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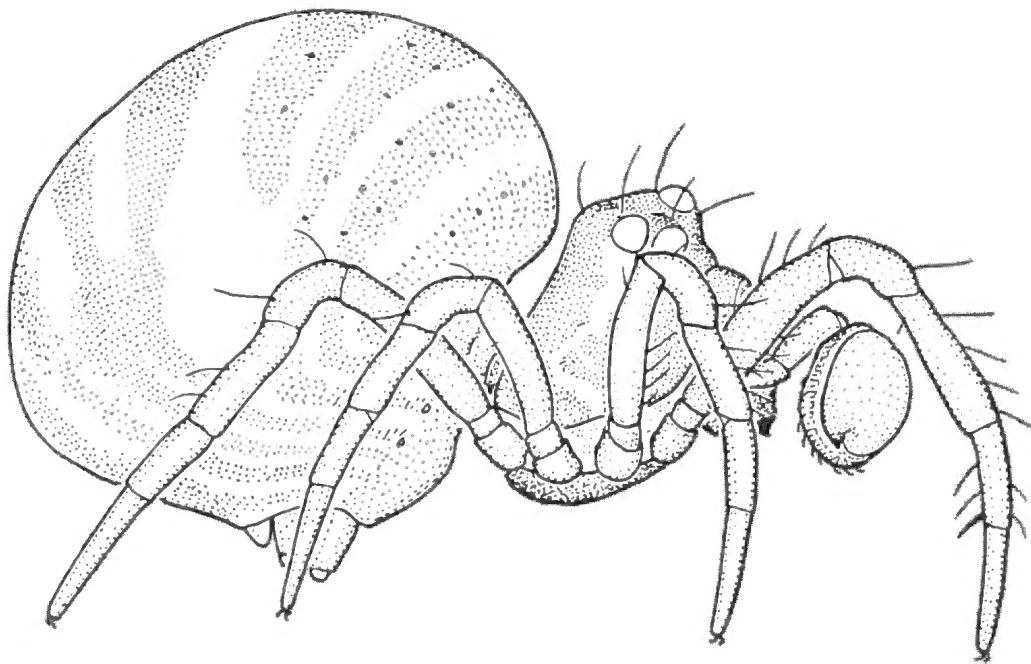
WAMBO PUTICASUS GEN. ET SP. NOV., A NEW RUTELINE FROM SOUTH QUEENSLAND (COLEOPTERA : SCARABAEIDAE)

P.G. Allsopp

Wambo puticasus gen. et sp. nov. is described from specimens collected in a pitfall trap near Dalby, south Queensland. It is closely related to *Anoplostethus* Brullé, *Epichrysus* White and *Paraschizognathus* Ohaus.
☐*Wambo, Rutelinae, Scarabaeidae, Coleoptera.*

P.G. Allsopp, Bureau of Sugar Experiment Stations, PO Box 651, Bundaberg, Queensland 4670; 28 October, 1987.

Carne (1958) last revised the Australian Rutelinae, placing most species in the Anoplognathini. He separated the two component subtribes, Anoplognathina and Schizognathina, on the presence or absence, respectively, of an anteromedian labial process which curves into the mouth cavity. The Anoplognathina comprise six genera, *Calloodes* White, *Repsimus* Macleay, *Anoplognathus* Leach, *Epichrysus* White, *Anoplostethus* Brullé and *Paraschizognathus* Ohaus. A further four species have since been added to *Paraschizognathus* (Carne, 1974; Allsopp and Carne, 1986a) and four to *Anoplognathus* (Carne, 1981; Allsopp and Carne, 1986b). The majority of Anoplognathina occur on or near the coasts and males are often attracted to lights. This paper describes a seventh genus from south Queensland.

ANIC = Australian National Insect Collection; QM = Queensland Museum.

Wambo gen. nov.

Type species: *Wambo puticasus* sp. nov.

DESCRIPTION

Male: Labrum with small anteroventral process contiguous with apex of labium. Clypeus (Fig. 1) transverse, length:width ratio 1:2.1, anterior margin more reflexed than lateral margins, lateral margins strongly anteriorly-divergent, dorsally glabrous; frontoclypeal suture distinct, with very slight posteriorly-directed median node. Frons (Fig. 1) setose, triangularly flattened. Mandibles without tooth at apex. Maxillary palps with terminal segment enlarged, dorsal surface with large oval sensorium. Labium with scattered long setae,

impressed at suture with submentum; mentum strongly pigmented at apex, forming small process curving into mouth cavity; labial palps small, sickle-shaped. Antennae 10-segmented, club 3-segmented, club shorter than shaft. Pronotum (Fig. 1) with posterior margin with single median lobe, disc glabrous. Elytra (Fig. 1) with intervals punctate, disc glabrous; epipleurae narrowly membranous, with lateral setae, posteriorly glabrous. Hind wings fully developed. Postcoxal process of prosternum short, broadly rounded with anterior longitudinal carina. Mesosternal process absent. Ventral thorax covered with abundant long setae. Fore tibiae 3-dentate; fore tarsal segments 1–4 *ca* as long as 5, without patches of specialised setae on segments 1–2; hind legs not enlarged; claws of all legs unequal, simple, the larger with weak longitudinal striation. Abdominal sternites setose. Pygidium densely setose, surface faintly transversely-wrinkled (difficult to see under setae).

Female: Unknown.

The generic name is of Aboriginal origin and is the name of the Shire in which the type locality of *W. puticasus* is situated. It is to be treated as masculine and acknowledges the interest in the area's fauna shown by the Lake Broadwater Natural History Association.

Wambo is most closely related to *Anoplostethus, Epichrysus* and *Paraschizognathus* in having the posterior margin of the pronotum rounded as a single lobe and a membranous border to the epipleurae, and in lacking a mesosternal process. *Wambo* differs from *Anoplostethus* in having the frons and lateral epipleurae setose, the antennal club longer relative to the shaft and a small, rather than a large and truncate, postcoxal pronotal
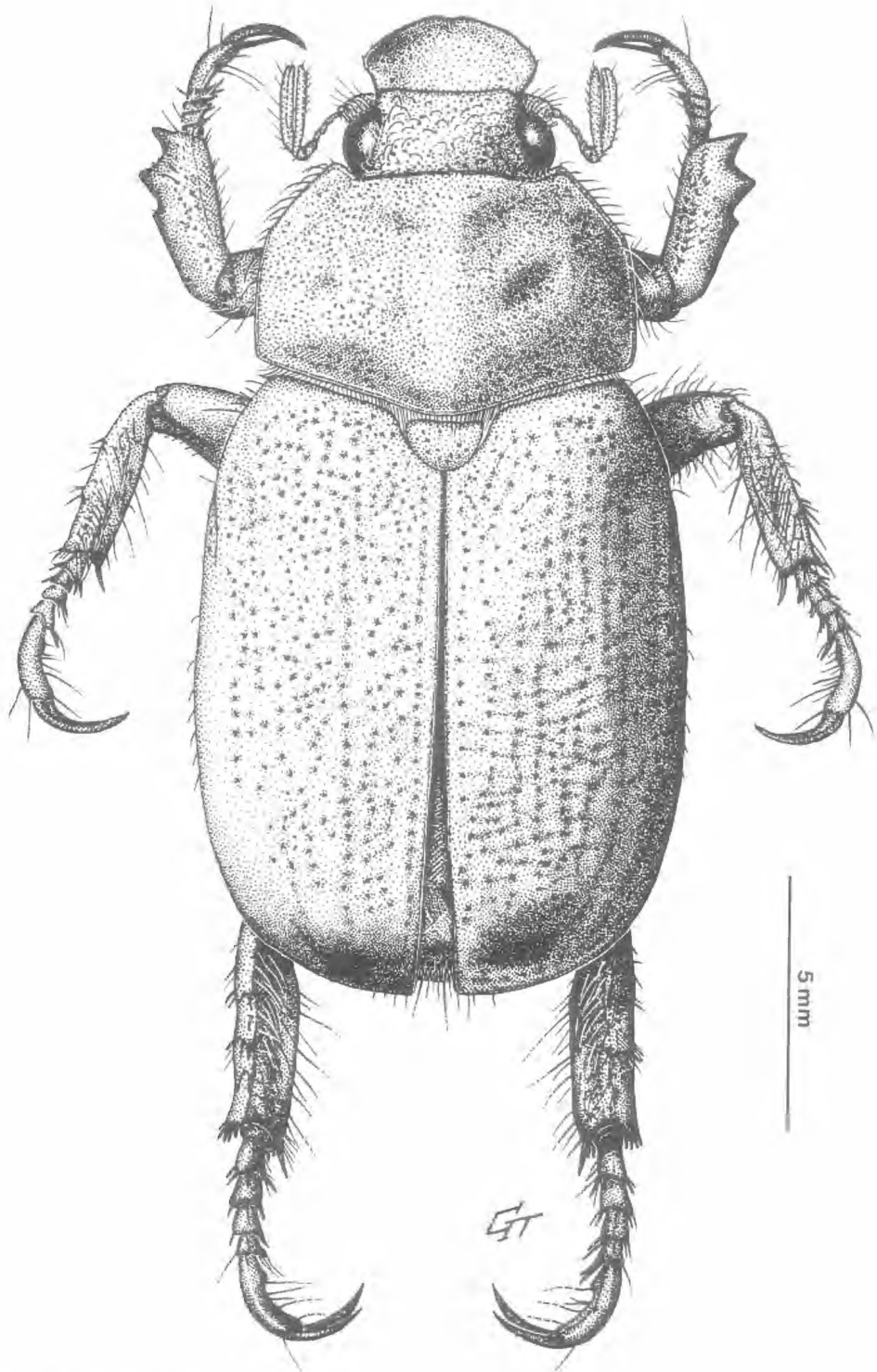
FIG 1. *Wambo puticasus* gen. et sp. nov. holotype male: dorsal view.

process, and in lacking dense patches of specialised setae on tarsal segments 1–2 and either adpressed white scales or a dense patch of specialised setae on the mentum. From *Epichrysus, Wambo* differs in having a glabrous pronotum and a more transverse clypeus with anteriorly-divergent sides. The more transverse clypeus with divergent sides of *Wambo* also distinguishes it from *Paraschizognathus*. In Carne's (1958) key to the Anoplognathina *Wambo* will not key past couplet 4. It may be included in the key by deleting couplets 4 and 5 and substituting the following:

4. Epipleurae glabrous or with decumbent white setae at base; males with specialised setae in a patch on mentum and on underside of fore tarsal segments 1–2 (Carne, 1958, figs 15–16) or with adpressed white scales on lateral mentum .... *Anoplostethus* Brullé
   Epipleurae with lateral setae; males without specialised setae or adpressed white setae on mentum or fore tarsi 5
5. Disc of pronotum setose ....
   .... *Epichrysus* White
   Disc of pronotum glabrous 6
6. Clypeus twice as wide as long, sides curved, anteriorly-divergent (Fig. 1) ....
   .... *Wambo* gen. nov.
   Clypeus less than twice as wide as long, sides slightly curved or straight, parallel or convergent (Carne, 1958, figs 19–20,23,25–31, 33; Carne, 1974, figs 2,5,14; Allsopp and Carne 1986a, fig. 1) ....
   .... *Paraschizognathus* Ohaus

Wambo puticasus sp. nov.

DESCRIPTION
  Male: Total length 18.4–18.7 mm.
  Clypeus, pronotum, scutellum, elytra, ventral thorax, femora and tibiae brown with green sheen, green sheen very pale or missing from some patches and replaced with red; frons darker green to blue with lighter green patches; pygidium, abdominal sternites and tarsi brown; antennae light brown; thoracic setae light yellow; abdominal setae white. Labrum with transverse row of setae. Clypeus (Fig. 1) with anterior margin rounded with slight median indentation; anterior face with scattered long setae arising from punctures; dorsum with punctures, surface shagreened. Frons (Fig. 1) with long setae arising from punctures, setae less dense near posterior margin, surface shagreened; canthus crossing ⅓ eye width, setose. Mandibles setose on lateral face and near apex. Maxillary palps with few long setae on segments 1–2, segment 3 with scattered minute setae. Labial palps with segment 2 produced around outer base of segment 3, apex of outer edge of segment 2 with long stout seta. Antennal shaft 1.2 times length of antennal club, scattered setae on both club and shaft. Pronotum (Fig.1) with length:width ratio 1:1.6, few long white setae along posterior margin and few short white setae on anterior margin near angles, disc with scattered punctures denser anteriorly and near centre line, surface shagreened, anterior margin with groove continuing across middle, posterior margin with well-defined ridge continuing across middle, anterior angles slightly acute but rounded, posterior angles obtuse and rounded, lateral margins with broadly rounded angle anterior to mid-line. All coxae and femora with scattered long setae; fore tibiae with line of strong yellow setae in line level with outer edge of tarsi, shorter white setae between these and inner edge, inner margin with long yellow setae, outer portion with few medium setae and scattered minute setae; mid and hind tibiae with 1 strong carina and 1 less-defined carina; tarsi with lower surface of segments 1–4 with 2 strong spines, each of these segments more produced ventrally than preceding, segment 5 with ventral notch. Scutellum setose towards basal angles, scattered setose punctures towards apex, remaining surface smooth, apex rounded. Elytra (Fig. 1) with intervals punctate, surface transversely wrinkled, apices square; epipleurae with membranous border continuing to apices. Pygidium with dense decumbent white setae, scattered longer erect yellow setae towards lateral margins and apex. Aedeagal parameres (Figs 2–3) symmetrical, tapering towards apex, slightly and gradually reflexed backwards along length, setose on inner surface near apex.
  Female: Unknown.
  The specific name is a compound noun in apposition formed from the Latin *puteus*, a pit, and *casus*, a fall, and refers to the collection method.
  Both specimens were taken in the one pitfall trap 2 km south of Lake Broadwater (G.B. Monteith pers. comm.). The trap was set in an
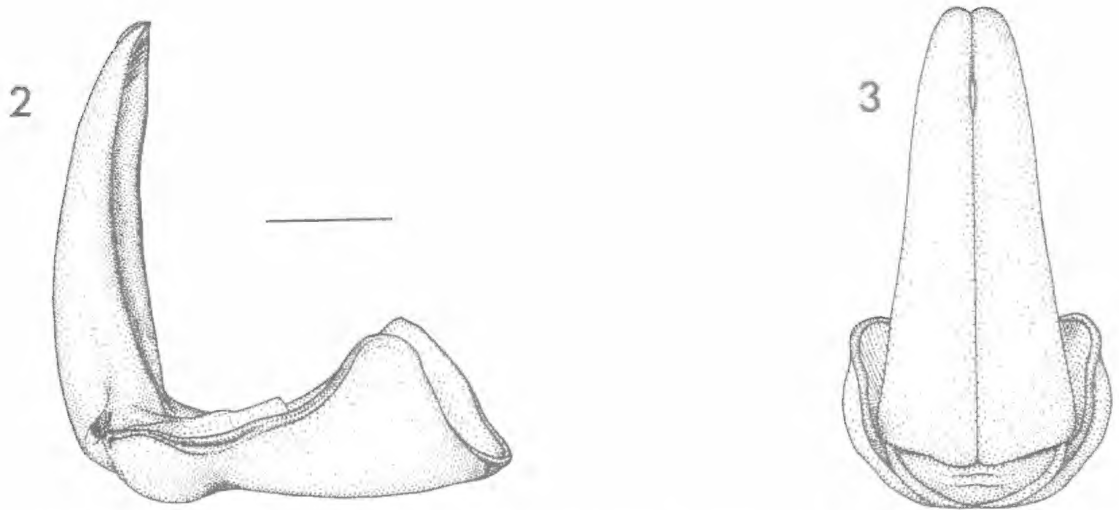
FIGS 2–3. *Wambo puticasus* gen. et sp. nov. holotype male: aedeagal parameres (scale line is 1mm): (2) lateral; (3) dorsal.

area of deep sand dominated by *Lomandra* sp. (mattrush) and with mixed eucalypts and scattered cypress pine (*Callitris* sp.). Six other traps set in this area and 63 traps set in nine other vegetation types in the Lake Broadwater area and left in place for 15 months yielded no further specimens. As all traps were roofed, both specimens must have entered by walking. They were possibly on the ground searching for a pheromone-emitting female.

The absence of green pigment from patches of the dorsal surface and replacement with dark red is similar to the variation in colour found in *Anoplostethus roseus* Blanchard (Carne, 1958). Both specimens have been partially squashed in pinning, making an apparent deep re-entrant angle between the elytra appear as an artefact.

ACKNOWLEDGEMENTS

The specimens were collected during a survey of the Lake Broadwater Environmental Park being conducted by the Lake Broadwater Natural History Association and the Queensland Museum as an Australian Bicentenary Project. I thank Dr Geoff Monteith and Mr Geoff Thompson, Queensland Museum for the loan of specimens and for the illustrations, respectively. Dr Phil Carne, CSIRO is thanked for his encouragement and advice.

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A NEW GENUS AND SPECIES OF GONEPLACID (CRUSTACEA : BRACHYURA) FROM QUEENSLAND, AUSTRALIA

P.J.F. DAVIE

Australocarcinus riparius gen. nov., sp. nov. is described from estuarine habitats in north Queensland. It resembles *Speocarcinus* species in overall facies but differs from them by the shape of the third maxilliped; pleopods one and two being subequal in length; and the second pair of legs being the longest not the third pair. It appears likely that this species broods its young until the megalopal or juvenile stage.
☐*Crustacea, Brachyura, Goneplacidae, Australocarcinus riparius, estuary, ecology, reproduction, abbreviated development.*

P.J.F. Davie, Queensland Museum, PO Box 300, South Brisbane, Queensland, 4101, Australia; 28 August, 1987.

In late 1986 the Mangrove Research Unit of the Australian Institute of Marine Science (A.I.M.S.), at Townsville, sent to the Museum specimens of a goneplacid crab they collected from a soft mud bank of the Murray River, NE.Q. This crab was remarkable in two ways: firstly, it did not appear to fit any previously described genus; and secondly the mature female was accompanied by 18 fully formed juveniles. These juveniles were apparently closely associated with the adult at the time of capture although they weren't detected until they were found, separated from the female, when she was washed from the 'handful of mud we threw into the bottle'. A subsequent trip to the area in January 1987 yielded several ovigerous females which were brought back to the laboratory alive but which later died. To the author's knowledge direct development is rare among brachyura and has not previously been found in members of the family Goneplacidae. The Museum mounted an expedition to north Queensland in March 1987 with one aim being to collect more specimens, and hopefully, to find either females with juveniles or ovigerous females which could be kept alive while the eggs developed. Unfortunately although a large number of specimens were collected none showed any egg development.

Queensland Museum is abbreviated in the text as QM. Measurements given, where not otherwise indicated, are of carapace breadth (c.b.).

Australocarcinus gen. nov.

DIAGNOSIS

Carapace smooth and glabrous, regions poorly defined; anterolateral margins rounded and dentate, posterolateral margins subparallel. Front about ⅓ of the total carapace width, formed of two rounded lobes, moderately deflexed, and without preorbital lobes or teeth. Orbits small, unarmed, with slightly raised rim. Eyestalks short, moveable, and with well developed corneas; completely retractable within orbit. Chelae robust, not markedly dissimilar although one slightly larger than the other. Legs long and slender, hirsute, second pair the longest. Male abdomen with segments three to five fused, segment three expanded laterally, slightly wider than segment one, neither segments one or three cover the sternum between the last pair of legs. Sternal segment eight in the male formed of two discrete plates; in female of normal form. First male pleopod stout, straight, and tapering to a simple apex; second male pleopod as long as first, slender but with reduction in width at about the middle, also ending in a simple apex.

REMARKS

The type species is *Australocarcinus riparius*.

In overall appearance, this genus appears closest to the American genus *Speocarcinus* to which it keys out. It does however differ in a number of important characters. 1) The merus of the 3rd maxilliped is quadrate, subequal in size and shape to the ischium and its anteroexternal angle is not especially prominent. 2) The 2nd ♂ pleopod is fine, and equal in

length to the 1st ♂ pleopod, 3) The epistome is quite broad, 4) The second pair of legs is the longest not the 3rd pair.

I am unable to confidently comment on its relationships to other genera. It clearly does not belong to the Rhizopinae which has recently been redefined and placed in the Pilumnidae (Ng, 1987). The rhizopines have typical pilumnid features, i.e. long, slender and sinuous first male pleopods; very short and sigmoid second male pleopods; and all male abdominal segments free. Because of this definition a number of genera can no longer be considered to belong to the Rhizopinae, but their new affiliations are in doubt. This group is currently under consideration pending a full revision by Dr D. Guinot (pers. comm.). *Australocarcinus* must also lie within this group.

The lengthened 2nd ♂ pleopod has been described in specimens identified as '*Typhlocarcinodes piroculatus*' by Serène (1964: 237–9) however these specimens have been placed in a new genus and species by Ng (1987). This new genus also apparently falls into the 'in limbo' group of genera mentioned above. A long second male pleopod is common in the Carcinoplacinae (see Guinot, 1969b) but due to the form of the abdomen *Australocarcinus* cannot be placed in that subfamily. It seems that the elongation of the second ♂ pleopod is a character which has arisen independently a number of times within the Goneplacidae.

The 2nd ♂ pleopods of the Indo-Pacific *Speocarcinus celebensis* Tesch, 1918, and *S. laevimarginatus* Yokoya, 1933, have apparently not been described but according to Guinot (1969c: 706) these species are congeneric, and not true *Speocarcinus* species. The present new species however differs from these in having segments 3–5 of the abdomen fused as in true *Speocarcinus* species and therefore cannot be considered also to be congeneric with those other Indo-Pacific species.

Australocarcinus riparius sp. nov.

MATERIAL EXAMINED
HOLOTYPE: QM W13113, ♂ (13.1 mm), Murray River, riverbank near Tate's Landing, NE.Q., 18.iii.1987, P. Davie, J. Short.

PARATYPES: QM W12915, 5 ♂ (6.8–13.1 mm), 7 ♀ (8.7–11.5 mm), same data as holotype. QM W12891, 1 ♂ (11.8 mm), Murray River, NE.Q., near entrance to Tate's Landing, in mud along bank, 17.iii.1987, P. Davie, J. Short; QM W12895, 12 ♂ (4.4–10.3 mm), 6 ♀

(6.3–11.1 mm), data as for W12891; QM W12916, 8 ♂ (8.1–12.2 mm), 10 ♀ (7.1–12.8 mm), Murray R., NE.Q., upstream of Tate's Landing, in riverbank, 14–16.iii.1987, P. Davie, J. Short; QM W13190, 1 juv. ♂ (4.5 mm) Murray River, NE.Q., edge of bank, low water neap, 15.v.1978, P. Davie; QM W13191, 1 ♀ (7.8 mm), Murray R., NE.Q., on algal mat near low water neap, upper estuary, 15.v.1978, P. Davie, R. Timmins; QM W13192, 1 ovig. ♀ (10.7 mm), Murray R., NE.Q., Jan. 1987, S. Frusher; QM W13193, 1 ♀ (9.7 mm), 18 juvs, Murray R., NE.Q., 26.xi.1986, S. Frusher and R. Giddins; QM W13194, 1 ♂ (10.0 mm), Bowen Creek, Hinchinbrook Is., NE.Q., April 1987, S. Frusher.

DESCRIPTION
Carapace: Wider than long (c. 1.25×), smooth, sparsely covered with very short hairs, which are most abundant on the posterolateral branchial regions; regions poorly defined but with cardiac and metagastric regions defined by shallow grooves. Protogastric and branchial regions noticeably swollen in large mature males. Carapace flat from side to side except for regional swellings, but fore and aft is strongly deflexed over anterior third. Posterolateral margins almost straight, slightly convex; branchial regions with a posterolateral facet reminiscent of the Varuninae. Anterolateral margins sharp and marked by four strong, slightly upturned, teeth, outer orbital edges without teeth, first anterolateral tooth long, low, truncate, commencing as a ridge a little way behind orbit, second to fourth teeth of similar form, forwardly vaulted, blunt; third tooth the largest; greatest carapace width across last anterolateral teeth.

Front broadly bilobed with no trace of preorbital teeth; slightly raised margin continuing smoothly around to encircle orbit. Eyes with corneas well developed, on moveable eyestalks; eyes retractable within orbits but still clearly visible in dorsal view. Antenna (including antennal peduncle) with free access to the orbit; antennal flagellum long extending laterally to a point in line with apex of second anterolateral tooth. Antennules fold transversely and are completely retractable under frontal lobes. Pterygostome adjacent to third maxillipeds and below anterolateral teeth with only short sparse setae but posterior to this are long dense plumose setae distinctly visible in dorsal view below the anterolateral margins.

Third maxillipeds (Fig. 1C). Merus and ischium subequal, both quadrate. Merus with outer margin convex but not strongly produced anterolaterally, inner and lower margins of

ischium and merus lined with fine setae. Palp with bristles, being very long and stout distally; these bristles slightly recurved and bearing on distal half of inner margin a series of short fine comb like teeth.

Male abdomen (Fig. 1E). Segments three to five fused. Telson elongate, rounded triangular. Penultimate segment c. $0.62 \times$ length of telson, with lateral borders shallowly sinuous. Segments three to five with straight divergent borders. Segment two constricted. Segment one narrow, laterally expanded but not as wide as base of the fused segments 3–5. Neither the base of segments 3–5, nor segment one cover the sternites between the last pair of walking legs.

Female abdomen (Fig. 2C) relatively narrow, not nearly covering sternal segments.

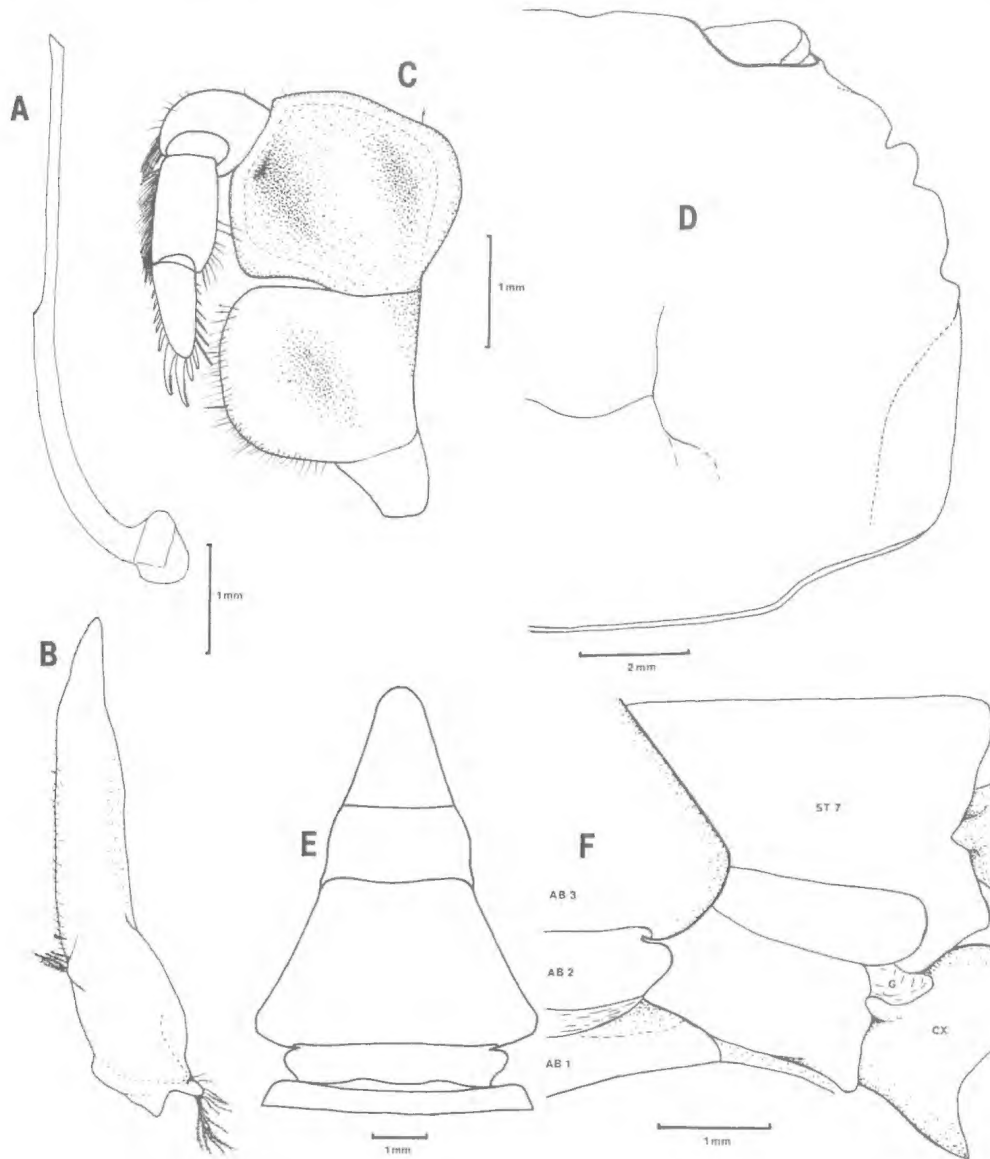First male pleopod (Fig. 1B) stout; tapering to

FIG. 1: *Australocarcinus riparius* gen. nov., sp. nov. A. second male pleopod; B. first male pleopod; C. third maxilliped; D. carapace; E. male abdomen; F. sternal segments and disposition of gonopod. AB = abdominal segment; ST = sternal segment; CX = coxa; G = gonopod.
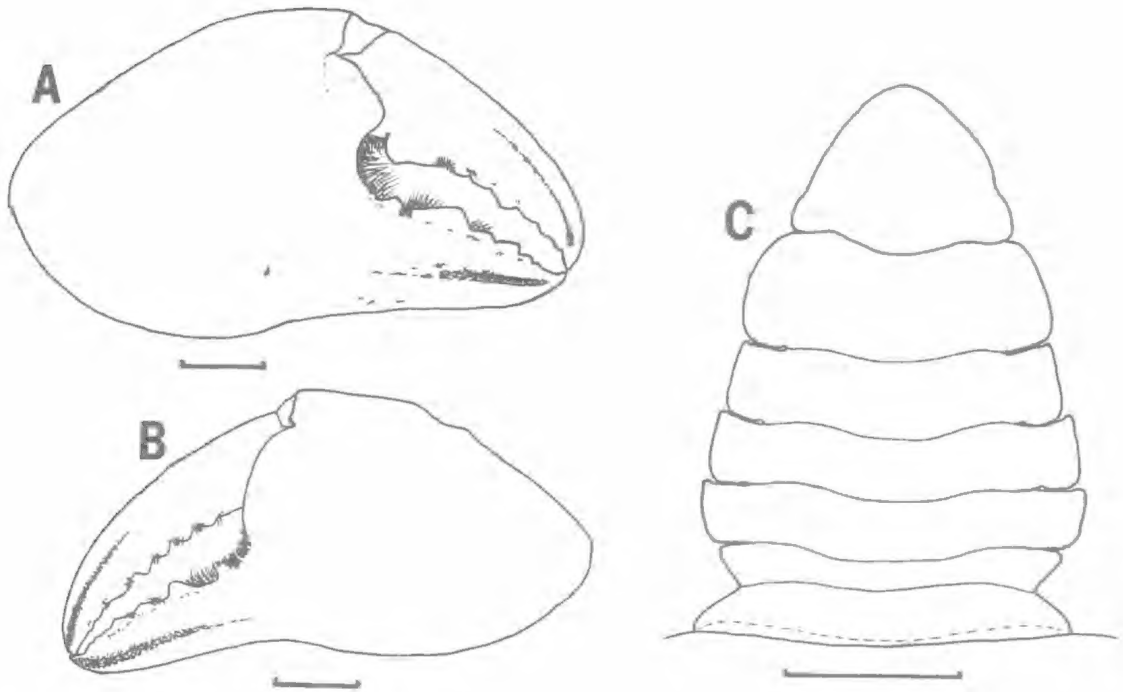
FIG. 2: *A. riparius*. A,B, right and left male chelae; C. female abdomen. Scale lines = 2 mm.

a simple, bluntly pointed tip. Distal quarter naked, medial half with sparse, short, simple hairs laterally. Bluntly rounded 'elbow' about ⅓ of distance from base with a few longer, plumose setae. Second male pleopod (Fig. 1A) subequal in length to first, slender; parallel sides but with a median constriction; tip obliquely slanted, with acute tip.

Sternite eight of male (Fig. 1F) with anterior third formed into a separate plate. Coxal gonopod appears to pass below the joint of the two plates of sternite eight. Sternite eight of female is a normal single plate.

Chelae of adult males (Fig. 2A,B) strongly developed, the right slightly the larger. Merus stout, triangular in section, with 6–8 large granules along outer inferior border and 2–3 on inner inferior border. Shaggily hirsute along inner borders of ishium and merus. Carpus subquadrate in dorsal view with strong blunt triangular tooth on inner edge; sparse short hairs present on surface. Palm of chelae swollen, inner and outer faces smooth, 1–3 granules present on inner superior border which is otherwise rounded. Both fingers with median grooves on inner and outer faces which bear short hairs, these run the length of the fixed fingers but are mainly restricted to the distal half of the dactyls.

Additional hair lined grooves present ventrally on fixed fingers, but are most prominent distally. Fingers pointed, with differentiated teeth that are subequal on smaller chela, but enlarged proximally on larger chela. In mature males dactyl of large chela $0.84 \times$ length of palm (palm measured in mid-line of outer face and excluding fixed finger); fingers of smaller chela relatively longer, $0.96 \times$ length of palm. Walking legs long, slender, unarmed, second pair the longest (c. $1.75 \times$ breadth of carapace). First pair with thick, dense clothing of long hairs on ventral and lateral faces of carpus, propodus, and dactylus. Other legs with dense hair confined to a narrow fringe on propodus and dactylus. Short and long hairs scattered sparsely over all segments of all legs.

DISTRIBUTION

Currently only known from the Murray River, NE. Queensland, and Bowen Creek on the nearby Hinchinbrook Island.

ECOLOGY

Appears to be restricted to estuaries. It is cryptic, and lives intertidally in the soft mud of river banks. It excavates its own burrows but the entrances to these are not distinguishable from
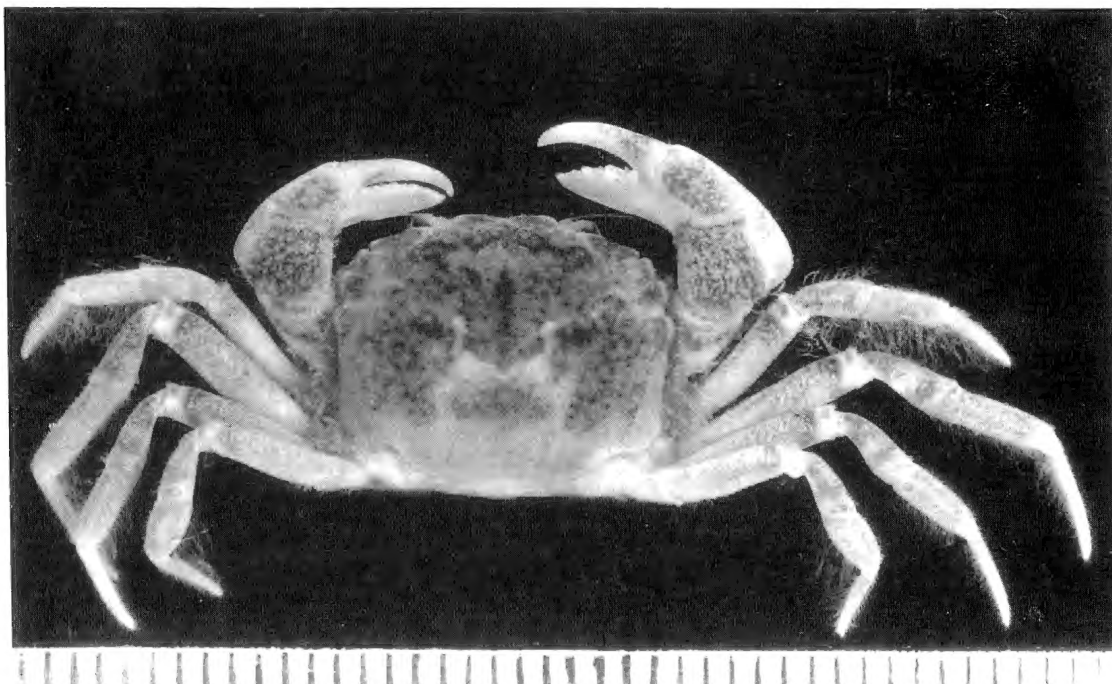
FIG. 3: *Australocarcinus riparius* gen. nov., sp. nov. Scale divisions in mm.

those of other crabs which inhabit the banks. Burrows may penetrate 20–30 cms into the bank and are typically narrow and meandering. A male and female pair are often found together in the same burrow.

They seem most abundant in the mid- to upper-estuary zone where salinities are greater than 20 p.p.t. only around November/December (pre-summer rains) and the water is almost fresh between February and August (Dr T. Smith, A.I.M.S., pers. comm.).

REPRODUCTION

As mentioned earlier it seems probable that this species may show direct development of the young, or at least abbreviated development with the final metamorphoses taking place in the burrow of the adult. The single ovigerous female in the collection had 71 eggs which each measured 1 mm in diameter. There were 18 juveniles associated with the other female already discussed, and these measured c. 1.7 mm c.b. Some of these may however have been lost in the collection process.

Considering that several ovigerous females were observed by the members of A.I.M.S. during December and January even though relatively few specimens were collected, it seems that reproduction may be largely confined to the spring and early summer months. By March when the author made his large collections none were observed. The period of highest salinities (10–20 p.p.t.) occurs between September and January, and this is probably pertinent.

Goneplacids are an atypical component of estuarine intertidal habitats. Abbreviated development would be a likely adaptation for exploitation of this labile environment. Strategies for reproduction and adaptations for estuarine life have been briefly reviewed by Davie (1985).

ETYMOLOGY

The specific name is latin and means frequenting river banks.

ACKNOWLEDGEMENTS

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THREE NEW SPECIES OF THE SPIDER GENUS *STIPHIDION* (ARANEAE : AMAUROBIOIDEA : STIPHIDIIDAE) FROM AUSTRALIA

VALERIE TODD DAVIES

Davies, V. Todd. 1988 11 7: Three new species of the spider genus *Stiphidion* (Araneae : Amaurobioidea : Stiphidiidae) from Australia. *Mem. Qd Mus.* **25**(2): 265–271. Brisbane. ISSN 0079-8835.

Descriptions of *Stiphidion diminutum* n. sp., *S. adornatum* n. sp. and *S. raveni* n. sp. show a range of female genital patterns and some elaboration of the ♂ palp when compared with the type species, *S. facetum*. The distributional range of *S. facetum* is extended northward to southeastern Queensland. The relationship of *Stiphidion* to other Australasian genera is discussed briefly, resulting in the exclusion of *Ischalea* and *Procambridgea* from the Stiphidiidae.
□ *Araneae, Stiphidiidae, Stiphidion, new taxa.*

Valerie Todd Davies, Queensland Museum, PO Box 300, South Brisbane, Queensland 4101, Australia; 30 January, 1986.

Stiphidion facetum, a cribellate spider from Tasmania, was described by Simon (1902), and has since been found in northern areas of New Zealand (Marples, 1959; Forster and Wilton, 1973). It has been placed in several different families and at present is the type genus of the Stiphidiidae. In the following, abbreviations and measurements follow Davies (1976).

STIPHIDION SIMON, 1902.

Stiphidion Simon, 1902, *Bull. Soc. ent. Fr.* 15: 242. Type species *Stiphidion facetum* Simon, 1902 by original designation.
Amarara Marples, R.R. 1959, *Trans. Roy. Soc. N.Z.* 87: 354. Type species *Amarara fera* Marples, 1959 by original designation. Taxonomic decision of Lehtinen (1967). *A. fera = S. facetum.*

DIAGNOSIS

Cribellate spiders with strongly recurved posterior eye row, a very unusual arrangement in amaurobiid spiders. Posterior spinnerets slender, longer than the anterior pair; the apical segment as long as the basal. Umbrella-shaped web where the spider rests on the substrate in the hollow 'handle' of the web.

DESCRIPTION

Medium-sized spiders. Cephalothorax pale brown edged in darker brown-black usually with darker lines diverging from deep, long fovea and defining cephalic and thoracic areas. Abdomen with pale median, cardial area, bordered anteriorly by white stripes or patches, usually two darker patches towards posterior end. See Forster and Wilton (1973, fig. 397) for photograph of *Stiphidion*. Long, slender, banded legs,

1423. Trochanters very shallowly notched. Feathery (ciliate) hairs on legs. Trichobothria in double row on tibiae, single row on metatarsi and tarsi. Bothria collariform, finely grooved; tarsal organ distal to trichobothria (Fig. 24). Few spines on legs, femora with 1–2 dorsal spines and usually one or more prolateral spines. Two closely spaced teeth on retromargin of cheliceral groove, 3 on promargin (Fig. 1). Row of long curved bristles on prolateral surface of chelicera. Labium wider than long, indented anteriorly. Sternum truncated anteriorly and pointed posteriorly; slightly wider than long, as wide as long or slightly longer than wide, depending on length of posterior point. Anterior and posterior eye rows strongly recurved, all eyes except ALE, encircled by black pigment (Fig. 2). AME large, usually larger than ALE. Cribellum divided; calamistrum sub-central. Large divided colulus in males. Anterior spinnerets stout, short apical segment. Posterior spinnerets slender, apical as long as basal segment (Fig. 3). Epigynum (Figs 4, 5, 6) with lateral fossae; lateral teeth absent. Tibia of ♂ palp with retrolateral and ventral apophyses (Fig. 16). Apex of cymbium short or long; bulge on retrolateral edge of cymbium. Median apophysis absent. Embolus spiniform arising prolaterally and describing semicircle to end retrolaterally. Extensive T-shaped conductor with forked apex (Figs 20, 21). The outer forked process supports the embolus and is grooved and pointed, occasionally bifid; the inner process laminate.

Stiphidion facetum Simon, 1902

S. facetum has been re-described and illustrated

by Forster and Wilton (1973). For scanning electron micrographs of cribellum see Davies (1976, plate 60E, F). *S. facetum*, originally described from Tasmania has been collected in eastern Australia as far north as southeastern Queensland where it is found, from an altitude of about 500m, in open forest and in rainforest areas, commonly on the edge of rainforests along pathways and streams.

MATERIAL EXAMINED

New Town, Hobart, Tasmania, V.V. Hickman, xii.1968, 1 ♂, QM S261; Scotsdale-St Helens Road, Tasmania, A. Rozefelds, 6.i.1981, 1 ♀, QM S262;

Jenolan Caves, New South Wales, J. Gallon, 6.v.1985, 1 ♀, QM S263; Gibraltar Ra., via Glen Innes, New South Wales, R.J. Raven, 10.xi.1980, 2 ♀, QM S264; Binna Burra, Lamington Nat. Pk, SE. Queensland, Y. Lubin, R.J. Raven, V.E. Davies, 12.ii.81, 1 ♂ (SEM palp), 1 ♀, QM S265; Queen Mary Falls, Killarney, SE. Queensland, R.J. Raven, 26.xii.1974, 1 ♂, QM S266; Great Dividing Ra., nr Teviot Brook, SE. Queensland, R. Raven, 25.xii.1974, 1 ♂, 2 ♀, QM S267; Cedar Ck. nr Samford, SE. Queensland, R. Raven, V.E. Davies, 21.xii.1978, 1 ♀ (epigyne drawn), 1 ♂, QM S268; Mt Glorious, SE. Queensland, R. Raven, 1 ♂, QM S269; Mt Archer, SE. Queensland, J. Gallon 29.iv.1985, 1 ♂, QM S270; Dandabah, Bunya Nat. Pk, V.E. Davies, 4.iii.1976, 2 ♀, QM S271; Mt Goonaneman, SE.

FIGS 1–6. *Stiphidion facetum* Simon. Fig. 1, chelicera, retrolateral. Fig. 2, eyes from above. Fig. 3, spinnerets, lateral. Figs 4–6, epigynum. Fig. 4, external (ventral). Fig. 5, external, cleared. Fig. 6, internal (dorsal), cleared.
FIGS 7–9. *Stiphidion diminutum* sp. nov. epigynum, holotype. Fig. 7, external. Fig. 8, external, cleared. Fig. 9, internal, cleared.

Queensland, R. Raven, V.E. Davies, 4–5.xi.1980, 3 ♀, QM S272; Lower Dry Ck, Kroombit Tops, Queensland, V.E. Davies, J. Gallon, 9–19.xii.1983, 4 ♀, QM S273.

Stiphidion diminutum sp. nov.

MATERIAL EXAMINED

HOLOTYPE: From small umbrella-shaped web, Beauty Spot 98, (rainforest), 860m, Kroombit Tops, Queensland, 24°22', 151°01', V.E. Davies, J. Gallon, 9–19.xii.1983, 1 ♀, QM S243.

PARATYPES: Same locality, collectors, date, 1 ♂, QM S244, 1 ♀, QM S245; Three Moon Ck (rainforest) 940m, Kroombit Tops, Queensland, V.E. Davies, J. Gallon 9–19.xii.1983, 1 ♂, 1 penult. ♂, QM S246, 3 ♀, 2 j, QM S247; 600m, Bulburin State Forest, Queensland, 24°32', 151°20', V.E. Davies, R. Kohout, 17–24.iii.1975, 8 ♀, QM S248, 5 ♂, QM S249; Bulburin State Forest, Queensland, V.E. Davies, R.J. Raven, 25–28.iii.1977, 3 ♀, QM S250, 1 ♂, 3 j, QM S251.

DESCRIPTION OF FEMALE

CL 1.8, CW 1.3, AL 2.5, AW 1.6. *S. diminutum* is smaller than the other species. Colour and pattern similar to *S. facetum*. Ratio of AME:ALE:PME:PLE is 5:5:6:8. Labium much wider than long, 1:0.5. Sternum slightly wider than long. Few spines on legs. Femoral spines, first leg d1100, p0100; second and third legs d1000, fourth leg d1000, r0001. Epigynum with reduced ridge between widely spaced fossae; insemination ducts looped (Figs 7, 8, 9).

Other females varied in size: CL 1.5–1.8, CW 1.3–1.5, AL 2.2–2.8, AW 1.7–2.3.

DESCRIPTION OF MALE

CL 1.6, CW 1.3, AL 1.8, AW 1.2. Dimensions of other males: CL 1.4–1.7, CW 1.2–1.3, AL 1.6–2.0, AW 1.0–1.3. Ratio of AME:ALE:PME:PLE is 6:5:6:7. Labium wider than long 1:0.6. Sternum slightly wider than long. Femoral spines, first leg d1100, p0011; second leg d1100, p0001, third and fourth legs d1100, r0001. Palp: cymbium hardly extended beyond tegulum (Fig. 22); bifurcate retrolateral apophysis and ventral apophysis on tibia (Fig. 17).

Stiphidion adornatum sp. nov.

MATERIAL EXAMINED

HOLOTYPE: From umbrella-shaped web on rock face, Curtis Falls, Mt Tamborine Nat. Pk, 670m, SE.

Queensland 27°55', 153°12', N. Clyde Coleman, R.J. Raven, V.E. Davies, 27.vi.1980, 1 ♀, QM S252.

PARATYPES: Same locality, collectors and date, 2 ♂, QM S253, 4 ♀, QM S254; O'Reillys, 945m, Lamington Nat. Pk, SE. Queensland, 28°12', 153°05', E. Dahms, R.J. Raven, V.E. Davies, 15.xi.1977, 1 ♀, 1j, QM S255, 2 ♂, QM S256; Mt Tamborine Nat. Pk, SE. Queensland, V.E. Davies, 22.vi.1975, 1 ♂, 4 j, QM S257; Mt Tamborine Nat. Pk, SE Queensland, C.L. Wilton, R.J. Raven, V.E. Davies, 10.vii.1974, 1 ♀, 1 j, QM S258.

DESCRIPTION OF FEMALE

CL 2.5, CW 1.8, AL 4.2, AW 2.6. Colour and pattern similar to *S. facetum*. Ratio of AME:ALE:PME:PLE = 9:8:7:9. Labium wider than long 1:0.75. Sternum as wide as long. Few spines on legs. Femoral spines, first leg d1100, p0011, r0011; other legs d1100, p0001, r0001. Epigynum with very long tightly coiled insemination ducts (Figs 10, 11, 12).

Variation in size of other females: CL 1.8–2.7, CW 1.7–1.8, AL 3.2–4.0, AW 2.3–2.8.

DESCRIPTION OF MALE

CL 2.6, CW 1.9, AL 3.3, AW 1.8. Dimensions of other males: CL 2.2–2.4, CW 1.6–2.0, AL 2.8–3.0, AW 1.6–1.8. Ratio of AME:ALE:PME:PLE is 9:6:9:9. Legs longer than those of female, similar spination. Palp: greatly extended T-shaped conductor embracing sides of very long cymbium (2.0); embolus very long, lying along rolled outer edge of conductor (Fig. 23); tibia with bifurcate retrolateral apophysis and ventral apophysis (Fig. 18). The species is named for the elaborate palp. Other material was collected from Gibraltar Ra., New South Wales, Stotts Is., Tweed R., New South Wales, and Mary Cairncross Park nr Maleny, SE. Queensland.

One ♂ was found in female's web; she was in the handle of umbrella and the male outside this area.
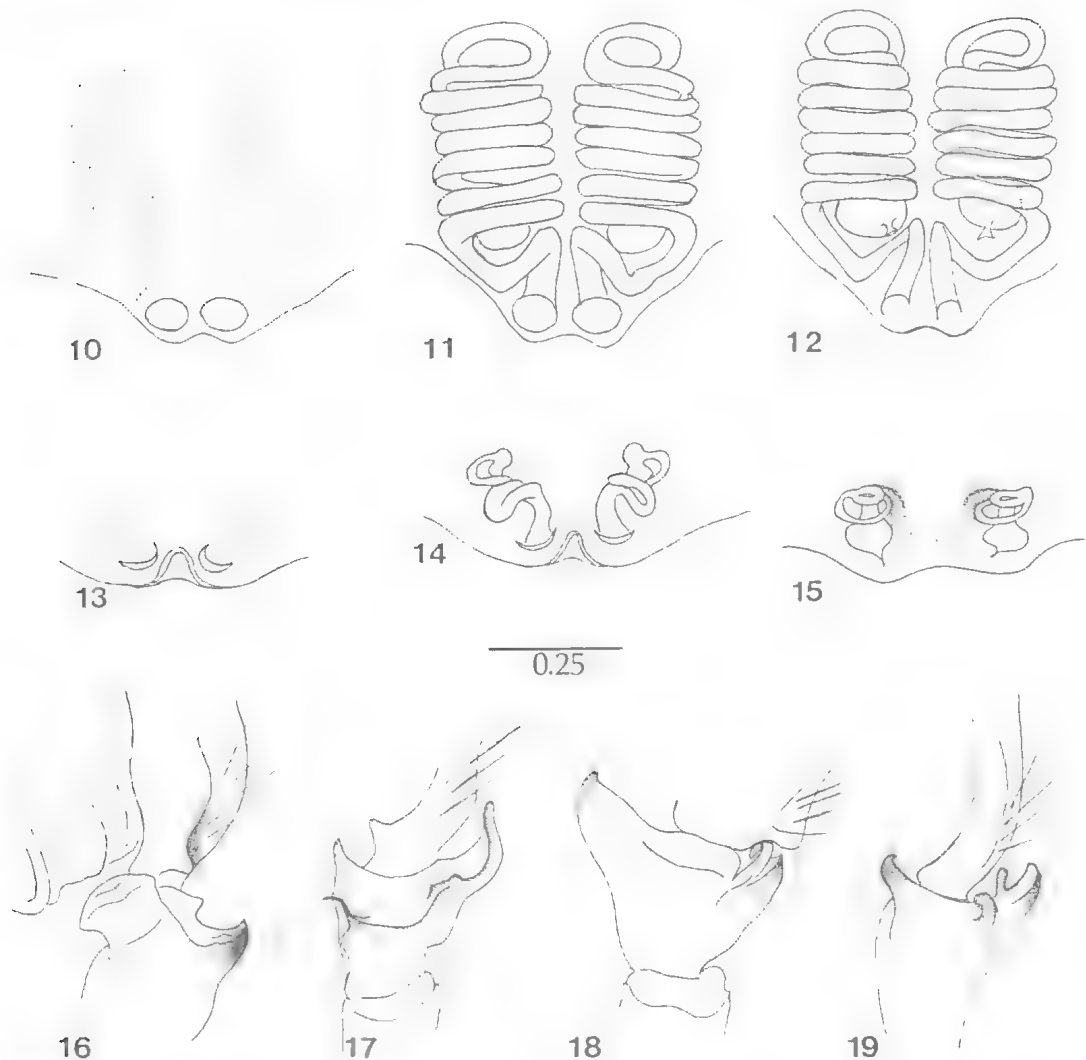
Stiphidion raveni sp. nov.

MATERIAL EXAMINED

HOLOTYPE: From web under rock, New England Nat. Pk, 1500m, snow gum (*Eucalyptus pauciflora*) forest, New South Wales, 30°30', 152°30', R.J. Raven, 3.xii.1973, 1 ♀, QM S259.

PARATYPE: New England Nat. Pk, New South Wales, W. Nash, R.J. Raven, 15.vii.1975, 1 ♂, 1 j, QM S260.

DESCRIPTION OF FEMALE

CL 2.6, CW 1.9, AL 3.3, AW 2.3. The abdominal pattern differs a little from *S. facetum* in that the cardial area is bordered by

FIGS 10–12. *Stiphidion adornatum* sp. nov., epigynum, S254. Fig. 10, external. Fig. 11, external, cleared. Fig. 12, internal, cleared.

FIGS 13–15. *Stiphidion raveni* sp. nov., epigynum, holotype. Fig. 13, external. Fig. 14, external cleared. Fig. 15, internal, cleared.

FIGS 16–19. ♂ tibial apophyses, retrolateral. Fig. 16, *Stiphidion facetum*. Fig. 17, *S. diminutum*. Fig. 18, *S. adornatum*. Fig. 19, *S. raveni*.

white patches rather than stripes. Ratio of AME:ALE:PME:PLE is 8:7:8:9. Labium wider than long 1:0.8. Sternum longer than wide 1:0.9. Femoral spines, first leg d1100, p0011, r0010; second leg d1100, p0011, r0011, third and fourth legs d1100, p0001, r0001. Epigynum with loosely coiled insemination ducts (Figs 13, 14, 15).

DESCRIPTION OF MALE

CL 2.3, CW 1.7, AL 2.5, AW 1.5. Ratio of AME:ALE:PME:PLE is 7:6:7:8. Labium wider than long 1:0.8. Sternum slightly longer than wide. Femoral spines, first leg d1100, p0011, r0011; second leg d1100, p0011, r0011; third leg d1100, p0011, r0011; fourth legs missing. Palp: cymbial apex short and pointed; outer process of conductor is bifid, inner process elongate (Fig. 25); trifurcate retrolateral apophysis and ventral apophysis on tibia (Fig. 19). The species is named for Robert Raven.

FIGS 20–25. *Stiphidion facetum*, 1. ♂ palp. Fig. 20, ventral, scale line 100u. Fig. 21, embolus on tip of bifurcate conductor, scale line 25μ. Figs. 22, 23, 1. palp, ventral. Fig. 22, *S. diminutum* S246, scale line 100u. Fig. 23, *S. adornatum*, S253, embolus displaced. Fig. 24, *S. facetum*, tarsal organ and trichobothrial base, scale line 20u. Fig. 25, *S. raveni*, S260, scale line 160μ.

FAMILY PLACEMENT AND RELATIONSHIPS

Stiphidion was originally placed in the Psechridae (Simon, 1902) and later in the Stiphidiinae (Dalmas, 1917) in that family. Marples (1959) assigned the genus (as *Amarara*) to the Dictynidae. Lehtinen (1967) transferred the Stiphidiinae, containing *Stiphidion, Baiami* and *Tjurunga*, to the Amaurobiidae. *Tjurunga*, known only from a female (type in Paris) from Tasmania, is not considered here. Elevated to family level (Forster and Wilton, 1973), the Stiphidiidae were considered to contain *Stiphidion, Baiami, Procambridgea, Corasoides* and the New Zealand genera *Cambridgea* (Berland's (1924) New Caledonian species, *C. simoni* does not appear to belong in the genus), *Nanocambridgea* and *Ischalea*.

Until more species of the Australian amaurobioids are described and familial synapomorphies are established, stiphidiine relationships will remain uncertain; some observations, however, may be made. *Ischalea* has least in common with the other genera; its habitus (Forster and Wilton, 1973, fig. 470), the presence of lateral teeth on the epigynum and a well developed median apophysis are enough to exclude it from the Stiphidiidae. *Procambridgea* has marked trochanteral notches, a proximal calamistrum and very reduced AME unlike any of the other genera, so that it too is unlikely to belong here.

In a comprehensive revision of *Baiami*, Gray (1981) found that the species showed a southern Australian distribution and he considered that *Baiami* was related to several undescribed genera from this region but probably not to *Stiphidion*. It is known that monotypic *Corasoides*, a large ecribellate spider is widely distributed in the southern half of Australia and also occurs in New Guinea (Main, 1982). It has a large sheet web on the top of which it runs, unlike *Baiami, Cambridgea* and *Nanocambridgea* which hunt under their sheets. The retreat of *Corasoides* goes down into the ground or into a hollow in a tree trunk where its thick, spherical egg-sac is placed. This is coated with alternative layers of soil and particles of dirt or wood. *Cambridgea* also coats its egg-sacs (up to 4) with debris from the ground and hangs them in its web (Forster and Forster, 1973). *Corasoides* lacks feathery (ciliate) hairs but with *Stiphidion* and *Baiami* it shares shallowly notched trochanters; a long spiniform embolus;

a large broad conductor the tip of which is bifurcate; a complex tibial apophysis consisting of a divided retrolateral, and a ventral apophysis; all lack a median apophysis. *Stiphidion* and *Baiami* have a sub-central calamistrum.

Cambridgea and *Nanocambridgea* have a small median apophysis, short spiniform embolus and usually a stridulatory apparatus of some kind between the pedicel and abdomen; none of these characters is found in the other genera. Monotypic *Nanocambridgea* has un-notched trochanters, feathery hairs, recurved eyes like *Stiphidion* and an epigynum and broad spiral conductor very like some *Corasoides*.

An undescribed Tasmanian ecribellate, known only from females has an umbrella-shaped web (R. Raven pers. comm.) and an internal epigynum very similar to *Stiphidion adornatum*. It has a large divided colulus, slightly recurved posterior eye row and slender posterior spinnerets which, unlike *Stiphidion*, are not longer than the anterior pair. It is, without doubt, a stiphidiine. As for *Baiami, Corasoides, Cambridgea* and *Nanocambridgea* they have the following characters in common with *Stiphidion*: slender posterior spinnerets, AME as large or only slightly smaller than ALE, sub-central calamistrum (when present), epigynum without lateral teeth, ♂ palp with spiniform embolus, extensive conductor and reduced or absent median apophysis. Though probably not stiphidiines they are retained in the Stiphidiidae.

ACKNOWLEDGEMENTS

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AN ILLUSTRATED GUIDE TO THE GENERA OF ORB-WEAVING SPIDERS IN AUSTRALIA

VALERIE TODD DAVIES

An illustrated key to 47 genera of orb-weaving spiders from 8 families is presented. Further notes on some of the genera are given. The females of *Miagrammopsidis, Nanometa, Heurodes* and the ♂ palps of *Nanometa, Herennia, Ordgarius* and *Pasilobus* are illustrated for the first time. *Dicrostichus* Simon, 1895, is newly synonymised with *Ordgarius* Keyserling, 1886, resulting in new combinations: *D. magnificus = O. magnificus* (Rainbow, 1897) n. comb.; *D. furcatus = O. furcatus* (O.P. Cambridge, 1877) n. comb.: *D. caliginosus* (Rainbow, 1894) = *O. furcatus* (O.P. Cambridge, 1877) n. syn. Other new combinations: *Uloborus variabilis = Philoponella variabilis* (Keyserling, 1887) n. comb.; *Meta argentiopunctata = Mesida argentiopunctata* (Rainbow, 1916) n. comb.
□*Key, spiders, orb-weaving, Australia.*

Valerie Todd Davies, Queensland Museum, P.O. Box 300, South Brisbane, Queensland 4101, Australia; 18 October, 1987.

Eight families of spiders that construct orb-webs or modifications of these for the capture of their prey, are recognised; all are represented in Australia. Spiders of the Uloboridae (5 genera) and Deinopidae (2 genera) possess an ancestral spinning organ, the cribellum, which produces thick sticky silk. The uloborid web may be reduced to a segment of an orb or even a single line (Miagrammopinae). In deinopids the basic orb-web structure (Coddington, 1986b) is more difficult to recognise as the catching-net with its thick cribellate silk tends to obscure the basic non-sticky threads on which the spider rests while holding its net. The Tetragnathidae (including the metines) are represented by 10 genera; the Araneidae (including nephilines) by 24 genera. In the latter the orb-web has been completely reduced in two sub-families, Celaeninae and Mastophorinae. Four families of minute-tiny spiders, Theridiosomatidae, Mysmenidae, Symphytognathidae and Anapidae also construct orb-webs.

There are four basic steps in the construction of an orb-web. First, the Y-shaped construction of the first three radii, which form the foundation of the web. Secondly, the formation of a framework for the rest of the radii and their construction. Thirdly, the spinning of a non-sticky scaffolding (or auxiliary) spiral from the centre of the web outwards and fourthly the spinning of a sticky spiral from the outside towards the centre; while doing this the spider usually removes the non-sticky spiral (Main, 1976; Levi, 1978; Coddington, 1986c).

Research into the silk glands, that are concerned with the production of the capture threads, has shown that in the uloborids the silk from the cribellum is combed (by the calamistrum) on to core fibres produced by pseudoflagelliform glands opening on the posterior spinnerets and fine paracribellar threads from glands on the median spinnerets (Peters, 1984). It is presumed that the sticky deinopid silk has a similar origin. It is of interest to note in all other cribellate spiders so far studied (Kovoor, 1977) the cribellar silk is combed on to fibres produced from ampullate glands on the anterior spinnerets. In the araneoid families the sticky capture silk is produced by aggregate glands opening on the posterior spinnerets. The core fibres on to which the sticky silk is laid are produced by flagelliform glands also opening on the posterior spinnerets. These glands are believed to be homologous with the pseudoflagelliform glands of uloborids. The aggregate glands are believed to be a synapomorphy of araneoids (Coddington, 1986c).

Recent behavioural studies by Eberhard (1982), Lubin (1986), Shear (1986) and others favour the conventional view that the orb-web has arisen twice, once in the cribellate orb-weavers and once in the araneoids. Brignoli (1979) and Levi (1980) both questioned this view and raised the issue of monophyly of the orb-web, earlier suggested by Wiehle (1931). Recently Coddington (1986c) produced some good evidence to suggest that the orb-web has

evolved only once and that the uloborids (and/or the deinopids) are the sister group of the superfamily Araneoidea. This latter group would include not only the orb-web families described here but also the Theridiidae, Nesticidae, Linyphiidae, Cyatholipidae and Mimetidae (Coddington, *loc. cit.*). When the homologies of anatomical structures such as the sclerites of the male palp and the spinning glands and spigots are fully understood, the origin of the orb-web may be resolved.

Acroaspis olorina Karsch, 1878, an araneid from Western Australia is not illustrated as no fresh material has been identified. The holotype female (originally pinned) is in the Museum fur Naturkunde der Humboldt Universitat, Berlin. It is a small spider with 3 posterior abdominal tubercles and a large epigynum which may have had a scape. The names of two Tasmanian genera, *Acrea* Urquhart, 1891, and *Collina* Urquhart, 1891, are *nomina dubia* as the figures, cited by Urquhart, were never published and the types are lost.

Because of the visibility and beauty of their webs the orb-web spinners, with the exception of the minute ones, have been more widely collected and are thus better known than most Australian spiders — an estimated eighty percent of which are yet to be described (Davies, 1985). It is hoped that this publication will encourage revision of the genera and descriptions of new species.

It is regretted that the key is not entirely satisfactory. There are exceptions (exc.) noted in some couplets and others do not work in the absence of one sex. In such cases examination of the drawings should indicate the direction to be taken and allow an identification to be made. Notes on some of the genera are given below the relevant part of the key.

The lengths of spiders in the size-classes used are as follows: 'large' more then 8.0, 'medium' more than 4.0, 'small' more than 2.0, 'tiny' more than 1.0, 'minute' 0.5-1.0mm.

The following abbreviations are used: ALE, anterior lateral eyes; AME, anterior median eyes; PLE, posterior lateral eyes; PME, posterior median eyes; MOQ, median ocular quadrangle; ALS, anterior lateral spinnerets; PMS, posterior median spinnerets; PLS, posterior lateral spinnerets

A key to all the Australian families of spiders and a glossary of the terms used may be found in Davies (1986).

ILLUSTRATIONS

A dorsal view of the female is usually drawn. The male is illustrated if it is much smaller than the female or has a special shape or other diagnostic features. Ventral and dorsal views are given for most epigyna and sometimes a view from behind (posterior) or from the side is drawn. The left palp of the male is illustrated, usually twice to show sclerites and paracymbium. With the exception of the two symphytognathid genera, each spider occupies a separate page of illustrations. When an undetermined species is illustrated, the name of the locality is given in brackets. The scale line beside each female indicates the body length in millimetres, unless labelled otherwise. Colour photographs of many of the spiders that are illustrated here may be found in Mascord (1980).

ACKNOWLEDGEMENTS

KEY TO GENERA

1 Tarsi shorter than metatarsi, ♀ palp with tarsal claw. Small-very large spiders 2
− Tarsi longer than metatarsi (exc. Theridiosomatidae). ♂ palp without claw, or without tarsus and other segments. Minute-tiny spiders 42
2 Cribellum and calamistrum. Tarsi IV with ventral row of macrosetae. ♂ palp without paracymbium 3
− Colulus, ♂ paracymbium 9
3 Femora II and III with trichobothria. Eyes in 2 rows .... ULOBORIDAE 4
− Femora without trichobothria. Eyes in 3 rows. ♂ tarsi I with dorsal notch. Net-casting spiders ....DEINOPIDAE 8
4 8 eyes. PLE not on tubercles. Femoral tubercle on ♂ palp. Sternum undivided ....
.... Uloborinae 5
− 4 eyes, lacking anterior row. PLE on lateral tubercles. No femoral tubercle on ♂ palp. Sternum divided. Web reduced to single-line web .... Miagrammopinae 7
5 Brush of hair on tibia I. Epigynum with paired posterior lobes (Pl. 1) .... Uloborus
− Without brush of hair on tibia I. Epigynum otherwise 6
6 Posterior row of eyes strongly recurved. Epigynum with ventral atrium. Conductor on ♂ palp (Pl. 2) .... Philoponella
− Posterior row of eyes slightly recurved. Epigynum otherwise. No conductor; long tegular spur on ♂ palp (Pl. 3) .... Zosis
7 Cephalothorax almost × 1♀ long as wide (Pl. 4) .... Miagrammopes
− Cephalothorax as long as wide (Pl. 5) ....Miagrammopsidis
(northern Australia)

In uloborids the venom glands are lacking. Diagnoses and descriptions of genera are given by Opell (1979). Coddington (1986c) discusses the presence of spinning glands and web-building behaviour that is unique to the family. Lubin (1986) shows modifications of the uloborid orb-webs, both elaborations and reductions and mentions the use of sticky cribellate silk along non-sticky radii, frame threads and barrier webs (cf. araneids). She attempts to show 'how the structure of a web may be influenced by the spider's ecological relationships. . .' suggesting 'that similar ecological pressures could have selected for an orb-type structure in different groups of spiders.'

In miagrammopines the tibia of the ♂ palp is extended into a blunt projection dorsally. Eggs are laid in a long string (Mascord, 1980, pl. 15: 4). Miagrammopes builds webs consisting of one or more sticky threads, attached to a non-sticky resting thread (Lubin, 1986).

tibia

PLE

trichobothria

calamistrum — macrosetae

♀

ventral

book-lung opening

epigynum

cribellum

ALS

PLS

spermatheca

fertilization duct

dorsal

median apophysis

spur

embolus

conductor

sub-tegular spur

posterior EPIGYNUM

♂ PALP

cymbium

femoral tubercle
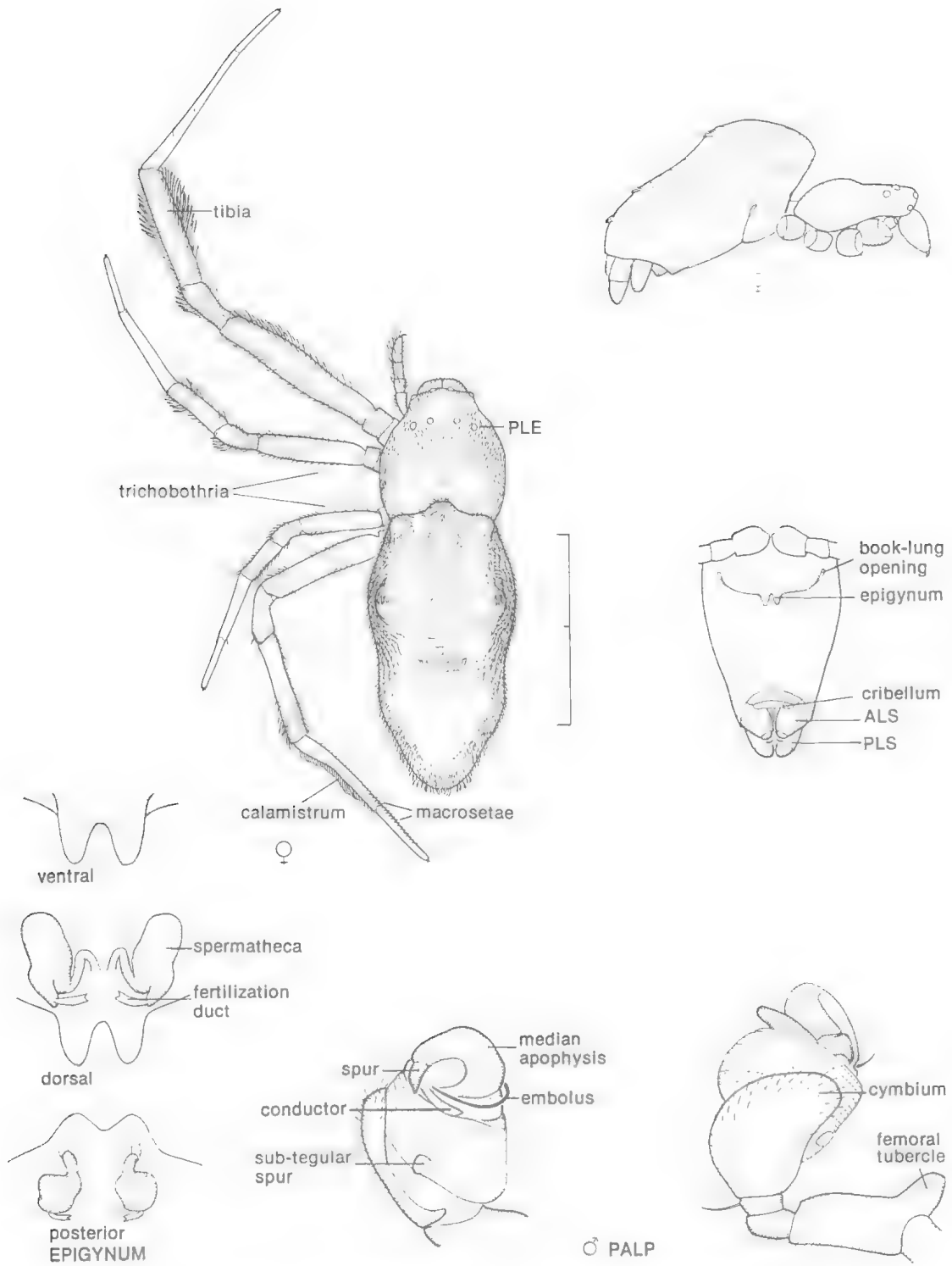
1. ULOBORUS SP (Davies Ck, north Queensland)

epigynum

femoral tubercle

embolus

median apophysis

conductor spike

spur

conductor

tegulum

cymbium

median haematodocha

gonopore

ventral

postero-dorsal

lateral

EPIGYNUM

♂ PALP

2. PHILOPONELLA VARIABILIS (KEYSERLING, 1887) N. COMB.

PMS
anal tubercle

♀

♂

insemination duct
fertilization duct

posterior EPIGYNUM

tegular spur

median apophysis
spur
cymbial setae
embolus
cymbium
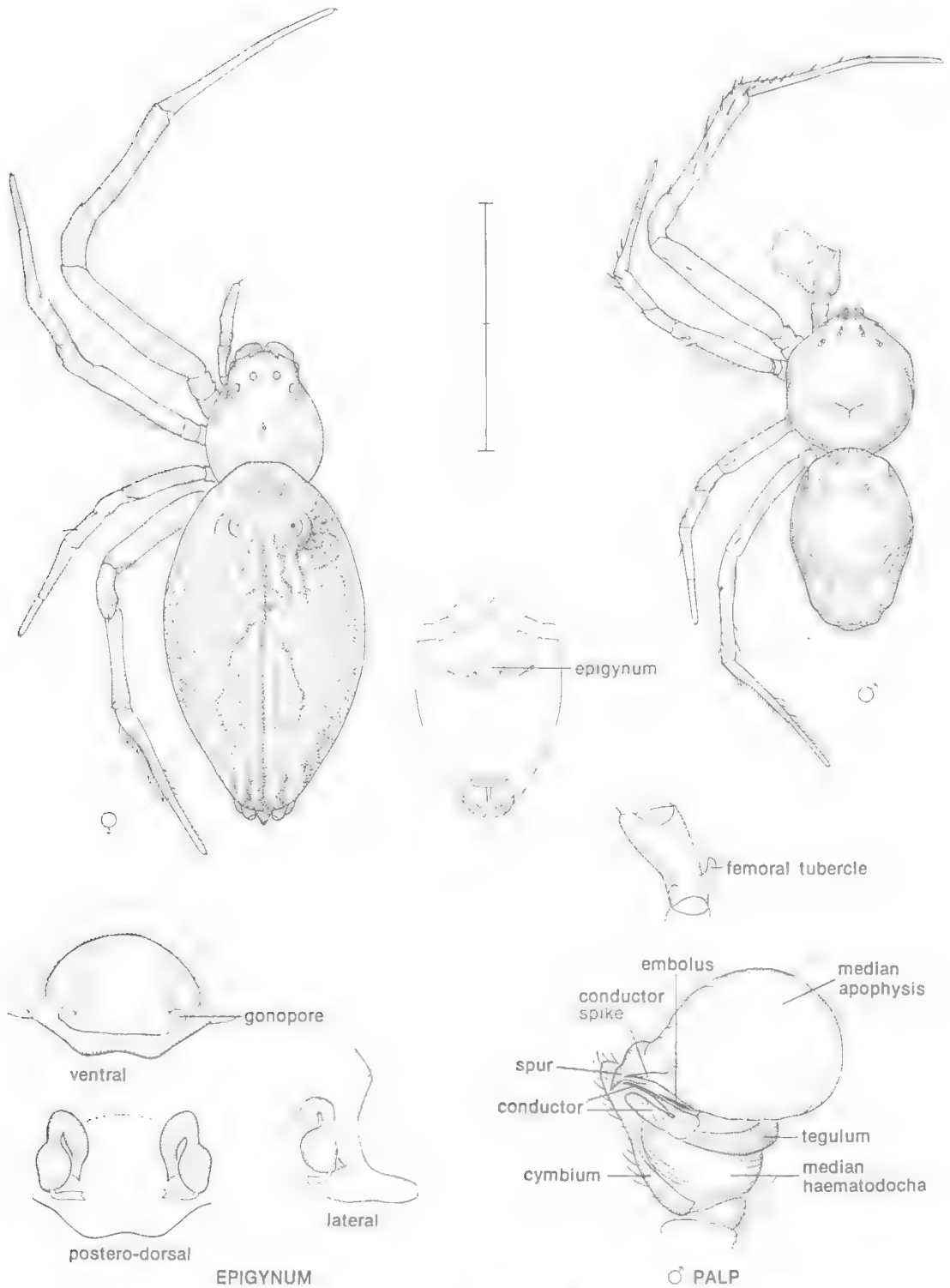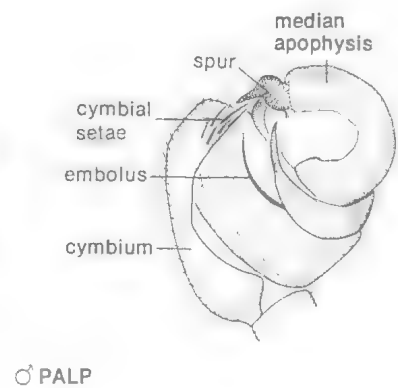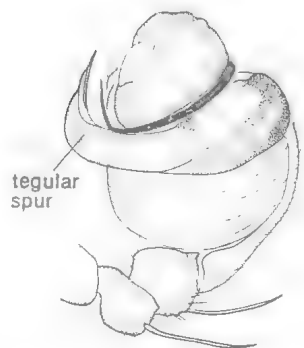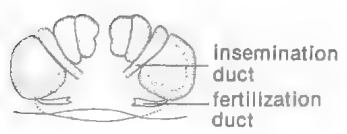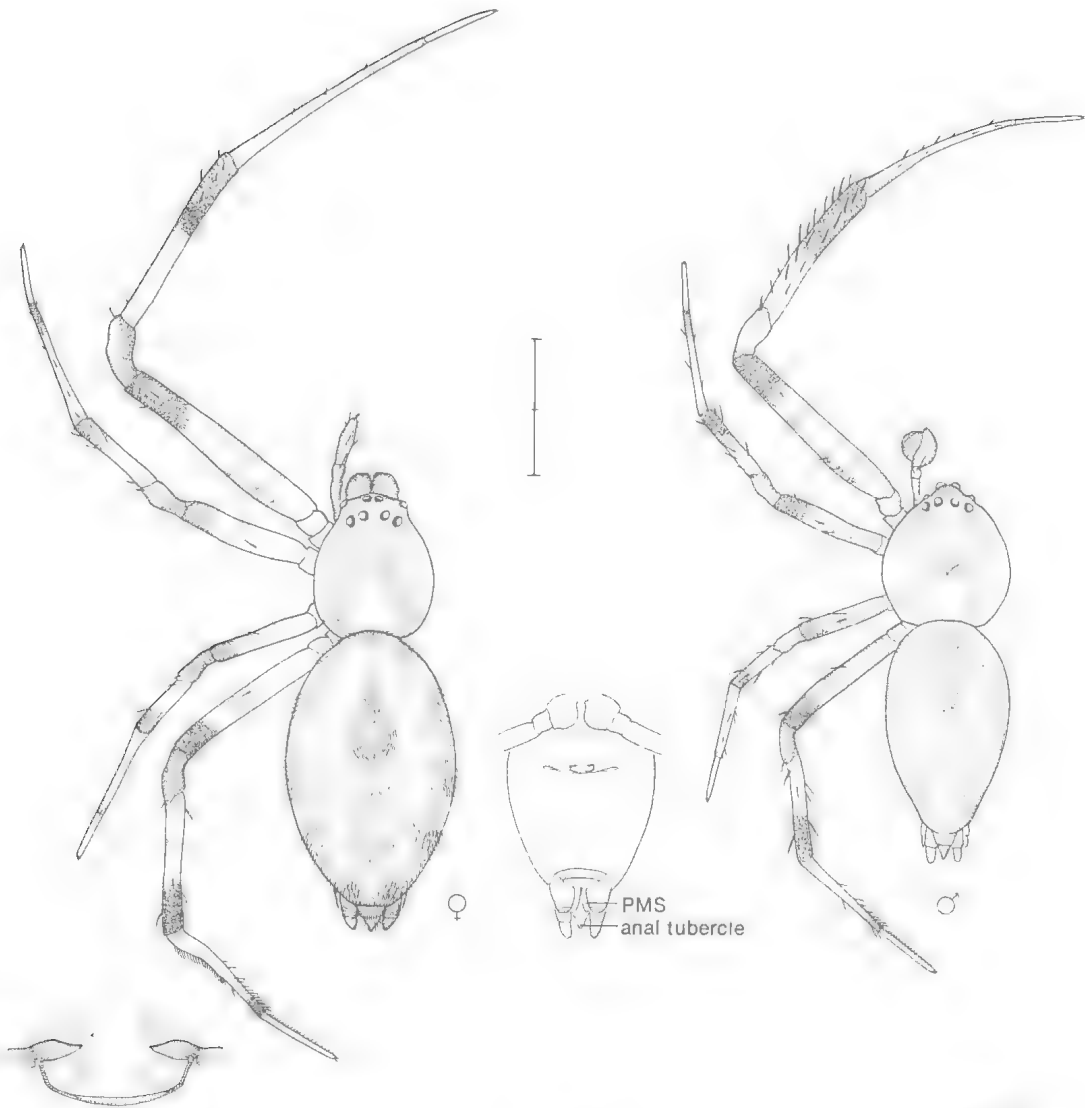
♂ PALP

3. ZOSIS GENICULATUS (OLIVIER, 1789)

endite
labium
sternal suture

fertilization duct
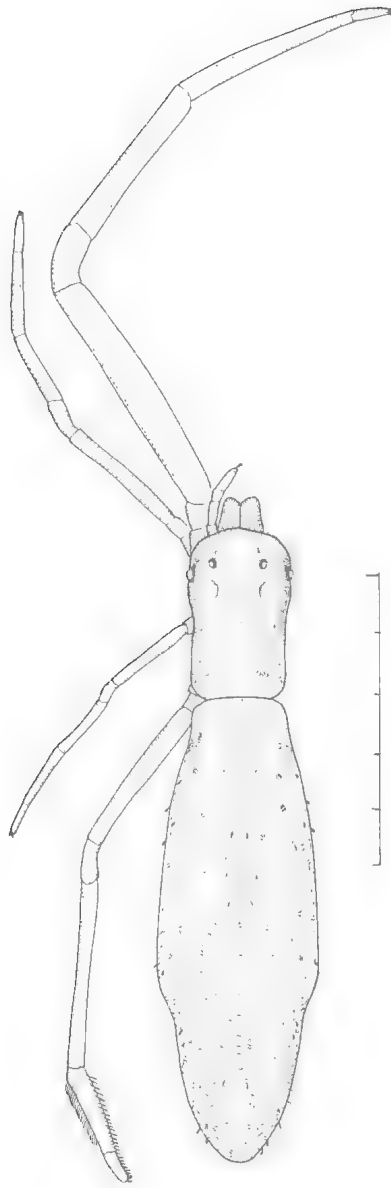
EPIGYNUM

♀ Cooloola, southeast Queensland

median apophysis
embolus
conductor

cymbium

tibial projection
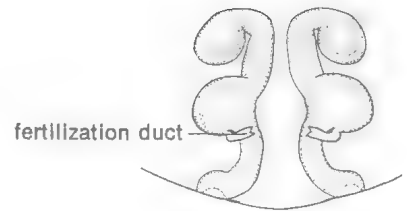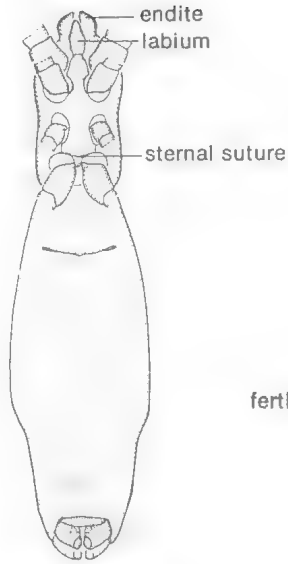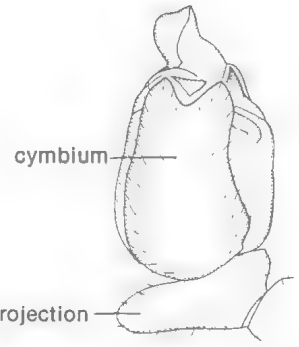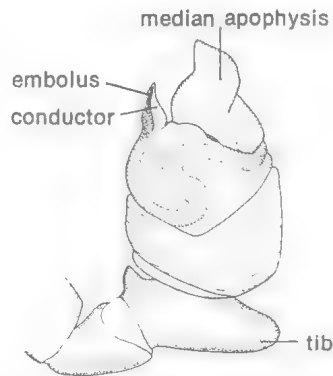
♂ PALP Braemar State Forest, southeast Queensland

4. MIAGRAMMOPES SPP

EPIGYNUM

endite
labium
sternal suture

median apophysis
conductor
embolus

♂ PALP
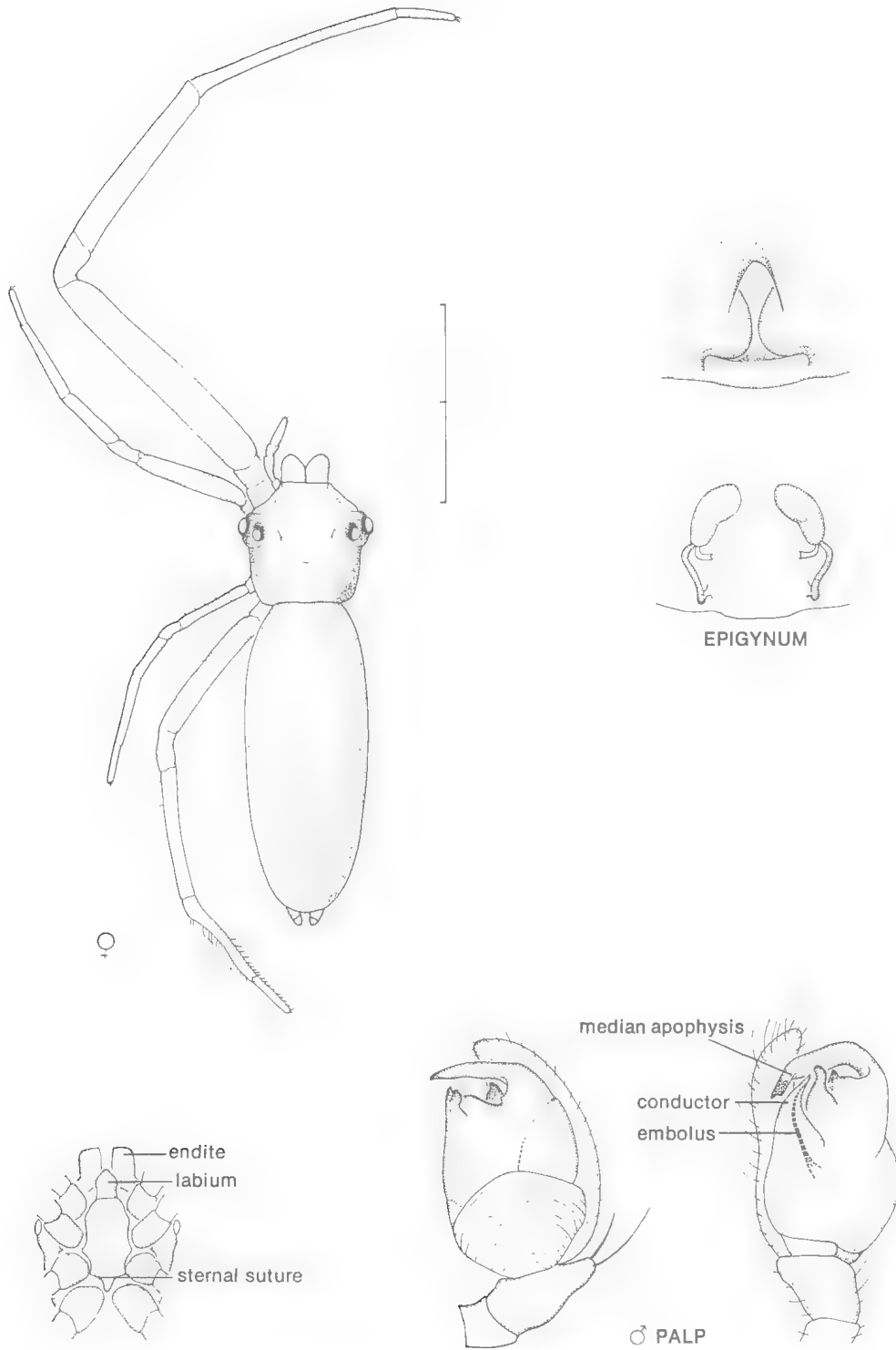
5. MIAGRAMMOPSIDIS FLAVUS WUNDERLICH, 1976.

8 PME greatly enlarged. Proximal prolateral bump on ♀ femur I (Pl. 6) .... *Deinopis*
– PME slightly larger than other eyes. Without bump on ♀ femur I (Pl. 7) .... *Menneus*
9 Without transverse furrows on epigastric plate. ♂ palpal tibia long, shaped like an inverted cone.
  Femoral trichobothria often present. ♂ not much smaller than ♀ .. TETRAGNATHIDAE 10
– Tranverse furrows on epigastric plate. ♂ palpal tibia short. Without femoral trichobothria. ♂
  often much smaller than ♀ .... ARANEIDAE 19
10 ♂ paracymbium separate and movable; spherical tegulum with coiled embolus and conductor at
   anterior end. Chelicerae porrect. Haplogyne (secondarily) (Pl. 8) ....
   .... Tetragnathinae *Tetragnatha*
– ♂ paracymbium broadly joined to cymbium; oval tegulum with embolus coiled with or lying free
  on conductor, occupying most of 'ventral' surface of tegulum. Chelicerae geniculate. Entelegyne
  .... metines 11
11 Long prolateral spines on tibiae and metatarsi I and II. Oval patch of sensory hairs on prolateral
   surface of ♂ tarsus I. Without orb-web (Pl. 9) .... Arkyinae *Arkys*
– Without long prolateral spines on tibiae and metatarsi I and II. Without sensory organ on ♂
  tarsus I. Orb-web 12
12 Paracymbium a long sclerotized flange on cymbium. Leaf-curling spiders .... Phonognathinae 13
– Paracymbium otherwise. Not known to be leaf curlers 14
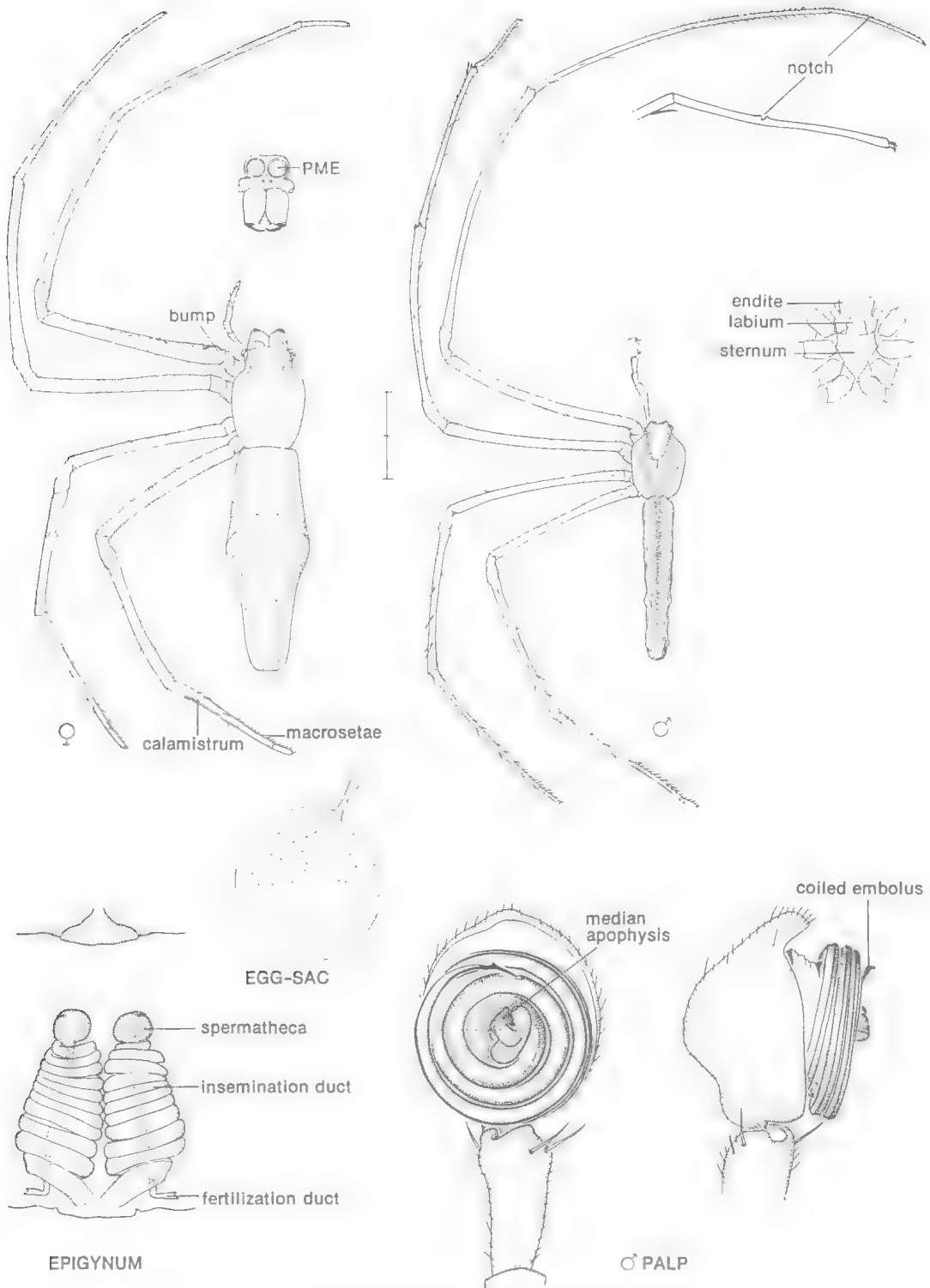
Coddington (1986b) has shown that deinopids display the same behaviour as orb-weavers in the
making of their webs. The sticky cribellate net that is used for prey catching is at all times connected
to the substrate by the guy lines. At rest, the Australian *Deinopis* spp. take up an X position with two
legs in each branch, a similar stance to *Argiope*. The egg-sacs are suspended near the web.

Menneus spp. (= *Avella*, Coddington, pers. comm.) are found in moist places, e.g., wet sclerophyll
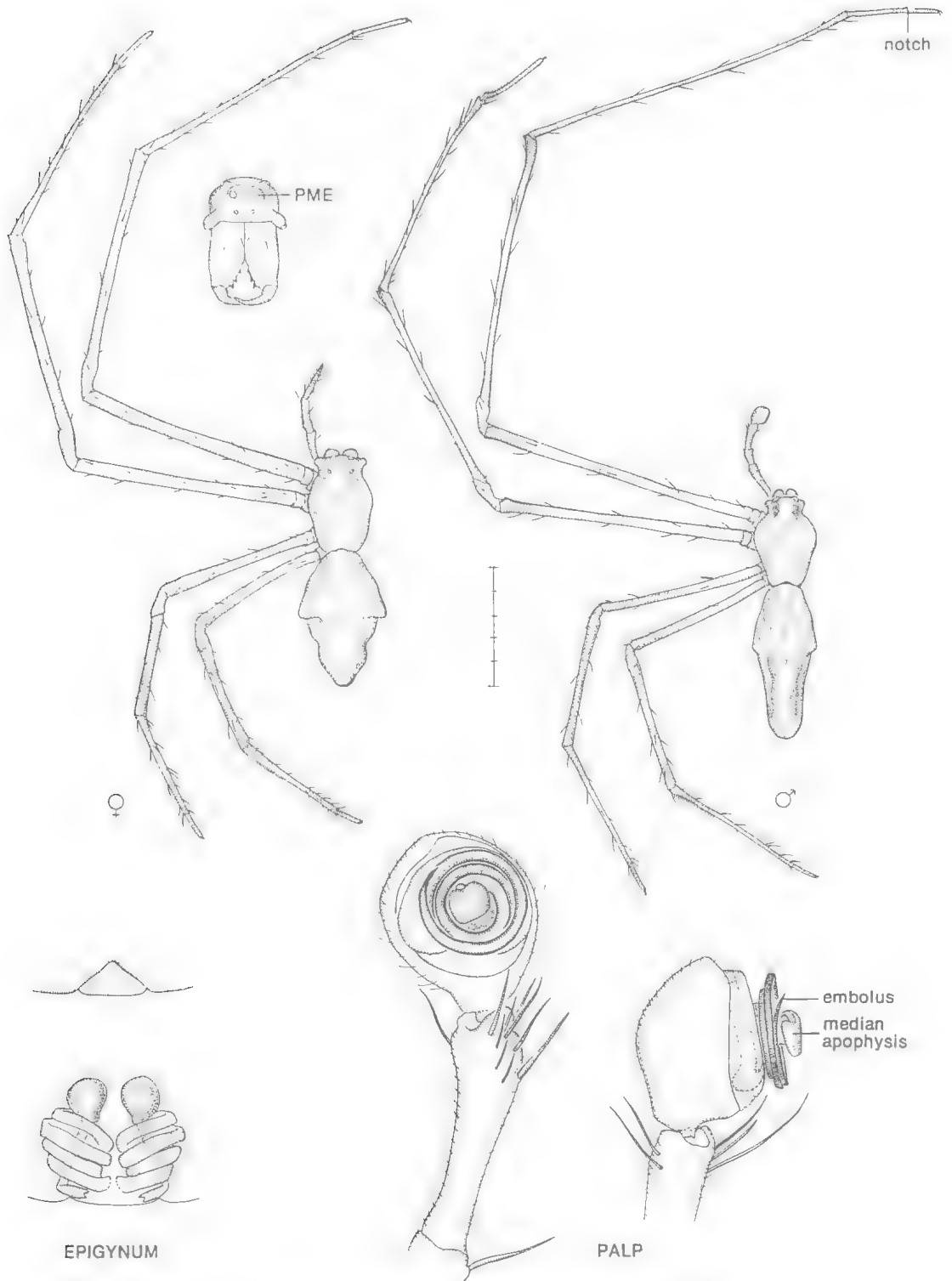and rainforest. The egg-sacs are placed in the litter (Mascord, 1980: 40).

Tetragnatha has a very long cylindrical abdomen and straight, unbranched femoral trichobothria
in a dorsal position. Males have clasping spur(s) on the chelicerae, distally. In the ♂ palp there is a
third sclerite, an embolic apophysis, coiled with the embolus and conductor (Levi, 1986: 94; Locket,
Milledge and Merrett, 1974: fig. 36,D). At rest, femora I and II are stretched out in front and III and
IV stretched out behind, in line with body.

In his catalogue, Brignoli (1983) separated the metines from the Tetragnathidae as a distinct
family, Metidae. Levi (1986) retains the metines as a sub-family of the Tetragnathidae but there is
some doubt that this is a monophyletic lineage (Coddington, 1986c).

The placement of *Arkys* has always been controversial. It was transferred by Heimer (1984) to the
Mimetidae as part of the superfamily Araneoidea. Forster and Platnick (1984) boldly included the
Mimetidae in the superfamily Palpimanoidea based on the presence of promarginal peg teeth and an
elevated cheliceral gland. As *Arkys* has neither of these characters it is illustrated here, tentatively
placed with the metines. Heimer *et al.* (1982) give details of the ♂ sensory organ. The apophysis
varies greatly between species (see *A. walckenaeri*). Main (1982) discusses prey-catching of *A.
nitidiceps* both off and on its reduced non-viscid web. Stowe (1986) records that its prey-wrapping
behaviour is araneid.

notch

PME

bump

endite
labium
sternum

♀   calamistrum ─── macrosetae

♂

EGG-SAC

spermatheca

insemination duct

median
apophysis

coiled embolus

fertilization duct

EPIGYNUM   ♂ PALP

6. DEINOPIS SUBRUFA L.KOCH, 1878

7. MENNEUS ANGULATUS L.KOCH, 1878

clasping spurs

♀ dorsal

♂ dorsal

CHELICERAE

♀ ventral

trichobothrium

♀

embolic
apophysis

embolus

conductor

expanded

spermatheca

conductor

cymbium

embolus

tegulum

paracymbium

VULVA

PALP
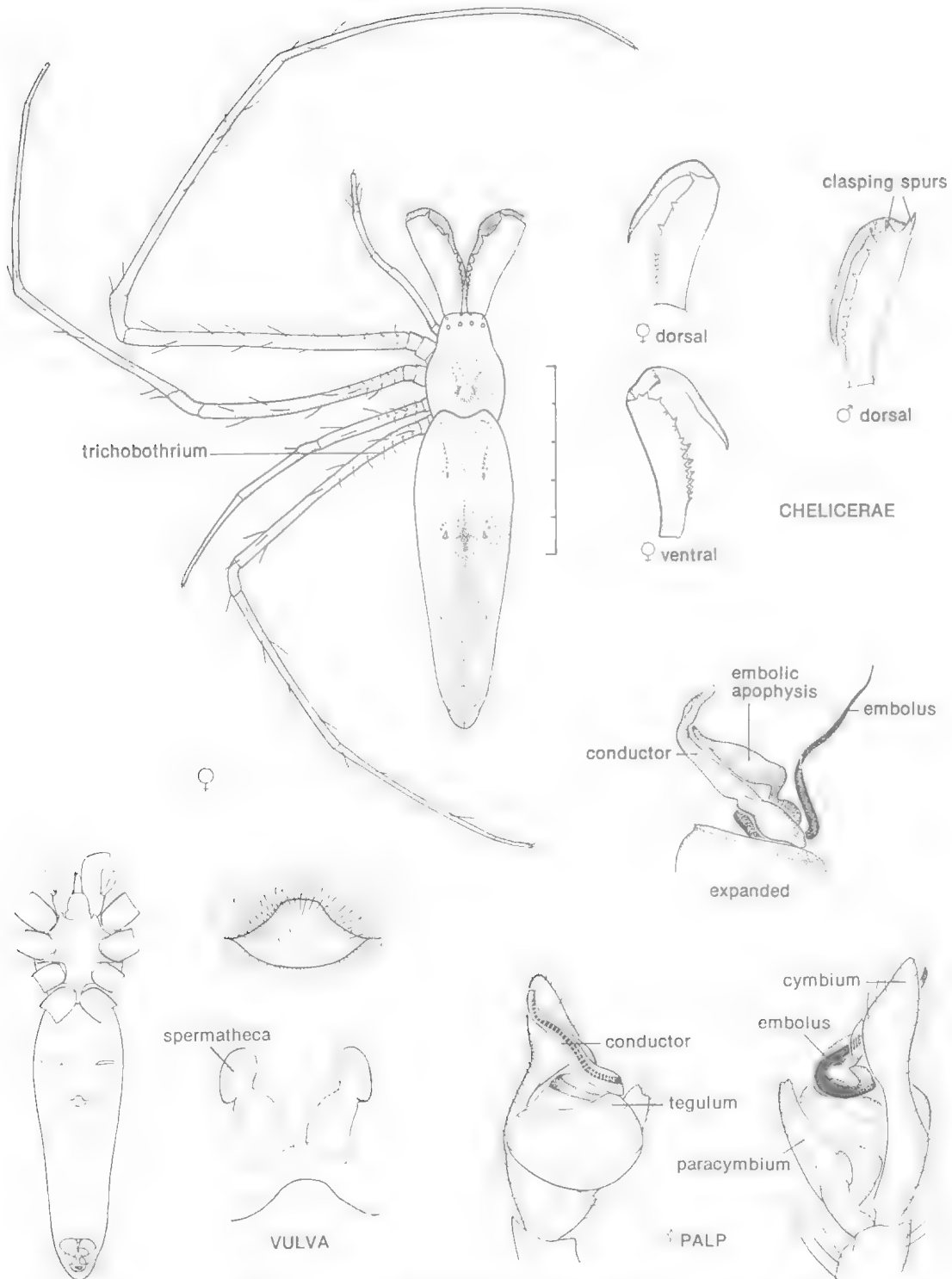
8. TETRAGNATHA NITENS (SAVIGNY & AUDOUIN, 1825)

sensory area

♂ TARSUS I

paracymbium

tibia

conductor

apophysis

tegulum

embolus

♂ PALP

♀

fertilization duct

posterior

EPIGYNUM

insemination duct

lateral

apophysis
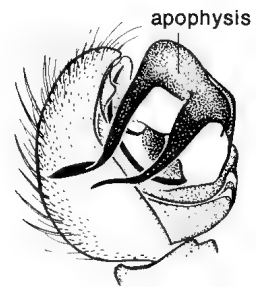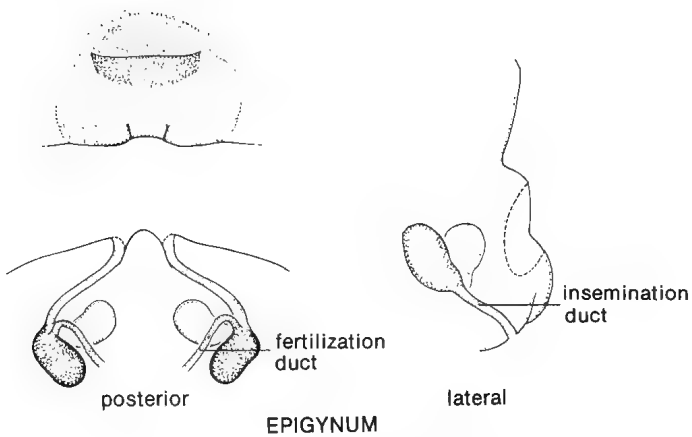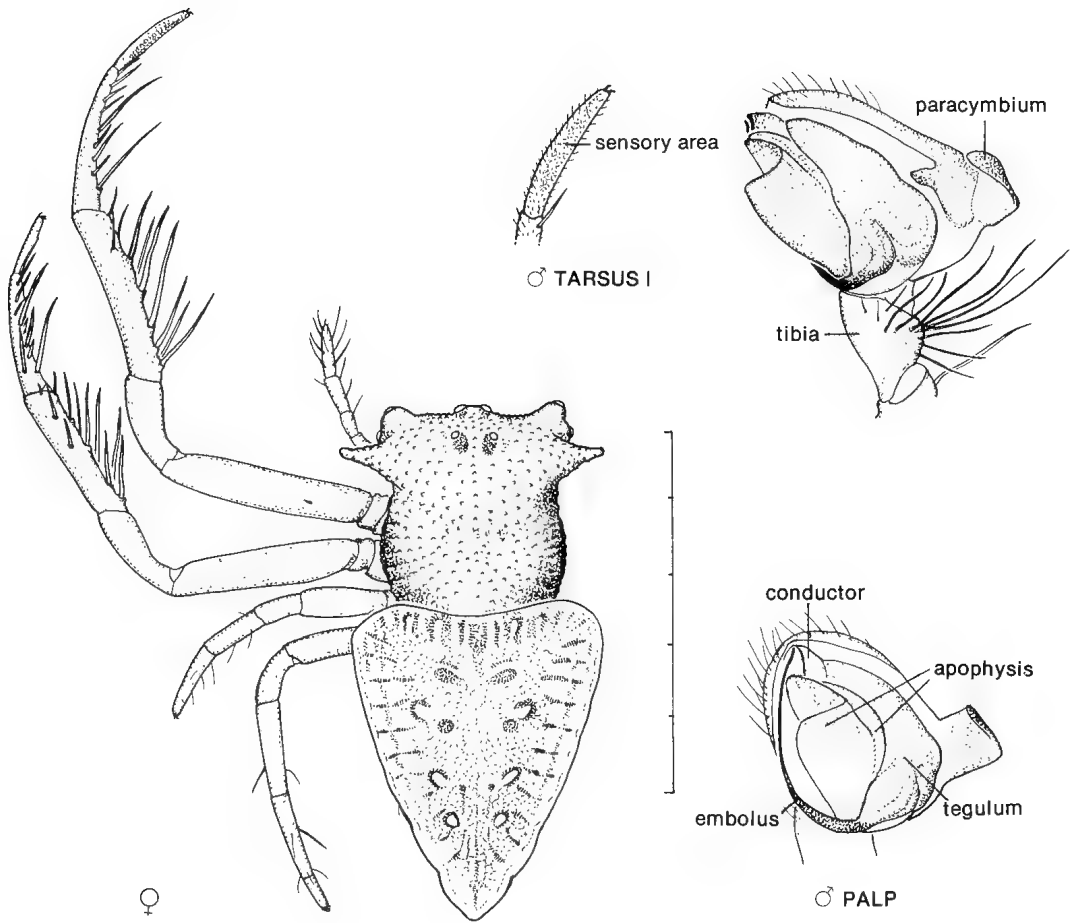
A. walckenaeri Simon, 1879

9. ARKYS CORNUTUS L.KOCH, 1871

paracymbium

embolus

coiled
conductor

PALP

spermathecal sac

spermatheca
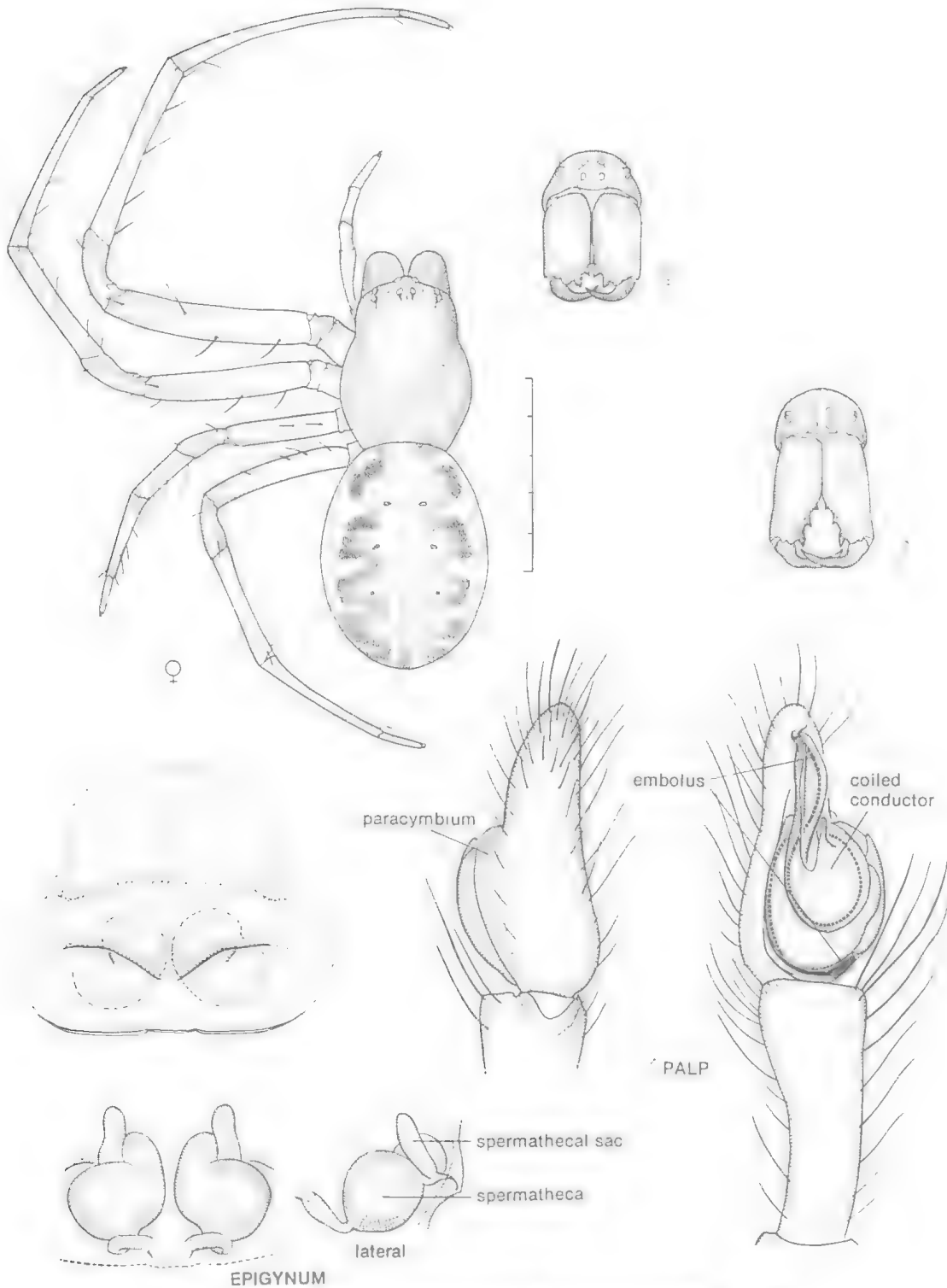
lateral

EPIGYNUM

10. PHONOGNATHA GRAEFFEI (KEYSERLING, 1865)

13 Paracymbium smooth-edged, on proximal half of cymbium. Epigynum regular shape postero-laterally (Pl. 10) .... *Phonognatha*
 – Paracymbium, with small proximal lobe, extending along length of cymbium. Epigynum horn-shaped posteriorly (Pl. 11) .... *Deliochus*
14 PME reduced. ♂ palpal trochanter short; paracymbium branching postero-laterally (Pl. 12) . ...Dolichognathinae *Dolichognatha*
 – PME normal. ♂ palpal trochanter long; paracymbium branching laterally or hook-like 15
15 Femoral trichobothria. ♂ embolus enclosed by or coiled with conductor; cymbium reduced; paracymbium hook-like with or without small lateral branch. Thin-walled spermathecal sacs as well as spermathecae in ♀ .... Leucauginae 16
 – Without femoral trichobothria. ♂ embolus lying free on conductor; cymbium not reduced; paracymbium with several branches .... Metinae 18
16 Two rows of long curved trichobothria on femur IV only 17
 – Single row of straight trichobothria on all legs. Very long leg I (Pl. 13) .... *Tylorida*
17 Paracymbium unbranched. Paired bumps on abdomen. ♂ chelicerae without clasping spurs (Pl. 14) .... *Leucauge*
 – Paracymbium with small lateral branch. Bumps on abdomen unpaired if present. Trichobothria obviously branched. ♂ chelicerae with clasping spurs (Pl. 15) .... *Mesida*
18 Endites much longer than wide. Epigynum sclerotized (Pl. 16) .... Metinae sp
 – Endites as long as wide. Epigynum lightly sclerotized. Small rainforest spiders (Pl. 17) .... *Nanometa*

Because of the long carapace, phonognathines have usually been regarded as nephilines; sometimes they leave the auxiliary non-sticky spiral in the web (Vollrath, pers. comm.). However the position of the ♂ palpal sclerites, the long palpal tibia and the similar size of the ♂ and ♀ indicate they are more likely metines. The spiral threads from an upper segment of the orb-web of *Phonognatha graeffei* are missing; the space is occupied by the curled leaf in which the spider rests. Details of web construction are not known.

Dolichognatha is usually regarded as a tetragnathine (Levi, 1981) because both *Tetragnatha* and *Dolichognatha* have lost the tapetum in the secondary eyes and show a similar looping arrangment of the rhabdoms (Homann, 1971). It is placed with the metines because the paracymbium is joined to the cymbium. The Australian Metinae, represented by an undescribed genus and *Nanometa*, are found in moist situations, mainly in rainforest.
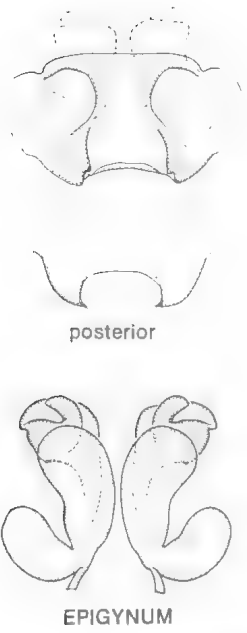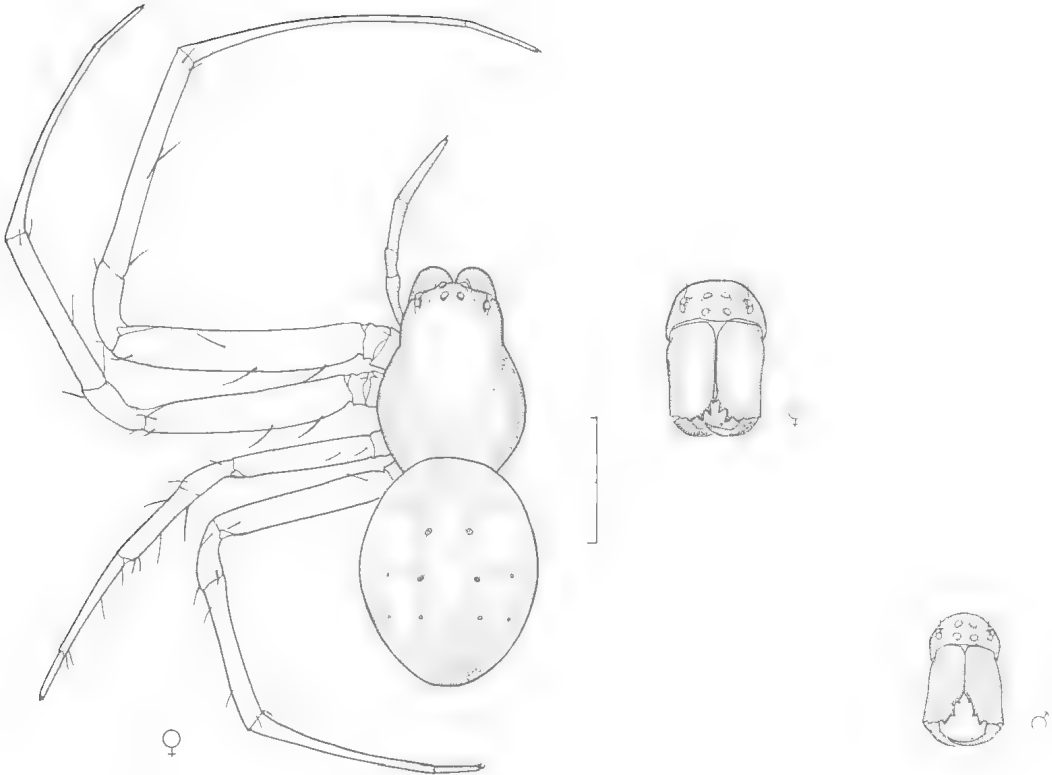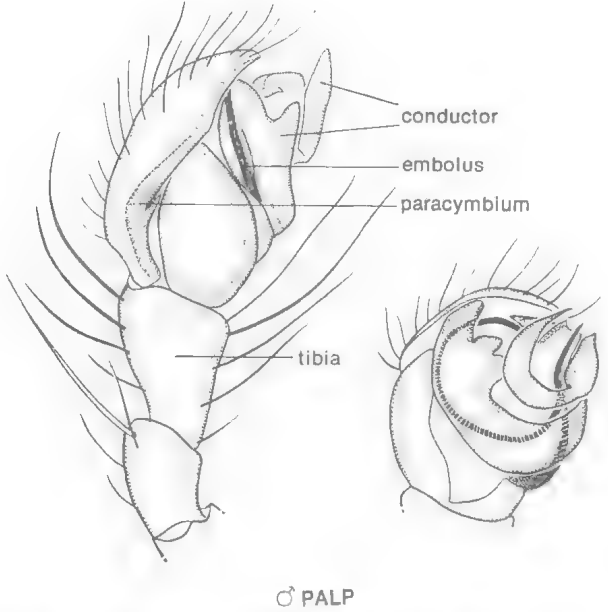
conductor

embolus

paracymbium

tibia

posterior

EPIGYNUM

♂ PALP

11. DELIOCHUS SP (Bulburin State Forest, mid-east Queensland)
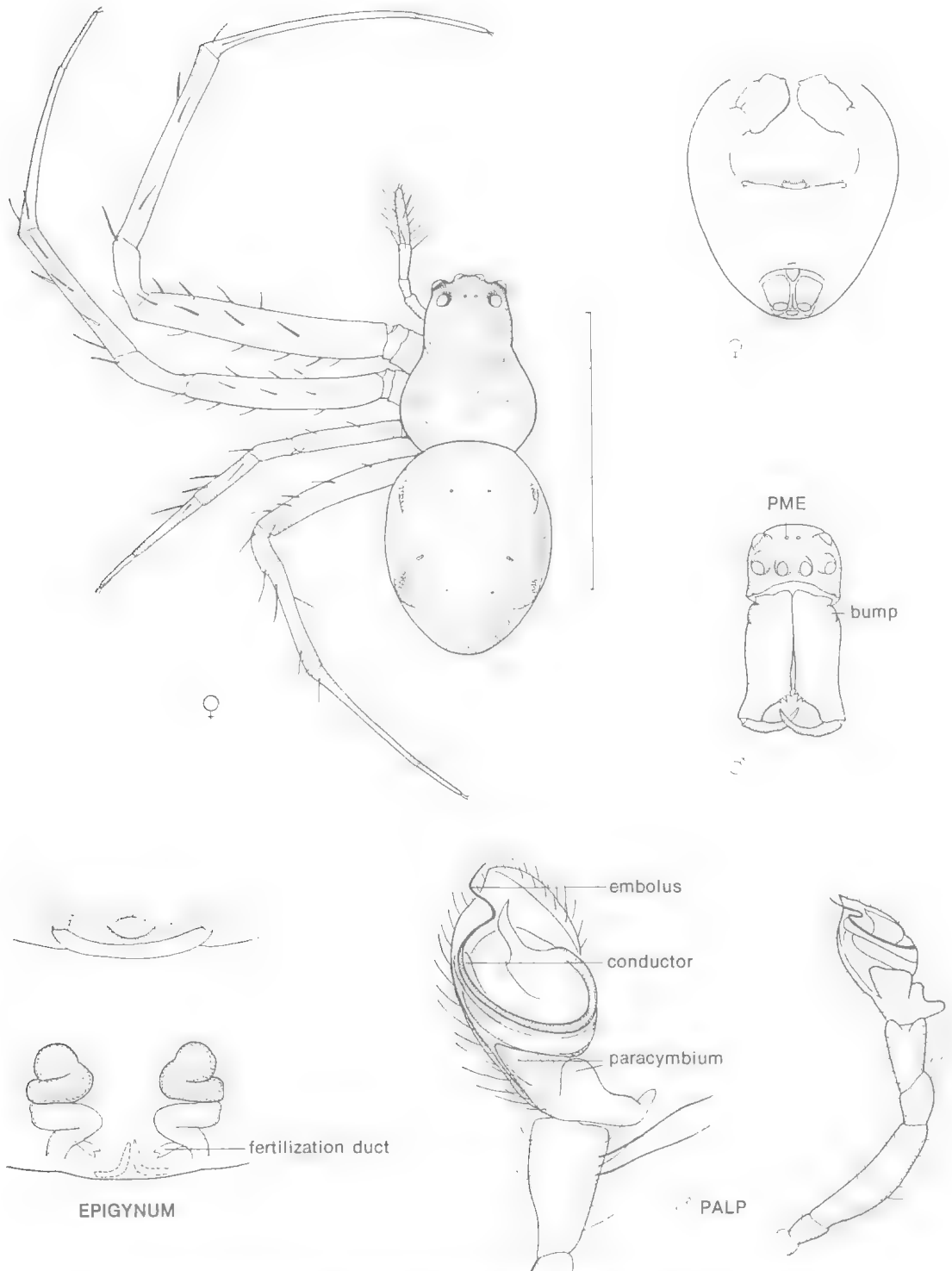
12. DOLICHOGNATHA SP (Iron Range, Cape York Peninsula, Queensland)

trichobothria

♀

embolus
conductor

tegulum

spermathecal sac

sub-
tegulum

paracymbium

trochanter

EPIGYNUM
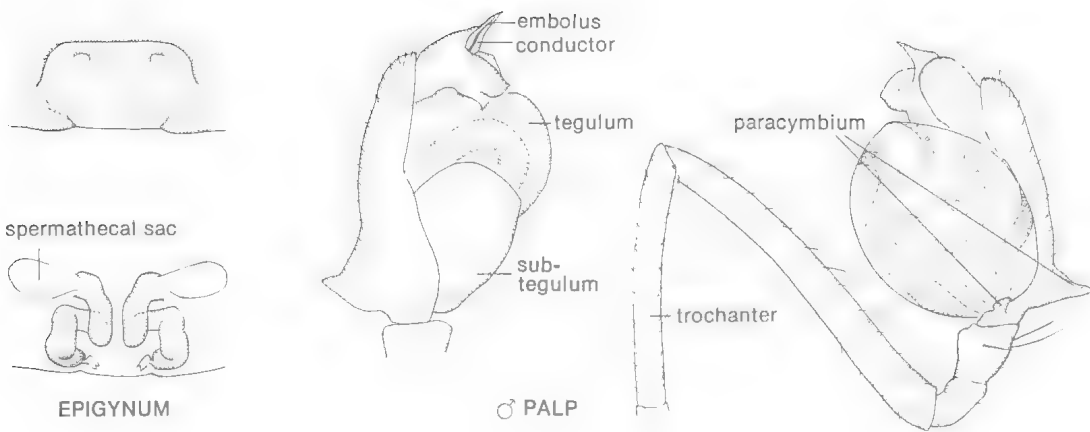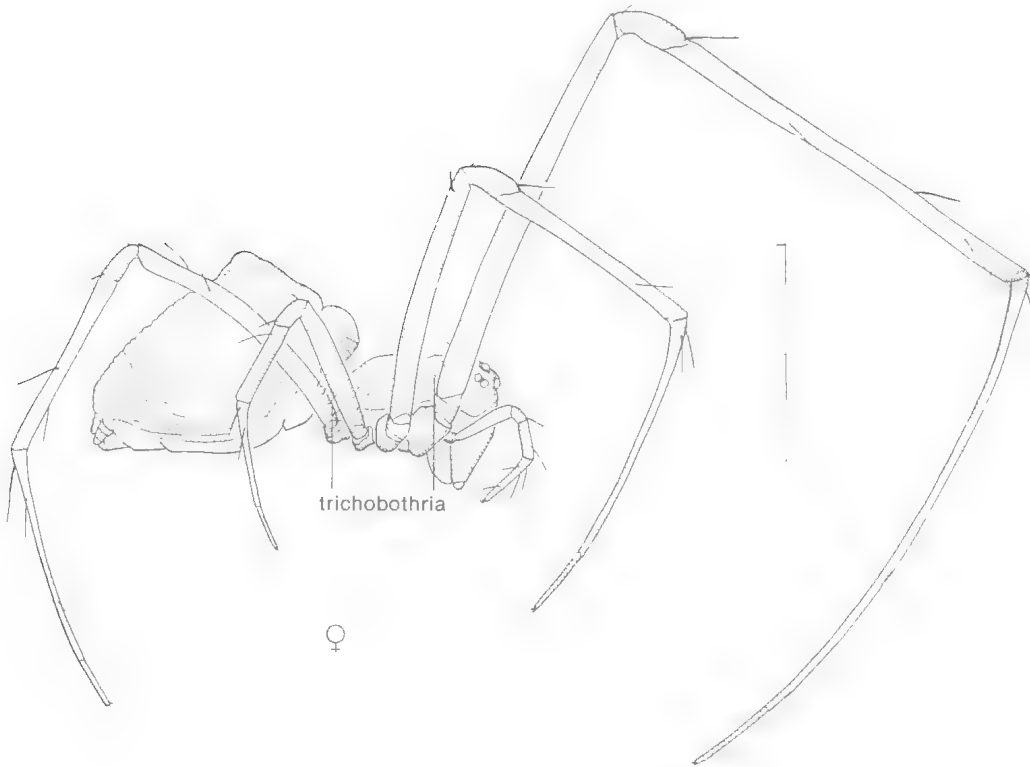
♂ PALP

13. TYLORIDA STRIATA (THORELL, 1877)

trichobothria

♀

trochanter

gonopore

spermathecal sac

fertilization duct

EPIGYNUM

embolus

conductor

paracymbium
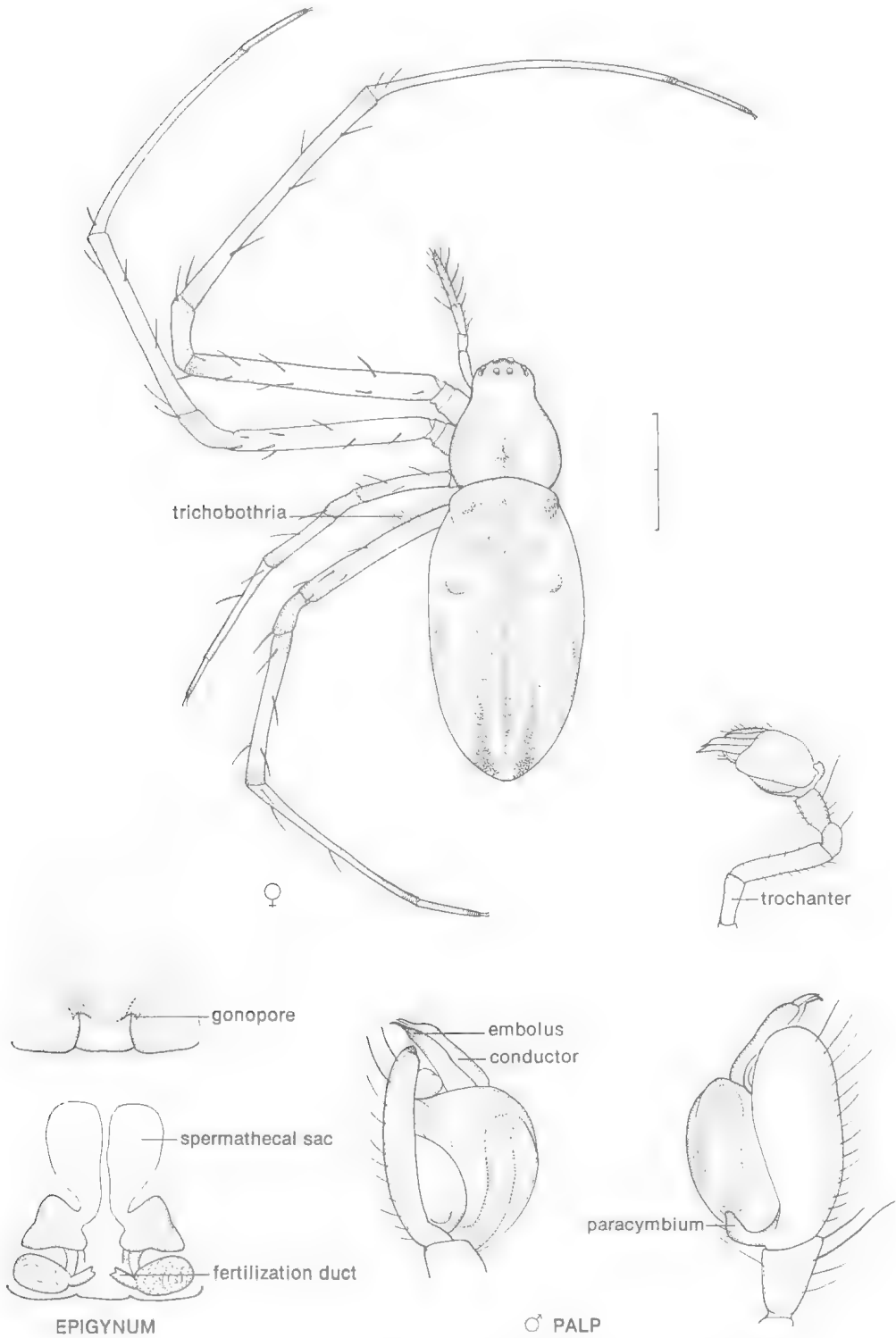
♂ PALP

14. LEUCAUGE GRANULATA (WALCKENAER, 1842)

trichobothria

♀

clasping spur

♂

spermathecal sac

EPIGYNUM

embolus
conductor

sub-tegulum

paracymbium

♂ PALP

trochanter
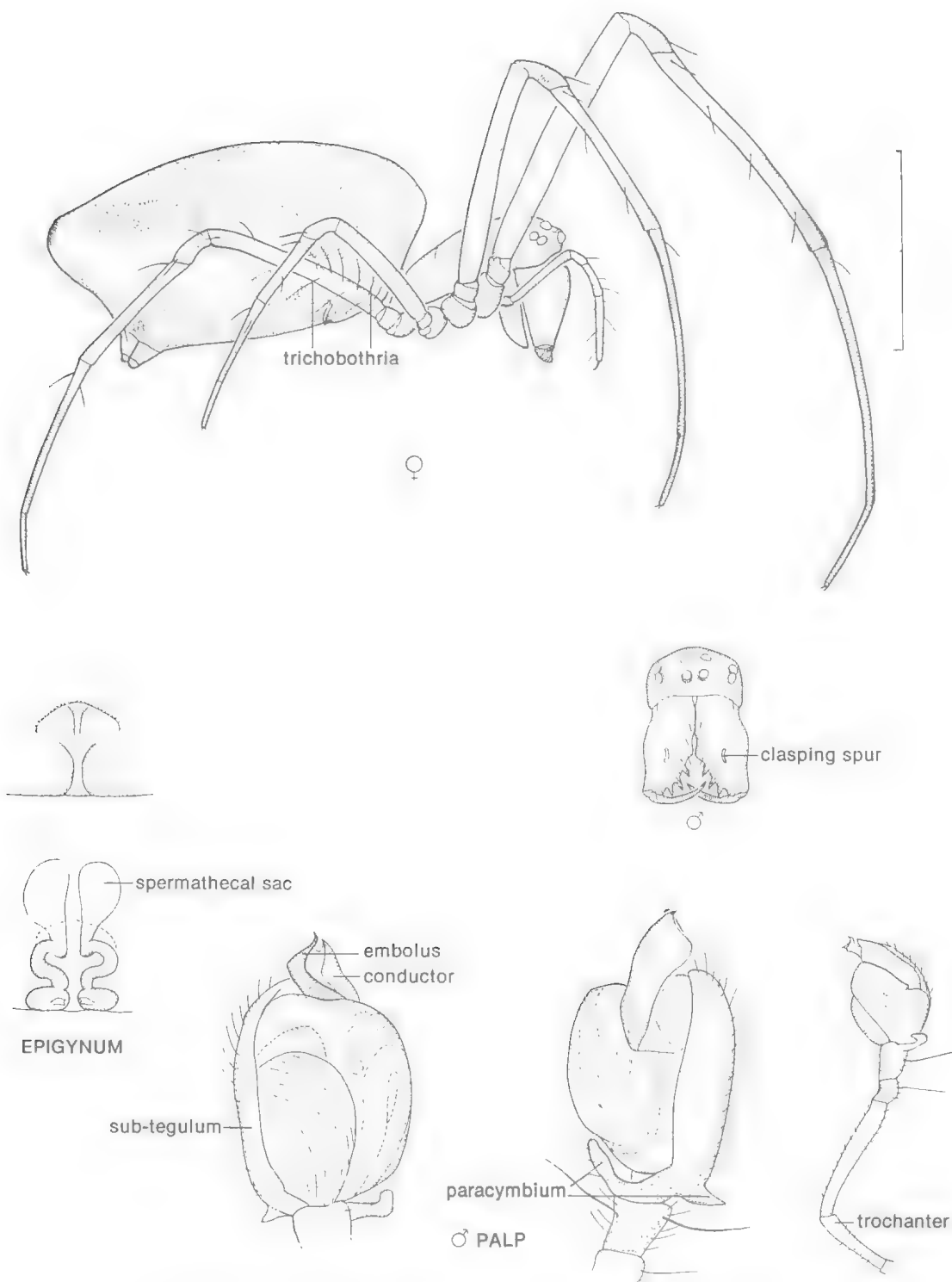
15. MESIDA ARGENTIOPUNCTATA (RAINBOW,1916) *N.COMB.*
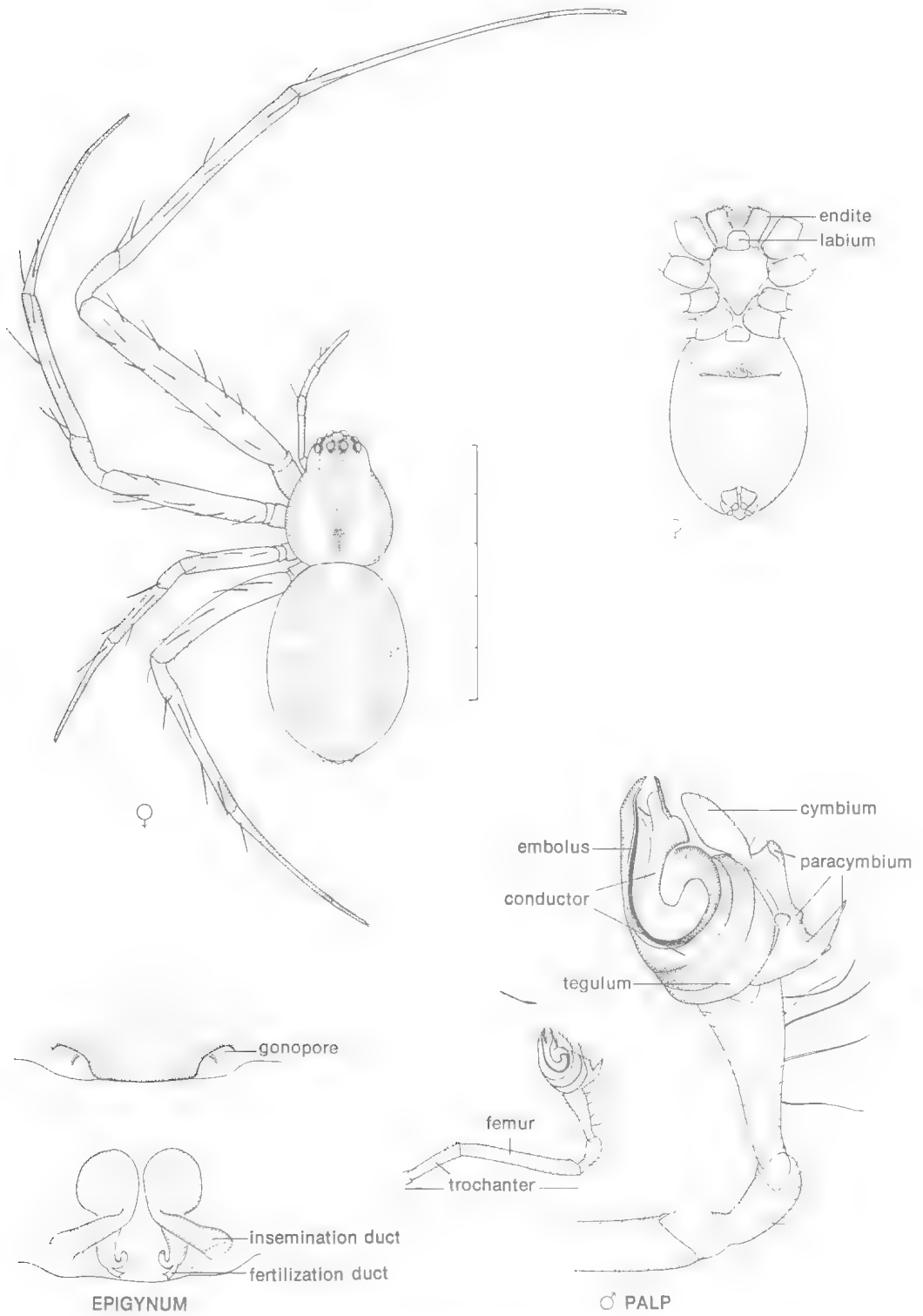
16. METINAE SP (Lamington National Park, southeast Queensland)

embolus

conductor

paracymbium

fertilization duct

EPIGYNUM
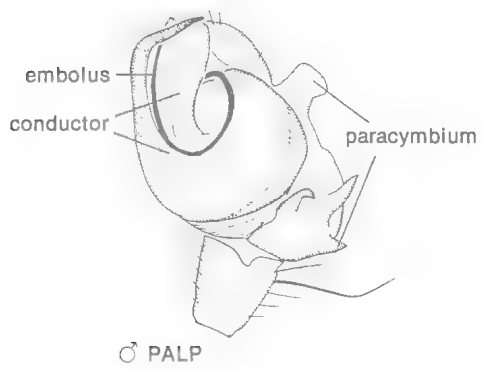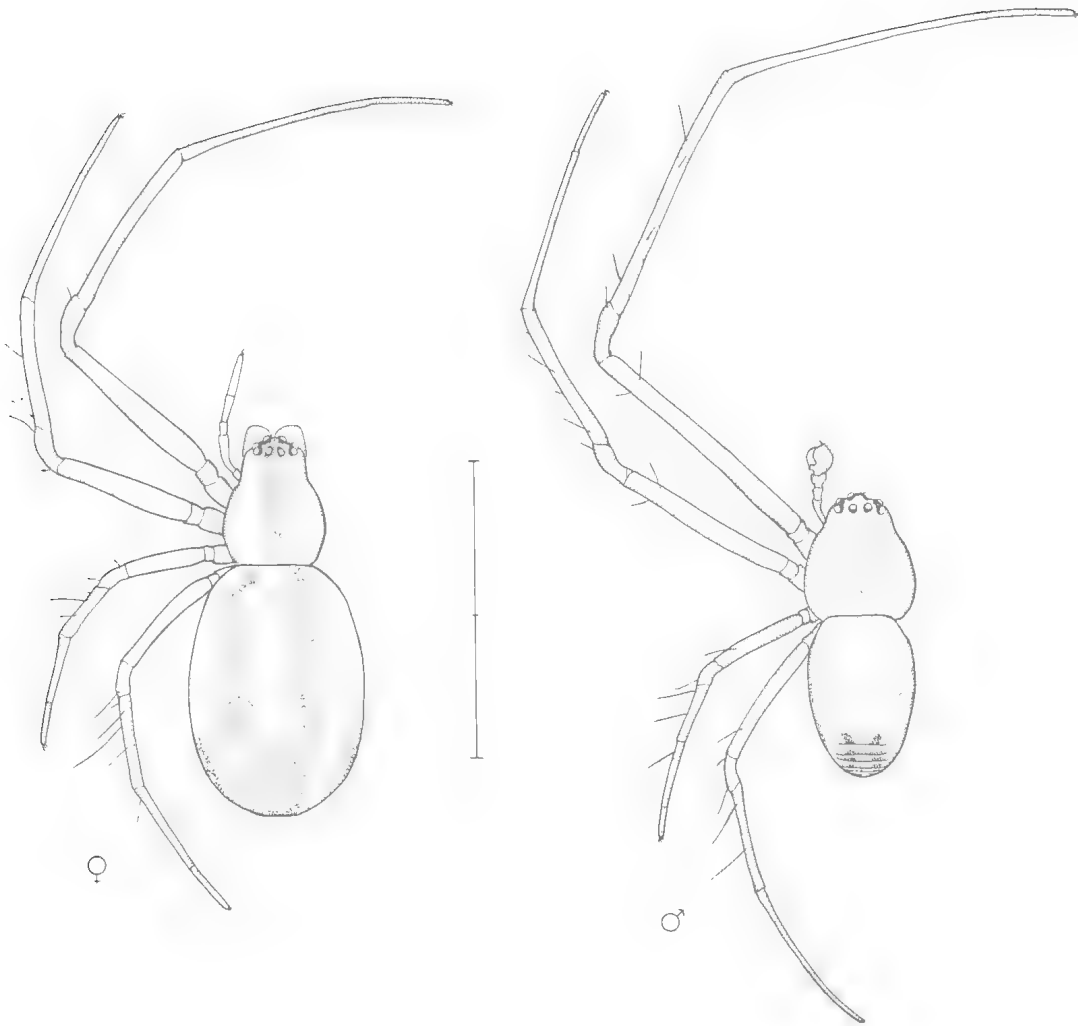
♂ PALP

17. NANOMETA SP (Mt Glorious, southeast Queensland)

19 ♂ palpal tibia not saucer-shaped. Paracymbium flat. ♂ small, ♀ large-very large ...... Nephilinae 20
  – ♂ palpal tibia saucer-shaped. Paracymbium hook-shaped (exc. *Paraplectanoides*). ♂ small or not
      much smaller than ♀ 22
20 Spiders with dark cephalothorax and smooth oval or cylindrical abdomen 21
  – Pale spiders with laterally crenellate flattish abdomen. Orb-webs modified to form a ladder-web
      with solid silk hub-cup (Pl. 18) .... *Herennia*
                                                                                                          (northern Australia)
21 Brushes of hair (very reduced in *N. maculata*) on tibiae and metatarsi of ♀. Sticky spiral of golden
      silk; barrier web(s) sometimes associated with orb. ♀ leg I at least × 5 length of cephalothorax
      (Pl. 19) .... *Nephila*
  – Without brushes of hair on legs of ♀. Sticky spiral of normal silk; long tubular retreat from hub of
      web. ♀ leg 1 about × 4 length of cephalothorax (Pl. 20) .... *Nephilengys*
                                                                                                          (northern Australia)

The nephilines show unique behaviour in the detailed construction of the radii of the web
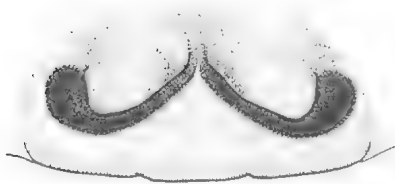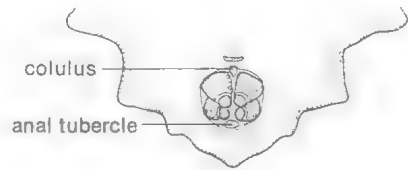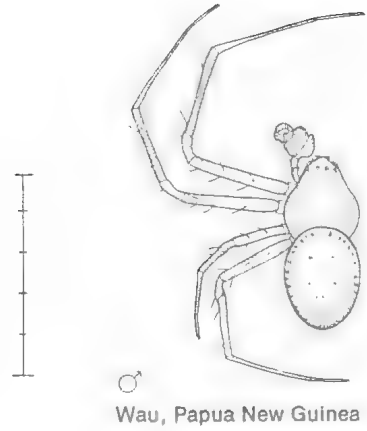(Eberhard, 1982). Coddington (1986c) further showed that nephilines have behavioural
apomorphies that suggest they represent a monophyletic lineage and that they lack the behavioural
synapomorphies that link the other non-cribellate orb-weavers. There are no established anatomical
apomorphies for the group. The non-removal of the auxiliary spiral during web building is also
found in *Phonognatha* (Vollrath *pers. comm.*) considered here to be a metine. Most *Nephila* spp., the
golden orb-web spiders, attach their egg-sacs to foliage near the web; however, *N. maculata* lays eggs
in an egg sac on the ground and covers this with litter (Robinson, 1980). After hatching the young
climb up into vegetation before dispersing.

Wau, Papua New Guinea

colulus

anal tubercle

East Alligator River, Northern Territory

conductor

embolus

tegular apophysis

cymbium

paracymbium

insemination duct

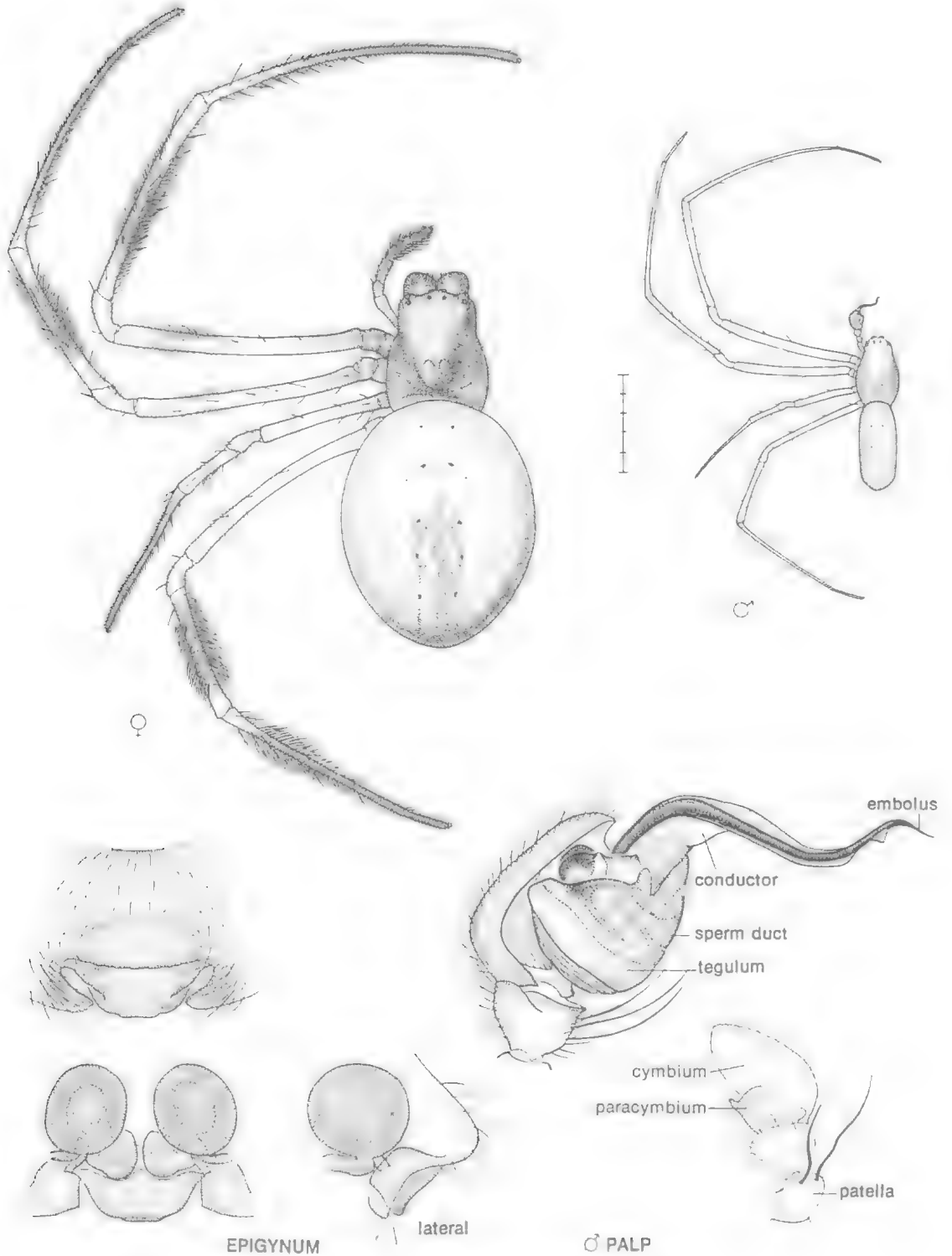fertilization duct
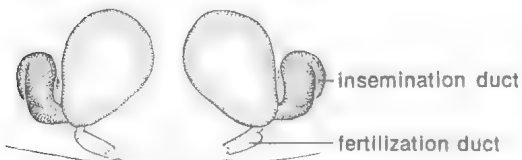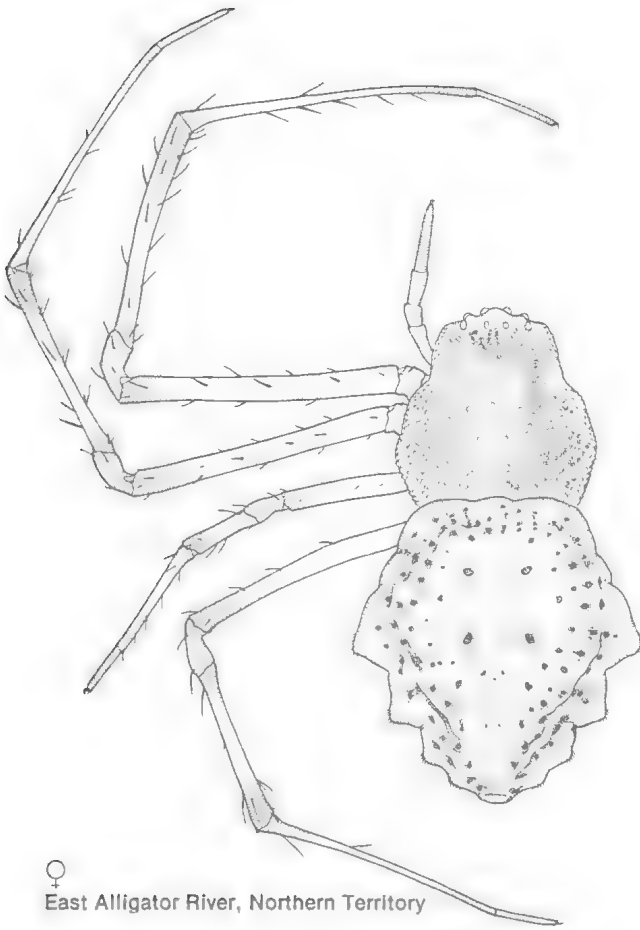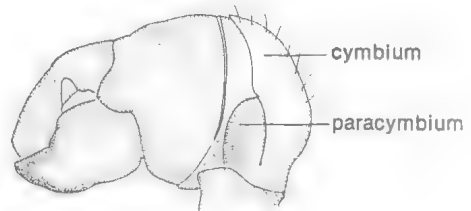
EPIGYNUM

♂ PALP

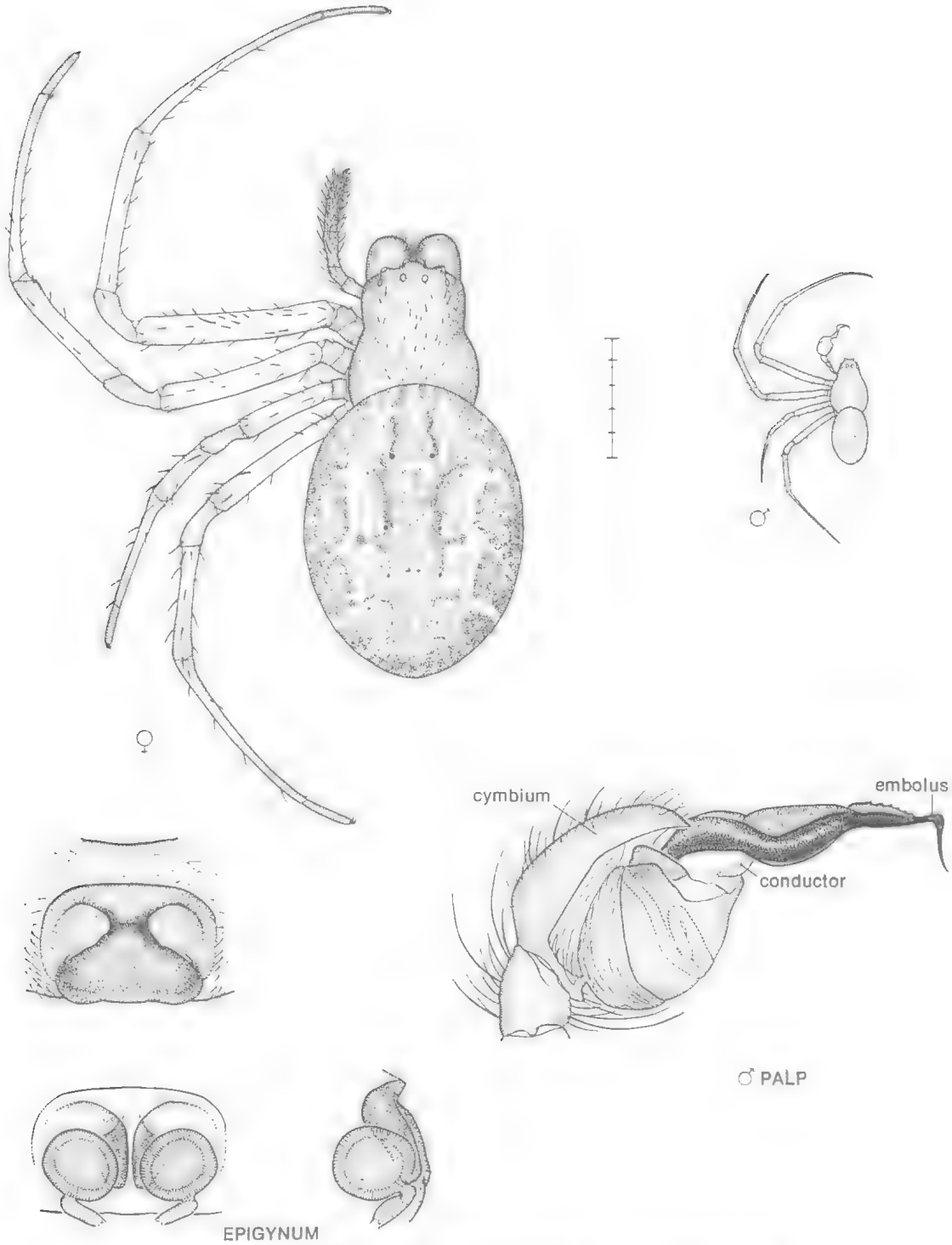**18. HERENNIA SPP**

EPIGYNUM   lateral   ♂ PALP

19. NEPHILA PLUMIPES (LATREILLE, 1804)
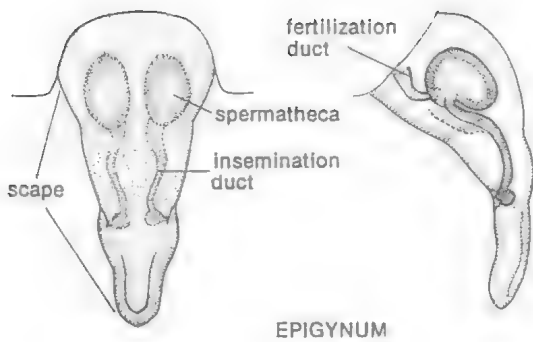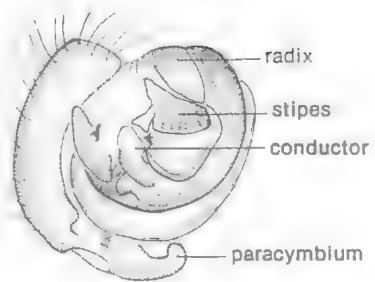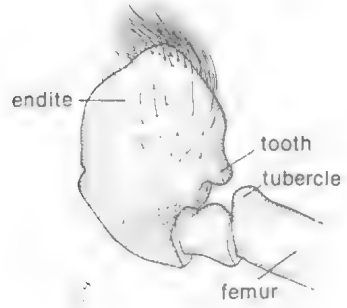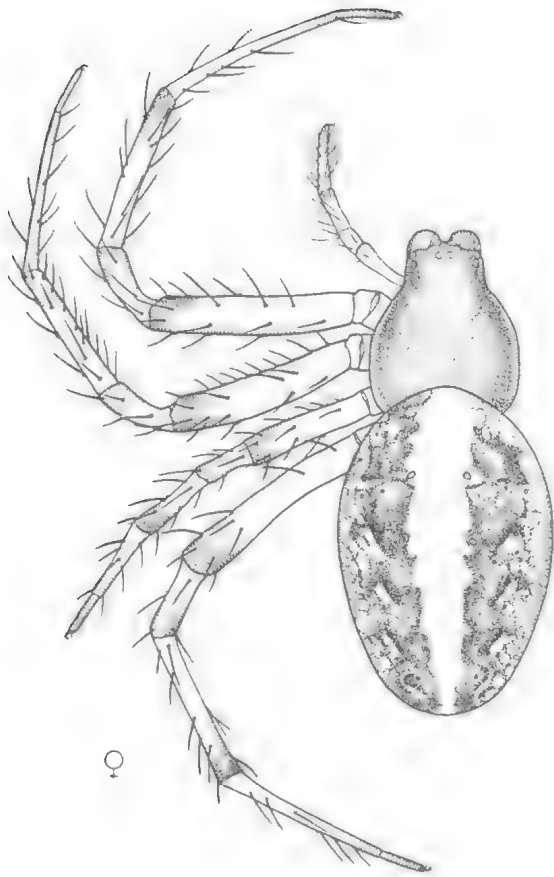
cymbium

embolus

conductor

♂ PALP

EPIGYNUM

20. NEPHILENGYS MALABARENSIS (WALCKENAER, 1841)

22 ♂ endite with tooth meeting tubercle on palpal femur. ♂ palp with terminal apophysis (exc. *Neoscona*). ♀ with long or short scape. ♂ only slightly smaller than ♀ .... Araneinae 23
 – ♂ endite without tooth. ♂ palp rarely with terminal apophysis. ♀ without scape. ♂ much smaller than ♀ 31
23 ♂ coxa I with postero-ventral spur (Pl. 24) 24
 – ♂ coxa I without spur 30
24 ♀ scape tongue-shaped, directed backwards. Sclerites of ♂ palp in narrow area between cymbium and tegulum; no terminal apophysis. ♂ palpal patella with 2 spines (Pl. 21) .... *Neoscona*
 – ♀ scape directed forwards and then backwards. Sclerites of ♂ palp not so confined. ♂ palpal patella with 1 spine 25
25 Carapace with high cephalic area 26
 – Carapace with normal cephalic area 27
26 Hairy cephalic area. PME more than × 2 diameter apart. Abdomen with multiple humeral bumps and lateral bumps (Pl. 22) .... *Carepalxis*
 – Smooth cephalic area. PME less than × ♀ diameter apart. Abdomen smooth. ♂ coxa IV with thorn-like ventral spines. Small spiders (Pl. 23) .... *Inepsion*
27 Very hairy cephalic area 28
 – Smooth or lightly haired cephalic area 29
28 PME smaller than AME. Abdomen not extended dorsally. Large-very large spiders (Pl. 24)
 .... *Eriophora*
 – PME larger than AME. Abdomen extended dorsally into turret-shape (Pl. 25) ..... *Heurodes*
29 PME less than × ♀ diameter apart. ♀ rounded cephalic area separated by deep V-shaped groove from thoracic area of carapace. Obliquely horizontal orb-web, usually decorated (Pl. 26) ....
 .... *Cyclosa*
 – PME × 1 diameter or more apart. No marked groove between cephalic and thoracic carapace. Vertical orb-web (Pl. 27) .... '*Araneus*'

Although many unmatched males have been examined none was certainly identified as *Carepalxis*.

♂ chelicerae of *Eriophora* spp have an anterior concavity accommodating the large palpal bulbs. This concavity is also found in *Heurodes* and *Cyclosa*. Some *Cyclosa* spp have short, rounded abdomens.

Many Australian araneines belong in a group at present placed in '*Araneus*'. The ♂♂ have a tooth on the endite meeting a tubercle on the palpal femur; a spur on coxa I, that fits into a groove on the proximal end of its femur II during mating and a terminal apophysis on the palpal bulb. The ♀♀ have a scape folded back on itself. Two further ♂ characters, a paramedian apophysis and a single spine on the palpal patella distinguish them from *Araneus* (Levi, 1983, unpublished key).

endite

tooth

tubercle

femur

radix

stipes

conductor

paracymbium

fertilization
duct

spermatheca

insemination
duct

scape

EPIGYNUM

stipes

median
apophysis

tegular
process

embolus

patella

♂ PALP
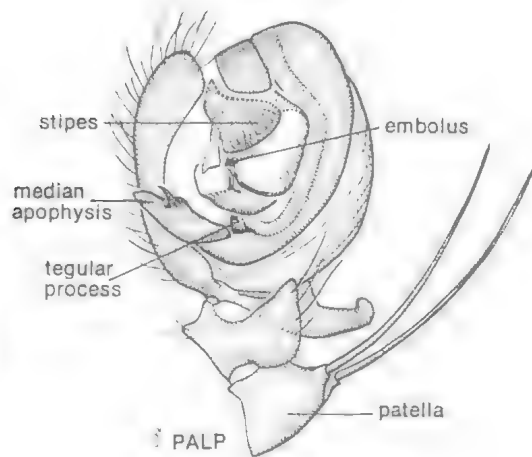
21. NEOSCONA THEISI (WALCKENAER, 1841)
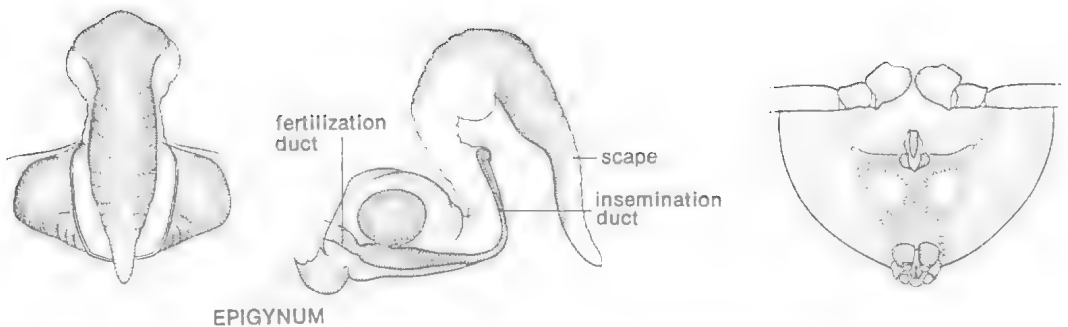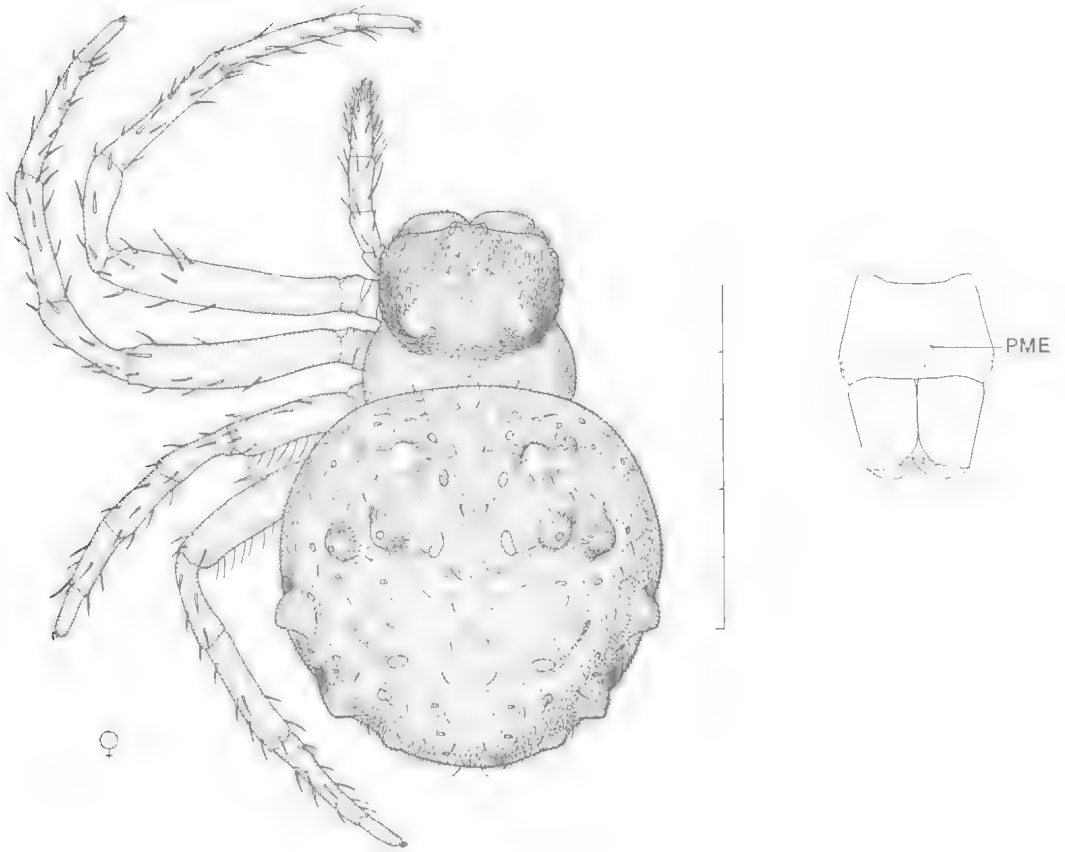
22. CAREPALXIS TUBERCULATA KEYSERLING, 1886

PME

spur

coxa iv

♂

♀

embolus

terminal
apophysis

conductor

median
apophysis

spermatheca

fertilization duct

EPIGYNUM

paracymbium

tibia

patella

PALP
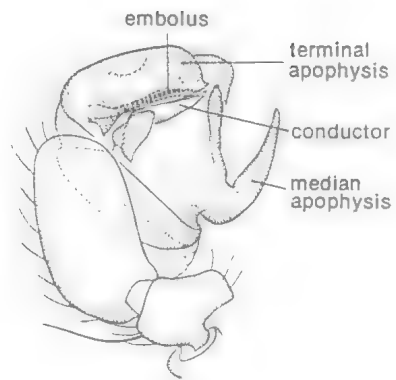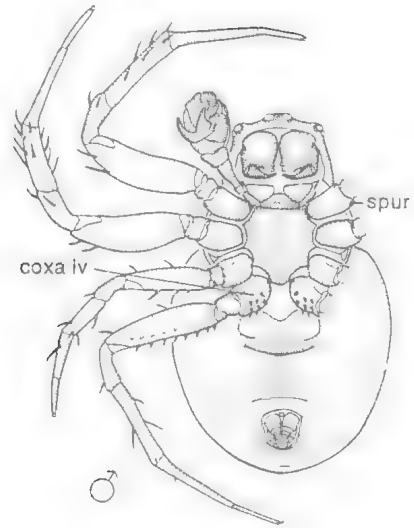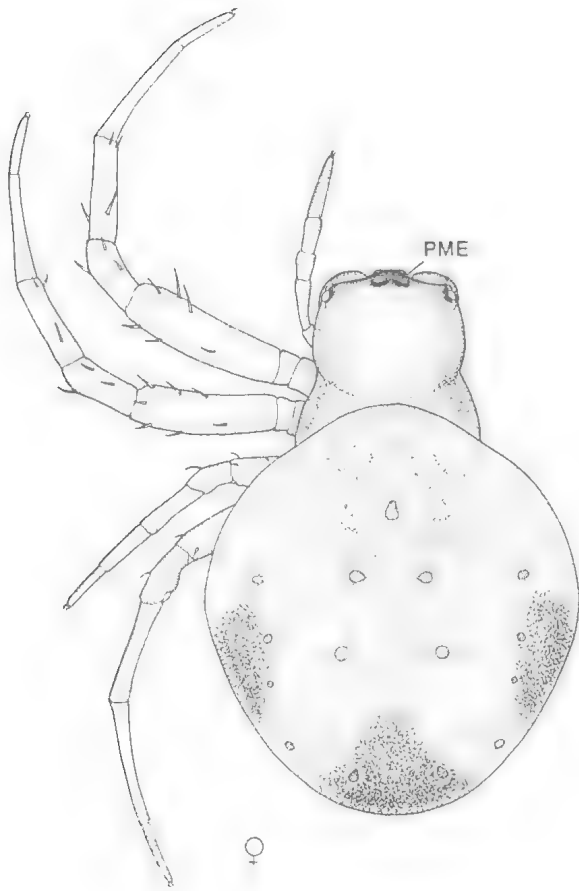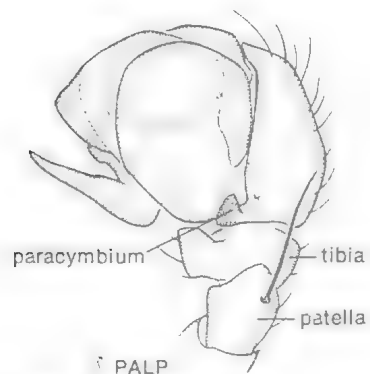
23. ANEPSION PELTOIDES (THORELL, 1878)
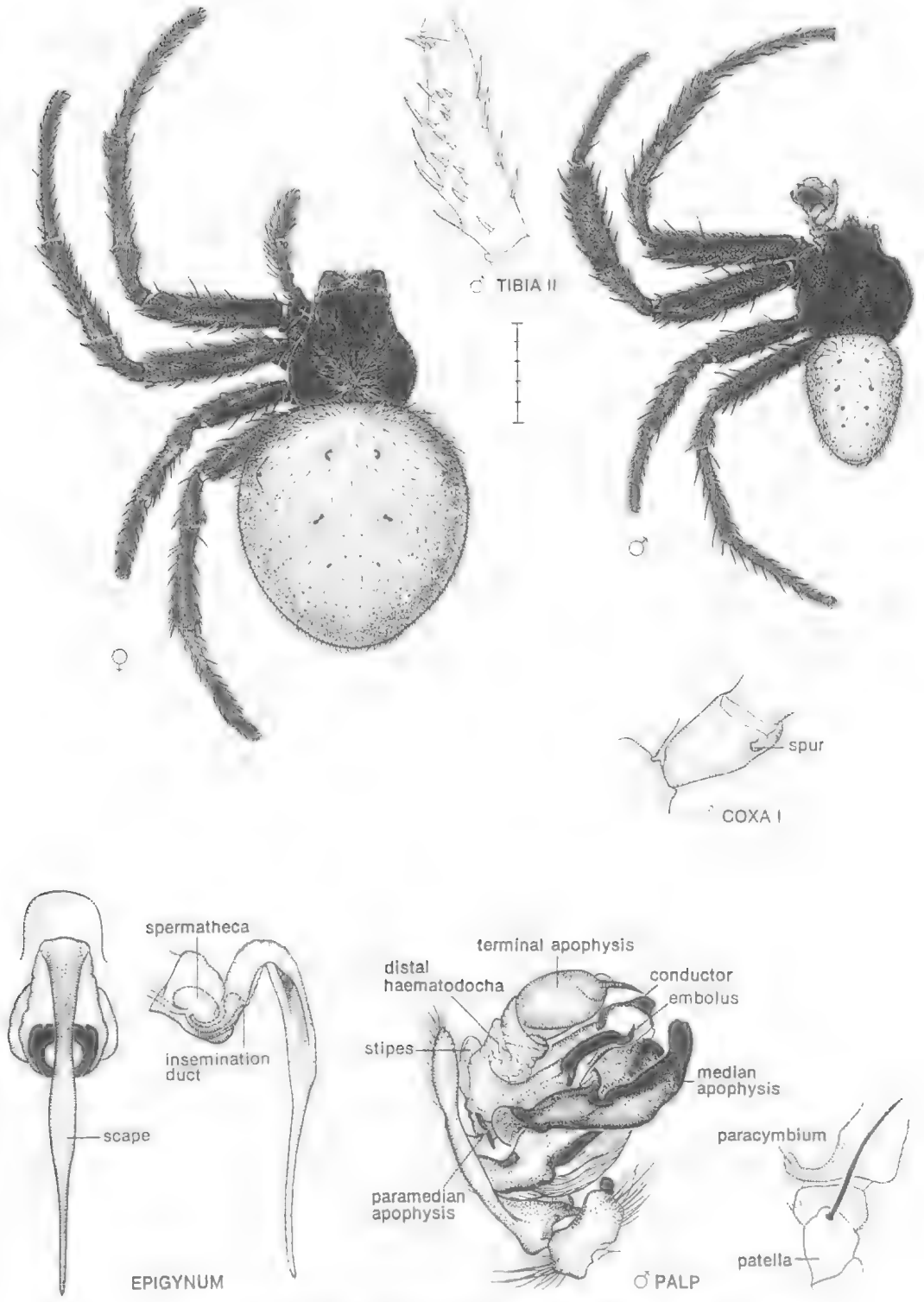
24. ERIOPHORA TRANSMARINA (KEYSERLING, 1865)

PME

excavated
chelicera

♀

♂ TIBIA II

terminal apophysis

paramedian
apophysis

conductor

embolus

median
apophysis

radix

posterior

EPIGYNUM

♂ PALP

paracymbium
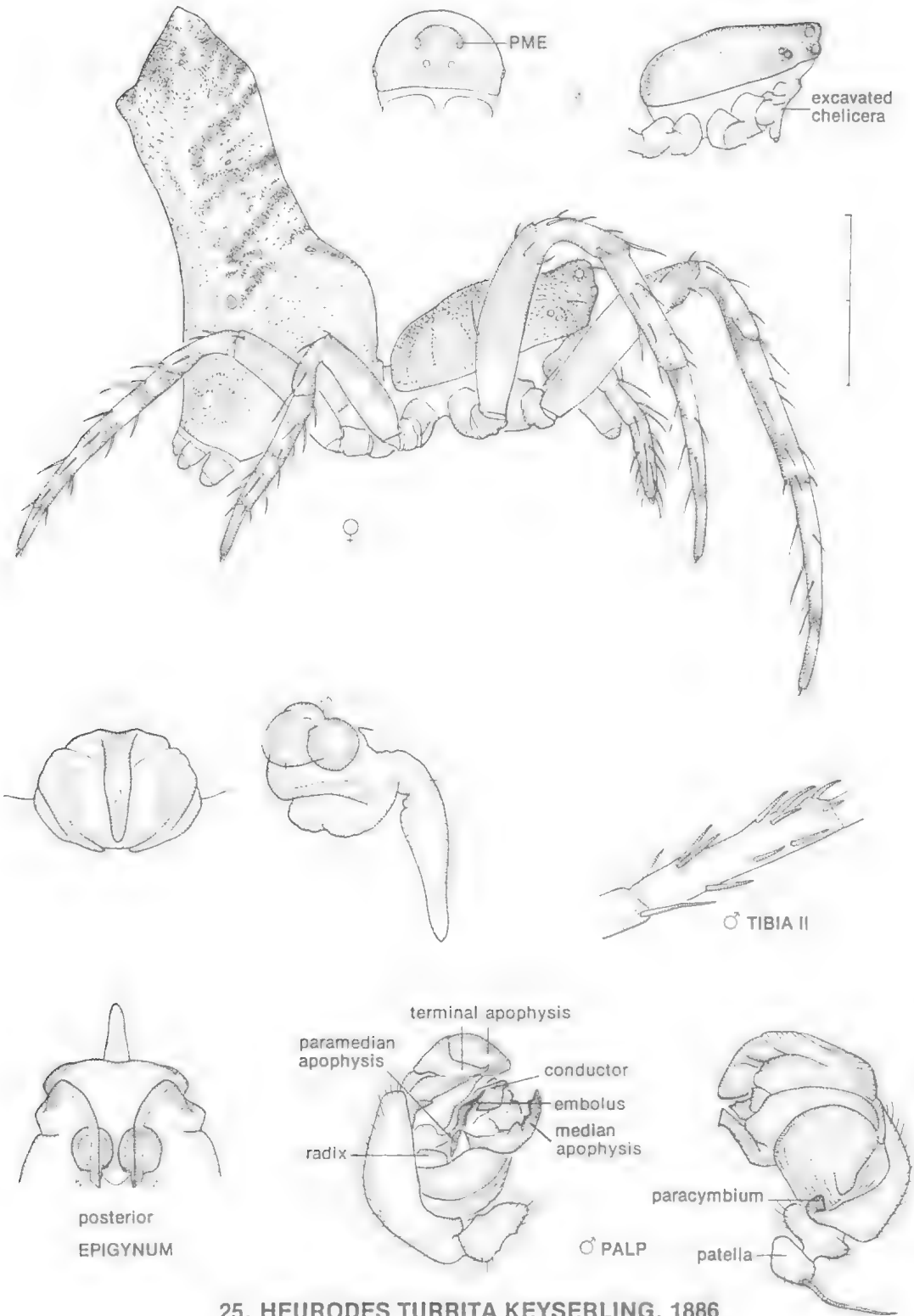
patella

25. HEURODES TURRITA KEYSERLING, 1886

PME

COXA I

TIBIA II

terminal apophysis

conductor

embolus

scape

median apophysis

paramedian apophysis

radix

paracymbium

patella

EPIGYNUM
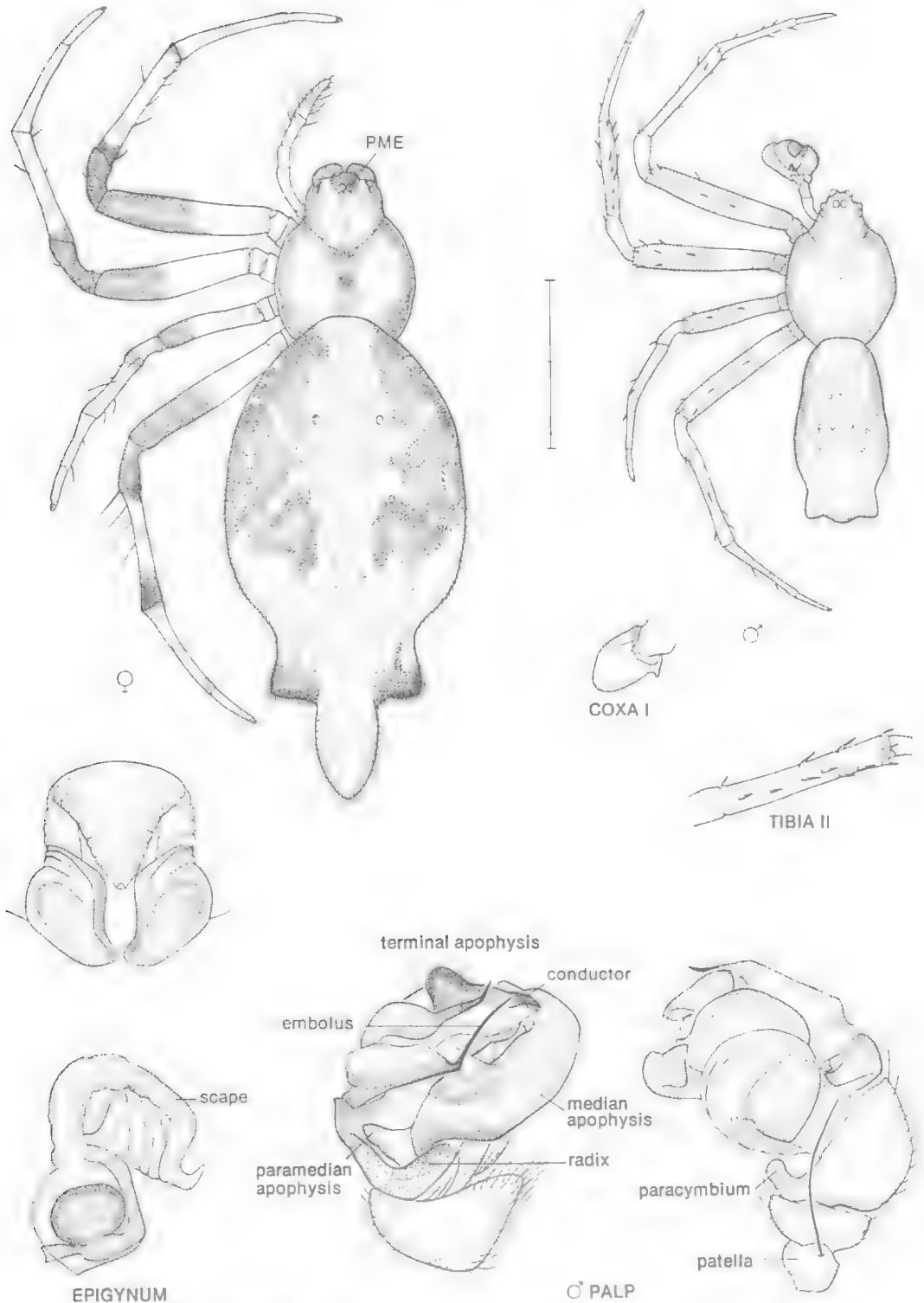
♂ PALP

26. CYCLOSA TRILOBATA (URQUHART, 1884)

tooth on endite
femoral tubercle
labium
♂

♂ COXA I

♂ COXA IV

TIBIA II

posterior
EPIGYNUM

terminal apophysis
stipes
paramedian apophysis
conductor
embolus
radix
paracymbium
median apophysis
patella
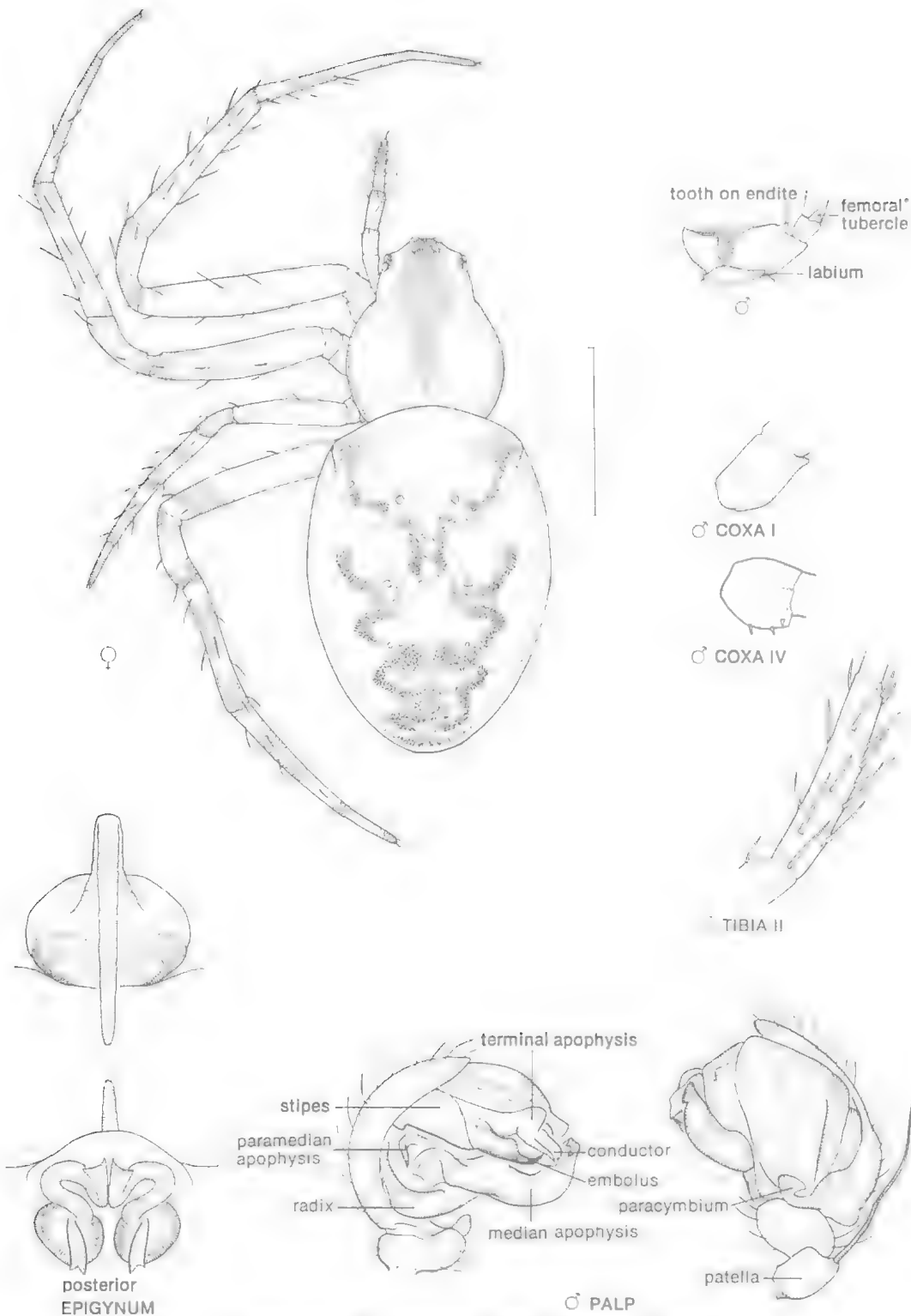
♂ PALP

27. 'ARANEUS' EBURNUS (KEYSERLING, 1886)

30 MOQ wider behind than in front. Abdomen wider than long. ♂ palpal patella with many spines (Pl. 28) .... *Dolophones*
 – MOQ wider in front than behind. Abdomen longer than wide. ♂ palpal patella with 2 spines (Pl. 29) .... *Larinia*
31 High smooth cephalic area. Abdomen with dorsal sclerotized discs 32
 – Flat cephalic area, or if high not smooth 33
32 Chelicera with flange on fang; ♀ abdomen without pointed projections (Pl. 30) .... incertae sedis *Paraplectanoides*
 – Chelicera normal. ♀ abdomen with 2 pairs of thick pointed lateral projections and usually 2 posterior projections. Sclerotized ring round spinnerets (exc. *Gasteracantha minax*) (Pl. 31) .... Gasteracanthinae *Gasteracantha*
33 Posterior eye row procurved .... Argiopinae 34
 – Posterior eye row straight or recurved 35
34 PME about same distance from each other as from PLE (Pl. 32) .... *Gea*
 – PME much closer to each other than to PME (Pl. 33) .... *Argiope*

Dorsal protuberances are found on the abdomens of some *Dolophones* spp.

Larinia is usually found in long grass; ♀♀ *L. phthysica* have a scape.

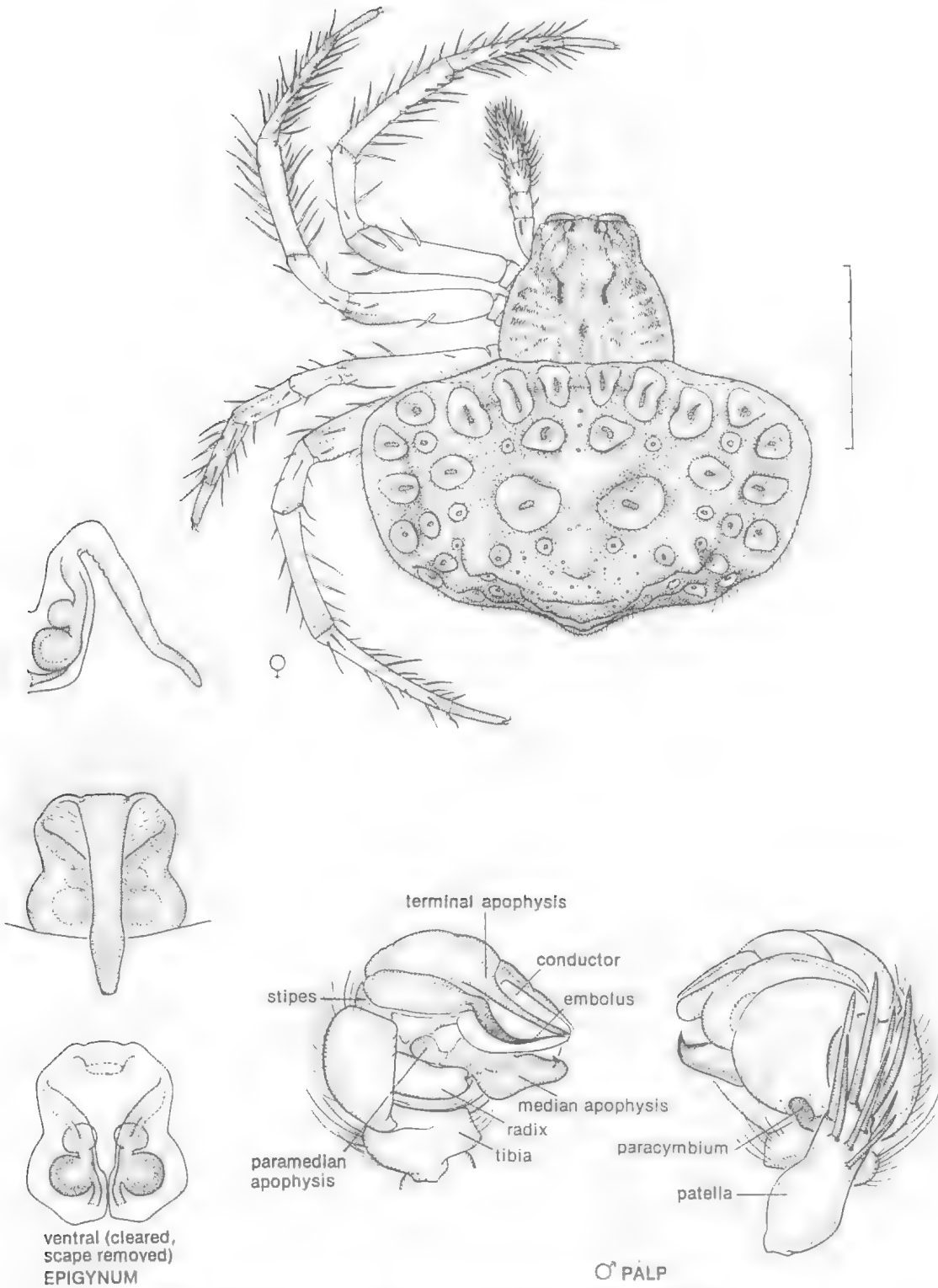*Paraplectanoides* is a very peculiar, long-lived (♀s to 6 years or more) spider. The flange on the fang overlies the comb (? preening) of spines on the promargin of the chelicera. Hickman (1975) described the web and nest of the spider. It spins a few intersecting horizontal threads attached to adjacent twigs near the ground; there is no spiral. A nest is built completely enclosing the radial threads and hub; a small entrance is left in the wall. There are no sticky threads and the spider rests under the hub. Prey enters and is captured when running on the inside of the mesh nest, not on the 'orb-web'. I consider it an araneine because it has transverse furrows on the epigastric plates, a paramedian apophysis and radix in ♂ palp.

♀ *Gasteracantha minax* is atypical of the genus in that the ring around the spinnerets is only slightly more sclerotized than the rest of the venter and the sclerotized knob between the epigynum and spinnerets is absent. See *G. brevispina* for these features.

Some *Argiope* spp build crossing zig-zag stabilamenta in their webs hence the name St Andrew's Cross spider for *A. aetherea* and *A. keyserlingii*. The spiders rest in the web in an X position (Mascord, 1980, pl. 24: figs 1, 3, 4, 5).

terminal apophysis

conductor

stipes

embolus

median apophysis

radix

paramedian
apophysis

tibia

paracymbium

patella

ventral (cleared,
scape removed)
EPIGYNUM

♂ PALP

28. DOLOPHONES TUBERCULATA (KEYSERLING, 1886)

lateral

ventral

posterior
EPIGYNUM

terminal apophysis

embolus

conductor

median
apophysis

tibia

tegulum

paracymbium

patella
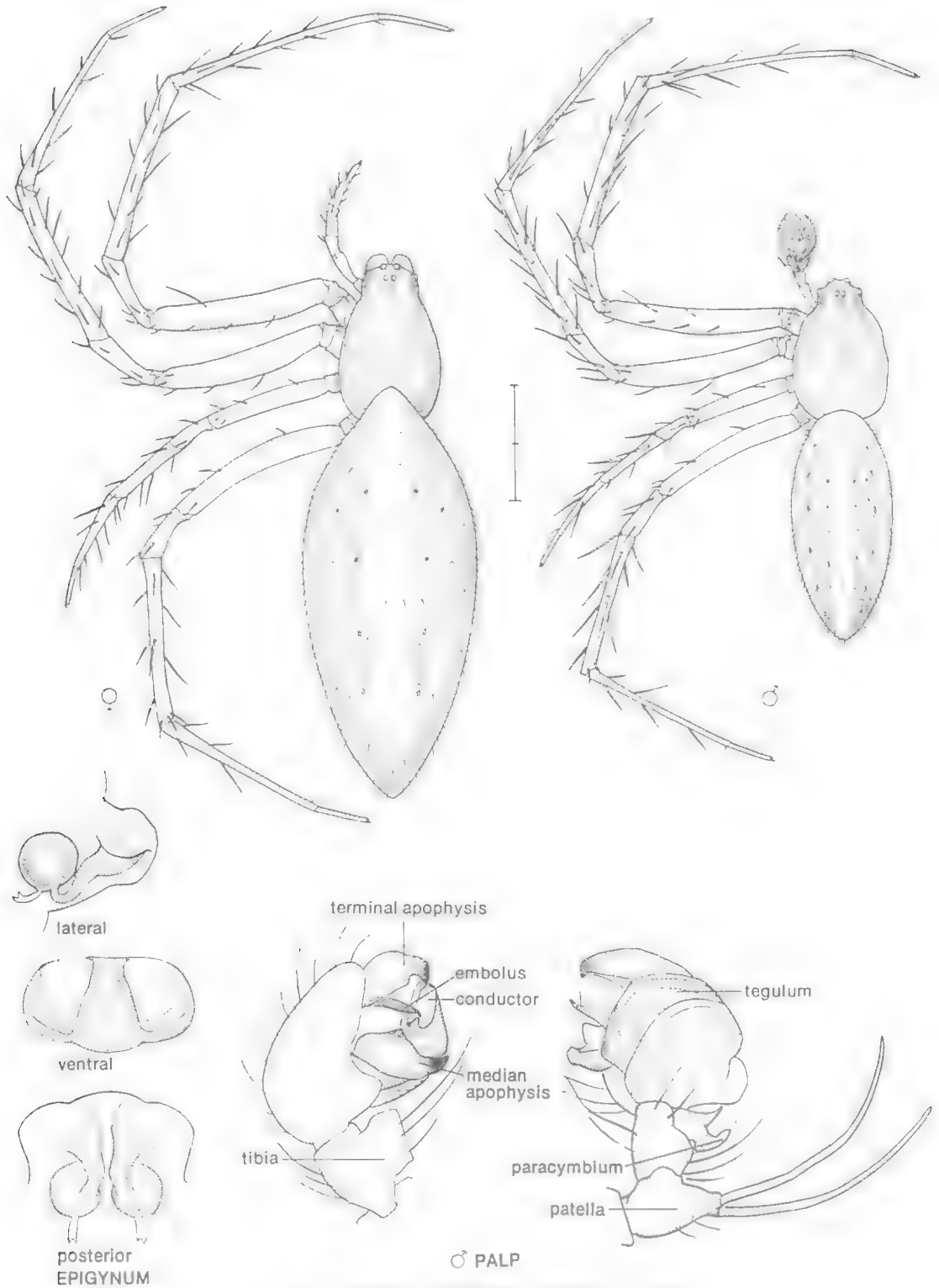
♂ PALP

29. LARINIA TABIDA (L.KOCH, 1872)

BOOK-LUNG COVER

tegulum
embolus
median apophysis
radix
paramediar apophysis
tegulum

sclerotized bump
flange on chelicerae
spines
flange on fang
CHELICERA

lateral

spermatheca

paracymbium

patella
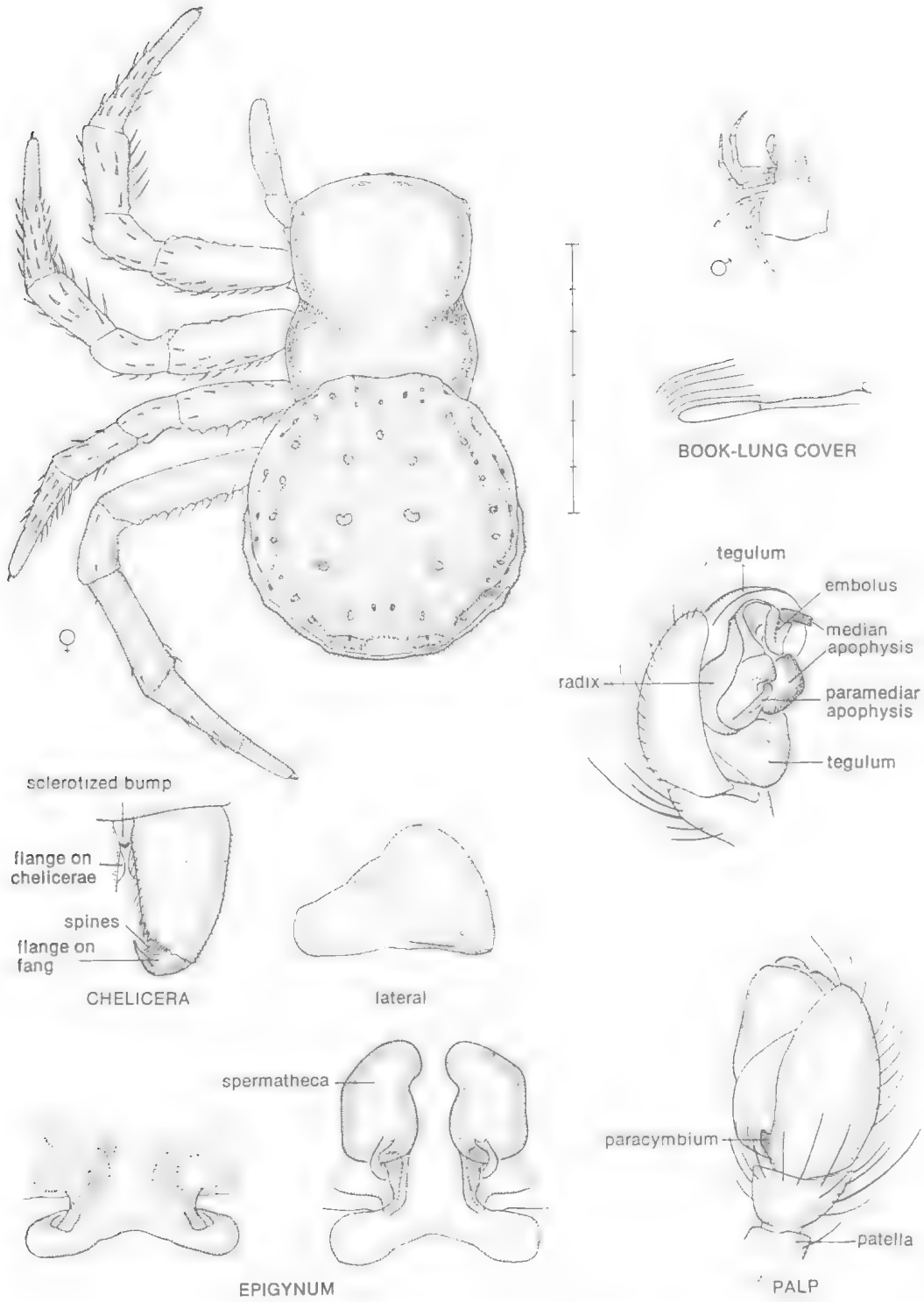
EPIGYNUM

PALP

30. PARAPLECTANOIDES CRASSIPES KEYSERLING, 1886

embolus
conductor
tegular process
median apophysis

posterior
EPIGYNUM

sclerotized bump

paracymbium
patella

G.brevispina (Doleschall, 1857)
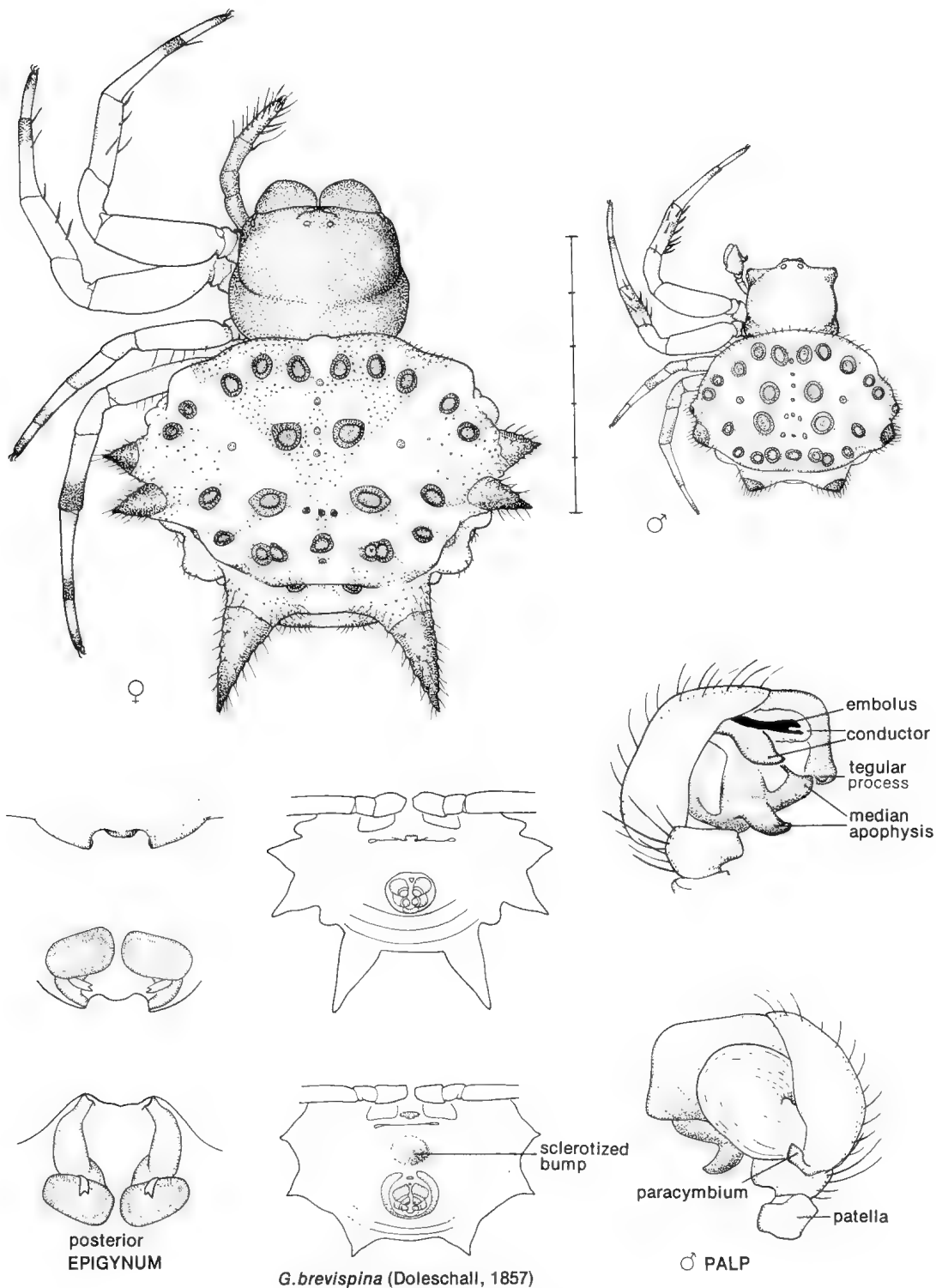
♂ PALP

31. GASTERACANTHA MINAX THORELL, 1859

paracymbium

patella

embolus

conductor

median apophysis

♂ PALP

♀

fertilization duct
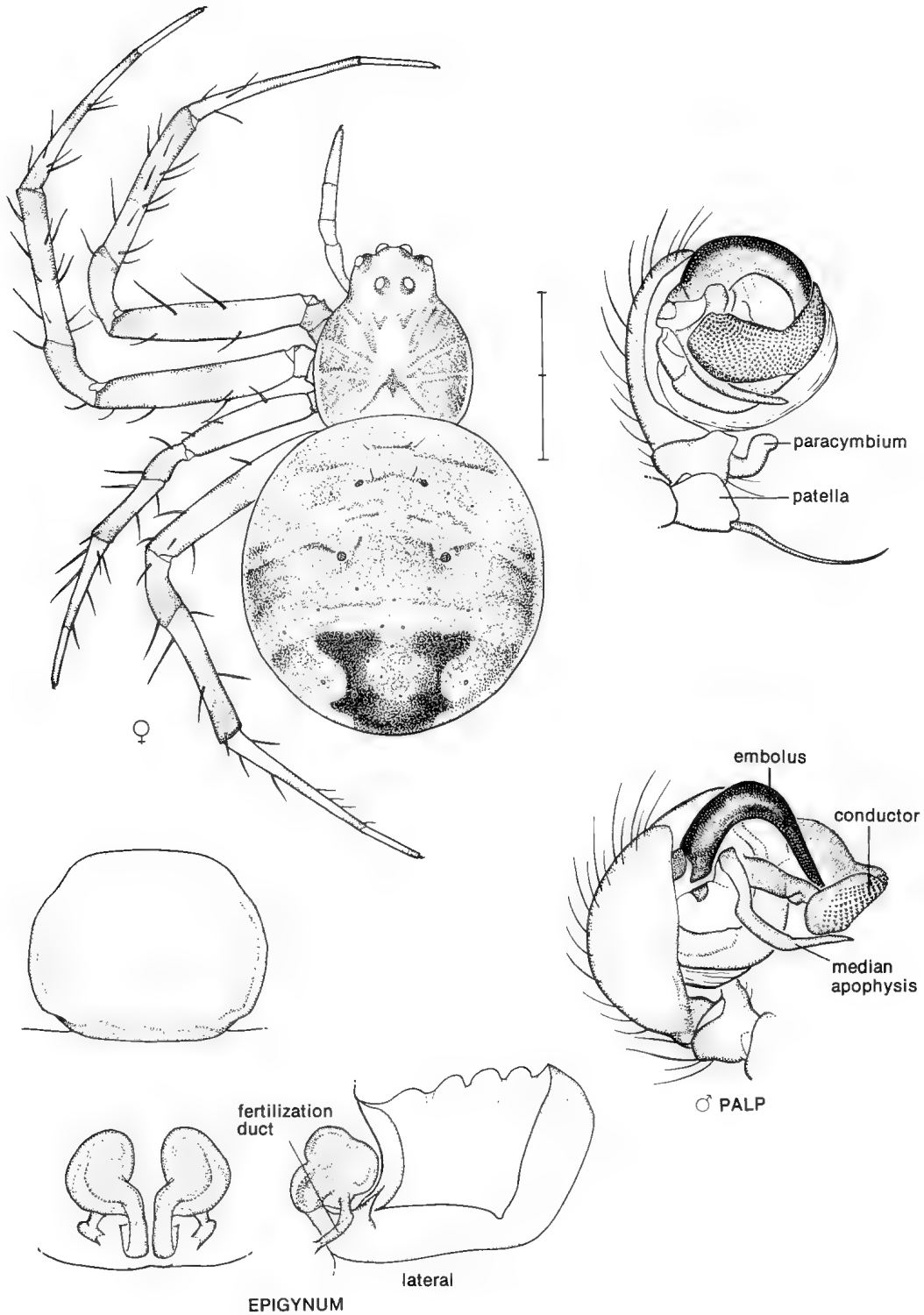
lateral

EPIGYNUM

32. GEA THERIDIOIDES (L.KOCH, 1872)

stipes

embolus

radix

spur
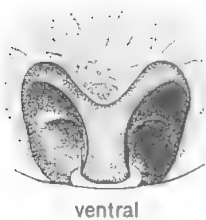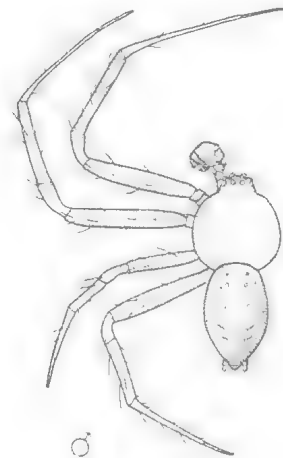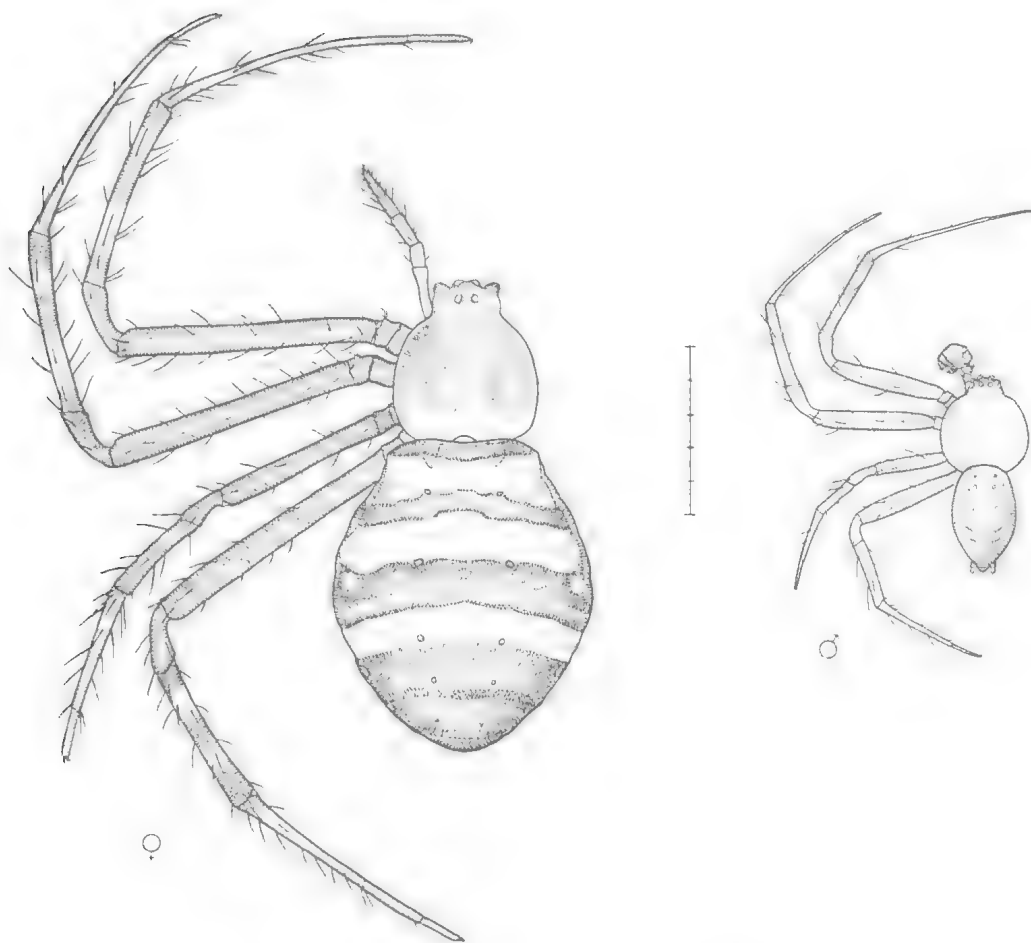
median
apophysis

ventral
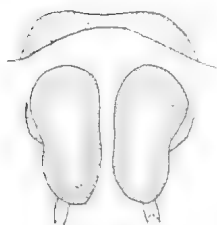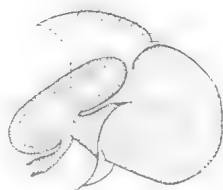
dorsal   lateral

EPIGYNUM
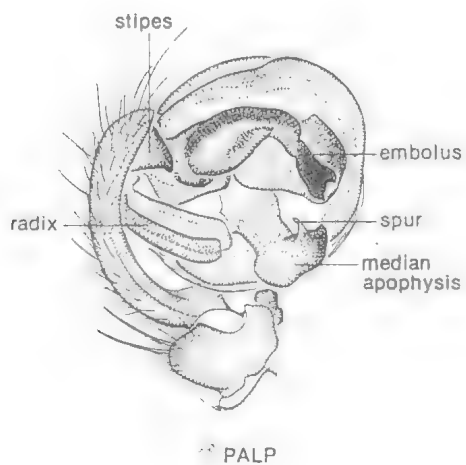
PALP

33. ARGIOPE KEYSERLINGII KARSCH, 1878

PLE

ventral

posterior
EPIGYNUM

conductor

median
apophysis

embolus

paracymbium

♂ PALP
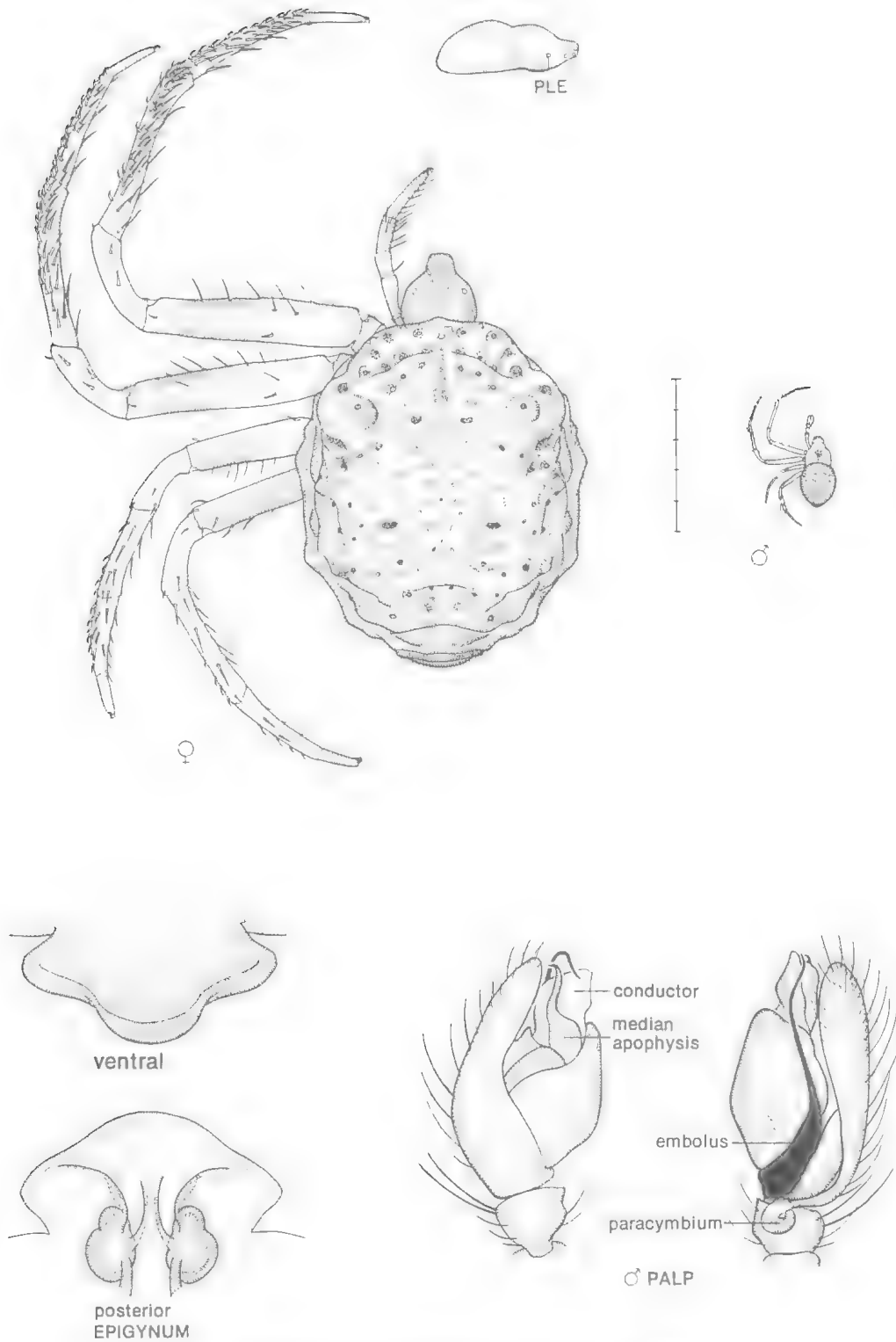
34. POLTYS ILLEPIDUS C.L.KOCH, 1843

35 Lateral eyes widely separated. Carapace narrowed anteriorly. ♂ median apophysis pointed (Pl. 34) .... Poltyinae *Poltys*
– Lateral eyes adjacent. Carapace pointed or truncated. Median apophysis bifid ....
.... Mastophorinae 36
36 Carapace pointed anteriorly. Posterior eye row slightly recurved. Without web (Pl. 35) ....
.... *Celaenia*
– Carapace truncated anteriorly 37
37 Carapace with branched protuberances dorsally. Bolas spider (Pls. 36, 37) .... *Ordgarius*
(= *Dicrostichus* nov. syn.)
– Carapace smooth 38
38 Abdomen wider than long .... Cyrtarachninae 39
– Abdomen longer than wide 41

Poltys is the only araneid in which the lateral eyes are widely separated. The abdomens of some species have bizarre dorsal protuberances. *Poltys* spins a dense orb-web with a closely spaced spiral and captures large numbers of moths (Stowe, 1986).
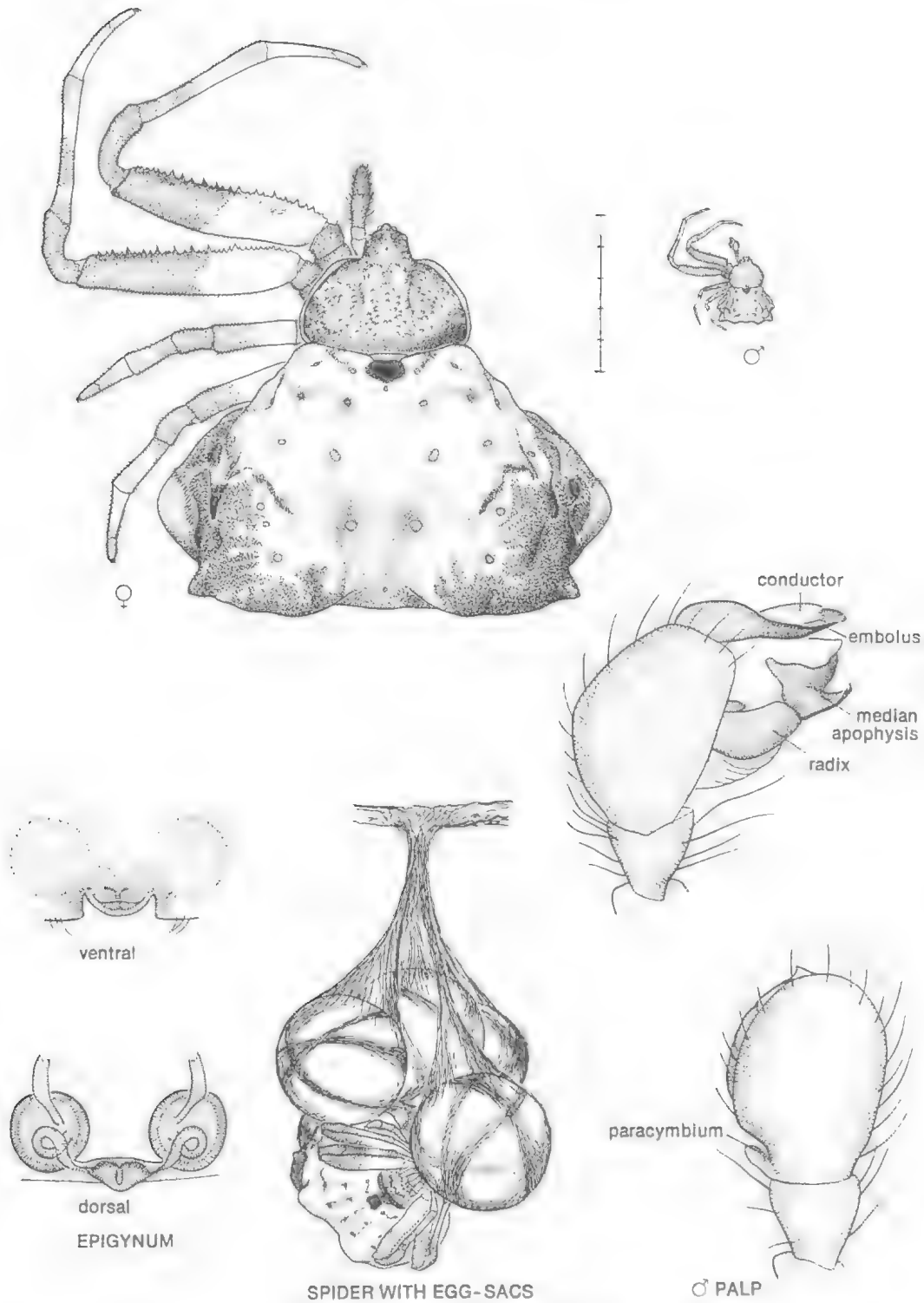
Celaenia kinbergii is known as the bird-dropping spider because of its colour and immobility when at rest (Mascord, 1980, pl. 33: 4). When active, it hangs upside-down from a line or the underside of a leaf with legs I and II spread (Stowe, 1986); ♂ moths are captured when they fly into the spider's outstretched legs. There is evidence to show that the moths are attracted by an odour which has the same effect as the sex pheromones produced by the ♀ moth. Hickman (1971) gives biological notes on three *Celaenia* spp.

From a study of the genital structures *Dicrostichus* Simon, 1895, is placed as a subjective junior synonym of *Ordgarius* Keyserling, 1886. Thus *Dicrostichus magnificus* = *Ordgarius magnificus* (Rainbow, 1897) n. comb.; *D. furcatus* = *O. furcatus* (O. P. Cambridge, 1877) n. comb.; *D. caliginosus* (Rainbow, 1894) = *O. furcatus* (O.P. Cambridge, 1877) n. syn. The mature ♂♂ are found in the egg-sacs. Moths are captured on the bolas when it is whirled by leg II as the moth aproaches. Coleman (1976) gives details of prey capture and egg-laying in *Ordgarius monstrosus*. As in *Celaenia* there is evidence to show that the spider emits an odour similar to that of the ♀ moth (Stowe, 1986). *Cladomelea* sp. has been reported from Australia (Mascord, 1980, pl. 32: 4).

conductor

embolus

median
apophysis

radix

ventral

dorsal

EPIGYNUM

paracymbium

SPIDER WITH EGG-SACS

♂ PALP

35. CELAENIA KINBERGII THORELL, 1868

EPIGYNUM

EGG-SACS

♂ PALP

conductor

embolus

median
apophysis

radix

paracymbium

patella
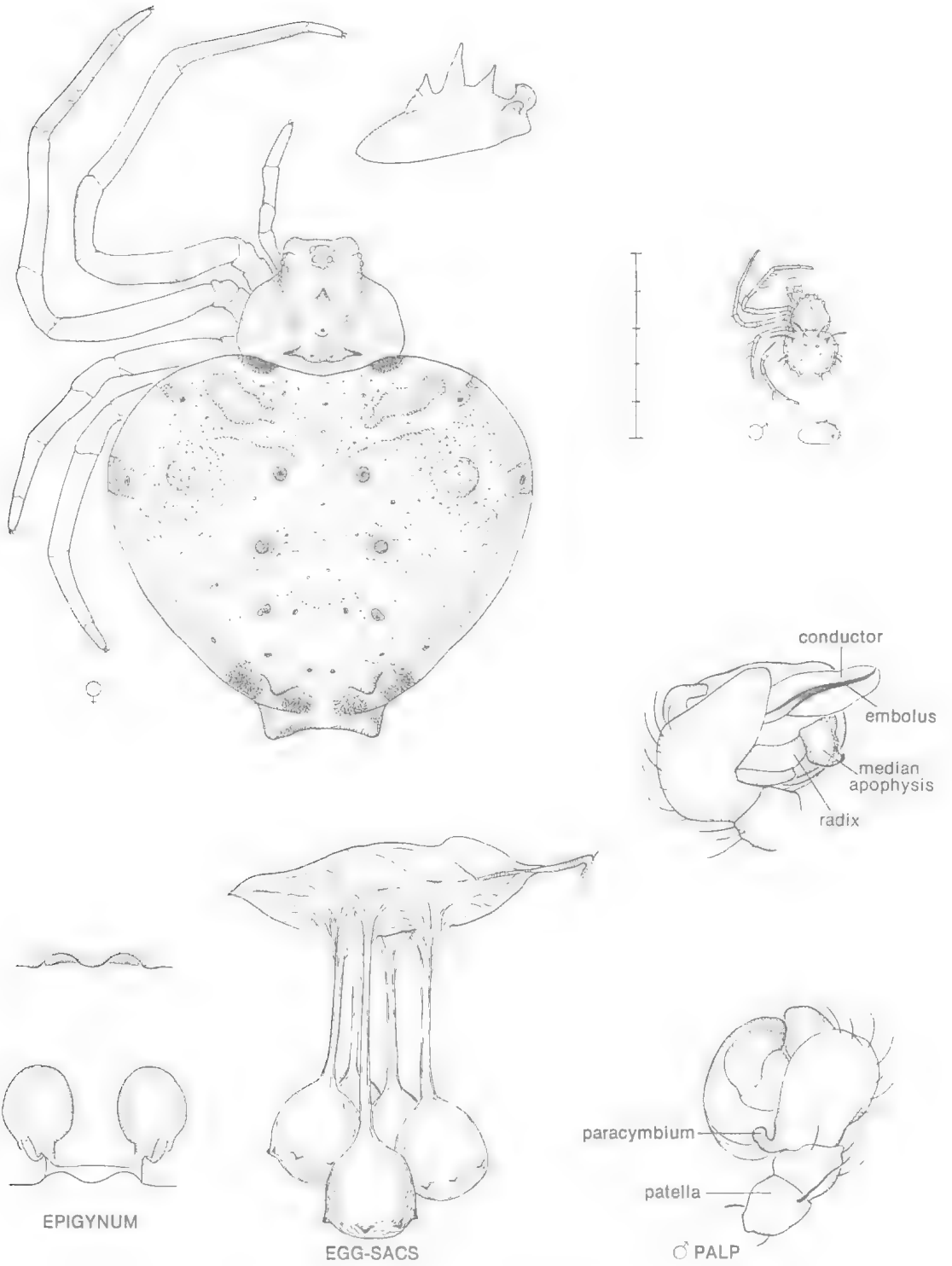
36. ORDGARIUS MONSTROSUS KEYSERLING, 1886

conductor
embolus
median apophysis
radix

instar i

ventral

fertilization duct

conductor
embolus

paracymbium

EPIGYNUM   SPIDER WITH EGG-SACS   ♂ PALP
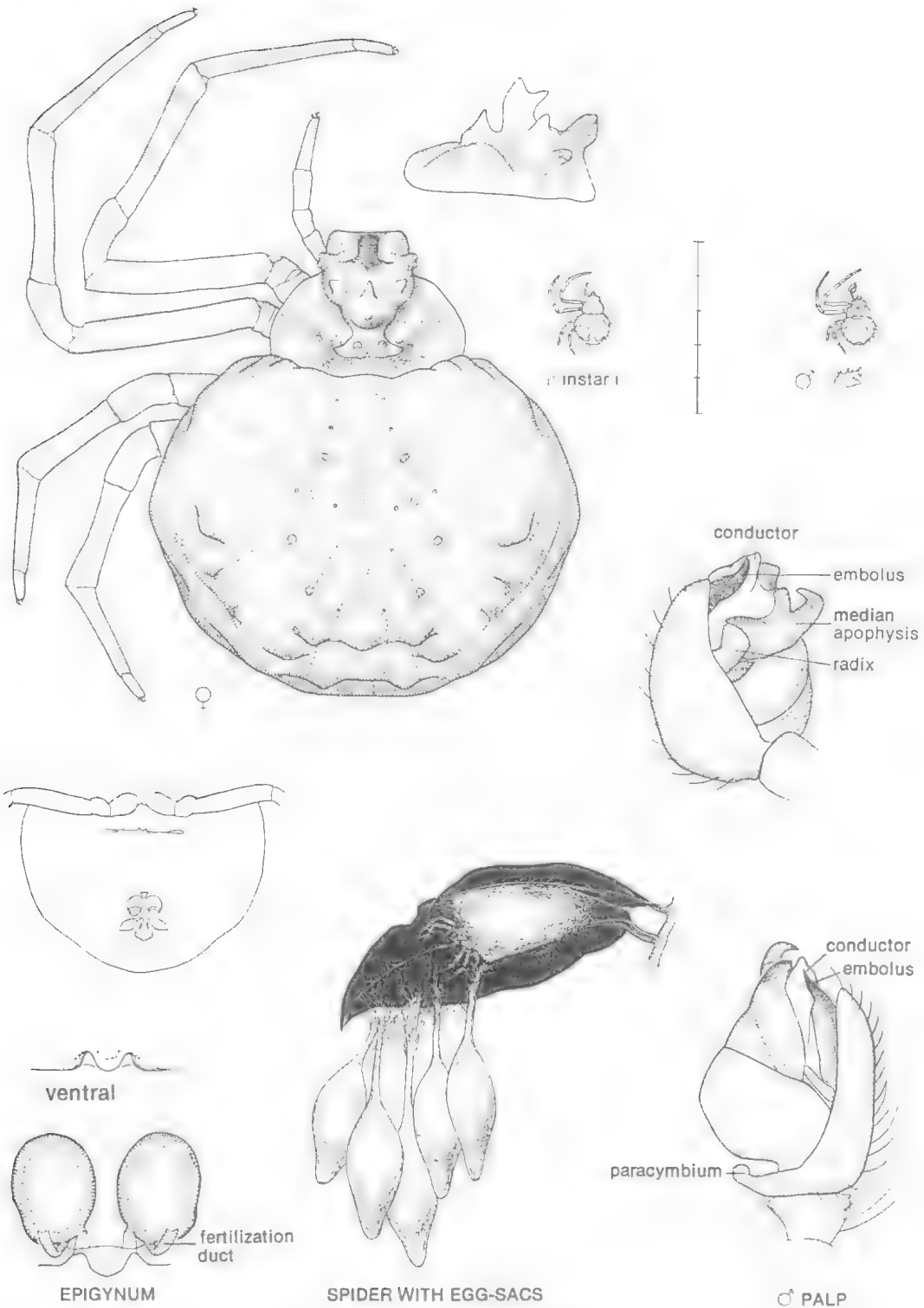
37. ORDGARIUS MAGNIFICUS (RAINBOW, 1897) N.COMB.

39 Abdomen smooth, without abdominal protuberances. Orb-web with spiral (Pl. 38) ....
.... *Cyrtarachne*
  – Abdomen with protuberances. Webs with loose spiral threads 40
40 Two large pointed abdominal protuberances dorsally. Complete orb-web (Pl. 39) ....
.... *Poecilopachys*
 – Large antero-lateral abdominal protuberances. Triangular horizontal web, a partial orb (Pl. 40) .
.... *Pasilobus*
41 Abdomen produced beyond spinnerets into long tail with pecular bumps on end. Obliquely
    horizontal orb-web. Scorpion-tailed spider (Pl. 41) .... Arachnurinae *Arachnura*
  – Abdomen normal. ♂ secondary conductor (from tegulum) encloses embolus. Tent-web spiders
    (Pl. 42) .... Cyrtophorinae *Cyrtophora*

♀ *Cyrtarachne* sp (? tricolor) has been found in Mareeba, north Queensland (Mascord, 1980, pl.
31: 5, 6); ♂ has not been collected. The webs of *Cyrtarachne*, *Poecilopachys* and *Pasilobus* have been
called 'spanning-thread webs' (Clyne, 1973; Stowe, 1986). Clyne gives a good description of the web
of *Poecilopachys*. The spanning threads of these webs are different from the viscid spiral threads of
other araneids in that one end — the 'low-shear joint' (Robinson, 1982) breaks when prey contacts
the thread. The stickiness is very effective in holding moths which are among the prey of these
spiders. The scales of moths often allow them to escape from other orb-webs.

    Cyrtophora webs lack a sticky spiral. The non-sticky spiral is not removed and the webs consist of
a horizontal orb, either in the form of a dome, tent or bowl-shape, with supporting irregular barrier
webs above and below. Webs of *C. moluccensis* may be solitary or colonial, in the latter case each is
occupied and defended by the individual. There is evidence from studies on the predatory behav-
iour of *Cyrtophora* that these webs are derived from typical orb-webs and are not their precursors
(Lubin, 1980).

fertilization duct

insemination duct
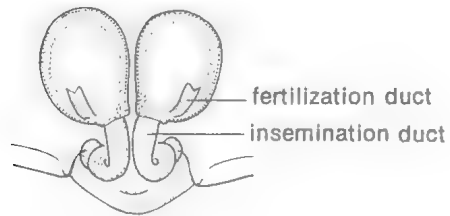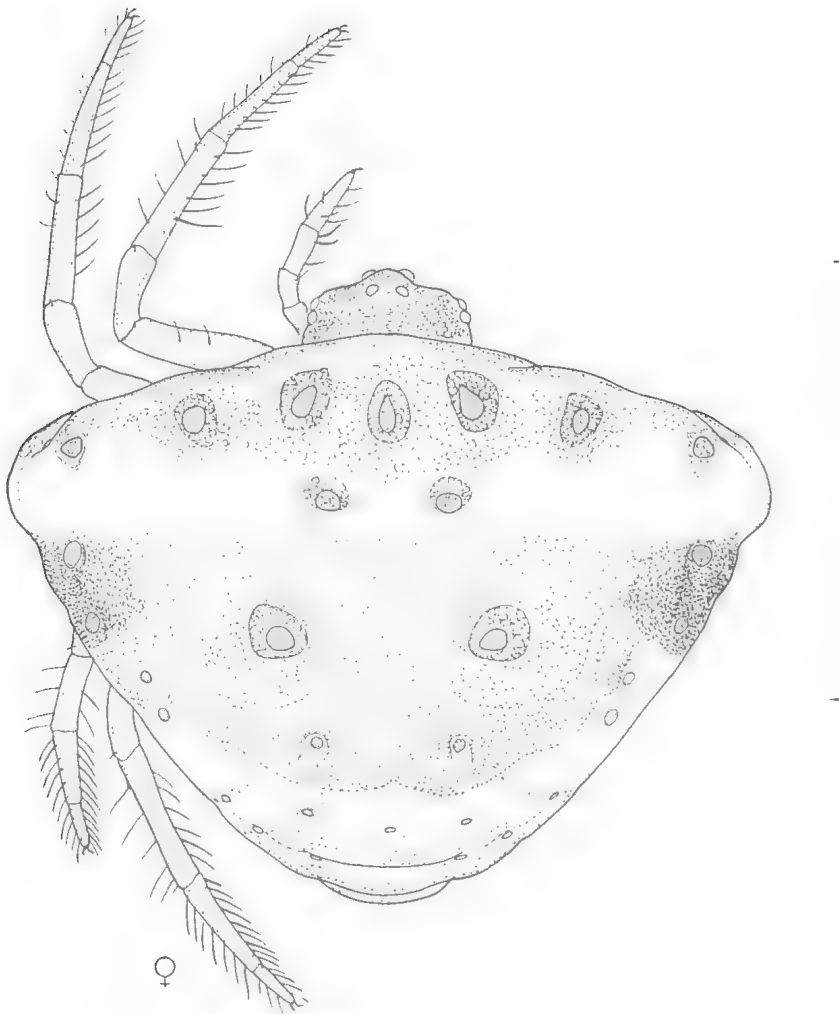
EPIGYNUM

38. CYRTARACHNE SP (Mareeba, north Queensland)

embolus

conductor

median apophysis

lateral
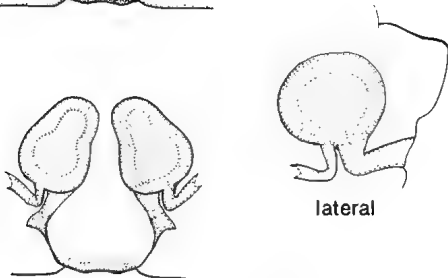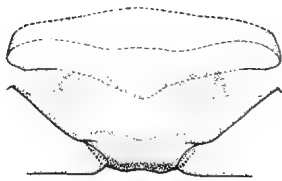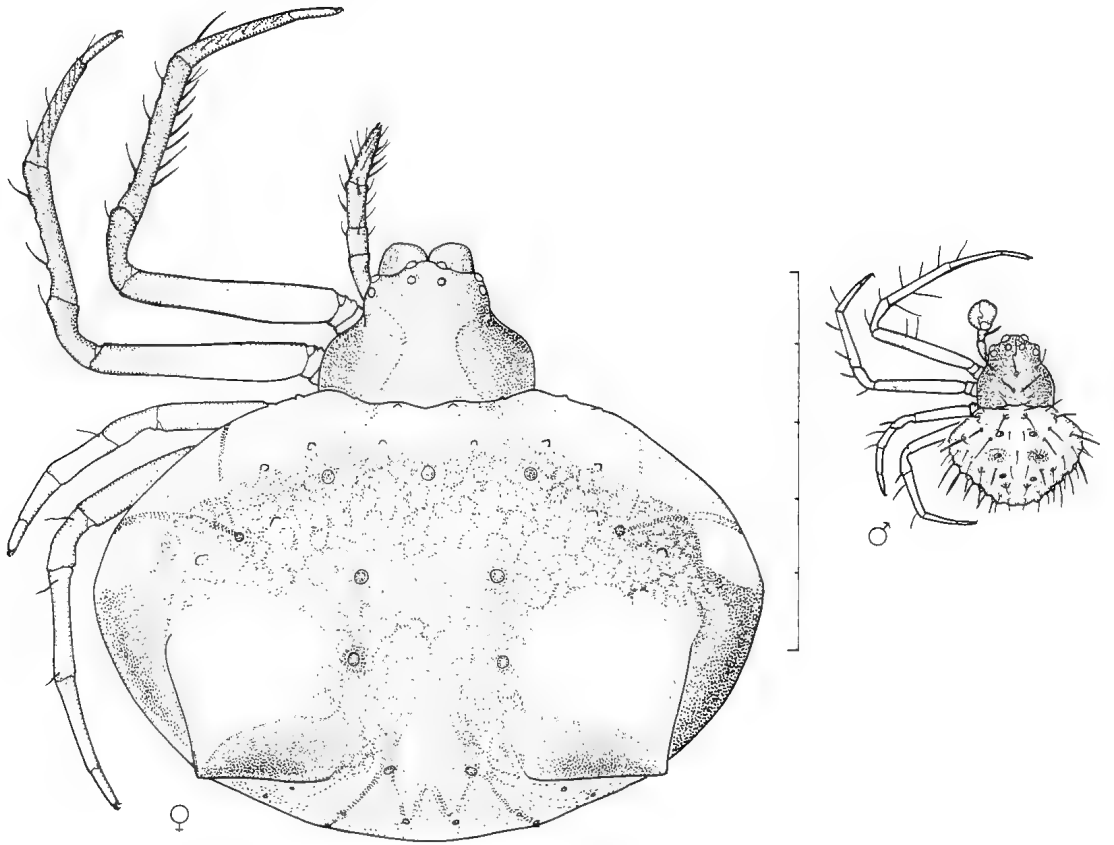
EPIGYNUM

paracymbium
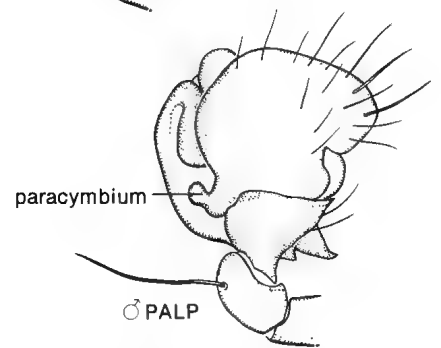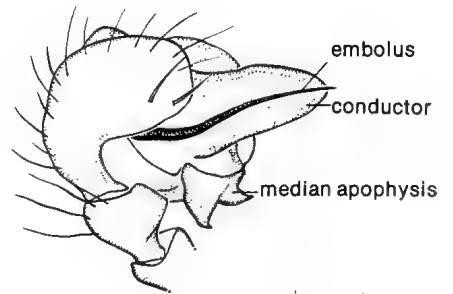
♂ PALP

39. POECILOPACHYS AUSTRALASIA (GRIFFITH & PIDGEON, 1883)

♂ Morobe Province,
Papua New Guinea

♀ Edmonton, north Queensland

embolus
conductor
median
apophysis
radix
paracymbium

EPIGYNUM

PALP

40. PASILOBUS SPP

terminal apophysis

embolus

stipes

conductor

paramedian apophysis

radix

median apophysis

fertilization duct

paracymbium

patella
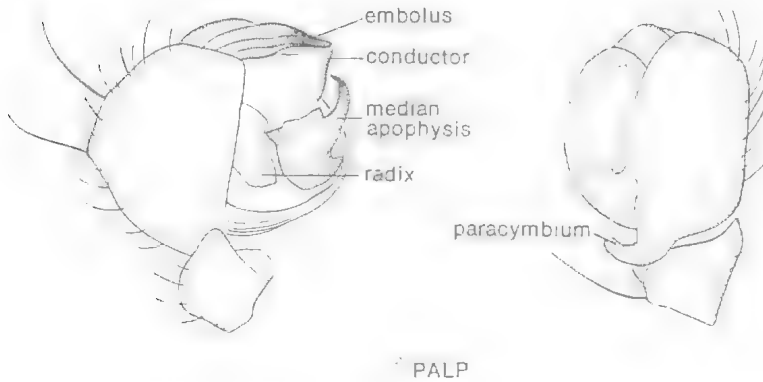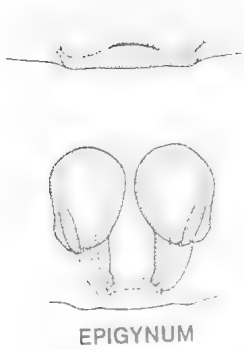
EPIGYNUM

PALP
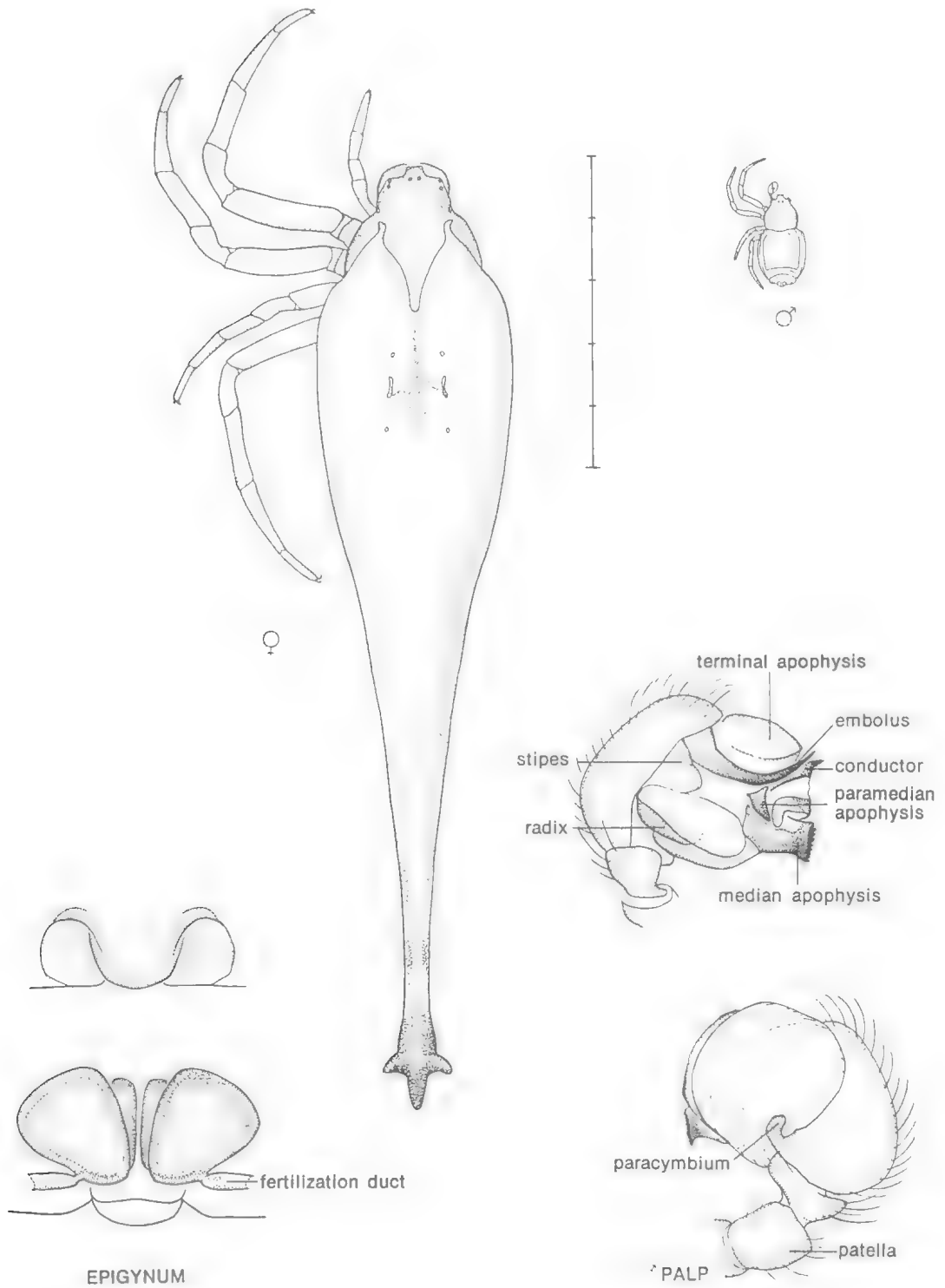
41. ARACHNURA HIGGINSII (L.KOCH, 1871)

median
apophysis

radix

conductor

stipes

embolus

median
apophysis

EPIGYNUM

lateral

♂ PALP
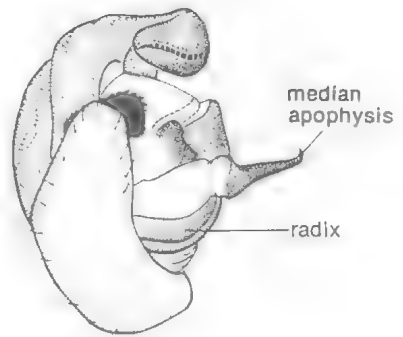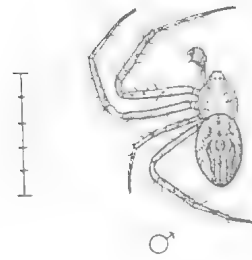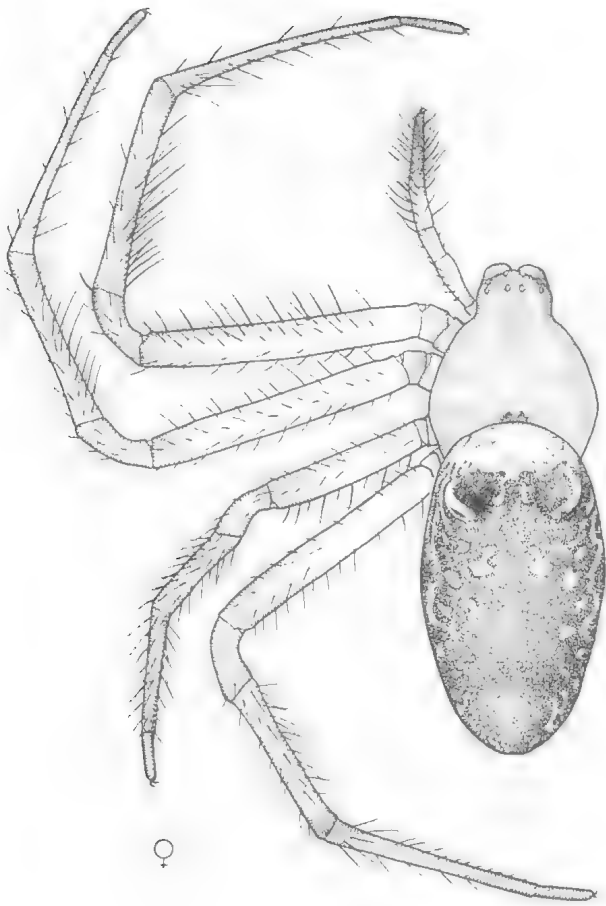
42. CYRTOPHORA MOLUCCENSIS (DOLESCHALL, 1857)

42 Tarsi shorter than metatarsi. Sternum with pair of anterior pit organs. Spring webs (Pl. 43)
....THERIDIOSOMATIDAE *Baalzebub*
– Tarsi longer than metatarsi. Sternum without pit organs 43
43 ♀ palp entire. Eight eyes. Abdomen unsclerotized. Femoral spot on femur I. Metatarsal clasping
spur on ♂ leg I. Entelegyne (Pl. 44) .... MYSMENIDAE *Mysmena*
– ♀ palp with segments missing. Four-eight eyes. Abdomen with or without sclerotized scute.
Without femoral spot or metatarsal spur. Haplogyne 44
44 Chelicerae fused at base. All segments of ♀ palp missing except the endite (coxa). Abdomen
unsclerotized .... SYMPHYTOGNATHIDAE 45
– Chelicerae free. Labral spur between chelicerae. ♀ abdomen usually unsclerotized, ♂ with scute
.... ANAPIDAE 46
45 6 eyes (Pl. 45A) .... *Symphytognatha*
– 4 eyes (Pl. 45B) .... *Anapistula*
46 Anterior book-lungs and posterior spiracle (difficult to see). Very high clypeus × 5 ALE (Pl. 46)
.... *Risdonius*
– Anterior book-lungs replaced by tracheae, no posterior spiracle. Clypeus × 2 ALE (Pl. 47)
.... *'Chasmocephalon'*

So far as they are known, Australian theridiosomatids make small orb-webs with few radials and spirals. From the centre of the orb a horizontal thread runs to a point of attachment. The spider rests, back close to the web, on this; as the spider shortens this thread the web is pulled into a cone shape. When prey touches the web the thread is released and the web springs forwards and straightens with the spider in the centre. Coddington (1986a) has recently revised the genera of the Theridosomatidae. He (1986c) has also found one synapomorphy that unites theridosomatids exclusively with symphytognathids, anapids and mysmenids. During web construction they all add hub loops after the hub bite-out as part of the hub modification. Other araneids may fill this space but not in the same fashion which is reminiscent of non-sticky spiral construction.

Mysmenids are found in leaf litter in both sclerophyll and rainforest areas. The web is probably like other *Mysmena* spp, a 3-dimensional orb-web with many out-of-place radii (Coddington, 1986c).

In symphytognathids the book-lungs are replaced with tracheae. In *Anapistula* a pair of posterior spiracles is present. The webs are small, closely woven, strictly 2-dimensional horizontal orbs (Coddington, 1986c).

The anapids spin horizontal orb-webs with the centre drawn up slightly, like a tent. This is supported by lines (radii) out of plane with the orb that are attached to the substrate above. Forster and Platnick, (pers. comm.) are revising the family: *'Chasmocephalon'* sp., illustrated here, will be placed in a new genus and several new Australian genera will be described.

pit organ
sternum

conductor
embolic division
median apophysis
tegulum
sub-tegulum

ventral

copulatory bursa

fertilization duct

dorsal
EPIGYNUM

tegulum

cymbial lamella
paracymbium
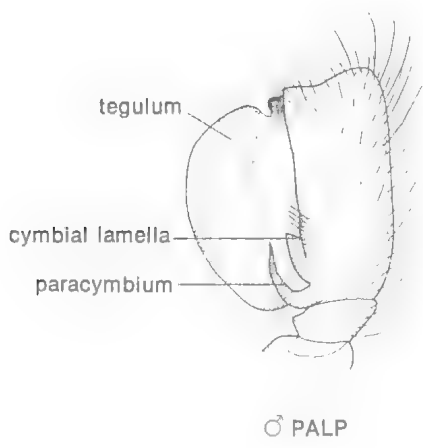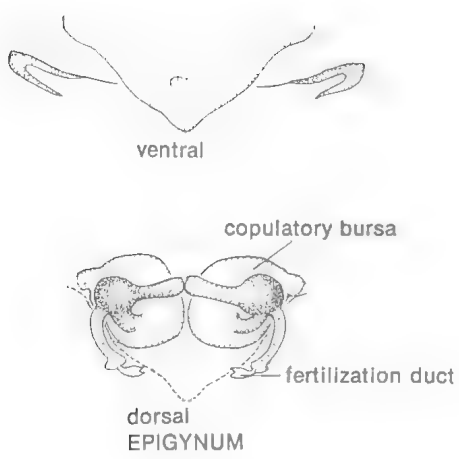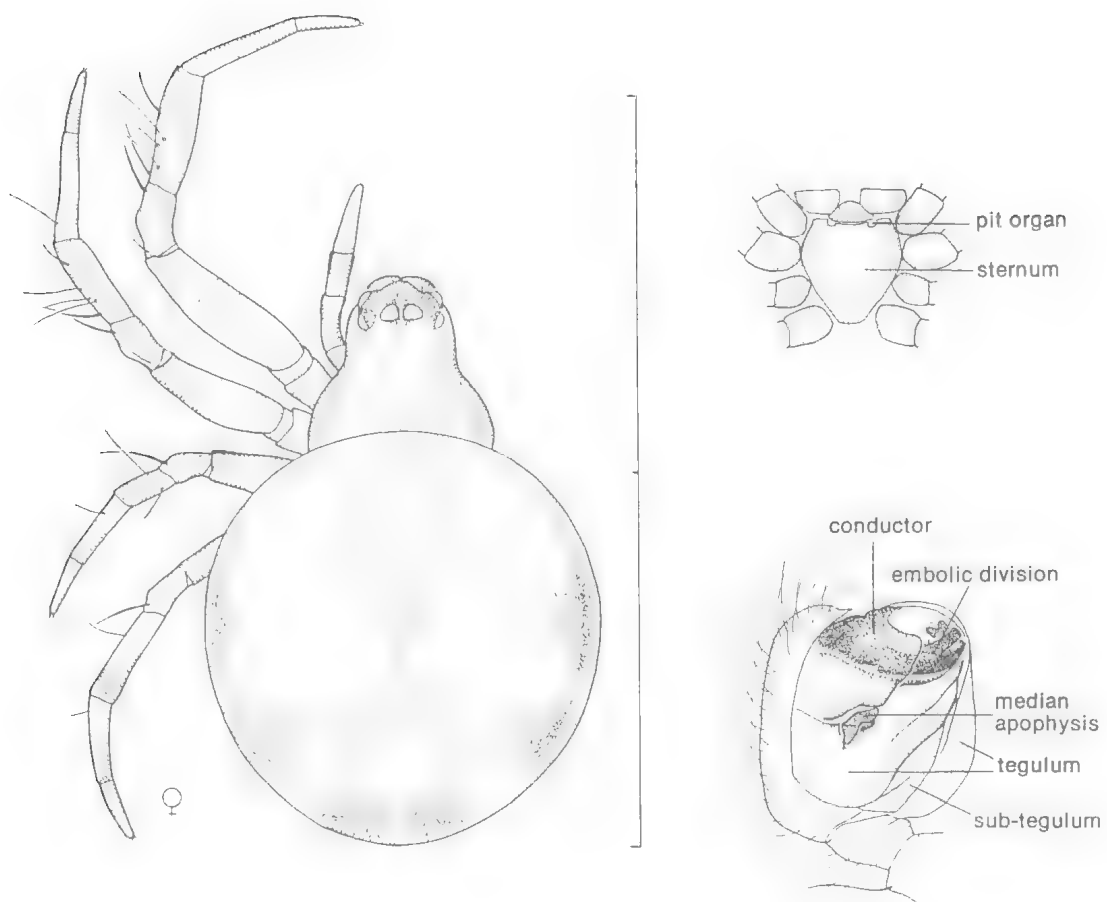
♂ PALP

43. BAALZEBUB BRAUNI (WUNDERLICH, 1976)

ventral femoral spot

FEMUR I

clasping spur

♂ METATARSUS I

cymbium

embolus

♀

fertilization duct

EPIGYNUM   ♂ PALP
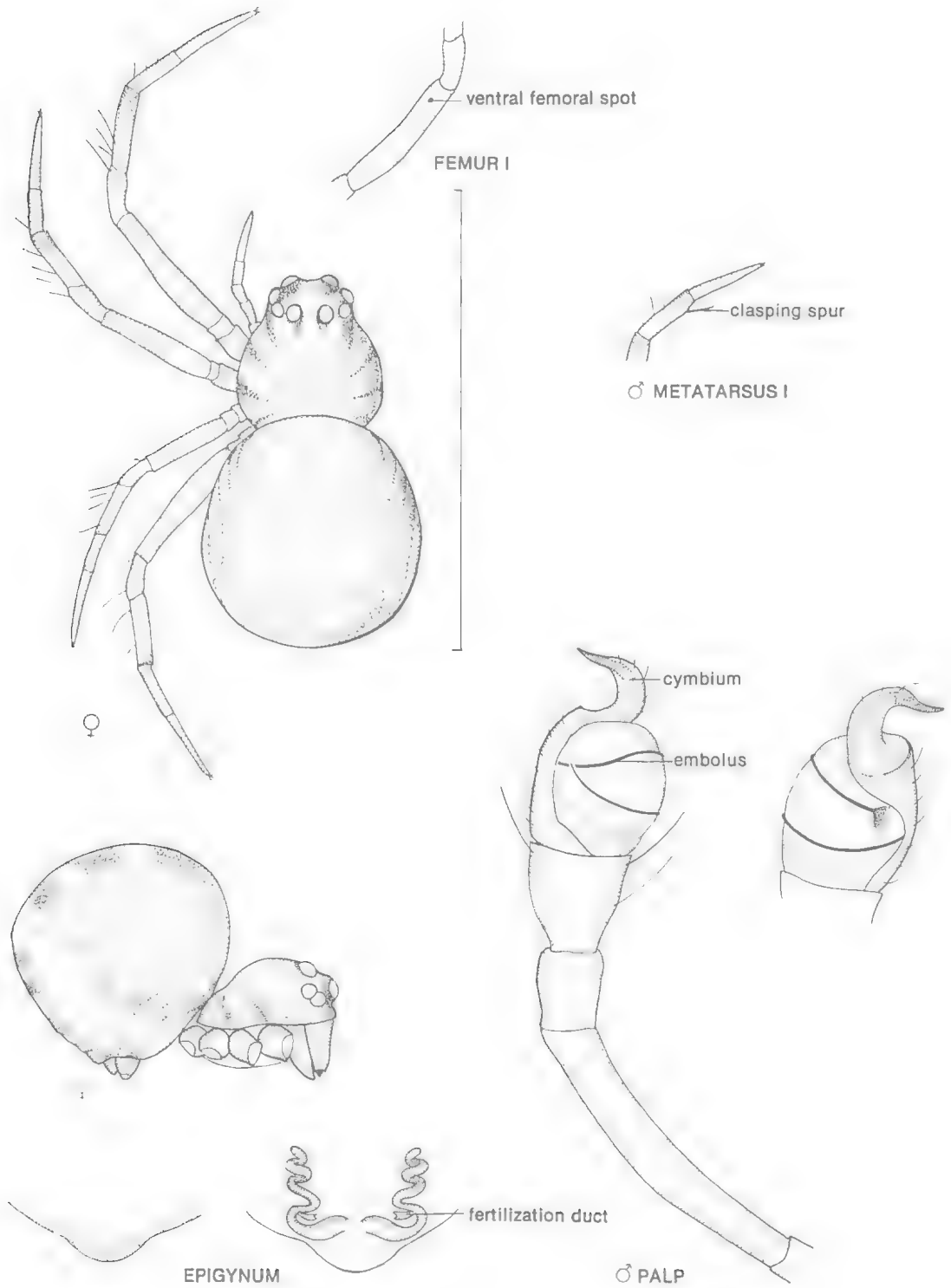
44. MYSMENA SP (nr Helenvale, north Queensland)

♀ nr Helenvale, north Queensland   ♂ Mt. Bellenden Ker, north Queensland
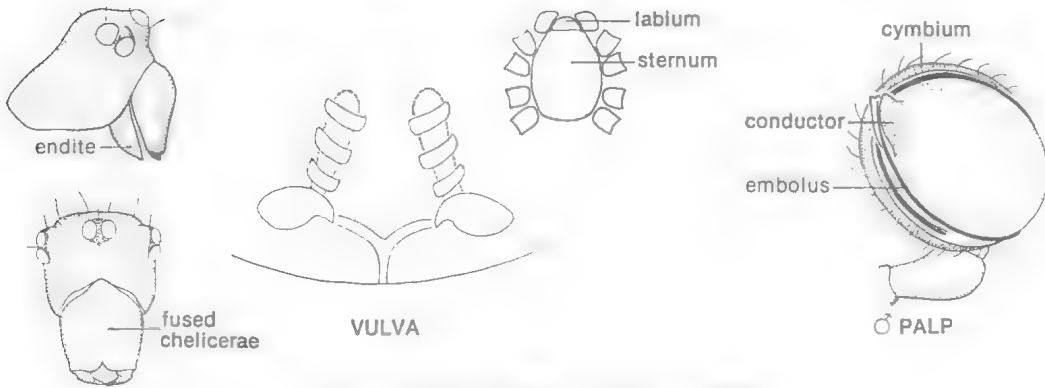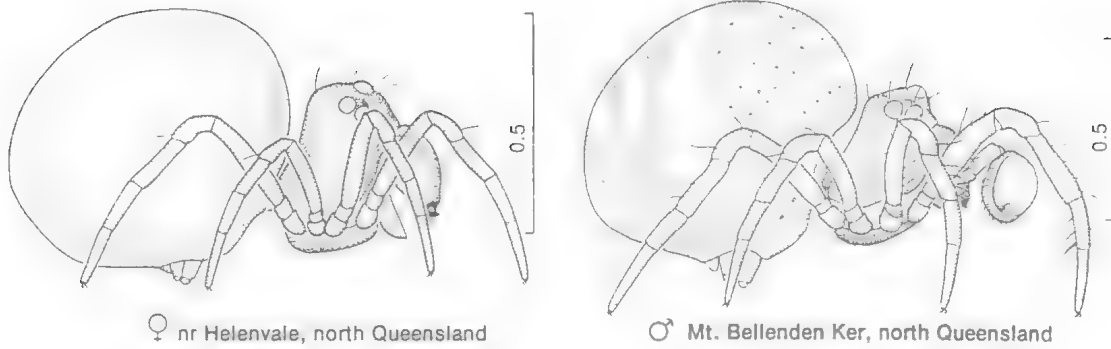
45A. SYMPHYTOGNATHA SPP
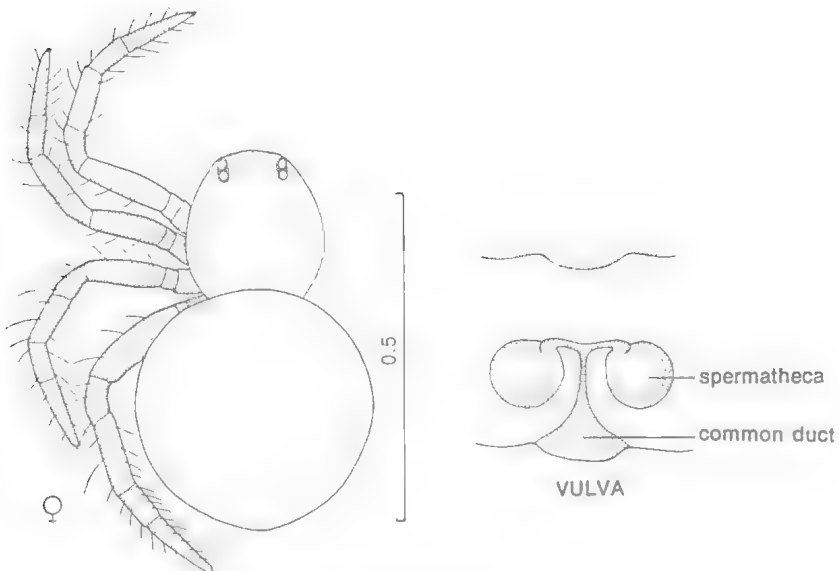
45B. ANAPISTULA AUSTRALIA FORSTER, 1959

scute

0.5

clypeus

labral spur — chelicera

book-lung
opening

tegular
apophysis

conductor

patellar
apophysis

embolus

posterior
receptaculum
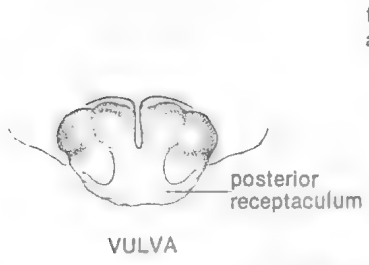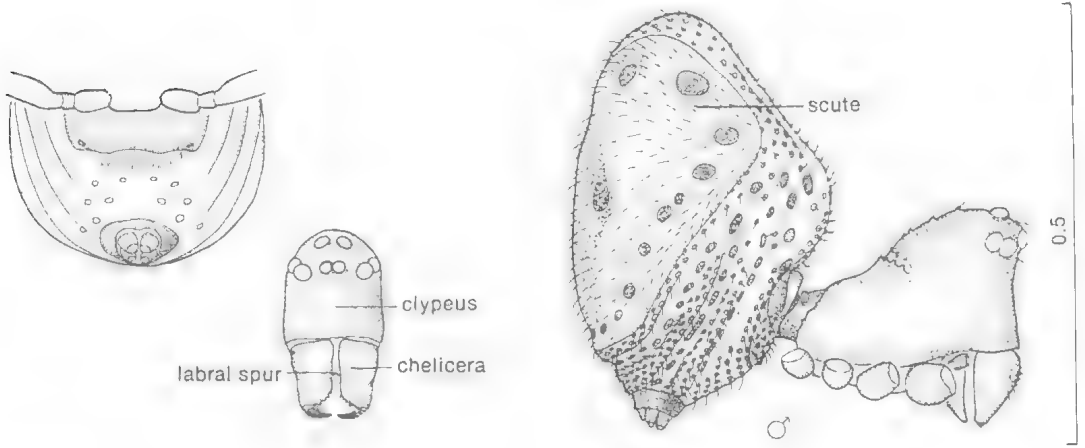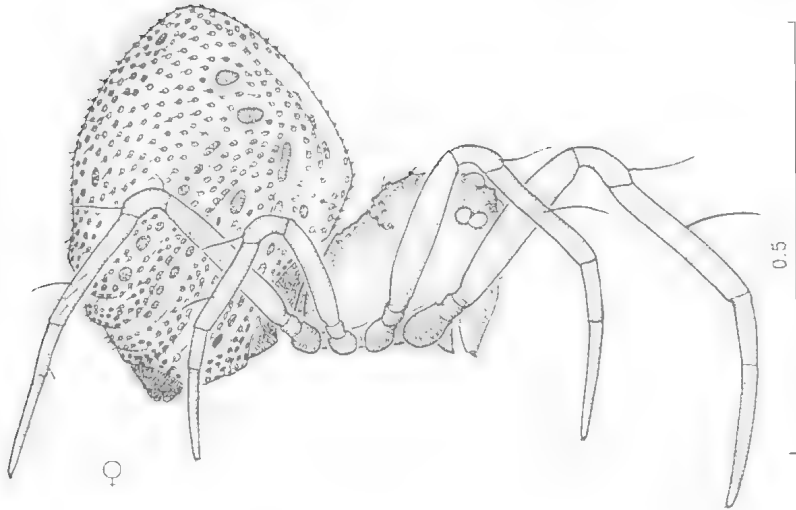
VULVA
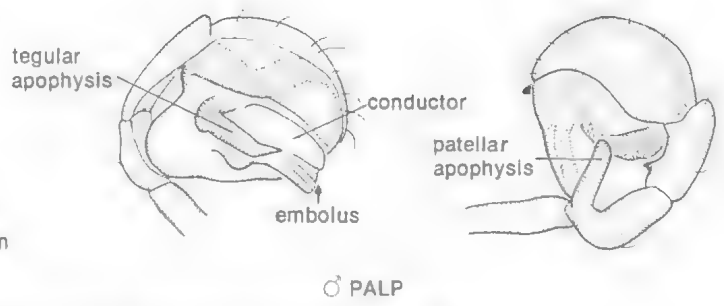
♂ PALP

46. RISDONIUS PARVUS HICKMAN, 1939

clypeus

labral spur

pedicel

scute

tracheal opening

conductor

embolus

tibia

patella

sternum

VULVA

♂ PALP
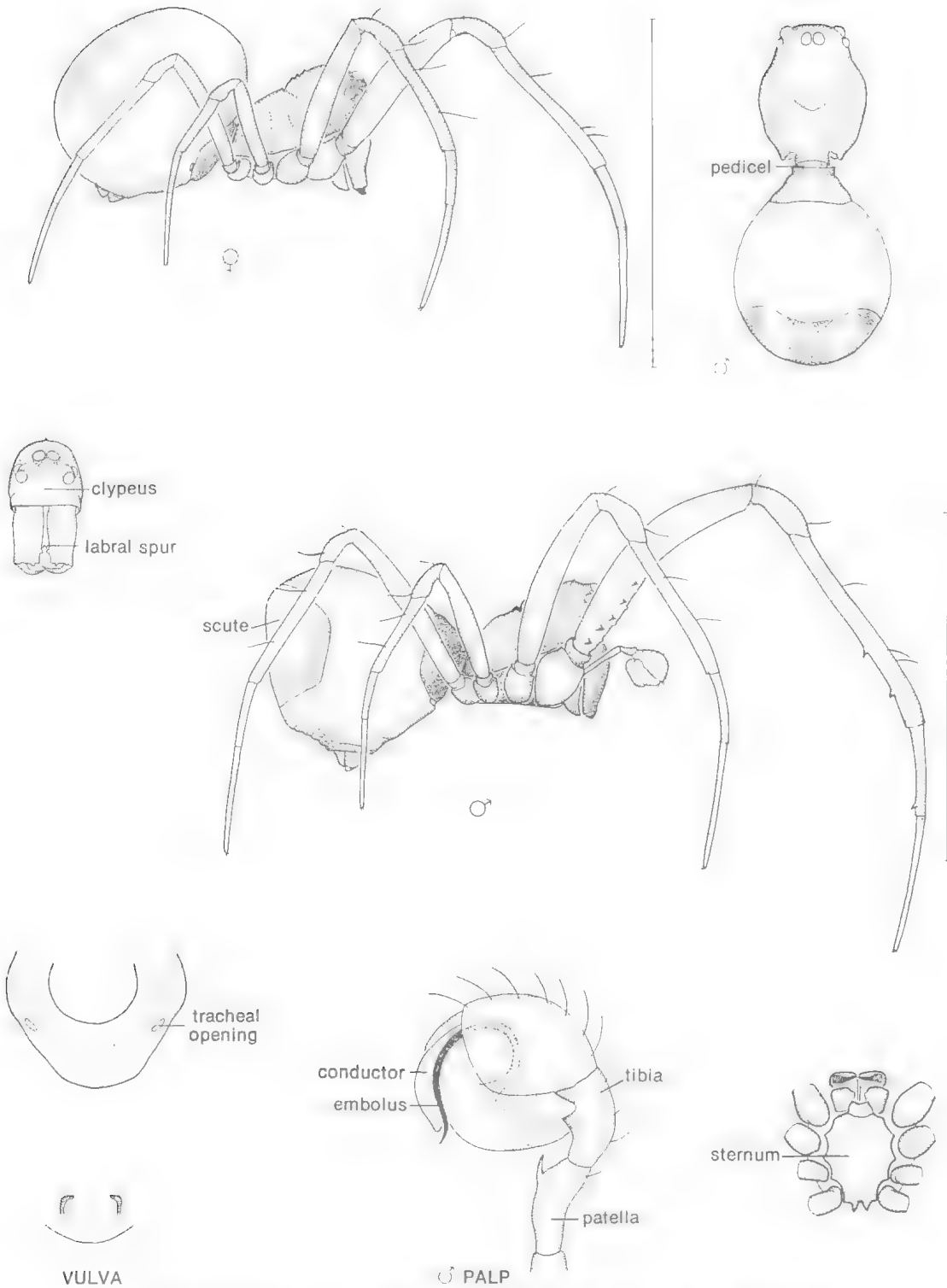
47. 'CHASMOCEPHALON' SP (Mt Bellenden Ker, north Queensland)

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A PRELIMINARY NOTE ON THE INTESTINAL FLAGELLATES OF THE AUSTRALIAN ANURA

B.L.J. Delvinquier and M.K. Jones

An examination of 62 species of anurans located eight species of intestinal flagellates: *Karotomorpha bufonis, Chilomastix caulleryi, Retortamonas dobelli, Giardia agilis, Spironucleus elegans, Monocercomonas batrachorum, Trichomitus batrachorum,* and *Tetratrichomonas prowazeki.*
□ *Intestinal protozoans, flagellates, Australian Anura.*

B.L.J. Delvinquier and M.K. Jones, Department of Parasitology, University of Queensland, St Lucia, Queensland, 4067, Australia; 11 February, 1987.

Between 1983 and 1985, 924 adult specimens of 62 species of native and introduced anurans and 115 tadpoles of *Bufo marinus* from 99 localities in all six States of mainland Australia, were checked for the presence of intestinal protozoans. Specimens are lodged with the Queensland Museum (QM). Anuran nomenclature follows Cogger, H.G., Cameron, E.E. and Cogger, H.M. (1983). 'Zoological Catalogue of Australia: Amphibia and Reptilia'. Vol. I. (Australian Government Printing Service: Canberra).

Abbreviations are: N = number; Kb = *Karotomorpha bufonis*; Ca = *Chilomastix caulleryi* (QM GL 4849); Rd = *Retortamonas dobelli*; Ga = *Giardia agilis*; Se = *Spironucleus elegans* (QM GL 4872, 4873); Mb = *Monocercomonas batrachorum* (QM GL 4874); Tb = *Trichomitus batrachorum* (QM GL 4875, 4876). In addition, one *Tetratrichomonas prowazeki* (QM GL 4876) was found in one out of three *Limnodynastes dorsalis*.

HOSTS	N	Kb	Ca	Rd	Ga	Se	Mb	Tb
BUFONIDAE								
Bufo marinus	267		15	7	1	162	57	206
(tadpoles)	115				35	48		25
HYLIDAE								
Cyclorana brevipes	1							1
novaehollandiae	6					2		5
Litoria alboguttata	1							1
caerulea	63			4	5	18	3	59
chloris	14					2	3	13
cyclorhyncha	5					5	1	1
dahlii	10					6	1	8
dentata	5					3	2	2
ewingii	3					3	1	1
fallax	72	9	1			45	7	19
gracilenta	5					2	1	4
inermis	26					7	1	10
infrafrenata	1					1		
latopalmata	20		2			4	4	11
lesueuri	38					15	4	16
moorei	1							
nannotis	2						1	1
nasuta	36		1			13	6	29
nigrofrenata	3							2
nyakalensis	5					1		2
pallida	21					16	6	14

HOSTS	N	Kb	Ca	Rd	Ga	Se	Mb	Tb
HYLIDAE (cont.)								
pearsoniana	3							
peronii	26				1	12	1	14
raniformis	1					1		
revelata	2					1		2
rheocola	11					2	2	1
rothii	32	1	2			22	4	20
rubella	26		1			6	1	19
serrata	2					1		
tornieri	15					6	2	11
tyleri	2							2
verreauxii	1					1		
Nyctimystes dayi	10					1		6
MYOBATRACHIDAE								
Adelotus brevis	3							2
Assa darlingtoni	4							2
Limnodynastes								
convexiusculus	2		1			1		2
dorsalis	3		1			2		3
dumerilii	4					4		2
ornatus	10					6	3	8
peronii	21					15	3	18
salmini	2							2
tasmaniensis	13					7	1	6
terraereginae	14					6		10
Mixophyes fasciolatus	6						1	3
iteratus	2							2
schevilli	3							1
Neobatrachus centralis	2					2	1	2
pelobatoides	3					2		2
pictus	4					4		3
Pseudophryne bibronii	1							1
coriacea	2					1		2
Ranidella bilingua	9					7	2	6
insignifera	1					1		
parinsignifera	20					15		1
signifera	39					30	6	6
Taudactylus acutirostris	3							
rheophilus	2		1					1
Uperoleia laevigata	4					1	1	2
MICROHYLIDAE								
Cophixalus ornatus	6							1
Sphenophryne robusta	2							2
RANIDAE								
Rana daemeli	4							2

REVISION OF THE GENUS *LYGISAURUS* DE VIS (SCINCIDAE : REPTILIA) IN AUSTRALIA

G. INGRAM AND J. COVACEVICH

The genus *Lygisaurus* de Vis, 1884, is resurrected from the synonymy of *Carlia* Gray, 1845, and eight species (*L. foliorum* de Vis, 1884; *L. timlowi* (Ingram, 1977); *L. laevis* (Oudemans, 1894); *L. tanneri* sp. nov., *L. sesbrauna* sp. nov.; *L. macfarlani* (Günther, 1877); *L. aeratus* (Garman, 1901); and *L. rococo* sp. nov.) are assigned to it. Small size, with supradigital scales on the fourth toe, and number of premaxillary teeth distinguish *Lygisaurus* from *Carlia*. Male breeding pattern and absence of keels or carinations further distinguish them. *Lygisaurus* also resembles *Menetia* superficially, but is readily distinguished from that genus by its transversely oriented supraoculars (*vs* obliquely oriented in *Menetia*).

Two other changes to established nomenclature are warranted from this review. *Lygisaurus foliorum* de Vis, 1884, is the senior synonym of the taxon traditionally known as *Carlia burnetti* (Oudemans, 1894). The name *Carlia foliorum*, used by Storr (1974) now refers to *Carlia munda* (de Vis, 1885). Because the holotype of *L. foliorum* is lost, a neotype is designated to stabilize the name.

□ *Scincidae, Reptilia, Lygisaurus, Carlia, taxonomy, Australia.*

G. Ingram and J. Covacevich, Queensland Museum, PO Box 300, South Brisbane, Queensland, 4101, Australia; 16 October 1987.

The identity of the type species of *Lygisaurus, L. foliorum* de Vis, 1885, has been elusive (Boulenger, 1887; Greer, 1975), and, because the type material has been lost (Covacevich, 1971), its identity can not be checked. However, de Vis's type description is fairly detailed and certain of the characters described by him — six supraciliaries, colour and pattern, leaf litter habitat, and fused lower eyelid — suggest strongly that *L. foliorum* is a senior synonym of *Ablepharus burnetti* Oudemans, 1894. There is, however, a complication. De Vis describes *L. foliorum* with 28 mid-body scale rows. Our concept of '*A. burnetti*' is based on Oudeman's (1894) description and our examination of 66 specimens of this taxon. Midbody scale counts on these range between 21 and 25, with a mean of 23.2. Nonetheless, despite this anomaly, we are convinced that, on balance, and acknowledging the errors which characterise de Vis's description (Ingram, in press), *L. foliorum* de Vis and *A. burnetti* Oudemans name the same taxon.

Boulenger (1887) said *Lygisaurus foliorum* might be allied to *Lygosoma mundum* (de Vis, 1885), and Storr (1974) used *foliorum* as the available name for that taxon within the genus *Carlia*. However, we think that taxon should properly be called *Carlia munda* (Cogger, 1986).

Further, the type locality of *foliorum* is Brisbane, where it it a common skink. The nearest to Brisbane *Carlia munda* has been collected is at Ipswich, 32 km away. In the following species accounts, we declare a neotype of *Lygisaurus foliorum* to stabilize the nomenclature.

The following body measurements and morphological characters are used in separating the species.

Distance from snout to vent in millimetres (SV); width of head at widest part as % of SV (HW); length of tail as % of SV, excluding specimens with regenerated tails (TL); length of hindlimb as % of SV (HL); number of supraciliaries (both sides of head counted): the supraciliaries are defined as that row of scales immediately below the supraoculars, bordered anteriorly by the prefrontal and bordered posteriorly by the supraoculars above and the ciliaries below; lower eyelid fused or not; size of the palpebral disc compared with the size of the ear aperture; shape of the ear aperture; size, shape and position of the ear lobules; number of supraocular scales; interparietal free or fused to the frontoparietal; number of supralabial scales (both sides of head counted); number of scales between the second presubocular and the nasal scale; number of midbody scale rows; number of scales in a line from chin to vent; number of

lamellae under the left fourth toe; colour and pattern of juveniles, adult males and females.

Specimens were examined from the following institutions: Queensland Museum (QM); Australian Museum (AM); Museum of Victoria (MV), and the Donald Thomson Collection (MV DTD); South Australian Museum (SAM); Zoologisch Museum, Amsterdam (ZMA); Museum of Comparative Zoology, Harvard (MCZ).

Lygisaurus de Vis

1884 *Lygisaurus* de Vis. *Proc. Roy. Soc. Qd* 1: 77. Type species by monotypy: *Lygisaurus foliorum* de Vis, 1884.

DIAGNOSIS

Lygisaurus spp. are small leaf-litter dwelling skinks with a digital formula of 4/5. They most closely resemble *Carlia* spp. and *Menetia* spp.

The following characters readily distinguish *Lygisaurus* spp. from *Carlia* spp. — striate body scales (*vs* keeled or carinate body scales in *Carlia*, at least in juveniles); small size, with maximum SV length of 40 mm (*vs* maximum SV length of 70 mm); number of supradigital scales on the 4th toe[1] (fewer than 10 *vs* 10 or more in *Carlia*); number of premaxillary teeth[1] (usually 15 *vs* usually 13 in *Carlia*); and male breeding colour (patternless, iridescent grey-green or grey-orange-brown, usually with bright red to orange throat[2], tail, and hind limbs *vs* grey to brown, but not iridescent, with one or two reddish lateral longitudinal stripes, and usually with blue throats, rarely red, in *Carlia*).

Lygisaurus is easily separated from *Menetia* by the alignment of the supraocular scales (transverse *vs* oblique in *Menetia*).

DISTRIBUTION

Irian Jaya, Papua New Guinea, Torres Strait Islands, north Queensland, and eastern Queensland and New South Wales, mainland Australia.

REMARKS

There is a potential junior synonym for *Lygisaurus*. *Protervascincus* was described by Wells and Wellington (1984) based on

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[1] These distinguishing characters were first observed by Cogger (1986).

[2] Not observed in *L. timlowi*, *L. sesbrauna* and *L. rococo*; colour fades in spirit.

Ablepharus burnetti Oudemans, 1894, a taxon we treat as a junior synonym of *L. foliorum*. Also, there is a potential junior synonym of either *L. aeratus* or *L. laevis* in Wells and Wellington (1985). This is *Protervascincus kuranda*. As there is a case before the International Commission on Zoological Nomenclature to have the works suppressed (Australian Society of Herpetologists, 1987); as the works have wreaked taxonomic chaos (Tyler, 1985); and as we (with many other taxonomists) have agreed not to use the names proposed therein (Grigg and Shine, 1985), we do not discuss the proposal further.

THE SPECIES OF *LYGISAURUS*

Eight species of *Lygisaurus* occur in Australia — *L. foliorum* de Vis, *L. timlowi* (Ingram), *L. laevis* (Oudemans), *L. tanneri* sp. nov., *L. sesbrauna* sp. nov., *L. macfarlani* (Günther), *L. aeratus* (Garman), *L. rococo* sp. nov. One of these species, *L. macfarlani*, is also found in New Guinea.

Lygisaurus foliorum de Vis
(Figs 1, 2, 3)

1884 *Lygisaurus foliorum* de Vis. *Proc. R. Soc. Qd* 1: 77. Holotype lost, from Brisbane, Queensland. Neotype, here designated, QM J23660, from. Mt Coot-tha, Brisbane, SE Queensland.
1894 *Ablepharus burnetti* Oudemans. *In* Semon, *Zool. Forsch. in Austral.* 5: 145. Burnett River, SE Queensland. Lectotype ZMA 11345 (here designated).
1948 *Ablepharus burnetti sydneyensis* Copland. *Proc. Linn. Soc. N.S.W.* 73: 362. Mt. Riverview Lookout, near Blaxland, New South Wales. Holotype AM R18589.

DIAGNOSIS

L. foliorum is a large *Lygisaurus*, with a maximum SV length of 39 mm.

L. foliorum and *L. timlowi* are the only species of *Lygisaurus* with the lower eyelid fused (or partially fused) above and with a large transparent palpebral disc. They are readily distinguished from each other by ear size and shape (*L. foliorum*, smaller than disc with longer axis horizontal *vs L. timlowi*, very much smaller than disc), ear lobules (present *vs* absent), supraoculars (4 *vs* usually 3, occasionally 1 or 2), interparietal scale (free *vs* fused to interparietal), supralabials (7 or 8, with the 5th or 6th under the eye *vs* 6, with the 4th under the eye), midbody

FIG. 1. *Lygisaurus foliorum* Peak Ranges, near Capella (S. Wilson).

scale count (21–25 *vs* 18–20), and lamellae under the fourth toe (17–23 *vs* 15–19).

L. foliorum appears to be a sister species of *L. aeratus* despite the fact that the latter species has a moveable eyelid, a character which may *appear* to be fused in spirit material and cause confusion between these two species. See discussion under *L. aeratus* for further detail.

DISTRIBUTION

Northeastern Queensland from Townsville region south to Blaxland area in mid-eastern New South Wales. In Queensland, west to the Carnarvon Range and St George. In N.S.W. west to Armidale and the Warrumbungle Mountains. Also Magnetic, Lindeman and Curtis Islands, and Mission Island, Hawkesbury River.

DESCRIPTION

SV: 15–39 (N = 83, mean 27.9). HW: 11–17 (N = 68, mean 14.5). TL: 124–175 (N = 23, mean 149.0). HL: 30–43 (N = 15, mean 33.3).

Supraciliaries 6, rarely 7 or 5 (N = 156, mean 6.0). Palpebral disc large. Lower eyelid fused above forming a fixed spectacle over the eye (sometimes the lower lid separates as an artefact of preservation and appears moveable). Ear aperture much smaller than palpebral disc; longer axis of aperture usually horizontal, with one to many acute or low, flat lobules. Four supraoculars (N = 152). Interparietal free. Supralabials 7, rarely 8 (N = 152, mean 7.0), with the fifth, rarely the sixth, under the eye. Usually 2, sometimes 3, scales between the second presubocular and the nasal scale (N = 65, mean 2.2). Midbody scale rows 21–25 (N = 66, mean 23.2). Number of scales from chin to vent 47–54 (N = 31, mean 49.4). Number of lamellae under fourth toe 17–23 (N = 65, mean 19.8).

Grey-brown scales lined with darker brown; labials flecked with dark brown; an indistinct dark line from nares through eye; scales on sides of throat edged in dark brown; underside white. Breeding male, light grey with pinkish orange throat, tail and hindlimbs.

HABITAT

Bark, leaf, stick, and grass litter in open forest and woodland.
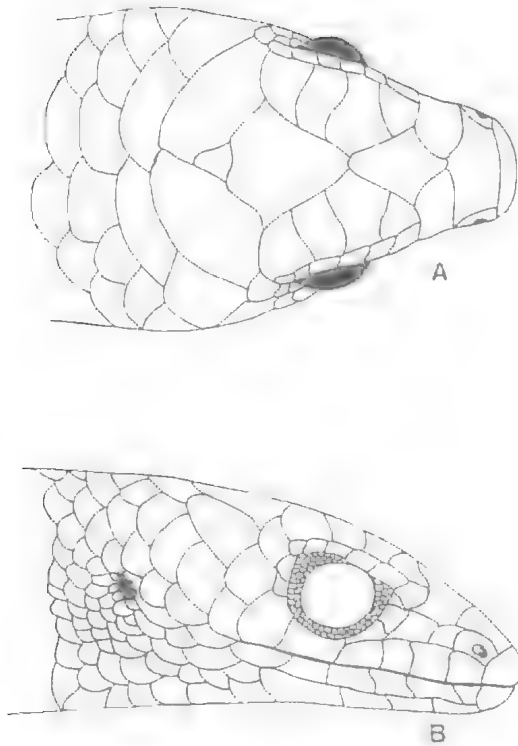
FIG. 2. *Lygisaurus foliorum* (QM J38622). A. Dorsal view of head. B. Lateral view of head.

REMARKS

Greer (1975: 74) excluded *Lygisaurus foliorum* de Vis from the synonymy of *C. melanopogon* (= *C. munda*) on the basis of size, keeling, and colour, but he did not align *foliorum* with other taxa noting '... there are still few diagnostic clues by which to determine the species' relationships; indeed, if it were not for the mention of the tetradactyl front limb and the relatively high midbody scale row count (28), it would be difficult to even identify the specimen as *Carlia* ...' We concur that *L. foliorum* is not a synonym of *C. munda* and have proposed a solution to the question of the identity of *foliorum*. To stabilize the nomenclature we have selected a neotype for *Lygisaurus foliorum* de Vis 1884.

NEOTYPE: QM J23660 Mt Coot-tha, Brisbane, SE Queensland (27°29'S, 152°57'E). Collected by C. Morris and A. Merrit on 22 July 1973.

SV: 30. HW: 15. Tail regenerated. HL: 30. Supraciliaries 6. Palpebral disc large. Lower eyelid fused above forming a fixed spectacle over the eye. Ear aperture much smaller than palpebral disc; longer axis of aperture horizontal, with pointed, wide lobules on the margins. Four supraoculars. Supralabials 7, with fifth under the eye. Two scales between the second presubocular and the nasal scale. Midbody scale rows 23. Number of scales from chin to vent 51. Number of lamellae under fourth toe 20.

We have examined the remaining two syntypes of *Ablepharus burnetti* Oudemans (ZMA 11345–6) from the original type series of four specimens. Two specimens are missing (Cogger, Cameron and Cogger, 1983). We have selected ZMA 11345 as the lectotype.

Copland (1948) based his concept of three subspecies largely on variation in the number of ear lobules. There is no justification for recognizing subspecific taxa because the variation is clinal. From south to north *L. foliorum* specimens show slight increases in total size, size of the palpebral disc, and number of mid-body scale rows and a slight decrease in the number of ear lobules.
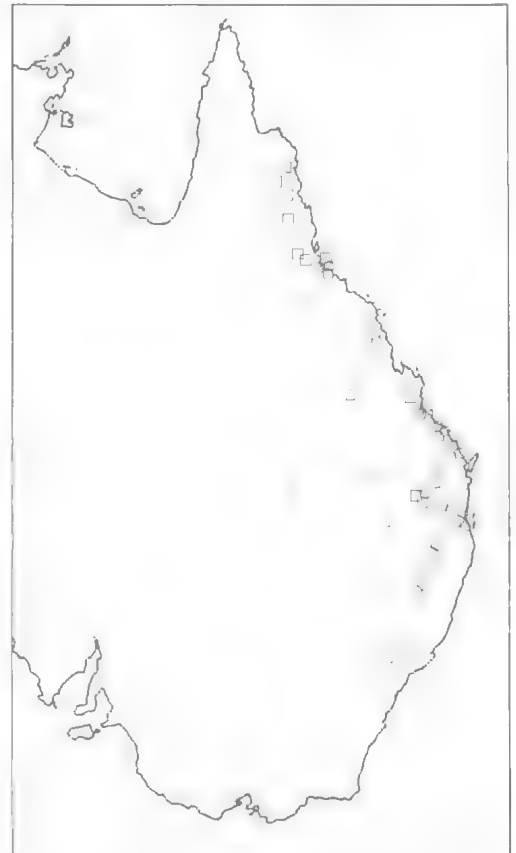
FIG. 3. Distribution of *Lygisaurus foliorum* (O), *L. timlowi* (□).

MATERIAL EXAMINED

1km W of Moongobulla (QM J26625); Magnetic Island (QM J26338); 36.3km SE of Townsville (QM J26640); Lindeman Island (AM R11173, 47166–70; QM J5643). Homevale (QM J33857, 33860); Oakey Creek, Homevale (QM J33900); "Retro", Capella (QM J15769–70); "Gaylong", Capella, (QM J15784, 15786); West Curtis Island (QM J24223–4); Rundle Range (QM J33764, 33812); Crest, Rundle Range (QM J33833); State Forest 60 E of Mount Larcom (QM J15733); Gladstone (AM R5036); 11.2km S of Miriamvale (QM J11894–5); Warro State Forest (QM J23795); Mount Warro, 17kms SW of Lowmead (QM J23853–4); 24.1km NW of Bundaberg (QM J11892); Bundaberg (QM J22008, 22323); Burnett River (AM R5338; ZMA 11345–6); Cordalba State Forest (QM J15648); 9.6km W of the firetower, Cordalba (QM J15796); Nathan Gorge (QM J38622); Eidsvold (AM R5413, 6340); Murphy's Lake, Taroom (QM J11893); 8km NW of Gayndah (QM J11898, 11902); 6.4km SE of Gayndah (QM J11896); Arcadia Valley via Injune (QM J25901); 22.5km W of Gympie (QM J11897); Chinchilla (QM J24207); Jandowae (QM J13772); Bryden (QM J11900); Crows Nest (QM J22785); Petrie (QM J22672); Enoggera, Brisbane (QM J11901); St Lucia, Brisbane (QM J24198); Mt Coottha (QM J23660); Daisy Hill (QM J24196–7, 24199); Mount Crosby (QM J11899); 3.2km E of Flinders Peak (QM J11903); St George (QM J23623); 9.6km SW of Beaudesert (QM J22023); 7.5km SW of Nerang (QM J24206); Barney View, Mt Barney (QM J21989); Lesley Dam via Warwick (QM J24363); 20km WNW of Tenterfield (QM J24201); 8km NE of Wyberba (QM J24202–5); 6km E of Wyberba (QM J11890); Wyberba (QM J24200); 37km W of Armidale (AM R31782); 33.7km W of Armidale (AM R31786); Warrumbungle Mountains (AM R15594); Mission Island, Hawkesbury River (AM R6076); Mt. Riverview Lookout, near Blaxland (AM R18589).

FIG. 4. *Lygisaurus timlowi* Barakula, via Chinchilla (S. Wilson).

Lygisaurus timlowi (Ingram)
(Figs 3, 4, 5)

1977 *Menetia timlowi* Ingram. *Vict. Nat.* 94: 185. Barmount, 80km NW of Marlborough, ME Queensland (22°32'S, 149°06'E). Holotype QM J24940.

DIAGNOSIS

L. timlowi is a small (maximum SV length 29 mm) *Lygisaurus* with a fused eyelid forming a spectacle over the eye, resembling *L. foliorum*. The diagnosis for *L. foliorum* details the characters which distinguish these two species.

DISTRIBUTION

From Shiptons Flat, Cape York Peninsula, west to Alpha and south to Chinchilla SE Queensland. Also Magnetic Island.

DESCRIPTION

SV: 15–29 (N = 18, mean 24.8). HW: 10–13 (N = 9, mean 11.6). TL: 114–137 (N = 3, mean 126.8). HL: 17–23 (N = 7, mean 20.1).

Supraciliaries 5, rarely 6 (N = 34, mean 5.1). Palpebral disc very large. Lower eyelid fused above, forming a spectacle over the eye. Upper ciliaries enlarged, appearing like a second row of supraciliaries. Ear aperture very small; very much smaller than the palpebral disc; no obvious lobules. Supraoculars usually 3, sometimes 2, rarely 1 (N = 30, mean 2.6). Interparietal fused to frontoparietal. Supralabials 6 (N = 26), with the fourth under the eye. Three, sometimes two scales between the second presubocular and the nasal scale, (N = 20, mean 2.7). Midbody scale rows 18–20 (N = 13, mean 19.5). Number of scales from chin to vent 52–61 (N = 5, mean 55.8). Number of lamellae under fourth toe 15–19 (N = 15, mean 16.5).

Brown dorsally, dark brown laterally, broken into dots on side of tail and head. Underside of tail heavily flecked with brown, rest of ventral surface sparsely flecked, but neck and chin white. Two specimens have orange tails.

REMARKS

Ingram (1977) hinted that *Menetia timlowi* might be a species of *Carlia* (*sensu Lygisaurus*). He noted that the species was similar to both *Menetia surda* and *Carlia burnetti* (= *Lygisaurus foliorum*). The important characteristic that he used to justify his decision to place *timlowi* in *Menetia* was 'the long narrow obliquely orientated first supraocular'. Ingram was mistaken. Unlike *Menetia*, which has obliquely orientated supraoculars, the condition of the supra-oculars in *timlowi* obviously is formed by fusion of the first 2 or 3 supraoculars. There is no reorientation of the supraoculars, only fusion. Thus they are transversely orientated. Because of this, we have placed *timlowi* in *Lygisaurus*. *L. timlowi*, in some specimens, also has the feature of two scales between the nasal and the second presubocular. This feature is found on most specimens of *L. foliorum* and some *L. aeratus*.

MATERIAL EXAMINED

Shiptons Flat (QM J45800); 2.9 km NNE of junction of Gulf and Kennedy Highways (AM R63131); 25.2 km NE of Cooktown Rd. via Windsor Tableland Forestry Rd (AM R63899); 40 Mile Scrub, 40 mi. W of Mt Garnet (QM J31041–2, 31053); 'Battery' (QM J44398–401); 'Boori' (QM J44383); crest of Warrigal Range, 27.4km E Torrens Creek (QM J38901); Magnetic Island (QM J24448); Alpha (QM J32468); Moonggoo (QM J36805); Barmount, 80km NW Marlborough (QM J24940); Byanda Station, 20km NNW Proston (QM J39171); 18 km N Chinchilla (QM J41373); 7km N Chinchilla (QM J26147).
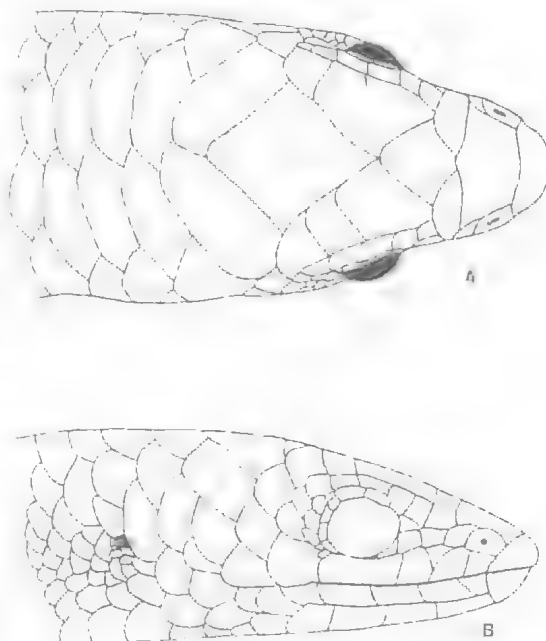
FIG. 5. *Lygisaurus timlowi* (QM J38901). A. Dorsal view of head. B. Lateral view of head.

Lygisaurus aeratus (Garman)
(Figs 6, 7, 8)

1901 *Lygosoma aeratum* Garman. *Bull. Mus. Comp. Zool.* 39: 7. Cooktown, Queensland. Holotype MCZ 6476.
1901 *Ablepharus heteropus* Garman. *Ibid.* p. 9. Great Barrier Reef, Queensland. Holotype MCZ 6484.

DIAGNOSIS

L. aeratus is a large (maximum SV length 39 mm) *Lygisaurus* with a moveable eyelid containing a large disc. It can be confused with *L. rococo* from which it may be distinguished by ear lobules (in *L. aeratus*, many sharp lobules *vs* in *L. rococo*, 1–5 flat lobules), supralabials (6, occasionally 5, with 4th or 5th entering the eye *vs* 7, with 5th which is grooved, entering the eye), and midbody scale count (19–24 *vs* 27–30), number of scales between chin and vent (43–54 *vs* 51–59). Some spirit specimens of *L. aeratus* can also be confused with specimens of *L. foliorum*. See 'remarks' below.

DISTRIBUTION

Prince of Wales Island, throughout Cape York Peninsula, and south to near Ingham, NE Queensland.

DESCRIPTION

SV: 18–39 (N = 67, mean 27.0). HW: 13–17 (N = 65, mean 14.9). HL: 28–35 (N = 30, mean 32.9). TL: 94–158 (N = 20, mean 136.1).

Supraciliaries 6, rarely 5 (N = 138, mean 5.9). Palpebral disc very large. Lower eyelid moveable. Ear aperture much smaller then palpebral disc; with longer axis of aperture usually horizontal, with sharp lobules subequal in size around the margin. Four supraoculars (N = 17). Interparietal free. Supralabials 6, rarely 7 or 5 (N = 54, mean 6.2), with the fourth under the eye or rarely the fifth. Three scales between the second presubocular and nasal scale, rarely two (N = 42, mean 2.9). Midbody scale rows 19–24 (N = 35, mean 22.5). Number of scales from chin to vent 43–54 (N = 30, mean 47.6).

FIG. 6. *Lygisaurus aeratus* Mt Mulligan (S. Wilson)

Number of lamellae under fourth toe 18–24 (N = 64, mean 20.1).

Olive brown above with a coppery head. Laterally brown with or without white speckling. Labials are darkly barred; sometimes this barring continues as a series of lines down the sides of the neck. Ventrally cream, with or without a series of brown spots forming lines from neck to tail. Breeding males have a red throat, red tail and red hind limbs.

HABITAT

Leaf litter of open-forest, woodland, and grasslands.

REMARKS

L. aeratus may be difficult to separate from *L. foliorum* in preservative, because it can be difficult to determine if the eyelid is fused above (the condition in *L. foliorum*), especially in older spirit specimens. They can be easily separated by the number of supralabials and number of scales between second presubocular and nasal

FIG. 8. Distribution of *Lygisaurus aeratus* (●), *L. rococo* (▲), *L. laevis* (△).

scale. Of the 66 specimens of *L. foliorum* we have examined, none had six supralabials, but *L. aeratus* may have seven. With respect to the number of scales between the second presubocular and the nasal scale, 77% of the *L. foliorum* had two, while in 64 *L. aeratus* throughout its range, 91% had three. The condition of two scales is because the first presubocular does not penetrate to the supralabials (compare Figs 2B and 7B).

Garman (1901) stated that *Lygosoma aeratum* had a moveable eyelid and *Ablepharus heteropus* did not. The holotype of the latter (MCZ 6484), however, does have a moveable eyelid with a very large palpebral disc. It also has six supralabials, six supraciliaries, and three scales between the second subocular and the nasal. The holotype of *Lygosoma aeratum* has a moveable eyelid with a very large palpebral disc, six and five supralabials, and two scales between the second presubocular and the nasal. Both specimens belong to the taxon described here. We have chosen *aeratus* as the available name because of page priority.

MATERIAL EXAMINED

Prince of Wales Island (AM R46227–34, 46321–9, 46344–5, 46482); 29 mls N of Coen (AM R40948–9);

FIG. 7. *Lygisaurus aeratus* (QM J40980). A. Dorsal view of head. B. Lateral view of head.

3–4 mls W of Rokeby Homestead (QM J23442); Coen Airport (QM J37527); Peach Creek, 12 km NE of Mt. Croll (QM J37489); 3 km N of Coen (QM J26272); 2 km up Lankelly Creek from bridge near Coen (QM J26263–5); 10 mls E of Coen (AM R16466, 47140); Melville Range, Cape Melville (QM J20511, 20517); Wakooka Outstation, Cape Melville (QM J20485); Strathgordon Homestead (SAM R9788); 24 km N of Glen Garland via Musgrave (QM J38029); Isabella Falls (QM J17818); 13 mls W of Cooktown (QM J27089); Cooktown (MCZ 6476); Shiptons Flat (QM J40975, 40977–82); 10 km N of Palmer River (AM R56789); Great Barrier Reef (MCZ 6484); Windsor Tableland (QM J38755); Walkamin, Atherton Tableland (QM J26691); Palm Beach, Cairns (SAM R2972); 19.9 km S of Ingham (QM J26611–3, 26615–7).

Lygisaurus rococo sp. nov.
(Figs 8, 9, 10)

HOLOTYPE

QM J46014 (formerly AM R112119), 3.2 km SE of Chillagoe Post Office, NE Queensland (17°10'S, 144°32'E), collected by A. Greer and P. Greer on 20 June, 1984.

DIAGNOSIS

L. rococo is a large, robust (maximum SV length 39 mm) *Lygisaurus* with a moveable lower eyelid with a large disc (like *L. aeratus*, with which it can be confused). See detailed diagnosis of *L. aeratus* for characters which readily separate these two species.

DISTRIBUTION

Known only from the limestone rocks of the Chillagoe area, Queensland.

DESCRIPTION

SV: 26–39 (N = 8, mean 33.2). HW: 13–17 (N = 7, mean 15.0). TL: 168–170 (N = 2, mean 169). HL: 38–46 (N = 6, mean 41.5).

Supraciliaries 6 (N = 18). Palpebral disc large. Lower eyelid moveable. Ear aperture smaller than palpebral disc; aperture round with 1 to 5 low flat lobules around margin. Four supraoculars (N = 12). Interparietal free.

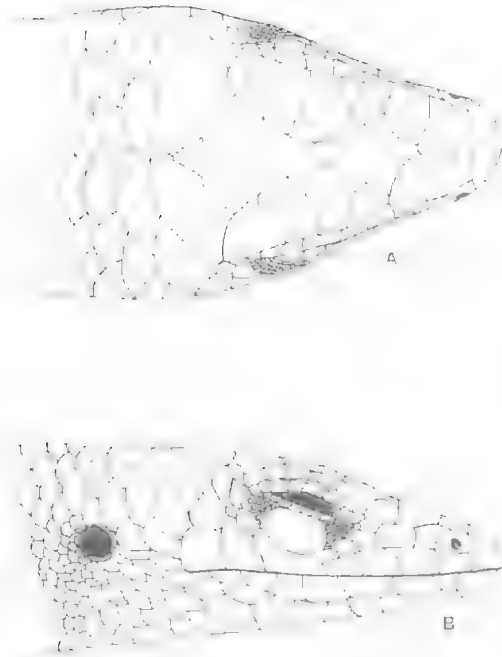FIG. 9. *Lygisaurus rococo* 7 km west of Chillagoe (S. Wilson).

Supralabials 7 (N = 16), with the fifth under the
eye; also the fifth has a groove in the upper
anterior corner. Three scales between the sec-
ond presubocular and the nasal scale (N = 4).
Midbody scale rows 27–30 (N = 9, mean 27.9).
Number of scales from chin to vent 51–59 (N =
8, mean 53.8). Number of lamellae under fourth
toe 23–26 (N = 9, mean 24.2).

Dark brown dorsally and laterally, becoming
coppery brown on the head. Steel-grey ventrally,
becoming creamy brown on the chin.
Undersides of feet are black.

HABITAT

Very restricted, amongst dry leaf litter
accumulated between limestone rocks (S.
Wilson pers. comm.).

REMARKS

L. rococo has the typical characters of a rock-
dwelling lygosomid skink. Covacevich and
Ingram (1978) listed these characteristics in
relation to the species *Cryptoblepharus fuhni, C.
litoralis, Carlia coensis, C. scirtetis, C. rimula*
(the last two as 'Carlia spp. nov.') and
Lampropholis mirabilis (as *Lampropholis* sp.
nov.). The features which set *L. rococo* apart
from other *Lygisaurus*, and which are indicative

of rock-dwelling habits, are high number of
midbody scales; large size; dark colouration;
large limbs and digits; high lamellae count for
fourth toe; and black palms and toe lamellae.

PARATYPES

7 km west of Chillagoe (QM J42068); 3.2 km SE of
Chillagoe P.O. (AM R112114–8); 14.9 km E of
Chillagoe P.O. (AM R112120–1).

Lygisaurus laevis (Oudemans)
(Figs 8, 11, 12)

1894 *Lygosoma laeve* Oudemans. In Semon's *Zool.
Forsch. in Austral* 5: 144. Cooktown, Queens-
land. Holotype ZMA 10994

DIAGNOSIS

L. laevis is a large (maximum SV length of 37
mm) *Lygisaurus* with a moveable eyelid con-
taining a small disc, a character it shares with *L.
tanneri, L. sesbrauna* and *L. macfarlani*. Table 1
summarizes features which distinguish these
four species. Other characters (midbody scale
count, chin-vent scale number, lamellae under
the 4th toe, and numbers of scales between the
second presubocular and the nasal) are not use-
ful in distinguishing the species. Table 1
emphasises the similarity of these four species.
It shows that *L. laevis* is most difficult to dis-
tinguish from *L. sesbrauna* from which it is dis-
tinguished consistently only by ear shape and
size of ear lobules.

DISTRIBUTION

Rainforests from Cooktown south to Mt
Molloy, Kuranda, and Bramston Beach, NE
Queensland.

DESCRIPTION

SV: 28–37 (N = 21, mean 32.8). HW: 13–16
(N = 18, mean 14.5). TL: 114–170 (N = 5, mean
141.9). HL: 31–39 (N = 12, mean 34.3).

Supraciliaries 6 or 7, rarely 8 (N = 42, mean
6.6). Palpebral disc small. Lower eyelid
moveable. Ear aperture subequal in size to the
palpebral disc; longer axis of aperture usually
horizontal, with sharp lobules subequal in size
around the margin. Four supraoculars (N = 21).
Interparietal free. Supralabials 7 (N = 36), with
the fifth under the eye. Three scales between the
second presubocular and the nasal scale.
Midbody scale rows 23–26 (N = 21, mean 24.6).
Number of scales from chin to vent 46–52 (N =
12, mean 48.4). Number of lamellae under
fourth toe 18–25 (N = 21, mean 21.3).
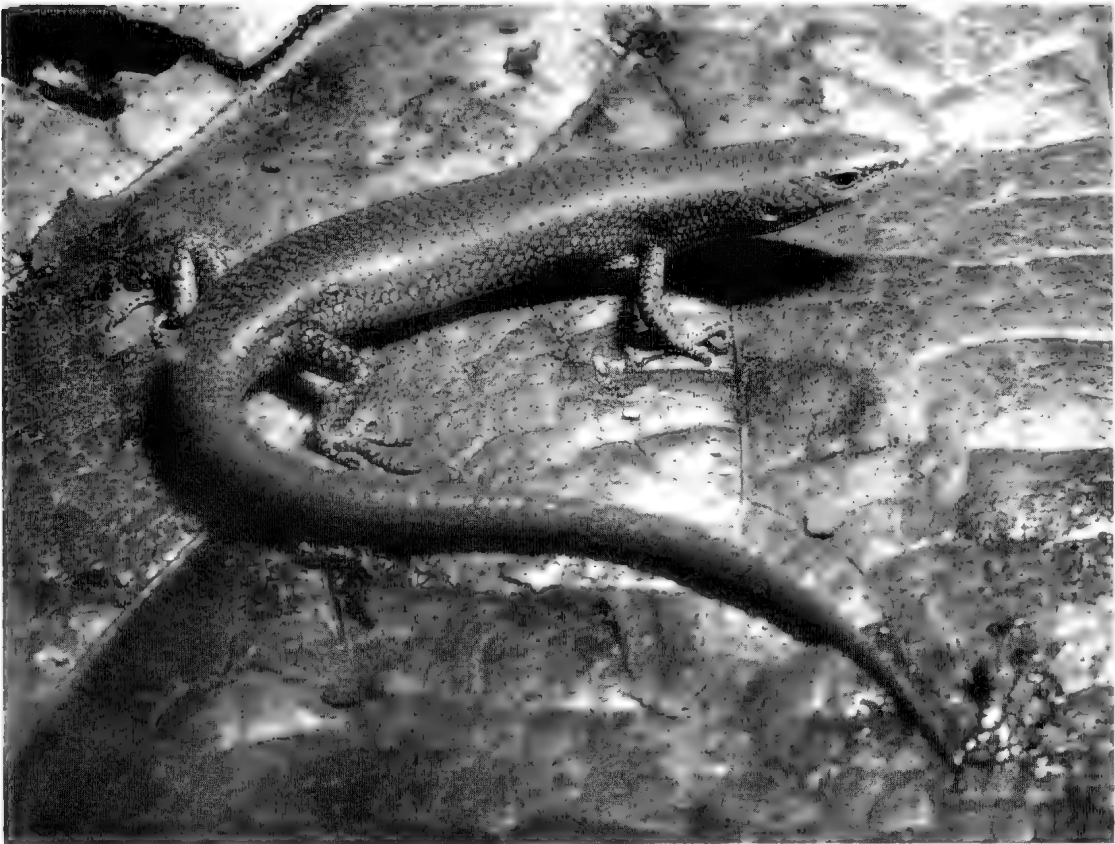
FIG. 11. *Lygisaurus laevis* Freedom Country, 8 km west of Kuranda (S. Wilson).

TABLE 1. A comparison of some features of four similar species of *Lygisaurus.*

	L. laevis	*L. tanneri*	*L. sesbrauna*	*L. macfarlani*
ear size	subequal to disc	smaller than disc	subequal to disc	smaller than disc
ear lobules	sharp, subequal	none or flat and low	sharp, anteriorly much longer	1 large; several smaller and blunt
supralabials	7	7(6)	7(6)	6(7)
supralabial entering eye	5	5(4)	5(4)	4(5)
ear shape	longer axis horizontal	round	round	round
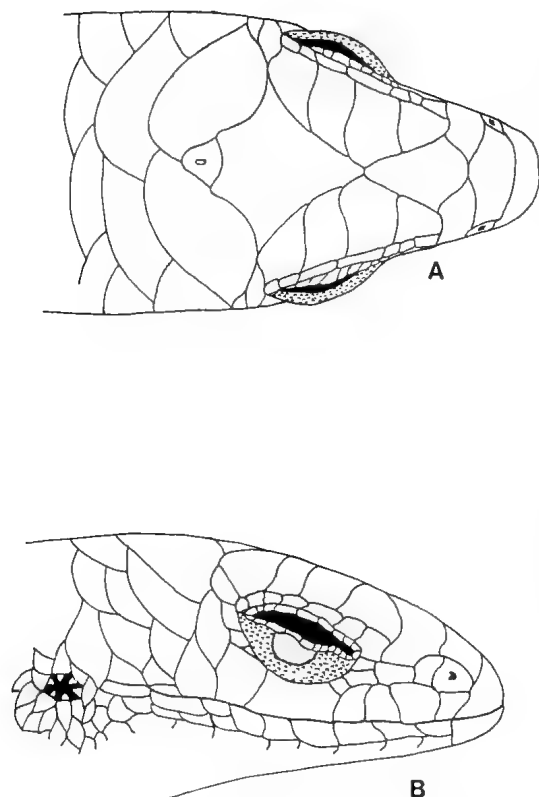
FIG. 12. *Lygisaurus laevis* (QM J27267). A. Dorsal
view of head. B. Lateral view of head.

Dark brown above sometimes with darker
indistinct stripes. Laterally black, sometimes
with pale speckling. Breeding male has a red tail
and throat. Ventrally cream, sometimes with
the scales edged darkly.

HABITAT
Leaf-litter of rainforest and its margins.

REMARKS
We have examined the holotype of *Lygosoma
laeve* Oudemans, ZMA 10994. It has seven
supralabials, an ear aperture that has the longer
axis horizontal, and sharp, pointed lobules
around the margins of the aperture. Also, like
many specimens of *L. laevis* from near
Cooktown, it has six supraciliaries.

MATERIAL EXAMINED
Cooktown (ZMA 10994); Shiptons Flat (QM
J17830-1, 40983-4); McAdams Creek, Amos Bay
(QM J25315-8); Bloomfield (QM J25298, 39437); Mt
Finlay (QM J27267); Hilda Ck, south base of Thorton

Peak (AM R56588); Mt Molloy (QM J25127);
Crowley Ck, via Mt Molloy (QM J27007, 27047); 7.8
km N of Kennedy Highway via Black Mt Rd, Kuranda
(AM R112996); 10 km NE of Kuranda (AM R56447);
Freedom Country, 8 km W of Kuranda (QM J42076-
7); Kuranda (AM R47196); 3 km SSW of Kuranda
(AM R56330); Acacia St, North Holloway Beach (AM
112984-6); Holloway Beach (AM R112957); Cairns
(QM J40365); Crystal Cascades (AM R112958-88,
115013-4); 0.3 km W of Yarrabah boundary on
Koombal Rd (AM R112989-95); 7 km N of Heales
Lookout, via Gillies Highway (AM R112997-8); 35.1
km S of Cairns (QM J26597-8); Russel Island (AM
R36654); Bramston Beach (AM 115009-11).

Lygisaurus sesbrauna sp. nov.
(Figs 13, 14, 15)

HOLOTYPE
QM J24664, Lake Boronto, Cape York Penin-
sula, N Queensland (10°46'S, 142°34'E), col-
lected by G.J. Ingram on 24 September, 1974.

DIAGNOSIS
A medium sized (maximum SV length 34
mm) *Lygisaurus* sharing several characters with
L. laevis, L. tanneri and *L. macfarlani* (see Table
1 for summary of differences). It is most easily
confused with *L. laevis*. For differences, see
diagnosis of *L. laevis*.

DISTRIBUTION
The wetter eastern side of Cape York Penin-
sula, from the tip south to Silver Plains,
Queensland.

DESCRIPTION
SV: 18-34 (N = 45, mean 27.6). HW: 13-17
(N = 35, mean 14.9). HL: 28-34 (N = 30, mean
32.0). TL: 111-145 (N = 11, mean 128.9).
Supraciliaries 7, rarely 8 and very rarely 6 (N
= 86, mean 7.1). Palpebral disc small. Lower
eyelid moveable. Ear aperture subequal in size
to the palpebral disc; aperture round, with sharp
lobules around the margin; the anterior lobules
are much the longer. Four supraoculars (N =
31). Interparietal free. Supralabials 7, rarely six
(N = 88, mean 6.9), with the fifth under the eye,
or rarely the fourth. Three scales between the
second presubocular and the nasal scale.
Midbody scale rows 22-26 (N = 30, mean 23.9).
Number of scales from chin to vent 40-49 (N =
33, mean 44.0). Number of lamellae under
fourth toe 21-26 (N = 30, mean 23.1).
Colour patterns vary between the two
extremes described below. Ground colour of
upper parts and sides red or lemon brown. On

FIG. 13. *Lygisaurus sesbrauna* Lockerbie Scrub, Cape York Peninsula (S. Wilson).

the back and neck there is a black vertebral stripe with 2–3 fine dark paravertebral lines. Pale dorsolateral lines irregularly edged in black. Sides with or without dark longitudinal lines. Labials speckled with dark brown. Black patch on head. There may be series of dark lines leading from the labials along the side of the neck. Ventrally cream with or without black speckling below; there maybe a series of dark lines under the tail.

Breeding males are known to lose the pattern described above and become uniform brown with red tail and legs. It is not known if they further develop a red throat in life. It is not possible to determine the presence of red throats from the preserved specimens.

HABITAT

Leaf litter of monsoon forest, open-forest, woodland, and heath.

REMARKS

This species may also be confused with *L. macfarlani* because females, juveniles, and non-breeding males have similar patterns. They can be easily distinguished in the hand by the nature of the pale dorsolateral stripes. These are neatly lined in black on *L. macfarlani* but on *L. sesbrauna* these are wider and the black lining is ragged on the edges.

ETYMOLOGY

The species name for Ses Brauna who generously assisted one of us (G.I.) with field work on Murray Island.

PARATYPES

Somerset (AM R56062, 56168); Blackwater Lagoon, 6 mls SW of Somerset (AM R40950; 40952–3); Lake Boronto (QM J25599, 25993); Naru Point (QM J25602); 2 km E of Lockerbie (QM J25615); Lockerbie (QM J24620, 24630–2, 25990, 42113); Shotgun Creek crossing (QM J26259); 1 km S of Captain Billy Creek crossing (QM J26206); Heathlands (QM J26204–5,26236); 3 mls N of Iron Range (AM R40952–3); Lamond Hill, Iron Range (QM J28057); Leo Creek (QM J32512, 32516, 37516–20); Buthen Buthen (QM J34461–3, 34465, 37522); 20 km S of Buthen Buthen (QM
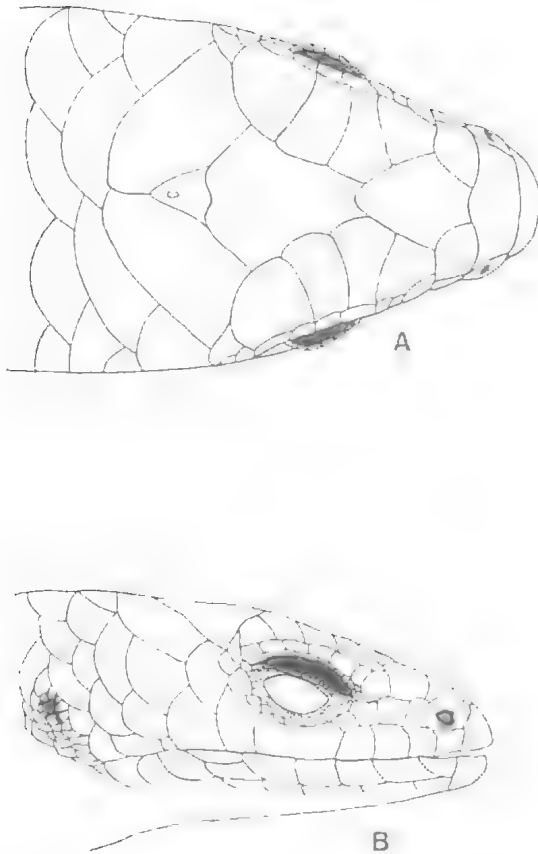
FIG. 14. *Lygisaurus sesbrauna* (QM J25615). A. Dorsal view of head. B. Lateral view of head.

J34578); 10 km NE of Coen (QM J37508); Lankelly Creek (QM J37525–6); Rocky Scrub (QM J37510, 37513–5, 37524); Attack Creek, 11 km NE of Birthday Mountain (QM J37523); 2 km E of Birthday Mountain (QM J38299); 7 km NW of Rocky River mouth (QM J38092); 29 km ENE of Mt. Croll (QM J37530–1); Silver Plains Station (MV D10192); 78 mls S of Coen (AM R21332).

Lygisaurus tanneri sp. nov.
(Figs 15, 16, 17)

HOLOTYPE
QM J32352, Morgan River crossing, near Hopevale Community, N Queensland (15°20'S, 145°02'E), collected by G.J. Ingram on 12 July, 1976.

DIAGNOSIS
A large (maximum SV 37), robust, species of *Lygisaurus* sharing several characters with *L.*
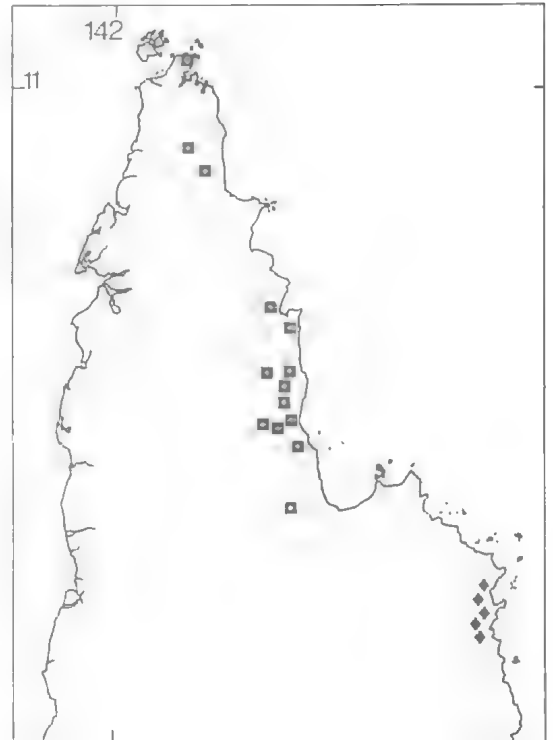
FIG. 15. Distribution of *Lygisaurus sesbrauna* (■), *L. tanneri* (◆).

laevis, L. rococo, and *L. macfarlani*. See Table 1, for summary of characters useful in distinguishing these four species. *L. tanneri* is most similar to *L. macfarlani* from which it is distinguished by ear lobules (none, or flat, low lobules in *L. tanneri* vs 1 — several large blunt lobules in *L. macfarlani*) and by supralabials (7, occasionally 6; with 5th, occasionally 4th, entering eye vs 6, occasionally 7; with 4th, occasionally 5th, entering eye).

L. tanneri may also be confused with *L. curtus*, of New Guinea, but the former lacks the dark nostril to ear line and white stripe from angle of the jaw to ear of *L. curtus*.

DISTRIBUTION
Riverine rainforest and monsoon forests between Starcke Station and the Endeavour River, north of Cooktown, Queensland.

DESCRIPTION
SV: 16–37 (N = 22, mean 30.3). HW: 13–18 (N = 18, mean 15.5). TL: 128–156 (N = 7, mean 144.1). HL: 30–39 (N = 18, mean 35.3).

FIG. 16. *Lygisaurus tanneri* Lily Creek, via Cooktown (S. Wilson).

Supraciliaries 7, rarely 6 (N = 44, mean 6.9). Palpebral disc small. Lower eyelid moveable. Ear aperture smaller than palpebral disc; aperture round without lobules or with low flat ones around margin. Four supraoculars (N = 22). Interparietal free. Supralabials 7, rarely 6 (N = 44, mean 6.8), with the fifth under the eye or rarely the fourth. Three scales between the second presubocular and the nasal scale. Midbody scale rows 22–27 (N=19, mean 25.2). Number of scales from chin to vent 46–50 (N = 20, mean 48.4). Number of lamellae under fourth toe 20–24 (N = 17, mean 22).

Tan to dark brown above, sometimes with a paler indistinct dorsolateral line, especially in immatures. Tan to dark brown with or without pale speckling laterally, sometimes contrasting with the dorsal colour. Breeding males have red tails and red throats.

Habitat

Leaf litter of riverine rainforest and monsoon forest.

Remarks

This species appears similar to *L. laevis*, with which it has seven supralabials in common, but the ear lobules and the round ear aperture suggest a relationship with *L. macfarlani*, or *L. curtus* of New Guinea. The large robust form is similar to that in *L. laevis*, *L. curtus* and some insular populations of *L. macfarlani*.

Etymology

Named for Mr Charles Tanner from whose property many of the type series were taken.

Paratypes

McIvor River, Starcke Station (QM J20609–11); McIvor River Crossing (QM J32362–4); 33 km N of creek crossing near Hopevale Mission (QM J32358–9); Jansen's Crossing, Endeavour River (QM J42771–2); Cedar Scrub (QM J22789); 15 km W of Cooktown (QM J24117–8); 15 km WNW of Cooktown (MV D13175–6); 13 km W of Cooktown (QM J22380, 27093–6); 11.3 km W of Endeavour River Bridge (AM R126336–47); 10.8 km W of Endeavour River Bridge
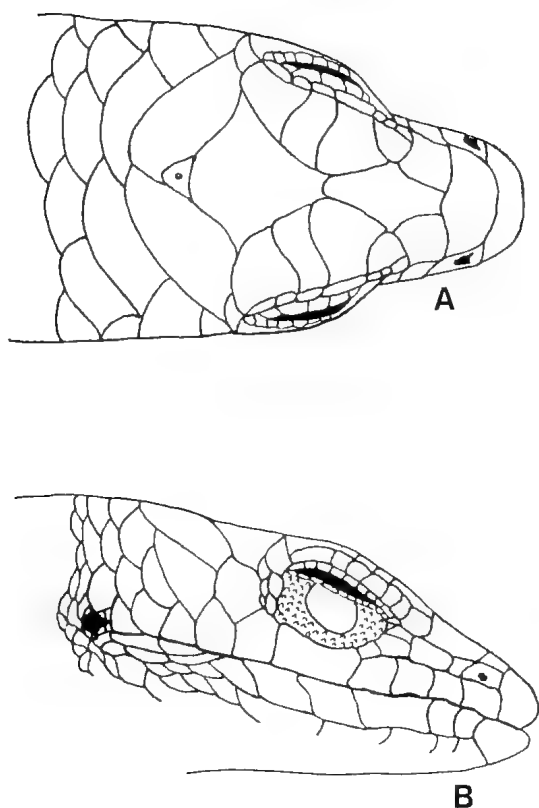
FIG. 17. *Lygisaurus tanneri* (QM J24118). A. Dorsal view of head. B. Lateral view of head.

(AM R126348); 0.5 km S of Endeavour River Bridge (AM R126349); Endeavour River, 9 mls W and 2 mls N of Cooktown (AM R26694–6); Endeavour River (SAM R9760a–b, 9938).

Lygisaurus macfarlani (Günther)
(Figs 18, 19, 20)

1877 *Carlia macfarlani* Günther. *Ann. Mag. Nat. Hist.* (4)19: 413. Somerset and islands of Torres Strait, Queensland. Lectotype BMNH 1946.8.16.49, here designated.

DIAGNOSIS

A large (maximum SV length 37), delicately-built species of *Lygisaurus* sharing several characters with *L. laevis, L. sesbrauna* and *L. tanneri*. See Table 1 for summary of characters useful in separating these species. *L. macfarlani* is most similar to *L. tanneri*. For differences, see diagnosis of *L. macfarlani*. *L. macfarlani* lacks the dark streak from nostril, through eye, to ear of *L. curtus*, a New Guinea species.

DISTRIBUTION

Found in the wetter parts of eastern Cape York south to Princess Charlotte Bay. Also the Torres Strait Islands. Extralimital in southwest Papua New Guinea.

DESCRIPTION

SV: 16–37 (N = 55, mean 30.3). HW: 13–18 (N = 49, mean 14.8). HL: 29–39 (N = 40, mean 34.1). TL: 124–167 (N = 15, mean 140.0).

Supraciliaries 7, rarely 6 or 8 (N = 112, mean 7.0). Palpebral disc small. Lower eyelid moveable. Ear aperture smaller than palpebral disc; aperture round usually with one large blunt anterior lobule and several blunt or low and flat ones on the other margins (on some of the Torres Strait islands the number of lobules may be reduced). Four supraoculars (N = 40). Interparietal free. Supralabials 6, rarely 7 (N = 112, mean 7.0), with the fourth, rarely the fifth, under the eye. Three scales between the second presubocular and the nasal scale. Midbody scale rows on island specimens 22–30 (N = 45, mean 25.3); on the mainland specimens 23–26 (N = 26, mean 24.3). Number of scales from vent to chin 43–51 (N = 32, mean 47.8). Number of lamellae under fourth toe 20–26 (N = 47, mean 22.7).

The skin is semi-translucent. Ground colour on upper parts and lateral surfaces fawn with a series of dark brown longitudinal stripes aligned through the centre of the scales. There are pale dorsolateral lines beginning behind the eyes and continuing to and along the tail. These lines are sharply delineated by dark brown. On the head there is a large dark patch. The labials have dark brown flecking. Ventrally cream, sometimes with brown speckling which may form lines under the tail.

Breeding males lose all this pattern and have a greenish grey colour with red legs, tail, and red on the chin and throat. Pattern and colour varies between the two extremes described above.

HABITAT

Leaf litter of monsoon forest, open forest, woodlands, heath, grasslands, and gardens.

REMARKS

This taxon has been traditionally known by the name *novaeguineae* (Boulenger, 1887; Mitchell, 1953; Cogger, Cameron and Cogger, 1983). Meyer's (1874) description of *Lygosoma (Carlia) Novae Guinea* is brief and not helpful

FIG. 18. *Lygisaurus macfarlani* Tip of Cape York Peninsula (S. Wilson).

for identifying the taxon described. Also, the holotype is missing (Cogger, Cameron, and Cogger, 1983). Meyer's description, translated from German, is as follows:

'Distinguished from *C. melanopogon* Gray by its brown violet metalic shimmering colour on the upper side and is black spotted on the head. Throat white and there is a white stripe under the eye. The white stripes on the scales of *melanopogon* never anterior. Body scales not small, in 23 rows. New Guinea'.

Although uninformative, the description of the colour and pattern does not match the colour and pattern of *L. macfarlani*, which does not have a white stripe under the eye. Neither does it match that of *L. curtus* of New Guinea. *L. curtus* (Boulenger, 1897) is a good species that can be distinguished from *L. macfarlani* by its robust form and the presence of a dark streak beginning at the nostril and continuing back 'through' the eye to the ear. A black streak is not mentioned by Meyer.

In summary, the species name *novaeguinea* cannot be applied convincingly to any of the *Lygisaurus* known from New Guinea. Clarification of the identity of the name will require review of the large collections of *Lygisaurus* species from that country.

Throughout the islands of the Torres Strait *L. macfarlani* has evolved many distinct insular forms. While Günther (1877) lamented the lack of detailed locality data for MacFarlane's specimens (these came from Somerset and islands of the Torres Strait), the types of *Carlia macfarlani* can be identified as specimens from the Darnley-Murray Island group in the northeast of the Strait. Samuel MacFarlane landed at Darnley Island in 1871 with Reverend Murray for the London Missionary Society (Souter 1963). However, they did not reach Murray Island until 1874. That event is still celebrated on the island today as 'The Coming of the Light'.

We have designated BMNH 1946.8.16.49 as the lectotype of *Carlia macfarlani* from the syntypes, BMNH 1946.8.16.49–51.

MATERIAL EXAMINED

Torres Strait Islands (BMNH 1946.8.16.49–51); Saibai Island (AM R48360); Dauan Island (AM R48535, 48550); Yam Island (AM R42365, 61665, 61764–75, 61805, 61829–32, 61873, 62470); Gabba Island (AM R48478–9); Murray Island (AM R42579–
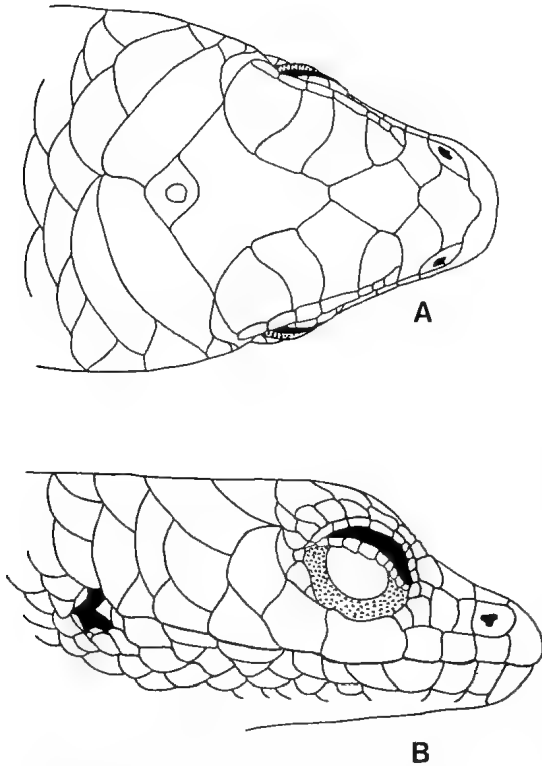
FIG. 19. *Lygisaurus macfarlani* (QM J28013). A. Dorsal view of head. B. Lateral view of head.
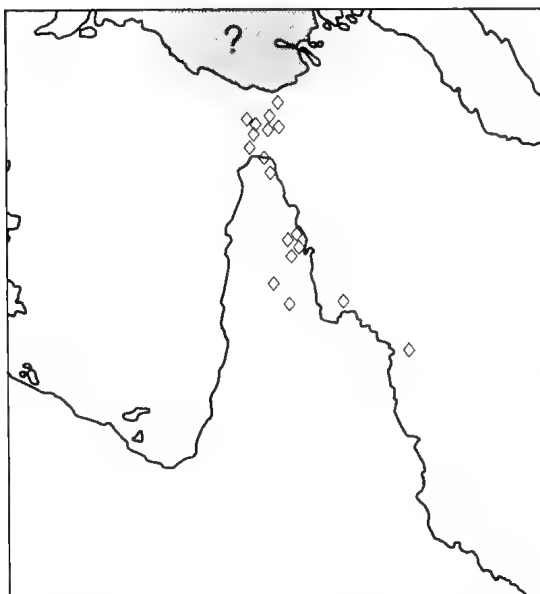
85, 44219–23, 45920, 46102–6, 46108–12); Weier (AM R45907); Dauar Island (AM 45937–8); Jervis Island (AM R48562); Coconut Island (AM R42546); Badu Island (AM R48598, 58978, 58980–4, 58988–97; 59026–30, 59032–3, 59052–7, 59077–83, 59085–6, 59088–104, 59120–1); Mabuiag Island (AM R48562); Moa Island (AM R46679–82, 46778–84, 46862–7, 46957); Wednesday Island (AM R61980); Thursday Island (AM R17022, 42380, 44240, 46173–5, 58957); Prince of Wales Island (AM R46216–7, 46220–1, 48989, 55960, 59183); Hammond Island (AM R42295, 46982–8); Horn Island (SAM R13674; AM R61900–2, 61946–7, 62478; QM J25653–4, 25668, 25690–2); Somerset (AM R56035–7); Naru Point (QM J24636); Lake Boronto (QM J25559, 25564); Great Woody Island (AM R62004–5); 0.5 km N of Pascoe River mouth (QM J32007); Iron Range (QM J7793–4, AM R47197); East Claudie River, Iron Range (QM J28011–5); Claudie River (MV D817); Bare Hill (MV DTD–D1245); Brown Creek, 12 km N of Mt Tozer (QM J37511); West Claudie River (QM J34380); 15 mls NE of Pascoe River (AM R40951); Buthen Buthen (QM J34464, 37521); 2 mls N of Coen (QM J23420); Coen Airport (QM J37529); Lankelly Creek, near Coen (QM J37509, 37528); Coen rubbish dump (AM R40947); Coen (AM R40947); 10 mls E of Coen (AM R16346, 47139); Rocky River (AM R16340, 21284); 11 km SW of mouth of Rocky River (QM J37507); 78 mls S of Coen (AM R21332); Flinders Island (QM J36181-4); Cape Melville (QM J37851); Lizard Island (AM R55001).

KEY TO THE SPECIES OF *LYGISAURUS*

1 Lower eyelid fused above forming a spectacle over the eye 2
Lower eyelid moveable 3

2(1) Interparietal fused to the frontoparietal scale .... *L. timlowi*
Interparietal free .... *L. foliorum*

3(1) Usually six supralabials 4
Seven supralabials 5

4(3) Usually seven supraciliaries; ear aperture round, blunt or flat lobules around margins .... *L. macfarlani*
Usually six supraciliaries; longer axis of ear aperture is horizontal, sharp ear lobules around margins .... *L. aeratus*

5(3) Midbody scale rows 27 or fewer; usually seven supraciliaries 6
Midbody scale rows greater than 26; usually six supraciliaries ....,...... *L. rococo*

FIG. 20. Distribution of *Lygisaurus macfarlani* (◇).

6(5) Sharp lobules surrounding ear opening 7
Ear lobules low and flat. sometimes absent
.... *L. tanneri*

7(6) Ear opening usually round with long
anterior lobules; well defined light
dorsolateral stripes in juveniles, females,
and non-breeding males ..... *L. sesbrauna*
Longer axis of ear opening usually horizontal with subequal sized lobules; no well
defined dorsolateral stripes in juveniles,
females and non-breeding males ... ...
.... *L. laevis*

ACKNOWLEDGEMENTS

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CRINOIDS FROM DEVONIAN LIMESTONES OF EASTERN AUSTRALIA

Peter A. Jell, John S. Jell, Brian D. Johnson, Ruth Mawson and John A. Talent

Crinoid material, often a significant constituent of many Devonian limestones in eastern Australia, includes calices of 26 taxa. A study of these taxa, based mainly on the calices is presented. The following new taxa are described: *Struszocrinus dulcaculus* gen. et sp. nov., *Pandanocrinus martinswellensis* gen. et sp. nov., *P. gueriensis* gen. et sp. nov., *P. wellingtonensis* gen. et sp. nov, *Melocrinites tempestus* sp nov., *Melocrinites solus* sp. nov., *Eucalyptocrinites fonzi* sp. nov., *Dolatocrinus peregrinus* sp. nov. and *Shimantocrinus distinctodorsus* gen. et sp. nov. The following six European Devonian species have been recognized and discussed: *Rhipidocrinus crenatus* (Goldfuss), *Hexacrinites interscapularis* Phillips, *H. spinosus* Muller, *Eucalyptocrinites rosaceus* Goldfuss, *E. praerosaceus* Yakovlev and *Cupressocrinites abbreviatus* Goldfuss. A few incomplete or poorly preserved specimens are referred to Spyridiocrinid gen. nov., Carpocrinid indet., *Rhipidocrinus?* sp., Polypeltid indet., *Pandanocrinus* sp. cf. *P. wellingtonensis* gen. et sp. nov., *Parapisocrinus* sp., Gasterocomid sp., *Cupressocrinites* sp. cf. *C. gracilis* Goldfuss, Inadunate indet. Two indeterminate crinoids are briefly described.
□ *Crinoids, Devonian, Eastern Australia.*

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Crinoidal skeletal fragments are common components of many Devonian limestones in eastern Australia but to date they have been recognized as disaggregated fragments usually of stems or more rarely of the crown. Alternatively they are preserved in massive clean limestones that extremely rarely fracture or weather to reveal the structure of the crinoid crown. Only four genera have been recognized previously in eastern Australian Devonian limestones (Philip, 1961; Bates, 1972) and two of these are doubtful assignments while a third is not specifically identifiable. It should be noted that two of these genera from the Early Devonian of Victoria, namely *Hexacrinites* and *Eucalyptocrinites*, are common among the faunas described below. Devonian crinoids from siliciclastic sediments are scarcely better known with only seven genera previously recognized (Bather, 1897; Chapman, 1903; Jell, 1982; Jell & Holloway, 1983). Over the last 10 years the senior author has studied Palaeozoic echinoderms particularly from Victoria (Jell, 1982; Jell, 1983; Jell & Holloway, 1983; Holloway & Jell, 1983), and a large fauna of Devonian crinoids remains to be described from fine sandstones and siltstones of the Melbourne Trough. The material described below has been assembled over several years and provides a marked contrast (taxonomic and preservational) with the fauna of the Melbourne Trough.

LOCALITIES AND AGES

Most of the crinoids described herein come from two main regions (Fig. 1), namely: the Pandanus Creek — Broken River area, 240km northwest of Charters Towers, northern Queensland and the Wellington area, 200km west northwest of Sydney, central New South Wales. Additionally, one species is described from Loyola in the Mansfield district (Fig. 1), 150km northeast of Melbourne, central Victoria, one fragment of a calyx and a weathered specimen are noted from the Burdekin River area just north of Charters Towers (Fig. 1) and two calices are recorded from Mount Etna, 25km north of Rockhampton (Fig. 1). Detailed information on each locality is provided in the Appendix.

PANDANUS CREEK — BROKEN RIVER AREA, NORTH QUEENSLAND

The Broken River Embayment (Broken River Province) to the west of Townsville, is a
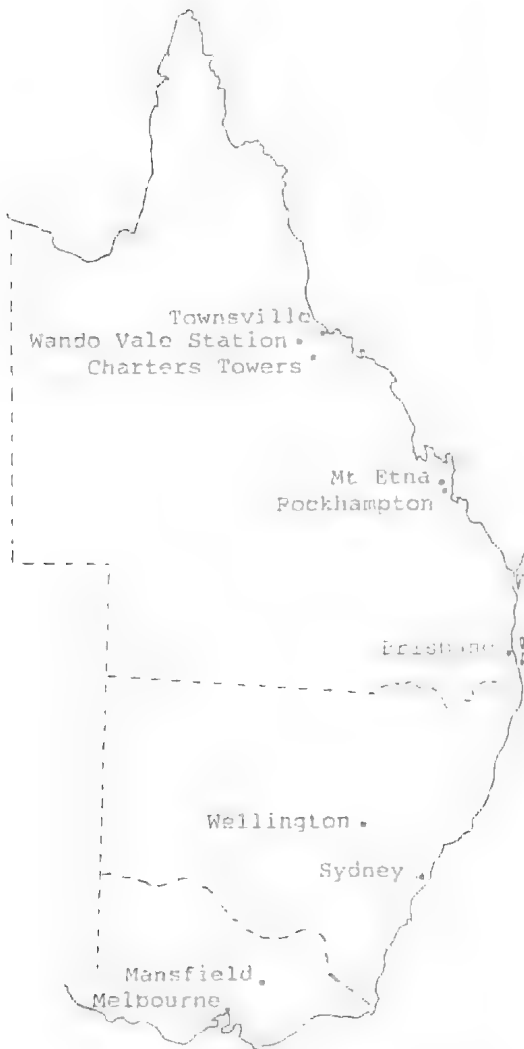
FIG. 1. Sketch map of eastern Australia showing towns referred to in locality descriptions.

deformed sedimentary terrain of the Tasman Fold Belt System faulted against Proterozoic rocks of the Georgetown Inlier to the northwest and lower Palaeozoic rocks of the Ravenswood-Lolworth Block to the south. The southwestern part (Graveyard Creek Subprovince) is less deformed and contains thick siltstone, arenite, conglomerate and limestone deposits (Arnold & Fawckner, 1980; Wyatt & Jell, 1980; Withnall et al., 1988). Biostratigraphy of these carbonates (Jell, 1968; Telford, 1975; Mawson et al., 1985) indicates 3 phases of Devonian marine sedimen-

tation separated in most, if not all, areas by unconformities (Fig. 2). The Graveyard Creek Formation was deposited mainly during the Silurian but Lochkovian carbonates are known at its top; no crinoids are known from this unit. The 250m thick Shield Creek Formation (Wyatt & Jell, 1980), of late Lochkovian to Pragian age, includes the Martins Well Limestone Member that yields many crinoid calices of *Pandanocrinus martinswellensis* gen. et sp. nov. in the vicinity of Martins Well. An associated assemblage of small (less than 1cm) species contains *Parapisocrinus* and *Cupressocrinites*. The third phase of deposition is the Broken River Group (formerly the Broken River Formation), a sequence of mixed facies from terrigenous and nearshore clastics, shallow nearshore shales and muddy carbonates to outer shelf limestones and conglomerates, and possibly slope deposits (Fig. 2). The stratigraphic nomenclature has been revised by Withnall et al. (1988) (Fig. 2). Its base is of late Emsian age and its top is Givetian. The group outcrops over wide areas (Mawson et al., 1985, fig. 1) and the full fauna has almost certainly not been sampled. Crinoids are a relatively rare component of muddy carbonate units (Wyatt & Jell, 1980), namely the late Emsian to Givetian Burges Formation and the Givetian Papilio Formation. Most of those described herein come from sites in the vicinity of Storm Dam north of Dosey Outstation (Mawson et al., 1985, fig. 1) north to the Broken River.

BURDEKIN RIVER AREA, NORTH QUEENSLAND
Sediments of the Burdekin Shelf form a sequence of Devonian and Carboniferous age resting unconformably on crystalline basement of the Lolworth-Ravenswood block. The initial Eifelian transgression is represented by the Fanning River Group that includes the basal Big Bend Arkose, and Burdekin Formation of biostromal limestone and calcareous mudstone; it ends with the regressive late Givetian Culti-vation Gully Formation. The specimen of *Cupressocrinites abbreviatus* Goldfuss, 1839, found as float in the Burdekin River bed by Zhen Yong Yi, and the indeterminate crinoid found by Greg McNamara in the Hervey Range, were almost certainly derived from the Givetian Burdekin Formation.

MOUNT ETNA, CENTRAL QUEENSLAND
Some 25km north of Rockhampton promi-nent limestones included in the Mount Holly

FIG. 2. Early to Middle Devonian units of the Graveyard Creek Subprovince, north Queensland showing their distribution in measured sections (from which conodont faunas have been obtained) against standard conodont zonation.

Beds (Kirkegaard, Shaw & Murray, 1970) are part of the eastern belt of the Craigilee Subprovince. Although the Mount Holly Beds are largely covered by younger post-Carboniferous sediments (Henderson, 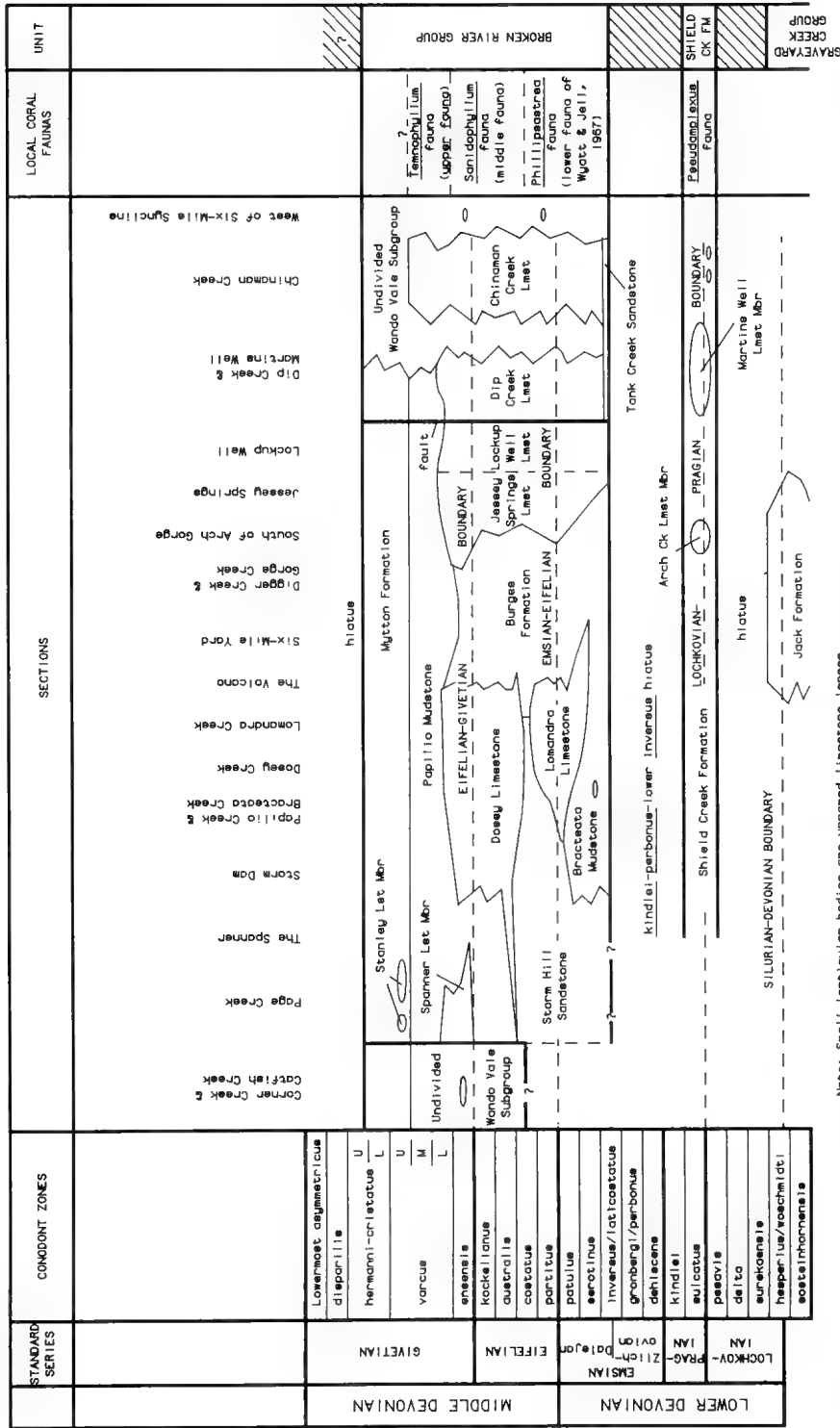1980) muddy limestone on the lower northeastern slopes of Mount Etna have yielded two incomplete calices of *Pandanocrinus*. Correlation and age of the limestone was discussed by Druce (1970), Strusz (1972), and Philip and Pedder (1967). It is now considered to be of early Pragian age, as also is the Martins Well Limestone Member which contains conodonts of the *sulcatus* biozone.

WELLINGTON, CENTRAL N.S.W.

The Molong Geanticline is a structural high extending in a north- south line through central New South Wales (Packham, 1969, fig. 1.1) some 200km west of Sydney. Marine sediments older than Late Devonian occur on both flanks and in the easterly belt limestones and shales, assigned to the Garra Formation, outcrop over a distance of 100km in a band no more than 5km wide (Packham, 1969, fig. 3.16). Crinoidal debris is a relatively common component of this carbonate sequence but calices have been found at only 3 localities. These occurrences are near the town of Guerie at the northern end of the carbonate belt and at two localities in the eastern belt of limestone adjacent to the town of Wellington. The formation, which is over 1000m thick, has been dated as Emsian (Strusz, 1972), Siegenian (Druce, 1970) and Lochkovian to Pragian (Johnson, 1975; Chatterton *et al.*, 1979). We agree with the late Lochkovian to Pragian range.

LOYOLA, CENTRAL VICTORIA

The Melbourne Trough of central Victoria is a structural trough, triangular in shape and containing a thick complete sequence of Early Cambrian to Middle Devonian marine strata overlain by nonmarine sediments. Loyola is a small district some 10–15km southwest of Mansfield that is situated on the extreme eastern edge of the Melbourne Trough. At Loyola a number of small limestone lenses are interbedded in the Norton Gully Sandstone; one of the lenses has been worked since last century in the now abandoned Griffith's Quarry. The fossil fauna of the quarry, principally corals, stromatoporoids and conodonts, has been described in some detail (Chapman, 1925; Hill, 1939; Pedder, 1967; Ripper, 1938, Strusz, 1968; Hill & Jell, 1970; Cooper, 1973). The last mentioned paper dealt with conodonts and provided an early Emsian age as well as a detailed locality map and detailed discussion of the stratigraphy. Mawson (1987, p. 284) reinterpreted the conodonts indicating a Pragian age in the *kindlei* biozone.

FAUNAL AFFINITIES

The most striking features of these crinoid faunas (Fig. 3) from eastern Australia are: 1, the presence of 6 species known previously from western Europe; 2, the presence of *Pandanocrinus* and *Shimantocrinus*, two new genera that we consider are ancestral to the North American Dolatocrinidae as well as *Dolatocrinus* Lyon, 1857 itself; and 3, the predominance of camerate crinoids in these carbonate-dwelling faunules compared to contemporary or slightly older faunas of terrigenous sediments in the Melbourne Trough that include camerates and inadunates in almost even numbers of taxa and individuals (P.A. Jell, unpubl. data).

Five of the seven species identified in relatively large collections from the Papilio Formation in the vicinity of Storm Dam in the *ensensis* and *varcus* conodont zones belong to species that are only known from similarly dated sediments in western Europe (i.e. in the Eifel of Germany or in southwestern England). This is an extremely close match that seems likely to be significant and not a chance occurrence. It accords well with the findings of Campbell & Davoren (1972) in respect of contemporary trilobite faunas at the generic level. For example, they found that compared to 13 Zlichovian faunas from around the world the Australian fauna (mainly from the southeastern part of the continent) had greatest affinity with faunas from Germany and Czechoslovakia. Similarly, Boucot, Johnson & Talent (1969) and Johnson (1979) found the late Emsian — early Eifelian and late Lower Devonian, respectively, brachiopod faunas of Australia were dominated by genera from their Old World Province (i.e. Europe) and they assigned eastern Australia accordingly. Our crinoid data from north Queensland support these views. However, the fauna of the Garra Formation (*sulcatus* biozone) is more equivocal. Of the 6 species recorded, 1 is found in Europe, 1 belongs to a cosmopolitan genus of North America and Europe and 4 are endemic; of these endemics 3 belong to *Pandanocrinus* and *Shimantocrinus*, interpreted
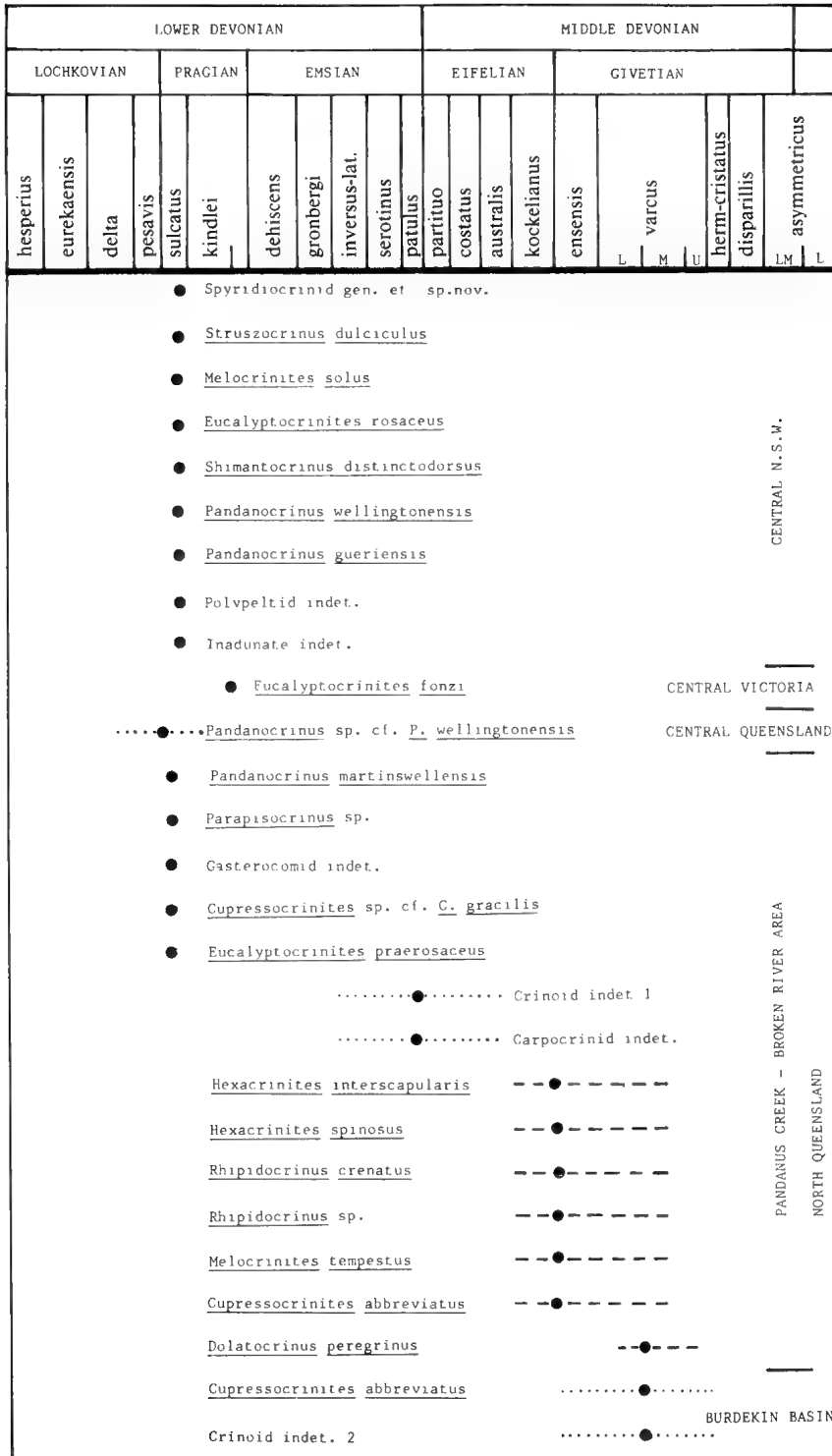
FIG. 3. Range chart for all crinoids described against standard conodont zonation. Dashed lines indicate known ranges; dotted lines indicate uncertain ranges.

below as ancestral to the largely North American Dolatocrinidae that is also represented in the Givetian of north Queensland by *Dolatocrinus*. Affinities of this fauna remain unclear but it is suggested that migration to North America was possible during the Emsian. Overall affinities of these eastern Australian crinoid faunas seems to be more strongly with the European Old World Province.

Detailed analysis of the content of these carbonate faunas as opposed to terrigenous faunas of Victoria where inadunates form a
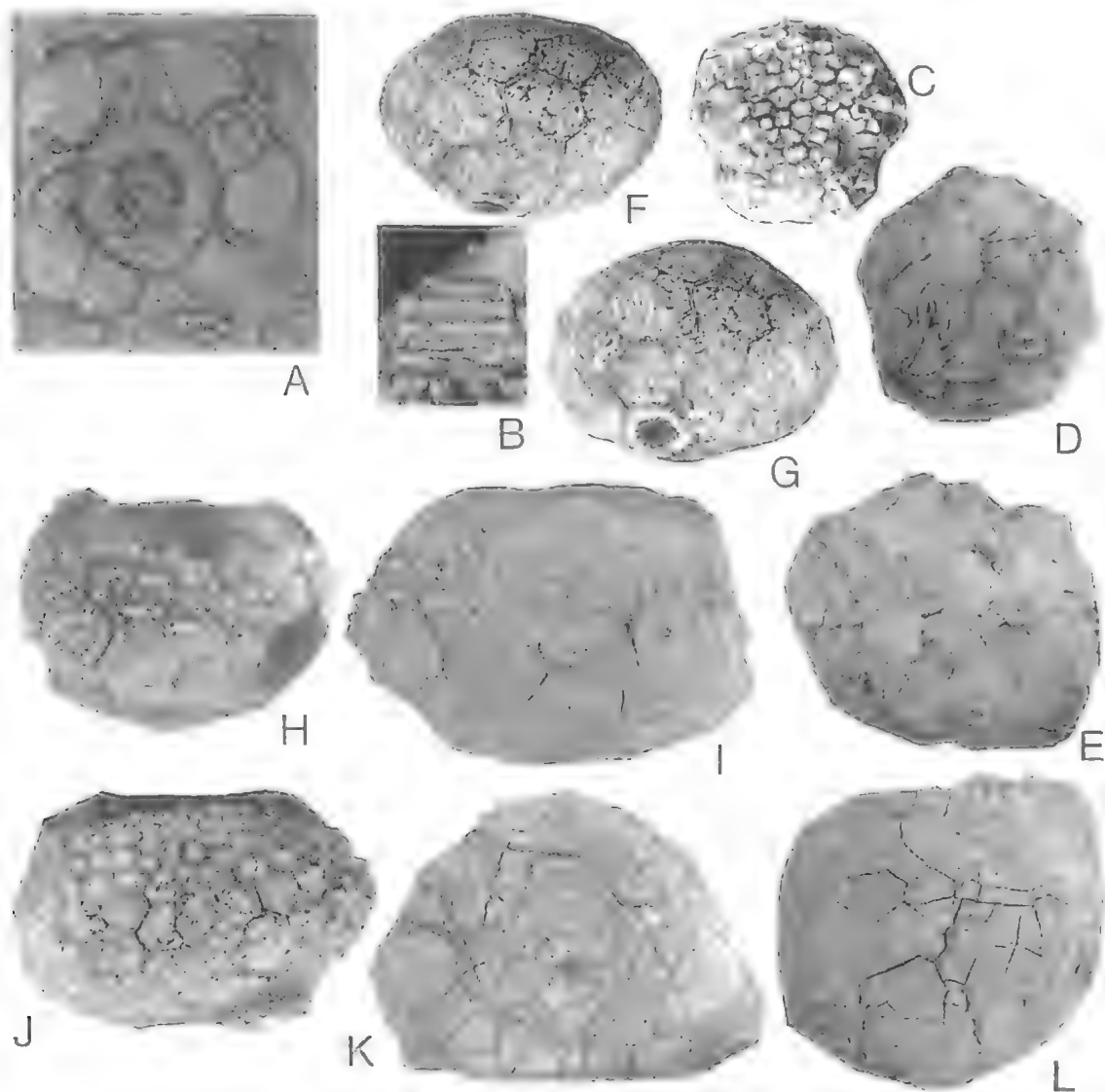
FIG. 4. A,B, Spyridiocrinid gen. et sp. nov. A, basal part of calyx showing stem attachment area and alternating radials and basals in single circlet, AMF72542, × 1.4. B, naturally weathered longitudinal section of stem section showing concealed internodals, AMF72542a, × 4. C–E, *Rhipidocrinus*? sp. C, oral view of tegmen, D,E, lateral to basal views of deformed calyx with B ray at 12 o'clock position, UQF75111, × 1, × 1.4 and × 1.6, respectively. F–L, *Rhipidocrinus crenatus* (Goldfuss, 1831). F,G, lateral views of calical fragment (orientation not known), UQF75112, × 1. H–J, lateral views of most complete calyx available from Australia, UQF75113, H, with C ray just left of centre × 1, I, with B ray central and C ray at left × 1.2, J, with D ray to right of centre and E ray to left × 1. K, basal view of fragmentary cup with C ray at 10 o'clock position QMF14771, × 0.9. L, lateral view of incomplete calyx (orientation unknown), QMF14869, × 0.8.

significant proportion of the whole fauna must await results of study of the latter faunas now in progress. However, it would seem that this significant ecological distinction may be identified as a determining factor in the distribution of inadunate crinoids and should be looked for in other areas of the world. It might be speculated that the carbonate environments had for one reason or another caused the non-camerate skeleton to disaggregate whereas the camerates were more securely held together. If this proves to be the real reason for the disparity mentioned above then crinoidal debris in these formations will prove to belong mainly to non-camerates: that study is beyond the scope of this paper.

SYSTEMATIC PALAEONTOLOGY

Terminology used herein as far as possible follows that used in the *Treatise on Invertebrate Paleontology Part T.* Material is deposited in the palaeontological collections of the following institutions, hereinafter indicated by the prefix shown : Department of Geology, University of Queensland, Brisbane (UQF), Queensland Museum, Brisbane (QMF), Australian Museum, Sydney (AMF), James Cook University, Townsville (JCF) and Museum of Victoria (NMVP). Locality Registers in these institutions are indicated by the prefixes: UQL — Department of Geology, University of Queensland, QML — Queensland Museum, NMVPL — Museum of Victoria.

Class Crinoidea
Subclass Camerata
Order Diplobathrida
Family Spyridiocrinidae Jaekel, 1918

Spyridiocrinid gen. et sp. nov.
(Figs 4A,B, 5)

MATERIAL EXAMINED
AMF72542, a weathered calical base from QML512.

OCCURRENCE
Pragin (*sulcatus* biozone), Garra Formation, near Wellington, central New South Wales.

DESCRIPTION
Calical fragment approximately 20mm in diameter, flat, exhibiting only the infrabasal circlet; next circlet of 10 plates consisting of basals alternating with radials. A prominent, broadly pitted ornament evident on
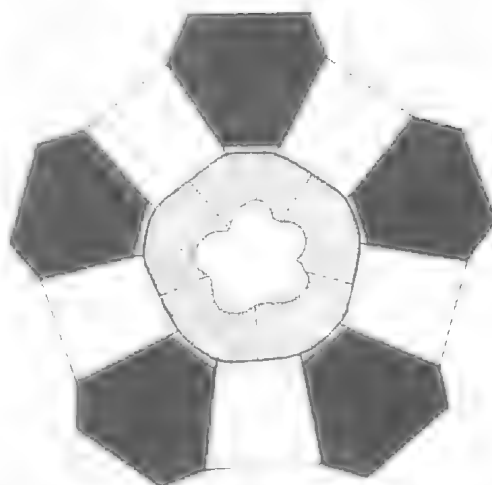
FIG. 5. Spyridiocrinid gen. et sp. nov. plate diagram with inferred sutures between infrabasals dashed but not observed.

unweathered parts of a few plates. Infrabasal circlet 10-sided, approximately 10mm across and almost completely concealed by the stem attachment. Small part of each infrabasal evident along the base of the radial plates outside the stem attachment area indicating 5 infrabasals. Stem circular, of low nudinodals concealing very short internodals; columnals with well-developed crenularia but not reaching periphery; pentalobate axial canal evident. Next circlet of 10 plates in two sets of 5, with each set having a distinctive shape. One set, probably the basals, consisting of rectangular plates only a little higher (5mm) than wide (4mm), but slightly lower than the other set. Second set, probably the radials, consisting of equidimensional (6mm high and 6mm wide) hexagonal plates, with widest point near top of plate at height of top of basals, with two short oblique sides converging up from widest point to top of plate. Remainder of crown unknown.

REMARKS
This calical fragment could be readily assigned to the Zygodiplobathrina of Ubaghs (1953, 1978) based on the circlet of 10 plates in 2 distinct sets surrounding the stem attachment which conceals the infrabasal circlet. However, Brower (1975) and Haugh (1979, p. 11) have considered this taxon to be polyphyletic. Accordingly we have sought possible relatives from among those genera that possess zygodiplobathrid bases. The flat

calical base and structure of the stem strongly suggest the Spyridiocrinidae. The distinctly different shapes of the radials and the basals is indicative of a new genus because all described species of *Spyridiocrinus* Oehlert, 1889 possess basals and radials of uniform shape and size. However, with this one incomplete calyx, further characterization of the genus is impossible. Breimer (1960, p. 257, reproduced Ubaghs, 1978, fig. 239.1f) showed a juvenile specimen

of *Rhipidocrinus crenatus* Goldfuss, 1831 with basals and radials alternating in a single circlet around the infrabasals. However, the N.S.W. specimen is distinguished by its size, wider base of radials contacting infrabasals, different ornament on plates, and possibly stem structure.

Detailed structure of the stem is derived from a weathered stem fragment adjacent to the specimen and interpreted as being part of this individual as are many other small calical and arm plates in the immediate vicinity.
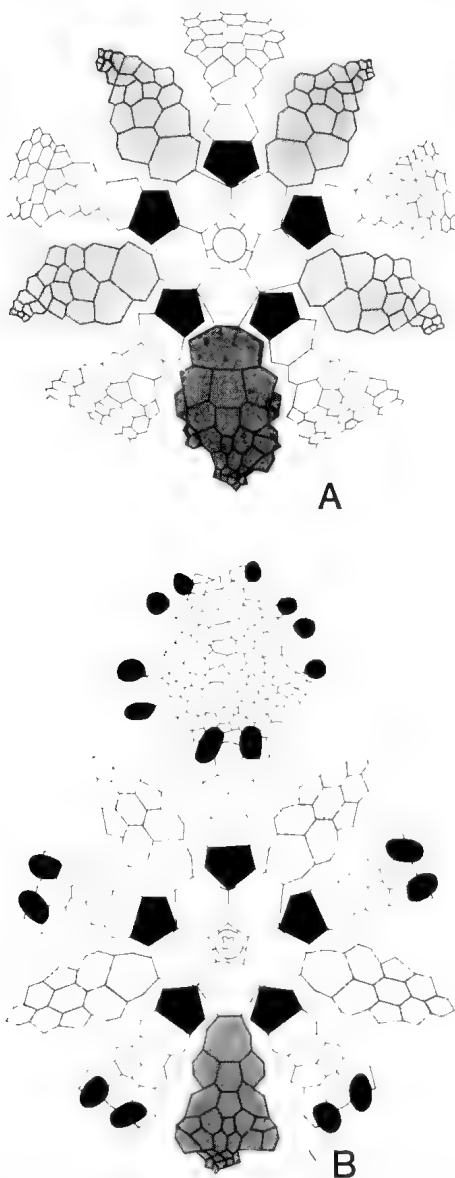
FIG. 6. Plate diagrams of A, *Rhipidocrinus crenatus* (Goldfuss, 1831) and B, *Rhipidocrinus*? sp. including the tegmen.

Superfamily Rhodocrinitoidea
Family Rhodocrinitidae Roemer, 1855

Rhipidocrinus Beyrich in Zittel, 1879

TYPE SPECIES
Rhodocrinites crenatus Goldfuss, 1831 from the Givetian of West Germany; by original designation.

DISCUSSION
This genus was discussed in detail by Breimer (1960). Unfortunately features considered by him to be distinctive of the genus (i.e. the style of branching and variation in the arrangement of lower calical plates) are not available on the Australian specimens. Nevertheless, German specimens of the type species (see Remarks on the species below) are very similar in all points where comparisons can be made.

Rhipidocrinus crenatus (Goldfuss, 1831)
(Figs 4F–L, 6A)

MATERIAL EXAMINED
Holotype Goldfuss, 1831, pl. 64, fig. 3.
Queensland material assigned. UQF75112, an incomplete calyx without free arms, stem or tegmen from UQL5229; UQF75113, a weathered fragment of a calyx from UQL5318; QMF14771, a badly weathered calyx showing basal plating from UQL5320; QMF14869, a damaged and weathered calyx showing plating of upper part of calyx and free arm bases from UQL5321.

OCCURRENCE
Late Eifelian — Givetian, Papilio Formation, near Storm Dam, Wando Vale Station, north Queensland.

DESCRIPTION

UQF75113. This specimen shows only one ray of the calyx and the adjacent interbrachials up to the level of the first secundibrachs. All the plates are weathered so as to be virtually smooth but some remnants of the radial ornament are evident in a few places. In this weathered state the plates are approximately 1mm thick. The pentagonal infrabasal circlet has a broad round depression for stem attachment. Hexagonal basals 10mm wide and 9mm high have their greatest width 2mm from their bases. The radial is pentagonal, 11mm wide and 10mm high with greatest width 4.5mm from bottom. The first primibrach is hexagonal, 12mm wide and 7mm high. The second primibrach is pentagonal, axillary, 8.5mm wide and 6.5mm high. Interbrachials begin with a large (12mm wide by 10.5mm high), 7-sided plate contacting the basal, radial and first primibrach, and supporting two smaller plates above.

UQF75112. This specimen has been slightly crushed laterally (i.e. through the A ray — CD interray axis); plate displacement and overriding has occurred in the basal region, where weathering has been most pronounced, smoothing off the ornament. The entire outline is not available for any one basal. Radials are variable in shape, 6-sided where observable. First primibrach 6-sided but rather irregular in shape in most rays. Second primibrach axillary, 6-sided in D and E rays but 5-sided in B and C rays (not evident in A ray). First secundibrach axillary, 6-sided, almost as large as second primibrach. First tertibrach supporting a fixed ramule on outer side of ray. Plates of fixed ramule marginally narrower and generally higher than main arm plates. At least 5 tertibrachs, usually hexagonal, fixed in calyx. Interprimibrachs numerous, up to 20 per interray; lowest one being largest plate in calyx, 7-sided, resting directly on basal and supporting two plates above; interprimibrachs irregularly arranged. Intersecundibrachs in single column of at least 4 plates. Primanal octagonal, supporting 3 plates above; remainder of anal series not clearly evident. Ornament, where present, of strong central boss with strong radial ridges on larger plates with radial ridges less prominent on smaller plates. Medial ray ridge evident in C ray and dividing on second primibrach.

QMF14771. This large individual was approximately 50–60mm in diameter but most of it is weathered away. The five equal infrabasals are evident forming a raised pentagonal base with wide axial canal. Numerous small pits in the infrabasals were probably caused by weathering rather than by boring organisms. The five large basals and several radials are evident with one ray exhibiting the typical structure upto the second secundibrach.

QMF14869. This badly damaged individual exhibits some of the ornament normal to sutural margins although weathered considerably. It also gives an idea of calical shape although it is laterally compressed and shows several of the free arm bases at the upper rim.

Upper arms, stem and tegmen not available.

REMARKS

This assignment to *R. crenatus* depends on comparison with specimens assigned to that species by Schultze (1867, pl. 7, fig. 1,1a– n) as well as reference to the original material of Goldfuss (1831, p. 211, pl. 64, fig. 3). In particular Schultze (1867, pl. 7, fig. 1g) showed a calyx with plates ornamented in exactly the same way as those of the Australian specimen (UQF75112), with the same arrangement of plates in the brachial series and particularly in the fixed ramules arising from the second secundibrach. The column of relatively large intersecundibrachs is also similar. Schultze (1867) illustrated a considerable variation in the calices he assigned to this species, recognizing two varieties. Although these may well represent separate species we have not examined Schultze's or any other European material and so prefer to assign the Australian form to *R. crenatus* in its broader sense. Breimer (1960) revised *R. perloricatus* Schmidt, 1905, elucidating many generic features in the process and distinguishing it from *R. crenatus* by its smooth, globose, calical plates.

Rhipidocrinus ? sp.
(Figs 4C–E, 6B)

MATERIAL EXAMINED
UQF75111, a calyx, damaged in some plates and also distorted by crushing from UQL5272.

OCCURRENCE
Early Givetian, Papilio Formation, near Storm Dam, Wando Vale Station north Queensland.

DESCRIPTION

Calyx bowl-shaped, of moderate height, with subhorizontal base, approximately 25mm in diameter and 15mm high, with smooth unornamented gently convex plates. Infrabasal circlet pentagonal, individual plates not discernible, apparently fused; circular stem attachment area situated centrally occupying most of infrabasal circlet, with central pentalobate canal evident in section. Basals large, 6mm high and 6mm wide at widest point, hexagonal except in C–D interray where it is 7-sided, in contact laterally with other basals for half height. Radials pentagonal except in C ray where it is hexagonal, isolated from other radials. First primibrach hexagonal, wider (6mm) than high (4mm). Second primibrach axillary, pentagonal, smaller than lower plates (4mm wide 4mm high at greatest height). First secundibrach usually hexagonal but a little variable in shape. Second secundibrach a large plate almost enclosing the base of the free arm. Ten free arms, no details available. Intersecundibrachs 2 only, lower one hexagonal, second between bases of five arms. Interprimibrachs numerous; lowest one hexagonal, large, 6.5mm wide by 6mm high, resting directly on basal with horizontal suture, and supporting 2 plates in second row then 3, 2 and 1 in succeeding rows. C–D interray with two pentagonal primanals separated by a vertical suture, with succeeding rows of 3, 3 and 2 up to the large anal opening. Tegmen of small polygonal plates, rather flat, with large anal opening slightly elevated near margin in posterior interray. Free arms and stem not known.

REMARKS

This specimen comes from the same unit as those described above as *R. crenatus* and one is tempted to infer that it may be a juvenile of that species. However, the smooth plates, the ten free arms emanating from the second secundibrachs, lack of fixed ramule and two primanals resting on a basal in C–D interray, all mitigate against such an identification. Nevertheless Breimer (1960, p. 257, fig. 5, righthand illustration; reproduced by Ubaghs, 1978, fig. 239, 1d) showed a juvenile of *R. crenatus* with two primanals resting on a single basal in the C–D interray. It should also be noted that the holotype of *R. crenatus* does not display elaborate ornament nor does it incorporate large numbers of secondary and higher brachials into the calyx; it is highly likely that this specimen is a juvenile of *R. crenatus*.

Class Camerata
Order Monobathrida
Suborder Tanaocrinina
Family Carpocrinidae deKoninck & Le Hon,
1854

Carpocrinid indet.
(Figs 7G–J, 8)

MATERIAL EXAMINED

QMF14881, a badly damaged calyx from QML547 (= UQL5209).

OCCURRENCE

Late Emsian — early Eifelian, Burges Formation just west of the Broken River Gorge, Wando Vale Station, north Queensland, collected by Aye Ko Aung.

DESCRIPTION

Calyx 20mm in diameter, with vertical sides and weakly convex base. Basal circlet hexagonal, of three equal plates, with sutures between them in B and E rays and C–D interray; axial canal small and weakly pentalobate. Radial circlet of six (five radials and primanal) large hexagonal plates each one wider than high. First primibrach quadrate, variable in shape from transverse to square or higher than wide, with gently convex edges. Second primibrach axillary, low, pentagonal. Single secundibrach axillary, often irregularly shaped particularly on upper side. Fixed tertibrachs irregularly shaped, markedly smaller than secundibrach and tending to alternate in zigzag fashion. Four arms per ray, the two outer arms apparently with smaller bases than the inner ones. Single intersecundibrachs and intertertibrachs present. Free arms unknown. Interprimibrachs restricted to one large 9-sided plate as wide as high, resting on the radial circlet and isolated from the tegmen. C–D interray with primanal in radial circlet supporting three secundanals with central one being markedly larger than laterals, isolated from tegmen or possibly connected by thin high plate. Tegmen high, possibly drawn out into tall vertical extension (anal tube?), consisting of large irregularly arranged polygonal plates.

REMARKS

Following the classification of Ubaghs (1978) this species is a monocyclic camerate with hexagonal basal circlet of three equal plates, with radials adjoining each other except for posterior primanal in same circlet, with quad-
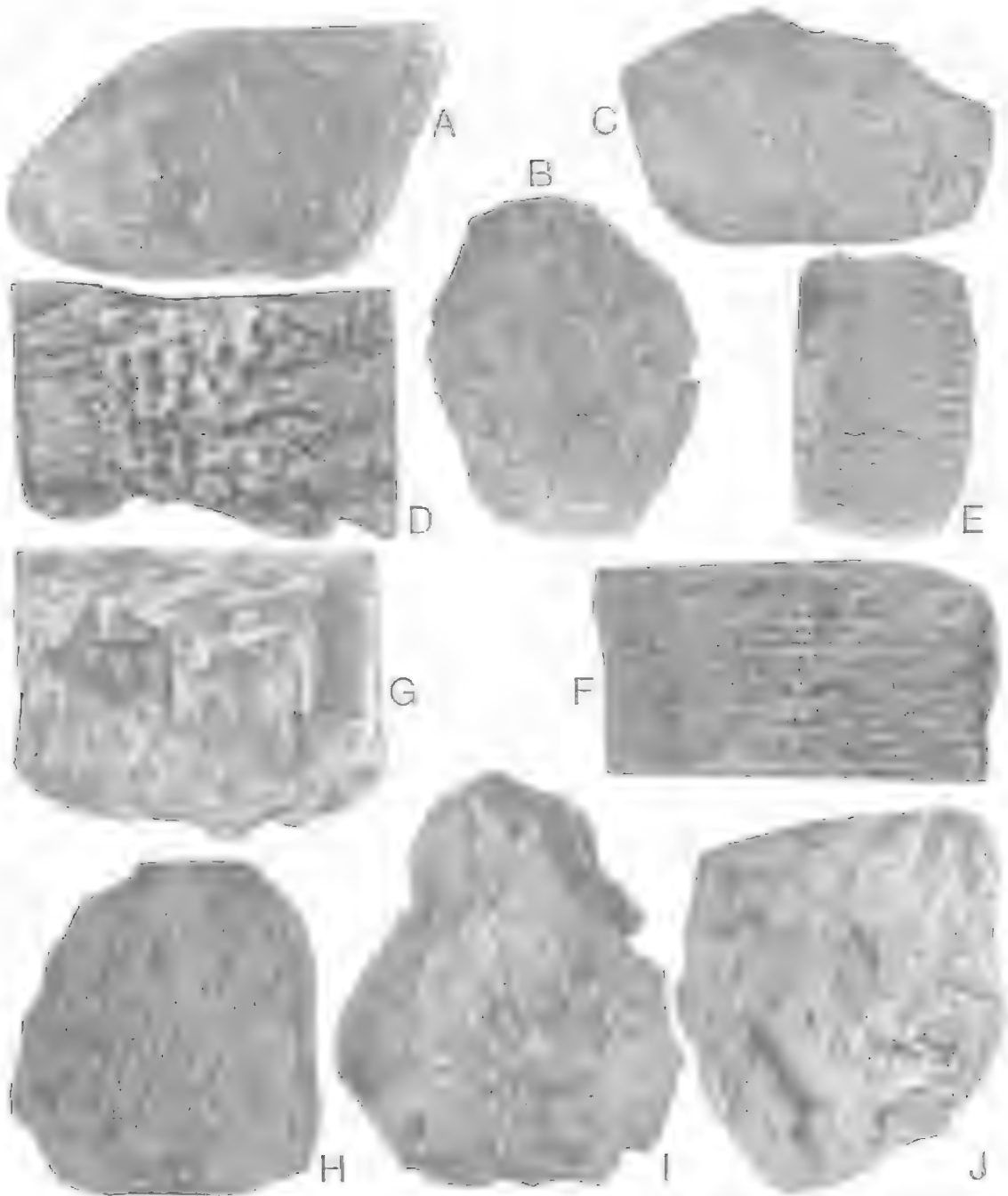
FIG. 7. A–F, Crinoid indet. 1. A–C, large calyx with few plates evident in two lateral and basal views (orientation uncertain), repectively, QMF14951, × 0.8. D–F, stem fragments in lateral view and variously weathered in D and F. QMF14954, 14952 and 14953, respectively, × 2. G–J, Carpocrinid indet. QMF14881, × 2. G, lateral view in C ray showing quadrate first primibrach and axillary second primibrach as well as almost vertical sides of calyx. H, lateral view in C–D interray showing hexagonal primanal in radial circlet supporting 3 secundanals whose margins are defined only by the margins of the single crystal structure of each plate. I, basal view with hexagonal basal circlet of 3 plates surrounded by radial circlet of 6 plates. J, lateral view in B ray showing some of smaller fixed brachials tending to biserial arrangement and possible development of 4 arms per ray.
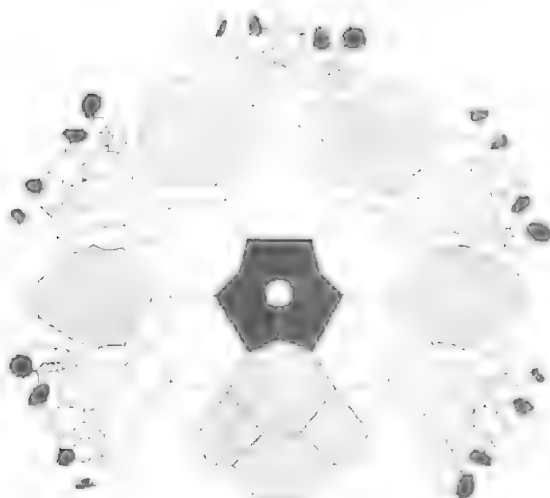
FIG. 8. Plate diagram of Carpocrinid indet.

rate first primibrach and 3 secundanals. This combination places it in the Carpocrinoidea. Within this superfamily this extremely poorly preserved specimen resembles most closely the Silurian *Desmidocrinus* of the Carpocrinidae; the single large interprimibrach, quadrate primibrach, 4 arms per ray, 2 fixed secundibrachs and fixed tertibrachs being significant. However, it is not assigned generically because of the poor understanding available from this specimen. It may be distinguished from *D. laurelianus* Springer, 1926 and *D. dubius* Springer, 1926 by its flatter bases, by its less transverse first primibrach and by its prominent single interprimibrach per interray. These two species from the Silurian Laurel Limestone at St Paul, Indiana, are the closest known forms to this Australian species but their separation in time and space suggests that they possibly represent different genera.

Struszocrinus gen. nov.

ETYMOLOGY

For Dr Des Strusz, Bureau of Mineral Resources, Canberra, for his extensive contribution to the stratigraphy and coral faunas of the Wellington District.

TYPE SPECIES

Struszocrinus dulciculus sp. nov. from the Garra Formation, Pragian, near Wellington, central New South Wales.

DIAGNOSIS

Carpocrinid with high bowl-shaped calyx; quadrate (rarely 5- or 6-sided) first primibrach; 4 to 7 ungrouped arms per ray; one secundibrach and, if present, one tertibrach per arm fixed in calyx; interprimibrachs 1 to 4 per interray not depressed and with a large 8-sided plate at the base resting on the radials; 2 or more usually 3 secundanals; 5 or 7 anal plates having a central anal column; tegmen of relatively few large plates; strong anal tube at least one third height of calyx.

DISCUSSION

The 2 major lineages of the Tanaocrinina that existed through the Devonian are the Periechocrinoidea and the Carpocrinoidea of Ubaghs (1978); the latter was referred to as the 'desmidocrinid section' by Moore & Laudon (1943, p. 86). The distinction between these two lineages is not always clear but Moore & Laudon (1943) explained the principal point as the early development of the quadrate first primibrach in the Carpocrinoidea. Ubaghs (1978, p. T443) noted in his diagnosis of the Periechocrinoidea that advanced members may have quadrangular first primibrachs. Ausich (1987) discussed the problems associated with distinction of these two superfamilies defining the Carpocrinoidea as a specialized lineage with reduced number of plates in the cups. As *Struszocrinus* has 4-, 5- and 6-sided first primibrachs this feature is not altogether definitive although the two latter forms are uncommon. Considering the normal form of this plate to be quadrate, because that is the shape it most commonly assumes with the extra sides as remnants from when interprimibrachs were smaller and more numerous, this Early Devonian form is assigned to the Carpocrinoidea. The free arm bases forming a distinct circlet just below the tegmen and anal tube suggest placement in the Batocrinidae but that family, first appearing and common in the Early Carboniferous contains no record of reduction in the number of secundanals, even in aberrant specimens. The single specimen of *S. dulciculus* with 2 secundanals may be considered aberrant. However, if this reduction has any significance then consideration must be given to the Periechocrinoidea where the Actinocrinitidae is a family that evolved apparently near the base of the Carboniferous with 2 secundanals in all its members. Moreover, Breimer (1962, p. 40) described an aberrant specimen of *Pyxidocrinus collensis* Breimer,

1962 (Periechocrinidae) with 2 secundanals in a species which otherwise always has three. The close similarity between *S. dulciculus* and the actinocrinitid *Cactocrinus proboscidialis* (Hall, 1858) particularly in having 4- and 6-sided first primibrachs in the same specimen (Ubaghs, 1978, fig. 266, 1b) must be noted. However, radiation of that family has been inferred from a common ancestry in the Early Carboniferous, probably through the Periechocrinidae and Eumorphocrininae Ubaghs, 1978 (Brower, 1967). Early Devonian *Struszocrinus* must therefore be considered a homeomorph of the highly evolved Carboniferous actinocrinitid *Cactocrinus*. Among Early Devonian periechocrinitids the combination of ungrouped arms, anal tube, large tegminal plates and quadrate first primibrachs is unknown and affinities must be denied.

This confusing combination of features makes our assignment uncertain until more of its close relatives are known. At present we consider *Struszocrinus* to be an advanced member of the Carpocrinidae. In its rare 5- and 6-sided but commonly 4-sided first primibrachs it presents the same sort of variation described by Ausich (1987) in his Llandoverian periechocrinids but the most usual quadrate shape suggests the Carpocrinoidea. Other features are consistent with this assignment as far as the family is known. *Struszocrinus* may well be ancestral to some if not all the Batocrinidae but that contention will depend on finding the members of such a lineage in the Middle and Late Devonian.

Struszocrinus dulciculus sp. nov.
(Figs 9, 10)

ETYMOLOGY

From the Latin diminutive of *dulcis* — sweet; the first specimen seen by the senior author was described by its collector as a 'little sweetie'.

MATERIAL EXAMINED

Holotype AMF72522, paratypes AMF72521, 72523 to 72528 and QMF14534 to 14535 all from QML512.

OCCURRENCE

Pragian (assumed *sulcatus* biozone), Garra Formation, near Wellington, central New South Wales.

DIAGNOSIS

As for genus.

DESCRIPTION

Calyx high, bowl-shaped with almost parallel sides just below the free arm bases and subhorizontal base; upto 20mm high excluding anal tube. Basal circlet barely visible in lateral view, of 3 equal plates separated by sutures in the B and E rays and the C–D interray, with small circular axial canal. Radial circlet of 3 hexagonal radials in A, C and D rays, two 7-sided radials in B and E rays and a 7-sided primanal; plates of this circlet largest in calyx, wider than high, all with horizontal upper surfaces; first primibrachs usually quadrate but in some individuals 5- or even 6-sided (Fig. 9A,J) in the A ray or the C and D rays (no pattern apparent), with convex margins, of variable height to width ratio but usually wider than high. Second primibrach axillary, wider than high, usually 5-sided but 6-sided or rarely 7-sided when in contact with upper interprimibrachs in any ray. Secundibrachs fixed, usually 1 rarely 2 in each half ray, axillary, usually 6-sided and wider than high. Tertibrachs usually only one or two fixed in calyx, first one often axillary (particularly inner one of each half ray); becoming wedge-shaped distally, apparently leading to biserial arms. Inter-secundibrachs not present. Interprimibrachs usually 2 or 3 per interray, rarely 4 or 5, one large plate at base with 8 or 9 sides followed above by one or more tiny plates; interprimibrachs isolated from tegmen by spread of fixed portions of arms. Large primanal higher than wide in radial circlet, but narrower than any radial; 3 secundanals in most specimens but only 2 in one specimen (Fig. 9D); a further row of 3 plates, the central one of which has high tapering central spire connecting with tegmen between arm bases; central column of anals tall and distinctive; total number of anal plates usually 5–7. Tegmen of large polygonal plates of gentle convexity almost half as high (excluding anal tube) as rest of calyx; five large orals medially, with C–D oral commonly strongly projecting; anal tube high but full extent unknown, situated subcentrally just posteriorly. Arm bases forming continuous circle around calyx interrupted only in C–D interray. Free arms and stem unknown.

REMARKS

Intraspecific variation is noted above in respect of shape of first primibrach and number of secundanals, and other variables include number of arms per ray, shape of secundibrachs,
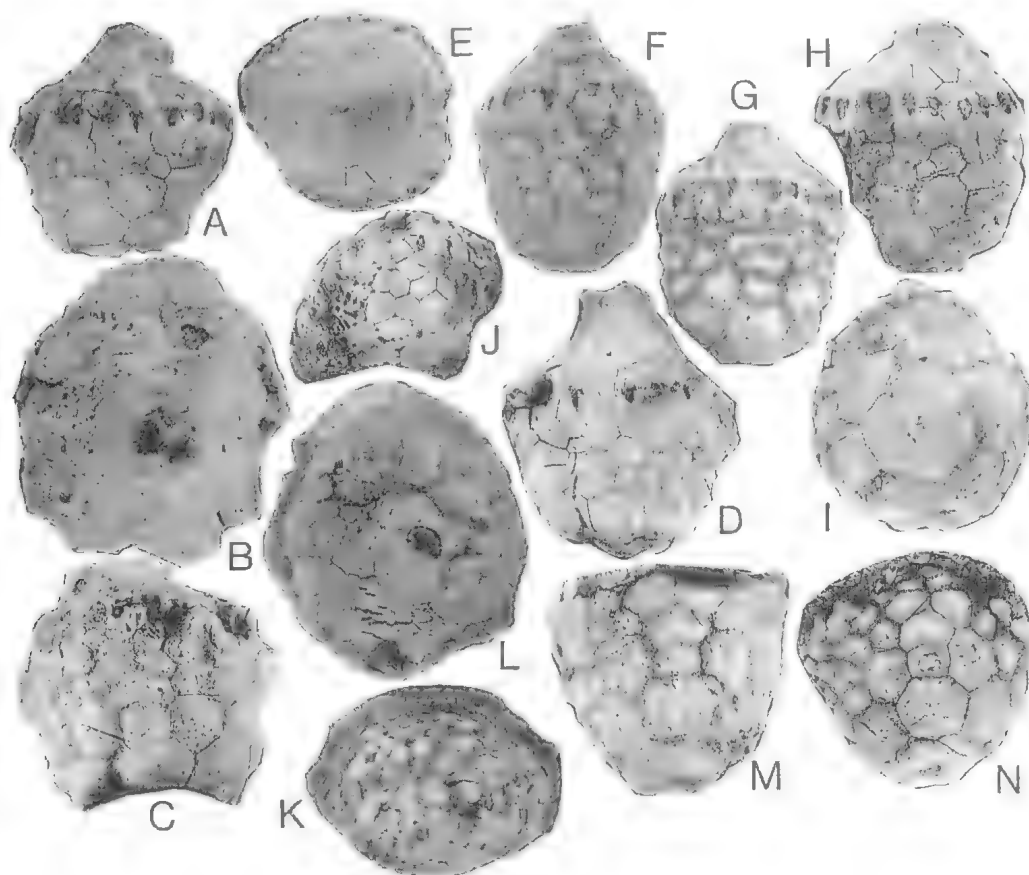
FIG. 9. *Struszocrinus dulciculus* gen. et sp. nov. all from QML512. A–D, AMF72522, × 1.5, × 2, × 1.8 and × 1.5 respectively. A, lateral view of A and E rays. B, tegmen showing fractured anal tube (A ray is at 12 o'clock). C, lateral view of B ray. D, lateral view of C–D interray showing hexagonal primibrach in radial circlet supporting 2 secundanals. E–I, Holotype, AMF72521, E and I × 2, F–H × 1.5. E, tegmen with A ray at 9 o'clock position. F, lateral view of C–D interray showing 3 secundanals resting on 7-sided primanal. G,H, lateral views of A ray and D–E interray respectively. I, basal view with A ray at 12 o'clock showing 3 equal basals and radial circlet of 6 plates. J,K, lateral and tegminal views of deformed calyx with D ray just right of centre and showing strongly convex plates of tegmen, AMF72526, × 2. L, small incomplete calyx in tegminal view with A ray at 12 o'clock, showing large tegminal plates, AMF72525, × 2.5. M, lateral view of incomplete calyx (orientation uncertain), AMF72527, × 2. N, lateral view of incomplete calyx in D ray showing an hexagonal second primibrach, QMF14543, × 1.5.

composition of tegmen, and general calical shape.

Superfamily Hexacrinitoidea
Family Hexacrinitidae Wachsmuth & Springer, 1885

Hexacrinites Austin & Austin, 1843

TYPE SPECIES

Platycrinus interscapularis Phillips, 1841 from the Middle Devonian of southern England.

Hexacrinites interscapularis Phillips, 1841
(Figs 11, 12G–M)

MATERIAL EXAMINED

Holotype Philips, 1841, pl. 14, fig. 39. Queensland Material UQF75119 from UQL4442; UQF75120–75123 from UQL4427; UQF75124 from UQL5228, UQF75125 from UQL5267; UQF75126 and 75127 from UQL5234; UQF75128 from UQL5317; UQF75129, 75130 and 75135–75138 from UQL5360; UQF75131, 75132 and QMF14597 from UQL5318; UQF75133 from UQL5227, UQF75134
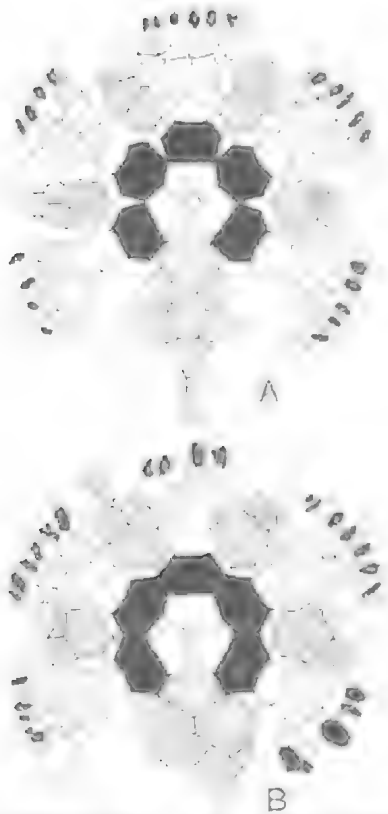
FIG. 10. Plate diagram of *Struszocrinus dulciculus* gen.
et sp. nov. A from AMF72521 and B from
AMF72522.

from UQL4745; QMFI4580 from UQL5305;
QMFI4594 and 14595 from UQL5252; QMFI4596.
14600. 14602 from UQL5356; QMFI4604 from
UQL5335; QMFI4743, 14745,14834, 14871, 14874
from UQL5321; QMFI4755, 14756, 14763 from
UQL5320; QMFI4843, 14845 from UQL5218;
QMFI4849 from UQL5267.

OCCURRENCE

Late Eifelian and Givetian, Papilio Forma-
tion, near Storm Dam, on Wando Vale Station,
north Queensland.

DESCRIPTION

Calyx high bowl-shaped with a subhorizontal
base and slender stem judging from diameter of
attachment area on base of calyx. Stem attach-
ment a concave circular area with distinct outer
rim and pierced centrally by extremely fine axial
canal (Fig.12H) but on slightly weathered speci-
mens this axial canal becomes distinctly tri-
angular (Fig.12G). Hexagonal basal circlet
divided

into three large equal plates by sutures in the B
and E rays and C–D interray. Large radial plates
standing almost vertically and becoming
slightly wider upwards; upper margin with rela-
tively wide lateral sections ascending medially,
then narrow horizontal sections either side of
the arm insertion. Arms not known except for
first three fixed brachials; first primibrach
usually low and narrow not in contact with
interbrachials at all, but in largest specimen
(Fig.12L) as high as second primibrach and
extending laterally to butt against first row of
interbrachials; second primibrach axillary,
usually higher than first and extending laterally
to first level of interbrachials; discrete, slender
axial canal penetrates the brachials and can be
seen to divide into the secundibrachs. Primanal
approximately same size as radials, hexagonal
supporting a pentagonal and an hexagonal plate
above and both are isolated from the arms by
high narrow plates resting on the C and D
radials. Interprimibrachs three in number with
hexagonal central one narrowing upwards and
lateral ones slightly excavated where they mar-
gin the arm. The tegmen is about half as high as
rest of calyx and is composed of relatively large
polygonal plates with some differentiation into
smaller plates in the five radial areas. Anal
opening on a distinct but low protrusion just
posterior to the centre of tegmen. Ornament on
all the calical plates of coarse tubercles which
become more numerous but less prominent
with growth.

DISCUSSION

This species has previously been described
from England and Germany. The Queensland
material is almost identical and we consider the
minor differences outlined below to be
intraspecific variation. The specimen illustrated
by Schultze (1867, pl. 8, fig. 5) from Kerpen,
Germany has its fourth primibrach axillary, has
a more convex base, more prominent ornament
and relatively larger tegminal plates. The Eng-
lish material has a more convex base. These dif-
ferences could not be considered of specific
significance.

One large specimen (Fig. 12I,J) exhibits an
extra plate of irregular outline and position on
the lower corner of the A radial. This plate is
5-sided with a pointed margin embayed into the
adjacent basal, with a broad groove running ver-
tically across one side of it and the two vertical
sides are not parallel. This plate can only
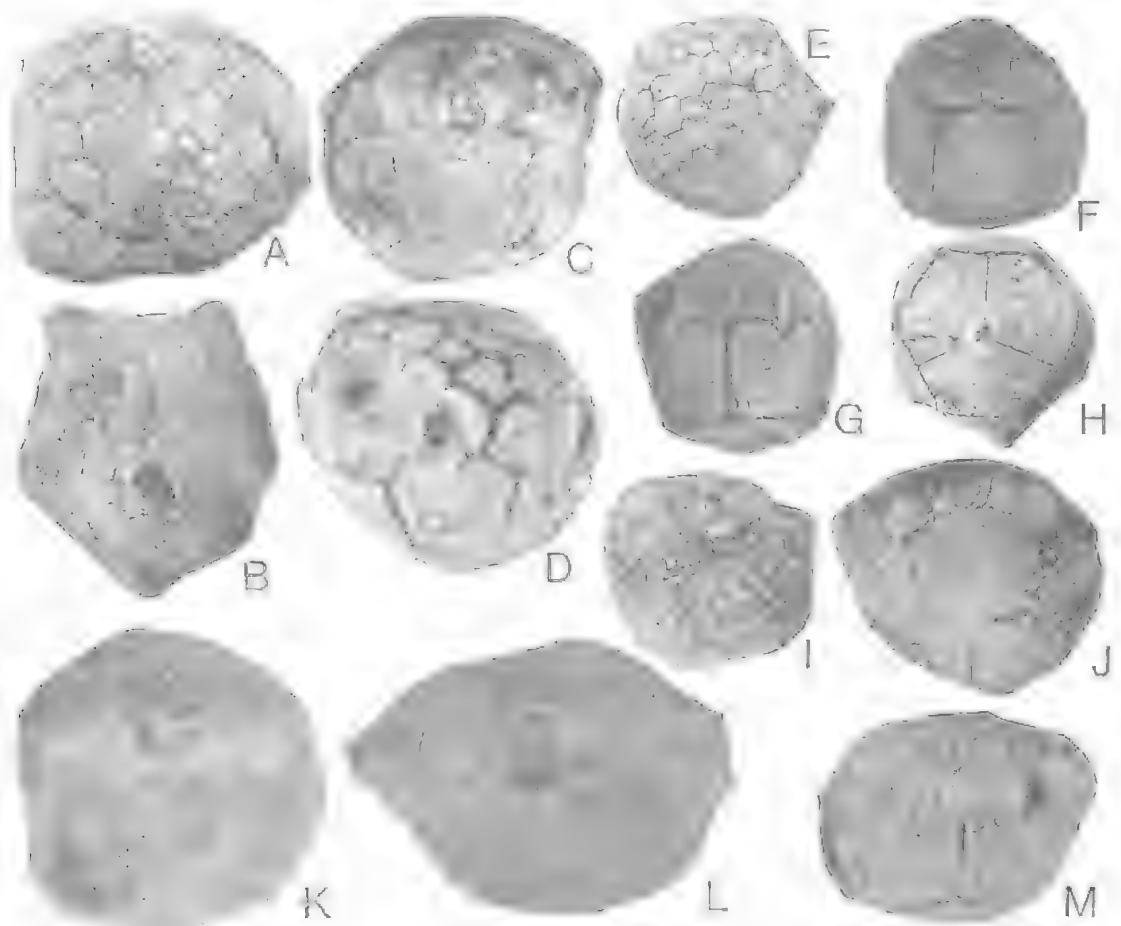
FIG. 11. *Hexacrinites interscapularis* Phillips, 1841. A, tegmen, incomplete on left side QMF14580, × 1. B,L, tegmen with A ray in 11 o'clock position and lateral view in E ray of large calyx UQF75128, × 1.5. C, lateral view in A ray UQF75130, × 1.5. D, oblique lateral view in C ray of small specimen UQF75121, × 1.5. E–H, tegminal with A ray in 3 o'clock position, lateral in C–D interray, lateral in A–E interray and basal (with A ray in 6 o'clock position) views of smoothed off calyx respectively, QMF14594, × 1. I, lateral view in B ray of small calyx showing well-developed ornament UQF75129, × 1. J, lateral view of small weathered specimen (orientation uncertain) UQF75123, × 1.5. K, lateral view in B ray of large calyx UQF75125, × 1. M, lateral view in A–E interray of small calyx UQF75120, × 1.5.

be interpreted as a reaction to some early damage to the individual that resulted in an extra growth centre albeit a small and irregular one.

Hexacrinites spinosus Muller, 1856
(Fig. 12A–F)

MATERIAL EXAMINED

Holotype Muller, 1856, pl. 1, fig. 13. Queensland Material UQF75110 from UQL5257; UQF75117 from UQL5317; QMF14746 from UQL5277.

OCCURRENCE

Givetian, Papilio Formation, near Storm Dam, on Wando Vale Station, north Queensland.

DESCRIPTION

Calyx bowl-shaped of medium height with strongly convex base. Basal circlet hexagonal, of 3 equal plates, with moderately large stem attachment area relative to size of plates. Radial plates large, parallel-sided to slightly expanding upwards, with horizontal lower margin and upper margin rising from lateral corners only a
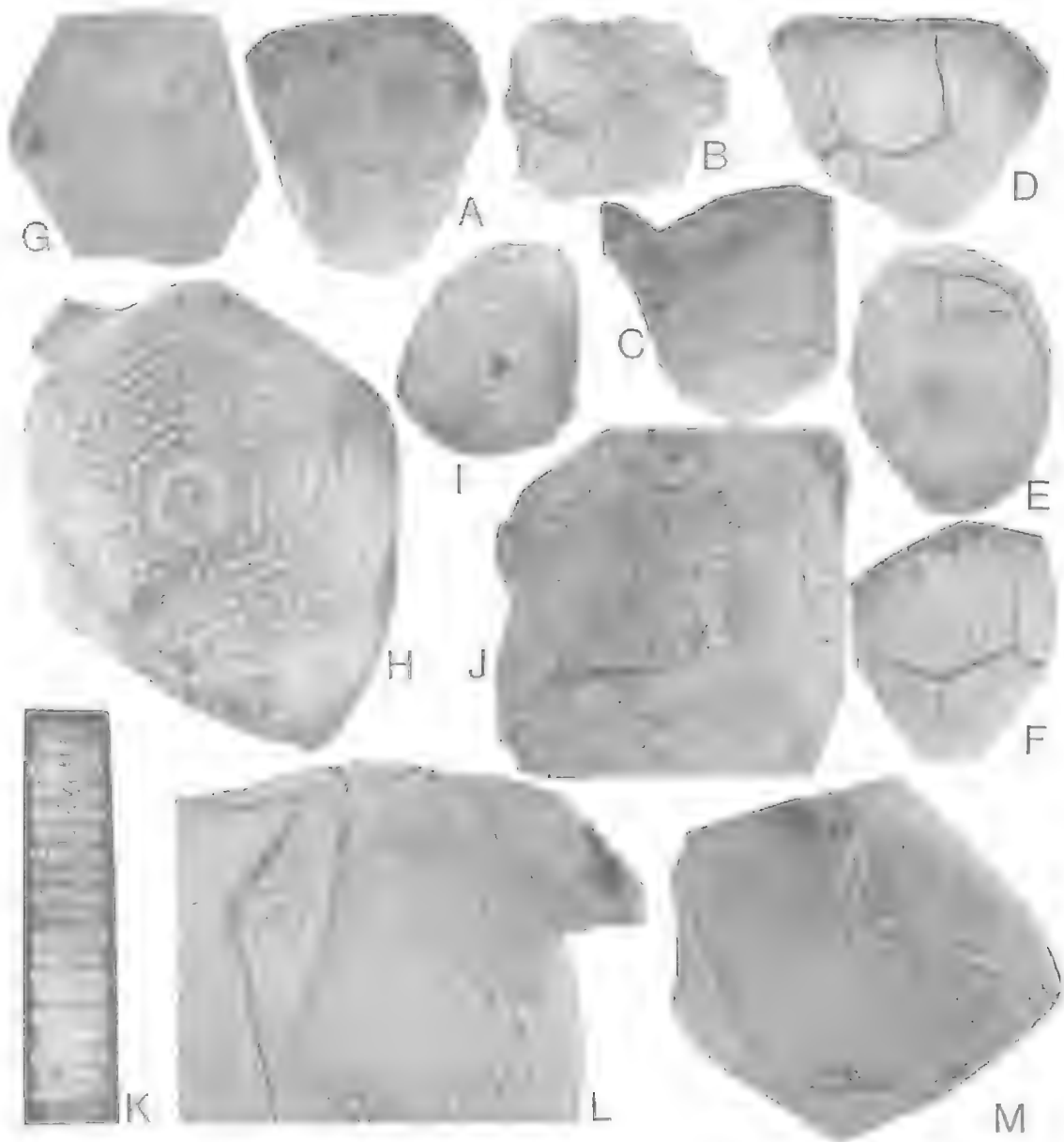
FIG. 12A–F, *Hexacrinites spinosus* Muller 1856. A,B, lateral in C– D interray and tegminal (with A ray in 3 o'clock position) views UQF75110, × 1.1. C, lateral view of incomplete calyx UQF75117, × 1. D–F, lateral, basal and lateral views, respectively, of incomplete calyx (orientation uncertain) QMF14746, × 1.8. G–M, *Hexacrinites interscapularis* Phillips, 1841. G, basal view of weathered calyx showing triangular section of axial canal towards inner surface of basal plates QMF14755, × 2. H, basal view of unweathered calyx with C ray in 11 o'clock position, showing very small axial canal and prominent rim around stem attachment area QMF14763, × 1.5. I,J, Basal with A ray in 12 o'clock position and lateral (A ray) views respectively, of large calyx with aberrant plate on lower right corner of radial UQF75125, × 0.75 and × 2, respectively. K, length of stem UQF75168. × 1.5. L,M, lateral view of free B ray arm base and lateral view of radial plate to which it is attached, respectively, QMF14834, × 2.

short distance to relatively wide arm insertion.
First primibrach axillary, low, extending lat-
erally to butt against interprimibrach. First
secundibrachs (as a pair) of similar dimensions
to first. Remainder of arms unknown. Primanal
similar in size to radial, but slightly narrower,
with broad V-shaped lower margin and irregular
upper margin suporting 5 or 6 tegminal plates. A
single large interbrachial rests on the radial circ-
let in each of the other interradii and is marginal
to the two adjacent arms and 5 or 6 smaller
tegminal plates. Tegmen convex, equal in height
to radial circlet, of numerous relatively large
plates, with a central pinnacle and depressed
anal opening well posterior not far from margin
in oral view. Ornament on plates of irregular
tubercles commonly elongate on radials to give
a maze pattern.

DISCUSSION
    This material is closely comparable with the
German species in distinctive features such as
tegminal plating (cf. Schultze, 1867, pl. 8, fig.
2f) (Fig. 12B), basal arm branching, calycal
shape, position of anal opening and ornament.
No differences have been observed.

Suborder Glyptocrinina
Superfamily Melocrinitoidea
Family Melocrinitidae d'Orbigny, 1852

Melocrinites Goldfuss, 1831

TYPE SPECIES
    Melocrinites heiroglyphicus Goldfuss, 1831
by subsequent designation of Roemer, 1855
from the Late Devonian of western Europe.

DISCUSSION
    We follow Kesling (1964) in considering
Ctenocrinus Bronn, 1840 to be a synonym of
Melocrinites. At the same time we acknowledge
that the presence or absence of outer rami on
each ray (probably first outer ramule fixed in
cup) allows most specimens of this group to be
separated into two readily recognizable groups.
Such subdivisions may be useful in discussions
of evolutionary trends (e.g. Brower, 1976) and
at best may be considered subgenera at the pre-
sent time. In terms of this subdivision the north
Queensland species would be assigned to

Melocrinites whereas that from Wellington
would belong to *Ctenocrinus*.

Melocrinites tempestus sp. nov.
(Figs 13A–H, 14A)

ETYMOLOGY
    From Latin *tempestas* — a storm; for Storm
Dam adjacent to the type locality.

MATERIAL EXAMINED
    Holotype QMF14844 a complete calyx from
UQL5218. Paratypes UQF75108, an incomplete
calyx from UQL4443, and QMF14853 and 14854
from UQL5318/69.

OCCURRENCE
    Givetian, Papilio Formation, near Storm
Dam,   Wando   Vale   Station,   north
Queensland.

DIAGNOSIS
    Member of *Melocrinites* with tall conical
calyx having ornament of widely spaced, low
tubercles on calical plates; tall radial and
primibrach   plates;   high   narrow   first
secundibrach relative to wide low second
secundibrach; flat tegmen and high narrow arms
widely separated from each other.

DESCRIPTION
    Calyx tall, conical, with convex base, less than
25mm in greatest diameter and almost 30mm in
height; surface of plates flat except for narrow
marginal band that descends to suture and
smooth except for inconspicuous ornament of
large, low, widely spaced tubercles.
    Basal circlet of 4 plates, with interplate
sutures in A, C, D and E rays, of at least 4mm
height. Radial circlet of 5, large, contiguous
plates, 9mm high and 8mm wide at the widest
point 3mm from the top, with 7 sides including
horizontal upper margin and broadly chevron
shaped basal margin. First primibrach 6-sided,
with horizontal upper and lower margins, 7mm
high by 6mm at greatest width near midheight.
Second primibrach axillary, 7-sided, 4mm high
and 4mm wide each at greatest extent of that
dimension. First secundibrach high but narrow
relative to succeeding secundibrachs which
become progressively lower, remain uniserial,
but fuse with the other arm of the same ray to
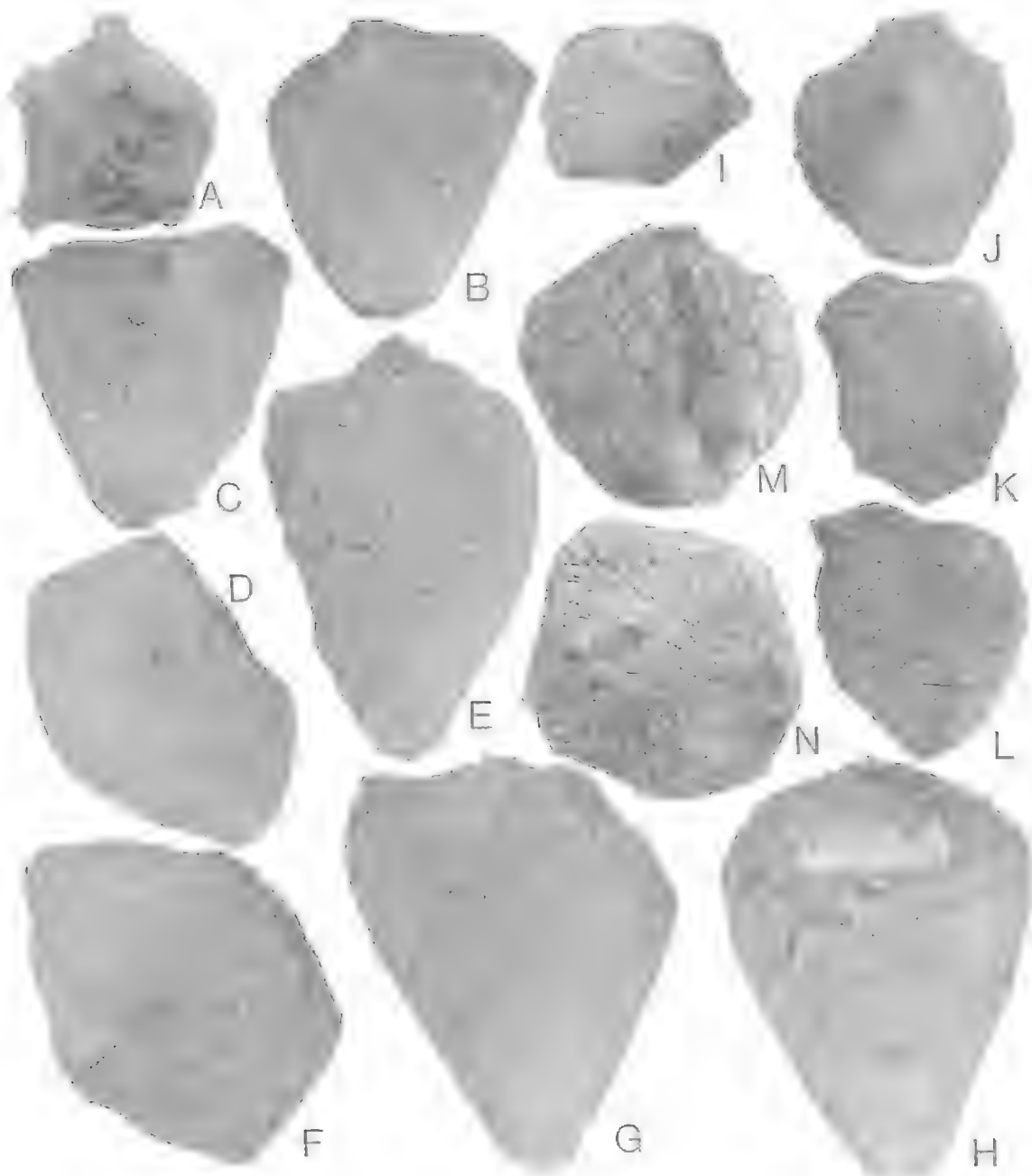
Fig. 13A–H, *Melocrinites tempestus* sp. nov. A–C, tegminal view with A ray in 12 o'clock position and two lateral views of A–E interray and A ray respectively on paratype UQF75108, × 1, × 1.8 and × 1.8, respectively. D–G, holotype in basal with A ray in 1 o'clock position, lateral D ray, tegminal with D ray at 10 o'clock and lateral (C–D interray) views, respectively, QMF14844, × 2. H, lateral view of paratype in C–D interray QMF14854, × 2. I–L, *Melocrinites solus* sp. nov. I–L, tegminal with A ray at 10 o'clock position, lateral C ray, lateral oblique A–B interray and lateral A–B interray views respectively of holotype AMF72519, × 1.2. M,N, lateral C ray and tegminal with D ray at 10 o'clock position views respectively, of paratype AMF72520, × 1.5.
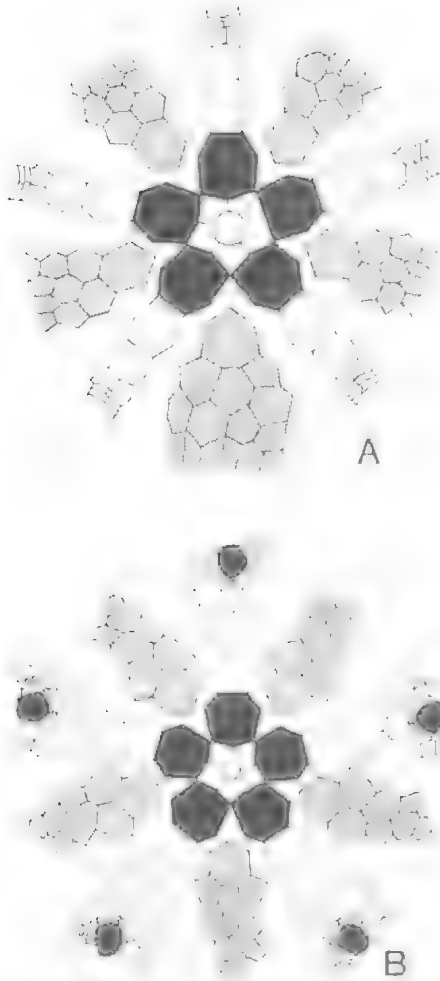
FIG. 14. Plate diagrams of A, *Melocrinites tempestus* sp. nov. and B, *Melocrinites solus* sp. nov.

form a single biserial ray trunk. Free arms not preserved but proximal portion high (7mm) and narrow (4mm) compared to other species of the genus. Intersecundibrachs not present. Interprimibrachs of a single large (7mm high by 6mm wide) plate at base, succeeded by 2 plates in the second range, then 3 in the third, and 4 in the fourth. Primanal 7-sided, supporting 3 secundanals then a larger number of irregular plates above. Tegmen almost flat, anal opening not evident.

REMARKS

This species resembles *M. aequus* Schmidt, 1942 from the Middle Devonian of Germany and *M. bainbridgensis* (Hall & Whitfield, 1875)

from the Middle Devonian of New York and Ohio, but differs from the former in ornament on plates, relative height of primibrachs, and number and arrangement of upper interprimibrachs and differs from the latter in the shape of primibrachs.

Melocrinites solus sp. nov.
(Figs 13I–L, 14B)

ETYMOLOGY
From Latin *solus* — alone; referring to single large intersecundibrach in each ray.

MATERIAL EXAMINED
Holotype AMF72519 and paratype AMF72520 from QML512.

OCCURRENCE
Pragian (*sulcatus* biozone), Garra Formation, near Wellington, central New South Wales.

DIAGNOSIS
Member of *Melocrinites* with median ray ridges extremely poorly defined as broadly angular corners to calyx; smooth but convex calical plates; a single large intersecundibrach in each ray; small outer arms in each ray fixed in calyx for their basal part; single large intertertibrach; small number of interprimibrachs (5–7); 3 secundanals; flat tegmen except for a fairly high anal pyramid situated almost centrally.

DESCRIPTION
Calyx of medium height, conical, with convex base, 15% higher than wide; surface of plates smooth, gently convex, with median ray ridges poorly developed and evident only as five broadly angular corners to calyx. Basal circlet of 4 plates, with interplate sutures in A, B, C and E rays, with basals evident laterally and almost vertical. Radials in contact laterally, 7-sided, as high as wide, with two lower sides at extremely large angle to each other and upper margin horizontal; first primibrach hexagonal, slightly wider than high, with greatest width near top; second primibrach pentagonal, axillary, with barely convex sutural margins. Secundibrachs 2 in each arm, hexagonal but somewhat variable in shape from arm to arm, with single, large, hexagonal intersecundibrach between upper axillary ones. Tertibrachs of inner arms low and wide, strongly in contact above intersecundibrach and presumably extending

through free arm giving a biserial appearance; in outer arms of each ray tertibrachs smaller but more or less equidimensional, 2 or 3 per arm, separated from main inner arm by 1 or 2 relatively large intertertibrachs. Interprimibrachs fewer than 10 per interray, with single hexagonal plate at bottom of each interray resting on two radials, followed above by 3 rows of 2 plates each that are 6- or 7-sided, usually a single narrow plate if any at all between free arm bases. C–D interray with single large 7-sided primanal resting on two radials, with 3 secundanals and succeeding rows decreasing (3,2,1) upwards. Tegmen of relatively large polygonal plates irregularly arranged and only gently convex, with prominent anal tube rising strongly and situated just behind centre. Free arms and stem unknown.

REMARKS

Almost all taxa previously described as *Ctenocrinus* are distinguished from *M. solus* in exhibiting some form of stellate ornament and/or median ray ridges on calical plates. The smooth species *C. rhenanus* Follmann, 1887 may be distinguished by its lack of intersecundibrachs. *Ctenocrinus loricatus* Schmidt, 1942 has very small intersecundibrachs and has depressed corners on its calical plates. Another smooth specimen was figured by Wachsmuth & Springer (1897, pl. 23, fig. 5) as *Melocrinites bainbridgensis* but it was later assigned to *Melocrinites clarkei* Goldring, 1923 (Bassler & Moodey, 1943); it may be distinguished by its large intersecundibrach.

Superfamily Eucalyptocrinitoidea
Family Eucalyptocrinitidae Roemer, 1855

Eucalyptocrinites Goldfuss, 1831

TYPE SPECIES
Eucalyptocrinites rosaceus Goldfuss, 1831 from the Eifelian of Germany by original designation.

DIAGNOSIS
See Ubaghs (1978, p.495).

DISCUSSION
Eucalyptocrinites is diverse and common in the Silurian of Europe and North America (Bassler & Moody, 1943; Webster, 1973, 1977) but only the type species from Germany and a

species from USSR have been described from the Northern Hemisphere Devonian. Philip (1961) described the first species from the Southern Hemisphere among the crinoids of the Emsian Toongabbie Limestone of Victoria. The genus seems to be widespread in the early Devonian of eastern Australia despite the small number of identifiable specimens which is apparently due to poor preservation and/or lack of collecting effort. For example Griffith's Quarry near Mansfield yields a massive crinoidal limestone which never fractures around the specimen but many very tall crowns are broken through and several specimens in collections of the Museum of Victoria almost certainly belong to *E. fonzi* sp. nov.; George Sweet's specimen, the holotype, may be taken to be an extremely lucky break perhaps from a part of the quarry being worked at the time, 80 years ago, and subsequently filled in or totally removed.

Reduction in the number of primibrachs from 2 to 1 (Witzke & Strimple, 1981) occurred during the history of the family. Those authors also suggested that this trend recurred several times in allied lineages. *Chicagocrinus* Weller, 1900 exemplifies one such lineage in the Silurian Racine Dolomite of the Chicago District in which the first primibrach is lost and the second greatly reduced. Interestingly, an associated species of *Eucalyptocrinites* (i.e. *E. depressus* Miller, 1880) has low first primibrach which might be expected to occur before the plate was lost altogether. A second example of this trend is in *Eucalyptocrinites* itself where *E. schultzei* sp. nov. and *E. fonzi* sp. nov. have both lost the first primibrach, but the second is in no way diminished.

The original description of *E. rosaceus* (Goldfuss, 1831, p. 214, pl. 64, fig. 7a–c) involved illustration of only one calyx which exhibits a low first primibrach and an axillary second primibrach. Subsequently, Schultze (1867) assigned specimens with a single large axillary primibrach sitting on each radial to the type species, *E. rosaceus*. One of these specimens has now become the standard illustration for the type species and indeed for the genus (see Ubaghs, 1978, fig. 299, 1a). The collection of specimens from New South Wales, here referred to *E. rosaceus* consistently exhibits 2 primibrachs with the first being quite low. On the other hand the specimen referred to *E. praerosaceus* Yakovlev, from north Queensland, although only a single representative, does have
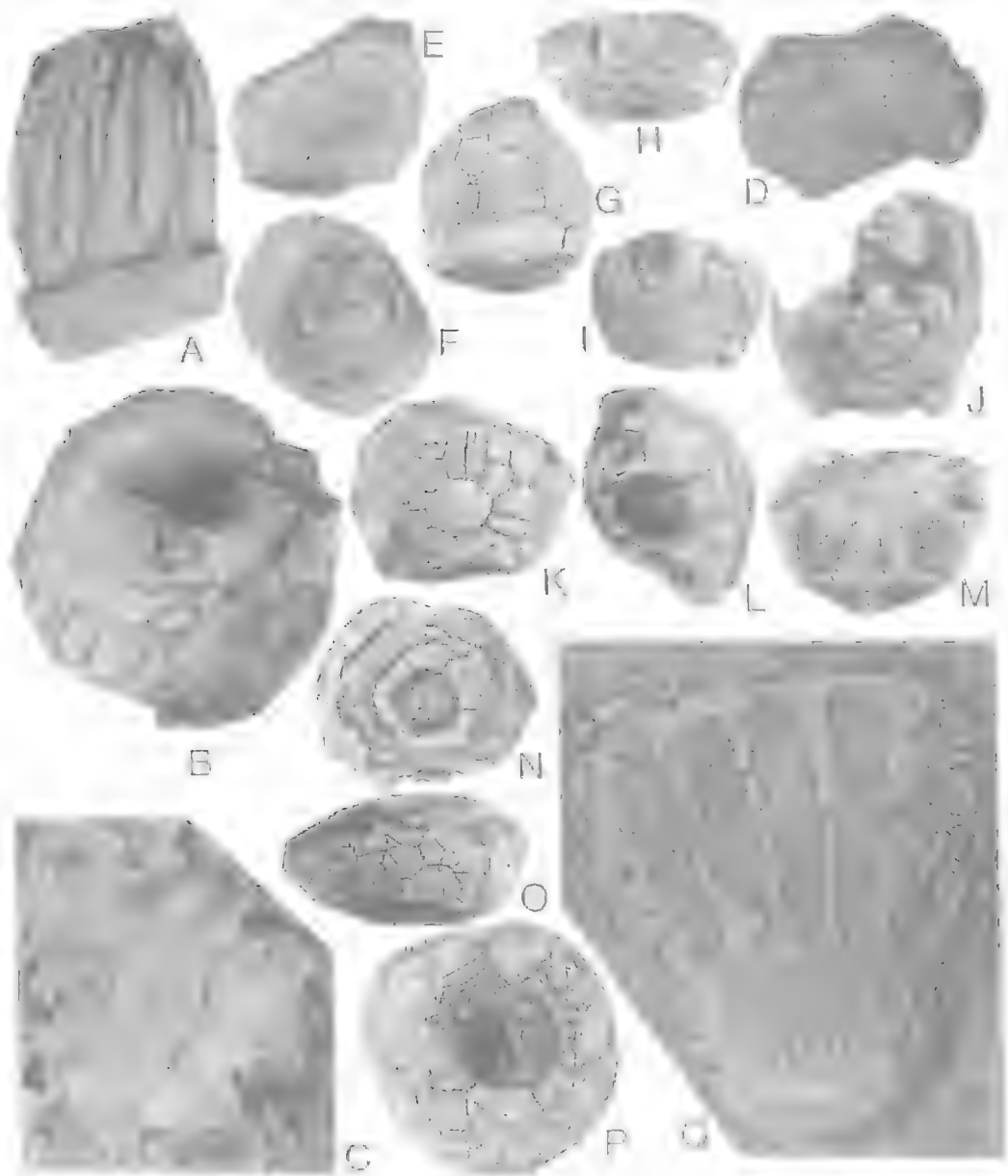
FIG. 15A–C, *Eucalyptocrinites fonzi* sp. nov. Holotype, NMVP109171, × 1.5. A, lateral view. B, basal view showing deep basal cavity and interprimibrach extending well down into basal depression. C, top of crown showing 6 plates centrally surrounded by upper surface of 10 tall columnal plates. D, *Eucalyptocrinites praerosaceus* Yakovlev, 1940 showing broad basal depression and plate margins difficult to distinguish from cleavage planes UQF75109, × 1.5. E–Q, *Eucalyptocrinites rosaceus* Goldfuss, 1831. E–G, lateral basal and lateral views respectively, QMF14546, × 1.5. H, lateral view of broad low calyx AMF72550, × 1.5. I,J, lateral views of weathered calyx AMF72546, × 1.5. K, lateral view AMF72552, × 1.5. L, basal view showing radials descending into basal depression AMF72553, × 1.5. M, naturally weathered vertical section of calyx showing height of basal depression and thickness of plates QMF14548, × 1.5. N, naturally weathered transverse section showing 5 radials on walls of basal depression AMF72549, × 1.5. O,P, lateral and basal views of low flaring calyx AMF72554, x1.5. Q, naturally weathered section through whole crown showing elongate vertical alcoves accommodating the free arms QMF14533, × 1.5.

only the single axillary primibrach. These observations lead us to the conclusion that the loss of the first primibrach is an evolutionary step that involved development of a separate species. The two species were apparently geographically isolated in Australia during the Pragian but sympatric in Germany during the Eifelian.

Eucalyptocrinites rosaceus Goldfuss, 1831
(Figs 15E–Q, 16A)

Eucalyptocrinites rosaceus Goldfuss, 1831, p. 214, pl. 64, fig. 7.
Eucalyptocrinites rosaceus Goldfuss; Schultze, 1867, p. 202, pl. 11, figs 6, 7 (not figs 1–5).

MATERIAL EXAMINED
Holotype Goldfuss, 1831, pl. 64, fig. 7. Other figured material includes Schultze, 1867, pl. 11, figs 5–7. Australian material assigned includes AMF72543–72550 and 72552–72554 and QMF14533, 14541, 14544, 14546, 14548, from QML512.

AUSTRALIAN OCCURRENCE
Pragian (*sulcatus* biozone), Garra Formation, near Wellington, central New South Wales.

DIAGNOSIS
Member of *Eucalyptocrinites* with most of radial plates in basal depression; upper suture on radial arcuate and concave; first primibrach a low wide rectangular plate; second primibrach large and axillary; single tall intersecundibrach present; arms housed in alcoves separated by pillar-like plates rising above interprimibrachs and intersecundibrachs; upper plates with flattened upper surfaces.

DESCRIPTION
Calyx of medium height, cone-shaped, with depressed base, approximately 20mm in diameter and 12mm high. Basal depression relatively small, of only 6mm diameter; full depth not exposed. On holotype sides of the calyx stand up steeply whereas on AMF72554 the calyx flares out to lowest tertibrachs. Radials with much of plate outside basal depression, with widest point (12mm) relatively high on plate and on side of calyx, with curved concave upper margin. First primibrach 7mm wide by 1 or 2mm high, with concave lateral and lower margins and horizontal upper margin, usually subrectangular but
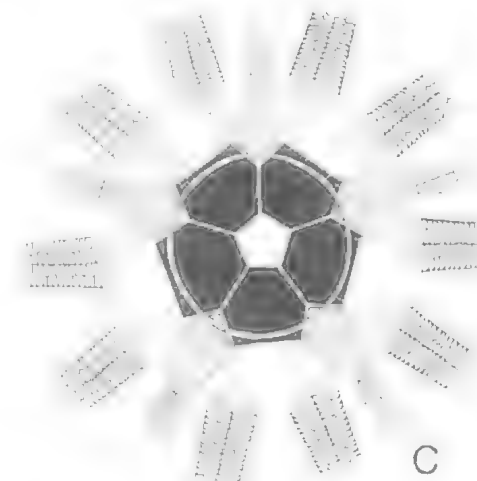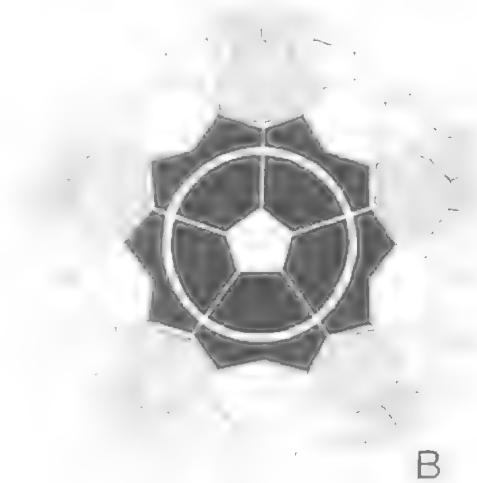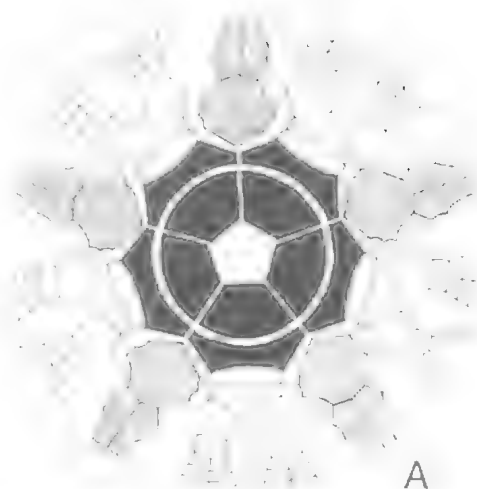

FIG. 16. Plate diagrams of A, *Eucalyptocrinites rosaceus*, B, *E. praerosaceus* and C, *E. fonzi*.

often irregular in shape with height on one side often decreasing to almost nothing. Second primibrach axillary, hexagonal, wider than high (6mm by 4mm in holotype), with horizontal upper margin supporting high large intersecundibrach that reaches same height as second row of interprimibrachs, with other two upper sides concave and supporting pentagonal first secundibrachs that are wider than high. Second secundibrach rectangular, axillary and each supporting a pair of quadrate tertibrachs. Interprimibrachs beginning with 10-sided plate of variable size but up to 7mm wide by 6mm high, with some concave sutural edges especially against first secundibrachs, and supporting pair of large high plates above. Second row of interprimibrachs at least 6mm high, 6-sided, with central vertical plane of symmetry between the two, forming a deep alcove with the intersecundibrach for the lower tertibrachs.

Higher parts of crown and all stem unknown.

Eucalyptocrinites praerosaceus
Yakovlev, 1940
(Figs 15D, 16B)

Eucalyptocrinites rosaceus Goldfuss; Schultze, 1867, pl. 11, figs 1, 2, 2a (not figs 5–7).
Eucalyptocrinites praerosaceus Yakovlev, 1940, p. 193.
Eucalyptocrinites rosaceus Goldfuss; Moore & Laudon, 1943, p.
Eucalyptocrinites rosaceus Goldfuss; Ubaghs, 1978, fig. 299, 1a–c.

MATERIAL EXAMINED
Holotype Yakovlev, 1940, fig. 1. One fragment of a calyx, UQF75109 from UQL3574.

AUSTRALIAN OCCURRENCE
Pragian (*sulcatus* biozone), Shield Creek Formation, near Old Pandanus Creek Homestead, north Queensland.

DIAGNOSIS
Member of *Eucalyptocrinites* resembling type species but with single axillary primibrach.

DESCRIPTION
Basal depression 5mm deep and 12–14mm in diameter with maximum diameter of calyx at level of top of radial circlet approximately 24mm. Basals not evident. Radials in contact with each other around lower part of calyx; part of radial evident laterally, having six sides,

supporting first primibrach centrally and lowest interprimibrach in conjunction with adjoining radial; 7.5mm wide at widest point and 2mm high above base. First primibrach 4.2mm high and 5.5mm wide, 7-sided, with broad base, axillary, supporting two arms and large intersecundibrach; first secundibrach pentagonal, 4mm wide by 3.5mm high, with horizontal upper margin supporting low (1mm high) wide secundibrach nestled between tall large interprimibrachs and the large intersecundibrach. First interprimibrach 6mm wide and 5mm high, not extending into basal depression, 8-sided, supporting two very thick high plates above. Stem and higher parts of crown not available.

REMARKS
This one incomplete fragment of a calyx resembles *E. praerosaceus* in all observable features including the position of the radial plates extending well into the basal depression, relative sizes and shapes of calical plates and the first primibrach being axillary. However, the depth of the basal depression is proportionally greater in European material (see Schultze, 1867, pl. 11, fig. 2) where the deepest part is higher than the secundibrachs whereas in the Queensland specimen it is much lower; calical plates in previously described material are convex with broad low tubercles on most specimens whereas the Queensland specimen has smooth plates that may be so through weathering; and the features of the upper arms etc. are not known on the Queensland specimen. With these reservations and in the belief that the depth of the basal depression may vary within the species we make tentative assignment to the Eurasian species. It should be noted that occurrences of this species are of comparable age.

Eucalyptocrinites fonzi sp. nov.
(Figs 15A–C, 16C)

ETYMOLOGY
For Alphonse H.M. Vandenberg, of the Geological Survey of Victoria, who first guided the senior author to the Loyola Limestone.

MATERIAL EXAMINED
Holotype NMVP109171A and B, part and counterpart of a complete crown that is tectonically distorted, fractured and not fully freed from matrix. It was

collected by George Sweet from Griffith's Quarry near Mansfield, Victoria.

OCCURRENCE

Pragian (*kindlei* biozone), Loyola Limestone lens of the Norton Gully Sandstone, southwest of Mansfield, central Victoria.

DIAGNOSIS

Member of *Eucalyptocrinites* with its first interprimibrach extending well into the basal depression, with hexagonal and axillary first primibrach and with five anal plates centrally on the upper surface of the crown and one accessory anal plate inside the circlet of 10 flattened tops to the pillar-like plates between the arms.

DESCRIPTION

Crown approximately 35–40mm high and 25mm in diameter. Calyx of medium height (8mm), conical with strongly depressed base. Basal depression wide, more than 12mm in diameter, of greater depth than height of calyx. Radials situated almost entirely within basal depression, having horizontal upper sutural margin barely on outer side of basal rim. First primibrach 7mm wide and 6mm high, hexagonal, axillary, bearing large intersecundibrach centrally and two pentagonal secundibrachs each supporting a curved second secundibrach on the concave upper margin. Second secundibrach axillary, extremely low and wide, set into slightly depressed alcove and broadly arcuate in shape. Arms becoming biserial above first tertibrach, tapering only gently, set into alcoves formed by tall pillar-like plates extending up from intersecundibrach and from interprimibrachs. These tall plates expand again distally to complete alcoves and then are capped by more or less flat plates in a circlet of ten surrounding six anal plates on distal end of crown. Anal plates in circlet of 4 hexagonal and one 7-sided plate surrounding central opening as well as a single pentagonal plate at the outer edge of the central circlet. First interprimibrach extending well into basal depression with its basal tip, hexagonal and relatively large, supporting pair of very high plates in second row which in turn support pillar-like plates extending to the top of the crown.

REMARKS

Size of the basal depression, extension of first interprimibrach into basal depression, axillary first primibrach, single tertibrach and six anal plates, provide a unique combination of features among known species of the genus with none being closely comparable. The general plate arrangement is, however, consistent with that for the rest of the genus particularly the housing for the arms and upper surface of crown.

Superfamily Dolatocrinoidea

This superfamily, used by Ubaghs (1953, p. 742), includes the group of families that evolved from the Patelliocrinoidea and retained the three basal plates. We suggest that three families are involved and that the Pandanocrinidae gave rise to both the Polypeltidae and the Dolatocrinidae with development of different morphologies.

Family Polypeltidae Angelin, 1878

Polypeltid indet.
(Figs 19P, 20)

MATERIAL EXAMINED

NMVP120789, a badly crushed and weathered calyx from NMVPL1958.

OCCURRENCE

Pragian, Garra Formation, near Wellington, central New South Wales.

DISCUSSION

The calyx is apparently bowl-shaped, with 10 free arms and only plates of upper part of calyx and tegmen evident on one side. Base of calyx is not evident upto axillary primibrach and interpretation of higher plates is open to two interpretations. There may be two columns of intersecundibrachs with lowest plate of each resting directly on axillary primibrach. Such an arrangement is rare and hence considered unlikely in this case. The other possibility is that the fixed secundibrachs are biserial, except for the first uniserial one, and there are no intersecundibrachs. Interprimibrachs are numerous, relatively small, in rows of 3 or 4 and upto 25 per interray. The tegmen consists of numerous irregular polygonal plates, apparently flat or slightly depressed. Free arms, stem and anal opening are not evident.

AFFINITY

These features suggest some resemblance to the Polypeltidae in respect of the fixed secundibrachs being numerous and going from uniserial to biserial, many interprimibrachs

connecting to tegmen and few intersecundibrachs also connecting to tegmen. In particular the Early Devonian Spanish *Trybliocrinus* Geinitz, 1869 has a single uniserial secundibrach then biserial secundibrachs above and has many interprimibrachs. This Australian individual is distinguished from *Trybliocrinus* by its very few intersecundibrachs and large, apparently 7-sided, axillary primibrach. Although no other affinity is immediately apparent for this individual, its assignment to the Polypeltidae is speculative given the paucity of its diagnostic features.

Family Pandanocrinidae nov.

DIAGNOSIS

Large camerate crinoids with arms free from early in secondary or tertiary brachitaxis (i.e. long series of secundibrachs or tertibrachs not fixed in cup), with hexagonal first primibrach, with relatively small numbers of interprimibrachs (i.e. upto 12), with no more than 5 or 6 intersecundibrachs if any at all, with 3 secundanals in C–D interray.

DISCUSSION

We herein suggest that *Pandanocrinus* may be ancestral to both the Polypeltidae and Dolatocrinidae and that the combination of features above sets it apart from each at the family level; a few other crinoids are tentatively assigned to the family.

Indicating that these three families might be closely associated are general calical shape and size, 3 unequal basals, biserial arms (numbering 10 in at least some, usually the older, members), somewhat similar plate ornament in at least some members and other features shared by Pandanocrinidae and Dolatocrinidae on the one hand and Pandanocrinidae and Polypeltidae on the other.

Understanding the origin of this group depends on the concept of the Patelliocrinoidea which is not very clear at present (Witzke & Strimple, 1981; Ausich, 1985). However, we do suggest that the Pandanocrinidae evolved from some member of the Patelliocrinidae probably in the Early or Middle Silurian.

From the Pandanocrinidae one lineage leads to the Polypeltidae attended by great increase in the number of fixed calical plates particularly in the brachials and interbrachials, by retention of the hexagonal first primibrach and differentiated C–D interray with three secundanals. The second lineage from the Pandanocrinidae leads to the Dolatocrinidae with development of the quadrate first primibrach and undifferentiated C–D interray in the species of *Dolatocrinus* itself (most other members of the family retain the differentiated anal interray) and retention or slight decrease in the number of calical plates and cup shape.

Some species at present assigned to *Technocrinus* Hall 1859. have 3 rather than 4 basals and are included in the Pandanocrinidae. One such species is *T. niagarensis* from the Upper Silurian (Pridolian) Decatur Limestone of Tennessee (Springer, 1921, p. 14, pl. 5, fig. 1). Plate ornament, calical plate shapes and sizes and particularly the 6-sided first primibrach ally this species with *Pandanocrinus*.

Moore & Laudon (1943) suggested the evolution of the Dolatocrinidae from the Clonocrinidae accompanied by a reduction in the number of basals from 4 to 3. Although that is a plausible proposal, evolution from the Pandanocrinidae seems more tenable; the num-

FIG. 17. *Pandanocrinus martinswellensis* gen. et sp. nov. A,B, enlargement (A) of part of basal view (B) with A ray in 11 o'clock position of large calyx showing circular borings UQF75174, × 2 and × 1 respectively. C, lateral view of free C ray arm base UQF75178, × 2.5. D,E, large stem sections with one (D) showing bases of large rootlets each with a central canal UQF75175, UQF75176 respectively, × 2. F, basal view of small badly weathered specimen (orientation uncertain) showing 3 basal plates UQF75177, × 1.2. G, tegminal view with A ray in 11 o'clock position showing numerous small polygonal plates with probable anal aperture situated peripherally near bottom UQF75178, × 1. H, lateral C ray view of holotype UQF75179, × 1. I,K, lateral views of calices (orientations uncertain) showing less common 5-sided second primibrach UQF75180, and 75182, × 1 and × 2, respectively. J, lateral D ray view of calyx weathered in upper part UQF75181, × 0.8. L,M, lateral and tegminal views (orientation uncertain) of weathered calyx with high-domed tegmen and five valleys in tegmen in interrays UQF75183, × 0.8. N, lateral view of fragment of calyx showing unweathered ornament UQF75184, × 0.6. O, basal view with B ray in 12 o'clock position of holotype showing 3 basal plates UQF75179, × 1.2. P, basal view with D ray in 2 o'clock position of large calyx showing aberrant development of a small triangular plate between radial and interprimibrach plates UQF75185, × 0.7. Q, lateral oblique view (orientation uncertain) of calyx showing fragment of proximal stem still attached and unweathered ornament UQF75186, × 1.
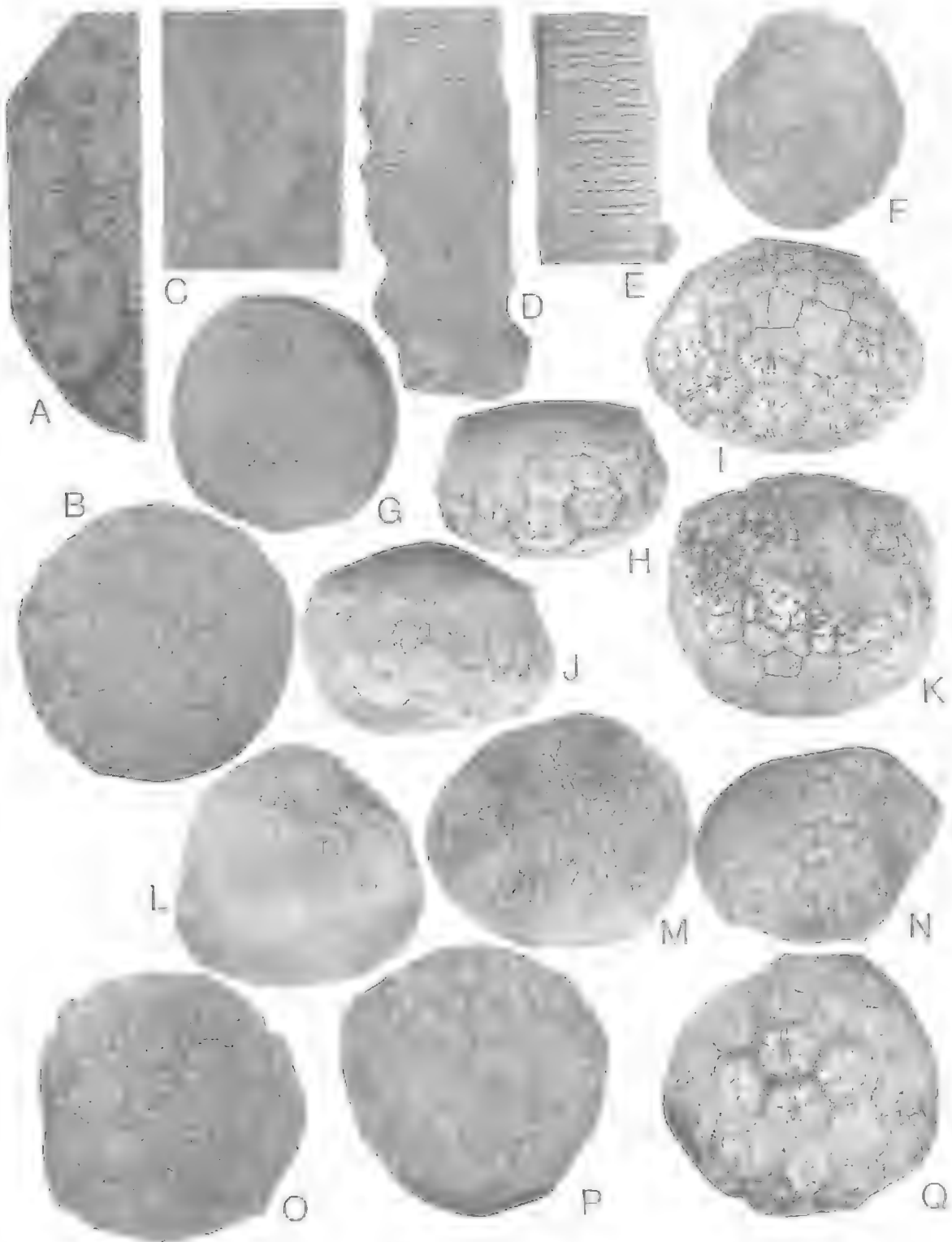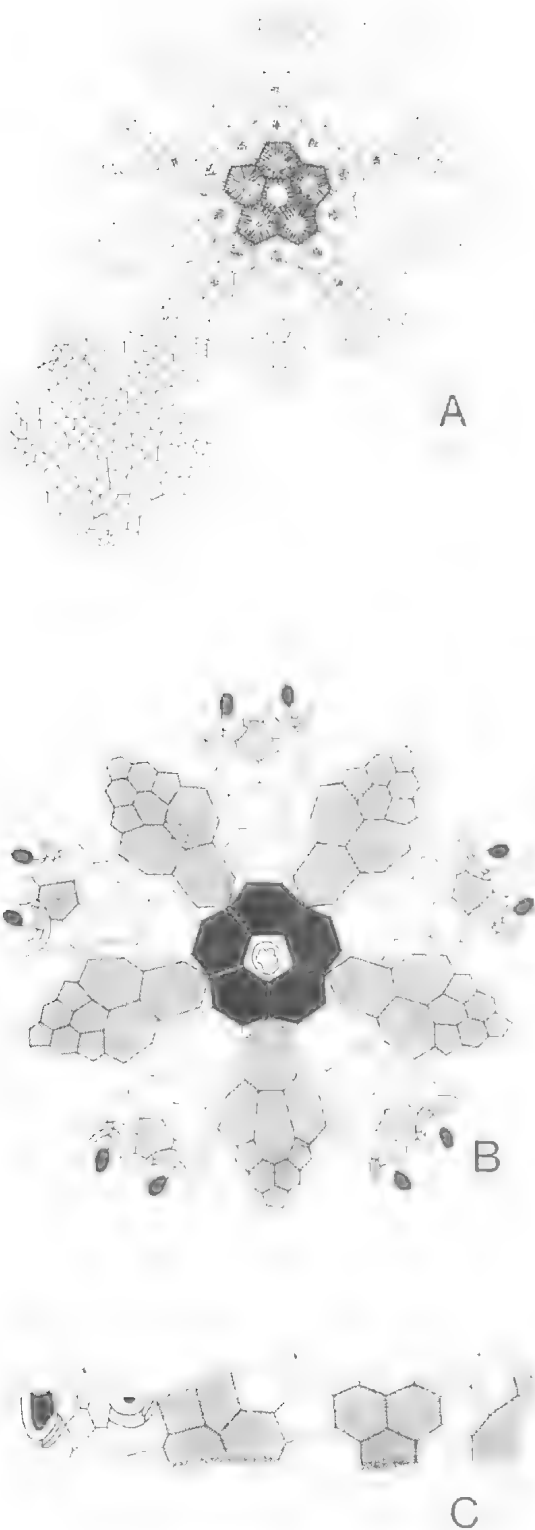
ber of basals remains constant, calical shape remains essentially low and flat bottomed, number of plates decreases as they move up out of the cup. Other lineages suggested by Moore & Laudon (1943) out of the Clonocrinidae retained the 4 basal plates and that stock is considered separate from the Dolatocrinoidea for this reason.

Pandanocrinus gen. nov.

ETYMOLOGY
Named for Pandanus Creek, the property on which the type locality occurs in north Queensland.

TYPE SPECIES
Pandanocrinus martinswellensis sp. nov. from the Pragian Martins Well Limestone Member, Shield Creek Formation, east of Pandanus Creek Homestead.

DIAGNOSIS
Large crinoid with bowl- to globe-shaped calyx of medium height and having a subhorizontal base. Basal circlet pentagonal, of three unequal plates, dividing sutures in A, E and C rays. Five hexagonal radials in lateral contact. First primibrach hexagonal, supporting large 5- or 7-sided axillary second primibrach. Arms biserial, 10 in number. Intersecundibrachs present. Interprimibrachs numerous (more than 10 in each interray), with 2 in second row except in posterior interray where large primanal supports 3 secundanals and usually a greater number of anals than there are interbrachials in other interrays. Tegmen of irregular polygonal plates, variable in height from slightly depressed to high domed; anal opening sub-central or peripheral posteriorly.

DISCUSSION
This genus has been distinguished and its relationships discussed in the family discussion above. It is the only certain member of the family at present.

FIG. 18. Plate diagrams of A, *Pandanocrinus martinswellensis* gen. et sp. nov. (including tegmen) drawn from holotype with more typical 7-sided second primibrach; B, *P. wellingtonensis* ge. et sp. nov. and C, *P.* sp. cf. *P. wellingtonensis* (drawn from Fig. 20A as far as revealed).

Pandanocrinus martinswellensis sp. nov.
(Figs 17, 18A, 19A–F)

Crinoid gen. et sp. nov. Hill, Playford & Woods, 1967, pl. D14, figs 9,10.

ETYMOLOGY
The species is named for Martins Well where it occurs in very large numbers (more than 300 calices have been collected there).

MATERIAL EXAMINED
Holotype UQF75179 from UQL3579. Paratypes UQF75174–75178, 75180– 75191 from UQL3579. A further 200 specimens, from UQL3579, in the collections of University of Queensland, Queensland Museum and Museum of Victoria have been examined.

OCCURRENCE
Pragian (*sulcatus* biozone), Martins Well Limestone Member of the Shield Creek Formation, at Martins Well on Pandanus Creek Station, north Queensland.

DIAGNOSIS
Member of *Pandanocrinus* with free arms originating from the calyx at the second secundibrach; intersection of the subradial ornament on each plate producing a central, pitted, depressed area; five rays strongly defined by four or five ridges normal to the plate margin. Calyx averaging 30–40mm diameter with only a single individual attaining 60mm diameter.

DESCRIPTION
Calyx of medium height, globe-shaped, with subhorizontal base, of average size 40mm diameter with a range from 20–60mm diameter in available collections; variable height depending on whether tegmen is flat (Fig.17H) or inflated (Fig.17L); range in height 17–50mm. Ornament on calical plates up to first secundibrachs consisting of sets of 4–6 sharp ridges normal to each sutural margin, longer ridges medially on each suture, shorter ones laterally as they merge with adjacent sets; ridges forming triangular shapes around three way sutural intersections; central area with six sets of ridges intersecting expressed as area of small rounded pits and pitted area strongly depressed as whole with prominent crests (usually 6) at the high corners between sets of ridges.

Basal circlet pentagonal, of 3 unequal plates, with sutures in A, C and E rays with circular depressed stem attachment area occupying most of circlet and defined by a raised annulus. Radials hexagonal, with straight margins and in contact laterally along vertical sutures; each plate larger than entire basal circlet. First primibrach same size and shape as radial. Second axillary, 7-sided rarely 6-sided, only slightly smaller than first. First secundibrach hexagonal, usually rather low but variable in height between individuals. Second secundibrach also variable in height, often irregular in shape against interbrachials but generally irregularly hexagonal. Free arm originating from second secundibrach and apparently biserial from base as wedge-shaped plates evident at broken base. Intersecundibrachs usually 3 or 4 with one hexagonal plate in first range then two in next and one in third; although usually fairly symmetrical a few individuals show irregularly shaped intersecundibrachs. Interprimibrachs numerous, upto 16 in most interrays with a minimum of one extra in C–D interray; in all except C–D interray a large hexagonal plate is at the base supporting a second row of two large plates, with successive rows of 3 plates gradually decreasing in size up the calyx. C–D interray has a single large 7-sided plate at base supporting 3 plates in next row, then rows of 3 or 4 plates higher up. Tegmen of smaller polygonal plates, usually in the range 2–5mm in average sized individuals; may be flat, gently depressed or inflated to the extent of being half calical height in at least one specimen; often with broad shallow depressions radiating to the five interrays; with anal opening a discrete circular aperture in posterior interray about halfway from middle to circumference, may be recessed within radial depression.

Free arms not known. Stem circular, with ossicles of uniform height.

REMARKS
This species differs from *P. geuriensis* sp. nov. in its smaller size, number of secundibrachs and plate ornament.

A number of specimens exhibit numerous small circular pits in the calical plates at random positions (Fig. 17A,B); some are on sutures others are in the centre of plates while others are irregularly placed entirely within the plate boundaries. These pits may be attributed to the ichnogenus *Tremichnus paraboloides* Brett, 1985 formed by some epizoan organism that either inhibited stereom growth or actively
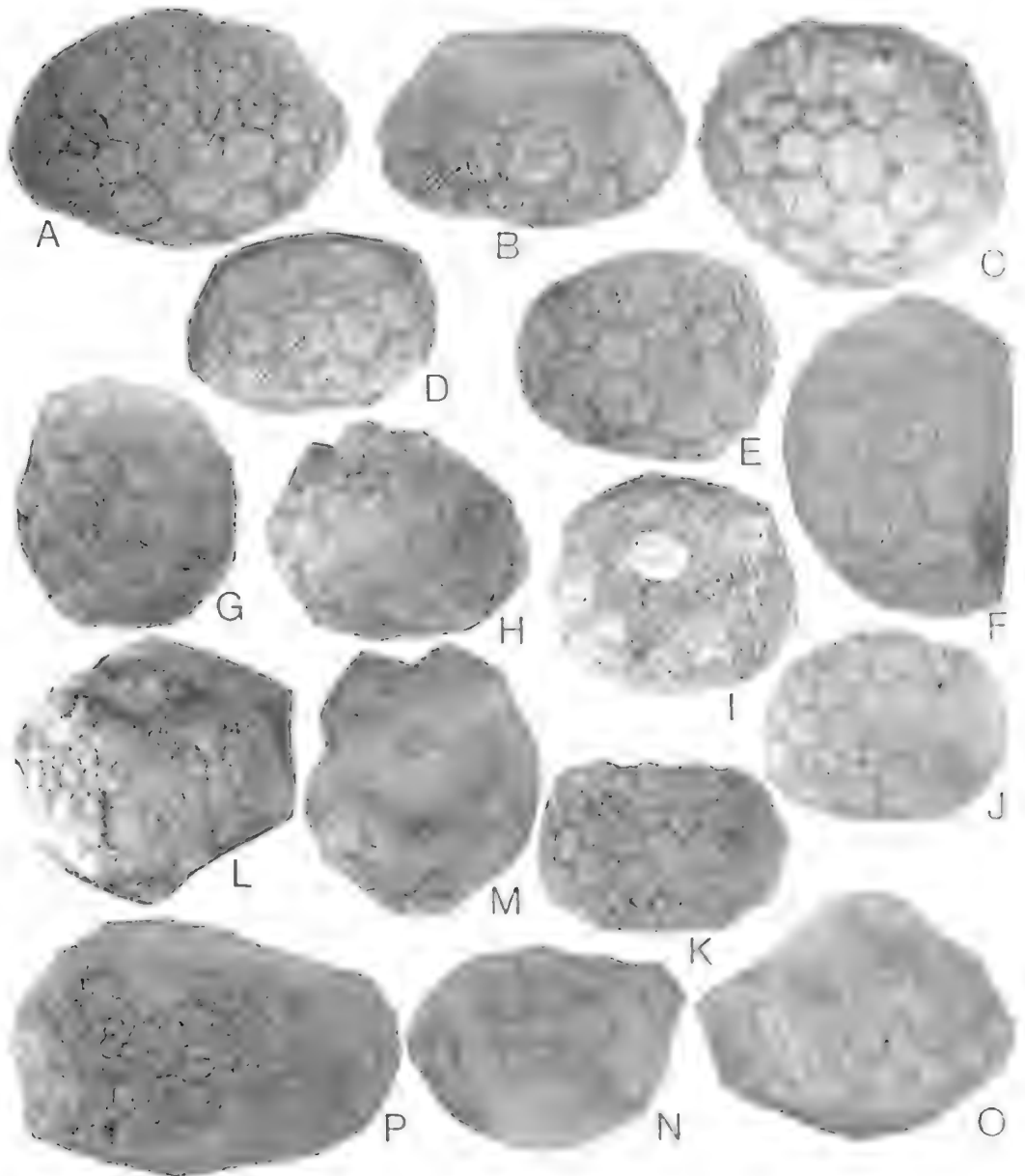
FIG. 19. A–F, *Pandanocrinus martinswellensis* gen. et sp. nov. A,B,D,E, lateral views in E–D, C–B, E–D and C–B interrays respectively of variously weathered calices showing unweathered ornament in parts and plate arrangement (E with C–D interray on extreme left of print), UQF75187, 75188, 75178, and 75190, respectively, × 1. C, lateral oblique view (orientation uncertain) of calyx showing base of free arm and boring excavating two plates UQF75189, × 1. F, basal view with A ray in 11 o'clock position of incomplete calyx with C–D interray at lower edge of print UQF75191, × 1. G–O, *Pandanocrinus geuriensis* gen. et sp. nov. (orientations uncertain) G,H, basal and lateral views of paratype calyx NMVP120771, × 0.6. I–K, tegminal, lateral oblique and lateral views of holotype calyx AMF50693, × 0.8. L,M, lateral oblique and tegminal views of weathered paratype calyx showing slightly depressed tegmen and base of central anal tube NMVP120770, × 0.6. N,O, lateral views of badly weathered paratype calices (N showing C–D interray on extreme right) NMVP120782 and 120777, respectively, × 0.6. P, Polypeltid indet. lateral view of incomplete, tectonically distorted calyx showing plating of upper parts only. NMVP120789, × 0.8.

bored into it either mechanically or chemically. This Australian example adds no more to the understanding of this ichnofossil but extends its distribution considerably.

Pandanocrinus geuriensis sp. nov.
(Fig. 19G–O)

ETYMOLOGY

For the town of Geurie, New South Wales near the type locality.

MATERIAL EXAMINED

Holotype AMF50693 an incomplete calyx from NMVPL1957, presented by Mr A. Graham of Dubbo in 1963. Paratypes NMVP120770–120786 from NMVPL1957, a series of rather poorly preserved calices in various degrees of weathering and a few stem fragments.

OCCURRENCE

Pragian or early Emsian, Garra Formation, near Geurie north of Wellington, central New South Wales.

DIAGNOSIS

Member of *Pandanocrinus* with free arms emanating from the calyx at the third or fourth secundibrach; radial ornament on each plate in sets of fine ridges normal to bounding sutures; centre of each plate strongly convex; attaining size of 70–80mm diameter with an average of 50–60mm.

DESCRIPTION

This species is described only where it differs from *P. martinswellensis*.

Calical shape is essentially the same but the tegmen is subhorizontal. On the basal circlet the raised annulus around the stem attachment area is closer to the outer margin of that circlet. There are a minimum of 3 fixed secundibrachs in each halfray; the 10 free arms originate from the third or fourth secundibrach. The intersecundibrachs are organized into two vertical columns above the pentagonal plate at the base of the series. The ornament on each calical plate involves the 5 sets of ridges normal to the sutures but the central area where they intersect is convex. It is larger, averaging 60mm in diameter as opposed to 40mm. On the stem are numerous strong cirral attachment areas.

REMARKS

It is generally poorly preserved due to weathering and adhereing matrix. The convex centres of calical plates are commonly smoothed off by weathering.
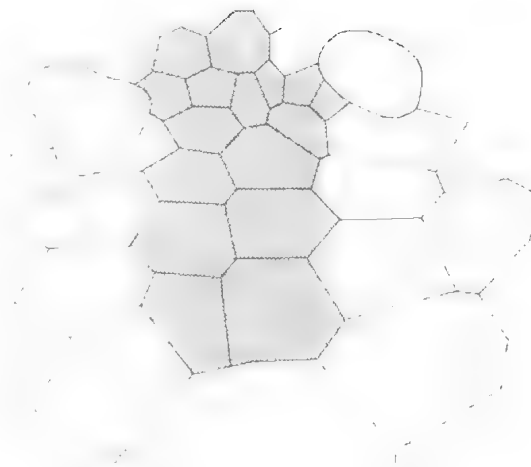
FIG. 20. Plate diagram of central part of Polypeltid indet. showing inferred double column of intersecundibrachs (shaded) (drawn from Fig. 19P).

Pandanocrinus wellingtonensis sp. nov.
(Figs 18B, 21C–K)

ETYMOLOGY

For the town of Wellington, New South Wales, adjacent to the type locality.

MATERIAL EXAMINED

Holotype AMF72539, paratypes AMF72529–72532, 72540, 72541 and QMF14532, 14537–14539, 14542 all from QML512. All are poorly preserved, incomplete and tectonically damaged calices.

OCCURRENCE

Pragian (*sulcatus* biozone), Garra Formation, near Wellington, central New South Wales.

DIAGNOSIS

Member of *Pandanocrinus* with low bowl-shaped calyx having sub-horizontal to gently depressed base; second primibrach pentagonal; two fixed secundibrachs; 10 biserial arms, with large intersecundibrachs; interprimibrachs relatively few in rows of two each after lowest larger plate. Tegmen of large polygonal plates; anal opening in C–D interray between arm bases; smooth broadly convex plates having low but distinct ridges normal to sutures in slight sutural depressions.

DESCRIPTION

Calyx of medium height, bowl-shaped, with sub-horizontal to slightly depressed base, ranging from 15–70mm in diameter; plates smooth and broadly convex, with depressed sutural margins, with discrete close spaced (1 per mm) ridges normal to sutures running from one plate to next. Basal circlet pentagonal, of three unequal plates, with sutures in A, E and C rays, occupied almost entirely by circular gently concave stem attachment area having pentalobate axial canal centrally; stem attachment with well-developed very fine crenularium. Radials hexagonal, wider than high, not quite as large as first primibrach, in contact laterally with each other. First primibrachs hexagonal, approximately same size as lowest interprimibrach and largest plates in calyx, just wider than high, with widest point above midheight. Second primibrach pentagonal, axillary, with similar maximum height and width. First secundibrach hexagonal, with longest sides on primibrach and parallel to it above. Second secundibrach much lower, wider, with concave upper margin. Third secundibrach low, fixed, becoming arcuate, with broad deep articulatory basins and becoming biserial. Interprimibrachs beginning with single large hexagonal plate, followed above by up to five rows of two hexagonal plates each. Intersecundibrachs resting on first secundibrachs, consisting of one large plate followed above by two smaller but taller plates, then a third row of two plates between free arm bases. C–D interray with 7-sided primanal; 3 secundanals with central tall one extending to top of tertanals which it separates; fourth row of anals above tall secundanal and immediately below deeply depressed anal opening between free arm bases. Tegmen of large convex polygonal plates, without clear differentiation of orals. Free arms and stem not available.

REMARKS

This species is simply distinguished from P. martinswellensis and P. geuriensis by its pentagonal second primibrach, plate ornament, and organization of the interprimibrachs. There is some variation in calical shape but most of this may be attributed to tectonic distortion; smaller specimens tend to be higher relative to diameter than larger specimens.

Pandanocrinus sp. cf P. wellingtonensis sp. nov.
(Figs 18C, 21A,B)

MATERIAL EXAMINED

UQF75170 and UQF75171 from UQL3522. These two calices are preserved as calcium carbonate embedded in a relatively clean, massive limestone; preparation to free them has not been attempted. Only a few plates are evident on each specimen

OCCURRENCE

Lochkovian or Pragian, Mount Holly Beds, Mt Etna near Rockhampton, central Queensland.

DESCRIPTION

UQF75170 shows the bases of two free arms of the one ray with low wedge-shaped arm plates evident and with a single large intersecundibrach below the free arm bases supporting a pair of tall intersecundibrachs at the level of the free arm bases. The pentagonal axillary primibrach resting on an hexagonal primibrach is evident in the adjacent ray with 2 interprimibrachs between the axillary primibrachs followed above by another row of two plates. In the next adjacent interray the two interprimibrachs between the axillary primibrachs rest on an apparently hexagonal interprimibrach that is presumably the lowest.

UQF75171 suggests the low bowl-shaped calyx and also exhibits the pentagonal axillary primibrach, two interprimibrachs between them, the bottom of the large intersecundibrach and a weathered but apparently stellate plate ornament.

DISCUSSION

These features are consistent with Pandanocrinus wellingtonensis except for the ornament which could possibly be the result of weathering although this seems unlikely. Among the species of Pandanocrinus the pentagonal axillary primibrach is distinctive of wellingtonensis. However, in the absence of information on several important features this assignment must remain speculative.

Family Dolatocrinidae Miller, 1890

Dolatocrinus Lyon, 1857

TYPE SPECIES

Dolatocrinus lacus Lyon, 1857 from the Lower Devonian Jeffersonville Limestone in Kentucky, U.S.A. by original designation.

DISCUSSION

As far as we are aware this genus has not previously been recorded outside North Amer-
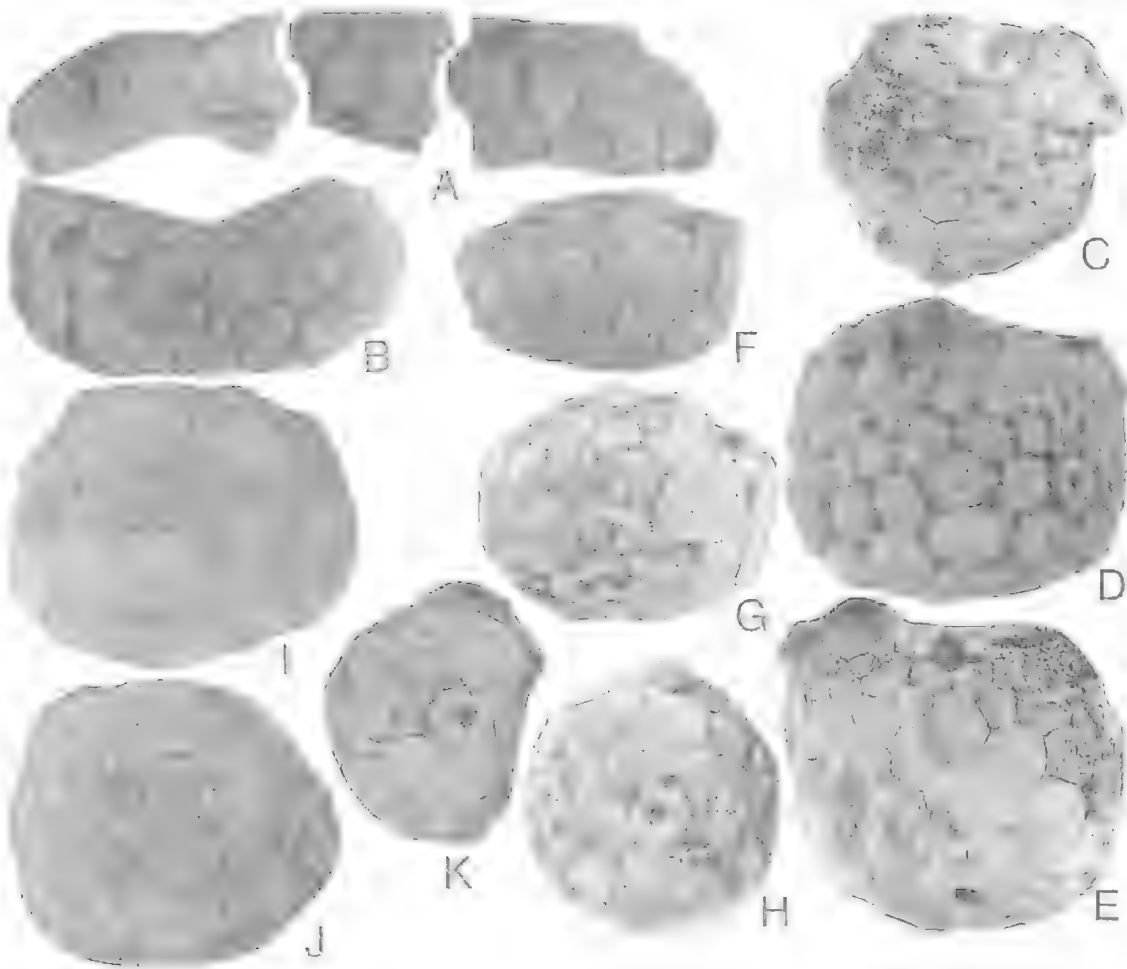
FIG. 21. A,B, *Pandanocrinus* sp. cf. *P. wellingtonensis* sp. nov. A, composite lateral view of only partly preserved and partly exposed calyx UQF75170, × 1.5. B, lateral view of incomplete calyx, UQF75171, × 1. C–K, *Pandanocrinus wellingtonensis* gen. et sp. nov. C–E, tegminal with D ray at 2 o'clock position, lateral B ray and lateral in C–D interray views of small paratype calyx AMF72540, × 2. F–H, lateral, lateral oblique and basal views (orientations uncertain) of holotype calyx AMF72539, × 0.7. I,J, lateral D ray and basal with D ray in 1 o'clock position views of large damaged paratype calyx AMF72541, × 0.7. K, basal view of incomplete paratype calyx showing 3 basal plates AMF72530, × 1.2.

ica. Its expanded distribution and the occurrence of its inferred ancestors and close relative, *Shimantocrinus*, in Australia are surprising when considered in terms of the rest of the Australian fauna.

Dolatocrinus peregrinus sp. nov.
(Figs 22, 23)

ETYMOLOGY

From Latin *peregrinus* — foreign, exotic; referring to this first record outside North America.

MATERIAL EXAMINED

Holotype QMF14818 from UQL5277. Paratypes QMF14866 and 14867 from UQL5320 and QMF14872 from UQL5321.

OCCURRENCE

Givetian, Papilio Formation, near Storm Dam, Wando Vale Station, north Queensland.

DIAGNOSIS

Member of *Dolatocrinus* with 10 arms; first secundibrach relatively large, extending as high as aperture for arm canal laterally and supporting second secundibrach from which free arm arises; with one or two pinnule apertures per arm, with one on interradial side always present and second on radial side when present in larger individuals; tegmen high domed; ornament on calical plates of raised reticulate ridges outlining a pattern of broad circular and elongate pits.

DESCRIPTION

Calyx ranging in size from 20–40mm diameter, low, bowl-shaped, with shallow basal depression. Calical ornament of raised reticulate ridges arranged randomly to define a pattern of broad circular and elongate pits, degenerating higher up the calyx between the free arm bases and on the tegmen.

Basal circlet pentagonal, almost completely concealed by large circular stem attachment area characterized by distinct fine crenularium; remainder of basal circlet occupied by prominent raised rim around attachment area; arrangement of basal plates concealed by stem attachment. Radial circlet of five 6-sided plates with concave upper margin supporting first primibrach, with widest point well above midheight and height to width ratio of nearly 1:2. First primibrach quadrate, with convex margins and height to width ratio of 1:2. Second primibrach pentagonal, axillary, with straight margins except for weakly concave lower margin on some specimens, with low lateral margins and height to width ratio of 1:2. Fixed secundibrachs two per arm; first rather large, as wide as base of second primibrach, L-shaped and extending well up the interradial side of the arm base; second secundibrach narrower, not extending as far interradially as first, and bearing the entire free arm base. Articulation on second secundibrach an immovable symplexy; 5 or 6 plates (3 or 4 tegminal plates) surround the central canal of each arm as it emerges from the calyx; central canal slightly elongate upwards in cross section; two large plates beneath axial canal quite thick, with concave articulating surface and bearing fine radiating crenellae;

smaller plates above axial canal much smaller and thinner. Interprimibrachs arranged similarly in each interray with one large 9-sided plate resting on radials and supporting smaller 5 or 6-sided interprimibrach above, with this in turn supporting 2 or 3 plates in the third row and then the tegminal plates. Tegmen strongly domed, consisting of relatively large polygonal plates, irregularly arranged, with anal opening directly through tegmen situated asymmetrically. Free arms and stem unknown.

REMARKS

This species resembles *D. lacus* in many respects but is distinguished by the high tegmen, plate ornament and shape of first secundibrach. *Dolatocrinus grandis* Miller & Gurley, 1894 has similar calical ornament although radial nature of the ornament is generally more apparent in that species than in *D. peregrinus*; moreover, *D. grandis* has numerous pinnule apertures, usually has median ray ridges, has more than two fixed secundibrachs and a deep basal depression. Other 10-armed species are readily distinguished by their plate ornament and secundibrach arrangement.

All four specimens have suffered lateral compression to differing degrees and the holotype has been dorsoventrally compressed as well. Preservation of the material is not good enough to compare the specimens in all features and variations observed are probably due to growth rather than variation. The smallest individual (Fig.22F,G) has a pinnule aperture only on the interradial side of each arm base; relative height of the tegmen decreases with growth; the size of the second secundibrach increases relative to size of the first secundibrach; and the relative size of the third row of interprimibrachs decreases.

Shimantocrinus gen. nov.

ETYMOLOGY

An anagram from McIntosh plus the usual termination for crinoid genera. For Dr George C. McIntosh of the Rochester Museum and Science Center whose assistance in this study has been considerable.
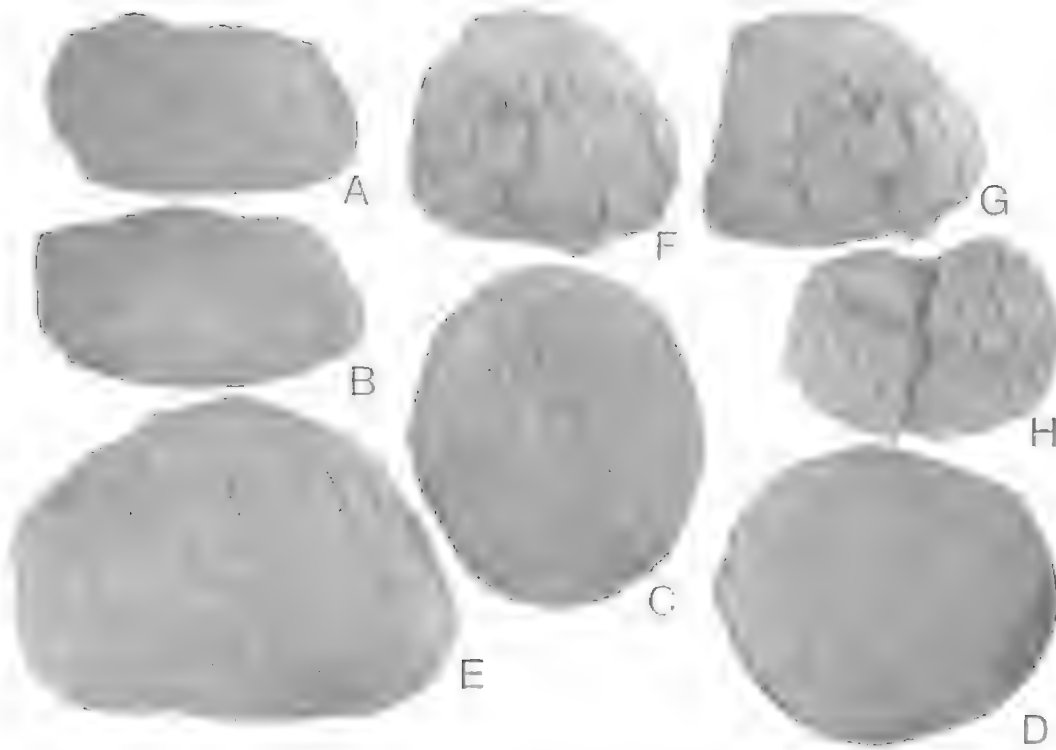
FIG. 22. *Dolatocrinus peregrinus* sp. nov. A–D, two lateral, basal and tegminal views, respectively, of holotype calyx QMF14818, × 1. E, lateral view of large paratype calyx showing pinnular apertures either side of free arm bases, QMF14866. × 1.5. F,G, lateral views of small incomplete paratype calyx showing pinnular aperture only on outer side of each free arm base, QMF14867, × 1.8. H, tegminal view of badly damaged paratype calyx QMF14872, × 1.

TYPE SPECIES

Shimantocrinus distinctodorsus sp. nov. Pragian (*sulcatus* biozone), Garra Formation, near Wellington, central New South Wales.

DIAGNOSIS

Member of Dolatocrinidae with low, globe-shaped, strongly lobate calyx wider than high, having concave base. Primibrachs 2 per ray, first one rectangular with convex margins except in C and D rays where it is pentagonal. Secundibrachs 3 or 4 fixed in each arm, becoming low and wedge-shaped after first. Intersecundibrachs not present. Arms 10 in number, biserial. Except in C–D interray interprimibrachs few, approximately 8 per interray; lowest in each interray a single, large, 10-sided plate supporting 2 interprimibrachs in second row. In C–D interray primanal 7-sided, supporting 3 large plates in second row, then numerous (upto 20) smaller plates above. Tegmen flat but strongly lobate, with steep, wide
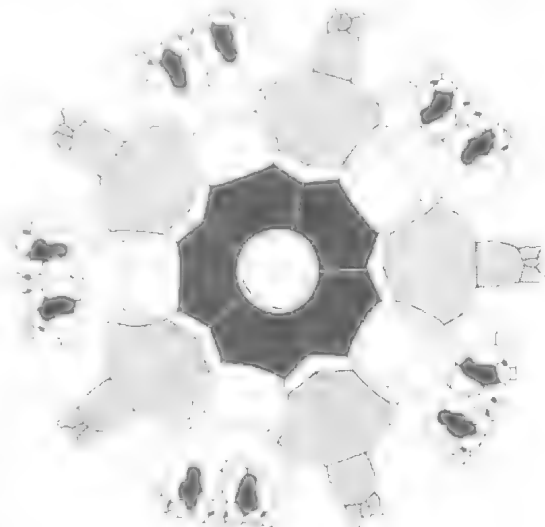
FIG. 23. Plate diagram of *Dolatocrinus peregrinus* sp. nov.

grooves running down between rays; with subcentral anal opening directly through flat-plated surface.

DISCUSSION

This genus is closely related to *Dolatocrinus* Lyon 1857 from the Early and Middle Devonian of North America but differs most significantly in having a strongly differentiated C–D interray. Springer (1921), Kesling & Mintz (1963) and Ubaghs (1978) all diagnosed *Dolatocrinus* as having an undifferentiated C–D interray. The monotypic patelliocrinid *Centriocrinus* is also closely similar in general form, number of arms, size and shape of radials and relatively few interprimibrachs but particularly if the C– D interray has 3 secundanals as quoted by Ubaghs (1978) contrary to the opinion of Wachsmuth & Springer (1897). It is distinguished by the apparently invariably hexagonal first primibrach which is more reminiscent of *Pandanocrinus*.

Shimantocrinus distinctodorsus sp. nov.
(Figs 24, 25)

ETYMOLOGY

From Latin *distinctus* — different and *dorsum* n. — back; referring to differentiated posterior interray.

MATERIAL EXAMINED

Holotype AMF72537 from QML512. Paratypes AMF72533–72536, 72538 and QMF14536 and 14540 from QML512.

OCCURRENCE

Pragian (*sulcatus* biozone), Garra Formation, near Wellington, central New South Wales.

DIAGNOSIS

As for genus.

DESCRIPTION

Calyx low, globe-shaped, with depressed base; ornament of irregular anastamosing ridges normal to sutures in distinct furrows around each plate. Basal circlet pentagonal, of 3 unequal plates, with azygous plate in A–E interray and interplate sutures in A, C and E rays; depressed circular stem attachment area occupying almost all of this circlet, with central pentalobate axial canal evident (Fig. 24C), and marked annular rim becoming less prominent with growth; depth of basal depression increasing with growth, calyx of 20mm diameter with flat base, those of more than 40mm diameter with marked depression. Radials hexagonal, in lateral contact

with each other, distinctively shaped with narrow base against basals, widest point high up above midheight and upper suture concave against first primibrach.

A,B and E rays. First primibrach quadrate, wider than high, with convex sutural margins. Second primibrach pentagonal, relatively low, axillary, with convex sutural margins laterally, but gently concave above and below. First secundibrach variable in shape, usually 5-sided but may be 6-sided, with sutural margin directly against large first interprimibrach and horizontal upper margin.Second secundibrach usually lower than first but distinctly higher than succeeding arm plates, usually axillary and of highly variable shape. One arm on one specimen (AMF72536) with an axillary first secundibrach. Above the second secundibrach arms becoming biserial, composed of low wide irregularly shaped tertibrachs of which no more than 10 are evident in any one series on the material available. Articulation between brachials near base of tertibrach series (Fig. 24O) appears as an immovable symplexy, with four separate plates surrounding an elongate axial canal that is quite close to the surface on inner side of arm but separated from outside by thick plates; with a low wide transverse ridge evident just below outer end of axial canal; articular faces of brachials with fine well-developed radiating crenellae.

C and D rays. Only differences between these and A, B, and E rays are described in these two rays. First primibrach pentagonal, with extra angle against C–D interray; first secundibrach against C–D interray not abutting primanal but instead having sutural margin against large lateral secundanals. Some asymmetry usually evident with rays curving from C–D interray to some degree.

Interprimibrachs. Single interprimibrach at base 10-sided, as high as wide, with greatest width near top; having sutural margins of different lengths with basals, first and second primibrachs and first secundibrachs and supporting 2 interprimibrachs separated by a vertical suture in the second range, with one or three small plates in third range.

C–D interray. Large primanal 7-sided, in contact with basals and first primibrach and supporting 3 secundanals; tertanals 3 in number then successive rows of smaller less regularly arranged plates. Second primibrachs and first secundibrachs of C and D rays contacting secundanals rather than primanal.

Stem and free arms not available.

REMARKS

This species, represented by 6 calices in variable states of preservation, shows some variation between the small calyx (Fig. 24A– D) of 20mm diameter and the larger ones of over 40mm diameter; this variation has been expressed in the description above but also applies to the general shape which becomes more globular, to the tertibrachs which become less regular, to the upper interprimibrachs which become less numerous and to the basal depression which becomes more depressed.

Affinities have been discussed under the generic discussion above.

Subclass Inadunata
Order Disparida
Family Pisocrinidae Angelin, 1878

Parapisocrinus Mu, 1954

TYPE SPECIES

Pisocrinus ollula Angelin, 1878 from the Upper Silurian of Europe by original designation.

Parapisocrinus sp.
(Fig. 27K–M)

MATERIAL EXAMINED

QMF14842, a badly eroded calyx from UQL3579.

OCCURRENCE

Pragian, (*sulcatus* biozone), Martins Well Limestone Member of the Shield Creek Formation, near Martins Well, Pandanus Creek Station, north Queensland.

DESCRIPTION

Calyx small (7mm diameter), low, bowl-shaped, with wide deep basal depression; thick lateral walls spreading very gently upwards. Basal circlet of tiny plates situated entirely within the deeper part of the basal depression. Parts of three large plates (A and D radials and B inferradial) and three smaller plates (B, C and E radials) all defined clearly by typical pisocrinid suture pattern, but upper margin of cup badly eroded so that it is only evident on the B inferradial. Lumen of calyx occupying less than half its diameter.

REMARKS

This specimen is assigned on the basis of its pisocrinid suture pattern and the basal circlet

being entirely confined to the basal depression. The incomplete nature of the calyx and generally poor state of preservation prevent specific assignment and useful comparison with other species. Bouska (1956) in discussing *Ollulocrinus* Bouska, 1956 (= *Parapisocrinus*) stated the generic features and alluded to the difficulty of identifying the sutures of the basal circlet. He assigned *Pisocrinus yassensis* Etheridge, 1904 from Yass, New South Wales to *Ollulocrinus* but that Late Silurian species is readily distinguished from the north Queensland Early Devonian specimen by the sharper rim to the basal depression and greater height to width ratio.

Order Cladida
Suborder Cyathocrinia
Family Gasterocomidae Roemer, 1854

Gasterocomid indet.
(Fig. 27A–H)

MATERIAL EXAMINED

QMF15152 and 15153, two badly weathered calices too poorly preserved for illustration or for definite identification. QMF14840 eight separate axillary brachial plates. All are from UQL3579.

OCCURRENCE

Pragian (*sulcatus* biozone), Martins Well Limestone Member of the Shield Creek Formation, near Martins Well, Pandanus Creek Station, north Queensland.

REMARKS

The calices are poorly preserved but QMF15152 does show one radial with a large but weathered articulatory surface pierced by a central canal and a circlet of 6 unequal plates at this level; unfortunately weathering has removed the base of the calyx and upper parts of the radials but what is preserved is consistent with *Arachnocrinus* Meek & Worthen, 1866 (see illustrations of Springer, 1911, pl. 2). The axillary brachials are close to those of *A. bulbosus* (Hall) (see Springer, 1911, pl. 2, figs 8,9) with Y-shaped canal on inner surface and isolated axial canal. Although this similarity is quite striking there is no guarantee that it is truely diagnostic. For the moment we prefer to leave the material in open nomenclature until better material is available to make a more positive identification.

Suborder Poteriocrinina
Family Cupressocrinitidae Roemer, 1854
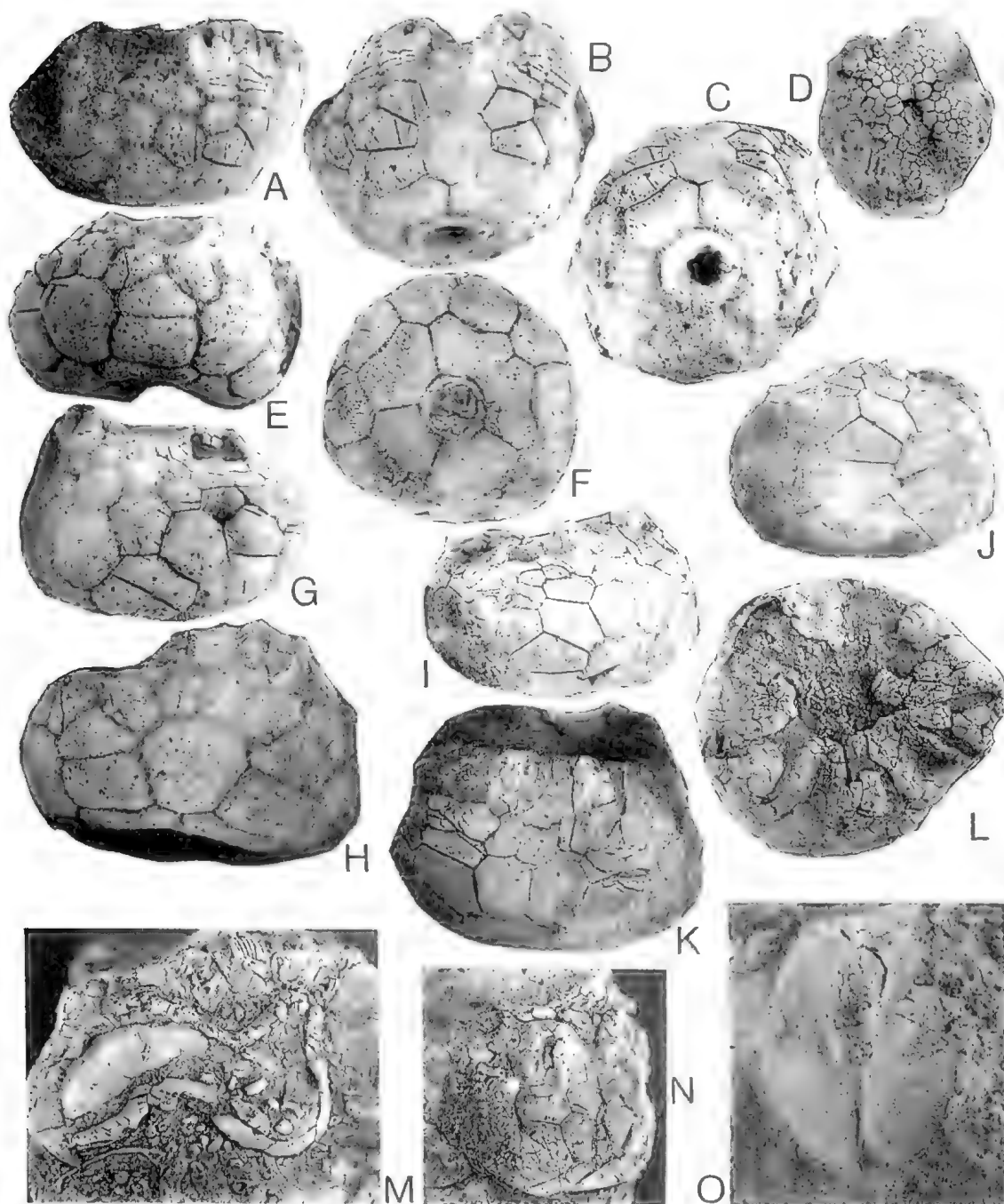
FIG. 24. *Shimantocrinus distinctodorsus* gen. st sp. nov. A–D, lateral in C–D interray, lateral in B–C interray, basal with C–B interray in 12 o'clock position and tegminal with A ray in 10 o'clock position views of small paratype calyx AMF72538, × 1.5, D × 1. E–H, lateral in B ray, basal with A ray at 3 o'clock, lateral in C–D interray and lateral in A–B interray views, respectively, of holotype calyx AMF72537, × 1. I–L, lateral in D ray, lateral oblique in D ray, lateral in C–D interray and tegminal with A ray at 4 o'clock views of large paratype calyx AMF72536, × 1. M,N, lateral views of natural section through paratype calyx and of D ray QMF14536, × 1. O, enlargement of articulatory face near base of free arm in B ray AMF72537, × 3.5.

Cupressocrinites Goldfuss, 1831

TYPE SPECIES

Cupressocrinites crassus Goldfuss, 1831 from the Late Devonian of Germany; by subsequent designation of Wachsmuth & Springer (1886, p. 105).

DISCUSSION

Cupressocrinites is a most distinctive genus (Moore, Strimple and Lane, 1978, p. 657) so that the Queensland material may be included with complete certainty. Distribution of the genus was restricted to Germany, Spain, Belgium and England (Moore, Strimple & Lane, 1978) until its recognition in Yunnan, China (Wang *et al.*, 1956), the Kuznetz Basin, and Urals, U.S.S.R. (Militsina, 1977) and now Queensland, Australia

Cupressocrinites abbreviatus Goldfuss, 1839
(Fig. 26)

MATERIAL EXAMINED

Holotype by monotypy the specimen figured by Goldfuss (1839, pl. 30, fig. 4), by Schultze (1867, pl. 2, fig. 1e) and by Moore, Strimple & Lane (1978, fig. 430, 2e).

QUEENSLAND MATERIAL

UQF75139 from UQL4440; UQF75140 and 75141 from UQL4443; UQF75142 from UQL5352; UQF75143–75148 from UQL5252; UQF75149–75151 from UQL5318; UQF75152 from UQL5364; UQF75153 from UQL5360; UQF75154 from UQL5285; UQF75155 from UQL4445; UQF75156 from UQL5220; UQF75157 from UQL5267; UQF75158 from UQL4441; UQF75159 and 75160 from UQL4442; UQF75161 from UQL5241; UQF75162 and 75163 from UQL4437; UQF75164 from UQL5372; QMF14582 from UQL5293; QMF14585 from UQL5348; QMF14586 from UQL5229; QMF14587–14589 from UQL5277; QMF14598, 14599, 14601, 14603 from UQL5356; QMF14868, 14873, 14875 from UQL5321. QMF14788 from float in the Burdekin River near Big Bend north of Charters Towers, north Queensland, probably derived from the Burdekin Formation.

OCCURRENCE

Givetian, Papilio Formation, near Storm Dam, Wando Vale Station, north Queensland; Burdekin Formation, Burdekin River north of Charters Towers, north Queensland.

DESCRIPTION OF QUEENSLAND MATERIAL

Fused infrabasals pentagonal to subrounded, appearing circular in more weathered specimens, with stem attachment including most of surface and exhibiting cruciform canal structure in stem. Five pentagonal basals each as high as wide, with gentle central convex bulge. Five low radials, twice as wide as high at maximum dimensions and these relative dimensions appear to be variable (e.g. the smaller specimens appear to have higher radials) Arms unbranched and highly modified to enclose a high conical space over the oral surface of the cup First primibrach as wide as the radial but extremely low; subsequent primibrachs numbering three in the smallest individual (Fig. 26D,E) but up to nine on larger complete specimens. Primibrachs 2–4 each bear a broad central tubercle and display the vertical linear ornament near their lateral margins. On one specimen a brachial series is displaced laterally showing the considerable thickness of each plate and exposing a series of horizontal ridges and grooves on the sides of the brachials that would be in contact with adjacent brachials (Fig. 26C). Adoral surface poorly preserved; four similar flat almost petaloid orals, and one bifurcate posterior oral present; apertures clearly defined by them.
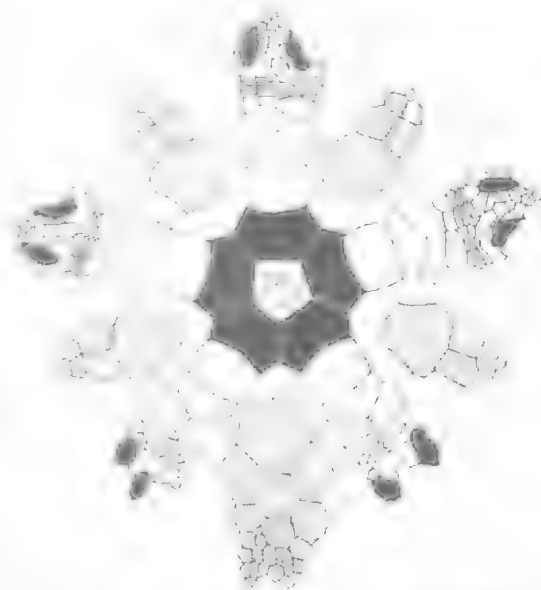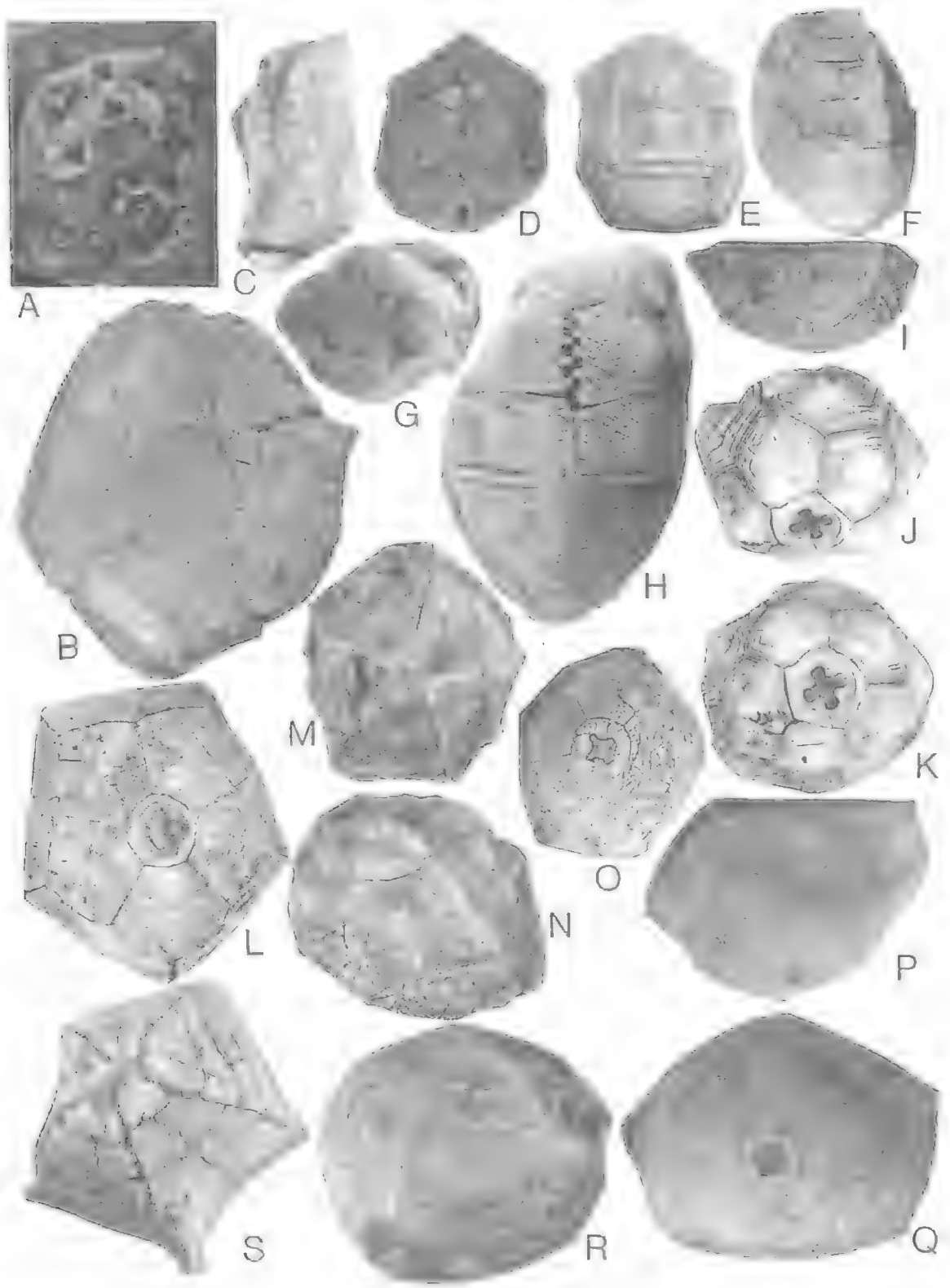

FIG. 25. Plate diagram of *Scutellocrinus distinctodorsus* gen. et sp. nov.

Discussion.

All specimens available from Queensland are weathered to some extent and most are incomplete, but collectively all the features of *C. abbreviatus* are displayed. A certain amount of variation in radial plate shape and in cup shape (from high cup-shaped to lower more bowl-shaped with increasing size) is evident in line with that exhibited by published illustrations of *C. abbreviatus* (Schultze, 1867, pl. 2). The largest specimen available bears a cemented radial holdfast structure on one of its basal plates with part of the holdfast extending across an interplate boundary suggesting that the attachment was made after the death of the host or at least after growth had ceased.

Cupressocrinites sp. cf. **C. gracilis** Goldfuss, 1831
(Fig. 27I,J)

Material Examined

QMF14841, a weathered calyx from UQL3579.

Occurrence

Pragian (*sulcatus* biozone), Martins Well Limestone Member of the Shield Creek Formation, near Martins Well on Pandanus Creek Station, north Queensland.

Description

Calyx small (approximately 8mm in diameter and 5mm high), low, with gently flaring sides; surface ornament unknown but apparently smooth. Infrabasal circlet not clearly exposed but low and evident in lateral view. Basals 5, as high as wide, with broadly convex lower margin. Radials much wider than high in lateral view, 5-sided, with radial canal aperture obvious on upper surface.

Remarks

Although its radials are lower and squatter than those in *C. gracilis* this individual is well within the range of variation in calical shape exhibited by this species (Schultze, 1867, pl. 3, fig. 2, 2a–g). As far as observed, the plate arrangement is identical and the upper surface of the calyx with conspicuous openings situated centrally in each radial plate is identical. Small columnals (e.g. QMF14841b) with four lateral canals around a larger central canal and characteristic of *Cupressocrinites* are found at this locality. The fact that some of the cup is not observable makes certain specific assignment impossible. It should be noted in passing that *C. assimilis* Dubatolova, 1964 is almost certainly a synonym of *C. gracilis*.

Inadunate indet.
(Fig. 27R)

Material Examined

AMF72551, a slightly disarticulated calyx, silicified and naturally weathered from a dark bioclastic limestone horizon GCR283 (see Mawson *et al.* (1988).

Occurrence

Pragian (*sulcatus* biozone), Garra Formation, near Wellington, central New South Wales.

Description

Calyx small, 5mm high, flaring only very gently upwards. Infrabasals extremely low, but visible laterally. Basals hexagonal but base almost horizontal, five in number. Radials largest plates in cup, 5-sided, as high as wide, with broadly concave upper margin. First primibrach quadrangular, convex below, transverse above, wider than high, as wide as radial. Second primibrach axillary, 5-sided, wider than

FIG. 26. *Cupressocrinites abbreviatus* Goldfuss, 1839. A,B, adoral views of damaged calices without arms, UQF75162, × 1 and QMF14873, × 1.5, respectively. C, lateral view of arm of a small crown showing horizontal grooves, UQF75150, × 1.5. D,E, adoral and lateral views of small crown QMF14868, × 2. F, lateral view of small crown UQF75149, × 1. G, end view of section of stem showing central canal and 4 peripheral canals QMF14856, × 4. H, lateral view of small crown QMF14740, × 2. I,L, lateral and aboral views of calyx , UQF75159, × 1.5. J,K, lateral oblique and aboral views of small calyx UQF14588, × 2. M,N, adoral and oblique views of damaged crown UQF75164, × 1.5. O, aboral view of large calyx UQF75145, × 0.6. P,Q, lateral and aboral views of large calyx showing a weathered attachment base of another crinoid on radial plate UQF75143, × 0.75. R, oblique view of upper part of large crown QMF14589, × 1. S, Adoral view of incomplete crown found as float in bed of Burdekin River just north of Charters Towers in vicinity of Big Bend, QMF14788, × 2.
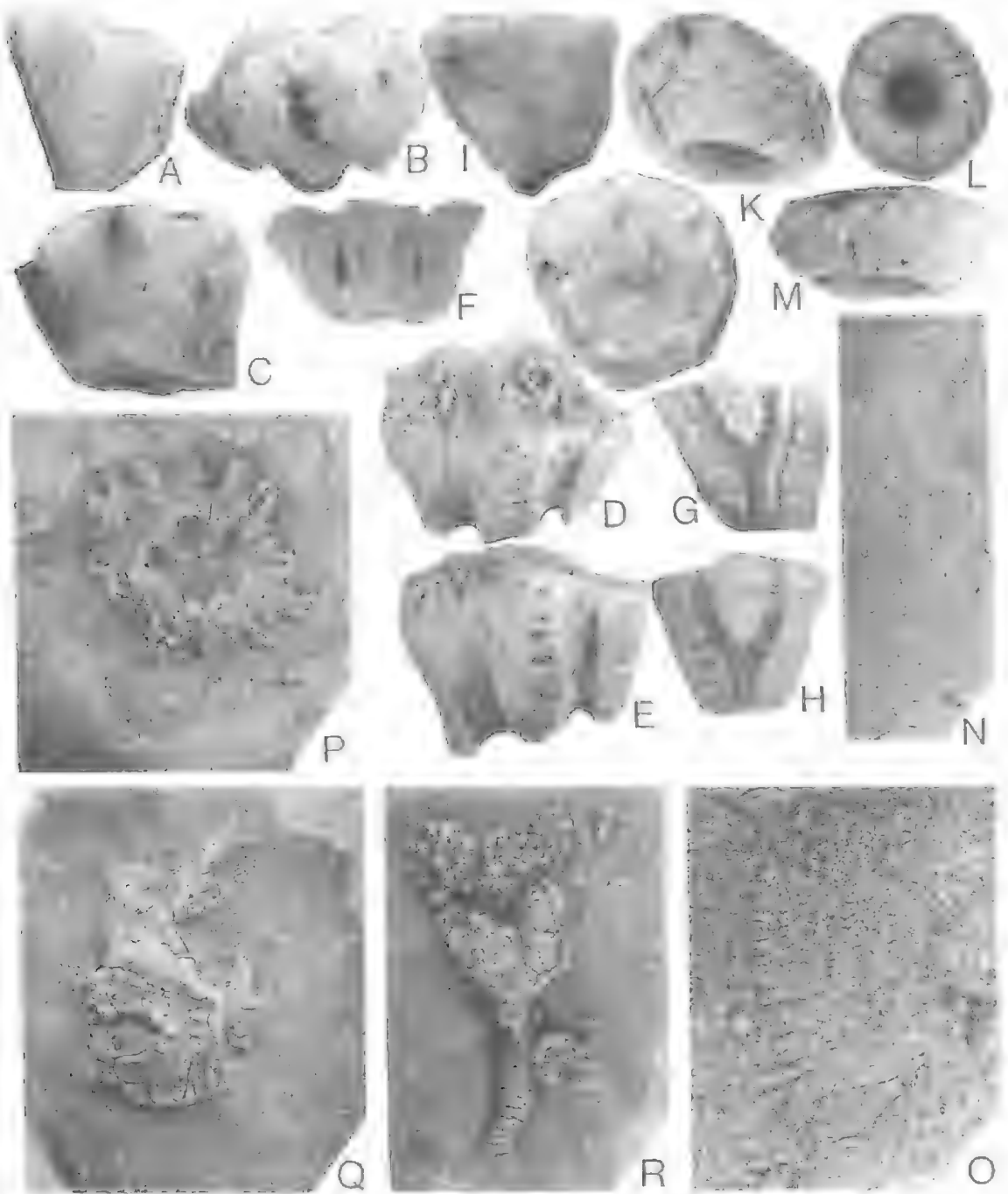
FIG. 27. A–H, Gasterocomid axillary brachials. A, lateral view QMF14840A, × 3. B–E, lower, lateral, adoral oblique and adoral views of plate QMF14840B, × 5. F,G, adoral and inner lateral views of plate QMG14840C, × 4. H,inner lateral view of plate QMF14840D, × 4. I,J, *Cupressocrinites* sp. cf. *C. gracilis* Goldfuss, 1831, lateral and adoral views of small poorly preserved calyx QMF14841, × 3. K–M, *Parapisocrinus* sp. lateral oblique, aboral and lateral views of small damaged calyx QMF14842, × 3. N,O, Crinoid indet. 2 JCF11361, × 0.8 and × 1.7, respectively. P,Q, crinoid attachment bases on heliolitid coral colonies from UQL5318, QMF14858 and 14859, × 2. R. Crinoid indet. 1, AMF72551, × 2.2.

high, as wide as first primibrach. Secundibrachs 3 in number, 3rd axillary, uniserial. Subsequent brachials indistinct but apparently uniserial. Anal plates not evident. Stem circular, of simple low discs each approximately 0.5mm high.

REMARKS

This specimen may be identified as an inadunate by the lack of interbrachials and lack of fixed brachials.

Crinoid Indet. 1
(Fig. 7A–F)

MATERIAL EXAMINED

QMF14591 a large, poorly preserved calyx. Associated large stem fragments QMF14592–14594 are consistent in size although this may not always be the best guide (Franzen-Bengtson, 1982). All are from QML547 (=UQL5209).

OCCURRENCE

Late Emsian or Eifelian, Burges Formation, just west of Broken River Gorge, Wando Vale Station, north Queensland.

REMARKS

The large calyx (60mm diameter × 25mm high) has a wide deep basal depression and although some plates are evident in several areas we were unable to determine any regular pattern to allow identification. Its inclusion here is because of the structure exhibited by associated stem fragments and its association with the indeterminate carpocrinid (Fig.7G-J, 8). Individual ossicles in the stem are pierced by canals that are expressed at the lateral surface by prominent tubercles which are seen to be aligned in vertical columns. The axial canal is relatively small being similar in proportion to that of the large stem figured by Franzen-Bengtson (1982, fig. 1B) but the radial canals in the Australian specimen are straight, unbranched and fewer.

Crinoid indet. 2
(Fig. 27N,O)

MATERIAL EXAMINED

JCF11361, a weathered individual from the Hervey Range.

OCCURRENCE

Givetian, Burdekin Formation at 441558 on the Townsville 1:250000 Geological Sheet in the Hervey Range.

REMARKS

This individual with a crown some 30mm high and 60mm of stem attached is exposed on the surface of a coarse bioclastic limestone and has weathered at the same rate as the matrix so that virtually only a section of the animal remains. However, several arms are evident so that the plane exposed must fortuitously be close to one side of the crown. Unfortunately the calyx is not well enough exposed for identification.

The calyx is 4 or 5 plates high but their identity is uncertain. The arms appear to be unbranched, biserial and highly pinnulate. The stem consists of a large number of very low columnals apparently alternating in height in some sections between higher and lower columnals. The significance of this specimen is that it demonstrates an as yet unknown crinoid fauna in sediments of the Burdekin Shelf. Together with the partial crown of *Cupressocrinites abbreviatus* found as float in the Burdekin River (Fig. 26S) this specimen represents all that is known to the authors at present of the crinoid fauna from the Burdekin Basin.

Crinoid attachment bases
(Fig. 27P,Q)

MATERIAL EXAMINED

QMF14859, 14860 and numerous unregistered specimens from numerous localities.

OCCURRENCE

Late Eifelian and Givetian, Papilio Formation in the vicinity of Storm Dam, Wando Vale Station, north Queensland.

REMARKS

These holdfasts may be classified on the scheme of Brett (1980) as Simple Discoidal Holdfasts in different stages of weathering and one (Fig. 27P) shows peripheral canals running down into the holdfast. Brett (1980, p. 356, fig. 6A) pointed out that *Cupressocrinites abbreviatus* has this type of terminal holdfast. As that species is very common in the same localities these holdfasts probably belong to it. A variety of other holfasts are known through this formation but a detailed study is outside the scope of this paper. Similarly, numerous different stem types are present at these localities but we have not studied them in detail.

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APPENDIX

Grid references given in square brackets refer to the following 1:100000 topographic maps: Burges (sheet No. 7859), Dubbo (8633), Mansfield (8123), Ridgelands (8951), Wando Vale (7858), Wellington (8632).

NORTH QUEENSLAND
Upper Martin's Well Limestone Member, Shield Creek Formation. Early Devonian, early Pragian, *sulcatus* conodont biozone. All localities are in the vicinity of Martins Well, 8km east of Pandanus Creek Homestead, 200km northwest of Charters Towers.

UQL2498 Burges [683683] upper part of limestone 70m east of Martins Well windmill. *Pandanocrinus martinswellensis*.

UQL2710 Burges [675680] westernmost outcrop of limestone 1km west of Martins Well Windmill. *Pandanocrinus martinswellensis*.

UQL3577, 3578, 3579, 3580, 4058 Burges [687683] five localities collected from east to west along the fence line 600m east of Martins Well windmill; all from upper part of limestone that is slightly folded in this area so that sequence is not strictly stratigraphic. *Pandanocrinus martinswellensis* (markedly abundant), *Parapisocrinus* sp., Gasterocomid indet. *Cupressocrinites* sp. cf. *C. gracilis*.
Shield Creek Formation. Early Devonian, early Pragian, *sulcatus* conodont biozone.

UQL3574 Burges [617712] detrital limestone bed on eastern slope of ridge 7.3km north of Old Pandanus Creek Homestead, 200km northwest of

Charters Towers. *Euralyptocrinites praerosaceus.*
Pandanocrinus martinswellensis.
Burges Formation, Broken River Group. Early Middle
Devonian, late Emsian to Givetian.

UQL5209 (=QML547) Burges [648459], prominent
limestone knoll on left bank 100m from mouth of 2nd
left bank side creek upstream from Jack Hills Gorge
on the Broken River, Wando Vale Station, 150km
northwest of Charters Towers. Carpocrinid indet

UQL5372 Burges [691535], 20m above Jessey
Springs Limestone in New Chum Gully, east of Jessey
Springs Hut, Wade Holding, 200km northwest of
Charters Towers. Givetian (*varcus* biozone.
Cupressocrinites abbreviatus.
Dosey Limestone, Broken River Group. Middle
Devonian, Eifelian to early Givetian.

UQL5234 Wando Vale [577394], very low in Dosey
Limestone on southeast flank of the Dosey syncline
2.6km northeast of Storm Dam, Wando Vale Station,
150km northwest of Charters Towers; no older than
costatus biozone. Eifelian. *Hexacrinites*
interscapularis.
Papilio Formation, Broken River Group. Middle
Devonian, late Emsian to Givetian, *kockelianus* to
varcus conodont biozones. All localities in the Storm
Dam area, north of Dosey Outstation to Six Mile Dam
north of Broken River, Wando Vale Station, 150km
northwest of Charters Towers.

UQL4427 Burges [597444], limestone rubble 300m
north of Broken River, southwest of old Six Mile
Yard. *Hexacrinites interscapularis, Rhipidocrinus*
indet.

UQL4437 Wando Vale [545365], on terrace edge
on south side of creek junction, 1.5km southwest of
Storm Dam; *varcus* biozone, Givetian. *C.*
abbreviatus.

UQL4440 Wando Vale [543364] in gully 200m
upstream from UQL4437; *varcus* biozone, Givetian.
C. abbreviatus.

UQL4441 Wando Vale [543364] 20m south of
UQL4440, *varcus* biozone, Givetian. *C.*
abbreviatus

UQL4442 Wando Vale [544367] shallow gully
1.4km southwest of Storm Dam; not younger than
ensensis biozone, late Eifelian or early Givetian. *C.*
abbreviatus, Hexacrinites interscapularis.

UQL4443 Wando Vale [544367] 60m up gully from
UQL4442; similar horizon to UQL4442. *C.*
abbreviatus, Melocrinites tempestus.

UQL4445 Wando Vale [543366] 220m up gully
from UQL4443; similar horizon to UQL4442.

UQL4447 Wando Vale [547366] 80m up gully from
UQL4445; similar horizon to UQL4442. *C.*
abbreviatus.

UQL5218 Wando Vale [559389] approximately
68m above base of formation in gully on east slope of
Storm Hill, 1.2km north of Storm Dam; ?late Eifelian.
Melocrinites tempestus.

UQL5220 Wando Vale [559398] basal 2m of for-
mation 1km north of Storm Hill; ? late Eifelian. *C.*
abbreviatus.

UQL5227 Wando Vale [574376] 20–30m above
base of formation on left flank of gully flowing into
Dosey Creek 2km east of Storm Dam; ?late Eifelian.
Hexacrinites interscapularis.

UQL5228 Wando Vale [574375] 70–120m above
base of formation on right flank of same gully as
UQL5227; same horizon as UQL5227. *H.*
interscapularis.

UQL5229 Wando Vale [560371] right bank of
Storm Dam Creek about 50m upstream from the con-
fluence with the gully into which Storm Dam over-
flows when filled; *varcus* biozone, Givetian.
Rhipidocrinus crenatus, C. abbreviatus.

UQL5231 Wando Vale [558368] high in the forma-
tion on the crest of hill 800m southeast of Storm Dam;
varcus biozone, Givetian.

UQL5241 Wando Vale [563371] high in the forma-
tion on the right flank of Storm Dam Creek; *varcus*
biozone, Givetian. *C. abbreviatus.*

UQL5243 Wando Vale [563370] high in the forma-
tion on Storm Dam Creek 50m south of UQL5241;
varcus biozone, Givetian.

UQL5252 Wando Vale [551366] south flank of low
hill 1km south of Storm Dam; ?*varcus* biozone,
Givetian. *C. abbreviatus, H. interscapularis.*

UQL5254 Wando Vale [544367] shallow gully
1.4km southwest of Storm Dam; not younger than
ensensis biozone, late Eifelian or early Givetian.

UQL5257 Wando Vale [558386] high in the forma-
tion at top of hill 800m north northeast of Storm
Dam; not older than middle *varcus* biozone, Givetian.
H. spinosus.

UQL5267 Wando Vale [543363] in gully 1.5km
southwest of Storm Dam; no older than UQL5257. *H.*
interscapularis.

UQL5268 Wando Vale [542362] 100m southwest
of UQL5267; same biozone as UQL5267 but slightly
above it, Givetian

UQL5269 Wando Vale [543364] gully 200m
upstream from UQL5267; approximately same hor-
izon as UQL5267.

UQL5272 Wando Vale [536360] on open ground
300m east of UQL5358; no older than *varcus* biozone,
Givetian. *Rhipidocrinus?* sp.

UQL5277 Wando Vale [570409] 51–56m above
base of section 300m east southeast of The Volcano;
assumed early Givetian. *C. abbreviatus, Dolatocrinus*
peregrinus, H. spinosus.

UQL5284 Wando Vale [539359.5] eroded area on
crest of low divide, on eastward extension of the north
arm of The Spanner; middle *varcus* biozone,
Givetian

UQL5285 Wando Vale [539359.5] on left flank of
small gully just northwest of eroded area on crest of
low divide on eastward extension of the north arm of
the Spanner; middle *varcus* biozone. *C. abbreviatus.*

UQL5293 Wando Vale [524369] gully 400m east of the divide between Dosey and Page Creeks; ?Givetian. *C. abbreviatus.*

UQL5305 Wando Vale [569404] southwesterly oriented gully 400m south of the Volcano; not older than *varcus* biozone. *H. interscapularis.*

UQL5317 Wando Vale [564394.5] 9m above the base of the formation 2km northeast of Storm Dam; late Eifelian of early Givetian. *H. interscapularis, H. spinosus.*

UQL5318 Wando Vale [565395] 65–116m above base of formation in gully 2.2km northeast of Storm Dam; no older than *ensensis* biozone. *Rhipidocrinus crenatus, C. abbreviatus, H. interscapularis, Melocrinites tempestus.*

UQL5320 Wando Vale [563392] section on ridge 2.9km northeast of Storm Dam; late Eifelian — Givetian. *Hexacrinites interscapularis, Cupressocrinites abbreviatus, Rhipidocrinus crenatus, Dolatocrinus peregrinus.*

UQL5321 Wando Vale [562390] creek section 3km northeast of Storm Dam; late Eifelian — Givetian. *Hexacrinites interscapularis, Cupressocrinites abbreviatus, Rhipidocrinus crenatus, Dolatocrinus peregrinus.*

UQL5352 Wando Vale [581409] 66.7m above base of formation in gully 900m northeast of where Papilio Creek emerges from the Storm Hill Sandstone; late Eifelian or early Givetian. *C. abbreviatus.*

UQL5356 Wando Vale [554367] east flank of Spongophyllum Hill, in head of eroding gully; *varcus* biozone, Givetian. *H. interscapularis, Melocrinites tempestus, Rhipidocrinus crenatus.*

UQL5358 Wando Vale [533360] small gully slightly north of west of low divide formed from extension of the north arm of the Spanner; middle *varcus* biozone, Givetian. *C. abbreviatus.*

UQL5360 Wando Vale [566374] eroding head of gully tributary to Storm Dam Creek; Givetian, no older than *varcus* biozone. *H. interscapularis, C. abbreviatus.*

UQL5364 Wando Vale [551366] low in the formation on south flank of hill 1km south of Storm Dam; Givetian, probably *varcus* biozone. *C. abbreviatus.*

Burdekin limestone, Fanning River Group. Middle Devonian, Eifelian to Givetian.

Float in bed of Burdekin River near Big Bend, north of Charters Towers; Givetian. *Cupressocrinites abbreviatus.*

Hervey Range, at [441558] on Townsville 1:250000 Geological Sheet; Givetian. Crinoid indet. 2.

CENTRAL QUEENSLAND
Mount Holly Beds. ?Lochkovian to Pragian.

UQL3522 Ridgelands [396367] base of north slope of Mount Etna, 30km north of Rockhampton, central Queensland. *Pandanocrinus* sp. cf. *P. wellingtonensis.*

CENTRAL NEW SOUTH WALES
Garra Formation. Early Devonian, late Lochkovian to Pragian.

QML512 Wellington [799867] richly fossiliferous limestone (Unit 18 of Johnson, 1975) 870m NNW of Mountain View Homestead on Wellington Caves Road. 9km SSW of Wellington, N.S.W.; apparently *sulcatus* biozone. Spyridiocrinid gen. et sp. nov., *Struszocrinus dulciculus, Ctenocrinus solus, Eucalyptocrinites rosaceus, Shimantocrinus distinctodorsus, Pandanocrinus wellingtonensis.*

NMVPL1957 Dubbo [729135] richly fossiliferous limestone on west side of an abandoned quarry on southwestern edge of Geurie between Dubbo and Wellington; presumed Pragian. *Pandanocrinus gueriensis.*

NMVPL1958 Wellington [761013] coralline limestone on hillside immediately southeast of Macquarie Park Homestead, 8km northwest of Wellington; presumed Pragian. Polypeltid indet.

GCR283 at 281.9m above base of stratigraphic section 300m south southeast of Wellington Caves office (see Mawson *et al.* in press, fig. 6, Table 2).

CENTRAL VICTORIA
Loyola Limestone, Norton Gully Sandstone. Early Devonian, Pragian (*kindlei* biozone).

Griffith's Quarry 11km southwest of Mansfield, 200km northeast of Melbourne, Victoria. Mansfield 1:100000 sheet [135904] *Eucalyptocrinites fonzi.*

SAMPLING THE DEMERSAL FAUNA FROM A COMMERCIAL PENAEID PRAWN FISHERY OFF THE CENTRAL QUEENSLAND COAST

CLIVE M. JONES and KURT DERBYSHIRE

Two hundred and eighty-one trawl samples (mean weight 35 kg) of benthic fish and invertebrates were gathered from an area of approximately 10,000 square km adjacent to the central Queensland coast, between January 1985 and June 1986. This area is presently subjected to seasonal fishing pressure by commercial prawn trawlers. Samples were taken from 24 fixed stations representing depths from 15 to 62 m, and a variety of bottom types. Of 477 taxa identified, 18 were commercially important. Despite the proximity of coral reefs, the fauna was dissimilar to the 'reef fauna' characteristic of the Great Barrier Reef. The results suggest a strong association between the demersal trawl faunas of north-eastern Australia and the Southeast Asian regions.
□ *Benthic fauna, demersal fauna, trawling, fishing, Great Barrier Reef, coral reef, faunal survey.*

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The prawn trawl fishery off Queensland's eastern central coast, between Lucinda and Bowen (18°30'S to 20°S), is characterised by two seasons, each representing specific areas of exploitation and target species. From March through to June, fishing effort is centred on the inshore coastal fringe in 10 to 30 m depth for tiger prawns (*Penaeus esculentus* and *P. semisulcatus*). Towards the end of this season, however, fishing effort shifts eastwards into deeper waters where king prawns (*P. longistylus* and *P. latisulcatus*) are sufficiently abundant to support fishing through to October (Robertson and Dredge, 1986). Two separate fisheries are thus recognised, the 'tiger prawn' fishery and the 'king prawn' fishery. Several important 'by-catch' species are also caught incidentally to the target species of each fishery. Although many prawn trawl fisheries are characterised by a similar seasonal and spatial transfer of effort, this fishery is unusual in that much of the fishing effort directed at king prawns is expended in the vicinity of coral reefs of the Great Barrier Reef complex.

As the king prawn fishery has developed over the past decade, fishing effort has expanded further eastwards into previously unfished areas and closer to individual reefs. The benthic faunal composition of these areas is poorly documented (Cannon and Goeden, 1982). Consequently, the trawl catch of the fishery is of considerable interest both to benthic community ecologists (see Cannon *et al.*, 1987) and to the managers of the Great Barrier Reef Marine Park. A comprehensive description of the benthic community subjected to trawling activity is essential to the assessment of fishing impact on adjacent coral reefs. The Queensland Department of Primary Industires initiated a survey of the commercially fished area in 1985. This paper provides details of the methods employed and species composition of the fishery. A second paper (Watson and Goeden, M.S.) examines the species diversity and spatial and temporal distribution of species.

METHODS

Monthly samples of trawl catch were gathered from 20 sites representative of both the tiger prawn and king prawn areas of the fishery (Fig. 1), during 1985. From January to June 1986, monthly sampling was continued at seven of these sites and was started at another four. Sampling was intentionally biased towards the king prawn grounds within inter-reef waters where the benthic faunal composition was of greatest interest. This sampling strategy jointly satisfied the requirements of the demersal fauna research program and of parallel Departmental programs concerned specifically with the commerical catch.
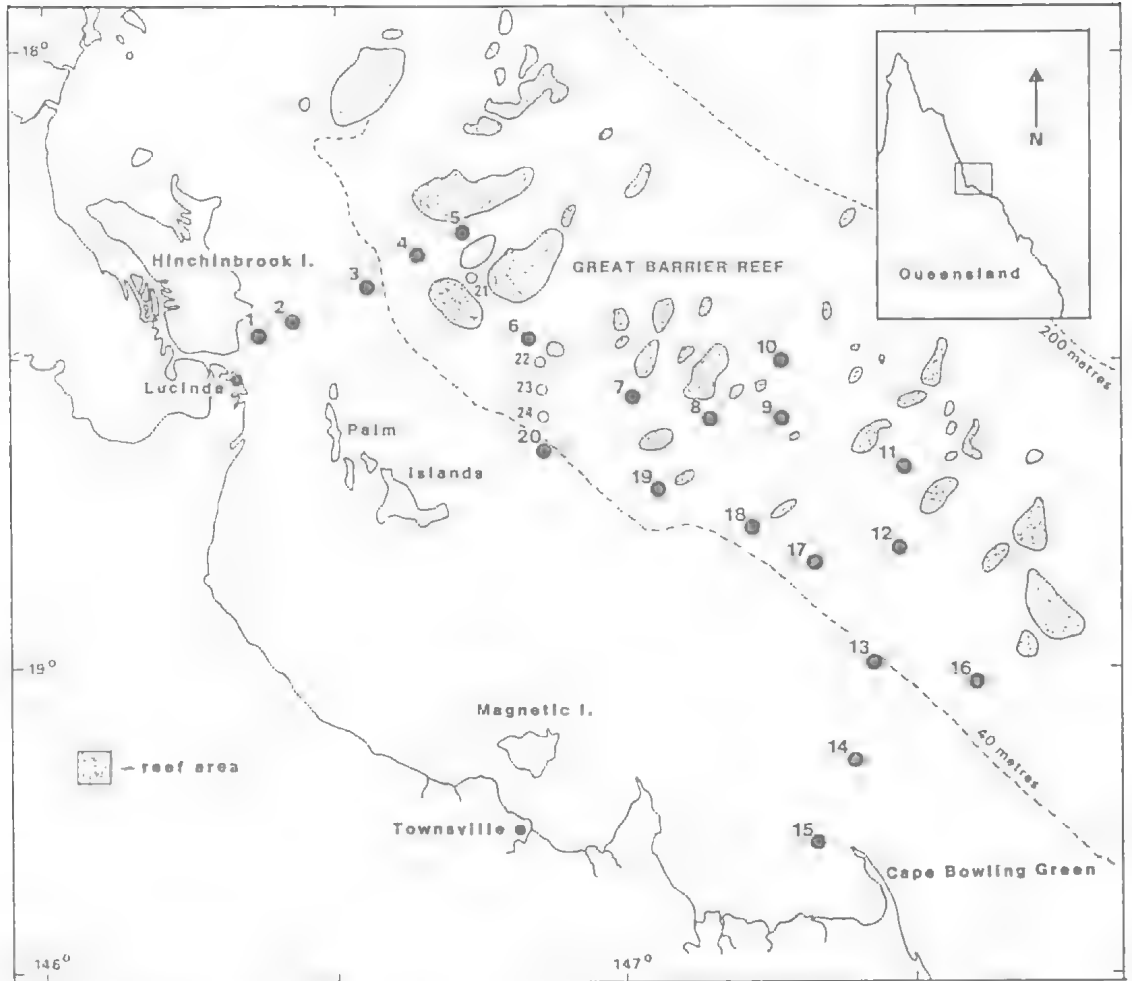
FIG. 1. Sampling stations. Stations 1 to 20 sampled each month from January to December 1985. Stations 1 to 6, 20 and additional stations 21 to 24 were sampled from January to June 1986.

Research officers conducted the sampling from the Fisheries Research Vessel 'Gwendoline May', a 20 m steel trawler, on consecutive nights around the time of new moon. The 'Gwendoline May' was equipped with commercial trawling gear: two 'Florida Flyer' nets, each of 12-metre headline length. The starboard net was made of 50 mm mesh, which is standard for the fishery; the port net was 40 mm mesh, which facilitated the capture of juvenile prawns.

For each sample, the nets were towed at 6 km/hr over the bottom and parallel to the depth contour, for approximately thirty minutes. Upon retrieval, the catch from each net was spilt onto a divided sorting tray. Catch sub-samples were taken from the standard commercial net (starboard), unless gear failure necessitated the

use of the port net's catch. The total catch of the starboard net was weighed after sponges, sea snakes, stingrays, shovel-nose sharks and other large elements had been recorded and removed. Each sub-sample (approx. 10 kg) was thoroughly washed in sea-water, weighed, labelled and frozen in a plastic tray. The remaining catch was sorted and species not previously recorded from the survey were retained for positive identification to augment the species list.

All catch sub-samples were sorted at the Northern Fisheries Research Centre in Cairns. Most fish, crustaceans, echinoderms, and molluscs were identified to species level. Other faunal elements were identified to family level or beyond, in most cases. The numerical abundance (number of individuals) of each

species within the sub-sample was also recorded. Extrapolating from the sub-sample, the number of each species in the total catch was then calculated. Biomass and size data for individual taxa were not collected.

While all fish, crustacean and mollusc species have been confirmed by staff of the Queensland Museum, the identifications of the other taxa are provisional only. It was not possible within the scope of this study to specifically identify Porifera, Cnidaria, Sipuncula, Annelida and Bryozoa. For the purposes of comparison with the published results of other faunal surveys, 'demersal fauna' refers to the total trawled catch of fish and macro-invertebrates.

TABLE 1. Commercially important species within the central Queensland prawn trawl fishery. Proportions given were based on the 1985/86 catch. Annual production, particularly for scallops can be highly variable. These percentages are not indicative of the relative monetary value of each species.

Species	Common Name	Estimated proportion of annual commercial catch by weight (%)	Comments
Penaeus longistylus	Red-spot king prawn	32.5	target species of 'king prawn' fishery
P. latisulcatus	Blue-leg king prawn	13.5	target species of 'king prawn' fishery
P. esculentus	Brown tiger prawn	9.0	target species of 'tiger prawn' fishery
P. semisulcatus	Grooved tiger prawn	9.0	target species of 'tiger prawn' fishery
P. merguiensis	Banana prawn	12.0	incidental species of 'tiger prawn' fishery; target species when abundant
P. monodon	Leader prawn	0.5	incidental species of 'tiger prawn' fishery
Metapenaerus endeavouri	Endeavour prawn	1.0	incidental species of 'tiger prawn' fishery
M. ensis	False endeavour prawn	4.0	incidential species of both fisheries
Thenus sp.1	Bay lobster ('sand bug')	10.0	incidental species of 'king prawn' fishery
T. orientalis	Bay lobster ('mud bug')	4.0	incidental species of 'tiger prawn' fishery
Amusium balloti	Saucer scallop	1.5	incidental and target species of the 'king prawn' fishery
Metapenaeopis mogiensis, M. palmensis, M. rosea, Trachypenaeus anchoralis, T. curvirostris, T. granulosus, T. fulvus	Coral prawns	3.0	incidental species of the 'king prawn' fishery Species not separated

RESULTS

A total of 477 taxa were identified from the survey, of which 18 (3.8%) were commercially important (Table 1). Fish and crustaceans were the most abundant components of the catch and accounted for 38% and 42% respectively of the total number of individuals caught (Table 2).

The relative abundance of each species over the entire survey was ranked according to the criteria: rare — less than 100 individuals captured; common — between 100 and 1000 individuals captured; abundant — more than 1000 individuals captured. A systematic list of all taxa is provided in the Appendix. The species ranked abundance and a list of stations at which it was caught is given for each taxa.

The majority of fish gathered were small benthic species of between 10 and 20 cm total length. Flatfish (particularly Bothidae and Paralichthyidae), goatfish (Mullidae), leatherjackets (Monacanthidae), grinners (Synodontidae) and threadfin bream (Nemipteridae) were the most numerous groups (Table 3). Fish species consituted around 75% of the biomass of the catch (Table 2).

Commercially important fish species (particularly Lutjanidae, Lethrinidae and Serranidae) were represented by small juvenile individuals only and they occurred infrequently.

Few of the species collected were considered to be typical coral reef associated fishes (see Russell, 1983). A comparison of the relative number of species in the 10 most speciose reef fish families (Table 4) indicated that the trawled fish fauna was dissimilar to that of the reef.

Crustacean catch was numerically dominated by portunid crabs (30%), small penaeid prawns (61%) (collectively referred to as coral prawns, see Table 1) and the targeted commercial prawns (8%). Despite their numerical abundance and commercial importance, crustaceans represented only 20% of the total biomass of the catch.

Maretia planulata, a small urchin, was the most numerous echinoderm and occasionally dominated a trawl catch. All other echinoderm species and species groups were uncommon. Their number in any one catch rarely exceeded 20 individuals and their contribution to the total catch weight was negligible.

DISCUSSION

The demersal fauna associated with the central Queensland king prawn fishery was characterised by high species diversity and low numerical abundance within individual taxa.

TABLE 2. Abundance and biomass of major taxonomic groups

Group	Abundance of Taxa		Abundance of Individuals %	Biomass %*
	Number	%		
Pisces	272	57	38.3	75
Crustacea	91	19	41.8	20
Echinodermata	50	11	15.8	2
Mollusca	49	10	3.7	1
Other animals	15	3	0.4	2
TOTAL	477	100	100.0	100

* Estimated

TABLE 3. Relative abundance (percent of individuals) of dominant fish groups.

Taxonomic Group	No. of species*	Abun-dance (%)
FLATFISH (Bothidae, Cynoglossidae, Paralichthyidae, Psettodidae)	11	19.6
GOATFISH (Mullidae)	4	10.6
Paramonacanthus japonicus (Monacanthidae)	1	7.5
LIZARDFISH (Synodontidae)	5	7.2
THREADFISH BREAM (Nemipteridae)	6	7.2
Lepidotrigla calodactyla (Triglidae)	1	3.9
APOGONS (Apogonidae)	5	3.6
Leiognathus splendens (Leiognathidae)	1	3.5
Sorsogonia tuberculata (Platycephalidae)	1	3.5
Hypodytes carinatus (Scorpaenidae)	1	3.0
REMAINING TAXA	237	31.4
TOTAL	272	100.0

* Only includes common species (present in 5% or more of samples).

TABLE 4. Comparison of the proportion (%) of species in ten fish families, representing coral reefs of the Great Barrier Reef and from the trawled fauna adjacent to coral reefs. Fish families selected were the ten most speciose families listed by Russell (1983).

Family	GBR	Trawled fauna
Gobiidae	12.1	0.7
Labridae	8.0	1.9
Pomacentridae	8.0	0.4
Blennidae	4.7	0.7
Apogonidae	3.8	6.3
Serranidae	3.7	3.0
Chaetodontidae	3.7	0.7
Acanthuridae	2.9	0.0
Muraenidae	2.7	0.7
Scaridae	2.6	0.0

Spatial variability in catch composition was pronounced (Watson and Goeden, M.S.). Dominance by an individual species or species group in a catch sample was rare although aggregations of the urchin *M. planulata* were evident from some samples. It is unlikely that their occurrence represented a static '*M. planulata* Community'.

Compared with the demersal trawl fisheries throughout the south-east Asian region (Pauly, 1979), Australia's tropical trawl fisheries are particularly selective in their target species. In Australia, these fisheries are based on large penaeid prawns, and there is only a secondary interest in a few incidental catch components such as bay lobsters (*Thenus* spp.) and squid (Lolliginidae). Despite the economic forces which have led to these differences, the species diversity of the trawled fauna reported from this survey is very similar to that documented for demersal faunas of north-eastern Australia and the south-east Asian region.

Examination of the species composition of the demersal faunas for the Gulf of Carpentaria (see Rainer, 1984, and references therein), the Gulf of Papua (see Watson, 1984, and references therein) and the coastal region of South-east Asia (see Shindo, 1973; Pauly, 1979, and references therein) indicates that the demersal trawl fauna of the central Queensland coast is tropical west Pacific in affinity. Although the ranked dominance order of taxa (at family level) differed between localities, all of the families listed in Table 3 are similarly dominant throughout the tropical west Pacific region. Over 70% of genera and 50% of species are also shared. The demersal trawl fauna represented only a small proportion of species endemic to the Great Barrier Reef region.

Although the central Queensland trawl fishery differs from others of the tropical west Pacific in its proximity to coral reefs, true reef associated species (Russell, 1983) were poorly represented in the fauna described. This indicates that coral reef faunas are largely discrete from those of the adjacent benthic environment which are subjected to commercial trawling.

ACKNOWLEDGEMENTS

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APPENDIX

Systematic list of taxa recorded from the central Queensland prawn fishery. Each taxon was classified according to
its relative abundance as: rare (R), less than 100 individuals sampled; common (C), between 100 and 1000
individuals sampled; abundant (A), more than 1000 individuals sampled. Stations listed are those at which each
taxon was present. Adjacent parentheses indicate species not distinguished during sampling.

Taxa	Abundance and Stations
P. MOLLUSCA	
C. GASTROPODA	
SC. PROSOBRANCHIA	
O. ARCHEOGASTRO-PODA	
F. FISSURELLIDAE	
Scutus unguis	R 4
O. MESOGASTROPODA	
F. XENOPHORIDAE	
Xenophora sp. 1	C 3-5, 7-14, 16-22
F. STROMBIDAE	
Strombus dilatatus	R 18-20, 22
Strombus vittatus	R 2
Terebellum terebellum	R 19
F. CYMATIIDAE	
Distorsio reticulata	R 20
F. BURSIDAE	
Bursa sp. 1	R 1
F. CASSIDAE	
Phalium bisulcatum	R 1
Phalium glabratum angasi	R 17
F. TONNIDAE	
Tonna cerevisina	R 18, 20
Tonna tetracotula	R 6
Tonna sp. 1	R 1
F. CYPRAEIDAE	
Cypraea sp. 1	R 14, 20
F. OVULIDAE	
Volva volva	R 2, 4, 10
F. NATACIDAE	
Polinices sp. 1	R 1
O. NEOGASTROPODA	
F. MURICIDAE	
Bedeva c.f. *paivae*	R 10, 12
Chicoreus banksii	R 19
Chicoreus sp. 1	R 1, 3, 5, 18
Murex nigrospinosus	R 16, 18, 19
Rapana rapiformis	R 6
F. FASCIOLARIIDAE	
Pleuroploca sp. 1	R 12
F. HARPIDAE	
Harpa articularis	R 19
F. VOLUTIDAE	
Melo sp. 1	R 3, 7, 14
Volutoconus grossi mcmichaeli	R 19
F. VASIDAE	

Taxa	Abundance and Stations
Tudicula armigera	R 19
SC. OPISTOBRANCHIA	
O. ANASPIDIA	
F. APLYSIIDAE	
Aplysia sp. 1	R. 12, 22
Dolabella auriculana	R 3, 13, 14, 16, 19
O. NOTASPIDIA	
F. PLEUROBRANCH-IDAE	
Pleurobranchidae sp. 1	C 2, 4, 8, 9, 12-15, 18-22, 24
O. NUDIBRANCHIA	
F. DORIDIDAE	
Dorididae sp. 1	R 11, 13, 20
F. CHROMODORI-DIDAE	
Ceratosoma cornigerum	R 4, 14, 15, 17
F. ARMINIDAE	
Armina sp. 1	R 2, 15
C. BIVALVIA	
SC. LAMELLIBRANCHIA	
O. TOXODONTA	
F. ARCIDAE	
Opularca tenella	R 15
O. ANISOMYARIA	
F. PECTINIDAE	
Chlamys leopardus	C 2, 3, 8-13, 16-20, 23
Chlamys sp. 1	R 8, 12, 19
F. AMUSIIDAE	
Amusium balloti	A 1-24
Amusium pleuronectes	A 1-3, 5, 6, 8, 15
F. SPONDYLIDAE	
Spondylus wrightianus	R 10
O. HETERODONTA	
F. CARDIIDAE	
Fragum hemicardium	R 13
F. TELLINIDAE	
Tellinidae sp. 1	R 16, 22
C. CEPHALOPODA	
SC. COLEOIDEA	
O. SEPIOIDEA	
F. SEPIIDAE	
Metasepia pfefferi	)
Sepia elliptica	A)1-24
Sepia plangon	)
Sepiadarium kochi	)
F. SEPIOLIDAE	
Euprymna sp. 1	C 4-8, 10-13, 16-21, 23, 24

Sepioloidea
lineolata R 3, 10, 11, 16
O. TEUTHOIDEA
F. LOLIGINIDAE
Loligo chinensis C 1, 2, 4-8, 10-14,
19, 20, 22, 23
Loligo sp. 1 R 1, 20
Loliolus sp. 1 R 2
O. OCTOPODA
F. OCTOPODIDAE
Octopus spp. C 1-24

P. CRUSTACEA
C. MALACOSTRACA
SC. HOPLOCARIDA
O. STOMATOPODA
F. GONODACTYLIDAE
Gonodactylus
graphurus R 5, 8, 15
F. HARPIOSQUIL-
LIDAE
Harpiosquilla harpax R 1, 15, 21
Harpiosquilla
melanoura R 19, 21
F. SQUILLIDAE
Squilla anomala C 1, 2, 6, 8, 15
Squilla costata R 1, 15
Squilla multicarinata C 2, 3, 8, 10-14, 16,
18, 19, 22, 23
Squilla nepa R 1
Squilla quinquedentata R 1, 2, 5
Squilla woodmasoni C 1-4, 6, 15, 24
Squilla sp. 1 R 8
Squilla sp. 2 R 1
SC. PERACARDIA
O. ISOPODA
Calcipila cornuta R 4, 16
Creniola saurida R 8
SC. EUCARIDA
O. DECAPODA
F. SOLENOCERIDAE
Solenocera australiana R 1
Solenocera sp. 1 C 1-10, 12, 13, 16,
17, 20-24
Solenocera sp. 2 R 4, 19
F. PENAEIDAE
Atypopenaeus
stenodactylus R 1
Metapenaeopsis A 3-5, 7-14, 16-22,
lamellata 24
Metapenaeopsis
mogiensis A)
Metapenaeopsis)
palmensis A)1-24
Metapenaeopsis rosea A)
Metapenaeus A 1-6, 8, 13-15, 17,
endeavouri 18, 20-24
Metapenaeus ensis A 1, 2, 5, 15
Parapenaeopsis cornuta R 1, 15
Penaeus canaliculatus R 4
Penaeus esculentus C 1, 2, 14, 15

Penaeus latisulcatus A 1-14, 16-21, 24
Penaeus longistylus A 2-14, 16-24
Penaeus merguiensis R 1, 2
Penaeus monodon R 1, 2, 15
Penaeus semisulcatus A 1, 2, 15
Trachypenaeus)
anchoralis A)
Trachypenaeus)
curvirostris A)1-24
Trachypenaeus A)
granulosus A)
Trachypenaeus fulvus A)
F. SICYONIDAE
Sicyonia cristata A 3-14, 16-24
F. ALPHIIDAE
Alpheus sp. 1 R 19
F. PALINURIDAE
Panulirus ornatus R 3, 21
F. SCYLLARIDAE
Scyllarus demani C 2-7, 9, 11-14,
16-21, 24
Scyllarus rugosus C 2-10, 12-14, 16-22
Scyllarus martensii R 5, 8, 9, 19, 22
Thenus orientalis A)
Thenus sp. 1 A)1-20, 22, 24
F. PAGURIDAE
Paguridae spp. R 2, 9, 11-13, 16,
17, 19, 20, 24
F. GALATHEIDAE
Galatheidae sp. 1 R 18
F. DROMIIDAE
Dromidia sp. 1 R 14
Dromidiopsis
australiensis R 2, 13, 14
Dromidiopsis edwardsi R 20
F. DORIPPIDAE
Dorippe frascone R 3, 20
F. LEUCOSIIDAE
Arcania elongata R 2, 3, 11-13
Ixa inermis R 5-24
F. MAJIDAE
Austrolobinia
capricornensis R 22
Hyastenus campbelli R 3-5, 11, 14, 15
Naxoides taurus R 1
Phalangipus
australiensis R 1, 2, 4, 13, 23
F. PARTHENOPIDAE
Cryptopodia sp. 1 R 1, 3, 14
Parthenope contrarius R 15, 16
Parthenope longimanus R 3, 15
Zebrida adamsi R 16, 20
F. CORYSTIDAE
Jonas luteanus R 2, 4, 8-12, 16,
17, 21, 23, 24
Notopus dorsipes R 6, 10
F. PORTUNIDAE
Charybdis anisodon R 1, 2
Charybdis calianassa R 1
Charybdis cruciata R 1, 4, 6, 15

Charybdis jaubertensis	*A 1-6, 12-14, 16-20, 22, 24*
Charybdis natator	*R 2, 3, 4, 14, 17, 21*
Charybdis truncata	*A 1-6, 8, 9, 15, 20-23*
Lupocyclus philippinensis	*R 3*
Lupocyclus rotundatus	*C 2, 4-14, 16-24*
Podophthalmus vigil	*R 1, 2, 15, 24*
Portunus argentatus	*A 1, 3-12, 15-17, 19, 21-24*
Portunus gracilimanus	*C 1-3, 7, 12, 15*
Portunus orbitosinus	*C 1-6, 8, 10, 11, 15, 16, 19*
Portunus pelagicus	*C 1-5, 7, 14, 15, 17, 21, 24*
Portunus rubromarginatus	*A 1-24*
Portunus sanguinolentus	*R 1, 4, 20*
Portunus tenuipes	*A 2-24*
Portunus tuberculosis	*R 1, 2*
Thalamita parvidens	*R 6*
Thalamita sima	*R 2*
Thalamita sp. 1	*R 3, 12, 22*

F. XANTHIDAE

Actumnus pugilator	*R 3, 13, 17-19*
Demania macnielli	*R 3, 8, 19*
Demania c.f. splendida	*R 10*
Eucrate dorsalis	*R 1, 8, 15*
Liagore rubromaculata	*R 2*
Neoxanthias michelae	*R 5*
Pilumnus ?longicornis	*R 9*
Pilumnus nigrispinifer	*R 19*
Thacanophrys longispinus	*R 13*
Trichia dromiaeformis	*R 22*

P. ECHINODERMATA
C. CRINOIDEA
SC. ARTICULATA
O. COMATULIDA

Comatulid spp.	*C 1-8, 10, 12-24*

F. COMASTERIDAE

Comanthina schlegeli	*R 21*

F. ASTEROMETRIDAE

Pterometra venusta	*R 11*

C. ASTEROIDEA
O. PHANEROZONIA
F. LUIDIIDAE

Luidia maculata	*R 4, 5, 14-18, 22*

F. ASTROPECTINIDAE

Astropecten zebra	*R 2, 14, 15, 23*

F. GONIASTERIDAE

Anthenea sp. 1	*R 10, 13, 14, 17, 20*
Goniasteridae sp. 1	*R 4*
Goniodiscaster australiae	*R 13*
Iconaster longimanus	*R 14*
Iconaster sp. 1	*R 14*
Stellaster equestris	*C 1-16, 8, 10-20, 24*

F. ORIASTERIDAE

Asterodiscus elegans	*R 12*
Culcita novaeguinea	*R 3*
Pentaceraster gracilis	*R 1, 2, 4, 6, 14, 15, 16*
Pentaceraster regulus	*R 14, 22*
Pentaceraster sp. 1	*R 15, 19*
Poraster superbus	*R 10, ?13*

F. OPHIDIASTERIDAE

Nardoa sp. 1	*R 3*
Tamaria fusca	*R 15, 17*
Tamaria megaloplax	*R 19*

F. METRODIRIDAE

Metrodira subulata	*A 3-5, 8, 10, 12, 14, 15, 17, 19-21*

O. SPINULOSIDA
F. ACANTHASTERIDAE

Acanthaster brevispinus	*R 5, 10*
Acanthaster planci	*R 19*

F. PTERASTERIDAE

Euretaster insignis	*R 14*

C. OPHIUROIDEA

Ophiuroid spp.	*R 2-4, 8, 13, 15, 20*

O. PHRYNOPHIURIDA
F. EURYALIDAE

Euryale aspera	*C 4-8, 16, 22-24*

O. GNATHOPHIURIDA
F. OPHIOTRICHIDAE

Ophiomaza cacaotica	*R 5, 8*
Ophiothrix martensi australis	*R 3, 6, 13*

O. CHILOPHIURIDA
F. OPHIODERMATIDAE

Ophiarachnella gorgonia	*R 20*
Ophiochasma stellatum	*R 2, 8, 9, 22*

C. ECHINOIDEA
O. CIDAROIDA
F. CIDARIDAE

Prionocidaris bispinosa	*C 2-5, 7, 9, 10, 12-15, 17, 19-21*

O. CENTRECHINOIDA
F. DIADEMATIDAE

Chaetodiadema granulatum	*C 1, 2, 5, 11, 12, 14-17, 19, 22*

F. TEMNOPLEURIDAE

Salmaciella dusumieri	*A 3-20, 22-24*
Temnotrema bothryoides	*C 2-4, 7, 12-18, 20, 21*
Temnotrema sp. 1	*R 13, 14, 20*

O. EXOCYCLOIDA
F. LAGANIDAE

Peronella lesueuri	*C 2, 3, 9, 10, 12-15, 17, 18*
Peronella orbicularis	*C 2-10, 12-14, 17-20*

F. SPATANGIDAE

Maretia planulata	*A 2-15, 17-22, 24*

C. HOLOTHUROIDEA
  O. DENDROCHIROTIDA
    F. CUCUMARIIDAE
      Pentacta anceps   R)
      Pentacta crassa   R)
      Pentacta   )
        quadrangularis   R)
      Psuedoclolochirus   )
        axiologus   R)
    F. PHYLLOPHORIDAE   )
      Actinocucumis typicus   R)
      Phyllophorus   )
      (Urodemella)   )
      holothuroides   R)
  O. ASPIDOCHIROTIDA   )
    F. HOLOTHURIIDAE   )*1-9, 11-22, 24*
      Actinopyga echinites   R)
      Bohadschia sp. 1   R)
      Holothuria   )
        (Mertensiothuria) sp. 1   R)
      Holothuria (Metriatyla)   )
        ocellata   R)
      Holothuria (Metriatyla)   )
        martensi   R)
    F. STICHOPODIDAE   R)
      Stichopus variegatus   R)

P. CHORDATA
C. ASCIDIACEA
    Zooanthus sp. 1   A   *2-6, 8-24*
    Ascidian spp.   A   *2-6, 9-10, 12-24*
C. CHONDRICHTHYES
  SC. ELASMOBRANCHI
    O. SELACHII
      F. ORECTOLOBIDAE
        Orectolobus sp. 1   R *3*
      F. HEMISCYLIDAE
        Chiloscyllium
        punctatum   R *1, 9*
    O. BATOIDEA
      F. RHYNCHOBATIDAE
        Rhynchobatus sp. 1   R *2, 24*
      F. DASYATIDAE
        Dasyatis kuhlii   R *1-3, 14*
        Himantura sp. 1   R *1*
C. OSTEICHTHYES
  SC. ACTINOPTERYGEI
    O. CLUPEIFORMES
      F. CLUPEIDAE
        Amblygaster sirm   R *4*
        Sardinella fimbriata   R *1*
      F. ENGRAULIDAE
        Thryssa hamiltoni   R *1*
        Thryssa setirostris   R *1, 2, 14, 15*
        Stolephorus devisi   R *1*
    O. ANGUILLIFORMES
      F. CONGRIDAE
        Conger cinereus   R *23*
      F. MURAENIDAE
        Gymnothorax
        reticularis   R *6*

        Gymnothorax
        undulatus   R *3*
      F. MURAENESCOC-
IDAE
        Muraenesox bagio   R *1*
      F. NETTASTOMA-
TIDAE
        Nettastomatidae sp. 1   R *13*
    O. SILURIFORMES
      F. PLOTOSIDAE
        Euristhmus lepturus   R *1*
        Euristhmus nudiceps   C *2, 4, 5, 15, 22, 23*
        Plotosus anguillaris   R *2, 3, 9, 20*
    O. MYCTOPHIFORMES
      F. SYNODONTIDAE
        Saurida
        micropectoralis   R *6*
        Saurida tumbil   C *1, 2, 5, 15, 23*
        Saurida undosquamis   A   *1-24*
        Saurida sp. 1 (juvenile)   R *1*
        Synodus sageneus   A   *2-4, 7, 9-14,*
                    16-21, 24
        Synodus similis   A   *2-22, 24*
        Synodus sp. 1   R *9*
        Trachinocephalus
        myops   A   *2-14,16-21, 23, 24*
    O. BATRACHOIDI-
FORMES
      F. BATRACHOIDIDAE
        Batrachomoeus
        trispinosus   C *4, 12, 14, 17-20, 24*
    O. LOPHIIFORMES
      F. ANTENNARIIDAE
        Antennarius
        commersoni   R *6, 11*
        Antennarius hispidus   R *4, 10, 11, 24*
        Antennarius mummifer   R *10, 19*
        Antennarius striatus   R *3, 6, 9-11, 13,*
                    14, 19, 21,
        Tathicarpus butleri   C *1, 3, 4, 9, 10, 12,*
                    13, 16-20, 23
      F. TETRABRACHIIDAE
        Tetrabrachium
        ocellatus   R *1, 11*
    O. OPHIDIIFORMES
      F. OPHIDIIDAE
        Sirembo jerdoni   R *2, 5, 8, 15, 22*
        Sirembo imberbis   R *1*
      F. CARAPIDAE
        Carapus c.f. homei   R *24*
        Jordanicus gracilis   R *5, 19*
    O. GADIFORMES
      F. BREGMACEROT-
IDAE
        Bregmaceros
        c.f. nectabanus   R *1, 15*
    O. BELONIFORMES
      F. BELONIDAE
        ?Ablennes hians (juv.)   R *24*
      F. EXOCOETIDAE
        Cypselurus sp. 1   R *1, 8*

F. HEMIRAMPHIDAE
  Euleptoramphus viridis   R 10
O. BERYCIFORMES
  F. HOLOCENTRIDAE
    Sargocentron rubrum   R 6, 9, 15, 22
O. SYNGNATHIFORMES
  F. SOLENICHTHYIDAE
    Solenostomus sp. 1   R 9
  F. SYNGNATHIDAE
    Halicampus grayi   R 3, 14, 19, 20
    Hippocampus whitei   R 10, 19
    Solegnathus lettiensis   R 5, 6, 12, 13, 20
  F. FISTULARIIDAE
    Fistularia commersoni   C 1-3, 5, 6, 8-11,
                                13, 14, 20-24
  F. CENTRISCIDAE
    Centriscus scutatus   A 1-17, 20
O. SCORPAENIFORMES
  F. SCORPAENIDAE
    Cottapistus cottoides   R 3, 13, 20
    Dendrochirus
    brachypterus   R 4, 7, 9, 11, 12,
                                17, 18, 20
    Dendrochirus zebra   R 3, 10, 17
    Erosa erosa   C 3-10, 12-14, 16-24
    Hypodytes carinatus   A 2-24
    Inimicus caledonicus   A 2-5, 7-24
    Liocranium
      praepositum   R 2
    Minous trachycephalus   C 3-9, 11, 12, 14-16,
                                19-24
    Minous versicolor   C 3-6, 8, 9, 12, 14,
                                15, 24
    Paracentropogon
      longispinus   A 2-4, 8, 13-15
    Parascorpaena pictus   R 15
    Peristrominous dolosus   C 4, 7, 10, 12,
                                16-19, 23
    Pterois volitans   C 2-6, 9, 12, 14-17
    Scorpaenopsis cirrhosa   R 2, 3, 13, 14
    Scorpaenopsis sp. 1   R 14
    Tetraroge leucogaster   C 3-5, 7-9, 11-13,
                                16-22, 24
  F. TRIGILIDAE
    Lepidotrigla
      calodactyla   A 2-24
  F. APLOACTINIDAE
    Aploactis aspera   C 2-4, 6, 9-13,
                                16-18, 20, 24
    Adventor elongatus   R 2
    Kanekonia
      c.f. queenslandica   R 6, 16
    Paraploactis c.f. obbesi R 16, 17, 20
    Paraploactis sp. 1   R 3
  F. PLATYCEPHALIDAE
    Elates ransonneti   C 1, 2, 15
    Inegocia isacanthus   A 1-6, 9, 11, 13-15,
                                17, 19-21, 24
    Onigocia macrolepis   R 9, 15
    Onigocia spinosus   R 2, 17
    Onigocia sp. 1   R 3
    Onigocia sp. 2   R 9, 18

Papilloculiceps
  (*Cymbacephalus*)
    nematophthalmus   R 2, 14
Platycephalus
    endractensis   R 1, 2, 15
Rogadius asper   C 2-6, 8, 9, 14,
                                19-24
Sorsogonia tuberculata   A 3-24
Suggrundus
    macracanthus   C 1, 2, 15
Suggrundus sp. 1   C 3-5, 10, 18
Suggrundus sp. 2   C 3-14, 16-24
O. DACTYLOPTERI-
FORMES
  F. DACTYLOPTERI-
DAE
    Dactyloptena orientalis   C 1, 3-6, 8, 10,
                                14-16, 19, 21, 24
    Dactyloptena papilio   A 1-24
O. PEGASIFORMES
  F. PEGASIDAE
    Zalises draconis   R 4, 8, 18, 20
O. PERCIFORMES
  F. SERRANIDAE
    Centrogenys vaigiensis   R 15
    Cephalopholis boenack   R 2, 16
    Cromileptes altivelis   R 24
    Epinephalus areolatus   R 21, 22
    Epinephalus quoyanus   R 5
    Epinephalus
      sexfasciatus   C 1-3, 5, 15
    Epinephalus tauvina   R 2
    Plectropomus
      maculatus   R 2
  F. PSEUDOCHRO-
MIDAE
    Pseudochromis
      quinquedentatus   R 1, 4, 24
  F. PLESIOPIDAE
    Fraudella carasiops   R 16, 20
  F. TERAPONIDAE
    Pelates quadrilineatus   C 1, 2, 14, 15, 21
    Pelates sexlineatus   R 2, 3, 15
    Terapon jarbua   R 1, 15
    Terapon puta   R 15
    Terapon theraps   C 1-4, 14, 15
  F. PRIACANTHIDAE
    Priacanthus
      macracanthus   C 2-10, 12-20, 22
    Priacanthus tayenus   C 1-5, 8, 15, 21
  F. APOGONIDAE
    Apogon aureus   R 22
    Apogon brevicaudatus   R 2
    Apogon ellioti   A 1-10, 12-24
    Apogon c.f. fasciata   C 1, 2, 14, 15
    Apogon nigripinnis   C 1-4, 6, 7, 12, 13,
                                16-20
    Apogon poecilopterus   A 1-6, 8-10, 13,
                                15-20, 24
    Apogon quadrifasciatus   A 1, 2, 5-11, 13, 15,
                                17-24

Apogon semilineatus	*R 5, 8, 10, 16*
Apogon septemstriatus	*C 1-11, 13, 14, 16-20, 22, 24*
Apogon sp. 1	*R 9, 16*
Apogon sp. 2 (juvenile)	*R 2, 5, 14, 21*
Apogon sp. 3	*C 3-5, 8-13, 16-20, 22, 24*
Apogonichthys sp. 1	*C 2, 8, 12-14, 16, 17, 20, 22*
Archamia fucata	*R 16, 22*
Pristiapogon exostigma	*R 10, 22*
Siphamia fuscolineata	*R 2, 4-6, 11, 12, 16, 17, 19, 20*
Siphamia sp. 1 (juvenile)	*R 5*

F. SILLAGANIDAE

Sillago maculata burrus	*C 1-4, 15*
Sillago sp. 1	*C 1, 3, 4*

F. RACHYCENTRIDAE

Rachycentron canadus	*R 3*

F. ECHENEIDIDAE

Echeneis naucrates	*R 2, 3, 5, 14*

F. CARANGIDAE

Alectis indica	*R 1, 15, 19*
Alepes apercna	*R 15*
Carangoides hedlandensis	*R 5*
Carangoides humerosus	*C 1-3, 5, 6, 10, 11*
Carangoides uii	*R 4, 19, 23*
Carangoides c.f. uii	*R 9, 10*
Caranx bucculentus	*R 15*
Decapterus macrosoma	*R)*
Decapterus russelli	*R)3, 4, 19, 21*
Gnathanodon speciosus	*R 2*
Parastromateus niger	*R 1*
Selar boops	*R)*
Selaroides leptolepis	*R)1, 2, 10, 15, 21*
Seriolina nigrofasciata	*R 10-12*
Ulua aurochs	*R 15*
Uraspis uraspis	*R 10*

F. LEIOGNATHIDAE

Gazza minuta	*R 15*
Leiognathus bindus	*R 1, 2, 15*
Leiognathus decorus	*R 1*
Leiognathus elongatus	*R 5, 8-10*
Leiognathus equulus	*C 1, 2*
Leiognathus moretoniensis	*C 1-3*
Leiognathus splendens	*A 1-3, 15*
Secutor ruconius	*R 1*

F. GERREIDAE

Gerres filamentosus	*R 2, 16*
Gerres sp. 1	*R 2, 15*
Gerres sp. 2	*R 2*
Pentaprion longimanus	*R 1, 2, 5, 15*

F. LUTJANIDAE

Lutjanus c.f. amabilis	*R 22*
Lutjanus carponotatus	*R 15*
Lutjanus erythropterus	*R 2, 15*
Lutjanus malabaricus	*R 1, 2, 15*
Lutjanus russelli	*R 2, 22*
Lutjanus sebae	*R 2, 6, 8, 14, 15*
Lutjanus vittus	*R 2, 5, 8, 9, 21*

F. CAESIONIDAE

Pterocaesio sp. 1	*R 21, 22*
Pterocaesio sp. 2	*R 19, 22*

F. NEMIPTERIDAE

Nemipterus furcosus	*A 2, 3, 5-9, 12-24*
Nemipterus hexodon	*C 1-3, 15*
Nemipterus c.f. marginatus	*A 2-24*
Nemipterus metopias	*R 2, 8-10*
Nemipterus tolu	*A 1-5, 8, 11, 16, 20-24*
Nemipterus sp. 1	*R 8*
Pentapodus paradiseus	*C 2, 3, 5, 8, 12-15, 20-22*
Pentapodus sp. 1	*R 11*
Pentapodus sp. 2	*R 8, 9*
Scolopsis monogramma	*R 21*
Scolopsis taeniopterus	*C 2, 3, 15*

F. HAEMULIDAE

Diagramma pictum	*C 2, 4, 7-9, 11, 15, 18, 19, 21, 23*
Pomadasys maculatus	*C 1-3, 15*
Pomadasys trifasciata	*C 1, 2, 15*

F. LETHRINIDAE

Gymnocranius bitorquatus	*R 12*
Lethrinus haemopterus	*R 1, 2, 12*
Lethrinus nematacanthus	*A 2-5, 8, 9, 12-22*

F. SPARIDAE

Argyrops spinifer	*R 2, 15*

F. SCIAENIDAE

Johnius amblycephalus	*R 2*
Johnius vogleri	*C 1, 2, 15*

F. MULLIDAE

Parupeneus cinnabarberinus	*R 21, 22*
Upeneus sulphureus	*A 1-3, 5, 15*
Upeneus sundiacus	*C 1-3, 7, 13, 15, 17, 18*
Upeneus c.f. tragula	*A 1-6, 8, 12-14, 17-20, 24*
Upeneus sp. 1	*A 3-24*

F. PEMPHERIDIDAE

Parapriacanthus ransonneti	*C 5, 7-10, 16, 18, 21-23*

F. EPHIPPIDAE

Drepane punctata	*R 1, 15*
Platax teira	*C 2, 5, 9, 12-15, 20-22, 24*
Zabidius novemaculeatus	*R 1, 2, 15*

F. CHAETODONTIDAE

Heniochus acuminatus	*R 22*
Parachaetodon ocellatus	*R 2, 14, 15, 21*

F. POMACANTHIDAE
Chaetodontoplus
duboulayi R 15
F. POMACENTRIDAE
Pristotis jerdoni A 2-24
F. CIRRHITIDAE
Cirrhitichthys aprinus R 5
F. CEPOLIDAE
Acanthocepola
abbreviata R 2
Acanthocepola
krusensterni R 10
F. SPHYRAENIDAE
Sphyraena flavicauda R 12, 15
F. POLYNEMIDAE
Polydactylus
heptadactylus R 1, 2, 15
F. LABRIDAE
Choerodon cephalotes C 1-3, 13-15
Choerodon monistigma R 2, 5, 8-10, 15, 22
Choerodon vitta R 5, 8, 15
Choerodon sp. 1 A 3-22, 24
Choerodon sp. 2 R 2, 4, 10, 18, 20
F. OPISTOGNATHIDAE
Opistognathus
latitabunda R 1
F. MUGILOIDIDAE
Parapercis diplospilus R 2
Parapercis nebulosa A 2-24
F. URANOSCOPIDAE
Ichthyoscopus fasciatus R 15
Uranoscopus sp. 1 R 5-7, 11, 17
F. BLENNIDAE
Meiacanthus
germinatus R 6, 8, 14, 15, 18
Xiphasia setifer R 19, 22
F. CALLIONYMIDAE
Calliurichthys grossi A 1-24
Calliurichthys
japonicus R 17
Dactylopus dactylopus A 2-4, 6-9, 11-14,
16-20, 22, 23
Orbonymus rameus A 3-5, 8, 9, 12-21, 24
Repomuscenus belcheri A 1-4, 13, 15, 16
Repomuscenus limiceps R 10
F. GOBIIDAE
Gobiidae sp. 1 R 1
Yongeichthys criniger R 1, 2
F. SIGANIDAE
Siganus fuscescens C 1-4, 13-15, 19-21
F. TRICHIURIDAE
Trichiurus lepturus R 1
O. PLEURONECTI-
FORMES
F. PSETTODIDAE
Psettodes erumei C 1-3, 5, 6, 15,
20-24
F. PARALICHTHYIDAE
Pseudorhombus argus C 2, 3, 5-8, 12, 16,
17, 23

Pseudorhombus arsius R 1, 2, 15
Pseudorhombus
diplospilus C 1-10, 12, 13,
16-24
Pseudorhombus
dupliciocellatus A 2, 4-14, 16-18,
20-24
Pseudorhombus
elevatus A 1-3, 5, 7, 10, 15, 23
Pseudorhombus
spinosus A 1-24
Pseudorhombus sp. 1 R 5, 20
F. BOTHIDAE
Arnoglossus
intermedius A 2-6, 8, 12-24
Arnoglossus waitei A 4-8, 10, 11, 21,
23, 24
Bothus sp. 1 R 10
Engyprosopon
grandisquama A 2-24
Engyprosopon sp. 1 A 3, 5-12, 14, 17,
18, 21
Grammatobothus
pennatus C 2-13, 16-24
Grammatobothus
polyophthalmus C 1-3, 5-7, 9, 10,
12-15, 21, 23
F. PLEURONECTIDAE
Samaris cristatus C 1, 3-9, 11-14, 16,
18-21, 24
F. SOLEIDAE
Aesopia cornuta R 2, 17, 18, 21
Dexillichthys muelleri R 1, 2, 15
Pardachirus pavoninus R 7, 12
Soleichthys sp. 1 R 2, 12, 14, 17, 18,
20
Strabozebrias
cancellatus R 2-4, 13, 14, 20
Zebrias craticula C 3, 4, 7, 9-12, 14,
16-20, 22, 24
F. CYNOGLOSSIDAE
Cynoglossus sp. 1 A 1-21, 23, 24
Cynoglossus sp. 2 R 1, 2, 5
O. TETRAODONTI-
FORMES
F. TETRAODONTIDAE
Amblyrhynchotes
spinosissimus R 10
Anchiosomus
multistriatus R 2, 4, 5, 9, 10,
18, 20, 22
Arothron immaculatus R 2
Arothron stellatus R 2, 8, 10, 16, 19
Canthigaster rivulata R 5, 22
Chelonodon patoca R 15, 17
Lagocephalus scleratus A 1-14, 16-24
Lagocephalus wheeleri R 1
Torquigener brevipinnis R 10
Torquigener
parcuspinus R 10

Torquigener tuberculiferus	*A*	*1-24*
Torquigener whitelyi	*C*	*1, 2, 15*

F. TRIACANTHIDAE
Triacanthus biaculeatus   *R 3*
Trixiphichthys weberi   *R 1, 2, 14, 15*

F. **BALISTIDAE**
Abalistes stellaris   *R 10, 12-14, 19, 23, 24*

F. **MONACANTHIDAE**
Aluterus monoceros   *R 2*
Anacanthus barbatus   *R 3, 5, 7-9, 12, 15*
Brachaluteres taylori   *R 3, 4, 6, 12, 14, 16, 19-21, 24*
Chaetoderma penicilligera   *R 3-5, 13, 14, 20*
Paramonacanthus japonicus   *A 1-24*
Paramonacanthus filicauda   *R 2*
Paramonacanthus sp. 1   *R 1, 2, 14, 15*
Pseudomonacanthus peroni   *R 2, 3, 14, 19*

F. **DIODONTIDAE**
Tragulichthys jaculiferus   *C 2, 3, 9, 13-15, 17, 18, 20*

F. **OSTRACIIDAE**
Lactoria cornuta   *C 2, 6-8, 10-13, 15-17, 19*

Rhyncostracion nasus	*C 2-5, 9, 11, 13-20, 24*
Tetrosomus gibbosus	*C 8-12, 16, 17, 19-21*

C. **REPTILIA**
SC. **LEPIDOSAURIA**
O. **SQUAMATA**
F. **HYDROPHIIDAE**
Acalyptophis peronii   *R*)
Aipysurus duboisii   *R*)
Aipysurus laevis   *R*)2-12, 14-19,)21-24
Hydrophis ornatus   *R*)
Hydrophiidae spp.   *R*)

P. **PORIFERA**
several spp.   *C 2-7, 8, 10, 12-14, 16, 18-22, 24*

P. **CNIDARIA**
Dendronephthia sp. 1   *C 1-15, 20, 23*
Dendronephthia sp. 2   *R 2, 22*
Cnidaria spp.   *R 1, 2, 4, 5, 15, 20, 22*

P. **SIPUNCULA**
several spp.   *R 4, 12, 17*

P. **ANNELIDA**
Chloea sp.   *R 4, 6, 12, 23*
Annelid spp.   *R 12, 14, 16, 18-20, 22*

P. **BRYOZOA**
several spp.   *R 14, 21*

A NEW SPECIES OF *POLYRHACHIS* (*POLYRHACHIS*) FROM PAPUA NEW GUINEA WITH A REVIEW OF THE NEW GUINEAN AND AUSTRALIAN SPECIES (HYMENOPTERA: FORMICIDAE: FORMICINAE)

RUDOLF J. KOHOUT

New Guinea and Australian species of the subgenus *Polyrhachis* of the genus *Polyrhachis* Fr. Smith are reviewed. *P. erosispina* Emery is reinstated from synonymy, raised to specific status, and compared with *P. bellicosa* Fr. Smith. An apparent case of a character displacement observed in these species is discussed. *P. taylori* sp. nov. is described from the Torricelli Mountains, Papua New Guinea. Workers and females of all three species are illustrated. Observations on nesting habits and distribution within Papua New Guinea are included.
□ *Formicidae, Polyrhachis (Polyrhachis), New Guinea, Australia, new species, biology, distribution.*

Rudolf J. Kohout, Queensland Museum, PO Box 300, South Brisbane, Queensland 4101, Australia; 6 August, 1987.

Subgenus *Polyrhachis* of the genus *Polyrhachis* Fr. Smith was revised by Hung (1970). He noted high levels of variability in some species, especially in *P. bellicosa* Fr. Smith, and considered this evidence of a chaotic conglomerate of individual and local variants "without any stable type to be followed". Hung synonymised all but one of the previously described infraspecific taxa, and recognised seven species as *bona fide* members of the subgenus. His system recognised *P. bellicosa* Fr. Smith as the only valid species present in Papua New Guinea.

I visited mainland Papua New Guinea and various adjacent islands in July, August and September, 1984 (with permission of the Conservator of Fauna, Department of Physical Planning and Environment, Port Moresby), to collect and observe *Polyrhachis* species in their natural environments. Special attention was given to nesting habits and distribution, and because much effort was made to locate nests, many previously unknown associations of workers with queens were established. This study is presented as the first in a series of papers dealing with the results of this trip.

The illustrations were drawn with the use of a Zeiss (Oberkochen) SR Steromicroscope and camera lucida. Where possible type material was used for this purpose. Because the holotype of *P. bellicosa* and the syntypes of *P. erosispina* are damaged on their mesosomal dorsa by mount-ing pins, details of their illustrations are based partly on additional, confidently identified specimens which resembled the types in all relevant details. The females illustrated for both species were chosen from colonies with workers confidently identified by type-comparison. The figures of *P. taylori* sp. nov. depict the holotype and a nidoparatype female, which has been appropriately labelled. The micrographs were prepared with a Hitachi S-530 Scanning Electron Microscope using uncoated specimens.

The following conventions for measurements and indices are used: TL — Total length (the necessarily composite measurement of the entire ant). HL — Head length (the maximum measurable length of the head in perfect full face view, measured from the anteriormost point of the clypeal border or teeth, to the posteriormost point of the occipital margin). HW — Head width (the width of the head in perfect full face view, measured immediately in front of eyes). CI — Cephalic index (HW $\times$ 100/ HL). SL — Scape length (the length of the antennal scape, excluding the condyla). SI — Scape index (SL $\times$ 100/ HW). PW — Pronotal width (the width of the pronotal dorsum measured at the bases of the pronotal spines, or across the humeri in species without spines). MTL — Metathoracic tibial length (the maximum measurable length of the tibia of the hind leg). PeH — Petiolar height (measured from the petiolar spiracle to the tangent point of the petiolar hook, in lateral view). PeI — Petiolar index (PeH $\times$ 100/ HL),

Abbreviations for institutions and depositories are those of Taylor and Brown (1985), with the following additions: ZIK — Zoological Institute of the Academy of Sciences, Ukrainian SSR, Kiev. RJK — R.J. Kohout, Brisbane (accessions and private collection data).

Polyrhachis bellicosa Fr. Smith
(Fig. 1 A,B,C,D,E,F; Fig. 2 A,B,C; Fig. 3 A,B,D,E)

Polyrhachis bellicosus Fr. Smith, 1859: 142. Holotype worker. INDONESIA: Aru Is. (A.R. Wallace), OUM (Examined).
Polyrhachis (Polyrhachis) bellicosa Fr. Smith: Hung. 1970: 5 (in part).

DIMENSIONS OF HOLOTYPE
TL 8.98; HL 2.06; HW 1.75; CI 85; (antennae missing); PW 1.03; MTL 3.65; PeH 1.78; Pel 86.

ADDITIONAL MATERIAL EXAMINED
PAPUA NEW GUINEA, NORTHERN PROV.: Owen Stanley Ra., 500 m, Mamba c. 7 km WNW of Kokoda, 08.51 S × 147.41E, 31 Aug.-1 Sept. 1984, RJK acc. 84.403. CENTRAL PROV.: 25 km NE of Sogeri, Musgrave Riv., 25.x.1984, T. Mala; Tapini, 1000-1100m, 18.v.1961, J.L. & M. Gressitt. MOROBE PROV.: nr. Wampit, c .50 m, c. 35 km W of Lae, 06.45 S × 146.40E, 24. & 27. Aug. 1984, RJK acc. 84.345, 365, 377; Lae, < 50m, 17 June 1972, R.W. Taylor acc. 72.371; Mindik, 1200-1600m, ix.1968, N.L.H. Krauss. CHIMBU PROV.: Keglsugl, 2600 m, 13.xiii.1969, J.L. Gressitt. MANDANG PROV.: Wanuma, viii.1968, N.L.H. Krauss. EAST SEPIK PROV.: Angoram, 10m, 13.viii.1969, J.L. Gressitt; Dreikikir, 350-400m, 23.vi.1961, J.L. & M. Gressitt. WEST SEPIK PROV.: Torricelli Mts., Lumi, 400-550m, 03.28 S × 142.02E, 4-13 Aug. 1984, RJK acc. 84.243, 260, 284; ditto, Oct. 1984, D. Waisi; Pes Mission, < 50m, c.12 km WSW of Aitape, 03.11 S × 142.15 E, 31 July — 3 Aug. 1984, RJK acc. 206. NEW BRITAIN PROV.: Gazelle Penins., Baining Mts., nr. Gaulim, c. 150 m, 04.28 S × 152.07 E. 13 July 1984, RJK acc. 84.52, 58, 59; c. 12 km SW of Vudal Agric. College, c. 200 m, 04.25 S × 151.57 E, 15 July 1984, RJK acc. 84.83. INDONESIA, WEST IRIAN: Nabire, S of Geelvink Bay, 1-20m, 2-9 July 1962, J.L. Gressitt. PHILIPPINES, MINDANAO: Agusan, 10 km SE S, Francisco, 12 Nov. 1959, Quate & Yoshimoto. AUSTRALIA, QUEENSLAND: Cape York Penins., Iron Range, 12.43 S × 143.18 E, 26-31 July 1981, RJK acc. 81/138, 216; ditto, 1-3 July 1976, P. Filewood; West Claudie River, Iron Range, 3-10 Dec. 1985, G.B. Monteith & D. Cook; Bamaga, nr. tip of Cape York, 10.53 S × 142.23 E, 18 March 1987, RJK acc. 87.3.

DIMENSIONS
Workers: TL 7.30-8.52; HL 1.80-2.12; HW 1.56-1.96; CI 83-97; SL 2.27-2.72; SI 132-154; PW 0.86-1.01; MTL 3.07-3.68; PeH 1.64-2.07; Pel 87-98 (50 workers measured).

Females: TL 9.77-10.08; HL 2.12-2.22; HW 1.56-1.66; CI 74-76; SL 2.95-3.02; SI 181-189; PW 1.41-1.51; MTL 3.93-4.03; PeH 1.11-1.21; Pel 51-57 (10 females measured).

There are two forms of the petiolar column in workers of *P. bellicosa*, as indicated in the accompanying illustrations. The holotype exhibits the least common of these, in which the anterior section at the immediate base of the spines is swollen (Fig. 1 A,C). Petiolar segments of such structure are rare among other specimens (e.g. Fig. 3 B,E). Only a small percentage of workers in any particular population show this remarkable configuration, and specimens intermediate to the more usual unswollen condition (Fig. 3 A,D) are uncommon. The swollen condition has been observed in populations of *P. bellicosa* from various parts of Papua New Guinea, but only where this species is sympatric with its closely related counterpart, *P. erosispina*.

The preceding was first perceived during field studies, and has been subsequently confirmed for other areas using previously collected material. It is obviously repeated under the same circumstances of contact with *erosispina* in populations of *P. bellicosa* in eastern Indonesia and in the Philippines. A worker of *P. bellicosa* with a swollen petiole was, for example, discovered in material containing both species from Nabire, Irian Jaya. Presence of the phenomenon on Aru Island is confirmed by the holotype itself, and documentation of the presence of *P. erosispina* by Karawajew (1927). The Philippine record is from Mindanao, where a worker with swollen node was collected with 'normal' specimens at the same locality as another undescribed species of the subgenus — a species closely related both to *bellicosa* and *erosispina*.

On the other hand, I have never observed the swollen petiolar condition in Australian populations of *P. bellicosa* despite careful examination of many hundreds of specimens. I believe this to be significantly correlated with the *absence* of any other closely related species in Australia. Indeed, no other species of subgenus (*Polyrhachis*), whether related to *bellicosa* or not, is known from that continent. It is unfortunate, from the taxonomic point of view, that this remarkable feature is relatively rare, for it is the most constant and reliable character identifying

P. bellicosa, even when other characters fail to distinguish the species from sympatric *erosispina* specimens (see, for example, fig. 3 A,B,C,D,E,F).

P. bellicosa was redescribed at length by Hung (1970) and details are not repeated here. The principal characters separating it from *P. erosispina* are given in the *erosispina* discussion below.

Polyrhachis erosispina Emery, 1900 Stat. nov.
(Fig. 1 G,H,I; Fig. 2 D,E,F; Fig. 3 C,F)

Polyrhachis bellicosa var. *erosispina* Emery, 1900: 713 (footnote). Syntype workers. NEW GUINEA: Ramoi (Beccari), INDONESIA: Celebes, Kandari (Beccari), MCG (Examined).
Polyrhachis (*Polyrhachis*) *bellicosa* Fr. Smith; Hung, 1970: 5 (in part).

LECTOTYPE SELECTION

I have examined three syntypes from the Emery Collection, kindly loaned by Dr R. Poggi of the Museo Civico di Storia Naturale, Genoa. Two of these bear identical locality labels reading "N. Guinea, Ramoi, II.1875, Beccari". One of them is here designated the *lectotype*. The specimen is in fair condition and bears three additional labels as follows: "*P. bellicosa* var. *erosispina* Emery" (in Emery's handwriting), "Syntypus" (printed on a red tag) and "Collezione Emery" (on a yellow tag). The second specimen, and a third, which bears the locality label "Celebes, Kandari, III.74., O. Beccari", are here designated as *paralectotypes*.

DIMENSIONS

Lectotype cited first: TL 9.07, 8.01–9.37; HL 2.18, 2.02–2.39; HW 1.93, 1.69–2.09; CI 89, 82–91; SL 2.81, 2.52–3.02; SI 146, 135–150; PW 1.15, 0.93–1.16; MTL 3.69, 3.43–4.08; PeH 2.09, 1.81–2.17; PeI 96, 84–97 (3 measured).

ADDITIONAL MATERIAL EXAMINED

PAPUA NEW GUINEA, NORTHERN PROV.: Owen Stanley Ra., 500m, Mamba c. 7 km WNW of Kokoda, 08.51 S × 147.41 E, 31 Aug.-1 Sept. 1984, RJK acc. 84.403; Pongani River, c. 500m, Boikiki Plant., c. 8 km NNE of Afore, 09.06 S × 148.25 E, 29–30 Aug. 1984, RJK acc. 84.382, 386; Kokoda, 400 m, 22.iii.1956, J.L. Gressitt; Keparra-Sengi, nr. Kokoda, 500m, 26.iii.1956, J.L. Gressitt; Cape Killerton, 0–5m, 6–13.v.1965, W.A. Steffan. CENTRAL PROV.: Mamai Estate, 60m, 17.ii.1965, P. Shanahan; Iongai,

1450m, 9 Nov. 1965, J. Sedlacek; Nunumai via Amazon Bay, July 1969, R. Pullen. GULF PROV.: Murua River, 0–3m, 17–18 Dec. 1964, J. Sedlacek. WESTERN PROV.: Oriomo Govt. Station, 26–28.x.1960, J.L. Gressitt. MOROBE PROV.: nr. Wampit, c. 50m, c. 35 km W of Lae, 06.45 S × 146.40 E, 24 & 27 Aug. 1984, RJK acc. 84.345, 348, 349, 350, 353, 365; Sarawaget Ra., 1000–1200m, 3 km E of Gain, 06.25 S × 146.46 E, 26 Aug. 1984, RJK acc. 84.363; Etep, 600–700m, ix.1968, N.L.H. Krauss; Kalalo, 750m, 20–30 Aug. 1966, G.A. Samuelson; Bulolo, March 1935, F.H. Taylor. MADANG PROV.: Wanuma, viii.1968, N.L.H. Krauss; Karkar I., Kurum, 100 m, viii.1968, N.L.H. Krauss. EAST SEPIK PROV.: c. 2–3 km S of Wirui, S of Wewak, 50-100m, 03.36 S × 143.37 E, 8 Aug. 1984, RJK acc. 84.256; Bainyik, nr. Maprik, 225m, 20–21.vi.1961, J.L. Gressitt; Angoram, 10 m, 13 Aug. 1969, J.L. Gressitt. WEST SEPIK PROV.: Torricelli Mts., Lumi, 400–550m, 03.28 S × 142.02 E, 4–13 Aug. 1984, RJK acc. 84.223, 228, 243, 248, 249, 267, 279, 284, 286; ditto, Oct. 1984, D. Waisi; Pes Mission, < 50m, c. 12 km WSW of Aitape, 03.11 S × 142.15 E, 31 July–3 Aug. 1984, RJK acc. 84.160; Oenake Range, 200-300m, c. 10 km WNW of Vanimo, 03.40 S × 141.12 E, 15 Aug. 1984, RJK acc. 84.288. NEW BRITAIN PROV.: Gazelle Penins., Baining Mts., c. 600 m, c. 3 km N of Malasait, 04.26 S × 151.53 E, 11 July 1984, RJK acc. 84.22. INDONESIA, WEST IRIAN: Nabire, S of Geelvink Bay, 1–20 m, 1–9 July 1962, J.L. Gressitt; Vogelkop, Fakfak, S coast of Bomberai, 10–100m, 10.vi.1959, T.C. Maa; Nabire, 10–40m, S of Geelvink Bay, 2.x.1962, H. Holtmann; Ifar, 400–450 m, 27 June 1962, J.L. Gressitt; Ifar, Cyclops Mts., 300–500m, 28–30.vi.1962, J.L. Gressitt.

DIMENSIONS

Workers: TL 8.01–9.39; HL 2.02–2.39; HW 1.69–2.09; CI 82–90; SL 2.52–3.02; SI 135–150; PW 0.93–1.16; MTL 3.43–4.08; PeH 1.81–2.07; PeI 84–95 (50 workers measured).

Females: TL 10.98–12.14; HL 2.52–2.72; HW 2.07–2.32; CI 80–85; SL 3.38–3.78; SI 156–176; PW 1.56–1.79; MTL 4.23–4.69; PeH 1.16–1.41; PeI 43–51 (20 females measured).

P. erosispina is closely similar to *P. bellicosa* and it seems likely that both have been derived from the same ancestral species. At localities where they are sympatric, morphological and ecological differences are somewhat accentuated and more distinct than those observed in allopatric situations, in which distinctions can become very tenuous. This seems to represent a case of *character displacement* (Brown and Wilson, 1956).

The females of both species are easily recognisable by their relative size and the shape of the head and petiole (Fig. 2 A–F). The workers, as indicated, are very variable, and, while they are
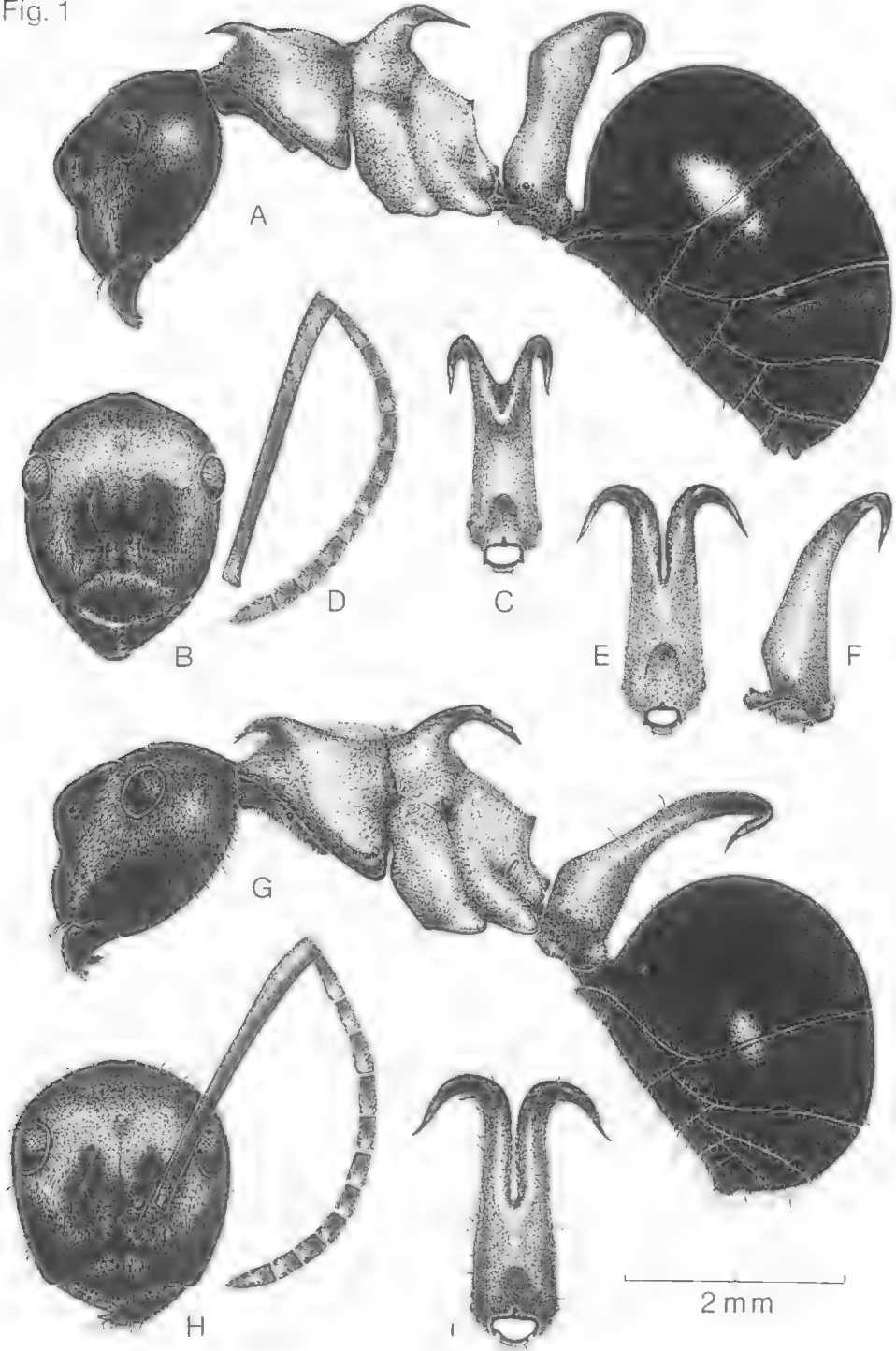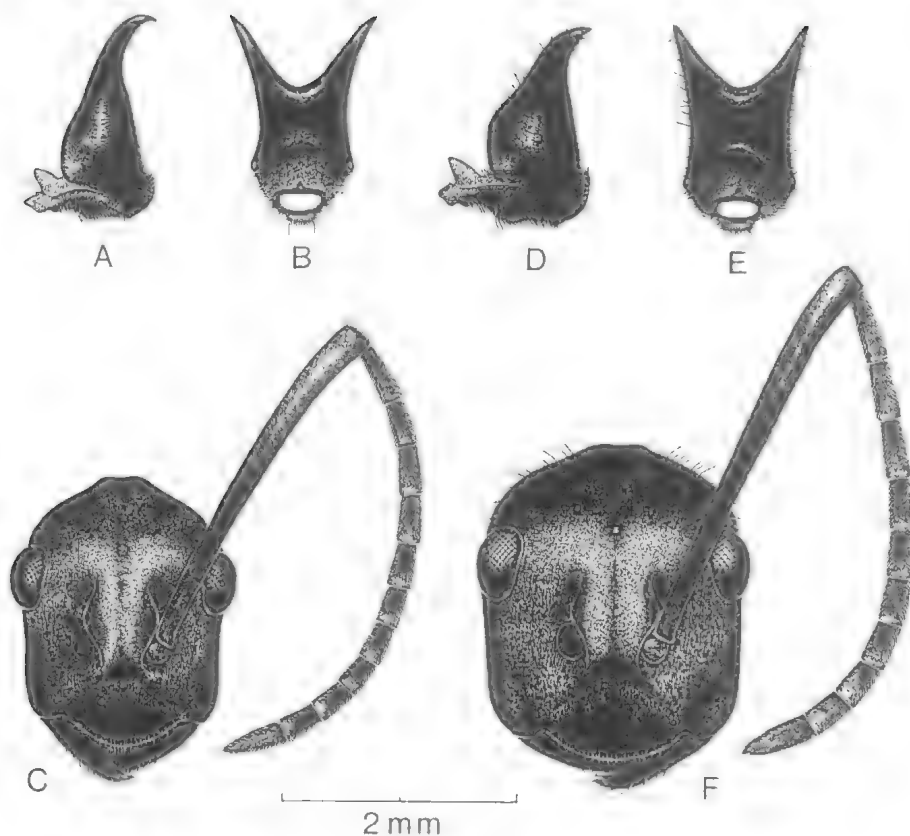
Fig. 1

2 mm

Fig. 2

FIG. 1 A–C *P. bellicosa* (holotype): A — lateral view (legs omitted); B — head in full face view; C — petiole (anterior).

FIG. 1 D–F *P. bellicosa* (compared): D — antenna; E, F — petiole, common form (anterior and lateral).

FIG. 1 G–I *P. erosispina* (lectotype): G — lateral view (legs and antennae omitted); H — head in full face view (right antenna omitted); I — petiole (anterior).

FIG. 2 A–C *P. bellicosa* (female): A, B — petiole (lateral and anterior); C — head in full face view (right antenna omitted).

FIG. 2 D–F *P. erosispina* (female): D, E — petiole (lateral and anterior); F — head in full face view (right antenna omitted).

usually separable, no single diagnostic character applies without reservation. A combination of characters has to be considered to differentiate both species successfully, and occasionally they must be identified with less than complete confidence.

The more reliable diagnostic characters are as follows:

P. bellicosa Fr. Smith	*P. erosispina* Emery
generally smaller (HL 1.79-2.12)	generally larger (HL 2.02-2.39).
in full face view, the eyes clearly break the outline of the head (Fig. 1 B).	in full face view, the eyes at most only marginally exceed the outline of the head, but usually do not (Fig. 1 H).
pronotal dorsum distinctly narrowed anteriorly and more or less broadly rounded posteriorly.	pronotal dorsum only very slightly narrowed anteriorly, with the sides almost parallel.
mesonotal dorsum in profile deeply and broadly impressed at the promesonotal suture (Fig. 1 A).	promesonotal suture only very narrowly impressed, the profile flat (Fig. 1 G).
mesonotal spines at their bases almost pyramidal, with the apical portions more or less horizontal and the dorsal edges entire (unless character displacement has occurred (see Fig. 3 A-F).	mesonotal spines from their bases lanceolate, with the apical portions usually recurved, and the dorsal edges frequently eroded (unless character displacement has occurred (see Fig. 3 A-F).
microsculpture very fine, especially on the head and pronotal dorsum; the latter with a glossy, almost polished, appearance.	microsculpture coarser, notably on the head, which is opaque; pronotal dorsum sub-opaque or only feebly shining, without a glossy, polished appearance.
short or medium-long hairs very sparse on mandibles, anterior clypeal margin, posterior face of anterior coxae, subpetiolar process and gastral sternites (pilosity is thus virtually absent from the whole dorsal surface of the body).	short to long hairs usually abundant over the entire body, especially on the head, lateral portions of pronotum, and petiole.

Polyrhachis taylori, sp. nov.
(Fig. 4 A,B,C,D,E,F)

MATERIAL EXAMINED

HOLOTYPE: PAPUA NEW GUINEA, WEST SEPIK PROV.: Torricelli Mts., Lumi, 400–550m, 03.28 S × 142.02 E, 4–13 August 1984, RJK acc. 84.247.

PARATYPES: data as for holotype (638 nidoparatype workers, 16 nidoparatype dealate females and imma-ture stages — eggs, larvae in various stages of development and pupae of workers and females); ditto, RJK acc. 84.249 (8 paratype workers).

TYPE DEPOSITION

Holotype, most nidoparatypes, 4 paratypes and immature stages in ANIC (Type no. 7731); 10 nidoparatypes (8 workers, 2 females) and 4 paratypes in RJK; 4 nidoparatypes (3 workers, 1

FIG. 3 A–F Scanning electron micrographs of mesonotal spines and petiole of *P. bellicosa* and *P. erosispina* from two different areas of sympatry showing apparent character displacement: A–C, Owen Stanley Range: A, B — *bellicosa*; C — *erosispina*. D–F, Torricelli Mountains: D, E — *bellicosa*; F — *erosispina*.

female) in BMNH: 2 nidoparatype workers each to BPBM, CAS, GMNH, KONE, MCG, MCZ, NHMW, QM, USNM, ZMB, ZSM, ZIK.

WORKER

Dimensions (holotype cited first): TL 7.08, 6.18–7.36; HL 1.70, 1.50–1.75; HW 1.45, 1.29–1.50; CI 85, 82–87; SL 2.21, 1.93–2.34; SI 152, 146–159; PW 0.76, 0.67–0.78; MTL 2.93, 2.56–3.06; PeH 1.40, 1.15–1.50; PeI 82, 77–85 (50 measured).

Mandibles with 5 teeth progressively shorter towards the base. Clypeus convex in profile, not carinate. Sides of head in front of eyes almost

straight, converging anteriorly, rounded behind the eyes. Antennal carinae sinuate, the area between them rather flat, with a weakly defined median longitudinal carina. Antennal scapes exceeding occipital border by approximately half their length. Eyes moderately convex, in full face view breaking the outline of the head. Median ocellus present; lateral ocelli obscure, sometimes lacking. Pronotal dorsum slightly convex in side view; the spines long and acute, projecting antero-laterally, with the tips gently downcurved; outer borders of spines each continuous basally with the rather ill-defined pronotal margin, which terminates at a distinct posteriolateral angle near the promesonotal suture. The latter clearly impressed on the mesosomal dorsum. Mesonotum convex, bearing a pair of pyramidal, rather compressed, posterodorsally projecting spines, with laterally curved tips. Metanotal groove indistinct. Propodeal dorsum weakly margined on each side, the margins terminating posteriorly as medially directed short transverse ridges which partially separate the basal and declivitous faces. Declivity abrupt, shorter than the dorsal face. Petiole columnar, bearing a pair of hook-shaped, transversally flattened spines, more or less divergent from their bases. Gaster eliptical, with first tergite covering less than half the dorsum.

Mandibles shining, finely longitudinally striate-punctate. Head feebly shining, closely reticulate-punctate, with sides less densely sculptured than dorsum. Mesosoma and petiole generally reticulate-punctate, somewhat irregularly reticulate-striate laterally; sculptural intensity reduced on the pronotal disc, which is fairly smooth and shining. Gaster moderately shining, very finely shagreened.

Mandibles, anterior clypeal margin, coxae, subpetiolar process and gaster with sparse, moderately long, sub-erect yellowish hairs. Eyes with numerous short erect hairs. Appressed to sub-erect, short, off-white pubescence abundant on entire body and appendages, without obscuring the underlying sculpturation.

Mandibles, head, antennae, tips of spines, tibiae and tarsi black. Body of mesosoma, petiole, coxae and femora (save for their apical portions) light reddish-brown. Gaster dark reddish-brown, with the base widely diffused with medium reddish-brown colouration. Posterior margins of tergites narrowly black.

FEMALE

Dimensions: TL 8,92–9,47; HL 1,92–1,96; HW 1.43–1.48; CI 73–76; SL 2.71–2.82; SI 185–196; PW 1.18–1.26; MTL 3.43–3.65; PeH 0.94–1.06; PeI 49–54 (16 measured).

Very different from the worker; and with the characters identifying full sexuality — complete thoracic structure and ocelli.

Mandibles with four teeth; the apical tooth 3x longer than those following, which are subequal in length. Clypeus convex in profile, the median portion strongly produced, anterior margin entire, posterior suture distinct, impressed medially, slightly elevated laterally and terminating as a short ridge at the base of the mandible. Sides of the head in front of eyes feebly to distinctly concave, virtually parallel; the cephalic outline strongly converging behind the eyes. Antennal carinae well elevated, more so than in worker; area between them gently concave, with a median longitudinal carina. Antennal scapes extending beyond occipital border by half their length. Eyes relatively large, convex. Pronotum with a pair of short, antero-laterally projecting spines. Mesoscutum quite high anteriorly, with a flat dorsal surface; median line terminating dorsally in a shallow depression; parapsides slightly elevated posteriorly. Mesoscutellum convex, transverse. Propodeal dorsum not marginate, sloping posteriorly to the declivity in an even, medially unbroken curve; posterior angles produced into upturned, medially separated transverse ridges, which do not meet at the midline. Petiole with antero-dorsal face concave, bearing a pair of slender, relatively long, widely diverging spines. Gaster elongated, elliptical.

Mandibles finely longitudinally striate-punctate, with numerous piliferous pits. Clypeus finely punctate. Head reticulate-punctate, the sculptural intensity increasing to coarse on vertex and occiput; moderately shining. Mesosoma and petiole reticulate-punctate, sculptural intensity increasing dorsally, with mesoscutum subopaque. Gaster microscopically reticulate-punctate, moderately shining.

Pilosity very sparse, consisting of short to medium long, sub-erect yellow hairs on mandibles, anterior clypeal margin, posterior faces of anterior coxae, subpetiolar process and posterior margins of terminal gastric tergites and sternites. Very short, fine, appressed yellow
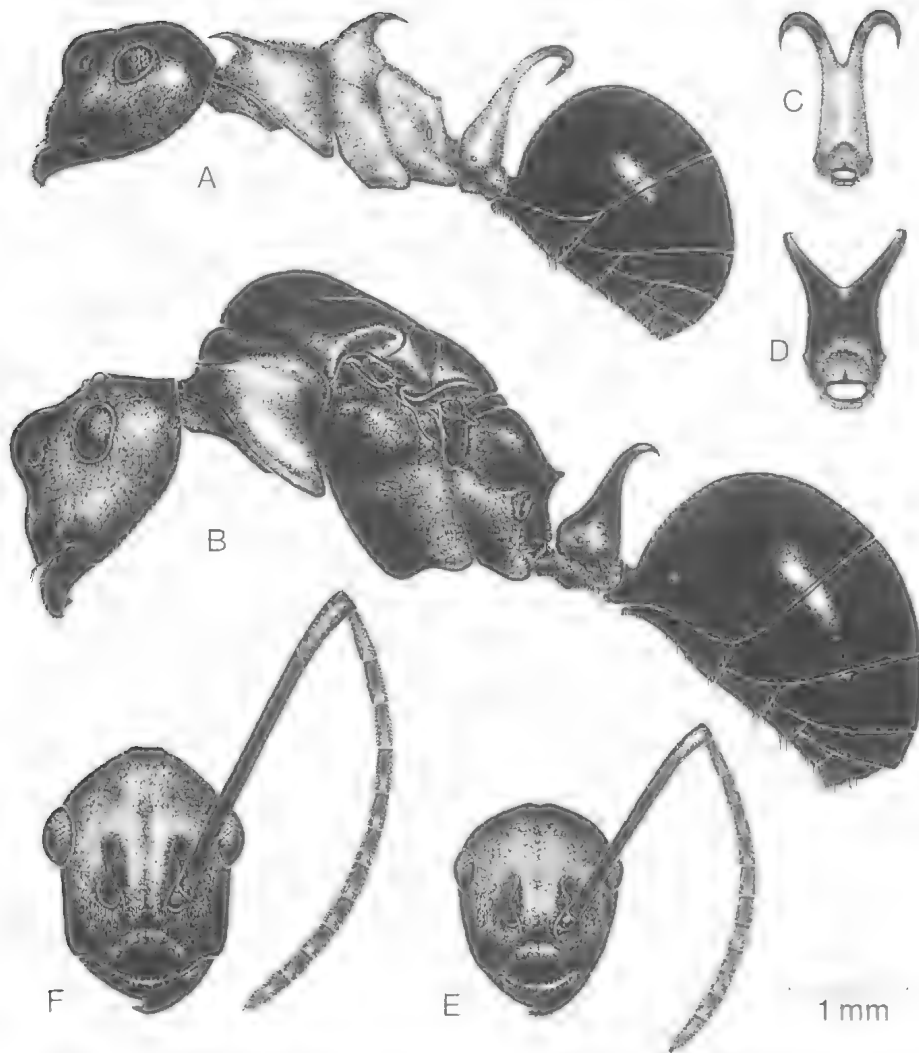
Fig. 4 A–F *P. taylori* (holotype worker and nidoparatype female). Lateral view (legs and antennae omitted): A — worker; B — female. Petiole (anterior): C — worker; D — female. Head in full face view (right antennae omitted): E — worker; F — female.

pubescence abundant all over the body and appendages.

Mandibles reddish-brown, bordered with black. Head and body largely black, with a reddish-brown cast on the neck, lateral portions of pronotum and on sides of petiole below stigma, except subpetiolar process, which is black. Antennal scapes, coxae, femora and tibia medium reddish-brown, somewhat infuscated dark brown, with femora a shade lighter; tarsi black. Gaster black with lateral margins of tergites and sternites infuscated dark reddish-brown.

MALE
    Unknown

IMMATURE STAGES

Eggs off-white, elongate-elliptical, 0.31–0.34 × 0.81–0.87 mm. Larvae with long, hook-terminated hairs. Pupae enclosed in cocoons.

P. taylori is easily recognisable by its small stature (HL < 1.75), which is well below the size of the smallest known *bellicosa* and *erosispina* specimens (HL > 1.80). The petiolar index in *taylori* is relatively low (PeI < 85) and the spines are more or less divergent from their bases. In *bellicosa* and *erosispina* the petiolar index is always higher (PeI > 85) and the spines are parallel for most of their length. These two species are common and widespread throughout Papua New Guinea, but *P. taylori* is known only from its type locality.

BIOLOGY AND OBSERVATIONS

Workers of *P. taylori* were first recognised foraging over felled trees in a native garden established in a clearing of primary forest. They were immediately conspicuous because of their small size. By tracking returning foragers the colony was located in a dry bamboo stick serving as a land marker, topped with a piece of black plastic sheeting. The nest occupied three adjoining internodes of the bamboo, and the only silk employed in its construction formed an ultra-thin lining on the walls of the cavities, and a small opening surrounded by the thickened bamboo node at the top, beneath the plastic cover. The colony was collected entire and comprised 639 workers (many of them callows), 16 dealate females and numerous immature stages, including eggs, small and large larvae and pupae of workers and females. A few additional specimens were collected from a second nest located under much the same circumstances in a nearby bamboo marker.

Besides *P. taylori*, the most common foragers in the surrounding area were the workers of *P. erosispina*. A nest of the latter was located on the edge of the primary forest, some 1.5m above the ground. It measured approximately 20cm in diameter, and was constructed between twisting multi-stems of a woody liana and the adjacent tree trunk. Its walls incorporated the foliage and shoots of an abundant tendril climber. This nest followed the basic structural design observed in *erosispina* throughout Papua New Guinea, and was typical in its situation in the lower arboreal zone. In areas with abundant bamboo growth *erosispina*, together with many other

Polyrhachis species (of subgenera other than *Polyrhachis*), normally nests in bamboo internodes, much as was the case with the *P. taylori* type colony.

The nests of *P. bellicosa* are somewhat similar to those of *P. erosispina*. They are, however, always situated relatively high in the vegetation, often some 3 to 5m above the ground. A few have been observed between clumped leaves of bamboo, but the great majority are constructed between lianas and other climbers pressing against tree trunks. The walls of these nests are normally supported by a strong network of tendrils from surrounding climbing vines, and incorporate other vegetation debris bounded with yellowish-brown silk. Some of the nests observed were quite huge. One in particular measured close to 50cm across and must have contained thousands, if not tens of thousands, of ants. The surrounding vegetation and forest floor was virtually covered by a network of trails with numerous foraging workers.

Regardless of colony size, dissected nests of *P. bellicosa* and *P. erosispina* always contained only one queen. The *P. taylori* type-colony on the other hand contained sixteen apparently reproductive females. Unfortunately field conditions did not allow for dissection and study of ovarian condition in these individuals.

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NOMENCLATURAL CHANGES AND NEW AUSTRALIAN RECORDS IN THE ANT GENUS *POLYRHACHIS* FR. SMITH (HYMENOPTERA: FORMICIDAE: FORMICINAE)

RUDOLF J. KOHOUT

Six former subspecies are elevated to specific rank: *P. ammon angusta* Forel, *P. daemeli argentosa* Forel, *P. ammonoeides crawleyi* Forel, *P. hermione cupreata* Emery, *P. schenkii lydiae* Forel and *P. terpsichore rufifemur* Forel. *P. andromache* Roger is removed from the synonymy of *P. ithona* Fr. Smith and reinstated as a valid species. Fourteen synonyms of species-group names are proposed: *P. ammon* (Fabr.) = *P. ammon angustata* Forel, *P. andromache* Roger = *P. connectens australiae* Emery, *P. dives* Fr. Smith = *P. exulans* Clark, *P. erato* Forel = *P. aeschyle* Forel, *P. fervens* Fr. Smith = *P. valerus* Fr. Smith = *P. indocilis* Santschi = *P. kershawi* Clark, *P. cupreata* Emery = *P. daemeli exlex* Forel, *P. mjobergi* Forel = *P. anguliceps* Viehmeyer, *P. ornata* Mayr = *P. hunterosa* Emery = *P. chrysothorax* Viehmeyer, *P. paxilla* Fr. Smith = *P. lachesis maeandrifera* Emery, *P. sokolova* Forel = *P. sokolova degener* Forel and *P. rufifemur* Forel = *P. terpsichore elegans* Forel. Two species, *P. consimilis* Fr. Smith and *P. paxilla* Fr. Smith, are recorded for the first time from Australia. □ *Formicidae, Polyrhachis, Australia, synonymy, distribution.*

Rudolf J. Kohout, Queensland Museum, PO Box 300, South Brisbane, Queensland 4101, Australia; 18 August, 1987.

Polyrhachis is a large formicine ant genus presently containing well over 800 species-group names, of which over 125 have been listed from Australia (Taylor, 1987). My studies on the systematics of the genus clearly indicate that this number will increase. Examination of type material has revealed a number of unsuspected synonyms, and that many currently infraspecific names should in fact be assigned specific rank. Also, a number of species previously known from elsewhere (New Guinea, Indonesia, etc.) are yet to be reported from localities along the northern fringe of the Australian continent. The most significant developments result from recent collecting activities. Particularly important are the surveys conducted by Dr G.B. Monteith, of the Queensland Museum, on Cape York Peninsula and the mountain ranges along the eastern Queensland coast. My collecting in the open forests and lowland rainforests of northern Australia, including the Gulf of Carpentaria area, has also been productive. These activities have brought to light some of the most interesting *Polyrhachis* species known to science. A decline in the number of valid species, versus available names of Ethiopian *Polyrhachis* was reported by Bolton (1973, 1974) when he reviewed that fauna. The Australian fauna shows the reverse relationship. It can confidently be predicted that, when the necess-

ary changes are implimented and new species described, the characteristically Australian subgenera, such as *P. (Hagiomyrma)* and *P. (Hedomyrma)*, will include probably three times as many species as there are names currently available. Considering the known undescribed species in other subgenera, and also species described from elsewhere but not yet reported from Australia, the overall total of continental *Polyrhachis* species must exceed the available names by a factor of at least two. This study is the first in a projected series dealing with the Australian fauna of the genus, paving the way to more detailed revisionary studies now in preparation. The available names have been set out by Taylor and Brown (1985) and Taylor (1987).

The illustrations were drawn using a Zeiss (Oberkochen) SR Stereomicroscope and camera lucida. The scanning electron micrographs were prepared with a Hitachi S–530 SEM, using gold coated specimens.

Conventions for measurements and indices are those of Bolton (1973) and Kohout (1988).

Distribution data are given as 'short' coordinates based on the 1-degree grid cell system initiated by Taylor (1987). The distribution ranges reported here take account also of specimens in the Australian National Insect Collection (ANIC), CSIRO, Canberra, another

major source of recently collected *Polyrhachis* material. The words "New Guinea" used alone indicate the whole island of that name in the geographic sense. The abbreviations used for institutions and depositories are identical to those of Taylor and Brown (1985), with the following addition: ZIK — Zoological Institute of the Academy of Sciences, Ukrainian SSR, Kiev.

Polyrhachis ammon (Fabricius, 1775)

Formica ammon Fabricius, 1775: 394. Holotype worker. AUSTRALIA, BMNH.
Polyrhachis ammon var. *angustata* Forel, 1902: 525. Holotype worker. AUSTRALIA: GMNH (Examined). Syn. nov.

The unique holotype of *P. ammon angustata* is damaged. It consists of the mesosoma, petiole

and gaster, with the head and most appendages missing. Direct comparison shows the promesonotal dorsum to be rather more narrowed posteriorly that is usual in specimens of *P. ammon*, but not to a degree considered of taxonomic importance. No other significant features distinguishing *angustata* could be found — I therefore consider it to be a junior synonym of *P. ammon*.

Polyrhachis andromache Roger, 1863
(Fig. 1 A,C; Fig. 3 A)

Polyrhachis hector Fr. Smith, 1859: 142. Holotype worker. INDONESIA: Aru Is., OUM (Examined). Nom. preocc. (Junior homonym of *Polyrhachis hector* Fr. Smith, 1857).
Polyrhachis andromache Roger, 1863: 8, 46. (Replacement name).
Polyrhachis connectens Emery, 1887: 230. Syntype workers. INDONESIA, NEW GUINEA: Pulo
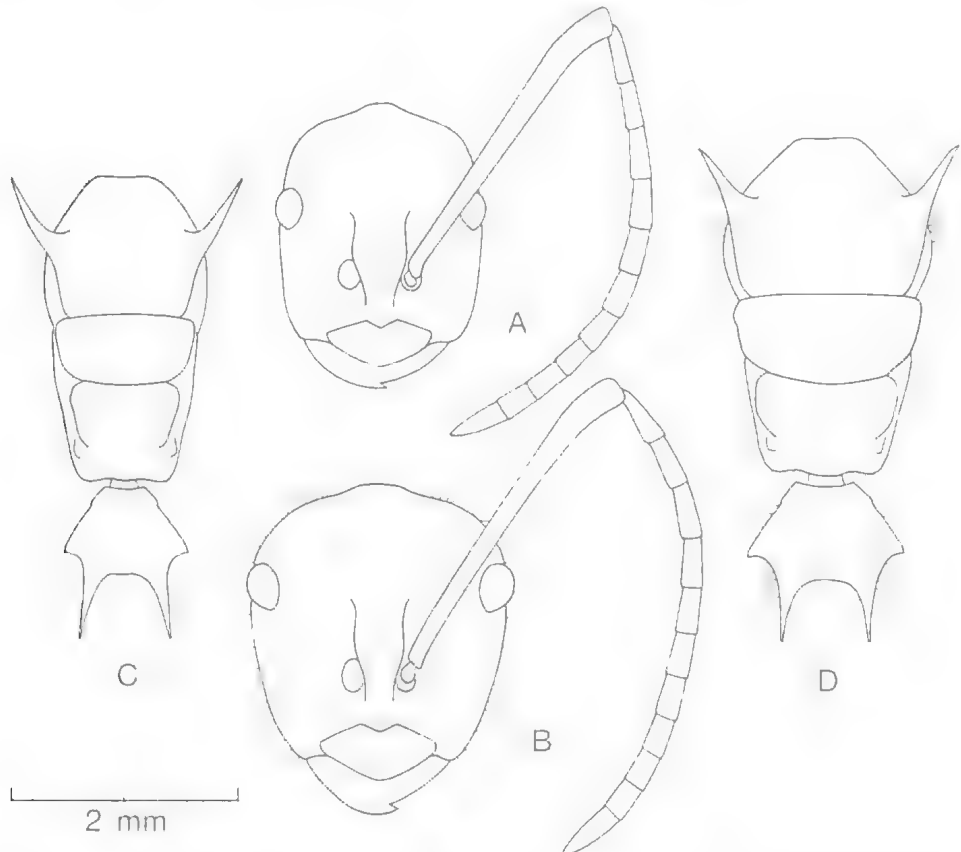
FIG. 1 A, B Head in full face view (right antenna omitted): A — *P. andromache* (holotype); B — *ithona* (syntype). C, D Mesosomal dorsum and petiole: C — *P. andromache* (holotype); D — *ithona* (syntype).

Faor, Fly River, Tangion Bair, Mansinam, Ramoi, Isole Aru, Wokan, MCG (Examined). Syn. by Emery (1897).

Polyrhachis connectens var. *australiae* Emery, 1887: 231. Syntype workers, female. AUSTRALIA: Cape York, Somerset, MCG (Examined). Syn. nov.

Polyrhachis relucens ssp. *decipiens* var. *australiae* Emery, 1897: 580; 1925: 202.

Polyrhachis relucens australiae Taylor and Brown, 1985: 140; Taylor, 1987: 62.

(*Polyrhachis ithona* Fr. Smith; Bolton, 1974: 177, Erroneous synonymy).

Bolton (1974) considered *P. andromache* to be conspecific with *P. ithona* (Fig. 1 B,D), and gave a synonymy which I believe to be erroneous. I have examined all the relevant types and have seen a substantial number of specimens from Australia, Papua New Guinea and Indonesia. As a result I consider both names to be those of valid species. *P. ithona* is easily separable in having numerous short hairs projecting from the sides of the head behind the eyes. Such hairs are never present in *P. andromache*. The head of *P. ithona* is much broader behind than in front and the antennal scapes relatively short (SI < 140) compared to those of *P. andromache* (SI > 145). *P. andromache* is also more slender and delicate than *ithona*, which is a relatively large and stoutly built species.

P. andromache usually nests in tree cavities (surface splits, hollow branches etc.), but occasionally builds pocket-like nests of silk and vegetation debris against tree trunks (Fig. 3 A). In Australia it inhabits the lowland rainforests of northern Cape York Peninsula, from the Torres Strait islands south to Iron Range (Grid cells 9/142, 10/142, 12/143).

Polyrhachis angusta Forel, 1902 Stat. nov.
(Fig. 2 A)

Polyrhachis ammon r. *angusta* Forel, 1902: 524 Syntype workers, females, males. AUSTRALIA: Queensland, Mackay, GMNH (Examined).

This species stands close to *P. ammon*, but is consistently separable by its distinctly slender, more gracile stature. The pronotum in dorsal view is almost quadrate, 0.7–0.8 times as wide as the head, with narrowly rounded shoulders, and the lateral margins distinctly sinuate behind. The propodeal spines are oblique to the main axis of the mesosoma in side view and

slightly divergent from above. In *P. ammon* the pronotum is more or less transverse with the shoulders broadly rounded and the lateral margins narrowed posteriorly and almost straight in outline. The propodeal spines project horizontally, and are subparallel. The appressed pubescence in *P. angusta* is shorter and more dilute, and the pilosity distinctly longer, than in *P. ammon*.

This species nests in soil and appears to be much less common than *P. ammon*. It is patchy distributed from Eungella in northern Queensland to central New South Wales (Grid cells 21/148, 27/152, 28/152, 31/152).

Polyrhachis argentosa Forel.
1902 Stat. nov.
(Fig. 2 G)

Polyrhachis daemeli r. *argentosa* Forel. 1902: 515. Syntype workers. AUSTRALIA: Queensland. Mackay, GMNH (Examined).

Direct comparison of syntypes of *P. daemeli argentosa* with original material of *P. daemeli* from the Naturhistorisches Museum, Vienna (Mayr collection) shows that they represent distinct species. *P. argentosa* is consistently smaller and more slender than *P. daemeli*, with the pronotal sculpturation less coarse, and the mesonotal/propodeal dorsum convex in profile, whereas it is almost straight in *P. daemeli*. *P. argentosa* lacks pubescence on the gastral dorsum and has virtually no pilosity on the dorsal surfaces of the body, which are abundantly pilose in *P. daemeli*.

This is a relatively common species, nesting in plant cavities, usually in small hollow branches. Distribution is restricted to central and northern Queensland, where *P. argentosa* has been taken from Proserpine, south to Rundle Range, northwest of Gladstone (Grid cells 20/148, 20/149, 21/148, 23/150).

Polyrhachis consimilis Fr. Smith, 1858

Polyrhachis consimilis Fr. Smith, 1858: 73, Pl. 4, figs 30, 31. Holotype worker. AFRICA: Sierra Leone, BMNH (Examined).

The type locality of this species, as given in the original description, is highly questionable. Bolton (1973) suggests that Smith was in error when he listed Sierra Leone as the provenence of the type specimen, and this opinion is now
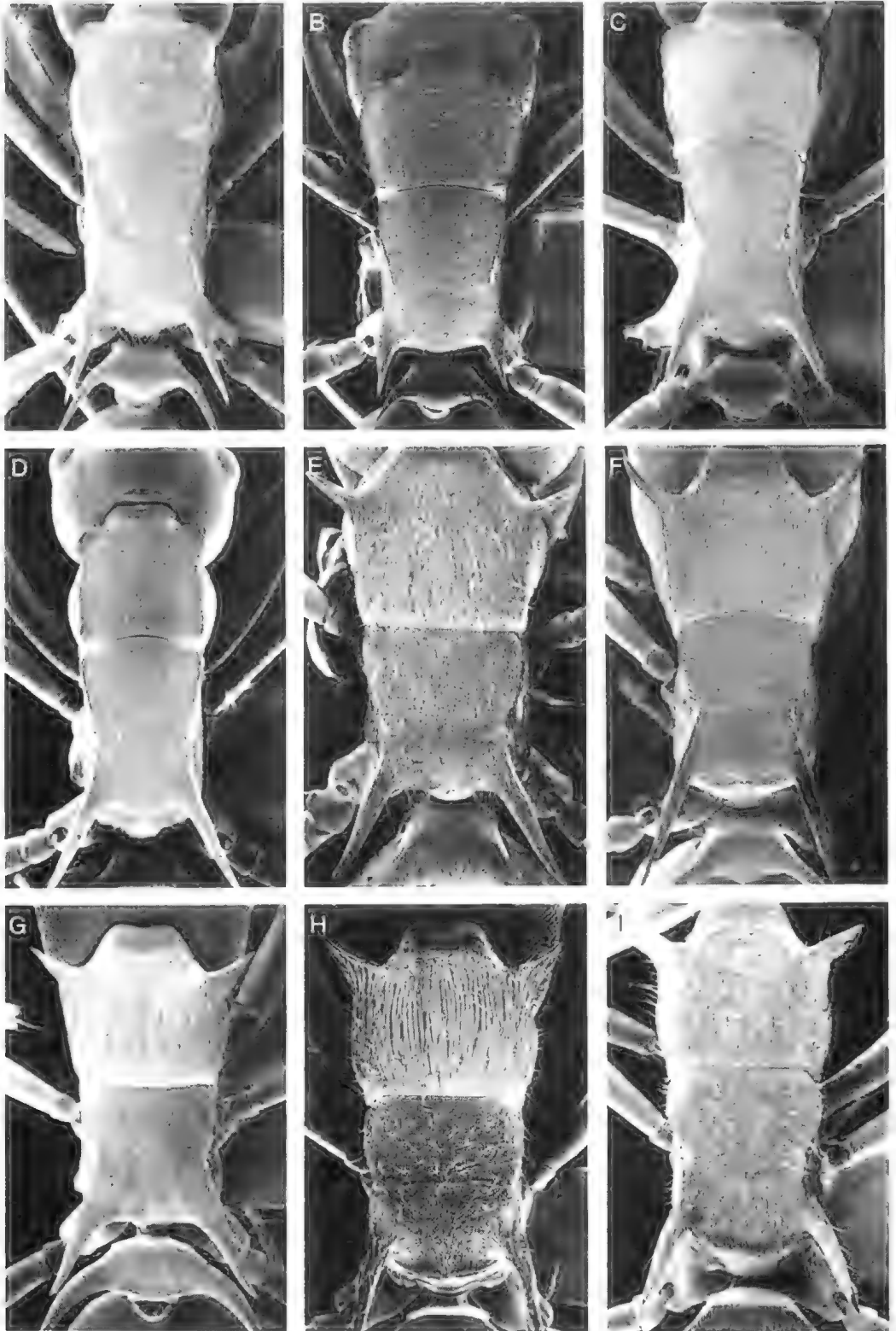
supported by the discovery of a single specimen in the Kimberley region of North Western Australia (near Kalamburu Mission, August 1967, collected by W. Leutert, Grid cell 14/126). I have directly compared this individual with the unique holotype of *P. consimilis* and am satisfied that they are conspecific.

The occurrence of this species in Australia represents an unexpected addition to the continental *Polyrhachis* fauna.

Polyrhachis crawleyi Forel, 1916 Stat. nov.
(Fig. 2 D)

Polyrhachis (Hagiomyrma) ammonoeides var. *crawleyi* Forel, 1916: 447. Syntype workers. NORTH AUSTRALIA, GMNH (Examined).

The unique holotype of *P. ammonoeides* Roger has apparently been lost. I have compared syntypes (Forel coll.) of *P. ammonoeides crawleyi* with specimens identified as *ammonoeides* in the BMNH and ZMB collections (one of which, ZMB, bears an identification label in Forel's handwriting). The two taxa are consistently separable, and I am confident that they are separate, valid species. *P. crawleyi* is smaller (HL <1.80), has longer antennal scapes (SI > 155) and the body is covered by very fine, somewhat dilute silvery pubescence. *P. ammonoeides*, on the other hand, is always larger (HL > 1.90), with much shorter antennal scapes (SI < 148), a generally more glossy appearance, and with pubescence virtually absent from all body surfaces except the gaster. The widely divergent propodeal spines are almost straight in *P. crawleyi*, while in *P. ammonoeides* their tips are distinctly turned outwards.

P. crawleyi is a ground nesting species found in North Queensland and the Northern Territory. It is known from Lakefield on Cape York Peninsula south to Rockhampton, areas to the south of the Gulf of Carpentaria, and the Darwin district (Grid cells 12/130, 12/131, 13/130, 13/131, 14/144, 18/139, 19/146, 20/148, 23/150).

FIG. 2 A — I Scanning electron micrographs of the mesosomal dorsum: A — *P. angusta*; B — *lydiae*; C — *schenkii*; D — *crawleyi*; E — *rufifemur*; F — *terpsichore*; G — *argentosa*; H — *daemeli*; I — *cupreata*. (Not to scale).

Polyrhachis cupreata Emery,
1895 Stat. nov.
(Fig. 2 I)

Polyrhachis hermione var. *cupreata* Emery, 1895: 357. Holotype worker. AUSTRALIA: Queensland, Cairns, MCG (Examined).
Polyrhachis (Hedomyrma) daemeli var. *exlex* Forel, 1915: 110. Holotype worker. AUSTRALIA: Queensland, Yarrabah, SMNH (Examined). Syn. nov.

I have examined the types of *hermione*, *hermione cupreata*, *daemeli* and *daemeli exlex* and I am confident that the separate status of *P. cupreata* is justified, that *exlex* is its junior synonym, and that *P. daemeli* and *P. hermione* are separate species. In *P. cupreata* the whole dorsum of the body is covered with a pale golden pubescence. In contrast, the pubescence in *P. daemeli* is always silvery and is virtually absent from its pronotal dorsum, while in *P. hermione* it is of a rich golden hue and covers most of the body, except the gaster. The mesonotum of *hermione* is strongly transverse, while it is only slightly wider than long in the other two species.

I have seen only one nest of *P. cupreata*, situated at the base of clumped *Pandanus* leaves and constructed of vegetation debris bonded with brownish silk. Distribution is seemingly confined to the coastal wetlands of North Queensland, with records from the Torres Strait islands south to Townsville, and the Northern Territory, where it has been taken on Cobourg Peninsula and near Darwin (Grid cells 9/142, 10/142, 11/132, 12/130, 12/143, 16/145, 17/145, 17/146, 18/145, 18/146, 19/146).

Polyrhachis dives Fr. Smith, 1859
(Fig. 3 B)

Polyrhachis dives Fr. Smith, 1857: 64. Holotype worker. SINGAPORE, BMNH (Examined).
Polyrhachis (Myrmhopla) exulans Clark, 1941: 91, pl. 13, fig. 24. Syntype (?) workers. AUSTRALIA: Northern Territory, Koolpinyah, NMV (Examined). Syn. nov.

Direct comparison of types and subsequent examination of numerous specimens has shown this synonymy to be quite straightforward. The distribution of *P. dives* in Australia is apparently confined to two widely separated areas, one in the Northern Territory (Koolpinyah), and the other in North Queensland (Yarrabah south to Mission Beach) (Grid cells 12/131, 16/145, 17/146). *P. dives* is very common in suitable

habitats in Papua New Guinea, but I have never seen material collected in the Torres Strait islands, on Cape York Peninsula, or south of the Gulf of Carpentaria. The species is only moderately variable, and, although the Australian populations are each apparently well isolated from others, Australian specimens are closely comparable to those from elsewhere.

Nesting habits seem to be identical throughout the range. *P. dives* is found in open woodlands and swampy coastal plains, where it builds a characteristic carton structure on the lower branches of trees and shrubs, joining the foliage and twigs with silk to form the nest (Fig. 3 B).

Polyrhachis erato Forel, 1902

Polyrhachis erato Forel, 1902: 512. Syntype workers. AUSTRALIA: Queensland, Mackay, GMNH, ANIC (Examined).
Polyrhachis (Hedomyrma) aeschyle Forel, 1915: 111. Holotype worker. AUSTRALIA: Queensland, Cedar Creek, SMNH (Examined). Syn. nov.

The only difference between *P. erato* and *P. aeschyle* appears to be the densely pubescent gastral dorsum of the former. However, a few patches of hairs on the gaster of the unique holotype of *P. aeschyle* seem obviously to be the remnants of pubescence now largely lost from the specimen, possibly by abrasion. I believe that when the specimen was fresh, its gaster would have been just as densely pubescent as those of the *P. erato* syntypes. These names are confidently considered to be synonyms.

P. erato nests in tree cavities or under bark on tree trunks, and is distributed from north to south Queensland on the eastern side of the Great Dividing Range. It occurs in a wide variety of habitats, ranging from open *Eucalyptus* forests to the coastal wallum communities (Grid cells 17/145, 21/148, 25/153, 26/153, 27/152, 27/153).

Polyrhachis fervens Fr. Smith, 1860

Polyrhachis fervens Fr. Smith, 1860: 101, pl. 1, fig. 26. Holotype worker. INDONESIA: Amboyna, OUM (Examined).
Polyrhachis valerus Fr. Smith, 1861: 40, pl. 1, fig. 10. Holotype worker. INDONESIA: Celebes (Tondano). OUM (Examined). Syn. nov.
Polyrhachis (Hedomyrma) bicolor Karawajew, 1927: 21, fig. 11. Holotype worker. INDONESIA: Amboina, ZIK (type presumed lost). Nom. preocc. (Junior homonym of *Polyrhachis bicolor* Fr. Smith, 1858).

Polyrhachis (Hedomyrma) indocilis Santschi, 1928: 139. (Replacement name for *Polyrhachis bicolor* Karawajew). Syn. nov.
Polyrhachis (Hedomyrma) kershawi Clark, 1930: 12, fig. 1, nos. 10, 10a. Syntype workers. AUSTRALIA: North Queensland, Claudie River, NMV (Examined). Syn. nov.

Prof. Radchenko of the Zoological Institute, Kiev, informs me that the unique holotype of Karawajew's homonym *P. bicolor* cannot be found in the Karawajew collection, and is presumed lost. However, the original description and illustration are sufficient to establish its synonymy beyond reasonable doubt.

The comparison of syntypes of *P. kershawi* with the holotypes of *P. fervens* and *P. valerus* shows all three taxa are essentially identical and that they undoubtedly represent various populations of a single species.

This species is distributed from Sulawesi to New Guinea and northern Australia. It is known from lowland rainforests at Bamaga near the tip of Cape York Peninsula and at Iron Range, where it usually nests in the dry hollow stems of bamboo (Grid cells 10/142, 12/143).

Polyrhachis lydiae Forel, 1902 Stat. nov.
(Fig. 2 B)

Polyrhachis schenkii r. lydiae Forel, 1902: 523. Syntype workers, female. AUSTRALIA: Queensland, Mackay, GMNH (Examined).

Direct comparison of the *schenkii* holotype with *lydiae* syntypes (Forel coll.) shows *lydiae* to be a distinct and valid species. The most obvious difference is the colour, which in *lydiae* ranges from light metallic green to greenish or bluish black, save for the anterior part of the pronotum, which is always more or less reddish brown. *P. schenkii* is uniformly light reddish brown. Also, the lateral margins of the pronotal and mesonotal dorsa are more strongly converging posteriorly in *schenkii* than in *lydiae*.

Both species nest in the ground, but they differ markedly in distribution. *P. lydiae* is known from Charters Towers in north Queensland, south to Raymond Terrace in central New South Wales (Grid cells 19/146, 20/145, 20/148, 21/148, 22/149, 23/150, 26/153, 27/152, 27/153, 28/151, 28/152, 28/153, 32/151). *P. schenkii* ranges from Papua New Guinea across the Torres Strait islands to Australia, where it occurs on Cape York Peninsula, and in the

Northern Territory (Grid cells 10/142, 11/132, 12/132, 12/136, 12/142, 12/143, 13/136, 14/136, 17/145).

Polyrhachis mjobergi Forel, 1915

Polyrhachis (Hedomyrma) mjobergi Forel, 1915: 112. Syntype workers. AUSTRALIA: Queensland, Glen Lamington, SMNH, GMNH (Examined).
Polyrhachis (Hedomyrma) anguliceps Viehmeyer, 1925: 148. Syntype workers. AUSTRALIA: New South Wales, Trial Bay, ZMB (Examined). Syn. nov.

Viehmeyer seems to have been unaware of Forel's *P. mjobergi* when he described *anguliceps*. I have examined the types of both names indicated above and am confident in declaring them conspecific.

This species is distributed from Eungella in northern Queenland to Batemans Bay in southern New South Wales, and is found at various elevations, mostly in open *Eucalyptus* forest (Grid cells 21/148, 23/149, 25/153, 26/152, 26/153, 27/153, 28/153, 30/152, 30/153, 32/151, 33/151, 35/150). It nests in any suitable cavities on trees, usually in dry hollow twigs or small branches.

Polyrhachis ornata Mayr, 1876

Polyrhachis ornata Mayr, 1876: 73. Syntype workers. AUSTRALIA: Queensland, Rockhampton, NHMW (Examined).
Polyrhachis (Hedomyrma) humerosa Emery, 1921: 18. Syntype workers. AUSTRALIA: Adelaide (?), MCG (Examined). Syn. nov.
Polyrhachis (Hedomyrma) chrysothorax Viehmeyer, 1925: 148. Syntype workers. AUSTRALIA: New South Wales, Trial Bay, ZMB (Examined). Syn. nov.

Direct comparison of the types has shown *P. humerosa* and *P. chrysothorax* to be obvious synonyms of *P. ornata*, representing the same, rather variable species. The differences between them are mostly trivial, based on such characters as the elevation and direction of spines, colour and density of pubescence and, to a lesser degree, on the shape of the petiolar dorsum and convexity of the clypeus. These characters appear at first to be geographically variable. Thus specimens from north and central Queensland are characterised by the pronotal teeth being produced and acute, the propodeal spines strongly divergent and elevated, and the anterior and posterior borders of the petiolar dorsum gently curved. The pubescence of the mesosoma is almost invariably of a rich copper hue, and completely obscures the underlying sculpturation, except for that on the spines and a small patch in the centre of pronotum, where the pubescence is diluted. In contrast, specimens from New South Wales and Victoria have the pronotum only angulate, the propodeal spines much shorter and subparallel, and the petiolar dorsum transverse and narrow, with the anterior and posterior borders parallel. The pubescence is brassy and much diluted, especially on the pronotal dorsum. However, these forms intergrade and in South East Queensland the variation is very marked, with the extreme conditions being represented in single series. When specimens from the whole range of distribution are considered together, no apparently taxonomically significant variability is evident, and the above synonymy follows naturally.

Nests of *P. ornata* can be very numerous, with the colonies usually occuping large hollow branches high in trees. The known distribution ranges from north Queensland to Victoria, where *P. ornata* has been recorded as far south as Bemm River. The original locality of *P. humerosa* was given as Adelaide, but I have never seen specimens collected in South Australia. I believe that the locality given by Emery is questionable, more so as the label under a syntype from the MCG reads 'Adelaide M', with the edge cut just through the letter 'M'. There apparently is no Adelaide M(ountain) in Australia, but *Mount Adelaide* is located in the Conondale Range in South East Queensland, where *P. ornata* is a common species. I suggest that this was the true source of the *humerosa* types. This is supported by the close similarity between recent Conondale Range collections and the syntype. (Summary distribution: 19/146, 20/149, 21/148, 23/150, 23/151; 26/152, 26/153, 27/152, 27/153, 30/153, 33/150, 33/151, 35/150, 37/148).

Polyrhachis paxilla Fr. Smith, 1863

Polyrhachis paxillus Fr. Smith, 1863: 17. Holotype worker. INDONESIA: Martabello I., OUM (Examined).
Polyrhachis lachesis ssp. *maeandrifera* Emery, 1897: 582. Holotype worker. NEW GUINEA: Paumomu River. MCG (Examined). Syn. nov.

It is obvious that Emery (1925) did not have a clear conception of *P. paxilla*, since he placed it

in the subgenus *P. (Chariomyrma)*, while listing *P. lachesis maeandrifera* properly as a *P. (Hagiomyrma)*. This is a very distinct and relatively invariable member of that subgenus. Examination of specimens from Indonesia, Papua New Guinea and Australia reveals almost negligible variability, and the relevant types, when compared, prove to be almost identical, justifying the above synonymy.

P. paxilla represents a new record for the Australian *Polyrhachis* fauna, and was first collected very recently near the tip of Cape York Peninsula (Bamaga, 10.53 S × 142.23E, 18.iii.1987, rainforest, RJK acc. 87.8), (Grid cell 10/142). I collected a nest on 27.viii.1984, near Wampit (06.45 S × 146.40 E), Morobe Prov., Papua New Guinea. It occupied the hollow interior of a small dry bamboo stem.

Polyrhachis rufifemur Forel, 1907 Stat. nov.
(Fig. 2 E)

Polyrhachis terpsichore var. *rufifemur* Forel, 1907: 41. Holotype worker. AUSTRALIA: New South Wales, Springwood, MNH (Examined).
Polyrhachis terpsichore r. *elegans* Forel, 1910: 84. Syntype workers. AUSTRALIA: Queensland, Kuranda, GMNH (Examined). Syn. nov.

Comparison of the unique alate female holotype of *P. terpsichore* with confidently identified females of *rufifemur* has proved beyond doubt that they represent separate species. Further examination also indicates that the light colour of the appendages of the *terpsichore* holotype, a character mentioned by Forel (1893, 1907), is probably due to that specimen being callow.

Direct comparison of the holotype of *rufifemur* with a syntype of *P. terpsichore elegans* indicates that they represent geographically varying populations of a single species. They were distinguished by Forel using characters now known to vary infraspecifically, such as the average size of individuals, the length and elevation of propodeal spines, and the colour and density of pubescence. The representatives of southern populations are generally smaller, with relatively short propodeal spines and more coppery golden pubescence, which almost obscures the underlying sculpturation. Those of northern populations (and some from southern mountains e.g. McPherson Range, Bunya Mountains) tend to be larger, with distinctly

longer propodeal spines. The pubescence is pale brassy and more dilute. This variability applies only to the workers as females vary only in size, and not in the other features discussed above. In spite of these differences I believe that these ants represent a single, albeit rather variable, species.

I have found nests of *P. rufifemur* only occasionally, always inside the cavity of a tree trunk, usually that of a *Melaleuca*. This species is relatively uncommon, with known records restricted to three widely separated areas, one in central New South Wales and the other two in the southern and northern Queensland (Grid cells 16/145; 26/151, 26/152, 26/153, 27/152, 27/153; 33/150).

Polyrhachis sokolova Forel, 1902
(Fig. 3 C — F)

Polyrhachis sokolova Forel, 1902: 522. Syntype workers. AUSTRALIA: Queensland, Mackay, GMNH (Examined).
Polyrhachis sokolova var. *degener* Forel, 1910: 84. Holotype worker. AUSTRALIA: Queensland, Mackay, GMNH (Examined). Syn. nov.

I consider this to be a straightforward synonymy, since the holotype of *degener* is obviously simply a small worker of *P. sokolova*.

This is the only species of *Polyrhachis* known to nest in marine and estuarine mud of the intertidal zone (Fig. 3 C — F). Its nests are mound-like, with a small opening at the top, and are completely submerged at each high tide. Distribution is limited to the tidal mudflats of coastal mangrove forests. *P. sokolova* has been taken along the coastline from Torres Strait to as far south as Gladstone in central Queensland (Grid cells 9/141, 9/142, 9/143, 9/147, 16/145; 18/146, 20/148, 21/149, 23/150, 23/151). I have also collected *sokolova* in southern Papua New Guinea.

A closely related, undescribed species with similar nesting habits, was recently collected by members of the Australian Littoral Society, from tidal mangrove flats on the north coast of the Northern Territory.
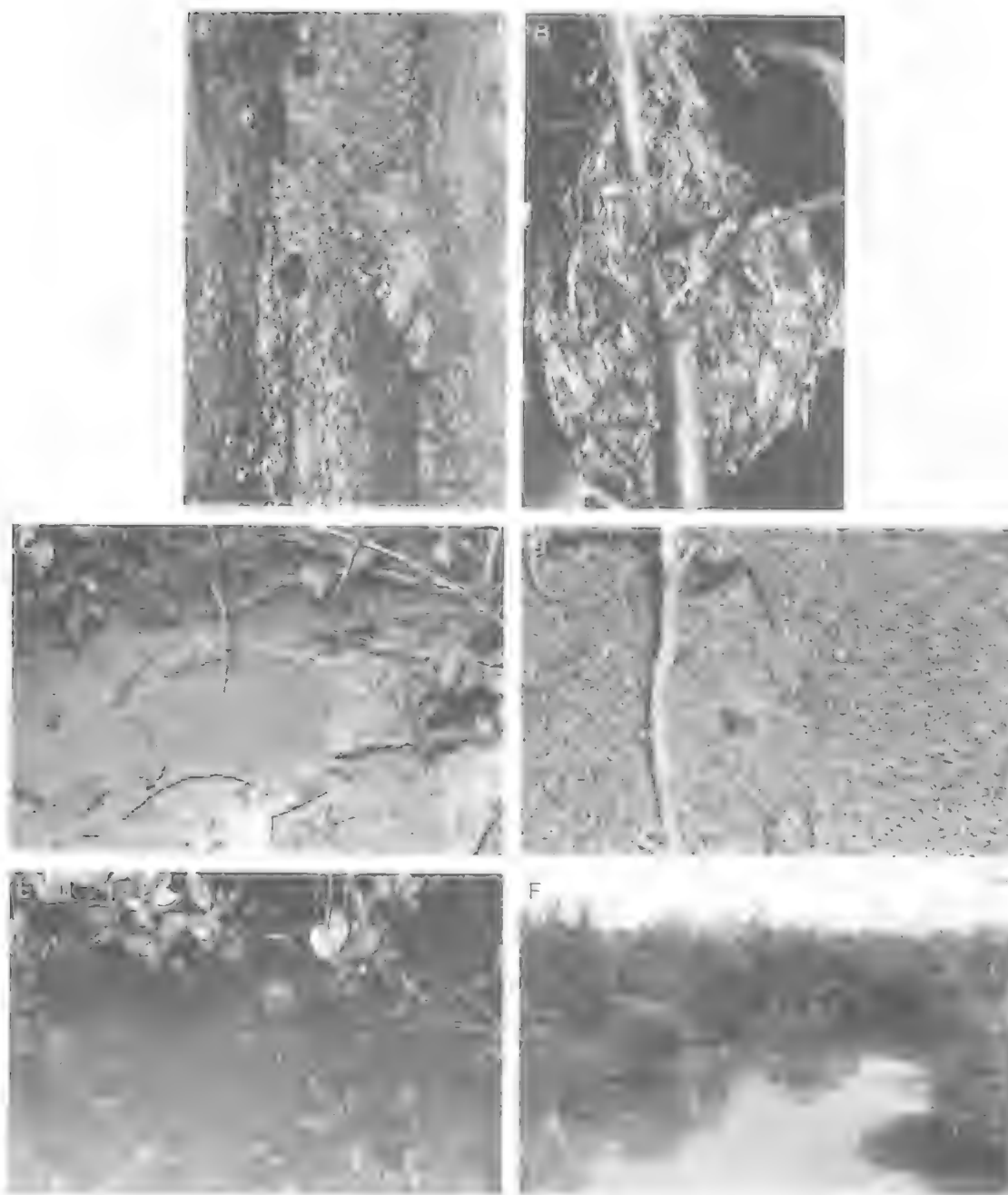
ACKNOWLEDGEMENTS

FIG. 3 A — F Nests of *Polyrhachis* ants. A *P. andromache* — pocket-like nest of silk and various debris against tree trunk (Lockerbie Scrub, near tip of Cape York). B *P. dives* — characteristic carton nest incorporating the foliage and twigs (Sth. Mission Beach, North Queensland). C *P. sokolova* — mound nest of excavated mud and sand particles. D ditto — close-up of a single entrance at the top of the nest. E ditto — same nest inundated. F intertidal mangrove zone (at high tide) where the nests of *P. sokolova* were observed and above photographs taken (Town Beach, Mackay, North Queensland).

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AN AUSTRALIAN SPECIES OF THE GENUS *BITTACUS* LATREILLE (MECOPTERA : BITTACIDAE)

KEVIN J. LAMBKIN

Bittacus eremus sp. nov. has been found at Kroombit Tops in central Queensland. This is the first record of the genus from the Australian region. The species is assigned to *Bittacus* Latreille as presently defined, but a reassessment of this large genus, which is now cosmopolitan, may be necessary.

☐ *Bittacidae, Bittacus, Mecoptera, taxonomy, Kroombit Tops, Australia.*

Kevin J. Lambkin, 75 Alexandra Street, Bardon, Queensland 4065, Australia; 1 May 1986

Bittacus Latreille is the largest and most widespread genus of the Bittacidae. It includes 102 valid described species and has been recorded from all zoogeographical regions, with the notable exception of the Australian region. Details of its distribution are as follows: Africa south of the Sahara (54 species), Europe (2 species), North America (10 species), South America (2 species), eastern and southern Asia (34 species) (Penny and Byers, 1979; Byers, 1979; Mickoleit, 1979; Londt, 1981; Willmann, 1983; Plutenko, 1985). In the present context, it is of interest that it has not been recorded from the Philippines, Malaysia or Indonesia.

In February 1984, Geoff Monteith of the Queensland Museum collected one male and one female specimen of a species of bittacid unlike any previously known from Australia. The specimens were taken at Kroombit Tops, a high (800–900 m) sandstone plateau approximately 65 km SSW of Gladstone, a town on the central Queensland coast. This remarkable species, with maculate wings, does not fit into any of the endemic Australian genera of the family (*Austrobittacus* Riek, *Edriobittacus* Byers, *Harpobittacus* Gerstaecker, *Symbittacus* Byers, *Tytthobittacus* Smithers) but, surprisingly, exhibits a suite of characters completely compatible with its placement in *Bittacus*.

The species is described and illustrated herein, and its assignment to the genus *Bittacus* is briefly discussed. All measurements are in millimetres. The interpretation of the thoracic sclerites follows that of Storch and Chadwick (1968).

Bittacus eremus sp. nov.
(Figs 1–8)

MATERIAL EXAMINED

HOLOTYPE: ♂ (Queensland Museum T.10,202, in alcohol), above (NW) Beauty Spot 98, Kroombit Tops, central Queensland, 24°22'08"S, 150°59'33"E (Queensland Department of Forestry 1:50.000 map 90492 (Kroombit): 962 034), 4.ii.1984, G.B. Monteith, 'at light'.

PARATYPE: ♀ (Queensland Museum T.10,203, in alcohol), as for holotype, but 'on grass at night'. No other specimens known.

DESCRIPTION

Body length. 20.2 (holotype ♂), 18.6 (paratype ♀).

Head. Ocelli large, projecting above head margin in anterior view; in both sexes median ocellus noticeably smaller than lateral ones (Fig. 2). Antenna with 17 (♂) or 18 (♀) flagellomeres. Width of ocellar triangle: 0.55; width between eyes: 0.43; length of flagellum: 7.3 (♂), 6.9 (♀); length of subterminal (4th) segment of maxillary palp: 0.29; length of terminal segment of maxillary palp: 0.26.

Thorax. Pronotum with 4 long, thick, black setae on anterior margin. Pterothorax with long, thick, black setae on mesoscutellum (2), metascutellum (2), anterodorsal region of mesanepisternum (1), and posterior margin of mesepimeron (1), these setae more prominent in ♂ than in ♀. Legs generally more robust in ♂ than in ♀, with hind legs more noticeably so; hind femur of ♂ very much broader and more spinose than that of ♀, with a dense covering of long, fine setae not present in ♀; hind coxa with 1 or 2 long, thick, black setae, more prominent in ♂ than in ♀; tibial spurs of fore, mid and hind legs of similar size, each pair with lateral spur longer than medial one; comparative lengths of tarsomeres (Fig. 5): see Table 1.
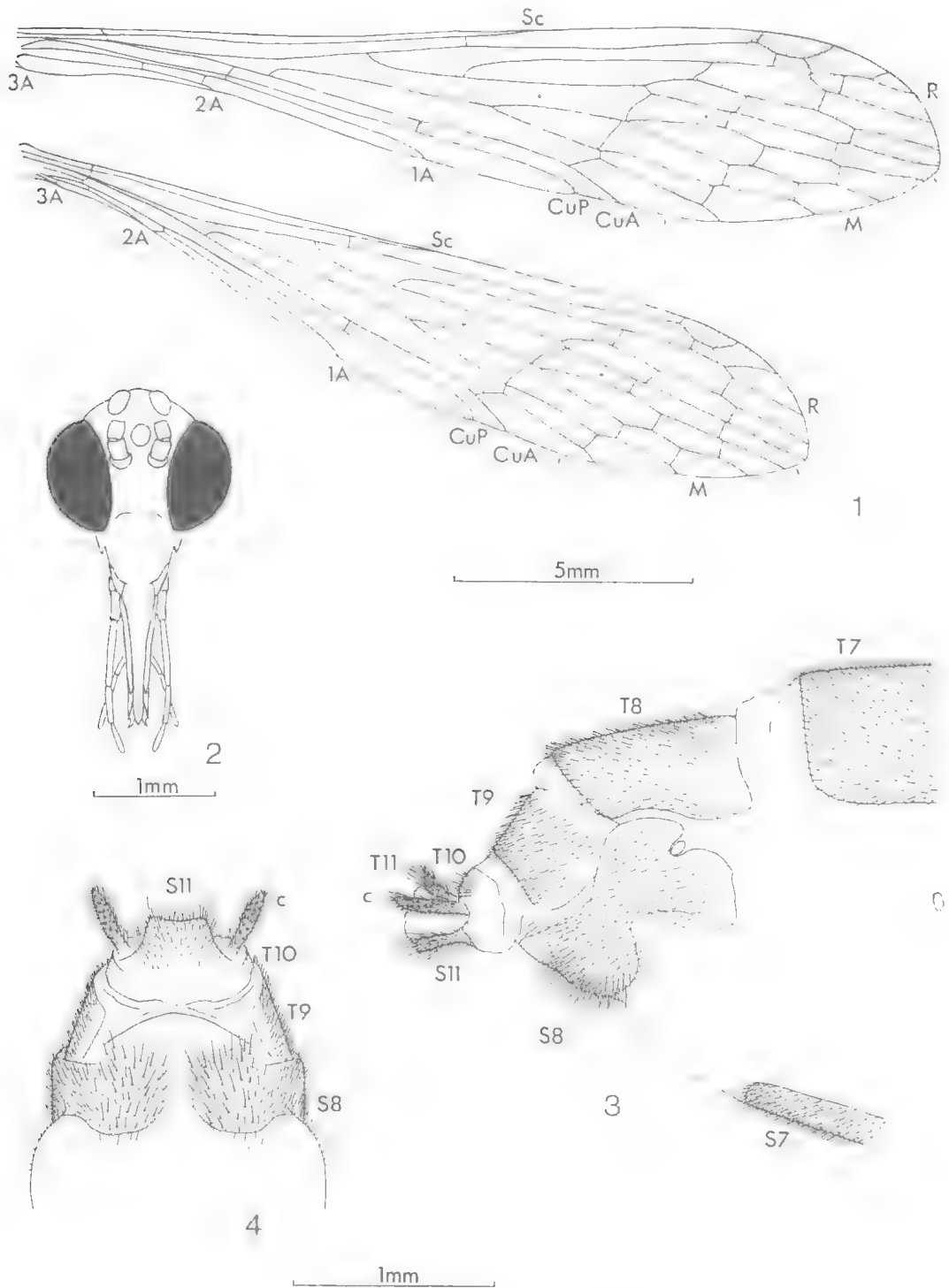
FIGS 1–4. *Bittacus eremus*, paratype female: 1, right wings; 2, head, anterior; 3, 4, apex of abdomen: 3, right lateral, 4, ventral. Abbreviations: c, cercus; S7, 8, 11, sterna 7, 8, 11; T7–11, terga 7–11.

TABLE 1. Tarsomere Length Measurements

Tarsomere		Holotype ♂	Paratype ♀
Fore tarsomere	1	4.4	4.0
	2	1.?	1.7
	3	1.?	1.0
	4	1.0	0.9
	5	0.?	0.6
Mid tarsomere	1	4.0	3.7
	2	1.8	1.6
	3	1.1	1.0
	4	0.9	0.9
	5	0.?	0.6
Hind tarsomere	1	2.8	2.5
	2	1.0	0.?
	3	0.9	1.8
	4	1.4	1.1
	5	1.1	0.?

Wings (Fig. 1): fore wing length: 20.5 (♂), 19.5 (♀); distal costal space without cross-veins; Sc joining costal margin distinctly distal to level of first fork of Rs (joining further distally in ♂than in ♀); 1 apical subcostal cross-vein at (♀) or just beyond (♂) level of first fork of Rs in fore wing, at level of ⅓ to ½ length of basal section of Rs (i.e., section between origin and first fork of Rs) in hind wing; 2 pterostigmal cross-veins in fore wing, 1 or 2 (♂) or 2 (♀) in hind wing; R_2 divergent from R_{1+5} at an acute angle; apical cross-vein between CuA and CuP just before (♀) or just after (♂) level of apex of $1A$; $1A$ joining hind margin at level of ⅓ to ½ length of basal section of Rs and well before level of first fork of M; apical cross-vein between CuP and $1A$ not present; basal cross-vein between $1A$ and $2A$ of fore wing about 2/3 length along $2A$.

Abdomen. Lateral margins of anterior terga without long, thick, black setae. Male (Figs 6–8): terga 3–8 with black antecostae. A pair of single-lobed eversible sacs between terga 6–7 and 7–8. Each epiandrial lobe long and prong-like, in lateral view (Fig. 6), in dorsal view (Fig. 7) tapering apically with apex curved mesad; mesal margin with 4 or 6 short spines apically, a hump just before ♀ length with numerous long setae along anterior margin and 2 short apical spines, and a posteroventrally directed prong-like projection at c. ¾ length with 2 short apical spines. Fused basistyles in lateral view with ventro-posterior margin evenly curved; dististyle-bearing lobes distinctly dorsally pro-

duced (Fig. 6). Dististyle small, with quite long dorsal setae; shape as in Fig. 8. Aedeagus of moderate length, recurved (not coiled), without a terminal filamentous extension. Tergum 10 a simple transverse dorsal plate (not visible in Fig. 6) with each posterior corner narrowly extended posteroventrally and thence curved dorsad around base of cercus to form a large roughly oval area mesal to cercus (Fig. 6); without setae. Cercus c. 6 times as long as wide, reaching nearly to dististyle. Tergum 11 small, but well developed and covered with setae; apical margin strongly convex in perpendicular view. Sternum 11 much shorter than tergum 11 and weakly developed, with only lateral and posterior margins sclerotized and setose; truncate, posterior margin in perpendicular view nearly straight with a small median projection. Female (Figs 3, 4): Terga 3–6 and 9 with black antecostae. Sternum 8 transverse, apparently not medially divided; in lateral view (Fig. 3) notched anterodorsally (to accommodate spiracle) and with a large emargination anteriorly; in ventral view (Fig. 4) with anterior margin strongly indented medially and posterior margin broadly convex; strongly pigmented except for anterodorsal corners, a narrow ventromedial strip and a broad ventral posterior marginal area; vestiture: lightly pigmented areas without setae, otherwise clothed with short, fine setae, with numerous longer thicker ones ventrally. Cercus c. 4 times as long as wide, reaching just beyond sternum 11. Sternum 11 slightly longer than tergum 11, each truncate with posterior margin nearly straight in perpendicular view. Spermatheca not examined.

Coloration. Head: head capsule yellow-brown with area of ocellar triangle black-brown, area between ocellar triangle and inner eye margin more brownish, clypeus paler, subgena dark brown to black-brown; scape and pedicel yellow-brown; flagellum dark brown; rostrum (of Hepburn 1969), labial palp and apical segments of maxillary palp brown, proximal segments of maxillary palp dark brown. Prothorax: notum cream-brown suffused with dark brown; pleural and cervical sclerites dark brown. Pterothorax: scutella, postnota, katepisterna, epimera and a broad median longitudinal stripe on scuta faintly brownish cream; anepisterna, preepisterna, lateropostnotum and rest of scuta dark brown to black-brown; ventral corners of preepisterna and posteroventral corner of mesepimeron each with a small black mark. Legs: coxae faintly brownish cream to pale
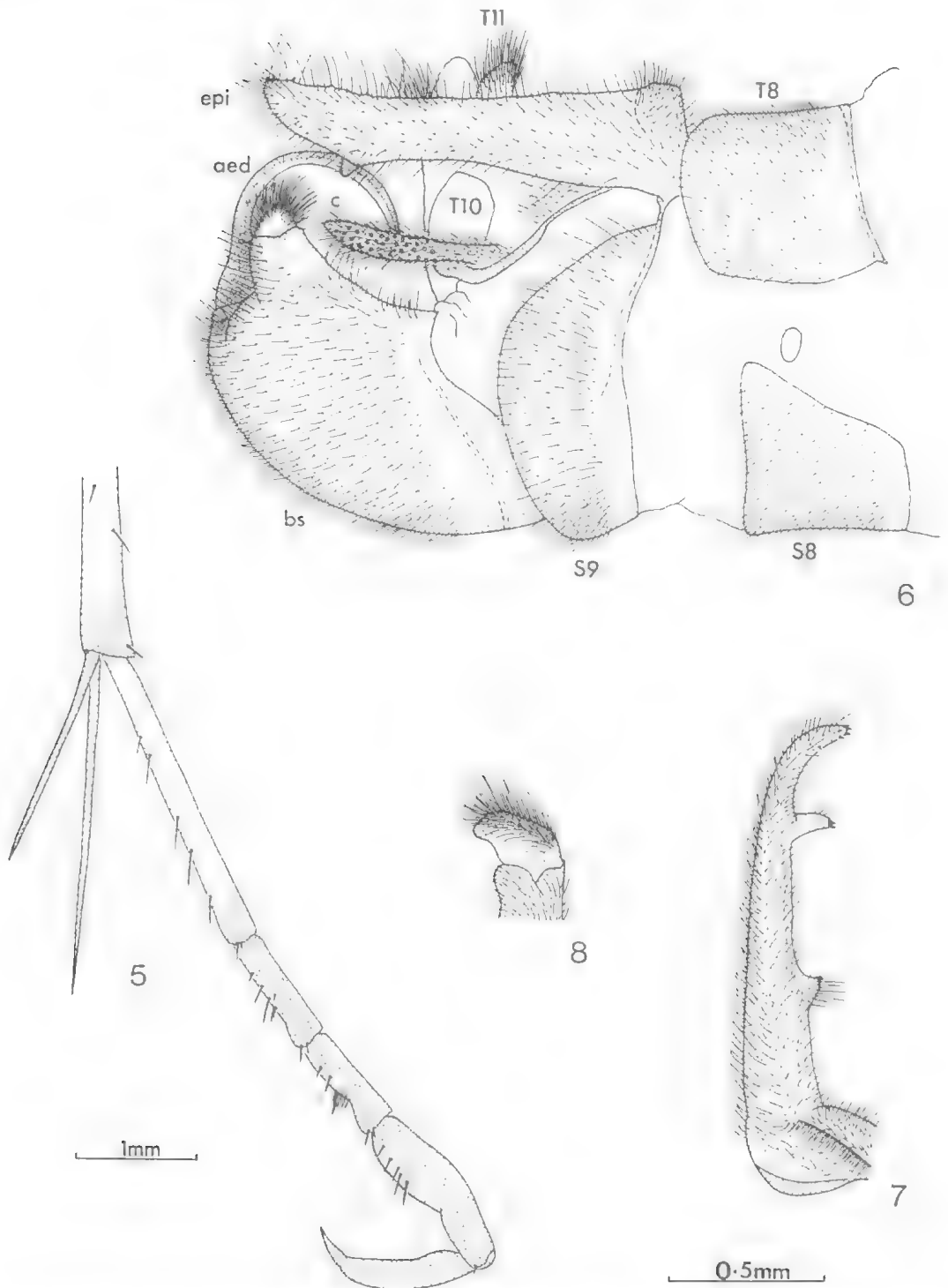
FIGS 5–8. *Bittacus eremus*, holotype male: 5, right hind tarsus and apex of tibia, mesal (setae omitted); 6, apex of abdomen, right lateral; 7 right epiandrial lobe, dorsal; 8, right dististyle, posterior, slightly ventrolateral. Abbreviations: aed, aedeagus; bs, basistyles; c, cercus; epi, epiandrial lobe; S8, 9, sterna 8, 9; T8, 10, 11, terga 8, 10, 11.

brown with anterior face of fore coxa dark brown; mid meron faintly brownish cream dorsally, dark brown ventrally, posterodorsal and ventral corners each with a small black mark; hind meron faintly brownish cream suffused with brown over ventral ⅔, posterodorsal margin with an elongate black mark; trochanters cream-brown; femora, tibiae and fore and mid tarsi yellow-brown, with femora paler basally and apices of tibiae black-brown (δ) or dark brown ($\female$); hind tarsus with apex of segment 1, segments 2–5 and claw dark orange-brown (δ) or orange-brown ($\female$), rest of segment 1 yellow-brown. Wings: venation brown to dark brown with base of M_4 in each wing and cross-veins near apex of each wing entirely or partly hyaline; a white thyridium at first fork of M in each wing; pterostigmata brown; membrane with a faint brownish tinge and patterned with pale brown to brown as indicated in Fig. 1. Abdomen of δ: terga 1–5 yellow-brown; tergum 6 brown to dark brown with a broad median area tapering anteriorly and terminating at c. 1/6 length yellow-brown; tergum 7 similar to 6, but dark brown shading to black-brown laterally and anteriorly, and with median yellow-brown area a little shorter; tergum 8 black-brown with a large spot on posterior margin yellow-brown; pleura white with some diffuse dull purple blotches; sterna 1–5 gradually shading from very pale yellow-brown (sternum 1) to yellow-brown (sternum 5); sternum 6 brown shading to dark brown posteriorly; sterna 7–9 black-brown; epiandrium pale brown with ventral margins of lobes brown to dark brown; tergum 10 with narrow extensions dark brown to black-brown and oval shaped areas pale brown to brown; basistyles black-brown with dorsal margins pale brown; cercus pale brown to brown; tergum 11, sternum 11 and dististyle pale brown. Abdomen of $\female$: terga 1–6, sterna 1–5 and pleura as in δ; terga 7 and 8 as in δ, but with lateral and anterior regions brown to dark brown; tergum 9 dark brown with some diffuse pale brown areas on posterior margin; sterna 6 and 7 dark brown, with 6 paler anteriorly; sternum 8 mostly black-brown; tergum 10 pale brown to dark brown; tergum 11, sternum 11 and cercus pale brown.

NOTES

B. eremus is the only Australian bittacid with the combination of hind tarsomere 1 considerably longer than tarsomere 4, and *1A* in the hind wing extended beyond the level of the origin of *Rs*.

The specific name is from the Greek adjective *eremus* (lonely) and alludes to the isolation of this species of *Bittacus*. Its nearest congeners live in China, Taiwan and Thailand.

Beauty Spot 98 is a small area (c. 40 ha) of rainforest on an upper tributary of Kroombit Creek. The specimens of *B. eremus* were collected on the ridge to the NW of Beauty Spot 98 in tall open eucalypt forest with dominant *Eucalyptus andrewsi* Maiden. Access is by a side road running NE from the main Department of Forestry road across Kroombit Tops at Forestry marker TA54.

DISCUSSION

Justification of the generic assignment of *B. eremus* requires an examination of the history of generic categories in the Bittacidae and hence the present status of the genus *Bittacus*. Until early this century the numerous newly described bittacid species from various parts of the world were all assigned to *Bittacus* Latreille, 1805, the type-species of which is the European *B. italicus* (Müller). Beginning late last century species have been gradually excised from that genus to become the bases of several new genera. Thus in 1885 Gerstaecker extracted two Australian species with hind tarsomere 1 of similar length to hind tarsomere 4 to form *Harpobittacus*; in 1893 McLachlan established *Apterobittacus* for an apterous Californian species; in 1913 Navás established *Pazius* to accommodate a Peruvian species with narrow subpetiolate wings and a very slender abdomen; in 1914 Esben-Petersen assigned a Brazilian species with four or five costal cross-veins and strongly banded wings to *Neobittacus*; in 1974 Byers established *Edriobittacus* to receive an Australian species with, *inter alia*, *1A* very short in the fore wing and almost entirely fused with *CuP* in the hind wing, and in 1979 he separated a long-described North American species with a unique combination of characters as *Hylobittacus*. *Thyridates* Navás, 1908, established to receive an old Chilean species, was long considered a trivial synonym of *Bittacus* until Willmann (1983) resurrected it to accommodate a group of 12 American *Bittacus* species with R_{2+3} diverging from R_{4+5} at 90° in both wings.

The diversity of the family has been further demonstrated this century by the discovery of additional species with 'special' features. These

newly discovered species led to the establish-
ment of the following new genera: *Kalobittacus*
Esben-Petersen, 1914, *Nannobittacus* Kimmins,
1927, *Anomalobittacus* Kimmins, 1928,
Anabittacus Kimmins, 1929, *Austrobittacus*
Riek, 1954, *Issikiella* Byers, 1972,
Tytthobittacus Smithers, 1973, *Orobittacus*
Villegas and Byers, 1981, and *Symbittacus*
Byers, 1986. The major distinguishing features
of these genera, except *Anomalobittacus*, are
summarised in the keys presented by Villegas
and Byers (1981) and Byers (1986). These keys
also include *Edriobittacus* and *Hylobittacus*,
and as well, augment the major distinguishing
features of *Harpobittacus*, *Apterobittacus*,
Pazius and *Neobittacus*. *Anomalobittacus* is
unique in being brachypterous (see Byers,
1971). As well as the above new genera, a large
number of additional *B. italicus*-like species
have been newly described this century,
especially from Africa and Asia, and assigned to
the old genus *Bittacus*.

Bittacus, the oldest genus of the family, has
thus come to be a repository for the very many
'non-outstanding' species of the family, basi-
cally similar to the genotype *B. italicus*, with the
following set of characters: eyes of moderate
size, not converging or touching below antennal
bases; antennae less than half as long as body;
hind tarsomere 1 considerably longer than
tarsomere 4; wings fully developed, not exten-
sively colour banded or conspicuously
narrowed basally; distal costal space without
cross-veins or with only one; R_{2+3} diverging
from R_{4+5} at an acute angle in both wings; one
or two pterostigmal cross-veins; $1A$ long and
well developed, in fore wing extending far
beyond level of origin of M, in hind wing
extending well beyond level of origin of Rs; male
with tergum 9 and sternum 9 not fused into a
continous ring, tergum 9 developed as paired
epiandrial lobes, dististyles nearly always small
and simple, cerci short, not extending beyond
tergum 9. *B. eremus* is such a species and there-
fore must be included in *Bittacus*. It can be dis-
tinguished from other species of the genus by
the combination of strongly patterned wings
and slender, prong-like epiandrial lobes. East-
ern Asian species with similarly patterned wings
(e.g. *B. maculatus* Issiki, *B. striatus* Issiki) have
much boarder and quite differently shaped
epiandrial lobes (Issiki, 1927; Cheng, 1957).

The determination of whether or not *Bittacus*
is a monophyletic (*sensu* Hennig) category must
await a thorough cladistic analysis of the species
of the family. Its taxonomic history as well as its
very wide distribution, which now includes Aus-
tralia, suggest that it may be paraphyletic. Until
such an analysis, however, further discussion of
its distribution, including the presence of an iso-
lated species in Australia, is both premature and
pointless.

ACKNOWLEDGEMENTS

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A RE-EXAMINATION OF *LITHOSMYLIDIA* RIEK FROM THE TRIASSIC OF QUEENSLAND WITH NOTES ON MESOZOIC 'OSMYLID-LIKE' FOSSIL NEUROPTERA (INSECTA : NEUROPTERA)

Kevin J. Lambkin

Lithosmylidia Riek, a genus of fossil Neuroptera from the Triassic of Queensland, is redescribed. Its three species *L. lineata* Riek, *L. parvula* Riek and *L. baronne* sp. nov., have affinities with the Osmylidae and/or Polystoechotidae. Similar 'osmylid-like' species from elsewhere in the Mesozoic are briefly discussed.
□ *Lithosmylidia, Neuroptera osmylid-like, Triassic, Mesozoic, Queensland.*

Kevin J. Lambkin, 75 Alexandra Street, Bardon, Queensland 4065, Australia; 14 September, 1987.

Lithosmylidia Riek is a genus of fossil Neuroptera established for two species from the Triassic of Mount Crosby in south-eastern Queensland (27°32'S, 152°48'E) (Riek, 1955). Two new fairly well-preserved specimens of *Lithosmylidia*, one from Mount Crosby, and the other from Triassic beds near Gayndah in central Queensland (25°37'S, 151°37'E), have prompted this revision and reassessment of *Lithosmylidia*, as well as a brief review of similar Mesozoic 'osmylid-like' species.

The Mount Crosby fossil insects occur in green shales of the Late Triassic (Karnian) (De Jersey, 1971) Mount Crosby Formation and have been collected at five separate exposures designated as Fossil Insect Localities, A,B,C,D, and E (details in Allen, 1961). Riek (1955) has recorded eight species of Neuroptera in six genera, one of which, *Lithosmylidia*, is the subject of the present study.

The specimen from near Gayndah was collected in grey shales of the Middle Triassic (de Jersey, 1979) Gayndah Beds in a road cutting approximately 3 km ENE of Gayndah. Fossil insects were discovered there in 1962 and recorded in an unpublished Geological Survey of Queensland report (Woods, 1962) which was referred to by Ellis (1968).

The following museum abbreviations are used: QM, Queensland Museum; UQDG, University of Queensland, Department of Geology.

Genus **Lithosmylidia** Riek

Lithosmylidia Riek, 1955, p. 678.

Type species, by original designation, *Lithosmylidia lineata* Riek, 1955.

DESCRIPTION

Neuroptera from the Triassic of Queensland, Australia. Forewing: medium to large, over $2 \times$ as long as wide; trichosors present; subcostal space apparently without crossveins; *Sc* and R_1 fused apically and thence curved posteriad to enter margin well before wing apex; apparently without r_1–*rs*, or with very few (1 only detected in 1 specimen of *L. parvula* Riek); *Rs* originating close to base of wing, with at least 10 pectinate branches; basal stem of *MA* apparently absent; crossveins of *Rs*–*MA* field not well preserved in most material, but apparently of limited extent (in the most clearly preserved specimen (QM F14359) restricted to a few random ones proximally and 2 irregular gradate series distally); *MP* forked near the base; *CuA* pectinately forked, with branches oblique; *CuP* dichotomously forked; anal field well developed, extending a considerable distance along posterior margin; 1*A* long and multibranched. Hindwing and other body parts not known.

NOTES

On the basis of venational variation in recent Neuroptera, the three species here included in *Lithosmylidia* are probably generically distinct. However, the available incomplete and often indistinctly preserved material does not offer enough information to justify and diagnose separate genera for each. *Lithosmylidia*, as presently defined, should thus be considered as a fairly broadly embracing 'holding' genus until

additional material permits futher clarification.

Because of the probable composite nature of the genus, the affinities of the three species of *Lithosmylidia* are considered separately. It can be said, however, that the genus has a combination of characters suggestive of the Polystoechotidae and/or the Osymlidae, viz. wing medium to large and over $2 \times$ as long as wide, *Sc* fused with R_1 and thence curved posteriad, *Rs* extensively pectinate, *MP* forked near the base, anal region extensive. However, it also has certain features (which may be preservation artifacts) which do not occur in either family, *viz.* the apparent absence of subcostal crossveins and, with the exception noted in the generic description above, of r_1–rs. The genus was originally ascribed by Rick to the Osmylidae Kempyninae, but the analyses which follow show that such a placement is not justified. The basal stem of *MA* figured by Riek (1955, fig. 22), and given by him as one of the generic characters, is not present in any of the forewing material examined herein.

Lithosmylidia lineata Riek
(Figs 1,2)

(*partim non*) *Lithosmylidia lineata* Riek, 1955, p. 678–9, fig. 22, pl. 3, figs 7–9. [Specimen C1642-3 (pl. 3, fig. 8) = *Lithosmylidia* sp. A.]

DESCRIPTION

Forewing. Width (between *Sc* and posterior margin at *CuA*): 7.7 mm (C2189–90), 5.7 mm (C867–8); branches of $Sc + R_1$ long, many deeply forked; *Rs* with 14 branches (data from C2189–90 only), each forked apically; *MA* forked apically, similarly to *Rs* branches; MP_1 and MP_2 deeply forked, each with 3 main branches; *CuA* deeply forked with 4 (C867–8) or 6 (C2189–90) main branches (in C2189–90 the distal branch is fused for a short length with the proximal branch of MP_2); *CuP* deeply forked, with 3 main branches; *1A* (based on C867–8 — see Fig. 2) ? obliquely pectinate; crossveins not well preserved, but apparently few in number, those detected illustrated in Figs 1,2; nygmata not detected; trichosors not preserved.

MATERIAL EXAMINED

Holotype UQDG C2189–90 (incomplete forewing), UQDG C867–8 (incomplete forewing), both 'Mount Crosby Insect Bed'.

NOTES

L. lineata must be considered as belonging in, or near to, the Polystoechotidae, based on the following combination of characters (see Table 3): basal stem of *MA* absent; crossveins of *Rs–MA* field apparently restricted to two irregular gradate series; *CuA* obliquely pectinate; *CuP* deeply dichotomous.

If *L. lineata* is considered a polystoechotid, then the position of the primary fork of *MP* does not necessarily indicate that the two specimens are forewings (one of the unique features of the hindwings of two of the three polystoechotid genera, *Polystoechotes* Burmeister and *Platystoechotes* Carpenter, is the lateness of the primary forking of *MP* — see Carpenter, 1940, figs 69, 71). The very long apical branches of MP_2 and *Cu* in the two specimens do, however, provide additional evidence that they are indeed forewings (these are much shorter in polystoechotid hindwings).

Specimen C867–8 is considerably smaller than the holotype, but has basically the same vein branching pattern. The fact that *CuA* has

FIGS 1, 2. *Lithosmylidia lineata*: 1, UQDG C2189–90 (holotype); 2, UQDG C867–8.

Fig. 3. *Lithosmylidia baronne*, QM F14358 (holotype) (*Sc* and *R* are contiguous basally, not fused).

two fewer main branches can be attributed to the smaller wing size. Similar intraspecific variation in size and absolute numbers of vein branches occurs in recent Polystoechotidae. The apparent difference in the number of crossveins cannot be considered significant, as crossveins are so poorly preserved in the material examined.

Lithosmylidia baronne sp. nov.
(Fig. 3)

DESCRIPTION

Forewing. Width (between *Sc* and posterior margin at *CuA*): 5.4 mm; costal margin broadly emarginate proximally; costal space quite broad, with crossveins widely spaced, apparently mostly simple, but a few deeply forked; humeral vein upright, simple; *Rs* with more than 6 branches, the 3rd one forked not far from its base; MP_1 and MP_2 deeply forked, MP_2 with 4 main branches; *CuA* deeply forked, with 5 main branches, the proximal one extensively subdivided; *CuP* deeply forked, with 3 main branches, CuP_2 simple; anals widely spaced basally; $1A$ appearing deeply dichotomously forked (the wing is, however, broken between *CuP* and $1A$ and it is possible that $1A$ is indeed pectinate); $2A$ forked close to base, the anterior fork with 5 short, simple, obliquely pectinate apical branches, the posterior fork with 4 such branches; $2A$ and $3A$ forming a loop basally enclosing $2a-3a$; $3A$ apparently simple; crossveins not well preserved, but apparently few in number, those detected illustrated in Fig. 3; nygmata not detected; trichosors preserved as in Fig. 3.

MATERIAL EXAMINED

Holotype QM F14358 (incomplete forewing), Gayndah Beds, road cutting *c.* 3 km ENE Gayndah, central Queensland (collected by K.J. Lambkin, 1975).

NOTES

This species differs from *L. lineata* in the deep forking of the third *Rs* branch, the extensively subdivided proximal branch of *CuA* and the simple CuP_2.

The affinities of the species are problematical. It has the following features which suggest the Polystoechotidae: basal stem *MA* absent; crossveins of *Rs–MA* field very limited; *CuA* obliquely pectinate; *CuP* deeply dichotomously forked. On the other hand, the humeral vein is simple and not strongly recurrent, $2A$ is extensively pectinate with the apical branches short

and simple, and $3A$ is simple (see Table 3). Indeed the pectinate form of $2A$, the simple nature of $3A$, and the fact that these veins form a basal loop enclosing $2a-3a$, are somewhat characteristic of the Osmylidae (see Table 2). If these features were considered apomorphous, and those listed above as suggestive of the Polystoechotidae to be generally plesiomorphous, then the species would necessarily be placed closer to the Osmylidae. In summary it may be said that *L. baronne* is an enigmatic osmylid-like species with a mix of osmylid and polystoechotid characters, as well as some features not occurring in either family (i.e. absence of a subcostal crossvein and r_1-rs).

Baronne is the name of the road near Gayndah where the insect bearing shales of the Gayndah Beds are exposed.

Lithosmylidia parvula Riek
(Figs 4, 5)

Lithosmylidia parvula Riek, 1955, p. 679.

DESCRIPTION

Forewing. Width (between *Sc* and posterior margin at *CuA*) *c.* 4.4 mm (QM F14359); posteroapical margin slightly emarginate; costal space quite narrow, with crossveins widely spaced, apparently mostly simple proximally and mostly forked distally; humeral vein slightly recurved, simple; $Sc + R_1$ field similar to that of *L. lineata*; specimen C1991–2 with 1 oblique r_1-rs near 3rd *Rs* branch, r_1-rs not detected in other material; *Rs* with 10 or 12 branches, each forked apically; crossveins of *Rs–MA* field restricted to a few random ones proximally and 2 irregular gradate series distally; $1m-cu$ oblique; apical branching of *MA* and *MP* not preserved; branches of *CuA* and *CuP* markedly shorter and *CuA* apparently more transversely pectinate than in the 2 preceding species; proximal branch only of *CuA* clearly preserved; *CuP* with 3 main branches; anals widely spaced basally; $1A$ long, with 6 short, mostly simple, obliquely pectinate branches; $2A$ long and extensively pectinately forked, with 8 branches, some of these with small marginal forks; $3A$ and proximal pectinate branch of $2A$ forming a loop basally enclosing $2a-3a$; $3A$ simple; crossveins of cubital and anal fields as in Fig. 4; 1 nygma detected (in QM F14359 — see Fig. 4), placed near primary fork of *MP* (because of fragmentation of the specimen in this region the exact position of the nygma is unknown); trichosors

FIGS 4, 5. *Lithosmylidia parvula*: 4, QM F1459 (*Sc* and *R* are contiguous basally, not fused; basal fork of *Cu* displaced anteriorly); 5, UQDG C1029–30 (holotype) (basal region only).

Fig. 6. *Lithosmylidia* sp. A, UQDG C1642–3.

Figs 7–9 (rough sketches only). Neuroptera *incertae sedis*: 7, UQDG C2088–9; 8, UQDG C786–7; 9, UQDG C1039–40.

detected in QM F14359, those preserved illustrated in Fig. 4.

MATERIAL EXAMINED

Holotype UQDG C1029–30 (indistinctly preserved complete forewing), UQDG C1991–2 (indistinctly preserved almost complete forewing), UQDG C2092–3 (indistinctly preserved incomplete forewing), all 'Mount Crosby Insect Bed'; QM F14359 (fragmented almost complete forewing), Mount Crosby Fossil Insect Locality B (collected by K.J. Lambkin, 1975).

NOTES

The above description is based almost entirely on QM F14359. The UQDG specimens are more or less complete but are very indistinctly

preserved, and have only contributed information on the form of the $Sc + R_1$ and the anal fields, and the number of *Rs* branches. Confirmation of the identity of the QM specimen was made by comparison of its anal field with that of the holotype (Fig. 5).

L. parvula is smaller than the preceding species, the branches of *Cu* are markedly shorter and *CuA* is apparently more transversely pectinate. It also differs from *L. baronne* in having a narrower costal space and in the structure of *2A*.

The affinities of *L. parvula* are again problematical, but the available material offers a more complete picture of its venation than in the preceding species. Except that *CuP* is dichotomous rather than pectinate (as it is in all osmylids), the species would, with confidence, be referred to the Osmylidae (see Table 2), albeit showing a unique mix of subfamily characters, *viz.* crossveins of *Rs–MA* field limited to a few random ones proximally and two irregular gradate series distally (Protosmylinae only), *MP* forked close to the base (Protosmylinae, Kempyninae, Spilosmylinae, Gumillinae, Osmylinae), anal field extensive, occupying a considerable part of the posterior margin (Kempyninae, Osmylinae, Stenosmylinae, Eidoporisminae); and having certain features not found in recent Osmylidae, *viz.* $1m$–cu oblique, and the apparent absence of the basal subcostal crossvein, numerous r_1–rs and the basal stem of *MA*. The absence of a clearly pectinate *CuP*, however, precludes *L. parvula* from the Osmylidae, but as in *L. baronne*, the presumed apomorphous structure of the anal field suggests a sister relationship with that family.

Lithosmylidia sp. A
(Fig. 6)

(*partim*) *Lithosmylidia lineata* Riek, 1955, p. 678–9, fig. 33, pl. 3, figs 7–9. [Specimen C1642–3 (pl. 3, fig. 8) *non Lithosmylidia lineata* Riek].

MATERIAL EXAMINED

UQDG C1642–3 (apical half of forewing), 'Mount Crosby Insect Bed'.

NOTES

This specimen was considered by Riek as the hindwing of *L. lineata*. There are no particular features which indicate that it is a hindwing and indeed the available evidence, tenuous though it is, suggests a forewing. Thus the $Sc + R_1$ field is

TABLE 1. Mesozoic 'osmylid-like' fossil Neuroptera[1]

Species[2]	Age and Locality	Figured[3]	Family Placement[4]
1. *Epigambria longipennis* Handlirsch, 1939	Ju, W. Germany	HN 1939, pl.7, fig.119	Epigambriidae (HN 1939) Nymphitidae (MA 1949, 1962)
2. *Epiosmylus longicornis* Panfilov, 1980	Ju, U.S.S.R.	PA 1980, fig.104	Epiosmylidae (PA 1980)
3. *Gigantotermes excelsus* (Hagen, 1862)	Ju, W. Germany	OP 1888, pl.30, fig. 1 (as *Apochrysa excelsa)* HN 1907, pl.48, fig 11	Nymphitidae (HN 1906) Neuroptera *i.s.* (MA 1949) Hemerobiidea *i.s.* (MA 1962)
4. *Grammosmylus acuminatus* Panfilov, 1980	Ju, U.S.S.R	PA 1980, fig.105	Grammosmylidae (PA 1980)
5. *Ineptiae meunieri* Handlirsch, 1906	Ju, W. Germany	–	Neuroptera *i.s.* (HN 1906; MA 1949) Hemerobiidae *i.s.* (MA 1962)
6. *Kasachstania fasciata* Panfilov, 1980	Ju, U.S.S.R.	PA 1980, fig.97	Osmylidae (PA 1980)
7. *Kirgisellodes ornatus* (Martynov, 1925)	Ju, U.S.S.R.	MV 1925, fig.11 MA 1962, fig.859	Prohemerobiidae (MV 1925) Osmylitidae (MA 1949, 1962)
8. *Lithosmylidia lineata* Riek, 1955	Tr, Australia	Figs 1,2	discussed herein
9. *L. parvula* Riek, 1955	Tr, Australia	Figs 4,5	discussed herein
10. *L. baronne* sp.nov.	Tr, Australia	Fig.3	discussed herein
11. *Loxophleps costalis* Handlirsch, 1939	Ju, E. Germany	HN 1939, pl.6, fig.111	Solenoptilidae (HN 1939) Neuroptera *i.s.* (MA 1949) Hemerobiidea *i.s.* (MA 1962)
12. *Melamnous indistinctus* Handlirsch, 1939	Ju, E. Germany	HN 1939, pl.7, fig.117	as 11.
13. *Melaneimon dubium* Handlirsch, 1939	Ju, E. Germany	HN 1939, pl.7, fig.120	as 11.
14. *Mesonymphes hageni* Carpenter, 1929	Ju, W. Germany	CA 1929, fig.1	Nymphitidae (CA 1929; MA 1949, 1962)
15. *M. rohdendorfi* Panfilov, 1980	Ju, U.S.S.R.	PA 1980, fig.115	Nymphidae (PA 1980)
16. *Mesopolystoechus apicalis* Martynov, 1937	Ju, U.S.S.R.	MV 1937, fig.18 MA 1949, fig.8 MA 1962, fig.860	Prohemerobiidae (MV 1937) Mesopolysteochotidae (MA 1949, 1962)
17. *Mesosmylina exornata* Bode, 1953	Ju, W. Germany	BO 1953, fig.320	Prohemerobiidae Mesosmylinae (BO 1953) Osmylitidae (MA 1962)
18. *M. mongolica* Ponomarenko, 1984	Ju, Mongolia	PO 1984, fig.1	Osmylidae (PO 1984)

TABLE 1. (continued)

Species[2]	Age and Locality	Figured[3]	Family Placement[4]
19. *M. sibirica* Ponomarenko, 1985	Ju, U.S.S.R.	PO 1985, fig.5	Osmylidae (PO 1985)
20. *Mesosmylus atalantus* Panfilov, 1980	Ju, U.S.S.R.	PA 1980, fig.103	Osmylidae (PA 1980)
21. *Microsmylus foliformis* Panfilov, 1980	Ju, U.S.S.R.	PA 1980, fig.114	Mesochrysopidae (PA 1980)
22. *Minonymphites orthophlebes* Hong, 1980	Tr, China	HO 1980, fig.16	Nymphitidae (HO 1980)
23. *Nymphites priscus* (Weyenbergh, 1869)	Ju, W. Germany	WY 1869, pl.34, figs 13,14 (as *Hemerobius priscus*)	Nymphitidae (HN 1906; MA 1949, 1962)
24. *N. braueri* Haase, 1890	Ju, W. Germany	HS 1890, pl.1, fig.11 HN 1907, pl.48, fig.9	as 23.
25. *N. lithographicus* Handlirsch, 1906	Ju, W. Germany	–	as 23.
26. *Osmyliodea distinctus* Panfilov, 1980	Ju, U.S.S.R.	PA 1980, fig.101	Osmylidae (PA 1980)
27. *Osmylites protogaeus* (Hagen, 1862)	Ju, W. Germany	OP 1888, pl.30, fig.2 (as *Chrysopa excelsa*) HS 1890, pl.1, fig.10 (as *Osmylites protogaea*) HN 1907, pl.48, fig.4	Prohemerobidae (HN 1906) Epigambriidae (HN 1939) Osmylitidae (MA 1949, 1962)
28. *Osmylopsis duplicata* (Giebel, 1856)	Ju, England	WS 1854, pl.18, fig.42 (as 'orthopterous wing') HN 1907, pl.48, fig.15	Neuroptera *i.s.* (HN 1906; MA 1949) Epigambriidae (HN 1939) Hemerobiidea *i.s.* (MA 1962)
29. *Palaeoleon ferrogeneticus* Rice, 1969	Cr, Canada	RI 1969, figs 2,3	Myrmeleontidae (RI 1969)
30. *Palparites deichmulleri* Handlirsch, 1906	Ju, W. Germany	–	Neuroptera *i.s.* (HN 1906; MA 1949) Hemerobiidea *i.s.* (MA 1962)
31. *Parosmylus latus* Panfilov, 1980	Ju, U.S.S.R.	PA 1980, fig. 102	Osmylidae (PA 1980)
32. *Petrushevskia borisi* Martynova, 1958	Tr, U.S.S.R.	MA 1958, fig.8 MA 1962, fig.858	Osmylitidae (MA 1958, 1962)
33. *Pronymphites elegans* Panfilov, 1980	Ju, U.S.S.R.	PA 1980, fig.99	Osmylidae (PA 1980)
34. *Pterocalla superba* Panfilov, 1980	Ju, U.S.S.R.	PA 1980, fig.100	as 33.
35. *Scapoptera recta* Panfilov, 1980	Ju, U.S.S.R.	PA 1980, fig.98	as 33.

TABLE 1. (continued)

Species[2]	Age and Locality	Figured[3]	Family Placement[4]
36. *Sialium sipylus* Westwood, 1854	Ju, England	WS 1854, pl.18, fig.24 HN 1907, pl.48, fig.10	Nymphitidae (HN 1906; MA 1949, 1962)
37. *Sibosmylina libelluloides* Ponomarenko, 1985	Ju, U.S.S.R.	PO 1985, fig.6	Osmylidae (PO 1985)
38. *Sogjuta speciosa* Martynova, 1958	Tr, U.S.S.R.	MA 1958, fig.9 MA 1962, fig.853	Nymphitidae (MA 1958, 1962) Osmylidae (AD 1969)
39. *Solenoptilon kochi* (Geinitz, 1887)	Ju, E. Germany	HN 1907, pl.41 fig.84	Solenoptilidae (HN 1906, 1939; MA 1949, 1962)
40. *S. martynovi* Martynova, 1949	Ju, U.S.S.R.	MA 1949, fig.6 MA 1962, fig.852	Solenoptilidae (MA 1949, 1962)
41. *Tetanoptilon brunsvicense* Bode, 1953	Ju, W. Germany	BO 1953, pl.13, fig.344	Solenoptilidae (BO 1953) Osmylitidae (MA 1962)

[1] Abbreviations: AD = Adams, BO = Bode, Cr = Cretaceous, CA = Carpenter, HS = Haase, HN = Handlirsch, HO = Hong, Ju = Jurassic, MC = MacLeod, MV = Martynov, MA = Martynova, OP = Oppenheim, PA = Panfilov, PO = Ponomarenko, RI = Rice, Tr = Triassic, WS = Westwood, WY = Weyenbergh, *i.s.* = *incertae sedis*.

[2] For the sake of convenience I have accepted Handlirsch's nomenclature of the 19th century species, even though the validity of some appears doubtful.

[3] Line drawings only included.   [4] 20th century references only.

no more narrow than in the holotype forewing of *L. lineata* (in both Osmylidae and Polystoechotidae, the $Sc + R_1$ field of the hindwing is invariable narrower than that of the forewing), $Sc + R_1$ does not extend as far around the apical margin as in the holotype forewing of *L. lineata* (in most Osmylidae $Sc + R_1$ in the hindwing extends slightly further around the wing margin towards the apex than in the forewing), and the branches of CuA are long (in the hindwing of the Polystoechotidae they are much shorter).

C1642–3 is similar in size and basic features to *L. lineata*, but differs in the much more deeply forked MA and branches of Rs and also in the apparently more extensively forked proximal branch of CuA, although this latter feature is uncertain owing to the doubtful identity of the veins in this region of the wing. Because of the difference in the form of the Rs branches and MA, C1642–3 cannot be considered as conspecific with *L. lineata*. Intraspecific vari-

ation of this extent does not occur in recent Neuroptera. The specimen is too incomplete to be named and is thus here designated *L.* sp. A.

The crossveins in the specimen are not well preserved and Fig. 6 shows all that were detected. Trichosors are present but not clearly preserved.

Neuroptera *incertae sedis*
(Figs 7–9)

Riek mentioned three further specimens from Mount Crosby (UQDG C2088–9, C786–7, C1039–40) in his descriptions of *Lithosmylidia* and referred these 'very doubtfully' or 'doubtfully' to *L. lineata* or *L. parvula*. The three specimens are all very fragmentary, as indicated by Riek, and until more clearly and completely preserved material of the *Lithosmylidia* species becomes available for exact comparison, they can be referred to as no more than Neuroptera

TABLE 2. Distinguishing features of the wings of Osmylidae

1. Trichosors present.
2. Membrane with microtrichia, including a modified area behind $3A$ (see Riek 1966).
3. Nygmata present.
4. Jugal lobe present.
5. $Sc + R_1$ entering margin well before wing apex, with branches short and usually mostly simple (apical field of wing thus occupied mostly by Rs).
6. Numerous r_1–rs.
7. Rs–MA field with a few to very numerous randomly placed crossveins proximally and 1 or 2 irregular gradate series distally; random crossveins not extending beyond level of point of fusion of Sc and R_1 (except in *Gumilla* Navás and *Porismus* McLachlan).

Forewing:

8. Humeral vein simple, at most only slightly recurrent.
9. 1 only (basal) subcostal crossvein (except *Porismus* which has numerous additional ones).
10. Origin of Rs close to base of wing; without presectoral veins (excluding basal stem of MA).
11. $1m$–cu and basal stem of MA usually, but not always, aligned; these veins upright or slightly oblique.
12. MP always forked, but fork variably placed, ranging from near the base (e.g. Protosmylinae) to near the margin (e.g. most Stenosmylinae).
13. Without 'oblique vein' (between MP and CuA — see Tillyard 1916).
14. At least CuP, and often CuA as well, pectinate, with branches more or less transverse.
15. CuP not fused with $1A$.
16. Anal field variable, but sometimes (e.g. Kempyninae, Stenosmylinae) quite extensive, reaching to *c*. 0.3–0.4 wing length and thus occupying a considerable part of the posterior margin.
17. Anals widely spaced basally; $1A$ and $2A$ of variable extent, but always clearly pectinate, with branches short and usually simple; $3A$ quite long, but not deeply forked; $2A$ and $3A$ often forming a loop basally, enclosing $2a$–$3a$.
18. Basal $1a$–$2a$ clearly distal to basal $2a$–$3a$.

Hindwing:

19. Subcostal crossveins as in forewing.
20. Origin of Rs close to wing base; without presectoral veins.
21. Stem of MA often present.
22. MP forked very close to base, at or before origin at Rs.

22. MP forked very close to base, at or before origin at Rs.
23. At least CuA, and often MP_2 as well, pectinate.
24. CuA extending to at least ½ wing length.
25. Base of CuP not developed as an upright cubital brace.
26. CuP not fused with $1A$.
27. CuP, when multibranched, pectinate.
28. Anal field of small but variable extent; $1A$ and $2A$ pectinate, $1A$ with 2–8 branches; $3A$ quite long, not deeply forked, distinctly angulate at $2a$–$3a$.

incertae sedis. C2088–9 (Fig. 7) is a clearly pre-served hindwing fragment which shows the very narrow costal space characteristic of hindwings, simple costal crossveins, the base of Rs, Rs pectinately branched, two clear r_1–rs, and most interestingly a nearly longitudinal basal stem of MA. C786–7 (Fig. 8) preserves the anterior api-cal region of a fore- or hindwing of similar size to that of the holotype of *L. lineata*, and shows the $Sc + R_1$ field (similar to that of *L. lineata*), Rs pectinately branched, a single crossvein between $Sc + R_1$ and Rs, and trichosors. C1039–40 (Fig. 9) preserves the apical posterior margin of a fore- or hingwing and shows the api-cal branches of (?) MA, MP and CuA.

NOTES ON MESOZOIC 'OSMYLID-LIKE' FOSSIL NEUROPTERA

Lithosmylidia falls into a group of Mesozoic fos-sil neuropterous wings which, for the sake of dis-cussion, are herein referred to as 'osmylid-like', and have the following features:

1. wing of medium to large size, at least $2 \times$ as long as wide,
2. Sc and R_1 fused apically and thence curved posteriad,
3. Rs with numerous pectinate branches run-ning towards the posteroapical margin.

This suite of very basic features is character-istic of the modern families Osmylidae, Polystoechotidae, Nymphidae and Myrmeleontidae, but several of these Mesozoic 'osmylid-like' wings demonstrate to varying degrees the characteristics of the Chrysopidae

TABLE 3. Distinguishing features of the wings of Polystoechotidae

1. Trichosora present.
2. Membrane without microtrichia, except for a modified area behind 3A. (see Riek 1966).
3. Nygmata present.
4. Jugal lobe present.
5. $Sc + R_1$ (*Polystoechotes*), or R_1 (not fused with Sc) (*Platystoechotes, Fontecilla*), entering margin near or before wing apex, with branches long and mostly forked.
6. Few r_1–rs (2–9 in material examined).
7. Crossveins of Rs–MA field restricted to 1 or 2 irregular gradate series (no crossveins proximally).

Forewing:

8. Humeral vein strongly recurrent, with numerous forked branches.
9. 1 only (basal) subcostal crossvein.
10. Origin of Rs close to base of wing; without presectoral veins.
11. Basal stem of MA absent; $1m$–cu oblique.
12. MP forked at c. ¼ length
13. Without 'oblique vein'.
14. MP_2 and CuA deeply pectinate, with branches strongly oblique; CuP deeply dichotomous.
15. CuP not fused with $1A$.
16. Anal field occupying an extensive area of base of wing, extending to c. 0.3 wing length.
17. Anals widely spaced basally; $1A$ deeply dichotomous (*Polystoechotes, Platystoechotes*), or primitively pectinate (i.e. with branches long, oblique and deeply dichotomously forked) (*Fontecilla*); $2A$ deeply dichotomous (*Polystoechotes*), or tending to pectination (*Platystoechotes, Fontecilla*); $3A$ long, deeply dichotomously forked; $2A$ and $3A$ not forming a loop basally.
18. $1a$–$2a$ clearly distal to $2a$–$3a$.

Hindwing:

19. Subcostal space without crossveins.
20. Origin of Rs close to wing base; without presectoral veins.
21. Stem of MA present.
22. MP forked close to base, before (*Fontecilla*) or after (*Polystoechotes, Platystoechotes*) origin of Rs.
23. MP_2 few branched, weakly pectinate; CuA pectinate, with branches oblique.
24. CuA extending to at least ½ wing length.
25. Base of CuP not developed as an upright cubital brace.
26. CuP not fused with $1A$.
27. CuP deeply dichotomous.
28. Anal field fairly extensive; $1A$ and $2A$ as in forewing, but with $1A$ in *Fontecilla* more obviously pectinate; $3A$ long and deeply forked, not angulate at $2a$–$3a$.

(see Adams, 1967), and have probably correctly been ascribed to the Mesochrysopidae — the family of Mesozoic chrysopid or near-chrysopid forms (Adams, 1985). Included in this latter group are the following Jurassic 'osmylid-like' species which will not be discussed further herein: *Mesochrysopa zitteli* (Meunier, 1898) (Handlirsch, 1907, pl. 48, fig. 14), *Aristenymphes perfectus* Panfilov, 1980, (Panfilov, 1980, fig. 108), *Chrysoleonites ocellatus* Martynov, 1925, (Martynov, 1925, fig. 10; Martynovoa, 1949, figs 4, 5, 1962, fig. 854), *C. intactus* Panfilov, 1980, (Panfilov, 1980, fig. 106), *C. plexus* Panfilov, 1980, (Panfilov, 1980, fig. 107), *Macronympha elegans* Panfilov, 1980, (Panvilov, 1980, fig. 110). *Nymphoides latus* Panfilov, 1980, (Panfilov, 1980, fig. 109), *N. udensis* Ponomarenko, 1984, (Ponomarenko, 1984, fig. 7), *Mesotermes heros* (Hagen, 1862) (Hagen, 1862, pl. 15, fig. 1 — as *Termes heros*) and *Pseudomyrmeleon extinctus* (Weyenbergh, 1869) (Weyenbergh, 1869, pl. 35, figs 16, 16a — as *Myrmeleon extinctus*). The latter two species are very poorly known and are included here only on the basis of Handlirsch's (1906, p. 613–4) assessment.

Of the remaining 'osmylid-like' wings several can be placed with some confidence in one or other of the Osmylidae, Polystoechotidae, Nymphidae or Myrmeleontidae, while others, although not showing features absolutely characteristic of one of these families, can be discussed in terms of showing more similarity to one or two rather than others. Table 1 lists alphabetically these 'osmylid-like' species and includes all Mesozoic fossil Neuroptera with the three characters listed above (excluding those ascribed to the Mesochrysopidae), as well as any others which have been included in the Osmylitidae, Nymphitidae and Mesopolystoechotidae, the families erected to include Mesozoic forms with affinities to the three modern families nominally alluded to. Of the 41 species listed three groups are excluded from further discussion for the following reasons:

Group 1: Epigambria longipennis, Gigantotermes excelsus, Kirgisellodes ornatus, Nymphites priscus, N. braueri, Osmylites protogaeus, Osmylopsis duplicata, Pronymphites

TABLE 4. Distinguishing features of wings of Nymphidae.

1. Trichosors present.
2. Membrane without microtrichia (except *Nesydrion* Gerstaecker — see Riek 1966).
3. Nygmata absent.
4. Jugal lobe absent.
5. $Sc + R_1$ entering margin at or beyond wing apex, with branches long and mostly forked ($Sc + R_1$ thus occupy a major part of the apical field).
6. Numerous r_1–rs.
7. Rs–MA field with numerous randomly placed crossveins extending beyond level of point of fusion of Sc and R_1.
7a. MA never extensively forked.

Forewing:

8. Humeral vein simple, at most only slightly recurrent.
9. At least 1 (basal) subcostal crossvein, and often with numerous additional ones.
10. Origin of Rs close to base of wing; without presectoral veins (excluding basal stem of MA).
11. 1m–cu and basal stem of MA aligned, and upright or slightly oblique.
12. MP forked between ¼ and ½ length, or simple.
13. Without 'oblique vein'.
14. At least CuP, and usually CuA as well, pectinate (CuA sometimes forming a large triangular area as in the Myrmeleontidae).
15. CuP not fused with 1A.
16. Anal field small, occupying a limited area extending, at most, to c. 0.2 wing length.
17. Anals closely spaced basally; 1A and 2A short, when multibranched, pectinate; 3A short, not deeply forked; 2A and 3A not forming a loop basally (except a very large one in *Austronymphes* Esben-Petersen).
18. Basal 1a–2a aligned with, or slightly proximal to, basal 2a–3a.

Hindwing:

19. One (basal) subcostal crossvein, or without basal one but with numerous others.
20. Origin of Rs either close to wing base (without presectoral veins), or more distally placed (with several presectorals).
21. Stem of MA absent.
22. MP forked very close to base, before origin of Rs.
23. MP_2 and CuA pectinate.
24. CuA of variable extent, but usually not reaching beyond ½ wing length.
25. Base of CuP developed as an upright cubital brace.
26. CuP and 1A fused in region of cubital brace, but separate distally.
27. CuP, when multibranched, pectinate.

28. Anal field occupying a very limited area at base of wing; 1A with, at most, 3 branches; 3A short, not deeply forked, not angulate at 2a–3a (except in *Austronymphes* where a large loop is formed similar to the forewing).

elegans and *Sialium sipylus* are all based on fairly complete and mostly well preserved wings, but unfortunately the available illustrations (see Table 1) are not accurate enough to allow any new discussion. Their reassessment must await a re-examination of their type-specimens.

Group 2: *Loxophleps costalis, Melamnous indistinctus, Melaneimon dubium, Mesosmylina sibirica, Microsmylus foliformis, Parosmylus latus, Scapoptera recta, Solenoptilon kochi* and *S. martynovi* are all based on fragmentary specimens which are not worth further consideration and for the most part should never have been named in the first place. *S. kochi* and *S. martynovi* are included in the list on the basis of wing shape and venational facies, even though both are figured with Sc not fused with R_1. *L. costalis* and *M. dubium* are listed because of their placement by Handlirsch (1939) with *Solenoptilon* in the family Solenoptilidae.

Group 3: *Ineptiae meunieri, Nymphites lithographicus* and *Palparites deichmulleri* are all poorly preserved and have never been illustrated with a line drawing. Any reassessment would require re-examination of their types. *I. meunieri* is included because of Handlirsch's (1906, p. 614) opinion that it was 'wahrscheinlich in die Nähe von Gigantotermes' (Table 1: 3), and *P. deichmulleri* because of Deichmüller's original observation (noted in Handlirsh, 1906, p. 614) that is was similar to *Palpares* Rambur (Myrmeleontidae).

The 20 remaining species are sufficiently well preserved and illustrated to be discussed with respect to the major distinguishing features of the wings of modern Osmylidae, Polystoechotidae, Nymphidae and Myrmeleontidae as given in Tables 2–5.

Epiosmylus longicornis is not well illustrated but has $Sc + R_1$ entering the margin before the wing apex, with branches short and simple, and CuP of the forewing extensively tranversely pectinate, and is thus almost certainly an osmylid. The extremely elongate antennae and extensive crossvein network are reminiscent of

the subfamily Gumillinae [one species only, *Gumilla longicornis* (Walker) — see Adams, 1977], although the branching of *MP* in the forewing seems to differ considerably (compare Panfilov 1980, fig. 104 with Navás, 1912, fig. 24).

Grammosmylus acuminatus is an enigmatic forewing remarkable for its extremely dense crossvein network. Its basic venational features are: *Sc* and R_1 fused apically but not curved posteriad; *Rs* arising close to wing base, with numerous pectinate branches; *MA* forked at about ½ length; *MP* forked near the base; *CuA* and *CuP* obliquely pectinately forked, *CuA* excessively so; anal field extensive. The affinities of *G. acuminatus* are problematic but it probably warrants the separate family status proposed by Panfilov.

Kasachstania fasciata has short, thick antennae and a forewing with few r_1–*rs*, limited crossveins in the *Rs–MA* field, MP_2 and *CuA* obliquely pectinately forked, *CuP* deeply dichotomously forked, anal field extensive and 1*A* apparently pectinately forked. This combination of characters is compatible with the Polystoechotidae, although 1*A* appears to be more clearly pectinate than in *Fontecilla* Navás (see Table 3).

Lithosmylidia lineata, *L. parvula* and *L. baronne* have been discussed in detail herein.

Mesonymphes hageni has the following combination of characters which place it clearly in the Nymphidae: $Sc + R_1$ entering margin well beyond wing apex, with branches long and deeply forked ($Sc + R_1$ thus occupying a major part of the apical field); several subcostal crossveins; forewing with origin of *Rs* close to wing base, without presectoral veins; *MP* forked near the base; hindwing with base of *CuP* developed as an upright cubital brace (Phillip Adams, pers. comm.; not illustrated by Carpenter, 1929). *Mesonymphes rohdendorfi* is a hindwing similar to that of *M. hageni*, although apparently without subcostal crossveins. The two species are almost certainly congeneric.

Mesopolystoechotes apicalis is better known from the specimen figured by Martynova (1949, 1962) rather than the fragmentary one in Martynov (1937). The Martynova specimen is the apical half of a polystoechotid hindwing with venation not all that dissimilar to that of the modern *Polystoechotes* (compare Martynova, 1949, fig. 8 with Carpenter, 1940, fig. 69). If this assessment is accurate, the venational interpret-

TABLE 5. Distinguishing features of the wings of Myrmeleontidae

1. Trichosors absent.
2. Membrane without microtrichia.
3–7. As in Nymphidae.
7a. *MA* sometimes extensively dichotomously forked.

Forewing:

8. Humeral vein simple, not recurrent.
9. Subcostal space without crossveins.
10. Origin of *Rs* remote from base of wing; at least 2 presectoral veins.
11. 1*m–cu* and basal stem of *MA* aligned and strongly oblique.
12. *MP* simple.
13. 'Oblique vein' usually obvious.
14. *CuP* or *CuP* + 1*A* pectinate; CuA_1 and CuA_2 enclosing a large triangular area, apparently formed basically of pectinate branches of CuA_1, but often developed as a complex network of cells.
15. *CuP* nearly always (except e.g. Stilbopteryginae, *Palpares*, *Pseudimares* Kimmins) fused with 1*A*.
16. As in Nymphidae.
17. As in Nymphidae.
18. Basal 1*a–2a* and basal 2*a–3*, when present, variably placed relative to each other.

Hindwing:

19. Subcostal space without crossveins.
20. Origin of *Rs* remote from wing base; at least 1 presectoral vein.
21. Stem of *MA* absent.
22. *MP* forked very close to base, before origin of *Rs*.
23. MP_2 extensively pectinate or forming a triangular area similar to *CuA* in forewing; *CuA* pectinate.
24. *CuA* short, not reaching ½ wing length.
25. Base of *CuP* developed as an upright cubital brace.
26. *CuP* fused with 1*A* from cubital brace to margin.
27. *CuP* + 1*A*, when multibranched, pectinate.
28. Anal field occupying a very limited area of base of wing; 2*A* and 3*A* nearly always simple (1*A* fused with *CuP*); 3*A* short, not deeply forked, not angulate.

ation of Martynova (1949) rather than Marytnova (1962) is correct.

Mesosmylina exornata is considered an osmylid forewing on the basis of the following combination of characters: $Sc + R_1$ entering margin well before wing apex, with branches

short and apparently simple; CuP transversely pectinate; anal field extensive, with anals widely spaced basally and $1A$ long, with numerous short, simple pectinate branches. The crossvein field, as figured by Bode, shows some unusual features e.g. numerous subcostal crossveins, one presectoral vein (excluding basal MA stem), numerous random crossveins in $Rs–MA$ field beyond level of point of fusion of Sc and R_1, but these must be treated with caution following Willmann's recent (1984) findings on the accuracy of Bode's descriptions and figures, especially the generous inclusion of numerous non-existent crossveins in his figures.

Mesosmylina mongolica is based on a reasonably complete forewing, but unfortunately critical areas of the base and apex are not preserved. It has the following features which I think are sufficient to place it in the Osmylidae: $Sc + R_1$ field, although not completely preserved, with branches short and mostly simple; CuP pectinate, although with only 4 marginal branches; $1A$ apparently long, with numerous short, simple pectinate branches. CuA and CuP of *M. mongolica* differ considerably from those of *M. exornata* and the two species are probably not congeneric.

Mesosmylus atalantus known from the forewing, a fragment of the hindwing and part of the abdomen, is poorly illustrated, even though the specimen itself (Panfilov, 1980, pl. 12, fig. 3) looks good. The forewing is probably that of an osmylid ($Sc + R_1$ entering margin well before wing apex, with branches short and simple; $Rs–MA$ field with a few random crossveins proximally and two irregular gradate series distally — as in the Protosmylinae; $1A$ long, apparently with numerous short, simple pectinate branches), although the form of CuP, which appears to have only four marginal branches, is not clearly indicated. The venation of this species appears to be fairly similar to that of *Lithosmylidia parvula*.

Minonymphites orthophlebes is known from a forewing which, although placed by Hong in the Nymphitidae, does not belong with the other species discussed herein as 'osmylid-like', and is included in this listing only for the sake of completeness. Its affinities are problematical to say the least. The only thing in common with the 'osmylid-like' species is the fact that Sc and R_1 are fused apically and thence curved posteriad, otherwise it has the following combination of features which may even preclude it from the

Neuroptera; no end-twigging on any veins; R apparently fused with Sc basally; apical branches of Rs merging with $Sc + R_1$; CuP and anals simple.

Osmyliodea distinctus is known from the apical half of probably a hindwing with the following features, on the basis of which it can be assigned to the Polystoechotidae: $Sc + R_1$ with branches quite long and forked; few $r_1–rs$; *crossveins of $Rs–MA$ field* few in number and restricted for the most part to one irregular gradate series; CuA obliquely pectinate as in Polystoechotes; CuP apparently deeply dichotomously forked.

Palaeoleon ferrogeneticus is known from the apical half of a fore- or hindwing which, on the basis of the following combination of characters, is almost certainly a myrmeleontid: $Sc + R_1$ entering margin well beyond wind apex, with branches long and deeply forked ($Sc + R_1$ thus a major component of the apical field); MA deeply and extensively dichotomously forked; MP (if a forewing) simple; CuA (if a forewing) or MP_2 (if a hindwing) extensively pectinate. Rice's figure (1969, fig. 2) is incorrectly labelled; thus his 'R_2, R_{2a}, R_3, R_4, R_5, M_1' = Rs, 'M_2, M_3, M_4' = MA, if the specimen is a forewing 'Cu_1' = MP and 'Cu_2' = distal section of CuA, if a hindwing 'Cu_1' = MP_1 and 'Cu_2' = distal section of MP_2.

Petrushevskia borisi is a very well preserved forewing with: $Sc + R_1$ entering margin well before wing apex; numerous $r_1–rs$; random crossveins of $Rs–MA$ field not extended beyond level of point of fusion of Sc and R_1; $1m–cu$ and basal stem of MA not aligned; CuP extensively pectinate; basal $1a–2a$ clearly distal to basal $2a–3a$; anals widely spaced basally, $1A$ and $2A$ long and pectinate, with branches short and mostly simple, $2A$ and $3A$ forming a loop basally. On the basis of the above combination of characters *P. borisi* is assigned to the Osmylidae, even though the basal stem MA is more oblique than in recent species.

Pterocalla superba is considered a polystoechotid forewing on the basis of the following combination of characters: limited $r_1–rs$; $Rs–MA$ field apparently with very few crossveins; MP_2 and CuA deeply pectinate, with branches strongly oblique; CuP and $1A$ deeply dichotomously forked; $2A$ apparently obliquely pectinate.

Sibosmylina libelluloides, although included by Ponomarenko (1985) in Panfilov's (1980) expanded Osmylidae, does not belong in this 'osmylid-like' group of species or probably even

in the Neuroptera. It is included herein for the sake of completeness only.

Sogjuta speciosa is known from a nearly complete forewing with: $Sc + R_1$ entering margin well before wing apex, with branches short and mostly simple; $Rs–MA$ field with two crossveins proximally and two irregular gradate series distally; *CuP* pectinate; anals widely spaced basally, *1A* pectinate, with branches short. On the basis of these features *S. speciosa* is considered an osmylid, even though it has only six $r_1–rs$.

Tetanoptilon brunsvicense, although poorly illustrated (see notes under *Mesosmylina exornata*), is considered a forewing on the basis of the broad separation at the base of the veins labelled 'Cu' and 'A' by Bode. If it was a hindwing as suggested by the narrow costal space, these veins would have to be *CuA* and *CuP* respectively, and thus have a common stem. If this venational interpretation is correct, *T. brunsvicense* must be considered an osmylid, with *CuP* transversely pectinate and the anal field extensive with *1A* very long, with numerous short, simple pectinate branches.

In summary, the 20 'osmylid-like' or supposed 'osmylid-like' species on which comment can be made can be classified into seven categories:

1. Species not 'osmylid-like' and possibly not even neuropterous: *Minonymphites orthophlebes, Sibosmylina libelluloides*.

2. Neuroptera of problematical affinities: *Grammosmylus acuminatus* (Grammosmylidae).

3. Species similar to Osmylidae or Polystoechotidae, but not able to be placed in either: *Lithosmylidia baronne, L. parvula*.

4. Probable Osmylidae: *Epiosmylus longicornis, Mesosmylina exornata, M. mongolica, Mesosmylus atalantus, Petrushevskia borisi, Sogjuta speciosa, Tetanoptilon brunsvicense*.

5. Probable Polystoechotidae: *Kasuchstania fasciata, Lithosmylidia lineata, Mesopolystoechotes apicalis, Osmyliodea distinctus, Pterocalla superba*.

6. Probable Nymphidae: *Mesonymphes hageni, M. rohdendorfi*.

7. Probable Myrmeleontidae: *Palaeoleon ferrogeneticus*.

Little comment can be made concerning the status of the families Osmylitidae, Nymphitidae and Mesopolystoechotidae while so many important species, including those of the type-genera of Osmylitidae and Nymphitidae, remain so poorly known.

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A NEW SPECIES OF *DILOMPUS* SCUDDER (HEMIPTERA : LYGAEIDAE)

M.B. MALIPATIL

Dilompus woodwardi sp. nov. (Lygaeidae : Artheneinae : Dilompini) is described and illustrated from New South Wales, Victoria, and southern Western Australia.
□ *Taxonomy, Dilompus, Lygaeidae, Hemiptera.*

M.B. Malipatil, Northern Territory Museum of Arts and Sciences, GPO Box 4646, Darwin, Northern Territory 0801, Australia; 14 July, 1987.

Scudder (1957) described the new genus and species *Dilompus robustus* from New South Wales and placed it in the subfamily Rhyparochrominae. Slater, Woodward and Sweet (1962) recorded *D. robustus* from Tasmania, South Australia and South-East Queensland. They also reviewed its systematic position and decided it belonged to the subfamily Artheneinae and the new tribe Dilompini. The present paper describes a second species of the genus *Dilompus* Scudder.

Dilompus woodwardi sp. nov.
(Figs 1–5)

MATERIAL EXAMINED

HOLOTYPE: ♂, Dainers Gap, 36.12S 148.43E, New South Wales, 6 November 1973, P. Morrow, 1585 m, *Euc. pauciflora* forest, Ex *Eucaltypus pauciflora*, in Australian National Insect Collection, CSIRO, Canberra.

PARATYPE: 1 ♀, Tidal overlook, Wilsons Promontory, Victoria, 20 July 1981, A. Andersen, *Eucalyptus baxteri* woodland, on *E. baxteri* fruit, in Northern Territory Museum, Darwin.

NON-TYPE: 1 ♀, 11 ml (*ca* 18 km) S. of Yanchep, Western Australia, 3 January 1966, J.A. Grant, BM-CSIRO Expedition, BM 1973–346, in British Museum (Natural History), London.

DESCRIPTION

Generally dark brown. Apex of clypeus slightly paler, antennae with 4th segment darker, pronotum posterior lobe area ferruginous dark brown with dark punctures, legs pale ferruginous with femora excluding apex shiny black, hemelytra pale ochraceous with punctures and areas on disc of corium dark ferruginous brown, membrane particularly in middle light yellow with base, apex and areas between veins dark brown, abdomen ferruginous.
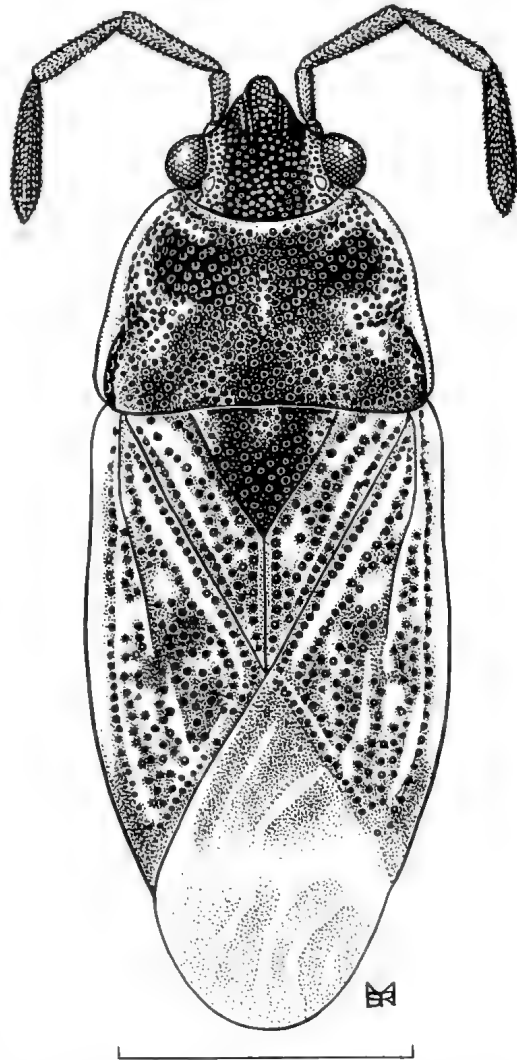
FIG. 1. *Dilompus woodwardi* holotype, dorsal view. Legs not shown. Scale 0.89 mm.

Body elongate ovate. Measurements of holo-
type ♂ with those of paratype ♀ in parentheses.
Total length 2.9(3.5); maximum width
1.16(1.55).

HEAD: Length 0.46(0.55), width across eyes
0.66(0.70), interocular space 0.39(0.45),
interocellar space 0.32(0.42), eye-ocellar space
0.02(0.03); length of antennal segments: I,
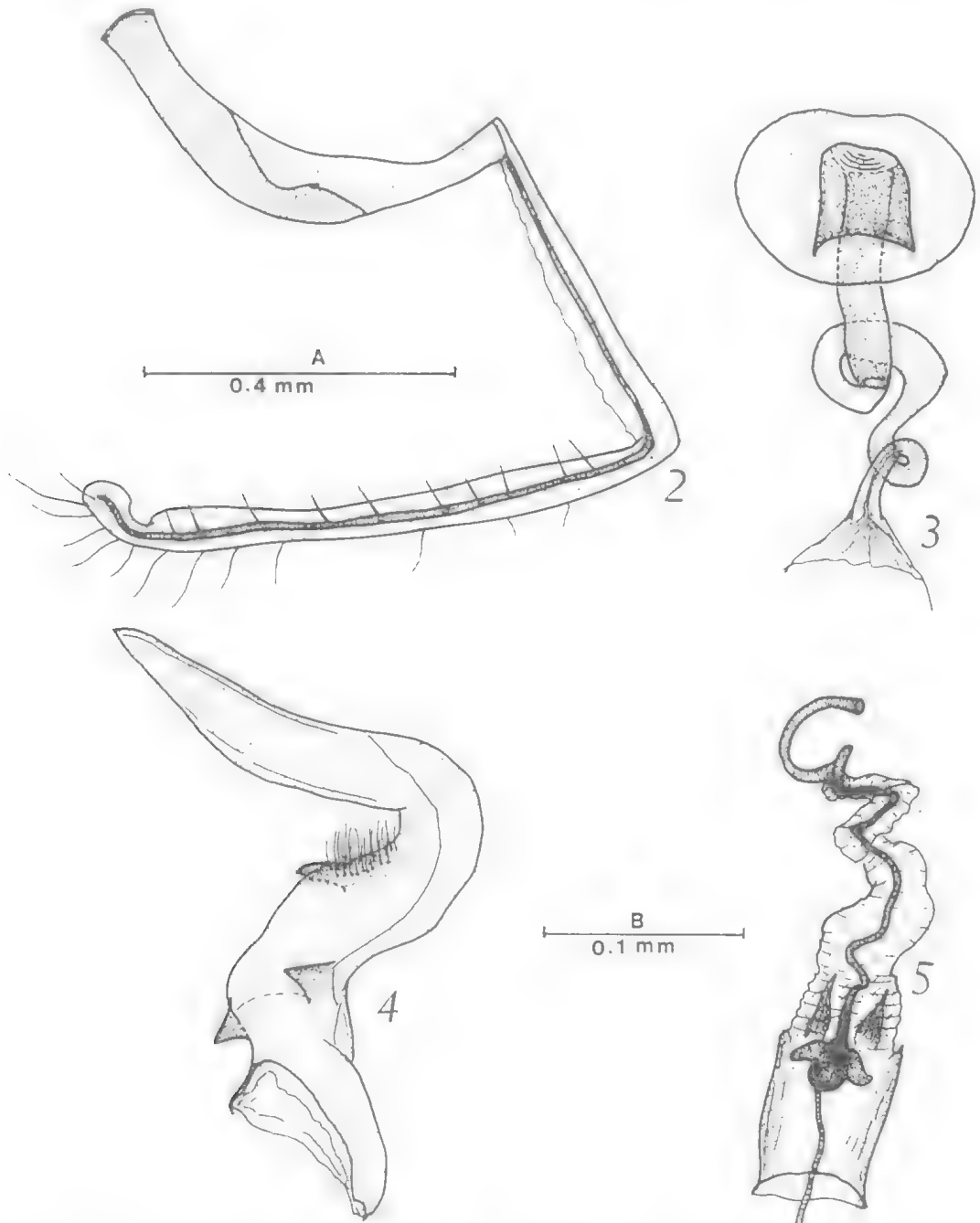
FIGS. 2-5. *Dilompus woodwardi*: 2, 3 — paratype ♀; 2 — 2nd gonocoxa and gonapophysis, 3 — spermatheca; 4, 5
— holotype ♂; 4 — right paramere, dorsal view; 5 — aedeagus. Figs 2, 5 to scale A; 3,4 to scale B.

0.16(0.23); II, 0.34(0.38); III, 0.31(0.36); IV, 0.46(0.50); labrum almost as long as labial 1st segment; labium slightly exceeding posterior coxae, length of segments: I, 0.45(0.58); II, 0.48(0.62); III, 0.37(0.48); IV, missing(0.24).

THORAX: Pronotum less than $2 \times$ as wide posteriorly as long, posterior margin slightly concave in front of scutellum, length 0.58(0.78), width posterior margin 1.08(1.28), width anterior margin 0.56(0.62); scutellum length 0.42(0.54), width 0.60(0.58); hemelytra well exceeding abdomen, length 1.98(2.40), length corium 1.45(1.88), claval commissure 0.39(0.56), width membrane 0.70(0.93).

ABDOMEN: First scent gland scar between terga III–VI *ca* 1½ $\times$ as wide as those between terga IV–V and V–VI which are subequal. Submedian trichobothria in almost rectilinear arrangement in ♂, in slightly triangular arrangement in ♀.

FEMALE GENITALIA: Ovipositor with 1st ramus traversing to most length of 1st gonapophysis, 2nd gonapophysis subapically notched as in Fig. 2; spermatheca (Fig. 3) with short duct, base of bulb deeply invaginated.

MALE GENITALIA: Pygophore posterior margin rounded; paramere (Fig. 4) strongly sickle shaped, with 3 small lobes on proximal ½ area — 1 dorsal and 2 ventral; aedeagus (Fig. 5), phallotheca moderately pigmented and with a pair of processes at distal end on either side of ejaculatory reservoir, body and wings well developed, helicoid process not distinct, gonoporal process 2–3 coiled.

NOTES

I dedicate this species to the late Dr T.E. Woodward, who influenced my research on lygaeid taxonomy so much, and who had organized to describe this species before his sudden death.

The new species differs from the only other species of the genus *Dilompus, D. robustus* Scudder, 1957, in having pronotum distinctly less than $2 \times$ as wide posteriorly as long (*ca* $2 \times$ as wide posteriorly as long in *robustus*); and the longer body which is more than $2 \times$ as long as wide ($2 \times$ in *robustus*).

Andersen (1985) recorded the species (as "gen. et sp. nov. (Dilompini)") on fruits of *Eucalyptus baxteri* in Wilsons Promontory, Victoria.

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ALBINISM IN THE PIGEYE WHALER SHARK *CARCHARHINUS AMBOINENSIS* (MÜLLER AND HENLE) FROM QUEENSLAND

R.J. McKay and K. Beinssen

An albino, immature female, pigeye whaler shark *Carcharhinus amboinensis* measuring 743 mm in total length was netted with many other normally pigmented sharks at Station Point between Cape Keppel and Seahill on the northern end of Curtis Island, Queensland, February 1987. This appears to be the first known albino individual of this species and the first record of albinism in the family Carcharhinidae.
□ *Sharks, albinism, Carcharhinus amboinensis*

R.J. McKay, Queensland Museum, PO Box 300, South Brisbane, Queensland 4101, Australia; K. Beinssen, Queensland National Parks and Wildlife Service, PO Box 1395, Rockhampton, Queensland 4700, Australia; 16 June, 1987.

A pigeye whaler shark *Carcharhinus amboinensis* (Müller and Henle, 1841) netted by Gladstone commercial fisherman Mr Lance Hayward appears to be the first record of albinism in the family Carcharhindae. The shark was taken in an 8 inch monofilament barramundi net at Station Point, between Cape Keppel and Seahill on the northern end of Curtis Island, Queensland, February 2, 1987. Mr Hayward recognized the shark to be a rarity because it was the first albino individual he and other long-standing Gladstone fisherman had seen or heard of. The specimen was given to the junior author who forwarded it to the Queensland Museum for identification. The specimen (see figure), registered I.22687, is a gutted immature female 743 mm in total length; first dorsal fin height 65 mm; second dorsal fin height 19 mm; length of rear tip of second dorsal fin 26 mm; internasal distance 50 mm; preoral distance 49 mm; lower teeth 11–2–11; precaudal vertebrae 91. The body and fins are entirely white, with pink irises of the eyes, as in a true albino (Fig. 1). Many other sharks of this species were also netted on the day of capture. They are frequently taken in barramundi *Lates cavifrons* nets.

The pigeye whaler grows to a length of 280 cm and according to Compagno (1984) are born at 71 to 72 cm. The smallest free-living specimen seen by Garrick (1982) measured 710 mm, and specimens from the Fitzroy River and near Seahill, Curtis Island described by Whitley (1943) were free-living at 732 and 804 mm in late March, 1943.

Albinism in elasmobranchs is relatively rare (see Dawson 1964, 1971; Nakaya 1973). Albinism in sharks has been reported for *Notorynchus*
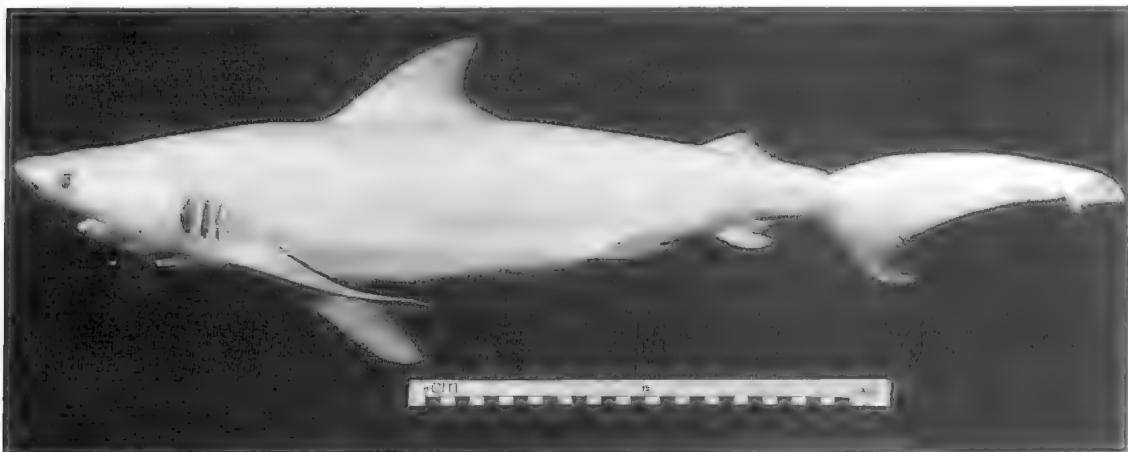
maculatus (Herald, 1953), *Mustelus californicus* (Herald, Schneebeli, Green and Innes, 1960; Cohen, 1973; Talent, 1973), *Sphyrna lewini* (McKenzie, 1970), *Stegastoma fasciatum* (Nakaya, 1973) and *Triakis semifasciata* (Follett, 1976). This is the first record of albinism in the genus *Carcharhinus* and in the family Carcharhinidae *sensu stricto*.

ACKNOWLEDGEMENTS

We thank Mr Lance Hayward for forwarding the shark for positive identification and for making enquiries on our behalf. We are most grateful for radiographs of the albino specimen supplied by Mr John Farrington and staff of the Department of Radiography, Royal Brisbane Hospital.

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A NEW SPECIES OF *RIDGEWAYIA* (COPEPODA, CALANOIDA) FROM THE GULF OF CARPENTARIA

B.H.R. OTHMAN AND J.G. GREENWOOD

Plankton collections in the Gulf of Carpentaria yielded two male specimens of a new species of copepod, *Ridgewayia flemingeri*, which is here described. The genus now contains 11 species, with the new species showing close similarity to *Ridgewayia typica* Thompson and Scott, 1903, and *Ridgewayia canalis* (Gurney, 1927). Males of *R. flemingeri* differ from all others of the genus in having numerous hairs on segments 11-17 of the right antennule, and in structure of the 5th legs.
□ *Copepoda, Calanoida, Ridgewayia, Gulf of Carpentaria, Australia*

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During studies of copepods from the Gulf of Carpentaria, two male specimens belonging to a new species of *Ridgewayia* were sampled. The species is described below. The specimens were taken in a net of mesh aperture size 140 μm towed from near-bottom to the sea surface through 50 metres of water in stepped-oblique hauls. Specimens were examined and dissected in glycerine/water and drawings were made using a Leitz HM-LUX microscope with the aid of a camera lucida. Type specimens have been deposited in the Queensland Museum (QM).

Ridgewayia flemingeri sp. nov.
(Figs 1 A–G, 2 A–F)

MATERIAL EXAMINED
HOLOTYPE: QM W12200 ♂♂ of total length 0.7 mm.
PARATYPE: QM W12201 ♂♂ dissected on two slides.
Both type specimens collected in plankton sample No. 8A2 at lat. 14°0.0'S, long. 141°25.5'E in the Gulf of Carpentaria on August 14th 1975 (see Rothlisberg and Jackson (1982) for sample details).

DESCRIPTION
Male: Length (TL) from anterior tip of prosome to extremity of furcal rami for 2 specimens is 0.63 and 0.70 mm. Prosome length to width ratio 2.28:1; prosome to urosome length ratio 2.51:1.
Body slender (Fig. 1 A,B) and more elongate than most other members of the genus. Head free from thorax. Fourth and 5th thoracic somites separated, 5th tapering into 2 symmetri-cal, narrow and slightly pointed margins in dorsal view; in lateral view these margins smoothly rounded except for conspicuous notch on ventral surface (Fig. 1 B). Posterior corners of 5th somite extend to posterior end of genital segment.
Urosome 5-segmented, all somites symmetrical but vary in size. Proportional lengths of these somites are given in Table 1.

TABLE 1: Proportional lengths of urosomal somites and furcal rami.

Somites	1	2	3	4	5	furcal rami
Proportions	24	21	19	13	4	19 = 100

Anal operculum with dentate distal margin is visible from dorsal aspect. Each furcal ramus about 1½ times longer than broad, with 5 prominent setae: First seta (from inner margin) about length of urosome; 2nd seta very strong, extending about twice length of urosome; 3rd seta strong and slightly longer than 1st; 4th seta 0.5 × length of 3rd; 5th seta equal length to furca itself.
First antenna of similar length to prosome. Left antenna 26-segmented, right with 22 free segments. Proximal 2 segments of right antenna broad and long, 4 distal segments narrow and long (Fig. 1 C); segments 11–17 furnished with plumous hairs on surface.
Second antenna with both basipod and endopod 2-segmented. First basipodal segment
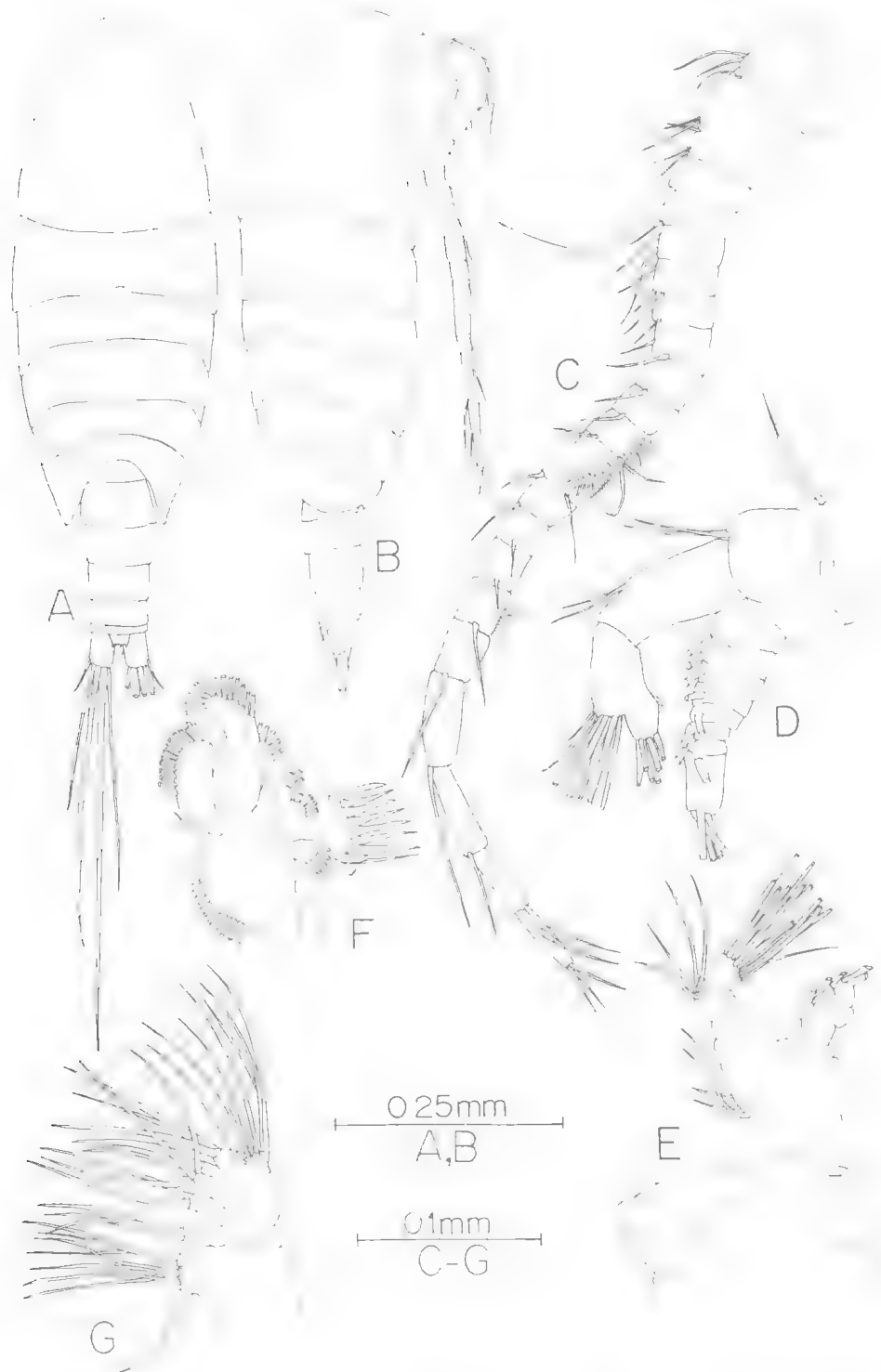
FIG. 1 *Ridgewayia flemingeri* sp. nov., male; A — dorsal view; B — lateral view; C — left 1st antenna; D — 2nd antenna; E — mandible; F — 1st maxilla; G — 2nd maxilla.

with one plumose inner distal seta; 2nd with 2 inner distal setae. First endopod segment 1½ times length of 2nd, with 2 setae on inner margin about ⅓ length from distal end; 2nd segment is 2-lobed, inner lobe with 8 setae of gradually increasing length from lateral to medial edge, except for most medial seta; outer lobe carries 6 terminal setae and 2 lateral spines at about ⅓ length from distal end. Exopod is of similar length to endopod, with 8 segments; first 7 segments progressively smaller (length and breadth), each bearing single medial seta; apical segment 4 times length of preceding segment and with 4 terminal setae.

Mandibular palp with large triangular basipod with 4 medial marginal setae (Fig. 1 E). Exopod 4-segmented, lengths of segments similar except for short 1st segment; first 3 segments each with single distomedial seta; 4th segment with 2 long 1 short apical setae. Endopod 2-segmented, the segments of equal length; first segment slightly broader than 2nd, with 4 medial marginal setae; 2nd segment has 10 apical setae. Mandibular blade expanded at apex, with numerous irregular sized and blunt teeth.

Basipod on 1st maxilla (Fig. 1 F) with 9 lateral setae, and a distal lobe bearing a single short seta. Medial margin 4-lobed; first lobe broadest, with 9 strong plumose spines and 1 small submarginal seta; remaining 3 lobes small, of equal size, with 4, 4 and 3 terminal setae respectively. Exopod a single segment, with 13 setae along lateral margin. Endopod 2-segmented, 1st bearing 5 medial setae, 2nd with 11 apical setae.

Second maxilla has 3 distinct segments (Fig. 1 G). Medial margins of the first 2 segments each bear 2 lobes. Proximal lobe of 1st segment bears 4 apical and 1 basal setae; distal lobe has 3 setae; lobes on the 2nd segment bear 3 and 2 setae respectively. Third segment 3-lobed, proximal lobe with 5 setae, middle with 3 setae, apical lobe with 7 setae; two setae, (one seta on the proximal and one on the middle lobe) of the 3rd segments are noticeably stouter than the rest and have pectinated margins.

Maxilliped 7-segmented (Fig. 2 A): First segment largest, with 3 groups of setae (1 + 2 + 3) on the medial margin. Second segment slightly shorter and much narrower than 1st, row of fine hairs near proximal medial margin, 3 short setae more distally, distal end of segment with 2 long setae; third and 4th segments each bear 4 setae; fifth segment with 1 seta on the distolateral margin, 3 setae on medial

margin; sixth segment with 2 medial setae; seventh segment bears 4 terminal setae. Row of minute surface spines present on anterior surfaces of segments 4 and 5.

Basis of 1st leg with a curved seta on distomedial inner margin extending midlength of 2nd endopod (Fig. 2 B). First and 2nd exopodal segments with a strong lateral spine of equal length to segment; distal to each spine is a flattened club-shaped process, naked and small in segment 1, large and serrate in segment 2. Third exopodal segment with lateral spine about midlength of the segment, plus an apical and a terminal spine; terminal spine approx. combined lengths of last 2 exopodal segments. Medial margin of exopod with one seta each on 1st and 2nd segments, 3 on 3rd segment. Endopod has 1, 2 and 5 setae on medial margin of the 1st, 2nd and 3rd segments respectively; triangular process present on distal outer margin of segments 1 and 2; 3rd segment with short terminal spine and a short naked seta about midlength of lateral margin.

Second to 4th legs similar in numbers and positions of setae and spines (Fig. 2 C, D, E). First and 2nd exopodal segments with 2 spines on distolateral margin, the most lateral being 3 times length of other. Third segment with 3 apical spines; innermost spine longest, almost equal to segment; outermost spine about ½ length of longest spine; central spine is minute. Third exopod segment with two lateral spines on 3rd and 4th legs, one on 2nd leg. Medial margins of exopods bears 1, 1 and 5 setae on 1st and 2nd and 3rd segments respectively.

Fifth leg complex (Fig. 2 F), both legs biramous, with 1-segmented endopod. Exopod 2-segmented in left, 3-segmented in right leg. Coxal segments of both legs fused, devoid of setae. Basis with a seta on anterior surface about ⅓ length from proximal end; 2 obtuse spines on distal margin of this segment in left leg, one directed toward endopod the other toward exopod. Segments of left exopod unequal, the 1st being slightly longer and broader. Distolateral margin of 1st segment with a small spinous process, and a long spine with serrate margins, reaching to slightly beyond end of 2nd segment. Second exopod segment with spinous process and long serrate spine similar in shape but slightly longer than those of 1st segment. Exopod ends with 2 naked seta-like apical structures, one short, other longer than segment and extending beyond serrate spine. Endopod of similar length to exopod; lateral margin with
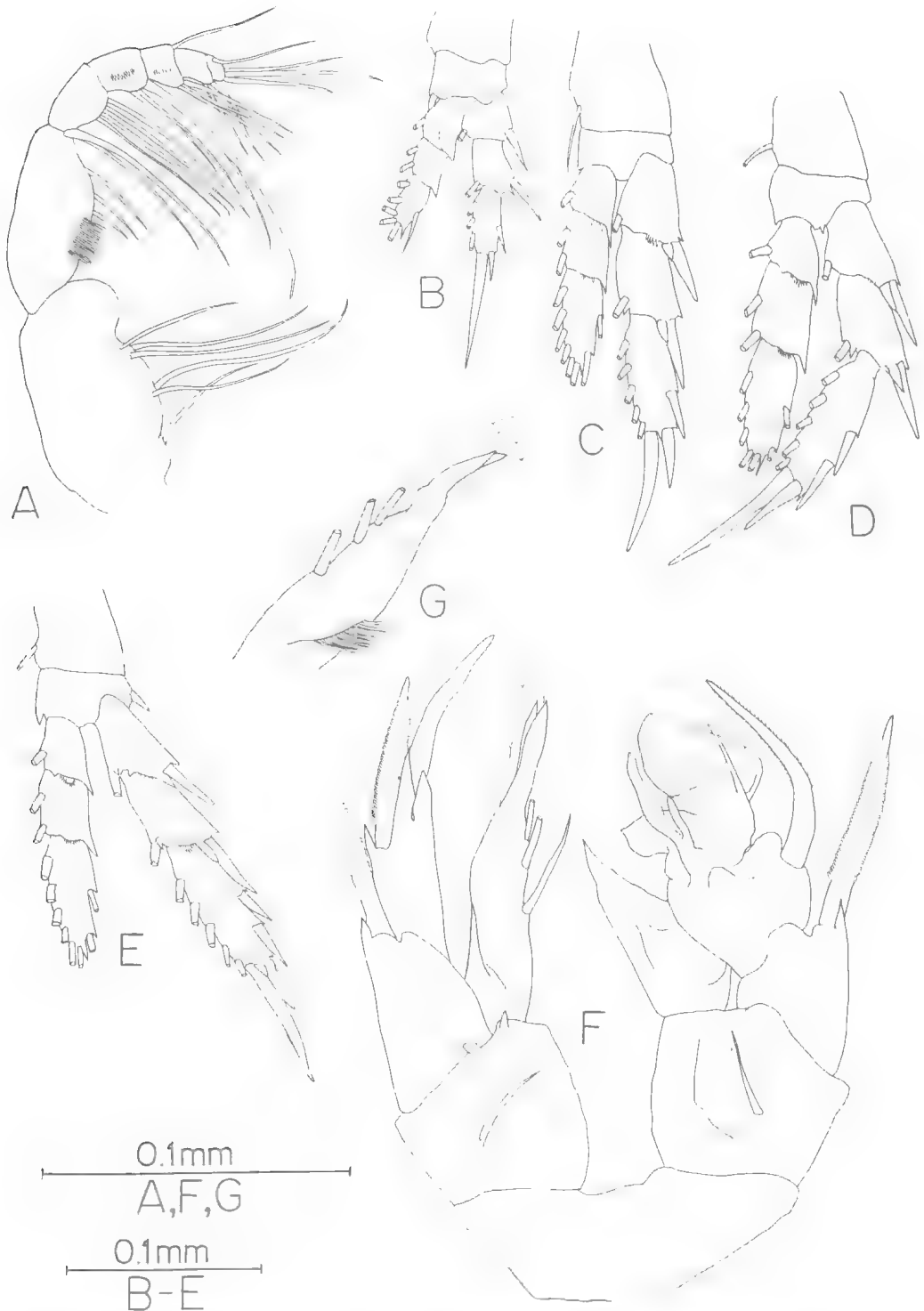
FIG. 2 *Ridgewayia flemingeri* sp. nov., male: A — maxilliped; B — 1st leg; C — 2nd leg; D — 3rd leg, E — 4th leg; F — 5th leg; G — terminal part of endopod of left 5th leg.

row of fine hairs proximally; medial margin bears 3 setae. Endopod terminates in 2 seta-like apical structures of equal length and a lobed lamellar sheath (Fig. 2 G).

Right fifth leg with seta on anterior surface of basipodite; 3 spinules also on this surface about ? length from distal end. First and 2nd exopodal segments of similar size; 1st segment with a minute stout spine on lateral margin at base of long serrate spine about twice length of segment; 2nd segment with strong medially curved spine distolaterally, reaching beyond tips of processes from 3rd segment; 3rd segment highly modified, having at least 4 membranous processes of various shapes and sizes. Endopod conical, tapering to very sharp point and extending to about the middle of the 3rd exopod segment.

ETYMOLOGY

The species is named in honour of the late Dr Abraham Fleminger of the Scripps Institute of Oceanography, La Jolla, USA for his overwhelming contributions to our knowledge of copepod taxonomy.

REMARKS

The family Ridgewayiidae was proposed by Wilson (1958) to accommodate a single genus *Ridgewayia*. Since then Fosshagen (1970) described two more genera. *Exumella* and *Placocalanus*, belonging to this family.

There are now 11 known species of *Ridgewayia*. The genus was first described by Thompson and Scott (1903) from the females of *Ridgwayia typica*. Later males of this species were described by Ummerkutty (1963). In her revision of the familial and generic placement of *Ridgewayia*, Wilson (1958) included Gurney's (1927) *Suezia canalis* and Esterly's (1911) *Lampoidopus marki* as members of this genus. The inclusion of the latter species was further substantiated by Yeatman's (1969) redescription of it. The following species are therefore now included in this genus: *Ridgewayia typica* Thompson and Scott, 1903; *Ridgewayia marki* (Esterly, 1911); *Ridgewayia canalis* (Gurney, 1927); *Ridgewayia gracilis* Wilson, 1958; *Ridgewayia shoemakeri* Wilson, 1958; *Ridgewayia krishnaswami* Ummerkutty, 1963; *Ridgewayia* sp. Yeatman, 1969; *Ridgewayia wilsoni* Fosshagen, 1970; *Ridgwayia* sp. Fosshagen, 1970, and *Ridewayia fosshageni* Humes and Smith, 1974.

Ridgewayia flemingeri closely resembles *Ridgewayia typica* and *Ridgewayia canalis* in that the male right antennule is 22-segmented. *R. flemingeri* males differ from those of all other members of the genus in the presence of numerous hairs on segments 11-17 of the right antennae. The structure of the 5th leg, *viz.* the hirsute lateral surface of the left endopod and the pointed distal end of the right endopod, is unique in *R. flemingeri*.

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PRELIMINARY OBSERVATIONS ON THE MATING BEHAVIOUR OF THE AUSTRALIAN MYGALOMORPH SPIDER *AUSTRALOTHELE JAMIESONI* (DIPLURIDAE, ARANEAE, ARACHNIDA)

ROBERT J. RAVEN

When mating, the male of *Australothele jamiesoni* Raven braces open the female's fangs with spurs on his first tibiae while spurs on the second tibiae clamp the first legs of the female at the metatarsal-tarsal joint or distally to it.
☐ *Behaviour, mating, spider, Mygalomorphae.*

Robert J. Raven, Queensland Museum, PO Box 300, South Brisbane, Queensland 4101, Australia; 24 April, 1987.

In most mygalomorph spiders whose mating behaviour is known spurs on the first legs of males serve to lock the fangs of females immobile or at least in a 'safe' position; however, some lock the palpal femur or first leg (Coyle, 1985, 1986). This locking of the female's fangs apparently prevents the male being killed and eaten before or during insemination. As with most spiders, until conspecific males are recognised as such they are regarded simply as prey. Spiders observed in this study provide new data for comparison because in males of *Australothele jamiesoni* Raven, 1984, spurs occur on both tibiae I and II. Courtship and mating of only one Australian mygalomorph, *Atrax infensus*, has been noted (Hickman, 1964). However, Mr Pat Walker of Toowoomba (Australia) did observe and photograph the mating of *Atrax formidabilis* (see Scott, 1980, fig. 21) and of *A. infensus* (in Hickman, 1964). Platnick (1971) divided spider courtship types into three groups, each based upon the nature of the prime releaser of male display. Of the three types, only two are recorded for the Mygalomorphae. Type I requires direct contact of male and female; type II requires only chemotactic perception of silk and/or perception of olfactory pheromones (Platnick, 1971).
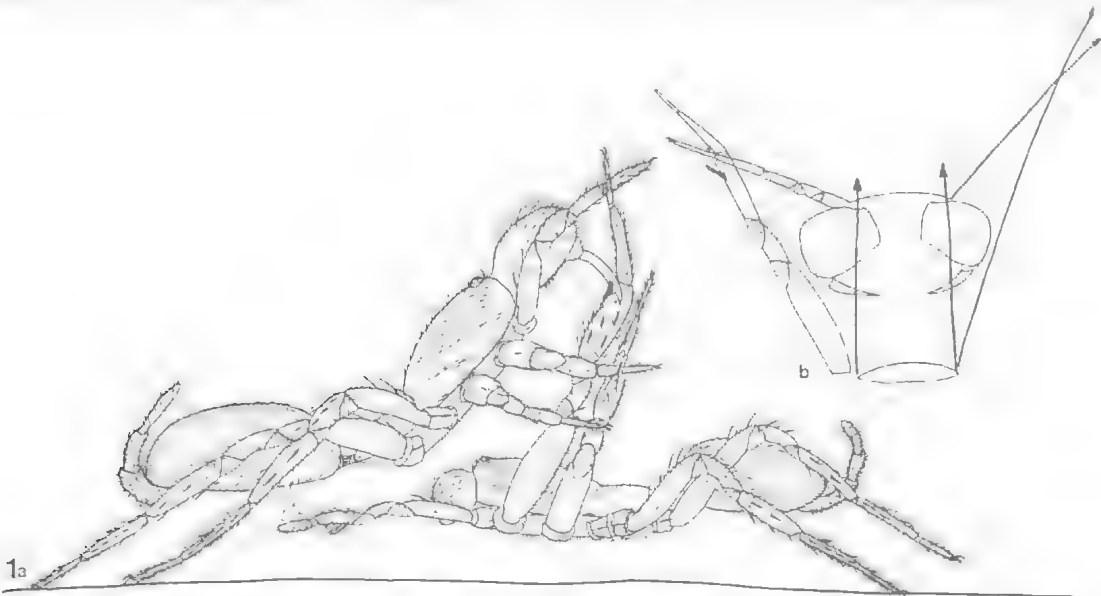
FIG. 1. *Australothele jamiesoni*, male (below) and female (above) mating. a: lateral view; b: semi-diagrammatic sagittal view.

MATERIALS AND METHODS

Males and females of *Australothele jamiesoni* were collected in closed forests of the Brisbane valley in southeastern Queensland. Specimens used were taken from two areas: Newmarket and Brookfield, near Brisbane (three mature females and two males) and Pidna State Forest, about 80 kms northwest of Brisbane (one male).

Males are trapped in pitfalls most commonly in winter (Raven, 1984). Hence, observations were made between 1800 and 0100 hours in a room lit by fluorescent light at ambient temperature and humidity in mid-winter. The observation chamber was covered with red- or green-tinted transparent cellophane to reduce light intensity while still allowing the spiders to be observed. Because the chamber was a round metal dish (*c.* 18 cms diameter, 5 cms high), spiders could not retreat into corners and interspider contact was inevitable. The male was placed in a glass vial (*c.* 3 cm long, 0.8 cm in diameter) that was plugged with moist, cotton wool and laid on its side. The vial was placed in different positions relative to the female and her web. All measurements of distances, angles, times, and frequency were estimated.

RESULTS

In nature (and to a lesser extent in the observation chamber), both sexes of *Australothele jamiesoni* build extensive, opaque white webs under and against rocks, logs, and embankments. Those webs usually have several openings leading to tubes that anastomose through the total space that the web occupies.

In the chamber, the female constructed a typical web between the lip and the outer 5–6 cm of the base. Numerous openings were evident and the female was discernible through thin silk of two or three parallel corridors in the main portion of the web. In the vial, the male made a horizontal web suspended across its diameter.

After the vial was in the chamber for 14 days, the plug enclosing the male was removed. Within 2 minutes, the male abandonned the vial and was replaced by the female spinning silk as she moved. She then turned to face out of the vial and the male quickly moved toward her and vibrating his cephalothorax and abdomen in unison. The vibration was a short vertical oscillation (amplitude, 1–2 mm; frequency, about 0.5 Hz). At the same time, the male's pedipalps began 'drumming', a small and inaud-ible vertical movement of similar amplitude to the preceeding vibration but at about 2 Hz. As he approached her, his first legs were raised at about 30–40 degrees to the horizontal. Both his first and second pairs of legs trembled and moved back and forwards, alternating between left and right legs. His approach continued with his palps drumming and in response to that she raised her cephalothorax and first legs to about 30 degrees to the horizontal and incompletely extended her fangs. These positions were attained four times, but were terminated each time when the male turned away and retreated. Each time, the female reinitiated the process by placing her tarsi on his front legs.

After the fifth such encounter, he moved under her pushing her high onto the vial's ceiling. His first legs were arched back along his body at an obtuse angle of about 120–140 degrees to the horizontal. His spur on tibia I and the proximal process on metatarsus I clasped each of her fangs. His second leg was arched back (to a lesser extent) and also laterally. His spur on tibia II and proximal process on metatarsus II clamped the metatarsus-tarsus articulation of her first leg. In that position, the male's palps, having drummed along her fangs, were advanced to her epigastric region where the emboli were inserted one at a time, for about 20 seconds each, with about 2 seconds between insertions. It was not possible to determine to which side of the female epigynum the male palp was applied, but his palp seemed to be parallel to his long axis indicating that his left palp probably inseminated her right spermatheca.

Unfortunately, at that time the chamber was bumped and he appeared either to release or lose his hold of her fangs and legs. In any case, she quickly impaled her fangs through his carapace. In about 30 seconds, he was motionless and transfixed by both fangs of the female. Presumably, she would have ingested him had I not removed him.

In the above case which was the only successful mating observed, the male was slightly smaller than the female. (Carapace length of males of *Australothele jamiesoni* vary from 4–8 mm, and that of females from 5–10 mm). When a putatively conspecific male (QM S590) about twice the size of the female (and from about 100 km from where she was collected) was used, she and other females of similar size repeatedly avoided the male; at no stage did the male respond to the female as a potential mate. However, when similarly sized or smaller males

from localities near those of females were used, both sexes behaved as if confronted by potential mates at some time during the observations. The discrepency in size between males of *Australothele jamiesoni* from disparate localities was discussed by Raven (1984: 14). Because no consistent morphological difference was observed, all populations were considered conspecific. The potential for electrophoretic studies to falsify that hypothesis is suggested by the avoidance behaviour of specimens from disparate localities.

In many cases, males responded to the web of females by raising and lowering their front legs as if stroking the surface. When the male confronted the female and touched her tarsi, his entire body quivered (amplitude, 1–2 mm). In one case, the male chased the female for several minutes and when she stopped and turned, the male quivered.

One male of *Australothele jamiesoni* was observed charging his palps with sperm. When first observed, he had spun a thin translucent sperm web about 1 cm square suspended from the sides of a jar and its main web. The spider was dorsal side up. Positioning his chelicerae over the sperm web with his palps extended forward over the edge and under it, the male dabbed his palpal bulbs alternately in the visible drop of sperm web hanging down from the web. Each palp dabbed about once per second almost continuously for two hours.

In the mating of *Atrax infensus*, the male pushed the female's cephalothorax into a near-vertical position and appeared to push against the female's fangs (which were closed) with its first legs (Hickman, 1964). Similarly, in the mating position of *Atrax formidabilis* (see Scott, 1980, fig. 21), the first legs are crossed at the distal metatarsi and keep the female's fangs closed. The spur on tibia II of the male operates in conjunction with a process on his second metatarsus, surrounding and presumably locking the female's second femur. Without such support, the female would probably fall backwards during mating. Numerous mating experiments using *A. jamiesoni* were attempted but all save one resulted in apparent undirected chasing of one spider by the other.

DISCUSSION

Because sample sizes were small, the observed behaviour may not be representative or the difference in the behaviours may not be significant. My assumptions are that they are both representative and significantly different. Also, because mating in *Australothele jamiesoni* and *Atrax* species occurs probably within the confines of either a delicate web or in a very deep burrow, observation of truly natural behaviour may never be possible. In the case of *Australothele* species, the web is significantly damaged before a spider can be found to be present. Hence, how can any behaviour that is observed be considered 'natural'?

I suggest that in mygalomorph taxa in which males possess tibial spurs on the anterior two pairs of legs, mating does not seem to involve a great deal of danger for the male from the female. When a male and female of *Atrax infensus* were kept in the same container for several days, the female made no attempt to attack the male (Hickman, 1964). Of these two *Atrax* species, only *Atrax formidabilis* has a spur present on the male tibia II. In *A. infensus*, both tibiae and metatarsi I and II have numerous spines and tibia II has a slight proximal thickening that could assist locking the female's femur, if such is the case. Hickman (1964) did not give details of the function of the legs of males in mating.

The apparently non-aggressive mating behaviour of *Atrax* contrasts with its general behaviour. If disturbed, males and females of all species found in southeastern Queensland and northern New South Wales immediately take up a classically aggressive striking position: the cephalothorax is arched back, the first three pairs of appendages are raised to vertical or near vertical positions, the chelicerae diverge at their bases and the fang tips each have a droplet of venom. In contrast, *A. jamiesoni* is not easily induced to assume such a pose.

In mygalomorph taxa in which males have much longer legs and palps than females, e.g. *Cethegus* (see Raven, 1984) and *Migas* (see Wilton, 1968), males may be able to inseminate females without coming within striking range of the female's fangs, as Coyle (1971) suggested is the case in *Aliatypus*. That might also be the case in *Missulena* in which the legs of the male (relative to their carapace length) are several times longer than that of the female. However, in the case of *Missulena* the female is usally much larger; thus presumably reducing any advantage gained through the long legs and palps of the male.

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A RE-EVALUATION OF THE RELATIONSHIPS OF *HELIX (THALASSIA) GAYNDAHENSIS* BRAZIER, 1875 (MOLLUSCA, PULMONATA, HELICARIONIDAE)

JOHN STANISIC

Iredale (1937) listed *Delinitesta gayndahensis* (Brazier, 1875) under the family Flammulinidae, a group of endodontoid snails recently placed in the Charopidae by Solem (1983). Iredale's assessment was based on gross conchological detail. Utilising scanning electron microscopy this assessment is re-evaluated. Results suggest that *D. gayndahensis* is a member of the limacacean family Helicarionidae. A redescription of the species is presented.

□ *Mollusca, Pulmonata, Helicarionidae, Delinitesta gayndahensis (Brazier, 1875), Relationships, Redescription.*

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Iredale (1937) placed a number of problematical genera within the family Endodontidae *sensu lato.* In several cases the placement was purely a matter of convenience and open to many questions. It has already been shown that some of these genera belong to quite different family units. Solem (1958) identified the north Queensland *Theskelomensor* Iredale, 1933, as a helicarionid taxon, while Solem (1959) transferred *Torresiropa* Iredale, 1933, to the Rhytididae as a subgenus of *Ouagapia* Crosse, 1894. *Delinitesta* Iredale, 1933, (type species: *Helix (Thalassia) gayndahensis* Brazier, 1875) and *Queridomus* Iredale, 1937, (type species: *Helix (Conulus) grenvillei* Brazier, 1876) represent two further questionable placements.

A study of the Charopidae of southeast Queensland subtropical rainforests has made it necessary to review the relationships of *Delinitesta gayndahensis* (Brazier, 1875). The status of *Queridomus grenvillei* (Brazier, 1876) will be considered elsewhere.

SYSTEMATIC REVIEW

All specimens used in this study were collected late last century. The lack of recently collected material is most likely a collecting artefact because related field work in south-east Queensland over the past 15 years has been concentrated in the moist, coastal rainforests. The specimens listed in this study represent all known material of *D. gayndahensis* and are in the collections of the Australian Museum (hereafter AM) and South Australian Museum (hereafter SAM).

Genus **Delinitesta** Iredale, 1933

Delinitesta Iredale, 1933, *Rec. Aust. Mus.* 19(1): 54; Iredale, 1937, *Aust. Zool.* 8(4): 321.

DIAGNOSIS

Shell medium in size, spire only slightly elevated, umbilicus very small, whorls about 5, normally coiled, last descending. Apical sculpture of moderately spaced, incised spiral lines. Post nuclear whorls with weak radial growth ridges crossed by numerous very closely spaced wavy incised spiral lines. Body whorl with prominent cord-like keel. Anatomy unknown.

TYPE SPECIES

Helix (Thalassia) gayndahensis Brazier, 1875, by original designation.

NOMENCLATURE AND PREVIOUS STUDIES

Brazier (1875) included *Helix gayndahensis* in the section *Thalassia* Albers, 1860. This was a contemporary catch-all for species with helicoid shells that had few or no sculptural features. Gude (1911) substituted *Nitor* for *Thalassia,* pointing out that the latter had priority in ornithological nomenclature. Hedley (in Hedley and Musson, 1892) considered that conchologically, the species came closest to *Hedleyoconcha* Pilsbry, 1893, (type species: *Helix delta* Pfeiffer, 1856). Iredale (1933) felt

that neither allocation was satisfactory and decided that the combination of shell texture, '. . . quaint keeling, and rounded base . . .' were characters meriting generic distinction. However, the reservations lingered, and Iredale (1937) listed the species alongside *Hedleyoconcha* in the Flammulinidae while expressing serious doubt over its relationships.

Delinitesta gayndahensis (Brazier, 1875)
(Fig. 1a–f, Table 1)

Helix (Thalassia) gayndahensis Brazier, 1875, *Proc. Linn. Soc. NSW.* **1**: 2 — Gayndah, Queensland; Hedley, 1901, *Proc. Linn. Soc. NSW.* **26**: 16, pl. 2, figs. 17–19.
Charopa (Thalassia) gayndahensis (Brazier), Tryon, 1886, *Man. Conch.* **2**: 215.
Flammulina gayndahensis (Brazier) Cox, 1909, *Alphabetical list of Australian Land Shells*, Part I, p.32.
Delinitesta gayndahensis (Brazier), Iredale, 1933, *Rec. Aust. Mus.* **19**: 54; Iredale, 1937, *Aust. Zool.* **8**(4): 321.

TYPE MATERIAL
Helix gayndahensis was described from material collected by George Masters, the first Curator of the Macleay Museum, Sydney. Unfortunately, no holotype was designated. Ponder and Stanbury (1972) identified four syntypes in the collection of the Macleay Museum and subsequently transferred them to the Australian Museum (AMA.119). However, the collections of the Australian Museum also include a number of other specimens which come from the type locality. It is highly probable that all these 'Gayndah' specimens are part of the original type lot collected by Masters. Herein all those specimens which could be associated with either George Masters or John Brazier were considered for selection of the lectotype. The lectotype comes from Brazier's collection and the label data includes habitat and publication details in his handwriting.

MATERIAL EXAMINED
LECTOTYPE: AMC.55443, 'found on the trunks of trees under bark', Gayndah, Queensland — here designated.
PARALECTOTYPES: AMA.119 ('on trees under bark', ex Brazier 4 specimens), AMC.101150 (ex Brazier, 1 specimen), AMC.10699 (Figd. Hedley, 1901, 1 specimen), AMC.142428 (Helms coll., ex Brazier, 3 specimens) — all from the type locality.
OTHER MATERIAL: Gayndah (9 specimens, AMC.95837, AMC.63682; 3 specimens, Cox coll., AMC.142429); Maryborough (1 specimen, Cox coll. AMC.142430); Eidsvold (3 specimens, SAM D.17961, identified by C. Hedley).

DESCRIPTION
Shell medium in size, diameter 7.66mm, with 5 + normally coiled whorls, last whorl descending. Apex and spire elevated. Spire protrusion 0.125 times body whorl width. Height 4.43 mm, H/D ratio 0.58. Protoconch of 1¾ whorls, sculptured with about 20 incised spiral striae regularly notched along their length. Postnuclear sculpture of numerous, very close wavy incised spiral lines, interrupted by weak radial growth ridges. Body whorl with a prominent peripheral cord-like keel and a noticeable supraperipheral sulcus, flattened above and rounded below the keel. Lip simple with columellar deflection slightly covering umbilicus. Parietal callus weakly developed, pustulose, white. Umbilicus narrow, width = 0.64 mm, D/U = 12.0. Columella vertical, aperture subovate. Sutures flat. Colour creamy yellow-horn.

COMPARATIVE REMARKS
The combination of small size, subglobose shape, macroscopically featureless shell and

TABLE 1: Variation in *Delinitesta gayndahensis* (Brazier, 1875)

REG. NO.	NUMBER OF SPECIMENS	HEIGHT (mm)	DIAMETER (mm)	H/D	D/U	WHORLS
AMC.101150	1	4.57	7.43	0.62	9.29	4½
AMC.10699	1	4.57	7.09	0.65	8.86	4½+
AMC.63682	4	4.83 (4.69–5.49)	7.76 (7.20–8.57)	0.62 (0.60–0.65)	9.69 (9.00–10.71)	5 (4⅞–5⅛+)
AMC.142430	1	4.69	8.00	0.59	10.00	5
AMC.55443 (Lectotype)	1	4.43	7.66	0.68	12.0	5+
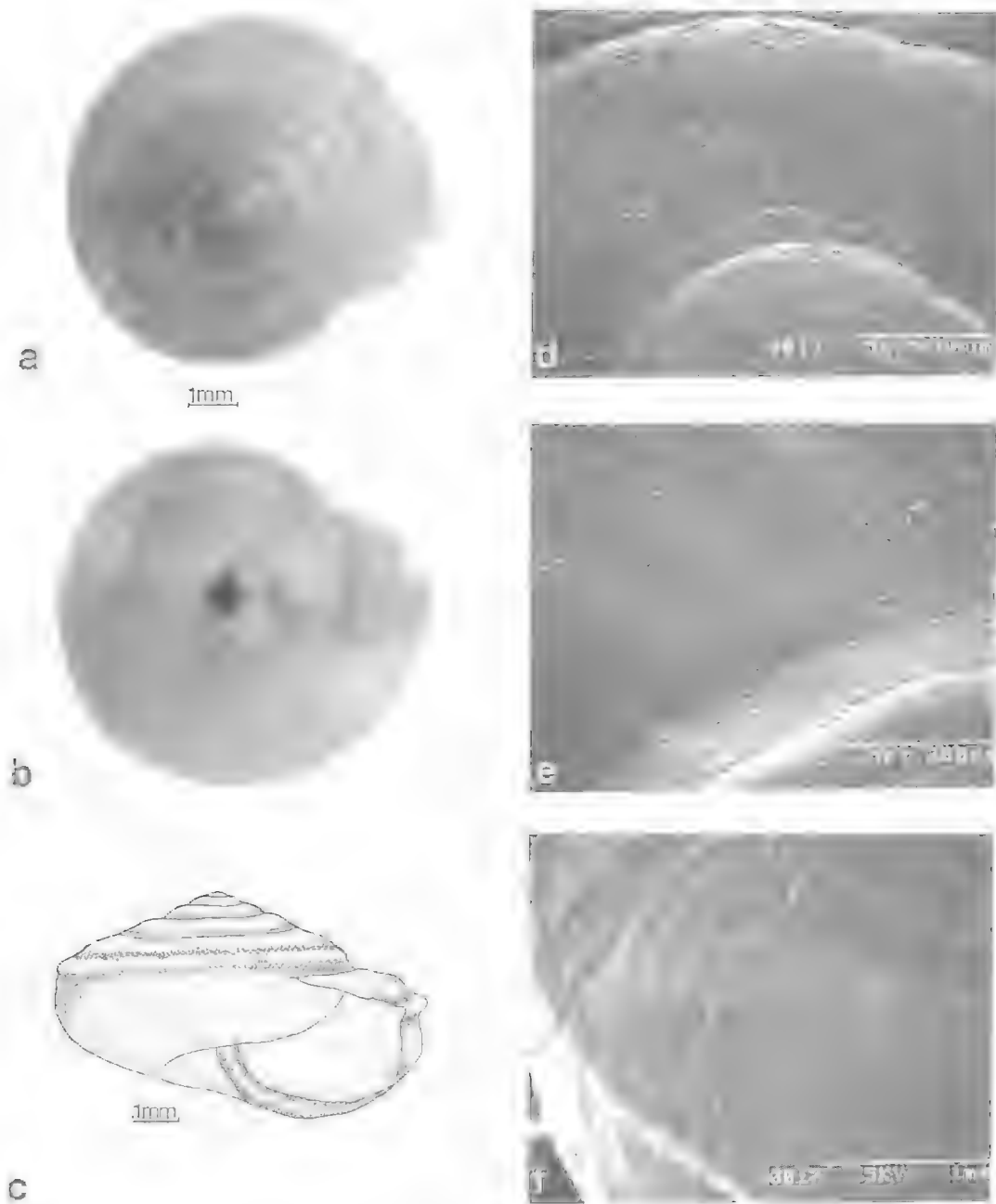
FIG 1. Details of the shell of *Delinitesta gayndahensis* (Brazier, 1875). (a–c) Lectotype, AMC.55443, (d–f) Gayndah, AMC.142429. (a,b) top and bottom views; (c) side view; (d) protoconch sculpture; (e) adult sculpture; (f) keel. (Scale lines as shown).

cord-like keel effectively distinguish *D. gayndahensis* from other Queensland land snails. *Theskelomensor creon* Solem, 1958, and *Theskelomensor lizardensis* (Pfeiffer, 1863), two helicarionids from north Queensland, possess peripheral keels but are easily separated from *D. gayndahensis* by their smooth protoconch, trochoidal shape and wide umbilicus. *Tarocystis*

responsivus (Hedley, 1912) from southern Queensland agrees with *D. gayndahensis* in overall shell shape and sculpture, but lacks the peripheral keel. Species of *Nitor* Gude, 1911, have similar sculpture but possess a very simple keel and have the whorls flattened above the periphery.

DISTRIBUTION AND HABITAT

D. gayndahensis is known from Gayndah, Eidsvold, and somewhat more questionably, Maryborough. The area around Gayndah is peppered with small rocky outcrops supporting semi-evergreen vine thickets which are home to a comparatively diverse land snail fauna and it is probable that *D. gayndahensis* occurs in these thickets.

DISCUSSION

The typical pattern of sculpture found in the Charopidae is a combination of strong radials and a complex microsculpture of fine radial riblets and crowded spiral cords (Solem, 1983). Although this sculpture may be secondarily reduced in some species or even modified, the spiral grooves and notches exhibited by *D. gayndahensis* (Fig. 1d, e) are not present in any charopid hitherto examined. To my knowledge the only Australian charopid taxa with incised spiral lines are '*Oreokera*' *corticicola* (Cox, 1866) from the coastal rainforests of northern New South Wales and the Border Ranges, and two undescribed species from the Miriam Vale area in southern Queensland. However these taxa have quite different sculpture on the protoconch and adult whorls, flammulated shells and lack any trace of a peripheral keel. Moreover the spiral lines are simple grooves and do not show the 'notching' present in *D. gayndahensis*.

On the other hand, the geographically proximate helicarionid genera *Tarocystis* Iredale, 1937, *Dendronitor* Iredale, 1933, and *Nitor* Gude, 1911, share this sculptural feature with *Delinitesta* (Stanisic, unpublished). Solem (1982) described a similar pattern of incised spiral lines and notches in species of *Westracystis* Iredale, 1939, from northern Australia. Unfortunately the present classification of the Australian helicarionids is chaotic and, while this group is numerically the third largest land snail family in Australia, only a handful of local species have been critically examined (Odhner, 1917; Baker, 1941; Kershaw, 1979,

1981; Solem, 1982). Nevertheless I suspect more detailed studies will show that the relationships of *D. gayndahensis* lie with the species currently listed under *Expocystis* Iredale, 1937, *Tarocystis* Iredale, 1937, and *Melocystis* Iredale, 1937.

Lack of material for anatomical study has restricted the nature of the preceding remarks to conchological comparisons. In spite of this the few sculptural features shown by *D. gayndahensis* are considered sufficient to remove it from the Charopidae (*sensu* Solem, 1983) and place it in the Helicarionidae.

The unusual keel of *D. gayndahensis* (Fig. 1c, f) is a feature found in various groups of extralimital helicarionids such as *Epiglypta* Pilsbry, 1893, and *Dignamoconcha* Iredale, 1944, from Lord Howe Island; *Orpiella* Gray, 1855, from the Solomon Islands; and *Harmogenanina* Germain, 1918, from the Reunion Islands. However, this structure represents a significant departure from the general shell patterns seen among Australian helicarionids and may be a secondary modification associated with the habitat shift to arboreal existence.

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THE GENUS *ARISTAENETUS* DISTANT (HEMIPTERA: LYGAEIDAE: RHYPAROCHROMINAE) WITH THE DESCRIPTION OF A NEW SPECIES

T.E. Woodward and Jane E. O'Donnell

The endemic Australian genus *Aristaenetus* (Lethaeini) and its type species *A. diffinis* (Walker) are redescribed. *A. similis* sp. nov. and its nymphs are described. Sexual dimorphism of the metapleural scent gland peritreme and variation in the structure of the female peritreme of both species are described and figured.
□ *Hemiptera, Lygaeidae, Aristaenetus, taxonomy, scent gland dimorphism.*

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Aristaenetus Distant is an endemic Australian genus belonging to the tribe Lethaeini Stål as redefined by Ashlock (1964) and as keyed out by Sweet (1967). The type species, *A. diffinis* (Walker), was described from Moreton Bay, south-east Queensland; its known distribution is now extended to north-east Queensland. *A. similis* sp. nov. is recorded from north-east Queensland to eastern New South Wales.

Abbreviations: ANIC Australian National Insect Collection, CSIRO, Canberra; BMNH British Museum (Natural History), London; DANSW Department of Agriculture, New South Wales, Rydalmere; QM Queensland Museum, Brisbane; SAM South Australian Museum, Adelaide; UC University of Connecticut, Storrs; UQ University of Queensland Insect Collection, Brisbane.

In the following descriptions all measurements are in millimetres, those of the primary type first, of other specimens in parentheses (8 ♂, 10 ♀ of *A. diffinis*; 12 ♂, 11 ♀ of *A. similis*). Length was measured for all specimens, then complete measurements were made of some of the largest and smallest and some intermediates.

The distances from apex of clavus to apex of corium (CC) and from apex of corium to apex of membrane (CM) are measured parallel to the median line of the body.

Aristaenetus Distant

Aristaenetus Distant, 1901, p. 507; Scudder, 1957, p. 154 (in Lethaeini); Slater, 1964, p. 808.
Type species *Rhyparochromus diffinis* Walker, 1872; by monotypy.

Redescription

Body: shining; of moderately large size (length about 6–9).

Head: porrect, conically produced but shorter than pronotum, length subequal to or a little greater than width; dorsal surface with fine, short, recumbent hairs, micropunctures and fine striae; base with two iridescent areas composed of overlapping blunt pegs (Fig. 1); ocellocular distance less than interocellar distance; cephalic trichobothria inserted about level with ocelli and anterior margins of eyes; ventral surface (Fig. 2A) without a deep median trough, but with a shallow anterior trough to about level of mid-line of eyes, not convexly swollen, transversely striate between eyes. Eyes not touching pronotum, with short hairs. Antennae slender, with a recumbent pubescence and sparser erect hairs shorter than width of segments; segment I with length much greater than interocular width, extending for about half its length beyond apex of head; segment IV longer than or subequal to III. Labium extending onto abdomen; segment I reaching or a little exceeding base of head; segment III equal or subequal in length to II; segment IV shortest. Paraclypeus with a distinct ventral carina.

Thorax: Pronotum wider posteriorly than long, strongly narrowed anteriorly where narrower than head; lateral margins concavely excavated, roundly thickened, not at all explanate; a transverse impression present between anterior and posterior lobes, at least at sides; anterior lobe weakly punctate, scarcely to moderately convex, with an anterior collar delimited by a transverse groove, with a long erect seta
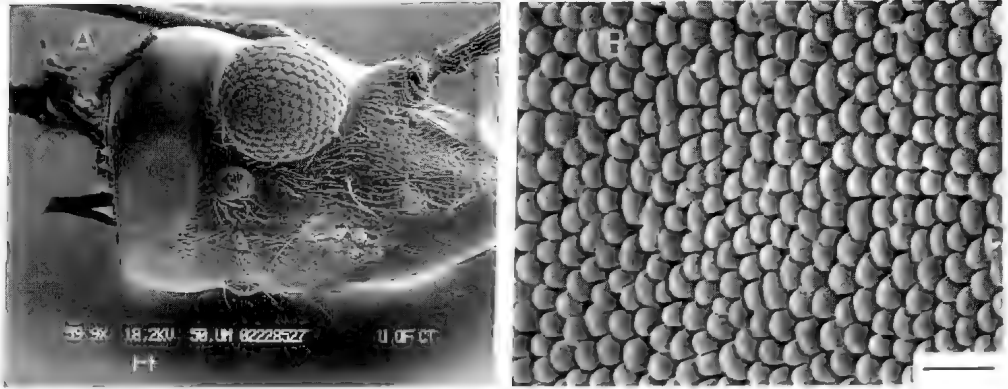
FIG. 1. *Aristaenetus diffinis*. A. Head, dorsolateral view, showing iridescent areas on left, SEM. Scale line = 50 µm. B. Part of iridescent area, showing pegs (posterior to right), SEM. Scale line = 100 µm.

near each anterolateral angle; posterior lobe strongly punctate, with a very low median carina, posterolateral angles convexly raised, posterior margin slightly convex. Scutellum finely punctate; considerably long.r than claval commissure; with a basal depression and behind this a raised subtriangular area. Clavus with four rows of punctures. Corium with costal margins acutely carinate and narrowly explanate, shallowly concave near basal third, gradually convex in apical two-thirds; with two rows of punctures, separated by a ridge, parallel to claval suture, rest of corium irregularly punctate. Membrane not or only shortly exceeding apex of abdomen, often leaving part of abdominal tergum VII exposed and sometimes all or part of connexiva of tergum VI; with basal cells and a transverse basal crease. Metapleural evaporative area and scent gland peritreme sexually dimorphic; evaporative area reaching more than half way across width of metapleuron, more extensive in ♂than in ♀; peritreme in ♂extremely long, curved back to near posterolateral angle of evaporative area, thence curved forward in reverse comma-shape (Fig. 2C, D), in ♀ variable but much shorter, not or less strongly curved backward (Figs 5–13). Legs slender; fore femur not much stouter than others, with an anteroventral series of long, slender, bristle-like spines and a more distal series of short, thorn-like spines. All tibiae with sharp spines. Hind basitarsus about twice as long as other two tarsomeres together.

ABDOMEN: Submedian trichobothria: on sternum III in triangular series on each side, with middle trichobothrium more posterior than two others; three trichobothria on each side of sternum IV in transverse linear series. Arrangement of trichobothria of sternum V typically lethaeine, with anterior two trichobothria close together, posterior trichobothrium much closer to posterior margin of sternum than to middle trichobothrium; posterior two trichobothrial areas of sternum VI not contiguous. Spermatheca (Figs 23, 24) with hemispherical bulb; with distal and proximal flanges, with distal part of duct between these widened; narrower proximal part of duct long, without a broadened ring-like region near entry to oviduct. A dorsal sac opening into genital chamber of ♀. Aedeagus (Figs 18–22) with long, distally coiled or looped vesical seminal duct; sperm reservoir with sleeve moderately to heavily sclerotised, fused with vesical seminal duct distally; arcuate extension variable; wings short and broad; holding sclerites very long, curving around wings proximally and fusing to form a "V" distally.

COMMENTS

Aristaenetus resembles *Neolethaeus* Distant (Ethiopian, Oriental, Australia and Pacific) in the presence of a punctate anterior pronotal collar demarcated by a distinct transverse impression, the clavus having four rows of punctures, the hemelytral membrane having a basal crease and large basal cells, the structure of the male genitalia and, as described by Khan and Woodward (1979), in the structure of the spermatheca and the presence of an accessory dorsal sac in the female. It differs from *Neolethaeus* in the head being about as wide as long (instead of wider than long) and with its ventral surface transversely striate instead of

FIG. 2. *Aristaenetus* spp. A. *A. diffinis*, head, ventrolateral view. SEM. Scale line = 50 μm. B. *A. similis*, female evaporative area and scent gland peritreme, SEM. C. *A. diffinis*, male evaporative area and scent gland peritreme, SEM. D. *A. similis*, male evaporative area and scent gland peritreme, SEM. B,C,D, scale line = 100 μm.

punctate, and the lateral pronotal margins being concave and not carinate nor explanate.

A very similar hypertrophy of the male scent gland peritreme occurs in *Neolethaeus cantrelli* Woodward (Australia) and *N. cheesmanae* Woodward (Australia and Papua New Guinea) (Woodward, 1968), and all 4 species of the neotropical genus *Bubaces* Distant (Brailovsky, 1981). If sexual dimorphism in this structure is a synapomorphy, then the clade so defined establishes a sister-group relationship between Australian and South American taxa; however,

other characters such as the male genitalia conflict with this interpretation. A cladistic analysis of the tribe by the junior author is in progess. This will determine whether synapomorphy or homoplasy more likely explains the observed character state distribution of this feature. Since these structures may play a role in male-male or male-female interactions (Brailovsky, 1981), independent evolution through sexual selection is a possibility.

Sperm reservoir morphology indicates relationships with *Neolethaeus*, *Lophoraglius* Wagner, *Sweetolethaeus* Slater, *Atkinsonianus* Distant, and *Afrodrymus* Scudder. These genera all share the presumed synapomorphy of long, distally joined holding sclerites. Further analysis is needed before sister-groups within this larger group can be determined. *Neolethaeus* is almost certainly composite, and probably contains within it the sister-group of *Aristaenetus*.

Key to the species of *Aristaenetus*

Pronotum (Fig. 3) without a pale median longitudinal stripe on posterior lobe; with lateral margins deeply concave, abruptly diverging to posterolateral angles; anterolateral setae arising from strongly produced tubercles .... *diffinis* (Walker)

Pronotum (Fig. 4) with a pale median longitudinal stripe on posterior lobe; with lateral margins shallowly concave, diverging gradually to posterolateral angles; anterolateral setae not arising from strongly produced tubercles .... *similis* sp. nov.

Aristaenetus diffinis (Walker)
(Figs 1, 2A-C, 3, 5-7, 14, 16, 18, 19, 22, 23)

Rhyparochromus diffinis Walker, 1872, pp. 116-117.
Aristaenetus diffinis: Distant, 1901, p. 508; Slater, 1964, p. 808; Scudder, 1967, p. 263.

MATERIAL EXAMINED
Queensland: LECTOTYPE ♀ (selected by Scudder, 1967), Moreton Bay (BMNH); 2 », Moreton I., 2.iv.1966, ex leaf litter, *Banksia*, coll. G.B. Monteith (QM, UQ) (1 ♂, QM, aedeagus inflated and illustrated); 1 ♀, Dunwich, Stradbroke I., 15-16.iv.1967, coll. B. Cantrell (dissected and scanned) (UC); 1 ♀, Ugly Gully, Brisbane, 4.x.1976, at light, coll. P Samson (UQ); 1 ♂, 8 ♀, 'Camp Milo', Cooloola, 3-13.iii.1970, *Banksia* dom. open forest, to light, coll. E. Dahms (QM); 1 ♀, Caloundra, 11.i.1972, coll. M.B.

Manpati (UQ); 1 ♀, Karana, Wattle Rd, 13.ii.1977, open forest, coll. A. Slater (QM); 4 ♂, 4 ♀, Telegraph Crossing, Dulhunty R., Cape York Pen., 2-4.vii.1975, under seeding *Callitris*, coll. G.B. Monteith (1 ♂ dissected and scanned) (QM, UC); 1 ♂ Dividing Range, 15 km W. of Captain Billy Creek, Cape York Pen., 11.40S, 142.45E, 4-9.vii.1975, coll. G.B. Monteith (QM).

REDESCRIPTION

COLORATION: Head, anterior lobe of pronotum and underside of thorax shining black; anterior pronotal collar sometimes reddish brown. Eyes reddish brown to dark brown. Ocelli red. Antennal segments I and II yellowish brown to reddish brown, both infuscated distally, I sometimes entirely infuscated reddish brown or black; III reddish brown to black proximally, white to pale brownish yellow distally; IV entirely dark reddish brown to black. Labium pale yellowish brown, segment IV reddish brown, infuscated distally. Posterior lobe of pronotum shining dark reddish brown to black, lacking a median pale stripe and pale sublateral spots on posterior margin; humeral angles sometimes pale. Scutellum, coxae, fore femora, distal part of mid and hind femora, dark brown to black; remainder of legs yellowish brown. Corium and clavus dark reddish brown to black; corium with a subapical, transverse, white or cream patch, usually interrupted in middle by dark vein, with costal margin pale at middle and often at base, usually with a pale patch near middle of disc and another near apex of claval commissure, and often with a pale stripe near claval suture; clavus with a pale stripe near posterior third of scutellum. Membrane, including veins, brown. Venter of abdomen dark reddish brown to black.

BODY: Length 8.5 (♂ 6.3-7.2, ♀ 7.2-8.8); maximum width 2.67 (♂ 2.02-2.51, ♀ 2.14-2.76).

HEAD: Length 1.54 (♂ 1.22-1.43, ♀ 1.26-1.61); width across eyes 1.34 (♂ 1.17-1.34, ♀ 1.20-1.42); interocular space 0.68 (♂ 0.50-0.64, ♀ 0.58-0.68); width of eye 0.33 (♂ 0.30-0.35, ♀ 0.31-0.37). Length of antennal segments I 1.16 (♂ 1.07-1.11, ♀ 1.05-1.18), II 1.70 (♂ 1.60-1.70, ♀ 1.56-1.82), III 1.61 (♂ 1.41-1.52, ♀ 1.33-1.61), IV (♂ 1.45-1.54, ♀ 1.31-1.59). Length of labial segments I 1.57 (♂ 1.36-1.43, ♀ 1.45-1.70), II 1.59 (♂ 1.36-1.41, ♀ 1.47-1.63), III 1.66 (♂ 1.32-1.39, ♀ 1.43-1.68), IV 0.80 (♂ 0.66-0.75, ♀ 0.72-0.84).

THORAX: Pronotum, scutellum, corium and clavus with short, fine, pale, semi-erect hairs,
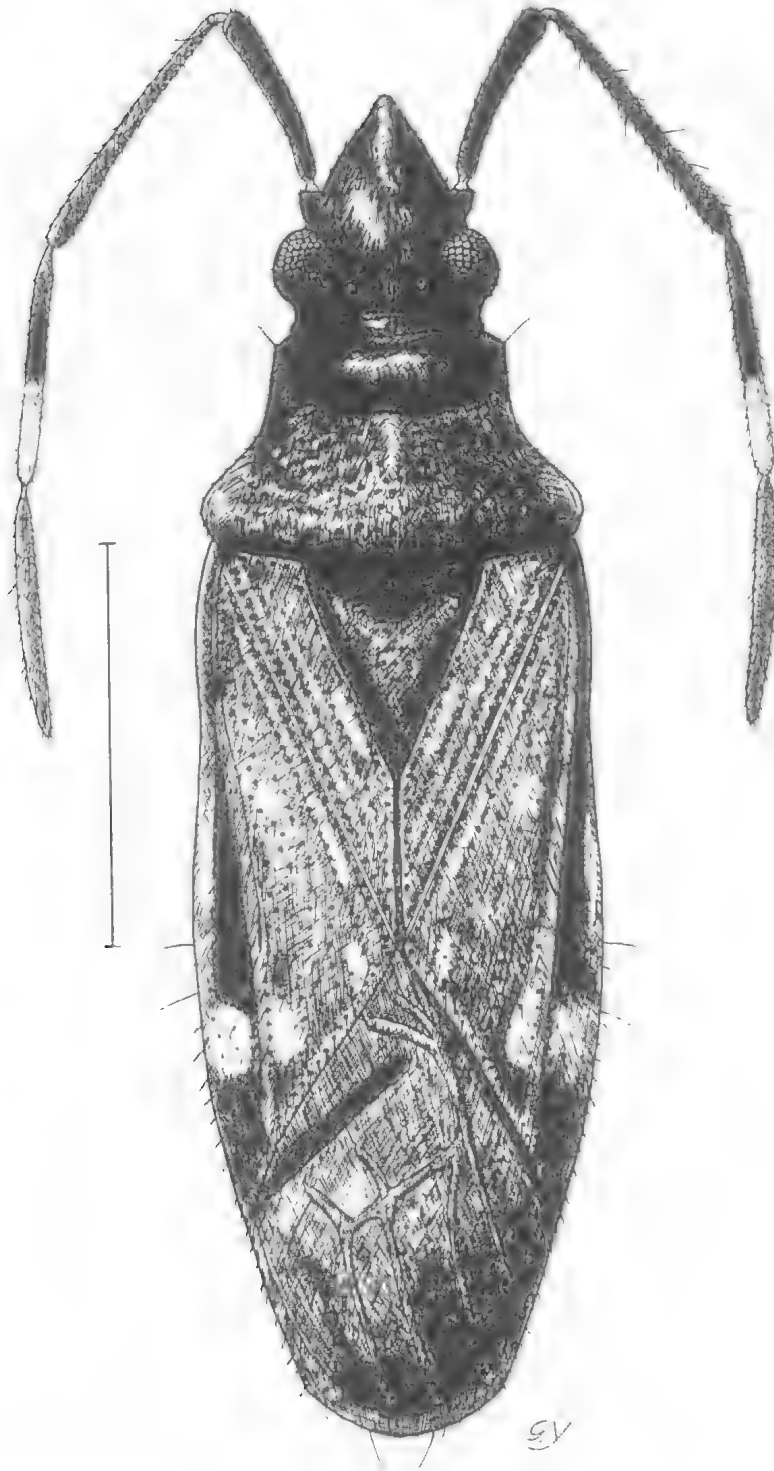
Fig. 3. *Aristaenetus diffinis*, female (Dulhunty R.), dorsal view. Scale line = 3.0 mm.

one from each puncture, longest on and near transverse pronotal impression. Pronotum with lateral margins deeply concavely excavated; transverse impression between anterior and posterior lobes well defined, deepest laterally, anterior lobe with long lateral setae each arising from a strongly protuberant tubercle, with calli confluent, smooth except for scattered micropunctures most obvious in shallow posterior fovea; posterior width of pronotum 2.51 (♂ 1.90–2.37, ♀ 2.09–2.60), median length 1.70 (♂ 1.39–1.58, ♀ 1.48–2.09). Scutellum: anterior width 1.30 (♂ 0.87–1.23, ♀ 0.94–1.50), median length 1.50 (♂ 1.10–1.34, ♀ 1.12–1.56). Length of claval commissure 0.88 (♂ 0.77–0.92, ♀ 0.63–0.98); CC 1.28 (♂ 0.91–1.44, ♀ 1.17–1.56); CM 1.36 (♂ 0.65–1.28, ♀ 0.69–1.35); corium 4.28 (♂ 3.24–3.87, ♀ 3.46–4.45). Scent gland peritreme of ♂ sinuously curved forward toward anterolateral angle of metapleural evaporative area before curving back (Fig. 2C), short peritreme of ♀ not or only slightly curved (Figs 5–7). Fore coxa with one strong bristle, mid and hind coxae with 3 strong bristles on exteroventral margin. Fore femur with an anteroventral row of 5 or 6 long, fine spines and 3 much shorter, thorn-like ventral spines near distal end, the most proximal longest.

ABDOMEN: Ventral surface with a covering of fine, decumbent hairs and longer, semi-erect hairs. Male: tergum VII (Fig. 14) with lateral margins shallowly concave, posterior margin narrow, strongly convex; paramere (Fig. 16) with apex narrow, curved, posterior lobe rounded; vesical seminal duct of aedeagus (Fig. 22) very long, narrow, not heavily sclerotised, with several loops. Female: spermatheca (Fig. 23) with duct extremely long; proximal flange sinuously curved, strongly oblique.

Aristaenetus similis sp. nov.
(Figs 2B,D, 4, 8–13, 15, 17, 20, 21, 24)

MATERIAL EXAMINED
Queensland: HOLOTYPE ♂, T.9437, Fraser Island, nr VA288, E. of Lake Bowarrady, 2–3.xii.1975, at light, coll. A. Slater and G. Thompson (QM); 1 PARATYPE ♂, T.9438, Fraser Island, Yidney Scrub, nr VB52, 3–4.xii.1975, in leaf litter, coll. G. Thompson and A. Slater (QM); 2 ♀ Paratypes, T.9439, 9440, Brisbane, 20.v.1964, coll. H.A. Rose (UQ); 2 ♂ Paratypes, same data (UC); 1 Paratype ♀, Brisbane, 15.iii.1942, coll. J.S. Ralston (UQ); 1 Paratype ♂, xii.1954, coll. F.C. Sweeney (UQ); 1 Paratype ♀, T.9441 St. Lucia,

Brisbane, 22–24.i.1975, coll. G. Thompson (QM); 1 ♂, 1 ♀ Paratypes, T.9442, 9443, same data except 24.vi.1975 (QM); 1 Paratype ♂, same data except 23.vi.1975 (UC); 2 ♂, 3 ♀ Paratypes, T.9444–9448, Mt Coot-tha, Brisbane, 13–20.iii.1971, ex leaf litter, coll. G.B. Monteith (QM); 1 Paratype ♂, same data (UC); 2 ♂, 2 ♀ Paratypes, T.9449–9452, Mt Coot-tha, Brisbane, 10.i.1975, ex leaf litter beneath eucalypts, coll. G.B. Monteith (QM); 2 ♀ Paratypes, T.9453, 9454, Mt Coot-tha, Brisbane, 17.x.1976, coll. A. Slater (QM); 1 Paratype ♂, Ashgrove, Brisbane, 16.iii.1947, coll. J. Rosser (UQ); 1 Paratype ♀, T.9455, Moggill, Brisbane, 1.ix.1963, coll. G.B. Monteith (QM); 1 Paratype ♂, T.9456, Moggill, Brisbane, 1.x.1955, coll. T.E. Woodward (QM); 1 Paratype ♀, Manly, Brisbane, iv.1954, coll. G. Hooper (UQ); 1 Paratype ♀, T.9457, Gold Creek Rd. Brookfield, Brisbane, 16.ii.1977, wet forest, coll. A. Postle and G. Thompson (QM); 1 Paratype ♂, Mt Nebo, 4.x.1954, leaf mould, coll. A.J. Peberdy (UQ); 1 Paratype ♀, T.9458, Cooloola, nr Fresh Water Lake, 3–13.iii.1970, rain forest, to light, coll. E. Dahms (QM); 2 ♂, 3 ♀ Paratypes, T.9459–9463, Imbil State Forest, 3.iv.1969, coll. B. Cantrell (QM); 1 Paratype ♀, T.9464, Kenilworth State Forest, 1.iv.1969, coll. B. Cantrell (QM); 1 Paratype ♀, T.9465, Amamoor, via Gympie, 28.ii.1976, coll. G.B. Monteith (QM); 1 Paratype ♀, Lacey's Creek, Mission Beach, 21.iv.1970, coll. G.B. Monteith (dissected and scanned) (UC), 1 Paratype ♂, 3 km W. of Mission Beach, 18.iv.1969, coll. I.F.B. Common and M.S. Upton (ANIC); 1 ♂, 1 ♀ Paratypes, T.9466, 9467, Palmerston Nat. Pk, via Innisfail, 23–24.iv.1968, coll. B. Cantrell (QM); 1 Paratype ♂, Tully, iii.1955, coll. A.J. Cowan (UQ). New South Wales: 1 Paratype ♀, Lennox Head, N. of Ballina, hind dunes, 10.iii.1981, coll. M.J. Fletcher and G.R. Brown; 1 Paratype ♂, Victoria Pk, Alstonville, 15 km E. of Lismore, 9.iii.1981, coll. M.J. Fletcher and G.R. Brown; 1 Paratype ♂, Beecroft [Sydney], 19.x.1966, at MV light, coll. O.M. Williams (all DANSW).

COLORATION: As for *A. diffinis* except for the following. Posterior lobe of pronotum with a pale median longitudinal stripe, broadest and best defined near posterior margin, and with a pair of pale sublateral spots on posterior margin. Veins of hemelytral membrane usually pale.

BODY: Length 7.0 (♂ 6.0–7.0, ♀ 6.8–8.3); maximum width 2.19 (♂ 1.76–2.23, ♀ 2.07–2.97).

HEAD: Length 1.30 (♂ 1.06–1.31, ♀ 1.91–1.28); width across eyes 1.16 (♂ 1.03–1.18, ♀ 1.08–1.28); interocular space 0.58 (♂ 0.51–0.60, ♀ 0.52–0.66); width of eye 0.29 (♂ 0.26–0.31, ♀ 0.27–0.31). Length of antennal segments I 1.00 (♂ 0.81–1.04, ♀ 0.93–1.13), II 1.50 (♂ 1.37–1.70, ♀ 1.34–1.62), III 1.25 (♂ 1.22–1.46, ♀ 1.22–1.45), IV 1.33 (♂ 1.30–1.52, ♀ 1.22–1.48). Length of labial segments I 1.30 (♂ 1.11–1.30, ♀ 1.27–
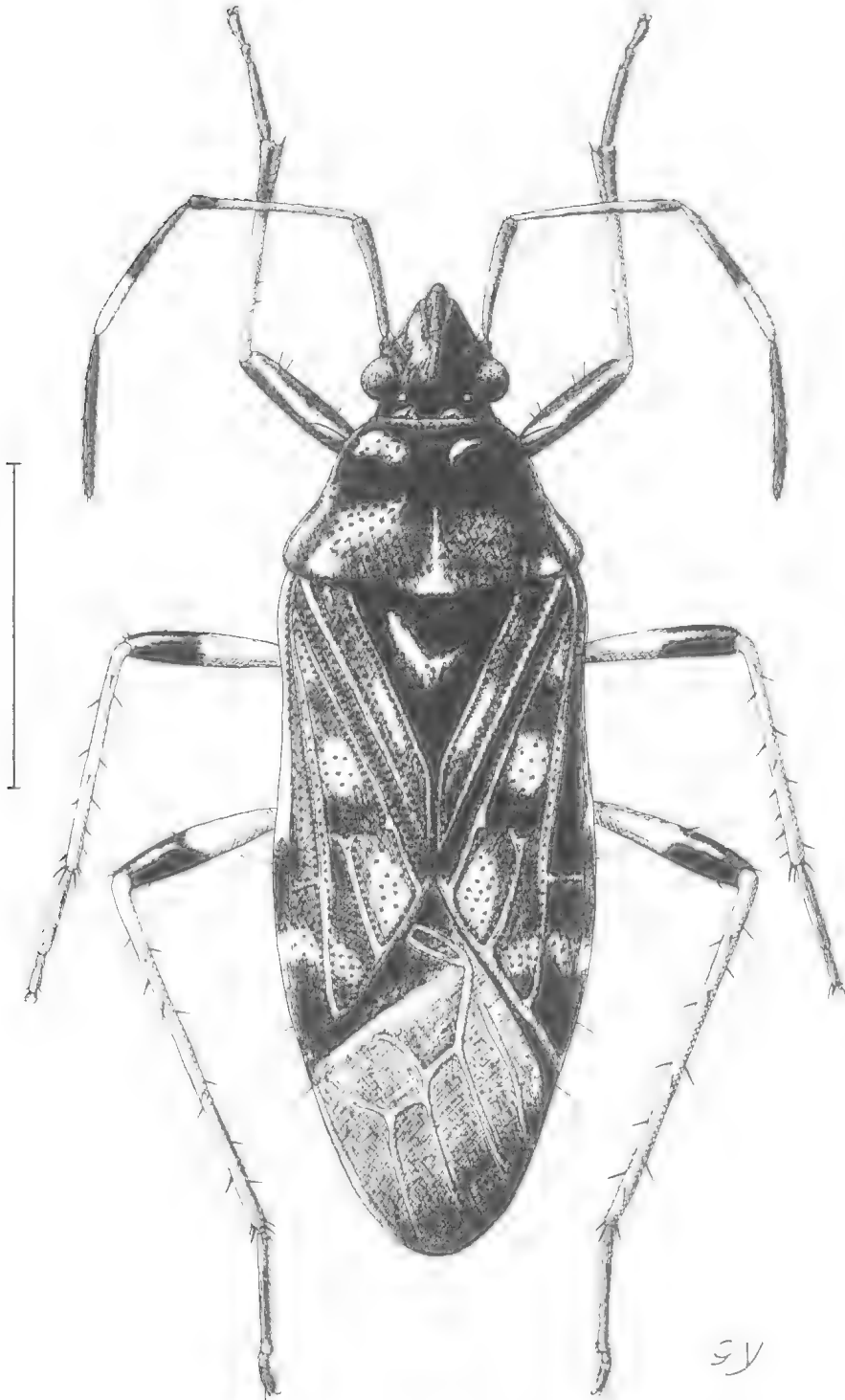
FIG. 4. *Aristaenetus similis*, paratype female (Cooloola), dorsal view. Scale line = 3.0 mm.
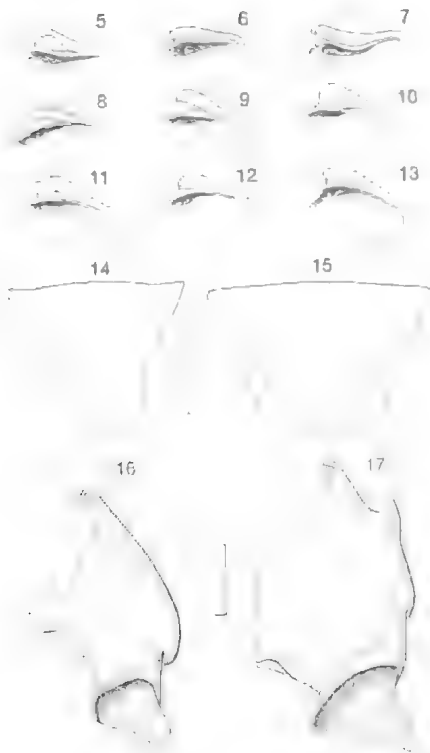
Figs 5–13. Female scent gland peritremes, *Aristaenetus* spp. 5–7 – *diffinis*; 8–13 – *similis*.

Figs 14, 15. Male abdominal tergum VII, *Aristaenetus* spp. 14 – *diffinis*; 15 – *similis*. Figs 5-15, scale line = 0.5 mm.

Figs 16, 17. Male: left paramere, inner view, *Aristaenetus* spp. 16 – *diffinis*; 17 – *similis*. Scale line = 0.1 mm.

1.49), II 1.25 (♂ 1.09–1.25, ♀ 1.19–1.42), III 1.22 (♂ 1.06–1.22, ♀ 1.11–1.49), IV 0.65 (♂ 0.57–0.65, ♀ 0.63–0.76).

THORAX: Dorsal hairs all very short and inconspicuous. Pronotum (Fig. 4) with lateral margins more shallowly excavated than in *A. diffinis* (Fig. 3); transverse impression between lobes shallower than in *A. diffinis* and restricted to lateral regions; anterior lobe with lateral setae not arising from strongly protuberant tubercles, with calli separated by band of fine punctures extending forward from shallow posterior fovea, surface of calli more obviously micropunctate than in *A. diffinis*; posterior width of pronotum 2.00 (♂ 1.65–2.00, ♀ 1.83–2.69), median length 1.44 (♂ 1.26–1.44, ♀ 1.33–1.80). Scutellum: anterior width 1.12 (♂ 0.82–1.12, ♀ 0.96–1.46), median length 1.26 (♂ 1.02–1.27, ♀ 1.20–1.62).

Length of claval commissure 0.76 (♂ 0.64–0.85, ♀ 0.71–0.95); CC 1.30 (♂ 0.88–1.38, ♀ 1.26–1.53); CM 1.50 (♂ 1.05–1.50, ♀ 1.00–1.65); corium 3.55 (♂ 3.18–4.10, ♀ 3.63–4.35). Scent gland peritreme of ♂ curved backward more abruptly than in *A. diffinis*, not sinuously curved forward (Fig. 2D), shorter peritreme of ♀ extremely varied in length and degree of curvature (Figs 8–13). Spination of coxae and fore femur as in *A. diffinis*.

ABDOMEN: Ventral hairs shorter than in *A. diffinis*. Male: tergum VII (Fig. 15) with lateral margins strongly concavely excavated, posterior margin broadly convex, subtruncate; paramere (Fig. 17) broadly expanded, apex narrow, posterior lobe with a more pointed projection; vesical seminal duct (Figs 20, 21) wider and more heavily sclerotised than in *A. diffinis*, with
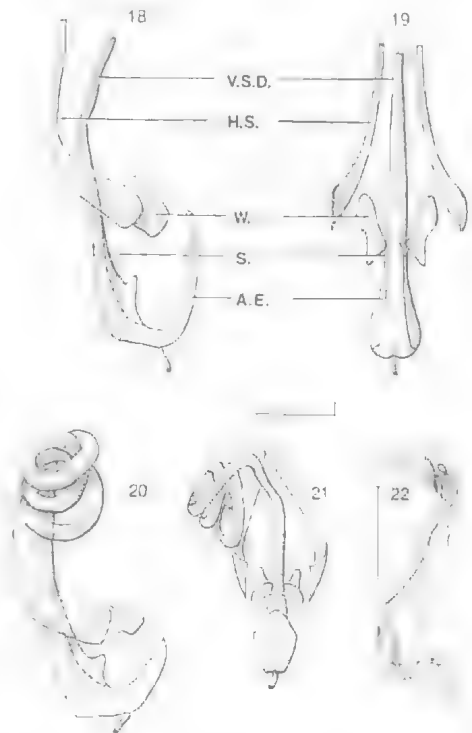
Figs 18–22. Male: aedeagal structures, *Aristaenetus* spp. 18, 19 – *diffinis*, sperm reservoir, 18 – lateral view, 19 – dorsal view; 20, 21 – *similis*, sperm reservoir and vesical seminal duct; 20 – lateral view, 21 – dorsal view; 22 – *diffinis*, aedeagus, lateral view, with vesica expanded. A.E. arcuate extension; H.S. holding sclerite; S. sleeve; V.S.D. vesical seminal duct; W. wing. Scale lines: 18-21 = 0.1 mm; 22 = 0.5 mm.
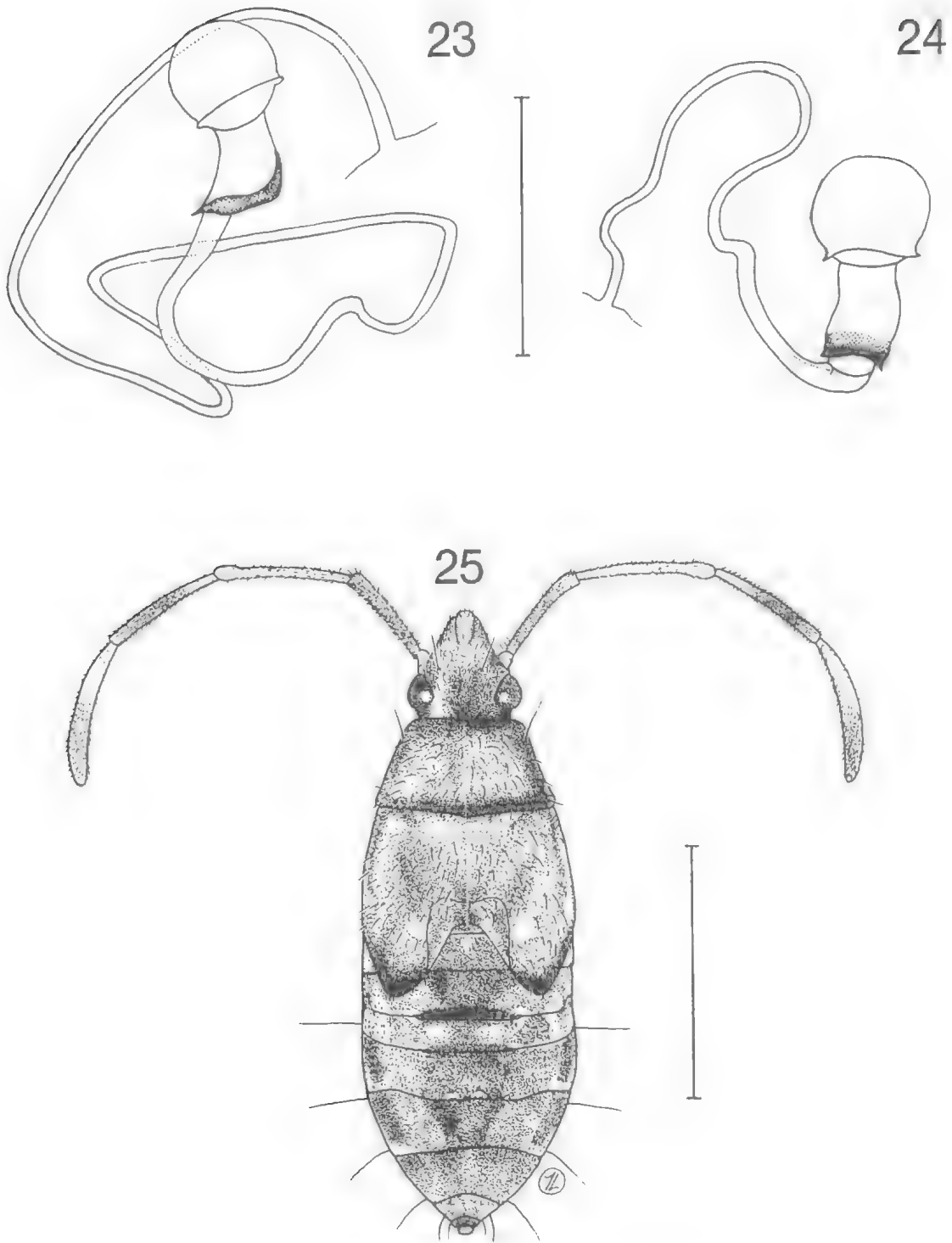
FIGS 23, 24. Spermathecae, *Aristaenetus* spp. 23 – *diffinis*; 24 – *similis*. Scale line = 0.5 mm.
FIGS 25. *Aristaenetus similis*, 5th instar nymph, dorsal view. Scale line = 2.0 mm.

about 3 coils. Female: spermatheca (Fig. 24) with duct *ca* ⅓ as long as in *A. diffinis* (Fig. 23); proximal flange annular, not oblique.

COMMENTS

In addition to the characters given in the key, *A. similis* differs from *A. diffinis* in the shorter labium; the pronotum having the transverse impression between the anterior and posterior lobes shallower and not extending so far toward the mid-line, and the calli separated by punctures and more distinctly micropunctate; the shorter body hairs; the less sinuously curved scent gland peritreme of the male; the structure of the paramere; the shorter and much thicker vesical seminal duct; the broad apex of abdominal tergum VII of the male; and the shorter spermathecal duct with the proximal flange not curved nor oblique.

NYMPHS OF *A. SIMILIS*

MATERIAL EXAMINED

Queensland: 4 instar V, 2 instar IV, Mt Coot-tha, Brisbane, 13–20.iii.1971, ex leaf litter (in 80% ethanol), associated with 2 ♂ and 3 ♀ paratypes, coll. G.B. Monteith (QM).

INSTAR V (Fig. 25)

COLORATION: Dark reddish brown. Antennae with segment I, *ca* distal ⅓ of III and more than distal ½ of IV infuscated reddish brown; proximal part of IV off-white. Labium yellowish brown, segment IV infuscated. The following creamish yellow: lateral margins of pronotum and of fore wing pads; patches near inner margins of wing pads, laterally on abdominal terga, sublaterally on terga III — V, anteromedially on tergum II, submedian pair on terga IV and V; basitarsi and tibiae; extreme distal ends of femora; abdominal sternum II anterolaterally. Coxae reddish cream with brown markings; fore trochanters brown; trochanters and proximal ends of femora of mid and hind legs off-white; extreme distal ends of femora creamish yellow to light red; all femora mainly brown; tarsomeres II light brown.

BODY: Length 4.62–5.54; maximum width 1.96–2.06.

HEAD: Porrect, produced; length 1.04–1.27; width 1.00–1.08; interocular space 0.57–0.59; width of eye 0.22–0.25; a little convex across vertex; dorsal surface with fine, pale, suberect hairs; anteclypeus reaching to *ca* ½ way along antennal segment I. Epicranial stem extremely

short, usually covered by pronotum; arms sinuate. Eyes remote from anterior pronotal margin. Antennal segments linear, I thickened and II slightly thickened at distal end, IV slightly curved; length I 0.84–0.92, II 1.22–1.31, III 1.12–1.16, IV 1.27–1.31. Labium elongate, reaching well onto abdominal sternum IV, segment I reaching base of head; length of segments I 1.08–1.18, II 1.08–1.18, III 1.02–1.08, IV 0.59–0.65.

THORAX: Nota and wing pads with fine erect hairs longer than those of head. Pronotum slightly convex in anterior half; subquadrate, with anterior and lateral margins straight, posterior margin slightly convex in middle; lateral margins narrowly explanate; with a pair of anterolateral setae inserted about level with lateral margins of eyes; median length 0.82–0.92, posterior width 1.53–1.63. Mesothoracic wing pads extending *ca* ¼–½ way along abdominal tergum III; length 1.53–1.71; lateral margins more widely explanate than those of pronotum. Coxal, tibial, and fore femoral spination similar to that of adult.

ABDOMEN: Elliptical. Scent gland sclerotisations straight between openings; that of terga III–IV slightly wider than IV–V; V–VI *ca* 1/10 as wide as III–IV.

INSTAR IV

Similar in coloration and morphology to instar V except:

BODY: Length 4.43–4.52; width 1.76–1.80.

HEAD: Length 0.92–1.08; width 0.88–0.92; interocular space 0.53–0.55; width of eye 0.18–0.19. Length of antennal segments I 0.75–0.78, II 1.04–1.08, III 0.92–0.94, IV 1.14–1.16. Length of labial segments I 0.98–1.02, II 0.90–0.92, III 0.88, IV 0.59.

THORAX: Lateral margins of pronotum and mesothoracic wing pads reaching to base of abdomen; length 0.84–0.88.

ACKNOWLEDGEMENTS

two dorsal illustrations of the adults and Mr T. Low that of the nymph. Mr G. Thompson inked in the drawings of the spermathecae, evaporative areas and scent gland peritremes and assisted with the assembling of illustrations. Dr J.A. Slater commented on the manuscript. Jim Romanow and Dr Alan Wachtel assisted with the SEM.

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PART 2 (Issued 7 November, 1988)

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