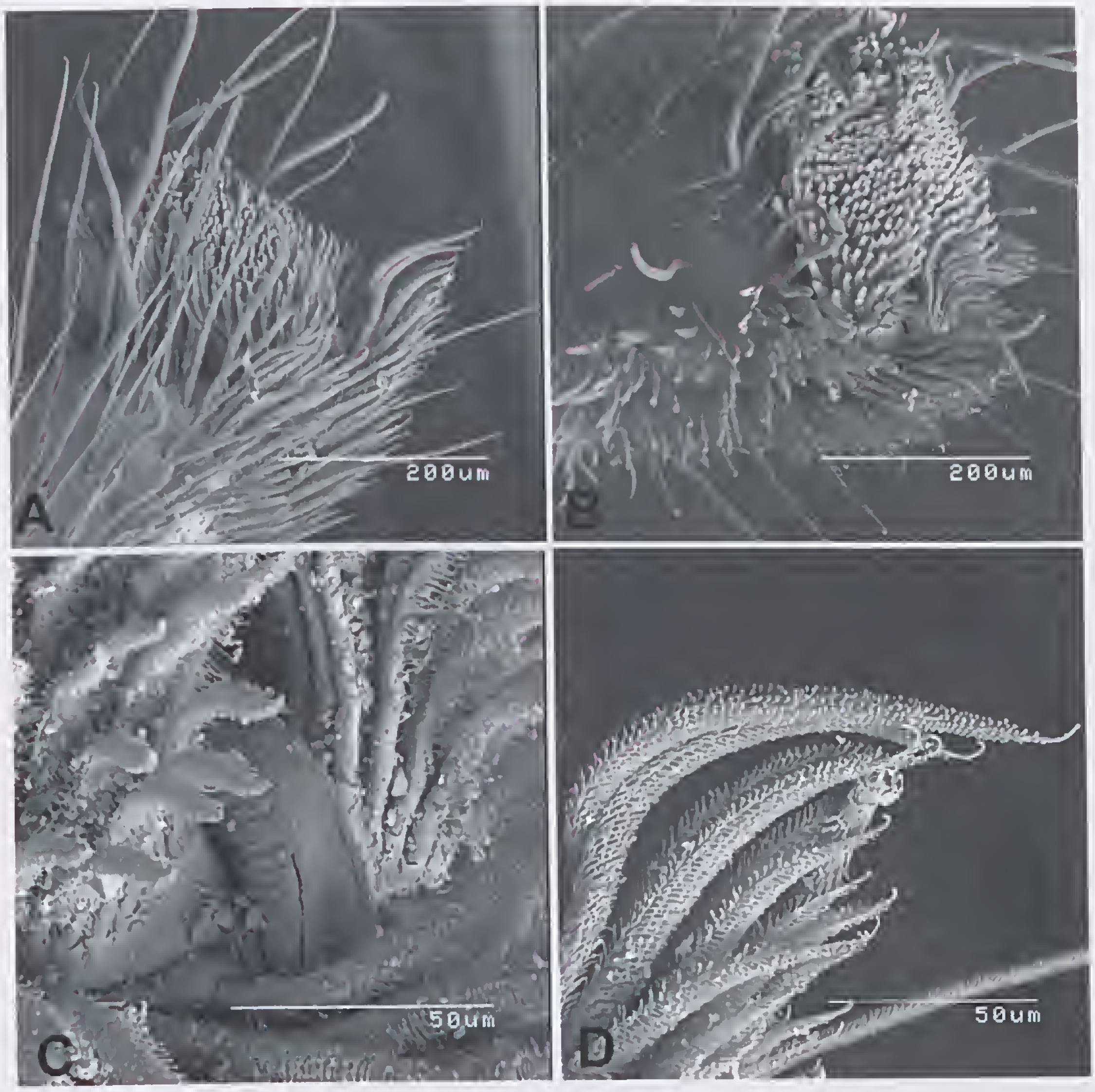

FIG. 40. *Kilyana hendersoni*, sp. nov., ♀, tarsus I, scanning electron micrographs. A, B, tip showing claw tufts and ventral scopuliform hairs, lateral (A) and axial (B) views; C, ridged sclerite below paired claws, axial view; D, ventral scopuliform hairs showing smoothly tapered tip.

## **Kilyana bicarinatus** sp. nov.
(Figs 35, 43, 44A-C; Table 16)

ETYMOLOGY. The specific epithet alludes to the median apophysis of the male.

MATERIAL. HOLOTYPE: ♂, Bulburin SF, 24°30'S 151°35'E, SE.Q, 25-28 Mar 1977, R. Raven, V. Davies, QM S32739. PARATYPES: allotype ♀, as for holotype but 17-24 Mar 1975, R. Kohout, V.E. Davies, QM S53562; 2 ♂♂, same data but 24°31'S 151°29'E, 580m, M. Gray, C. Horseman, AM KS6793. OTHER MATERIAL: 9 juv., as for holotype, QM S31458.

DIAGNOSIS. Males resemble those of *Kilyana corbeni* in the flared form of median apophysis but more angular and the tibia apophysis is simple open groove; females differ in that the epigyne is medially two ridges forming a vee-shape; males and females differ from those of the sympatric *Birrana bulburin* in lacking a tarsal rod.

DESCRIPTION. Holotype ♂. Carapace 5.52 long, 4.24 wide. Abdomen 4.88, 2.80 wide.

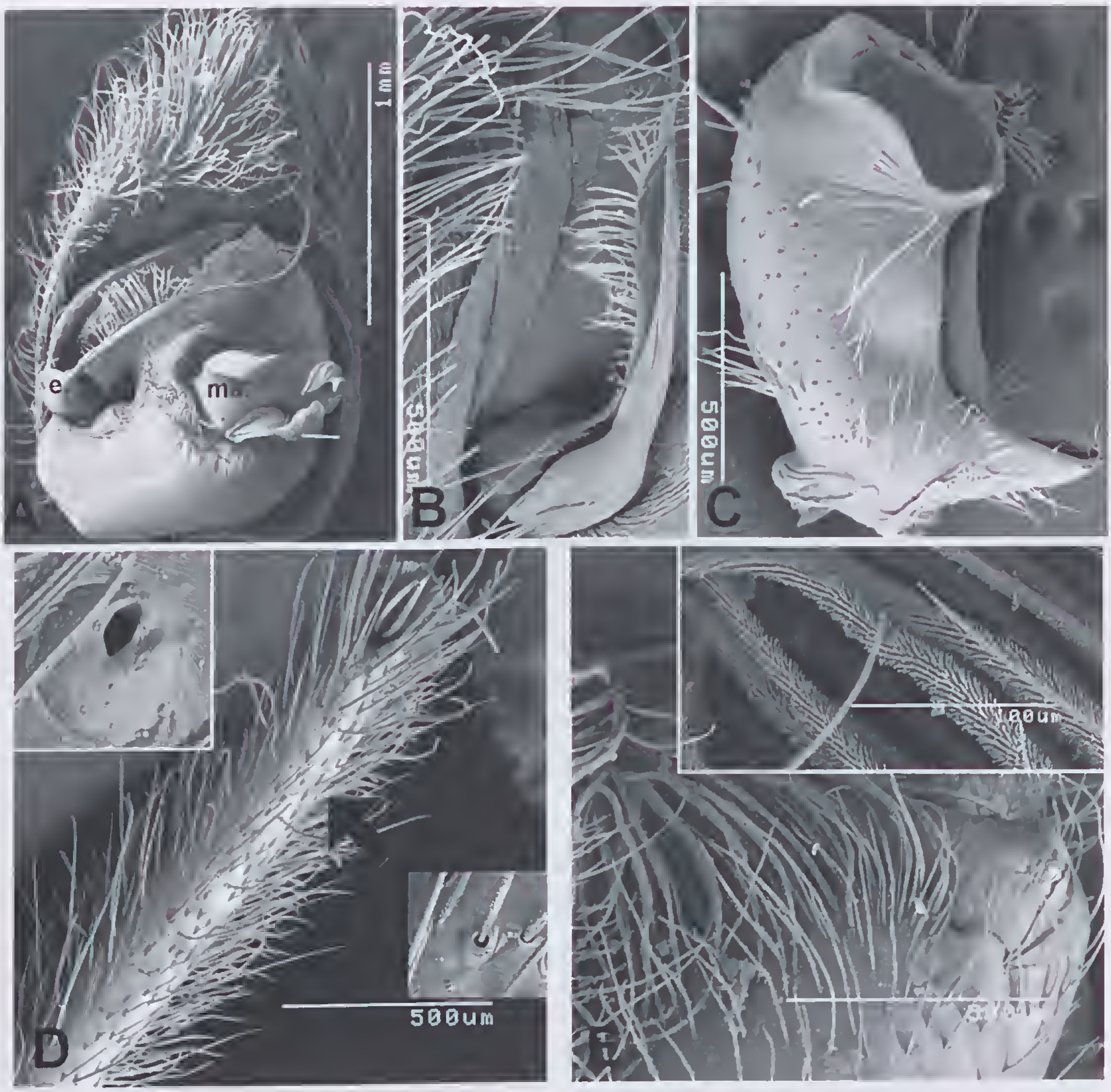

FIG. 41. *Kilyana hendersoni*, sp. nov., ♂ palp, scanning electron micrographs. A, cymbium and bulb, ventral view; B, embolus base with filamentous brush, prolateral view; C, tibia showing groove and basal process, ventral view; D, tarsus IV showing tarsal organ (arrow gives position, inset upper right) and trichobothrial cup (inset lower left); E, prolateral cheliceral face with thickened 'fang setae' (inset).

*Colour*: freshly moulted; carapace orange brown with fine dark radiating lines on caput and thorax, narrow black margin of closed semicircles; large dark bands down chelicerae; abdomen dorsally (slightly damaged) yellow brown with larger longitudinal pallid areas anteriorly forming into fine transverse lines posteriorly; venter with narrow black medial V broken by two pallid stripes (inferred from juvenile). Legs with bands, slightly paler than carapace, mottled brown under femora. Sternum yellow brown with 3 pairs dark spots opposite coxae I-III; maxillae and labium orange brown with darker central areas.

*Eyes*: Front edge of PLE just behind back edge of PME. AME:ALE:PME:PLE, 6:6:8:8. Eye group front width: back width: length, 36:49:51. Interspaces: AME-AME, 1.2; AME-ALE, 1.0; PME-PLE, 1.7; PME-PME, 1.3.

*Spines*: I: fe pv1p1d3r4; pa r1; ti p2d3r3pv5rv4; me p3r3v2.2.1. II: fe pv1p2d3r4; pa r1; ti p2d3r3pv5rv4; me p3r2v2.2.2.1. III: fe p4d3r3; pa r1; ti p2d2r2v2.2.2; me p1.2.2r1.1.2v2.2.2. IV:

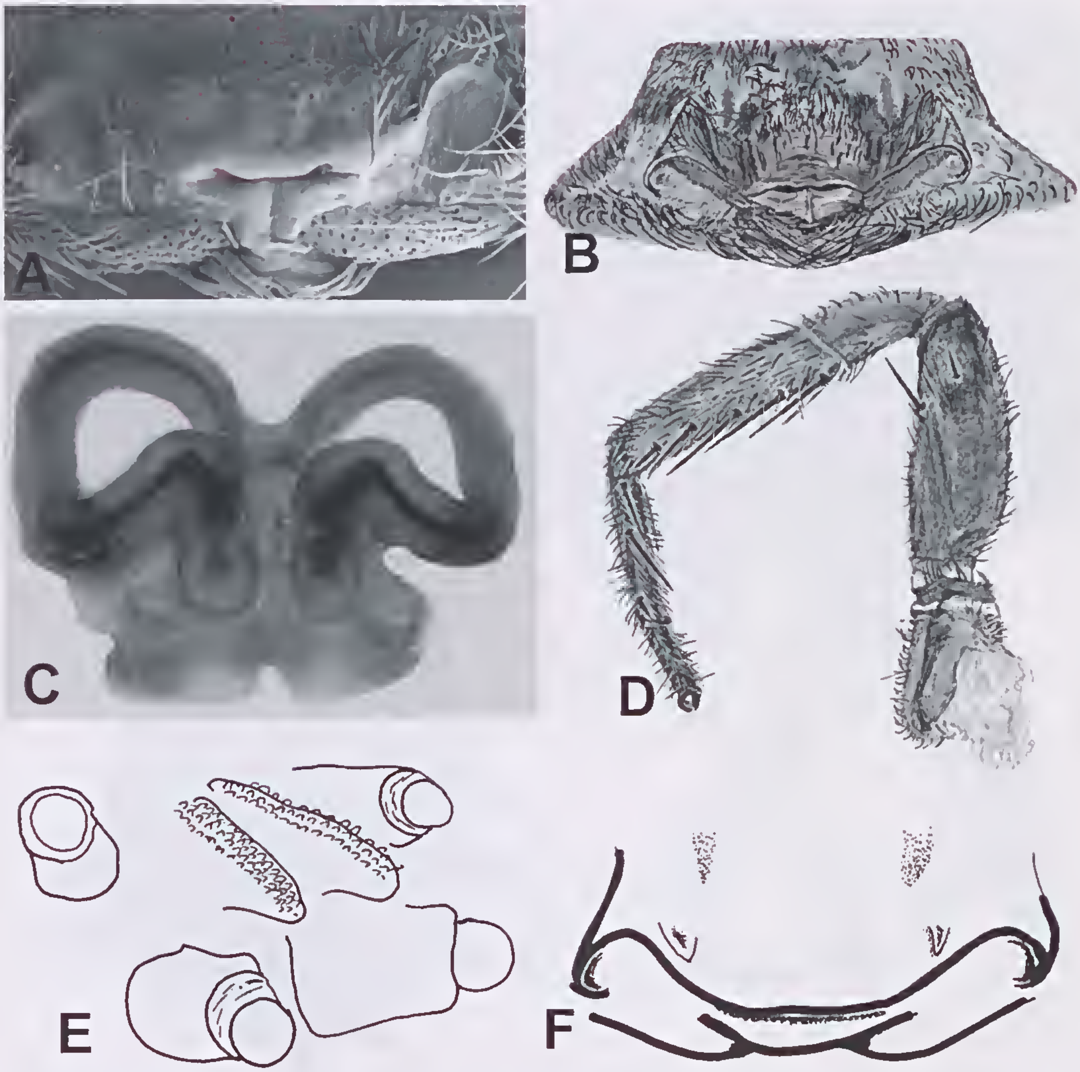

FIG. 42. *Kilyana hendersoni*, sp. nov., ♀. A, B, F, epigyne; C, vulva; D, leg I, prolateral view; E, spinnerets, axial view with PLS dorsal.

fe p3d3r2; pa r1; ti p2d2r2v.2.2.2; mc p1.1.1.2r1.2.2.2v2.2.2. Palp: fe p1d1.2. Matt of hairs on dorsal femora.

*Legs*: scopula absent. Claws with 3-4 long, wide teeth almost concealed by tufts. Tibial crack I-IV prolateral, more distal on I, II than III, IV. Trochanteral notches shallow, slightly asymmetrical, twice as wider as deep.

*Palp* (Fig. 43A-C): tibia short, no apophysis but retrodorsally with longitudinal keel and more entally an asymmetrical shallow trough. *Cymbium*: roughly rectangular with wide retrobasal edge and steep sides; prolateral paracymbial flange width forming retrodistal groove and shallow channel along basal fold; scopula dorsally for distal 1/3. Tegulum reverse L-shape, narrow basally and laterally narrow; long triangular translucent pallid flat plate near but not enclosing embolus basally. Median apophysis a large triangular plate slightly upcurved prolaterally with sharply reflexed triangular process or retrodistal corner; distally with long deep groove, functionally a conductor. Embolus lies in groove formed by distal edge of

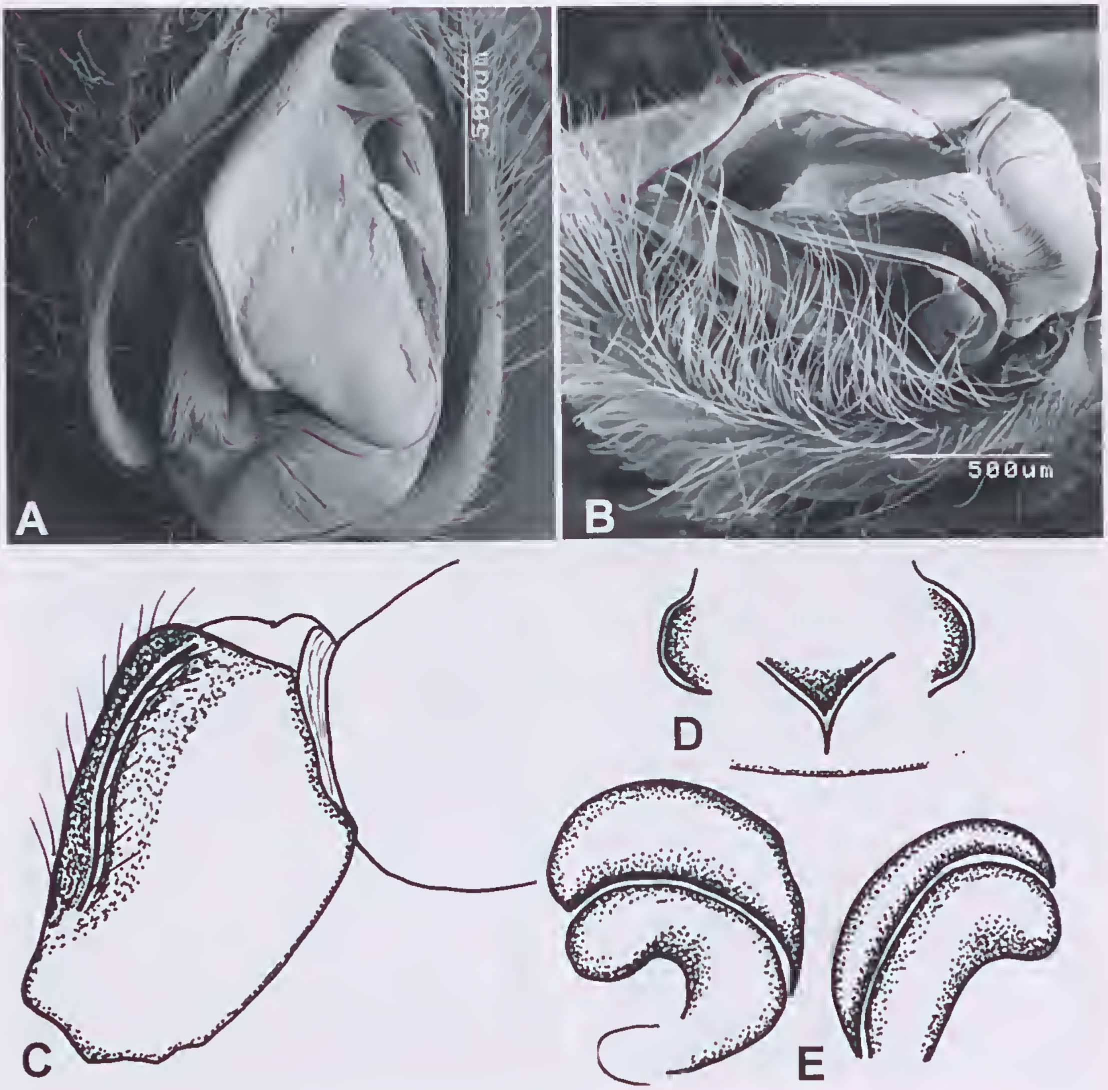

FIG. 43. *Kilyana bicarinatus*, sp. nov., ♂ palp A-C. A, B, bulb and cymbium, ventral (A) and prolateral (B) view; C, retrolateral tibial apophysis, retrolateral view showing groove; D, epigyne; E, vulva.

median apophysis but reaching paracymbial flange.

Allotype ♀. Carapace 5.70 long, 4.31 wide. Abdomen 5.64 long, 1.06 wide.

Like *Kilyana obrieni* but: *Colour*: carapace dark orange brown with fine dark radiating lines on caput; chelicerae dark reddish brown; abdomen dorsally fawn with no pattern evident. Legs orange brown.

*Eyes*: lateral eyes on common tubercle; AME on distinct mound.

*Legs*: scopula on metatarsi I, II in 3 lines; dense, uniform for length of tarsi I-IV.

*Spinnerets*: retracted; PMS with spigots in dorsal band and apically.

*Epigyne* (Figs 43D,E, 44B,C): wider than long with outer edges each defined by long concave ridge between which a broadly V-shaped pair of ridges converge posteriorly; vulva of two relatively large ducts overlying each other.

DISTRIBUTION AND HABITAT. Rainforest at Bulburin State Forest, SE Qld.

FIG. 44. *Kilyana bicarinatus*, sp. nov., ♀, A-C. A, cephalothorax & abdomen, dorsal view; B, epigyne; C, vulva. D, *Kilyana kroombit*, sp. nov., ♀, maxillae and labium, ventral view.

TABLE 16. Leg measurements of *Kilyana bicarinatus*, holotype male.

| | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 2.08 | 1.96 | 1.84 | 2.12 | 1.12 |
| Patella | 1.04 | 1.00 | 0.84 | 0.96 | 0.50 |
| Tibia | 1.88 | 1.64 | 1.36 | 1.92 | 0.50 |
| Metatarsus | 1.72 | 1.32 | 1.56 | 2.40 | - |
| Tarsus | 0.80 | 0.60 | 0.60 | 0.92 | 1.00 |
| Total | 7.52 | 6.52 | 6.20 | 8.32 | 3.12 |

### **Kilyana campbelli**, sp. nov.
(Figs 35, 45, 46F-G; Table 17)

ETYMOLOGY. For Bruce Campbell, Deputy Director, Queensland Museum, 1964-1998.

MATERIAL. HOLOTYPE: ♂, Nimbin, 28°36'S 153°13'E, NE NSW, rainforest, 14 Jun 1982, A.Rozefelds, D.Sinclair, QM S31406. PARATYPES: allotype ♀, Terania Ck, near Lismore, NE NSW, 28°34'S 153°19'E, 340m, rainforest, April-May 1976, M. Gray, C. Horseman, AM KS 10090; 1 ♀ [2 juv.], same data, AM KS 10090; 1 ♂, Red scrub Flora Reserve, north of Lismore, NE NSW, 28°38'S 153°19'E, 1 Apr 1976, M. Gray, C. Horseman, AM KS 9190.

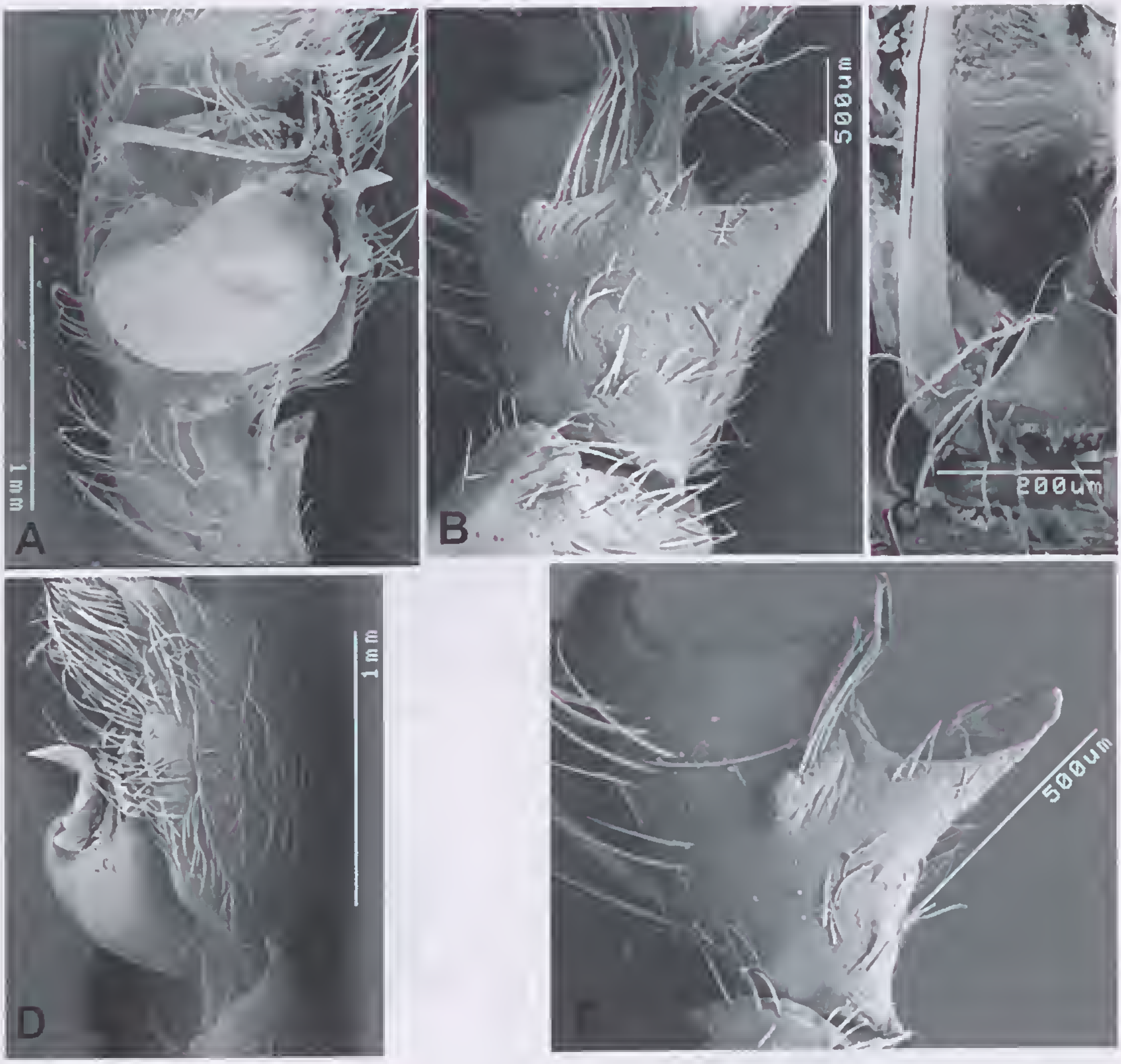

FIG. 45. *Kilyana campbelli*, sp. nov., ♂ palp, scanning electron micrographs. A, D, tibia and bulb, ventral (A) and retrolateral (D) view; B, E, tibia, retrolateral (B) and ventral (E) view.

DIAGNOSIS. Resembles *K. kroombit* in regular outline of the unsclerotised zone around the small median apophysis but the embolus lies transverse and the tibial apophysis is a flange not a longitudinal groove; females differ in that the epigyne is two distinct strongly procurved ridges posteriorly much like *Birrana bulburin* from which they differ in lacking a tarsal rod.

DESCRIPTION. Holotype ♂. Carapace 3.92 long, 2.96 wide. Abdomen 4.08, 2.80 wide.

*Colour*: carapace yellow brown with fine radiating dark lines on caput, wider bands on edges and ectal edges, small dark triangle anterior to fovea. Abdomen fawn with darker areas bounded by two fine pale lines and irregular pallid area anteriorly, dark area almost entire on posterior medial abdomen; shadows ventrally on central abdomen. Legs not banded, pallid. Sternum with darkened radial pattern centrally.

*Eyes*: AME:ALE:PME:PLE, 8:9:9:12. Eye group front width: back width: length, 51:66:32. Interspaces: AME-AME, 1.0; AME-ALE, 0.7; PME-PLE, 1.3; PME-PME, 1.6. Front of ALE cut through back edge of AME. Front edge of PLE along back edge of PME.

*Spines*: I: fe pv1p1d3r4; pa r1; ti p2d2r3pv5rv4; me p1r1v2.2.2. II: fe, p2d3r4; pa r1; ti p2d2r3pv5rv4; me p1r1v2.2.2. III: fe p4d3r4; pa

TABLE 17. Leg measurements of *Kilyana campbelli*, holotype male.

| | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 2.92 | 2.92 | 2.61 | 3.38 | 1.38 |
| Patella | 1.38 | 1.38 | 1.31 | 1.38 | 0.61 |
| Tibia | 3.00 | 2.69 | 1.85 | 2.69 | 0.77 |
| Metatarsus | 2.92 | 2.61 | 2.46 | 3.61 | 1.46 |
| Tarsus | 1.00 | 1.08 | 1.00 | 1.46 | |
| Total | 11.22 | 10.68 | 9.23 | 12.52 | 4.22 |

r1; ti p2d2r2v2.2.2; me p1.2.2 r1.1.2v 2.2.2. IV: fe p3d3r1; pa r1; ti p2d2r2v.2.2.2; me p1.1.1.2r2.2.2 v7. Palp: fe p1d1.2; pa 0; ti p2.

*Legs*: scopula absent. Claws with 2 long and 1 short basal tooth. Tibial crack on I-IV prolaterally distinct, less so retrolaterally. Trochanteral notches shallow, asymmetrical.

*Palp* (Fig. 45A-E): patella dorsal apex a sclerotised saddle at tibial juncture. Tibia across venter with low asymmetrical mound; tibia short, incrassate with large RTA twisted ventrally truncate to give concave edge; prodorsal and distally a broad concave trough runs diagonally to distal dorsal corner. Cymbial scopula dorsally for distal 1/8. Cymbium almost rectangular, rounded edges with broad anterior fold and wide retrodistal groove. Prolateral paracymbial flange a distinct low triangle basally. Tegulum broad, ovoid, basally; with ovoid retrolateral window with retrolateral small claw-like median apophysis. Embolus wide, flat, in prodistal origin reflexes back slender and slightly to base near tip of median apophysis then reflexes dorsally to lie near distal cymbial groove.

Allotype ♀, like male except:

*Spinnerets*: PMS dorsally with 2 lines each of 20-30 spigots.

*Epigyne* (Fig. 46F,G): roughly ovoid defined with two broad U-shaped ridges converging centrally to form narrow septum which is overlaid by n-shaped ridge.

DISTRIBUTION AND HABITAT. Rainforest in the Nimbin area of N NSW.

### **Kilyana corbeni** sp. nov.

(Figs 35, 46A-E; Table 18)

ETYMOLOGY. For Chris Corben and his role in the discovery of the gastric brooding habits of the frog *Rheobatracus silus* Liem, 1973.

MATERIAL. HOLOTYPE: ♂, Booloumba Ck, Conondale Ra, 26°39'S 152°39'E, SE.Q, rainforest, pitfall, 29 Nov 1974-22 Feb 1975, G & S. Monteith, QM S31396. PARATYPES: allotype ♀, Booloumba Ck, Conondale Ra (low), 26°39'S 152°39'E, rainforest, pitfall, 29 Nov 1974-22 Feb 1975, G & S. Monteith, QM S31397; 1 ♂, same data, QM S31398; 1 ♂ 1 ♀, Conondale Ra, Sunday Ck, 26°43'S 152°34'E, rainforest, intercept flight trap, 29 Nov 1991-7 Jan 1992, D.J. Cook, QM S25182, QM S25184. All in SE.Q.

DIAGNOSIS. Males differs from those of the sympatric *K. ingrami* in lacking the distal groove on the median apophysis, dorsal tibial spines about 1/2 lateral (cf. equal) and tegulum has very long longitudinal component; females have the copulatory groove clearly inverted U-shaped and only about twice as wide as long whereas in *K. ingrami* it is broadly recurved and about 3.5 times wider than long.

DESCRIPTION. Holotype ♂. Carapace 6.24 long, 4.96 wide. Abdomen 5.52, 3.76 wide.

*Colour*: carapace yellow brown with broken dark areas along margins, laterally PLE on caput edge, two bands up posterior slope and triangular areas submarginally on interstriae, fovea red. Abdomen dorsally fawn with dark shoulders and small dark areas in posterior half, ventrally yellow brown with small dark areas. Femora yellow brown with broad ring at ends, tarsus yellow brown; rest reddish brown. Apical maxillae dark.

*Eyes*: AME:ALE:PME:PLE, 12:13:12:13. Eye group front width: back width: length, 79:100:41. Interspaces: AME-AME, 1.1; AME-ALE, 0.9; PME-PLE, 2.2; PME-PME, 1.6. Front of ALE cut along back edge of AME. Front edge of PLE behind back edge of PME.

*Spines*: I: fe pv1p1d3r4; pa r1; ti p2d3r3pv5rv4; me p2r2v2.2.2. II: fe pv1p2d3r4; pa r1; ti p2d2r3v2.2.2.2.2; me p3r3v2.2.2. III: fe p4d3r4; pa r1; ti p2d2r2v2.2.2; me p1.2.2r2.1.2v 2.2.2. IV: fe p4d3r1; pa r1; ti p2d2r2 v.2.2.1; me p4r5v1.2.2.2. Palp: fe p1d1.2.

*Legs*: scopula absent; light pile of yellow brown hairs. Large pallid RCH. Tibial crack on I-IV distinct. Trochanteral notches shallow, symmetrical.

*Palp* (Fig. 46A-C): patella short, not incrassate with broad sclerotised ledge dorsodistally. Tibia: ridge joins basoventrally with low curved ridge and glabrous shallow area distally, retrolaterally with large basal process bearing large socketed truncate spine; retrodistally with narrow bluntly pointed process; mid-dorsally with bowed process bearing triangular large socketed spine much smaller than retrolateral. Cymbium apically widely folded truncate ovoid;

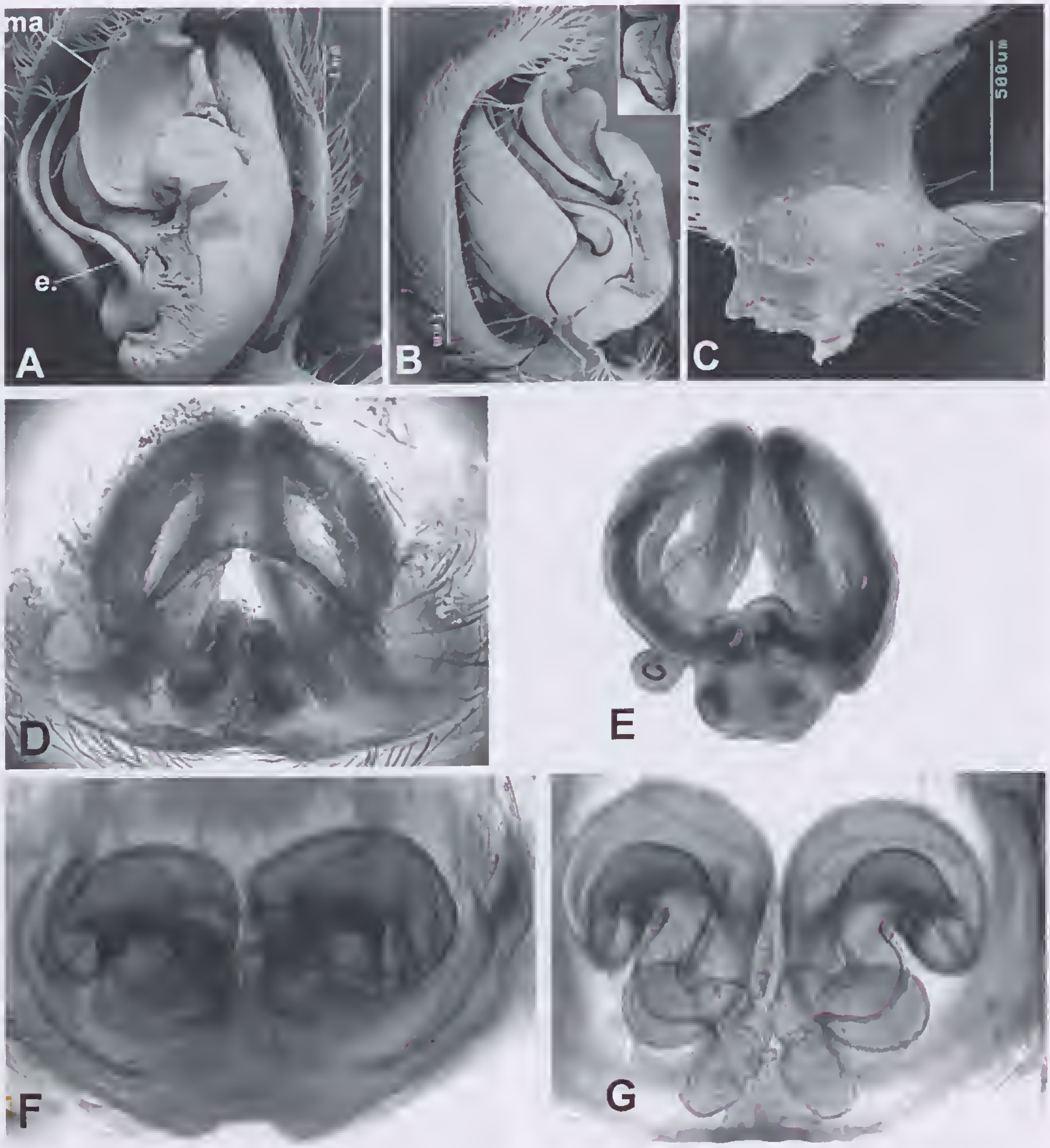

FIG. 46. A-E, *Kilyana corbeni*, sp. nov., scanning electron micrographs. A-C, ♂ palp. A, B, cymbium and bulb, ventral (A) and prolateral (B) view with inset showing process beside median apophysis, retrolateral view; C, tibia and cymbium, showing tibial apophysis, ventral view. D-E, ♀; D, epigyne, E, vulva. F-G, *Kilyana campbelli*, sp. nov., scanning electron micrographs, ♀; F, epigyne, G, vulva.

retrolaterally with wide heavily sclerotised angular ridge distally joining with distal fold to make short deep groove; scopula dorsally for distal 1/4; paracymbial discontinuity a slight extension. Tegulum large, reverse C-shaped, but basal lobe more long than across basally. Median apophysis is free of tegulum, a large open scoop or spoon-shaped process apically twisted. Embolus arises probasally with subtegular shield and tegulum; origin conical, reflexes in S-shape from short basal to prolateral and emerging in long tapering tip in cymbial fold; as for all species prolateral cymbial edge with shield of long curved setae (in right line) extending into embolus.

TABLE 18. Leg measurements of *Kilyana corbeni*, holotype male and allotype female.

| Male | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 4.23 | 4.31 | 3.92 | 4.69 | 2.15 |
| Patella | 2.00 | 2.15 | 1.85 | 1.85 | 1.00 |
| Tibia | 4.23 | 3.69 | 3.00 | 3.85 | 0.54 |
| Metatarsus | 4.00 | 3.69 | 3.46 | 4.61 | 2.31 |
| Tarsus | 1.54 | 1.38 | 1.31 | 1.69 | |
| Total | 16.00 | 15.22 | 13.54 | 16.69 | 6.00 |
| **Female** | **I** | **II** | **III** | **IV** | **Palp** |
| Femur | 3.31 | 3.15 | 2.92 | 3.69 | 1.61 |
| Patella | 1.61 | 2.07 | 1.31 | 1.77 | 0.69 |
| Tibia | 2.85 | 2.69 | 2.00 | 3.08 | 0.85 |
| Metatarsus | 2.38 | 2.31 | 2.31 | 3.61 | 1.31 |
| Tarsus | 0.77 | 0.85 | 1.00 | 1.15 | |
| Total | 10.92 | 11.07 | 9.54 | 13.30 | 4.46 |

Allotype ♀, like male except: Carapace 5.36 long, 4.64 wide. Abdomen 8.80, 7.20 wide.

*Chelicerae*: 3p, 3r.

*Eyes*: AME:ALE:PME:PLE, 12:12:14:15. Eye group front width: back width: length, 80:106:44. Interspaces: AME-AME, 1.3; AME-ALE, 1.2; PME-PLE, 2.0; PME-PME, 1.5.

*Legs*: scopula absent. Claws with 3 short teeth on palp & legs.

*Spines*: I: fe pv1p1d3r2; pa 0; ti pv5rv4; me v2.2.2. II: as for I but fe pv1p2d3r3. III: fe p4d3r4; pa r1; ti p2d2r2v2.2.2; me p1.1.2r2.1.2v2.2.2. IV: fe p3d3r1; pa r1; ti p2d2r2v5; me p1.1.1.2r2.1.1.2 v7. Palp: fe d1.2; pa 0; ti p2d1; ta p3d1r1.

*Epigyne* (Fig. 46D,E): a broad recurved groove; vulva G-shaped.

*Spinnerets*: PMS each with two lines of spigots dorsally.

DISTRIBUTION AND HABITAT. Rainforest at Booloumba Ck, Conondale Range, SE Qld, where it is sympatric with *Kilyana ingrami*.

### **Kilyana dougcooki** sp. nov.

(Figs 35, 47; Table 19)

ETYMOLOGY. For Doug Cook.

MATERIAL. HOLOTYPE: ♂, Upper Tallebudgera Valley, 28°15'S 153°16'E, SE.Q, rainforest, Mar-Jul 1985, D.J. Cook, QM S31403. OTHER MATERIAL. QM S25073

DIAGNOSIS. Males differ from those of *K. ingrami* in pincer-like tibial apophysis and simple, longitudinal, hooked median apophysis.

TABLE 19. Leg measurements of *Kilyana dougcooki*, holotype male.

| | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 3.46 | 3.61 | 3.31 | 3.92 | 1.77 |
| Patella | 1.77 | 1.69 | 1.61 | 1.46 | 0.85 |
| Tibia | 3.92 | 3.38 | 2.46 | 3.31 | 0.69 |
| Metatarsus | 3.61 | 3.08 | 3.08 | 3.69 | 1.54 |
| Tarsus | 1.38 | 1.23 | 1.15 | 1.54 | |
| Total | 14.14 | 12.99 | 11.61 | 13.92 | 4.85 |

DESCRIPTION. Holotype ♂. Carapace 4.88 long, 3.60 wide. Abdomen 3.68, 2.64 wide.

*Colour*: carapace orange brown with dark hairs along strial edge. Legs without bands. Abdomen fawn brown, anteriorly pallid, posterior central area with irregular dark mottling; ventral abdomen pallid with dark areas. Sternum pallid with dark radial bands.

*Eyes*: AME:ALE:PME:PLE, 10:9:11:12. Eye group front width: back width: length, 60:83:35. Interspaces: AME-AME, 1.1; AME-ALE, 1.0; PME-PLE, 1.7; PME-PME, 1.3. Front of ALE well back from back of AME. Front edge of PLE along back edge of PME.

*Spines*: I: fe pv1p1d3r4; pa r1; ti p2d3r3pv5rv4; me p3r3v2.2.2. II: fe pv1p3d3r4; pa r1; ti p3d3r3pv5rv4; me p3r3v2.2.2. III: fe p4d3r4; pa r1; ti p3d2r2v2.2.2; me p1.2.2r2.2v2.2.2. IV: fe p4d3r2; pa r1; ti p2d2r2v.2.2.2; me p1.1.2r2.2.2v7, unpaired. Palp: fe p1d1.2.

*Legs*: scopula absent. Claws with 2-3 small teeth; tufts united. Tibial crack I-IV prolaterally distinct, weakly discernible retrolaterally on III, IV. Trochanteral notches shallow, asymmetrical.

*Palp* (Fig. 47A-E): *Tibia*: incrassate distally with raised ovoid diagonal mound retrodistally; mound with small conical reddish process turned distally toward large curved megaspine (socketed) with mounded base, midventrally with low rounded unsclerotised mound with glabrous area prolaterally. *Cymbium*: subovoid; retrobasally folded widely narrow distally to form shallow groove; margin wide prodistally; dorsal scopula for distal 2/5. *Bulb*: tegulum large, scoop-shaped on retrobasal corner; median apophysis small, roughly rectangular with small medial point and larger apical distal triangular tip; embolus originates on prolateral edge tapers quickly into smooth curving tip terminated near cymbial groove.

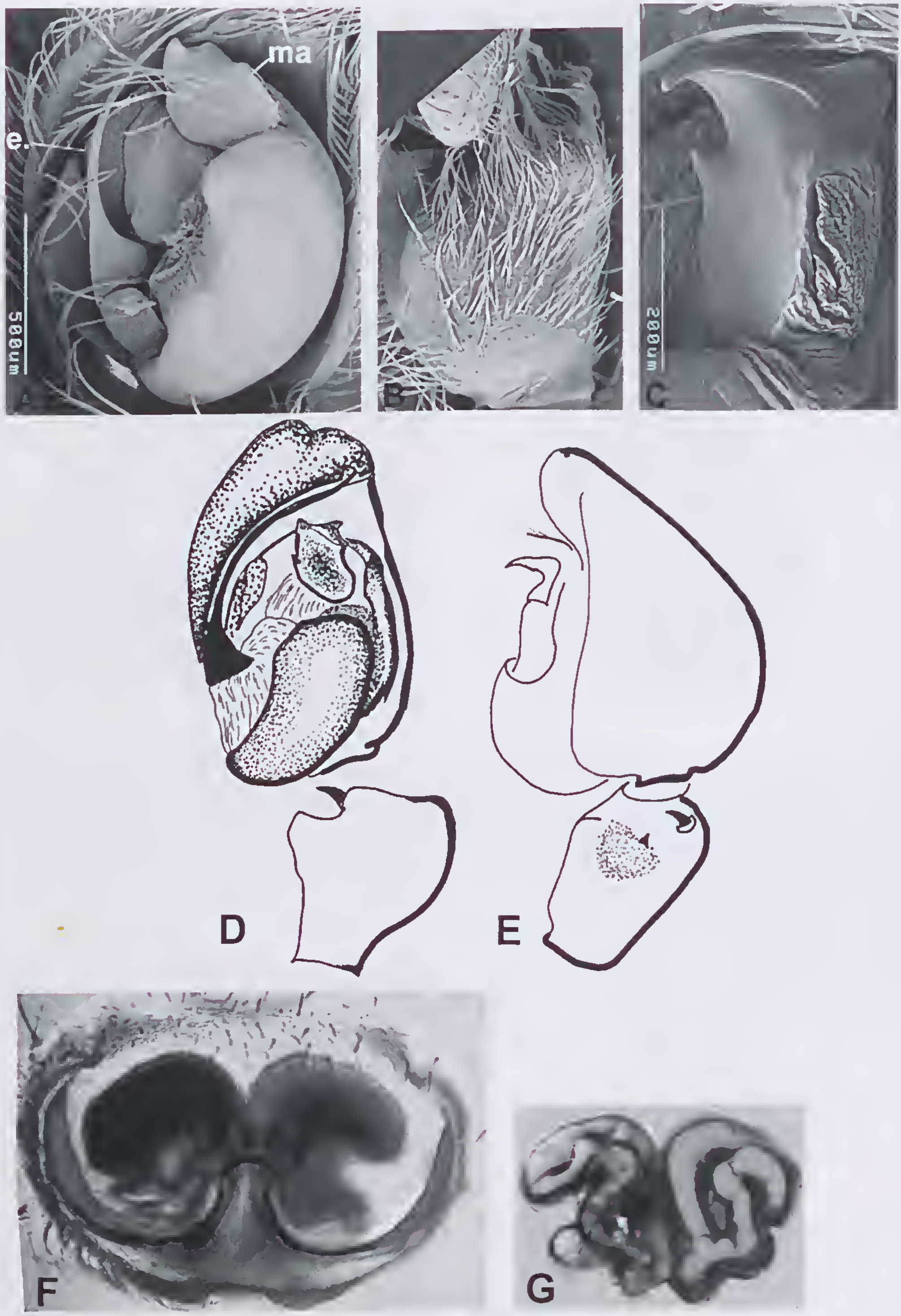

FIG. 47. *Kilyana dougcooki*, sp. nov. A-C, ♂ palp, scanning electron micrographs; A, cymbium and bulb, ventral view; B, tibial apophysis, retrolateral view; C, median apophysis, ventral view. D-E, ♂ palp; D, E, tibia, cymbium and bulb, ventral (D) and retrolateral (E) view. F-G, ♀; F, epigyne, G, vulva.

DISTRIBUTION AND HABITAT. Upper Tallebudgera Valley and probably also Mt Tamborine, in rainforest.

REMARKS. Because the female and male have not been taken at the same locality and the two localities (Mt Tamborine, Upper Tallebudgera Valley, respectively), the female is not designated a paratype but the epigyne is figured (Fig. 47F,G).

### **Kilyana eungella**, sp. nov.
(Figs 35, 48; Table 20)

ETYMOLOGY. A noun in apposition taken from the type locality.

MATERIAL. HOLOTYPE: ♀, Broken R, Eungella NP, 21°11'S 148°31'E, MEQLD, rainforest, 4 Sep 1988, R.Raven, J.Gallon, T.Churchill, QM S13870. PARATYPES: ♀, Pease's Lookout, Eungella NP, 21°07'S 148°31'E, rainforest, pitfall & intercept traps, 17 Nov 92-mid Apr 93, G.Monteith D.Cook, QM S31404; 1 ♀, Eungella (schoolhouse), 21°08'S 148°29'E, rainforest, pitfall, 11-14 Feb 1986, R.Raven, J.Gallon, QM S29310; 2 ♀, Mt William, Dalrymple Heights, 21°01'S 148°36'E, 1120m, rainforest, Apr 1975, M. Gray, C. Horseman, AM KS6565. All in MEQ. OTHER MATERIAL. AM KS6383.

DIAGNOSIS. The paired broadly procurved copulatory grooves in the female are unique in the genus.

DESCRIPTION. Holotype ♀. Carapace 5.12 long, 4.00 wide. Abdomen 7.12, 5.36 wide.

*Colour*: carapace, legs and abdomen yellow brown. Carapace with darker radial pattern. Chelicerae without stripes. Abdomen fawn with slightly darker shoulders. Legs III, IV with distinct bands and mottling sternum with slightly darker radial lines.

*Chelicerae*: 3p, 3r, all large.

*Eyes*. AME:ALE:PME:PLE, 10:11:13:12. Eye group front width: back width: length, 73:103:36. Interspaces: AME-AME, 1.8; AME-ALE, 1.1; PME-PLE, 2.6; PME-PME, 1.8. Front of ALE behind back edge of AME. Front edge of PLE is just behind back edge of PME.

TABLE 20. Leg measurements of *Kilyana eungella*, holotype female.

| | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 2.77 | 2.61 | 2.54 | 3.15 | 1.38 |
| Patella | 1.00 | 1.54 | 1.38 | 1.38 | 0.69 |
| Tibia | 3.31 | 2.15 | 1.69 | 2.54 | 0.85 |
| Metatarsus | 2.23 | 2.07 | 2.07 | 3.31 | 1.15 |
| Tarsus | 0.85 | 0.85 | 0.61 | 1.15 | |
| Total | 10.16 | 9.22 | 8.29 | 11.53 | 4.07 |

*Spines*: I: fe pv1p1d1; pa 0; ti pv5rv4; me v2.2.2. II: as for I but fe pv1p2d3r3. III: fe p3d3r2; pa 0; ti p2d2r2v2.2.2; me p1.2.2r2.1.2v2.2.2. IV: fe p3d3r1; pa r1; ti p2d2r2v5; me p1.1.1.2r 2.2.2v2.2.3. Palp: fe d1.2; pa 0; ti p1r1; ta p3d1.

*Legs*: scopula very weak on metatarsi, tarsi I, II. Claws: 2-3 short on palp & legs. Trochanteral notches very shallow.

*Epigyne* (Fig. 48A-D): a broad shallow ovoid plate with 2 distal smoothly curving groove leading to spiralled spermathecae.

*Spinnerets*: PMS each with a long dorsal ridge. Colulus a triangular plate.

DISTRIBUTION AND HABITAT. Rainforest on the Eungella Range, west of Mackay, mid E Qld.

REMARKS. As most of the material has 3 teeth retrolaterally on the chelicerae and only one has 4 teeth (QM S31340) but the epigynes & vulva of both are alike, the quadridentate condition is considered an intraspecific variant. The vulva of QM S31304 are relatively slightly longer than the holotype (Fig. 48B).

### **Kilyana ingrami** sp. nov.
(Figs 35, 49, 50; Table 21)

ETYMOLOGY. For Dr Glen Ingram.

MATERIAL. HOLOTYPE: ♂, Conondale Ra, 26°45'S 152°37'E, SE.Q, 1-3 May 1976, R.J. Raven, QM S31393. PARATYPES. ♂, Booloumba Ck, Conondale Ra, 26°39'S 152°39'E, rainforest, litter, 13-18 May 1976, R.J. Raven, QM S31395; Allotype ♀, Conondale Ra, 26°45'S 152°37'E, 1-3 May 1976, R.J. Raven, QM S31394; 1 ♂ [4 juv.], same data, QM S29345; 1 ♂, Little Yabba Ck, 26°37'S 152°41'E, rainforest, pitfall, 10 Aug-9 Nov 1974, G.& S. Monteith, QM S31399; 5 ♂, Mapleton Falls NP, 26°38'S 152°51'E, rainforest, flight intercept trap, 8 Jan-3 Mar 1992, D.J. Cook, QM S39589; 1 ♂ 1 ♀, Tungi Ck, 26°40'S 152°28'E, rainforest, pitfall, 10 Nov-29 Dec 1974, G.& S. Monteith, QM S31407; 1 ♀, same data but 18 Dec 1996-20 Jan 1997, G. Monteith, QM S39093; 1 ♀, Cold Ck, SE. QLD, 26°28'S 152°41'E, 122m, 16 June-23 Aug 1975, G.B. & S.R. Monteith, QM S53411; 2 ♀, same data but 31 Dec 1974-27 Mar 1975, QM S 53410; ♂, Amamoor Ck, 26°24'S 152°36'E, 120m, rainforest, pitfall trap, 24 Sep 2001-15 Jan 2002, G.B. Monteith, QM S54301; ♀, Dingo Ck, via Traveston, 26°20'S 151.52'E, SE.Q, 9 Nov-31 Dec 1974, G.& S. Monteith, QM S54302. All in SE.Q. OTHER MATERIAL. QM S25200.

DIAGNOSIS. Males differ from those of *Kilyana corbeni* in having a distinct groove across the distal median apophysis of the palp; females differ in that the copulatory groove is broadly recurved and about 3.5 times wider than long

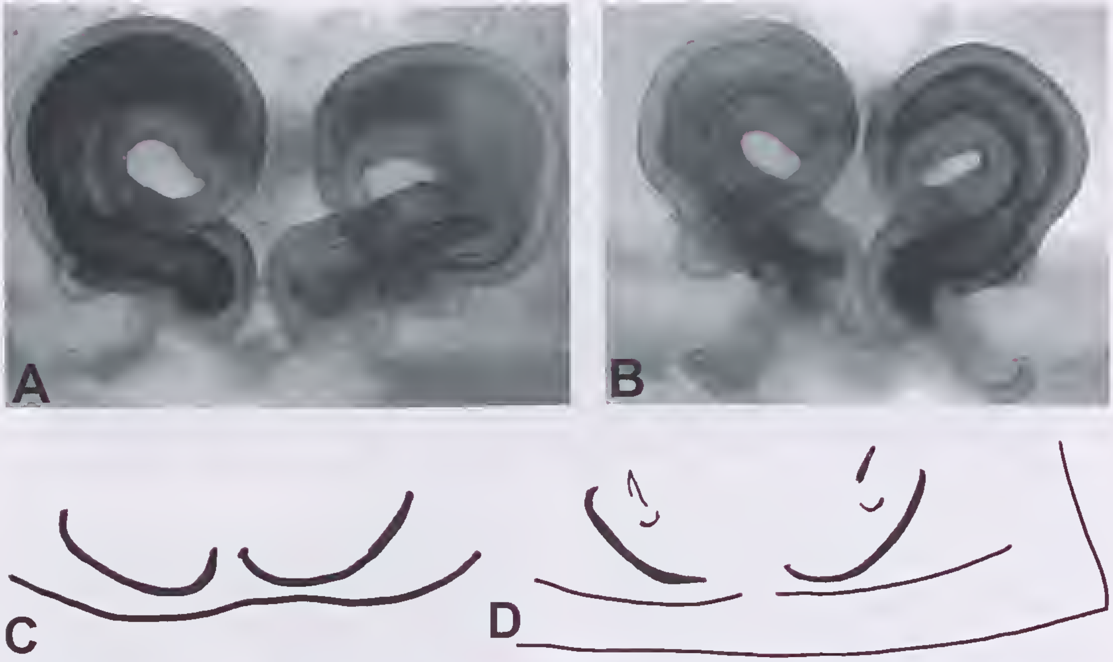

FIG. 48. *Kilyana eungella*, sp. nov., ♀; vulva, QMS13870 (A), QMS31404 (B); epigyne QMS13870 (C), QMS31404 (D).

whereas in *Kilyana corbeni* it is clearly an inverted U and only about twice as wide as long.

DESCRIPTION. Holotype ♂. Carapace 5.52 long, 3.76 wide. Abdomen 4.72, 3.44 wide.

*Colour*: carapace orange brown fine darker margins and along caput edge. Abdomen dorsally pallid with black rings at base of setae, darkness increases in back half. Legs not banded. Sternum with slightly darker areas opposite intercoxal corners; maxillae and labium anterior laterally dark. Abdomen ventrally is pallid with black transverse flecks.

*Eyes*: front edge of ALE along back edge of AME. Front edge of PLE along back edge of PME. ALE clearly smallest. ALE & PLE on common tubercle. AME:ALE:PME:PLE, 11:10:13:15. Eye group front width: back width: length, 63:87:40. Interspaces: AME-AME, 1.1; AME-ALE, 1.0; ALE-PLE, 0.0; PME-PLE, 1.6; PME-PME, 1.3.

*Chelicerae*: 3p, 3r.

*Spines*: I: fe pv1p1d3r4; pa r1; ti p2d3r3pv5rv4; me p5r4rv2.2.2. II: fe v1p2d4r4; pa r1; ti p2d3r2v2.2.2.2; me p5r4v2.2.2. III: fe p4d4r3; pa r1; ti p2d2r2v2.2.2; me p1.1.2r2.2.1v2.2.2. IV: fe p4d3r1; pa r1; ti p2d2r2v.2.2.2; me p1.1.1.2r2.2.2. Palp: fe p1d1.2, pa 0, ti p1.

*Legs*: scopula absent. I, II laterigrade. Tibial crack on I-IV grooved; 2-3 teeth on claws. Trochanteral notches shallow, (3-4 wider than deep) deeper in back of notch to front. Setation on legs, sternum, maxillae and labium short, sparse.

*Palp* (Fig. 49A-F): tibia stout, retrolaterally concave, glabrous with 4 processes: basoventrally a rounded diagonal ridge, retrodistally a flattened hand-shaped process; two very large modified

TABLE 21. Leg measurements of *Kilyana ingrami*, holotype male and allotype female.

| Male | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 3.77 | 3.85 | 3.46 | 3.85 | 1.92 |
| Patella | 1.92 | 1.85 | 1.61 | 1.69 | 0.85 |
| Tibia | 3.69 | 3.23 | 2.31 | 3.46 | 0.85 |
| Metatarsus | 3.77 | 3.00 | 2.77 | 4.38 | 2.07 |
| Tarsus | 1.38 | 1.23 | 1.23 | 1.38 | - |
| Total | 14.53 | 13.16 | 11.38 | 14.76 | 5.69 |
| Female | I | II | III | IV | Palp |
| Femur | 3.15 | 2.54 | 2.85 | 3.31 | 1.46 |
| Patella | 1.92 | 1.69 | 1.31 | 1.85 | 0.92 |
| Tibia | 2.77 | 2.38 | 1.69 | 2.77 | 0.92 |
| Metatarsus | 2.54 | 2.31 | 2.23 | 3.85 | 1.23 |
| Tarsus | 0.92 | 1.00 | 0.92 | 1.23 | - |
| Total | 11.30 | 9.92 | 9.00 | 13.01 | 4.53 |

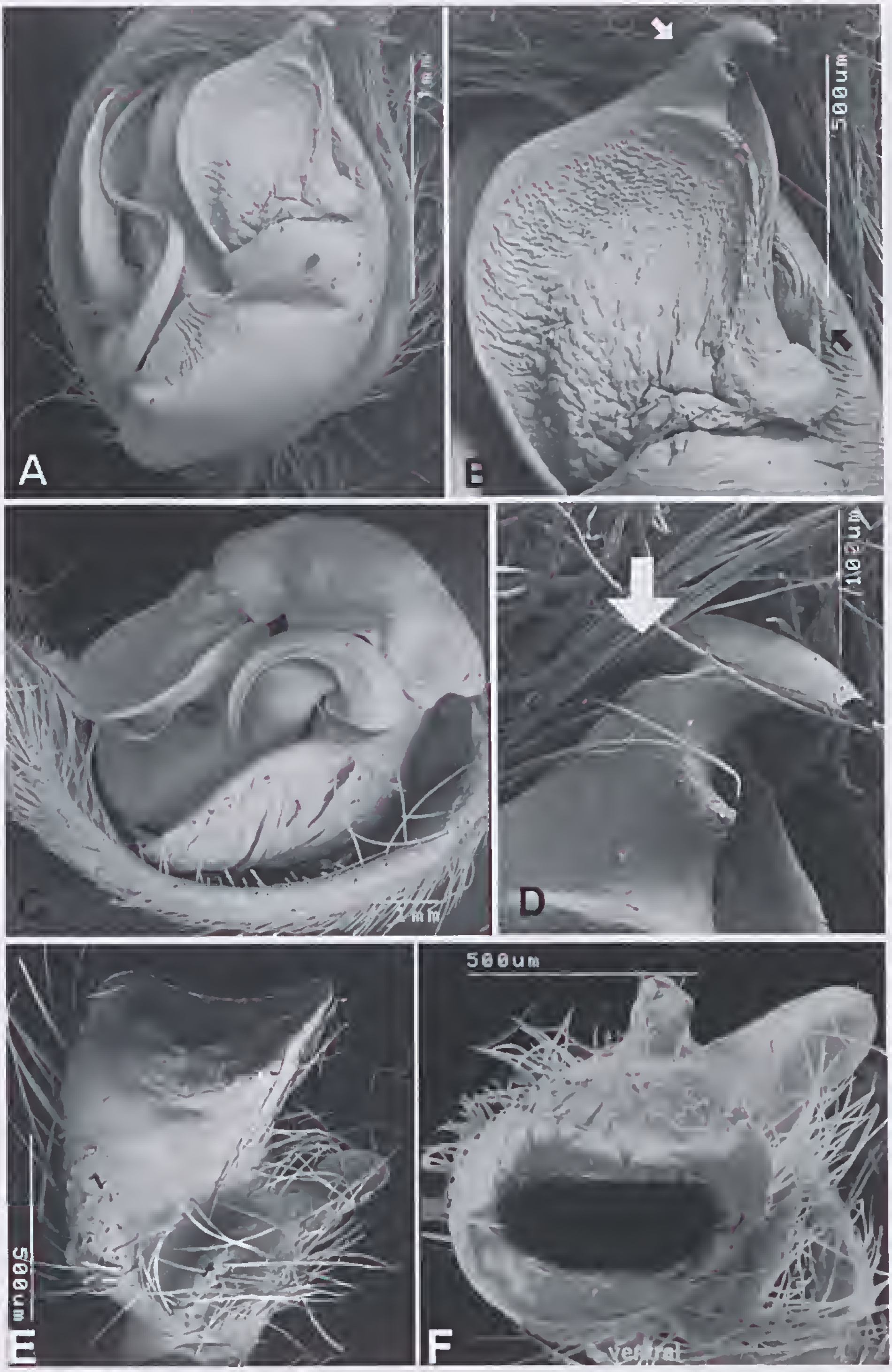

FIG. 49. *Kilyana ingrami*, sp. nov., ♂ palp, scanning electron micrographs. A, C, cymbium and bulb, ventral (A) and prolateral (C) view; B, D, median apophysis, with distal groove (arrow), ventral view. E, F, ♂ palpal tibia, ventral (E) and axial view looking to base (F).

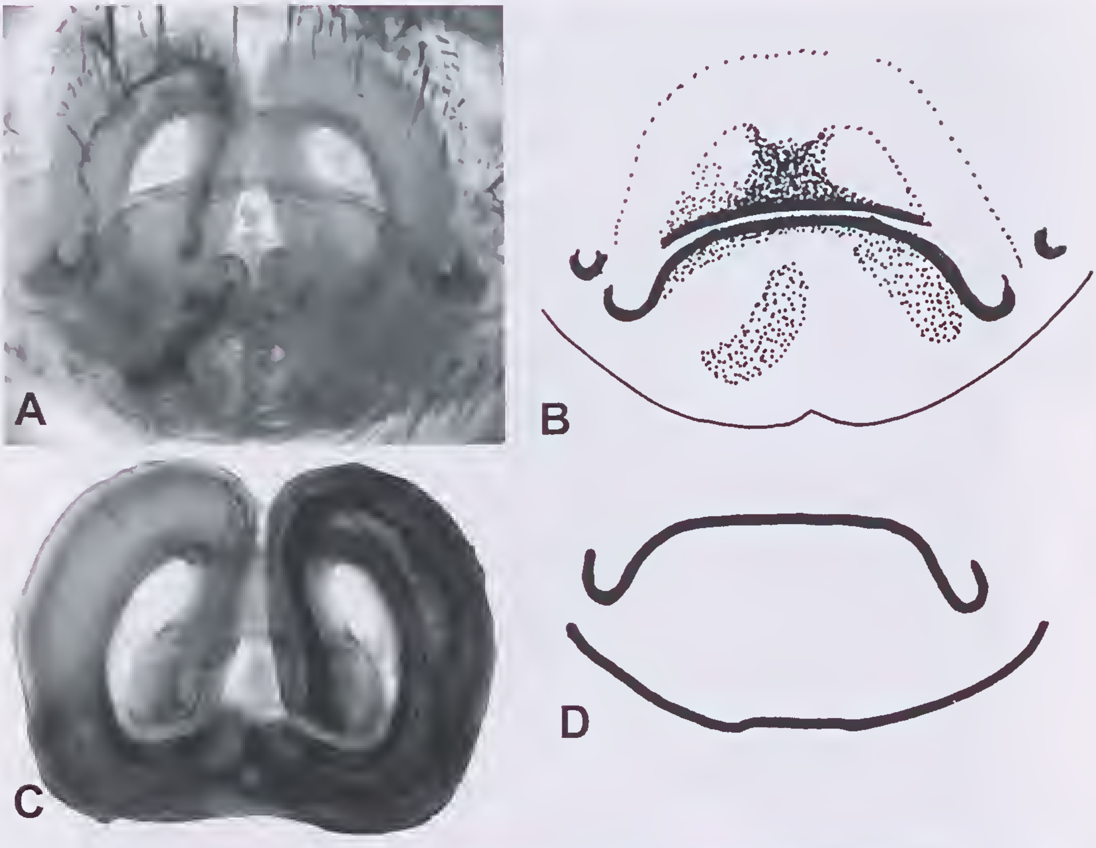

FIG. 50. *Kilyana ingrami*, sp. nov., ♀, A, B, D, epigyne, showing variability in transverse groove; C, vulva.

spines retrobasally, dorsal spine short conical, broad; retrolateral a wider spine but diagonally truncate to base giving concave ovoid apex, dorsal surface convex; tibia excavate between megaspines and cymbium. Cymbium: scopula extent apical 1/3; dorso-basally with very sclerotised collar; dorsally with large basal flattened area; apically folded to make broad tip and retrolateral groove apically. Tegulum large basal and retrolateral 'mirror C' shaped, subtegular shield arises up beside cymbium on prodorsum. Embolus S-shaped, basally small, probasal with long rectangular flange, broken paraembolic process passes ventrally then reflexes forward arising near cymbial groove with flared tip. Median apophysis large, sclerotised, triangular with two flanges on each side, all converge apically.

Allotype ♀. As for male except as follows: Carapace 5.68 long, 3.92 wide. Abdomen 5.28, 3.76 wide.

*Carapace*: Markings on lateral cephalothorax darker; rings on distal femora- metatarsi; pilosity like male but hairs darker.

*Chelicerae*: 3p, 3r.

*Eyes*: AME:ALE:PME:PLE, 10:11:12:16. Eye group front width: back width: length, 79:104:43. Interspaces: AME-AME, 1.3; AME-ALE, 1.4; PME-PLE, 2.7; PME-PME, 1.8. Front edges of ALE behind back edge of AME. Front edge of PLE is behind back edge of PME.

*Spines*: I: fe pv1p1d3r3; pa 0; ti pv5rv4; me v2.2.2. II: as for I but fe p3d3r3. III: fe p4d3r4; pa r1; ti p2d2r2v2.2.2; me p1.2.2r.2.2.2v2.2.2. IV: fe p3d3r1; pa r1; ti p2d2r2v2.2.2; me p1.1.1.2r2.2.2v2.2.2. Palp: fe d1.2; pa 1; ti p2d1; ta p3r3.

*Legs*: scopula on tarsi I, II; weak and weak in distal third of metatarsi I, II.

*Epigyne* (Fig. 50A-D): a broad excavate shield-shaped plate, centrally with wide inverted U-shaped ridge with recurved end; vulva G-shaped.

DISTRIBUTION AND HABITAT.Rainforest in the Conondale Range, SE Qld.

### **Kilyana kroombit** sp. nov.
(Figs 35, 44D, 51, 52; Table 22)

ETYMOLOGY. A noun in apposition, from the type locality.

MATERIAL. HOLOTYPE: 1 ♂, Kroombit Tops (Site 5), 24°25'S 151°03'E, SE.Q, rainforest, pitfall, 10-18 Dec 1983, G.Monteith, V.Davies, J.Gallon, G.Thompson, QM S31401. PARATYPES. Allotype ♀, as for holotype, QM S31402; 2 ♀, Kroombit Tops, Beauty Spot 98, 24°25'S 151°03'E, rainforest, 9-19 Dec 1983, V.Davies, J.Gallon, QM S32951; 2 ♂ 1 ♀ [3 juv.], Kroombit Tops, 24°25'S 151°03'E, pitfall, 23 Feb 1982, G. Monteith, R. Raven, D. Yeates, QM S32784. All in SE.Q. OTHER MATERIAL. 3 juveniles, as for QM S32784.

DIAGNOSIS. Males differ from those of *Kilyana hendersoni* in the much less extensive groove retrolaterally on the tibial apophysis, the less expansive median apophysis and the absence of the paraembolic fringe, from the sympatric *K. obrieni* in the presence of a groove on the palpal tibia. Females have the most subtle epigynes of the genus; it is broad with at most a tiny medial inverted U-shaped aperture and very shallow lateral grooves.

DESCRIPTION. Holotype ♂. Carapace 5.04 long, 3.92 wide. Abdomen 4.32, 3.20 wide.

*Colour*: carapace and legs orange brown with fine dark bands anteriomedially, lateral of eyes and PLE, along caput edge and distally along interstrial ridges and radially from fovea. Two dark stripes down each chelicera. Abdomen fawn with 4 irregular darker areas in posterior half; ventral abdomen pallid with black flecks centrally. Legs yellow brown with dark mottling under femora. Distal metatarsi darker.

*Eyes*: AME:ALE:PME:PLE, 10:13:10:14. Eye group front width: back width: length, 64:86:38. Interspaces: AME-AME, 1.0; AME-ALE, 1.0; PME-PLE, 1.8; PME-PME, 1.3.

*Spines*: I: fe pv1p1d3r4; pa r1; ti p3d3r3pv5rv4; me p3r3v2.2.2. II: fe pv1p3d3r4; pa r1; ti p2d3r3pv5rv4; me p3r3v2.2.2. III: fe p4d3r4; pa r1; ti p2d2r2v2.2.2; me p1.2.2r2.1.2v2.2.2. IV: fe p4d3r2; pa r1; ti p2d2r2v2.2.2; me p5r6v8. Palp: fe p1d1.2.

*Legs*: scopula absent. Claws with 2-3 teeth. Tibial crack on I-IV distinct on both sides of tibia. Trochanteral notches shallow, deeper in back of notch to front, ca. 4 × wider than deep. Tufts distinct, united.

*Palp* (Fig. 51A-D, 52D,E): patella slightly incrassate with distodorsal sclerotised extension. Tibia with long, deep, diagonal groove across retrolateral face and forming uniform mound basally; rounded ridge on dorsal side; apically on lower side a low conical process beside longer blade-like process set or long retrodorsal ridge along tibia edge. Opposing edge of cymbium basally rounded forming tube with diagonal groove retrodorsally across cymbial corner; cymbial scopula dorsally for distal 1/2; cymbium asymmetrically folded apically with broad folded margin proventrally; prolateral paracymbial flange long, strong continues to tip to form groove. Tegulum large bowl-like on retrobasal corner, with ovoid window retrolaterally from which arises small slender hooks; median apophysis with basal transluscent flange orthogonally. Embolus originates prodistally, tapers quickly diagonal across to apical cymbial groove retrolaterally.

Allotype ♀. Carapace 5.92 long, 4.48 wide. Abdomen 5.76, 3.92 wide.

*Colour*: darker areas more extensive on cephalothorax, triangular dark prefoveal area. Abdomen light brown dorsally with dark 'shoulders' median dark dome broken as it widens posteriorly as two dark bands with series of 4 vaguely defined dark chevrons down back; ventrally pallid with large area of dark flecking centrally. Sternum fawn with radiating dark line, coxae and legs with scattered dark flecking darkest on distal femora and metatarsi. Chelicerae orange brown with 2 dark bands down each and converging distally.

*Chelicerae*: 3p, 3r.

*Eyes*: AME:ALE:PME:PLE, 12:12:13:14. Eye group front width: back width: length, 83:110:41.

TABLE 22. Leg measurements of *Kilyana kroombit*, holotype male and allotype female.

| Male | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 3.92 | 3.69 | 3.38 | 4.23 | 1.69 |
| Patella | 1.77 | 1.61 | 1.31 | 1.31 | 1.08 |
| Tibia | 4.23 | 3.23 | 2.54 | 3.61 | 0.77 |
| Metatarsus | 4.08 | 3.31 | 3.00 | 4.85 | 1.46 |
| Tarsus | 1.77 | 1.38 | 1.31 | 1.61 | |
| Total | 15.77 | 13.22 | 11.54 | 15.61 | 5.00 |
| Female | I | II | III | IV | Palp |
| Femur | 3.61 | 3.61 | 3.00 | 4.00 | 1.54 |
| Patella | 1.85 | 2.00 | 1.69 | 1.77 | 1.00 |
| Tibia | 3.08 | 2.54 | 2.00 | 3.08 | 1.00 |
| Metatarsus | 3.00 | 2.61 | 2.61 | 3.92 | 1.38 |
| Tarsus | 1.00 | 1.08 | 1.00 | 1.31 | |
| Total | 12.54 | 11.84 | 10.30 | 14.08 | 4.92 |

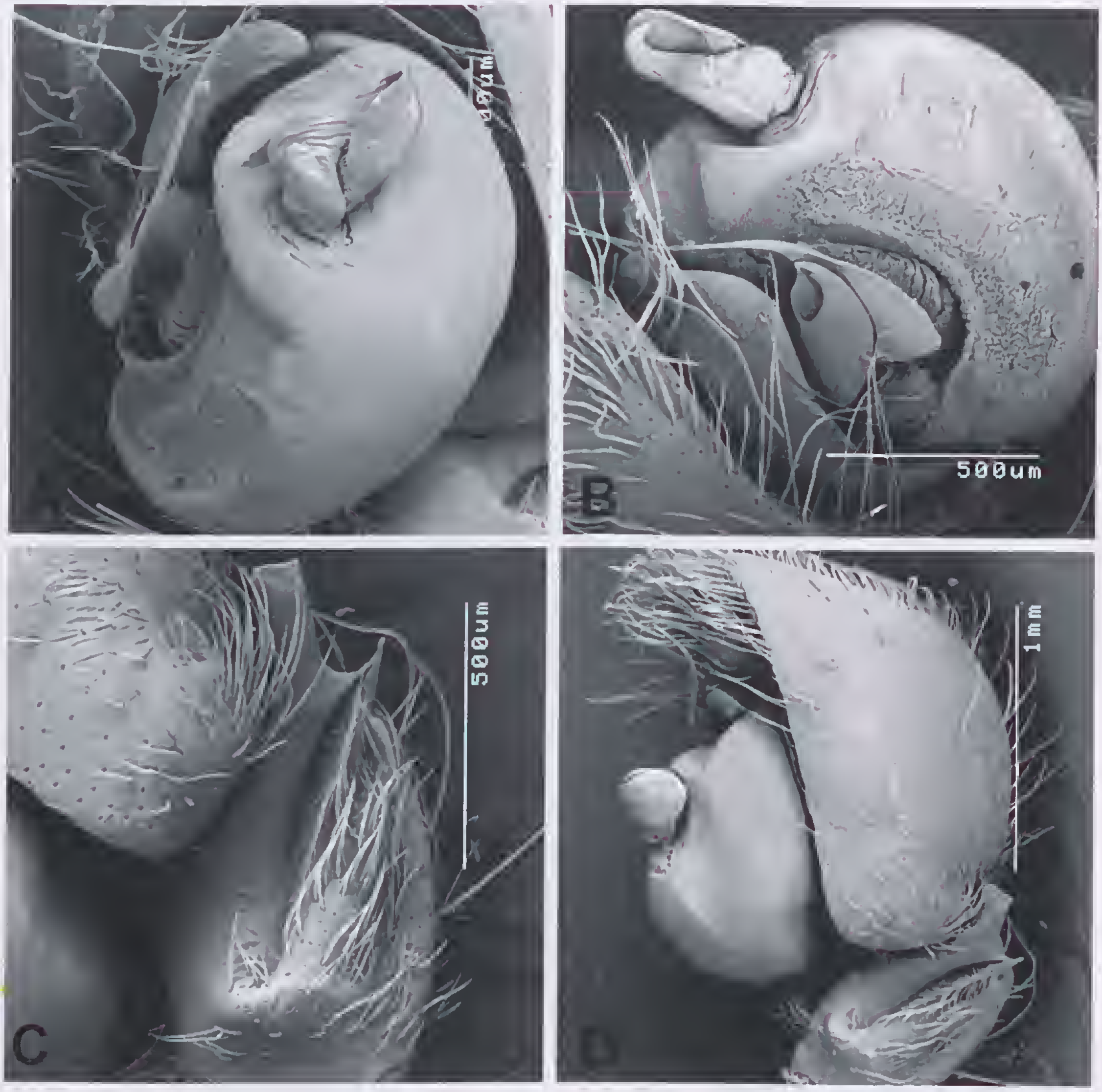

FIG. 51. *Kilyana kroombit*, sp. nov., ♂ palp, scanning electron micrographs. A, B, cymbium and bulb, ventral (A) and prolateral (B) view; C, tibia and cymbium and bulb (D), retrolateral view.

Interspaces: AME-AME, 1.3; AME-ALE, 1.2; PME-PLE, 2.3; PME-PME, 1.7.

*Spines*: I: fe pv1p1d2r2; pa 0; ti pv5rv4; me v2.2.2. II: as for I but fe p2d3r3. III: fe p4d3r2; pa r1; ti p2d2r2v2.2.2. me p1.2.2r1.1.1.2v2.2.2. IV: fe p1d3r1; pa r1; ti p2d2r2v5; me p1.1.1.2r1.1.1.2 v1.2.2.2. Palp: fe d1.2; pa 0; ti p2d1; ta p3d1.

*Epigyne* (Fig. 52A-C): a very wide flat plate with pair of parallel grooves anteriorly, and low mound medially, a subdistal median cone; vulva sigmoidal, very small.

DISTRIBUTION AND HABITAT. Rainforest and adjacent open forest at Kroombit Tops, SE Qld.

## Kilyana lorne, sp. nov.
(Figs 35, 53; Table 23)

ETYMOLOGY. Noun in apposition with the type locality.

MATERIAL. HOLOTYPE: ♂, Lorne SF, nr Lorne, site 86(4), NSW, 31°35'S 152°57'E, D. Milledge, 11 Apr 1979, AM KS5662. PARATYPE. ♂, same data but site 86(3), AM KS5384.

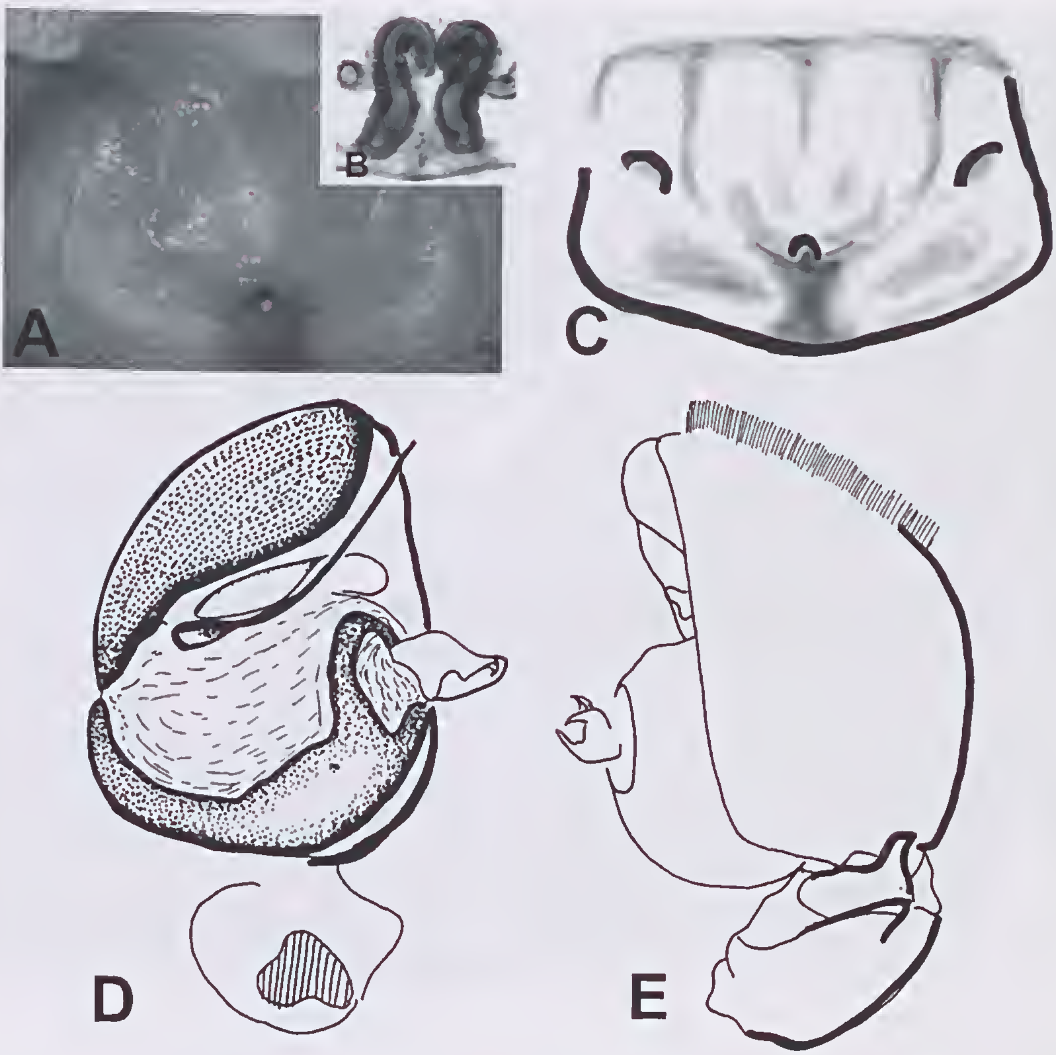

FIG. 52. *Kilyana kroombit*, sp. nov. A-C, ♀; A,C, epigyne, B, vulva. D-E, ♂ palpal tibia, cymbium & bulb ventral (D) and retrolateral (E) views.

DIAGNOSIS. Males resemble those of *Kilyana hendersoni* in the grooved form of the tibial apophysis but differ in the distal spinose keel (Fig. 53D,E).

DESCRIPTION. Holotype ♂. Carapace 6.06 long, 4.63 wide. Abdomen 6.56 long, 3.95 wide.

*Colour*: carapace red brown with radiating black lines along striae and thicker irregular band submarginally. Abdomen dorsally fawn with brown dorsal sigilla posteriorly with dark crescent; anterior scute weak; venter pallid without pattern except around genital area. Legs dark orange brown.

*Carapace*: strong bristles of long off-white hairs overhang lateral eyes, fewer such hairs between PME. AME on conical mound.

TABLE 23. Leg measurements of *Kilyana lorne* sp. nov. holotype male.

| | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 4.50 | 4.38 | 4.13 | 5.06 | 2.44 |
| Patella | 2.31 | 2.19 | 2.00 | 2.13 | 1.38 |
| Tibia | 4.81 | 4.19 | 3.06 | 4.00 | 1.13 |
| Metatarsus | 4.44 | 4.00 | 3.56 | 5.31 | - |
| Tarsus | 1.63 | 1.44 | 1.69 | 1.69 | 1.88 |
| Total | 17.69 | 16.20 | 14.06 | 18.19 | 6.83 |

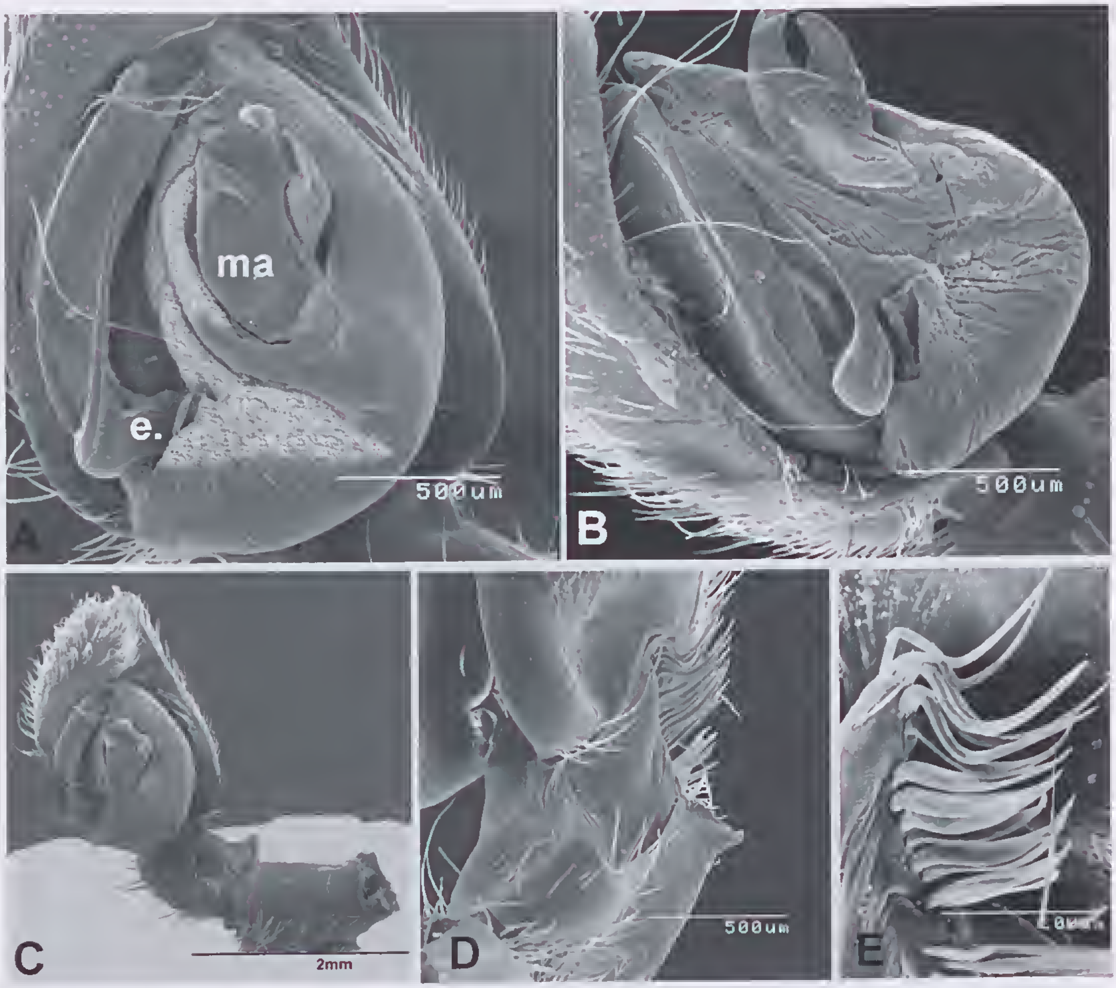

FIG. 53. *Kilyana lorne*, sp. nov., ♂ palp, scanning electron micrographs. A, B, cymbium and bulb, ventral (A) and prolateral (B) view; C, patella, tibia and cymbium, showing small tibia, ventral view; D, E, tibial apophysis, retrolateral view.

*Chelicerae*: 2p, 3r.

*Spines*: I: fe pv1p1d3r5; pa r1; ti p2d3r3pv5rv4; me p3r3v2.2.2. II: as I but fe, pv1p3d3r4; pa r1. III: fe p4d3r4; pa r1; ti p2d2r2v2.2.2; me p1.2.2r1.1.1.2v2.2.2. IV: as III but fe p4d3r1; me p1.1.1.2r1.2.2v2.2.2. Palp: fe p1d1.1.2; pa 0; ti p1.

*Legs*: scopula weak but distinct on all tarsi; weak, of long hairs for length of metatarsi I, II, distal on III, absent on IV.

*Palp* (Fig. 53A-E): tibia retrolaterally with long groove (like *Kilyana hendersoni*) converging basally into conical mound, distodorsally above groove a small backwardly directed digitiform process; distal edge of groove forms conical process opposing broad, ovoid, shallow saddle on retrodorsal basal cymbium; the process distally with a distal ridge of spine-like bristles, most ventral basally sinuous (Fig. 53E). Tegulum C-shaped; tongue-like subtegular groove opposed tegulum with embolus originating prolaterobasally and lying transversely. Junction of tegulum and median apophysis unsclerotised with C-shaped distal tegular extension partially encircling chelate or apically bipartite median apophysis.

*Female*: unknown.

DISTRIBUTION AND HABITAT. Lorne State Forest, NSW.

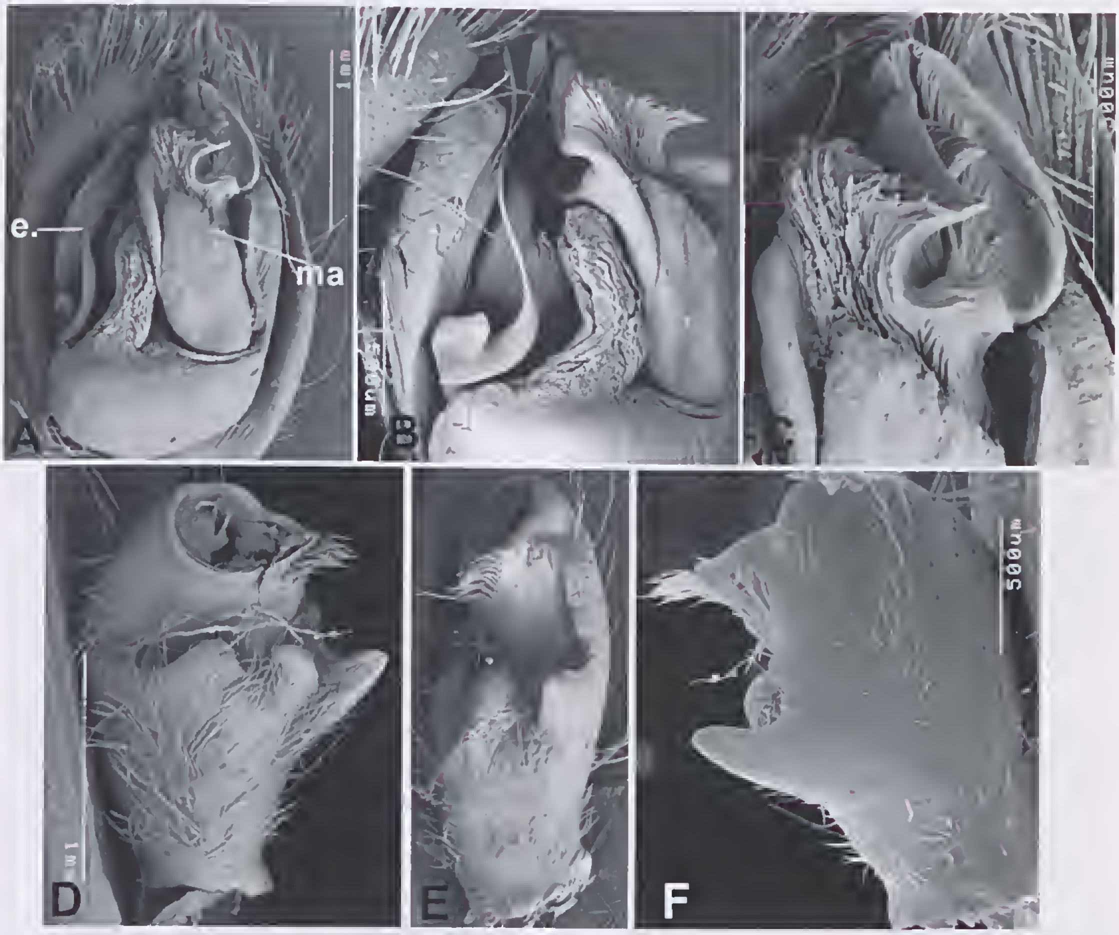

FIG. 54. *Kilyana obrieni*, sp. nov., ♂ palp, scanning electron micrographs. A, B, cymbium and bulb, ventral (A) and prolateral (B) view; C, patella, tibia and cymbium, showing small tibia, ventral view; D-F, tibial apophysis, retrolateral (D), ventral (E), dorsal (F) views.

### **Kilyana obrieni** sp. nov.
(Figs 35, 54, 55; Table 24)

ETYMOLOGY. For the late Graham O'Brien, Director Administrative Services, Queensland Museum, 1986-1997.

MATERIAL. HOLOTYPE: ♂, QMS58264, Kroombit Tops, SE.Q, 24°22'S 152°01'E, R. Raven, G. Monteith, 28 Feb 1982. PARATYPE: allotype ♀ QMS 58264, as for holotype.

DIAGNOSIS. Males are easily separated from the sympatric *Kilyana kroombit* by the very sculptured and complex median apophysis and females differ in the simple S-shaped spermathecae.

DESCRIPTION. Holotype ♂. Carapace 7.50 long, 5.45 wide. Abdomen 7.20 long, 4.89 wide.

*Colour*: Carapace dark orange brown with dark radiating lines; darker around eyes; dark bands down chelicerae; abdomen dorsally light greenish brown; no scute evident anteriorly; anterior medially pallid with 2 irregular darker stripes and pallid zone through to anterior pair of dorsal sigilla; venter like female

*Chelicerae*: 3p, 3r.

*Spines*: I: fe pv1p1d3r3; pa r1; ti p3d3r3pv5rv4; me p3r3v2.2.2. II: as I but fe pv1p3d3r3; pa r1. III: fe p3d3r3; pa r1; ti p2d2r2v2.2.2; me p1.2.2r1.1.2v2.2.2. IV: as III but fe p3d3r1; me p1.1.1.2r1.1.1.2v2.2.2.2.2. Palp: fe p1d1.2.

*Legs*: scopula absent; claws with 3-4 long teeth; tibiae to tarsi I, II with very long curved hairs laterally.

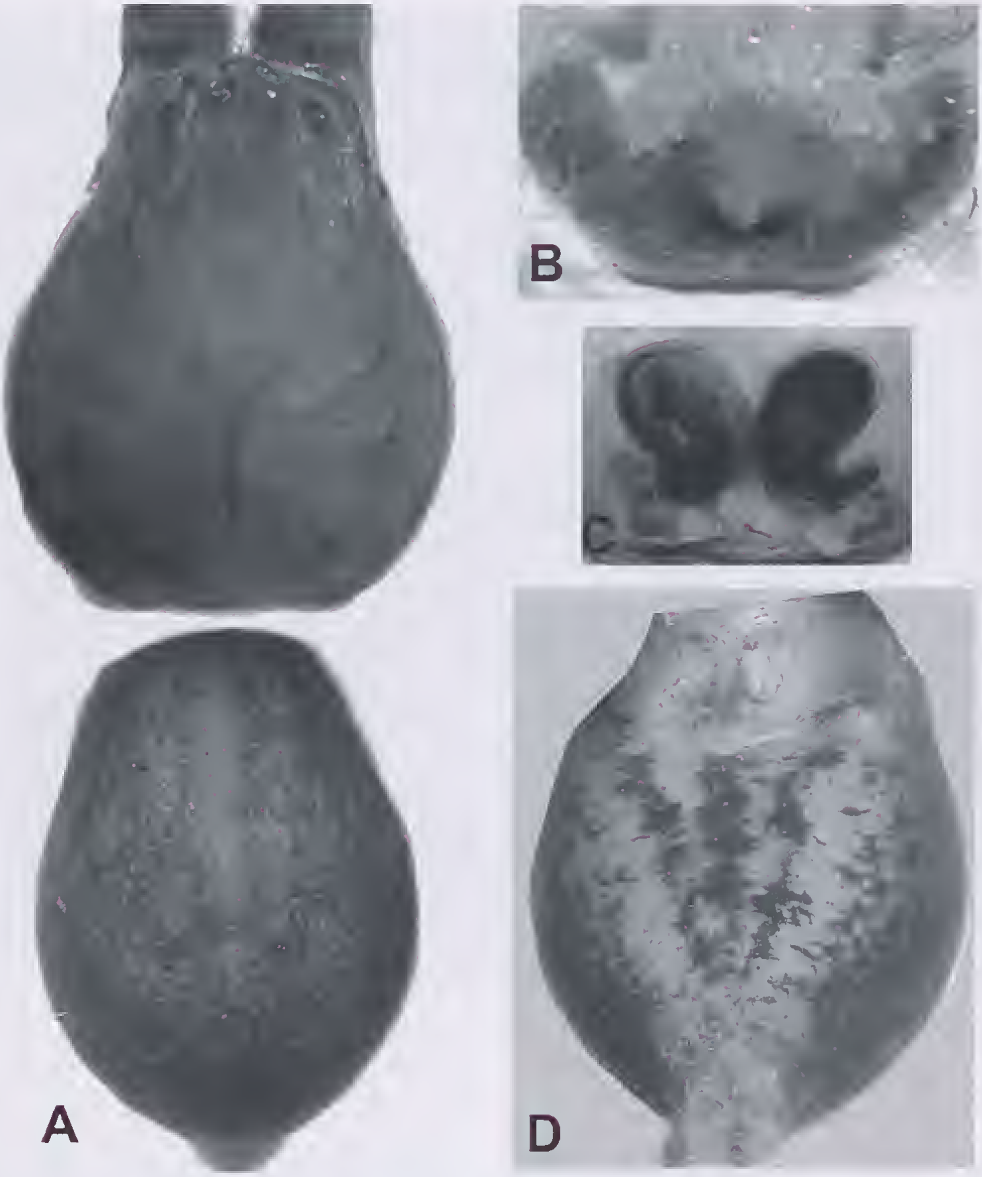

FIG. 55. *Kilyana obrieni*, sp. nov., ♀. A, cephalothorax & abdomen, dorsal view; B, epigyne; C, vulva; D, abdomen, ventral view.

*Palp* (Fig. 54A-F*)*: tibia with low rounded dorsolateral tibial apophysis, tibia roughly barrel-shaped with distoventral deep concavity for distal third and bounded by two roughly triangular ventral processes. Cymbium: rounded rectangular, apically asymmetrical with extensive hirsute apical fold in prodistal corner and large flat retroventral flange basally; scopula dorsally for distal 1/3. Tegulum large, basally with two unsclerotised lamellae: one large prolateral and one slender retrolaterally that flanks large free complex median apophysis which is a large heavily sclerotised with transverse wide keels, two distal prongs and one subdistal and distodorsally with roughly ovoid scoop. Embolus with basodorsal 'thumb' originates distal of tegulum prolaterally quickly flattens then becomes filiform and lies in groove formed by distal edge of median apophysis but reaching paracymbial flange.

TABLE 24. Leg measurements of *Kilyana obrieni* sp. nov. holotype male and allotype female.

| Male | I | II | III | IV | Palp |
|---|---|---|---|---|---|
| Femur | 6.31 | 5.63 | 4.94 | 5.94 | 2.88 |
| Patella | 2.56 | 2.75 | 2.25 | 2.31 | 1.13 |
| Tibia | 6.75 | 5.00 | 3.56 | 4.75 | 1.25 |
| Metatarsus | 7.31 | 5.00 | 4.19 | 6.63 | |
| Tarsus | 2.56 | 1.69 | 1.94 | 1.94 | 2.31 |
| Total | 25.49 | 20.07 | 16.44 | 21.57 | 7.57 |
| **Female** | **I** | **II** | **III** | **IV** | **Palp** |
| Femur | 5.44 | 5.38 | 5.00 | 5.94 | 2.56 |
| Patella | 3.13 | 3.00 | 2.56 | 2.69 | 1.56 |
| Tibia | 4.75 | 3.44 | 3.19 | 4.56 | 1.63 |
| Metatarsus | 4.38 | 3.13 | 5.56 | 5.69 | |
| Tarsus | 1.38 | 1.25 | 1.50 | 1.50 | 2.13 |
| Total | 19.08 | 16.20 | 17.50 | 20.38 | 7.88 |

Allotype ♀. Carapace 8.16 long, 7.64 wide. Abdomen 9.39 long, 6.20 wide.

*Colour*: carapace dark orange brown with dark radiating lines on caput and thorax which break up into reticulate areas laterally; large dark bands down chelicerae; abdomen dorsally dark brown with pallid ostiate region flanked by 4 sigilla posteriorly with black crescents; venter mostly pallid yellow brown with medial zone forming three irregular broken longitudinal bands flanked by paler lines. Legs orange brown.

*Eyes*: lateral eyes on common tubercle; AME on distinct mound.

*Chelicerae*: p2, 3r.

*Legs*: scopula on metatarsi I, II distinct, denser distally but for length; dense, uniform for length of tarsi I, II; few scopuliform hairs on distal lateral metatarsi III.

*Spines*: I: fe pv1p1d3r2; pa 0; ti pv5rv4; me v2.2.2. II: as for I but fe p4d3r3. III: fe p4d3r3; pa r1; ti p2d2r2v2.2.2; me p1.2.2r2.1.2v2.2.2. IV: as III but fe p4d3r1; me p1.1.1.2r1.2.2v2.2.2. Palp: fe d1.2; pa d1.2; ti p2d1; ta p2.1r2.

*Claws*: 2 long and one basal shorter tooth on paired claws; palpal claw with 6 long teeth.

*Spinnerets*: retracted; PMS with spigots in dorsal band and 2 apically.

*Epigyne* (Fig. 55B,C): externally a wide procurved distal ridge with short median septum; internally spermathecae form strongly folded S.

DISTRIBUTION AND HABITAT. Open forest at Kroombit Tops; it occurs with *K. kroombit*.

## ACKNOWLEDGEMENTS

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## APPENDIX 1: Data Matrix

```
xread
'Zoropsidae_last_via_DELTA 11:57 06-AUG-03'
66 44
Tengella             0000000000000?000000000?0000?0001021000000000000010000010000000000
Psechrus             00001000001??????000000?0100?1???001000000011110000000010000000001
Fecenia              0000000010000?000001000?0100?000000100000001111000??00010000??0001
Udubada              111?001011000?2?11000110111??????202120000?0000011?0?1011100??0101
Uduba3               111?001011000?2?11000110111??????202120000?000001120?1011000??0101
Zorocrates           001?000010000?00000100100100?02??000021000?00000110011021001??0?00
Devendra seriatum    101?0010000010??0000000?000201???000000100??000010?001011000??0?20
Devendra pardale     101?0010000010??0000000?000200001000000100??00001020?1011000??0?20
Campostichomma       10110010100010??000000100100?01??202120100??0000102011011001??0120
Raecius              111?0010000010??0001000?0000?0000000000000??00001100?1011101??0102
Zorodictyna          110?001100000?000000100?000200000000100000?000001110?1011201??0?01
Takeoa               011?000000000?000000100?0200?02??000011100?1001?1100?0?51000??0?01
Acanthoctenus        01000000000010??0000000?0100?1???000100110010010110010151200??0100
Zoropsis France      1111000000000?010000100?0301?0010000000100210011111010151100000101
Zoroposis Canary I   1111000000000?010000100?0001?00100000001002100111 1?010151100000101
Kilyana hendersoni   1111000001000?0100000110011??????000000100210011110011121201000111
Birrana bulburin     1111000001000?010001100?011??????002000100210011113011121201000111
Krukt piligyna       1111000101000?010000100?0101?0001002000100210011113011121201000111
Megateg elegans      1111000001000?010001100?0401?1???002000100210011113011121201000111
Huntia deepensis     11110001000011??0000010?0000?02??002000100210001111010111001000111
Uliodon NZ           01110000001??????000100?0000?02??002000100200001110011111100000111
Amauropelma truel.   00000000000110??1000000?0002101??002000110110010100011111001000020
Machadonia robustus  100?0000000011??0000000?000201???131000100?10000111011021100000120
Machadonia urbense   11010000000011??0000000?000200000131000100?1000011?011021100000120
Phanotea pering      11100000100011??0000000?020200010020000000220000111010011000000?20
Phanotea spX         11100000000111??0000000?02021001002000000002?00001100110110 00??0?20
Phanotea spA         11100000000111??0000000?03021001002000000002?000011??11011000??0?20
Senoculus            000?000010000?000000000?011??????101000110110000100100111010001021
Mituliodon tarantul. 0000000010000?00000001110100?1???000020100010010111001000000000020
Dolomedes            0000000010000?00001001101100?1???100021100010000010100010111101020
Pisaura              0000000010000?00001101101100?1???010001100010000000100010210101020
Trechalea            0000010011000?1?021001101100?01??000010100010000000101050200010020
Rhoicinus            0000110010000?1?02100110110221???000010100010000000100010001010020
Lycosa               0000100010000?2?121001101100?01??020010101010000010100000001010020
Sosippus             0000100010000?2?121001111100?01??020010101010000010101000000010020
Phoneutria           00000000000011??0000000?0002001??021000110110010110001131200000020
Ctenus               00000001000011??0001000?0202001??021010111110010110001131200??0020
Stiphidion           0000010101??????000000?0100?1???201000100000100000100000000001001
Tapinillus           0000000010000?000000000?011??????001000000010100000100000210001021
Australian tengel.   0000001000000?000000000?0002001??002000100000000000011141101000120
Bengalla spV         0010001000000?2?00000111010201???002000100000000101011131001000020
Miturga              0000000010000?11120100110101?1???002000000010000110001000000000020
Diaprograpta         0000000010000?11000001100100?1???002000100010010110001000000000020
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ccode -0.65;
proc / ;
```

# *TUARANGISAURUS AUSTRALIS* SP. NOV. (PLESIOSAURIA: ELASMOSAURIDAE) FROM THE LOWER CRETACEOUS OF NORTHEASTERN QUEENSLAND, WITH ADDITIONAL NOTES ON THE PHYLOGENY OF THE ELASMOSAURIDAE

SVEN SACHS

SACHS, S. 2005 01 10: *Tuarangisaurus australis* sp. nov. (Plesiosauria: Elasmosauridae) from the Lower Cretaceous of northeastern Queensland, with additional notes on the phylogeny of the Elasmosauridae. *Memoirs of the Queensland Museum* **50**(2): 425-440. Brisbane. ISSN 0079-8835.

The skull and associate cervical vertebrae of an elasmosaur from the Lower Cretaceous of northeastern Queensland are described as a new species of *Tuarangisaurus*, *Tuarangisaurus australis*. They represent the oldest record of that genus and the first secure outside New Zealand. A phylogenetic analysis based on 19 characters of the skull and cervical vertebrae is undertaken. One tree is presented, including all valid members of the Elasmosauridae for which sufficient cranial material is known. The results give an example for the interrelationship of the Elasmosauridae and show the probable position of *Tuarangisaurus*.

❑ *Plesiosauria, Elasmosauridae, Tuarangisaurus, Lower Cretaceous, Albian, Queensland.*

*Sven Sachs, Institut für Paläontologie, Freie Universität Berlin, Malteser Strasse 74-100, Haus D, 12249 Berlin, Germany; 13 July 2004.*

The plesiosaurian Elasmosauridae is known from the Lower Jurassic to the Upper Cretaceous, during which time it had an almost worldwide distribution. Most taxa referred to this group had an extremely elongated neck and a proportionately small head.

In Australia, only a small number of elasmosaur remains are known (Cruickshank et al., 1999; Kear, 2003). Among them, there are 4 rather complete specimens, of which 2 are represented by about 80% of the postcranium. The first of these has been excavated by a field-party of the Queensland Museum at the Walsh River (Doncaster Member, Wallumbilla Formation, Late Aptian) west of Chillagoe (NE Queensland); the second one was found at Grampien Valley (Doncaster Member, Wallumbilla Formation, Late Aptian) near Richmond (N Queensland) (Sachs, 2004).

Another specimen from Andamooka in the South Australian Museum, Adelaide is about 50-60% complete and consists of opalised bones (Kear, pers. com. 2001).

The fourth more complete specimen is the holotype of *Woolungasaurus glendowerensis* Persson (1960). The type material was discovered in 1891 (QMF3567) and 1893 (QMF3568) at Glendower Station near Hughenden and has been restudied (Sachs, 2004). Another specimen Persson (1982) referred to *Woolungasaurus* is a skull that is broken into an anterior and posterior part. The posterior portion was discovered first (by T. Noonan) along with a number of vertebrae and was donated to the Geological Survey of Queensland (GSQF10552, F10550 a+b and F10551). Later, in 1976, a field party comprising R. Molnar, R. Thulborn and M. Wade discovered the anterior part of the skull. This specimen was first catalogued at the Australian Museum in Sydney (old catalogue number AM F60056), but has since been transferred to Brisbane where both parts were donated to the Queensland Museum.

Other probable elasmosaur remains were found in the Northern Territory (Bathurst Island Formation, Albian, sensu Murray 1987) and in Western Australia (Colalura Sandstone, Bajocian, sensu Cruickshank & Long, 1998 and Molecap Greensand, Cenomanian-?Santonian, sensu Teichert & Matheson, 1944).

A greater number of elasmosaur specimens, including relatively complete skeletons, are known from New Zealand (Hector, 1874; Hiller et al, 1997; Owen, 1861, 1870; Seeley, 1877; Welles & Gregg, 1971; Wiffen & Moisley, 1986). On the basis of this material *Mauisaurus haasti* Hector, 1874 and *Tuarangisaurus keyesi* Wiffen & Moisley, 1986 were erected. In general the remains from New Zealand are younger than the Australian ones. *Mauisaurus* is known from the Conway Formation (Maastrichtian), while *Tuarangisaurus* are from the Tahora Formation (Mid-Campanian).

In this paper the skull described by Persson (1982) shall be redescribed and classified. Based on this specimen and its associated postcranial elements, 19 phylogenetically interesting features are proposed. An analysis of these characters within the Elasmosauridae and *Muraenosaurus* as outgroup member was undertaken.

ABBREVIATIONS. *Institutional Abbreviations*. AM, Australian Museum, Sydney; ANSP, Academy of Natural Sciences, Philadelphia; GPIM, Geologisch-Paläontologisches Museum, Münster; GSQ, Geological Survey of Queensland, Brisbane; MLP, Museo de La Plata, La Plata; NZGS, New Zealand Geological Survey, Lower Hutt; QM, Queensland Museum, Brisbane; UCMP, University of California Museum of Paleontology, Berkeley; USNM, United States National Museum of Natural History, Washington D.C.

*Anatomical Abbreviations*. aac, atlas-axis-complex; aar, angular-articular complex; aas, angular- articular suture; an, angular; bo, basioccipital; bm, bite mark; d, dentary; en, external naris; exo, exoccipital; fr, frontal; gf, glenoid fossa; hy, hyoid; ipf, interpterygoid fenestra; j, jugal; mt, mandibular tooth; mx, maxilla; mxp, maxillary process; mxt, maxillary tooth; ns, neural spine; pa, parietal; pb, parietal bridge; pl, palatine; pm, premaxilla; pmr, premaxillary ridge; pmt, premaxillary tooth; po, postorbital; prf, prefrontal; ps, parasphenoid; pt, pterygoid; rp, retroarticular process; q, quadrate; qc, quadrate condyle; sa, surangular-articular; sq, squamosal.

## SYSTEMATICS

### SAUROPTERYGIA Owen, 1860
### PLESIOSAURIA De Blainville, 1835
### Superfamily PLESIOSAUROIDEA Nopcsa, 1928
### Family ELASMOSAURIDAE Cope, 1868

### **Tuarangisaurus** Wiffen & Moisley, 1986

TYPE SPECIES. *Tuarangisaurus keyesi* Wiffen & Moisley, 1986.

DIAGNOSIS. See Wiffen & Moisley (1986: 207).

### **Tuarangisaurus australis** sp. nov.

*Woolungasaurus* cf. *W. glendowerensis* Persson, 1982: 647-655.

"*Woolungasaurus*" Thulborn & Turner, 1993: 489ff.

Elasmosaurid: Kear, 2003: 288f.

ETYMOLOGY. Latin *australis*, southern; refers to the southern continent Australia.

MATERIAL. Holotype. QMF11050, an almost complete, but crushed skull and mandible, with attached atlas-axis complex; QMF12216-19, an anterior cervical vertebra; QMF12217, 2 associated posterior cervical vertebrae.

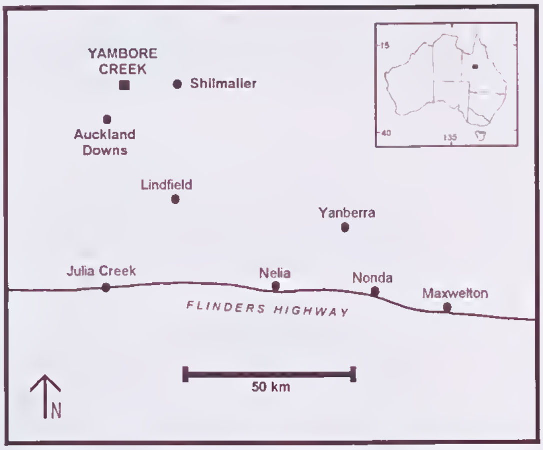

FIG. 1. Map of the wider Julia Creek area, showing the locality of QMF11050 at Yambore Creek.

TYPE LOCALITY. (Fig. 1) Yambore Creek, N of Julia Creek, N Queensland, Toolebuc Formation, Wilgunya Group, Albian (Senior et al., 1978).

DIAGNOSIS. Premaxillae forming narrow dorsal keel along midline bearing 5 teeth each; last premaxillary tooth at premaxillary-maxillary suture; posterior maxillary process following jugal over entire length and terminating at the level of last dentary tooth; jugal long, low; anterior margin of dentary forming a beak; mandibular symphysis short, expanded to level of dentary tooth four; dentary with 18 teeth per ramus; last dentary teeth more prominent than last maxillary teeth; retroarticular process short relative to jaw length; atlas-axis-complex short and high, ventrally bearing prominent sagittal crest; anterior cervical vertebrae shorter than high.

DESCRIPTION. As mentioned before, the skull consists of two pieces, and is broken just anterior of the orbita. It is almost complete, but compressed dorsolaterally, so that only the left side is well-preserved (Figs 2, 3, 6). Parts of the skull, such as the skull roof and the occipital region could not be described properly as the specimen is badly crushed. The anterior portion of the skull, as well as most of the right mandibular ramus and the dentition is well visible. As is usual in elasmosaurs the skull is relatively long and low. The external naris is visible as a broad oval opening that is situated close to the orbita. The latter is prominently developed and, due to the lack of the ventral border by the maxilla, nearly circular in shape. About in the middle of the orbita, an elongate

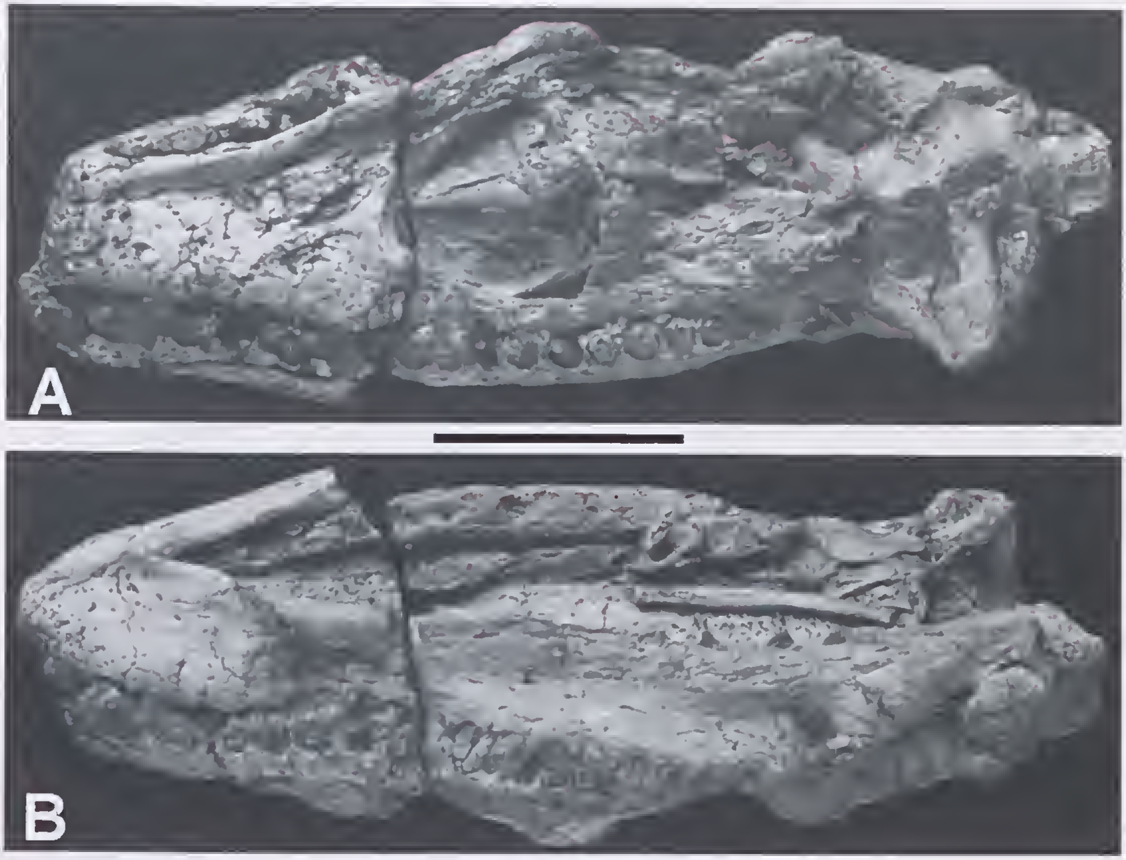

FIG. 2. Skull of *Tuarangisaurus australis* sp. nov., QMF11050 in dorsal (A) and ventral (B) views. Scale = 10cm.

element is visible. Persson (1982) misidentified this bone as the frontals, therefore concluding that the dorsal and the ventral half of the left orbita were the left and the right orbitae. Thulborn & Turner (1993) showed that this structure could be a part of either the pterygoid or the vomer. In the posterior part of the skull, the quadrate and the quadrate condyle are well visible. The right mandibular ramus is almost complete and still articulates with the quadrate. A well preserved hyoid is situated ventrally, in the posterior part of the specimen (Fig. 4). Posteriorly still in articulation with the skull is the atlas-axis complex (Fig. 5A). The fact that the atlas and axis are co-ossified indicates that the specimen represents an adult individual. As the atlas is still in connection with the condylus occipitalis and also partly covered by the squamosal, its shape could not be described. The axis on the other hand, as well as the ventral section of the atlas-axis complex is well visible.

As Thulborn & Turner (1993) showed, there are 3 bite marks of a larger plesiosaur visible on the skull (Fig. 3). A very prominent bite mark is situated in the anterior section of the lower jaw, somewhat behind the symphyseal part on the right ramus. A second relatively large bite mark is situated further posteriorly on the lateral surface of the right mandibular ramus, underneath the coronoid process. The third, relatively small, bite mark is on the left side in the lower part of the squamosal. These bite marks could originate from a large pliosaur, such as *Kronosaurus queenslandicus*, that has been found in the same area.

*Premaxilla*. The premaxilla is visible on the left side of the skull and is here almost completely preserved. Only the anteriormost part is corroded and therefore missing. In anterodorsal aspect both premaxillae are well ossified and are separated by a barely visible, straight suture. Ventrally the well-preserved suture to the maxilla runs posteromedially at an angle of about 60° to

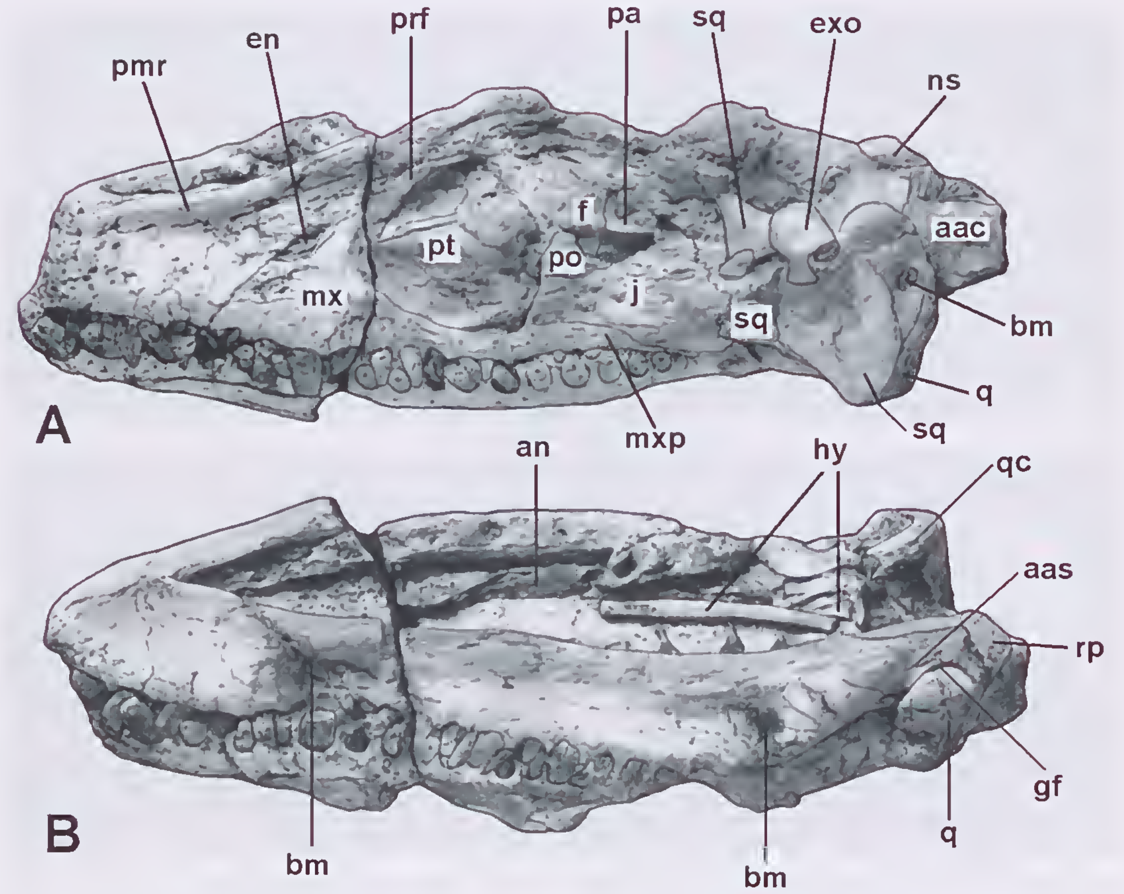

FIG. 3. Skull of *Tuarangisaurus australis* sp. nov. QMF11050 in dorsal (A) and ventral (B) views with explanations.

the transverse plane to the anterolateral edge of the external naris. With a broad dorsal section the premaxilla forms the slightly concave medial edge of the external naris. Behind the external naris, it touches the dorsal margin of the maxilla with a short suture. The posterior termination of the premaxilla, probably to the frontals, is not preserved. The tooth-bearing part is somewhat more robust and bears three teeth. Although the anteriormost section of the premaxillae is missing, it can be calculated that two more teeth were present, bringing the total to five. The first preserved tooth (pmt 3) is relatively short and completely exposed. The next one (pmt 4) is massively developed, but incomplete, as most of the labial and the total apecal part are missing. The third preserved tooth (pmt 5) is badly crushed, but was also massively build. It is situated directly at the premaxillary-maxillary suture and is approximately twice as large as the first preserved maxillary tooth. Between each tooth there is a gap of about 1cm for the interlocking of the dentary teeth.

*Maxilla.* The left maxilla is almost completely preserved. Only the part that turns posteriorly to frame the orbita anteroventrally and contact the anterior section of the jugal lacks its dorsal margin. On the right side of the skull only the tooth-bearing part of the maxilla is visible. Generally the maxilla is a massive element. It contacts the premaxilla anteroventrally and here forms the lateral and posterior edge of the external naris. With the projection of the dorsal-most part, it contacts a structure that might represent the prefrontal. As mentioned before the posterior section of the maxilla is incompletely preserved. At the posteriormost part that is formed as a long process, an irregular suture to the jugal is visible. It ventrally follows the jugal to nearly its posterior end and thereby gradually thins out dorsoventrally, terminating immediately behind the level of the last dentary tooth. The tooth-bearing part of the maxilla is somewhat more robust and nearly all teeth are still in their alveoli. The second, third and fourth tooth are very prominent, in which the third maxillary tooth appears to be the largest in the maxilla. The teeth become gradually smaller posteriorly. In the most posterior section two extremely small replacement teeth are situated. In the right maxilla 12 teeth are visible, in the left one 14 (in contrast to Persson (1982: 649) who counted 10 in the right and 11 in the left maxilla), so that probably a total number of 15 or 16 teeth per side was present.

*Postorbital*. The postorbital section of the specimen is heavily crushed. The only more undistorted fragment is a short triangular shaped piece that is situated in about the middle of the posterior part of the enlarged orbita. It contacts the jugal with a well visible, smooth, ventrally convex suture. This fragment appears to represent only the anterior section of the ventral portion of the postorbital so that the bone was probably more expanded posteriorly. Some other fragments, which are situated underneath the named element and medially of the orbita, could also belong to the postorbital.

*Frontal*. A broad, flat element that is situated above the named postorbital fragment is here interpreted as part of the frontals. Its visible dorsal surface is smooth and shows a shallow vault in about its midsection. As the underlying parietal fragment bears a sagittal crest, this vaulting can be the result of post-burial compression.

*Prefrontal*. A low, elongate, slightly curved element that is situated laterally, behind the premaxilla, touching the anterodorsal process of the maxilla, is here interpreted as the prefrontal. It forms most of the dorsal edge of the orbita.

*Parietal*. Although there are some fragments present in the area of the skull roof where the temporal fenestrae were placed, only one can clearly be determined as part of the parietal. It shows a well developed, sharp, but low crest. On both sides of the crest the dorsal margin is shallowly inclined. This fragment probably formed part of the most anteromedial edges of the temporal fenestrae.

*Jugal*. The jugal is well exposed on the left side and, in lateral view, has a rectangular outline. Its original shape cannot be reconstructed with certain, as part of the anterior section that probably contacted the midsection of maxilla and took part of the ventral framework of the orbita is not preserved. Posteriorly the jugal contacts the squamosal with a well visible, somewhat anteriorly oriented, serrated suture. Ventrally the irregular posteroventrally running suture between the jugal and maxilla is visible. Dorsally, in the preserved anterior section, the jugal contacts the postorbital with a slightly concave suture.

*Squamosal*. The squamosal is almost completely preserved on the left side, in which only its dorsal margin is missing. Anteriorly it contacts the jugal with a high, serrated suture. In lateral view the ventral surface of the squamosal is shallowly posteroventrally curved. In ventral view it can be seen that the bone was here relatively thin. Posteriorly the squamosal covers the quadrate laterally and is then, with its posterior margin, slightly up- and forwardly arched. The suture between the squamosal and the quadrate is not visible, indicating that this area was well ossified. A triangular shaped fragment that is situated anterior of the ?exoccipital could be a part of the posterodorsal arch of the squamosal to the parietal.

*Quadrate*. The quadrate is well visible on the left side and is covered by the squamosal laterally. Due to the compression the quadrate has moved medially, so that its condyle has an anteromedial position. The latter does not seem to be depressed; it has a rectangular shape and is expanded medially with the ventral surface well rounded anteroposteriorly. At the lateral side of the ventral margin a shallow depression is visible. The posterior side of the condyle is somewhat ventrally oriented. Interestingly there is a concave excavation on the internal side of the condyle, so that at its dorsal and ventral side a short tip is formed. This concavity seems not to be produced postmortem. It could have served for the articulation of the quadrate process of the pterygoid. A dividing of the articulation surface in two clearly distinguishable condyles (condylus lateralis quadrati and condylus medialis quadrati, after Maisch, 1998) as it can be find e.g. in *Muraenosaurus*, is not present. At the lateral side the condyle emerges from the prominent shaft of the quadrate in which it is well curved posteromedially. As mentioned before a clear suture between the quadrate and the squamosal cannot be seen. Eventually a line that starts at the lateroventral side of the squamosal-quadrate-complex and is upwardly directed could represent this suture, but similar lines are visible in other parts of the skull too and may be quoted as breaking lines rather than sutures. Dorsally, the thin quadrate process of the pterygoid, is attach to the condyle.

*?Pterygoids*. Situated in the middle of the orbita there are 2 elongated, broad fragments, which were interpreted as frontals by Persson (1982). Thulborn & Turner (1993) pointed out that they might represent midline bones of the palate and could be parts of either the vomer or the pterygoids. I agree with this determination. Unfortunately, because of their poor and fragmentary preservation it is impossible to give a clearer statement. Only the position and the visible shape as broadly rounded makes it probable that these elements are parts of the pterygoids.

*Braincase Elements*. Situated at the level of the upper part of the squamosal, inward of the atlas-axis-complex, there is an isolated element. It consists of a main body that has a nearly quadratic outline and two short, broad processes, which are situated at the end of the main body. The later is relatively flat and has a slightly expanded end, opposite of where the processes are situated. The surface of this portion is shown as deeply convex, but it seems that parts of the margin are broken. The short ?lateral edge that is exposed, bears a crest. The named processes, which are probably incompletely preserved, are shown as short and broad. The upper one of these has a nearly horizontal position in the specimen and is broad oval in cross-section. The lower process is more vertically directed. Its basal margin seems to be tighter than the well-expanded ventral margin. It was not possible to make a secure determation of this element, but it shows similarities to the exoccipital-opisthotic (these bones are often fused in plesiosaurs, as seen e.g. in *Muraenosaurus*, Maisch, 1998, fig. 9, here also called otoccipital).

*Dentary*. The lateral side of the mandible is completely exposed at the left side of the specimen. The symphysis is straight and relatively short (expanded to the level of the fourth dentary tooth). A suture separating the two rami is not visible, which again shows that the skull was well ossified. The anteriormost part of the dentary is oblique posteroventrally by an angle of about 50° to the vertical plane. Laterally, behind the symphyseal portion the margin is smoothly depressed and bears some small foramina of different sizes. The dorsal side of the dentary is more robust. Towards its midsection the mandibular ramus becomes slightly lower dorsoventrally. Posteriorly, in the coronoid section, the ramus is again high and then inclined posteroventrally towards the glenoid fossa. The ventral margin of the ramus is well rounded and thickened anteriorly. The suture from the dentary to the surangular-articular-complex and the angular is only barely visible, due to the presence of a bite mark (Fig. 3). The dorsal side of the surangular-articular complex bears a sharp edge and slopes down by an angle of about 40° to the horizontal plane. Altogether the mandible bears 36 alveoli (18 per ramus), in which mostly parts of the teeth are still present. Only the anteriormost teeth are prominent, with mandibular teeth 2-5 developed as large fangs.

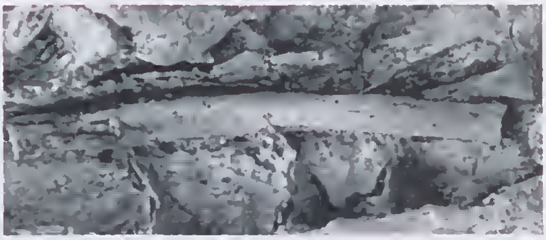
FIG. 4. Hyoid of *Tuarangisaurus australis* sp. nov. QMF11050 in ventral view, measuring 10cm.

*Angular-Surangular-Articular*. The angular is only partially visible. Internally, at the left ramus it is particularly detached, but can only be described as very thin, flat element as no characteristics are present. Better preserved is the posterior part, which is well visible at the right mandibular ramus. The retroarticular process is broken off and somewhat displaced. In lateral view it is short and almost quadratic in shape. It shows a slight transversal concavity at its posterior edge. The suture from the angular to the articular-surangular (according to Brown, 1981, these bones appear to be fused in all plesiosaurs, so that this suture should here only be called angular-articular suture) is well visible in the ventral section of the posterior part of the right ramus. The suture first runs straight posteriorly and is then, at the level of the anterior section of the glenoid fossa upwardly and slightly hindwardly curved, from where it runs straight posteriorly. Its termination is unclear as it is last visible directly underneath the glenoid fossa (the section behind is thus called the angular-articular-complex). The latter is still connected with the quadrate so that its shape cannot be described.

*Hyoid*. Both hyoids are preserved (Fig. 4) in which only the right one is well exposed, while the left one is underlying the right, so that only its posterior margin is visible. They are rod-shaped,

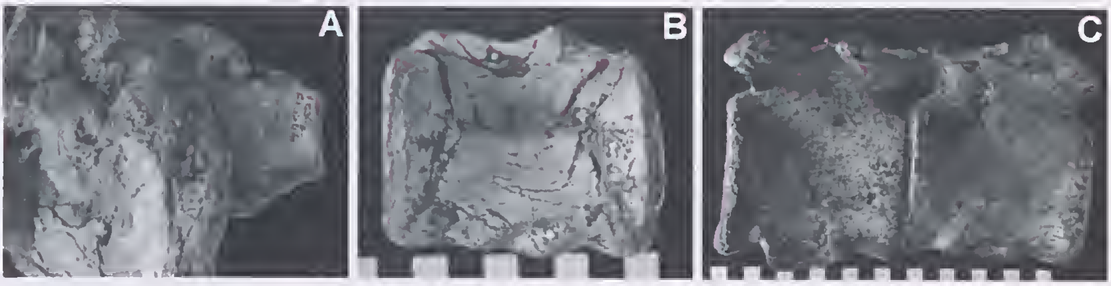

FIG. 5. Vertebrae of *Tuarangisaurus australis* sp. nov. QMF11050 in lateral views. A, atlas-axis complex; B, anterior cervical vertebra; C, posterior cervical vertebrae; scale bar units = 1cm.

very long, slightly curved and slender. The anterior and posterior end facts are oval in cross-section. The anterior end facet is only weakly concave while the posterior one shows a somewhat stronger concavity. Both facets are slightly broader than the shaft. The later is flattened and has a sharp medial edge, while the lateral edge is well rounded. The anterior half of the right hyoid is somewhat depressed dorsoventrally and therefore slightly broadened lateromedially.

*Atlas-Axis Complex.* The atlas-axis complex is still connected with the skull (Fig. 5A), therefore only the axis is well exposed and can be described. In general the complex has a nearly quadratic shape and is relatively high. In the center of the ventral surface a prominent, sharp sagittal keel is formed. This keel is present upon the entire length of the centrum and anteriorly becomes larger dorsoventrally. Posteriorly the keel is fused with the edge of the articular facet. On both sides of the keel the ventral margin is slightly longitudinally excavated. The rib facets are situated on the lateroventral side of the complex. On the left side also part of the cervical rib is preserved that has a horizontally oval cross-section and is lateromedially relatively thin. The lateral side of the atlas-axis complex is nearly flat and only in the ventral half posteriorly slightly depressed. Dorsally parts of the thin neural arches are preserved. The neural canal was relatively broad, ventrally just weakly concave and occupied about 50% of the breadth of the axis centrum. The articular facet of the latter is about circular and slightly concave. Its dorsal side is almost straight; the lateral sides are weakly rounded. At the ventral side the attachment of the named keel is visible medially.

Dorsally, anterior of the atlas-axis complex, there is a thin, well-rounded crest that is mostly covered by sediment. The posterior margin of this crest shows a breaking surface. It most probably is this the neural spine that has been pressed forwards during the compaction of the skull.

*Cervical Vertebrae.* The centrum of the preserved isolated anterior cervical vertebra (QMF12216-19) has a broad oval outline and is about as wide as long, but clearly lower (5B). Its articular facets are weakly concave, with well-rounded edges. The lateral margin is depressed at one side. In about its mid-section a sharp, medially situated lateral longitudinal crest is formed. Dorsally and ventrally of the crest the margin is longitudinally excavated. Due to the compression, the neural canal is not visible. The rib facets are situated laterally, about in the middle of the ventral surface. They are elongated and ovoid in outline. The ventral surface of the centrum is somewhat depressed. A well developed thin sagittal crest is visible that separates two relatively small nutritive foramina, which are situated in the anterior half of the centrum. On both sides of the crest, the margin is depressed anteroposteriorly.

The posterior cervicals (QMF12217) are accurately preserved (Fig. 5C). The centra are slightly broader than long and longer than high, so that they have a nearly quadratic outline. Dorsally and ventrally, the centra are weakly excavated medially. The ventral margin of the centra is concavely depressed. Medially, somewhat anterior to the midline, two relatively large nutritive foramina are present. A small, flat crest separates them. The rib facets are very prominent, elongated oval in outline and are situated ventrally in the middle of the lateral side. Anterior and posterior to the rib facets the lateral margin is somewhat concave. Each rib facet is oriented lateroventrally at an angle of about 45° to the vertical plane. In the second vertebra, remains of the cervical ribs are preserved. Laterally, above the parapophyses a weak longitudinal crest is visible. This crest probably represents the lateral longitudinal crest that is well developed in the anterior cervical vertebra. Above the crest the lateral margin is somewhat depressed. The articular facets of the centra are weakly concave, with rounded edges. A dorsal suture between the centrum and the neural arches is not visible. The neural arches are relatively thin and border the broadly triangular neural canal. The margin of the zygapophyses is discernable. In lateral view the prezygapophyses rise above the level of the centrum to about half of their length, in which they are dorsally oriented at an angle of about 40° to the horizontal. The postzygapophyses are higher than the level of the prezygapophyses. They do not rise over the level of the centrum and are dorsally oriented at an angle of about 60° to the horizontal plane. The neural process is present only by its basal margin. It is relatively thin, but prominently broadened anteroposteriorly.

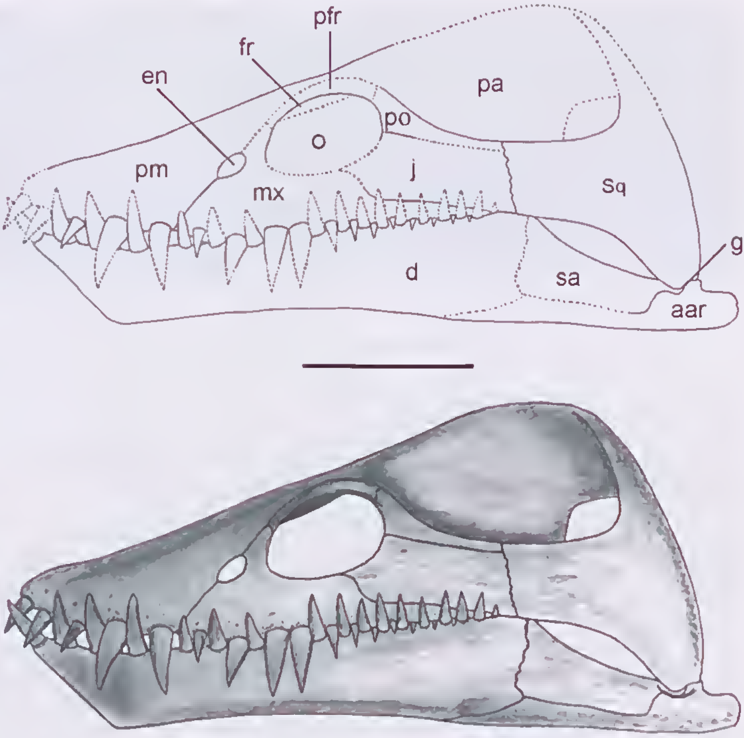

FIG. 6. Reconstruction of the skull of *Tuarangisaurus australis* sp. nov. in lateral view; A, outline drawing (stippled areas are incomplete or not preserved); B, restoration. Scale = 10cm.

## COMPARISON OF *TUARANGISAURUS KEYESI* AND *TUARANGISAURUS AUSTRALIS*

The type material of *T. keyesi* Wiffen & Moisley, 1986, comprises a skull (NZGSCD425) (Fig. 7) and the 9 anterior-most cervical vertebrae including the atlas-axis complex (NZGSCD426). The skull is fairly complete and, except for the posterior sections of the mandibulae and the occipital region, well preserved. *T. keyesi* shares a number of characters with *T. australis*. In both the premaxillae form a beak with a narrow dorsal keel along their midline. The posterior sections of the premaxillae form the concave medial edge of the external nares. Each premaxilla bears five fang-like teeth; the last of them is very prominent and situated directly at the premaxillary-maxillary suture. The later runs to the anterolateral margin of the external naris with an angle of about 60° to the horizontal. The maxilla forms the lateral and posterior edge of the external nares. Posteriorly a thin maxillary processs is formed that follows the jugal to its posterior section, thereby becoming gradually smaller dorsoventrally. The maxillary tooth count is 15-?16 per side. The anterior section of the jugal contacts the maxilla and the postorbital with a large serrated suture. Posteriorly the jugal contacts the squamosal via a distinct serrated suture. The dorsal jugal-postorbital suture is somewhat concave. The ventral surface of the squamosal is shallowly posteroventrally curved. In lateral view the squamosal is only slightly up- and forwardly arched. The anteriormost part of the dentary is posteroventrally oriented by an angle of about 50° to the transverse plane. The anterior portions of the dentary form a beak. The posterior dentary teeth are very prominent and clearly larger than the posterior maxillary teeth. Towards its midsection the dentary becomes slightly narrower dorsoventrally. Posteriorly in the coronoid section, the jaw becomes higher again. The ventral margin of the mandibular ramus is rounded and anteriorly relatively thick. The axis is nearly quadratic in outline, having a

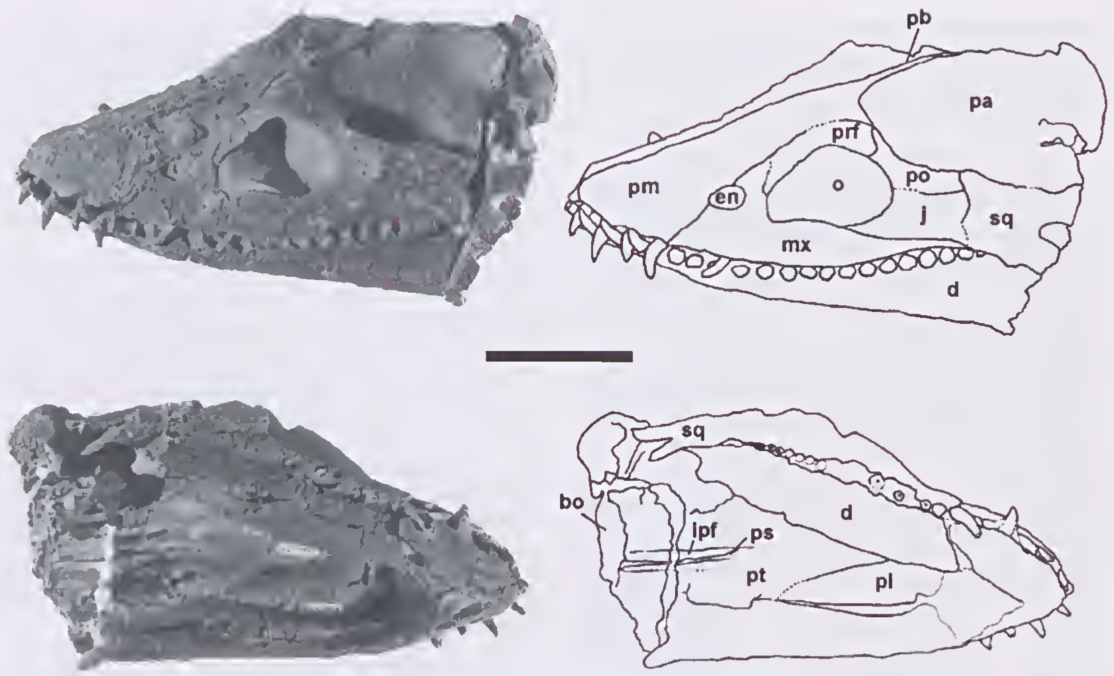

FIG. 7. Skull of *Tuarangisaurus keyesi* NZGS CD425 in lateral and ventral view with schematic outline drawings (stippled areas are incomplete or not preserved). Scale = 10cm.

prominent sagittal keel in the centre of the ventral surface. The cervical rib is lateroventrally directed by an angle of about 45°. The neural canal is relatively broad and occupies about 50% of the breadth of the axis centrum.

*T. australis* can be distinguished from *T. keyesi* by a number of osteological features, its providence and age. All materials of *T. keyesi* known so far are from the Mangahouanga Stream site at Hawke's Bay (North Island, New Zealand). The fossil bearing Maungataniwha Member of the Tahora Formation is interpreted as being approximately mid-Campanian in age (Isaac et al., 1991). The Queensland specimen is from the Albian Toolebuc Formation.

The osteological differences between *T. australis* and *T. keyesi* are the position of the external nares, which in *T. keyesi* are somewhat more anteriorly situated, about at the level of the third and fourth maxillary teeth. The third premaxillary tooth that in *T. keyesi* is very large and about as prominent as the 5th premaxillary tooth, while it is rather short in *T. australis*. The last premaxillary tooth that (calculated from the size of the alveoli), in *T. keyesi* did not differ much in size from the 1st maxillary tooth, while in *T. australis* the last premaxillary tooth is about twice as large as the first maxillary tooth. The posterior process of the maxilla, which in *T. keyesi* terminates at the level of the penultimate dentary tooth, while it terminates directly behind the last dentary tooth in *T. australis*. The anterior parietal section that in *T. keyesi* is formed as a thin bridge, while it is rather sharp in *T. australis*. The jugal, that in *T. keyesi* is rather trapezoid in outline, while it appears to be more rectangular in *T. australis*. The jugal-squamosal suture that in *T. keyesi* is clearly more anteriorly situated than in *T. australis*. The quadrate condyle, which in *T. australis* is shorter and more robust. The mandibular symphysis that in *T. keyesi* only expands to the level of dentary tooth 3, while it expands to the level of dentary tooth 4 in *T. australis*. The dentary that in *T. keyesi* bears 21 teeth per ramus and only 18 in *T. australis*. The dentary teeth, which in *T. keyesi* are almost equal in size throughout the dentition, while in *T. australis* the anterior 5 teeth are larger. The retroarticular process that in *T. keyesi* is about twice as long as broad, while it is about as long as broad in *T. australis*. The posterior articular facet of the axis, which in *T. keyesi* is broad oval in shape and deeply concave, while it is more circular and less concave is *T. australis*.

Based on the listed osteological similarities *T. australis* is referred to *Tuarangisaurus*, and because of the identified differences from *T. keyesi*, it is treated as a separate species.

## CLADISTIC ANALYSIS

The ingroup includes all valid members of the Elasmosauridae of which sufficient cranial material is known. Thus *Elasmosaurus*, *Aphrosaurus*, *Fresnosaurus* and *Moraenosaurus* are excluded from the analysis. As outgroup member *Muraenosaurus* was chosen, which according to O'Keefe (2002) belongs to the Cryptoclididae, although it has long been included in the Elasmosauridae. Recent analyses of elasmosaurid taxa have been undertaken by Carpenter (1999), Bardet et al. (1999) and Gasparini et al. (2003), and the characters are partly based upon their results.

REFERRED TAXA. OUTGROUP: *Muraenosaurus* Seeley, 1874. INGROUP: *Occitanosaurus* Bardet, Godefroit & Sciau, 1999, *Brancasaurus* Wegner, 1914, *Libonectes*, Carpenter, 1997, *Thalassomedon* Welles, 1943, *Tuarangisaurus* Wiffen & Moisley, 1986, *Callawayasaurus* Carpenter, 1999, *Styxosaurus* Welles, 1943, *Hydralmosaurus* Welles, 1943, *Aristonectes* Cabrera, 1941, *Hydrotherosaurus* Welles, 1943 and *Terminonatator* Sato, 2003.

CHARACTER DESCRIPTIONS. **1.** Orbita - temporal fenestra relative size. ***0.*** equal in size. ***1.*** orbita smaller than temporal fenestra. (modified from Gasparini et al., 2003). Outgroup. In *Muraenosaurus* the orbitae and temporal fenestrae are about equal in size (Andrews, 1910, fig. 46). Ingroup. In most elasmosaurs the temporal fenestrae are clearly larger than the orbitae, as present in *Occitanosaurus* (Bardet et al., 1999, fig. 3), *Libonectes* (Carpenter, 1997, fig. 2), *Thalassomedon* (Carpenter, 1999, fig. 12), *Callawayasaurus* (Carpenter, 1999, fig. 13), *Styxosaurus* (Welles & Bump, 1949, fig. 3), *Hydralmosaurus* (Carpenter, 1999, fig. 7), *Hydrotherosaurus* (UCMP 33912, Sachs, pers. obs. 2001) and *Tuarangisaurus*. In *Brancasaurus* both are about equal in size (Wegner, 1914, fig. 1). In *Aristonectes* (Gasparini et al., 2003) and *Terminonatator* (Sato, 2003) the conditions are unknown.

**2.** Premaxillary tooth count. ***0.*** five. ***1.*** between 1 and 6. ***2.*** > 6. (modified from Gasparini et al., 2003). Outgroup. Primitively five premaxillary teeth are present in *Muraenosaurus* (Andrews, 1910). Ingroup. The number of premaxillary teeth is highest in *Aristonectes* with 10-13 per side (Gasparini et al., 2003), which also is the most increased number of premaxillary teeth in all sauropterygians. *Terminonatator* has nine premaxillary teeth per side (Sato, 2003). Eight premaxillary teeth have been estimated for *Elasmosaurus* (Cope, 1869, 1875), but only 6 alveoli are visible (ANSP 10081, Sachs, pers. obs. 2001). Five premaxillary teeth are present in *Libonectes* (Welles, 1949), *Brancasaurus* (Wegner, 1914), *Hydralmosaurus* (Carpenter, 1999), *Callawayasaurus* (Welles, 1962), *Styxosaurus* (Welles & Bump, 1949), *Occitanosaurus* (Bardet et al., 1999), *Hydrotherosaurus* (UCMP 33912, Sachs, pers. obs. 2001, in addition to 4, counted by Welles, 1943) and *Tuarangisaurus*. The number of premaxillary teeth is lowest in *Thalassomedon* with only 4 teeth per side (Welles, 1943).

**3.** Premaxilla-parietal contact. ***0.*** absent. ***1.*** present. (modified from Carpenter, 1999). Outgroup. In *Muraenosaurus* a premaxillary-parietal contact is not established as the frontals intermediate between the 2 elements (Andrews, 1910). Ingroup. A premaxilla-parietal contact is established in *Callawayasaurus, Hydralmosaurus*, *Libonectes*, *Styxosaurus*, *Thalassamedon*, *Tuarangisaurus keyesi* (after Carpenter, 1999: tab. 2) and *Terminonatator* (Sato, 2003). The premaxillae and parietals are separated by the frontals in *Occitanosaurus* (Bardet et al., 1999, fig. 3), *Brancasaurus* (Wegner, 1914, fig. 1) and *Hydrotherosaurus* (Sachs, pers. obs 2001). This section of the skull is not well preserved in QMF 11050 and *Aristonectes* (Gasparini et al., 2003).

**4.** Maxilla-jugal contact. ***0.*** maxilla does not follow the jugal posteriorly. ***1.*** a posterior process of the maxilla follows the jugal to its posterior section. ***2.*** maxilla terminates posterior of the jugal. Outgroup. In *Muraenosaurus* only the anteriormost sections of the jugals are in touch with the maxillae (Andrews, 1910, fig. 46). Ingroup. In most elasmosaurs the maxilla follows the jugal to nearly its posterior end, as it is present in *Libonectes* (Welles, 1949, plate 1), *Styxosaurus*, *Hydralmosaurus* (Welles, 1952, fig. 5+6) and *Tuarangisaurus*. In *Brancasaurus* (Wegner, 1914, fig. 1) and *Thalassomedon* (Carpenter, 1999, fig. 13) the maxilla is somewhat larger than the jugal and runs further posteriorly. This appears also to be the case in *Terminonatator* (Sato, 2003, fig. 5a), although the jugal is only fragmentarily preserved. For *Callawayasaurus* Welles (1962: 18) wrote 'the maxillary probably ends posteriorly below the middle of the jugal arch in a downcurved slender point'. Only a short contact in the anterior section of the jugal is present in *Occitinosaurus* (Bardet et al, 1999, fig. 3). The jugal is not known in *Aristonectes* (Gasparini et al., 2003) and the condition is unclear in *Hydrotherosaurus* as not clear suture is visible in that part of the skull (UCMP33912, Sachs, pers. obs. 2001).

**5.** Maxillary tooth count. ***0.*** 17 or more. ***1.*** 14-16. ***2.*** 13 or fewer. Outgroup. According to Brown (1981) *Muraenosaurus* bears 16 teeth per maxilla. Ingroup. The number of maxillary teeth is 14-16 in *Libonestes* (14 after Carpenter, 1999) and *Tuarangisaurus* (15-16). The number is lower than 14 in *Hydralmosaurus* (13 after Welles, 1952), *Terminonatator* (13, after Sato, 2003), *Occitinosaurus* (12 after Bardet et al., 1999), *Styxosaurus* (11 after Welles & Bump, 1949) and *Callawayasaurus* (9 after Welles, 1962). 13 alveols are visible in

*Hydrotherosaurus*, in which the posterior ones are not clear (UCMP 33912, Sachs pers. obs. 2001). According to Welles (1943: 158) *Thalassomedon* only bears 7 teeth per maxilla, while in the drawing of Carpenter (1999, fig. 12) 13 teeth are visible. The largest number of maxillary teeth among all sauropterygians is present in *Aristonectes* with about 51-53 teeth per side (Gasparini et al., 2003). The number is unclear in *Brancasaurus*, as the maxillae are incompletely preserved (Wegner, 1914).

**6.** Maxillary termination. ***0.*** maxilla terminates posterior to the level of the last dentary tooth. ***1.*** maxilla terminates close to the level of the last dentary tooth. Outgroup. In *Muraenosaurus* the maxilla terminates farther behind the level of the last dentary tooth about at the level of the posterior margin of the orbita (Andrews, 1910, fig. 46). Ingroup. The maxilla terminates close to the level of the last dentary tooth in *Callawayasaurus* (Welles, 1962, fig. 3), *Styxosaurus* (Welles, 1952, fig. 5), *Terminonatator* (Sato, 2003, fig. 5), *Tuarangisaurus* and probably also in *Hydralmosaurus* (Welles, 1952, fig. 6) and *Aristonectes* (Gasparini et al. 2003, fig. 1). The maxilla is further posteriorly expanded in *Libonectes* (Carpenter, 1997, fig. 5), *Thalassomedon* (Carpenter, 1999, fig. 12) and *Brancasaurus* (Wegner, 1914, fig. 1). The situation is unknown in *Occitanosaurus* as the lower jaw is missing (Bardet et. al., 1999) and in *Hydrotherosaurus* (UCMP 33912, Sachs, pers. obs. 2001) as this part of the skull is not well preserved.

**7.** Jugal-squamosal contact. ***0.*** by a short suture or no contact is established. ***1.*** by a long suture. Outgroup. In *Muraenosaurus* only a short suture in the ventral half of the squamosal is developed (Andrews, 1910, fig. 46). Ingroup. A long squamosal-jugal contact is present in most elasmosaurs. It can be found in *Styxosaurus*, *Hydralmosaurus* (Welles, 1952, fig. 5+6), *Thalassomedon* (Carpenter, 1999, fig. 12), *Libonectes* (Welles, 1949, plate 1) and *Tuarangisaurus*. In *Callawayasaurus* this section is somewhat distorted, but a long suture between the squamosal and the jugal is visible (Welles, 1962, fig. 3). A short suture is developed in *Occitinosaurus* (Bardet et al., 1999, fig. 3) and *Brancasaurus* (Wegner, 1914, fig. 1) as here the anterior margin of the squamosal also articulates with the postorbital. As mentioned before the jugal is only fragmentarily preserved in *Terminonatator* (Sato, 2003) and is missing in *Aristonectes* (Gasparini et al., 2003), so that no statements are possible for these taxa. In *Hydrotherosaurus* the posterior suture to the squamosal is not preserved (UCMP33912, Sachs, pers. obs. 2001).

**8.** Jugal-postorbital contact. ***0.*** suture long relative to the length of the jugal. ***1.*** suture short relative to the length of the jugal. (modified from Bardet et al., 1999). Outgroup. A long postorbital suture is present in *Muraenosaurus*, reaching over most of the dorsal edge of the jugal (Andrews, 1910, fig. 46). Ingroup. The jugal-postorbital suture is comparatively long in *Styxosaurus* (Welles, 1952, fig. 5), *Hydralmosaurus* (Welles, 1952, fig. 6), *Callawayasaurus* (Welles, 1962, fig. 3), *Occitinosaurus* (Bardet et al., 1999, fig. 3), and *Tuarangisaurus*. It is short in *Libonectes* (Welles, 1949, plate 1), *Thalassamedon* (Carpenter, 1999, fig. 12) and *Brancasaurus* (Wegner, 1914, fig. 1), while this section of the skull is not preserved in *Aristonectes* (Gasparini et al., 2003) and *Terminonatator* (Sato, 2003) and the condition is unclear in *Hydrotherosaurus* (UCMP 33912, Sachs, pers. obs. 2001).

**9.** Jugal-orbita contact. ***0.*** Jugal does not take part in the margin of the orbita. ***1.*** Jugal takes part in the margin of the orbita. Outgroup. In *Muraenosaurus* the jugal forms the posterior half of the lateral margin of the orbita (Andrews, 1910, fig. 46b). Ingroup. The jugal is participated in forming the orbita in all referred elasmosaur taxa with the exception of *Occitanosaurus* (Bardet et al., 1999, fig. 1) Here the jugal is dorsally covered by the postorbital. In *Terminonatator* only a fragment of the right jugal is preserved, but according to its position it appeared to have been participated in forming the orbita too (Sato, 2003, fig. 5). The jugal is unknown in *Aristonectes* (Gasparini et al., 2003).

**10.** Jugal-temporal fenestra contact. ***0.*** jugal is excluded from the dorsal margin of the temporal fenestra. ***1.*** jugal takes part in the dorsal margin of the temporal fenestra. (sensu Carpenter, 1999). Outgroup. In *Muraenosaurus* the jugal is not participated in the margin of the temporal fenestra, as it is dorsally covered by the postorbital, which forms the anteroventral margin of the fenestra (Andrews, 1910). Ingroup. The jugal takes part on the dorsal margin the temporal fenestra in *Thalassamedon* (Carpenter, 1999, fig. 12), *Callawayasaurus* (Welles, 1962, fig. 3), *Hydralmosaurus* (Welles, 1952, fig. 6), *Styxosaurus* (Welles, 1952, fig. 5), *Libonectes* (Carpenter, 1997, fig. 5) and *Tuarangisaurus*. The jugal is dorsally covered by the postorbital and therefore not participated in *Occitinosaurus* (Bardet et al., 1999, fig. 3) and *Brancasaurus* (Wegner, 1914, fig. 1). The condition is unknown in *Terminonatator* (Sato, 2003) and *Aristonectes* (Gasparini, et al. 2003) and unclear in *Hydrotherosaurus* (UCMP 33912, Sachs, pers. obs. 2001).

**11.** Postfrontal. ***0.*** present. ***1.*** absent. (sensu Bardet et al., 1999). Outgroup. The postfrontals are present in *Muraenosaurus* (Andrews, 1910). Ingroup. The postfrontal is a primitive element and is present in *Occitanosaurus* (Bardet et al., 1999, fig. 3) and *Brancasaurus* (Wegner, 1914, fig. 1) and absent in all other referred elasmosaur taxa. The according section of the skull is unknown in *Aristonectes* (Gasparini et al., 2003).

**12.** Squamosal-postorbital contact. ***0.*** present. ***1.*** absent. Outgroup. In *Muraenosaurus*, a clear contact between the postorbital and the squamosal is present (Andrews, 1910, fig. 46). Ingroup. The squamosal does not touch the postorbital in *Styxosaurus* (Welles, 1952, fig. 5), *Thalassomedon* (Carpenter, 1999, fig. 12), *Callawayasaurus* (Welles, 1962, fig. 3) and *Tuarangisaurus*. A contact is present in *Occitanosaurus* (Bardet et al., 1999, fig. 3) and *Brancasaurus* (Wegner, 1914, fig. 1). In *Hydrotherosaurus* a zigzagged suture seems to be present, but is not well visible (UCMP 33912, Sachs, pers. obs. 2001). A contact has also been suggested for *Hydralmosaurus* (Welles, 1952, fig. 6), but this reconstruction appears to be doubtful. The section is not well preserved in *Libonectes* (Carpenter, 1997, fig. 2) and is missing in *Aristonectes* (Gasparini et al., 2003) and *Terminonatator* (Sato, 2003).

**13.** Dentary teeth per ramus. ***0.*** 21 or more. ***1.*** 18-20. ***2.*** 17 or fewer. Outgroup. In *Muraenosaurus* the tooth count is 22 per dentary ramus (Brown, 1981). Ingroup. The number of dentary teeth is 18-20 in *Libonectes* (17/18, after Carpenter, 1997), *Callawayasaurus* (19, after Welles, 1962), *Terminonatotor* (17/18, after Sato, 2003) and QMF1150 (18). According to Welles (1943) the mandible of *Thalassamedon* only bears 16 teeth per ramus. However, following the photo of UNSM 50132 in Carpenter (1999, fig. 12) at least 19 teeth per ramus are present. The number is higher in *Tuarangisaurus keyesi* (21, NZGS CD425, Sachs pers. obs. 2001) and *Brancasaurus* (21, after Wegner, 1914) and lower in *Styxosaurus* (17, after Welles & Bump, 1949). In *Hydralmosaurus* 17 teeth are present (after Welles, 1952), but Carpenter (1999, p. 156) suggests that the number might be higher. The number is most increased in *Aristonectes* with about 60-65 teeth per dentary ramus (Gasparini et al., 2003). The condition is unclear in *Hydrotherosaurus* (UCMP 33912, Sachs, pers. obs. 2001) and unknown in *Occitanosaurus* (Bardet et al., 1999).

**14.** Shape of dentary teeth. ***0.*** posterior-most dentary teeth are not markedly more prominent than posterior-most maxillary teeth. ***1.*** posterior-most dentary teeth very prominent in relation to the posterior-most maxilla teeth. Outgroup. In *Muraenosaurus* the posterior dentary teeth are about equal in size with the last maxillary teeth (Andrews, 1910, fig. 46). Ingroup. The posterior dentary teeth are clearly more prominent than the posterior maxillary teeth in *Libonectes* (Carpenter, 1997, fig. 5), *Styxosaurus* (Welles, 1952, fig. 5), *Hydralmosaurus* (Welles, 1952, fig. 6), *Callawayasaurus* (Welles, 1962, fig. 3), *Terminonatator* (Sato, 2003, fig. 5), *Hydrotherosaurus* (UCMP33912, Sachs, pers. obs. 2001) and *Tuarangisaurus*. The posterior dentary teeth are about equal in size with the last maxillary teeth in *Thalassomedon* (Carpenter, 1999, fig. 12). This section is not well preserved in *Brancasaurus*, but the teeth seem not to be more prominent than the posterior maxillary teeth (GPIM A36, Sachs, pers. obs. 1999). Rather small posterior dentary teeth have been reconstructed for *Aristonectes*, but they still appear to be larger than the posterior maxillary teeth (Gasparini et al., 2003).

**15.** Length of retroarticular process. ***0.*** long relative to jaw length. ***1.*** short relative to jaw length. Outgroup. *Muraenosaurus* has a long retroarticular process (Andrews, 1910, fig. 46). Ingroup. The retroarticular process is comparatively short in *Styxosaurus* (Welles, 1952, fig. 5), *Hydralmosaurus* (Welles, 1952, fig. 6), *Callawayasaurus* (Welles, 1962, fig. 3), *Terminonatator* (Sato, 2003, fig. 5), *Aristonectes* (Gasparini et al., 2003, fig. 1) and *Tuarangisaurus* (in which the process is somewhat longer in *T. keyesi* than in QMF11050). The retroarticular process is rather long in *Thalassomedon* (Carpenter, 1999, fig. 12), *Libonectes* (Carpenter, 1997, fig. 5), *Hydrotherosaurus* (Welles, 1943, fig. 4) and *Brancasaurus* (GPIM A36, Sachs, pers. obs. 1999).

**16.** Axis shape. ***0.*** centrum short and high. ***1.*** centrum long and low. (modified from Carpenter, 1999). Outgroup. The axis is short and high in *Muraenosaurus* (Andrews, 1910, fig. 49). Ingroup. The axis centrum is short and high in *Brancasaurus* (Wegner, 1914, fig. 2), *Libonectes* (Carpenter, 1997, fig. 1), *Thalassamedon* (Welles, 1943, plate 22), *Occitanosaurus* (Bardet et al, 1999, plate 2), *Aristonectes* (Cabrera, 1941, fig. 2), *Hydrotherosaurus* (Welles, 1943), *Callawayasaurus* (UCMP38349, Sachs pers. obs., 2001) and *Tuarangisaurus*. The centrum is long and low in *Styxosaurus* (Sachs, 2004), *Hydralmosaurus* (Cope, 1877) and *Elasmosaurus* (Cope, 1869, plate 2). The axis vertebra is unknown *Terminonatator* (Sato, 2003).

**17.** Shape of the cervical centra. ***0.*** anterior cervical centra shorter than high or the length and height is about equal. ***1.*** anterior cervical centra longer than high. Outgroup. In *Muraenosaurus* the length and height are about equal (Andrews, 1910). Ingroup. The anterior cervical centra are longer than high in *Styxosaurus* (Sachs, 2004), *Hydralmosaurus* (Cope, 1877), *Libonectes* (Welles, 1949), *Elasmosaurus* (Welles, 1952), *Occitanosaurus* (Bardet et al., 1999), *Callawayasaurus* (Welles, 1962), *Terminonatator* (Sato, 2003), *Hydrotherosaurus* (Welles, 1943) and *Tuarangisaurus*. These measurements are about equal in *Thalassomedon* (Welles, 1943), *Brancasaurus* (Wegner, 1914) and *Aristonectes* (Cabrera, 1941).

**18.** Cervical vertebrae number. ***0.*** fewer than 30. ***1.*** 30-40. ***2.*** 40-50. ***3.*** 50-60. ***4.*** 60 or more. (modified from Carpenter, 1999). Outgroup. *Muraenosaurus* comprises 44 cervicals (Brown, 1981). Ingroup. The number of cervicals is lowest in *Brancasaurus* (37, Wegner, 1914), *Occitanosaurus* (43, Bardet et al., 1999), *Terminonatator* (51, Sato, 2003) and *Callawayasaurus* (56, Welles, 1962). The number of cervicals is 60 or more in *Hydrotherosaurus* (60, Welles, 1943), *Libonectes* (62, Carpenter, 1999), *Thalassomedon* (62, Welles, 1943), *Styxosaurus* (62, Carpenter, 1999), *Hydralmosaurus* (62, Welles, 1999) and *Elasmosaurus* (72, ANSP10081, Sachs pers. obs. 2001). The total number is unknown in *Aristonectes*, but at least 23 cervical vertebrae are present in MLP 40-XI-14-6 (Cabrera, 1941, Gasparini et al., 2003) and *Tuarangisaurus*.

**19.** Lateral longitudinal crest on cervical centra. ***0.*** absent. ***1.*** present. (sensu Bardet et al., 1999). Outgroup. A lateral longitudinal crest is present in *Muraenosaurus* (Andrews, 1910). Ingroup. This character is present in all elasmosaurs except for *Brancasaurus* (Wegner, 1914), which is a juvenile.

## EXPLANATION OF THE PHYLOGENETIC ANALYSIS

METHODS. The data matrix (Table 1) was analysed using PAUP version 3.1.1 (Swofford & Begle, 1993) with 100 heuristic searches and random addition of sequences. The first goal of the analysis was to show an example for the possible interrelationship of the Elasmosauridae; the second goal was to find the position of *Tuarangisaurus* within the family. All characters were left unordered. With a heuristic search, 3 equally most parsimonious trees were obtained, each with a length of 32 steps, a consistency index (CI) of 0.719, homoplasy index (HI) of 0.281 and retention index (RI) of 0.763. All trees support the position of *Libonectes* as sister taxon of *Thalassamedon*, *Terminonatator* as sister taxon of *Aristonectes* and *Styxosaurus* as sister taxon of *Hydralmosaurus*. In all trees *Tuarangisaurus* and *Callawayasaurus* have a single standing position (Fig. 8). The principal difference of the trees is the position of *Callawayasaurus*, which is either the sister taxon of group 7 or of group 8.

Group 1 includes all elasmosaurs, except for *Brancasaurus* where character 19, the longitudinal lateral crest in the cervical centra, is not present. According to Brown (1993) the crest is a diagnostic feature for the Elasmosauridae, but is only fully developed in adults. However, as shown in *Styxosaurus glendowerensis* (Sachs, 2004), a well developed crest can be present in juveniles too. Thus it remains questionable if *Brancasaurus* really represents an elasmosaur or would rather belong in the relationship of the Cryptoclididae (supported by two characters only present in *Brancasaurus* and *Muraenosaurus*; 1(0) and 18(2)).

Group 2 includes the members of groups 4, 7 and 8 based on characters 6(1) and 15(1). The maxilla is primitively more expanded posteriorly than at the level of the last dentary tooth and the retroarticular process is then usually also rather long. Both characters can therefore be quoted as advanced if present. Group 3 includes elasmosaur taxa showing more plesiomorphic conditions, containing the members of group 5 and 6 as well as *Hydrotherosaurus*. It is characterised only by character 15(0), an elongate retroarticular process. Group 4 includes *Callawayasaurus*, *Tuarangisaurus* and group 7, showing a feature complex of characters 5(1) + 8(0) that is unique for this group. Group 5 comprises the most basal members of the Elasmosauridae, thus showing characters 3(0), 7(0), 10(0) and 11(0) as plesiomorphic conditions that are characteristic for this group. Group 6 that is formed by *Thalassomedon* and *Libonectes* is characterised a feature complex of character 6(0) + 18(4) that is unique among the Elasmosauridae.

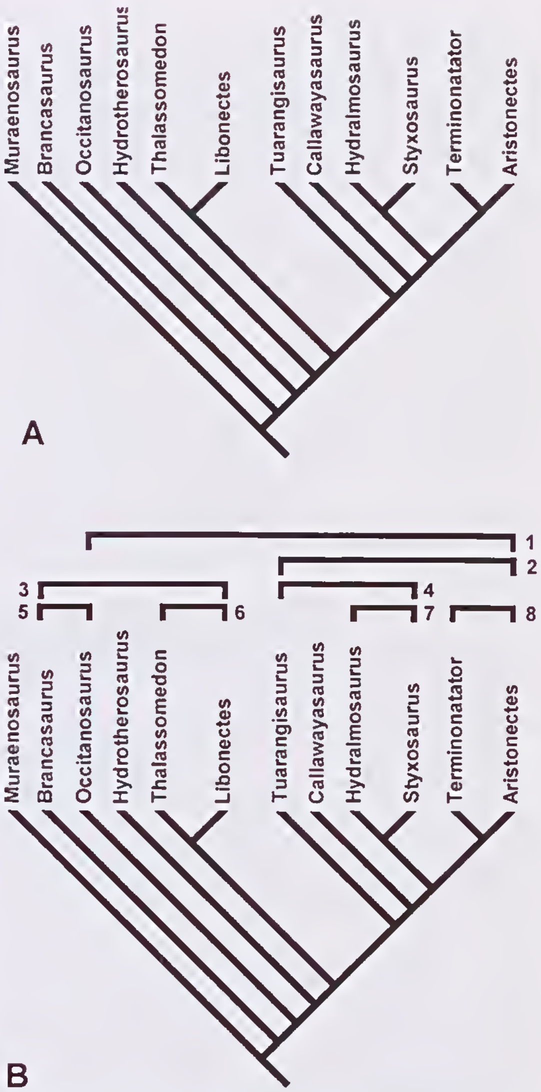

FIG. 8. Phylogenetic tree of the Elasmosauridae. A, consensus tree, showing the position of *Tuarangisaurus* and its interrelationships; B, composition of groups 1-8.

Group 7 shows a number of advanced features, e.g. character 5(2), 13(2), 16(1) and 18(4) that in this combination is only present in this group. It can be concluded that an elongate but low axis centrum is an advanced feature, especially considering the fact that the number of cervical vertebrae is equal with that in *Libonectes* and *Thalassomedon* where a more quadratic shaped axis centrum is developed. These characters support the high phylogenetic position of group 7. Considering the fact that an elongate and low axis centrum, together with the most increased number of cervical vertebrae in all sauropterygians is also present in *Elasmosaurus platyurus*, it can be concluded that this taxon probably belongs to

TABLE 1. Data matrix.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Muraenosaurus* | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 |
| *Occitanosaurus* | 1 | 0 | 0 | 0 | 2 | ? | 0 | 0 | 0 | 0 | 0 | 0 | ? | ? | ? | 0 | 1 | 2 | 1 |
| *Brancasaurus* | 0 | 0 | 0 | 2 | ? | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| *Libonectes* | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | ? | 1 | 1 | 0 | 0 | 1 | 4 | 1 |
| *Thalassomedon* | 1 | 1 | 1 | 2 | 2 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 1 |
| *Tuarangisaurus* | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0+1 | 1 | 1 | 0 | 1 | ? | 1 |
| *Callawayasaurus* | 1 | 0 | 1 | 1 | 2 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 3 | 1 |
| *Styxosaurus* | 1 | 0 | 1 | 1 | 2 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 4 | 1 |
| *Hydralmosaurus* | 1 | 0 | 1 | 1 | 2 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 1 | 1 | 4 | 1 |
| *Aristonectes* | ? | 2 | ? | ? | 0 | 1 | ? | ? | ? | ? | ? | ? | 0 | 1 | 1 | 0 | 0 | ? | 1 |
| *Hydrotherosaurus* | 1 | 0 | 0 | ? | 2 | ? | ? | ? | 1 | ? | 1 | 0 | ? | 1 | 0 | 0 | 1 | 4 | 1 |
| *Terminonatator* | ? | 2 | 1 | 2 | 2 | 1 | ? | ? | 1 | ? | 1 | ? | 1 | 1 | 1 | ? | 1 | 3 | 1 |

group 7 too. Group 8 is characterised by only one character 2(2), the incensement of premaxillary teeth.

DISCUSSION. This analysis indicates that *Tuarangisaurus*, is more primitive than *Styxosaurus* and *Hydralmosaurus* from the Western Interior Seaway of North America, *Terminonatator* from the Maastrichtian of Canada and *Aristonectes* from the Maastrichtian of Patagonia. *Tuarangisaurus* shows characters 3(1), 6(1), 12(1), 14(1), 15(1) and 17(1) as advanced features. It is more advanced than group 3 in characters 6(1) and 15(1); more advanced than group 5 in characters 3(1), 6(1), 7(1) and 10-15(1); more advanced than group 6 in characters 6(1) and 15(1) and more advanced than *Hydrotherosaurus* in characters 3(1), 12(1) and 15(1). *Tuarangisaurus* is less advanced than *Callawayasaurus* in character 5(2), less advanced than group 7 in characters 5(2), 13(2) and 16(1) and less advanced than group 8 in characters 2(2) and 4(2). Thus *Tuarangisaurus* belongs in the closer relationship of group 7 and *Callawayasaurus*, but seems to be less advanced than both.

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TABLE 2. Measurements of the alveols (approximate), skull and postcranial elements.

| | | | | | |
|---|---|---|---|---|---|
| Pmt 1 | ?mm | Dt 1 | 11mm | Length of the skull anteropoteriorly | 40cm |
| Pmt 2 | ?mm | Dt 2 | 16mm | Anteroposterior length of the premaxilla along the alveolar-part | ca. 7.0cm |
| Pmt 3 | ?mm | Dt 3 | 15mm | Anteroposterior length of the maxilla | ca. 21cm |
| Pmt 4 | 12mm | Dt 4 | 14mm | Height of the maxilla at the anterior edge of the orbita | ca. 6.0cm |
| Pmt 5 | 13mm | Dt 5 | 12mm | Length of the posterior process of the maxilla | ca. 6.0cm |
| Mxt 1 | 8mm | Dt 6 | 11mm | Largest distance between the posterior edge of the external naris and the anterior edge of the orbita | 1.7cm |
| Mxt 2 | 12mm | Dt 7 | 9mm | | |
| Mxt 3 | 13mm | Dt 8 | ?mm | Anteroposterior diameter of the external naris | 2.3cm |
| Mxt 4 | 13mm | Dt 9 | 10mm | Dorsoventral diameter of the external naris | 1.2cm |
| Mxt 5 | 11mm | Dt 10 | 10mm | Anteroposterior diamteter of the orbita | 8.0cm |
| Mxt 6 | 8mm | Dt 11 | 9mm | Length of the jugal anteroposteriorly | ca. 8.0cm |
| Mxt 7 | 8mm | Dt 12 | 13mm | Length of the mandibular symphysis | 6.2cm |
| Mxt 8 | 7mm | Dt 13 | 12mm | Length quadrate condyle | 3.6cm |
| Mxt 9 | 7mm | Dt 14 | 11mm | Breadth quadrate condyle | 1.4cm |
| Mxt 10 | 6mm | Dt 15 | 10mm | Height quadrate condyle | 1.4cm |
| Mxt 11 | ?mm | Dt 16 | 9mm | Length of the hyoid anteroposteriorly | 10.0cm |
| Mxt 12 | ?mm | Dt 17 | 9mm | Breatdh of the hyoid posteriorly | 1.0cm |
| Mxt 13 | ?mm | Dt 18 | 7mm | Height of atlas-axis complex | 3.4cm |
| Mxt 14 | ?mm | | | Breadth of atlas-axis complex | 3.3cm |
| Mxt 15 | ?mm | | | Length of anterior cervical vertebra | 6.4cm |
| | | | | Breadth of anterior cervical vertebra | 6.9cm |
| | | | | Height of anterior cervical vertebra | 5.0cm |
| | | | | Length of first posterior cervical vertebra | 9.8cm |
| | | | | Breadth of first posterior cervical vertebra | 10.4cm |
| | | | | Height of first posterior cervical vertebra | 8.3cm |

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# TWO NEW SPECIES OF *BRANCHINELLA* (ANOSTRACA: THAMNOCEPHALIDAE) AND A REAPPRAISAL OF THE *B. NICHOLLSI* GROUP

BRIAN V. TIMMS

Timms, B.V. 2005 01 10: Two new species of *Branchinella* (Anostraca: Thamnocephalidae) and a reappraisal of the *B. nichollsi* group of the Australian arid-zone. *Memoirs of the Queensland Museum* **50**(2): 441-452. Brisbane. ISSN 0079-8835.

*Branchinella clandestina* sp. nov. is described from the Queensland Paroo and *B. mcraei* sp.nov. from the Pilbara in Western Australia. Both have a simple frontal appendage consisting of a trunk and two branches, but differ from each other and other similar species such as *B. affinis* Linder, *B. longirostris* Wolf and *B. latzi* Geddes by many features. These two species increase the number of described Australian *Branchinella* to 31 species. The raising of *B. nichollsi hattahensis* Geddes and *B. nichollsi buchananensis* Geddes, both present in the Paroo catchment, to species status is confirmed with lectotypes designated and species descriptions provided. Similarities and differences between *B. nichollsi, B. hattahensis* and *B. buchananensis* are discussed. ❑ *Branchinella, Anostraca, Thamnocephalidae, new species.*

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Until a few years ago, Australia had 18 described species of *Branchinella*. Belk & Brtek (1995) elevated, with no discussion or justification, the 2 subspecies of *B. nichollsi* Linder to species rank (thus *B. buchananensis* Geddes 1981 and *B. hattahensis* Geddes 1981) to swell the Australian list to 20 species. Timms (2001, 2002) and Timms & Geddes (2003) added 9 species, mainly from remote areas. Collecting from such areas has yielded 2 further species, described here.

The uncritical elevation of *B. n. buchananensis*, and *B. n. hattahensis* to species status has not been questioned, or supported, on anatomical grounds, but Remigio et al.(2003), using DNA, concluded that *B. buchananensis* and *B. hattahensis* were related at the subspecific level (no material of *nichollsi* was available). No formal decision was made.

## SYSTEMATICS

Class CRUSTACEA Brünnich, 1772
Order ANOSTRACA, Sars, 1867
Family THAMNOCEPHALIDAE Packard, 1883
**Branchinella** Sayce, 1902

### **Branchinella clandestina** sp. nov.
(Figs 1,2)

ETYMOLOGY. The name arises from this fact that this species lives in a pool that was seen regularly for many years of a long-term study of the Paroo but not sampled until the 13th year. In other words it probably lived many times when the pool was full, right under the collector's gaze, yet went unnoticed — a clandestine existence.

MATERIAL. HOLOTYPE: ♂ Queensland Museum (hereafter QM) W26951. ALLOTYPE: ♀ QMW27006. PARATYPES: QMW27007 five ♂♂. All collected from the type locality by the B.V. Timms, 5 December, 2001. OTHER MATERIAL. Four ♂♂ raised in December 2002 from dried mud from the type locality, QMW27008.

TYPE LOCALITY. Unnamed flood plain pool near Caiwarro Crossing of the Paroo River, Currawinya National Park, 28°41'55"S, 144°46'40"E, SW Queensland. Collected under permit WITK00786602 issued by the Queensland Parks and Wildlife Service.

DESCRIPTION. *Male*. Length of mature males 10-11.2mm; holotype 10.8mm.

First antennae slightly longer than proximal segment of second antenna (Fig. 1A); apex bevelled and bearing subapically 2 short setae and 2-3 recurved hair-like setae. Second antennal basal segments fused medially for about one-third of their length proximally. These segments with a raised field of minute denticles along much of their length medially. Distal segment of second antenna slightly longer than length of the proximal segment, flattened, blade-like, curved with apices directed anteriolaterally (Fig. 1A). In life (Fig. 1B) the second antennae presents with the proximal segment vertical at right angles to the body axis, and the distal segments curved in three planes, so that the concave medial surface faces anteriorly and the convex lateral surface is aligned ventromedially. Curvatures on the medial and lateral margins of the distal segment different so that segment is widest in the central part. Apical

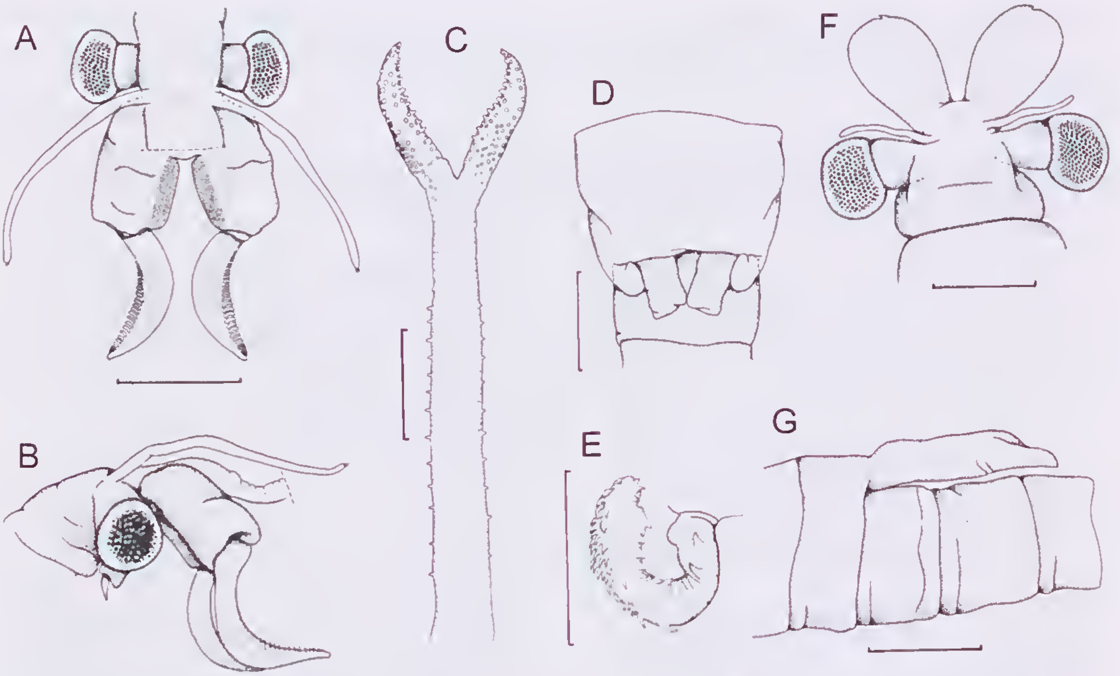

FIG. 1. *Branchnella clandestina* sp. nov. A, lateral view of head of ♂; B, dorsal view of ♂ second antenna; C, dorsal view of frontal appendage of ♂; D, rigid portion of base of penes; E, penis; F, dorsal view of head of ♀; G, lateral view of brood pouch. Scale bars =1mm.

two-thirds of distal segment with transverse ridges on the concave medial margin which appears anteriolaterally placed when viewed dorsally (Fig 1A).

Frontal appendage (Fig. 1C) about half body length and consisting of a long narrow trunk and two simple branches about a fifth of the length of the trunk. Trunk weakly pseudosegmented with small, simple, blunt papillae spaced along each lateral margin. Branches distal two thirds bearing dense papillae on both margins of the branches and continuing on the ventral surface in rows of 3-5 papillae.

Rigid basal portion of penes (Fig. 1D) cylindrical and protruding beyond the genital segments onto the first abdominal segment. Each attended laterally by a small rounded protrusion, smaller than the bases of the penes. Eversible portion of penes (Fig. 1E) about twice as long as rigid base and margined with a row of triangular denticles laterally and similar denticles apically on medial side, but soon becoming spike-like and crowded on the distal two-thirds of the penis.

Fifth thoracopod (Fig. 2A) with endites 1+2 (fused) and 3 broad and with evenly curved margins bearing numerous setae; endite 1+2 about 4 times the size of endite 3. Each endite with a one-sided pectinate anterior setae, the second setae about half as long again as the first setae. Both attended by a small spine proximally. Endites 4-6 small asymmetrical protrusions covered in small spines. Endites 4, 5 and 6 with 2,2, and 1 anterior setae respectively, the distal member of each pair distinctly longer than the proximal member. These anterior setae plumose. Endites 4, 5 and 6 with 3, 2 and 2 posterior setae respectively. Endopodite broadly rounded, almost quadrangular bearing many plumose setae, long on the lateral margin decreasing to short on the medial margin. Bases of these setae unadorned. Exopodite twice as long as endopodite, suboval and bearing numerous plumose setae. Epipodite suboval, widest proximally and longer than the endopodite; margin unadorned. Praeepipodite twice as long as broad; margin with a series of small asymmetrical spines.

Telson with cercopods subequal in length to the three posterior-most abdominal segments and bearing plumose setae on both margins. Setae longest midway along each cercopod.

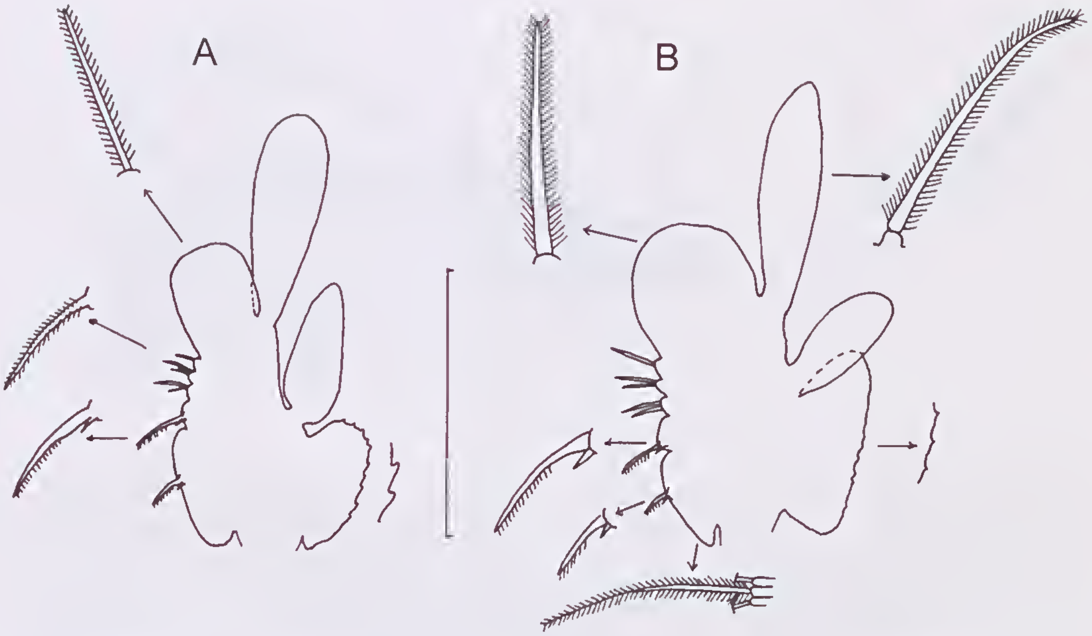

FIG. 2. Fifth thoracopods: A, *Branchinella clandestina* sp. nov.; B, *Branchinella mcraei* sp. nov. Scale bar = 1mm.

*Female.* Length of allotype 12.2mm. No other female lengths available. First antennae (Fig. 1F) slightly shorter than the eye plus eye stalk, and also shorter than the second antennae. First antenna setae as in male. Second antennae subcylindrical, tapering proximally and slightly longer than eye stalk plus eye; apex rounded and bearing a sharp projection flanked laterally by a small longitudinal notch. No setae on distal margin. Brood pouch (Fig. 1G) extending over three abdominal segments, distal part cylindrical. Thoracopods and cercopods similar to those of male.

DIAGNOSIS. Male with frontal appendage of a trunk and 2 simple branches. Each branch about 1/5 length of the trunk. Distal segment of second antenna curved medially and anteriorly and twisted so that lateral surface and medial surfaces appear opposite to their usual position.

REMARKS. This species is most similar to *B. affinis*, *B. latzi*, *B. longirostris* and the other new species described here, *B. mcraei*. All share a broadly similar frontal appendage; i.e. an appendage consisting of a trunk and two simple branches and with sensory papillae. Of this group, *B. longirostris* readily separates as it has spines at the base of the branches and a lateral protuberance proximal to these spines (Timms, 2004, fig. 70). The relative length of the trunk and branches separate *B. clandestina* from *B. affinis* and *B. mcraei* — in *B. clandestina* the branches are about one fifth of the total length of the frontal appendage (Fig. 1C), whereas in *B. affinis* they are about half (see Timms, 2004, fig 69) and in *B. mcraei* and *B. latzi* about one quarter to one third (Fig. 4B and ibid, fig 71). *B. clandestina* has the distal segment of the second antenna curved in three planes, so that it is curved medially and anteriorly (Fig. 1B), whereas in the other four species this segment is curved only medially (Figs 3, 4A and ibid, figs 69, 70, 71). Furthermore there is a difference in the number of sensory papillae in the four species — in *B. latzi* both trunk and branches are covered in papillae (ibid, fig 71), compared to papillae only on the distal half of the frontal appendage (i.e. the branches plus some of the trunk) in *B. mcraei* (Fig. 4B), only on the distal two thirds of the branches in *B. clandestina* (Fig. 1C) and not at all in *B. affinis* (ibid, fig. 69).

Other less diagnostic differences between the 5 species concern the basal segment of the second antenna and the base of the penes. Considering the second antenna, only the two new species have a pad of papillae medially on the unfused distal part of the basal segment. *B. affinis* usually has a small area of papillae medioapically on the

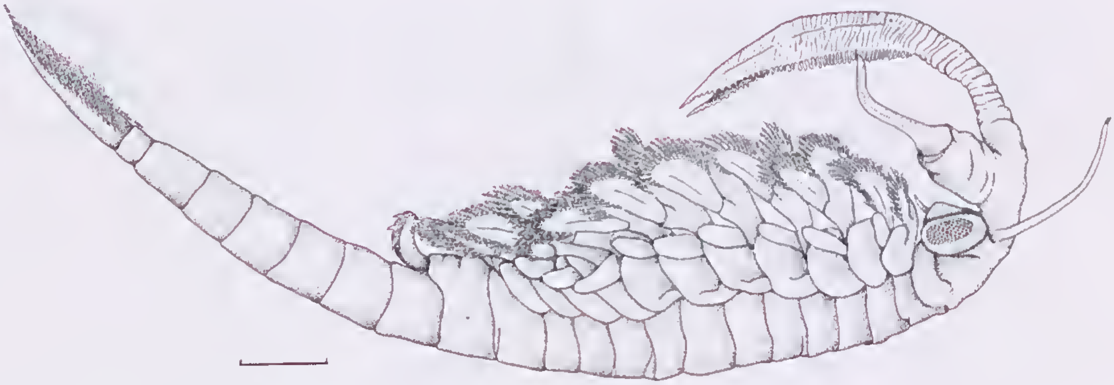

FIG. 3. Lateral view of ♂ *Branchinella mcraei* sp. nov. Scale bar = 1mm.

basal segment, while B. *longirostris* and *B. latzi* lack such papillae. Four of the five species have lateral processes on the base of the penes, the exception being *B. latzi*. Not surprisingly for *Branchinella* (Geddes, 1981; Timms, 2004) the females cannot be distinguished apart, except for *B. clandestina* and *B. longirostris* which have bulbous second antenna. These two can be separated by the prominent apical point being centrally placed in *B. longirostris*, while *B. clandestina* has a small apical point medially displaced and a notch lateral to this (cf. fig. 89 in Timms, 2004 with Fig. 1F).

### **Branchinella mcraei** sp. nov.
(Figs 2-4)

ETYMOLOGY. For Jane McRae, Western Australian Dept of Conservation and Land Management, Wanneroo, who collected the specimens and previously two other new fairy shrimp from Western Australia (Timms, 2002).

MATERIAL. HOLOTYPE: ♂ West Australian Museum (hereafter WAM) C34035. ALLOTYPE: ♀ WAM C34036. PARATYPES: WAMC34037 five ♂♂ and 5 ♀♀. OTHER MATERIAL. 13 ♂♂ and 20 ♀♀ from type locality, WAMC34038. All collected by A. Pinder & J. McRae, 27 August, 2003.

TYPE LOCALITY. Myanore Creek Pool, Pilbara, WA, 21°29.6'S, 115°46.5'E. This is site PSW014 of CALM's Pilbara study (S. Halse, pers. comm.). At the time of collection pH was 7.3, TDS 33mg/L and the pool was a very turbid reddish brown.

DESCRIPTION. *Male*. Length of adults (Fig. 3) 8.5-9.4mm; holotype 8.8mm.

First antennae approximately 3/4 length of second antenna (Fig. 4A); apex bevelled and bearing subapically three subequal short setae and typically 2 minute, recurved hair-like setae. Proximal segment of second antennae (Fig. 4A) fused basally and remainder set laterally at about 45°. Second antenna proximal segment with a longitudinal blade-like medial ridge armed with denticles; the 2 ridges separated by a central, transverse, recessed unadorned area of the clypeus somewhat shorter in length of the ridges. Distal segment of second antenna with an expanded base, remaining portion evenly thin, circular in cross section and curved medially in the middle part. An elongated patch of minute denticles on dorsal middle section and extending proximally onto expanded base; distal half with slight transverse ridges medially; apex hyaline and pointed. Distal segment slightly longer than proximal segment and generally held at right angles to the body axis.

Frontal appendage (Fig. 4B) about half body length and consisting of a wide trunk and two branches about a third of the trunk length. Each branch like an elongated triangle with a long tapering apex. Proximal half of trunk strongly pseudosegmented and unadorned. Remainder of trunk and lateral edge of branches with numerous short digitiform spineless papillae. Smaller similar papillae on the shanks of digitiform papillae and also on ventrally in rows onto the pseudosegments of the trunk and branches carrying each digitiform lateral papillae. Each row with 3-4 papillae on proximal part of trunk, increasing to 5-6 at the trunk-branch boundary, decreasing to 2-3 at the branch apex. Medial edge of each branch, ventral surface of proximal trunk, central ventral surface of distal trunk, and whole of dorsal surface of trunk and branches unadorned.

Rigid basal portion of penes (Fig. 4C) almost confined to genital segments; penes bases cylindrical and protruding a little onto first

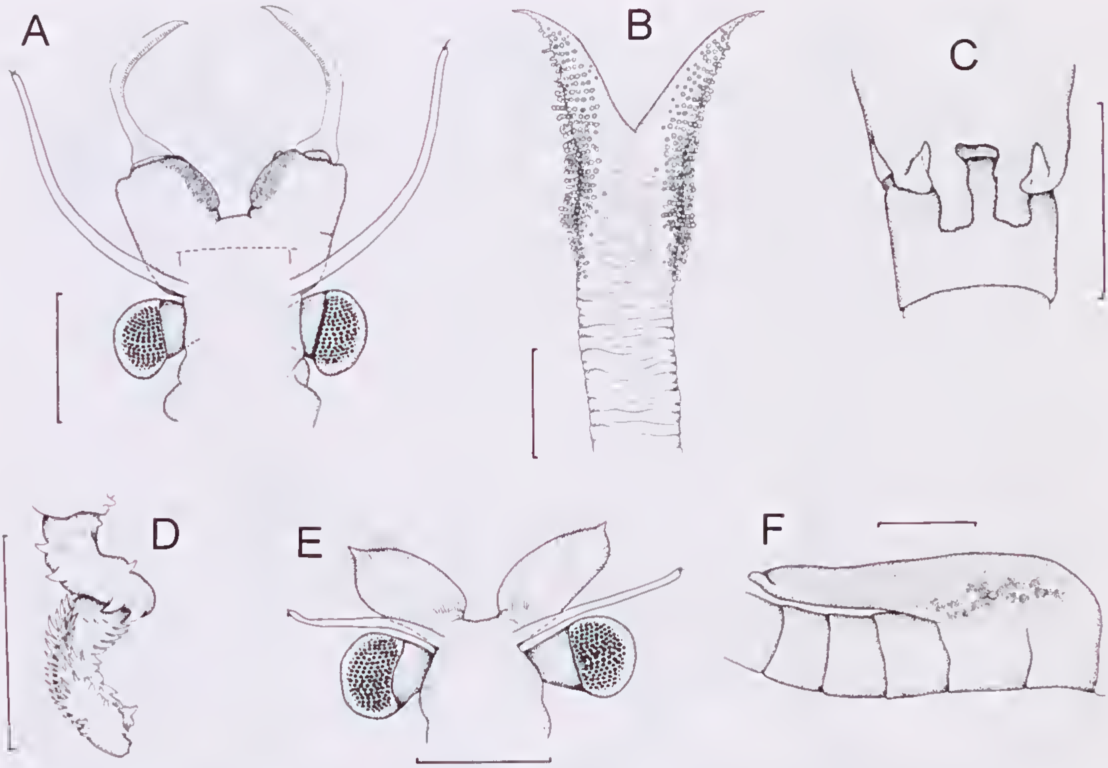

FIG. 4. *Branchinella mcraei* sp. nov. A, dorsal view of ♂ head; B, dorsal view of frontal appendage of ♂; C, rigid portion of base of penes; D, penis; E, dorsal view of head of ♀; F, lateral view of brood pouch. Scale bars = 1mm.

abdominal segment and each attended laterally by a flaccid triangular projection subequal in length to the rigid basal portion of penes. Eversible portion of penis (Fig. 4D) approximately twice as long as basal portion of penes; laterally with a single row of broadly based triangular spines and medially with a few similar spines apically, but most the medial surface covered sharp and narrow spines. Sometimes, even in the same animal, penal spines greatly reduced to a few well-spaced small spines on each surface.

Fifth thoracopod (Fig. 2B) with endites 1+2 (fused) and 3 broad with evenly curved margins bearing numerous posterior setae; endite 1+2 about 3 times the size of endite 3. Each endite with anterior seta with a pecten on one side, the second anterior seta almost twice as long as the first. Both attended by a small spine proximally. Endites 4-6 small asymmetrical protrusions covered with small spines. Endites 4, 5 and 6 with two, two and one plumose anterior setae respectively, the distal of each pair slightly longer than the proximal setae. Endites 4, 5 and 6 with three, two and two posterior setae respectively. Endopodite broadly rounded and bearing many plumose setae, long on the lateral margin decreasing to short on medial margin. Bases of these setae unadorned. Exopodite narrowly suboval and bearing numerous long setae. Epipodite suboval and unadorned and shorter than endopodite. Praeepipodite 2-3 times as long as broad and margin typically smooth, but maybe weakly serrated with minute spines on proximal lateral edge in some specimens.

Telson with cercopods approximately as long as 2.5 posteriormost abdominal segments and bearing plumose setae of both margins. Setae longest midway along each cercopod.

*Female.* Length of adults 9.2-10.0mm; allotype 9.5mm. First antennae (Fig. 4E) with setae as in male; subequal in length to second antennae. Second antenna leaf-like, about 3 times longer than wide and terminating in a symmetrically placed narrow sharp projection. Numerous small hair-like setae on the distal margin. Brood pouch (Fig. 4F) extending back over almost 6 segments, 2 genital and 3-4 abdominal; distal part

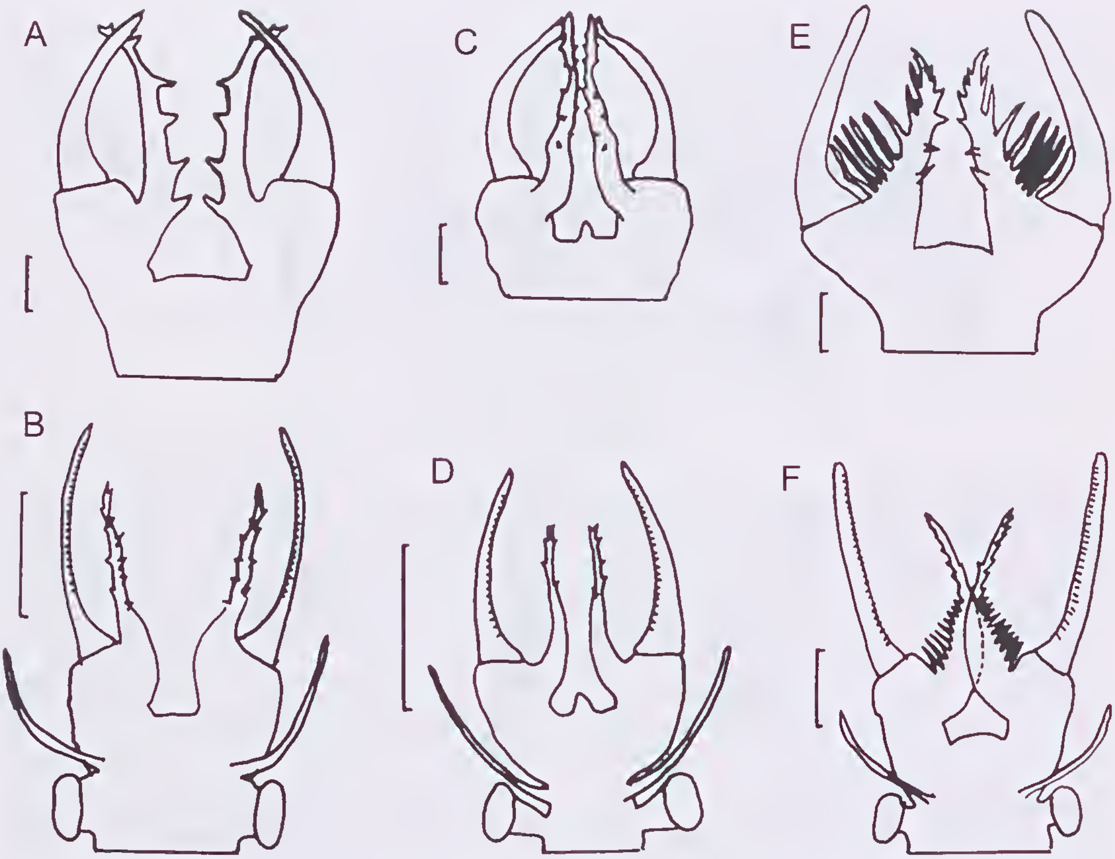

FIG. 5. Dorsal views of ♂ heads or second antennae of members of the *Branchinella nichollsi* Linder complex: A, *B. nichollsi* from Geddes, 1981, fig. 5a; B, *B. nichollsi* from Timms, 2004, fig. 54a and based on material from Lake Arrow, WA; C, *B. hattahensis* Geddes from Geddes, 1981, fig. 5b; D, *B. hattahensis* Geddes from Timms, 2004, fig. 55a; E, *B. buchananensis* Geddes from Geddes, 1981, fig. 5c; F, *B. buchananensis* Geddes from Timms, 2004, fig. 53a and based on Lake Gidgee material. Scale bars = 1mm.

cylindrical. Thoracopods and cercopods similar to those of male.

DIAGNOSIS. Male with frontal appendage in the form of a trunk and 2 simple branches. Branches about 1/3 length of trunk and with a narrow appendage apically. Flaccid triangular projection lateral to base of penes and subequal in length.

REMARKS. This species is most similar to *B. affinis*, *B. latzi*, *B. longirostris* and *B. clandestina*, due mainly to broadly similar frontal appendages. Differences between the 5 species have been discussed in the remarks for *B. clandestina*, but further comments are needed here on the distinction between *B. mcraei* and *B. latzi*, the species most similar to *B. mcraei*. The two are most easily separated by the structure of the branches of the frontal appendage. In *B. latzi* the branches are oval with a narrow appendage apically (Timms, 2004, fig. 71) compared with the triangular branches that narrow evenly apically in *B. mcraei* (Fig. 4B). A further distinction between these two species is the lateral projections to the bases of the penes in *B. mcarei* and their absence in *B. latzi*.

## THE *BRANCHINELLA NICHOLLSI* GROUP

*Branchinella nichollsi* Linder 1941 consists of 3 taxa, *B. nichollsi nichollsi*, *B. nichollsi hattahensis* and *B. nichollsi buchananensis*, originally described as subspecies by Geddes (1981) but elevated to species uncritically by Belk & Brtek (1995). A re-examination of the material available of *B. nichollsi hattahensis* and *B. nichollsi buchananensis* to Geddes and of new collections of all three taxa follows.

### **Branchinella nichollsi** Linder, 1941
(Fig. 5A,B)

*Branchinella nichollsi* Linder, 1941: 249, fig 33.
*Branchinella nichollsi nichollsi* Geddes, 1981: 264, fig. 5a.

NEW MATERIAL. WAM C34039 from Lake Arrow, via Kalgoorlie, WA, 30°32'S, 121°24'E, 14 May 1995, coll. A Chapman.

REMARKS. Both Linder (1941) and Geddes (1981) provided an adequate description of *B. nichollsi*. In brief, its distinctive features concern the lack of a frontal appendage and an antennal appendage apomedially on the basal segment of the second antenna. Geddes (1981) showed this antennal appendage as about the same length as the distal segment and with about 5 short branches subequally spaced medially (Fig. 5A). However, the new material has this appendage only about 2/3 length of the second segment and with about 10 unorientated papillae (Fig. 5B). The penes have ligulate lobes lateral to their bases (Linder, 1941; Geddes, 1981); in the new material these lobes are curved laterally and slightly longer than the base of the penes (Timms, 2004, fig. 54b). This is a minor difference and is considered intraspecific variation. The thoracopods are also distinctive (Linder, 1941; Geddes, 1981, fig. 5c) with the large endopodite (significantly larger than the exopodite in all thoracopods except the first) and the posterior setae numbering 6-7:5-7:5 on endites 4, 5, and 6 respectively, instead of 3:2:2 as in most other Australian species of *Branchinella*.

DIAGNOSIS. Male lacks a frontal appendage, but has an apomedial outgrowth from basal segment of second antenna. Outgrowth tubular with short or long papillae along whole length. Clypeus without a blunt triangular outgrowth medially. Base stem of penis without a transverse protrusion laterally.

### **Branchinella buchananensis** Geddes, 1981
(Figs 5E,F, 6, 7)

*Branchinella nichollsi buchananensis* Geddes, 1981:264, fig 5e.
*Branchinella buchananensis* Geddes; Belk & Brtek, 1995: 323-324.

ETYMOLOGY. From Lake Buchanan.

MATERIAL. LECTOTYPE: ♂ QMW26939. PARALECTOTYPES: two ♂♂, QM 26940, 12 ♀♀, QM W26941; All collected by T.S. House, 10 July, 1971. OTHER MATERIAL. QMW26942, QMW216943, Hatch Lake, Wombah Station, via Hungerford, 28°56'S, 144°57'E, QMW26944, QM W26945, Gidgee Lake, NW NSW, 29°33'S, 144°50'E.

TYPE LOCALITY. Lake Buchanan, NE Qld, 21°36'S, 145°52'E.

DESCRIPTION. *Male*. Length of adults 19.2-31mm; lectotype 23mm. First antennae 80% the length of the proximal segment of the second antenna (Fig. 6A); apex bevelled and bearing a subapical tuft of 3 short subequal setae. Second antennae (Fig. 6A) fused at base with much of the basal segment cylindrical. Distal segment of second antennae with a swollen asymmetrical base with remaining portion evenly thin, rounded in cross section and bent slightly medially just beyond the base. Distal segment a little longer than proximal segment. Dorsal surface of distal segment covered with small polygons, which are elongated a little towards the apex; ventral surface with small raised transverse ridges.

Frontal appendage absent. Antennal appendage present on the medial surface of proximal segment of second antenna (Fig. 6A). Antennal appendage lamellar at base narrowing apically and about two-thirds the length of distal segment of second antenna. Antennal appendage bears numerous long papillae on lateral surface, gradually becoming shorter towards the apex and eventually replaced by short papillae apically which also extend halfway down the distomedial margin. Proximal 10 (or so) of the long papillae terminating in spiny anvil-like expansions, with remainder and the short papillae terminating in a sharp point, each with a few short lateral spines.

Rigid basal portion of penes (Fig. 6B) cylindrical and protruding onto about 1/3 of the first abdominal segment. Each penis base attended laterally by a conical soft outgrowth protruding beyond the bases of the penes and separated from them basally by a hemispherical cavity rimmed laterodorsally by the outgrowth. Penis not extended on lectotype or paralectotypes, but one is available in the Gidgee Lake material (Fig. 6C). Everted penis about 2mm long (whole animal length 29mm) and almost the length of first two abdominal segments. A narrow row of broadly based asymmetrical spines on lateral surface and a broad row of similar spines on medial surface near apex, but subapically changing to numerous narrow spines. All spines point basally.

Fifth thoracopod (Fig. 7) with endites 1+2 (fused) and 3 broad with evenly curved margins bearing numerous posterior setae (ca 40 and 10 respectively); endite 1+2 almost 3 times the size of endite 3. Endite 1 +2 with two anterior setae,

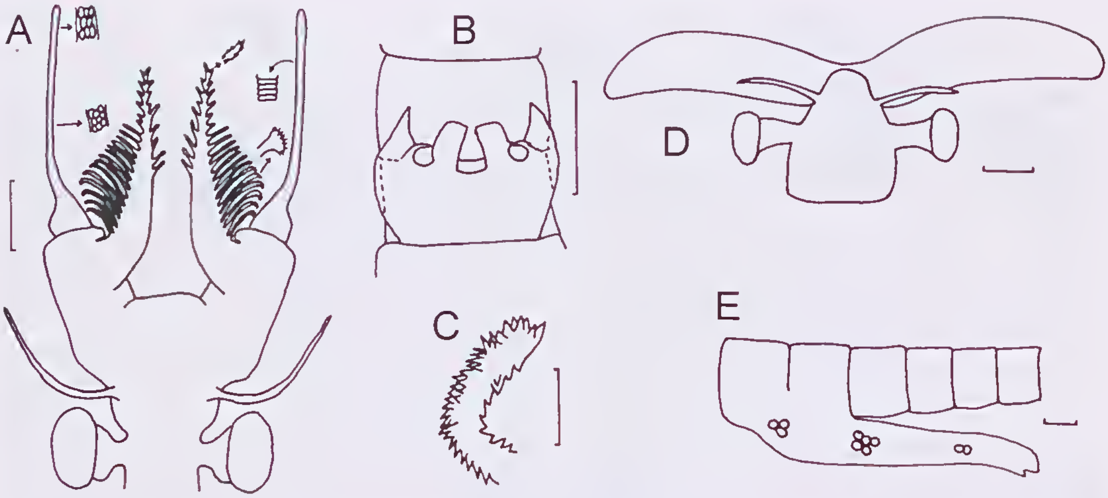

FIG. 6. *Branchinella buchananensis* Geddes. A, dorsal view of head of ♂ holotype; B, ventral view ♂ genital segments; C, lateral view of ♂ penis from Lake Gidgee; D, dorsal view of head of ♀ allotype; E, lateral view of brood pouch of ♀ allotype. Scale bars = 1mm.

the basal one smooth and with no subtending spine, the distal one with a double row of pectinate setae on one side and a small subtending spine. Anterior setae of endite 3 almost twice the length of the anterior setae of endite 1+2 and with a double row of pectinate setae on one side. Endites 4-6 asymmetrical protrusions about the size of the 3rd endite and covered with small spines. Endites 4, 5 and 6 with two, two and one anterior setae respectively, and six, five and five posterior setae respectively Proximal anterior setae of endites 4 and 5 smooth and twice as long as distal anterior setae; later with a double row of pectinate setae. Endopodite large, twice as long as exopodite and broadly triangular with a blunt apex. Setae (about 14) on medial surface smooth, but with a few short spines crowning pedestal-like bases and with a cluster of very small spines near and beyond a small pit about a third way along their length. Setae on medial surface of endopodite and the posterior setae of the endites glabrous. Setae on lateral surface plumose and with 0-8 spines crowning their pedestals. These setae decrease in length basally and in number of crowning spines on the pedestals (6-8 near apex, 3-5 midway, and 0-1 basally). Exopodite subquadrate but with a rounded apolateral corner. Its setae numerous (>50), thinner and longer than exopodite setae, but still plumose and with pedestals crowned with little spines (3-6). Epipodite oval three times longer than wide and unadorned. Praeepipodite twice as long as broad and with minor crenulations on lateral margin.

Telson with cercopods about as long as last two abdominal segments. Cercopods bear plumose setae of both margins; these setae almost subequal along each cercopod, but definitely shorter proximally and apically.

*Female.* Length of adults 20-33mm, paralectotype 28mm. First antennae (Fig. 6D) filiform and about one third the length of second antenna. Second antenna lamellar with a rounded asymmetrical apex and reaching back to 2nd or 3rd thoracic segments. Brood pouch (Fig. 6E) extending over genital segments and almost four abdominal segments; distal part cylindrical. Thoracopods and cercopods similar to those of male.

DIAGNOSIS. Male lacks a frontal appendage, but has an apomedial antennal appendage from basal segment of second antenna. Proximally this appendage is lamellar with numerous long lateral papillae. Base of penis without a transverse protrusion laterally.

REMARKS. Material from Gidgee Lake differs slightly from the type material from Lake Buchanan and also from the Hatch Lake sample. The antennal appendage has fewer long papillae than in the Lake Buchanan specimens, with only 7-8 anvil-tip papillae and 4 of the spear-pointed papillae in the September 1998 sample. The May 2000 sample differs further in that these long papillae are without specially modified apices and are also fewer in number (Fig. 5F). Also the surface of the claspers is unadorned. Given that these Gidgee specimens (mean length 18.7mm) are smaller than Buchanan specimens (mean length 24.8mm) and the September 1998 Gidgee males (mean length 28mm), they may be undeveloped (meaning that the apices differentiate later in development, and that adornment of the distal segment of the second antenna are also a late-developing feature). On the other hand, all Gidgee specimens had a reduced number of long papillae on the apomedial outgrowth of the second antenna, so this character is not fixed in this species.

### **Branchinella hattahensis** Geddes, 1981
### (Figs 5C,D, 8)

*Branchinella nichollsi hattahensiss* Geddes, 1981: 264, fig 5b.

*Branchinella hattahensis* Geddes; Belk & Brtek, 1995: 324.

ETYMOLOGY. From Hattah Lake.

MATERIAL. LECTOTYPE: ♂, QMW26946, November 1971, coll. G Arthur; PARALECTOTYPES: four ♂♂, one ♀, QMW26947 November 1971, coll. G Arthur. OTHER MATERIAL: QM W26948, Lake Numalla, 28°42'S, 144°19'E, QM W26949, Mid Kaponyee Lake, Currawinya National Park, SW Qld, 28°50'S, 144°19'E, QM W26950, South Kaponyee Lake, Currawinya National Park.

TYPE LOCALITY. Hattah Lake, 34°44'S, 142°21'E, NW Victoria.

DESCRIPTION. *Male*. Length of adults 18-44mm; lectotype 44mm. First antennae subequal in length to proximal segment of the second antenna (Fig. 8A); apex bevelled and bearing subapically a tuft of 2-3 subequal short setae. Second antennae proximal segments (Fig. 8A) fused at base with approximately half of distal portion free, cylindrical and aligned with body axis. Clypeus with a blunt triangular outgrowth ventromedially. Distal segment of second antennae with a swollen asymmetrical base with long, thin remaining portion, rounded in cross section, slightly curved medially but near apex curvative reversed so that apex curved laterally. Distal segment about 1.5 times longer than proximal segment. Dorsal surface of distal segment granulated, ventral surface with small raised transverse ridges.

Frontal appendage absent. Antennal appendage present on medial surface of proximal segment of second antenna (Fig. 8A). Antennal appendage tubular, narrowing only a little along its length and almost as long as the distal segment of antenna; numerous short papillae on apical half.

Rigid basal portion of penes (Fig. 8B) cylindrical and protruding onto approximately a third of the first abdominal segment. Mid length each penis base with a short transverse protrusion laterally and attended laterally by a pointed soft outgrowth about same length as bases of penes and separated from them basally by a hemispherical cavity. Everted penis about 3mm long and almost the length of two abdominal segments. A narrow row of broadly based asymmetrical spines on lateral surface and a broad row of similar spines on medial surface near apex, but subapically changing to numerous narrow spines. All spines point basally.

Fifth thoracopod as in *Branchinella buchananensis* but with epipodite relatively shorter, i.e. length twice width.

Telson and cercopods also as in *Branchinella buchananensis*.

*Female*. Length of adults 16-45.5mm, paralectotype 45.5mm. First antennae (Fig. 8C) filiform and about 1/4 length of second antenna. Second antenna lamallar with a markedly asymmetrical apex with a blunt point and reaching back to 2nd or 3rd thoracic segments. Brood pouch (Fig. 8D) extending back over 2 genital segments and 3.5 abdominal segments; distal part cylindrical. Thoracopods and cercopods similar to those of male.

DIAGNOSIS. Male lacks a frontal appendage, but has an apomedial antennal appendage from basal segment of second antenna. Antennal appendage tubular with short papillae on apical half. Clypeus with a blunt triangular outgrowth ventromedially. Base of penis with a transverse protrusion laterally.

REMARKS. The Queensland material is slightly different from the Victorian specimens in that the antennal appendage is only about 3/4 length of the distal segment of the second antenna and has fewer papillae (Fig. 5D). This difference may not be phenotypic, but could be developmental (cf. remarks on *B. buchananensis*).

## DISCUSSION

*Branchinella clandestina* sp. nov. and *B. mcraei* sp. nov. have characteristics which place them in Geddes (1981) Group II: both have a frontal appendage consisting of a long trunk and two simple branches, short endopodites, and 2-4 anterior setae on endites 4-6. Geddes (1981)

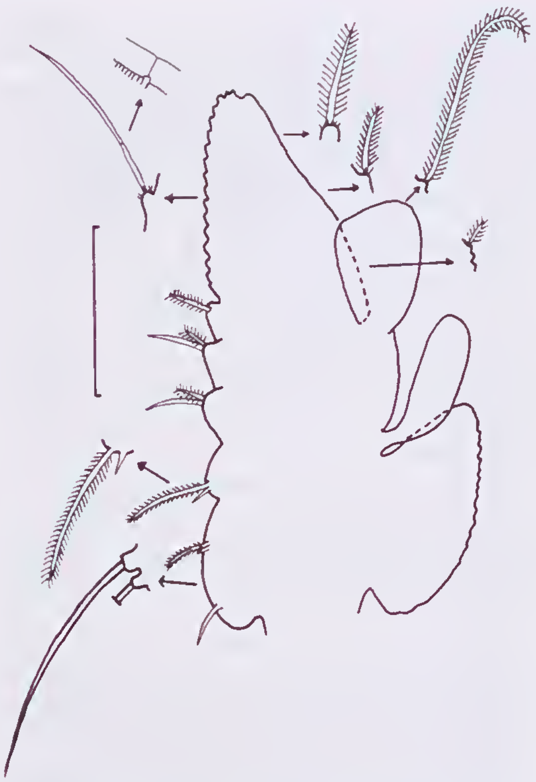

FIG. 7. Fifth thoracopod of *Branchinella buchananensis* Geddes. Scale bar = 1mm.

places the *B. nichollsi* complex (*B. nichollsi*, *B. hattahensis*, *B. buchananensis*) among his Group I species, because of their large, robust bodies, long endopodites which are sparsely setulated medially, numerous anterior setae on endites 4-6, and females with long second antennae. While these similarities seem valid morphologically, relationships between species based on mitochondrial DNA did not support these 2 groupings, though it did recognise his Group III (Remigio et al., 2003). Group II species separated on their DNA affinities as 2 groups quite distinct from each other; it is not known to which of the 2 subgroups the new species belong . Group I species also comprise 2 well separated groups, with *B. hattahensis* and *B. buchananensis* comprising 1 subgroup (and presumedly *B. nichollsi* also belongs here). The other subgroup contains *B. australiensis* and *B. occidentalis*.

The 3 species in the *B. nichollsi* group are closely related, probably more so than other species of *Branchinella*. Based on mitochondrial DNA evidence, Remigio et al. (2003) claimed they are of subspecies status, but there are many distinct morphological differences between the three. In antennal features, *B. buchananensis* is quite different with its antennal appendage having many long papillae on basolateral surface and shorter papillae apically, compared to only a few short papillae mainly in the apical half in *B. nichollsi* and *B. hattahensis*. In the later pair there is some variation between populations in these papillae (for *B. nichollsi* compare Fig. 5A with 5B; and for *B. hattahensis* compare Figs 5C, 8A with 5D). These 2 species are however easily separated on antennal features, since *B. hattahensis* has a medial process on the clypeus and *B. nichollsi* does not. The 3 are also easily separable on features of the male genital area. Both *B. hattahensis* and *B. buchananensis* have a hemispherical cavity between the penis base and lateral outgrowth, whereas *B. nichollsi* does not. *B. hattahensis* is unique in having a transverse ridge on the penis base. The penes themselves are similar in structure in *B. buchananensis* and *B. hattahensis*; no data are available for *B. nichollsi*. Another difference between the species is in the structure of the fifth thoracaopod, with this time *B. nichollsi* being the most different. It has 7:7:5 posterior setae on endites 4-6, whereas the other two have 6:5:5 respectively. This slightly greater number of posterior setae is reflected elsewhere on the thoracopod, e.g. ca 50 on the first endite in *B. nichollsi* compared to ca 40 in the other 2 species. These differences are about the same order of magnitude as perceived differences among the *B. affinis* group (*B. affinis*, *B. clandestina* sp. nov., *B. latzi*, *B. longirostris*, *B. mcraei* sp. nov. — see earlier in remarks about *B. clandestina* sp. nov.) and also, for example, between *B. halsei* and *B. lyrifera* (Timms & Geddes, 2003). These comparisons indicate that division at the species rank is warranted.

The females of all 3 forms are inseparable from each other, not unusual for *Branchinella* (Geddes, 1981; Timms, 2004). However, *B. buchananensis*, *B. hattahensis* and *B. nichollsi* together are distinguishable from other females of *Branchinella* (Timms, 2004). This is because of the lamellar second antennae (Fig. 6B) being about twice the length of the intereye distance, and so much shorter than the lamallar antenna of *B. australiensis* and *B. occidentalis* and much bigger than those of most other species. The brood sac (Fig. 6C) tends to be almost 6 segments long overall and thus is a little longer than in many species of *Branchinella* where it is about 5 segments long.

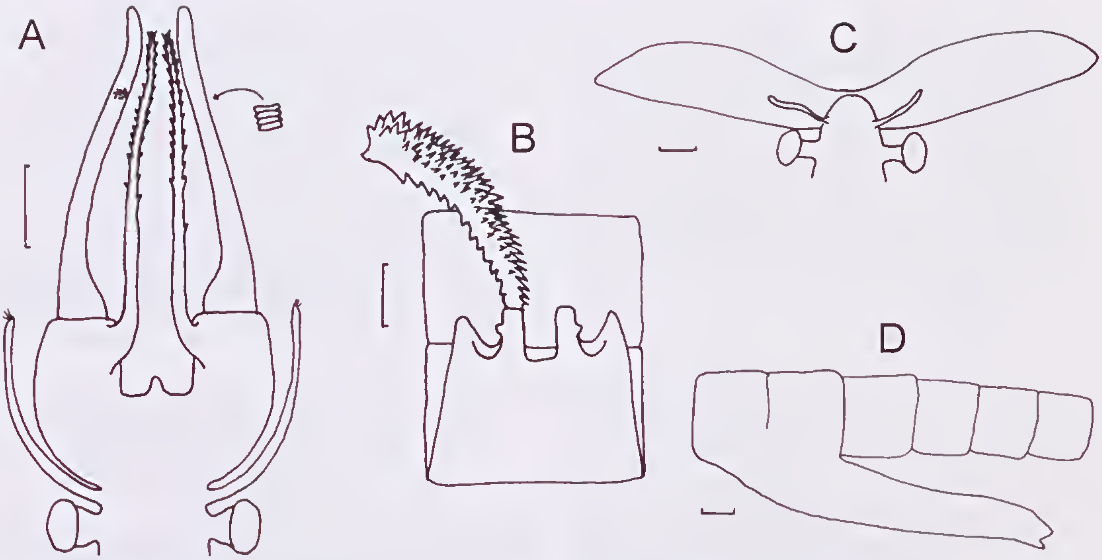

FIG. 8. *Branchinella hattahensis* Geddes. A, dorsal view of ♂ head; B, ventral view of ♂ genital area with one penis everted; C, dorsal view of head of ♀; D, lateral view of brood pouch of ♀. Scale bars = 1mm.

Ecologically, there are similarities but some differences between the 3 species. Geddes (1981) thought, on limited evidence, that all 3 species were halophilic; certainly *B. buchananensis* was reported to live in waters from 15.7-42.6g/L. However Timms (2002) showed that *B. nichollsi* lives in fresh — hyposaline conditions and the highest actual salinity recorded is only 1.5g/L in Lake Arrow (Chapman & Timms, in press). My unpublished records from the Paroo show *B. hattahensis* can live, at most, in subsaline water (i.e. < 3g/L) and *B. buchananensis* lives in hyposaline waters to 15.1g/L. So it seems that *B. buchananensis* is the species with the greatest halotolerance, with the other 2 only slightly more tolerant than most other *Branchinella*, except *B. simplex* and *B. australiensis* (Geddes, 1973). Halotolerance refers to NaCl waters, virtually the only type in Australia (Hart & McKelvie, 1986). Another ecological difference between the 3 species is that *B. nichollsi* and *B. buchananensis* live in lakes that are usually have clear water, whereas *B. hattahensis* lives in turbid freshwater lakes that may increase in salinity as they dry. *B. nichollsi* is apparently confined to a small area in the eastern Goldfields of WA, while *B. hattahensis* occurs from N Victoria to SW Qld, with the northern part of this range overlapping with the distribution of *B. buchananensis* which is now known from NW NSW to NE Qld. The area of overlap is quite small and is restricted to a small area near Hungerford, SW Qld; in this area, as elsewhere, the 2 species inhabit different types of lakes (Timms & Sanders, 2002).

While the 3 forms in the *B. nichollsi* complex have many morphological similarities, some ecological similarities and are very closely placed in the phylogram of Remigio et al. (2003), I believe they are distinct species, as did Belk & Brtek (1995). Despite some variation between populations, some of which is explainable as variation due to stage of development (as in *B. buchananensis* in Gidgee Lake), each is now known from a number of sites and they are always distinct morphologically. Furthermore, *B. buchananensis* and *B. hattahensis* are sympatric but apparently do not interbreed.

The 5 species discussed here are of very unequal conservation status. *B. buchanenensis* has legal status as a vulnerable fish species in NSW (Anon, 2002), but it is unprotected in Queensland. The rationale for this is the limited habitat in NSW is threatened by gypsum mining whereas in Queensland there are no threats to its habitat. The other 4 species are unprotected, and although rarely collected, the habitats of 3 of them are unthreatened. The exception is *B. nichollsi* whose habitat is some episodic salinas in the eastern goldfields of WA (Timms, 2002). The problem is that the hydrology of some of these is being changed by either mining directly on the lake or using the lake as a receiving basin for saline groundwater. In that the species apparently hatches and grows only in fresh or slightly saline water, the addition of extra salt in its habitat could threaten its existence (see Timms, in press). If IUCN (2000) Red List criteria were applied to the conservation status of these species, all would be classed as 'data deficient' because so little is known on their biology, but more research would probably result in a 'vulnerable' classification for *B. nichollsi* and *B. buchananensis*.

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